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Acts whose titles are printed in light type are those relating to day-to-day management of agricultural matters, and are generally valid for a limited period.

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II

(Acts adopted under the EC Treaty/Euratom Treaty whose publication is not obligatory)

DECISIONS

COMMISSION

COMMISSION DECISION

of 23 January 2009

amending Decisions 2006/861/EC and 2006/920/EC concerning technical specifications of interoperability relating to subsystems of the trans-European conventional rail system

(notified under document number C(2009) 38)

(Text with EEA relevance)

(2009/107/EC)

THE COMMISSION OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Community,

Having regard to Directive 2008/57/EC of the European Parliament and of the Council of 17 June 2008 on the interoperability of the rail system within the Community (Recast) ([1]), and in particular Article 6(1) thereof,

Having regard to the recommendation of the European Railway Agency on the intermediate revision of the freight wagon TSI (ERA/REC/INT/03-2008) of 27 October 2008,

Whereas:

(1) Article 12 of Regulation (EC) No 881/2004 of the European Parliament and the Council of ([2]) requires that the European Rail Agency (hereinafter referred to as the Agency) shall ensure that the technical specifications for interoperability (TSIs) are adapted to technical progress and market trends and to the social requirements and propose to the Commission the amendments to the TSIs which it considers necessary.

(2) By Decision C(2007) 3371 of 13 July 2007, the Commission gave a framework mandate to the Agency to perform certain activities under Council Directive 96/48/EC of 23 July 1996 on the interoperability of the trans-European high-speed rail system ([3]) and Directive 2001/16/EC of the European Parliament and of the Council of 19 March 2001 on the interoperability of the trans-European conventional rail system ([4]). Under the terms of this framework mandate, the Agency was requested to perform the revision of the TSI Rolling Stock — Freight wagon, adopted by Commission Decision 2006/861/EC of 28 July 2006 concerning the technical specification of interoperability relating to the subsystem rolling stock — freight wagons of the trans-European conventional rail system ([5]), as well as to provide technical opinions on critical errors and to publish a list of detected minor errors.

(3) The entry into force of the 1999 Convention concerning International Carriage by Rail (COTIF) on 1 July 2006 brought in new rules governing the technical specifications applicable to wagons. The former RIV Agreement between railway undertakings was replaced partially by a new private and voluntary agreement, the General Contract of Use (GCU) ([6]) between railway undertakings and wagon keepers, as well as by Decision 2006/861/EC.

(4) Whilst wagons registered under the RIV agreement required only one authorisation issued by the registering Railway Undertaking, Directive 2001/16/EC required an authorisation for each Member State. This problem was provisionally resolved by section 7.6 of the Annex to Decision 2006/861/EC which provides that once safety certification or

([1]) OJ L 191, 18.7.2008, p. 1.
([2]) OJ L 164, 30.4.2004, p. 1, as corrected OJ L 220, 21.6.2004, p. 3.
([3]) OJ L 235, 17.9.1996, p. 6.
([4]) OJ L 110, 20.4.2001, p. 1.
([5]) OJ L 344, 8.12.2006, p. 1.
([6]) The GCU website: http://www.gcubureau.org

authorisation of placing in service is granted for grouped wagons in one Member State, this certification or authorisation shall be mutually recognised by all Member States in order to avoid duplication of safety and interoperability checks by Safety Authorities. It also provides that insofar as Decision 2006/861/EC contains open points, authorisations for placing in service will be mutually accepted, except as indicated in Annex JJ to that Decision. However, insofar as Annex JJ does not clearly identify the conditions under which an authorisation of placing in service of a wagon in one Member State has to be mutually recognised in other Member States, the application of section 7.6 of the Annex to Decision 2006/861/EC has led to differing interpretations. This has resulted in legal uncertainty and difficulties for the industry which has called for immediate action by the Commission.

(5) That problem can now be resolved because Article 23(1) of Directive 2008/57/EC provides that vehicles in complete conformity with TSIs covering all aspects of the relevant subsystems without specific cases and without open points that are strictly related to technical compatibility between vehicle and network, shall not be subject to any additional authorisation for placing in service as long as they run on TSI conform networks in the other Member States or under the conditions specified in the corresponding TSIs.

(6) Decision 2006/861/EC contains a number of open points and technical errors. Whilst National Technical Rules could apply in order to comply with the essential requirements linked to the open points, there is no legal certainty that these national solutions would be accepted by other Member States. In addition, in accordance with Article 7 of Directive 2008/57/EC, the appropriate procedure in the case of important or critical errors is to amend the relevant TSI specifications immediately.

(7) In order to reinstate full interoperability of freight wagons dedicated to international transport, an immediate revision of to Decision 2006/861/EC is necessary in order to clarify the conditions under which an authorisation for placing in service a TSI conform wagon shall be valid in all other Member States.

(8) Wagons which have been authorised to be placed in service according to Article 22(1) of Directive 2008/57/EC and which are provided with an authorisation valid in all Member States in accordance with Article 23(1) of Directive 2008/57/EC should be marked with a clear and easy to recognise alphabetical marking. It is therefore necessary to amend Annex P.5 to the TSI relating to the subsystem Traffic Operation and Management of the trans-European conventional rail system adopted under Commission Decision 2006/920/EC ([1]).

(9) Decisions 2006/861/EC and 2006/920/EC should therefore be amended accordingly.

([1]) OJ L 359, 18.12.2006, p. 1.

(10) The measures provided for in this Decision are in accordance with the opinion of the Committee established in accordance with Article 29(1) of Directive 2008/57/EC,

HAS ADOPTED THIS DECISION:

Article 1

Amendments to Decision 2006/861/EC

Decision 2006/861/EC is amended as follows:

a) The following Article is inserted:

'*Article 1a*

Technical Documents

1. The European Railway Agency (ERA) shall publish on its website the content of Annex LL as an ERA Technical Document.

2. The ERA shall publish on its website the list of fully approved composite brake-blocks for international transport referred to in Annexes P and JJ as an ERA Technical Document.

3. The Agency shall publish on its website the additional specifications related to the draw gear referred to in Annex JJ as an ERA Technical Document.

4. The Agency shall keep the Technical Documents referred to in paragraphs 1 to 3 up to date and inform the Commission of any revised version. The Commission shall inform the Member States through the Committee established under Article 29 of Directive 2008/57/EC. Should the Commission or a Member State consider that a Technical Document does not meet the requirements of Directive 2008/57/EC or of any other Community legislation, the matter shall be discussed in the Committee. On the basis of the Committee's deliberations and upon request of the Commission, the Technical Documents shall be withdrawn or modified by the Agency.'

b) The Annexes are amended as set out in Annex I.

Article 2

Amendment to Decision 2006/920/EC

Annex P.5 to Decision 2006/920/EC is amended as set out in Annex II.

Article 3

If the marking 'TEN' of freight wagons which were placed in service before the entry into force of this Decision is not in conformity with the meaning specified in Annex II, that marking shall be removed by 31 December 2010.

Article 4

This Decision shall apply from 1 July 2009.

Article 5

This Decision is addressed to the Member States.

Done at Brussels, 23 January 2009.

For the Commission

Antonio TAJANI

Vice President

ANNEX I

The Annexes to Decision 2006/861/EC are amended as follows:

1) The Annex is amended as follows:

(a) Section 4.2.3.3.2 is replaced by the following:

'This remains an open point except for wagons wich comply with the conditions set out in section 7.6.4.'

(b) In section 4.2.3.4.2.1, the second indent on Y/Q forces is replaced by the following:

'— **Y/Q forces**

To limit the risk of wheel climb on the rail the quotient of lateral force Y and vertical load Q of a wheel shall not exceed

$(Y/Q)_{lim}$ = 0,8 for dynamic on-track tests

$(Y/Q)_{lim}$ = 1,2 for stationary tests'

(c) In section 4.2.3.4.2.2, the first sentence is replaced by the following:

'Wagons are able to run on twisted tracks when (Y/Q) for stationary tests does not exceed the limit given in section 4.2.3.4.2.1 in a curve of radius R = 150 m and for a given twisted track:'

(d) The following section is inserted after section 6.2.3.2.1.3:

'6.2.3.2.1.4. *Exemptions from stationary tests*

Freight wagons are exempted from the stationary tests mentioned in section 4.2.3.4.2.1 if they comply with the requirements of UIC leaflet 530-2 (May 2006)'

(e) Section 7.6 is replaced by the following:

'7.6 *AUTHORISATION FOR PLACING IN SERVICE OF TSI CONFORM WAGONS*

7.6.1. In accordance with Article 17(1) of Directive 2008/57/EC, where compliance with the TSIs has been achieved and an EC Declaration of Verification is issued within one Member State for freight wagons, this shall be mutually recognised by all Member States.

7.6.2. When seeking authorisations of placing in service under Article 21 of Directive 2008/57/EC, applicants may seek authorisations for placing in service of grouped wagons. Wagons may be grouped according to series, in which case Article 21(13) of Directive 2008/57/EC applies, or according to type, in which case Article 26 of that Directive applies.

7.6.3. In accordance with Article 21(5) of Directive 2008/57/EC, the authorisation for placing in service granted by one Member State shall be valid in all Member States unless additional authorisations are requested. However Member States may use this possibility only under the conditions specified in Articles 23 and 25 of that Directive. In accordance with Article 23(4) of that Directive, one of the conditions allowing a Member State to request for an "additional authorisation" procedure is the case of open points related to technical compatibility between infrastructure and vehicles. To this end, Annex JJ sets out the list of open points as requested in Article 5(6) of that Directive and also identifies those open points that may require additional checks with a view to ensuring technical compatibility between infrastructure and vehicles.

7.6.4. An authorisation of placing in service granted by one Member State shall be valid in all other Member States under the following conditions:

(a) the wagon has been authorised in accordance with Article 22 of Directive 2008/57/EC, on the basis of this TSI, including the verifications related to the open points identified in Annex JJ part 1;

(b) the wagon is compatible with the 1435 mm track gauge;

(c) the wagon has a G1 loading gauge, as specified in Annex C3;

(d) the wagon is equipped with an axle distance that does not exceed 17 500 mm between two adjacent axles;

(e) the wagon complies with the requirements of Annex JJ part 2.

7.6.5. Even if a wagon has been authorised for placing in service, there is a need to ensure that it is operated on compatible infrastructures; this may be done through the use of Infrastructure and Rolling Stock registers.'

2) Annex B is amended as follows:

(a) in point B.3, remark 4) is replaced by the following:

'4) Existing wagons that can be forwarded with the same loads as in S-traffic at 120 km/h, are already marked with the sign "**" placed to the right of the maximum load markings; no additional wagons can be added to this category.'

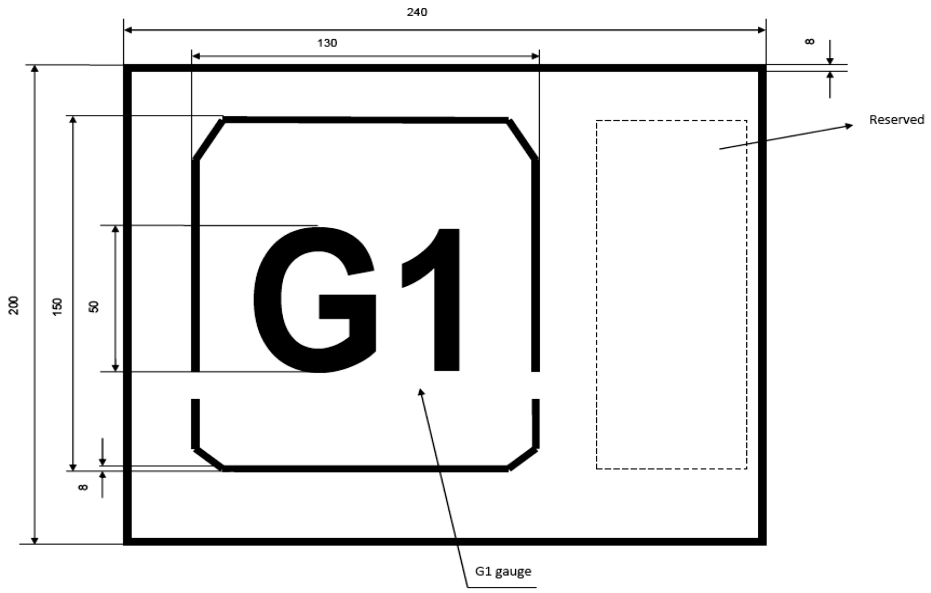
(b) in point B.3, the following remark is added:

'5) New wagons with the braking performance of "S2"-wagons according to the table in section 4.2.4.1.2.2, that can be forwarded with the same loads as in S-traffic at 120 km/h according to particular specifications listed in Annex Y, shall have the sign "***" placed to the right of the maximum load markings.'

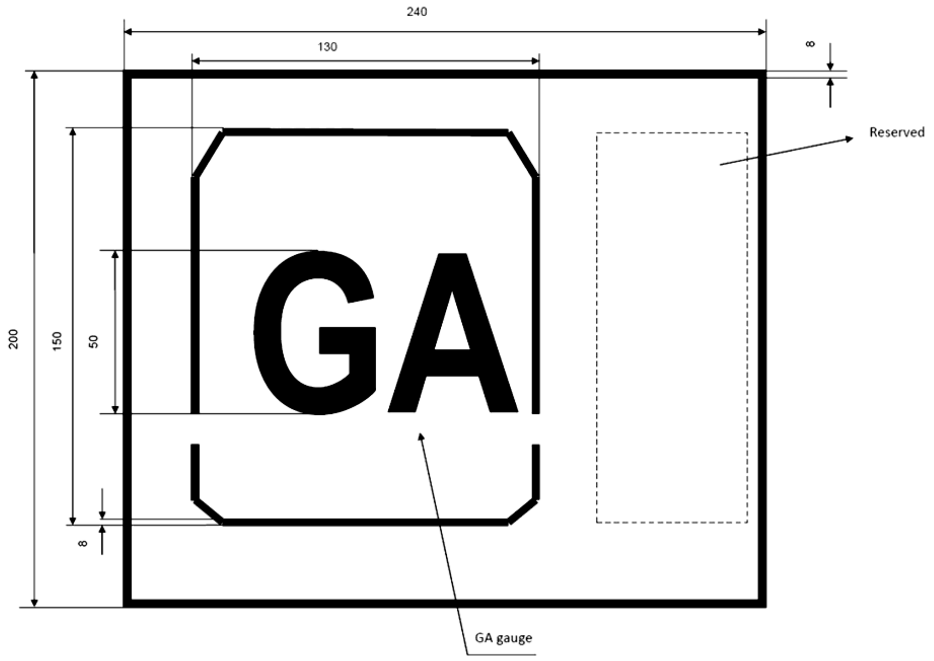
(c) point B.32 is replaced by the following:

'B.32. MARKING OF WAGONS GAUGE

(1) Wagons built to gauge G1 will be marked as follows:



(2) Wagons built to gauges GA, GB or GC will be marked as follows:



,

3) In Annex L, point L.1.4.2.1, the last sentence is replaced by the following:

'When monobloc wheels are fitted to wagons that are 100 % tread braked, the following parameters should be taken into account:

Wheel diameter range (in mm)	1 000 to 920 and 920 to 840	840 to 760	760 to 680
Power	50 kW	42,5 kW	38 kW
Application time	45 min	45 min	45 min
Running speed	60 km/h	60 km/h	60 km/h

Note: For specific types of freight traffic, the values for power and/or application time and/or running speed and/or axle loads and/or wheel diameters can be modified to check on the thermo-mechanical behaviour of these wheels in the context of a limited utilisation.'

4) In Annex P, point P.1.10, 'Brake blocks', is replaced by the following:

'P.1.10. **Brake blocks**

The test procedure for design assessment to be used for the Interoperability Constituent brake blocks is to be carried out in accordance with the specification in Annex I section I.10.2. This specification is still an open point for composite brake blocks.

Composite brake blocks that are already in use have passed the assessment according to P.2.10 successfully. The list of fully approved composite brake blocks for international transport is set out in a Technical Document to be published by the European Rail Agency on its website.'

5) Annex JJ is replaced by the following:

'ANNEX JJ

JJ.1. LIST OF OPEN POINTS

The table hereunder summarises the open points of this TSI and classifies each of them if related (column "YES") or not (column "NO") to technical compatibility between infrastructure and vehicles.

TSI reference	Title	YES	NO
4.2.3.3.2	Hot axle box detection	X	
4.2.6.2	Aerodynamic effects		X
4.2.6.3	Cross winds	X	
4.3.3	Traffic operation and management subsystem		X
6.1.2.2	Assessment of welding joints shall be made according to national rules.	X	
6.2.2.1	Assessment of welding joints shall be made according to national rules.	X	
6.2.2.3	Assessment of Maintenance	X	
6.2.3.4.2	Aerodynamic effects		X
6.2.3.4.3	Cross winds	X	
Annex E	Wheel treads remain an open point until EN is published	X	
Annex L	The specification of cast steel wheels is an open point. A new EN is requested.	X	
Annex P			
P.1.1	Distributor		X
P.1.2	Relay valve for variable load and automatic empty-load change-over		X
P.1.3	Wheel slide protection device		X
P.1.7	End Cocks		X
P.1.10	Brake blocks — Design assessment	X	
P.1.11	Accelerator valve		X
P.1.12	Automatic variable load sensing and empty/load changeover device		X
P.2.10	Brake blocks — Product assessment	X	

JJ.2. CLOSURE OF OPEN POINTS AND ADDITIONAL SPECIFICATIONS IN THE CASE OF WAGONS REFERRED TO IN SECTION 7.6.4

1. **Closure of open points**

For wagons identified in section 7.6 of this TSI, the open points identified in column "YES" of Annex JJ-1 are closed in this section.

1.1. *Hot Axle Box detection*

The open point identified in section 4.2.3.3.2 of this TSI is closed if the wagon complies with the specifications of the related ERA Technical Document.

1.2. *Cross winds*

The open point identified in sections 4.2.6.3 and 6.2.3.4.3 of this TSI is closed without any mandatory provision concerning wagon design. Some operational measures could apply.

1.3. *Assessment of welding joints*

The open point identified in sections 6.1.2.2 and 6.2.21 of this TSI is closed with the application of EN 15085-5 of October 2007.

1.4. *Assessment of maintenance*

The open point identified in Annex D of this TSI is closed as follows: Any maintenance file which:

(a) was applied by a former registering RU member of RIV at the time of the revocation of RIV, or

(b) was approved in accordance with a national or international rule

and which also complies with the requirements of this TSI is valid. The in-service performances are considered as satisfactory.

1.5. *Wheel treads*

The open point identified in Annex E of this TSI is closed as follows: the wheel tread defects will be considered in the maintenance frame.

1.6. *Cast wheels*

The open point identified in Annex L of this TSI is closed as follows: cast steel wheels are not authorised pending the publication of a European standard

1.7. *Design and Assessment of composite brake blocks*

The open point identified in Annexes P.1.10 and P.2.10 of this TSI is closed with the related technical document which is published on the ERA website.

2. **Additional specifications**

The following additional specifications are also required for wagons identified in section 7.6.4.

2.1. *Buffers and draw gears*

— In addition to the specifications of section 4.2.2.1.2.1 of this TSI, it is also required that buffers of wagons must be fitted with a guiding device for the plunger which prevents the latter from revolving freely around its longitudinal axis. The permitted tolerance for rotation is ± 2° for buffers when new.

— In addition to the specifications of section 4.2.2.1.2.2 of this TSI, it is also required that:

(a) The intermediate draw gear of each set of permanently coupled wagons (or multiple wagons) must have a breaking strength in traction higher than that of the end draw gear.

(b) The ERA Technical Document on "additional specifications applicable to the draw gear" related to the following issues also applies (the prEN 15551 is expected to be published in April 2009):

— dynamic energy capacity,

— attachments,

— stroke and anti-rotation device,

— mechanical resistance,

— elastic characteristics,

— markings,

— buffer override calculation and buffer plate material,

— dimension of the draw bar aperture,

(c) For the mechanical resistance of assemblies, the draw gear (excluding elastic device), draw hooks, and screw coupling shall be designed for a life time of thirty years. Twenty years may be agreed at the customer's request.

(d) The following table shows the range of forces and number of cycles to be applied for the dynamic type test.

Conditions for the dynamic type tests

Operational requirements			Range of forces to be applied		
Lifecycle (years)	Survival probability (%)	Safety factor (f_N)	Designation	Step 1	Step 2
			1MN	ΔF1 = 200 kN	ΔF2 = 675 kN
			1,2 MN	ΔF1 = 240 kN	ΔF2 = 810 kN
			1,5 MN	ΔF1 = 300 kN	ΔF2 = 1015 kN
				N1 in cycles	N2 in cycles
20	97,5	1,7	All	10^6	$1{,}45 \times 10^3$
30	97,5	1,7	All	$1{,}5 \times 10^6$	$2{,}15 \times 10^3$

The dynamic type tests have to be carried out on three draw gears without elastic device. All three samples have to endure the tests without showing any damage. They shall not show any cracks, and the tensile force shall not drop below 1 000 kN.

2.2. *Strength of main vehicle structure*

In addition to the specifications of section 4.2.2.3.1 of this TSI, it is also required that:

— only tests and calculations for which numerical simulations have been validated are accepted;

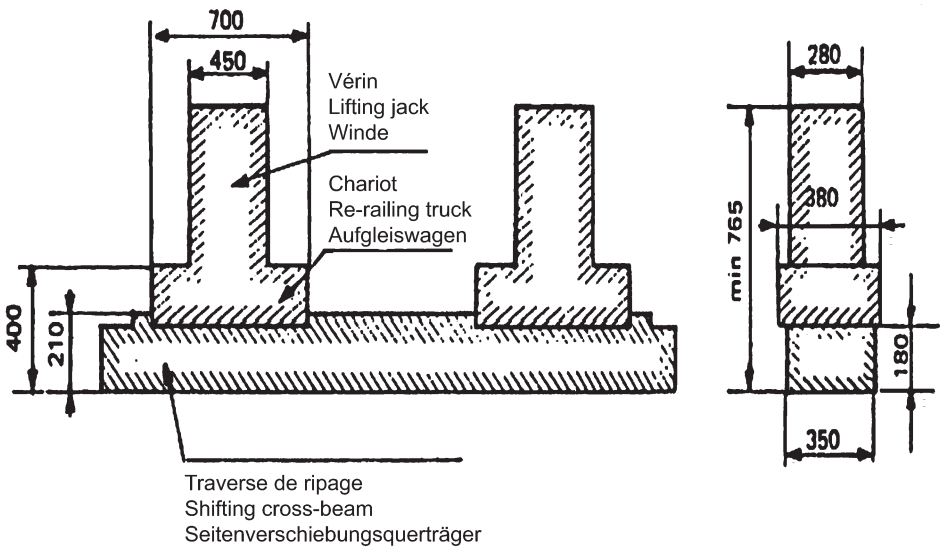
— the maintenance file should take into account the following: the use of thermomechanical rolled steel requires special measures regarding heat (treatment).

2.3. *Jacking*

In addition to the specifications of section 4.2.2.3.2.4 of this TSI, the compliance of the jacking with the following diagram is also required:

Figure

Relevage sur la voie / Rerailing



2.4. *Axle*

In addition to the specifications of section 5.4.2.4 and Annex M 1.4 of this TSI, for maximum permissible stresses the following standards apply: EN 13103 section 7, EN 13260 section 3.2.2 and EN 13261 section 3.2.3.

2.5. *Dynamic behaviour of the vehicle*

In addition to the specifications of section 4.2.3.4 of this TSI, it is required that for the particular cases of the bogies not listed in annex Y, EN 14363 or leaflet UIC 432 apply.

In addition to the specifications of section 4.2.3.4.2.2 of this TSI on safety against derailment when running on twisted tracks:

— One of the three methods given in EN 14363 applies;

— Freight wagons are exempted from these tests if they comply with the requirements of UIC leaflet 530-2.

2.6. *Longitudinal compressive force*

In addition to the specifications of sections 4.2.3.5 and Annex R of this TSI, compliance with section 3.2 of UIC leaflet 530-2 is also required, except for the requirements to communicate with and to receive the agreement from the UIC Study Group (SG) 2.

2.7. *Braking*

2.7.1. Energy storage

In addition to the specifications of section 4.2.4.1.2.4 of this TSI, it is required that the energy storage has to be designed in such a way that after a brake application (with the maximum brake cylinder pressure and maximum possible cylinder output stroke of the wagon at any load state) the pressure in the auxiliary reservoir must be at least 0,3 bar more than the brake cylinder pressure without the addition of any further energy.

2.8. *Two-axle wagons*

In addition to the specifications of section 4.2.3.4.2.4 of this TSI, the application of UIC leaflet 517 is mandatory for the calculation of the suspension of two-axle wagons.

2.9. *Electric or electromagnetic interference*

Wagons fitted with a source of energy which may cause electrical interference must be examined against leaflets UIC 550-2 and 550-3. The electromagnetic signature of maximum train compositions must be validated.

2.10. *Special types of wagons*

For each of the following types of wagon, the related additional specifications apply:

— For wagons fitted with internal combustion engine: UIC leaflet 538;

— For multiple and articulated wagons: UIC leaflet 572;

— For wagons for the carriage of containers, swap bodies and horizontally loaded movable units: UIC leaflet 571-4;

— For heat insulated and refrigerated wagons: UIC leaflet 554-2;

— For semi trailers on bogies: UIC leaflet 597.

2.11. *Wagons coming to UK*

The wagons coming to the UK must also comply with UIC leaflet 503 requirements related to the specific UK conditions.'

6) The following new Annex is inserted after Annex KK:

'ANNEX LL

HOT AXLE BOX DETECTION REFERENCE DOCUMENT

Note: this Annex is also published as a Technical Document of the European Railway Agency and will be further maintained in accordance with Article 1a(4).

1. TERMS AND DEFINITIONS

For the purposes of this Annex, the following terms and definitions apply.

Axle bearing: a bearing or bearing assembly on a rail vehicle axle that transmits a proportion of the weight of the rail vehicle directly to the wheelset.

Axle box: the structure, including for example cartridge bearing adaptor, which houses, or is in contact with, the axle journal bearing and provides an interface with the bogie and/or suspension arrangement.

Hot axle box detector (HABD):

Target zone: a defined area on the underside of an axle box that is designed to have its temperature monitored by a HABD.

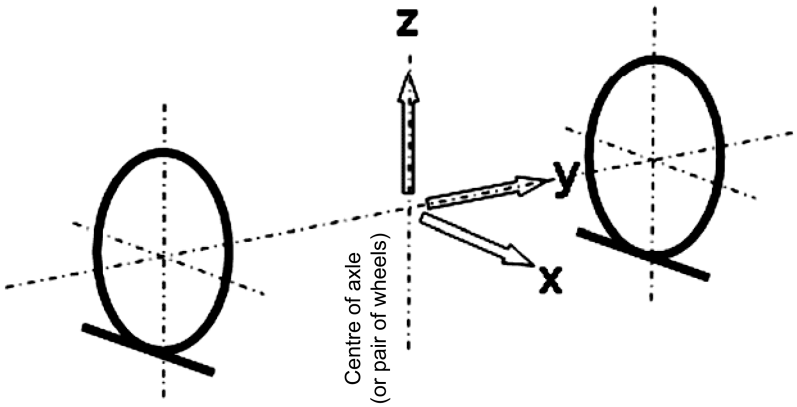
Target area: the plan view dimensions, that is in the XY plane, of the target zone.

Prohibitive zone: a zone in which heat sources such as exhausts, which might influence the behaviour of a HABD, are excluded or thermally shielded.

Rolling stock coordinates: rolling stock coordinates, figure 1, are based on the right hand rule Cartesian coordinate system, where the positive X-axis (longitudinal) is along the vehicle in the direction of travel, the Z-axis is vertically upwards and the origin is at the centre of the wheelset axle. The Y-axis is the lateral axis.

Figure 1

Rolling Stock Coordinates



Wheelset: a unit comprising: an axle, two wheels and their axle bearings, or a pair of independent wheels located at the same longitudinal position and their bearings.

Heat source: a part of the rolling stock that may have a temperature above the in-service running temperature of the underside of the axle box, such as a hot load or an exhaust pipe.

2. SYMBOLS AND ABBREVIATIONS

For the purposes of this Annex, the following symbols and abbreviated terms apply:

HABD	Hot Axle box Detector
IM	Infrastructure Manager (as defined in the TSIs)
LPZ	Longitudinal length in mm of the prohibitive zone
LTA	Longitudinal length in mm of the target area
PZ	Prohibited zone
RST	Rolling stock (as defined in TSI)
RU	Railway Undertaking (as defined in TSI)
TA	Target area
TSI	Technical Specification for Interoperability
WPZ	Lateral width in mm of the prohibitive zone
WTA	Lateral width in mm of the target area
YPZ	Lateral position in mm of the centre of the prohibitive zone relative to the centre line of the vehicle
XTA	Longitudinal position of the centre of the target area relative to the centre line of the vehicle
YTA	Lateral position of the centre of the target area relative to the centre line of the vehicle

3. ROLLING STOCK REQUIREMENTS

This section contains the requirements for the rolling stock side of the HABD interface.

3.1. **Target Zone**

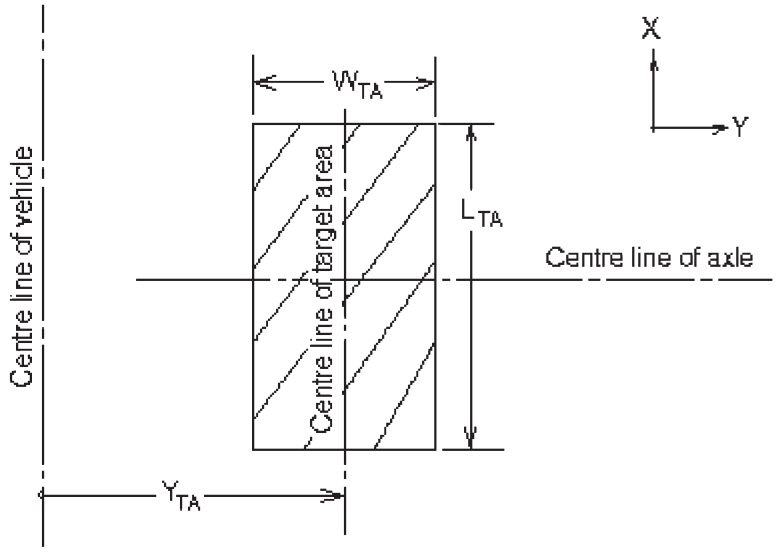
The target zone is an area on the underside surface of an axle box described by the intersection of the axle box with a virtual cuboid that has a horizontal cross sectional area given by the dimensions XTA and YTA using the rolling stock coordinates. The horizontal cross sectional area of the virtual cuboid is therefore congruent to the plan view area (that is in the XY plane) of the target zone, herein named the target area.

3.2. **Target area**

The target area is set in space relative to the axle dimensions, and defines an area in which a HABD can focus to monitor the temperature of an axle box. Figure 2 shows the position and minimum dimensions of the target area using rolling stock coordinates.

Figure 2

Dimensions and position of the target area (TA) in the XY plane (viewed from below)



3.3. **Dimensions of the Target Area**

Taking into account mechanical tolerances the target area shall:

— have a lateral width, WTA, greater than or equal to 50 mm;

— have a longitudinal length, LTA, greater than or equal to 100 mm.

3.4. **Position of the Target Area in the XY plane**

In the XY plane the centre of the target area shall be positioned at a lateral distance, YTA, relative to the centre of the axle (or centre of a pair of wheels at the same position), where 1 065 mm is less than or equal to YTA and YTA is less than or equal to 1 095 mm. In the longitudinal axis the centre of the target area shall be congruent with the centre line of the axle.

3.5. **Visibility requirements for the Target Area**

Rolling stock shall be designed with no obstruction between the target zone and the HABD that would impede or prevent the HABD from focusing within the target zone and thereby prevent a measurement of its thermal radiation.

Note: The design of the rolling stock axle box should aim to achieve a homogeneous temperature distribution within the target zone.

4. OTHER MECHANICAL DESIGN REQUIREMENTS

To minimise the opportunity for a HABD to calculate a temperature from a heat source that is not an axle box, rolling stock shall be designed so that other heat sources, for example hot payload or exhaust, are not immediately adjacent to or directly above the target area position. To facilitate this no other heat source shall be located within the prohibitive zone defined in this document.

Note 1: If, due to the design of the rolling stock, it is possible/unavoidable for a heat source other than that of an axle box to be contained within the prohibitive zone, that heat source shall be thermally shielded to prevent erroneous temperature calculations by a HABD measuring its thermal radiation.

Note 2: The prohibitive zone shall be maintained for all rolling stock, including for example rolling stock with inboard bearings.

4.1. **Prohibitive Zone**

The prohibited zone is defined by a rectangular area, which includes the target area, and is extended vertically to form a virtual cuboid. The dimensions of the cuboid are LPZ and WPZ in the XY plane and HPZ in the vertical axes. Figure 3 shows a possible position of the target area in the prohibitive zone using rolling stock coordinates.

The dimensions of the prohibitive zone's cuboid, taking into account mechanical tolerances, shall be:

— lateral width, WPZ, greater than or equal to 100 mm;

— longitudinal length, LPZ, greater than or equal to 500 mm;

— vertical height, HPZ, starts at a point in the XY plane immediately above the HABD and ends at either the height of the target area, the height of a thermal shield or the height of the vehicle.

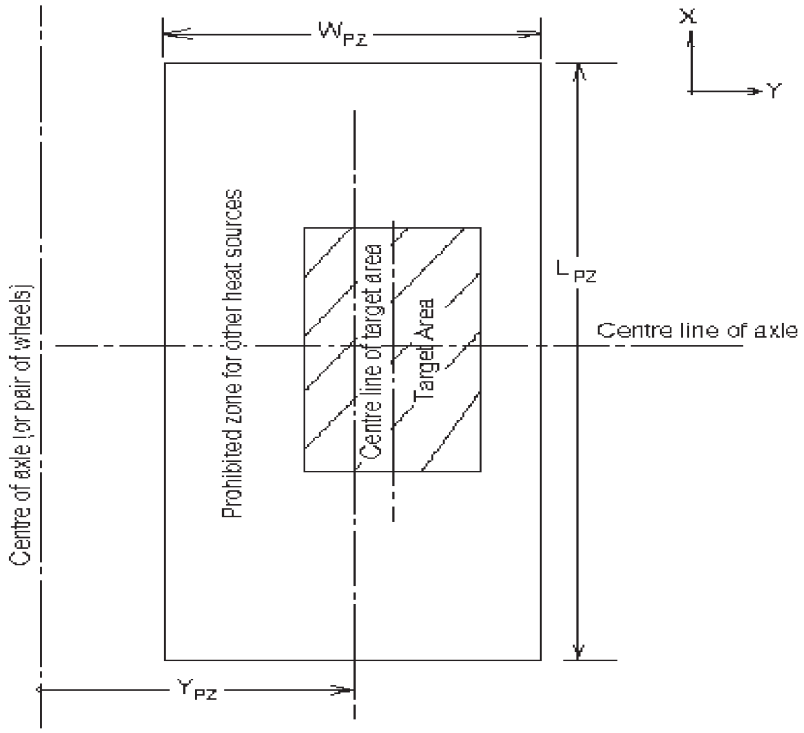
The position of the centre of the prohibitive zone in the X-Y plane shall be:

— in the lateral direction, YPZ = 1080 mm ± 5 mm measured relative to the centre of the axle (or centre of a pair of wheels at the same position);

— in the longitudinal direction it shall be congruent with the centre line of the axle ± 5 mm.

Figure 3

Dimensions of the prohibitive zone (PZ) in the XY plane (viewed from below) showing a possible position of a target area



5. CROSS REFERENCE TABLE

For the purposes of traceability a cross-reference table relating this document with the original prEN 15437 is included

Document Section Ref.	prEN15437 Section Ref.
1	3.0
2	4.0
3	5
3.1	5.1
3.2	5.1.1
3.3	5.1.2
3.4	5.1.3
3.5	5.1.4
4	5.2
4.1	5.2.1'

ANNEX II

Annex P.5 of Decision 2006/920/EC is replaced by the following:

'ANNEX P.5

ALPHABETICAL MARKING OF THE INTEROPERABILITY CAPABILITY

"TEN": Vehicle which complies with the following conditions:

— it complies with all relevant TSIs which are in force at the moment of placing in service and has been authorised to be placed in service according to Article 22(1) of Directive 2008/57/EC,

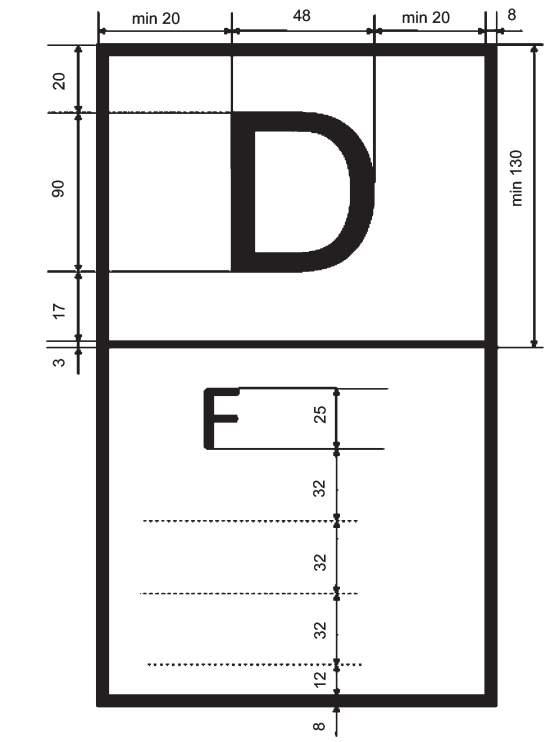
— it is provided with an authorisation valid in all Member States in accordance with Article 23(1) of Directive 2008/57/EC, or, as an alternative, it has received individual authorisations by all Member States,

"PPV/PPW": Wagon which complies with PPV/PPW agreement (inside OSJD States) (original: ППВ (Правила пользования вагонами в международном сообщении).

Notes:

a) Vehicles marked TEN correspond to coding 0 to 3 of the first digit in the vehicle number specified in Annex P.6.

b) Vehicles which are not authorised for operation in all Member States need a marking indicating the Member States where they have been authorised. The list of authorising MS should be marked according to one of the following drawings, where D stands for the MS who has granted the first authorisation (in the given example, Germany) and F stands for the second authorising MS (in the given example, France). The MS are codified in accordance with Annex P.4. This may cover vehicles which are TSI compliant or which are not. These vehicles correspond to coding 4 or 8 of the first digit in the vehicle number specified in Annex P.6.


min 20
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90
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D
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12
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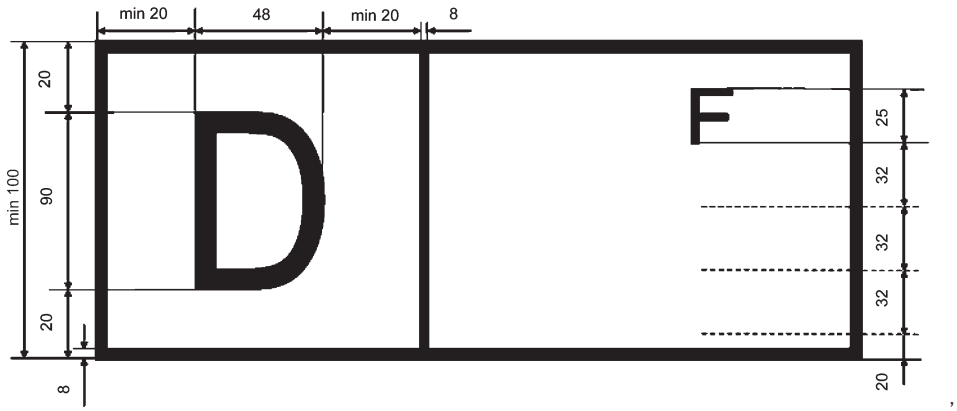
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ACTS ADOPTED BY BODIES CREATED BY INTERNATIONAL AGREEMENTS

Only the original UNECE texts have legal effect under international public law. The status and date of entry into force of this Regulation should be checked in the latest version of the UNECE status document TRANS/WP.29/343, available at: http://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29fdocstts.html

Regulation No 100 of the Economic Commission for Europe of the United Nations (UNECE) — Uniform provisions concerning the approval of battery electric vehicles with regard to specific requirements for the construction, functional safety and hydrogen emission

Revision 2

Incorporating all valid text up to:

Supplement 1 to the original version of the Regulation — Date of entry into force: 21 February 2002

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REGULATION

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3. Application for approval
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8. Penalties for non-conformity of production
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ANNEXES

Annex 1 — Communication

Annex 2 — Arrangements of approval marks

Annex 3 — Protection against direct contacts of parts under voltage

Annex 4 — Measurement of the insulation resistance using the traction battery

Annex 5 — Symbol for the indication of a voltage

Annex 6 — Essential characteristics of the vehicle

Annex 7 — Determination of hydrogen emissions during the charge procedures of the traction battery

1. SCOPE

The following prescriptions apply to safety requirements with respect to all battery electric road vehicles of categories M and N, with a maximum design speed exceeding 25 km/h.

2. DEFINITIONS

For the purpose of this proposal:

2.1. 'Battery electric road vehicle' means a vehicle with bodywork intended for road use, powered exclusively by an electric motor whose traction energy is supplied exclusively by a traction battery installed in the vehicle.

2.2. 'Vehicle type' means battery electric road vehicles which do not differ in such essential aspects as:

dimensions, structure, shape and nature of constituting materials;

installation of the power system components, battery or battery packs;

nature and type of electric and electronic components.

2.3. 'Approval of a type of battery electric road vehicle' means the approval of a type of electric vehicle regarding construction and functional safety requirements specific to the use of electric energy.

2.4. 'Traction battery' means the assembly of all battery modules which are electrically connected, for the supply of energy of the power circuit.

2.5. 'Battery module' means the smallest single energy storage consisting of one cell or an assembly of cells, electrically connected in serial or in parallel, placed in one container and mechanically associated.

2.6. 'Battery pack' means a single mechanical assembly comprising battery modules and retaining frames or trays. A vehicle may have one or several, or no battery pack.

2.7. 'Auxiliary battery' means the battery unit whose reserve of energy is used only for the auxiliary network supply.

2.8. 'Auxiliary network' means the assembly of auxiliary electric equipment with similar functions to the one used on vehicles equipped with an internal combustion engine.

2.9. 'On-board charger' means an energy electronic converter linked by construction to the vehicle and used for charging the traction battery from an external electric power supply (mains network).

2.10. 'Coupling system' means all the parts used to connect the vehicle to an external electric power supply (alternative or direct current supply).

2.11. 'Power train' means the electrical circuit including:

(i) the traction battery;

(ii) the electronic converters (on-board charger, electronic control of the traction motor, DC/DC converter, etc.);

(iii) the traction motors, the associated wiring harness and connectors, etc.

(iv) the charging circuit;

(v) the power auxiliary equipment (e.g. heating, defrosting, power steering, etc.).

2.12. 'Drive train' means specific components of power train: traction motors, electronic control of the traction motors, the associated wiring harness and connectors.

2.13. 'Electronic converter' means an apparatus allowing the control and/or transfer of electric energy.

2.14. 'Passenger and load compartment' means the space in the vehicle for occupant accommodation and bounded by the roof, floor, side walls, outside glazing, front bulkhead and the plane of the rear-seat back support and eventually the partition between it and the compartment(s) containing the battery or battery modules.

2.15. 'Drive direction control unit' means a specific device physically actuated by the driver in order to select the drive direction (forwards or backwards), in which the vehicle will travel if the accelerator is actuated.

2.16. 'Direct contact' means the contact of persons or livestock with live parts.

2.17. 'Live parts' means any conductor or conductive part(s) intended to be electrically energised in normal use.

2.18. 'Indirect contact' means contact of persons or livestock with exposed conductive parts.

2.19. 'Exposed conductive part' means any conductive part which can readily be touched and which is not normally alive, but which may become electrically energised under fault conditions.

2.20. 'Electrical circuit' means an assembly of connected live parts through which an electrical current is designed to pass in normal operation conditions;

2.21. 'Active driving possible mode' means a vehicle mode when application of pressure to the accelerator pedal (or activation of an equivalent control) will cause the drive train to move the vehicle.

2.22. 'Nominal voltage' means the root-mean-square (rms) value of the voltage specified by the manufacturer, for which the electrical circuit is designed and to which its characteristics are referred.

2.23. 'Working voltage' means the highest root-mean-square (rms) value of an electrical circuit voltage, specified by the manufacturer, which may occur across any insulation, in open circuit conditions or under normal operating conditions.

2.24. 'Electrical chassis' means a set made of conductive parts electrically linked together, and all other conductive parts electrically linked to them, whose potential is taken as a reference.

2.25. 'Key' means any device designed and constructed to provide a method of operating a locking system which is designed and constructed to be operated only by that device.

3. APPLICATION FOR APPROVAL

3.1. The application for approval of a vehicle type with regard to specific requirements for the construction and functional safety of battery electric road vehicles shall be submitted by vehicle manufacturer or by his duly accredited representative.

3.2. It shall be accompanied by the undermentioned documents in triplicate and following particulars:

3.2.1. Detailed description of the battery electric road vehicle type as regards to the shape of the bodywork, the electric drive train (motors and controllers), traction battery (type, capacity, battery management).

3.3. A vehicle representative of the vehicle type to be approved shall be submitted to the technical service responsible for conducting the approval tests.

3.4. The competent authority shall verify the existence of satisfactory arrangements for ensuring effective control of the conformity of production before type approval is granted.

4. APPROVAL

4.1. If the vehicle submitted for approval pursuant to this Regulation meets the requirements of paragraph 5 below and Annexes 3, 4, 5 and 7 to this Regulation, approval of this vehicle type shall be granted.

4.2. An approval number shall be assigned to each type approved. Its first two digits (at present 00 for the Regulation in its original form) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party shall not assign the same number to another vehicle type.

4.3. Notice of approval or of refusal or of extension or withdrawal of approval or production definitely discontinued of a vehicle type pursuant to this Regulation shall be communicated to the Parties to the Agreement applying this Regulation, by means of a form conforming to the model in Annex 1 to this Regulation.

4.4. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation an international approval mark consisting of:

4.4.1. A circle surrounding the letter 'E' followed by the distinguishing number of the country which has granted approval ([1]).

4.4.2. The number of this Regulation, followed by the letter 'R', a dash and the approval number to the right of the circle described in paragraph 4.4.1.

4.5. If the vehicle conforms to a vehicle type approved under one or more other Regulations annexed to this Agreement in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.4.1 need not be repeated; in this case the Regulation and approval numbers and the additional symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.4.1.

4.6. The approval mark shall be clearly legible and shall be indelible.

4.7. The approval mark shall be placed on or close to the vehicle data plate affixed by the manufacturer.

4.8. Annex 2 to this Regulation gives examples of the arrangements of the approval mark.

5. SPECIFICATIONS AND TESTS

5.1. Vehicle construction requirements

5.1.1. Traction battery

5.1.1.1. Installation of the traction battery in the vehicle shall not allow any potential dangerous accumulation of gas pockets.

([1]) 1 for Germany, 2 for France, 3 for Italy, 4 for the Netherlands, 5 for Sweden, 6 for Belgium, 7 for Hungary, 8 for the Czech Republic, 9 for Spain, 10 for Yugoslavia, 11 for the United Kingdom, 12 for Austria, 13 for Luxembourg, 14 for Switzerland, 15 (vacant), 16 for Norway, 17 for Finland, 18 for Denmark, 19 for Romania, 20 for Poland, 21 for Portugal, 22 for the Russian Federation, 23 for Greece, 24 for Ireland, 25 for Croatia, 26 for Slovenia, 27 for Slovakia, 28 for Belarus, 29 for Estonia, 30 (vacant), 31 for Bosnia and Herzegovina, 32 for Latvia, 33 (vacant), 34 for Bulgaria, 35 (vacant), 36 for Lithuania, 37 for Turkey, 38 (vacant), 39 for Azerbaijan, 40 for The former Yugoslav Republic of Macedonia, 41 (vacant), 42 for the European Community (Approvals are granted by its Member States using their respective ECE symbol), 43 for Japan, 44 (vacant), 45 for Australia, 46 for Ukraine, 47 for South Africa and 48 for New Zealand. Subsequent numbers shall be assigned to other countries in the chronological order in which they ratify or accede to the Agreement Concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions, and the numbers thus assigned shall be communicated by the Secretary-General of the United Nations to the Contracting Parties to the Agreement.

5.1.1.2. Battery compartments containing battery modules which may produce hazardous gases shall be safely ventilated.

5.1.1.3. The traction battery and the power train shall be protected by properly rated fuses or circuit breakers. The manufacturer shall supply data to the laboratory which allows verification that their calibration ensures opening, if necessary;

5.1.2. Protection against electric shock

5.1.2.1. Protection against direct contact with live parts of the power train:

5.1.2.1.1. If the working voltage of the electric circuit is lower than 60 volts DC or 25 volts AC, no requirements are necessary;

5.1.2.1.2. Direct contact with live parts of the electrical power train whose maximum voltage is at least 60 volts DC or 25 volts AC shall be prevented either by insulation or by the use of covers, protection grills, perforated metal sheets, etc. These protections shall be reliably secured and shall be mechanically resistant. They shall not be able to be opened, disassembled or removed without the use of tools.

5.1.2.1.3. In passenger and load compartments live parts in any case shall be protected by enclosures having a protection degree of at least IPXXD.

5.1.2.1.4. Enclosures in other areas of the vehicle shall have a protection degree of at least IPXXB.

5.1.2.1.5. In the engine compartment the access to live parts shall only be possible with voluntary action.

5.1.2.1.6. After opening the cover, the access to the parts of the coupling system shall be protected with IPXXB protection.

5.1.2.1.7. Protection degrees IPXXB and IPXXD are related respectively, to the contact of a jointed test finger and a test wire with hazardous parts (Annex 3).

5.1.2.1.8. Vehicle markings

Protection covers of live parts described in paragraph 5.1.2.1.2 shall be marked by a symbol as described in Annex 5.

5.1.2.2. Protection against indirect contacts with exposed conductive parts of the power train.

5.1.2.2.1. If the working voltage of the electric circuit is lower than 60 volts DC or 25 volts AC, no requirements are necessary;

5.1.2.2.2. The design, installation, and manufacture of electric material shall be such that insulation failures are avoided;

5.1.2.2.3. Protection against indirect contacts shall be ensured by using insulation and additionally, the exposed conductive parts of the on-board equipment shall be galvanically connected together. This potential equalisation is obtained by connecting the exposed conductive parts together either by a protective conductor, e.g. wire, ground truss, or directly by the vehicle metallic chassis. Two exposed conductive parts welded together are considered as having no discontinuity points. If there is some discontinuity, this point shall be by-passed by potential equalisation.

5.1.2.3. Insulation resistance

5.1.2.3.1. The insulation resistance measurement is performed after maintaining the vehicle for a conditioning time of 8 hours with the following conditions:

temperature: 23 ± 5 °C,

humidity: 90 % + 10/- 5 %.

5.1.2.3.2. Using a measuring DC voltage equal to the nominal voltage of the traction battery, insulation resistances between any exposed conductive part and each polarity of the battery shall have a minimum value of 500 Ω/V of the nominal voltage (Annex 4 contains an example of how this test may be conducted).

5.1.2.3.3. Resistance of the protective conductor:

The potential equalisation resistance between any two exposed conductive parts shall be lower than 0,1 Ω. This test shall be performed by a current of at least 0,2 A.

5.1.2.4. Connection of the vehicle to the mains network:

5.1.2.4.1. In no case the vehicle shall be capable to move by its own means when it is galvanically connected to an energy supply network or to an off-board charger;

5.1.2.4.2. The components used when charging the battery from an external source shall allow the charging current to be cut in case of disconnection without physical damage;

5.1.2.4.3. The coupling system parts likely to be live shall be protected against any direct contact in all operating conditions;

5.1.2.4.4. All exposed conductive parts shall be electrically linked through a conducting wire plugged to earth when charging.

5.2. Functional safety requirements

5.2.1. Power on procedure:

5.2.1.1. The power on procedure shall be applied via a key switch.

5.2.1.2. It shall not be possible to remove this key in any position that energises the drive train or makes active driving possible.

5.2.2. Running and stopping conditions:

5.2.2.1. At least a momentary indication must be given to the driver either:

(a) when the vehicle is in 'active driving possible mode'; or

(b) when one further action is required to place the vehicle in 'active driving possible mode'.

5.2.2.2. When the state of charge of the battery reaches the minimum state of charge value defined by the manufacturer, the user shall be warned to perceive this situation quickly enough to be able to drive the vehicle, on its own power, at least out of the traffic zone.

5.2.2.3. Unintentional acceleration, deceleration and reversal of the drive train shall be prevented. In particular, a failure (e.g. in the power train) shall not cause more than 0,1 m movement of a standing unbraked vehicle.

5.2.2.4. When leaving the vehicle, the driver shall be informed by an obvious signal (e.g. optical or audible signal) if the drive train is still in the active driving possible mode.

5.2.3. Reversing

5.2.3.1. Reversing shall be possible only after operation of a specific control. This action shall require either:

(a) the combination of two different actuations; or

(b) an electric switch which allows reverse to be engaged only when the vehicle is moving at a forward speed not exceeding 5 km/h. Above this speed all actions on this device shall be ignored. The device shall have only one stable position.

5.2.3.2. The state of the drive direction control unit shall be readily identified to the driver.

5.2.4. Emergency power reduction

5.2.4.1. If the vehicle is equipped with a device to limit the performance in an emergency (e.g. overheating of a component) the user shall be informed by an obvious signal.

5.3. Determination of hydrogen emissions

5.3.1. This test must be carried out on all battery electric road vehicles referred to in paragraph 1 of this Regulation.

Road vehicles equipped with non-aqueous electrolyte batteries or sealed 'gas recombinant' batteries are excluded.

5.3.2. The test must be conducted following the method described in Annex 7 to the present Regulation. The hydrogen sampling and analysis must be the ones prescribed. Other analysis methods can be approved if it is proven that they give equivalent results.

5.3.3. During a normal charge procedure in the conditions given in Annex 7, hydrogen emissions must be below 125 g during 5 h, or below 25 × t2 g during t2 (in h).

5.3.4. During a charge carried out by an on-board charger presenting a failure (conditions given in Annex 7), hydrogen emissions must be below 42 g. Furthermore the on-board charger must limit this possible failure to 30 minutes.

5.3.5. All the operations linked to the battery charging are controlled automatically, included the stop for charging.

5.3.6. It shall not be possible to take a manual control of the charging phases.

5.3.7. Normal operations of connection and disconnection to the mains or power cuts must not affect the control system of the charging phases.

5.3.8. Important charging failures must be permanently signalled to the driver. An important failure is a failure that can lead to a disfunctioning of the on-board charger during charging later on.

5.3.9. The manufacturer has to indicate in the owner's manual, the conformity of the vehicle to these requirements.

5.3.10. The approval granted to a vehicle type relative to hydrogen emissions can be extended to different vehicle types belonging to the same family, in accordance with the definition of the family given in Annex 7, Appendix 2.

6. MODIFICATIONS AND EXTENSION OF THE TYPE APPROVAL FOR VEHICLE TYPE

6.1. Every modification of the vehicle type shall be notified to the administrative department which approved the vehicle type. The department may then either:

6.1.1. consider that the modifications made are unlikely to have an appreciable adverse effect and that in any case the vehicle still complies with the requirements; or

6.1.2. require a further test report from the technical service responsible for conducting the tests.

6.2. Confirmation or refusal of approval, specifying the alteration shall be communicated by the procedure specified in paragraph 4.3 above to the Parties to the Agreement applying this Regulation.

6.3. The competent authority issuing the extension of approval shall assign a series number for such an extension and inform thereof the other Parties to the 1958 Agreement applying the Regulation by means of a communication form conforming to the model in Annex 1 to this Regulation.

7. CONFORMITY OF PRODUCTION

7.1. Every vehicle approved under this Regulation shall be so manufactured as to conform to the type approved by meeting the requirements set out in paragraph 5 above.

7.2. In order to verify that the requirements of paragraph 7.1 are met, suitable controls of the production shall be carried out.

7.3. The holder of the approval shall, in particular:

7.3.1. ensure the existence of procedures for the effective quality control of vehicles;

7.3.2. have access to the testing equipment necessary for checking the conformity of each approved type;

7.3.3. ensure that test result data are recorded and that the annexed documents remain available for a period to be determined in agreement with the administrative department;

7.3.4. analyse the results of each type of test, in order to verify and ensure the consistency of characteristics of the vehicle, making allowance for permissible variations in industrial production;

7.3.5. ensure that for each type of vehicle at least the tests prescribed in paragraph 5 of this Regulation are carried out;

7.3.6. ensure that any set of samples or test pieces giving evidence of non-conformity with the type of test in question shall give rise to a further sampling and test. All the necessary steps shall be taken to reestablish conformity of the corresponding production.

7.4. The competent authority which has granted type approval may at any time verify the conformity control methods applied in each production unit.

7.4.1. At every inspection, the test records and production records shall be presented to the visiting inspector.

7.4.2. The inspector may take samples at random to be tested in the manufacturer's laboratory. The minimum number of samples may be determined according to the results of the manufacturer's own checks.

7.4.3. When the quality level appears unsatisfactory or when it seems necessary to verify the validity of the tests carried out in application of paragraph 7.4.2, the inspector shall select samples to be sent to the technical service which has conducted the type approval tests.

7.4.4. The competent authority may carry out any test prescribed in this Regulation.

7.4.5. The normal frequency of inspections by the competent authority shall be one per year. If unsatisfactory results are recorded during one of these visits, the competent authority shall ensure that all necessary steps are taken to reestablish the conformity of production as rapidly as possible.

8. PENALTIES FOR NON-CONFORMITY OF PRODUCTION

8.1. The approval granted in respect of a vehicle type, pursuant to this Regulation may be withdrawn if the requirements laid down in paragraph 7 are not complied with, or if the vehicle or its components fail to pass the tests provided for in paragraph 7.3.5 above.

8.2. If a Contracting Party to the Agreement applying this Regulation withdraws an approval it has previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation, by means of a communication form conforming to the model in Annex 1 to this Regulation.

9. PRODUCTION DEFINITELY DISCONTINUED

If the holder of the approval completely ceases to manufacture a type of vehicle approved in accordance with this Regulation, he shall so inform the authority which granted the approval. Upon receiving the relevant communication, that authority shall inform thereof the other Contracting Parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the model in Annex 1 to this Regulation.

10. NAMES AND ADDRESSES OF TECHNICAL SERVICES RESPONSIBLE FOR CONDUCTING APPROVAL TESTS AND OF ADMINISTRATIVE DEPARTMENTS

The Contracting Parties to the 1958 Agreement applying this Regulation shall communicate to the United Nations secretariat the names and addresses of the technical services responsible for conducting approval tests and the administrative departments which grant approval and to which forms certifying approval or extension or refusal or withdrawal of approval or production definitely discontinued, issued in other countries, are to be sent.

ANNEX 1

COMMUNICATION

(maximum format: A4 (210 × 297 mm))

issued by: Name of administration:
.....
.....
.....
.....

Concerning (2): APPROVAL GRANTED
APPROVAL EXTENDED
APPROVAL REFUSED
APPROVAL WITHDRAWN
APPROVAL DEFINITELY DISCONTINUED

of a battery electric road vehicle pursuant to Regulation No 100

Approval No: ..... Extension No: . .....

1. Trade name or mark of the vehicle: .....
2. Vehicle type: .....
3. Vehicle category: .....
4. Manufacturer's name and address: .....
5. If applicable, name and address of manufacturer's representative: .....
6. Vehicle submitted for approval on: .....
7. Technical service responsible for conducting approval tests: .....
8. Date of report issued by that service: .....
9. Number of report issued by that service: .....
10. Location of the approval mark: .....
11. Reason(s) for extension of approval (if applicable) (2): .....
12. Approval granted/extended/refused/withdrawn (2): .....
13. Place: .....
14. Date: .....
15. Signature: .....
16. The documents filed with the request for approval or extension may be obtained on request.

(1) Distinguishing number of the country which has granted/extended/refused/withdrawn approval (see approval provisions in the Regulation).

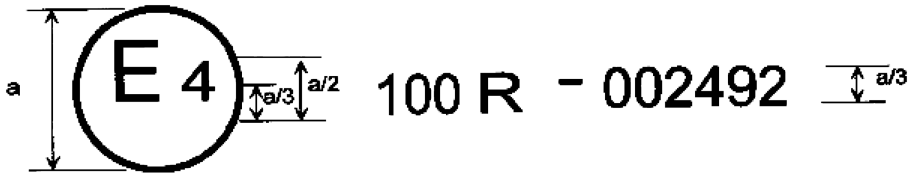
(2) Strike out what does not apply.

ANNEX 2

ARRANGEMENTS OF APPROVAL MARKS

Model A

(see paragraph 4.4 of this Regulation)

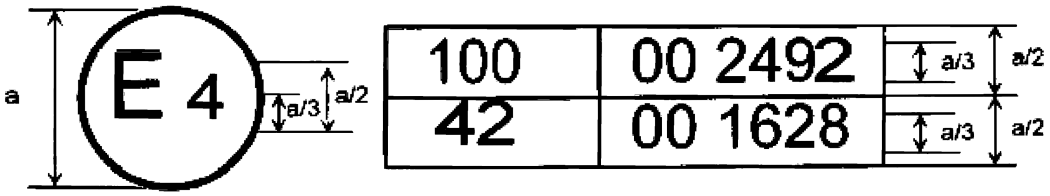


a = 8 mm min.

The above approval mark affixed to a vehicle shows that the battery electric road vehicle type concerned has been approved in the Netherlands (E4), pursuant to Regulation No 100, and under the approval number 002492. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of Regulation No 100 in its original form.

Model B

(see paragraph 4.5 of this Regulation)



a = 8 mm min.

The above approval mark affixed to a vehicle shows that the battery electric road vehicle concerned has been approved in the Netherlands (E4) pursuant to Regulations Nos 100 and 42 ([1]). The first two digits of the approval numbers indicate that, at the dates when respective approvals were granted, both Regulations Nos 100 and 42 were in their original form.

([1]) The latter number is given only as an example.

ANNEX 3

PROTECTION AGAINST DIRECT CONTACTS OF PARTS UNDER VOLTAGE

Extract from the IEC 529 Standard (1989)

1. DEFINITIONS

For the purpose of this standard, the following definitions apply:

1.1. Enclosure

A part providing protection of equipment against certain external influences and, in any direction, protection against direct contact (IEV 826-03-12).

Note: This definition taken from the existing international electrotechnical vocabulary (IEV) needs the following explanations under the scope of this standard:

(a) Enclosures provide protection of persons (or livestock) against access to hazardous parts.

(b) Barriers, shapes of openings or any other means — whether attached to the enclosure or formed by the enclosed equipment — suitable to prevent or limit the penetration of the specified test probes are considered as a part of the enclosure, except when they can be removed without the use of a key or tool.

1.2. Direct contact

Contact of persons (or livestock) with live parts (IEV 826-03-05).

Note: This IEV definition is given for information. In this standard 'Direct contact' is replaced by 'Access to hazardous parts'.

1.3. Degree of protection

The extent of protection provided by an enclosure against access to hazardous parts, against ingress of solid foreign objects and/or against ingress of water and verified by standardised test methods.

1.4. IP code

A coding system to indicate the degrees of protection provided by an enclosure against access to hazardous parts, ingress of solid foreign objects, ingress of water and to give additional information in connection with such protection.

1.5. Hazardous part

A part that is hazardous to approach or touch.

1.5.1. Hazardous live part

A live part which, under certain conditions of external influences, can give an electric shock (see IEC 536, at present Document 64(CO)196).

1.5.2. Hazardous mechanical part

A moving part, other than a smooth rotating shaft, that is hazardous to touch.

1.6. Protection provided by an enclosure against access to hazardous parts.

The protection of persons against:

(a) contact with hazardous low-voltage live parts;

(b) contact with hazardous mechanical parts;

(c) approach to hazardous high-voltage live parts below adequate clearance inside an enclosure.

Note: This protection may be provided:

(a) by means of the enclosure itself;

(b) by means of barriers as part of the enclosure or distances inside the enclosure.

1.7. Adequate clearance for protection against access to hazardous parts

A distance to prevent contact or approach of an access probe to a hazardous part.

1.8. Access probe

A test probe simulating in a conventional manner a part of a person or a tool, or the like, held by a person to verify adequate clearance from hazardous parts.

1.9. Object probe

A test probe simulating a solid foreign object to verify the possibility of ingress into an enclosure.

1.10. Opening

A gap or aperture in an enclosure which exists or may be formed by the application of a test probe at the specified force.

2. TESTS FOR PROTECTION AGAINST ACCESS TO HAZARDOUS PARTS INDICATED BY THE ADDITIONAL LETTER

2.1. Access probes

Access probes to verify the protection of persons against access to hazardous parts are given in table l.

2.2. Test conditions

The access probe is pushed against any openings of the enclosure with the force specified in table 1. If it partly or fully penetrates, it is placed in every possible position, but in no case shall the stop face fully penetrate through the opening.

Internal barriers are considered part of the enclosure as defined in paragraph 1.1.

For tests on low-voltage equipment, a low-voltage supply (of not less than 40 V and not more than 50 V) in series with a suitable lamp should be connected between the probe and the hazardous parts inside the enclosure. Hazardous live parts covered only with varnish or paint, or protected by oxidation or by a similar process, are covered by a metal foil electrically connected to those parts which are normally live in operation.

The signal-circuit method should also be applied to the hazardous moving parts of high-voltage equipment.

Internal moving parts may be operated slowly, where this is possible.

2.3. Acceptance conditions

The protection is satisfactory if adequate clearance is kept between the access probe and hazardous parts.

In the case of the test for the additional letter B, the jointed test finger may penetrate to its 80 mm length, but the stop face (Ø 50 mm × 20 mm) shall not pass through the opening. Starting from the straight position, both joints of the test finger shall be successively bent through an angle of up to 90° with respect to the axis of the adjoining section of the finger and shall be placed in every possible position.

In case of the tests for the additional letter D, the access probe may penetrate to its full length, but the stop face shall not fully penetrate through the opening. See Annex A for further clarification.

Conditions for verification of adequate clearance are identical with those given in paragraph 2.3.1 below.

2.3.1. For low-voltage equipment (rated voltages not exceeding 1 000 V AC and 1 500 V DC):

The access probe shall not touch hazardous live parts.

If adequate clearance is verified by a signal circuit between the probe and hazardous parts, the lamp shall not light.

Table 1

Access probes for the tests for protection of persons against access to hazardous parts

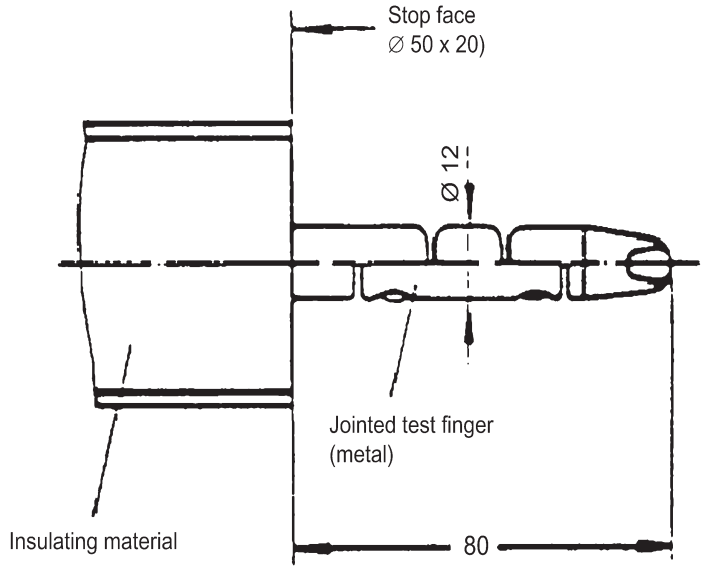
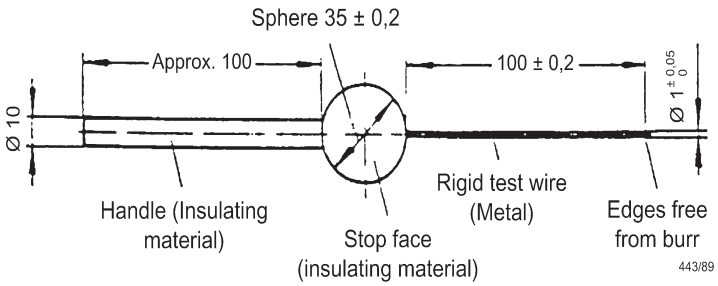
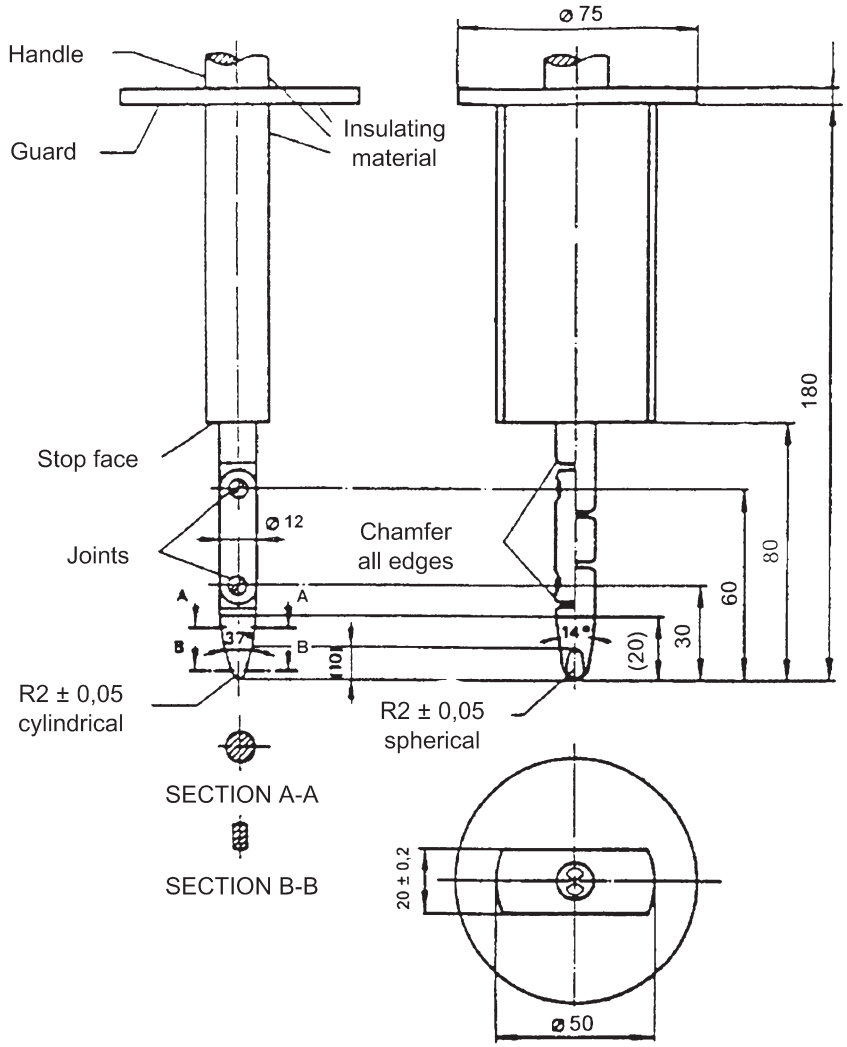
First numeral	Additional letter	Access probe	Test force
2	B	Jointed test finger See Figure 1 for full dimensions 	10 N ± 10 %
4, 5, 6	D	Test wire 1,0 mm diameter 100 mm long 	1 N ± 10 %

Figure 1

Jointed test finger



Material: metal, except where otherwise specified

Linear dimensions in millimeters

Tolerances on dimensions without specific tolerance:

On angles 0/- 10°

on linear dimensions:

up to 25 mm: 0/- 0,05

over 25 mm: ± 0,2

Both joints shall permit movement in the same plane and the same direction through an angle of 90° with a 0 to + 10° tolerance.

ANNEX 4

MEASUREMENT OF THE INSULATION RESISTANCE USING THE TRACTION BATTERY

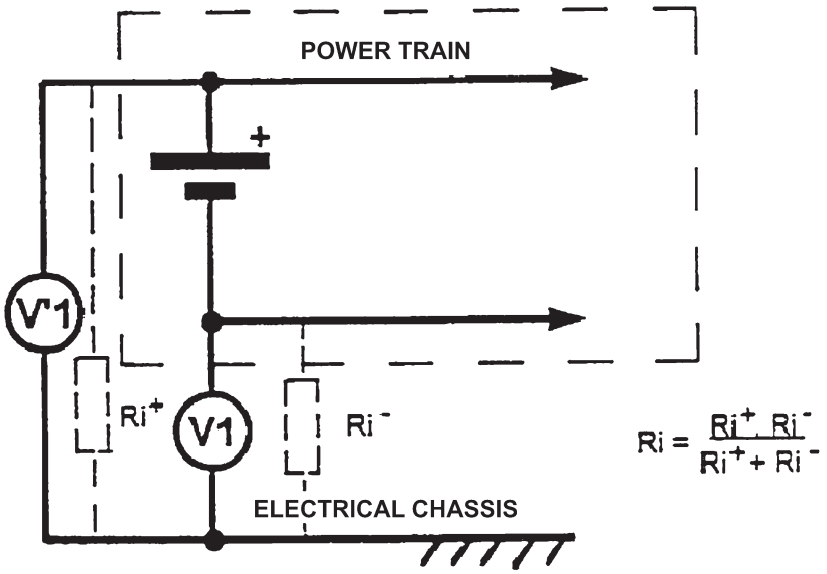
1. DESCRIPTION OF THE TEST METHOD

The traction battery shall be fully charged

The voltmeter used in this test shall measure DC values and have an internal resistance greater than 10 MΩ.

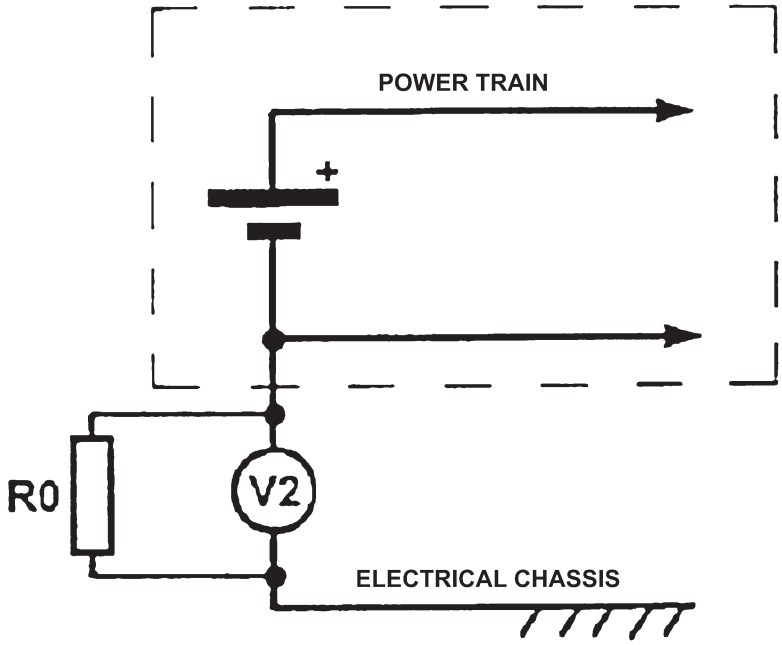
Measurement shall be made in two steps:

Step one:



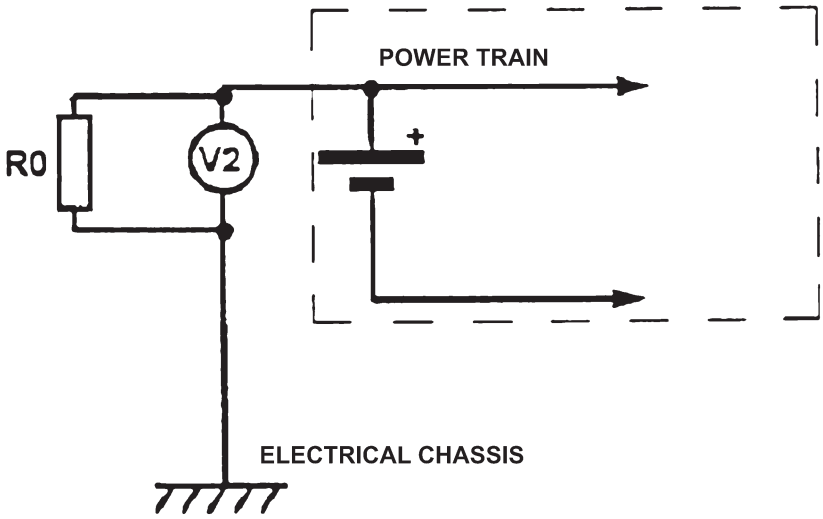
Measure V1 and V'1.

Step two:



if V1 > V'1

Step three:



if V1 < V'1

where Ro is a resistance of 500 Ω/V

The value of the insulation resistance Ri is given by one of the formula:

$$Ri = \frac{V1 - V2}{V2} \times Ro \text{ or } Ri = \frac{V'1 - V2}{V2} \times Ro$$

ANNEX 5

SYMBOL FOR OF THE INDICATION OF A VOLTAGE

(Reference to ISO 3864 and IEC 417k standards)

Black on a yellow ground

ANNEX 6

ESSENTIAL CHARACTERISTICS OF THE VEHICLE

1. GENERAL DESCRIPTION OF VEHICLE

1.1. Trade name or mark of the vehicle: .....

1.2. Vehicle type: .....

1.3. Manufacturer's name and address: .....

1.4. If applicable, name and address of manufacturer's representative: .....

1.5. Brief description of the power circuit components installation or drawings/pictures showing the location of the power circuit components installation: .....

1.6. Schematic diagram of all electrical functions included in power circuit: .....

1.7. Working voltage: V

1.8. Drawing and/or photograph of the vehicle:

2. DESCRIPTION OF MOTOR(S)

2.1. Make: .....

2.2. Type: .....

2.3. Working principle: .....

2.3.1. Direct current/alternative current/number of phases ([1])

2.3.2. Excitation: separate/shunt/series/compound ([1])

2.3.3. Synchron/asynchron ([1])

2.3.4. Cooling system: air/liquid ([1])

3. DESCRIPTION OF TRANSMISSION

3.1. Type: manual/automatic/none/others (to specify) ([1]): .....

3.2. Transmission ratios: .....

3.3. Dimension of tyres: .....

4. TRACTION BATTERY

4.1. Trade name and mark of the battery: .....

4.2. Indication of all types of electrochemical couples used: .....

.....

4.2.1. Nominal voltage: V

4.2.2. Number of battery cells

4.2.3. Number of battery modules

Gas combination rate (in per cent)

4.3. Type(s) of ventilation for battery module/pack ([1]): .....

4.4. Description of cooling system (if any): .....

4.5. Brief description of maintenance procedure (if any): .....

4.6. Battery energy: ..... kWh

4.7. End of discharge voltage value: V

5. POWER TRAIN ELECTRONIC CONVERTERS AND POWER AUXILIARY EQUIPMENT

5.1. Brief description of each electronic converter and auxiliary equipment: .....

5.2. Make of electronic converter assembly: .....

5.3. Type of electronic converter assembly: .....

5.4. Make of each auxiliary equipment: .....

5.5. Type of each auxiliary equipment: .....

5.6. Charger: on board/external ([1])

5.6.1. Make and type of different charger parts ([2])

5.6.2. Drawing description of the charger ([2])

Output nominal power (kW) ([2])

Maximum voltage of charge (V) ([2])

5.6.5. Maximum intensity of charge (A) ([2])

Make and type of control unit (if any) ([2])

5.6.7. Diagram of operating, controls and safety ([2])

5.6.8. Description and characteristics of charge periods ([2])

5.7. Specification of mains:

5.7.1. Type of mains: single phase/three phase ([1])

5.7.2. Voltage: V

6. FUSE AND/OR CIRCUIT BREAKER

6.1. Type: .....

6.2. Diagram showing the functional range: .....

7. POWER WIRING HARNESS

7.1. Type: .....

([1]) — Strike out what does not apply.

([2]) — For vehicles equipped with an on-board charger.

ANNEX 7

DETERMINATION OF HYDROGEN EMISSIONS DURING THE CHARGE PROCEDURES OF THE TRACTION BATTERY

1. INTRODUCTION

This Annex describes the procedure for the determination of hydrogen emissions during the charge procedures of the traction battery of all battery electric road vehicles, according to paragraph 5.3 of this Regulation.

2. DESCRIPTION OF TEST

The hydrogen emission test (Figure 7.1) is conducted in order to determine hydrogen emissions during the charge procedures of the traction battery with the on-board charger. The test consists in the following steps:

(a) vehicle preparation;

(b) discharge of the traction battery;

(c) determination of hydrogen emissions during a normal charge;

(d) determination of hydrogen emissions during a charge carried out with the on-board charger failure.

3. VEHICLE

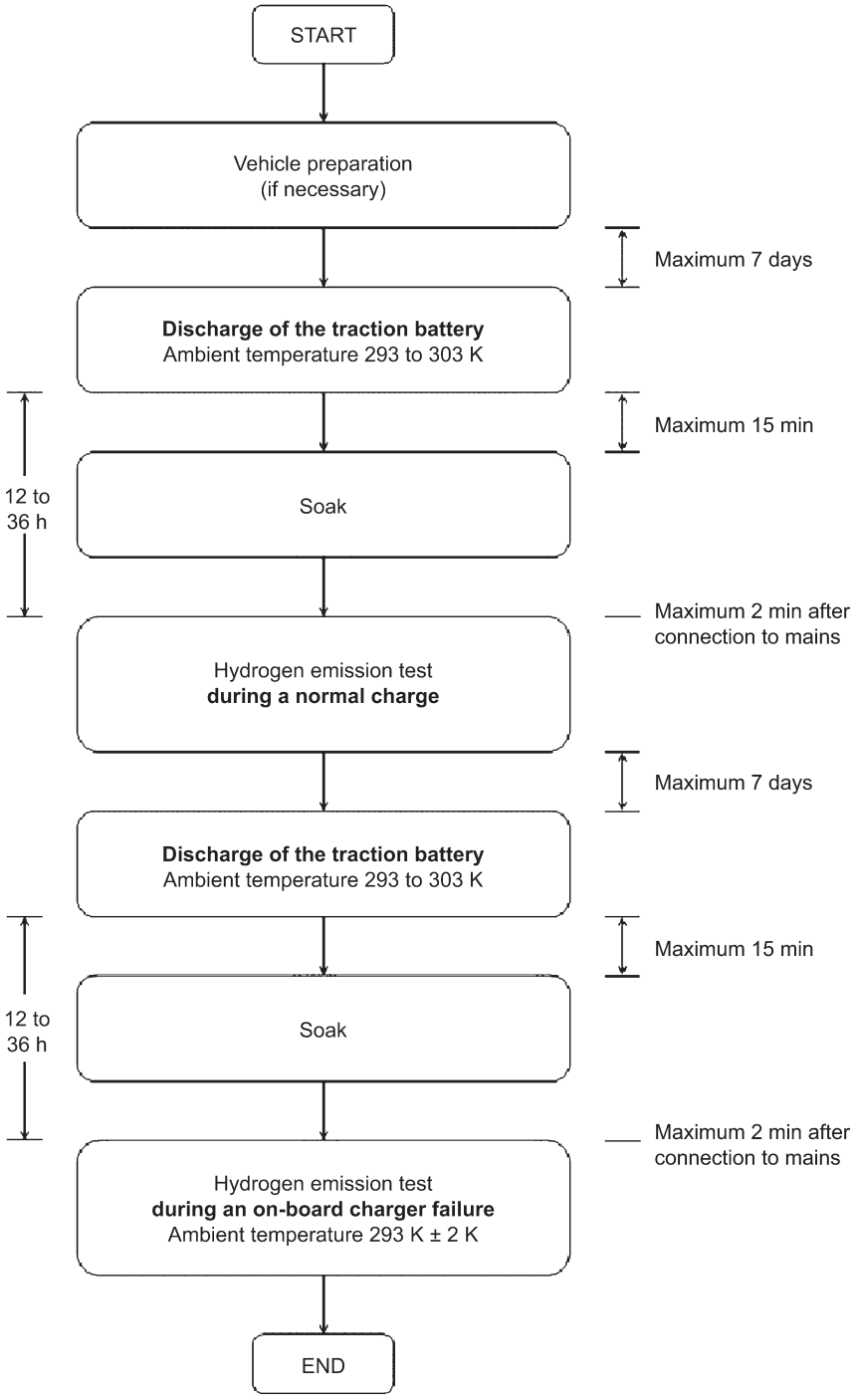
3.1. The vehicle must be in good mechanical condition and have been driven at least 300 km during seven days before the test. The vehicle must be equipped with the traction battery subject to the test of hydrogen emissions, over this period.

3.2. If the battery is used at a temperature above the ambient temperature, the operator must follow the manufacturer's procedure in order to keep the traction battery temperature in normal functioning range.

The manufacturer's representative must be able to certify that the temperature conditioning system of the traction battery is neither damaged nor presenting a capacity defect.

Figure 7.1

Determination of hydrogen emissions during the charge procedures of the traction battery



4. TEST EQUIPMENT FOR HYDROGEN EMISSION TEST

4.1. Chassis dynamometer

The chassis dynamometer must meet the requirements of the 05 series of amendments to Regulation No 83.

4.2. Hydrogen emission measurement enclosure

The hydrogen emission measurement enclosure must be a gas-tight measuring chamber able to contain the vehicle under test. The vehicle must be accessible from all sides and the enclosure when sealed must be gas-tight in accordance with Appendix 1 to this Annex. The inner surface of the enclosure must be impermeable and non-reactive to hydrogen. The temperature conditioning system must be capable of controlling the internal enclosure air temperature to follow the prescribed temperature throughout the test, with an average tolerance of ± 2 K over the duration of the test.

To accommodate the volume changes due to enclosure hydrogen emissions, either a variable-volume or another test equipment may be used. The variable-volume enclosure expands and contracts in response to the hydrogen emissions in the enclosure. Two potential means of accommodating the internal volume changes are movable panels, or a bellows design, in which impermeable bags inside the enclosure expand and contract in response to internal pressure changes by exchanging air from outside the enclosure. Any design for volume accommodation must maintain the integrity of the enclosure as specified in Appendix 1 to this Annex.

Any method of volume accommodation must limit the differential between the enclosure internal pressure and the barometric pressure to a maximum value of ± 5 hPa.

The enclosure must be capable of latching to a fixed volume. A variable volume enclosure must be capable of accommodating a change from its 'nominal volume' (see Annex 7, Appendix 1, paragraph 2.1.1), taking into account hydrogen emissions during testing.

4.3. Analytical systems

4.3.1. Hydrogen analyser

4.3.1.1. The atmosphere within the chamber is monitored using a hydrogen analyser (electrochemical detector type) or a chromatograph with thermal conductivity detection. Sample gas must be drawn from the mid-point of one side-wall or roof of the chamber and any bypass flow must be returned to the enclosure, preferably to a point immediately downstream of the mixing fan.

4.3.1.2. The hydrogen analyser must have a response time to 90 per cent of final reading of less than 10 seconds. Its stability must be better than 2 per cent of full scale at zero and at 80 per cent ± 20 per cent of full scale, over a 15-minute period for all operational ranges.

4.3.1.3. The repeatability of the analyser expressed as one standard deviation must be better than 1 per cent of full scale, at zero and at 80 per cent ± 20 per cent of full scale on all ranges used.

4.3.1.4. The operational ranges of the analyser must be chosen to give best resolution over the measurement, calibration and leak checking procedures.

4.3.2. Hydrogen analyser data recording system

The hydrogen analyser must be fitted with a device to record electrical signal output, at a frequency of at least once per minute. The recording system must have operating characteristics at least equivalent to the signal being recorded and must provide a permanent record of results. The recording must show a clear indication of the beginning and end of the normal charge test and charging failure operation.

4.4. Temperature recording

4.4.1. The temperature in the chamber is recorded at two points by temperature sensors, which are connected so as to show a mean value. The measuring points are extended approximately 0,1 m into the enclosure from the vertical centre line of each side-wall at a height of 0,9 ± 0,2 m.

4.4.2. The temperatures of the battery modules are recorded by means of the sensors.

4.4.3. Temperatures must, throughout the hydrogen emission measurements, be recorded at a frequency of at least once per minute.

4.4.4. The accuracy of the temperature recording system must be within ± 1,0 K and the temperature must be capable of being resolved to ± 0,1 K.

4.4.5. The recording or data processing system must be capable of resolving time to ± 15 seconds.

4.5. Pressure recording

4.5.1. The difference Δp between barometric pressure within the test area and the enclosure internal pressure must, throughout the hydrogen emission measurements, be recorded at a frequency of at least once per minute.

4.5.2. The accuracy of the pressure recording system must be within ± 2 hPa and the pressure must be capable of being resolved to ± 0,2 hPa.

4.5.3. The recording or data processing system must be capable of resolving time to ± 15 seconds.

4.6. Voltage and current intensity recording

4.6.1. The on-board charger voltage and current intensity (battery) must, throughout the hydrogen emission measurements, be recorded at a frequency of at least once per minute.

4.6.2. The accuracy of the voltage recording system must be within ± 1 V and the voltage must be capable of being resolved to ± 0,1 V.

4.6.3. The accuracy of the current intensity recording system must be within ± 0,5 A and the current intensity must be capable of being resolved to ± 0,05 A.

4.6.4. The recording or data processing system must be capable of resolving time to ± 15 seconds.

4.7. Fans

The chamber must be equipped with one or more fans or blowers with a possible flow of 0,1 to 0,5 m^3/second in order to thoroughly mix the atmosphere in the enclosure. It must be possible to reach a homogeneous temperature and hydrogen concentration in the chamber during measurements. The vehicle in the enclosure must not be subjected to a direct stream of air from the fans or blowers.

4.8. Gases

4.8.1. The following pure gases must be available for calibration and operation:

purified synthetic air (purity < 1 ppm C_1 equivalent; < 1 ppm CO; < 400 ppm CO_2; < 0,1 ppm NO); oxygen content between 18 and 21 per cent by volume,

hydrogen (H_2), 99,5 per cent minimum purity.

4.8.2. Calibration and span gases must contain mixtures of hydrogen (H_2) and purified synthetic air. The real concentrations of a calibration gas must be within ± 2 per cent of the nominal values. The accuracy of the diluted gases obtained when using a gas divider must be within ± 2 per cent of the nominal value. The concentrations specified in Appendix 1 may also be obtained by a gas divider using synthetic air as the dilution gas.

5. TEST PROCEDURE

The test consists in the five following steps:

(i) vehicle preparation;

(ii) discharge of the traction battery;

(iii) determination of hydrogen emissions during a normal charge;

(iv) discharge of the traction battery;

(v) determination of hydrogen emissions during a charge carried out with the on-board charger failure.

If the vehicle has to be moved between two steps, it shall be pushed to the following test area.

5.1. Vehicle preparation

The ageing of traction battery must be checked, proving that the vehicle has performed at least 300 km during seven days before the test. During this period, the vehicle must be equipped with the traction battery submitted to the hydrogen emission test. If this cannot be demonstrated then the following procedure will be applied.

5.1.1. Discharging is stopped:

(a) when the vehicle is not able to run at 65 per cent of the maximum thirty minutes speed; or

(b) when an indication to stop the vehicle is given to the driver by the standard on-board instrumentation; or

(c) after having covered the distance of 100 km.

5.1.2. Initial charge of the battery

The charge is carried out:

(a) with the on-board charger;

(b) in an ambient temperature between 293 K and 303 K.

The procedure excludes all types of external chargers.

The end of traction battery charge criteria corresponds to an automatic stop given by the on-board charger.

This procedure includes all types of special charges that could be automatically or manually initiated like, for instance, the equalisation charges or the servicing charges.

5.1.3. Procedure from paragraphs 5.1.1 to 5.1.2 must be repeated two times.

5.2. Discharge of the battery

The traction battery is discharged while driving on the test track or on a chassis dynamometer at a steady speed of 70 per cent ± 5 per cent from the maximum thirty minutes speed of the vehicle.

Stopping the discharge occurs:

(a) when an indication to stop the vehicle is given to the driver by the standard on-board instrumentation; or

(b) when the maximum speed of the vehicle is lower than 20 km/h.

5.3. Soak

Within fifteen minutes of completing the battery discharge operation specified in paragraph 5.2, the vehicle is parked in the soak area. The vehicle is parked for a minimum of 12 hours and a maximum of 36 hours, between the end of the traction battery discharge and the start of the hydrogen emission test during a normal charge. For this period, the vehicle must be soaked at 293 K ± 2 K.

5.4. Hydrogen emission test during a normal charge

5.4.1. Before the completion of the soak period, the measuring chamber must be purged for several minutes until a stable hydrogen background is obtained. The enclosure mixing fan(s) must also be turned on at this time.

5.4.2. The hydrogen analyser must be zeroed and spanned immediately prior to the test.

5.4.3. At the end of the soak, the test vehicle, with the engine shut off and the test vehicle windows and luggage compartment opened must be moved into the measuring chamber.

5.4.4. The vehicle shall be connected to the mains. The battery is charged according to normal charge procedure as specified in paragraph 5.4.7 below.

5.4.5. The enclosure doors are closed and sealed gas-tight within two minutes from electrical interlock of the normal charge step.

5.4.6. The start of a normal charge for hydrogen emission test period begins when the chamber is sealed. The hydrogen concentration, temperature and barometric pressure are measured to give the initial readings C_{H2i}, T_i and P_i for the normal charge test.

These figures are used in the hydrogen emission calculation (paragraph 6.). The ambient enclosure temperature T must not be less than 291 K and no more than 295 K during the normal charge period.

5.4.7. Procedure of normal charge

The normal charge is carried out with the on-board charger and consists of the following steps:

(a) Charging at constant power during t_1.

(b) Over-charging at constant current during t_2. Over-charging intensity is specified by manufacturer and corresponds to the one used during equalisation charging.

The end of traction battery charge criteria corresponds to an automatic stop given by the on-board charger to a charging time of t_{1+t2}. This charging time will be limited to t_{1+5} h, even if a clear indication is given to the driver by the standard instrumentation that the battery is not yet fully charged.

5.4.8. The hydrogen analyser must be zeroed and spanned immediately before the end of the test.

5.4.9. The end of the emission sampling period occurs t_{1+t2} or t_{1+5} h after the beginning of the initial sampling, as specified in paragraph 5.4.6. The different times elapsed are recorded. The hydrogen concentration, temperature and barometric pressure are measured to give the final readings C_{H2f}, T_f and P_f for the normal charge test, used for the calculation in paragraph 6.

5.5. Hydrogen emission test with the on-board charger failure

5.5.1. Within seven days maximum after having completed the prior test, the procedure starts with the discharge of the traction battery of the vehicle according to paragraph 5.2.

5.5.2. The steps of the procedure in paragraph 5.3 must be repeated.

5.5.3. Before the completion of the soak period, the measuring chamber must be purged for several minutes until a stable hydrogen background is obtained. The enclosure mixing fan(s) must also be turned on at this time.

5.5.4. The hydrogen analyser must be zeroed and spanned immediately prior to the test.

5.5.5. At the end of the soak, the test vehicle, with the engine shut off and the test vehicle windows and luggage compartment opened must be moved into the measuring chamber.

5.5.6. The vehicle shall be connected to the mains. The battery is charged according to failure charge procedure as specified in paragraph 5.5.9 below.

5.5.7. The enclosure doors are closed and sealed gas-tight within two minutes from electrical interlock of the failure charge step.

5.5.8. The start of a failure charge for hydrogen emission test period begins when the chamber is sealed. The hydrogen concentration, temperature and barometric pressure are measured to give the initial readings C_{H2i}, T_i and P_i for the failure charge test.

These figures are used in the hydrogen emission calculation (paragraph 6). The ambient enclosure temperature T must not be less than 291 K and no more than 295 K during the charging failure period.

5.5.9. Procedure of charging failure

The charging failure is carried out with the on-board charger and consists of the following steps:

(a) Charging at constant power during t'_1.

(b) Charging at maximum current during 30 minutes. During this phase, the on-board charger is blocked at maximum current.

5.5.10. The hydrogen analyser must be zeroed and spanned immediately before the end of the test.

5.5.11. The end of test period occurs t'_{1+30} minutes after the beginning of the initial sampling, as specified in paragraph 5.8.8. The times elapsed are recorded. The hydrogen concentration, temperature and barometric pressure are measured to give the final readings C_{H2f}, T_f and P_f for the charging failure test, used for the calculation in paragraph 6.

6. CALCULATION

The hydrogen emission tests described in paragraph 5 allow the calculation of the hydrogen emissions from the normal charge and charging failure phases. Hydrogen emissions from each of these phases are calculated using the initial and final hydrogen concentrations, temperatures and pressures in the enclosure, together with the net enclosure volume.

The formula below is used:

$$M_{H2} = k \times V \times 10^{-4} \times \left(\frac{\left(1 + \frac{V_{out}}{V}\right) \times C_{H2f} \times P_f}{T_f} - \frac{C_{H2i} \times P_i}{T_i} \right)$$

where:

M_{H2} = hydrogen mass, in grams
C_{H2} = measured hydrogen concentration in the enclosure, in ppm volume
V = net enclosure volume in cubic metres (m^3) corrected for the volume of the vehicle, with the windows and the luggage compartment open. If the volume of the vehicle is not determined a volume of 1,42 m^3 is subtracted
V_{out} = Compensation volume in m^3, at the test temperature and pressure
T = ambient chamber temperature, in K
P = absolute enclosure pressure, in kPa
k = 2,42

where: i is the initial reading
f is the final reading

6.2. Results of test

The hydrogen mass emissions for the vehicle are:

M_N = hydrogen mass emission for normal charge test, in grams
M_D = hydrogen mass emission for charging failure test, in grams

Appendix 1

CALIBRATION OF EQUIPMENT FOR HYDROGEN EMISSION TESTING

1. CALIBRATION FREQUENCY AND METHODS

All equipment must be calibrated before its initial use and then calibrated as often as necessary and in any case in the month before type approval testing. The calibration methods to be used are described in this appendix.

2. CALIBRATION OF THE ENCLOSURE

2.1. Initial determination of enclosure internal volume

2.1.1. Before its initial use, the internal volume of the chamber must be determined as follows. The internal dimensions of the chamber are carefully measured, taking into account any irregularities such as bracing struts. The internal volume of the chamber is determined from these measurements.

The enclosure must be latched to a fixed volume when the enclosure is held at an ambient temperature of 293 K. This nominal volume must be repeatable within ± 0,5 per cent of the reported value.

2.1.2. The net internal volume is determined by subtracting 1,42 m^3 from the internal volume of the chamber. Alternatively the volume of the test vehicle with the luggage compartment and windows open may be used instead of the 1,42 m^3.

2.1.3. The chamber must be checked as in paragraph 2.3. If the hydrogen mass does not agree with the injected mass to within ± 2 per cent then corrective action is required.

2.2. Determination of chamber background emissions

This operation determines that the chamber does not contain any materials that emit significant amounts of hydrogen. The check must be carried out at the enclosure's introduction to service, after any operations in the enclosure which may affect background emissions and at a frequency of at least once per year.

2.2.1. Variable-volume enclosure may be operated in either latched or unlatched volume configuration, as described in paragraph 2.1.1. Ambient temperature must be maintained at 293 K ± 2 K, throughout the 4-hour period mentioned below.

2.2.2. The enclosure may be sealed and the mixing fan operated for a period of up to 12 hours before the four-hour background-sampling period begins.

2.2.3. The analyser (if required) must be calibrated, then zeroed and spanned.

2.2.4. The enclosure must be purged until a stable hydrogen reading is obtained, and the mixing fan turned on if not already on.

2.2.5. The chamber is then sealed and the background hydrogen concentration, temperature and barometric pressure are measured. These are the initial readings C_{H2i}, T_i and P_i used in the enclosure background calculation.

2.2.6. The enclosure is allowed to stand undisturbed with the mixing fan on for a period of four hours.

2.2.7. At the end of this time the same analyser is used to measure the hydrogen concentration in the chamber. The temperature and the barometric pressure are also measured. These are the final readings C_{H2f}, T_f and P_f.

2.2.8. The change in mass of hydrogen in the enclosure must be calculated over the time of the test in accordance with paragraph 2.4 and must not exceed 0,5 g.

2.3. Calibration and hydrogen retention test of the chamber

The calibration and hydrogen retention test in the chamber provides a check on the calculated volume (paragraph 2.1) and also measures any leak rate. The enclosure leak rate must be determined at the enclosure's introduction to service, after any operations in the enclosure which may affect the integrity of the enclosure, and at least monthly thereafter. If six consecutive monthly retention checks are successfully completed without corrective action, the enclosure leak rate may be determined quarterly thereafter as long as no corrective action is required.

2.3.1. The enclosure must be purged until a stable hydrogen concentration is reached. The mixing fan is turned on, if not already switched on. The hydrogen analyser is zeroed, calibrated if required, and spanned.

2.3.2. The enclosure must be latched to the nominal volume position.

2.3.3. The ambient temperature control system is then turned on (if not already on) and adjusted for an initial temperature of 293 K.

2.3.4. When the enclosure temperature stabilises at 293 K ± 2 K, the enclosure is sealed and the background concentration, temperature and barometric pressure measured. These are the initial readings C_{H2i}, T_i and P_i used in the enclosure calibration.

2.3.5. The enclosure must be unlatched from the nominal volume.

2.3.6. A quantity of approximately 100 g of hydrogen is injected into the enclosure. This mass of hydrogen must be measured to an accuracy of ± 2 per cent of the measured value.

2.3.7. The contents of the chamber must be allowed to mix for five minutes and then the hydrogen concentration, temperature and barometric pressure are measured. These are the final readings C_{H2f}, T_f and P_f for the calibration of the enclosure as well as the initial readings C_{H2i}, T_i and P_i for the retention check.

2.3.8. On the basis of the readings taken in paragraphs 2.3.4 and 2.3.7 and the formula in paragraph 2.4, the mass of hydrogen in the enclosure is calculated. This must be within ± 2 per cent of the mass of hydrogen measured in paragraph 2.3.6.

2.3.9. The contents of the chamber must be allowed to mix for a minimum of 10 hours. At the completion of the period, the final hydrogen concentration, temperature and barometric pressure are measured and recorded. These are the final readings C_{H2f}, T_f and P_f for the hydrogen retention check.

2.3.10. Using the formula in paragraph 2.4, the hydrogen mass is then calculated from the readings taken in paragraphs 2.3.7 and 2.3.9. This mass may not differ by more than 5 per cent from the hydrogen mass given by paragraph 2.3.8.

2.4. Calculation

The calculation of net hydrogen mass change within the enclosure is used to determine the chamber's hydrocarbon background and leak rate. Initial and final readings of hydrogen concentration, temperature and barometric pressure are used in the following formula to calculate the mass change.

$$M_{H2} = k \times V \times 10^{-4} \times \left(\frac{\left(1 + \frac{V_{out}}{V}\right) \times C_{H2f} \times P_f}{T_f} - \frac{C_{H2i} \times P_i}{T_i} \right)$$

where:

M_{H2} = hydrogen mass, in grams
C_{H2} = measured hydrogen concentration into the enclosure, in ppm volume
V = enclosure volume in cubic metres (m^3) as measured in paragraph 2.1.1
V_{out} = compensation volume in m^3, at the test temperature and pressure
T = ambient chamber temperature, in K
P = absolute enclosure pressure, in kPa
k = 2,42

where: i is the initial reading
f is the final reading

3. CALIBRATION OF THE HYDROGEN ANALYSER

The analyser should be calibrated using hydrogen in air and purified synthetic air. See paragraph 4.8.2 of Annex 7.

Each of the normally used operating ranges is calibrated by the following procedure.

3.1. Establish the calibration curve by at least five calibration points spaced as evenly as possible over the operating range. The nominal concentration of the calibration gas with the highest concentrations to be at least 80 per cent of the full scale.

3.2. Calculate the calibration curve by the method of least squares. If the resulting polynomial degree is greater than 3, then the number of calibration points must be at least the number of the polynomial degree plus 2.

3.3. The calibration curve must not differ by more than 2 per cent from the nominal value of each calibration gas.

3.4. Using the coefficients of the polynomial derived from paragraph 3.2 above, a table of analyser readings against true concentrations shall be drawn by steps no greater than 1 per cent of full scale. This is to be carried out for each analyser range calibrated.

This table shall also contain other relevant data such as:

Date of calibration

Span and zero potentiometer readings (where applicable)

Nominal scale

Reference data of each calibration gas used

The real and indicated value of each calibration gas used together with the percentage differences

Calibration pressure of analyser

3.5. Alternative methods (e.g. computer, electronically controlled range switch) can be used if it is proven to the technical service that these methods give equivalent accuracy.

Appendix 2

ESSENTIAL CHARACTERISTICS OF THE VEHICLE FAMILY

1. PARAMETERS DEFINING THE FAMILY RELATIVE TO HYDROGEN EMISSIONS

The family may be defined by basic design parameters which must be common to vehicles within the family. In some cases there may be interaction of parameters. These effects must also be taken into consideration to ensure that only vehicles with similar hydrogen emission characteristics are included within the family.

2. To this end, those vehicle types whose parameters described below are identical are considered to belong to the same hydrogen emissions.

Traction battery:

— Trade name or mark of the battery

— Indication of all types of electrochemical couples used

— Number of battery cells

— Number of battery modules

— Nominal voltage of the battery (V)

— Battery energy (kWh)

— Gas combination rate (in per cent)

— Type(s) of ventilation for battery module(s) or pack

— Type of cooling system (if any)

On-board charger:

— Make and type of different charger parts

— Output nominal power (kW)

— Maximum voltage of charge (V)

— Maximum intensity of charge (A)

— Make and type of control unit (if any)

— Diagram of operating, controls and safety

— Characteristics of charge periods

NOTE TO THE READER

The institutions have decided to no longer quote in their texts the last amendment to cited acts.

Unless otherwise indicated, references to acts in the texts published here are to the version of those acts currently in force.