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Railway applications — Rolling stock — Testing of rolling stock on completion of construction and before entry into service

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National foreword

This British Standard is the UK implementation of EN 50215:2009. It supersedes BS EN 50215:1999 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee GEL/9, Railway Electrotechnical Applications, to Subcommittee GEL/9/2, Railway Electrotechnical Applications - Rolling stock.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Bahnanwendungen - Bahnfahrzeuge - Prüfung von Bahnfahrzeugen nach Fertigstellung und vor Indienststellung

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CENELEC

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Foreword

This European Standard was prepared by SC 9XB, Electromechanical material on board rolling stock, of Technical Committee CENELEC TC 9X, Electrical and electronic applications for railways.

The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 50215 on 2009-07-01.

This European Standard supersedes EN 50215:1999.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2010-07-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2012-07-01

Contents

1 Scope

This European Standard specifies general criteria to demonstrate by testing that newly constructed complete railway vehicles conform with standards or other normative documents.

This standard is intended to be used as technical instructions for the processing of tests which may be needed for demonstration of certain technical requirements where they are relevant.

This standard is not intended to be used as a list of approval requirements without consideration of aforementioned technical requirements.

This standard, as a whole or in part, applies to all railway vehicles except special purpose vehicles such as track-laying machines, ballast cleaners and personnel carriers. The extent of application of the standard for particular vehicles will be specifically mentioned in the contract.

NOTE 1 The parts of the standard which are applicable will depend on the type of vehicle (e.g. passenger, freight, powered, trailer, etc.).

NOTE 2 The scope of this standard excludes railbound and road/rail vehicles for construction and maintenance of railway infrastructure.

NOTE 3 This standard does not deal with tests carried out on components or equipment before fitting to the vehicle.

In so far as this standard is applicable it may be used for the following:

- generator sets mounted on a vehicle provided for auxiliary purposes;
- the electrical transmission used on trolley buses or similar vehicles;
- control and auxiliary equipment of vehicles with non-electrical propulsion systems;
- vehicles guided, supported or electrically propelled by systems which do not use the adhesion between wheel and rail.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 12663:2000, *Railway applications - Structural requirements of railway vehicle bodies*

EN 13129-2:2004, *Railway applications - Air conditioning for main line rolling stock - Part 2: Type tests*

EN 13272:2001, *Railway applications - Electrical lighting for rolling stock in public transport systems*

EN 13452-2:2003, *Railway applications - Braking - Mass transit brake systems - Part 2: Methods of test*

EN 13775-1:2003, *Railway applications - Measuring of new and modified freight wagons - Part 1: Measuring principles*

EN 13775-2:2003, *Railway applications - Measuring of new and modified freight wagons - Part 2: Freight wagons with bogies*

EN 13775-3:2003, *Railway applications - Measuring of new and modified freight wagons - Part 3: Freight wagons with 2 wheelsets*

EN 13775-4:2004, *Railway applications - Measuring of new and modified freight wagons - Part 4: Bogies with 2 wheelsets*

EN 13775-5:2003, *Railway applications - Measuring of new and modified freight wagons - Part 5: Bogies with 3 wheelsets*

EN 13775-6:2004, *Railway applications - Measuring of new and modified freight wagons - Part 6: Multiple and articulated freight wagons*

EN 14067-4:2005, *Railway applications - Aerodynamics - Part 4: Requirements and test procedures for aerodynamics on open track*

EN 14067-5:2006, *Railway applications - Aerodynamics - Part 5: Requirements and test procedures for aerodynamics in tunnels*

EN 14363:2005, *Railway applications - Testing for the acceptance of running characteristics of railway vehicles - testing of running behaviour and stationary tests*

EN 14531-1:2005, *Railway applications - Braking - Methods for calculation of stopping distances, slowing distances and immobilisation braking - Part 1: General algorithms*

EN 14750-2:2006, *Railway applications - Air conditioning for urban and suburban rolling stock - Part 2: Type tests*

EN 14752:2005, *Railway applications - Bodyside entrance systems*

EN 14813-2:2006, *Railway applications - Air conditioning for driving cabs - Part 2: Type tests*

EN 15806 [1)], *Railway application - Braking - Static brake testing*

EN 50121-3-1:2006, *Railway applications - Electromagnetic compatibility - Part 3-1: Rolling stock - Train and complete vehicle*

EN 50121-3-2:2006, *Railway applications - Electromagnetic compatibility - Part 3-2: Rolling stock - Apparatus*

EN 50126-1:1999, *Railway applications - The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS) - Part 1: Basic requirements and generic process*

EN 50153:2002, *Railway applications - Rolling stock - Protective provisions relating to electrical hazards*

EN 50155:2007, *Railway applications - Electronic equipment used on rolling stock*

EN 50163:2004, *Railway applications - Supply voltages of traction systems*

EN 50206-1:1998, *Railway applications - Rolling stock - Pantographs: Characteristics and tests - Part 1: Pantographs for main line vehicles*

EN 50206-2:1999, *Railway applications - Rolling stock - Pantographs: Characteristics and tests - Part 2: Pantographs for metros and light rail vehicles*

EN 50238:2003, *Railway applications - Compatibility between rolling stock and train detection systems*

EN 50317:2002 (+ A1:2004 + A2:2007), *Railway applications - Current collection systems - Requirements for and validation of measurements of the dynamic interaction between pantograph and overhead contact line*

EN 50343:2003, *Railway applications - Rolling stock - Rules for installation of cabling*

EN 50388:2005, *Railway applications - Power supply and rolling stock - Technical criteria for the coordination between power supply (substation) and rolling stock to achieve interoperability*

EN 60077-1:2002*, Railway applications - Electric equipment for rolling stock - Part 1: General service conditions and general rules* (IEC 60077-1:1999, mod.)

[1)] At draft stage.

EN 60077-2:2002*, Railway applications - Electric equipment for rolling stock - Part 2: Electrotechnical components - General rules* (IEC 60077-2:1999, mod.)

EN 60077-3:2003*, Railway applications - Electric equipment for rolling stock - Part 3: Electrotechnical components - Rules for d.c. circuit-breakers* (IEC 60077-3:2001)

EN 60077-4:2003, *Railway applications - Electric equipment for rolling stock - Part 4: Electrotechnical components - Rules for AC circuit-breakers* (IEC 60077-4:2003)

EN 60077-5:2003, *Railway applications - Electrotechnical equipment for rolling stock - Part 5: Electrotechnical components - Rules for HV fuses* (IEC 60077-5:2003)

EN 60310:2004, *Railway applications - Traction transformers and inductors on board rolling stock* (IEC 60310:2004)

EN 60322:2001, *Railway applications - Electric equipment for rolling stock - Rules for power resistors of open construction* (IEC 60322:2001)

EN 60349-1:2000 (+ A1:2002), *Electric traction - Rotating electrical machines for rail and road vehicles - Part 1: Machines other than electronic convertor-fed alternating current motors* (IEC 60349-1:1999 + A1:2002)

EN 60349-2:2001, *Railway applications - Rotating electrical machines for rail and road vehicles - Part 2: Electronic converter-fed alternating current motors* (IEC 60349-2:1993, mod.)

EN 60529:1991 (+ A1:2000), *Degrees of protection provided by enclosures (IP Code)* (IEC 60529:1989 + A1:1999)

EN 61287-1:2006, *Railway applications - Power convertors installed on board rolling stock - Part 1: Characteristics and test methods* (IEC 61287-1:2005)

EN 61377-1:2006, *Railway applications - Rolling stock - Part 1: Combined testing of inverter-fed alternating current motors and their control system* (IEC 61377-1:2006)

EN 61377-2:2002, *Railway applications - Rolling stock - Combined testing - Part 2: Chopper-fed direct current traction motors and their control* (IEC 61377-2:2002)

EN 61377-3:2002, *Railway applications - Rolling stock - Part 3: Combined testing of alternating current motors, fed by an indirect convertor, and their control system* (IEC 61377-3:2002)

EN ISO 3095:2005, *Railway applications - Acoustics - Measurement of noise emitted by railbound vehicles* (ISO 3095:2005)

EN ISO 3381:2005, *Railway applications - Acoustics - Measurement of noise inside railbound vehicles* (ISO 3381:2005)

3 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

3.1
manufacturer
organisation which has the technical responsibility for the supply of the vehicle system

NOTE There may be more than one manufacturer where the contract for the vehicle is split in two or more parts.

3.2
manufacturer's works
location where the assembly of the vehicles is completed and where static tests are generally performed

3.3
purchaser
organisation which orders and will own the vehicle

NOTE The purchaser may have the responsibility for direct negotiations with the manufacturer, unless that responsibility is delegated to the user, a main contractor or a consultant.

3.4
supplier
organisation which has the responsibility for the supply of individual items of equipment or groups of equipment to the manufacturer

3.5
supplier's works
location where individual items of equipment or groups of equipment are manufactured

3.6
contract
all the component parts of the technical specifications agreed between manufacturer and purchaser, consisting of purchaser's technical specifications, manufacturer's technical responses, minutes of meetings, and any other formal contract documents

3.7
user
organisation which will use the vehicle

NOTE The user will be a train operator and may be the purchaser, or another party who is using the vehicle on behalf of the purchaser through, for example, a leasing arrangement.

3.8
infrastructure controller
organisation which controls the railway infrastructure, including, for example, track, signalling, communications and structures

3.9
type test
a test of one or more devices, system or complete vehicle to show that the design meets the required specifications and the relevant standards

3.10
routine test
a test to which each vehicle is subjected to during or after manufacture to ascertain whether it complies with the specified criteria

3.11
safety-related
carries responsibility for safety

3.12
voluntary test
any additional test (either type or routine) added to the Test Plan by agreement between the manufacturer and the purchaser

3.13
validation documentation
documented evidence that a product, process or service is in conformance with specified requirements or other normative documents

3.14
test plan
the plan of the tests to be undertaken by the manufacturer as presented within its Quality Plan, including all supporting information on the conduct of the tests

NOTE In the context of this standard, the Test Plan includes all subordinate test specifications.

3.15
Quality Plan
document specifying which procedures and associated resources shall be applied by whom and when to a specific project, product, process or contract

[ISO 9000:2000]

3.16
Approval Authority
any body other than the purchaser with the legal right to require tests to be performed on vehicles within the scope of this standard and to whom compliance verification must be demonstrated

NOTE These bodies may be different in each country and may include national or international regulatory bodies, national safety authorities, infrastructure controllers, and Notified Bodies.

4 Requirements

4.1 General

The manufacturer shall exercise control over all activities affecting the quality of the products to ensure that the requirements of the standards or other normative documents to which the declaration refers are met.

For this purpose the manufacturer shall have at his disposal all necessary means for carrying out this control at all levels (for example raw materials, supplies, production, finished products or packing). Information shall be available on the manufacturer's quality system and the results of tests as appropriate.

The manufacturer shall establish and maintain a quality system. This shall include auditable procedures covering the final inspection and test operations, including workmanship standards, test specifications, test records, calibration of test instruments and equipment, document control, control of non-conforming products and personnel training.

NOTE It is recommended that manufacturers operate a quality system in accordance with EN ISO 9001.

The Quality Plan for the design, production, inspection and testing of the product shall include a Test Plan defining how the manufacturer will demonstrate conformance to the specified requirements.

The contract shall define the various tests to be undertaken on completed vehicles and before entry into service to assure the purchaser that:

- the vehicles comply with the technical requirements of the contract (type tests, 3.9, see also 5.3.1);
- every vehicle conforms to the design standard proved in the type tests (routine tests, 3.10, see also 5.3.2).

All component type and routine tests shall be successfully completed according to the relevant standards and specifications, except as permitted by 6.1, before the tests within the scope of this standard are commenced. The tests covered by this standard are to demonstrate correct interfacing with the functions of the vehicle.

This standard does not cover the following types of testing:

- endurance and reliability;
- development;
- investigative (except for guidance only);
- system test, such as subassembly or system combined test.

4.2 Third party test facilities

If it is intended to use third party test facilities this shall be declared and agreed at the time of contract with details of the third party, its test facilities and accreditation included in the Test Plan (see 4.3).

This shall of necessity apply to:

- static tests necessitating the vehicle to be moved to a specialized test centre not belonging to either the manufacturer or the purchaser;
- dynamic tests on another system not belonging to either the manufacturer or the user.

It is recommended that third party test facilities are accredited to EN ISO/IEC 17025.

NOTE The purchaser or the approval authority of the country concerned may require tests to be carried out by an accredited test facility independent of the manufacturer.

4.3 Test Plan

The various tests to be undertaken by the manufacturer shall be presented by the manufacturer within its Quality Plan as a Test Plan which shall detail the following:

a) the test programme;

b) the component and equipment type tests to be completed before undertaking each vehicle test;

c) the test facilities to be used, including, as appropriate, their accreditation and competence details, and their level of independence from the manufacturer;

d) the test methods;

e) the vehicle loading conditions for each test;

f) the environmental conditions for each test;

g) the limits and tolerances of any test measuring methods;

h) the success criteria for each test;

i) the Corrective Action process;

j) the validation documentation.

Where the contract requires validation of certain tests or documents by the purchaser, these shall be identified in the Test Plan.

Where the contract requires safety to be demonstrated by a series of tests derived from a Safety or Risk Assessment performed in accordance with EN 50126-1, or as required by an external Approval Authority then these tests shall be included in the test programme and identified as such in the Test Plan. The term “safety-related” is used (see definition 3.12, derived from EN 50129) in this standard to identify those tests which might be in this category. The final decision on whether a test is safety-related rests with those who determine the contribution made by the test to the responsibility for safety.

The auditable process used to derive the information for the Test Plan shall ensure that the list of tests produced to support the validation documentation is comprehensive.

The configuration (type numbers, serial numbers, modification status) of key components, including revisions of software, shall be recorded as a “quality” record

On successful completion of each test the validation documentation shall be prepared by the manufacturer.

5 Categories of tests

5.1 General

The Test Plan shall present the tests to be carried out in the following categories:

a) preliminary adjustment tests (see 5.2);

b) acceptance tests, which include:

- type tests, see 5.3.1;
- routine tests, see 5.3.2;

c) investigation tests (see 5.4).

The tests may be simplified or omitted by agreement between purchaser and manufacturer:

i) if the vehicles concerned are demonstrated to be identical to vehicles previously constructed and for which experience is available, or if the vehicles are equipped with motors or other important components stipulated by the purchaser;

ii) if it can be shown by documentary proof that equivalent tests have been performed under representative conditions.

5.2 Preliminary adjustment tests

Before submitting the vehicle to the acceptance tests, the manufacturer may require to carry out preliminary adjustment tests which cannot be made in manufacturer's works and which may involve test runs on the user's lines with or without load. In this event, at least the minimum amount of testing required for safe running (see 6.2) shall be completed to the satisfaction of the user and the infrastructure controller.

The maximum total distance of the trial runs to obtain necessary adjustments should be agreed in the contract and shall take into account the type of vehicle, more especially its maximum speed and the new devices which are incorporated. Failing a specified value in the contract, a maximum run not exceeding 5 000 km should be adopted for vehicles which are to be subjected to the type tests.

Test runs may only be undertaken under the supervision and with the participation of a qualified agent appointed by the user. The user shall also appoint the driver of the vehicle.

5.3 Acceptance tests

5.3.1 Type tests

These tests shall be performed over an agreed duration to demonstrate that the vehicle design complies with the performance requirements specified in the contract. They are listed in Tables A.1 and A.2 and described in Clauses 8 and 9.

The tests shall be undertaken on the first vehicles built to the design unless otherwise agreed at the time of contract and included in the Test Plan.

If the type tests are performed on a prototype or pre-production vehicle, then the manufacturer shall agree with the purchaser those additional tests which are necessary on the first production built vehicle to be included in the Test Plan.

The tests shall be performed under the appropriate test conditions as explained in Clause 6.

Voluntary type tests may be required only if they are specified in the Test Plan.

5.3.2 Routine tests

These tests shall be carried out on each vehicle to be delivered. They are listed in Tables A.1 and A.2 and described in Clauses 8 and 9 (see Clause 6).

Specific parameters used in the type test should be selected as the test criteria for compliance of each vehicle. The routine tests shall include sufficient measurements and checks to confirm compliance with the selected test criteria.

The tests shall be performed under the appropriate test conditions as explained in Clause 6.

The results obtained in the routine tests shall, taking into account acceptable tolerances, not be less satisfactory than those obtained for the type tests.

In cases where observations made during the corresponding type tests make it unnecessary for the routine test to be repeated in its entirety, a limited range or sample of routine tests, or a simplified form of those tests stated in the summary tables, or declarations of conformity may be accepted by agreement in the contract.

Any necessary additional routine tests shall be agreed in the contract and included in the Test Plan.

5.3.3 Tests required by Approval Authority

Tests required by Approval Authorities and those tests demonstrating safety (see 4.3) shall be clearly identified in the Test Plan. Tests regarded as in this category are shown in Tables A.1 and A.2.

5.4 Investigation tests

Investigation tests are special tests of an optional character and are carried out in order to obtain additional information. They shall be carried out only if they are specified in the contract.

These tests may be arranged by agreement between purchaser and manufacturer. In each particular case, the purchaser and manufacturer shall agree on the operating method and the programme for these tests.

The results of investigation tests shall not be used as a reason for refusing to accept the vehicle.

6 Test conditions

6.1 General

Tests shall be performed under the prevailing ambient conditions unless otherwise specified.

The Test Plan shall take account of the nature and site of each test and should cover:

a) type and routine test programmes, especially in those cases where this standard allows the parties a freedom of choice;

b) static tests (see 6.2);

c) dynamic tests (see 6.3);

d) methods for testing for environmental conditions, e.g. snow, rain, dust, temperature, etc. where these conditions are seasonal;

e) factory tests on components which, due to shortage of suitable test facilities at the supplier's works, are required to be carried out on the completed vehicle either statically or dynamically.

6.2 Static tests

These tests should normally take place at the manufacturer’s works and are described in Clause 8.

These tests shall include checks that the vehicle is sufficiently safe to undertake the dynamic tests.

The test facilities shall be appropriate and sufficient to ensure the tests are performed consistently; otherwise, the manufacturer shall inform the purchaser of any limitations of their test facilities with respect to these tests.

Where tests are performed at a third-party facility (see 4.2) which involves transportation of the vehicle to or from that facility, sufficient tests shall be undertaken by the manufacturer to ensure that the transportation can be completed safely.

6.3 Dynamic tests

The tests are normally undertaken on the lines over which the vehicle is intended to operate or, if not available, over lines with similar characteristics as specified in the contract, and are described in Clause 9.

The purchaser shall arrange access to the lines as appropriate and the necessary crew under the conditions specified in the contract.

Operation of the test trains shall comply with all regulations of the infrastructure controller.

The purchaser shall provide all the necessary facilities for any preparation for dynamic tests (including preliminary test running) under the conditions specified in the contract.

Where it is necessary to undertake the dynamic tests on the track of another infrastructure controller, the selected route, its characteristics and conditions of operation shall be agreed at the time of contract.

It is permitted to perform some or all of the dynamic tests at a dedicated facility by agreement.

NOTE 1 Attention is drawn to the need to ensure that the responsibilities of all parties involved in performing the dynamic tests are clearly defined.

NOTE 2 Attention is also drawn to the need to complete all the necessary preliminaries such as the relevant parts of the Reliability, Availability and Maintenance Case and the Safety Case before undertaking the dynamic tests.

7 Validation documentation

The validation documentation shall contain sufficient information to identify the vehicle and all its major components and enable these to be traced through the test records. As a minimum the following shall be provided:

a) the name and address of the organisation which produced the documentation;

b) the name and address of the manufacturer;

c) the identification of the vehicle and its major components by name, type, model number and any relevant supplementary information such as lot number, batch or serial number and modification level;

d) the standards or normative documents referenced in the contract or Test Plan in a clear and concise way;

e) all supplementary information such as grade or category of the vehicle components;

f) the date of the documentation;

g) the signature and title or an equivalent marking of the authorised signatory.

8 Schedule of static tests

8.1 General

The manufacturer shall undertake the schedule of static tests as defined in the Test Plan. Table A.1 gives a representative list of static tests which may be included in the schedule. The list shall not be taken as exhaustive but may be used as a guideline in the process used by the manufacturer to produce his Test Plan.

In the absence of specific requirements in the contract, the following tests (8.2 – 8.20) shall be included in the Test Plan as appropriate for the type of vehicle covered in the contract.

Unless otherwise stated in the subclause heading, the following requirements are for both the Type and Routine Tests. Where different requirements are specified for these tests, they are detailed in separate subclauses for Type and Routine Tests.

8.2 Dimensional tests

8.2.1 Objective

To verify that the outside dimensions of the vehicle, any clearances and flexible connections when completely assembled and in working order, comply with the limits set out in the contract.

8.2.2 Type tests

8.2.2.1 Outside dimensions (safety-related test)

For each type of vehicle the outside dimensions of the vehicle shall be measured and checked against the limits set out in the contract, which may include the following conditions:

a) the range of adjustment of all appropriate components (for example air suspension);

b) the range of tolerances for wear and tear (for example wheel wear);

c) the range of loading conditions (see 8.5.2);

d) the range of movement in case of failure or damage (for example suspension components);

e) the worst case combinations of the above a) to d).

Clearances of items that may intrude into limiting dimensions, for example doors which open outwards, shall be taken into account and checked under working conditions if required by the contract.

Where dimensions are determined by calculation, suitable dimensions shall be identified to be checked and included in the Test Plan.

Requirements for freight wagons are given in EN 13775-1 to -6.

Where the contract does not specify a static loading gauge for the vehicle, the manufacturer shall declare a kinematic or swept envelope in accordance with rules agreed in the contract. The tests required to justify the kinematic or swept envelope shall be included in the Test Plan. The conditions a) to e) above, and the intrusion of items into the limiting dimensions, shall be taken into account in the determination of the envelope.

Requirements for vehicle acceptance are given in EN 14363 (for vehicles with cant deficiency compensation system, EN 14686 and for freight vehicles with static wheel loads higher than 112,5 kN, EN 15687 are in the course of preparation by CEN/TC 256).

8.2.2.2 Clearance tests (safety-related test)

Tests shall be carried out to determine whether the specified clearances are achieved during relative movements for the load conditions specified in the contract as follows:

a) between vehicle bodies and bogies;

b) between adjacent coupled vehicles.

See the note after 8.2.2.3 below.

8.2.2.3 Hose and cable length tests

Tests shall be carried out to determine the appropriate length for bogie and inter-car hoses and cables.

NOTE The clearances and lengths determined by tests 8.2.2.2 and 8.2.2.3 can be calculated, and verified by test, which can be carried out statically, using a bogie rotation table and traverser, or during the dynamic tests.

8.2.2.4 Current collector static tests (safety-related test)

It shall be ascertained statically that the operation of current collectors is satisfactory within the limits of movement and static contact force specified in the contract.

Tests shall be made on pantographs, including the limiting dimensions of lateral displacement, as specified in EN 50206-1 or EN 50206-2.

Requirements for gauging are given in UIC Leaflet No. 505-1.

8.2.3 Routine tests

Outside dimension tests (8.2.2.1) and clearance tests (8.2.2.2) shall be carried out in one load condition only (see 8.5.2), and confined to key dimensions determined from the type test.

Parts with provision for adjustment according to the wear of the wheels (such as stone guards, snowploughs, sanding pipes and life guards) shall be checked for correct adjustment.

8.3 Gauging test

8.3.1 Objective

To verify that the envelope of the vehicle is in accordance with the design.

8.3.2 General (type and safety-related test)

The contract may specify the size of the vehicle in a number of alternative ways, requiring different tests for verification, for example:

Build gauge – if the dimensions of the vehicle are specified, the dimensional checks in 8.2 are sufficient verification.

Kinematic envelope – if a kinematic envelope is specified, an analysis of the dynamic movements of the vehicle is required, supported by the coefficient of flexibility (sway) test (8.3.3) to validate the calculations used in the analysis.

Swept envelope – if the vehicle is being run on a line where clearances are less than the normal clearances specified by the infrastructure controller, a swept envelope, taking account of centre throw and end throw on curves may be required, supported by the coefficient of flexibility (sway) test (8.3.3) to validate the swept envelope calculations.

8.3.3 Coefficient of flexibility test (type test and safety-related test, voluntary)

If required to verify the calculation of a kinematic or swept envelope, then this test shall be a mandatory type test for each vehicle type.

Requirements are given in EN 14363.

If required by the contract, the manufacturer shall supply the calculated values of the coefficient of flexibility in both minimum and crush load states (see 8.5.2).

The coefficient of flexibility shall be determined by direct measurement (sway test).

Requirements are given in UIC Leaflet No. 505-5 which defines the coefficient of flexibility. This definition is summarised as follows:

- when an empty or loaded vehicle is placed, when stationary, on a canted track D, the running level of which forms an angle δ with the horizontal, its body leans on its springs and forms an angle η with the perpendicular to the rail level;
- the ratio δ/η calculated or measured after eliminating the influence of dissymmetries and that of the friction of springs and shock absorbers is called the coefficient of flexibility of the vehicle and is designated by the letter "s".

8.3.4 Routine test or equivalent (safety-related test)

The geometry of each vehicle shall be verified by suitable means such as a routine test using a template or a controlled production process.

8.4 Lifting ability test (type and safety-related test)

8.4.1 Objective

To verify the ability of the vehicle to be lifted under conditions as specified in the contract.

8.4.2 Type test

The test consists of lifting the vehicle at the designed lifting points using either overhead cranes or jacks. It shall be checked that the vehicle mechanical interfaces, attachments, deflections etc. are within the tolerances specified in the contract. As a minimum the tests shall demonstrate that the vehicle can be lifted without permanent deformation occurring.

8.5 Weighing tests

8.5.1 Objective

To verify that the vehicle mass and distribution complies with the limits set out in the contract.

This normally includes, for each type of vehicle, tests for the following parameters:

a) the vehicle mass;

b) the measured load per axle;

c) the measured load per wheel (if specified).

8.5.2 Load cases

The load cases shall be specified in the contract. The recommended load cases are given in Table 1.

Table 1 - Recommended load cases

		Minimum load	Normal load	Exceptional/ crush load
Passenger/freight loads		0	See following text	
Tooling		Complete		
Crew		0	Full complement	
Level of	Sand	0	2/3	Full
	Water for heating, toilets, catering, etc.	0	2/3	Full
	Fuel	0	2/3	Full
	Thermal engine coolants & lubricants	Normal	Normal	Normal
	Other fluids & lubricants	Normal	Normal	Normal

For vehicles intended to carry passengers or freight loads, in the absence of other information from the purchaser the loads shall be determined as follows.

- **Minimum load:** loading state of the vehicle specified in the contract in which the vehicle is complete and which will enable the vehicle to be moved or towed.
- **Normal load:** load as specified in the contract for the performance tests, for example motoring or braking.
- **Exceptional/crush load:** maximum load that can be operated safely under conditions specified in the contract and used for specific performance tests, for example, emergency braking.

For vehicles not intended to carry passenger or freight loads, for example locomotives, the normal and exceptional/crush passenger/freight load is assumed to be zero, i.e. the same as minimum load.

In order to reduce to a minimum the handling of additional loads, dimensional tests and weighing operations may be:

- carried out in the same loading state;
- executed in loading states other than those specified in the contract, provided suitable corrections are applied to the recorded values.

NOTE EN 15663, concerning vehicle mass definition, is currently in the course of preparation by CEN/TC 256.

8.5.3 Type tests (safety-related test)

The weight of the vehicle and the vertical load exerted by each wheel on the track shall be measured and shall be accompanied by a statement as to the accuracy of the measuring equipment. The weighing tests are normally carried out at the manufacturer’s works, but may be done at the purchaser’s or user's facility by prior arrangement. If the measuring equipment is used in the open air (outside a building), the effects of the prevailing environmental conditions (for example wind and rain) shall be recorded and taken into account.

Unless stated otherwise in the contract, the loading state of the vehicle during the weighing operations shall be minimum load and crush load. Tests at normal load may be carried out as investigative or voluntary tests.

Weighing tests may be preceded by adjustment of the suspension, carried out by means which, in principle, do not require the measurement of loads but only checks of a dimensional character.

Immediately before the test, a means shall be employed to activate the primary and secondary suspension systems (for example by running the vehicle over a section of track with level differences) to reduce the likelihood of excessive locked-in forces and the vehicle being off-centre.

The vehicle shall be run at reduced speed on to the weighing site, with frictional dampers disconnected and bogie inter-couplers loosened (if fitted). After activation of the suspension system and during weighing, no alteration or adjustment shall be made to the vehicle. No artificial alteration shall be made by means of blows, shaking or other procedure to the state of the body and the suspension produced by the previous activation of the suspension system and arising from friction between the several parts of the suspension.

Four successive and complete weighing operations shall be carried out, the vehicle being moved and measured twice in both directions, so as to eliminate as far as possible the errors resulting from balance inaccuracies and friction.

The value of the measurements shall be taken as the arithmetic mean of the values noted during the weighing operations.

Alternative weighing methods may be used as appropriate to the vehicle suspension system (e.g. spring or air suspension) or the weighing equipment available (e.g. running the vehicle over the weighing site, then lowering the vehicle vertically onto the weighing machine). In this case, the conditions and number of weighing operations shall be defined in the contract.

The mass of the vehicle, and the load of the individual axles on the vehicle shall meet the requirements of the contract, taking into account the following:

- the maximum and minimum mass, and allowable tolerance on the overall mass of the vehicle;
- the maximum load and allowable tolerance on the load of each axle on the vehicle;
- the difference in load from one side of the vehicle to the other.

The following measurements when defined in the contract shall be tested:

- the excess mass of the vehicle in running order over that stated in the contract;
- for motive power units, the static adhesive load;
- for motive power units, the load on each driving axle compared to the average value of the loads on driving axles intended to exert the same tractive effort;
- the load per axle compared to the figure permissible on the lines on which the vehicle is to run; this figure shall be specified in the contract;
- the load on the line of the wheels on one side compared to the average of the loads on both lines of wheels and for a given axle, the load per wheel compared to the average load per wheel of this axle.

8.5.4 Routine tests (safety-related test)

The weighing tests defined in 8.5.3 shall be carried out except as indicated below.

The loading state of the vehicle shall be minimum load.

Two successive weighing operations shall be carried out.

For wagons and non-powered carriages, a Declaration of Conformity is acceptable if agreed in the contract.

8.6 Sealing tests

8.6.1 Objective

To verify that the sealing (e.g. the IP rating according to EN 60529) employed on the vehicle and any filters, separators or similar devices comply with the performance specified in the contract.

8.6.2 Type tests

The Test Plan shall include tests of the vehicle body and equipment cases and cupboards to verify that the contract requirements are met. The vehicle shall be complete with all relevant interior fittings, equipment and covers. The tests shall take account of the factors in the following clauses, as appropriate.

a) Where the contract includes air-conditioning or pressure ventilation equipment, the parts of the vehicle or equipment covered by that equipment shall be tested in accordance with 8.15.5.

b) The water tightness of the body and electrical equipment boxes mounted outside the body, including all openings, doors, covers, cover strips or crevices which might allow penetration of water or snow, shall be tested.

   The validation of water tightness shall be conducted in conditions representative of the climate in which the vehicles are to operate. The regime of representative testing shall be agreed in the contract and included in the Test Plan.

   A distinction shall be made between the water-tightness of the openings (air inlets, etc.) which depends essentially on design and the water-tightness of covers (doors, windows, bonnets, etc.) which depends primarily on installation and the condition of the joints.

   The tightness of openings and covers as well as the effectiveness of the arrangements provided for the evacuation of water from certain compartments shall be such that the observed water penetration is not liable to have an adverse effect on cabling, electrical equipment or any other equipment necessary for maintaining the vehicle in proper working order.

c) The effectiveness of blinds, louvres, filters, dust separators and in general all devices for cleaning the air drawn into the equipment boxes shall be verified to ensure the safety of cabling, switchgear, or any other apparatus necessary for the satisfactory operation of the vehicle.

d) The proper mounting of the louvres, filters, dust separators, etc., shall be verified.

e) Arrangements to prevent ingress of other contaminants such as snow or sand shall be tested to ensure proper operation of equipment, as appropriate.

Further guidance on tests for sealing of enclosures is given in EN 60529.

8.6.3 Routine tests (voluntary test)

A simplified water test and other specific tests shall be carried out as specified in the Test Plan.

8.7 Electrical insulation tests (routine tests)

8.7.1 General

Objective: To test the insulation integrity of the vehicle electrical circuits.

These tests are routine tests which may be carried out on the completed vehicle. They may also be carried out on an incomplete vehicle, in the manufacturer's works upon completion of the cabling, after mounting but before connection of items of electrical equipment already tested individually for dielectric strength. In the latter case, a check of the insulation impedance of each of the circuits shall be carried out once the vehicle has been entirely completed. Reference should also be made to EN 50343.

Equipment such as rotating machines, which has previously passed insulation tests to an agreed standard may also be disconnected before the vehicle insulation test.

Where the contract calls for double insulation of the electrical equipment from the car body, for example, trolley bus systems, then it shall be verified that such insulation exists and that each part of the insulation system can withstand the requirements of the insulation tests in this clause.

8.7.2 Voltage withstand test

Most frequently, the equipment is composed of several circuits with different insulation levels; each one shall be separately tested to earth, all other circuits being in principle earthed.

As necessary, contactors and switchgear should be closed or short circuited to ensure that all parts of the circuit are connected. All precautions shall be taken in order to avoid possible appearance of abnormal voltages due to capacitive or inductive effects.

Equipment likely to suffer during the tests, e.g. electronic components, shall be disconnected or short circuited. Such equipment shall have previously passed an insulation test to an agreed standard.

The withstand test voltage shall be applied for one minute between each of the various cable circuits and earth. Its value shall be equal to 85 % of the test voltage of single pieces of apparatus defined by standards in force (for example, EN 60077, EN 60310, EN 60322, EN 60349 and EN 61287), for the component of the circuit having the lowest test voltage.

8.7.3 Insulation impedance test

In the absence of values specified in the contract, the test voltage shall be at least 500 V and the minimum insulation impedance values measured shall not be less than those given below:

- 5 MΩ for circuits having a rated voltage equal to or greater than 300 V d.c. or 100 V a.c.;
- 1 MΩ for circuits having a rated voltage less than 300 V d.c. or 100 V a.c.

A value of less than 1 MΩ may be agreed in the contract to take account of known conditions, such as high humidity, use of armoured cables, etc.

Alternatively, the manufacturer shall propose the insulation impedance values to be used, for approval by the purchaser.

Such conditions, and ambient conditions (temperature and relative humidity), shall be recorded.

If an insulation impedance test is carried out both before and after the voltage withstand test, the test conditions shall be the same for both tests and the impedance value measured by the test following the voltage withstand test shall not be lower by more than 10 % than that measured in the initial test.

8.8 Protective bonding and return circuits tests (routine and safety-related test)

Objective: To verify that the protective bonding and return circuits on the vehicle meet the requirement of the contract.

Electrical connections are required on the vehicle:

a) to fix the electrical potential of various circuits and the vehicle's mechanical parts to protect against the risk of electric shock;

b) to protect bearings from damage resulting from the effects of stray currents;

c) to ensure a return path for certain circuits (e.g. traction current return, train heating circuit).

Tests shall be done to ensure that protective bonding and return circuits meet the requirements of EN 50153.

It shall be checked that the flexible connections are made to a suitable length for accommodating the maximum relative movements of the points connected.

It shall be checked that the earth and return terminals are easily accessible and visible for checking.

8.9 Air system tests

8.9.1 General

Objective: To establish that all pneumatic components operate as specified in the contract, when installed on the vehicle and connected within the air system and to determine whether the air-tightness of the pneumatic equipment complies with the limits set out in the contract.

If the braking system does not use air, then the tests in this clause shall apply as far as appropriate. Any amendment to the test criteria shall be agreed in the contract and included in the Test Plan.

8.9.2 Air tightness of main reservoirs and other air equipment (routine and safety-related test)

With the vehicle in normal operating conditions, the main air reservoirs shall be filled to maximum working pressure and then isolated from the compressors.

8.9.2.1 Main reservoirs and associated devices

With the various items of compressed air equipment (braking circuits, doors, suspension, electropneumatic devices, etc.) isolated and not under pressure, it shall be checked that after the time specified in the contract the reduction of the pressure in the main reservoirs is not greater than that specified in the contract.

In the absence of values specified in the contract, the pressure shall not fall by more than 20 kPa (0,2 bar) after 5 min from an initial pressure between the maximum and minimum settings at which the main reservoir pressure is regulated.

8.9.2.2 Main reservoirs and associated devices combined with other pneumatic equipments

With the various items of compressed air equipment under pressure (except those intentionally designed to have certain inherent leaks), but not in operation, it shall be checked that the pressure in the main reservoirs has not fallen by a value and during a time period specified in the contract.

In the absence of specified values, the pressure shall not fall in 20 min to a value less than the minimum value compatible with the proper functioning of all the equipment from an initial pressure between the maximum and minimum settings at which the main reservoir pressure is regulated.

When a motor coach or locomotive is intended to be coupled with trailers not fitted with main reservoirs and forming part of the same fixed train set or multiple unit, the tests of 8.9.2.1 and 8.9.2.2 shall be repeated on the complete fixed train set. The time limits and allowable leakage in this case shall be agreed in the contract depending on the composition of the fixed train set or multiple unit.

Depending on the type of brakes used, the procedure for testing the air-tightness of the main brake pipes shall be agreed in the contract and included in the Test Plan.

8.9.3 Air tightness of brake cylinders and auxiliary reservoirs (routine and safety-related test)

By using the drivers brake handle or other means, maximum working pressure shall be applied to the brake cylinders and associated auxiliary reservoirs. The air supplies shall then be isolated.

In the absence of values specified in the contract, the pressure in the brake cylinders shall not fall by more than 10 kPa (0,1 bar) after 3 min.

8.9.4 Checking operation of compressed air equipment (type and safety-related test where appropriate)

The correct operation of all compressed air equipment shall be checked, for example:

- safety and protective devices;
- pressure regulating device;
- isolating cocks (shut-off valves);
- drain valves;
- pressure transducers and switches;
- compressor duty cycle, if tested by static simulation (see also 9.18);
- warning horns;
- air driers.

Where the contract covers a fixed train set or multiple unit, the operation shall be checked on the complete train set or multiple unit.

8.10 Hydraulic system tests (type, routine and safety-related test where appropriate)

Objective: To determine whether the oil-tightness of the hydraulic equipment complies with the limits set out in the contract and to establish that all hydraulic components operate as specified in the contract, when installed and connected to the hydraulic system.

As a type test, the correct operation of all hydraulic equipment shall be checked, for example:

- hydraulic pumps;
- hydraulic motors (e.g. cooling group, radiator fan, etc.);
- safety and protective devices;
- pressure limiters;
- non-return valves;
- shut-off valves;
- drain valves.

As a routine test**,** with the vehicle in normal operating conditions, the hydraulic system shall be filled to maximum working pressure and then isolated from the pump. It shall be checked that after the time specified in the contract the reduction of the pressure in the system is not greater than that specified in the contract and that there are no visible signs of hydraulic fluid leakage.

8.11 Friction brake system tests

8.11.1 General

Objective: To verify that the brake system operates in accordance with the design, to give sufficient confidence that the dynamic tests may take place, and that all production vehicles are to the same standard.

The following systems shall be functionally checked statically:

a) emergency brake;

b) service brake;

c) interface between the friction and the electric brake, where fitted (if done by simulation in place of a dynamic test, see 9.4);

d) interface with other systems such as wheelslide control, load weighing, traction control (where fitted);

e) mobility of brake rigging.

8.11.2 Pneumatically applied brake systems

8.11.2.1 Type tests (safety-related tests)

The purpose of these tests is to verify, in conjunction with dynamic braking tests, that the operation of the brake system and the application of force at the brake shoes or linings complies with the contract.

These tests shall be carried out after completion of the air system tests specified in 8.9. A check shall be made that the brake rigging is correctly adjusted. Tests shall be made at static for the service brake in order to check the characteristics specified in the contract for the complete pneumatic brake system, in particular, time of application and release of the brakes and maximum pressures at the brake cylinders under different operating conditions.

The measurements of brake cylinder pressure and timings shall be repeated for the emergency brake and a number of intermediate positions of the service brake controller.

Where applicable, the operation of the wheelslide dump valves or other anti-skid devices should be checked, for example, blow down time, application time and release time. The operation of the dump valves appropriate to the wheelslide signal should also be checked.

When the vehicle is equipped with a load weighing system, the brake cylinder pressures shall be measured with the vehicle in the minimum, normal and exceptional/crush load conditions. This test may be carried out using simulated loads, provided that the load detection devices are tested during other tests being carried in each of the loading states of the vehicles.

Requirements for static brake test procedures (EN 15806) are in preparation by CEN/TC 256.

8.11.2.2 Routine tests (safety-related test)

A simplified form of test, to avoid loading the vehicle, shall be carried out. This test shall demonstrate that all braking systems are equivalent to those type tested.

8.11.3 Other systems (type, routine and safety-related as appropriate)

Where vehicles are fitted with other braking systems designed to slow or stop the train, such as spring or hydraulically applied brakes, electrically or mechanically actuated brakes, mechanical or magnetic track brakes or any other systems, type and routine tests shall be carried out to achieve the same objective as defined in 8.11.1, following the same principles as defined in 8.11.2.

8.11.4 Sanding systems (type, routine and safety-related test)

Where sanding is employed to assist braking, the tests shall demonstrate that the required braking performance is met without interference with either infrastructure systems such as points and crossings and train detection or train systems such as braking, electrical or air supplies. The test criteria shall be included in the Test Plan. If dynamic tests are required by the contract, they can be combined with the braking tests (see 9.4).

For a type test, the following shall be checked as appropriate against the contract:

- correct activation of sanding in braking mode (and traction mode if fitted);
- correct operation of interface with wheelslide detection system;
- means of isolation of sanding function, and associated indications;
- manual control (if provided);
- the effect of sander operation on auxiliary supplies (including electrical and pneumatic);
- sand capacity, delivery rate and usage monitoring, as appropriate;
- sand specification;
- sand deposition and spread.

For a routine test, a simplified function test which demonstrates delivery rate shall be carried out. If a manual test function is fitted, it may be sufficient for the routine test.

8.12 Parking brake type tests (safety-related test)

Objective: To verify that the parking brake system satisfies the requirements of the contract.

The test criteria to demonstrate the effectiveness of the parking brake system (operating conditions and measurement of applied forces) shall be included in the Test Plan.

If the train is maintained stopped for a limited period by a parking brake subject to leaks (e.g. hydraulic or air brake) the brake shall be applied with maximum force and it shall be verified during a period specified in the contract that there is no significant fall-off in the force applied.

NOTE The duration of the parking brake test depends on the operating conditions.

8.13 Auxiliary power supply system tests

8.13.1 Objective

To verify that the auxiliary power supply systems operate as specified in the contract when installed on the vehicle and connected to their proper loads, including battery charging.

8.13.2 Type tests (safety-related tests where appropriate)

The tests shall check the performance of the auxiliary power supply system connected to its loads over the range of loads defined in the specification.

It shall be checked that the input and output of the auxiliary power supply system is kept within the continuous rating or other ratings, these ratings being in accordance with those given in the relevant standards, as specified in the contract.

If the auxiliary power supply system components have not been fully tested at the supplier's works, owing to, for example, lack of suitable facilities, then additional tests can be included in the Test Plan by agreement between the manufacturer and the purchaser.

The Test Plan shall include test criteria for the following:

- power up;
- starting of the loads, including time delays where necessary;
- battery charging;
- cooling arrangements;
- load-shedding;
- cross-feed arrangements (where one or more vehicles are fed from an alternative power supply on another vehicle), including changeover switching.

Where appropriate (for example where rotating machines or external cooling form part of the system), the tests specified in 8.15.2 shall also apply to the auxiliary power supply system.

Where the power supply feeds functions essential for the safety of the train, such as magnetic track brakes, the type tests shall be identified as safety-related in the Test Plan.

8.13.3 Routine tests

Functional and operating tests at nominal voltage shall be carried out. The characteristics of the auxiliary power supply system at nominal voltage shall be verified against the contract requirements and the type test results.

8.14 Battery charging tests

8.14.1 Objective

To verify that the battery and its charging system meet the requirements of the contract.

8.14.2 Type test

The following tests shall be made on the vehicle's battery and battery charger to verify:

a) that the battery charging equipment is capable of furnishing a sufficient but not excessive charge to the battery, as required in the contract;

b) that the supply is capable of charging the battery under all load conditions within the contract for the vehicle, e.g. maximum and minimum supply voltages, thermal engine operating speeds, ambient temperature limits, etc.;

c) except for chargers supplied only for standby use, that the charger is capable of supplying all the load assigned to the battery and other loads as appropriate when the vehicle is in operation including the effect of any load shedding;

d) that capacity exists for charging the battery in a time period allowing full charge to the battery in a normal operating duty cycle during a 24 h period;

e) that the ventilation of battery boxes is sufficient to ensure no dangerous build-up of gases during charging periods;

f) that the battery circuit parameters comply with the contract requirements for the conditions specified in the contract. The following parameters shall be measured as appropriate:

   1) the maximum charging current;
   2) the maximum voltage or charging voltage over the specified temperature range as appropriate;
   3) the floating voltage;
   4) the floating current;
   5) the discharging current;
   6) the discharging time;

g) that the voltage ripple level is within the maximum level specified in the contract when the battery charger is operated with a disconnected battery;

h) that the off-charge battery is capable of maintaining operation of the vehicle during the time period specified in the contract and under the conditions specified in the contract, especially taking into account essential supplies such as emergency lighting (see also 8.15).

NOTE Restriction of operations, e.g. reduced lighting or disconnection of non-essential systems, is possible (load-shedding).

The test criteria shall be included in the Test Plan.

These tests can be carried out during the auxiliary power system type tests.

8.14.3 Routine test

For a routine test on a battery and charger it is sufficient to check:

a) maximum charging current with its limitation value;

b) maximum voltage;

c) steady state floating voltage;

d) steady state floating current.

8.15 Auxiliary and control system tests

8.15.1 Objective

To verify that the auxiliary and control systems operate as specified in the contract when installed on the vehicle and connected to the correct auxiliary power supply and other interface loads.

8.15.2 General tests

8.15.2.1 Type tests

For each system defined in 8.15.3 to 8.15.8, it shall be checked, during static sequence tests, that the individual and sequential operation of all items of equipment, in the various circuits, including, for example, air-operated switchgear, is correct and has not been impaired during final installation.

Any interfaces that exist between the systems shall be included in the tests.

Electrical clearances of the assembled equipment shall be checked, especially at connections.

It shall be checked that the settings of adjustable protective devices and relays, etc., are correct.

A check shall be made that the operation of air-operated switchgear is not hindered by too small a cross-section of their supply pipes or lack of reservoir capacity.

In the case of forced cooling of auxiliary electrical equipment and auxiliary power supplies, if the equipment concerned has not been tested on the test bed with the same cooling units and with cooling ducts of the same size as those of the vehicle, a check shall be made on the vehicle that the volume of cooling air complies with that designed or specified. This may be checked by measuring the difference in static pressure across the auxiliary equipment, providing a table showing the relationship between static pressure difference and air volume is available for equipment under test. The ducts shall be checked for air-tightness.

A check shall be made on the direction of rotation of auxiliary machines and the phase rotation of a.c. supplies.

Starting tests on the auxiliary machines shall be made taking account of the machine duty cycle and range of operation, and starting conditions specified in the contract.

Where a freight traction vehicle is fitted with a radio remote control system to provide remote control by an external operator, reference should be made to EN 50239.

8.15.2.2 Routine tests

For all systems defined in 8.15.3 to 8.15.8, functional and operating tests at nominal voltage shall be carried out. The tests shall include more than one start of auxiliary machines.

In order to avoid setting up interface tests for each vehicle, a simplified set of functional tests, derived from the type test, using set values or simulations where appropriate, may be carried out to verify that each vehicle meets the test criteria, provided that all the equipment on the vehicle under test is exercised. Further suggestions are given in 8.15.3 to 8.15.8.

8.15.3 Train control (safety-related tests where appropriate)

8.15.3.1 Single unit operation

All control functions shall be tested from their controllers, switches and pushbuttons in the cab and any other appropriate location on the vehicle, to ensure that the correct sequence of events occurs so far as is possible statically (see also 8.17).

This test shall be performed for all normal, emergency and default operating modes specified in the contract.

If appropriate, these tests may be combined with individual system tests (see 8.15.4 to 8.15.8).

8.15.3.2 Interfacing between systems

All interfaces between systems shall be tested for correct operation and sequence in all modes specified in the contract. If appropriate, these tests may be combined with individual system tests (see 8.15.4 to 8.15.8).

8.15.3.3 Multiple operation

If the vehicle or multiple unit trainset is intended to operate coupled to other vehicles or trainsets controlled from a single driving cab, type tests shall be made to prove the functions that are required to operate in multiple, for example:

- traction and braking circuits;
- fault indications and signals;
- compressor interlocks;
- paralleling or transfer of auxiliary supplies or batteries;
- door operation;
- safety loops for the control of brakes or doors;

- control of lights, heaters and other auxiliaries;
- passenger emergency systems;
- passenger information.

Where train wires are crossed, for example to ensure correct identification of the direction of motion or the opening side for doors, then these functions shall be checked for all practical combinations of vehicles in multiple normally found in service.

These functions shall also be checked at all operating or driving positions.

For a routine test it is permitted that multiple operation be checked by simulation of other vehicles.

8.15.4 Door control systems (safety-related test)

It shall be checked that external and internal power operated doors, steps and remotely controlled door locking systems function correctly as specified in the contract.

The checks shall include all door indicators, safety loop circuits and operating systems for normal and emergency access and egress under all operating conditions as specified in the contract.

Requirements for door system tests are given in EN 14752. Those tests not already carried out on a mock-up or rig shall be carried out on the complete vehicle.

8.15.5 Heating, ventilation and air-conditioning system tests (safety-related test where appropriate)

The type tests shall check the correct operation of comfort and environmental control systems for both passenger and traincrew areas, including the adequacy of sealing of doors and windows against draughts.

It shall be checked in particular that the heating equipment and air conditioning or pressure ventilation equipment as appropriate are capable of maintaining the temperatures and airflows under the conditions specified in the contract.

If required in the contract, the equipment used to protect the vehicle against pressure shocks shall be checked (see also 9.14).

The tightness of air ducts used on the vehicle, for passenger/crew air-conditioning should be checked as a routine test, for example with a smoke producing device.

Specific tests may be required for traincrew areas to satisfy the relevant safety authorities.

Type tests shall be performed in accordance with EN 13129-2, EN 14750-2 and EN 14813-2.

8.15.6 Lighting system

8.15.6.1 Type tests (emergency lighting tests are safety-related tests)

A meter shall be used to measure the illuminance level at the reading level at seat positions and floor level in the vestibules and gangways to check that the required level is achieved for both full and emergency lighting.

The requirements for lighting are specified in EN 13272.

8.15.6.2 Routine test (safety-related test where appropriate)

The test shall ensure that all lights work and that the switching of lights (e.g. normal and emergency, separate circuits, etc.) is correct, including any default conditions, as specified in the contract.

8.15.7 Other systems (type, routine and safety-related tests where appropriate)

It shall be checked that under all specified test conditions, all other systems, where fitted, function correctly in their operating environment, in accordance with the contract.

Where fitted, the following systems shall be tested. These system tests may be classed as safety-related or be required by Approval Authorities, depending on their use:

- passenger information;
- public address;
- communication;
- radio;
- fire detection and extinguishing.

Where fitted, systems to be tested shall include, for example:

- train management;
- diagnostic systems;
- data transmission;
- video;
- television;
- toilet;
- water systems;
- catering equipment.

For catering equipment, the tests shall ensure correct operation in accordance with the contract, especially in respect of operating and surface temperatures, and safety in use.

The closing and locking systems of all internal and external equipment and panel hatches, doors and covers intended for access shall be checked for correct operation.

8.15.8 Software controlled systems (safety-related test where appropriate)

It shall be verified that the software used in vehicle systems has been tested and validated in accordance with the requirements of EN 50155 as amended.

On each vehicle, it shall be checked that the software fitted is the same validated version.

8.16 Tests on thermal engine and associated generating sets

8.16.1 General

Objective: To verify that the thermal engine and generating set operates as specified in the contract, when installed on the vehicle and connected to its proper loads and protective equipment.

Where the engine and generators are not tested together before assembly on the vehicle (see UIC 623), the test procedure for the complete engine and generator on the vehicle shall be as defined in the contract.

Before undertaking any of the following tests, the manufacturer shall ensure that the alignment of the coupling between the engine and the generators has been checked to ensure that it is in accordance with the design.

Where appropriate the clauses below shall be applicable to thermal engine driven generator sets used for supplying auxiliary power to a train separately from the traction power unit.

8.16.2 Operating speeds of the thermal engine (type test)

The no-load speed (rpm) of the engine at idling, maximum speed, and all intermediate speed positions of the speed controller (when applicable), shall be measured to check the correct operation of the speed control system.

The loaded speed (rpm) of the engine at all load settings specified as normal operating points shall be measured. The test shall be performed on a static load bank.

Speed tolerances shall be in accordance with the contract.

8.16.3 Thermal engine protective devices (type test)

The correct operation of protective devices of the thermal engine such as thermostats, pressure gauges, overspeed, fire detectors, emergency stop etc. shall be checked.

The operation of sensors other than overspeed can be simulated by external means, provided that sensors have been calibrated by their suppliers.

8.16.4 Thermal engine fluid, air and exhaust circuits (routine test, safety-related test where appropriate)

The tightness of all reservoirs, pipes and ducts of the thermal equipment (fuel, oil, cooling fluid, exhaust and compressed air cranking) shall be checked.

The operation of the fuel supply, the pre-heating, pre-lubricating and cold cranking devices shall be checked.

8.16.5 Engine driven auxiliaries

8.16.5.1 Type test

The correct operation of the engine driven auxiliary systems shall be demonstrated with regard to:

- the intended performance;
- the operating temperature and altitude range;
- the engine speed range.

8.16.5.2 Routine test

As a minimum the following shall be checked:

- the rotational speed and directions of the various auxiliaries driven by the thermal engine;
- the correct tension of the driving belts;

and, if compressor accessories are fitted:

- the build-up of the pressure in the main reservoir;
- the setting of the unloading valve and of the safety valve.

8.16.6 Cranking of the thermal engine (type test)

The cranking of the engine (cold or pre-heated if necessary) at ambient temperature shall be checked having regard to the details necessary for minimum temperatures specified in the contract. These details and the number of successive cranking operations to be made by the battery or other means of cranking (e.g. compressed air) shall be as agreed in the contract.

8.16.7 Operation of the thermal engine

8.16.7.1 Type test

The thermal engine shall be connected to a static load bank.

Test conditions shall be maintained for a reasonable time to allow engine temperature to reach its final value.

The following shall be checked:

a) that the anti-vibration mounts are effective at all conditions of engine speed and load. The vibration level of the engine generator assembly shall be measured and shall comply with the values specified in the contract, if applicable;

b) that the torsional dampers are effective if the calculation of the torsional critical speeds shows that resonances could be excited from the engine;

c) that the cooling system has an inbuilt heat dissipation capability sufficient to meet the agreed cooling margin and to maintain the cooling fluid temperature at the design level in the whole range of the operating ambient conditions;

d) that air management within the cooler group and for engine room scavenging meets the declared performance;

e) the tightness of all pipes and ducts of the thermal equipment and of the aspirated air ducting of the engine;

f) that heat sensitive equipment and parts, such as electronics, cabling, plastic pipes and tubing, rubber details etc. are not subjected to excessive temperature;

g) the operation of the regulating equipment;

h) that temperature and pressure values of the fluids used in cooling and lubricating systems are in agreement with the contract specifications;

i) that inlet pressure and exhaust pressure and temperature are in agreement with the contract specifications;

j) the manufacturer's stated turbo-charger surge margin shall be verified by test if required by the contract;

k) the diesel engine exhaust composition shall be checked;

l) that the fuel consumption at various conditions of engine speed and load meets the agreed performance.

8.16.7.2 Routine test

The thermal engine shall be connected to a static load bank.

With the engine and generators at normal working temperature and excitation conditions set to conform with those specified in the contract, the manufacturers declared curves for generator losses shall be used to check the gross supply to the electrical equipment at full power and agreed intermediate power settings. The checks listed at 8.16.7.1 e) to k) should also be carried out against the nominal values confirmed by the type tests.

8.17 Traction system tests (type, routine and safety-related tests where appropriate)

Objective: To verify that the traction system responds correctly to its control signals in order to demonstrate its fitness for dynamic tests.

All sequencing and built-in test programmes shall be tested before the vehicle is moved.

In particular, the selection of forward and reverse, initiation of motoring and electric braking functions and removal of traction power shall be checked for correct operation with both valid and invalid control inputs.

Where the traction system is force-cooled, the operation of the cooling systems shall be checked, including airflow and air speed; correct starting sequence of cooling fans; and time delays, if any, before stopping cooling fans. Other tests on the cooling system shall be in accordance with 8.15.2.

Where sanding is employed to assist traction, the tests shall demonstrate that the required performance is met without interference with infrastructure systems such as points and crossings and train detection (see 8.11.4). The test criteria shall be included in the Test Plan.

8.18 Operability and maintainability (type test)

8.18.1 General

Objective: To verify that the vehicle meets the requirements of the contract for safety and ease of operation and maintenance.

All areas where staff have access in the normal course of their duties, for operation, maintenance and overhaul shall be checked for compliance to the requirements of the contract and the relevant safety authorities, both for operation and safety.

These checks should include and take account of the following:

- accessibility to mechanical parts, including:
  - protection against the possibility of contact with moving parts such as blowers, couplings, belts, sharp edges, etc.;
  - protection against risks from air intakes;
- accessibility to electrical parts, including:
  - safety clearances from fixed or movable live equipment;
  - prevention of accidental contact with live electrical parts taking into account the difference between
    1) compartments containing apparatus liable to be subjected to a high voltage by an external supply source (coupled vehicle, station or depot supply) for which access involves a prior disconnection and/or earthing of certain points of the circuits, and
    2) compartments containing only equipment of the vehicle traction circuit for which a single electric safety device (e.g. opening of the main contactor) is sufficient;
  - protection against electrical arcing from circuit-breaking devices such as high-speed circuit-breakers or contactors;
  - protective bonding for the electrical equipment and for parts of the vehicle which may accidentally be made alive (see 8.8);
- dismounting (doors, steps, ladders);
- access for and ease of cleaning;
- conformance with standards;
- interchangeability, where specified;
- access for testing;
- discharge time of power capacitors, including warning labels;
- protection against fire (type and accessibility of extinguishers, operation of fire protection systems, see also 8.20);
- protection of parts with a risk of harmful temperatures (e.g. exhaust systems);
- provision of necessary warning signs as required in the contract (in particular, hot surfaces, high voltage conditions or moving parts).

If required by the contract, maintainability shall be tested by a demonstration.

8.18.2 Cabs and traincrew areas (safety-related test)

Checks on working conditions of traincrew areas shall be carried out as far as possible during static tests and shall be completed during dynamic tests. For driving cabs, reference may be made to the appropriate standard.

Requirements are currently specified in UIC Leaflet 651 (a European Standard is in the course of preparation by CEN/TC 256).

The test criteria shall be included in the Test Plan and should take into account:

- dimensions and layout, including protection from injury, exits and evacuation, and provision and access to emergency equipment;
- driver sightlines and the effect of reflections in the windscreen, including performance of windscreen wipers, windscreen washers, windscreen de-misters and windscreen de-frosters (if any);
- visibility of controls, instruments (especially when illuminated) and indicator lamps both in sunlight and at night without detrimental effect from direct or reflected light so as to cause any optical illusion;
- ergonomic design of controls and seats to minimise inaccuracy in operation or undue physical tiredness, and risk of inadvertent operation.

8.18.3 Passenger areas (safety-related test where appropriate)

Facilities for evacuation, including walkways and emergency exit doors, windows and associated facilities, shall be checked against the contract.

Facilities for disabled people, such as accessible areas including toilets, mechanical aids to accessibility and aids for the mobility, visual and hearing impaired shall be checked against the contract.

8.18.4 Rescue (safety-related test where required)

Facilities for rescuing the vehicles, including the use of special or adaptor couplers, shall be checked against the contract.

8.19 Noise and vibration tests (type test, safety-related test where appropriate)

Objective: To verify that the noise and vibration emitted by the vehicles when stationary complies with the contract.

Tests shall be performed on a completed vehicle or vehicles as appropriate to demonstrate that the noise levels in the passenger and crew areas and outside the vehicle are compliant with the values specified in the contract.

The noise level tests shall be performed in accordance with EN ISO 3095 and EN ISO 3381, for stationary vehicle type tests, for test procedures specified in the contract.

Requirements are in course of preparation by CEN.

Tests shall be performed on a completed vehicle or vehicles as appropriate to demonstrate that vibration caused by the operation of the apparatus or machines on the vehicle (compressor set, blower, electromagnetic equipment, circuit breakers, thermal engines, etc.) is not a source of discomfort to the passengers or traincrew.

Requirements for vibration tests, where necessary, are given in EN 12663.

8.20 Safety-related system tests (routine tests)

Objective: To verify that all safety-related systems not covered by the specific requirements elsewhere in Clause 8 perform in accordance with the requirements of the contract after they have been installed to the vehicle.

For example, the following shall be tested where applicable:

- automatic emergency brake;
- automatic vigilance equipment;
- drivers safety device or equipment;
- automatic train protection equipment, or any equivalent speed regulating and on-board signalling equipment;
- vehicle speedometers;
- event or data recording equipment;
- fire detection and extinguishing devices;
- passenger emergency equipment;
- safety-related circuits in other subsystems (e.g. brakes, doors);
- bells, whistle, horns.

This list is not exhaustive, and shall be amended as appropriate in accordance with the contract.

9 Schedule of dynamic tests

9.1 General

The manufacturer shall undertake the schedule of dynamic tests as defined in the Test Plan. Table A.2 gives a representative list of dynamic tests which may be included in the schedule. The list is not exhaustive but shall be used as a guideline in the process used by the manufacturer to produce his Test Plan.

In the absence of specific requirements in the purchaser's specification, the following tests (9.2 – 9.20) shall be included in the Test Plan as appropriate for the type of vehicle covered in the contract. For vehicles intended to operate in fixed formation trainsets, the tests shall be conducted in train configurations representative of those in which the vehicles may normally operate.

Unless otherwise stated, the following requirements are for both the Type and Routine Tests. Where different requirements are specified for these tests, they are detailed in separate clauses for Type and Routine Tests.

9.2 Traction performance (tractive effort/speed characteristics)

9.2.1 Type test

Objective: To verify that the traction performance meets the specified criteria. The tests are restricted to checking the starting and acceleration performance up to the maximum specified speed.

The vehicle, unit or train shall be taken through the starting and acceleration cycles specified at the time of the contract, up to the required speeds at all the specified load conditions (to include at least the minimum and crush loaded conditions). The tests shall be made under good adhesion conditions and, when specified, under adverse adhesion conditions.

The tests shall demonstrate that the tractive effort/speed characteristics comply with the requirements specified in the contract. The values can be deduced from starting and acceleration tests under known conditions by measurement of vehicle speed against time.

Alternative methods of demonstrating the vehicle performance may be proposed by the manufacturer or requested by the purchaser and included in the contract.

It shall be checked that acceleration is achieved smoothly throughout the control sequence without jerks in excess of the value specified in the contract.

Where applicable, during these tests, measurements shall be taken to demonstrate compliance with EN 50388.

9.2.2 Routine test

Each vehicle shall be taken through the starting and acceleration cycles at the specified load case agreed in the Test Plan.

It shall be checked that the acceleration is as specified. The values can be deduced from the tests defined in the Test Plan by measurement of the vehicle speed against time. It should be checked qualitatively that any transitions occur without abnormal jerks.

9.3 Traction performance (journey time check) (voluntary type test)

Objective: To verify the ability of the vehicle to meet the specified running schedules and energy consumption.

The tests shall check that the times for either the individual distances or the total distance are in accordance with those specified in the contract and that the energy consumption is within the tolerance specified in the contract.

If the purchaser intends to carry out tests to check a "typical run" schedule, he shall supply the manufacturer, before placing the contract, with all the particulars relating to the "typical run" and to the "typical train" to be used, under the same conditions as those appearing below.

For the test run:

- maximum times to be observed for running the whole distance or various parts thereof;

For the test route:

a) lengths, gradients and curvature details of the lines;

b) stopping or dwell times;

c) maximum speeds allowable on the various sections;

d) an estimate of the service line voltage over the test route;

e) the suitability of the line for regenerative braking (if applicable);

f) load conditions.

The test shall be performed on vehicles which have completed the agreed period of running-in and in accordance with the following conditions specified in the contract:

- load conditions;
- dry adhesion;
- calm weather;
- temperature range;

and, if required for confirmation of energy consumption:

a) the vehicle's load or the hauled load;

b) number of axles or train length;

c) weight multiplication factor to be used to allow for the inertia of the rotating masses, including any trailing vehicles not under test;

d) resistance to motion curve at different speeds for the vehicles, including any trailing vehicles not under test;

e) the braking effort curve for the vehicles at various speeds, including any trailing vehicles not under test;

f) the maximum acceleration and the maximum variation in acceleration allowable;

g) the maximum braking deceleration allowable;

h) the driving mode - manual or automatic.

For a vehicle with a thermal engine, the characteristics of the fuel and lubricating oil shall comply with those specified by the thermal engine manufacturers and accepted by the user.

As an alternative test, vehicles with thermal engines may have energy consumption tests carried out on a stationary vehicle using a duty cycle agreed in the contract.

The test shall be carried out on rolling stock which has already had a period of running, in calm weather and in temperature conditions agreed in the contract.

The electrical energy consumption (active or reactive) may be deduced by calculation after measurement of line voltage and current values with instruments placed either on the vehicle itself or on a vehicle coupled to it (e.g. a dynamometer car). In addition, the line voltage may be checked by means of a recording voltmeter. The line receptivity for regenerative braking may be monitored.

The mean values of the fuel consumption obtained for a thermal engine during the successive runs shall be measured.

The electrical or fuel energy consumption measured may depend on certain uncontrolled variables which can be introduced: for example, operating conditions, speed differences and in particular the receptivity of the line where regenerative braking is specified. Following the tests, the manufacturer may recalculate the predicted values of energy consumption as a result of any changes to the testing conditions.

9.4 Braking tests

9.4.1 Type test (safety-related tests)

Objective: To verify that the vehicle braking systems meet the performance requirements of the contract.

9.4.1.1 General

The dynamic tests of the braking systems on the vehicle shall include, either measurement of distance against speed during deceleration between agreed speeds (for example, stopping distances), including the maximum specified speed, or measurement of deceleration over the specified speed range up to maximum specified speed. The tests shall also check that the braking is achieved smoothly and without jerks, particularly where the system involves blending of one braking method to another.

The tests shall demonstrate the performance of all braking systems of the vehicle (for example, emergency and service, pure air brake or blended air and electric brake or hydraulic retarder).

Tests of other braking systems (for example, magnetic track brake) shall be carried out as agreed in the contract.

All relevant standards shall be taken into account for the braking tests.

NOTE UIC Leaflets 540, 541-03, 541-05, 541-3, 541-4, 541-5, 543, 544-1, 544-2, 546, 547 and 660 should be taken into account for these braking tests. However, requirements for braking tests for mass transit systems are given in EN 13452-2. Other standards for high speed trains (EN 15734-2), multiple units and passenger coaches are in the course of preparation by CEN/TC 256.

9.4.1.2 Vehicle conditions

For vehicles designed to carry passengers or goods, these type tests shall be carried out in the load conditions specified in the contract or, if not specified, in the minimum load condition (tare) and the exceptional/crush load condition. Further tests may be required to verify that the required stopping distance is met over the whole load range, to cater for non-linearities in the characteristics of the friction materials, and the use of load-weighing systems which vary the brake force applied.

For motive power units, the tests shall be carried out at normal load.

The tests shall be performed with all systems in working order and, when specified in the contract, with some brake devices or bogies isolated.

For friction brake systems, the brake shoes, pads or linings shall have been bedded-in.

For vehicles provided with slack adjusters, type tests shall be carried out with new brake shoes, pads or linings; for vehicles without slack adjusters, type tests shall be carried out with brake shoes, pads or linings worn to their wear limits.

9.4.1.3 Route conditions

The tests shall be carried out on a well-bedded track.

Unless otherwise specified, tests shall be carried out on dry track. If tests are carried out in the prevailing atmospheric conditions (i.e. with the rails wet or dry) the conditions shall be recorded with the results.

By agreement between the purchaser, user and manufacturer, tests can be carried out on track where adhesion conditions have been artificially degraded to simulate actual conditions to be found in service (see also 9.4.1.6).

9.4.1.4 Methods of measuring stopping distances

The method of measuring stopping distances may vary between contracts to take account of conditions prevailing in different countries but the method used shall ensure that the objective of the test is met. This subclause describes one method for measuring stopping distances but other methods, for example using on-board speed and distance measuring equipment and graphical presentation, may be used.

NOTE For trains approved by UIC in international traffic, the test requirements are specified in UIC Leaflet 544-1.

Requirements for braking tests for mass transit systems are given in EN 13452-2. Other standards (including EN 14531-1 to -6, concerning stopping distances and EN 15734-2, concerning high speed trains) are in the course of preparation by CEN/TC 256.

Stopping distances are measured on straight level track with the vehicle running either by itself, or with other vehicles in the case of multiple unit trains, or with the number of trailing coaches required in the contract.

At least three checks shall be made for each setting or each type of brake (emergency, service and, if needed, blended electric). The actual number of tests shall depend on the variation of results obtained in each check and shall be carried out as shown in a) to d) below:

a) before passing the brake application marker, motoring power shall be cut off, the speed of the vehicle being close to the reference speed for the test. When passing the marker, the required brake setting is applied;

b) accurate measurement shall be taken of:

   - the measured stopping distance L in metres, recorded during each test;
   - the speed V km/h at the application of braking (this speed shall be uniform and should not differ from the reference speed V_0 by more than ± 3 km/h);

c) the curve of speed variation with time during the braking period should also be recorded, together with the necessary additional parameters (pressures, currents, etc.) in order to determine graphically the deceleration rate where this is required. The deceleration rate shall comply with the service or emergency braking rate as required in the contract;

d) a check shall be made where applicable that the pressure in the brake pipe returns to normal between tests.

If the measurement of stopping distance cannot be carried out on an absolutely level stretch of track, the level of the straight stretch chosen shall not vary by more than ± 4 mm/m. For any divergence from the level track or the value of *V*, the measuring stopping distance *L* shall be corrected by the following formula:

$$L_1 = L \times \frac{3{,}92 \times (1 + R_0) \times V_0^2}{[3{,}92 \times (1 + R_0) \times V^2] \pm i \times L}$$

where:

L_1 is the corrected stopping distance, in metres

L is the measured stopping distance, in metres

V_0 is the initial reference speed in kilometres per hour

V is the actual initial speed in kilometres per hour

i is the gradient in millimetres per metre ‰

R_0 is the factor for rotational inertia

In the absence of a specified figure for R_0 in the contract, the value of 0,08 may be used.

In the formula, before i, the + sign is used for a downgrade and the - sign for an upgrade.

The corrected stopping distance L_1, so determined, shall not be longer than that specified in the contract for each setting or each type of brake.

9.4.1.5 Frequency of brake tests

The frequency of braking tests repeated one after the other, shall be arranged to check that during the most severe specified conditions the energy required by the braking system (air, oil, battery, etc.) does not exceed the capacity of the energy source.

9.4.1.6 Wheel-slide protection

Where the braking system includes a wheel-slide protection (WSP) system(s) the braking tests shall include checks that the system(s) perform(s) as specified. See also 8.15.8. Reference to UIC Leaflet 541-05 is recommended. Where sanding is employed to assist braking, the dynamic tests shall verify that the vehicle and sanding equipment meet the criteria given in 8.11.4.

9.4.1.7 Emergency braking

Tests shall be carried out to check the brake performance with the brake controller or the automatic devices for driving in the emergency position. Further tests to check conformance of additional brakes such as magnetic track or eddy-current systems shall be performed as agreed in the contract. These tests may be carried out as part of the tests specified in 9.4.1.4 above. These tests may be required by Approval Authorities as part of the acceptance criteria for the vehicles.

9.4.1.8 Electrical braking tests

For vehicles equipped with electrical braking, the following checks shall be made for all levels of service brake and for braking applied, either manually or automatically:

a) that, in the case of electrical holding braking on a downhill grade, the actual braking fully complies with the performance specified in the contract;

b) that the voltage appearing at the terminals of the motors and regulating equipment does not exceed the designed value or the value specified in the contract;

c) that the current in the traction motors does not exceed the designed value or the value specified in the contract;

d) that there is no abnormal self-excitation of the traction motors either when braking or when hauled dead;

e) that, in the case of regenerative braking on a.c. supply lines, the power factor is within the figures specified in the contract;

f) that, in the case of regenerative braking and in the event of loss of the power supply, external short circuit of the power supply, pantograph bounce, lack of receptivity of the power supply, line gaps or neutral sections, transition takes place to an alternative braking system as specified in the contract;

g) that, in the case where a composite braking system is incorporated, e.g. blended braking or substitutional braking, a smooth transition occurs without significant jerk, underbraking or overbraking between the different braking systems e.g. air brake, rheostatic electric brake and regenerative electric brake;

h) that the electric braking builds up and releases steadily without significant jerk. Unless otherwise specified in the contract, a jerk rate of 1 m/s^3 should not be exceeded, except under emergency braking conditions.

9.4.2 Routine tests (safety-related tests)

Unless otherwise specified in the contract, each vehicle built shall be subject to line braking tests (including the requirements of 9.4.1.7) at a single load condition (e.g. minimum or normal load) on dry track. Any variation in these conditions shall be noted with the results.

The braking stops shall be made from the maximum speed specified in the contract and the stopping distances measured as shown in 9.4.1 or permitted alternative as specified in the contract. These tests can be combined with other commissioning tests. Some of these tests may be required by Approval Authorities as part of the acceptance criteria for the vehicles.

A simplified check of the operation of the wheelslide protection system (if fitted) shall be performed on each vehicle. This check may be performed during or derived from other routine dynamic tests using appropriate measuring equipment.

A simplified check of the operation of the dynamic brake (if fitted), to check transition, blending and application/release (generally as described in 9.4.1.8 f), g) and h)) shall be performed on each vehicle. This check may be performed during or derived from other routine dynamic tests.

If agreed in the contract, routine tests for wagons and trailer coaches can be covered either by the static tests (see 8.11), provided that they provide sufficient demonstration that the vehicle conforms to the type tested vehicle, or by a Declaration of Conformity.

9.5 Traction and braking thermal capacity tests (type test, safety-related test where appropriate)

Objective: To verify that the traction and braking equipment can operate the specified duty cycles within specified temperature limits.

NOTE 1 These tests may be combined with those covered in 9.3, and some items may be covered by a combined test of traction equipment before installation in the vehicle. Some of these tests (particularly braking tests) may be required by Approval Authorities as part of the acceptance criteria for the vehicles.

It shall be checked that when operated at the specified duty cycles, the temperature rises of the equipment are within the design limits for the particular equipment.

Measurements shall be made to check that the following equipment operates within specified temperature ranges (see also paragraph below):

- rotating electrical machines;
- cooling fluids (e.g. for main transformer, inverter);
- electrical resistors, starting and braking;
- reactors;
- power semi-conductors;
- cable insulation;
- cable ducts and conduits;
- auxiliary machines;
- control switchgear;
- capacitors;
- equipment compartments and equipment cases;
- cooling air;
- transmission links between traction motor and wheels;
- mechanical brake elements;
- axle boxes;
- wheelsets;
- friction brake components.

NOTE 2 This list is not exhaustive; the actual list should be as agreed in the contract.

The operating conditions of the thermal engine shall be checked, in particular temperatures and pressures of the various fluids used in its operation, and temperatures in the engine compartment. The integrity and efficiency of the thermal engine exhaust system shall be checked to ensure that no harmful gases can enter the engine compartment, driving cab or passenger compartments with all doors and windows closed.

The above tests shall be repeated with the vehicle operating with parts of the equipment (e.g. traction motors) isolated in the conditions required in the contract.

When the vehicle is required to carry out emergency duties to assist other vehicles, it is recommended that the above tests are repeated in the conditions required by the emergency duties as specified in the contract.

9.6 Resistance to motion (voluntary type test)

Objective: To verify the vehicle's resistance to motion and where applicable the rotational inertia.

This test should be carried out under dry adhesion conditions and calm weather.

The vehicle shall be set in motion at the maximum speed specified in the contract on a line of known gradient, without curves as far as possible, and the speed shall be allowed to decrease without the action of the brakes. The variations in speed, time and the distance run shall be recorded by suitable means from which a curve of resistance to motion can be derived, taking into account the line gradient and the influence of the rotating masses.

Tests for resistance to motion may be carried out by using a dynamometer car or an instrument for measuring deceleration.

For electrically powered vehicles, resistance to motion may also be deduced from the electrical power consumed by the traction circuits, taking into account the efficiency of the traction motors and all power losses in the traction system.

In the case of trains with variable compositions, it may be necessary to carry out these tests with each alternative composition.

The method of calculating the resistance to motion shall be agreed in the contract.

9.7 Speed regulating system tests (type and routine tests, safety-related where appropriate)

Objective: To verify the operation of speed regulating systems.

Where applicable, vehicles equipped with speed regulating systems shall be type tested to verify:

- that the vehicle speed is controlled in a smooth manner, without significant jerks or oscillations between braking, coasting and acceleration;
- that the traction and braking equipment is not subject to an excessive number of operations or frequency of operation (to minimise component wear compared to a manually driven vehicle);
- that the acceleration and braking rates in response to changed commands are within the limits specified in the contract;
- that the vehicle speeds resulting from the speed regulating systems are as specified in the contract and do not exceed any tolerances on the set speeds;
- that the stopping position accuracy at platforms and other stopping locations (e.g. stop signals) is as specified in the contract.

For a routine test, a simplified test of the functions of the speed regulating system shall be carried out.

Some of these tests may be required by Approval Authorities as part of the acceptance criteria for the vehicles.

9.8 Automatic train protection systems (type, routine and safety-related tests)

The proper functioning of vehicles equipped with an automatic train protection system shall be checked according to the procedures agreed in the contract and included in the Test Plan.

In particular, the following shall be checked:

a) the protection system operates at the speeds and in response to signals, either external (lineside) or internal (trainborne, such as display of recommended speed in cab), specified in the contract, either to apply the emergency brakes or otherwise alert the driver that the vehicle speed has to be reduced;

b) in the case that the emergency brakes are applied, the motoring power is automatically cut off and the braking rate specified in the contract is applied. The vehicle shall stop within the braking distance specified in the contract;

c) there is no inadvertent action during the tests and that the protection system does not operate without cause unless actual overspeed or failure to stop has occurred.

The automatic train protection system shall be tested over the full operating conditions to check correct operation.

For a routine test, a simplified test of the functions of the automatic train protection system shall be carried out.

These tests are likely to be required by Approval Authorities as part of the acceptance criteria for the vehicles.

9.9 Vehicle/track interaction

9.9.1 Safety of running

9.9.1.1 Objective

To verify the safety in operation of the vehicle in the following areas:

a) safety against derailment;

b) safety against shifting of the track;

c) safety against excessive mechanical stresses on the rails and their means of fixation, on wheels, axles and certain parts of the bogies;

d) safety against the consequences of a suspension fault (deflated air suspension, for example);

e) safety systems to prevent wheels locking.

9.9.1.2 Type test (safety-related test)

The vehicle shall, if possible, be run on lines on which it is intended to work including tunnels, both at speeds within the range demanded by the timetable and at the maximum speeds specified in the contract.

Running tests may also be made on other tracks in average conditions selected by agreement between purchaser and manufacturers.

Requirements for vehicle acceptance are given in EN 14363 (for vehicles with cant deficiency compensation system, EN 14686 and for freight vehicles with static wheel loads higher than 112,5 kN, EN 15687 are in the course of preparation by CEN/TC 256).

9.9.1.3 Routine test (safety-related test)

The parameters used to assess conformance shall be based on data generated by the type test performed in accordance with 9.9.1.2. The parameters selected and the limit values to check conformance shall be agreed in the contract and included in the Test Plan.

9.9.2 Suspension clearances, inter-vehicle clearances (voluntary type and safety-related test where appropriate)

Objective: To verify that adequate clearances are provided for operation of the vehicle on the specified limiting cases of radius of curvature, applied cant, etc. in all loading conditions of the vehicle.

The operation of the vehicle on curved track shall be checked by running the vehicle over a curve of minimum specified radius at the speed specified in the contract, while a check is made that there is no restriction of movement or binding, that jumper cables, pneumatic couplings, connections to motors and current return connections are of sufficient length, that the motor ventilating bellows and the drives operated from an axle of the vehicle (e.g. speed recorder drive) are so designed as to avoid damage.

The vehicle shall be coupled to another similar vehicle, or to a vehicle of another type as required in the contract, to run in service coupled with the first named. The vehicle shall be run over reverse curves and it shall be checked that the vehicle behaves in a satisfactory manner, i.e. that there is neither binding nor overriding of the drawgear or corridor connections, if these are provided. The test shall be effected with the coupling gear fully under tension.

In the case of vehicles provided with automatic coupling, the possibility of coupling on curves of a radius, as specified in the contract shall be verified.

A check shall be made that the running over curves and point work takes place without binding and without permanent deformation of the track.

The tests required on curved track shall be repeated where appropriate on straight track with the maximum changes of gradient specified in the contract.

Where the contract calls for operation on curved track with changes of gradient and cant, this shall be checked (e.g. ferry-boat services, tram systems).

Consideration should be given to wheel wear and the effect of incorrect operation or damage to the suspension (i.e. deflated air suspension or broken springs) causing the vehicle's body to be in contact with the bogie or wheels at one or more places.

Whilst these tests can be carried out on the relevant infrastructure controller’s tracks, some may be carried out on prepared track in a depot or the manufacturer’s works, provided that the track is in a proper state of maintenance.

The movement of the vehicle on curved track can be checked statically by means of a traverser or turntable, turning one bogie with respect to the car body (see 8.2.2.2 and 8.2.2.3).

9.10 Ride comfort quality (voluntary tests)

9.10.1 Objective

To verify that the ride comfort quality meets the requirements specified in the contract.

9.10.2 Type test

The vehicle shall be run on lines agreed with the purchaser as representative of the track over which it is intended to operate. The track quality, permitted operating speeds, population of curves, installed cant and cant deficiency shall be representative of that specified in the contract. The methods of evaluation and test conditions shall be defined in the Test Plan.

NOTE Guidance on methods of evaluation and test conditions is given in ENV 12299.

9.10.3 Routine test (voluntary test)

The parameters used to assess the conformance of each vehicle built shall be based on data generated by the type test (9.10.2). The parameters selected and the limit values shall be agreed between the manufacturer and the purchaser and included in the Test Plan.

9.11 Kinematic gauging

9.11.1 Type test (safety-related tests)

Objective: To verify that the vehicle complies with the kinematic gauging requirements specified in the contract.

These tests may be combined with the ride comfort quality tests covered at 9.10.2 using data computed from the suspension displacements to check the motion of the vehicle body. The same data may be used to check the pantograph sway motion (where fitted) to check conformance with pantograph gauge limits.

If agreed in the contract, calculation supported by static tests may be used to compute the kinematic or swept envelope (see 8.3).

9.11.2 Routine test (voluntary)

The parameters used to assess the conformance of each vehicle built shall be based on data generated by the type test, see 9.11.1. The parameters selected and the limit values shall be agreed in the contract.

These tests may be combined with the ride comfort quality tests, see 9.10.3.

9.12 The operation of wheel flange lubricators (safety-related routine test only)

Objective: To verify that wheel flange lubricators provide lubrication as specified in the contract without contamination of wheel tread or rail head.

Where fitted to the vehicle these units shall be tested in accordance with the supplier's instructions.

9.13 Current collector and power supply compatibility tests (safety-related type test only)

Objective: To verify that current collectors perform as specified in the contract and that the vehicle is compatible with the power supply system on which it is intended to operate.

Before performing these tests the static type and routine tests (see 8.7 and 8.8) shall be completed.

The vehicle shall be run at the maximum speed specified in the contract on lines over which it is to operate. If the vehicle is required to run in a train with more than one pantograph raised or collector shoe in contact (e.g. locomotives or motor coaches in multiple unit trains), then the current collection shall be checked in the operating conditions specified in the contract (e.g. speed, distance between current collectors). Tests shall be performed in each direction of motion.

The quality of the supply system, over which the tests shall be run, shall be agreed in the contract and included in the Test Plan.

A check shall be made that satisfactory current collection takes place, without damage, abnormal wear or vibration of either the collector or the supply in accordance with EN 50206-1 or EN 50206-2.

The weather at the time of the test should be noted.

The electrical and mechanical operation of the current collector and associated electrical circuits over neutral sections and gaps in the third-rail shall be checked.

In the case of a pantograph, a check shall be made with the pantograph raised, in both directions of travel and up to the maximum speed specified in the contract, that the aerodynamic effect does not cause forces which, in addition to the static forces, exceed the upper and lower limits specified in the contract. This check shall be repeated with vehicles in multiple if specified in the contract (for example, in the case of a vehicle with a short distance between the two pantographs).

A check shall also be made that the aerodynamic effect is not such as to produce an unauthorised raising of the lowered pantograph and has no adverse influence on the proper execution of raising or lowering movements at speed.

Requirements for testing of the dynamic interaction between the pantograph and the overhead line are given in EN 50317.

Where applicable, compatibility tests shall be carried out in accordance with EN 50388.

It shall be verified by measurement that the calculated maximum pantograph sway is not exceeded taking into account the worst dynamic movement of the vehicle (see also 9.10.2 and 9.11.1). Reference may be made to UIC leaflet 505-1, EN 50206-1 or EN 50206-2. This test may be carried out statically (see 8.2.2.4).

9.14 Aerodynamic effects (type tests only, safety-related where appropriate)

Objective: To verify that the aerodynamic characteristics of the vehicle conform to the requirements specified in the contract.

Special tests shall be made as specified in the contract to cover aerodynamic effects as follows:

a) to check the resistance of the mechanical parts of the vehicle to aerodynamic shock waves. The tests may cover the effects due to trains passing at speed on the adjacent track and passage through tunnels;

b) to check the pressure tightness of the vehicle structure;

c) to check there are no adverse effects on air intakes to systems such as cooling, air conditioning, etc.;

d) to check for slipstream effects and the effects of cross-winds.

Requirements for test procedures for aerodynamic requirements of rolling stock are given in EN 14067-4, -5 and -6 (EN 14067-6 is in the course of preparation by CEN/TC 256).

9.15 Electromagnetic compatibility (type tests only)

9.15.1 Internal interference within the vehicle (safety-related where appropriate)

Objective: To verify that all equipment functions correctly after installation, without interference effects.

Where equipment tests in accordance with EN 50121-3-2 confirm that there is sufficient margin between the electromagnetic emissions and the immunity levels of the equipment within the vehicle, further testing of that equipment is not required.

The vehicle test shall be executed as follows:

All contactors, relays and other possible sources of noise of the electrical circuits on the vehicle, shall be operated in sequence, to ensure there is no harmful electrical interference with the vehicle circuits, due to electromagnetic radiated or conducted signals.

Reference should be made to EN 50121-3-2 for detailed methods of checking the immunity of control equipment from electromagnetic emissions.

9.15.2 External interference produced by the vehicle (safety-related)

Objective: To verify that the interference spectrum (amplitudes, frequencies, psophometric currents etc.) produced by the vehicle under all loading conditions complies with the values specified in EN 50121-3-1, or the contract.

EN 50121-3-1, Clause 6, sets out the parameters for testing the complete vehicle to account for various operating environments.

Tests shall be conducted in accordance with EN 50121-3-1, unless otherwise agreed in the contract to determine that no adverse effects occur, under all normal conditions that prevail on the railway over which the vehicles are intended to operate, for example:

- at different distances from the sub-station;
- at different speeds and accelerations, in motoring and braking.

Requirements for the tests are set out in EN 50238, including specific requirements for testing of rolling stock to establish train characteristics affecting train detection systems. Information on existing train detection systems is given in CLC/TR 50507.

Where applicable, it shall be checked that the detection devices or monitoring systems, which are fitted for monitoring critical frequencies, operate as specified in the contract.

Test reports shall be produced and submitted in accordance with the requirements of the infrastructure controller over whose lines the vehicles are intended to operate.

9.15.3 Radio frequency interference (safety-related)

Objective: To verify that the vehicle does not produce excessive electromagnetic interference at radio frequencies.

The test shall be conducted in accordance with EN 50121-3-1 unless otherwise agreed in the contract, at the critical frequencies and maximum levels defined therein.

9.15.4 External interference to the vehicle (safety-related)

Objective: To verify that the vehicle can operate satisfactorily when subject to externally radiated interference levels as specified in the contract.

EN 50121-3-1, Clause 5, states that no tests are performed on a complete vehicle. Compliance shall be proved by immunity tests in accordance with EN 50121-3-2, in conjunction with an EMC Test Plan.

It shall be the responsibility of the purchaser to communicate to the manufacturer at the time of the contract any potential source of interference for the vehicle which might not be considered as part of a normal railway system.

9.15.5 Electrostatic discharges (voluntary test)

Objective: To verify that the vehicle operates satisfactorily when subject to electrostatic discharges at the levels specified.

When specified in the contract the manufacturer shall carry out electrostatic discharge tests in accordance with EN 50121-3-2.

9.16 Interruption & voltage/jump and short circuit test (voluntary type test only)

9.16.1 General

Objective: To verify that voltage changes in the external supply do not adversely affect the performance of the vehicle.

These tests shall only be undertaken on the complete vehicle when the type test specified in EN 61377-1, -2 or -3 has not been performed on a test bed subject to agreement between the purchaser and manufacturer.

Tests shall be made under different line conditions (e.g. voltage, line inductance) to be found in service, for example either at the substation or at the furthest distance from the substation.

In the case of equipment with the final drive consisting of a.c. or d.c. commutator motors directly connected to the power supply via passive units (transformers, tapchangers, rheostats, diodes, etc.) the tests shall be made in the following three different conditions:

- minimum field on the traction motors (if applicable);
- maximum speed of the vehicle;
- one hour current rating of traction motors.

In the case of equipment with converters and in the absence of information specified in the contract, the tests shall be made in the following three different conditions:

- maximum current in the power circuit;
- maximum output voltage of the converters;
- maximum speed of the vehicle.

In addition, where applicable, the co-ordination of protective systems between the traction vehicle and the power supply infrastructure shall be checked in accordance with EN 50388.

9.16.2 Voltage jump tests

The supply voltage shall be increased suddenly from approximately the nominal supply voltage. The increase shall be based on the requirements of EN 50163.

Various methods can be employed to carry out the tests, in particular it may be possible:

- to operate on the controls of the supply substations; or
- to short-circuit suddenly a resistor located on the vehicle itself or on another vehicle coupled to it; or
- to disconnect suddenly a heavy load connected in parallel with the vehicle on test; or
- to switch in a supply substation previously out of service.

In the case of a vehicle provided with regenerative braking, a test with a sudden drop in voltage (of the order of 10 %) shall be carried out at maximum speed and at the maximum regenerated current obtainable at this speed (and also at the maximum speed obtainable with the maximum regenerated current specified in the contract). These tests can be carried out by suddenly connecting a heavy load in parallel with the vehicle on test.

The tests shall not adversely affect the equipment. The equipment shall continue to deliver the same performance without permanent damage, even in the most severe operating conditions (after reconnection, if the protective equipment disconnected the propulsion equipment when the voltage jump was applied).

9.16.3 Interruption tests

For traction and regenerative braking, the external supply voltage shall be disconnected and reconnected with the total time of interruption being in the range from 10 ms to 10 s, as agreed in the contract. All protective devices, including no-voltage protection devices, shall be in operation for these tests.

A number of tests shall be carried out to ensure that the specified range of intervals between interruptions is fully covered. The tests can be carried out by disconnecting and reconnecting the circuit by means of a circuit-breaker.

The tests shall not adversely affect the equipment. The equipment shall continue to deliver the same performance without permanent damage, even in the most severe operating conditions (after reconnection, if the protective equipment disconnected the propulsion equipment during the interruption).

Where applicable, the traction equipment shall comply with EN 50388.

9.16.4 Voltage variation testing

All the equipment on the vehicle, particularly the auxiliary equipment, shall be tested for correct operation over the full range of the line voltage specified in the contract.

A number of tests shall be carried out to ensure that the range of voltage is covered (e.g. maximum, minimum and nominal line voltage).

9.16.5 Short circuit test

For traction and regenerative braking the external supply voltage shall be short circuited for unlimited time. All protective devices shall be in operation for these tests.

The tests shall not adversely affect the equipment, and the line current shall not exceed the values specified in the contract. After reconnection, the equipment shall be able to continue to deliver the performance specified in the contract without any permanent damage, even in the operating conditions as specified.

Where applicable, a short-circuit test complying with EN 50388 shall be carried out.

9.17 Noise tests

9.17.1 Type test

Objective: To verify that the internal noise and noise emitted by the vehicles complies with the specification.

External noise tests shall be performed in accordance with EN ISO 3095; internal noise tests in accordance with EN ISO 3381. In each case, the tests shall be those identified as type tests using the measurements and in the conditions specified in the standard. The test procedures to be used shall be specified in the contract.

9.17.2 Routine test (voluntary test)

If required by the contract, measurements performed to check that sample vehicles conform to the standard demonstrated by the type test above shall be in accordance with the monitoring tests defined in EN ISO 3095 and EN ISO 3381.

9.18 Air systems – Compressor duty cycle (type test, safety-related where appropriate)

Objective: To verify that the installed compressors can deliver the required amount of air to meet all system requirements.

Tests shall be undertaken representative of the most demanding duty cycle for the air system when operating specified services, including, for example, operation of any air-activated door systems, warning horns, etc.

Locomotives shall be tested hauling the maximum load specified in the contract.

Multiple units shall be tested in the crush-laden condition.

The tests shall include the following measurements:

- main reservoir pressure;
- main reservoir pipe pressure;
- air suspension pressure (where applicable);
- time taken to fully charge the system (see also static test in 8.8);
- duration of compressor operations;
- air dew point downstream of the air drier.

The tests shall demonstrate the following:

- charge time from a completely empty system is within the time specified in the contract (normally not greater than 15 min), except for locomotives hauling freight wagons;
- the system is maintained at its working pressure when operating in normal service with all air operated equipment in use;
- when specified in the contract that the vehicle is capable of operating the air system of itself and a disabled unit/vehicle(s).

NOTE This test can be carried out during other dynamic tests (for example, the traction performance test, see 9.3). Alternatively, the test can be carried out with defined leakage, provided that it can be demonstrated that the air consumption is representative of the specified duty.

9.19 Windscreen wipers (type test)

Objective: To verify that the windscreen wipers and washers and demisters give the specified clear area of the windscreen at all operating speeds and weather conditions.

The test shall cover all operating speeds up to the maximum specified in the contract. The tests shall be performed preferably in adverse weather conditions.

The wipers shall clean a specified area and not be adversely affected by aerodynamic effects.

The windscreen washer shall operate as specified in the contract.

9.20 Train control system (type test, safety-related where appropriate)

Objective: To check that all train control systems function correctly in the dynamic environment.

Some of these tests can be combined with other dynamic tests: for example, motoring control tests can be done during traction performance tests (9.2).

During dynamic testing, all train control systems and circuits shall be checked to ensure that they are operating correctly as specified in the contract. In particular, the following shall be checked:

- sequence of control;
- operation of time delays;
- operation of interlocks;
- operation from valid coded signals;
- interface between different systems.

Where appropriate, the vehicle auxiliary systems tested statically in accordance with 8.15 shall be checked to ensure that they operate correctly in dynamic conditions, without any adverse effects from the operation of the traction and braking systems or any other effects from the movement of the vehicle.

In particular the following shall be checked:

- public address system audibility;
- radio operation on the intended infrastructure;
- track-to-train data links including closed circuit television;
- data transmissions in the dynamic environment;
- train management systems, including diagnostic systems, using inputs from the operating vehicle in real time;
- internal closed circuit television or video systems.

Where a freight traction vehicle is fitted with a radio remote control system to provide remote control by an external operator, reference should be made to EN 50239.

Annex A
(informative)

List of tests

Table A.1 – List of static tests

Subclause	Test	Type of test	Loco	Freight	Pass.	Freight MU	MU	Refer to
8.2	Dimensional tests							
8.2.2	Type tests							
8.2.2.1	Outside dimensions	C, T, S	O	O	O	O	O	EN 13775 EN 14363
8.2.2.2 a	Clearance tests (car body to bogie)	C, T, S	O	O	O	O	O	
8.2.2.2 b	Clearance tests (vehicle to vehicle)	C, T, S	O	O	O	O	O	
8.2.2.3	Hose and cable length tests	C, T	O	O	O	O	O	
8.2.2.4	Current collection	T, S	(O)	n/a	n/a	(O)	(O)	EN 50206-1 EN 50206-2
8.2.3	Routine tests	R	O or D of C	O or D of C	O or D of C	O or D of C	O or D of C	
8.3	Gauging test							
8.3.2	General	T, S	O	O	O	O	O	
8.3.3	Coefficient of flexibility test	T, S	(O or V)	(O or V)	(O or V)	(O or V)	(O or V)	UIC 505-5 EN 14363
8.3.4	Routine tests	R, S	O	O	O	O	O	
8.4	Lifting ability test	T, S	O	O	O	O	O	
8.5	Weighing tests							
8.5.3	Type tests	T, S	O	O	O	O	O	
8.5.4	Routine tests	R, S	O	O or D of C	O or D of C	O	O	
8.6	Sealing tests							
8.6.2	Type tests	T	O	O	O	O	O	EN 60529
8.6.3	Routine tests	R	V	V	V	V	V	
8.7	Electrical insulation tests							
8.7.2	Voltage withstand test	R	O	O	O	O	O	
8.7.3	Insulation impedance test	R	O	O	O	O	O	
8.8	Protective bonding and return circuits tests	R, S	O	O	O	O	O	EN 50153

Table A.1 – List of static tests *(continued)*

Subclause	Test	Type of test	Loco	Freight	Pass.	Freight MU	MU	Refer to
8.9	Air system test							
8.9.2 8.9.3	Air tightness test	R, S	O	O	O	O	O	
8.9.4	Functional test	T, (S)	O	O	O	O	O	
8.10	Hydraulic system tests (tightness)	R, (S)	(O)	(O)	(O)	(O)	(O)	
8.10	Hydraulic system tests (functional)	T, (S)	(O)	(O)	(O)	(O)	(O)	
8.11	Friction brake system tests							
8.11.2	Pneumatically applied brake systems							
8.11.2.1	Type tests	T, S	O	O	O	O	O	
8.11.2.2	Routine tests	R, S	O	O	O	O	O	
8.11.3	Other systems	T, R, S	(O)	(O)	(O)	(O)	(O)	
8.11.4	Sanding system	T, R, S	(O)	(O)	(O)	(O)	(O)	
8.12	Parking brake type tests	T, S	O	O	O	O	O	
8.13	Auxiliary power supply system tests							
8.13.2	Type tests	T, (S)	O	O	O	O	O	
8.13.3	Routine tests	R	O	O	O	O	O	
8.14	Battery charging tests							
8.14.2	Type tests	T	O	O	O	O	O	
8.14.3	Routine tests	R	O	O	O	O	O	
8.15	Auxiliary and control system tests							
8.15.2	General tests							
8.15.2.1	Type tests	T	O	O	O	O	O	
8.15.2.2	Routine tests	R	O	O	O	O	O	
8.15.3	Train control static functions							
8.15.3.1	Single unit operation	T, R, (S)	O	(O)	O	O	O	
8.15.3.2	Interfacing between systems	T, R, (S)	O	(O)	O	O	O	
8.15.3.3	Multiple operation	T, R, (S)	(O)	(O)	(O)	O	O	

Table A.1 – List of static tests *(continued)*

Subclause	Test	Type of test	Loco	Freight	Pass.	Freight MU	MU	Refer to
8.15.4	Door control systems	T, R, S	O	(O)	O	(O)	O	
8.15.5	Heating, ventilation and air-conditioning system tests							
	Traincrew areas	T, R, S	O	n/a	O	O	O	EN 13129
	Passenger areas	T, R	n/a	n/a	V	n/a	V	EN 13129
	Freight wagons	T, R	n/a	(O)	n/a	(O)	n/a	
8.15.6	Lighting system tests							
	Type tests	T, (S)	O	V	O	V	O	EN 13272
	Routine tests	R, (S)	O	V	O	V	O	EN 13272
8.15.7	Other systems							
	Safety-related	T, R, S, (A)	(O)	n/a	(O)	(O)	(O)	
	Not safety-related	T, R	(V)	n/a	(V)	(V)	(V)	
8.15.8	Software controlled systems							
	Safety-related	T, (S)	O	(O)	O	(O)	O	EN 50155
	Not safety-related	T	V	n/a	V	(V)	V	
	Software version	R, S	O or D of C	(O or D of C)	O or D of C	(O or D of C)	O or D of C	
8.16	Tests on thermal engine and associated generating sets							
8.16.2	Operating speeds of the thermal engine	T	V or D of C	(V or D of C)	(V or D of C)	V or D of C	V or D of C	
8.16.3	Thermal engine protective devices	T	O or D of C	(O or D of C)	(O or D of C)	O or D of C	O or D of C	
8.16.4	Thermal engine fluid, air and exhaust circuits	R, (S)	O	(O)	(O)	O	O	
8.16.5	Engine-driven auxiliaries							
8.16.5.1	Type tests	T	V or D of C	(V or D of C)	(V or D of C)	V or D of C	V or D of C	
8.16.5.2	Routine tests	R	V or D of C	(V or D of C)	(V or D of C)	V or D of C	V or D of C	
8.16.6	Cranking of the thermal engine	T	V or D of C	(V or D of C)	(V or D of C)	V or D of C	V or D of C	

Table A.1 – List of static tests *(continued)*

Subclause	Test	Type of test	Loco	Freight	Pass.	Freight MU	MU	Refer to
8.16.7	Operation of the thermal engine							
8.16.7.1	Type tests	T	V or D of C	(V or D of C)	(V or D of C)	V or D of C	V or D of C	
8.16.7.2	Routine tests	R	O or D of C	(O or D of C)	(O or D of C)	O or D of C	O or D of C	
8.17	Traction system tests	T, R, (S)	O	n/a	n/a	O	O	
8.18	Operability and maintainability							
8.18.1	General	T	V	V	V	V	V	
8.18.2	Cabs and traincrew areas	T, S	O	n/a	O	O	O	UIC 651
8.18.3	Passenger areas	T, (S)	n/a	n/a	V, (O)	n/a	V, (O)	
8.18.4	Rescue	T, (S)	V, (O)	V, (O)	V, (O)	V, (O)	V, (O)	
8.19	Noise and vibration tests	T, (S)	V, (O)	V, (O)	V, (O)	V, (O)	V, (O)	EN ISO 3095 EN ISO 3381
8.20	Safety-related system tests	R, S	O	(O)	(O)	O	O	

The symbols in the columns have the following meanings:
O = Obligatory
V = Voluntary
D of C = Declaration of Conformity
T = Type test
R = Routine test
C = Calculation
S = Safety-related
A = may be required by Approval Authorities
n/a = not applicable

Where a symbol appears in brackets (e.g. (O), (V), (R)) the test applies where the equipment is fitted or if the test is appropriate. Refer to the relevant clause for further details.

Tests may be waived if the conditions of 5.1 are met.

Table A.2 – List of dynamic tests

Subclause	Test	Type of test	Loco	Freight	Pass.	Freight MU	MU	Refer to
9.2	Traction performance (tractive effort/speed characteristics)							
	Type tests	T	V	n/a	n/a	V	V	
	Routine tests	R	V or D of C	n/a	n/a	V or D of C	V or D of C	
9.3	Journey time check	T	V	n/a	n/a	V	V	
9.4	Braking tests							
9.4.1	Type tests (all) (emergency braking)	T, S, (A)	O	O	O	O	O	UIC 540 series EN 14531 EN 13452-2
9.4.2	Routine tests	R, S, (A)	O	O or D of C	O or D of C	O	O	
9.5	Traction and braking thermal capacity tests							
	Traction thermal capacity tests	T	V or D of C	n/a	n/a	V or D of C	V or D of C	
	Braking thermal capacity tests	T, S, (A)	O	O	O	O	O	
9.6	Resistance to motion	T	V	V	V	V	V	
9.7	Speed regulating system tests	T, R, (S) (A)	V, (O)	n/a	n/a	V, (O)	V, (O)	
9.8	Automatic train protection systems	T, R, S, (A)	O	n/a	n/a	O	O	
9.9	Vehicle/track interaction							
9.9.1	Safety of running	T, R, S	O	O or D of C	O	O	O	UIC 518 EN 14363
9.9.2	Suspension clearances, inter-vehicle clearances	T, (S)	V	V	V	V	V	
9.10	Ride comfort quality							
9.10.2	Type test	T	V	V	V	V	V	ENV 12299
9.10.3	Routine tests	R	V	V	V	V	V	
9.11	Kinematic gauging							
9.11.1	Type test	T, S	O or C	O or C	O or C	O or C	O or C	
9.11.2	Routine tests	R	V	V	V	V	V	

Table A.2 – List of dynamic tests *(continued)*

Subclause	Test	Type of test	Loco	Freight	Pass.	Freight MU	MU	Refer to
9.12	The operation of wheel flange lubricators	R, S	(O)	(O)	(O)	(O)	(O)	
9.13	Current collector tests	T, S	O	n/a	n/a	O	O	EN 50206 EN 50317 UIC 505-1
9.14	Aerodynamic effects	T, (S)	O	O	O	O	O	EN 14067
9.15	Electromagnetic compatibility							
9.15.1	Internal interference within the vehicle	T, (S)	V, (O)	(V)	V, (O)	V, (O)	V, (O)	EN 50121
9.15.2	External interference produced by the vehicle	T, S	O	(O)	O	O	O	EN 50121 EN 50238
9.15.3	Radio frequency interference	T, S	O	(O)	O	O	O	EN 50121 EN 50238
9.15.4	External interference to the vehicle	T, S	O	(O)	O	O	O	EN 50121 EN 50238
9.15.5	Electrostatic discharges	T	V	(V)	V	n/a	n/a	
9.16	Interruption & voltage/jump and short circuit test	T	V	n/a	n/a	V	V	EN 50163
9.17	Noise tests							
9.17.1	Type test	T	O	O	O	O	O	EN ISO 3095 EN ISO 3381
9.17.2	Routine test	R	V	V	V	V	V	EN ISO 3095 EN ISO 3381
9.18	Air systems – Compressor duty cycle	T, (S)	V or (O)	n/a	n/a	V or (O)	V or (O)	
9.19	Windscreen wipers	T	O	n/a	n/a	O	O	
9.20	Train control system	T, (S)	V, (O)	(V)	V, (O)	V, (O)	V, (O)	

The symbols in the columns have the following meanings:
O = Obligatory
V = Voluntary
D of C = Declaration of Conformity
T = Type test
R = Routine test
C = Calculation
S = Safety-related
A = may be required by Approval Authorities
n/a = not applicable

Where a symbol appears in brackets (e.g. (O), (V), (R)) the test applies where the equipment is fitted or if the test is appropriate. Refer to the relevant clause for further details.

Tests may be waived if the conditions of 5.1 are met.

Bibliography

EN 50129:2003, *Railway applications - Communication, signalling and processing systems - Safety related electronic systems for signalling*

EN 14033-1:2008, *Railway applications - Track - Railbound construction and maintenance machines - Part 1: Technical requirements for running*

EN 14033-2:2008, *Railway applications - Track - Railbound construction and maintenance machines - Part 2: Technical requirements for working*

ENV 12299:1999, *Railway applications - Ride comfort for passengers - Measurement and evaluation*

EN ISO 9001:2000, *Quality Management Systems - Requirements* (ISO 9001:2000)

EN ISO/IEC 17025:2005, *General requirements for the competence of testing and calibration laboratories* (ISO/IEC 17025:2005)

CLC/TR 50507:2007, *Railway applications - Interference limits of existing track circuits used on European railways*

UIC Leaflet 505-1: 10th Edition, 2006*, Railway transport stock - Rolling stock construction gauge*

UIC Leaflet 505-5: 2nd Edition, 1977 + 4 amendments, *Basic conditions common to leaflets 505-1 to 505-4 - Notes on the preparation and provisions of these leaflets*

UIC Leaflet 518: 3rd Edition, 2005, *Testing and approval of railway vehicles from the point of view of their dynamic behaviour - Safety - Track fatigue - Ride quality*

UIC Leaflet 540: 5th Edition, 2006, *Brakes - Air Brakes for freight trains and passenger trains*

UIC Leaflet 541-03: 1st Edition, 1984, *Brakes - Regulations concerning manufacture of the different brake parts - Driver's brake valve*

UIC Leaflet 541-05: 2nd Edition, 2005, *Brakes - Specifications for the construction of various brake components - Wheel slide protection device (WSP)*

UIC Leaflet 541-3: 6th Edition, 2006, *Brakes -Disc brakes and their application - General conditions for the approval of brake pads*

UIC Leaflet 541-4: 3rd Edition, 2007, *Brakes - Brakes with composition brake blocks - General conditions for certification of composite brake blocks*

UIC Leaflet 541-5: 4th Edition, 2006, *Brakes - Electropneumatic brake (ep brake) - Electropneumatic emergency brake override (EBO)*

UIC Leaflet 543: 13th Edition, 2007, *Brakes - Regulations governing the equipment of trailing stock*

UIC Leaflet 544-1: 4th Edition, 2004, *Brakes - Braking power*

UIC Leaflet 544-2: 2nd Edition, 1983, *Conditions to be observed by the dynamic brake of locomotives and motor coaches so that the extra braking effort produced can be taken into account for the calculation of the braked-weight*

UIC Leaflet 546: 5th Edition, 1967 and 5 amendments, *Brakes - High power brakes for passenger trains*

UIC Leaflet 547: 4th Edition, 1989, *Brakes - Air brake - Standard programme of tests*

UIC Leaflet 623-1: 4th Edition, 2006, *Approval procedures for the diesel engines of motive power units*

UIC Leaflet 623-2: 4th Edition, 2006, *Approval tests for the diesel engines of motive power units*

UIC Leaflet 623-3: 3rd Edition, 2003, *Series test and acceptance conditions for diesel engines of motive power units*

UIC Leaflet 651: 4th Edition, 2002, *Layout of drivers' cabs in locomotives, railcars, multiple-unit trains and driving trailers*

UIC Leaflet 660: 2nd edition, 2002, *Measures to ensure the technical compatibility of high-speed trains*

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