



JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS E 4041 : 2009

(JARI/JSA)

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

ICS 45.060.01

Reference number : JIS E 4041 : 2009 (E)

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E 4041 : 2009

Date of Establishment: 1967-08-01

Date of Revision: 2009-04-28

Date of Public Notice in Official Gazette: 2009-04-28

Investigated by: Japanese Industrial Standards Committee

Standards Board

Technical Committee on Railways and Rolling Stock

JIS E 4041 : 2009, First English edition published in 2014-12

Translated and published by: Japanese Standards Association
Mita MT Building, 3-13-12, Mita, Minato-ku, Tokyo, 108-0073 JAPAN

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Land, Infrastructure, Transport and Tourism, through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Association of Rolling Stock Industries (JARI)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14. Consequently, **JIS E 4041 : 1999** is replaced with this Standard, and **JIS E 4022** and **JIS E 4042** to **JIS E 4046** have been withdrawn and replaced with this Standard.

This **JIS** document is protected by the Copyright Law.

Attention is drawn to the possibility that some parts of this Standard may conflict with patent rights, applications for a patent after opening to the public or utility model rights. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying any of such patent rights, applications for a patent after opening to the public or utility model rights.

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

Introduction

This Japanese Industrial Standard has been prepared based on the second edition of IEC 61133 published in 2006 with some modifications of the technical contents, by adding specification items or others that are not given in the corresponding International Standard with an aim to meet the actual conditions in Japan.

The portions with continuous sidelines or dotted underlines are the matters in which the contents of the corresponding International Standards have been modified. The matters contained in Annex JA are unique contents of JIS that are not given in the corresponding International Standard. A list of modifications with the explanations is given in Annex JB.

1 Scope

This Standard specifies general criteria to demonstrate by testing that railway vehicles, on completion of construction and before entry into service, conform with standards or other normative documents.

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.) (see tables A.1 and A.2).

NOTE 2 This Standard does not deal with tests carried out on components and equipment before fitting to the vehicle.

Insofar as this Standard is applicable it may be used for the following.

- a) Generator sets mounted on a vehicle provided for auxiliary purposes.
- b) The electrical or engine-driven traction systems used on trolley buses or similar vehicles.
- c) Control equipment and auxiliary equipment on trailing vehicles not equipped with electrical or engine driven traction systems.
- d) Vehicles that are guided or supported without depending on adhesion between the wheels and rails and which are driven electrically or by engine.

NOTE 3 The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

IEC 61133 : 2006 *Railway applications — Rolling stock — Testing of*

rolling stock on completion of construction and before entry into service (MOD)

The symbols which denote the degree of correspondence in the contents between the relevant International Standard and JIS are IDT (identical), MOD (modified), and NEQ (not equivalent) according to ISO/IEC Guide 21.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. For standards with the year indication, only the editions of the indicated year shall be applied and the revisions (including amendments) made thereafter shall not be applied. For those without the indication of the year, the most recent edition (including amendments) shall be applied.

JIS C 0920 *Degrees of protection provided by enclosures (IP Code)*

NOTE : Corresponding International Standard : IEC 60529 : 2001 *Degrees of protection provided by enclosures (IP Code)* (IDT)

JIS E 4001 *Railway rolling stock — Vocabulary*

JIS E 4011 *Measuring methods for mass of railway rolling stock*

JIS E 4014 : 2007 *Rolling stock — Test methods for insulation resistance and withstand voltage*

JIS E 4016 *Illuminance for railway rolling stock — Recommended levels and measuring methods*

JIS E 4021 *Rolling stock — Measurement of noise inside railbound vehicles*

NOTE : Corresponding International Standard : ISO 3381 *Railway applications — Acoustics — Measurement of noise inside railbound vehicles* (MOD)

JIS E 4025 *Rolling stock — Acoustics — Measurement of noise emitted by railbound vehicles*

NOTE : Corresponding International Standard : ISO 3095 *Railway applications — Acoustics — Measurement of noise emitted by railbound vehicles* (MOD)

JIS E 5004-1 *Electric equipment for rolling stock — Part 1 : General service conditions and general rules*

NOTE : Corresponding International Standard : IEC 60077-1 *Railway applications — Electric equipment for rolling stock — Part 1 : General service conditions and general rules* (MOD)

JIS E 5004-2 *Electric equipment for rolling stock — Part 2 : Electrotechnical components — General rules*

NOTE : Corresponding International Standard : IEC 60077-2 *Railway applications — Electric equipment for rolling stock — Part 2 : Electrotechnical components — General rules* (MOD)

JIS E 5004-3 *Railway applications — Electric equipment for rolling stock — Part 3 : Electrotechnical components — Rules for d.c. circuit-breakers*

NOTE : Corresponding International Standard : IEC 60077-3 *Railway applications — Electric equipment for rolling stock — Part 3 : Electrotechnical components — Rules for d.c. circuit-breakers* (MOD)

JIS E 5004-4 *Railway applications — Electric equipment for rolling stock — Part 4 : Electrotechnical components — Rules for a.c. circuit-breakers*

NOTE : Corresponding International Standard : IEC 60077-4 *Railway applications — Electric equipment for rolling stock — Part 4 : Electrotechnical components — Rules for AC circuit-breakers* (MOD)

JIS E 5004-5 *Railway applications — Electric equipment for rolling stocks — Part 5 : Electrotechnical components — Rules for HV fuses*

NOTE : Corresponding International Standard : IEC 60077-5 *Railway applications — Electric equipment for rolling stock — Part 5 : Electrotechnical components — Rules for HV fuses* (MOD)

JIS E 5006 *Electronic equipment for rolling stock*

NOTE : Corresponding International Standard : IEC 60571 : 1998 *Electronic equipment used on rail vehicles* (MOD)

JIS E 5007 *Traction transformers and inductors for rolling stock*

NOTE : Corresponding International Standard : IEC 60310 *Railway applications — Traction transformers and inductors on board rolling stock* (MOD)

JIS E 5008 *Rolling stock — Power convertors installed on board rolling stock*

NOTE : Corresponding International Standard : IEC 61287-1 *Railway applications — Power convertors installed on board rolling stock — Part 1 : Characteristics and test methods* (MOD)

JIS E 5011-1 *Rolling stock — Combined testing of power convertor with ac motors — Part 1 : Inverter system*

NOTE : Corresponding International Standard : IEC 61377-1 : 2006 *Railway applications — Rolling stock — Part 1 : Combined testing of inverter-fed alternating current motors and their control system* (MOD)

JIS E 5011-2 *Rolling stock — Combined testing of power convertor with ac motors — Part 2 : Convertor-inverter system with intermediate dc link*

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

JIS E 5051 *Rolling stock — Protective provisions against electrical hazards*

NOTE : Corresponding International Standard : IEC 61991 *Railway applications — Rolling stock — Protective provisions against electrical hazards* (MOD)

JIS E 6101 *Railway rolling stock — DC traction motors — Test methods*

NOTE : Corresponding International Standard : IEC 60349-1 *Electric traction — Rotating electrical machines for rail and road vehicles — Part 1 : Machines other than electronic convertor-fed alternating current motors* (MOD)

JIS E 6102 *AC traction motors for rolling stock*

NOTE : Corresponding International Standard : IEC 60349-2 *Electric traction — Rotating electrical machines for rail and road vehicles — Part 2 : Electronic convertor-fed alternating current motors* (MOD)

JIS E 6302 : 2004 *Pantographs for rolling stock*

NOTE : Corresponding International Standard : IEC 60494-1 : 2002 *Railway applications — Rolling stock — Pantographs — Characteristics and tests — Part 1 : Pantographs for mainline vehicles* (MOD) and IEC 60494-2 : 2002 *Railway applications — Rolling stock — Pantographs — Characteristics and tests — Part 2 : Pantographs for metros and light rail vehicles* (MOD)

JIS E 6401 *Power resistors for rolling stock*

NOTE : Corresponding International Standard : IEC 60322 *Railway applications — Electric equipment for rolling stock — Rules for power resistors of open construction* (MOD)

JIS Q 17025 *General requirements for the competence of testing and calibration laboratories*

NOTE : Corresponding International Standard : ISO/IEC 17025 *General requirements for the competence of testing and calibration laboratories* (IDT)

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

3 Terms and definitions

For the purposes of this Standard, the terms and definitions given in JIS E 4001 and the following apply.

NOTE : Main terms and definitions regarding railway ground facilities are given in JIS E 2001, IEC 62128-1 and IEC 62128-2.

3.1 manufacturer

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

There may be more than one manufacturer where the contract for vehicles is split in two or more parts such as body, bogie, and equipment.

3.1A free issue materials

among the articles used for vehicles, articles which are procured with a separate contract by the purchaser or user and provided free-of-charge to the manufacturer

NOTE : For tests related to relevant free issue materials after completion of ve:

hicle construction, see 6.1.

3.2 manufacturer's works

location where the assembly of the vehicles (including body, bogie, and equipment) is completed and where static tests are generally performed

3.3 purchaser

organisation which orders and will own the vehicle

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

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, structures

3.9 type test

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

test to which each vehicle (including single or multiple equipment and systems) is subjected to during or after manufacture to ascertain whether it complies with specified criteria

3.11 safety-related

NOTE : This term is not defined because of unfamiliarity in Japan at this time.

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

NOTE : For the meaning of “validation”, see NOTE 2 of 4.3.

3.14 test plan

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

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

3.16 approval authority

any body other than the purchaser (see 3.3) 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

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

3.16A rail/road vehicle

vehicles configured to run on both railway tracks and roads

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 (e.g. raw materials, supplies, production, finished products or packing). There shall be available information on the manufacturer's quality system and the results of tests as appropriate.

The manufacturer shall establish and maintain an appropriate 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 **JIS Q 9001**.

4.1.1 **Quality Plan**

The quality plan (see 3.15) for the design, production, inspection and testing of the product shall include a test plan (see 3.14 and 4.3) 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 :

- a) **Type test** The vehicles comply with the technical requirements of the contract (see 3.9 and 5.3.1);
- b) **Routine test** Every vehicle conforms to the design standard proved in the type tests (see 3.10 and 5.3.2);
- c) **Additional tests according to a separate contract** For example, 4.1.2 a) to c).

4.1.2 **Tests on major vehicle components**

All component type and routine tests shall be successfully completed according to the relevant standards and specifications, except as permitted by 6.1 e), 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, which therefore shall be separately agreed between the manufacturer and the purchaser if necessary.

- a) Endurance and reliability
- b) Development
- c) Investigative (except for guidance only)
- d) 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 the following types of testing.

- a) Static tests necessitating the vehicle to be moved to a specialized test center not belonging to either the manufacturer or the purchaser.
- b) Dynamic tests on another system not belonging to either the manufacturer or the user. It is recommended that third party test facilities be accredited to **JIS Q 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

NOTE 1 This includes, as appropriate, their accreditations 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 method
- h) The success criteria for each test
- i) The corrective action process
- j) The validation documentation (see 3.13)

Where the contract requires validation of certain tests or documents by the purchaser, these shall be identified in the test plan. In particular, when validation evidences shall be preserved, the necessity should be agreed in advance between the manufacturer and the purchaser.

NOTE 2 "Validation" refers to "confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled" (see 3.8.5 in JIS Q 9000 : 2006).

Where the contract requires safety to be demonstrated by a series of tests derived from a safety or risk assessment performed as required by the purchaser, the user or an external approval authority, then these tests shall be included in the test programme and identified as such in the test plan.

NOTE 3 The test items especially related to safety are indicated in Note ^{a)} and/or Note ^{b)} under test items in tables A.1 and A.2.

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 tests in the test plan (see 3.14 and 4.3) shall be indicated into the following categories.

5.1.1 Categories of test plan

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
 - 1) Type tests (see 5.3.1)
 - 2) Routine tests (see 5.3.2)
- c) Investigation tests (see 5.4)

5.1.2 Partial omission of test items

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

- a) 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 paid for or stipulated by the purchaser.
- b) 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 (see 5.3), the manufacturer may require to carry out preliminary adjustment tests which cannot be made in manufacturer's works and which may involve test run on the user's line with or without load. In this event, at least the minimum amount of testing required for safe running (see 6.2 and 9.1A) 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.

NOTE : See 6.3 for the total distance of the trial runs for normal acceptance conditions for vehicle.

Test runs may only be undertaken under the supervision and with the participation of a qualified agent appointed by the railway operator or 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.

NOTE : The list of test items in tables A.1 and A.2 is the guidance for the manufacturer to create a test plan.

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 based on the agreement between the manufacturer and the purchaser.

5.3.2 Routine tests

These tests shall be carried out on each vehicle to be delivered. Examples of test items are listed in tables A.1 and A.2, while test contents of each test item are specified in clauses 8 and 9.

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.

NOTE : The list of test items in tables A.1 and A.2 is the guidance for the manufacturer to create a test plan.

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

Routine test may be changed as follows according to agreement between the manufacturer and the purchaser when it is determined from the results of corresponding type tests that there is no need to repeat the same test.

- a) Limit of test scope or sampling routine test
- b) Partial omission of test items
- c) Omission of test based on declaration of conformance through existing validation documents, etc.

5.3.3 Tests required by approval authority

Tests required by approval authorities and those tests demonstrating safety shall be clearly identified in the test plan.

NOTE : The test items especially related to safety are indicated in Note ^{a)} and/or Note ^{b)} under test items 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 the purchaser and the manufacturer. In each particular case, the purchaser and the 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 should take into account of the purpose and site of each test, and cover the following items. Tests of free issue materials to be incorporated into completed vehicles shall be agreed in advance among the free issue material supplier, the manufacturer and the purchaser.

a) Type and routine test programmes

NOTE : Matters in this Standard for which the manufacturer and the purchaser can choose freely shall be clearly indicated.

b) Static tests (see 6.2)

c) Dynamic tests (see 6.3)

d) Methods for testing for environmental conditions, for example 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 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 (see 9.1A).

Where tests are performed at the third-party facility (see 4.2) which involves movement of the vehicle, sufficient tests shall be undertaken, through the application of 9.1A, by the manufacturer to ensure that the movement can be completed safely.

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.

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.

~~Such dynamic tests are normally performed on main tracks managed by the user (see 3.7), and are related to vehicle authorization matters. Therefore, they shall be carried out under the responsibility of the purchaser or the user. The manufacturer (see 3.1) and the supplier (see 3.4) shall cooperate in good faith.~~

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 (see 3.8).

The purchaser shall provide all the necessary facilities for any preparation for dynamic tests [including preliminary test running (see 5.2)] under the conditions specified in the contract.

All related parties involved in dynamic tests shall clarify responsibilities.

~~For dynamic tests involving free issue materials, the test items, test contents, preparation of test materials and responsible party for the relevant test shall be agreed in advance among the free issue material supplier, the manufacturer and the purchaser.~~

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 between the manufacturer and the purchaser.

~~As part of type tests, the total distance of the trial runs before handover to the purchaser shall be about 100 km unless otherwise specified in the contract.~~

NOTE : All the necessary preliminaries such as the relevant parts of the reliability, availability, maintenance case and the safety case before undertaking the dynamic tests should be considered between the manufacturer and the purchaser.

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.
- 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 title and signature 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 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 from 8.1A onwards, 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.

8.1A Visual inspection (routine test)

For the following matters, the absence of abnormality shall be verified through inspections in actual standstill conditions including installing conditions.

- Vehicles overall
- Free issue materials
- All components and equipment
- Cabling (see 8.7A), piping

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 the minimum loading conditions, comply with the limits set out in the contract.

8.2.2 Type tests

8.2.2.1 Outside dimensions

For each type of vehicle, the outside dimensions of the vehicle shall be measured and checked against the limits set up specified by the railway operator and/or railway infrastructure manager. If vehicle gauge is not specified for some reason, the manufacturer shall declare kinematic gauging (see 8.2.2.1A) to the purchaser.

Equipment which cannot be used without exceeding vehicle gauge as agreed between the manufacturer and the purchaser (e.g. steps which temporarily extend externally, stone guards, emergency doors) may exceed vehicle gauge within tolerances that ensure safe operation of the vehicle.

The outside dimensions of the vehicle shall include the following conditions.

- a) The range of adjustment of all appropriate components (e.g. air suspension)
- b) The range of tolerances for wear and tear (e.g. wheel wear)
- c) The range of loading conditions (see 8.5.2)
- d) The range of movement in case of failure or damage (e.g. suspension components)
- e) The worst case combinations of the above a) to d)

8.2.2.1A Kinematic gauging (limit for moving vehicle outside dimensions when vehicle gauge is not specified)

If vehicle gauging is not specified for some reason, the manufacturer shall specify kinematic gauging and declare to the purchaser in accordance with the rules agreed upon in the contract. Kinematic gauging accounts for the following lateral motions and displacements caused by radius of track curvature, train speed through curved sections, and vehicle dimensions. It should be calculated in advance from values based on design specifications, and the verification methods should be included in the test plan.

- a) Dimensions of lateral body displacement and dimensions of body tilt, subjected to the coefficient of flexibility (see 8.3.3) of the body suspension device.
- b) Dimensions of maximum lateral displacement of the body suspension device subjected to centrifugal force, when vehicles run through curved routes with insufficient cant.
- c) Dimension when passing through curved sections and when both edges of the body is displaced to the outer side of the curve and the middle is displaced to the inner side of the curve (this is related to the vehicle wheel base or distance between two bogies, body length and width as well as influenced by the flexibility of the body suspension device).

NOTE : Regarding lateral displacement of the body suspension device in static conditions and to vehicle gauge expansion on curved tracks, sufficient space is given between vehicle gauge and construction thus 8.2.2.1A is not applied in Japan.

8.2.2.2 Clearance tests

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

(see 8.2.2.3).

- a) Between vehicle bodies and bogies
- b) Between adjacent coupled vehicles

8.2.2.3 Hose and cable length tests

This test shall be carried out to determine through inspection that there is appropriate length and mounting of hoses and cables between the body and bogie and between coupled vehicles even if vehicles are relatively displaced in such timings as passing curves (including simulated movement for pendulum vehicles or tilting vehicles).

A test to give, between the body and bogie, the turning displacement equivalent to that given when the vehicle passes curves is called displacement test. A typical method of this test is to place one bogie of a complete vehicle on a traverse or turntable and to turn the bogie with respect to the car body and to be carried out at the same time as the test in 8.2.2.2 a) (for pendulum vehicles or body-tilting vehicles, a device that can simulate the said device shall be used as necessary). If a factory has a curved track equivalent or similar to the minimum radius specified in the contract, the test between car bodies is performed by placing vehicles on the track section. They should be reconfirmed through dynamic test as well.

8.2.2.4 Current collector static tests

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. The time for the pantograph to be raised and lowered shall be agreed between the manufacturer and the purchaser.

In particular, tests shall be made on pantographs, including the limiting dimensions of lateral displacement, as specified in JIS E 6302, if required in the contract.

NOTE : 6.6 of JIS E 6302 : 2004 specifies that "The pantograph shall be extended to its upper operating position. When a force of 300 N is applied successively on each side of the part of the frame which supports the collector head, the displacement shall be less or equal to 30 mm on each side. After each application force, there shall be no permanent deformation".

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. The heights of the body, center of the coupler, and bogie frame shall be ascertained to be within limits specified in the contract.

Parts with provision for adjustment according to the wear of the wheels (e.g. stone guards, snowploughs, sanding pipes) 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 (see

8.2.2.1).

8.3.2 General (type tests)

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

8.3.2.1 Vehicle gauge

It shall be verified that the vehicle does not exceed the specified vehicle gauge.

NOTE : 8.3.2.2 is hardly applied in Japan, because railway operators specify the vehicle gauge.

8.3.2.2 Kinematic gauging (limit for moving vehicle outside dimensions when vehicle gauge is not specified)

When kinematic gauging is specified by the purchaser or the user, the manufacturer shall carry out coefficient of flexibility test as a static test of the maximum tilt of the car body by the suspension device (see 8.3.3) to validate the calculation used in the vehicle running characteristics (see 8.2.2.1A).

8.3.3 Coefficient of flexibility test (voluntary type test)

If required to verify the calculation of kinematic gauging (see 8.3.2.2), then this test shall be carried out for each vehicle type.

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).

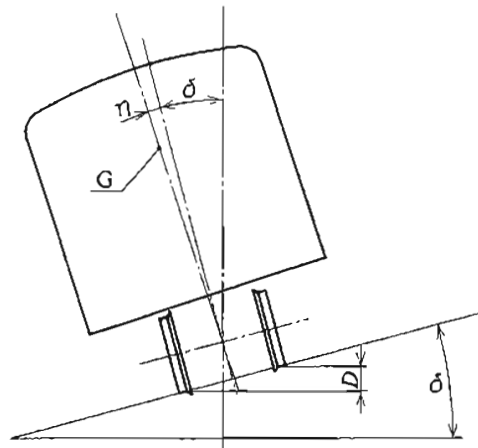
The coefficient of flexibility shall be determined by direct measurement (sway test).

NOTE : "Coefficient of flexibility" is the maximum tilt ratio of the car body when it tilts inward with respect to the cant by the suspension device in stationary conditions, and is defined as follows (see figure 0A and UIC 505-5).

- When a minimum loaded vehicle, empty vehicle, or exceptional/crush-loaded vehicle is placed in stationary conditions on a track with cant D , the track surface constitutes angle δ from level, and the car body is tilted due to the suspension supporting it, consisting angle η against the rail's perpendicular surface.
- The coefficient of flexibility shall be defined by the following equation using calculated or measured values that exclude the influence of asymmetry, spring friction, and damper, etc.

$$s = \frac{\eta}{\delta}$$

where, s : coefficient of flexibility
 η : tilt angle of body (degree)
 δ : tilt of track (degree)



NOTE : D is track cant, G is the gravity center.

Figure 0A Relationship of coefficient of flexibility

8.3.4 Geometry of each vehicle (routine 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 Hoisting or lifting ability test (voluntary type test)

8.4.1 Objective

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

8.4.2 Test method

The test consists of hoisting or lifting the vehicle at the designed lifting points using any one of overhead cranes, lifts or jacks. It shall be checked that the vehicle mechanical interfaces, attachment deflections etc. are within the tolerances specified in the contract. As a minimum, the tests shall demonstrate that the vehicle can be hoisted or lifted without permanent deformation occurring. For vehicles characterized by low torsional rigidity of the car body, the test may be omitted or conducted under test conditions agreed between the purchaser and the manufacturer (see 4.4 of JIS E 7106 : 2006).

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.

- The vehicle mass
- The measured load per axle

- c) The measured load per wheel

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

Item	Minimum load	Tare mass ^{a), b)}	Exceptional/ crush load
Passenger/freight loads	0	0	According to contract
Tooling	Complete (constant value)		
Crew	0	0	Crew capacity
Sand	0	Full	Full
Water for heating, toilets, catering, etc.	0	Full	Full
Fuel	0	Full	Full
Thermal engine coolants and lubricants	Standard (normal)	Standard (normal)	Standard (normal)
Other fluids and lubricants	Standard (normal)	Standard (normal)	Standard (normal)
Notes ^{a)} In the corresponding IEC standard, "normal load" is in between minimum load and exceptional/crush load instead of "tare mass". Among the exceptional/crush load conditions, the conditions are that each amount of sand, water for toilets, and fuel is 2/3 of the full amount. "normal load" is not used as the measurement condition in Japan, thus is deleted in JIS. ^{b)} "Tare mass" of a vehicle has been used conventionally in Japan, thus conditions are changed to match those for tare mass.			

For vehicles intended to carry passengers or freight loads, unless stated otherwise from the purchaser, the loads shall be as follows.

- a) **Minimum load** Vehicle loading specified in the contract with the vehicle fully equipped and in a movable state either autonomously or by traction.
- b) **Tare mass** Minimum load with full load of sand, water and fuel and under load conditions specified in the contract for performance tests such as powering and braking (crew, passengers, and freight not included).
- c) **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.

NOTE 1 : Unless otherwise specified, the calculated mass of passenger and crew per person shall be 55 kg [see 5.1 b) of JIS E 7103 : 2006].

NOTE 2 : "Mass in working order" conventionally used in locomotives shall be tare mass plus mass of specified crew capacity.

In order to reduce to a minimum the handling of additional loads for load measure-

ment conditions, dimensional tests (see 8.2) and weighing operations (see 8.5) may be conducted under one of the following conditions agreed between the manufacturer and the purchaser :

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

8.5.3 Type tests

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 (e.g. 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 or tare mass as agreed between the manufacturer and the purchaser. Exceptional/crush load state tests may be conducted as a voluntary test or investigation test.

The method for vehicle weighing test shall be in accordance with JIS E 4011. The vehicle loading conditions shall be as agreed between the manufacturer and the purchaser.

The vehicle shall be run at reduced speed on to the weighing site, with friction 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 suspension produced by the previous activation of the suspension system and arising from friction between the several parts of the suspension. Other testing methods appropriate to the format of the suspension device (e.g. coil spring or air suspension) or the weighing device available (e.g. system where the vehicle is transported to the weighing point and then lowered vertically onto the weighing device) may be used. In this case, the conditions for and number of measurements shall be specified in the contract.

The mass of the vehicle, the load of the individual axles and the load of the left and right axles on the vehicle shall meet the requirements of the contract, taking into account the following a) to d). The following e) to h) measurements when defined in the contract shall be tested.

- a) The maximum and minimum mass, and allowable tolerance on the overall mass of the vehicle
- b) The maximum load and allowable tolerance on the load of each axle on the vehicle
- c) Value of measured load per left and right wheel for each axle and difference with

the average load per wheel for said axle

- d) Value of total load per wheel on left and right rows of the vehicle (left and right) and difference with the average total load per wheel for both rows
- e) The excessive mass of the vehicle in running order over that state in the contract
- f) For motive power unit (vehicle with driving unit for running), the static adhesive load
- g) For motive power unit, the load on each driving axle compared to the average load on driving axles intended to exert the same tractive effort
- h) Load per axle compared to the figure permissible load on the lines on which the vehicle is to run. This figure shall be specified in the contract

8.5.4 Routine tests

Weighing tests shall be conducted according to the method specified in 8.5.3. Loading conditions shall be the same as type tests. For wagon and non-powered carriages, a declaration of conformity is acceptable if agreed in the contract.

8.5A Gravity centre tests (voluntary type test)

Gravity centre test of vehicles, when previously agreed between the manufacturer and the purchaser in its conduct, shall be carried out according to the prescribed method in advance. The method includes calculation instead of measurement.

8.6 Sealing tests

8.6.1 Objective

To verify that the sealing (e.g. the IP rating according to JIS C 0920) employed on the vehicle and any filters, separators or similar devices comply with the performance specified in the contract.

Water tightness test shall be carried out in accordance with the specifications in Annex JA, unless otherwise specified.

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, louvers, 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 louvers, 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 **JIS C 0920**.

8.6.3 Routine tests

Water tightness tests shall be conducted as same as type tests, however, the simplified water test and other specific tests shall be carried out as specified in the test plan.

8.6A Air tightness test (routine test)

8.6A.1 General

Air tightness shall be tested when vehicles have air-tight structures to prevent passengers from being discomforted by changes in air pressure at the entries/exits of tunnels and inside tunnels.

Verification tests of vehicle air tightness shall be conducted when agreed in advance between the manufacturer and the purchaser. The test shall be conducted by increasing the pressure in the vehicle higher than the atmospheric pressure. The test may be conducted on a single car instead of a train set.

8.6A.2 Test method

Openings on vehicles such as doors, windows, exhausts and drain holes shall be given the same conditions as those given during vehicle operation. Openings at the coupler of the body, if any, shall be sealed with a sealing plate or others.

Compressed air shall be fed from a test device to a car. The atmospheric pressure in the car shall be increased to the pressure specified in the contract. When the air supply is stopped, the pressure in the car will decrease gradually. The time for the pressure to drop from the value, specified in the contract and obtained immediately after the stop of air supply, to another specified value (e.g. pressure from 4 kPa to 1 kPa) shall be measured. The measured time shall be confirmed to meet the standard value specified in the contract.

NOTE : In order to confirm each air tightness of doors, windows, welds or others before conducting air tightness test, such measure as applying soap water onto these parts are taken while the pressure in the car is elevated.

8.7 Electrical insulation tests (routine tests)

8.7.1 General

These tests are intended to test the insulation integrity of the vehicle electrical circuits.

They 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.

Equipment such as rotating machines, which has previously passed insulation tests of the standard as agreed between the manufacturer and the purchaser 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 (type 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, for example electronic components, shall be disconnected or short-circuited. Such equipment shall have previously passed an insulation test of the standard as agreed between the purchaser and the purchaser.

Withstand voltage test shall be carried out by the following Rule 1 or Rule 2, according to the agreement between the manufacturer and the purchaser.

Rule 1

The withstand test voltage shall be applied for 1 min between each of the various cable circuit and earth. Its value shall be equal to 85 % of the minimum test voltage of the separate test voltages of apparatus defined by standards applied to components composing the circuit (such as JIS E 5004-1 to JIS E 5004-5, JIS E 5007, JIS E 5008, JIS E 6101, JIS E 6102, and JIS E 6401).

Rule 2

It shall be in accordance with 7.2 and 7.3 of JIS E 4014 : 2007.

8.7.3 Insulation impedance test

The insulation impedance test shall be carried out by the following Rule 1 or Rule 2, according to the agreement between the manufacturer and the purchaser.

Rule 1

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

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

Rule 2

It shall be in accordance with 7.1 of JIS E 4014 : 2007.

For example, a value of less than 1 MΩ may be as agreed between the manufacturer and the purchaser 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 withstand voltage test, the test conditions shall be the same for both tests and the impedance value measured after the withstand voltage test shall be not lower by more than 10 % than that measured before the withstand voltage test.

If the insulation impedance tests before and after the withstand voltage test are conducted under significantly different weather or humidity conditions, the measured values may be changed into an appropriate range as agreed between the manufacturer and the purchaser.

8.7A Cable inspection (routine tests)

Cables installed in vehicles shall be checked through inspection that they comply with the cable connection diagram; the wire type and sizes comply with the design drawing; they are bundled separately by voltage and differing circuits and are fixed; and, as necessary, they are stored in a conduit made of the material with its electromagnetic compatibility (EMC) considered. Exposed wires shall be confirmed that they have sufficient protection against external flying objects, as necessary.

8.8 Protective bonding and return circuits tests (type tests)

The objective of this test is 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 for the following purposes.

- 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 JIS E 5051.

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.

8.8A Minimum operation voltage/minimum operation air pressure test (type test)

The major electrical equipment and pneumatic components in the vehicle (e.g. pantograph lock release, auxiliary power supply startup, cranking of the thermal engine, and operation of auxiliary air compressor of a.c. motor vehicle, etc.) shall be checked that they operate at minimum operation voltage and minimum operation air pressure as specified in the contract.

If reliable operation of these devices or components can be checked with standalone tests, those test records may replace this.

8.9 Air system tests

8.9.1 General

The objective of this test is 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 section 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 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

It shall be checked through inspections that the pressure drop in the main reservoir does not exceed the value specified in the contract after a period specified in the contract has passed when various pneumatic components (such as brake circuit, door operating equipment, air body suspension device, electromagnetic pneumatic components) are pressurized with the compressed air source then air supply is shut off (e.g. methods such as operating isolating cocks).

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 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

The correct operation of all compressed air equipment shall be checked. The examples are as follows.

- a) Safety and protective devices
- b) Pressure regulating device
- c) Brake control device or brake operating device
- d) Security brake equipment
- e) Wheel slide protection device
- f) Isolating cocks (shut-off valves)
- g) Drain valves
- h) Pressure transducers and switches

- i) Compressor duty cycle, if tested by static simulation (see 9.18)
- j) Warning horns
- k) 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

The objective of this test is 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.

- a) Hydraulic pumps
- b) Hydraulic motors (e.g. cooling group, radiator fan, etc.)
- c) Safety and protective devices
- d) Pressure limiters
- e) Non-return valves
- f) Shut-off valves
- g) Drain valves
- h) Calliper device

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

The objective of this test is 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 interface between the friction and the electric brake, where fitted (if done by simulation in place of a dynamic test, see 9.4)
- c) Security brake
- d) Interface with other systems such as wheelslide control, load weighing, traction