

2nd edition, February 2003

Translation

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Motive power units - Bogies and running gear - Bogie frame structure strength tests

Engins moteurs - Bogies et organes de roulement - Essais de résistance des structures de châssis de bogies

Triebfahrzeuge - Drehgestelle und Laufwerke - Festigkeitsprüfung an Strukturen von Drehgestellrahmen



UNION INTERNATIONALE DES CHEMINS DE FER
INTERNATIONALER EISENBAHNVERBAND
INTERNATIONAL UNION OF RAILWAYS

Leaflet to be classified in Volumes :

V - Rolling Stock

VI - Traction

VIII - Technical specifications

Application :

With effect from 1 January 1994

All members of the International Union of Railways

Record of updates

1st edition, January 1994 First issue

2nd edition, February 2003 Retyped in FrameMaker.

The person responsible for this leaflet is named in the UIC Code

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Summary

This leaflet is part of a set concerning the technical approval of motor bogies. It describes the rig tests performed to verify the ability of bogie frames to withstand in-service loads.

1 - Introduction

This leaflet is part of a set concerning the technical approval of motor bogies which also includes *UIC Leaflet 615-0, 615-1, 515-3, 615-4 and 515-5* (see Bibliography - page 16).

It describes the rig tests performed to verify the ability of bogie frames to withstand in-service loads.

Four groups of tests are distinguished:

- **Static tests** with "exceptional" loads.

These tests verify that there is no risk of permanent bogie deformation due to superposition of the maximum in-service loads.

- **Static tests** to simulate the main in-service loads.

These tests verify that there is no risk of fatigue cracks due to superposition of the main in-service loads (vertical and transverse forces, effects of track twist).

- **Static tests** to simulate particular in-service loads.

These tests verify that there is no risk of localised fatigue cracks due to repetitive stresses originating from the bogie components (motors, brakes, shock-absorbers, anti-roll bars) and from running through small-radius curves.

- **Fatigue tests**

These tests enable the overall bogie service life to be ascertained, the safety margin to be evaluated and possible weak points not identified by the static tests to be detected. They shall, therefore, be performed after the static tests. Considering the capabilities of existing test installations, these tests can only be recommended.

The values of the forces to be applied, as quoted in this document, are not yet founded on a solid base of experience and should therefore be considered as provisional.

2 - General conditions

It shall be verified that bogie frames used for the tests fully conform to the design drawings and have been manufactured using the same processes as during series production.

- It is recommended that the static tests be performed on the bogie incorporating its suspension and, where relevant, its traction motors.
- For practical reasons this arrangement is usually not possible for the fatigue tests; hence the test set-up for these tests shall be analysed carefully.

The test set-up shall reproduce the deformations observed in service as closely as possible. Particular attention shall be paid to the transmission of those forces that are distributed over several interconnecting elements (pivot, springs, stops, etc.).

Stresses at the points of highest stress are measured by means of strain gauges, using:

- unidirectional gauges for those places where the direction of the main stress is known,
- bi-directional gauges for those places where the two main directions are known,
- tri-directional gauges (rosettes) in all remaining cases.

The active part of the strain gauges shall not exceed 6 mm.

The locations of the gauges should only be defined by experienced personnel, using the results of finite-element analysis. If required, preliminary tests can be performed, using strain-indicating varnish or any other appropriate method.

Notation and load definitions :

- n_b = number of bogies
- n_e = number of wheelsets per bogie
- m^+ (kg) = bogie weight
- m_v (kg) = empty weight of vehicle in running order (where relevant, with fuel and water load)

Test loads for passenger-carrying vehicles, calculated in accordance with *UIC Leaflet 566* (see [Bibliography - page 16](#)) for main-line vehicles.

- | | |
|--|--|
| c_1 : <ul style="list-style-type: none"> - 1 passenger of 80 kg per seat^a - 4 passengers per m² in the corridors and entrance vestibules^b - 300 kg per m² in the luggage compartments | c_2 : <ul style="list-style-type: none"> - 1 passenger of 80 kg per seat^a - 2 passengers per m² in the corridors and entrance vestibules^c - 300 kg per m² in the luggage compartments |
|--|--|

a. 70 kg for suburban-type vehicles.

b. may be increased up to 10, depending on type of service.

c. may be increased up to 4, depending on type of service

3 - Static tests with exceptional loads

3.1 - Definition of applied loads

(See diagram in Appendix A - page 13)

- Vertical test loads per bogie (one for each sole-bar) :

$$F_{z1max}(N) = F_{z2max}(N) = \frac{1,4}{2n_b} g (m_v + c_1 - n_b m^+)$$

- Transverse test load per bogie:

$$F_{ymax} = 2 \left(10^4 + \frac{(m_v + c_1)g}{3n_e n_b} \right)$$

- Warping of the bogie corresponding to 100% off-loading at the level of one of the wheels, in order to simulate the case of a derailed bogie.

NB:

1. Longitudinal forces are not simulated in the case of the test programme with exceptional loads.
2. For bogies with 3 wheelsets ($n_e = 3$), it is assumed that the centre wheelset does not participate in the transmission of transverse forces.
3. The factor 1,4 can be increased to 2 in exceptional cases, where the operating conditions are considered to be particularly severe.

3.2 - Test procedure and results to be obtained

The test is performed in two stages:

- a preliminary test, performed with loads equal to half the maximum values, to ascertain that no major problems will occur during the full-load test;
- the full-load test, which must not result in the elastic limit being exceeded at any point, or in any permanent deformation after removal of the test loads.

Inertia forces acting on the bogie are not simulated during this test. Therefore, the transverse force applied above the secondary suspension to balance the forces at the level of the wheels is generally too large. If, as a result, the elastic limit is exceeded in components located above the secondary transverse suspension, the test shall be performed again for those components only, with the transverse force reduced by half.