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Loadings of coach bodies and their components

International Union of Railways

Leaflet to be classified in Volumes :

IV - Operating
V - Transport stock

Amendments

1	1.01.92		
Add	1.10.92		

Obligatory provisions are preceded by an asterisk : *

Note

This leaflet forms part of a set which also includes :

- Leaflet 440 : Loudspeaker systems in RIC coaches.
- Leaflet 515 : Coaches – Running gear.
- Leaflet 532 : Trailing stock – Signal lamp brackets – Coaches – Fixed electric signal lamps.
- Leaflet 550 : Power supply installations for passenger stock.
- Leaflet 551 : Steam heating.
- Leaflet 552 : Electric power supply for trains taken from the train cable.
- Leaflet 553 : Ventilation, heating and air-conditioning in coaches.
- Leaflet 554-1 : Power supply to electrical equipment on stationary railway vehicles from a local mains system or another source of energy at 220 V or 380 V, 50 Hz.
- Leaflet 555 : Electric lighting in passenger rolling stock.
- Leaflet 560 : Doors, entrance platforms, windows, steps, handles and handrails of coaches and luggage vans.
- Leaflet 561 : Means of intercommunication for coaches.
- Leaflet 562 : Baggage racks and coat hooks.
- Leaflet 563 : Fittings provided in coaches in the interests of hygiene and cleanliness.
- Leaflet 564-1 : Coaches – Windows made from safety glass.

- Leaflet 564-2 : Regulations relating to fire protection and fire-fighting measures in passenger-carrying railway vehicles or assimilated vehicles used on international services.
- Leaflet 565-1 : Special comfort and constructional characteristics for sleeping cars accepted in international traffic.
- Leaflet 565-2 : Special comfort and constructional characteristics and rules of hygiene for restaurant cars accepted in international traffic.
- Leaflet 567-1 : Standard X- and Y-type coaches accepted for running on international services – Characteristics.
- Leaflet 567-2 : Standard Z-type coaches accepted for running in international traffic – Characteristics.
- Leaflet 567-3 : Constructional arrangements on coaches with a view to the application of the automatic coupler on the Member railways of the UIC and on the Member railways of the OSJD.
- Leaflet 567-4 : Standard open bogie van adapted for the conveyance of motor cars – Characteristics.
- Leaflet 568 : Loudspeaker and telephone systems in RIC coaches – Standard technical characteristics.
- Leaflet 569 : Regulations to be observed in the construction of coaches and vans suitable for conveyance by train ferry.
- Leaflet 580 : Inscriptions and markings, route indicators and number plates to be affixed on coaching stock used in international traffic.

Contents

0 - General

This leaflet contains loadings for coaches used in international traffic, and for their components.

1 - Coach body

1.1 - Design characteristics

* **1.1.1** - The body of the passenger coach comprises the underframe, the side walls, the end walls and the roof, which together form a tubular beam.

* **1.1.2** - The end walls, strenghtened by anti-collision pillars, shall be so joined to the headstock, cantrail and roof that the energy produced by a collision is absorbed first by deformation of the end wall section before other parts of the coach body are deformed. The assembly shall still retain adequate resistance to horizontal shearing forces.

* **1.1.3** - The coach body, in running order and mounted on the bogies, shall be so designed that under all load conditions its natural frequencies differ from the hunting and pitching frequencies of the bogie, so that no resonance occurs throughout the speed range.

1.2 - Test loads

1.2.1 - The coach body shall withstand the following test loads without permanent deformation and without exceeding the permitted stresses:

* **1.2.1.1** - A static compressive load of :

- 2 000 kN minimum at buffer level,
- 500 kN minimum diagonally at buffer level,
- 400 kN minimum at a level 350 mm above buffer centre line (1),
- 300 kN minimum at the level of the window guard-rail (1),
- 300 kN minimum at the level of the cantrail (1).

(1) Not applicable to the standard open bogie van for conveyance of motor vehicles.

The load, as shearing stress, must be applied on one wall at first; the point of application on the other must be at buffer height.

- 2 000 kN minimum on the automatic coupler buffing gear (1).

(On impact stop "c" (Appendix 1) or on flange bearing surface (Appendix 2)).

* **1.2.1.2** - A static tensile load of :

- 1 500 kN minimum on the "a" traction stops of the automatic coupler (design with traction stops) (Appendix 1) (1).
- 1 000 kN minimum on the "b" traction stops (design with traction stops) (Appendix 1) (1).
- 1 500 kN minimum on the "c" flange bearing surface of the automatic-coupler or on the fastening screws (design with flange) (Appendix 2) (1).

* **1.2.1.3** - A static verticle load of :

$$F_z = 1.3\ (m_1 + m_2) \times g\ [N]$$

evenly distributed.

Wherein :

m_1 = weight of coach body in running order

m_2 = number of seats (2) x 80 kg + area of side corridor and vestibules [m²] x 4 x 80 kg

$g = 9.81\ m/s^2$.

(1) Conditions for the forces transmitted by the automatic coupler : see also UIC leaflet 567-3.

(2) Seats in compartments only or lounge coach.

For the standard open bogie van for conveyance of motor vehicles, m_2 is expressed as follows :

m_2 = maximum load of van = 15 t. The maximum per-tier load of 10t shall not be exceeded.

For conventional vans, m_2 is expressed as follows:

$$m_2 = m_L \cdot F_L$$

wherein

m_L = 300 [kg/m²] = minimum load per 1 m² of loading area.

F_L = loading area including side corridor and vestibules [m²].

1.2.1.4 - It is recommended that buffing tests be conducted as described under 4.1.3. These tests serve to check the calculations described in 2.1.4 and to test the functional safety of components fastened in and to the coach.

* **1.2.2** - If during purely compressive or tensile testing the deflection is directed positively, i.e. downwards, the coach body shall withstand the following test loads without permanent deformation and without exceeding the permitted stresses :

1.2.2.1 - A static compressive load of :

2 000 kN at buffer or automatic-coupler level applied at the same time as the vertical load specified under 1.2.1.3.

1.2.2.2 - A static tensile load of :

1 500 kN at the same time as the vertical load specified under 1.2.1.3.

1.2.2.3 - A vertical load from the weight of the vehicle when lifted beneath the headstock in the area of the side buffers, of

$$F_z = (m_1 + m_3) X g \quad N$$

wherein:

m_1 = weight of the lifted part of the empty coach body in running order, lying on the bogie at the other end of the vehicle (equal to approx. half the weight of the coach body, when this is symmetrical),

m_3 = weight of the bogie at the end of the coach at which the vehicle is raised.

1.2.3 - It is recommended that a roof test-piece be subjected to a compression test until it collapses or buckles.

1.3 - Loads under service conditions

Loads occurring under service conditions may lead to material fatigue strength of the material:

$$F_z = 1.2\ (m_1 + m_4) X g \quad N$$

wherein:

m_1 = weight of the coach body in running order,

m_4 = payload.

The payload shall be determined as follows: (1)

- 1 passenger per seat,
- 2 passengers per m^2 in side corridors and entrance vestibules,
- 2 passengers per service compartment,
- 300 kg per m^2 of the luggage compartment,
- For open standard bogie vans for conveyance of motor vehicles: maximum load 15 t; a maximum load of 10 t per tier shall not be exceeded.

(1) The weight of a passenger, incl. luggage, shall be assumed as 80 kg.

1.4 - Vibration

It is recommended that behaviour under vibration be investigated by means of tests on fully-equipped passenger coaches in running order or on coach bodies.

1.5 - Aerodynamic loads on pressure-resistant coach bodies, requirements and test loads

(in abeyance).

2 - Component parts of coaches

2.1 - Test loads

Component parts and their fastenings shall withstand the following test loads without permanent deformation and without exceeding the permitted stresses:

2.1.1 - Component parts mounted in coaches:

* **2.1.1.1** - General test loads

2.1.1.1.1 - For the weight of a passenger, assume:

- 100 kg as maximum load,
- 80 kg as average load including luggage,
- 75 kg as average load without luggage.

2.1.1.1.2 - For assumed maximum loads and moments which a passenger may exert:

See Appendices 3 to 6.

* **2.1.1.1.3** - When calculating the mechanical strength of fastenings of coach components, the values to be used for accelerations or forces are those given under points 2.1.4.1 and 2.1.4.2.

2.1.1.1.4 - Components and their fastenings to be mounted inside vehicles may be designed for a longitudinal acceleration of 3 g on coaches fitted with hydrostatic or hydrodynamic buffers.

* **2.1.1.2** - Special test loads:

Luggage racks: 1000 N downwards per metre length and an exceptional load of 850 N as a single load exerted at any point on the front edge.

Umbrella racks: 250 N downwards per metre length.

Coat hooks : 300 N downwards,
250 N horizontally in each direction.

Seats (per seat), see Appendix 7 :

– 1 500 N horizontally at any point on the upper part of the supporting component (upper part of the seat back).

– 750 N vertically and/or horizontally at the front end of the armrest.

– 1 200 N upwards or 1 000 N downwards at the front edge of the seat (1).

Folding table : 750 N downwards at the centre of the table.

Tip-up seat : 1 000 N downwards at the centre of the seat.

Floor (2) :

The van shall be subjected to the load of a motor vehicle with a maximum weight of 2.5 t. Instead of a motor vehicle, the loads specified under 4.2.1.5 may be applied.

2.1.2 - Component parts mounted on coaches

* **2.1.2.1** - Special test loads :

– entrance and loading doors : 2 500 N/m² (3) or 1 900 N/m² (4) plus 800 N applied as a point load on the centre of the door leaf,

– intercommunicating doors : 2 400 N/m² (3)
1 800 N/m² (4).

Examples of the application of test loads to external doors are shown in Appendix 9 :

– windows : 2 500 N/m² (3) or 1 900 N/m² (4).

(1) According to seat construction.
(2) For the standard open bogie van for conveyance of motor vehicles.
(3) For V = 200 km/h on open track, including wind pressure of 700 N/m².
(4) For V = 160 km/h on open track, including wind pressure of 700 N/m².

2.1.3 - Exceptional loads due to vandalism

Components subject to vandalism shall be tested on the basis of the loads occurring under service conditions.

2.1.4 - Buffing impact

* **2.1.4.1** - To allow for the loads resulting from buffing impact the following accelerations, acting on the dead weight of the components, shall be assumed in design of the fastenings :

– longitudinally : 5 g

– transversely : 1 g

– vertically : c g (including gravity).

c = 3 at the coach end, falling linearly to 1.5 at the coach centre.

* **2.1.4.2** - Design of fastenings (1)

In calculating the mechanical strength of the fastenings of components on coaches, the following loads shall be taken as a basis :

– longitudinally : $F_x = m_1 \cdot 5\,g$ [N]

– transversely : $F_y = m_1 \cdot g$ [N]

– vertically : $F_z = m_1 \cdot c \cdot g$ [N]

wherein

m_1 = the weight (kg) to be allowed for the component

g = acceleration due to gravity = 9.81 m/s²

c = see 2.1.4.1.

The resultant of the loads F_x, F_y, F_z shall be used.

(1) The calculations may be replaced by a buffing test.

2.1.4.3 - Recommended as permissible stresses for the calculation in accordance with 2.1.4.2 are those which result from application of the safety factors specified in 3.2.1.

2.2 - Loads under service conditions

* 2.2.1 - Components and their fastenings mounted in and on coaches shall withstand the following loads under service conditions without exceeding the fatigue strength of the material :

2.2.1.1 - The following accelerations resulting from the loads occurring in service act (in addition to the acceleration due to gravity) on the components :

- longitudinally : $a_x = 1.6\ m/s^2$ for conventional braking
  $a_x = 2.5\ m/s^2$ for electromagnetic braking.
- transversely : $a_y = 1.5\ m/s^2$ transverse acceleration including non-compensated centrifugal acceleration.
- vertically : $a_z = 2\ m/s^2$ in addition to dead weight.

2.2.1.2 - The following shall be taken as loads acting on the components : (1)

- longitudinally : $F_x = m_t \cdot (\pm a_x)$ [N]
- transversely : $F_y = m_t \cdot (\pm a_y)$ [N]
- vertically : $F_z = m_t \cdot (1\ g \pm a_z)$ [N]

wherein :

m_t = the weight [kg] allowed for the component

$a_{x,y,z}$ = accelerations [m/s^2]

g = acceleration due to gravity = 9.81 m/s^2.

The resultant of the loads F_x, F_y and F_z shall be used.

2.2.2 - See section 3 for permissible stresses under loading.

(1) For calculating the mechanical strength of coach body-bogie connecting parts, see point 2.6.2 of UIC leaflet 515

*** 2.3 - Conditions for adjustable seats in special coaches**

Adjustable seats may only be used in special coaches. They must comply with the following specifications.

Reserved

3 - Limit loads

3.1 - Permissible stresses

Permissible stresses are calculated as the quotient of the material load limit and a safety factor S. Depending on whether the loads concerned are exceptional, i.e. non-recurring or very rare, or fatigue loads, the limit load value should be based on the yieldstress($\sigma_{0.2}$) or the fatigue limit (1), i.e. :

– for exceptional loads :

$$\sigma_{perm.} = \frac{1}{S} \cdot \sigma_{0.2} \left(= \frac{1}{S} \cdot \sigma_B\right)$$ e.g points 1.2 et 2.1

– for fatigue loads :

$$\sigma_{perm.} = \frac{1}{S} \cdot \sigma_d$$ e.g. items 1.3 and 2.2.

For steel, the permissible stresses may also be determined by the breaking limit.

* 3.2 - Safety factors

The following minimum safety factors shall be observed for the various types of loading :

3.2.1 - Test loads : points 1.2 and 2.1

– against fracture (for steel)	S = 1.5
– against yield stress ($\sigma_{0.2}$) :	
· for non-welded structural and securing parts	S = 1.0
· for welded structural and securing parts	S = 1.1

3.2.2 - Loads under service conditions : items 1.3 and 2.2

– against fracture (for steel)	S = 2.2
– against fatigue stress (2) :	
· for non-welded structural and securing parts	S = 1.5
· for welded structural and securing areas	S = 1.65

(1) On this aspect, see fatigue strength diagrams in ORE report B 12/RP 17.

(2) These safety factors are already allowed for in the fatigue strength diagrams of ORE B 12/RP 17.

4 - Test conditions and methods

4.0 - General

The purpose of tests is to determine :

1 - the strength of the structure by application of test loads,

2 - the strength of the structure by application of loads as experienced under service conditions,

3 - the dynamic vibration pattern.

Tests shall be implemented :

– by static simulation of the loads which may occur in service,

– by determining stresses with the aid of wire strain gauges,

– by measuring deformation under various loadings,

– by modal analysis.

Tests are subdivided into 4 categories :

– Static tests on test rigs for exceptional loadings :

The purpose of these tests is to check that there is no danger of permanent deformation of the coach body or its individual component parts, and that no fractures will occur when the maximum loadings which may occur exceptionally in service are superimposed.

– Static tests on test rigs to simulate loads occurring in service :

Such tests serve to check whether fatigue cracks in the coach body may be expected when the loads occurring in service are superimposed.

– Buffing test :

This test serves to check the calculations for the fastenings, and the functional safety of components mounted in and on the coach.

– Vibration test :

This test serves to determine the natural frequencies of the coach.

4.1 - Coach body

4.1.1 - Static tests on the test rig, of the coach body under test loads (exceptional loads).

– Tests shall be conducted on a test rig on which it is possible to apply test loads at those points where they will occur in service.

– The coach body shall be fitted with wire strain gauges and rosettes at all heavily-loaded points, in particular at areas of stress concentration.

– Before and during the preliminary and actual tests, the following shall be measured :

- the strains at the critical points, incl. longitudinal members, cantrail, corners of the cut-outs for entrance doors and windows,
- the deflection between the main cross-bearers,
- any residual deflection,
- any residual deformation, incl. that of door and window openings.

– For the compression, tensile and vertical loading tests in accordance with 4.1.1.1 to 4.1.1.4, it is recommended that the coach body be preloaded, in order to stabilize the overall structure.

– Loads should be increased in stages up to 75 % of the maximum load, after which at least 2 tests should be performed with the maximum load. The last measurement made with the maximum load shall be evaluated.

4.1.1.1 - Compression tests on the coach body (item 1.2.1.1)

– A load of at least 1 000 kN shall be applied to each buffer axis.

– A load of at least 500 kN shall be applied diagonally to the side buffer axis.

– A load of at least 2 000 kN shall be applied to the "c" compression stops (see Appendix 1) or to the "c" flange bearing surface (see Appendix 2) of the automatic coupler.

4.1.1.2 - Tensile tests on the coach body (item 1.2.1.2)

– A load of at least 1 500 kN shall be applied either at the "a" traction stops (see Appendix 1) or at the "c" flange bearing surface or fastening screws (see Appendix 2) of the automatic coupler.

– A load of at least 1 000 kN shall be applied at the "b" traction stops (see Appendix 1) of the automatic coupler.

The tensile test under a load of 1 000 kN may be omitted if the "a" and "b" stops are combined to form a single component.

4.1.1.3 - Compression tests on the coach body (1) (item 1.2.1.1)

Suitable equipment shall be used to ensure an even distribution of the overall test load on the relevant coach components. The reaction forces to the compression loads shall be applied in the same horizontal plane.

(1) Not applicable to the standard open bogie van for the conveyance of motor vehicles.

Loads of at least :

— 400 kN at a level 350 mm above the buffing centre-line.

— 300 kN at the level of the window sill rail.

— 300 kN at the level of the cantrail

shall be applied.

4.1.1.4 - Vertical loading of the coach body (items 1.2.1.3, 1.2.2.1 and 1.2.2.2)

— The entire surface of the floor shall be evenly loaded with the aid of weights or suitable equipment. If winches are used, their weight shall be included in the applied load.

— The coach body to be tested shall be loaded with evenly-distributed weights, the weight of which shall be determined as follows :

$$\text{weight of load} = \frac{F_z}{g} - \text{weight of coach body.}$$

The value F_z shall be determined as described under 1.2.1.3.

— If application of a static horizontal compression load of 2 000 kN, at buffer or automatic coupler buffing gear level, in accordance with item 1.2.1.1, causes a positive (downward) deflection of the coach body, the test specified under 1.2.1.1 shall also be carried out. This test involves application of the aforementioned horizontal compression load together with the vertical load stipulated under 1.2.1.3.

— If application of a static tension load of 1 500 kN to the "a" traction stops or the "c" flange bearing surface (or the fastening screws) of the automatic coupler, in accordance with 1.2.1.2, causes a positive (downward) deflection of the coach body, it is also advisable to carry out the test specified under 1.2.2.2. This test entails applying the aforementioned horizontal tension load together with the vertical load stipulated under 1.2.1.3.

— The static stresses (σ_1) may be calculated with the aid of the stresses σ determined under load, multiplying by the factor :

$$1 + \frac{\text{weight of coach body}}{\text{weight of load}}$$

— For the standard open bogie van for the conveyance of motor vehicles, testing shall cover both load alternatives as described under 1.2.1.3, and specifically :

- 15 t total load with 10 t on the bottom tier and 5 t on the top tier,
- 15 t total load with 5 t on the bottom tier and 10 t on the top tier.

4.1.1.5 - Rerailing test (item 1.2.2.3)

The coach body shall be loaded with an evenly-distributed load such that the total weight corresponds to that of the unoccupied coach body in running order.

The loaded coach body shall lie at one end on the bogie which is wedged on the track, and at the other end is lifted at the headstock in the area of the side buffer ; the bogie at the lifted end of the coach shall be secured firmly to the coach body.

4.1.1.6 - Results to be obtained

— At no measuring point shall the permissible stresses be exceeded.

— After removal of the load, there shall be no permanent deformation of the coach body.

4.1.2 - Static test on test rig to simulate loads occurring under service conditions (item 1.3).

4.1.2.1 - The weights to be applied shall be distributed as described under item 4.1.1.4 :

- The coach body to be tested shall be loaded with distributed weights, the weight of which shall be determined as follows :

$$\text{weight of load} = \frac{F_z}{g} - \text{weight of coach body}$$

The value F_z shall be determined as described under item 1.3.

- The stresses (σ_1) to be taken into account shall be determined in accordance with 4.1.1.4.

4.1.2.2 - Results to be obtained

At no measuring point shall the permissible stresses for fatigue strength be exceeded.

4.1.3 - Buffing tests

4.1.3.1 - During the course of the tests, the following values shall be measured :

- The stress and acceleration values at the critical points of the structure, at the points of connection between coach and bogies and at the fastenings of components mounted in and on the coach, in particular where heavy weights are mounted on the coach.
- The stresses occurring shall be detected by wire strain gauges, and analysed unfiltered.
- The accelerations shall be measured in the x, y and z directions. The limit frequency of the low-pass filters shall be at least 32 Hz.
- The forces behind the buffers or behind the spring elements of the automatic coupler. The results shall be used unfiltered.
- The actual buffing speeds.

4.1.3.2 - A vehicle (1) of 80 t gross weight shall run against the fully-equipped, unoccupied, unbraked coach, in running order and standing freely on the track.

The coach shall be equipped with side buffers or with the spring element of the automatic coupler. The equipment shall correspond to that on the standard vehicle.

The tests shall be performed at increasing speeds (4, 6, 8 km/h) up to 10 km/h or up to a measured buffer loading of 1 000 kN or a maximum acceleration of 5 g.

The features of the buffer or automatic coupler spring element shall be checked before the test, unless they are of a design with known features.

4.1.3.3 - Results to be obtained

At no point of the structure shall permanent deformation occur.

After the buffing test, the vehicle shall be in working order.

No part of the vehicle shall be damaged.

4.1.4 - Vibration tests

4.1.4.1 - The dynamic identification of the complete and fully-equipped coach body may be effected either by modal analysis or by spectral analysis (2).

The analysis serves to identify and characterize the modes of vibration of the coach body in the 5 to 40 Hz frequency range.

(1) The vehicle used for buffing shall conform to the requirements set out in item 3.1 of ORE report B 12/RP 17.

(2) The specification may prescribe further additional conditions relating to loading of the coach body.

4.1.4.2 - Results to be obtained

The natural frequencies of the coach body shall differ from the frequencies transmitted through the bogie.

4.1.5 - Roof strength testing

4.1.5.1 - In the absence of knowledge of the real load collective, the strength of the vehicle roof construction should be verified by testing.

Here, the calculated resistances to bulging should be compared with the experimentally-determined buckling strength.

The following calculated safety factors are recommended :

Roof construction	Calculated safety factor	
	$S_{bulging}$	$S_{buckling}$
corrugated sheet metal	1.6 - 2.0	1.6 - 2.0
smooth sheet metal	0.4 - 0.5	1.5 - 1.8

Differentiation between the :

– calculated safety factors $S_{bulging}$ and $S_{buckling}$ and

– the experimentally-determined safety factor S_{actual}

is necessary because the calculated results differ from the experimentally-determined results due to various influencing factors. To be certain of avoiding failure of the corrugated sheet metal design, higher values for the calculated safety factors are recommended without exception.

$S_{actual} = 1.3$ shall be regarded as the absolute lower limit of the safety factor to be confirmed experimentally.

4.1.5.2 - To confirm the calculated values, it is recommended that roof test-pieces :

– with a length exceeding 1.25 times the roof arch spacing and

– with a width of approx. 0.33 of the roof periphery

be subjected to compression tests, in order to determine the failure limit experimentally.

The roof test-pieces shall be mounted parallel and subjected to evenly-distributed compressive loads until they bulge or buckle. The pattern of the compressive loads up to the maximum shall be recorded.

4.1.5.3 - Results to be obtained :

The safety factor S_{actual} against failure shall be at least 1.3 for the critical value concerned.

The safety factor S is determined from :

$$S = \frac{\sigma_{failure}}{\sigma_{resultant}}$$

with $\sigma_{failure} = \frac{F_{max}}{A_{actual}}$ = stress during failure (bulging, buckling)

determined from the measured maximum compressive load F_{max} divided by the cross-section of the roof test-piece A_{actual}.

The calculated resultant stress at the apex of the roof is comprised of :

$$\sigma_{resultant} = \sigma_{compression}(F_z) + \sigma_{tension}(F_x) + \sigma_{compression}(F_x)$$

wherein :

σ compression $(F_z) = \dfrac{Mb_{max}(F_z)}{W_{roof}}$ Compressive stress (–) occurring at the apex of the roof due to the vertical load F_z as defined under 1.2.1.3.

σ tension $(F_x) = \dfrac{Z(F_x)}{A_{coach\ body}}$ Tensile stress (+) occurring at the apex of the roof due to the static tensile stress F_x as defined under 1.2.2.2.

σ compression $(F_x) = \dfrac{Mb_{max}(F_x)}{W_{roof}}$ Compressive stress (–) occurring at the apex of the roof due to the static tensile stress F_x as defined under 1.2.2.2.

4.1.6 - Measurement of pressure resistance

(in abeyance).

4.2 - Component parts of coaches

4.2.1 - Static testing on test rigs, using test loads, of components mounted in and on coaches.

Tests on the component concerned may be conducted outside the vehicle. In such cases, the component shall be mounted exactly as in the coach.

Deformation shall be measured by wire strain gauges, attached at suitable measuring points.

4.2.1.1 - Luggage racks

The test load, applied by means of a load or by suitable equipment, shall be distributed over the entire surface of the luggage rack and shall correspond to a loading of 1 000 N per metre length.

The point load of 850 N per element on the front edge shall be applied either by means of an attached weight or by a test cylinder.

4.2.1.2 - Umbrella racks and coat hooks

The respective test loads in the various directions shall be applied by means of an attached weight and by tensile forces.

4.2.1.3 - Seats

The tests are intended to check the supporting structure of the seats and their fittings (armrests, tables).

The loads shall be applied consecutively, three times per seat.

Loads shall be applied by means of suitable equipment, rising from O N up to the test load specified in Appendix 7. The seat or its fittings shall then be subjected to this test load for at least 1 second.

Until the test load is reached, the test equipment shall maintain a rate of 100 ± 20 mm per minute.

4.2.1.4 - Door leaves of external doors

- The closed and mechanically-locked door shall be subjected to a load acting outwards :
  - and as specified under 2.1.2.1, distributed evenly over the entire door surface, together with the additional point load of 800 N,
  - or alternatively in the form of the point loads as specified in Appendix 9.
- The surface loading shall be effected with the aid of weights or suitable equipment. The point loads shall be applied either by means of weights or by a hydraulic press.
- There shall be no deformation which would impair the normal operation, safety and sealing of the closed door.

4.2.1.5 - Strength of the floor of the standard open bogie van for conveyance of motor vehicles

Four loads of 625 kg shall be applied simultaneously at various points on the floor, on four support surfaces each of 200 cm² (width 150 mm) which are 2 700 mm apart along the length of the van and 1 400 mm apart across its width.

4.2.1.6 - Results to be obtained

After removal of the load, neither the component nor its mountings shall reveal any permanent deformation.

4.2.2 - Testing of external window glazing on test rigs

In addition to national and international regulations, it is recommended that tests be carried out on test rigs, to check the sealing, limit loads, and resistance to temperature fluctuations.

4.2.2.1 - Sealing test on double glazing

The sealing of double glazing shall be checked by determining the dew point.

The dew point is checked by applying a cold liquid mixture (for example, dry ice + acetone or alcohol) to one side of the double glazing by means of suitable equipment.

There should be no trace of condensation or rime between the panes before the temperature has reached – 60 °C.

In the case of double glazing with high reflectance, the test should be made on the pane without reflective coating.

4.2.2.2 - Fatigue loading test

In this test, the glazing together with its frame is mounted on a stand in the same way as in the vehicle.

The window is subjected to variations in pressure.

The course of the test is as follows :

a) 10^5 load cycles with a sinusoidal pressure variation of ± 1 500 Pa (surface load) with a frequency of 6 Hz.

During the test, the window is sprayed with water from spray nozzles (see Appendix 8 for layout). The rate of water sprayed on the surface of the glazing shall be 2 l/m² per minute.

The inside of the window shall then be checked. There shall be no trace of water having passed from one side to the other.

b) 10^6 load cycles with a sinusoidal pressure variation of ± 2 500 Pa (surface load), with a frequency of 3 Hz.

During the test, the deflection of the inner and outer glazing shall be measured in the centre. It shall not exceed the following values :

Deflection in the centre (mm)	Smallest dimension for width or height mm
5	up to 350
7	from 350 to 600
10	from 600 to 1 000

Following this test, the dew point of double glazing shall be checked and should be below – 60 °C.

c) 10^5 load cycles with a sinusoidal pressure variation of ± 1 500 Pa (surface load) with a frequency of 6 Hz, with spraying as for (a) above.

The result of the test shall correspond to that required under (a) above.

On completion of tests a, b and c, the glazing shall be removed from its frame.

There should be no defects or changes in its component parts, such as :

– cracks in the frame,

– sealing breaking loose,

– detachment of sealing and of rubber clamping strip,

– cracking or shattering.

4.2.2.3 - Test to verify resistance to extreme fluctuations of temperature.

The glazing to be tested, together with its frame, shall be cooled for 2 hours to – 5 °C.

The outside of the glass shall be wetted with water at + 60 °C from spray nozzles with a flow rate of 2 l/m² per minute.

Results to be obtained :

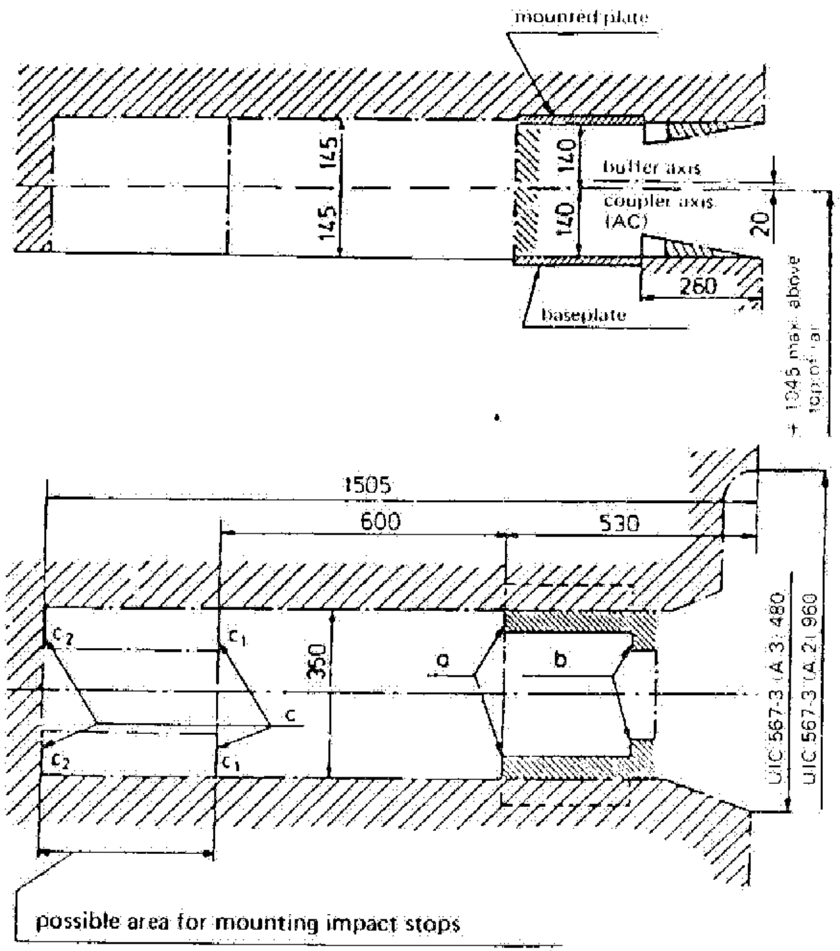
– no fracture shall occur (glass and frame),

– the sealing shall not have deteriorated,

– in the case of double glazing, the dew point shall be below – 60 ° C.

APPENDIX 1

Position of the axial impact and traction stops

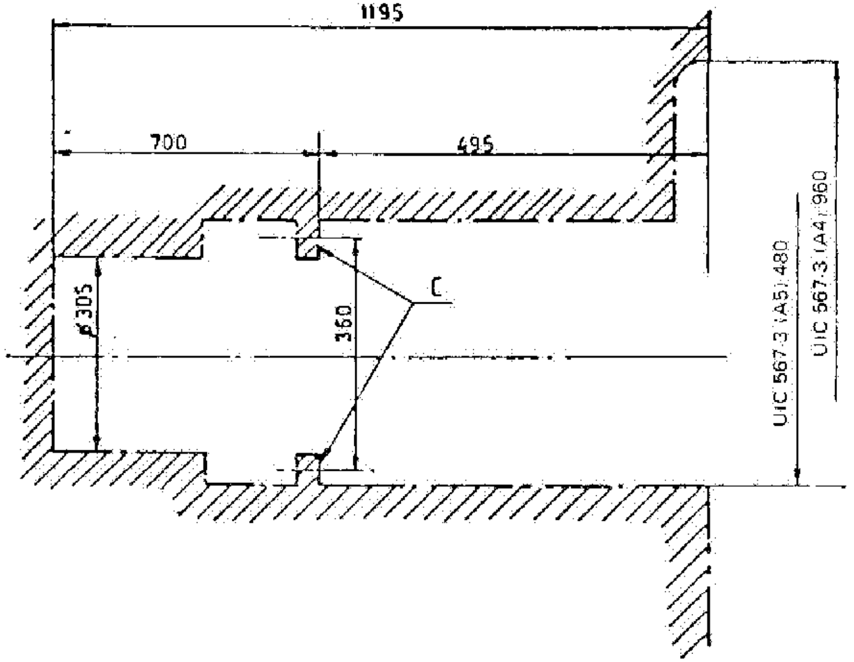


a-b-c- = stops

For all prototype vehicles to which the automatic push-pull coupling can be fitted (extract from UIC leaflet 567-3, Appendices 2 and 3).

APPENDIX 2

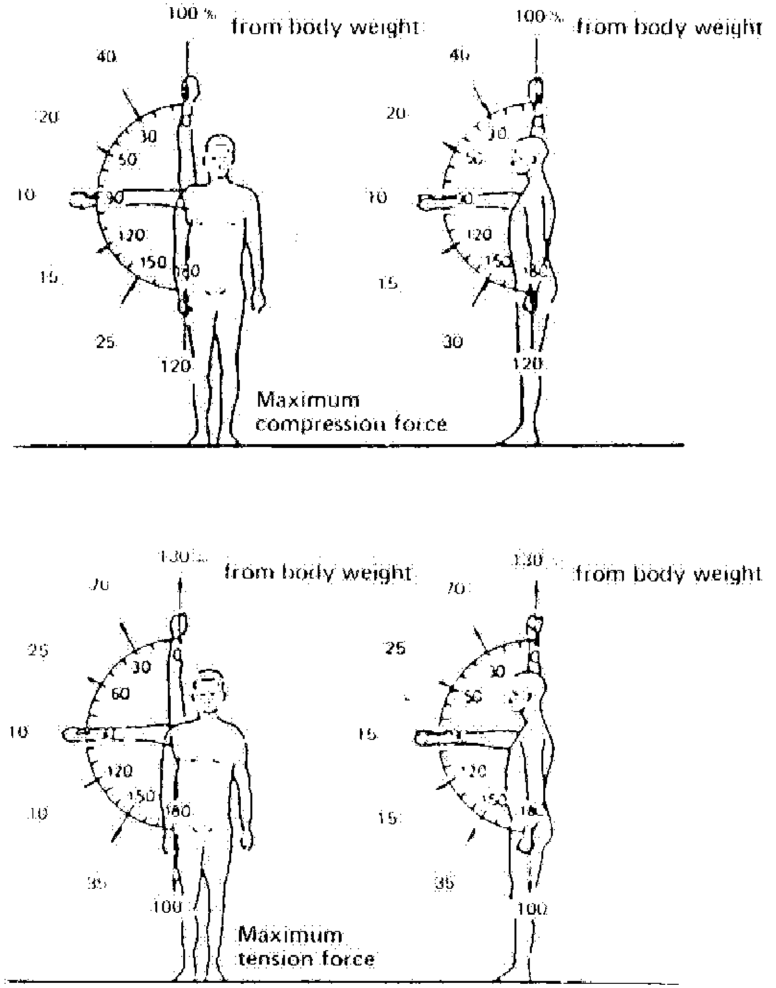
Layout of the flange mounting face



For all prototype vehicles suitable for fitting of the automatic push-pull coupling (extract from UIC leaflet 567-3, Appendices 4 and 5).

APPENDIX 3

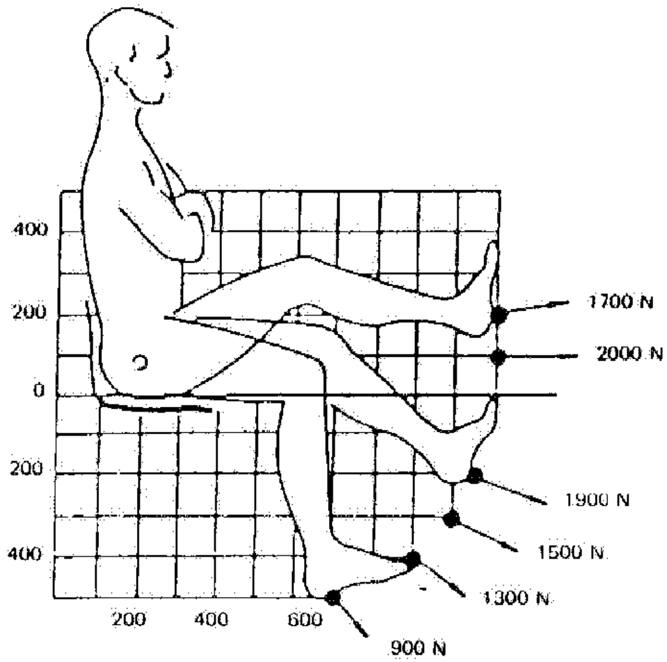
Maximum tension and compression forces, depending on position and direction of the arm



From "Vademecum ergonomie" by : F. Kellermann, P. van Wely, P. Willems NIVE, Nederlandse Vereniging voor Management, Kluwer, Deventer 1979.

APPENDIX 4

Maximum compression forces, depending on the position and direction of the leg

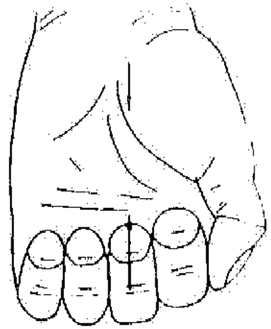


From "Vademecum ergonomie" by: F. Kellermann, P. van Wely, P. Willems NIVE. Nederlandse Vereniging voor Management, Kluwer, Deventer 1979.

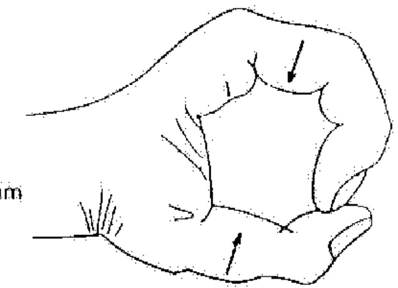
APPENDIX 5

Examples of hand and finger forces

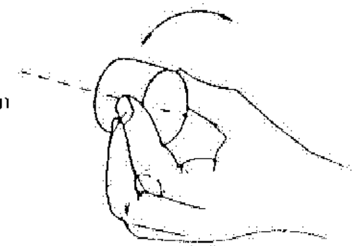
max. 100 N



max. 120 N
for a diameter
of approx. 40 mm



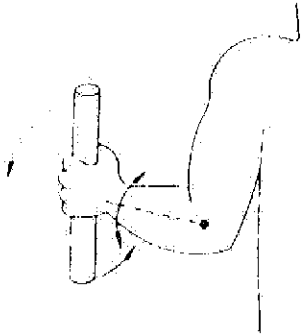
3 . . . 4 Nm
for a diameter
of approx. 40 mm



See also: U. Burandt, "Ergonomie für Design und Entwicklung", Verlag Dr. O. Schmidt, Köln, 1978. A. Damon, H.W. Stoudt, R.A. McFarland "The Human Body in Equipment Design", Harvard University Press, Cambridge, Massachusetts 1966.

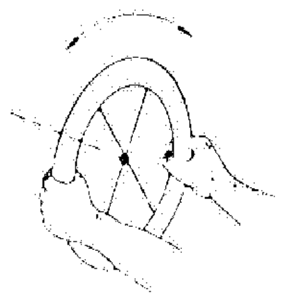
APPENDIX 6

Examples of torques which can be exerted by the hands



10 Nm

	1 hand (Nm)	2 hands (Nm)
Ø 100 mm	5	9
Ø 200 mm	10	18
Ø 300 mm	13	20

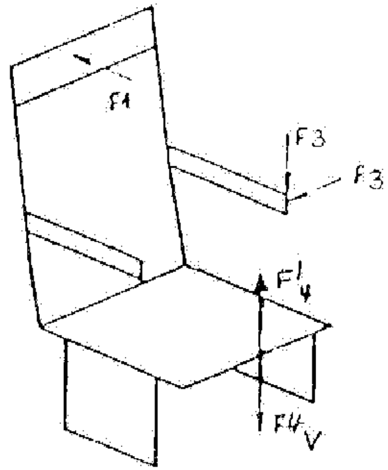


Ø 600 mm
150 Nm

See also : U. Burandt, "Ergonomie für Design und Entwicklung", Verlag Dr. O. Schmidt, Köln, 1978. A. Damon, H.W. Stoudt, R.A. McFarland "The Human Body in Equipment Design", Harvard University Press, Cambridge, Massachusetts 1966.

APPENDIX 7

Test loads for seats, folding tables and tip-up seats



F1 1 500 N horizontally, at any point on the upper part of the supporting structure (per seat) on an area of 380 × ~~7~~80 mm.

F3 750 N vertically and horizontally on individual seats. Only vertically on compartment seats (1).

F4 1 000 N downwards applied to a seating surface of 380 × 220 mm or,

F'4 1 200 N upwards (1) on the front edge of the seat, depending on its construction.

Folding table

750 N vertically in the centre.

Tip-up seat

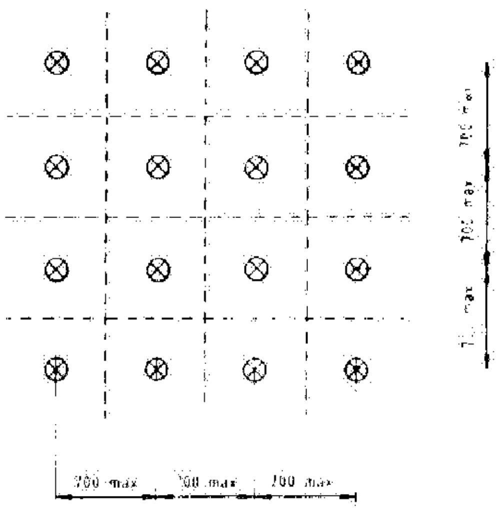
1 000 N vertically in the centre of the seat surface.

(1) The punch shall have a diameter of 250 mm and an edge radius of 25 mm.

APPENDIX 8

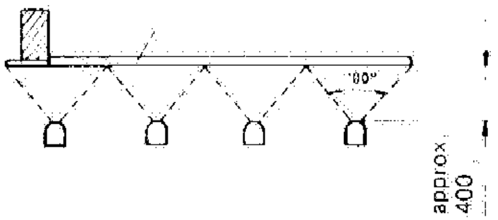
Layout of spray nozzles for tests on external window glazing

⊗ Spray nozzles

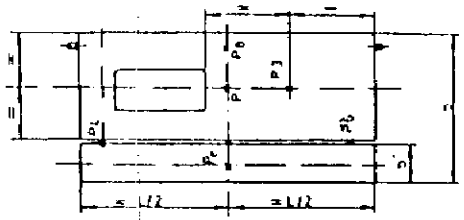
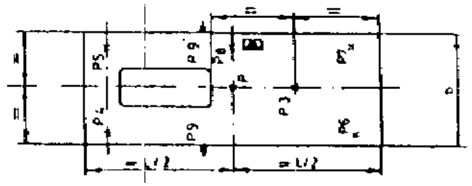
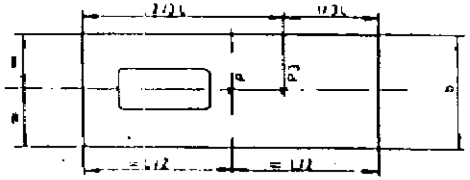
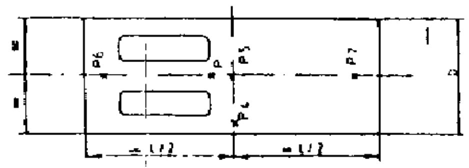
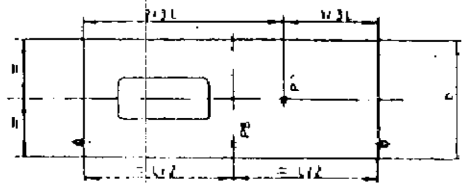


Grid of spray nozzles

Test window



Test loads on external doors of coaches and vans

	Type	Fitted and locked door under point loading	
Entrance doors	Folding hinged door	P3 = 2250 N P6 = 1600 N P4 = 1600 N P8 = 3500 N	
		Stepboard coverings : P2 = 800 N	
	Swing-plug door	P3 = 2250 N P7 = 2400 N P4 = 1600 N P8 = 2400 N P5 = 1600 N P9 = 7500 N P6 = 1600 N or P9'	
Side loading doors	Sliding door	P3 = 3500 N	
	Folding door	P4 = 2000 N P5 = 3000 N P6 = 2000 N P7 = 2000 N	
Intercom-municating doors	Sliding door	P3 = 2500 N P8 = 2800 N These values apply for speeds up to 200 km/h.	

Application

With effect from 1 January 1990 for coaches to be built, with the exception of:

- point 1.2.1.1 (1st paragraph) 1.1.92
- point 2.1.1.1.3 .... 1.9.91
- point 2.3 .... 1.7.91

All UIC Railways.

Record references

Most recent headings under which the question has been examined:

- *Question additional to the programme - Approval of the revision of Leaflet 566.*
(Traction and Rolling Stock Committee Zurich, June 1983).

- *Question 45/A/22.3* - Revision of Leaflet 566 : "Loadings of coach bodies and their components".
(Traction and Rolling Stock Committee, Helsinki, June 1989).

- *Question 45/A/FIC* - Revision of leaflet - Point 17.2 - Provision to be added.
(Traction and Rolling Stock Committee, Paris, June 1990).

- *Question 45/A/22.3* - Point 18.1 - Additional arrangements for tests to assess the shearing resistance of the side wall / underframe structure.
- Point 18.2 - Additional arrangements for sliding seats in coaches.
(Traction and Rolling Stock Committee, Stockholm, June 1991).

Application

With effect from 1 January 1983 :

— Point 1 for X, Y and Z-type coaches ;

— Tests on luggage racks (except the point load of 850 N per component part) and umbrella racks in accordance with Item 2.1.1.2 for RIC .

With effect from 1 January 1990 for new coaches.

All UIC railways.

Record references

Most recent headings under which the question has been examined :

— *Question additional to the programme* - Approval of the revision of Leaflet 566.
(Traction and Rolling Stock Committee, Zürich, June 1983).

— *Question 45/A 22.3* - Révision of Leaflet 566 : "Loadings of coach bodies and their components".
(Traction and Rolling Stock Committee, Helsinki, June 1989).