

Railway applications — Railway rolling stock — Buffers

ICS 45.060.01

National foreword

This British Standard is the UK implementation of EN 15551:2009+A1:2010. It supersedes BS EN 15551:2009, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by **A1** **A1**.

In order to achieve compatibility with existing infrastructure in the UK, the existing published Railway Group Standards require wagons be designed to negotiate 70 m curves. For some wagons, for example container flats, the use of the buffer head radius and/or buffer stroke specified in this European Standard could result in drawbar loads exceeding the recommended maximum of 250 Kn (see Clause 5, Table 3). The use of the tighter buffer head radius (1250 mm) and longer buffer stroke (114 mm) has traditionall y been used on UK specific rolling stock .

The UK participation in its preparation was entrusted to Technical Committee RAE/1/-/9, Wagons (tank/freight).

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

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

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This European Standard was approved by CEN on 31 January 2009 and includes Amendment 1 approved by CEN on 28 September 2010.

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Foreword

This document (EN 15551:2009+A1:2010) has been prepared by Technical Committee CEN/TC 256 “Railway applications”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2011, and conflicting national standards shall be withdrawn at the latest by May 2011.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document includes Amendment 1, approved by CEN on 2010-09-28.

This document supersedes EN 15551:2009.

The start and finish of text introduced or altered by amendment is indicated in the text by tags **A1** **A1**.

A1 This document has been prepared under a mandate given to CEN/CENELEC/ETSI by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 2008/57/EC.

For relationship with EU Directive 2008/57/EC, see informative Annex ZA, which is an integral part of this document. **A1**

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

The main purpose of normative documents used until now for the delivery of buffers (UIC leaflets, national standards) was a complete definition of the acceptance procedures and of the buffers characteristics which were to be verified.

Product qualification was sometimes mentioned but the procedures used and the product characteristics to be verified during qualification were not given.

This European Standard addresses all buffer characteristics that are assembly characteristics and finished product characteristics and do not arise from a choice of design parameters such as diameters, interferences, materials etc.

The buffer and its components are delivered by suppliers that operate a quality system.

NOTE The quality systems used should offer equivalence with EN ISO 9001.

This European Standard is based on UIC 526-1, UIC 526-3, UIC 527-1, UIC 528, UIC 573, UIC 827-1 and UIC 827-2.

For coaches the technical content at present is limited to that given in UIC 528:2007.

1 Scope

This European Standard defines the requirements for buffers with 105 mm, 110 mm and 150 mm stroke for vehicles or units which use buffers and screw coupling at the coupling interface with other interoperable rolling stock. It covers the functionality, interfaces and testing procedures, including pass fail criteria, for buffers.

NOTE Typically, buffers with a stroke of 105 mm are used on freight wagons and locomotives, buffers with a stroke of 110 mm are used on coaches and locomotives and buffers with a stroke of 150 mm are used on freight wagons.

It defines the different categories of buffers, the space envelope, static and dynamic characteristics and energy absorption.

It includes a calculation method to determine the minimum size of the buffer head to avoid override between buffers.

It defines the static and dynamic characteristics of the elastic systems.

It also defines the requirements for buffers with integrated crash elements (crashworthy buffers) for tank wagons only according to RID.

The requirements of this European Standard also apply to locomotives and passenger coaches which have to meet the crashworthiness requirements of EN 15227 for buffers in normal service only. The properties for the energy absorbing function are defined in EN 15227 and the requirements specified in Clause 7 for tank wagons according to RID are not applicable to locomotives and passenger coaches.

Diagonal buffers are excluded from this European Standard.

For vehicles which have to comply with crashworthiness requirements (locomotives, cab cars or passenger coaches according to EN 15227, tank wagons according to RID), typically crashworthy buffers (buffers with a deformable housing and/or the need for an opening in their mounting flange) or buffers which form part of a combined system consisting of a special buffer (e.g. middle flange buffer) and a deformation element are used. For these types of buffers, interoperability is possible, but interchangeability with freight wagon buffers is not required, and therefore the requirements of 5.2 (Fixing on vehicle and interchangeability), 5.3 (Buffer dimensions) do not apply, those of 5.4 (mechanical characteristics of buffers) and 5.6 (marking) apply with restrictions.

2 Normative references

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

EN 1369, *Founding — Magnetic particle inspection*

EN 1370, *Founding — Surface roughness inspection by visual/tactile comparators*

EN 10025-2, *Hot rolled products of structural steels — Part 2: Technical delivery conditions for non-alloy structural steels*

EN 10204:2004, *Metallic products — Types of inspection documents*

prEN 12663-2, *Railway applications — Structural requirements of railway vehicle bodies — Part 2: Freight wagons*

EN 15085-5, *Railway applications — Welding of railway vehicles and components — Part 5: Inspection, testing and documentation*

EN 15227, *Railway applications — Crashworthiness requirements for railway vehicle bodies*

EN ISO 868, *Plastics and ebonite — Determination of indentation hardness by means of a durometer (Shore hardness) (ISO 868:2003)*

ISO 37, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 48, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

ISO 188, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*

ISO 815-1, *Rubber, vulcanized or thermoplastic — Determination of compression set — Part 1: At ambient or elevated temperatures*

ISO 815-2, *Rubber, vulcanized or thermoplastic — Determination of compression set — Part 2: At low temperatures*

3 Terms and definitions

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

3.1
buffer
absorber device of compressible type constituted by housing, elastic system, buffer head and flange fitted at each side of the end of wagons which have to be in contact with other interoperable rolling stock

NOTE For this European Standard, buffer means side buffer.

3.2
housing
assembly consisting of a plunger, a buffer base and an anti-rotation device but without elastic system

NOTE Casing or body are other words for housing, but only housing is used in this European Standard.

3.3
plunger
movable part of the housing consisting of a sliding and guiding tube and an active face named buffer head

3.4
base
part of the housing fixed to the wagon headstock

NOTE The base consists of a guiding tube and a supporting plate (flange)

3.5
anti-rotation device
device preventing the rotation of the plunger around the longitudinal axis of the buffer

3.6
elastic system
system allowing the reversible deflection of the plunger and absorbing energy during buffing or running operation

NOTE Spring system is another common word for elastic system.

3.7 stored energy

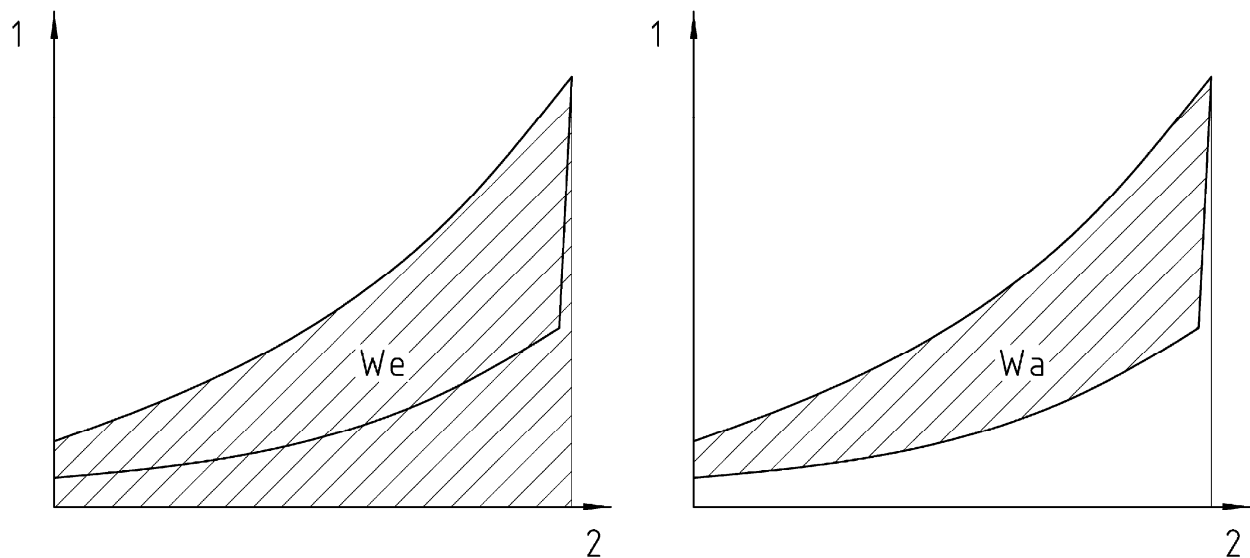
W_e
energy (W_e) stored by a buffer for a given elasticity stroke

NOTE The stored energy is represented, on the force-stroke diagram, by the area lying between the compressive curve, the axis of the abscissa and the straight line, perpendicular to the axis, corresponding to the stroke under consideration, see Figure 1.

3.8 absorbed energy

W_a
energy (W_a) absorbed by a buffer for a given elasticity stroke

NOTE The absorbed energy is represented, on the force-stroke diagram, by the area lying between the compressive curve and the return curve, see Figure 1.



Key

- 1 force in kN
- 2 stroke in mm
- W_e stored energy in kJ
- W_a absorbed energy in kJ

Figure 1 — Force-stroke diagram for stored and absorbed energy

3.9 dynamic working capacity

stored energy under dynamic test conditions obtained during the impact between two wagons

3.10 damping

A
ratio of absorbed energy divided by stored energy

NOTE It is calculated using the following equation:

$$A = \frac{W_a}{W_e} \times 100$$

where:

A is the damping;

W_a is the absorbed energy;

W_e is the stored energy.

3.11

crashworthy buffer

buffer with an additional function to allow plastic deformation to absorb energy for abnormal impacts

4 Classification and designation

4.1 General

Buffers are classified according to their stroke and their dynamic energy capacity W_{ed} .

4.2 Buffers with buffer stroke 105 mm (Categories A, B and C)

These buffers are classified according to their dynamic energy capacity W_{ed} as specified in Table 1.

Table 1 — Buffer stroke 105

Buffer category	Dynamic energy capacity W_{ed}
A	≥ 30 kJ
B	≥ 50 kJ
C	≥ 70 kJ

4.3 Buffers with buffer stroke 110 mm

Buffers with a stroke of 110 mm are generally used on coaches to protect them against buffing impacts at speeds of up to 10 km/h.

Designation is reserved for this issue of the European Standard.

NOTE UIC 528 does not specify a designation for this buffer.

4.4 Long stroke buffer 150 mm

Wagons used for carriage of impact-sensitive goods may be fitted with 150 mm stroke buffers in order to maintain the accelerations exerted on goods at the lowest level possible while complying with the minimum requirements of prEN 12663-2.

NOTE The possibilities for use of hydrodynamic buffers are described in ERRI Report B36/RP 30.

150 mm-stroke buffers are designated by the letter "L".

4.5 Interaction coupling/buffer

To ensure that the train is able to negotiate curves at 150 m radius safely, the static characteristics of draw gears and buffers should be coordinated.

NOTE Refer to prEN 15839 for details.

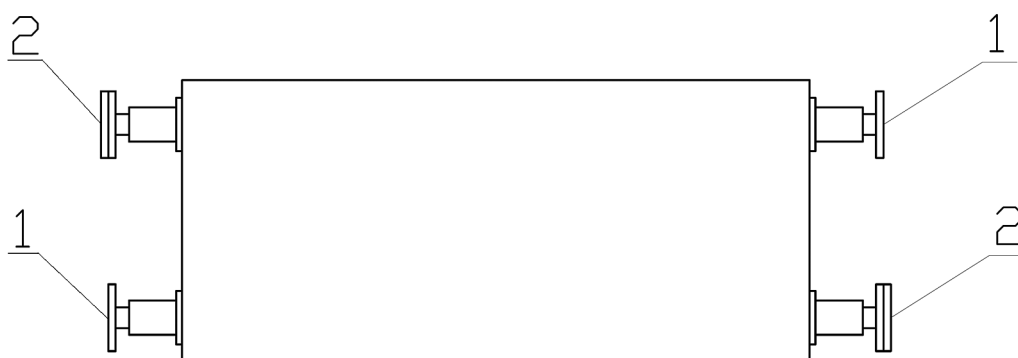
5 Requirements

5.1 General

Two buffers shall be fitted at each vehicle end with the same elastic system, category, head dimension, stroke and type of housing.

Housings which differ only in the buffer head plate material or insert are considered to be identical.

NOTE When a non-metallic insert or head is provided on one of the 2 buffers per wagon end, it should be placed diagonally according to Figure 2.



Key

- 1 Buffer with metallic head
- 2 Buffer with non-metallic insert or head

Figure 2 — Mounting of buffers with non-metallic insert or head (top view for freight wagons)

5.2 Fixing on vehicle and interchangeability

The buffers shall be fixed to the vehicle headstock by means of four bolted M 24 fasteners.

For 105 mm and 150 mm stroke buffers for freight wagons, dimensions and spacing needed on headstock for the buffer support plate for interchangeability are given in Figure 3.

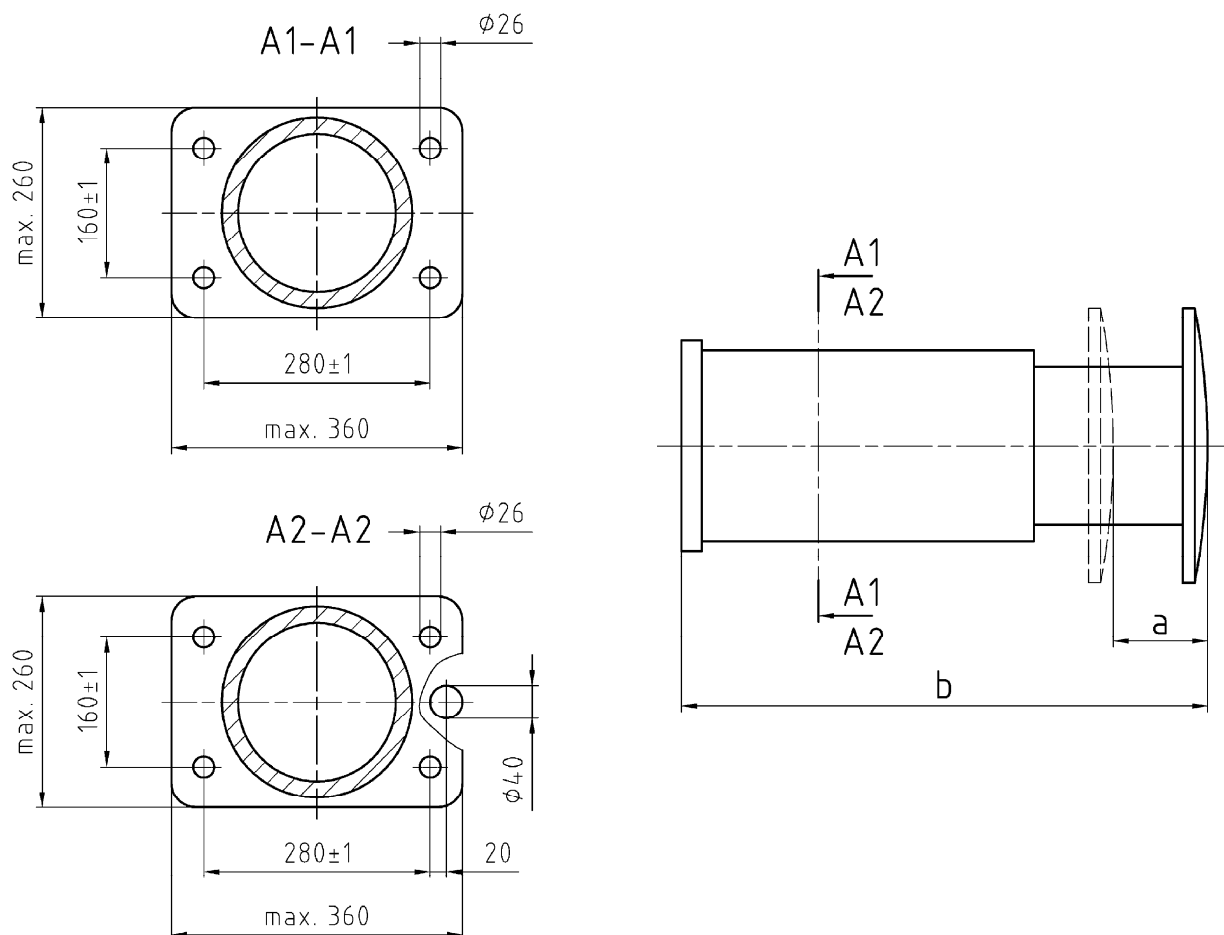
The 105 mm stroke buffer flange shall cover the location for the pin (see cross section A1-A1 of Figure 3). This pin is to prevent the fixing of a 105 mm stroke buffer where a long stroke buffer is required.

The 150 mm stroke buffer flange shall have a location for the pin (see the location in cross section A2-A2 of Figure 3).

For vehicles which have to comply with crashworthiness requirements (locomotives, cab cars or passenger coaches according to EN 15227, tank wagons according to RID), which use crashworthy buffers or buffers

which form part of a combined system consisting of a special buffer and a deformation element, interchangeability with freight wagon buffers is not required. For these vehicles, a different fixation of the buffers (e.g. concerning position of flange, bolt diameter, quantity of bolts and their position) may be used, and Figure 3 is not applicable.

Dimensions in millimetres



Key

A1 section is for 105 mm stroke buffer

A2 section is for long stroke buffer

a is the stroke 105 mm or 150 mm

b is the buffer length (see Table 2)

Figure 3 — Fixing dimensions of 105 mm and 150 mm stroke buffers for interchangeability

5.3 Buffer dimensions

Common dimensional characteristics for all buffer categories are provided in Table 2.

Table 2 — Buffer dimensional characteristics

Dimensions in millimetres

	Stroke 105 mm buffer	Stroke 110 mm buffer	Stroke 150 mm buffer
Stroke a	105_{-5}^0	110_{-5}^0	150_{-5}^0
Buffer length b	620	650	665

The spacing of the buffer is specified in Annex A.

The buffer shall be equipped with an anti-rotation device avoiding free rotation on longitudinal axis. The maximum allowed rotation is set at $\pm 2^\circ$ for buffer when they are new.

The width of the buffer head shall be as specified in 6.2.

For locomotives, cab cars or passenger coaches according to EN 15227 equipped with crashworthy buffers or buffers which form part of a combined element consisting of a special buffer and a deformation element, a different position of the fixation flange and a spacing of bolts different from Figure 3 may be used, and the buffer length **b** defined in Table 2 is not applicable.

5.4 Mechanical characteristics of buffers

The entire buffer unit fitted to the wagon shall be capable of withstanding the loads specified in Table 3:

Table 3 — Proof loads for buffers

	Force F_i for stroke 105 mm and 150 mm	Force F_i for stroke 110 mm
Longitudinal force (centred) F_1 , exerted on the buffer head	$\geq 2\,500$ kN	$\geq 1\,250$ kN
Longitudinal force (off-centre) F_2 , exerted on the buffer head	≥ 500 kN	≥ 300 kN
Vertical force F_3 , exerted on the body of the buffer	≥ 200 kN	≥ 200 kN
Total longitudinal force F_4 , exerted by the base plate of the buffer on a test frame	$\geq 2\,500$ kN	$\geq 1\,250$ kN
Longitudinal force F_5 for buffer heads > 450 mm, exerted on the buffer head	≥ 250 kN	-----
Life-cycle test on customer request, force F_6	≥ 250 kN	-----

Conditions governing the application of these forces are set out in Figure 4.

The corresponding test methods are specified in Annex B.

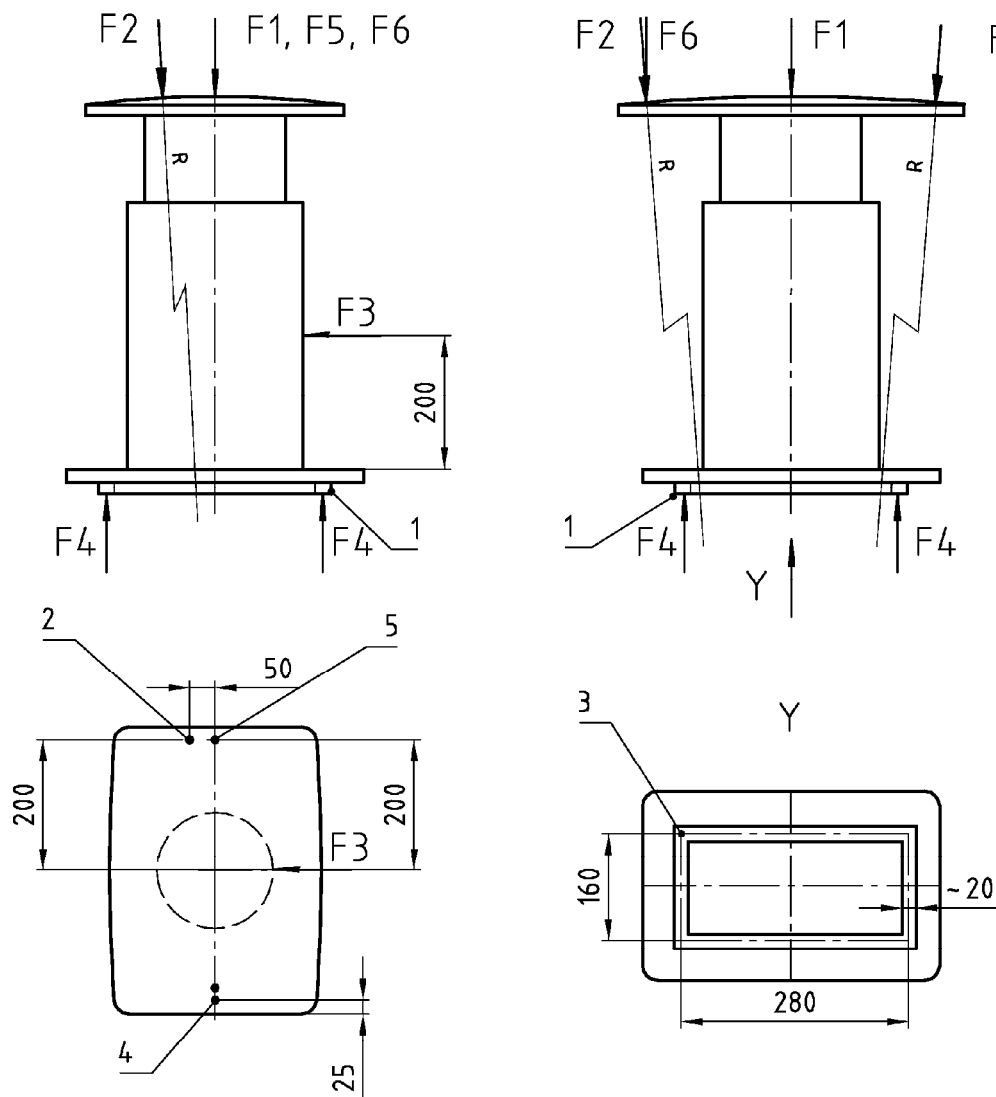
After each of the tests F_1 , F_2 , F_3 and F_5 , the buffer shall continue to be in a condition that allows normal functioning, and any permanent deformation shall fall within the tolerance range stipulated for manufacture. In addition, the diameters measured on the main buffer components shall not have changed by more than 0,2 %.

After Test F_4 , the base plate shall not show any permanent deformation.

After Test F_6 , no visible cracks shall appear.

For crashworthy buffers or buffers which form part of a combined system consisting of a special buffer and a deformation system, proof loads F1, F3 and F4 are not applicable. For test of the other proof loads, a different way of fixation from that indicated in Figure 4 shall be chosen in order to represent the real fixation and load situation on the vehicle as close as practically possible.

Dimensions in millimetres



Key

- 1 support frame (used with for testing with F4 force)
- 2 point of application of F2
- 3 centre line of fastening bolts
- 4 point of application of F5
- 5 point of application of F6
- R radius of buffer head

Figure 4 — Points of application of forces

5.5 Elastic devices

5.5.1 Types of elastic devices

- Rubber elastomer or other elastomer elastic systems
- Friction spring/Ring spring
- Hydrodynamic or hydrostatic systems
- Combined spring

See Annex C for requirements.

5.5.2 Static characteristics

The static characteristics common to all categories of buffers in position and direction of F1 are defined in Table 4.

These characteristics shall be measured as specified in Annex D on a complete buffer.

Table 4 — Static characteristics

	Buffer with 105 mm stroke	Buffer with 110 mm stroke with conventional springs	Buffer with 110 mm stroke with hydrodynamic and hydrostatic springs	Buffer with 150 mm stroke
Stroke				
Initial	10 kN - 50 kN	7,5 kN - 20 kN	7,5 kN - 50 kN	15 kN - 90 kN
after 25 mm	30 kN - 130 kN	10 kN - 40 kN	-	60 kN - 130 kN
after 50 mm	-	-	60 kN - 200 kN	-
after 60 mm	100 kN - 400 kN	50 kN - 150 kN	-	100 kN - 220 kN
after 100 mm	350 kN - 1000 kN	-	-	150 kN - 390 kN
after 105 mm	-	300 kN - 1000 kN	≤ 600 kN	-
after 125 mm	-	-	-	200 kN - 520 kN
after 145 mm	-	-	-	350 kN - 880 kN
Stored energy (W_e) for an effort not exceeding 1 000 kN	≥ 12,5 kJ	≥ 10 kJ	-	-
Stored energy (W_e) for a force ≤ 880 kN	-	-	-	≥ 18 kJ
Stored energy (W_e) for a force ≤ 600 kN	-	-	≥ 12 kJ	-
Absorbed energy (W_a) corresponding to the preceding stored energy	≥ 0,5 W_e	≥ 0,5 W_e	≥ 0,5 W_e	≥ 0,5 W_e

NOTE 1 Table 4 applies to the temperature range - 25 °C to + 45 °C. For temperature range - 40 °C to + 35 °C, performances could be different.

Test on buffers with stroke of 110 mm with hydrodynamic and hydrostatic springs shall also determine whether the return force exerted by the buffer at compression of 30 mm, 60 mm and 100 mm depths, respectively remains virtually constant for 10 minutes.

5.5.3 Dynamic characteristics

Dynamic characteristics are those obtained when a test vehicle fitted with the buffers to be tested is impacted by another test vehicle.

The values imposed are designed to ensure adequate protection of the passengers, the goods carried and of the vehicle structure against buffing impact, particularly in marshalling yards.

Dynamic testing is specified in Annex E.

Endurance testing under service load is specified in Annex F.

Endurance testing for life-cycle simulation is specified in Annex G.

The tests specified in Annex E, Annex F and Annex G are certification tests and not acceptance tests as part of the quality control process. Customers shall however be free to repeat these tests at their discretion.

5.5.4 Endurance testing under service load for elastic device

See Annex F.

5.5.5 Endurance testing for life-cycle simulation

See Annex G.

5.6 Marking

Buffers shall be marked as indicated in Figure 5 and Figure 6.

The minimum size of the letters is defined in Figure 6.

This marking shall be applied during manufacture or inserted on a security affixed metal plate depending on the method of manufacture.

Dimensions in millimetres

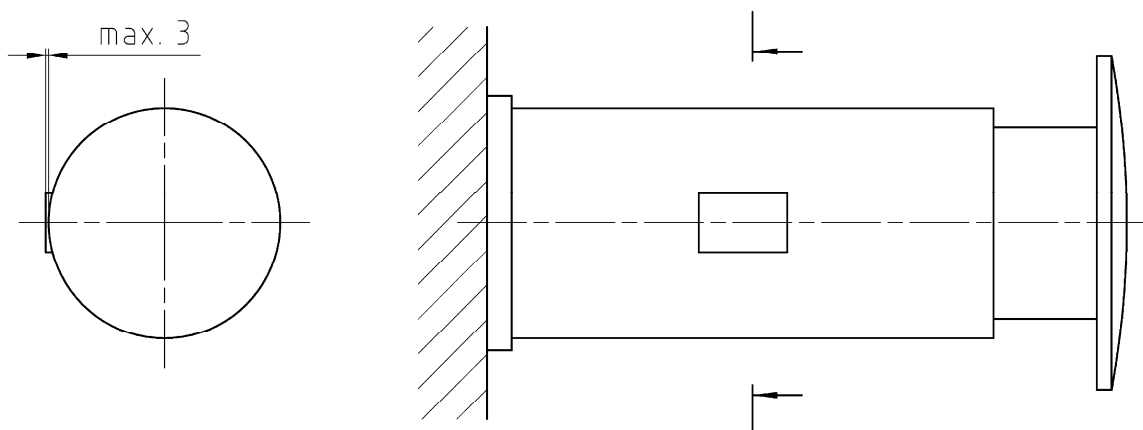
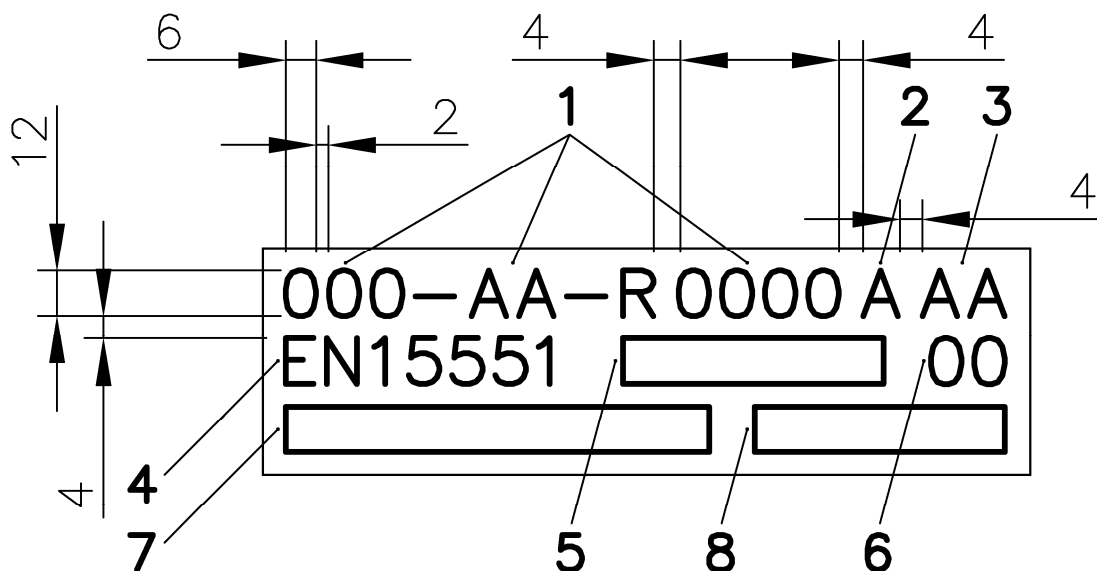


Figure 5 — Location of the mark

For crashworthy buffers or buffers which form part of a combined system of a special buffer and a deformation element, a different place or a different technology than a metal plate may be chosen. However, the layout and letter size as defined in Figure 6 shall be maintained.

Dimensions in millimetres



Key

- 1 stroke – category (for 105 mm and 150 mm stroke buffers) – buffer head radius
- 2 type of buffer head
S – standard
H – hardened (for hardness > 450 Hv)
P – synthetic material
- 3 type of elastic system
F – friction spring
R – rubber spring
P – polymer spring
S – hydrostatic capsule
D – hydrodynamic capsule
for combined elastic systems, combine the letters, for example
FD – friction spring/hydrodynamic capsule
- 4 EN 15551
- 5 space for manufacturer's logo
- 6 two last digit of production year
- 7 space for identification number of Notified Body
- 8 space for owner's name/logo

Figure 6 — Marking

Other layouts may be agreed with customer subject to the manufacturing process used.

6 Housing

6.1 Plunger and base

See Annex H

6.2 Buffer head

6.2.1 Materials

6.2.1.1 General

Buffer head materials shall be compatible with each other and with the materials currently used in operation.

Compatible buffer head materials are listed in I.2.

For new buffer head materials the compatibility with existing buffer materials shall be demonstrated. I.1 gives guidelines to do so.

6.2.1.2 Hardness of buffer head

For steel buffer head, hardness HV of active surfaces measured at a depth of 0,5 mm from the surface shall be $\geq 160 HV30$.

6.2.1.3 Roughness of the surface

The roughness value R_a for the surface condition of buffer heads expressed by the mean arithmetic deviation shall be ≤ 25 . These provisions apply only to buffer heads made of steel.

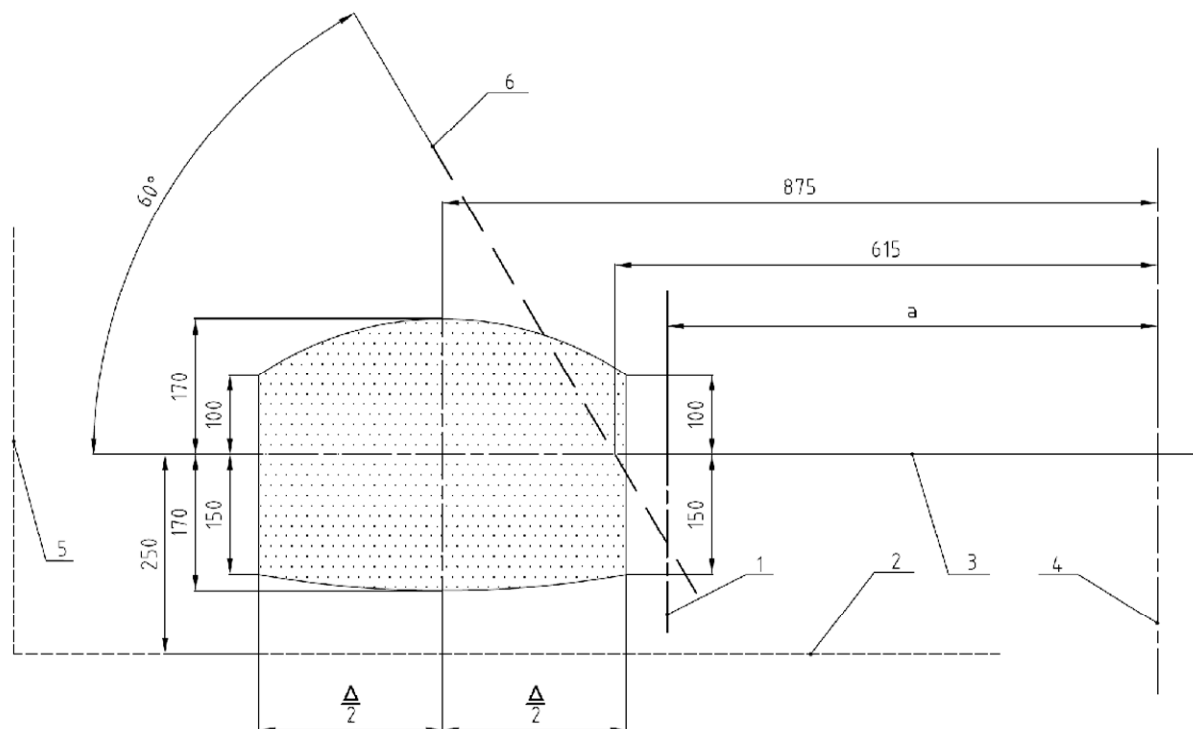
The European Standard applying to the surface conditions on the cast disc is EN 1370.

6.2.2 Boundary dimensions

Buffer heads shall not exceed the limits shown in Figure 7:

- LINE 5 towards the outside, the limit of the construction gauge defined for the vehicle concerned;
- LINE 1 towards the vehicle centre line, for wagons, a vertical line situated 600 mm from the vehicle centre line and for coaches and locomotives equipped with 110 mm stroke buffers, a vertical line situated 540 mm from the vehicle centre line. This limit ensures, generally, the observance of the space to be kept free for the shunter;
- LINE 2 towards the ground, a horizontal line situated 250 mm below the centre line of the buffers.

Dimensions in millimetres



Key

- 1 internal limit
- 2 lower limit
- 3 level of buffer centre line
- 4 wagon centre line
- 5 construction gauge limit
- 6 limit for vehicles with interconnecting gangway



minimum surface

	for wagons	for coaches and locomotives with 110 mm stroke buffer
a	600	540

Figure 7 — Boundary dimensions and minimum surface of buffer heads

For buffers 550 mm wide, the minimum size may be reduced by $2 \times R50$ in the lower corners of the buffer head.

6.2.3 Standard dimensions of buffer head

6.2.3.1 Buffers with stroke of 105 and 150 mm

The standard height of buffer heads shall be 340 mm, i.e. 170 mm on either side of the centre line of the housing.

Buffer heads shall be convex and the radius of curvature of their spherical working surfaces shall be $(2\,750 \pm 100)$ mm.

Standard width of the buffer head (Δ in Figure 7) of standard gauge wagons (distance between centre line of buffers 1 750 mm) shall be as specified in Table 5.

Table 5 — Standard widths of buffer heads

Dimensions in millimetres

Value Δ calculated according to Annex J	Corresponding standard width
$\Delta \leq 400$	450
$400 < \Delta \leq 550$	550

The minimum width of buffer heads on wagons accepted for traffic between the European standard gauge network and the Spanish broad gauge network (distance between centre line of buffer 1 850 mm) shall be 100 mm more than the width calculated in accordance with Annex J and Table 5.

The minimum width of buffer heads on wagons accepted for traffic between the European standard gauge network and the Finnish network (distance between centre line of buffer 1 790 mm) shall be 40 mm more than the width calculated in accordance with Annex J and Table 5.

The buffer heads shall not have any irregularities that might pose problems for shunting staff. The edges of their working surfaces shall be rounded with a radius of at least 50 mm and the edge of the buffer head shall have a curvature of 5^{+2}_0 mm.

The regulations relating to the layout of S-curves (length of straight section that may be necessary between a curve and a reverse curve) may influence the dimensioning of the buffer heads and allowing for the running of vehicles without special precautions, are given in Annex K.

6.2.3.2 Buffers with stroke of 110 mm

Value Δ shall be calculated according to Annex J.

Buffer heads shall be convex and the radius of curvature of their spherical working surface shall be equal to (1500 ± 100) mm.

For vehicles with a large transversal clearance (> 40 mm) between vehicle and axle on small-radius curves, buffers with width exceeds the minimum value should be used.

Long coaches (length exceeding 25 m) should be fitted with buffers with a minimum buffer head width of $\Delta = 635$ mm.

7 Crashworthy buffers for tank wagons according to RID

Crashworthy buffers shall comply with the provisions of Annex L and those given below. The requirements on wagons are defined in EN 12663.

Crashworthy buffers shall fulfil all requirements of Clause 5 and Clause 6.

Instead of Annex A, the envelope of the crashworthy components incorporated into the buffers or that of the crashworthy component + buffer assembly shall comply with the provisions of Annex M.

NOTE In Annex M, this envelope is nearly the same as that described in Annex A, where cross section B-B is equal to cross section A-A and cross section C-C is equal to cross section D-D.

For energy absorbing components used on locomotives (or coaches), EN 15227 is applicable instead of Annex L.

Annex A (normative)

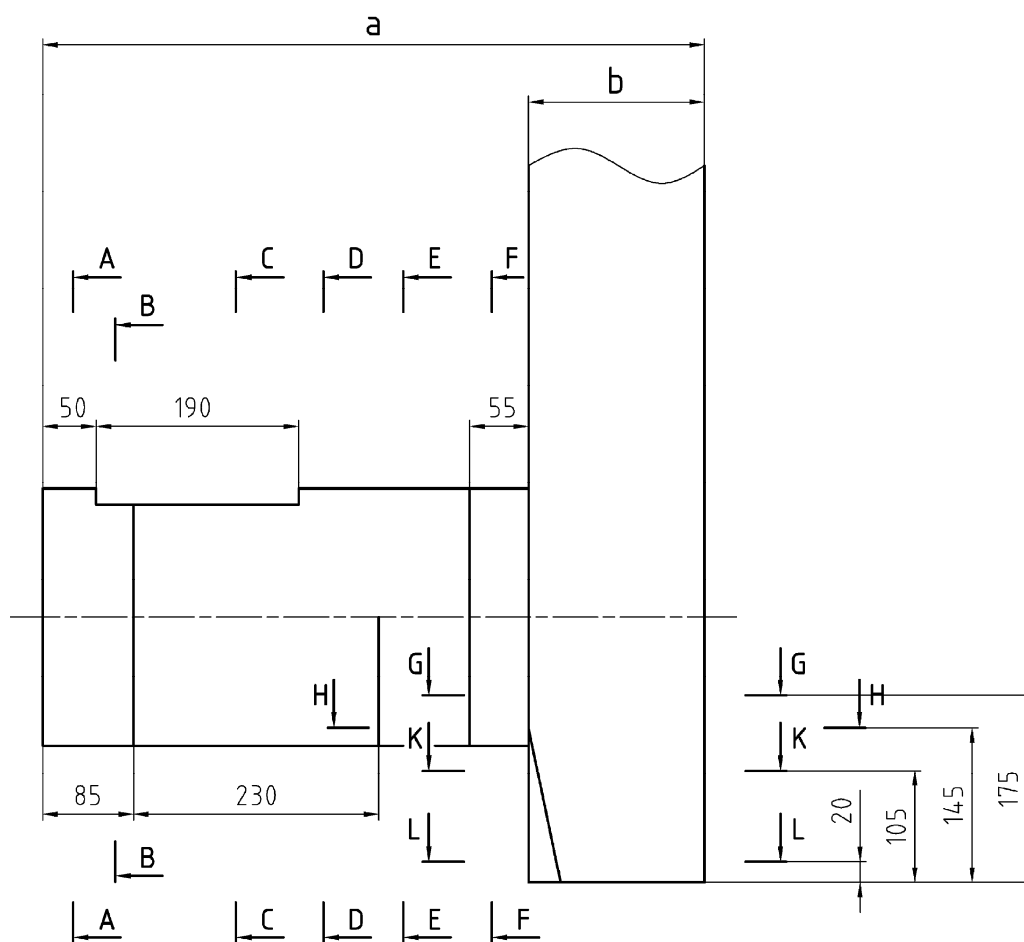
Maximum space envelope of buffer

A.1 Requirements for space envelope of buffer

A.1.1 Buffers for freight wagons

Any parts of the buffer including the working position shall be within the maximum space envelope as indicated in Figure A.1.

Dimensions in millimetres



Key

	Stroke 105	Stroke 150
a	620	665
b	165	210

Figure A.1 — Dimension of the maximum space envelope of buffer - Side view