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Railway applications - Automatic coupler - Performance requirements, specific interface geometry and test method

Bahnanwendungen - Automatische Kupplung - Leistungsanforderungen, spezifische Schnittstellengeometrie und Prüfverfahren

Applications ferroviaires - Attelage automatique - Exigences concernant la performance, la géométrie des interfaces et les méthodes d'essai

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This European Standard was approved by CEN on 17 November 2013.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (EN 16019:2014) 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of an identical text or by endorsement, at the latest by September 2014, and conflicting national standards shall be withdrawn at the latest by September 2014.

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 has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of 2008/57/EC.

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

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1 Scope

This European Standard specifies the requirements for Type 10 automatic couplers for railway applications.

It defines the minimum interface requirements in order to allow automatic coupling (mechanical and pneumatic) of two Type 10 automatic couplers.

The interfaces of the end coupler specified in this European Standard:

— enable the rescue of a train set in an event of a breakdown by another trainset of different type, without the need to use an intermediate coupler adapter, accessories or component;

— are the reference interfaces to which the rescue coupler defined by EN 15020 will comply.

It does not define:

— interface requirements concerning electrical connections;

— clearance requirements around the coupler head;

— the height above top of rail for the coupler;

— the position of the pivot point of the coupler.

2 Normative references

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

EN 15020, *Railway applications - Rescue coupler - Performance requirements, specific interface geometry and test methods*

EN ISO 6892-1, *Metallic materials - Tensile testing - Part 1: Method of test at room temperature (ISO 6892-1)*

ISO 2768 (all parts), *General tolerances*

3 Terms and definitions

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

3.1
Type 10 automatic coupler
latch-type automatic coupler allowing the mechanical, pneumatic and in some cases electrical connection between two train units or train sets without manual assistance, also known as “Scharfenberg® system Type 10” automatic coupler[1)]

3.2
coupler head
part of couplers, consisting of coupler head housing with gathering elements, coupler lock, uncoupling device, air pipe connections and an appropriate interface towards the rear part of the coupler

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1) Scharfenberg® is a registered trademark of Voith Turbo Scharfenberg, Salzgitter, Germany. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CEN of the product bearing this trademark. Equivalent products may be used if they can be shown to lead to the same results.

3.3
main reservoir pipe
pipe containing air pressure at a value which is sufficient to supply subsystems, including the brake system

[SOURCE: EN 14478:2005, 4.9.6.10]

3.4
brake pipe
pipe containing and conveying air, enabling train brake control

[SOURCE: EN 14478:2005, 4.9.6.7, modified]

3.5
uncoupling pipe
pipe containing and conveying air, enabling uncoupling of the coupler locks

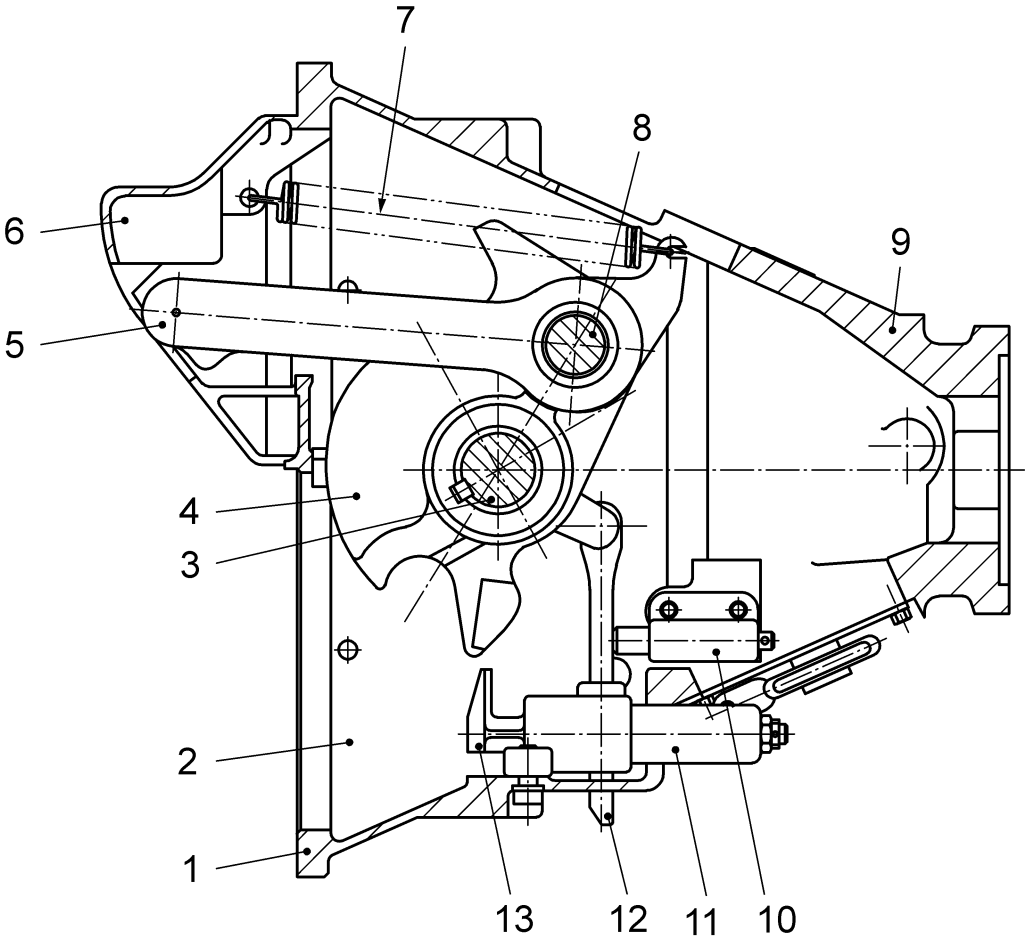
4 Product requirements

4.1 Automatic coupler head characteristics

The coupler head of the automatic coupler shall be equipped with a pivoting coupler lock, enabling the mechanical connection of two vehicles. The coupler lock consists of the following parts: hook plate, coupling link, central pin, tension springs, release bar holder, and release bar with trigger device. In order to ensure a maximum gathering range, both vertically and horizontally, the coupler head shall be provided with male cone, female cone and gathering horn, such that the couplers can be aligned and centred also in curves and in case of vertical mismatch. The coupler head dimensions shall be according to Annex A.

Tolerances for dimensions shall be according to ISO 2768, tolerance class mK, unless otherwise specified in this standard.

The principle arrangement of a coupler head is shown in Figure 1. Alternatives to this principle arrangement are allowed as long as functional and interface compatibility are maintained and the clauses of this standard remain applicable.



Key

1	coupler face	6	male cone	11	trigger device
2	female cone	7	tension spring	12	release bar
3	main pin	8	coupling link pin	13	trigger
4	hook plate	9	coupler head housing		
5	coupling link	10	release bar holder		

Figure 1 — Principle arrangement of coupler head

When coupled, the coupler lock elements are subjected to tensile load and form a parallelogram ensuring equilibrium of forces and an equal load distribution onto both coupling links. The equilibrium of forces prevents involuntary unlocking of the coupler locks and reduces wear.

Compressive loads are transmitted through the flat coupler faces of the coupler heads.

The automatic coupler head shall be designed to withstand the following forces without permanent deformation:

— tensile load = 1 000 kN;

— compressive load = 1 500 kN.

These values are for normal operating conditions. If the coupler is used only for rescue conditions, lower values are allowed; these loads are defined in EN 15020.

When coupled, the coupler locks ensure a nearly slack-free connection between the automatic couplers. Coupler lock play is evidenced by a distance between the coupler faces of two coupled coupler heads. An example of how to measure coupler lock play of a single coupler is shown in Annex C. Coupler lock play of a single coupler shall not exceed 0,8 mm in the new condition.

4.2 Coupling system positions

4.2.1 General

The state of coupling shall be made visible e.g. by contrasting coloured release bar or any other solution.

4.2.2 Ready-to-couple position

In the ready-to-couple position, the coupling link shall be retracted and lie close to the edge of the male cone and the release bar shall hold the hook plate. In this position, where the tension springs are loaded, the release bar shall project over the side of the coupler head housing and shall be engaged with the catch of the trigger device. See Figure 2.

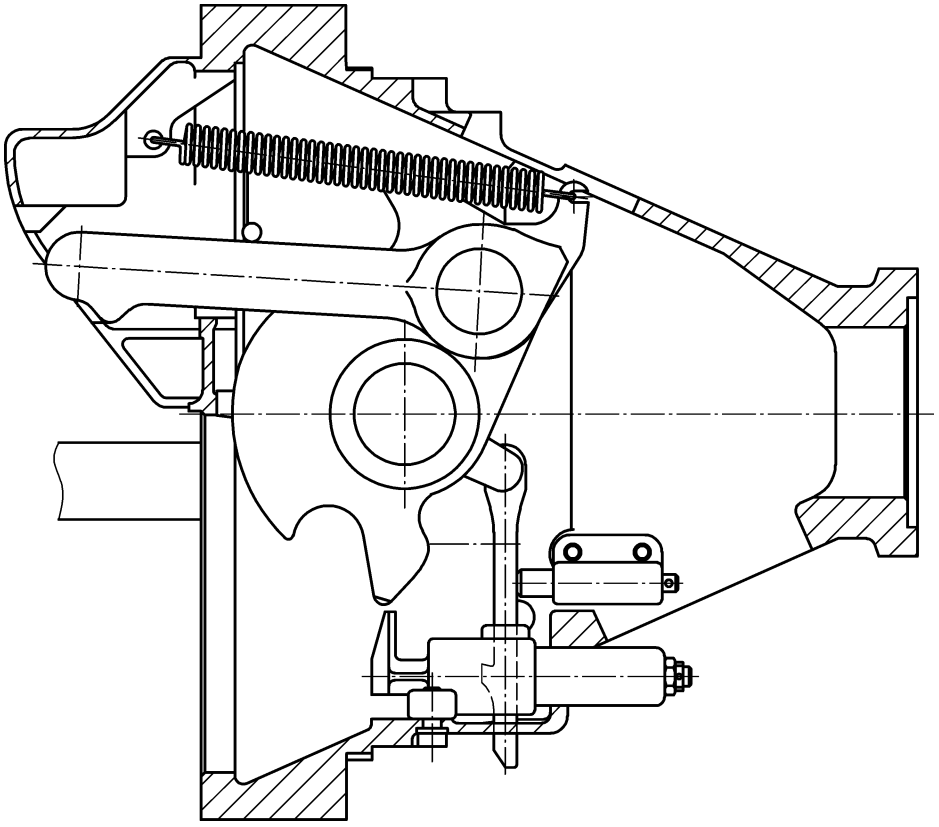


Figure 2 — Ready-to-couple position

4.2.3 Coupled position

As the coupler faces mate, the male cones entering the female cones shall press the triggers backwards, in order for the release bars to be released. The release bar shall be retracted in the coupler head housings when they engage with the trigger devices. After the release bars have been released, the tension springs shall turn the hook plates counter clockwise until they reach the stops in the coupler head housings. In the coupled position, the coupler locks are engaged. See Figure 3.

The release bar shall be retreated into the coupler head housings when they engage with the trigger devices.

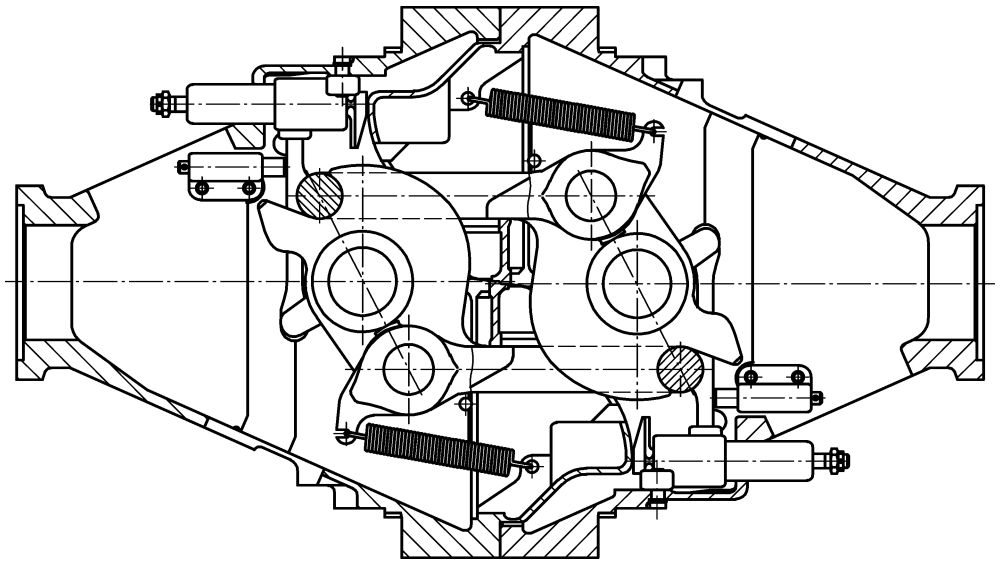


Figure 3 — Coupled position

4.2.4 Uncoupled position

In this position, the release bars shall retain the hook plates by engaging with the trigger devices. As the couplers move apart, the locking system returns to the ready-to-couple position. The release bars shall protrude from the coupler head housings when they engage with the trigger devices. See Figure 4.

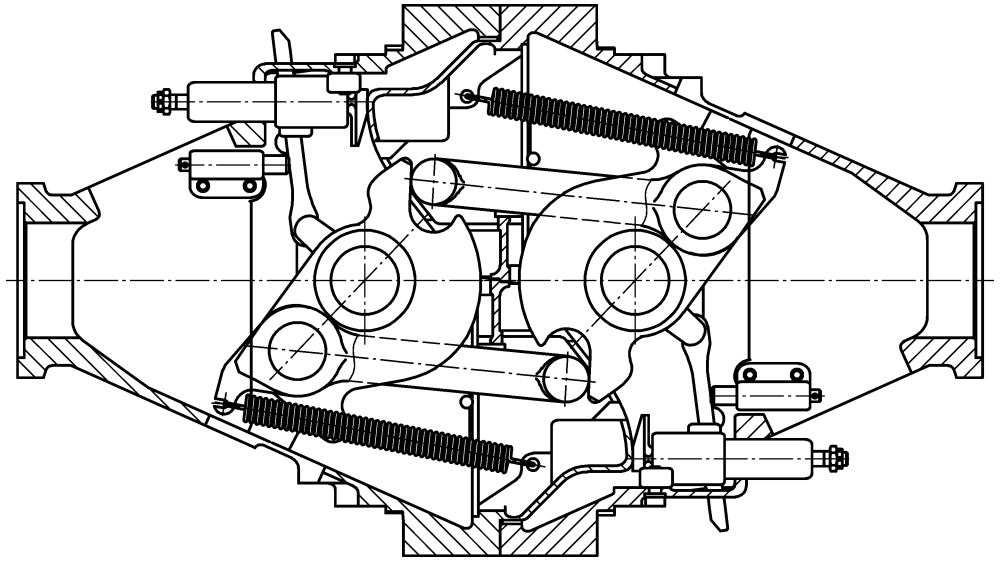


Figure 4 — Uncoupled position

4.3 Coupling requirements

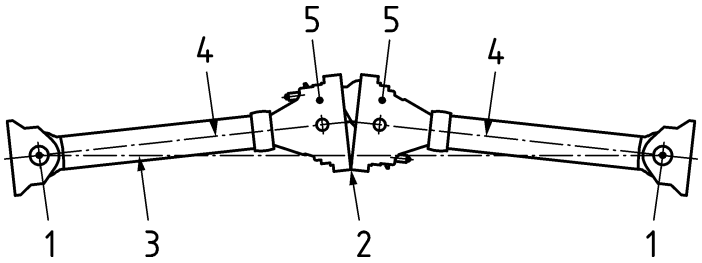
4.3.1 Mechanical coupling

The mechanical coupling procedure between two couplers shall be automatic.

The coupler should be designed to ensure that coupling is possible when the vertical and horizontal mismatch is inside the gathering range shown in Figure B.1 and Figure B.2 with parallel surfaces, i.e. when the centre of the opposite coupler is mismatched up to the chain dotted edge of central point "M" of the coupler in the drawing.

If the coupler faces are in an angular position relative to each other, the projection of the opposite coupler "M" point should hit inside the hatched surface of Figure B.1 and Figure B.2. Additionally, the first contact point shall be external to the triangular area formed by the lines 3 and 4 in Figure 5. This ensures a successful coupling.

Figure 6 shows an unsuccessful coupling position since the first contact point is within the triangular area formed by the lines 3 and 4.



Key

1 pivot point

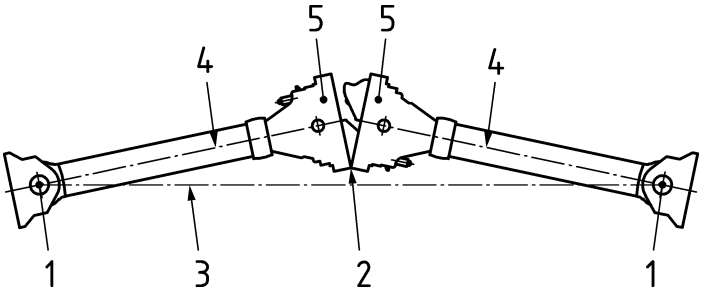
2 first contact point of coupler faces

3 line between pivot points

4 centre line of coupler

5 coupler head

Figure 5 — Successful coupling in curves



Key

1 pivot point

2 first contact point of coupler faces

3 line between pivot points

4 centre line of coupler

5 coupler head

Figure 6 — Unsuccessful coupling in curves

4.3.2 Pneumatic coupling

The air pipes (brake pipe, main reservoir pipe and uncouple pipe) shall be connected automatically by means of the air pipe connections in the course of the mechanical coupling operation (see Figure A.1).

The air pipe connection of the brake pipe is located in the coupler face (see Annex A) and shall ensure the sealing of the brake pipe in coupled condition. A valve controlled by the main pin shall open the brake pipe

upon coupling and close it upon uncoupling. As the main pin will not turn in case of coupler rupture, the brake pipe shall remain open and commence an automatic train stopping.

The air pipe connection of the main reservoir pipe is located in the coupler face (see Annex A) and shall ensure the sealing of the main reservoir pipe in coupled condition. When uncoupled, the main reservoir pipe shall be closed. When coupling, the air pipe connections shall open.

The air pipe connection of the uncoupling pipe is located in the coupler face (see Annex A). The uncoupling pipe only conveys compressed air during the uncouple operation.

All pneumatic components shall be tightness-tested according to the requirements of 5.2.4.2.

The dimensions of the air pipe connection interfaces are defined in Annex D.

4.4 Uncoupling

The coupler shall be fitted with an uncoupling device.

In case of an emergency, for example loss of air pressure, it shall be possible to manually open the coupler lock. Uncoupling should be done automatically by opening the coupler locking mechanism of the automatic couplers.

If the coupler is used only for rescue conditions, the automatic uncoupling device and uncoupling pipe are not compulsory.

5 Tests

5.1 Type tests

5.1.1 General

The coupler has to be validated on a test bench to see that the hook plates go to a locked position.

The type test, consisting of strength, dimension and gathering range tests, shall be performed on automatic couplers representative of serial production.

The function tests defined in 5.2.4 shall be done also during the type test.

5.1.2 Strength test

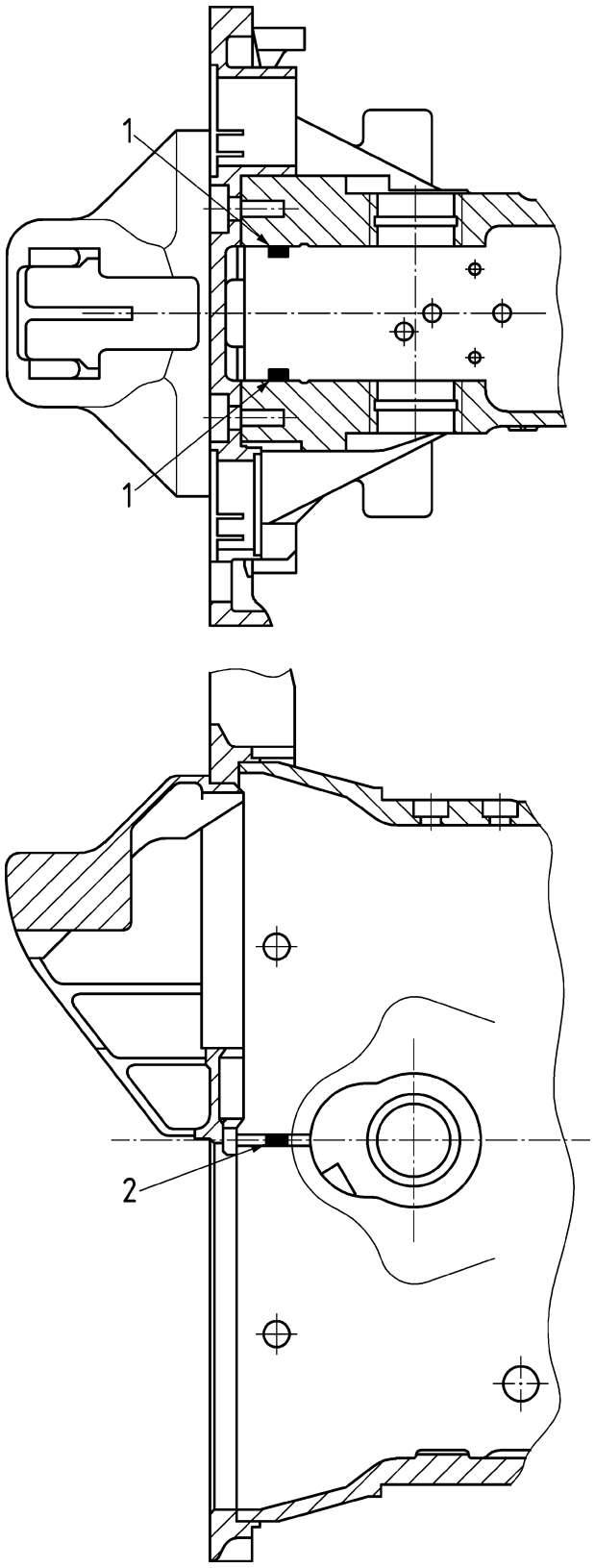
It shall be demonstrated by means of static tests that the coupler head of the automatic coupler withstands the loads stated in 4.1.

The tests shall in each case be performed on unstressed coupler heads which have not been tested before.

Two coupler heads shall be coupled in order to conduct the tensile test. Resistance strain gauges shall be applied at appropriate positions on the coupler head housing, the hook plate and the coupling link of one of the coupler heads (the specimen).

The position of the two rear strain gauges shall be chosen to be one of the options shown in Figure 9, i.e. 1a or 1b or 1c and 2a or 2b. The design shown in Figure 9 is an example. Depending of the design, the gauges have to be positioned as close as possible to where the highest stresses are expected to be found.

At least, they should be placed at the positions shown in Figure 7 to Figure 9.

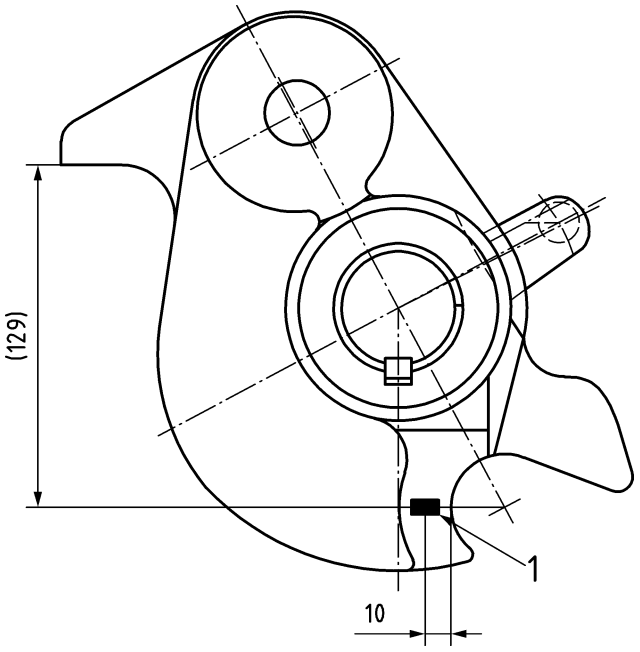


Key

1 strain gauges side view 2 strain gauge top view

Figure 7 — Strain gauges on the coupler head housing for the tensile test (tensile and compressive)

Dimensions in millimetres

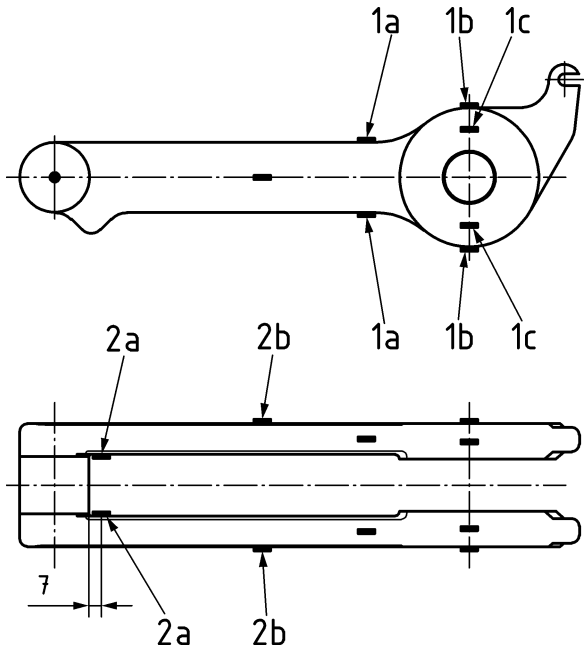


Key

1 strain gauges (top and bottom)

Figure 8 — Strain gauge on the hook plate for the tensile test

Dimensions in millimetres



Key

1a, 1b, 1c strain gauges in the rear 2a, 2b strain gauges in the front

Figure 9 — Strain gauges on the coupling link for the tensile test

Two coupler heads shall be coupled in order to conduct the compression test. Resistance strain gauges shall be applied at appropriate positions on the coupler head housing of one of the coupler heads (the specimen), at least however at the positions shown in Figure 7.

Alternatively, the compression test can be performed on the specimen only by means of an appropriate test device instead of the other coupler head.

The loads shall be applied gradually up to the maximum value and held for 1 min.

The maximum tensile and compressive loads shall not cause permanent deformation ($\leq R_{p0,2}$ limit) of the coupler head.

It is recommended that:

— the coupler heads used for the type test are preloaded so as to stabilize the overall structure;

— the maximum force is applied incrementally at least twice;

— the instrumentation is reset to zero before the final test.

The results of the final test shall be taken into account in the validation.

The strains measured under the maximum applied loads, shall be

$\varepsilon \leq \varepsilon_{limit} = R_{p0,2}/E$

where

ε	measured strain
E	is Young's modulus of the material;
$R_{p0,2}$	is the stress at which the material undergoes a 0,2 % non-proportional (permanent) extension during a tensile test as defined in EN ISO 6892-1;
ε_{limit}	is the limit of elongation of the material.

Evaluation of local stress concentrations may be done according to EN 12663-1:2010, 5.4.2.

After applying and removing the maximum tensile load, the coupler locks of the coupler heads shall move freely. This can for example be demonstrated by manually uncoupling the coupler heads.

5.1.3 Dimension test

5.1.3.1 General

The following dimension tests in accordance with Annex A shall be performed on a coupler representative of serial production.

5.1.3.2 Dimension tests on the coupler head

— Diameter and position of the male cone;

— diameter and position of the female cone;

— position of the guiding horn mounting hole;

— position of the central pin mounting hole.

5.1.3.3 Dimension tests on the hook plate

— Position of the central pin mounting hole;

— diameter and position of the hook plate recess;

— position of the coupling link pin mounting hole.

5.1.3.4 Dimension tests on the coupling link

Clearance between the coupling link pin mounting hole in the hook plate and the coupling link interface (219 mm as shown in Figure A.4).

5.1.4 Gathering range test

The type tests shall be performed using two automatic couplers, in order to demonstrate the gathering range as well as automatic coupling operation under the following conditions:

Two automatic couplers shall be capable of coupling reliably within the hatched area on Figure B.1 and Figure B.2 under the conditions described in 4.3.1. Compliance with this requirement shall be demonstrated by means of coupling tests or calculations.

5.2 Routine tests

5.2.1 General

Routine tests shall be conducted during assembly and after final assembly.

The routine test program prescribes the following tests to be performed on all serial production automatic couplers.

5.2.2 Visual checks

— Check if the coupler is completely and correctly assembled in compliance with the drawing;

— check if the coupler lock moves freely;

— check if the coupler lock elements are sufficiently greased;

— check if contact surfaces of coupling link, hook plate and coupler face are free of dirt, paint and paint splashes.

5.2.3 Dimension test

— Check coupler lock play as described in 4.1 by means of an appropriate gauge; refer to Annex C.

— Check male cone height; refer to Annex A.

5.2.4 Function tests

5.2.4.1 General

Two coupler heads shall be coupled on a test bench in order to conduct the functional tests.

5.2.4.2 Function test of the air connections

All pneumatic components as a whole system shall be tightness-tested.

Air connections shall be checked for leakage in the coupled state with a test pressure of 10 bar and 5 bar and in the uncoupled state with a test pressure of 10 bar. The coupler connected with the test equipment by a reservoir of up to 20 l volume, the pressure loss shall not exceed 0,1 bar over a test period of 10 min.

5.2.4.3 Function test of the automatic coupler with 6 bar test pressure

The following requirements shall be met during automatic coupling operation:

— coupler lock shall couple correctly;

— coupler lock shall audibly latch;

— release bar shall be retracted inside the coupler head housing.

The following requirements shall be met during automatic as well as manual uncoupling operation:

— coupler shall uncouple correctly;

— the catch of the release bar shall be engaged at the coupler head housing;

— coupler lock shall return to the ready-to-couple position when the vehicles move apart;

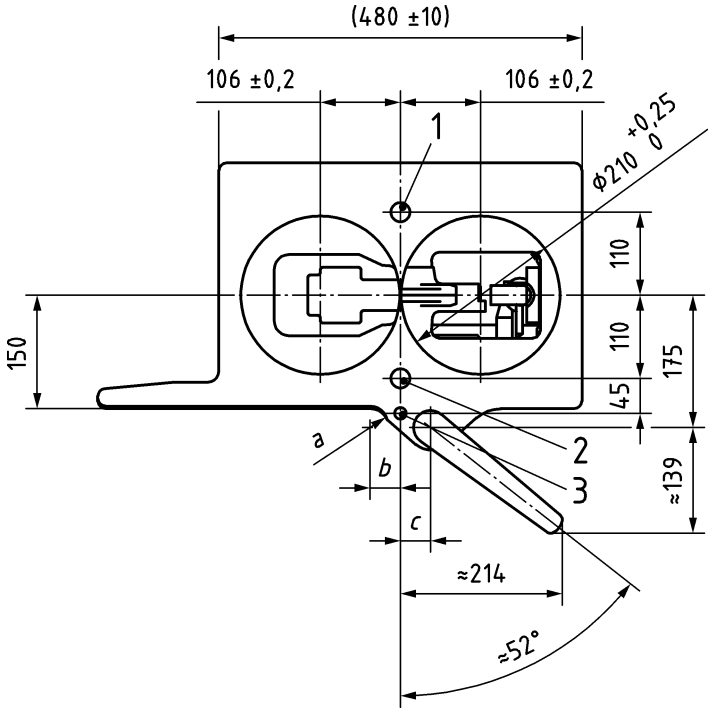
— release bar shall protrude outside the coupler head housing.

Annex A
(normative)

Automatic coupler interface

The figures in this annex define the automatic coupler interface.

Dimensions in millimetres



Key

1 brake pipe 2 main reservoir pipe 3 uncoupling pipe

	System 1	System 2	System 3
a	R25	R23,5	R20
b	40	40	37,5
c	40	42	40

Figure A.1 — Automatic coupler head (front view)

Dimensions in millimetres

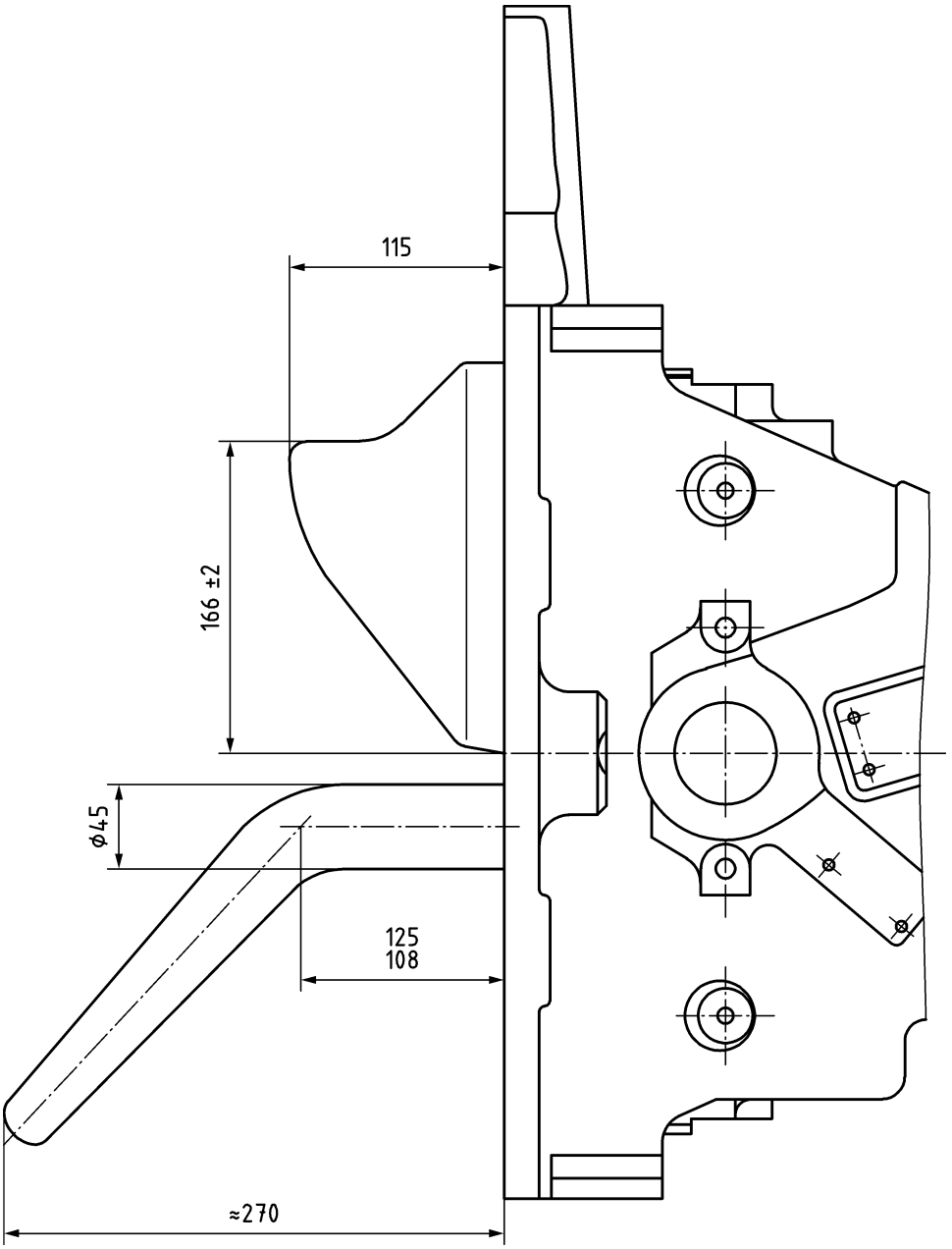


Figure A.2 — Automatic coupler head (top view)

Dimensions in millimetres

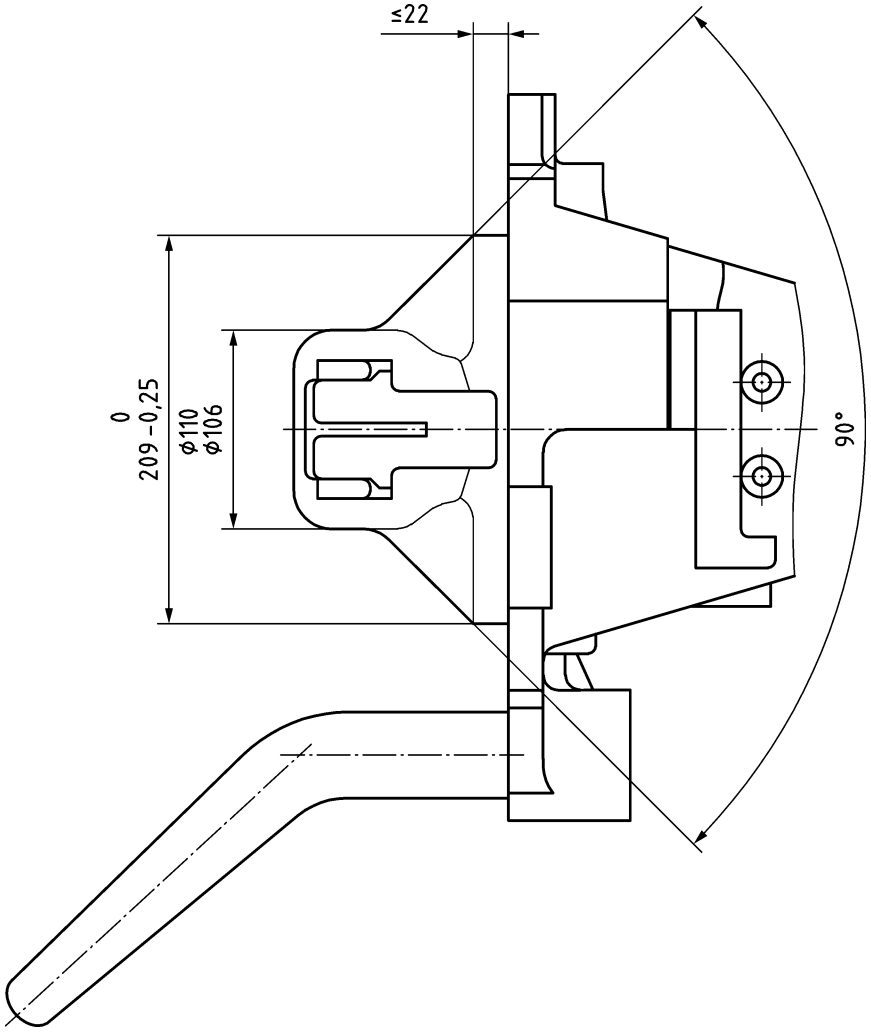


Figure A.3 — Automatic coupler head (lateral view)

Figure A.4 is intended to specify the interface requirements only, not for manufacturing purposes. It shows nominal dimensions which have to be fulfilled. ISO 2768 does not apply to Figure A.4.

Dimensions in millimetres

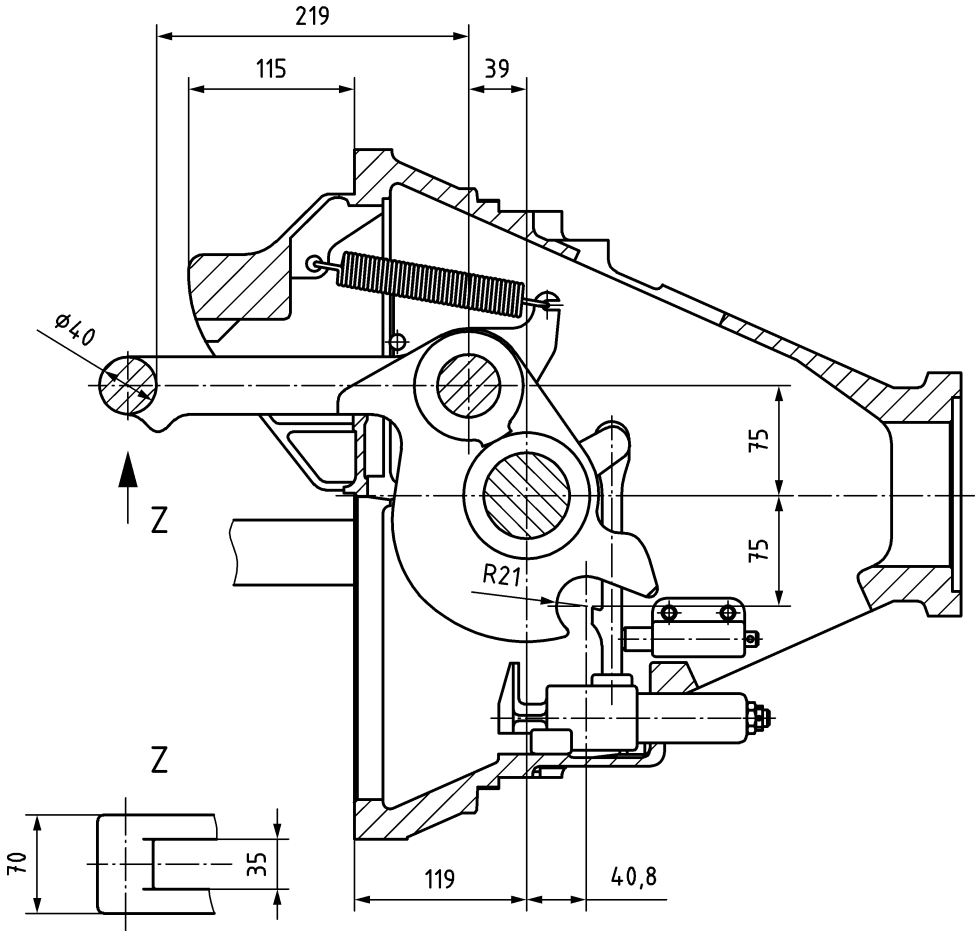


Figure A.4 — Automatic coupler head in the coupled position (cross section)

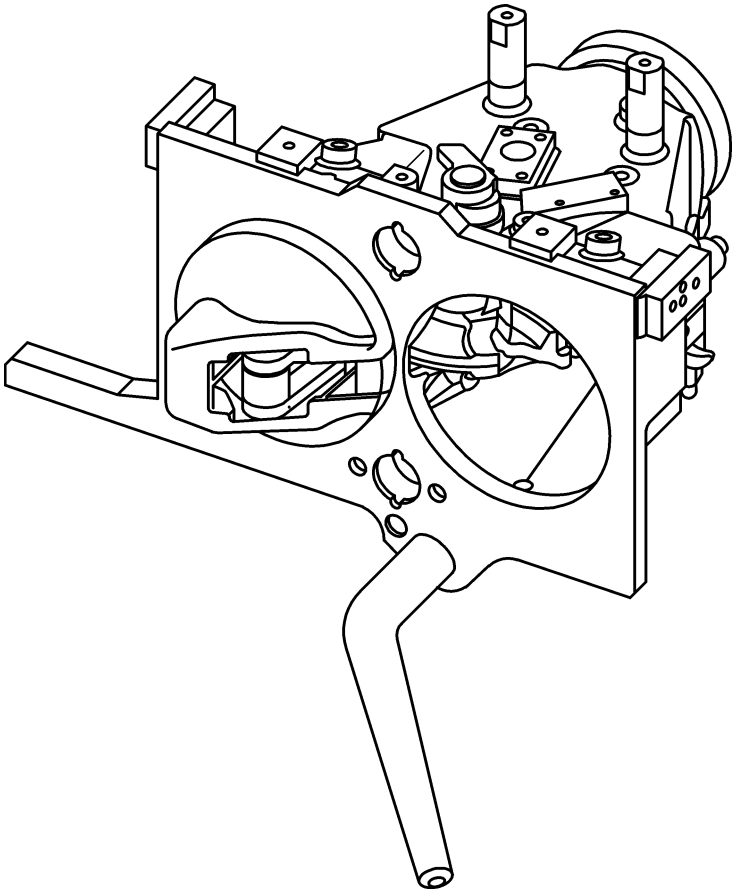


Figure A.5 — Automatic coupler head (isometric view)

Annex B
(informative)

Gathering range

Dimensions in millimetres

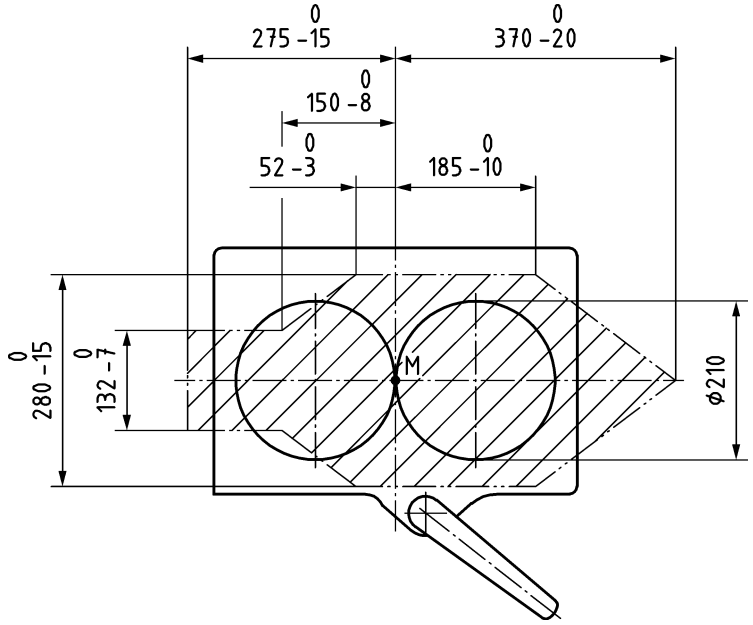
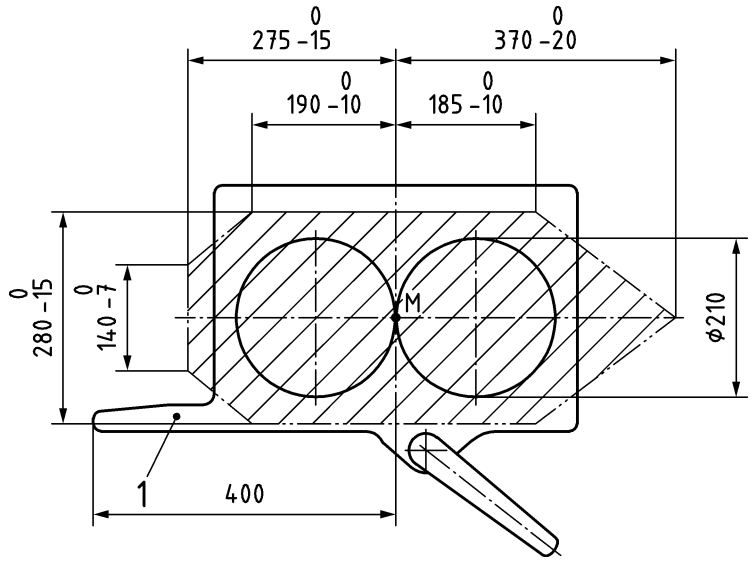


Figure B.1 — Typical gathering range of the Type 10 coupler

Dimensions in millimetres



Key

1 guide bar

Figure B.2 — Typical gathering range of the Type 10 coupler with guide bar

Annex C
(informative)

Example method of coupler lock play measurement

Coupler lock play can be measured using a coupler lock play gauge (Figure C.1) as described below.

Key

1	base plate	3	handle	5	coupling link pin
2	hook plate	4	coupling link		

Figure C.1 — Coupler lock play gauge Type 10

Measurement of the coupler lock play is shown in Figure C.2 and Figure C.3:

— the coupler lock is turned to the coupled position, for example by using the rod (9);

— the coupler head face (11), male (13) and female cone (10) of the coupler lock as well as the coupler lock elements are thoroughly cleaned (for example hook plate recess 15);

— the protection covers are stripped off (8) from the magnets (7) of the gauge;

— the coupling link pin (5) is pulled out of the hook plate (4) of the gauge, the coupling link is removed (6);

— the correct torque limit on the handle (3) is set;

— the handle (3) is put on the threaded mandrel of the gauge;

— the base plate (1) of the gauge is put against the coupler face (11);

— the coupling link (12) is hooked into the hook plate recess of the gauge (2);

— the coupling link of the gauge (6) is hooked into the hook plate recess of the coupler (15);

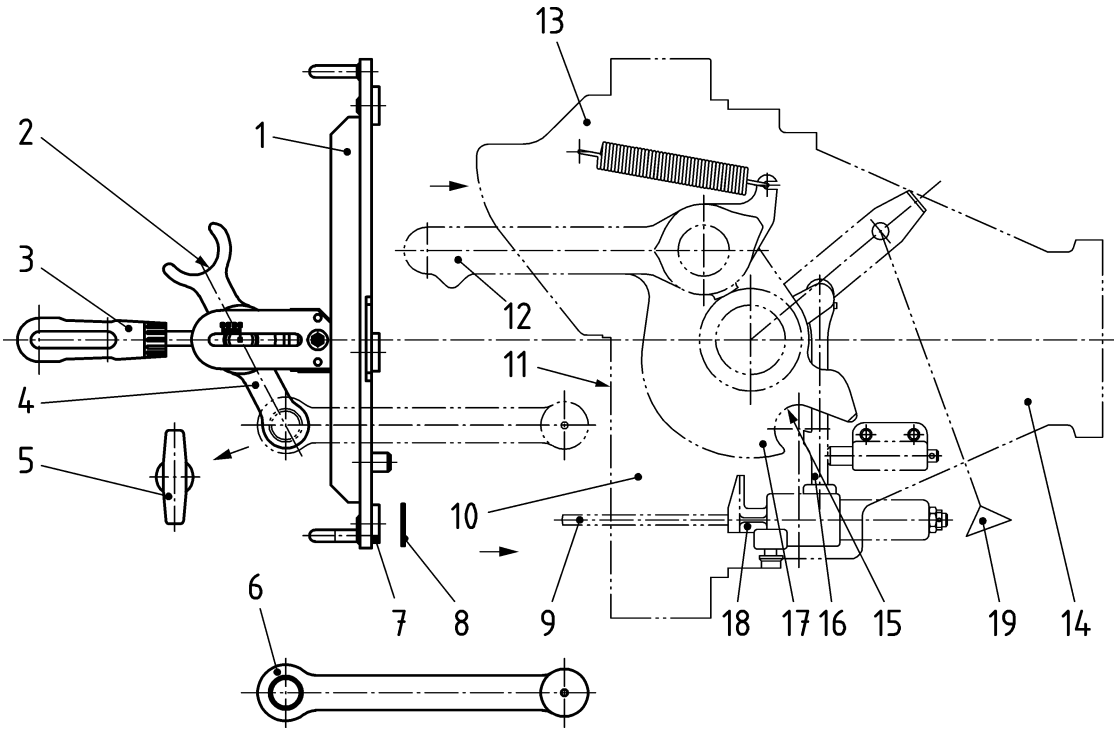
— the position of the hook plate of the gauge is adjusted by turning the handle counter clockwise, until the coupling link pin can be inserted (a second person can turn the coupler lock);

— gauge is put under tensile force by turning the handle clockwise until it idles;

— coupler play is read (gauge is provided with a Vernier scale indicating coupler play down to 1/10 mm);

— if the allowable coupler play is exceeded, the coupler lock is removed and dismantled. The dimensions of the coupler lock elements are checked using a caliper and any elements that do not reach the limiting size shall be replaced;

— the coupler lock is reinstalled.



Key

1	base plate	8	protective sheet	15	hook plate recess of the coupler
2	hook plate recess of the gauge	9	rod	16	release bar
3	handle	10	female cone	17	hook plate
4	hook plate	11	coupler face	18	stem
5	coupling link pin	12	coupling link	19	uncoupling device
6	coupling link	13	male cone		
7	magnet	14	coupler head		

Figure C.2 — Coupler lock play gauge

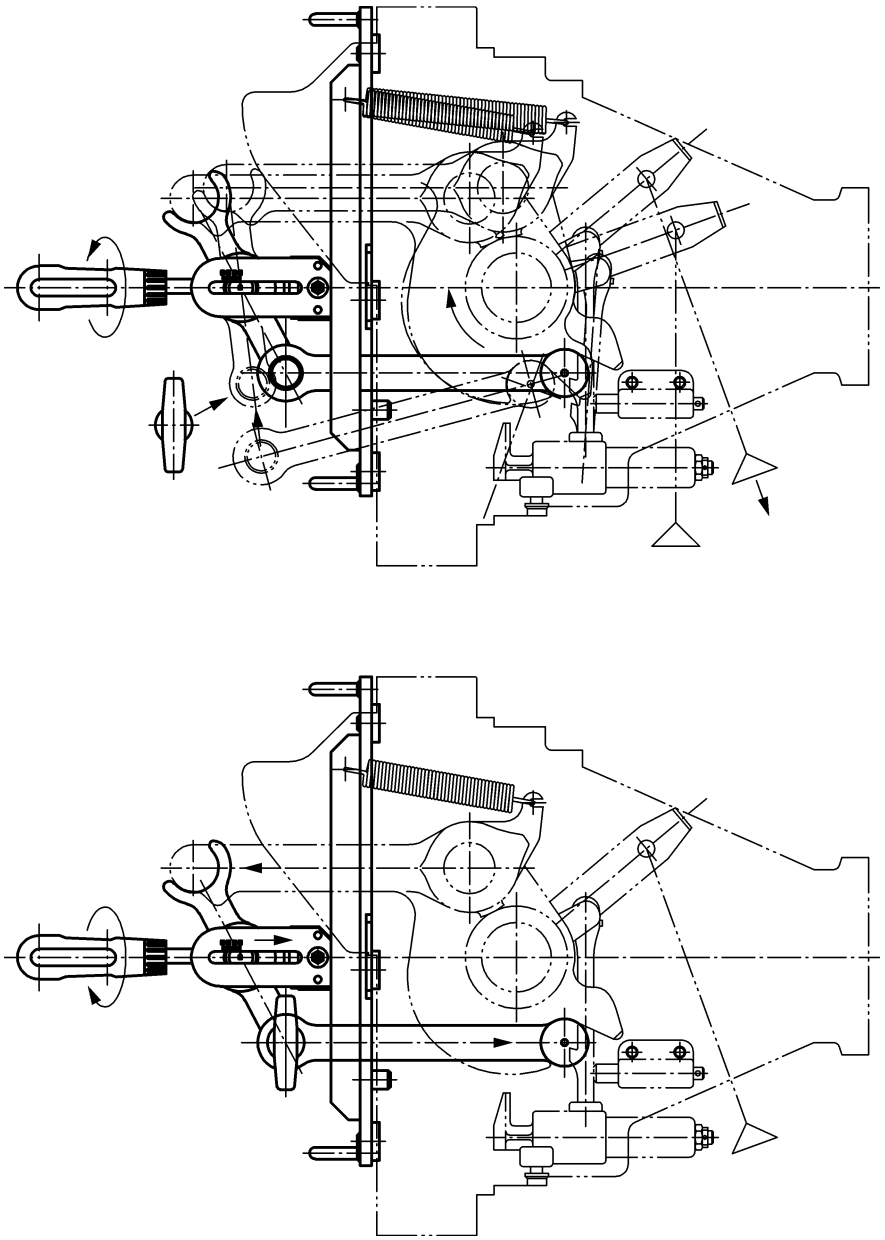
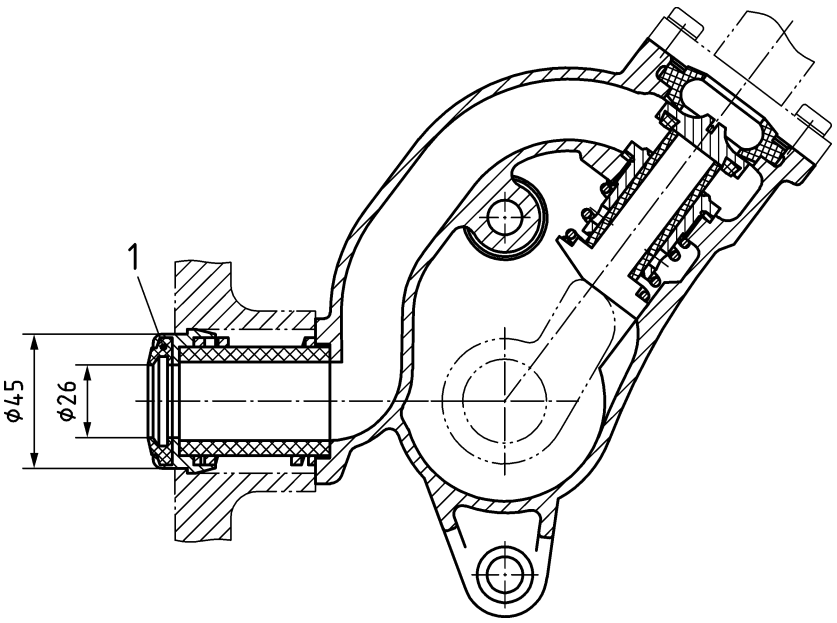


Figure C.3 — Coupler lock play measurement

Annex D
(normative)

Air pipe connections

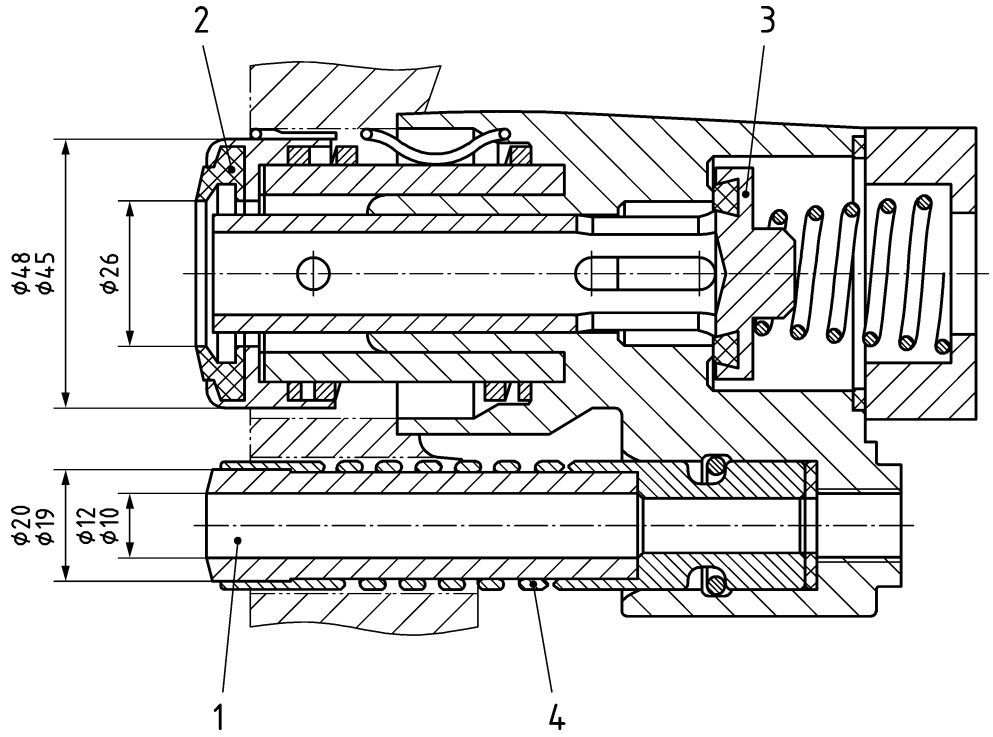
Inner and outer dimensions of the air pipe connection seals shall be according to Figure D.1 and Figure D.2. Air pipe connections may be of a design other than the one shown.



Key

1 seal

Figure D.1 — Brake pipe valve



Key

1	rubber tube	3	valve tappet
2	seal	4	spring

Figure D.2 — Main reservoir and uncoupling valve

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2008/57/EC

This European Standard has been prepared under a mandate given to CEN/CENELEC/ETSI by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the Directive 2008/57/EC [2)].

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in Table ZA.1 for HS Rolling Stock and Table ZA.2 for CR Locomotives and Passenger Rolling Stock, confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard, the HS RST TSI published in the OJEU dated 26 March 2008 and Directive 2008/57/EC

Clause/subclauses of this European Standard	Chapter/§/annexes of the TSI	Corresponding text, articles/§/annexes of the Directive 2008/57/EC	Comments
The whole standard applies	4. Characterisation of the subsystem 4.2 Functional and technical specification of the subsystem 4.2.2 Structure and mechanical parts 4.2.2.2 End couplers and coupling arrangements to rescue trains § 4.2.2.2.1 Subsystem requirements 4.2.2.2.2 Interoperability constituent requirements § 4.2.2.2.2.1 Automatic centre buffer coupler ANNEX K Coupler K.1 Schematic of the coupler	Annex III, Essential requirements 1 General requirements 1.1 Safety Clauses 1.1.1, 1.1.3, 1.1.5 1.2 Reliability and availability 1.5 Technical compatibility 2 Requirements specific to each subsystem 2.4 Rolling stock 2.4.1 Safety §1 2.4.2 Reliability and availability 2.4.3 Technical compatibility §3	

2) The Directive 2008/57/EC adopted on 17th June 2008 is a recast of the previous Directive 96/48/EC 'Interoperability of the trans-European high-speed rail system' and 2001/16/EC 'Interoperability of the trans-European conventional rail system' and their revision by Directive 2004/50/EC of the European Parliament and of the Council of 29 April 2004 amending Council Directive 96/48/EC on the interoperability of the trans-European high-speed rail system and Directive 2001/16/EC of the European Parliament and of the Council on the interoperability of the trans-European conventional rail system'.

Table ZA.2 — Correspondence between this European Standard, the CR TSI LOC and PASS RST published in the OJEC dated 26 March 2011 and Directive 2008/57/EC

Clause/subclauses of this European Standard	Chapter/§/annexes of the TSI	Corresponding text, articles/§/annexes of the Directive 2008/57/EC	Comments
The whole standard applies	4.Characterisation of the Rolling stock subsystem 4.2 Functional and technical specifications of the subsystem 4.2.2 Structure and mechanical parts 4.2.2.2 Mechanical interfaces § 4.2.2.2.3 End coupling	Annex III, Essential requirements 1 General requirements 1.1 Safety Clauses 1.1.1, 1.1.3, 1.1.5 1.2 Reliability and availability 1.5 Technical compatibility 2 Requirements specific to each subsystem 2.4 Rolling stock 2.4.1 Safety §1 2.4.2 Reliability and availability 2.4.3 Technical compatibility §3	

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

[1] EN 14478:2005, *Railway applications - Braking - Generic vocabulary*

[2] EN 12663-1, *Railway applications - Structural requirements of railway vehicle bodies - Part 1: Locomotives and passenger rolling stock (and alternative method for freight wagons)*