

TIS working group digital automatic coupler (DAC)

Specification of a digital automatic coupler for freight wagons

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Issue Record	Issue	Date	Comments	Source
1		March 2020	void	Euro Spec "Specification for automatic freight couplers"

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1. FOREWORD

The specification at hand serves as a technical description of a digital automatic coupling (DAC) for freight traffic in Europe.

The main target is to improve the reliability and quality of trains by using common and standardized functional and non-functional specification and verification methods.

The benefits of using this Spec:

- Increase of reliability by sharing good practice and experience;
- Simplification of the tender process in time and cost because of fewer variations in requirements between tenders;
- Standardized products and cost reduction due to harmonization of train operators' requirements.

The DAC specifications comprise merged functional and product basic requirements. The focus on it are technical aspects exclusively based on the existing requirements.

The DAC Spec is a voluntary specification designed to be used within the European region. The primary field of application is the European rolling stock domain and all associated interfaces.

Regarding the hierarchy this common specification can be positioned as follows, in order of prevalence:

- EN standards
- UIC/ UNIFE Technical Recommendations (TecRecs)
- UIC Codes (leaflets)
- Company Specifications

2. INTRODUCTION

This document is a voluntary specification, produced by Deutsche Bahn (DB), Ermewa SA, GATX Rail Germany GmbH, Österreichische Bundesbahnen (ÖBB), Schweizerische Bundesbahnen (SBB) and VTG AG with support of the railway industry Amsted Rail, Axtone S.A., CAF, Dellner Couplers AB, Knorr Bremse Systeme für Schienenfahrzeuge GmbH, Les Appareils Ferroviaires, MSV Metal Studenka, Miner Enterprises Inc., J.M. Voith SE&Co.KG, OLEO international and Wabtec Europe.

Individual companies may choose to mandate it through internal instructions/procedures or contract conditions.

Purpose of this document

- This document provides a voluntary specification for "Digital automatic couplers" for use by companies in the rail sector if they so choose.
- The document is set out in the same format as EN standards including, where appropriate, normative and informative annexes to facilitate the interface with European standards (Euro-Norms).

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Application of this document

- This specification is voluntary. Individual companies may however elect to mandate all or part of its use through company procedures or contract conditions. Where this is the case, the company concerned must specify the nature and extent of application.
- Specific compliance requirements and dates of application have therefore not been identified since these will be the subject of the internal procedures or contract conditions of those companies that choose to adopt this standard.

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Approval and authorization of this document

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3. SCOPE

This specification is applicable to freight wagons that are equipped with digital automatic couplers.

The purpose of this document is to provide a common specification for digital automatic couplers in freight wagons between train operators. This document is to replace individual company specific functional requirements. It constitutes a common reference being used for tendering and verification.

In this specification new requirements are added and for several requirements it is described how compliance to the requirement will be verified.

This specification is not intended to block innovation or to prevent improvement in automatic coupling systems. For this reason, a rationale is given for each requirement.

If applicable, the requirements are referenced to the EN 15380 structure. It is foreseen that more requirement sets and European standards will make use of this common reference structure.

4. NORMATIVE REFERENCES

The following referenced documents are indispensable for the application of this document. ENs are developed by CEN¹ or CENELEC² and are made available from their members.

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

TSI LOC & PAS	Technical specification for interoperability relating to the 'rolling stock - locomotives and passenger rolling stock' subsystem of the rail system in the European Union - Commission regulation (EU) N° 1302/2014 published 12/12/2014 (Directive 2008/57/EC)
TSI INF	Technical specification for interoperability relating to the subsystem 'infrastructure' of the rail system in the European Union - Commission regulation (EU) N° 1299/2014 published 18/11/2014 (Directive 2008/57/EC)
TSI WAG	technical specification for interoperability relating to the subsystem 'rolling stock – freight wagons' of the rail system in the European Union and repealing Decision 2006/861/EC
EN 12663-1	Railway applications - Structural requirements of railway vehicle bodies - Part 1: Locomotives and passenger rolling stock (and alternative method for freight wagons)

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EN 13803	Railway applications. Track. Track alignment design parameters. Track gauges 1435 mm and wider - Part 2: Switches and crossings and comparable alignment design situations with abrupt changes of curvature
EN 15380-2	Railway applications - Designation system for railway vehicles - Part 2: Product groups
EN 15551	Railway applications - Railway rolling stock - Buffers
EN 16019	Railway applications - Digital automatic coupler - Performance requirements, specific interface geometry and test method
EN 16116-1:2014-01	Railway applications - Design requirements for steps, handrails and associated access for staff -
EN 16116-2:2014-01	Part 1: Passenger vehicles, luggage vans and locomotives Part 2: Freight wagons
EN 50124-1	Railway applications - Insulation coordination - Part 1: Basic requirements - Clearances and creepage distances for all electrical and electronic equipment Part 2: Overvoltage's and related protection
EN 60529	Degrees of protection provided by enclosures (IP Code)
prEN 16839	Railway applications - Rolling stock - Head stock layout
UIC 522	Technical conditions to be fulfilled by the digital automatic coupler of the UIC and OSJD Member Railways
UIC 530-1	design measures on freight wagons with regard to the introduction of automatic coupling
UIC 530-2	wagons- running safety

1 Comité Européen de Normalisation / European Committee for Standardization <http://www.cen.eu>

2 Comité Européen de Normalisation Électrotechnique / European Committee for Electrotechnical Standardization - <http://www.cenelec.eu>

5. TERMS AND DEFINITIONS DIGITAL AUTOMATIC COUPLER

Digital automatic coupler is defined as a central buffer coupling that works automatically.

Note:

The requirements described in this specification are valid for digital automatic couplers for use in freight trains. For digital automatic couplers for use in passenger trains there exist different or additional requirements.

coupler head

Coupler head is defined as the front part of an digital automatic coupler that is used for mechanical coupling and uncoupling. Moreover, the connections for compressed air are also integrated in the coupler head. In addition, the contacts of the electrical coupler are mounted on, under or at the side of the coupler head.

electrical coupler

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Electrical coupler is defined as a system that is used for connecting or disconnecting the electrical lines automatically which transfer control signals or (low voltage) current from one wagon / loco to another.

horizontal and vertical support

Horizontal and vertical support (centering device) is defined as a system at the rear part of a coupler that moves - in the uncoupled condition - the complete coupler back into the middle position after it has been deflected.

The centering device keeps the 'free-standing' digital automatic coupler (when in the uncoupled condition) in the longitudinal axis of the train.

split collar	Split collar (shell-type sleeve, muff) is defined as a fastening element consisting of two metal half-shells (normally made of cast parts) that are joined by fasteners.
draw and buffing gear	Draw and buffing gear is defined as a damping element in the middle of the coupler that can absorb and transfer compressive forces and transfer tensile forces.
pivot anchor	Pivot anchor is defined as a device at the end of the coupler that allows a horizontal and vertical movement of the coupler. The pivot anchor consists of a spherical bearing (rose bearing) or an elastic joint and a bearing bracket
bearing bracket	Bearing bracket is defined as a plate or block at the rear of the coupler that provides attachment points for the coupler. The bearing bracket is attached to the headstock or the car body underframe.
locking plate	Locking plate is defined as a washer made from flexible sheet steel used for a form-locking anti-twist protection of nuts.
drawing	Drawing is defined as drawings for assemblies and single parts. When item numbers are given on the drawing a bill of material is mandatory and should be provided to the customer together with the drawing.
bill of material	Bill of material is defined as a list that includes information about the part's name, description, the dimensions and the material.
test	Test is defined as a fixed combination of test specification, testing and test report. The test specification normally is provided to the customer for approval before the beginning of the test.
contractor	Contractor is defined as the company that is responsible for the supply of the digital automatic coupler. If a complete vehicle or train set is bought the contractor is the vehicle manufacturer who bears the overall responsibility.
maintenance manual	Maintenance manual is defined as a compiled set of information for the maintenance of an entity treated (i.e. digital automatic coupler). The maintenance manual is part of the maintenance file.
maintenance file	Maintenance file is defined as a structured collection of all required information or data for the maintenance of an entity treated (i.e. digital automatic coupler).
mechanical isolation switch	Mechanical isolation switch is defined as a mechanical or pneumatical valve that disconnects the electrical coupler from pneumatical power.

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The mechanical isolation switch is part of the digital automatic coupler and installed on it. The mechanical isolation switch should give the operator the possibility to put the electrical coupler (back) into the uncoupled condition where e.g. the part(s) of the electrical coupler are located besides or on the top of the coupler head.

electrical isolation switch

Electrical isolation switch is defined as a switch that isolates the pins of the electrical coupler from the electrical system of the train.

6. SPECIFICATION

6.1. Aim

The aim of this specification is to provide a list of requirements that are important for defining digital automatic couplers which are used in freight wagons or/and locos. It should be considered that there exist different or additional requirements for digital automatic couplers for use in passenger trains.

In addition to the requirements the different documents, tests or other proofs are listed that are necessary for the verification of the fulfilment of the requirements.

The given requirements are fully compliant with Technical Specifications for Interoperability (TSI) and referenced european standards (EN).

6.2. List of requirements

The different columns in the table have the following meanings:

ID:

The identification number is a unique identification of each requirement. It ensures that the requirement remains uniquely traceable. It enables traceability to need, solutions and documents. The ID prefix for the specification for digital automatic couplers is defined as AUACO.

Requirement classification:

The requirement classification defines the importance and legal status of the requirement to the project. It is used to differentiate between the requirements regarding relevance and legal status like Requirement (RE - mandatory), Design Recommendation (DR), Optional Requirement (OR) or Information (INFO - only for information).

Requirement text:

Requirement text gives a description of the requirement.

Rationale:

The rationale provides the reason why the requirement is needed and points to any supporting analysis, trade study, modelling, simulation or other substantive objective evidence.

Product element EN 15380-2:

This column gives the link between the requirement and the product element of the EN 15380-2. By this the requirement is related to the item of the product breakdown of EN 15380-2. The first letter for the main product group (MPG) should be S for vehicle connection provisions. The second letter for the sub product group (SPG) should be B for digital automatic couplers.

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Status:

The status gives an indication of the approval state of the requirement. It is used to describe a defined status of a requirement in a standard database or requirement maturity level during a project.

Change since last release:

This column is used to indicate when and where the document has been changed.

Source:

The source gives an indication where the requirement originates from. It determines the traceability of the requirement to previous experiences like projects, working groups, lessons learned.

Comment of owner:

In this column remarks of the owner to the requirements are listed. This allows the owner to provide comments.

Annex to requirement:

Any appendices to the requirement given to the supplier industry can be found here. This information is used to relate the requirement to stored documents.

Requirement type:

The requirement type gives the intent and kinds of properties the requirement represents. These aids collecting requirements into groups for analysis and allocation.

Verification:

The information regarding the verification is given in five columns that cover certain instants of time. The columns to be filled out are offer of tenderer(s), design review, first article inspection (FAI) of components, first integration inspection (FI) and take-over. In each column the requested document (concept, drawing, calculation) or test is listed that should be provided or performed by the manufacturer until the given instant of time.

The list of requirements for the digital automatic couplers is divided into the following chapters:

1 General requirements for the digital automatic coupler

2 Mechanical part

3 Energy absorption system

4 Pneumatic connections of the digital automatic coupler

5 Electrical connections of the digital automatic coupler (mechanical part)

6 Safety

7 General requirements (part of the system requirement specification)

8 Hybrid coupler

16 21 63 52 36 21 21 31 21 21 21
 # 11 18 53 20 14 14 16 14 19 19 20

technical Specification automatic coupler for freight wagons/ hybridcoupler for locos (version V1.00)

ID	Requirement classification	Requirement-text	Wertung	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type
AUCO.1	--	Automatic couplers									
AUCO.2	--	1 General requirements for the automatic coupler									
AUCO.3	INFO	The AC shall be used exclusively for freight applications. It is not foreseen for passenger applications	Info	General	SB	draft	--	Shift2Rail			General
AUCO.4	RE	The AC shall be compatible with the UIC wagon standard interfaces.	Muss (für Hybridkupplung)	General	SB	draft	--	Shift2Rail			General
AUCO.5	RE	The installation space according to UIC 530-1 annex 4c, is decisive for the design of the coupling.	Muss	General	SB	draft	--	TIS working group			General
AUCO.6	INFO	The AC shall be temporary compatible with the UIC Screw Coupler. <u>Note:</u> The adapter shall be an "coupler- wagon", at one site with UIC- coupler, at the opposite site with an	Info	General	SB	draft	--	Shift2Rail			General
AUCO.7	INFO	Exception from this requirement (AUCO 5) can be made for wagons in isolated traffic operations.	Info	General	SB	draft	--	Shift2Rail			General
AUCO.8	RE	The coupler assembly shall be as simple as possible, but robust.	Muss	General	SB	draft	--	Shift2Rail			General
AUCO.9	RE	The weight of the coupler shall be minimized. <u>Note:</u> The weight of the AC shall not be more than the UIC-Couplingsystem (2 Buffers, screw-coupler and draw hook inclusive draw-gear) At least the coupler shall weight less equal 370-380 kg .	Muss	General	SB	draft	--	Shift2Rail			General
AUCO.10	RE	The coupler head shall restrict a strength from 2.000 kN for pressure forces without any plastic deformations. The coupler head shall restrict a strength from - 1.000 kN for draw forces - 2.000 kN for pressure forces without any plastic deformations (R _p 0,2). <u>Note:</u> This requirement shall forestalling a destruction of the casing of the coupler head in case of a bounce.	Muss	General	SB	draft	--	Shift2Rail			General

ID	Requirement classification	Requirement-text	Wertung	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type
AUCO.11	RE	The wagon and the components of it shall fulfill TSI WAG, Chapter 4.2.5 Environmental conditions and at least the temperature class T1 to T3 (40°C to -45°C).	Muss	General	SB	draft	--	Shift2Rail			General
AUCO.12	OR	The automatic coupler shall fulfil the requirements of the energy absorption concept for the wagon, incl. Requirements from to TE22 of RID.	Option	Safety	SB	draft	--	Shift2Rail			Safety
AUCO.13	OR	The automatic coupler shall not cause a climbing of car bodies or a derailment in case of collision up to 150 kN vertical force.	Option, gilt nur für RID-Fahrzeuge	Safety	SB	draft	--	Shift2Rail			Safety
AUCO.14	OR	If the automatic coupler has been exposed to unacceptable load that may have caused a damage to the draw and buffing gear, this damage shall be obviously visible. <u>Note:</u> According to coupling sow's guidance (level 2/4/5) a mechanical or automated solution be used	Option, Anzeige bei Ausschöpfung der max. zulässigen Belastung	Safety, maintainability	SB	draft	--	Shift2Rail			Maintenance, Safety
AUCO.15	--	2 Mechanical part									
AUCO.16	RE	The design shall minimize the lateral and vertical efforts transmitted to the wagons, during curve negotiation.	Soll	General	SB	draft	--	Shift2Rail			General
AUCO.17	RE	The horizontal gathering range in straight tracks: the couplers shall to interact safe with up to 120 mm difference in height in their centre lines in minimum.	Muss	Experience of operators	SB	draft	--	Shift2Rail			General
AUCO.18	RE	The vertical gathering range of the coupler head will be in the range of 220 mm minimum at each side.	Muss	Experience of operators	SB	draft	--	Shift2Rail			General
AUCO.19	DR	The distance between pivots and the overhang, in order to define the automatic coupler, should be calculated according to the formula given in UIC 530-1. <u>Note1:</u> Automatic couplings need only be connectable up to a track curve radius $R \geq 150$ m. The requirements of UIC leaflet 522 also apply. <u>Note 2:</u> A graphical evaluation of the geometric requirements is permissible.	Soll	Experience of operators	SB	draft	--	Shift2Rail		UIC 530-1	General
AUCO.20	RE	On straight tracks the coupler shall be able to couple automatically without manual intervention.	Muss	Experience of operators	SB	draft	--	Shift2Rail			General

ID	Requirement classification	Requirement-text	Wertung	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type
AUCO.21	DR	Vehicles with automatic coupler shall be coupled with manual intervention on transition curves between straight tracks and curves of a minimum radius of 150 m.	Muss	Experience of operators	SB	draft	--	Shift2Rail			General
AUCO.22	DR	Vehicles with automatic coupler shall be able to couple with manual assistance on reverse curves of a minimum radius of 150m, with a 6 m intermediate straight track.	Muss	Experience of operators	SB	draft	--	Shift2Rail			General
AUCO.23	DR	Vehicles with automatic coupler shall be able to couple without manual assistance on reverse curves of a minimum radius of 190m, without intermediate straight track.	Muss	Experience of operators	SB	draft	--	Shift2Rail			General
AUCO.24	DR	Vehicles with automatic coupler shall allow running on ramps with a maximum inclination of 1/16 when coupled. The practicability of ferryboat ramps with a crease corner from at most 2°30' and a curve radius of 150 m is to be proved. <u>Note:</u> used only by inclinations in the coupled state; no coupling	Muss	Experience of operators	SB	draft	--	Shift2Rail			General
AUCO.25	DR	proper coupling must be ensured a) in straight track between 2km/h and minimum 7km/h b) in curve radius 150m up to 5 km/h c) in s-bow 190m with 6 m straight track up to 5 km/h d) in s-bow 120 m with 20m straight track up to 5 km/h	Muss	Experience of operators		draft	--	GATX			General
AUCO.26	RE	The automatic coupler shall be mechanical and pneumatical compatible with the coupling type "?". <u>Note:</u> The coupling must be compatible within the coupling family.	Muss	Notification to one type of automatic coupler gives a possibility to let turn freight car everywhere in	SB	draft	--	EuroSpec automatic coupler type 10			General

ID	Requirement classification	Requirement-text	Wertung	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type
AUCO.27	RE	It shall be possible, by means of a manual operation at the lateral sides of the vehicle, to set the locking mechanism in a position in which the heads remain uncoupled until the vehicles separate and they are ready revert to the coupled position, after separation of the vehicles. It shall also be possible to keep the locking mechanism in the uncoupled position, to prevent undesired coupling, at the hump.	Muss	Safety, Operating conditions for the personnel, Experience of operators	SB	draft	--	Shift2Rail			General
AUCO.28	RE	In event of failure of the horizontal or vertical support the coupler head shall not fall down and reach the track.	Muss	Safety	SB	draft	--	EuroSpec automatic coupler type 10			Safety
AUCO.29	RE	The main pin of the coupler head shall be lubricated/ greased.	Muss	Avoidance of self-lubricating bearings for the main pin because of bad	SB	draft	--	EuroSpec automatic coupler type 10			Maintenance
AUCO.30	DR	The coupling height is 1040 +5/-15 mm from the top of rail (TOR) according to TSI CR.	Muss	Usability	-	draft	--	Shift2Rail / TSI CR		TSI CR	General, Operation
AUCO.31	RE	The automatic coupler shall work unrestricted and reliably under all operational conditions, e.g. rain, pollution, washing water, snow, ice and particularly in hot summers as well as in cold winters. These conditions shall not have any influence on the function of the coupler.	Muss	Reduce maintenance costs, reliability for life time	SB	draft	--	Shift2Rail			General
AUCO.32	RE	Manual Uncoupling shall be possible without external tooling-	Muss	Use in case of malfunction, during maintenance, in case of emergency / rescue	SB	draft	--	Shift2Rail			Operation
AUCO.33	RE	Manual uncoupling shall be possible by one person with a maximum manual tractive power (tension load) of 200 ... 250 N on the coupler's handle.	Muss	Operating condition	SB	draft	--	EuroSpec automatic coupler type 10			Operation
AUCO.34	RE	The manual uncoupling device shall be visible and accessible.	Muss	Operating conditions for the personnel, feasibility in maintenance	SB	draft	--	Shift2Rail			Operation

ID	Requirement classification	Requirement-text	Wertung	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type
AUCO.35	RE	The coupler head shall restrict a strength from - 1.000 kN for draw forces - 2.000 kN fo pressure forces without any plastic deformations (R _p 0,2). <u>Note:</u> In case of overload, the coupling head should not be damaged. . A nominal breaking point for loads above 1500 kN should be located in the drawbar.	Muss	Safety, acc. to EN 12663-2,	SB	draft	--	Shift2Rail			Strength
AUCO.36	RE	The automatic coupling shall have a long-term firmness for tractive powers and compressive forces of 270 ... 290 kN in service. The actual force is only for prototype coupler. Real forces will be kind during 2020 (TIS value on long value is under construction) <u>Note:</u> Value comes from IGW testing, real this could be 450 kN in relation to the current maximum tractive forces of existing lokos. In the future, higher continuous loads are also possible if locomotives are operated to realise a higher tractive power (e.g.6-axle locos).	Muss	Safety		draft	--				
AUCO.37	RE	The automatic coupling shall have an "buffer position" for shunting operation.	Muss	Experience of operators							General
AUCO.38	INFO	The "buffer position" allows disengagement and re-injection during manoeuvring without a new coupling	Info								
AUCO.39	RE	The change from the " buffer position " to the "ready for automatic coupling" position must be possible manually from outside the borderline of the vehicle.	Muss	Experience of operators							General
AUCO.40	INFO	In case that the vehicle is not in any category acc. to EN 12663-2 the value of the pulling force the automatic coupler has to resist can be adapted to the vehicle strength.	Info	-	-	draft	--	EuroSpec automatic coupler type 10		EN 12663	General
AUCO.41	RE	The casing of the automatic coupler shall resist a compressive force up to 2000 kN without causing any irreparable damage to the coupler head (e.g. cracks or plastic deformation).	Muss	Experience of operators	SB	draft	--	EuroSpec automatic coupler type 10			Strength
AUCO.42	RE	The pivoting range of the automatic coupler shall be +/- 11° in vertical and +/- 20° in horizontal direction.	Muss	Operating condition	SB	draft	--	EuroSpec automatic coupler type 10			Operation

ID	Requirement classification	Requirement-text	Wertung	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type
AUCO.43	RE	The automatic coupler shall allow the train to operate on slope connections with a radius according to TSI Infrastructure for vertical curves.	Muss	Operating condition	SB	draft	--	Shift2Rail			Operation
AUCO.44	RE	The automatic coupler shall have a centring device.	Muss	Improvement of the ease of use and the reliability of the coupling process	SB	draft	--	Shift2Rail			Operation
AUCO.45	RE	The horizontal support of the automatic coupler shall operate mechanically.	Muss	Use of a reliable design	SB	draft	--	Shift2Rail			Operation
AUCO.46	RE	The automatic coupling shall be designed in such a way that it can be used either with cross-beam support or with strut support.	Muss	Use of a reliable design	SB	draft		TIS working group			General
AUCO.47	RE	The mechanical connecting elements, horizontal and vertical support of the automatic coupler and its fastening elements shall withstand the operating load during its lifetime./ between 2 heavy maintenance levels. (Note: lifetime 30 years)	Muss	Experience of DB: plastic deformations on two different coupler types	SB	draft	--	Shift2Rail			General
AUCO.48	INFO	For wagons with automatic couplers it shall be possible to drive on rail curves with R =75 m in the coupled state.	Info	Experience of operators	SB	draft	--	TIS working group			General
AUCO.49	RE	The automatic coupler shall stay stable in the uncoupled condition. Appearing relative movements may not lead to the destructions in the vehicle structure	Muss	Safety; to ensure a defined position of the coupler	SB	draft	--	Shift2Rail			Operation
AUCO.50	DR	When using the automatic coupler, connected vehicles shall be able to run through curves with radii $r \geq 120$ m without any restrictions.	Muss	To ensure smooth operation on curves with small radii	SB	draft	--	Shift2Rail			Operation
AUCO.51	DR	When using the automatic coupler, connected vehicles shall be able to run through curves with radii $r \geq 100$ m without any restrictions.	Muss	to ensure smooth operation on curves with small radii	SB	draft	--	Shift2Rail			Operation

ID	Requirement classification	Requirement-text	Wertung	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type
AUCO.52	INFO	When using the automatic coupler, connected vehicles shall be able to run through S-curves with radii $r \geq 150$ m without any restrictions (according to EN 13803 Kap.6.12,	Info	European standard (EN 13803)	SB	draft	--	Shift2Rail		EN 13803	Operation
AUCO.53	INFO	Track conditions are defined in the TSI Infrastructure chapter "Interfaces with the rolling stock subsystems" too.	Info	-	-	-	--				-
AUCO.54	OR	The automatic coupler shall be equipped with an automatically operated uncoupling device. Note: An automatic uncoupling device is mandatory for DAC 5. Nevertheless, the space provided for this purpose must also be taken into constructional consideration in the case of previous versions.	Option bis DAK 4, ab DAK 5 Muss	Improvement of the ease of use when uncoupling	SB	draft	--	Shift2Rail			Operation
AUCO.55	OR	If there is an uncoupling device: The uncoupling device may be pneumatic or an electrical device.	Option bis DAK 4, ab DAK 5 Muss					EuroSpec automatic coupler type 10			
AUCO.56	OR	Uncoupling shall be possible from any active drivers cab.	Option bis DAK 4, ab DAK 5 Muss	Safety	SB	draft	--	EuroSpec automatic coupler type 10			Operation
AUCO.57	OR	The active driver cab might not be near to the coupler involved into the uncoupling process.	Option bis DAK 4, ab DAK 5 Muss	-	-	--	--				-
AUCO.58	OR	If the uncoupling device is not in action it shall be in a neutral situation (ready to couple position).	Option bis DAK 4, ab DAK 5 Muss	Experience of operators	-	draft	--	Shift2Rail			-
AUCO.59	INFO	The active driver cab shall only be located where coupling or uncoupling is going to be executed (local to the coupler involved).	Info bis DAC 4, Muss ab DAC 5)	Safety	SB	draft	--	EuroSpec automatic coupler type 10			Operation
AUCO.60	OR	The active driver cab is located near to the coupler involved in the uncoupling process.	Option bis DAK 4, ab DAK 5 Muss	-	-	--	--				-
AUCO.61	OR	Locos only Automatic uncoupling shall only be possible when the following conditions occur: -Train speed is 0 km/h; -The brake pipe (BP) pressure is lower than 3,5 bar. and -The operator has activated the automatic/manual uncoupling signal/mechanism. Note: Besides, the logic for the speed recognition does not lie on the wagon, only on the locomotive	Option	Safety, experience of operators	SB	draft	--	Shift2Rail			Operation, Safety

ID	Requirement classification	Requirement-text	Wertung	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type
AUCO.62	RE	During the uncoupling process the uncoupling device of the two connected couplers shall work simultaneous.	Muss	Experience of the operators (bad experiences with a certain coupling system)	SB	draft	--	Shift2Rail			Operation
AUCO.63	OR	The contractor shall provide the time required for the replacement of the coupler head including the electrical connections by 2 persons.	Option	Maintenance costs	SB	draft	--	EuroSpec automatic coupler type 10			Maintenance
AUCO.64	RE	The contractor shall provide the time required for the replacement of the coupler head by 2 persons.	Muss	Maintenance costs	SB	draft	--	EuroSpec automatic coupler type 10			Maintenance
AUCO.65	RE	The replacement of a coupler head shall be possible within 60 min by 2 persons.	Muss	Maintenance costs	SB	draft	--	EuroSpec automatic coupler type 10			Maintenance
AUCO.66	RE	The necessary tools, resources and devices for the maintenance and replacement of the automatic coupler or parts of it (including the electrical coupler) shall be agreed	Muss	Maintenance costs	SB	draft	--	Shift2Rail			Maintenance
AUCO.67	INFO	The use of special tools for maintenance and replacement of the automatic coupler or parts of it shall be avoided.	Info	-	-	--	--				-
AUCO.68	RE	Where the use of special tools for maintenance and replacement of the automatic coupler or parts of it is required the customer shall be provided with the detailed information. This document informs about the operation purpose, which measurements have to be made, which values are acceptable (e. g. system technical threshold value) and how the calibration of the special tools has to be made (point of time, procedure).	Muss	Maintenance costs	SB	draft	--	Shift2Rail			Maintenance
AUCO.69	RE	Related to the ordered wagon types or wagon series the fixing of the coupler head to the coupler, e. g. with a split collar, shall be the same for all couplers regarding dimensions or diameters.	Muss	Maintenance costs	SB	draft	--	Shift2Rail			Maintenance
AUCO.70	OR	The replacement of an uncoupling device shall be possible within 60 min by 1 person.	Option	Maintenance, experience of the operators	SB	draft	--	EuroSpec automatic coupler type 10			Maintenance

ID	Requirement classification	Requirement-text	Wertung	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type
AUCO.71	RE	The contractor shall provide drawings necessary for maintenance, a maintenance manual / file that includes all required actions for the maintenance of the coupler.	Muss	Maintenance planning	SB	draft	--	EuroSpec automatic coupler type 10			Maintenance
AUCO.72	RE	The contractor shall provide the time required for the maintenance and the different maintenance steps of the automatic coupler (including electrical and data connections).	Nuss	Maintenance planning	SB	draft	--	EuroSpec automatic coupler type 10			Maintenance
AUCO.73	RE	The automatic coupler shall reach a reliability of "Z" %, based on the operating time between the manufacturing and the first complete overhaul or between two complete overhauls. <u>Note:</u> The verification of the achieved percentage regarding reliability has to be defined and agreed with the customer.	Muss	Maintenance costs	SB	draft	--	Shift2Rail			Operation, Reliability
AUCO.74	RE	The automatic coupler shall reach a reliability in the way that it will reach an operational reliability level of "Y" breakdowns per million km. <u>Note:</u> "Y" and the verification of the achieved reliability level (e.g. minor, major, significant) has to be defined and harmonised with the customer.	Muss	Maintenance costs	SB	draft	--	EuroSpec automatic coupler type 10			Operation, Reliability
AUCO.75	RE	The main parts of the automatic coupler (e.g. coupler head, draw and buffing gear, pivot anchor) shall be connected with connecting elements to be solved simply	Muss	Reduction of work during maintenance	SB	draft	--	Shift2Rail			Maintenance
AUCO.76	OR	The automatic coupler, especially the coupler head, shall be equipped with a top protection against rain, washing water, windscreen cleaning agents, or snow and ice.	Option	Experience of operators	SB	draft	--	EuroSpec automatic coupler type 10			Operation
AUCO.77	RE	The greasing of automatic coupler parts shall be possible without dismounting any main parts, e.g. coupler head, draw bar, electrical coupler, draw and buffing gear, pivot anchor, centring device. The greasing intervall shall be 6 years. Maintenance under service is to describe by the supplier.	Soll	Experience of operators	SB	draft	--	Shift2Rail			Maintenance

ID	Requirement classification	Requirement-text	Wertung	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type
AUCO.78	RE	The coupler head, coupler shank (draw bar), draw and buffing gear, electric coupler, centring device and connecting elements shall be indelibly marked with the supplier's brand, the date of manufacturing and the serial number.	Muss	Experience of operators	SB	draft	--	Shift2Rail			Maintenance
AUCO.79	RE	The system for manual uncoupling shall work without malfunction or destruction of any parts - except for wearing parts, e. g. cable pull - during the whole life time of the coupler/ between 2 heavy maintenances.	Muss	Experience of operators	SB	draft	--	Shift2Rail			Maintenance
AUCO.80	RE	The manual uncoupling system shall withstand an operating force of at least 2000 N without any measurable plastic deformation during its whole life time. The direction of the force should be in the same direction as the uncoupling system is operated. The application of the force should be where the hand of the operator activates the uncoupling system.	Muss	Experience of operators	SB	draft	--	EuroSpec automatic coupler type 10			Maintenance
AUCO.81	--	3 Energy absorption system									
AUCO.82	RE	The draw bar (draw and buffing gear) shall be equipped with a reversible elastic element for energy absorption.	Muss	Experience of operators	SB	draft	--	Shift2Rail			Damage prevention
AUCO.83	RE	The elastic energy absorption system shall endure a life cycle test analogous to EN 15551, Chapter 5.5 and Annex C. <u>Note</u> The values given in EN 15551 stand for a buffer and must be doubled with regard to the requirements for an automatic coupling.	Muss	Experience of operators	SB	draft	--	Shift2Rail		EN 15551	Reliability
AUCO.84	INFO	The wear or leakages (oil, air) of the elastic system can imply a drop of the energy absorption of the coupler in reversible dynamic conditions.	Info	-	-	--	--				-
AUCO.85	OR	The automatic coupler shall be equipped with a system (e.g. sensors, measurement of leakage, maintenance detection) that indicates when the system is no longer able to absorb enough energy in dynamic conditions. The manufacturer shall define and describe this kind of system.	Option	Innovation	SB	draft	--	Shift2Rail			Maintenance, Safety

ID	Requirement classification	Requirement-text	Wertung	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type
AUCO.86	INFO	An energy absorption of 80 % of the elastic system in new condition is considered to be the limit. A value below this level is not appropriate to keep the elastic system in service.	Info	-	-	draft	--				-
AUCO.87	OR	The reversible elastic system shall detect and show whether it is still working after it has been exposed to an impact or crash without dismantling any parts of the elastic system.	Option	Experience of operators	SB	draft	--	EuroSpec automatic coupler type 10			Maintenance, Safety
AUCO.88	INFO	In coupled condition the interaction between traction spring and compression spring has to avoid any increase of tension force in the couplers when the train is braked and parked.	Info	-	-	draft	--	Shift2Rail			-
AUCO.89	RE	The reversible elastic element should absorb energy during the coupling up to 8 km/h with the pushing 90 t against 80 t without every damage to the automatic coupler (and to the vehicle).	Muss	Experience of operators	SB	draft	--	EuroSpec automatic coupler type 10			Strength, Damage prevention
AUCO.90	RE	For locos only The elastic system shall be designed in the way that the deceleration (inside the drivers cab) does not exceed 2 g for coupling up to 7 km/h.	Muss	Experience of operators	SB	draft	--	EuroSpec automatic coupler type 10			Strength, Damage prevention, Safety
AUCO.91	RE	During coupling up to 12 km/h or maximum force of 2.000 kN when pushing 90 t against 80 t without any damage on the automatic coupler (and to the vehicle).	Muss	Experience of operators	SB	draft	--	Shift2Rail			Strength, Damage prevention
AUCO.92	RE	The reversible and irreversible energy absorption system shall be able in the way that the deceleration (inside the cab) does not exceed 3 g for coupling up to 12 km/h or a maximum force of 2.000 kN.	Muss	Experience of operators	SB	draft	--	EuroSpec automatic coupler type 10			Strength, Damage prevention, Safety
AUCO.93	INFO	The irreversible energy absorption element shall be replaced after a collision or heavy shunt.	Info	-	-	--	--				-
AUCO.94	OR	The automatic coupler shall have a visible indicator that shows that the irreversible energy absorption element has been triggered.	Option	Experience of operators	SB	draft	--	Shift2Rail			Maintenance, Safety
AUCO.95	OR	The driver shall be warned if any irreversible energy absorption element has been used.	Option	Innovation	SB	draft	--	Shift2Rail			Safety

ID	Requirement classification	Requirement-text	Wertung	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type
AUCO.96	--	4 Pneumatic connections of the automatic coupler									
AUCO.97	RE	The automatic coupler shall be pneumatically compatible with the coupling type "Y".	Muss	To offer interoperability between different vehicles, to reduce number of different adaptors;	SB	draft	--				Operation
AUCO.98	INFO	Regarding other coupler types further information has to be provided by the operator.	Info	-	-	draft	--	EuroSpec automatic coupler type 10			-
AUCO.99	RE	The pneumatic connection of the automatic coupler shall be done automatically after or simultaneously to the mechanical connection.	Muss	Experience of operators	SB	draft	--	Shift2Rail			Safety
AUCO.100	RE	The disconnection of the pneumatic connection shall be done automatically before or simultaneously to the mechanical uncoupling.	Muss	Experience of operators	SB	draft	--	Shift2Rail			Safety
AUCO.101	RE	If the automatic coupler is unintentionally disconnected, an emergency braking of the train shall be initiated.	Muss	General, Safety	SB	draft	--	EuroSpec automatic coupler type 10			Safety
AUCO.102	RE	The diameter of the pipe lines inside the automatic coupler shall be 5/4 ".	Muss	Experience of operators	SB	draft	--	EuroSpec automatic coupler type 10		EN 16019	Safety
AUCO.103	RE	The brake pipe valve shall be directly mechanically activated by working of the mechanical coupling device of the coupler head.	Muss		SB	draft	--	Shift2Rail			Safety
AUCO.104	RE	When not in use, the air pipes must be protected against the penetration of dirt and humidity.	Muss	Experience of operators	SB	draft		TIS working group			Safety
AUCO.105	--	5 Electrical and data connections of the automatic coupler (mechanical part)									
AUCO.106	RE	The electrical coupler shall have the protection class IP 54/55 (during coupled and uncoupled condition).	Muss	Acc. to EN 60529 no rain water is allowed to reach the	SB	draft	--	EuroSpec automatic coupler type 10			Reliability, Safety

ID	Requirement classification	Requirement-text	Wertung	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type
AUCO.107	RE	The electrical coupler shall fulfil the requirements according to EN 50124-1 regarding clearances and creepage distances for equipment.	Muss	Acc. to EN 50124-1	SB	draft	--	EuroSpec automatic coupler type 10		EN 50124	Reliability, Safety
AUCO.108	RE	Single contacts of the electrical coupler shall be replacable from the front without removing or replacing the complete electrical coupler.	Muss	Experience of operators	SB	draft	--	EuroSpec automatic coupler type 10			Maintenance
AUCO.109	RE	The electrical contacts of the automatic coupler shall ensure the connection of control signal lines, data bus lines, lines for transmitting signals and voltage between coupled vehicles and between the train and the loco(s). <u>Note:</u> Actually the voltage is to be limited to 110 V with a current of 50 amperes.	Muss	Safety, experience of operators	SB	draft	--	EuroSpec automatic coupler type 10			Operation, Safety
AUCO.110	INFO	The signal transfer between the couplings can also be realised as a WiFi, NFC or via bluetooth.	Info								
AUCO.111	RE	The mechanical, pneumatic and electrical connections shall be made within a period of 10 seconds.	Muss	Experience of operators	SB	draft	--	EuroSpec automatic coupler type 10			Operation
AUCO.112	RE	The electrical coupling shall be made within a certain period of time (2 to 6 seconds), after a complete mechanical and pneumatic coupling has been made.	Muss	Experience of operators	SB	draft	--	EuroSpec automatic coupler type 10			Operation
AUCO.113	INFO	The maximum time expended for these connections does not impair any other vehicle functions, e. g. of the TCMS.	Info	-	-	draft	--				-
AUCO.114	RE	The mechanical and pneumatic uncoupling shall be made within a certain period of time (2 to 6 seconds), after a complete electrical uncoupling has been made.	Muss	Experience of operators	SB	draft	--	EuroSpec automatic coupler type 10			
AUCO.115	RE	The connection and separation of the mechanical and electrical connection shall be done automatically (without additional activities by the operating personnel).	Muss	Experience of operators	SB	draft	--	EuroSpec automatic coupler type 10			Operation

ID	Requirement classification	Requirement-text	Wertung	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type
AUCO.116	OR	If the electrical/ data coupler is separate from the mechanical coupler: The electrical coupler shall automatically move to the back position (uncoupling position) only if it is operated by the automatic uncoupling device. Alternative: The electric connecting component should go after separation to a parking position.	Option	-	-	draft	--	EuroSpec automatic coupler type 10			-
AUCO.117	RE	Locos only: The electrical coupler shall have a "mechanical isolation switch".	Muss	Experience of operators	SB	draft	--	EuroSpec automatic coupler type 10			Maintenance
AUCO.118	INFO	Locos only: The "mechanical isolation switch" is used for the manual separation or isolation of the electrical coupler and is activated by the maintenance personnel.	Info	-	-	--	--				-
AUCO.119	OR	Only for electrical coupler separate from the mechanical coupler: If the "mechanical isolation switch" of the electrical coupler is used (activation of the switch) the electrical coupler shall stay steady and shall not automatically move. If the "mechanical isolation switch" of the electrical coupler is used again (deactivation of the switch) the electrical coupler shall stay in the current position as well (no automatic movement).	Option	Experience of operators	SB	draft	--	EuroSpec automatic coupler type 10			Maintenance
AUCO.120	OR	Only for electrical coupler separate from the mechanical coupler: If the "mechanical isolation switch" of the electrical coupler has been activated the electrical coupler shall offer the possibility to be moved manually.	Option	Experience of operators	SB	draft	--	EuroSpec automatic coupler type 10			Maintenance
AUCO.121	RE	Locos only: The position or the state of the "mechanical isolation switch" shall be visible to the maintenance personal outside of the vehicle.	Muss (Locos only)	Safety, experience of operators	SB	draft	--	EuroSpec automatic coupler type 10			Maintenance
AUCO.122	INFO	The electrical coupler shall have an "electrical isolation switch" that is used by the operating personnel. Note: The electrical isolation switch is part of the delivery of the vehicles manufacturer.	Info	-	-	draft	--				Operation
AUCO.123	INFO	The "electrical isolation switch" is used for the electrical separation or isolation of the electrical coupler and is activated by the operating personnel.	Info	-	-	draft	--				-

ID	Requirement classification	Requirement-text	Wertung	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type
AUCO.124	INFO	The "electrical isolation switch" for the operating personnel shall be located in a cab (adjacent to the coupler). <u>Note:</u> The electrical isolation switch is part of the delivery of the vehicles manufacturer .	Info	-	-	draft	--				Operation
AUCO.125	OR	The "electrical isolation switch" shall be operated from the active cab and shall switch off all current to the (corresponding) electrical coupler, including cables and connectors.	Option	Experience of operators	SB	draft	--	EuroSpec automatic coupler type 10			Operation
AUCO.126	RE	The "electrical isolation switch" shall offer the possibility to be locked and secured against unauthorised unlocking.	Muss	Experience of operators	SB	draft	--	EuroSpec automatic coupler type 10			Operation
AUCO.127	INFO	Further information about the number of contacts, the contact arrangement and the contact assignments shall be given in the specification module "Vehicle control system" .	Info	-	-	--	--				-
AUCO.128	INFO	The train manufacturer shall provide the coupler manufacturer with all required information regarding the number and arrangement of contacts that have to be connected by the electrical coupler.	Info	-	-	--	--				-
AUCO.129	INFO	Further information about environmental conditions shall be given in the specification module "System specification" of the technical requirement specification.	Info	-	-	draft	--				-
AUCO.130	RE	The electrical contacts of the automatic coupler shall not be damaged during normal operation (when electrical coupling and/or uncoupling is successful as well as unsuccessful).	Muss	Experience of operators	SB	draft	--	EuroSpec automatic coupler type 10			Maintenance, Operation
AUCO.131	RE	Checking and adjusting the position of the electrical coupler shall be required a maximum once at 6 years.	Muss	Experience of operators; reduction of work in maintenance	SB	draft	--	EuroSpec automatic coupler type 10			Maintenance
AUCO.132	RE	The train bus bar (main power line between wagons and between train and loco) shall be coupled by the automatic coupler.	Muss	Innovation	SB	draft	--	EuroSpec automatic coupler type 10			General

ID	Requirement classification	Requirement-text	Wertung	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type
AUCO.133	RE	The electrical coupler shall be equipped with a protection of the pins against influences from outside (when the electrical coupler is not connected to another one).	Muss	Experience of operators; protection against humidity and dirt	SB	draft	--	EuroSpec automatic coupler type 10			Soiling prevention
AUCO.134	RE	The potential interferences between the seals and the protection or between the seals and the body of the electrical coupler shall not generate any disturbance to the protection.	Muss	Bad experiences of operators with covers that did not open or close properly because of problems with	SB	draft	--	EuroSpec automatic coupler type 10			Operation
AUCO.135	RE	In case of a collision the protection shall prevent the electrical coupler from making short circuits.	Muss	Safety	SB	draft	--	EuroSpec automatic coupler type 10			Safety
AUCO.136	RE	The contact resistance for energy transmission and ep brake must be less than 5 mOhms (7 mOhms including reserve over lifetime). <u>Info:</u> This includes the transition from the line of one wagon through the coupling and into the line of the following wagon.	Muss	Reduction of power losses at the coupler interfaces to provide sufficient power over	SB	draft					Operation
AUCO.137	RE	The contact resistance for data transmission must be less than 25 mOhms. <u>Info:</u> This includes the transition from the line of one wagon through the coupling and into the line of the following wagon.	Muss	Provide reliable signal transfer between two wagons.	SB	draft					Operation
AUCO.138	RE	The insulation resistance between the electrical power contacts (110 V level) and coupler ground shall be at least 800 MOhms.	Muss	Provide sufficient isolation resistance in the whole train configuration	SB	draft					Operation

ID	Requirement classification	Requirement-text	Wertung	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type
AUCO.139	RE	The dielectric withstand test is to be conducted with 1500 V according to EN 50155 (for operating voltages of 72 V to 125 V DC).	Muss	Fulfillment of EN 50155	SB	draft					Operation
AUCO.140	--	6 Safety									
AUCO.141	RE	The entire automatic coupler shall be earthed according to UIC 533.	Muss	Safety	SB	draft	--	EuroSpec automatic coupler type 10		UIC 533	Safety
AUCO.142	RE	The occurrence of an unintentional mechanical disconnection without working of the brake on the hauled train or / and the leading train shall not exceed 10^{-9} per operation hour.	Muss	Safety and risk analyses	SB	draft	--	EuroSpec automatic coupler type 10			Safety
AUCO.143	RE	The occurrence of unintentional uncoupling shall not exceed 10^{-6} per operating hour.	Muss	Safety and risk analyses	SB	draft	--	EuroSpec automatic coupler type 10			Safety
AUCO.144	--	7 General requirements (part of the system requirement specification)									
AUCO.145	RE	Each attachment point at the coupler where there is made a mechanical connection (e.g. by bolts or screws) shall not be secured by a locking plate.	Muss	Maintainability	SB	draft	--	EuroSpec automatic coupler type 10			Maintenance
AUCO.146	RE	Attachment points at couplers shall be secured e. g. by the use of self-locking nuts.	Muss	-	-	draft	--				-
AUCO.147	RE	The coupler and the spring device should operate for a period of at least six years without requiring maintenance. This does not include ordinary day-to-day maintenance to be carried out during service hours, such as greasing and cleaning of the parts subject to particularly heavy wear.	Muss	Maintainability	SB	draft	--	EuroSpec automatic coupler type 10			Maintenance
AUCO.148	RE	X % (e.g.: 98%) at least of the DAK must be produced with recyclable materials	Muss	Environment	SB	draft		TIS working group			

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AUCO.149	INFO	It will happen during a long period, because of the workshops capacities and availabilities. This means that we will start to replace first the couplers of block trains, and of the locomotives. But what about the isolated railcars, and what about the engines owned by the private sidings which move the railcars at our client's plants? It could be interesting also to ask for the development of a specific tool able to connect (in particular conditions of use) the standard couplers to the new ones.	Info			-					
AUCO.150		8 Hybrid coupler (special case)									
AUCO.151	INFO	Hybrid couplings (Hycou) represent a special design of the couplings.	Info	basic requirement	SB	draft	--	TIS working group			
AUCO.152	INFO	They allow coupling not only to the automatic coupling as well to the conventional UIC coupling system.	Info	basic requirement	SB	draft	--	TIS working group			
AUCO.153	INFO	Hybrid couplings should only be used on locomotives.	Info	basic requirement	SB	draft	--	TIS working group			
AUCO.154	RE	The hybrid coupling shall, in the 'automatic coupling' position, fulfil all the requirements of the automatic coupling, in particular the requirements for safety, passable track geometry and strength.	Muss	Safety	SB	draft	--	TIS working group			
AUCO.155	RE	If the connective element is a draw hook The draw hook of the hybrid coupling for connection to the UIC coupling shall fulfil the requirements for the 1.5 MN draw hook in accordance with EN 15566.	Muss	Safety	SB	draft	--	TIS working group		EN 15566	
AUCO.156	RE	If the connective element is a screw coupler The screw coupler of the hybrid coupling for connection to the UIC coupling shall fulfil the requirements for the 1.5 MN screw coupler in accordance with EN 15566.	Muss	Safety	SB	draft	--	TIS working group		EN 15566	
AUCO.157	RE	The used buffers shall fulfil the requirements for category "C" buffers for freight wagons according to EN 15551.	Muss	Safety	SB	draft	--	TIS working group		EN 15551	
AUCO.158	RE	The hybrid coupling must be able to be mounted on/ into the underframe of the existing locomotive without major structural changes to the vehicle structure.	Muss	Safety, Experience of operators	SB	draft	--	TIS working group			
AUCO.159	RE	For new locomotives, the hybrid coupling must be designed so that it is compatible with the installation space in accordance with UIC leaflet 530-1, annex 4c.	Muss	Safety, Experience of operators	SB	draft	--	TIS working group			

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AUCO.160	RE	If the automatic coupling function is not required, the automatic coupling head shall not affect the function of the UIC coupling point.	Muss	Safety, Experience of operators	SB	draft	--	TIS working group			
AUCO.161	RE	If the automatic coupling function is not required, the automatic coupling shall be secured against unintentional movement.	Muss	Safety, Experience of operators	SB	draft	--	TIS working group			
AUCO.162	RE	If the automatic coupling function is not in use, the spaces to be respected according to the clearance gauge according Chapter 4.2.2 of TSI CR/ EN 16839 shall not be	Muss	Safety	SB	draft	--	TIS working group			
AUCO.163	RE	The hybrid coupling shall be designed in such way that, when it is used or when changing from automatic coupling mode to UIC coupling mode, the physical strain on the operator is kept to a minimum (e.g. 150...170 N).	Muss	Experience of operators	SB	draft	--	TIS working group			
AUCO.164	OR	The change between the operating modes may take place via pneumatic, electrical or mechanical activation.	Option	Experience of operators		draft	--	TIS working group			
AUCO.165	RE	If components to be carried on the vehicle are required for mode change, their single weight shall not exceed 25 kg.	Muss	Compliance with work safety and health	SB	draft	--	TIS working group			
AUCO.166	RE	The mode change does not require any tools (e.g. wrench, pincer, hammer...).	Muss	Experience of operators	SB	draft	--	TIS working group			
AUCO.167	RE	When using the UIC coupling point the pneumatic connection between the vehicles shall be made manually.	Muss	Experience of operators	SB	draft	--	TIS working group			
AUCO.168	RE	The pneumatic connection between the vehicles with different coupling systems shall be made via a UIC/TSI compliant interface.	Muss	Experience of operators	SB	draft	--	TIS working group			
AUCO.169	RE	When the UIC coupling point use the electrical and signal connections between the vehicles this shall be made manually.	Muss	Experience of operators	SB	draft	--	TIS working group			
AUCO.170	OR	The connection for the electrical signal transmission between the rolling stock shall be made via a UIC/TSI compliant interface.	Option	Experience of operators	SB	draft	--	TIS working group			

Tests with digital automatic coupling (DAC)

In the digital automatic coupling (DAC) project, automatic freight car couplings are provided for test purposes by the currently designated manufacturers for testing on individual cars. The vehicle types serving as test carriers are to be selected and named. At present, a total of 4 couplings per manufacturer is assumed for single wagon testing.

The couplings are to be tested for compliance with technical requirements under almost real conditions in order to test the functionality of each type of coupling. For the time being it is assumed that the mechanical and pneumatic functionality will be tested. On the automatic couplings there are E contact couplings which are used for tests of the interaction of the mechanical component and the E contact coupling and for continuity measurements as well as functional tests.

Conditions linked to track geometries are tested in real driving tests. Conditions that are linked to climatic requirements are tested both in a climatic chamber and later at the demonstrator train.

For the single wagon test, freight cars are equipped with the automatic coupling and a train is assembled from these cars. Each of the freight cars, with exception of the end cars, will be equipped with an automatic coupler from the participating manufacturers at both ends of the car. The couplings are mounted in such a way that similar couplings are opposite each other and can be coupled.

At one end of the end cars there is an automatic coupling, while the UIC interface (side buffer, screw coupling and draw hook) is retained at the other end of the car. This guarantees the possibility of coupling to the traction units.

The attached test requirements are derived from the requirements and bundled, because partly several specifications from the SPEC AK Güt EUROPA can be tested in the same way. The reference to the specifications is made by a corresponding reference to the specification number (e.g. AUCO.XYZ). AUCO stands for "automatic coupler".

Structure of the test overview

The test overview is structured in tabular form and divided into tests on the single wagon.

The test concept for demonstrator train is under development.

current no.	test designation	test execution	covered requirements	bided result	reached result	result complied	free text field
Tests on single wagon / demonstrator train							

Running number indicates the sequential number of the test

Test name	names the test
test execution covered requirements	describes the test and, if necessary, the number of individual tests reference to the request number from the "SPEC AK Güt EUROPE Requirements (e.g. AUCO XYZ)
bided results	describe the bided result
reached result	describe the reached result of the automatic coupling
result complied	marked in the columns with
	 fully met
	 for not fulfilled to be marked.

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If a requirement is only partially fulfilled, it shall be considered as "not fulfilled" in the assessment. The results achieved in the corresponding test(s) shall be documented.

Free text field

here insert further additions/ information

Tests on single wagons/
demonstrator train

serves to differentiate between single car test and test on the demonstrator train. However, the test requirements are listed in different documents.

Test execution and period

Single car tests

According to the schedule of the DAC project, the single car tests will be carried in 2020.

For the tests, the vehicles are to be used both unloaded and fully loaded.

The test end for the single wagons is planned for the 1st quarter of 2021.

The couplers are to be tested with the vehicles, as far as possible, on tracks and in a climate chamber. The test period is planned for the 2nd and 3rd quarter of 2020, as the evaluation of the results is to be incorporated into the couplers which will be procured for the demonstrator train, if possible.

Objective: To prove the functionality of the DAC to potential operators

Construction of the test train

With the single wagon test the following basic conditions are to be considered:

- Test of coupling systems DAC type 4 (Schwab, 2x system "Scharfenberg"[®], SA3) from four different manufacturers,
- with these four coupling systems DAC four same carriage groups by three freight cars in each case are to be equipped as follows (a total of twelve carriages),
- Carriages 1 in front: Screw coupling (because of incompatibility of the different coupling systems)
- Carriages 1 behind: DAC (of the respective manufacturer)
- Carriages 2 in front and behind: DAC
- Carriages 3 in front: DAC
- Carriages 3 behind: Screw coupling

Static tests

In the absence of a complete coverage of the test requirements by standards/regulations of technology, the following specifications are to be used for this purpose and tests are to be carried out by analogy:

- DIN EN 15551, Annex D
- UIC 522 (2) approval automatic coupling
- MB 523 technical conditions for automatic couplers
- UIC 530 (1) constructive measures underframe quality for automatic couplers

Dynamic tests

- DIN EN 15551, Annex E
- DIN EN 15566, Annex A
- MB 524 (1) Spring apparatus for automatic freight couplers 1978-01-01 incl. modification 1 to 6 d
- MB 530 (2) Freight wagon driving safety

During the dynamic tests, forces, accelerations and displacements occurring both at the coupling itself and at the interface between coupling and vehicle structure shall be recorded and documented.

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As a minimum, measuring points for the force measurement shall be provided:

- clutch lock
- coupling head casing/ housing
- connection coupling head housing - coupling arm
- coupling clutch/ arm
- connection clutch arm - spring mechanism / damping device
- connection of spring system/damping device to the vehicle structure.

As a minimum, measuring points for acceleration absorption shall be provided:

- coupling head
- connection coupling - vehicle structure
- vehicle structure (underframe of the wagon)
- electric coupler

As a minimum, measuring points for distance measurements shall be provided:

- coupling clutch/ arm with regard to horizontal and vertical deflection
- spring mechanism/ damping device regards to maximum strokes in tension and shock direction
- electric coupler actuation (conformity with allowed timespan for completed acutation)

Tests on pneumatics / brakes

The tests for the pneumatic connection and effectiveness of the brake are concerned both with maintaining the functionality and adherence to braking and release times. The form basis for carrying out the corresponding tests are:

- EN 14198
- EN 15355
- EN 15611
- UIC 540
- UIC 544 (1)

Tests on the E contact coupling

Freight wagons must be equipped with electric and electronic components. Single wagon tests will be executed on wagons which are part of the test train described above (four different types of automatic couplers, three wagon variants per coupler type). The electric interfaces of the provided automatic couplers shall comply with the requirements defined in the document "Requirements for the electrical contacts in the coupling" in its latest version.

Tests on the data communication shall be planned, executed and evaluated separate. They are not part of this document.

Testing overview single wagons

The following tests shall be carried out

1. Contact resistance per coupler interface

This test shall be executed in standstill on one coupler interface (two wagons), with the respective contacts being electrically isolated from the wagon circuits. See test specification sequence 9.1.

2. Insulation resistance of the power net

This test shall be executed on the power net (110 V circuit) on a wagon decoupled from other wagons, with all respective contacts of the power net being short-circuited, and the insulation resistance shall be measured against wagon ground. See test specification sequence 9.2.

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3. *Contact formation during coupling*

Target of this test is to show successful electric contact formation during coupling and stable electric contacts in the coupled state. The tests shall be executed in conjunction with the mechanical tests of the coupler, test specification sequences 3, 4, and 5.

During the tests at different temperatures (sequence 5), the requirement concerning the allowed timespan for completed acutation of the electric coupler shall be verified.

4. *Field test of coupling shock*

Test of coupling shock (accelerations in three dimension) on the e-coupler during coupling and operation. See test specification sequence 9.4.

5. *Power transfer along the train*

In this test, the transfer of electric power from the locomotive to the last freight car shall be shown in a configuration of all 12 cars (three cars for each of the four automatic coupler types). Power transfer shall take place via electric couplers, connection cables at the screw couplers and the wiring on the cars. See test specification sequence 9.5

6. *Test of the electromagnetic compatibility*

Test shall demonstrate compliance of the electric and electronic equipment of the freight car with admissible electromagnetic emission. During these tests, the power transfer along the train shall be working as well as data transmission, especially over the wireless channels.

7. *Charging and discharging of the buffer battery*

This test shall demonstrate the functionality of the buffer batteries on each car. It shall verify the ability to charge the batteries from the power net, maintain electric functionality upon disconnection and recharge the batteries upon recovery of the power supply. See test specification sequence 9.6.

8. *Replacement of electric contacts*

This test shall verify that an exchange of single contacts in the electric coupler is possible with reasonable effort. Contacts shall be exchangeable from the front without removing or replacing the complete electric coupler. See test specification sequence 11.1.

Coupling tests in different track geometries

The coupling tests shall be performed 5 times per test. The following vehicle combinations shall be selected:

- wagon fully loaded with wagon empty
- wagon fully loaded with wagon fully loaded
- wagon empty with wagon empty.

1. *Coupling on straight track*

Both vehicles to be coupled are facing each other on a straight track. The distance between the couplings must be at least 2 m. Exceptions are coupling speeds above 4 km/h. Here the distance is to be selected so that the specified speed is reached when the couplings meet.

The passive-coupling vehicle stands free and is not braked; the active-coupling vehicle is pushed onto the passive-coupling vehicle at the specified speeds.

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2. *coupling in curves without an intermediate straight line*

a. Single curve

Both vehicles to be coupled are positioned in the track curve. The distance between the couplings must be at least 2 m. Exceptions are coupling speeds above 4 km/h. Here the distance shall be selected so that the specified speed is reached when the couplings meet.

The passive coupling vehicle is free standing and not braked, the active coupling vehicle is pushed onto the passive coupling vehicle at the specified speeds. The passive-coupling vehicle is positioned in such a way that the coupling plane is in the transition from the straight track to the curved track.

b. S- curve

Both vehicles to be coupled are positioned in the track curve. The distance between the couplings must be at least 2 m. Exceptions are coupling speeds above 4 km/h. In this case, the distance shall be selected so that the specified speed is reached when the couplings meet.

The passive coupling vehicle is free standing and not braked, the active coupling vehicle is pushed onto the passive coupling vehicle at the specified speeds.

The position of the coupler is to be selected so that it is in the transition from the track curve to the opposite curve.

3. *coupling in S-curves with intermediate straight*

Both vehicles to be coupled are positioned in the track curve. The distance between the couplings must be at least 2 m. Exceptions are coupling speeds above 4 km/h. Here the distance shall be selected so that the specified speed is reached when the couplings meet.

The actively coupling vehicle is pushed on at the specified speed.

The passive coupling vehicle is positioned in such a way that the coupling position is in the middle of the intermediate straight.

Impact tests

The impact tests are carried out to assess the behaviour of the vehicles at different impact speeds. These tests are carried out 5 times in all combinations of loading conditions. The aim is to absorb the forces occurring at the specified measuring points and to determine accelerations acting on the vehicle and the load from recorded force and travel data.

The overrun test at 12 km/h, which is intended to simulate a shunting impact with failed track brakes and non-existent brake shoes, is to be carried out as the last test series.

Documentation of the results

The performance and results of all tests shall be documented in the form of a report. The specific test conditions shall also be addressed.

The recorded data shall be clearly summarized and presented in a corresponding tabular form. Achieved minimum and maximum values shall be highlighted in different colors. In addition, the data shall be presented in graphical form over the entire test procedure.

The partners of the TIS working group "Project DAK" are to be included.

These partners will accompany the tests, at least temporarily.

A joint evaluation of the test results based on the documentation to be prepared is planned.

Additional information

documentation to be provided by the manufacturer (minimum scope)

- Assembly instructions on the vehicle/interface definition (including details of relevant tightening torques)
- Operating instructions for the component, including permissible tensile and compressive forces (Rp0.2), minimum coupling speed, total weight, partial weights of the individual assemblies, designed swivel angles horizontally and vertically, designed spring deflections for compression and tension, design of energy absorption ...
- Maintenance documentation for service / maintenance in operation
- complete documentation of the product, including strength certificates (test protocols, alternatively FEM calculations, test certificates etc.) of the safety-relevant components lying in the force flow, material specifications, manufacturing certificates (e.g. welding design test part I and part II, approval certificates of the subcontractors, material certificates)

Demonstrator Train (Preview)

The demonstrator train is formed from 24 wagons. Besides, all wagons are equipped with the same coupling type. Aim position is to simulate a real operational service by this train. In the demonstrator train the same types of car are used, like in the single carriage test, however, on the suitable aim number increased, i.e., the number of the vehicles is doubled.

Aim position of the demonstrator train is also to be used in all European climate areas.

With the demonstrator train, experiments are carried out in circulation with the target to simulate a real service.

The "climate tests" under wintry conditions occur in winter, mainly in northern countries (e.g., Sweden).

During the European circulation coupling and uncoupling should be carried out. Aim position is to realise 10.000 coupling-/uncouplings.

Besides, the demonstrator train is to be equipped completely with measuring equipment and at every coupler place the following data are to be generated:

- Strength effect with coupling processes on the coupling head, coupling rod, damping equipment and interface coupling vehicle structure
- Recording accelerations in the named areas with the coupling-/uncoupling
- Recording active forces and accelerations under service

The recorded data are to be processed in tabular form. Besides, minimum values and maximum values are to be marked, in addition, in colour.

In addition, a graphic representation, in each case separate is to be generated from the data table for forces, accelerations and ways.

In parallel with recording the precalled identity values a test of the electric equipment and the data connections occurs. In addition there exists a separate description.

The electric tests on the demonstrator train shall demonstrate the reliability and availability of the electric coupler and the electric power supply including the buffer batteries. During the field tests with the demonstrator train, relevant electrical parameters will be monitored and recorded. The values are given in the test specification, chapter 2.3.2. Data shall be readily accessible, ideally via mobile connection with the traction vehicle.

In addition to the continuously measured values, recurring tests have been specified:

- Contact resistance per coupler interface
- Isolation resistance of the electric coupler
- Power transfer along the train
- Charging and discharging behaviour of the buffer battery

Additional tests concerning the communication functionality and equipment are planned. They will be executed and realized separate.

Tests with the digital automatic coupling (DAC) by the operator V1.00

Sequence no.	Name of test	Requirement type	Tests performed	Requirements covered	Results expected	Results achieved, by manufacture	Free text field	additional comments
Tests on single wagon								
1	Weighing the coupling to determine its net mass	Mandatory		AUCO.9	Total weight of a coupling ≤ 380 kg			
2	Coupling of the automatic coupling against a UIC coupling point (side buffers and screw coupling) without the use of adapters (special test for the hybrid coupler of	Mandatory	Coupling test for the automatic coupling with a vehicle with buffers and screw coupling without the use of adapters		A coupling can be achieved without an special adapter			
2.1.	Creating buffer contact on a straight track (only locos with dual mode coupler)	Mandatory						
3	Coupling tests with couplings of the same type under the following conditions (before the tests begin, the couplings are equipped with sensors to record compressive and tensile forces, distances and acceleration measurements)	Mandatory						All tests from chapter 3 and 4 shall be carried out in the vehicle combination full-full, empty-full and empty-empty.
3.1	On straight track							
3.1.1	At v= 2 km/h	Mandatory						
	Wagon empty	Mandatory						
	Wagon fully loaded	Mandatory						
3.1.2	with v= 4 km/h	Mandatory						
	Wagon empty	Mandatory						
	Wagon fully loaded	Mandatory						
3.1.3	with v= 6 km/h	Mandatory						
	Wagon empty	Mandatory						
	Wagon fully loaded	Mandatory						
3.1.4	with v= 8 km/h	Mandatory						
	Wagon empty	Mandatory						
	Wagon fully loaded	Mandatory						
3.1.5	with v= 10 km/h	Mandatory						
	Wagon empty	Mandatory						
	Wagon 50% loaded	Mandatory						
	Wagon fully loaded	Mandatory						
3.1.6	At v= 12 km/h (simulated impact running down from the hump without a rail brake)	Mandatory						
	Wagon empty	Mandatory						Attention: the max. speed depended from maximum force level of 2.000 kN for which wagons are designed. Based on requirement for standard buffer test (max. 3.000kN/wagon end) force shall not become higher than 3.000 kN
	Wagon fully loaded	Mandatory						Attention: the max. speed depended from maximum force level of 2.000 kN for which wagons are designed. Based on requirement for standard buffer test (max. 3.000kN/wagon end) force shall not become higher than 3.000 kN
	Wagon empty	Mandatory						
	Wagon fully loaded	Mandatory						

Sequence no.	Name of test	Requirement type	Tests performed	Requirements covered	Results expected	Results achieved, by manufacture	Free text field	additional comments						
3.2	In curved track R 190 m													
3.2.1	At v= 2 km/h	Mandatory	Coupling tests with identical coupling types, 5 test attempts per requirement	AUCO 10 to 36	Coupling provides a reliable connection under the defined track geometries, boundary conditions and speeds, including electrical connection of the contacts.									
	Wagon empty	Mandatory												
	Wagon fully loaded	Mandatory												
3.2.2	At v= 4 km/h	Mandatory												
	Wagon empty	Mandatory												
	Wagon fully loaded	Mandatory												
3.2.3	with v= 6 km/h	Mandatory												
	Wagon empty	Mandatory												
	Wagon fully loaded	Mandatory												
3.2.4	At v= 8 km/h	Mandatory												
	Wagon empty	Mandatory												
	Wagon fully loaded	Mandatory												
3.3	Curved track R 150 m, manual alignment of the couplings permitted													
3.3.1	At v= 2 km/h	Mandatory												
	Wagon empty	Mandatory												
	Wagon fully loaded	Mandatory												
3.3.2	with v= 4 km/h	Mandatory												
	Wagon empty	Mandatory												
	Wagon fully loaded	Mandatory												
3.3.3	At v= 6 km/h	Mandatory												
	Wagon empty	Mandatory												
	Wagon fully loaded	Mandatory												
3.3.4	At v= 8 km/h	Mandatory												
	Wagon empty	Mandatory												
	Wagon fully loaded	Mandatory												
3.4	S-curve 190 m													
3.4.1	with v= 2 km/h	Mandatory												
	Wagon empty	Mandatory												
	Wagon fully loaded	Mandatory												
3.4.2	At v= 4 km/h	Mandatory												
	Wagon empty	Mandatory												
	Wagon fully loaded	Mandatory												
3.5	S-curve 150 m, manual alignment of the couplings permitted													
3.5.1	At v= 2 km/h	Mandatory												
	Wagon empty	Mandatory												
	Wagon fully loaded	Mandatory												
3.5.2	At v= 4 km/h	Mandatory												
	Wagon empty	Mandatory												
	Wagon fully loaded	Mandatory												
3.6	S-curve 150 m, with 6 m intermediate straight, manual alignment of the couplings permitted													
3.6.1	At v= 2 km/h	Mandatory												
	Wagon empty	Mandatory												
	Wagon fully loaded	Mandatory												
3.6.2	At v= 4 km/h	Mandatory												

Sequence no.	Name of test	Requirement type	Tests performed	Requirements covered	Results expected	Results achieved, by manufacture	Free text field	additional comments
	Wagon empty	Mandatory						
	Wagon fully loaded	Mandatory						
4	Running on various track geometries in the coupled state							
4.1	Passage through curved track 190 m,							
	Wagon empty	Mandatory						
	Wagon fully loaded	Mandatory						
4.2	Passage through curved track 190 m, pushed							
	Wagon empty	Mandatory						
	Wagon fully loaded	Mandatory						
4.3	Passage through curved track 150 m,							
	Wagon empty	Mandatory						
	Wagon fully loaded	Mandatory						
4.4	Passage through curved track 150 m, pushed							
	Wagon empty	Mandatory						
	Wagon fully loaded	Mandatory						
4.5	Passage through S-curve 190 m, pulled							
	Wagon empty	Mandatory						
	Wagon fully loaded	Mandatory						
4.6	Passage through S-curve 190 m, pushed							
	Wagon empty	Mandatory						
	Wagon fully loaded	Mandatory						
4.7	Passage through S-curve 150 m, pulled							
	Wagon empty	Mandatory						
	Wagon fully loaded	Mandatory						
4.8	Passage through S-curve 150 m, pushed							
	Wagon empty	Mandatory						
	Wagon fully loaded	Mandatory						
4.9	Passage through S-curve 150 m with 6 m intermediate straight, pulled							
	Wagon empty	Mandatory						
	Wagon fully loaded	Mandatory						
4.10	Passage through S-curve 150 m with 6 m intermediate straight, pushed							
	Wagon empty	Mandatory						
	Wagon fully loaded	Mandatory						
4.11	Passage through curved track 100 m,							
	Wagon empty	Mandatory						
	Wagon fully loaded	Mandatory						
4.12	Passage through curved track 100 m, pushed							
	Wagon empty	Mandatory						
	Wagon fully loaded	Mandatory						
4.13.	Passage through curve 75 m	Mandatory						
4.14	Navigating a ramp with 2°30' pitch, pulled	Mandatory						

Running on the track geometries in the coupled state with identical coupling types, 5 test attempts per requirement

AUCO 10 to 36

Able to run on the described track geometries without restriction, as both a pulled and pushed unit.
Electrical connection is stable and uninterrupted under all conditions.

Sequence no.	Name of test	Requirement type	Tests performed	Requirements covered	Results expected	Results achieved, by manufacture	Free text field	additional comments
	Wagon empty	Mandatory						
	Wagon fully loaded	Mandatory						
4.15	Navigating a ramp with 2°30' pitch, pushed	Mandatory						
	Wagon empty	Mandatory						
	Wagon fully loaded	Mandatory						
4.16	Navigating a ramp with 2°30' pitch and overlapping with a 150 m curved track, pulled	Mandatory						
	Wagon empty	Mandatory						
	Wagon fully loaded	Mandatory						
4.17	Navigating a ramp with 2°30' pitch and overlapping with a 150 m curved track, pushed	Mandatory						
	Wagon empty	Mandatory						
	Wagon fully loaded	Mandatory						
5.	Coupling under defined climatic conditions							
5.1	Coupling in cold conditions	Mandatory						
5.1.1.	Coupling at 0°C, dry	Mandatory						
5.1.2.	Coupling at 0°C, spray	Mandatory						
5.1.3.	Coupling at -10°C, covered in snow, dry	Mandatory						
5.1.4.	Coupling at -10°C, covered in snow, coupling iced, layer thickness 5 mm	Mandatory						
5.1.5.	Coupling at -20°C, covered in snow, dry	Mandatory						
5.1.6.	Coupling at -20°C, covered in snow, coupling iced, layer thickness 5 mm	Mandatory						
5.1.12.	Coupling at -25°C, covered in snow, dry	Mandatory						
5.1.7.	Coupling at -25°C, covered in snow, coupling iced, layer thickness 5 mm	Mandatory						
5.2.	Coupling at 40°C, dry	Mandatory						
6.	Measurement of the response speed when braking/releasing brakes	Mandatory	Proof of the brake response time in accordance with UIC 544-1 and breakdown velocity in accordance with EN 14198, 5 test attempts each	AUCO 102	No reduction in the brake response times when braking and releasing brakes			
7.	Recording the operating force of the manual uncoupling equipment	Mandatory	Proof of compliance with the permissible operating force, 5 test attempts each	AUCO 33	The specified release force of the manual uncoupling equipment remains within the range 150 ... 170 N			
8.	Impact tests to determine the strength of the coupling head and the forces and accelerations occurring in the vehicle	Mandatory			Complies with the specified requirements			
8.1.	Determination of the maximum forces occurring in the coupling head at an impact speed of 8 km/h and 90t against	Mandatory	Proof of required strength against plastic deformation of the coupling head and the acceleration that occurs in the vehicle as well as the forces acting on the vehicle-		Force occurring in the coupling head ≤ 2000 kN			

Sequence no.	Name of test	Requirement type	Tests performed	Requirements covered	Results expected	Results achieved, by manufacture	Free text field	additional comments
8.2.	Determination of the maximum forces occurring in the connection between the coupling head and the base frame at an impact speed of 8 km/h and 90t against 80t	Mandatory	coupling interface, 5 test attempts per requirement, Measurement of the acceleration impact on the electric coupler (test concept chapter 2.3.4).	AUCO 902 to 92	Force occurring at the interface to the base frame \leq 2000 kN			
9.	Electrical connections							
9.1	Contact resistance per coupler interface (chapter 2.2.1 in testing concept)	Mandatory	Determination of contact resistance of all coupler contacts in	AUCO.167 AUCO.168	Contact resistance below the specified value, depending on the			
9.2	Insulation resistance (chapter 2.2.6 in testing concept)	Mandatory	Determination of insulation resistance of all coupler contacts to the coupler ground.	AUCO.169 AUCO.170	Insulation resistance of the pins associated with the 110 V power net are above the specified value.			
9.3	Data transfer between wagons (chapter 2.2.3 in testing concept)	Mandatory	Determination of communication capability of the coupler, including the hard-wired CAN communication, powerline communication and radio	refer to testing specification	Successful data transfer according to the specifications.			
9.4	Power transfer along the train (chapter 2.2.2)	Mandatory	Test of successful power transfer along several wagons (up to 12)	refer to testing specification	Voltage at last wagon above the limit, voltage drop at each coupler within specification.			
9.5	Data transfer along the train (chapter 2.2.4)	Mandatory	Test of successful data transfer along several wagons (up to 12)	refer to testing specification	Data transfer works within specification values in dependence on the communication protocols.			
9.6	Charging and discharging of the buffer battery	Optional	Test of charging of the buffer battery and test of providing power supply in the uncoupled state.	refer to additional testing specification	Charging time, discharging time			not mandatory for evaluation of the electric coupler
10.	Test dismantling/assembly of the coupling head by 2 persons	Mandatory	Test dismantling/assembly of the coupling head by 2 persons in a workshop	AUCO 52 to 62	Coupling head can be replaced by 2 persons within 60 minutes, no special tools required (except lifting equipment).			
11.	Test dismantling/assembly of the automatic coupling equipment by 1 person in 60 minutes (if available)	Mandatory	Test dismantling/assembly of the automatic coupling equipment by 1 person in 60 minutes in a workshop	AUCO 62	Replacement of automatic decoupling equipment by 1 person in 60 minutes, no special tools required.			
11.1	Test replacement of the electric contacts (chapter 2.2.10 in the electric testing concept)	Test exchange of single contacts from the front without removing / replacing the complete electric coupler.	AUCO. 108	Test exchange of single contacts from the front using only the manufacturer-specified tools and successfully executed within the time specified by the manufacturer.				
12.	Final examination of the coupling	Mandatory						
12.1.	Measurement of the couplings	Mandatory			No dimensional changes outside the manufacturing tolerance range			

Sequence no.	Name of test	Requirement type	Tests performed	Requirements covered	Results expected	Results achieved, by manufacture	Free text field	additional comments
12.1.1.	Inspection of the main dimensions of the coupling	Mandatory	Separate protocols must be produced for these measurements based on the manufacturer's data.		No dimensional changes outside the manufacturing tolerance range			
12.1.2.	Inspection of the functional dimensions	Mandatory			No dimensional changes outside the manufacturing tolerance range			
12.1.3.	Recording the actual characteristic curve for the damping unit	Mandatory			Permissible deviation from the target characteristic curve within			
12.2.	Inspection for damage visible to the naked eye, e.g. breaks, plastic deformations, fractures, cracks in the visible area of the	Mandatory	Separate protocols must be produced for these inspections. Guidelines for the assessment and admissibility of the recorded properties after the completion of the test must be agreed separately with the manufacturer. Professional supervision can be provided by DB Systemtechnik GmbH, TT.TVE 31(2).					
12.3.	Step-by-step disassembly of the couplings into the main subassemblies with inspection for damage visible to the naked eye, e.g. breaks, plastic deformation, fractures, cracks, abrasions together with manufacturer	Mandatory						
12.3.1.	Measurement of components from 12.2.	Mandatory						
12.3.2.	NDT inspection of parts in the load path from 8.2 (optional)	Mandatory						
12.8	Test lubrication during service	Mandatory	Test lubrication of all possible lubrication positions by 1 people.		Wear elements can be lubricated by 1 people within 2 minutes without any special tools.			