EuroSpec

Specification for Automatic Couplers

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Specification for automatic couplers

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1	September 2016	void	EuroSpec “Specification for automatic couplers”

List of open points / non-agreed items

No.	Chap.	Open point / non-agreed item	Finalisation
1	-	void	-

1 FOREWORD

EuroSpec is a group of European train operating companies providing harmonised product specifications for use in train procurement and refurbishment.

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

The benefits of using EuroSpecs:

- Increase of reliability by sharing good practice and experience;
- Simplification of the tender process in time and cost as a result of fewer variations in requirements between tenders;
- Standardised products and cost reduction due to harmonisation of train operators’ requirements.

The EuroSpec specifications comprise merged functional and product basic requirements. All EuroSpec specifications focus on technical aspects exclusively based on the existing national requirements.

A EuroSpec specification 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)
- EuroSpec Specifications
- Company Specifications

2 INTRODUCTION

This document is a voluntary specification, produced by SNCF (SNCF), the Association of Train Operating Companies (ATOC), Deutsche Bahn (DB), Nederlandse Spoorwegen (NS), Österreichische Bundesbahnen (ÖBB) and Schweizerische Bundesbahnen (SBB).
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 “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 in order to facilitate the interface with Euro Norms.

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.

Safety responsibilities

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Approval and authorisation of this document

- The content of this document was approved for publication by the technical bodies of SNCF (SNCF), the Association of Train Operating Companies (ATOC), Deutsche Bahn (DB), Nederlandse Spoorwegen (NS), Österreichische Bundesbahnen (ÖBB) and Schweizerische Bundesbahnen (SBB).

3 SCOPE

This specification is applicable to rolling stock that is equipped with automatic couplers.

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

This specification is an add-on to the Technical Specifications for Interoperability (TSI) and EuroNorms (ENs). In addition to this document further train operator specific specifications might be defined. The specification contains requirements at a system level for the automatic coupler and its interfaces, and unifies the required performances of the different operators.

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 CEN[1] or CENELEC[2] 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)**
EN 12663-1	Railway applications - Structural requirements of railway vehicle bodies - Part 1: Locomotives and passenger rolling stock (and alternative method for freight wagons)
EN 13803-2	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

[1] Comité Européen de Normalisation / European Committee for Standardisation - www.cen.eu

[2] Comité Européen de Normalisation Électrotechnique / European Committee for Electrotechnical Standardisation - www.cenelec.eu

EN 15380-2	Railway applications - Designation system for railway vehicles - Part 2: Product groups
EN 15551	Railway applications - Railway rolling stock - Buffers
EN 16019:2014-06	Railway applications - Automatic coupler - Performance requirements, specific interface geometry and test method
EN 16116-1:2014-01 EN 16116-2:2014-01	Railway applications - Design requirements for steps, handrails and associated access for staff - 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: Overvoltages and related protection
EN 60529	Degrees of protection provided by enclosures (IP Code)
EN ISO 13732-1:2006-09	Ergonomics of the thermal environment - Methods for the assessment of human responses to contact with surfaces - Part 1: Hot surfaces
UIC 522	Technical conditions to be fulfilled by the automatic coupler of the UIC and OSJD Member Railways

5 Terms, definitions and abbreviations

automatic coupler	Automatic coupler is defined as a central buffer coupling that works automatically. (For further information refer to EN 16019:2014-06, chapter 3.) **Note:** The requirements described in this specification are valid for automatic couplers **type 10** for use in passenger trains. **For automatic couplers for use in freight trains there exist different or additional requirements.**
coupler head	Coupler head is defined as the front part of an 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. (For further information refer to EN 16019, chapter 3.)
electrical coupler	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 coach / train to another.
horizontal and vertical support	Horizontal and vertical support (centring 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 centring device keeps the 'free-standing' 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.
front surface heating	Front surface heating is defined as an electrical heating system that is integrated in the front plate of the coupling head.
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 has to 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.
FMEA	FMEA is defined as an analytic method in the reliability engineering. It is the abbreviation of Failure Mode and Effects Analysis. This method is used in the quality and safety management systems.
contractor	Contractor is defined as the company that is responsible for the supply of the 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. 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. automatic coupler).
mechanical isolation switch	Mechanical isolation switch is defined as a mechanical or pneumatical valve that disconnects the electrical coupler from pneumatical power. The mechanical isolation switch is part of the automatic coupler and installed on it. The mechanical isolation switch has to 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 automatic couplers which are used in passenger trains. It has to be considered that there exist different or additional requirements for automatic couplers for use in freight 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 Euro Norms (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 needs, solutions and documents. The ID prefix for the specification for automatic couplers is defined as AUCO.

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 with regard to 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) has to be S for vehicle connection provisions. The second letter for the sub product group (SPG) has to be B for automatic couplers.

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. This 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 (FII) and take-over. In each column the requested document (concept, drawing, calculation) or test is listed that has to be provided or performed by the manufacturer until the given instant of time.

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

1 General requirements for the automatic coupler

2 Mechanical part

3 Energy absorption system

4 Pneumatic connections of the automatic coupler

5 Electrical connections of the automatic coupler (mechanical part)

6 Safety

7 General requirements (part of the system requirement specification)

ID	Requirement classification	Requirement-text	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type	Verification				
											Offer of Tenderer(s)	Design Review	First Article Inspection (FAI) of components	First Integration Inspection (FII)	Take-over
AUCO.1	--	**Automatic couplers**	-	-	--	--				-	-	-	-	-	-
AUCO.2	--	**1 General requirements for the automatic coupler**	-	-	--					-	-	-	-	-	-
AUCO.3	RE	The automatic coupler shall fulfil the requirements of the energy absorption concept for the complete train set.	Safety	SB	--					Safety		at CDR: concept at FDR: drawings, documentation regarding collision safety (calculation, simulation)			
AUCO.4	RE	The automatic coupler shall not cause a climbing of car bodies or a derailment in case of collision.	Safety	SB	--					Safety		at CDR: concept at FDR: drawings, simulation			
AUCO.5	RE	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.	Safety, maintainability	SB	--					Maintenance, Safety		at CDR: concept at FDR: drawings, documentation, simulation			
AUCO.6	--	**2 Mechanical part**	-	-	--					-	-	-	-	-	-
AUCO.7	RE	The automatic coupler shall be mechanically compatible with the coupling type "Scharfenberg" type 10.	Offer interoperability between different vehicles, reduce number of different adaptors	SB	--					General		at CDR: concept at FDR: drawings			
AUCO.8	RE	When using an automatic coupler head type 10 of the system "Scharfenberg", the coupler shall fulfil the requirements of EN 16019 (March 2014).	EN 16019 defines the basic requirements for automatic coupler heads type 10	SB	--					General		at FDR: confirmation of fulfilling EN 16019			
AUCO.9	RE	In event of failure of the horizontal or vertical support the coupler head shall not fall down and reach the track.	Safety	SB	--					Safety			at type test: simulation or test (of the train manufacturer)		
AUCO.10	OR	The main pin of the coupler head shall be lubricated with grease.	Avoidance of self-lubricating bearings for the main pin because of bad experiences	SB	--					Maintenance		at CDR: concept at FDR: drawings			
AUCO.11	INFO	The contractor shall abide to a coupling height of 1025 +15/-5 mm from the top of rail (TOR) according to TSI Loc & Pas.	-	-	--					-	-	-	-	-	-
AUCO.12	RE	The automatic coupler shall work unrestricted and reliably under all environmental conditions, e.g. rain, washing water, snow, and particularly in hot summers as well as in cold winters. These conditions shall not have	Reduce maintenance costs, reliability for life time	SB	--					General					

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											Offer of Tenderer(s)	Design Review	First Article Inspection (FAI) of components	First Integration Inspection (FII)	Take-over
		any influence on the function of the coupler.													
AUCO.13	INFO	A coupling overhang on the ends of the multiple units (from the rear of the coupling head to the front of the cab) of ≥ 175 mm is recommended.	-	-	--					-	-	-	-	-	-
AUCO.14	RE	Personnel shall be able to uncouple the automatic coupler manually.	Use in case of malfunction, during maintenance, in case of emergency / rescue	SB	--					Operation			at type test: functional test		
AUCO.15	RE	Manual uncoupling shall be possible by one person (with a maximum manual tractive power (tension load) of 250 N on the handle).	Operating condition	SB	--					Operation			at type test: functional test (with a load of 250 N)		
AUCO.16	RE	The manual uncoupling device shall be visible and accessible.	Operating conditions for the personnel, feasibility in maintenance	SB	--					Operation		at FDR: drawings	at type test or FAI: functional test		
AUCO.17	RE	The automatic coupler shall resist a pulling force up to 1000 kN without causing any irreparable damage to the coupler (e.g. cracks or plastic deformation).	Safety, acc. to EN 12663-1, chpt. 6.2.2, category L, P-I, P-II (locomotives, coaches, train sets)	SB	--					Strength					
AUCO.131	INFO	In case that the vehicle is not in category L, P-I or P-II acc. to EN 12663-1 the value of the pulling force the automatic coupler has to resist can be adapted to the vehicle strength.	-	-	--					General	-	-	-	-	-
AUCO.18	OR	The automatic coupler shall resist a compressive force up to 1000 kN without causing any irreparable damage to the coupler (e.g. cracks or plastic deformation). Note: This requirement is valid for underground railway cars, commuter railway system cars or light railcars.	Safety, acc. to EN 12663-1, chpt. 6.2.2, category P-III (underground railway cars, commuter railway system cars, light railcars)	SB	--					Strength					
AUCO.19	RE	The automatic coupler shall resist a compressive force up to 1500 kN without causing any irreparable damage to the coupler (e.g. cracks or plastic deformation).	Safety, acc. to EN 12663-1, chpt. 6.2.2, category P-II (coaches, train sets)	SB	--					Strength					
AUCO.132	INFO	In case that the vehicle is not in category P-II acc. to EN 12663-1 the value of the compressive force the automatic coupler has	-	-	--						-	-	-	-	-

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											Offer of Tenderer(s)	Design Review	First Article Inspection (FAI) of components	First Integration Inspection (FII)	Take-over
		to resist can be adapted to the vehicle strength.													
AUCO.**20**	RE	The vertical pivoting range of the automatic coupler shall be at least +/- 6 °.	Operating condition	SB	--					Operation		at FDR: drawings			
AUCO.**21**	INFO	Coupling between vehicles shall be possible with a difference of height between vehicle axles which does not exceed approx. 135 mm when vehicles are lined up.	-	-	--					-	-	-	-	-	-
AUCO.**22**	RE	The automatic coupler shall allow the train to operate on slope connections with a radius according to TSI Infrastructure for vertical curves.	Operating condition	SB	--					Operation					
AUCO.**23**	RE	The automatic coupler shall have a centring device.	Improvement of the ease of use and the reliability of the coupling process	SB	--					Operation		at CDR: concept at FDR: drawings			
AUCO.**24**	OR	The horizontal support of the automatic coupler shall operate pneumatically.	Use of a reliable design solution	SB	--					Operation		at CDR: concept at FDR: drawings			
AUCO.**25**	RE	The bearing bracket, horizontal and vertical support of the automatic coupler and its fastening elements shall withstand the operating load during its lifetime.	Experience of SNCF: plastic deformations on two different coupler types	SB	--					General					
AUCO.**26**	OR	The automatic coupler shall stay stable in the uncoupled-condition. It should not swing or bounce during normal operation.	Safety; to ensure a defined position of the coupler (head)	SB	--					Operation				at type test: simulation or test	
AUCO.**27**	RE	Automatic coupling shall be possible when using the activated centring device on curve radii r ≥ 250 m (on the same level, i.e. without vertical displacement of the couplers).	To ensure that coupling is possible on curves with small radii	SB	--					Operation					
AUCO.**28**	OR	Automatic coupling shall be possible when using the deactivated centring device on curve radii r ≥ 180 m (on the same level, i.e. without vertical displacement of the couplers).	To ensure that coupling is possible on curves with small radii	SB	--					Operation					
AUCO.**29**	OR	Automatic coupling shall be possible on the same level (without vertical displacement of the couplers) on curve radii r ≥ 150 m.	To ensure that coupling is possible on curves with small radii	SB	--					Operation					
AUCO.**30**	OR	Automatic coupling shall be possible in the	To ensure that coupling is	SB	--					Operation					

ID	Requirement classification	Requirement-text	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type	Verification				
											Offer of Tenderer(s)	Design Review	First Article Inspection (FAI) of components	First Integration Inspection (FII)	Take-over
		tangent point between a straight line and a curve radius r ≥ 150 m. NOTE: Before coupling the couplers have to be arranged manually in the way that they are able to couple.	possible on curves with small radii												
AUCO.**31**	RE	When using the automatic coupler, connected vehicles shall run through curves with radii r ≥ 150 m without any restrictions.	To ensure smooth operation on curves with small radii	SB	--					Operation					
AUCO.**32**	OR	When using the automatic coupler, connected vehicles shall run through curves with radii r ≥ 125m without any restrictions.	to ensure smooth operation on curves with small radii	SB	--					Operation					
AUCO.**33**	RE	When using the automatic coupler, connected vehicles shall run through S-curves with radii r ≥ 150 m without any restrictions (according to EN 13803-2, chpt. 8.4, tab. 5).	European standard (EN 13803, EN 15551)	SB	--					Operation					
AUCO.**34**	INFO	Track conditions can be found in the TSI Infrastructure chapter "Interfaces with the rolling stock subsystems".	-	-	--					-	-	-	-	-	-
AUCO.**35**	RE	The automatic coupler shall be equipped with an automatically operated uncoupling device.	Improvement of the ease of use when uncoupling	SB	--					Operation		at CDR: concept at FDR: drawings, functional description			
AUCO.**36**	RE	Uncoupling shall be possible from any active cab.	Safety	SB	--		ÖBB			Operation		at CDR: concept at FDR: functional description			
AUCO.**37**	INFO	The active cab might not be near to the coupler involved into the uncoupling process.	-	-	--					-	-	-	-	-	-
AUCO.**38**	OR	The active cab shall only be located where coupling or uncoupling is going to be executed (local to the coupler involved).	Safety	SB	--					Operation		at CDR: concept at FDR: functional description			
AUCO.**39**	INFO	The active cab is located near to the coupler involved in the uncoupling process.	-	-	--					-	-	-	-	-	-
AUCO.**40**	RE	During the uncoupling process the increase of the pressure in the uncoupling cylinders of the two connected couplers shall be simultaneous.	Experience of the operators (bad experiences with a certain coupling system)	SB	--					Operation		at FDR: pneumatic drawing	at type test: functional test		

ID	Requirement classification	Requirement-text	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type	Verification				
											Offer of Tenderer(s)	Design Review	First Article Inspection (FAI) of components	First Integration Inspection (FII)	Take-over
AUCO.**41**	RE	The contractor shall provide the time required for the replacement of the coupler head including the electrical connections by 2 persons.	Maintenance costs	SB	--					Maintenance		at FDR: document / information of the manufacturer			
AUCO.**42**	RE	The replacement of a coupler head including the electrical coupler shall be possible within 60 min by 2 persons.	Maintenance costs	SB	--					Maintenance		at FDR: document / information of the manufacturer			
AUCO.**43**	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 with the client.	Maintenance costs	SB	--					Maintenance		at CDR: concept at FDR: document / information of the manufacturer		at type test or FAI: maintenance instruction	
AUCO.**44**	INFO	The use of special tools for the maintenance and replacement of the automatic coupler or parts of it shall be avoided.	-	-	--					-	-	-	-	-	-
AUCO.**45**	RE	Where the use of special tools for the 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).	Maintenance costs	SB	--					Maintenance		at CDR: concept at FDR: document / information of the manufacturer		at type test or FAI: maintenance instruction	
AUCO.**46**	RE	Related to the ordered train types or train 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.	Maintenance costs	SB	--					Maintenance		at CDR: concept at FDR: drawings			
AUCO.**47**	RE	The replacement of an uncoupling cylinder shall be possible within 60 min by 1 person.	Maintenance, experience of the operators	SB	--					Maintenance		at FDR: document / information of the manufacturer			
AUCO.**48**	RE	The contractor shall provide a maintenance manual / file that includes all required actions for the maintenance of the coupler.	Maintenance planning	SB	--					Maintenance		at CDR: concept at FDR: drawings, maintenance instruction (draft document)		at type test or FAI: maintenance instruction	

ID	Requirement classification	Requirement-text	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type	Verification: Offer of Tenderer(s)	Verification: Design Review	Verification: First Article Inspection (FAI) of components	Verification: First Integration Inspection (FII)	Verification: Take-over
AUCO.**49**	RE	The contractor shall provide the time required for the maintenance and the different maintenance steps of the automatic coupler (including electrical connections).	Maintenance planning	SB	--					Maintenance		at CDR: concept at FDR: drawings, maintenance instruction (draft document)		at type test or FAI: maintenance instruction	
AUCO.**50**	OR	The automatic coupler shall be designed in the way that it will reach a reliability of 98 %, based on the operating time between the manufacturing and the first complete overhaul or between two complete overhauls. Note: The verification of the achieved percentage regarding reliability has to be defined and agreed with the customer.	Maintenance costs	SB	--					Operation, Reliability		at CDR: list of references to former projects at FDR: verification document (calculation, test data)			
AUCO.**51**	OR	The automatic coupler shall be designed in the way that it will reach an operational reliability level of x breakdowns per million km. Note: "x" and the verification of the achieved reliability level (e. g. minor, major, significant) has to be defined and harmonised with the customer.	Maintenance costs	SB	--					Operation, Reliability		at CDR: list of references to former projects at FDR: verification document			
AUCO.**52**	OR	The main parts of the automatic coupler (e.g. coupler head, draw and buffing gear, pivot anchor) shall be connected with split collars.	Reduction of work during maintenance	SB	--					Maintenance		at CDR: concept at FDR: drawings			
AUCO.**53**	RE	The coupler head of the automatic coupler shall be equipped with a front surface heating system which defrosts the end face if environmental or operating conditions (including the preparation for service) demand this.	Experience of operators	SB	--					Operation		at CDR: concept at FDR: drawings, data sheets	at type test: climate chamber		
AUCO.**54**	INFO	Further information about environmental conditions are given in the specification module "System specification"of the technical requirement specification of the particular	-	-	--					-	-	-	-	-	-

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											Offer of Tenderer(s)	Design Review	First Article Inspection (FAI) of components	First Integration Inspection (FII)	Take-over
		procurement project.													
AUCO.**55**	INFO	Surfaces that are heated by the front surface heating system shall not reach a temperature higher than 60 °C according to EN ISO 13732-1:2006-09.	-	-	--					-	-	-	-	-	-
AUCO.**56**	RE	The front surface heating system shall be switched on and off automatically.	Experience of operators	SB	--					Operation		at CDR: concept at FDR: drawings of the electrical schema / functional description			
AUCO.**57**	OR	The front surface heating system shall have the possibility to be switched on and off manually (by a switch or a circuit breaker) for maintenance or safety reasons.	Experience of operators	SB	--					Maintenance, Safety		at CDR: concept at FDR: drawings of the electrical schema / functional description			
AUCO.**58**	RE	The front surface heating system shall be replacable by maintenance personnel without disassembling the coupler and under operating conditions (outside of special workshops).	Experience of operators	SB	--					Maintenance		at CDR: concept at FDR: drawings, maintenance instruction (draft document)		at type test or FAI: maintenance instruction	
AUCO.**59**	RE	The front surface heating shall be replaced in a maximum of 45 minutes by maintenance personnel including the functional test.	Experience of operators	SB	--					Maintenance		at FDR: verification document (confirmation that time frame is kept)	at type test: replacement of the front surface heating		
AUCO.**60**	OR	The automatic coupler, especially the coupler head, shall be equipped with a top protection against rain, washing water, windscreen cleaning agents or snow.	Experience of operators	SB	--					Operation		at CDR: concept at FDR: drawings			
AUCO.**61**	OR	The coupler head of the automatic coupler (including the top protection) shall be designed so that it can be walked on and able to be used as a step, without damaging any part of the coupler.	Request of the operators Note: Because of safety requirements the vehicle has to be equipped with grips or rails (acc. to EN 16116-1, chapter 5.4 and EN 16116-2, chpt. 4.3).	SB	--					Operation, Maintenance		at FDR: verification document (confirmation of the vehicle manufacturer), calculation, FEM report (at least draft version)		at type test: stepping test	
AUCO.**62**	OR	The central automatic coupler shall be equipped with a (partly) removable (front) protection against snow, water and general	Experience of operators	SB	--					Operation		at CDR: concept at FDR: drawings			

ID	Requirement classification	Requirement-text	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type	Verification: Offer of Tenderer(s)	Verification: Design Review	Verification: First Article Inspection (FAI) of components	Verification: First Integration Inspection (FII)	Verification: Take-over
		pollution.													
AUCO.**63**	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.	Experience of operators	SB	--					Maintenance		at CDR: concept at FDR: drawings, maintenance instruction (draft document)			
AUCO.**64**	RE	The coupler head, coupler shank (draw bar), draw and buffing gear, electric coupler, centring device and bearing bracket shall be indelibly marked with the supplier's brand, the date of manufacturing and the serial number.	Experience of operators	SB	--					Maintenance		at FDR: drawings	checking at the coupler		
AUCO.**65**	OR	The automatic coupler shall move freely backwards into the underframe of the carbody after the irreversible energy absorption element has been used completely to enable employment of further crash elements behind the coupler's position. (Note: The construction of the car body has to be taken into consideration.)	Safety reason	SB	--					Safety		at CDR: concept at FDR: simulation (CAD / FEM modell)			
AUCO.**66**	RE	The system for manual uncoupling shall work without malfunction or destruction of any parts - except for wearing parts, e. g. cables - during the whole life time of the coupler.	Experience of operators	SB	--					Maintenance		at CDR: list of references to former projects at FDR: verification document (fatigue calculation)			
AUCO.**67**	RE	The manual uncoupling system shall withstand a manual operating force of at least 1000 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 uncoulping system.	Experience of operators	SB	--					Maintenance		at CDR: concept at FDR: simulation (CAD / FEM modell)	calculation / FEM report		
AUCO.**68**	--	**3 Energy absorption system**	-	-	--					-	-	-	-	-	-
AUCO.**69**	RE	The draw bar (draw and buffing gear) shall be equipped with a reversible elastic element for energy absorption.	Experience of operators	SB	--					Damage prevention		at CDR: concept at FDR: drawing			
AUCO.**70**	RE	The elastic energy absorption system shall endure a life cycle test analogous to EN	Experience of operators	SB	--					Reliability		at CDR: concept	at type test (of the energy absorption system): life		

ID	Requirement classification	Requirement-text	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type	Verification: Offer of Tenderer(s)	Verification: Design Review	Verification: First Article Inspection (FAI) of components	Verification: First Integration Inspection (FII)	Verification: Take-over
		15551 life cycle test.											cycle test		
AUCO.133	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.	-	-	--		SNCF			-	-	-	-	-	-
AUCO.134	OR	The automatic coupler shall be equipped with a system (e.g. sensors, measurement of leakage, maintenance detection) that detects when the system is no longer able to absorb enough energy in dynamic conditions. The manufacturer shall define and describe this kind of system.	Innovation	SB	--		SNCF			Maintenance, Safety	concept	at FDR: drawing, description	at type test: functional test		
AUCO.135	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.	-	-	--		SNCF			-	-	-	-	-	-
AUCO.71	OR	The reversible elastic system shall detect and show whether it is still working after is has been exposed to an impact or crash without dismantling any parts of the elastic system.	Experience of operators	SB	--					Maintenance, Safety		at CDR: concept at FDR: drawing	visible inspection		
AUCO.136	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.	-	-	--		SNCF			-	-	-	-	-	-
AUCO.72	RE	The reversible elastic element shall absorb energy during coupling up to 6 km/h with the longest possible train formation without any damage on the automatic coupler (and to the train).	Experience of operators	SB	--					Strength, Damage prevention		at CDR: concept at FDR: drawing, calculation / strength report	at type test: test (with an automatic coupler on a test bench)	at type test: coupling test (with vehicles)	
AUCO.73	RE	The elastic system shall be designed in the way that the deceleration (inside the cab) does not exceed 2 g for coupling up to 6 km/h.	Experience of operators	SB	--					Strength, Damage prevention, Safety		at CDR: concept at FDR: drawing, calculation / strength report		at type test: coupling test (with vehicles)	

ID	Requirement classification	Requirement-text	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type	Verification				
											Offer of Tenderer(s)	Design Review	First Article Inspection (FAI) of components	First Integration Inspection (FII)	Take-over
AUCO.**74**	RE	The draw bar (draw and buffing gear) shall be equipped with an irreversible element for energy absorption.	Experience of operators	SB	--					Damage prevention		at CDR: concept at FDR: drawing	visual inspection		
AUCO.**75**	RE	The reversible and irreversible elements shall absorb energy during coupling up to 10 km/h with the longest possible train formation without any damage on the automatic coupler (and to the train).	Experience of operators	SB	--					Strength, Damage prevention		at CDR: concept at FDR: drawing, calculation / strength report, simulation			
AUCO.**76**	RE	The reversible and irreversible energy absorption system shall be designed in the way that the deceleration (inside the cab) does not exceed 3 g for coupling up to 10 km/h.	Requirement is based on demands regarding the protection of personnel and passengers. Compare to EN 15551, appendix E.	SB	--					Strength, Damage prevention, Safety		at CDR: concept at FDR: drawing, calculation / strength report, simulation			
AUCO.**77**	INFO	The irreversible energy absorption element shall be replaced after a collision or heavy shunt.	-	-	--					-	-	-	-	-	-
AUCO.**78**	RE	The automatic coupler shall have a visible indicator that shows that the irreversible energy absorption element has been triggered.	Experience of operators	SB	--					Maintenance, Safety		at CDR: concept at FDR: drawing		visual inspection	
AUCO.**79**	OR	The driver shall be warned if the irreversible energy absorption element has been used.	Innovation	SB	--					Safety		at CDR: concept at FDR: drawings of the electrical schema / functional description	at type test (of the absorption element): functional test		
AUCO.**80**	--	**4 Pneumatic connections of the automatic coupler**	-	-	--					-	-	-	-	-	-
AUCO.**81**	RE	The automatic coupler shall be pneumatically compatible with the coupling type "Scharfenberg type 10".	To offer interoperability between different vehicles, to reduce number of different adaptors; EN 16019, June 2014, chapter 4.3.2 Pneumatic coupling	SB	--					Operation		at CDR: concept at FDR: drawings / functional description			

ID	Requirement classification	Requirement-text	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type	Verification				
											Offer of Tenderer(s)	Design Review	First Article Inspection (FAI) of components	First Integration Inspection (FII)	Take-over
AUCO.137	INFO	Regarding other coupler types, e.g. "type 20", further information has to be provided by the operator.	-	-	--					-	-	-	-	-	-
AUCO.82	RE	The pneumatic connection of the automatic coupler shall be done automatically after or simultaneously to the mechanical connection.	Experience of operators	SB	--					Safety		at FDR: functional description	at type test: coupling test		
AUCO.83	RE	The disconnection of the pneumatic connection shall be done automatically before or simultaneously to the mechanical separation.	Experience of operators	SB	--					Safety		at FDR: functional description	at type test: coupling test		
AUCO.84	RE	If the automatic coupler is unintentionally disconnected, an emergency braking of the train shall be initiated.	EN 16019, June 2014, chpt. 4.3.2	SB	--					Safety		at CDR: concept at FDR: drawings / functional description	at type test: functional test		
AUCO.85	RE	The airtightness of the pipe lines inside the automatic coupler shall fulfil the requirements from EN 16019.	EN 16019, June 2014, chpt. 5.2.4.2	SB	--					Safety		at CDR: concept	at type test: test of airtightness, test report		
AUCO.86	INFO	Depending upon the need for airtightness of the complete train it could be necessary to demand an airtightness for the automatic coupler that is higher than the one given in EN 16019.	-	-	--					-	-	-	-	-	-
AUCO.87	RE	The brake pipe valve shall be directly mechanically activated by the rotation of the main pin of the coupler head.	EN 16019, June 2014, chapter 4.3.2	SB	--					Safety		at CDR: concept at FDR: drawings			
AUCO.88	RE	If no uncoupling command is activated the uncoupling cylinder shall be connected to atmospheric pressure.	Safety	SB	--					Safety		at CDR: concept at FDR: pneumatic schema		at type test: pressure test	
AUCO.89	INFO	If no pressure is inside the uncoupling cylinder the inner construction of the uncoupling device disables that the device works and that it disconnects the automatic couplers.	-	-	--					-	-	-	-	-	-
AUCO.90	RE	The connection of the uncoupling cylinder to	Safety (risk of unintentional	SB	--					Safety		at CDR:	at type		

ID	Requirement classification	Requirement-text	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type	Verification				
											Offer of Tenderer(s)	Design Review	First Article Inspection (FAI) of components	First Integration Inspection (FII)	Take-over
		atmospheric pressure (e. g. by a small drilling or a valve) shall allow successive uncoupling and shall not disturb the increase of the pressure in the uncoupling cylinder.	movement of the vehicle)									concept at FDR: pneumatic schema	test: pressure test		
AUCO.**91**	--	**5 Electrical connections of the automatic coupler (mechanical part)**	-	-	--					-	-	-	-	-	-
AUCO.**92**	RE	The electrical coupler shall have the protection class IP65 (during coupled and uncoupled condition).	Acc. to EN 60529 no rain water is allowed to reach the pins.	SB	--					Reliability, Safety		at FDR: confirmation (of the manufacturer of electrical coupler)	at type test: insulation test (regarding humidity acc. to environmental conditions)		
AUCO.**93**	RE	The electrical coupler shall fulfil the requirements according to EN 50124-1 regarding clearances and creepage distances for equipment.	Acc. to EN 50124-1	SB	--					Reliability, Safety		at FDR: confirmation (of the manufacturer of electrical coupler)	at type test: test (regarding clearances and creepage distances for equipment)		
AUCO.**94**	RE	Single contacts of the electrical coupler shall be replacable from the front without removing or replacing the complete electrical coupler.	Experience of operators	SB	--					Maintenance		at CDR: concept at FDR: drawings	at type test: maintainability test (replacement of contacts)		
AUCO.**95**	RE	The electrical contacts of the automatic coupler shall ensure the connection of control signal lines, data bus lines and lines for transmitting signals between coupled vehicles.	Safety, experience of operators	SB	--					Operation, Safety		at CDR: concept at FDR: drawings of the electrical schema / functional description			
AUCO.**96**	RE	The mechanical, pneumatic and electrical connections shall be made within a period of 10 seconds.	Experience of operators	SB	--					Operation		at FDR: functional description			
AUCO.**97**	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.	Experience of operators	SB	--					Operation		at FDR: functional description	at type test: coupling test		
AUCO.**98**	INFO	The maximum time expended for these	-	-	--					-	-	-	-	-	-

ID	Requirement classification	Requirement-text	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type	Verification				
											Offer of Tenderer(s)	Design Review	First Article Inspection (FAI) of components	First Integration Inspection (FII)	Take-over
		connections (6 seconds) does not impair any other vehicle functions, e. g. of the TCMS.													
AUCO.**99**	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.	Experience of operators	SB	--							at FDR: functional description	at type test: coupling test		
AUCO.**100**	RE	The connection and separation of the mechanical and electrical connection shall be done automatically (without additional activities by the operating personnel).	Experience of operators	SB	--					Operation		at FDR: functional description	at type test: coupling / uncoupling test		
AUCO.**101**	INFO	The electrical coupler shall automatically move to the back position (uncoupling position) only if it is operated by the pressure in the uncoupling pipe.	-	-	--		SNCF			-	-	-	-	-	-
AUCO.**102**	RE	The electrical coupler shall have a "mechanical isolation switch".	Experience of operators	SB	--					Maintenance		at FDR: drawing / functional description			
AUCO.**103**	INFO	The "mechanical isolation switch" is used for the manual separation or isolation of the electrical coupler and is activated by the maintenance personnel.	-	-	--					-	-	-	-	-	-
AUCO.**104**	RE	When 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. When 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).	Experience of operators	SB	--					Maintenance		at FDR: drawing / functional description	at type test: coupling / uncoupling test with using the "mechanical insulation switch"		
AUCO.**105**	RE	When the "mechanical isolation switch" of the electrical coupler has been activated the electrical coupler shall offer the possibility to be moved manually.	Experience of operators	SB	--					Maintenance		at FDR: functional description	at type test: movement test with the electrical coupler		
AUCO.**106**	RE	The position or the state of the "mechanical isolation switch" shall be visible to the maintenance personal outside of the train.	Safety, experience of operators	SB	--					Maintenance		at FDR: drawing / functional description		visual inspection	
AUCO.**107**	INFO	The electrical coupler shall have an "electrical isolation switch" that is used by the operating personnel.	-	-	--					Operation		at FDR: drawing / functional description			

ID	Requirement classification	Requirement-text	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type	Verification				
											Offer of Tenderer(s)	Design Review	First Article Inspection (FAI) of components	First Integration Inspection (FII)	Take-over
		Note: The electrical isolation switch is part of the delivery of the manufacturer of the train.													
AUCO. **108**	INFO	The "electrical isolation switch" is used for the electrical separation or isolation of the electrical coupler and is activated by the operating personnel.	-	-	--					-	-	-	-	-	-
AUCO. **109**	INFO	The "electrical isolation switch" for the operating personnel shall be located in the cab (adjacent to the coupler). Note: The electrical isolation switch is part of the delivery of the manufacturer of the train.	-	-	--					Operation		at FDR: drawing / functional description	at type test: coupling / uncoupling test with using the "electrical insulation switch"		
AUCO. **110**	RE	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.	Experience of operators	SB	--					Operation		at FDR: functional description	at type test: electrical test with the electrical coupler		
AUCO. **111**	RE	The "electrical isolation switch" shall offer the possibility to be locked and secured against unauthorised unlocking.	Experience of operators	SB	--					Operation		at FDR: functional description		at type test: locking mechanism test on the vehicle	
AUCO. **112**	INFO	Further information about the number of contacts, the contact arrangement and the contact assignments is given in the specification module "Vehicle control system", chapter TCMS of the technical requirement specification of the particular procurement project.	-	-	--					-	-	-	-	-	-
AUCO. **113**	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.	-	-	--					-	-	-	-	-	-
AUCO. **114**	RE	The electrical coupler of the automatic coupler shall be equipped with a heater that defrosts the electrical coupler.	Experience of operators	SB	--					Operation		at CDR: concept at FDR: drawings, data sheets		at type test: climate chamber	
AUCO.	INFO	Further information about environmental	-	-	--					-	-	-	-	-	-

ID	Requirement classification	Requirement-text	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type	Verification: Offer of Tenderer(s)	Verification: Design Review	Verification: First Article Inspection (FAI) of components	Verification: First Integration Inspection (FII)	Verification: Take-over
115		conditions are given in the specification module "System specification" of the technical requirement specification of the particular procurement project.													
AUCO. **116**	RE	The (pneumatic) actuating devices of the electrical coupler shall be equipped with a heating system.	Experience of operators	SB	--					Operation		at CDR: concept at FDR: drawings, data sheets			
AUCO. **117**	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).	Experience of operators	SB	--					Maintenance, Operation		at CDR: concept / references at FDR: drawings	at type test: coupling / uncoupling test with inspection of the contacts		
AUCO. **118**	RE	Checking and adjusting the position of the electrical coupler shall be required a maximum once a year.	Experience of operators; reduction of work in maintenance	SB	--					Maintenance		at CDR: concept / references		check the maintenance instruction	
AUCO. **119**	OR	The train bus bar (high voltage line / main power line between cars) shall be coupled by the automatic coupler.	Innovation	SB	--		DB			General		at CDR: concept / references at FDR: drawings of the electrical schema		at type test: coupling / uncoupling test	
AUCO. **120**	RE	The electrical coupler shall be equipped with a permanent protective cover (movable shield) that protects the pins against influences from outside (when the electrical coupler is not connected to another one).	Experience of operators; protection against humidity and dirt	SB	--		DB (VDE standard), SNCF, SBB			Soiling prevention		at CDR: concept at FDR: drawing			
AUCO. **121**	RE	The protective cover shall work properly. The potential interferences between the seals and the cover or between the seals and the body of the electrical coupler shall not generate any disturbance in the movement of the cover. The cover shall be able to close or open completely when the movement of the electrical coupler is ordered.	Bad experiences of operaters with covers that did not open or close properly because of problems with the sealing	SB	--		SNCF			Operation		at CDR: concept / references at FDR: drawings		at type test: coupling / uncoupling test	
AUCO. **122**	RE	In case of a collision the protective cover shall prevent the electrical coupler from making short circuits.	Safety	SB	--					Safety		at CDR: concept at FDR: drawing		visual inspection	

ID	Requirement classification	Requirement-text	Rationale	Product element EN 15380-2	Status	Change since last release	Source	Comment of owner	Annex to requirement	Requirement type	Verification				
											Offer of Tenderer(s)	Design Review	First Article Inspection (FAI) of components	First Integration Inspection (FII)	Take-over
AUCO. **123**	--	**6 Safety**	-	-	--					-	-	-	-	-	-
AUCO. **124**	RE	The entire automatic coupler shall be earthed according to UIC 533.	Safety	SB	--					Safety		at CDR: concept at FDR: drawings, electrical schemes, coupler documentation			
AUCO. **125**	RE	Automatic uncoupling shall only be possible under the following conditions that have to be fulfilled simultaneously: 1) The velocity is 0 km/h. 2) The brake pipe (BP) pressure is lower than 3,5 bar. 3) The main reservoir pipe (MP) pressure is higher than 5 bar. 4) The driver has activated the automatic uncoupling signal.	Safety	SB	--					Safety		at CDR: concept at FDR: pneumatic scheme		at type test: functional test	
AUCO. **126**	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.	Safety and risk analyses	SB	--					Safety		at FDR: FMEA			
AUCO. **127**	RE	The occurrence of unintentional uncoupling shall not exceed 10^{-6} per operating hour.	Safety and risk analyses	SB	--					Safety		at FDR: FMEA			
AUCO. **128**	--	**7 General requirements (part of the system requirement specification)**	-	-	--					-	-	-	-	-	-
AUCO. **129**	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.	Maintainability	SB	--		SNCF			Maintenance		at CDR: concept at FDR: drawing	visual inspection		
AUCO. **130**	INFO	Attachment points at modern couplers are secured e. g. by the use of Nord-Lock washers or self-locking nuts.	-	-	--					-	-	-	-	-	-

6.3 Definition of Attributes

Attribut	Definition of attribute	Function of attribut	Value of attribute	Definition of value	Function of value
ID	Unique Identification of the requirement	Ensure that the requirement remains uniquely traceable, and to enable traceability to needs, solutions and documents	Prefix.ID		
Requirement classification	Importance and legal status of the requirement to the project	To differentiate between the requirements with regard to relevance and legal status like Requirement (RE - mandatory), Design Recommendation (DR) or Optional Requirement (OR)	Requirement (RE)	Requirement (RE) is a functional or non-functional requirement, which must be fulfilled by the supplier.	If a requirement in a EuroSpec specification is marked as a Requirement (RE), a supplier shall not offer an alternative.
			Design Recommendation (DR)	A Design Recommendation is a non-functional requirement and provides a solution for a linked RE.	A Design Recommendation is linked to one or more (functional) requirements. It gives guidance of the design to the supplier. If the supplier follows the design recommendation, he can use this as a demonstration of compliance to the requirements to which it refers. If a requirement in a EuroSpec specification is marked as a Design Recommendation, a supplier may offer an alternative solution to fulfil the linked (functional) requirement.
			Optional Requirement (OR)	An Optional Requirement is a requirement from the EuroSpec specification for which the train operating company (TOC) has to decide if it will be applied to a project. If an Optional Requirement is chosen by a TOC in a project, it must be fulfilled by the supplier (like RE).	The function of an Optional Requirement is to provide a choice between different (functional) requirements. The reasons for the choice could be different train concepts or different opinion between the TOC's. An Optional Requirement can be a functional or a non-functional requirement.
			Information (INFO)	Information (INFO) is a textual statement without a legal status.	An Information (INFO) can be used in EuroSpec specifications for additional information, e.g. definitions of terms, etc.
Requirement-text	Description of the requirement	Draft the requirement	---	---	---
Rationale	Reason to state the requirement	To describe the reason why a requirement is stated (traceability to the need) To describe the chosen text of the requirement The rationale provides the reason that the requirement is needed and points to any supporting analysis, trade study, modelling, simulation, or other substantive objective evidence	---	---	---
Product element EN 15380-2	Link between requirement and the product element of the EN 15380-2	To relate the item of the product breakdown of EN 15380-2	---	---	---
Status	Indication of the approval state of the requirement	To describe a defined status of a requirement in a standard database or requirement maturity level during a project	draft	Proposition for a new requirement or a re-written requirement (Status is set by the expert team)	The requirement is in work by the expert team
			under review	The requirement is under review by the requirement review board (Status is set by the expert team)	The review process for the requirement is running
			approved	The requirement has been approved by the requirement review board (Status is set by the requirement review board)	The requirement can be published
			rejected	The requirement has been rejected (Status is set by the requirement review board or by the expert team during writing)	The requirement is no longer in use
Source	Indication from where the requirement originates	To determine the traceability of the requirement to previous experiences like projects, working groups, lessons learned	---	---	---
Comment of owner	Remarks of the owner to the requirement	To allow the owner to provide comments	---	---	---
Annex to requirement	Any appendices to the requirement given to the supplier industry	To relate the requirement to stored documents			

6.4 Definition Verification

Point in time	Definition	
Offer of Tenderer(s)	Point in time to compare the offers of tenderers	
Design Review	Point in time to confirm general design of system or system element will fulfil the requirement	
First Article Inspection (FAI) of components	Point in time to confirm developed system or system element will fulfil the requirement	
First Integration Inspection (FII)	Point in time to verify integrated system or system element, will comply with the requirement	
Take-over	Point in time when the train operation company finally takes-over the train from the supplier.	

Methods for validation and verification	Definition	Function
Inspection	An inspection is an examination of the item against applicable documentation to confirm compliance with requirements.	Inspection is used to validate and verify properties best determined by examination and observation. Inspection is generally non-destructive and typically includes the use of sight, hearing, smell, touch, and taste; simple physical manipulation; mechanical and electrical gauging; and measurement.
First Article Inspection (FAI)	A FAI is a special form of inspection of components, subsystems or systems manufactured under series conditions to see if it meets specifications and to ensure that the process can and does reliably produce what is intended. A FAI is carried out before approval of series production and is typically called for in a contract.	A FAI includes all relevant functional, non-functional, quality and produce process requirements to components, subsystems or systems. A FAI can be carried out when all corresponding validation and verification methods - for example design reviews, type tests, calculations etc.- are successfully finished.
Analysis	Use of analytical data or simulations under defined conditions to show theoretical compliance	Used where testing to realistic conditions cannot be achieved or is not cost-effective. Analysis may be used when such means establish that the appropriate requirement, specification or derived requirement is met by the proposed solution.
Design Review	A formal and systematic validation within a product development process of components, subsystems or systems whereby a design is detailed and evaluated against its requirements.	Validation of agreed functional and non-functional requirements of the system and identification and elimination of potential problems and errors as early as possible.
Simulation	Simulation is the imitation of the operation of a real-world process or system over time. A model represents the key characteristics, behaviors or functions of the selected physical or abstract system or process. The model represents the system itself, whereas the simulation represents the operation of the system over time. Simulations can be used to show under defined conditions theoretical compliance.	Used where testing to realistic conditions cannot be achieved or is not cost-effective. Simulation may be used when such means establish that the appropriate requirement, specification, or derived requirement is met by the proposed solution. Simulation can be used e.g. in the process of development to show movement and functional processes, dynamic loads and stresses.
Calculation	Calculation to validate or verify agreed or specified parameter under defined parameters and rules of calculation by a mathematical proof to show theoretical compliance.	For the input-parameters of the calculation, methods of calculation and the result parameter are presented and evaluated.
Demonstration	A qualitative exhibition of functional performance, usually accomplished with no or minimal instrumentation or test equipment. Demonstration uses a set of test activities with system stimuli selected by the supplier to show that system or system element response to stimuli is suitable or to show that operators can perform their allocated functions when using the system. Observations are made and compared with predetermined responses.	Demonstration may be appropriate when requirements or specifications are given in statistical terms (e.g., mean time to repair, average power consumption, etc.).
Routine Test	Examination of every component, subsystem or system during or after the manufacturing process to prove its compliance with the requirements.	
Test	An action by which the operability, maintainability or performance capability of an item is quantitatively verified when subjected to controlled conditions that are real or simulated.	These verifications often use special test equipment or instrumentation to obtain very accurate quantitative data for analysis.
Type test	Test of one or more components, subsystems or the system to prove that the construction is in compliance with the required specification and the relevant standards.	The test object must not be manufactured under series conditions. Type testing includes the validation of required parameter. Several type tests can be necessary for one test object.
Certification	Certification is a written assurance that the system or system element has been developed in accordance with the required standard, and meets the requirements. This assures that the system or system element can perform its assigned functions to a negotiated standard.	The development reviews and system verification and validation results form the basis for certification. Certification is generally performed by a third party against an accepted standard.

7 BIBLIOGRAPHY

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EuroSpec

"EuroSpec" stands for European Specifications for railway rolling stock. The activity is an initiative of several European train operating companies (TOC). The main focus is on trains consisting of self-propelled carriages, using electricity as the motive power (EMU).

Paris, London, Munich (München), Utrecht, Kopenhagen (København), Vienna (Wien), Bern

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