

# EuroSpec



## Specification for air conditioning of railway vehicles



Mobility  
Networks  
Logistics



# **Specification for air conditioning of railway vehicles**

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## Issue Record

Issue	Date	Comments	Source
1	July 2014	void	EuroSpec "Specification for air conditioning of Railway Vehicles"
2	December 2015	Verification for several requirements added and changed.	
3	July 2016	Modification of some requirements	

## List of open points / non-agreed items

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

## 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 standard 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)/ International Railway Standards (IRS)
- EuroSpec Specifications
- Company Specifications

## Introduction

This document is a voluntary standard, produced by SNCF (SNCF), Association of Train Operating Companies (ATOC), Deutsche Bahn (DB), Nederlandse Spoorwegen (NS), Danske Statsbaner (DSB), 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 standard on the "Specification for air conditioning of railway Vehicles" 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 ENs.

### Application of this document

- This standard 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 authorisation of this document

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## 1 SCOPE

This specification is applicable for rolling stock that is equipped with air conditioning systems.

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

This specification is an add-on to the Technical Specifications of Interoperability (TSI) and Euronorms. In addition to this specification other train operator specific specifications might be defined. The specification contains requirements at the system level of the air conditioning systems and its interfaces, and unifies the required performances of the different operators.

This specification is not intended to block innovation or to prevent improvement. For this purpose each requirement is preceded by an objective.

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

## 2 NORMATIVE REFERENCES

The following referenced documents are indispensable for the application of this document. ENs are developed by CEN<sup>1</sup> or CENELEC<sup>2</sup> and are made available from their members.

<sup>1</sup> Comité Européen de Normalisation/ European Committee for Standardization - [www.cen.eu](http://www.cen.eu)

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

**FOR DATED REFERENCES, ONLY THE EDITION CITED APPLIES. FOR UNDATED REFERENCES, THE LATEST EDITION OF THE REFERENCED DOCUMENT (INCLUDING ANY AMENDMENTS) APPLIES.**

## 3 TERMS, DEFINITIONS AND ABBREVIATIONS

### 3.1 Ventilation mode

Mode which provides the required fresh air rate without heating or cooling

### 3.2 Cooling mode

Mode which enables the interior temperature to be lowered or maintained

### 3.3 Heating mode

Mode which enables the interior temperature to be raised or maintained

### 3.4 Preconditioning

Mode which enables the interior temperature to be adjusted to the comfort level either by preheating or precooling depending on the external and internal conditions. (usually without the presence of passengers)

### 3.5 Preheating mode

Mode which enables the interior temperature to be raised (usually without the presence of passengers)

### 3.6 Precooling mode

Mode which enables the interior temperature to be lowered (usually without the presence of passengers)

### 3.7 Passenger areas

Areas of the train intended to be accessible by passengers

### 3.8 Contaminated air

Air from areas like toilet, catering service, nursery and switching cabinets

### 3.9 Complete air conditioning system

All parts which are responsible for cooling, heating, ventilation, filtering and air distribution into the passenger, train staff or driver compartment

### 3.10 Ingressed water

Water that has entered the system from outside (e.g.rainwater, snow melt water and washing water)

### 3.11 Interior temperature setting (Tic)

Target temperature to be achieved by the room air

### 3.12 Mean interior temperature (Tim)

Arithmetic mean of the interior temperatures according to the respective standard (EN 13129-1, EN 1475-1, EN 14813-1)

### 3.13 Mean exterior temperature (Tem)

Arithmetic mean of the exterior temperatures according to the respective standard (EN 13129-1, EN 1475-1, EN 14813-1)

### **3.14 Tem1**

The temperature (above the design point temperature), which is the highest or lowest temperature at which the aircondition system has to provide a defined mean interior temperature where cooling without any active power reduction shall be possible.

### **3.15 Tem2**

The temperature (above Tem1) where at least 50% cooling power (not taking into account the effect of Coefficient of Performance (COP) variation due to temperature rise) shall be possible.

### **3.16 Tem3**

The temperature (above Tem2) where the air conditioning system shuts down due to a high pressure sensor signal.

### **3.17 Air conditioning unit**

Group of air conditioning components mounted together in a way that they can be treated as one part in maintenance.

### **3.18 Finned device heat exchanger**

Heat exchanger with fins to transfer heat (no micro channel heat exchanger)

### **3.19 First Article Inspection (FAI)**

Defined in "EuroSpec Requirements Management"

### **3.20 Type test**

Defined in "EuroSpec Requirements Management"

### **3.20 Compliance statement**

Statement of the supplier that the product complies with the relevant requirement



## 4 SPECIFICATIONS

This chapter describes the requirements and their objectives given in the Addendum.

The indication in the first column defines the **specification type**:

- RE: Required
- OP: Option
- DR: Design Recommendation
- TX: Information

The last two columns indicate the classification according to EN15380-2.

MPG: Main Product Group.

L - air conditioning

SPG: Sub Product Group.

A - Air conditioning

B – intake/evacuation of air

C – treatment

D – distribution

E - regulation

## 5 BIBLIOGRAPHY

EN 13129 Parts 1 & 2	Railway applications — Air conditioning for main line rolling stock — Comfort parameters and type tests
EN 14750 Parts 1 & 2	Railway applications - Air conditioning for urban and suburban rolling stock
EN 14813 Parts 1 & 2	Railway applications - Air conditioning for driving cabs
EN 378	Refrigerating systems and heat pumps - Safety and environmental requirements
EN 45545 series	Railway applications - Fire protection on railway vehicles
EN 50155	Railway applications - Electronic equipment used on rolling stock
EN 61373	Railway applications - Rolling stock equipment - Shock and vibration tests
EN 779	Particulate air filters for general ventilation - Determination of the filtration performance
EN 15380 series	Railway applications – Designation system for railway vehicles
EN 60529	Degrees of protection provided by enclosures (IP code)

# Specification for air conditioning of railway vehicles

## Addendum

Type [RE, OP, DR, TX]	Nb.	Chapter product- structure	Chapter objective structure	Requirement	Objective	EN 15380-2 MPG	EN 15380-2 SPG	Verification
<b>4.01</b>				<b>General</b>				
OP	4.01.01	General	General	The air conditioning system shall fulfil the requirements of EN 13129 for main line rolling stock within the given maintenance periods in the presence of contamination, ageing and wear and tear.	To assure proper thermal comfort for passengers and train staff during the entire lifetime of the vehicle.	L	A	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Simulation of the thermal comfort</li> <li>• Type test</li> <li>• Test bench trials (static, dynamic) according to EN 13129-2 with a test report. These test bench trials have to be performed for all different vehicle types, unless otherwise agreed.</li> </ul>
OP	4.01.02	General	General	The air conditioning system shall fulfil the requirements of EN 14750, cat. A/B (to be defined by the operator) for urban and suburban rolling stock within the given maintenance periods in the presence of contamination, ageing and wear and tear.	To assure proper thermal comfort for passengers and train staff during the entire lifetime of the vehicle.	L	A	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Simulation of the thermal comfort</li> <li>• Type test</li> <li>• Test bench trials (static, dynamic) according to EN 14750-2 TL2 with a test report. These test bench trials have to be performed for all different vehicle types, unless otherwise agreed.</li> </ul>
OP	4.01.03	General	General	The air conditioning system shall fulfil the requirements of EN 14813 for driving cabs within the given maintenance periods in the presence of contamination, ageing and wear and tear.	To assure proper thermal comfort for drivers during the entire lifetime of the vehicle.	L	A	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Simulation of the thermal comfort</li> <li>• Type test</li> <li>• Test bench trials (static, dynamic) according to EN 14813-2 TL2 with a test report. These test bench trials have to be performed for all different vehicle types, unless otherwise agreed.</li> </ul>
RE	4.01.05	General	General	The air conditioning system shall fulfil the requirements of EN 50155 Electronic equipment used on rolling stock.		L	A	<ul style="list-style-type: none"> <li>• A compliance statement by the supplier with respect to the standard</li> <li>• Concept</li> <li>• Type test</li> <li>• First article inspection</li> </ul>

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## Addendum

Type [RE, OP, DR, TX]	Nb.	Chapter product- structure	Chapter objective structure	Requirement	Objective	EN 15380-2 MPG	EN 15380-2 SPG	Verification
RE	4.01.06	General	General	The air conditioning system shall fulfil the requirements of IEC 61373 Rolling stock equipment - Shock and vibration tests.		L	A	<ul style="list-style-type: none"> <li>• A compliance statement by the supplier with respect to the standard</li> <li>• Concept</li> <li>• Type test</li> <li>• First article inspection</li> </ul>
RE	4.01.07	General	General	External air drawn in shall not be affected by exhaust air and/or contamination from the train set equipment. Where a temperature rise of external air drawn in cannot be prevented, it shall be taken into account in the design point definition of the air conditioning system.	To assure proper air quality.	L	B	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase by computational fluid dynamics (CFD)</li> <li>• Test in Operation</li> <li>• Type test</li> <li>• Compliance statement</li> </ul>
RE	4.01.08	General	General	Effects of heat from electrical equipment and/or environment on air conditioning system sensors and/or components shall be avoided and/or taken into account by the regulation of the air conditioning system (e.g. solar radiation).	To assure proper thermal comfort for passengers, train staff and drivers.	L	B	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.01.09	General	General	Condensation on parts of the air conditioning installation shall not affect other systems or components of the train.	To assure safe, hygienic and durable operation of the train.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.01.10	General	General	The test program for the series tests of the air conditioning system on the vehicle shall be agreed with the customer.	To assure conformity to the design documentation.	L	A	<ul style="list-style-type: none"> <li>• First article inspection</li> </ul>

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Type [RE, OP, DR, TX]	Nb.	Chapter product- structure	Chapter objective structure	Requirement	Objective	EN 15380-2 MPG	EN 15380-2 SPG	Verification
	<b>4.02</b>			<b>Documentation</b>				
RE	4.02.01	Documentation	Documentation	In addition to the requirements mentioned in the Eurospec "Specification for the documentation of railway vehicles" the supplier shall provide all documentation necessary to repair and replace each single part of the control unit. The details are described in the customer specification.	Function modifications and repair of the control unit shall be possible, during the whole lifetime of the train. New development of air conditioning system control unit or future upgrade shall be possible.	L	A	<ul style="list-style-type: none"> <li>• Acceptance of the last vehicle by the customer</li> </ul>
RE	4.02.02	Documentation	Documentation	In addition to the requirements mentioned in the Eurospec "Specification for the documentation of railway vehicles" the supplier shall provide cleaning instructions for the complete air conditioning system.	Maintainability of the system.	L	A	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> <li>• Acceptance of the first vehicle by the customer</li> </ul>
RE	4.02.03	Documentation	Documentation	In addition to the requirements mentioned in the Eurospec "Specification for the documentation of railway vehicles" the data files of all tests in the climatic chamber shall be provided in a digital format to be agreed with the customer.	Documentation of the performance of the system.	L	A	<ul style="list-style-type: none"> <li>• End of type test</li> </ul>
	<b>4.03</b>			<b>Performance</b>				
RE	4.03.01	Performance	Performance	In the temperature range between the design point temperature and a Tem1 defined by the customer, the system shall be able to provide cooling without any active cooling power reduction.	To provide maximum possible comfort in extreme conditions.	L	A	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.03.02	Performance	Performance	At Tem higher than Tem1 (see 4.03.01) where cooling without any active power reduction shall be available, the cooling power shall only be reduced to the necessary level to prevent a system shut down.	To prevent shut down of the cooling circuit.	L	A	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>

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## Addendum

Type [RE, OP, DR, TX]	Nb.	Chapter product- structure	Chapter objective structure	Requirement	Objective	EN 15380-2 MPG	EN 15380-2 SPG	Verification
RE	4.03.03	Performance	Performance	The Tem3 at which the system shut down occurs shall be stated.	To evaluate the performance of the system.	L	A	<ul style="list-style-type: none"> <li>• Offer</li> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.03.04	Performance	Performance	The minimum Tem at which the system shut down occurs shall be defined by the operator.	To evaluate the performance of the system.	L	A	<ul style="list-style-type: none"> <li>• Offer</li> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.03.05	Performance	Performance	The measures taken to prevent the system shut down, shall be stated.	To evaluate the performance of the system.	L	A	<ul style="list-style-type: none"> <li>• Offer</li> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.03.06	Performance	Performance	The available cooling power, as a function of Tem above Tem1, shall be stated in the offer.	To evaluate the performance of the system.	L	A	<ul style="list-style-type: none"> <li>• Offer</li> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.03.07	Performance	Performance	In the temperature range between Tem1, defined in 4.03.01, and Tem2, defined by the customer, the system shall be able to provide at least 50% cooling power.	To evaluate the performance of the system.	L	A	<ul style="list-style-type: none"> <li>• Offer</li> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.03.08	Performance	Performance	The necessary cooling power at the design point shall be provided in case of a condenser area blockage of up to 25%.	Cleaning of the condenser not more often than once a year.	L	A	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test of the air conditioning system unit</li> </ul>
OP	4.03.09	Performance	Performance	The necessary cooling power at the design point shall be provided in case of a reduced condenser air flow of up to 25%.	Cleaning of the condenser not more often than once a year.	L	A	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test for design point</li> </ul>

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Type [RE, OP, DR, TX]	Nb.	Chapter product- structure	Chapter objective structure	Requirement	Objective	EN 15380-2 MPG	EN 15380-2 SPG	Verification
	<b>4.04</b>			<b>Technical</b>				
RE	4.04.01	Technical	Technical	Each air conditioning system shall have a separate control unit.	Availability of the system.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> </ul>
RE	4.04.02	Technical	Technical	Where the train has a bus system, each control unit shall communicate via the bus system.	Maintainability	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.04.03	Technical	Technical	There shall be at least 20% free memory space on the control unit for further changes.	To cater for future (as yet unspecified) requirements, extension of the functionality of the controller shall be possible.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.04.04	Technical	Technical	At least 10% spare input and 10% spare output channels of the control unit shall be provided with a minimum of five spare input and five spare output channels.	To cater for future (as yet unspecified) requirements, extension of the functionality of the controller shall be possible.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.04.05	Technical	Technical	The air conditioning system shall fulfil the requirements of EN 378 Safety and environmental requirements.		L	A	<ul style="list-style-type: none"> <li>• a compliance statement from the supplier</li> <li>• Concept</li> <li>• Type test</li> <li>• First article inspection</li> </ul>
RE	4.04.06	Technical	Technical	The air conditioning system shall cause a pressure difference between the inside of the vehicle and the ambience (Delta P) of at least +3Pa and in accordance with the operation of the doors.	To prevent the intake of undefined quantities of unconditioned outside air.	L	B	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.04.07	Technical	Technical	The air conditioning system shall make use of air filters which are in accordance with class G4 of EN 779 except for condensor air filters.	To ensure air quality.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• First article inspection</li> </ul>

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Type [RE, OP, DR, TX]	Nb.	Chapter product- structure	Chapter objective structure	Requirement	Objective	EN 15380-2 MPG	EN 15380-2 SPG	Verification
OP	4.04.08	Technical	Technical	The air conditioning unit shall be of a monobloc type (All components required for heating, ventilation and air conditioning are combined in one unit.)	To improve system tightness of the cooling circuit, maintainability, exchangeability, etc.	L	A	<ul style="list-style-type: none"> <li>• Concept</li> <li>• First article inspection</li> </ul>
OP	4.04.09	Technical	Technical	The cooling circuit shall have a low pressure switch or transducer.	To protect against too low pressure.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.04.10	Technical	Technical	The electrical heater shall only operate when ventilation is present.	To prevent overheating.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.04.11	Technical	Technical	Where there is a condensate collector it shall be inclined towards the drainage.	To ensure immediate and safe drainage of condensate.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.04.12	Technical	Technical	Where there is a condensate collector its drainage shall be at the lowest position of the collector.	To ensure immediate and safe drainage of condensate.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.04.13	Technical	Technical	If there is a set point adjuster, then its value shall be ignored during preconditioning (Mode which enables the interior temperature to be adjusted to the comfort level either by preheating or precooling depending on the external and internal conditions. (usually without the presence of passengers.) periods. After preconditioning periods the set point shall be in mid position (+/- 0K).	To ensure thermal comfort at the beginning of train operation.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.04.14	Technical	Technical	In contrast to EN13129 the preconditioning period shall end when the deviation of $T_{im}$ from $T_{ic}$ is less than 2 Kelvin.	To ensure thermal comfort at the beginning of train operation.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.04.15	Technical	Technical	If components have to be cooled by the air conditioning system, this shall be assured in all operating modes, e.g. during recirculation mode.	To ensure safe operation of the train.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>



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Type [RE, OP, DR, TX]	Nb.	Chapter product- structure	Chapter objective structure	Requirement	Objective	EN 15380-2 MPG	EN 15380-2 SPG	Verification
RE	4.04.17	Technical	Technical	Water produced by condensation from the air conditioning system shall be drained immediately in a manner that is safe and invisible to passengers and shall not affect other components of the vehicle.	To ensure safe, hygienic and durable operation of the train.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.04.18	Technical	Technical	Where finned devices are used, the fins shall be seamless through the entire depth of the heat exchanger.	To reduce the accumulation of dirt.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> </ul>
OP	4.04.19	Technical	Technical	Where finned devices are used, the condenser inter-fin distance shall not be less than 4 mm.	For easier cleaning of the condenser.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Presentation and validation of cleaning process</li> </ul>
OP	4.04.20	Technical	Technical	Where finned devices are used, the evaporator inter-fin distance shall not be less than 2.5 mm.	For easier cleaning of the evaporator.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Presentation and validation of cleaning process</li> </ul>
OP	4.04.21	Technical	Technical	Where finned devices are used, the heat exchanger fin thickness shall not be less than 0.25 mm using copper fins and 0.35 mm using aluminium fins.	To prevent deformation of the heat exchanger fins.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Presentation and validation of cleaning process</li> </ul>
RE	4.04.22	Technical	Technical	The maximum leakage rate for each fitting/connection of the cooling circuit shall be less than 5g/year.	Environmental protection.	L	D	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Proof as a Series test</li> <li>• Proof as a Type test after shock and vibration test</li> </ul>
RE	4.04.23	Technical	Technical	In the determination of the lifetime of the compressor, power cut offs shall be taken into account.	To assure durable operation of the compressor.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Proof in operation</li> </ul>

# Specification for air conditioning of railway vehicles

## Addendum

Type [RE, OP, DR, TX]	Nb.	Chapter product- structure	Chapter objective structure	Requirement	Objective	EN 15380-2 MPG	EN 15380-2 SPG	Verification
	<b>4.05</b>			<b>Operation</b>				
OP	4.05.01	Operation	Operation	The air conditioning system shall prevent fogging of the windows.	To provide passenger comfort.	L	A	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test (no fogging of the windows occurs during all of the type tests)</li> </ul>
RE	4.05.02	Operation	Operation	The air conditioning system shall always be able to start up without a time lag when the vehicle is powered, even after being unpowered for any period of time under extreme external conditions. Possible storage conditions for long time storage shall be agreed upon between the supplier and customer.	To assure the operation of the air conditioning system under extreme external conditions.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Design calculation</li> <li>• Type test by extreme external conditions</li> </ul>
RE	4.05.03	Operation	Operation	The air conditioning system shall manage power cut-offs during operation of the train in a way that the effect on thermal comfort and air quality is minimised. The frequency and duration of the power interruption will be defined by the operator. The technical solution shall be agreed between the supplier and customer.	To assure thermal comfort for passengers.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Proof in operation</li> </ul>
OP	4.05.04	Operation	Operation	Tic shall be adjustable by +/-2 Kelvin by a set point adjuster (see EN13129).	To be able to adjust thermal comfort individually in zones of the train or for the whole train.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.05.05	Operation	Operation	The set point adjuster shall be accessible by the driver and/or the on-board staff.	To be able to adjust thermal comfort individually in zones of the train or for the whole train.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>

# Specification for air conditioning of railway vehicles

## Addendum

Type [RE, OP, DR, TX]	Nb.	Chapter product- structure	Chapter objective structure	Requirement	Objective	EN 15380-2 MPG	EN 15380-2 SPG	Verification
OP	4.05.06	Operation	Operation	If a failure occurs in a component of the air conditioning system, the air conditioning system shall switch to a partial redundancy of the component to ensure at least half of the normal performance of the system with respect to heating, cooling and ventilation (e.g. two cooling circuits, two separate fans with independent power supply, ...).	To assure thermal comfort for passengers, train staff and drivers in degraded mode.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.05.07	Operation	Operation	The thermal comfort and fresh air flow rates according to the EN 14750-1 and EN 14813-1 and/or EN 13129-1 shall be fulfilled for all vehicle operational speeds.	To assure thermal comfort for passengers, train staff and drivers.	L	A	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test <ul style="list-style-type: none"> <li>• The supplier shall do measurements for fresh-, exhaust-, and condensor air flow rates during dynamic tests at the maximum vehicle operational speed.</li> <li>• The supplier shall do measurements for fresh-, exhaust-, and condensor air flow rates during stationary tests using the same measurement equipment as for the dynamic tests.</li> <li>• Using the results of static and dynamic tests the suppliers shall prove that the thermal comfort and the fresh airflow rates are fulfilled.</li> </ul> </li> </ul>
OP	4.05.08	Operation	Operation	The regulation system shall provide a variation in $T_{ic}$ due to a variation in $T_{em}$ , less than or equal to 2 Kelvin per hour .	To maintain the thermal comfort in case of rapid variation of $T_{em}$ (tunnel, thunderstorm,...).	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.05.09	Operation	Operation	The design of the air ducts shall prevent condensation on their outside surfaces.	To prevent water inside the coach.	L	D	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>

# Specification for air conditioning of railway vehicles

## Addendum

Type [RE, OP, DR, TX]	Nb.	Chapter product- structure	Chapter objective structure	Requirement	Objective	EN 15380-2 MPG	EN 15380-2 SPG	Verification
	<b>4.06</b>			<b>Air Quality</b>				
RE	4.06.01	Air Quality	Air Quality	Contaminated air shall be fed directly into the exhaust air.	No odours in other passenger areas.	L	D	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test according to prEN 13129-1, 12.1.3</li> </ul>
RE	4.06.02	Air Quality	Air Quality	The air conditioning system shall permanently provide a lower pressure level in contaminated areas (e.g. toilets, vestibule, nursery, catering service...) than in the adjacent areas.	No odours in other passenger areas.	L	D	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test according to prEN 13129-1, 12.1.3</li> </ul>
OP	4.06.03	Air Quality	Air Quality	The toilet area shall be maintained at a lower pressure level than the adjacent passenger area also in recirculation mode.	No odours in other passenger areas.	L	D	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.06.04	Air Quality	Air Quality	The air conditioning system shall provide an air change rate of the toilet higher than 20 times per hour.	No odours in the toilet.	L	D	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.06.05	Air Quality	Air Quality	The air intakes and outlets inside the coach shall be designed in a way that the entry of foreign substances, fluids and grease (galley) is prevented.	To assure safe and reliable air-conditioning operation.	L	B	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.06.06	Air Quality	Air Quality	The air intakes and outlets shall be designed in a way that the entry of emissions due to the operation of the train e.g. braking, is prevented independently of vehicle speed, direction of travel, coupling status and/or cross wind.	To assure passenger comfort.	L	B	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Test in operation</li> </ul>
RE	4.06.07	Air Quality	Air Quality	The fresh and return air duct system shall be protected by filters against pollution at suitable positions.	To ensure thermal comfort and air quality.	L	D	<ul style="list-style-type: none"> <li>• Concept</li> <li>• First article inspection</li> </ul>

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## Addendum

Type [RE, OP, DR, TX]	Nb.	Chapter product- structure	Chapter objective structure	Requirement	Objective	EN 15380-2 MPG	EN 15380-2 SPG	Verification
RE	4.06.08	Air Quality	Air Quality	There shall be no alternating use of air ducts.	To assure proper hygienic conditions.	L	D	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• First article inspection</li> </ul>
RE	4.06.09	Air Quality	Air Quality	The air distribution system of the air conditioning system shall force the air which is used for purposes like cooling/heating/ventilation of electrical equipment and/or switching cabinets and/or sanitary areas and/or galley areas directly into the exhaust duct.	To assure proper air quality.	L	D	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.06.10	Air Quality	Air Quality	Internal insulation in the air ducts shall have a closed surface according to IP 54 in EN 60529.	Maintainability of the system.	L	D	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> </ul>
RE	4.06.11	Air Quality	Air Quality	The air conditioning system shall prevent the condensate entering into the air supply ducts in any operating mode of the air conditioning unit.	To prevent water inside the coach.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
	<b>4.07</b>			<b>Diagnoses</b>				
OP	4.07.01	Diagnoses	Diagnoses	All controller parameters known by the controller shall be possible to be saved on an external storage device (e.g. USB Stick, SD Card,...).	Maintainability of the system.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.07.02	Diagnoses	Diagnoses	The sampling rate for the recording of all controller parameters shall be changeable starting by 1/second to 1/30 minutes by steps of 1 second.	Maintainability of the system.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.07.03	Diagnoses	Diagnoses	The data files of all controller parameters shall be provided in a digital format to be agreed with the customer.	Maintainability of the system.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> <li>• Agreement by the customer of Data files of all parameters provided in digital format</li> </ul>

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## Addendum

Type [RE, OP, DR, TX]	Nb.	Chapter product- structure	Chapter objective structure	Requirement	Objective	EN 15380-2 MPG	EN 15380-2 SPG	Verification
OP	4.07.04	Diagnoses	Diagnoses	The diagnostic system shall generate a message when, according to the measured value for interior temperature the requirements with respect to interior temperature are not fulfilled.	Maintainability of the system.	L	E	<ul style="list-style-type: none"> <li>• Offer</li> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.07.05	Diagnoses	Diagnoses	<p>The diagnostic system shall diagnose at least the following components:</p> <ul style="list-style-type: none"> <li>• compressors</li> <li>• fans</li> <li>• power supply</li> <li>• sensors</li> <li>• controller</li> <li>• heater</li> <li>• pressure protection system</li> <li>• dampers</li> <li>• safety devices</li> </ul>	Maintainability of the system.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.07.06	Diagnoses	Diagnoses	The air conditioning system shall automatically monitor the amount of the refrigerant when the cooling function is in operation.	Reliability and availability of the system.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.07.07	Diagnoses	Diagnoses	When the amount of loss of refrigerant of the air conditioning system is more than 10%, the air conditioning system shall give a signal and display the amount lost.	Reliability and availability of the system.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
	<b>4.08</b>			<b>Maintenance</b>				
RE	4.08.01	Maintenance	Maintenance	The air conditioning control unit shall provide the maintenance staff of the train operator with the ability to get access to the control unit via a standard laptop.	It shall be possible to optimise the operation of the air conditioning system. Parameter adjustments of the controller shall be possible.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>

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## Addendum

Type [RE, OP, DR, TX]	Nb.	Chapter product- structure	Chapter objective structure	Requirement	Objective	EN 15380-2 MPG	EN 15380-2 SPG	Verification
RE	4.08.02	Maintenance	Maintenance	<p>The control unit shall provide the maintenance staff with the ability to adjust the following operating parameters if applicable:</p> <ul style="list-style-type: none"> <li>- set point temperature,</li> <li>- CO<sub>2</sub> Level,</li> <li>- set points of the pressure protection system,</li> <li>- offset values of all sensors</li> </ul>	It shall be possible to optimise the operation of the air conditioning system. Parameter adjustments of the controller shall be possible.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.08.03	Maintenance	Maintenance	The source code and compilation tool of the control unit shall be provided at the end of the warranty period .	Function modifications of the controller shall be possible, during the whole lifetime of the train. New development of air-conditioning system controllers or future upgrade shall be possible.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.08.04	Maintenance	Maintenance	After the warranty period five software adjustments of the air conditioning control unit, without adding new functions, at the request of the customer, shall be included in the scope of supply.	To assure evolution of the software.	L	E	
RE	4.08.05	Maintenance	Maintenance	The life of all filters shall fit into the Maintenance plan.	To reduce maintenance costs.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Proof in operation</li> </ul>
RE	4.08.06	Maintenance	Maintenance	Filter dryer, coolant sight gauge, humidity indicator, connections for HP and LP service pressure gauges, coolant discharge and charge cut-off valves, HP and LP pressure switches and thermostatic expansion valves shall be accessible for the maintenance staff via service hatches or doors.	To reduce maintenance costs.	L	A	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>

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## Addendum

Type [RE, OP, DR, TX]	Nb.	Chapter product- structure	Chapter objective structure	Requirement	Objective	EN 15380-2 MPG	EN 15380-2 SPG	Verification
RE	4.08.07	Maintenance	Maintenance	The condenser shall be able to be cleaned by the cleaning staff in the opposite direction of the airflow without the need to remove assemblies (e.g. condenser fan) whilst in place on the vehicle.	To reduce maintenance costs.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Presentation and validation of cleaning process</li> </ul>
OP	4.08.08	Maintenance	Maintenance	Mounting and dismounting of components of the air conditioning system shall be possible without special tools.	To reduce maintenance costs.	L	A	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.08.09	Maintenance	Maintenance	If the air conditioning unit is intended to be repaired off the train, then the supplier shall provide an offer for a test bench for all functions.	To reduce maintenance costs.	L	A	<ul style="list-style-type: none"> <li>• Offer</li> </ul>
RE	4.08.10	Maintenance	Maintenance	A specific handling device for transport of the air conditioning unit and a drawing of this device produced by the supplier shall be provided.	To transport the air conditioning unit, without risk of damage.	L	A	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> </ul>
RE	4.08.11	Maintenance	Maintenance	The cooling circuit shall have connections for inspection and pressure gauges.	Maintainability of the system.	L	A	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> </ul>
OP	4.08.12	Maintenance	Maintenance	The accessibility of pressure taps, refrigerant fluid indicator with humidity indicator and resettable safety devices for roof-mounted air conditioning units shall be possible for the maintenance staff from the inside of the vehicle.	Maintainability of the system.	L	A	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.08.13	Maintenance	Maintenance	For the observation of the motor-compressor oil quantity, there shall be an oil level indicator.	Maintainability of the system.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> </ul>
RE	4.08.14	Maintenance	Maintenance	For the observation of parameters of the cooling circuit, the cooling circuit shall have a fluid and humidity indicator.	Maintainability of the system.	L	A	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> </ul>
OP	4.08.15	Maintenance	Maintenance	Filters shall be changeable from the inside of the train or from a station platform.	Maintainability of the system.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>



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Type [RE, OP, DR, TX]	Nb.	Chapter product- structure	Chapter objective structure	Requirement	Objective	EN 15380-2 MPG	EN 15380-2 SPG	Verification
RE	4.08.16	Maintenance	Maintenance	The removal and replacement of air filters shall be possible by one person within 5 minutes per filter installation, without special tools, and without the need to dismount other equipment except the filter itself or its support frame.	Maintainability of the system.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.08.17	Maintenance	Maintenance	The replacement of an air conditioning unit shall be possible without dismounting anything other than the unit itself.	Maintainability of the system.	L	A	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.08.18	Maintenance	Maintenance	The evaporator shall be able to be cleaned by the cleaning staff in the opposite direction to the airflow without the need to remove assemblies (e.g. supply fan) whilst in place on the vehicle.	Maintainability of the system.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.08.19	Maintenance	Maintenance	Water drains shall be accessible for the staff for cleaning without dismounting other parts.	Maintainability of the system.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.08.20	Maintenance	Maintenance	Desoldering and dismounting of cooling circuit components shall be possible for the maintenance staff without dismounting other parts or cables.	Maintainability of the system.	L	A	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.08.21	Maintenance	Maintenance	All air conditioning system components exposed to washing water shall be resistant to corrosion that may be caused by the cleaning agents used by the customer.	To assure durable operation of the air conditioning system.	L	A	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Proof in operation</li> </ul>
OP	4.08.22	Maintenance	Maintenance	Internal insulation in the air ducts shall withstand mechanical stress due to cleaning or maintenance.	Maintainability of the system.	L	D	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Proof in operation</li> </ul>
RE	4.08.23	Maintenance	Maintenance	Where dampers are used to regulate the air flow in the ducts, the dampers shall be adjustable and replaceable via service hatches.	To reduce maintenance costs.	L	D	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>

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## Addendum

Type [RE, OP, DR, TX]	Nb.	Chapter product- structure	Chapter objective structure	Requirement	Objective	EN 15380-2 MPG	EN 15380-2 SPG	Verification
	<b>4.09</b>			<b>Energy Saving</b>				
RE	4.09.01	Energy Saving	Energy Saving	<p>The supplier shall propose energy saving options in the offer which include for every option at least:</p> <ul style="list-style-type: none"> <li>• a calculation of the total annual energy consumption, with and without the proposed energy saving options</li> <li>• proposal and costs for a type test</li> <li>• proposal and costs for trials with a test bench (the test specification has to be agreed with the customer) to measure the power consumption as an input for the calculation of the total annual energy consumption referring to a given duty cycle.</li> </ul>	To save energy.	L	A	• Offer
RE		Energy Saving	Energy Saving	The supplier shall calculate the total annual energy consumption, with and without the proposed energy saving options.	To save energy.	L	A	• Concept, including a power saving potential statement
RE	4.09.02	Energy Saving	Energy Saving	The air conditioning system shall adjust the fresh air quantity according to the actual passenger occupation.	To save energy.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Calculation of energy saving potential (in the offer)</li> <li>• Proof in design phase</li> <li>• Type test (additional: simulate different occupations; continuously measuring of the fresh air value)</li> </ul>
OP	4.09.03	Energy Saving	Energy Saving	The preconditioning shall start automatically at the latest possible time taking account of the outside temperature and the desired starting time of operation of the train.	To ensure thermal comfort at the beginning of train operation.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
DR	4.09.04	Energy Saving	Energy Saving	Based on a duty cycle provided by the customer, the supplier shall provide the annual energy consumption of the air conditioning system.	To assess Life Cycle Cost (LCC) with regards to energy consumption.	L	A	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.09.05	Energy Saving	Energy Saving	In standby operation the air conditioning system shall maintain T <sub>im</sub> between +7°C and +30°C. In this temperature range there shall be no heating or cooling.	To save energy.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>

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Type [RE, OP, DR, TX]	Nb.	Chapter product- structure	Chapter objective structure	Requirement	Objective	EN 15380-2 MPG	EN 15380-2 SPG	Verification
	<b>4.10</b>			<b>Environment</b>				
RE	4.10.01	Environment	Environment	The air conditioning system shall fulfil all requirements independently of weather conditions, driving in tunnels, vehicle speed, direction of travel, coupling status and/or cross wind.	To assure proper thermal comfort for passengers, train staff and drivers.	L	A	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Compliance statement</li> </ul>
RE	4.10.02	Environment	Environment	The air conditioning system shall not be affected by snow, rain or ice (e.g.: blocking of motor-driven fan by a build-up of snow or ice) independent of vehicle speed, direction of travel, coupling status or cross wind.	To assure safe and reliable airconditioning operation.	L	B	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.10.03	Environment	Environment	Ingressed water shall not be collected in the air conditioning system.	To assure safe, hygienic and durable operation of the train.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.10.04	Environment	Environment	Ingressed water shall not affect the air conditioning system independently of vehicle speed, direction of travel, coupling status and/or cross wind.	To assure safe, hygienic and durable operation of the train.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.10.05	Environment	Environment	Ingressed water shall be drained immediately in a manner that it is safe and invisible for passengers and shall not affect other components of the vehicle.	To assure safe, hygienic and durable operation of the train.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.10.06	Environment	Environment	Water shall not ingress into the air treatment unit of the air conditioning system.	To assure safe, hygienic and durable operation of the train.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
	<b>4.11</b>			<b>Safety</b>				
RE	4.11.01	Safety	Safety	If there is a failure in the fresh air supply system, heating and/or cooling system the air conditioning system shall inform the train staff and driver by a visible signal.	To assure passenger comfort.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>

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## Addendum

Type [RE, OP, DR, TX]	Nb.	Chapter product- structure	Chapter objective structure	Requirement	Objective	EN 15380-2 MPG	EN 15380-2 SPG	Verification
TX	4.11.02	Safety	Safety	According to EN 45545 heating devices of the air conditioning system shall have at least two temperature related safety devices.	Ensure safe operation of the heater by means of redundant safety device.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
RE	4.11.03	Safety	Safety	The device with the highest temperature cut off shall not reset automatically and shall interrupt the power supply of the heater in a reliable manner without auxiliary power (constraint to EN 45545-5).	Ensure safe operation of the heater by means of redundant safety device.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.11.04	Safety	Safety	The device with the highest temperature cut off shall not reset automatically and shall interrupt the power supply of the heater and ventilation in a reliable manner without auxiliary power.	Ensure safe operation of the heater by means of redundant safety device.	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.11.05	Safety	Safety	If specific faults, to be defined by the operator, cause the air conditioning system to shut down, then the air conditioning system shall not restart automatically.	Safety	L	E	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>
OP	4.11.06	Safety	Safety	The air conditioning system shall be designed in a way that maintenance staff are protected against dust when changing the filters.	No release of dust to the surroundings.	L	C	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Proof in design phase</li> <li>• Type test</li> </ul>



# *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).

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