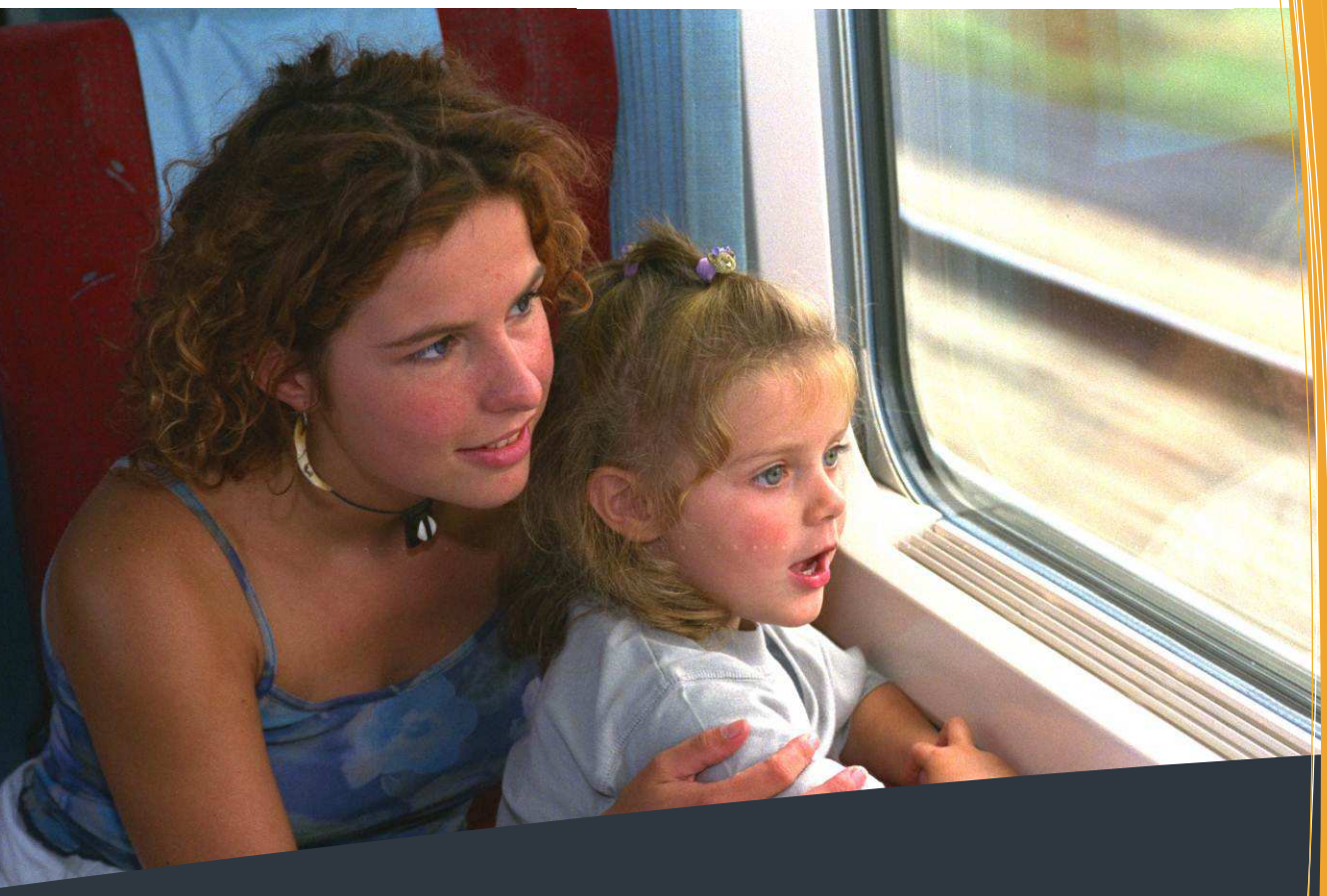
EuroSpec



# Specification for air conditioning of Railway Vehicles

SNCF ATOC DB Mobility Networks Logistics NS DSB SJ ÖBB

EuroSpec

# Specification for air conditioning of railway vehicles

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# 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

# Introduction

This document is a voluntary specification, produced by Société nationale des chemins de fer français (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 specification 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 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 Société nationale des chemins de fer français (SNCF), Association of Train Operating Companies (ATOC), Deutsche Bahn (DB), Nederlandse Spoorwegen (NS), Danske Statsbaner (DSB) and Österreichische Bundesbahnen (ÖBB) and Schweizerische Bundesbahnen (SBB).

# 1 SCOPE

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

The purpose of this document is to provide a common specification for air conditioning systems in rolling stock units between operators. 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). Besides this specification additional operator specific specifications might be defined. The specification contains requirements on system level of the air conditioning systems and its interfaces, and unifies the requested 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 foreseen that more requirement sets and European standards will make use of this common reference structure.

# 2 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.

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

[2] Comité Européen de Normalisation Électrotechnique/ European Committee for Electrotechnical Standardization - 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 Preheating mode

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

## 3.5 Precooling mode

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

## 3.6 Passenger areas

Areas of the train intended to be accessible by passengers

## 3.7 Contaminated air

Air from areas like toilet, galley, nursery,

## 3.8 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

## 3.9 Ingressed water

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

## 3.10 Interior temperature setting (Tic)

Target temperature to be achieved by the room air

## 3.11 Mean interior temperature (Tim)

Arithmetic mean of the interior temperatures according to the respective standard

## 3.12 Mean exterior temperature (Tem)

Arithmetic mean of the exterior temperatures according to the respective standard

## 3.13 Air conditioning unit

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

# 4 SPECIFICATIONS

This chapter describes the requirements and their objectives.

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

RE: Required

OP: Option

DR: Design Recommendation

TX: Information

| Type | 4.01 | General | Objective | Proof / Validation |
|---|---|---|---|---|
| OP | 4.01.01 | The air conditioning system shall fulfill 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. | • Concept<br>• Simulation of the thermal comfort<br>• Type test<br>• Test bench trials (static, dynamic) according to EN 13129 with a test report. These test bench trials have to be performed for all different vehicle types, if not otherwise agreed. |
| OP | 4.01.02 | The air conditioning system shall fulfill 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. | • Concept<br>• Simulation of the thermal comfort<br>• Type test<br>• Test bench trials (static, dynamic) according to EN 14750 TL 2 with a test report. These test bench trials have to be performed for all different vehicle types, if not otherwise agreed. |
| OP | 4.01.03 | The air conditioning system shall fulfill 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. | • Concept<br>• Simulation of the thermal comfort<br>• Type test<br>• Test bench trials (static, dynamic) according to EN 14813 TL 2 with a test report. These test bench trials have to be performed for all different vehicle types, if not otherwise agreed. |
| RE | 4.01.04 | The air conditioning system shall fulfill the requirements of EN 45545 Fire protection on railway vehicles. | | • Concept<br>• Type test<br>• First article inspection |

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|---|---|---|---|---|
| RE | 4.01.05 | The air conditioning system shall fulfill the requirements of EN 50155 Electronic equipment used on rolling stock. | | • a compliance statement with respect to evey single clause of the standard<br>• Concept<br>• Type test<br>• First article inspection |
| RE | 4.01.06 | The air conditioning system shall fulfill the requirements of IEC 61373 Rolling stock equipment - Shock and vibration tests. | | • a compliance statement with respect to evey single clause of the standard<br>• Concept<br>• Type test<br>• First article inspection |
| RE | 4.01.07 | 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 has to be taken into account in the design point definition of the air conditioning system. | To assure proper air quality. | • Concept<br>• Proof in design phase<br>• Dynamic type test<br>• Compliance statement |
| RE | 4.01.08 | Air conditioning system sensors and/or components shall not be affected by heat and/or emissions from electrical equipment and/or the environment (e.g. ballast bed, solar radiation). | To assure proper thermal comfort for passengers, train staff and drivers. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.01.09 | 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. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.01.10 | The test program for the series tests of the air conditioning system on the vehicle shall be agreed with the customer. | Maintainability of the system. | • First article inspection |
| **Type** | **4.02** | **Documentation** | **Objective** | **Proof / Validation** |
| RE | 4.02.01 | The supplier shall provide all documentations 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.<br>New development of air conditioning system control unit or future upgrade shall be possible. | • Acceptance of the last vehicle by the customer |
| RE | 4.02.02 | The supplier shall provide cleaning instructions for the complete air conditioning system. | Maintainability of the system. | • Concept<br>• Proof in design phase<br>• Type test<br>• Acceptance of the first vehicle by the customer |
| RE | 4.02.03 | The data files of all tests in the climatic chamber shall be provided in a digital -format to be agreed with the customer. | Maintainability of the system. | • End of type test |
| **Type** | **4.03** | **Performance** | **Objective** | **Proof / Validation** |
| RE | 4.03.01 | In the temperature range between the design point temperature and a Tem defined by the customer, the system shall be able to provide 100% cooling power. | To provide maximum possible comfort in extrem conditions. | • Concept<br>• Proof in design phase<br>• Type test |

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| RE | 4.03.02 | At Tem higher than temperatures where 100% cooling power has to 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. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.03.03 | The Tem at which the system shut down occurs shall be stated.<br>OP:The minimum Tem at which the system shut down occurs shall be defined by the operator. | To evaluate the performance ot the system. | • Offer<br>• Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.03.04 | The measures taken to prevent the system shut down, shall be stated. | To evaluate the performance ot the system. | • Offer<br>• Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.03.05 | The power decrease, as a function of Tem above Tem where 100% cooling power has to be available, shall be stated in the offer.<br>OP: The cooling power available as a function of Tem above Tem where 100% cooling power has to be available, shall be more than 50% of the design cooling power. | To evaluate the performance ot the system. | • Offer<br>• Concept<br>• Proof in design phase<br>• Type test |
| OP | 4.03.06 | The necessary cooling power at the design point shall be provided in case of a condensor area blockage of up to 25%. | Clean the condensor not more often than once a year. | • Concept<br>• Proof in design phase<br>• Type test of the air conditioning system unit |
| OP | 4.03.07 | The necessary cooling power at the design point shall be provided in case of a reduced condensor air flow of up to 25%. | Clean the condensor not more often than once a year. | • Concept<br>• Proof in design phase<br>• Type test for design point |
| **Type** | **4.04** | **Technical** | **Objective** | **Proof / Validation** |
| RE | 4.04.01 | Each air conditioning system shall have a separate control unit. | Availability of the system. | • Concept<br>• Proof in design phase |
| RE | 4.04.02 | Where the train has a bus system, each control unit shall communicate via the bus system. | Maintainability, redundancy and thermal comfort. | • Concept<br>• Proof in design phase<br>• Type test |
| OP | 4.04.03 | 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. | • Concept<br>• Proof in design phase<br>• Type test |
| OP | 4.04.04 | 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. | • Concept<br>• Proof in design phase<br>• Type test |

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| RE | 4.04.05 | The air conditioning system shall fulfill the requirements of EN 378 Safety and environmental requirements. | | • a compliance statement of the supplier<br>• Concept<br>• Type test<br>• First article inspection |
| RE | 4.04.06 | The air conditioning system shall cause a pressure difference between inside and outside pressure (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. | • Concept<br>• Proof in design phase<br>• Type test |
| OP | 4.04.07 | The air conditioning system shall shall make use of filters which are in accordance with class G4 of EN 779. | To ensure air quality. | • Concept<br>• First article inspection |
| OP | 4.04.08 | The air conditioning unit shall be of a monobloc type. | To improve system tightness of the cooling curcuit, maintainabillity, exchangeabillity, etc. | • Concept<br>• First article inspection |
| OP | 4.04.09 | The cooling circuit shall have a low pressure switch. | To protect against too low pressure. | • Concept<br>• Proof in design phase<br>• Type test |
| OP | 4.04.10 | The electrical heater shall only operate when ventilation is present. | To prevent overheating. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.04.11 | Where there is a condensate collector it shall be inclined towards the drainage. | To prevent water inside the coach. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.04.12 | Where there is a condensate collector its drainage shall be at the lowest position of the collector. | To prevent water inside the coach. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.04.13 | If there is a set point adjuster, then its value shall be ignored during preconditioning periods. | To ensure thermal comfort at the beginning of train operation. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.04.14 | In contrast to EN13129 the preconditioning period shall end when the deviation of Tim from Tic is less than 2 Kelvin. | To ensure thermal comfort at the beginning of train operation. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.04.15 | 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. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.04.16 | Water produced by condensation from the air conditioning system shall not be collected in the air conditioning system. | To ensure safe, hygienic and durable operation of the train. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.04.17 | 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 units. | To ensure safe, hygienic and durable operation of the train. | • Concept<br>• Proof in design phase<br>• Type test |

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| OP | 4.04.18 | Where finned devices are used, the fins shall be seamless through the entire depth of the heat exchanger. | To reduce the accumulation of dirt. | • Concept<br>• Proof in design phase |
| OP | 4.04.19 | Where finned devices are used, the condensor inter-fin distance shall not be less than 4 mm. | For easier cleaning of the condensor. | • Concept<br>• Proof in design phase<br>• Presentation and validation of cleaning process |
| OP | 4.04.20 | Where finned devices are used, the evaporator inter-fin distance shall not be less than 2.5 mm. | For easier cleaning of the evaporator. | • Concept<br>• Proof in design phase<br>• Presentation and validation of cleaning process |
| OP | 4.04.21 | 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. | • Concept<br>• Proof in design phase<br>• Presentation and validation of cleaning process |
| RE | 4.04.22 | The maximum leakage for each fitting/connection of the cooling circuit shall be less than 5g/year. | Environmental protection. | • Concept<br>• Proof in design phase<br>• Proof in operation |
| RE | 4.04.23 | The compressor shall withstand power cut offs in a way that this does not affect the lifetime of the compressor. | To assure durable operation of the compressor. | • Concept<br>• Proof in design phase<br>• Proof in operation |
| **Type** | **4.05** | **Operation** | **Objective** | **Proof / Validation** |
| OP | 4.05.01 | The air conditioning system shall prevent fogging of the windows. | To provide passenger comfort. | • Concept<br>• Proof in design phase<br>• Type test(no fogging of the windows occure during all the typetests) |
| RE | 4.05.02 | 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. | To assure the operability of the air conditioning system under extreme external conditions. | • Concept<br>• Design calculation<br>• Type test by extreme external conditions |
| RE | 4.05.03 | 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. | • Concept<br>• Proof in design phase<br>• Proof in operation |
| OP | 4.05.04 | Tic shall be adjustable +/-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. | • Concept<br>• Proof in design phase<br>• Type test |
| OP | 4.05.05 | 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. | • Concept<br>• Proof in design phase<br>• Type test |

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| RE | 4.05.06 | 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 curcuits, two seperate fans with independent power supply, …). | To assure thermal comfort for passengers, train staff and drivers in degraded mode. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.05.07 | 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. | • Concept<br>• Proof in design phase<br>• Type test<br>• The supplier shall do measurements for fresh-, exhaust-, and condensor air flow rates during dynamic tests at the maximum vehicle operational speed.<br>• 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.<br>• Using the results of static and dynamic tests the suppliers shall proof that the thermal comfort and the fresh airflow rates are fulfilled. |
| OP | 4.05.08 | The regulation system shall provide a variation in Tic due to a variation in Tem, less or equal than 2 Kelvin per hour . | To maintain the thermal comfort in case of rapid variation of Tem (tunnel, thunderstorm,…). | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.05.09 | The design of the air ducts shall prevent condensation on the outside surfaces of the ducts. | To prevent water inside the coach. | • Concept<br>• Proof in design phase<br>• Type test |
| **Type** | **4.06** | **Air Quality** | **Objective** | **Proof / Validation** |
| RE | 4.06.01 | Contaminated air shall be fed directly into the exhaust air. | No odours in the passenger areas. | • Concept<br>• Proof in design phase<br>• Type test according to prEN 13129-1, 12.1.3 |
| RE | 4.06.02 | 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 the passenger areas. | • Concept<br>• Proof in design phase<br>• Type test according to prEN 13129-1, 12.1.3 |
| OP | 4.06.03 | The toilet area shall be maintained at a lower pressure level than the adjacent passenger area also in recirculation mode. | No odours in the passenger areas. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.06.04 | The air conditionning system shall provide an air change rate of the toilet higher than 20 tmes per hour. | No odours in the toilet. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.06.05 | 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 airconditioning operation. | • Concept<br>• Proof in design phase<br>• Type test |

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| RE | 4.06.06 | 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. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.06.07 | The fresh and return air duct system shall be protected against pollution by filters at suitable positions. | To ensure thermal comfort and air quality. | • Concept<br>• First article inspection |
| RE | 4.06.08 | There shall be no alternating use of air ducts. | To assure proper hygienic conditions. | • Concept<br>• Proof in design phase<br>• First article inspection |
| RE | 4.06.09 | 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. | • Concept<br>• Proof in design phase<br>• Type test |
| OP | 4.06.10 | Internal insulation in the air ducts shall have a closed surface according to IP 54. | Maintainability of the system. | • Concept<br>• Proof in design phase |
| RE | 4.06.11 | The air conditioning system shall prevent the condensate entering into the air supply ducts in any operating mode -of the air condition. | To prevent water inside the coach. | • Concept<br>• Proof in design phase<br>• Type test |
| **Type** | **4.07** | **Diagnoses** | **Objective** | **Proof / Validation** |
| OP | 4.07.01 | Any set of parameters of all controller parameters known by the controller shall be possible to save on an external storage device (e.g. USB Stick, SD Card,…). | Maintainability of the system. | • Concept<br>• Proof in design phase<br>• Type test |
| OP | 4.07.02 | The sampling rate of all controller parameters shall be changeable starting by 1/second to 1/30 minutes by steps of 1 second. | Maintainability of the system. | • Concept<br>• Proof in design phase<br>• Type test |
| OP | 4.07.03 | The data files of all controller parameters shall be provided in a digital format to be agreed with the customer. | Maintainability of the system. | • Concept<br>• Proof in design phase<br>• Type test<br>• Agreement by the customer of Data files of all parameters provided in digital format |
| OP | 4.07.04 | The diagnostic system shall generate a message when the requirements with respect to interior temperature are not fullfilled. | Maintainability of the system. | • Offer<br>• Concept<br>• Proof in design phase<br>• Type test |

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| RE | 4.07.05 | The diagnostic system shall diagnose at least the following components:<br>• compressors<br>• fans<br>• power supply<br>• sensors<br>• controller<br>• heater<br>• pressure protection system<br>• dampers<br>• safety devices | Maintainability of the system. | • Concept<br>• Proof in design phase<br>• Type test |
| OP | 4.07.06 | The air conditioning system shall automatically monitor the amount of the refrigerant -in the Tem range from 10°C to 35°C. | Reliability and availability of the system. | • Concept<br>• Proof in design phase<br>• Type test |
| OP | 4.07.07 | 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 of loss. | Reliability and availability of the system. | • Concept<br>• Proof in design phase<br>• Type test |
| **Type** | **4.08** | **Maintenance** | **Objective** | **Proof / Validation** |
| RE | 4.08.01 | The air conditioning control unit shall provide the TOC´s maintenance staff of the 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 airconditioning system. Parameter adjustments of the controller shall be possible. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.08.02 | The control unit shall provide the maintenance staff with the ability to adjust the following operating parameters:<br><br>- Set point temperature,<br>- CO2 Level,<br>- set points of the pressure protection system,<br>- offset values of all sensors | It shall be possible to optimise the operation of the airconditioning system. Parameter adjustments of the controller shall be possible. | • Concept<br>• Proof in design phase<br>• Type test |
| OP | 4.08.03 | 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 airconditioning system controllers or future upgrade shall be possible. Demonstration of the level of security of the system is available. | • Concept<br>• Proof in design phase<br>• Type test |
| OP | 4.08.04 | After the warranty period five software changes of the air conditioning control unit at the request of the customer shall be included in the scope of supply. | To assure evolution of the software. | |

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| RE | 4.08.05 | The filter life shall fit into the operator´s existing servicing schedule. | To reduce maintenance costs. | • Concept<br>• Proof in design phase<br>• Proof in operation |
| RE | 4.08.06 | 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. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.08.07 | 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. | • Concept<br>• Proof in design phase<br>• Presentation and validation of cleaning process |
| OP | 4.08.08 | Mounting and dismounting of components of the air conditioning system shall be possible without special tools. | To reduce maintenance costs. | • Concept<br>• Proof in design phase<br>• Type test |
| OP | 4.08.09 | If the air conditioning unit is supposed to be repaired off the train, then the supplier shall provide a cost for a test bench for all functions. | To reduce maintenance costs. | • Offer |
| RE | 4.08.10 | 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. | • Concept<br>• Proof in design phase |
| RE | 4.08.11 | The cooling circuit shall have connections for inspection and pressure gauges. | Maintainability of the system. | • Concept<br>• Proof in design phase |
| OP | 4.08.12 | 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. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.08.13 | For the observation of the motor-compressor oil level, there shall be an oil indicator. | Maintainability of the system. | • Concept<br>• Proof in design phase |
| RE | 4.08.14 | For the observation of parameters of the cooling circuit, the cooling circuit shall have a fluid and humidity indicator. | Maintainability of the system. | • Concept<br>• Proof in design phase |
| OP | 4.08.15 | Filters shall be changeable from the inside of the train or from a station platform. | Maintainability of the system. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.08.16 | The removal and replacement of air filters shall be possible by one person within 5 minutes, without specific tools, and without any other dismounting except of the filter itself or its support frame. | Maintainability of the system. | • Concept<br>• Proof in design phase<br>• Type test |

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| OP | 4.08.17 | The replacement of an air conditioning unit shall be possible without dismounting anything other than the unit itself. | Maintainability of the system. | • Concept<br>• Proof in design phase<br>• Type test |
| OP | 4.08.18 | 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. | • Concept<br>• Proof in design phase<br>• Type test |
| OP | 4.08.19 | Water drains shall be accessible for the cleaning staff for cleaning without dismounting other parts. | Maintainability of the system. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.08.20 | Desoldering and dismounting of cooling circuit components shall be possible for the maintenance staff without dismounting other parts or cables and without taking additional precautions. | Maintainability of the system. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.08.21 | 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. | • Concept<br>• Proof in design phase<br>• Proof in operation |
| OP | 4.08.22 | Internal insulation in the air ducts shall withstand mechanical stress due to cleaning or maintenance. | Maintainability of the system. | • Concept<br>• Proof in design phase<br>• Proof in operation |
| RE | 4.08.23 | 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. | • Concept<br>• Proof in design phase<br>• Type test |
| **Type** | **4.09** | **Energy Saving** | **Objective** | **Proof / Validation** |
| RE | 4.09.01 | The supplier shall propose energy saving options in the offer. | To save energy. | • Concept, including a power saving potential statement<br>• Proof in design phase.<br>The total annual energy consumption with and without energy saving possibilities shall be calculated referring to a given duty cycle.<br>• Type test.<br>• Test bench trials (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.<br>• Calculation of the total annual energy consumption referring to a given duty cycle using the results of the test bench trials. |
| RE | 4.09.02 | The air conditioning system shall adjust the fresh air quantity according to the actual passenger occupation. | To save energy. | • Concept<br>• Calculation of energy saving potential(in the offer)<br>• Proof in design phase<br>• Type test(additional: simulate different occupations; continuously meassuring of the fresh air value) |

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| OP | 4.09.03 | 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. | • Concept<br>• Proof in design phase<br>• Type test |
| DR | 4.09.04 | Based on a duty cycle provided by the customer, the supplier shall provide the annual energy consumption of the air conditioning system. | To assess LCC with regarde to energy consumption. | • Concept<br>• Proof in design phase<br>• Type test |
| OP | 4.09.05 | In standby operation the air conditioning system shall maintain Tim between +7°C and +30°C. In this temperature range there shall be no heating or cooling. | To save energy. | • Concept<br>• Proof in design phase<br>• Type test |
| **Type** | **4.10** | **Environment** | **Objective** | **Proof / Validation** |
| RE | 4.10.01 | The air conditioning system shall fulfill 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. | • Concept<br>• Proof in design phase<br>• Compliance statement |
| RE | 4.10.02 | 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. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.10.03 | Ingressed water shall not be collected in the air conditioning system. | To assure safe, hygienic and durable operation of the train. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.10.04 | 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. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.10.05 | Ingressed water shall be drained immediately in a manner that it is safe and invisible for passengers and shall not affect other units. | To assure safe, hygienic and durable operation of the train. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.10.06 | Water shall not ingress into the air treatment unit of the air conditiong system. | To assure safe, hygienic and durable operation of the train. | • Concept<br>• Proof in design phase<br>• Type test |
| **Type** | **4.11** | **Safety** | **Objective** | **Proof / Validation** |
| RE | 4.11.01 | 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. | • Concept<br>• Proof in design phase<br>• Type test |

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| TX | 4.11.02 | 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. | • Concept<br>• Proof in design phase<br>• Type test |
| RE | 4.11.03 | The device with the highest temperature cut off must not reset automatically and interrupts the power supply of the heater in a reliable manner without auxillary power (constraint to EN 45545-5). | Ensure safe operation of the heater by means of redundant safety device. | • Concept<br>• Proof in design phase<br>• Type test |
| OP | 4.11.04 | 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 auxillary power. | Ensure safe operation of the heater by means of redundant safety device. | • Concept<br>• Proof in design phase<br>• Type test |
| OP | 4.11.05 | If a fault causes the air conditioning system to shut down, then the air conditioning system shall not restart automatically. | Safety | • Concept<br>• Proof in design phase<br>• Type test |
| OP | 4.11.06 | 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. | • Concept<br>• Proof in design phase<br>• Type test |

# 5 BIBLIOGRAPHY

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|---|---|
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| 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 | Railway applications – Designation system for railway vehicles |

# 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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