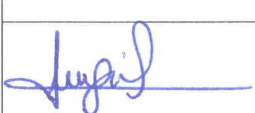
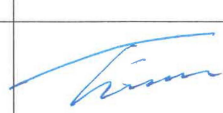


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TECHNICAL SPECIFICATION OF HVAC SYSTEM

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Date of Prep.	09/06/2026
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1. SUBJECT AND SCOPE

This document describes the technical requirements for the procurement of the **HVAC System** to be installed on the COCO LOCO (hereafter called LOCO) produced by Turkish Railway Vehicles Industry Inc. (hereafter called ADMINISTRATION) identical for DIESEL and ELECTRICAL configurations.

The Bidder shall offer a solution totally compliant with the requirements of this specification.

After signing the contract, possible deviations from this specification or from other specifications and norms mentioned in this document, shall be validated by written agreements between ADMINISTRATION and the Contractor.

The Bidder shall make clause by clause comment into present technical specification together with their offer.

This Technical Specification and its annexes have been prepared in Turkish and English. In the event of any inconsistency between the two, the Turkish language shall prevail.

IMPORTANT NOTE:

The present document shall be examined by the Bidder, together with the following document:

TŞ400048 – Electric General Technical Specification

TŞ400049 – Diesel General Technical Specification

in order to know general applicable requirements established at LOCO level.

2. DEFINITIONS & REFERENCE DOCUMENTS

2.1. INTRODUCTION

Within this Technical System Specification, the following definitions are applied to the words reported below:

- “the End Client” means the railway company that will be the user of the locomotive.
- “the Administration” means the Turkish Railway Vehicles Industry Inc. (TÜRASAS)
- “the Contractor” means the company who wins the tender to supply the good object of this specification
- “documentation” means all or any specifications, drawings, reports, networks, operating and maintenance manuals and all other information whether on paper or on digital or other format which is prepared by the Contractor in the course of the contract
- “the Bidder” means the company who want to join to the tender to supply the good object of this specification

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2.2. ACRONYMS AND DEFINITIONS

The acronyms and definitions used in this document are reported in the following Table

Acronymus	Description
TÜRASAS	Turkish Railway Vehicles Industry Inc.
TSI LOC&PAS	Document 1302/2014/EU and relative amendments of the European Commission (Technical specification for interoperability relating to the rolling stock — locomotives and passenger rolling stock subsystem of the rail system in the European Union)
UIC	International Railway Association
RAMS	Reliability - Availability- Maintainability- Safety
TCMS	Train Control Management System
ERTMS	European Rail Traffic Management System
ADMINISTRATION	TÜRASAS
Bidder	The company who want to join to the tender to supply then good object of this specification
Contractor	The winner of the tender and the Contractor of the products covered by this spec.
EN	European Standard
TSE	Turkish Standards Institute
UNI	National Standards Unit
EC	European Community
ISO	International Standard Organization
CAD	Computer Aided Design
Loco	Diesel –Mainline Locomotive
NoBo	Established by the relevant commission of the European Union under the directive 2016/ 797 / EC on the ""Interoperability of the rail system within the European Union"" directive. “Notified Body”
TSI SRT	Document 1303/2014 / EU of the European Commission (the technical specification for interoperability relating to ‘safety in railway tunnels’ of the rail system of the European Union)
TSI CCS	Document 2023/1695/EU of the European (the technical specification for interoperability relating to the control-command and signaling subsystems of the rail system in the European Union)
TSI NOI	Document 1304/2014 / EU of the European Commission ((technical specification for interoperability relating to the subsystem rolling stock — noise)
CSM	Document 402/2013/EU of the European Commission (Common Safety Method for Risk Evaluation and Assessment)
ECM	Electronic Control Module
HCU	HVAC Control Unit
N/A	Not Applicable
TBD	To be defined
LRU	Line Replaceable Unit

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Acronymus	Description
LCC	Life Cycle Cost
CBM	Condition Base Maintenance
FAI	First Article Inspection
MDBF	Mean Distance Between Failure
MTBF	Mean Time Between Failure
IEC	International Electrotechnical Commission
IRIS	International Railway Industry Standard
EMC	Electromagnetic Compatibility
TBC	To be confirmed
IP	Ingress Protection
HMI	Human Machine Interface
TMS	Train Manage System
SWL	Sound Power Level

Table 1 – Acronyms and Definition

2.3. REFERENCE DOCUMENTS

In the following table the documents used for reference documents

Ref	Document	Title
1	TS400048	Electrical Technical Specification
2	TS400049	Diesel Technical Specification
3	TB50160	Standard List
4	TB50165	RAMS Targets Allocation
5	TB50161	Fire classification

Table 2 – Reference Documents

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2.4. SCOPE OF SUPPLY

2.4.1. HARDWARE

The Bidder/Contractor shall provide all relevant components related to the manufacturing and assembly of the HVAC according to this technical specification including the fixing elements. The scope of supply of the Bidder/Contractor shall include all the components installed in the LOCO, but not to be limited to, as follows:

For Driver HVAC the main components to be considered inside each driver HVAC unit shall be:

- 1 Evaporator, air fan – power source 400Vac 3ph 50Hz and 110Vdc in emergency cases
- 1 compressor – power source 400Vac 3ph 50Hz
- 1 condenser – power source 400Vac 3ph 50Hz
- 1 sets of internal heaters – power source 400Vac 3ph 50Hz
- 1 HCU's – power source 110Vdc
- Piping
- Temperature sensors and relevant cables, inside the units
- H/L pressure switches
- Liquid tank (if any)
- All other needed equipment and/or components (like air dampers, air filters, valves, connectors, etc.).
- Internal exhaust air extractor fan 400Vac 3ph 50Hz

Compressors shall have independent gas cycles. All of these components above will be described in detail in the next sections.

For the driver HVAC Units, the main structure shall be two and positioned on the roof of the cabins, using a plenum in order to obtain the correct airflow distribution.

The scope of supply of the HVAC components also includes, but is not limited to, the following:

- 2D manufacturing drawings (dwg, pdf) and 3D data
- BOM list
- Fixing calculations
- Structural calculations
- Thermal power calculation
- Tests reports
- Assembly instructions
- Maintenance, cleaning and repair instructions
- Standards, tests and certification of the materials used

The quantity of wheels is given in the following table;

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Description	Per each LOCO	
	Drawing No	Quantity
HVAC Unit	TBD	2

Table 3 – Quantities

2.4.2. SOFTWARE

The Contractor will provide all the software for the system maintenance and operation of the HVAC so that the minimum will be as follows:

- Operational Software
- Diagnostic & Test Software

The SW development shall be at least as per the Basic Integrity level requirements defined in the EN 50716.

If any, Contractor shall provide diagnostic software tools as 6 pieces (programs, special connection cables, licences, CBM data cloud access and analysis, etc.).

If a special software tool for uploading application software, downloading diagnostic files or other functions is necessary, Contractor shall provide related software tool.

It is under responsibility of the Contractor to develop the software control of the HVAC system, to guarantee full required performances.

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2.4.3. SPECIAL TOOLS

Generally, the usage of special tools shall be avoided to perform preventive and corrective maintenance.

If this is not possible, the Bidder/Contractor shall provide a list of tools and 2 complete sets of special tools free of charge.

Nevertheless, if they are essential for maintenance (upon Contractor and ADMINISTRATION agreement), following information shall be supplied in a dedicated section of the Maintenance Manual:

- descriptions and technical data (including SW if present)
- drawings (2D/3D)
- use instructions
- list of tasks where the tools usage is mandatory (and of course Maintenance Cards shall refer to the relevant special tools when is needed)
- all the information for purchasing it correctly (technical data, builder, price, and so on) if the special tool is available on the market

The Contractor shall provide the software tools necessary to manage the life cycle of the system (monitoring and troubleshooting SW, special connection cables and adaptors, diagnostics and CBM data cloud access and analysis, etc.).

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3. STANDARDS TO BE COMPLIED

The LOCO shall be designed, assembled and tested according to the following international reference standards:

European Standards: TSI, EN;

International standards: UIC; ISO; IEC;

Other International Standards: DIN, NF F, UNI, CEI, etc.

National Standards: Technical documents published in accordance with TSE directives and related annexes

Unit System: SI (International System of Units)

The complete standards list is indicated in the TB50160.

In conformity assessments to be carried out by the Bidder/Contractor, and in respect of other requirements to be fulfilled by the product subject to this Technical Specification and its constituent equipment and sub-components, where such requirements are not explicitly defined herein, the directives, standards and requirements listed above shall be applied in the order of priority specified.

Where compliance with these directives, standards and requirements is not possible, other relevant international standards, European national standards, national standards, TCDD guidelines, and requirements stipulated by national legislation may be applied.

If a gap exists in the standards with the defined order of priority, such a gap shall be filled by the subsequent standard.

In case of any amendments to the standards/norms referred to under this clause during the execution of the Contract:

- The Contractor shall notify the Administration in writing within twenty (20) working days following the date of entry into force of such amendment.
- Within one (1) calendar month after providing such notification, the Contractor shall prepare the necessary processes to comply with the new requirements and submit them to the Administration for approval. However, the approval process shall not exceed two (2) months (60 calendar days) from the date the amendment enters into force.
- The Administration shall review the process and notify the Contractor of its decision within fifteen (15) working days.

Amendments to directives, standards, or norms shall not prevent completion of certification.

By reviewing this Technical Specification and its annexes, the Bidder/Contractor shall confirm that the product, its constituent equipment and sub-components comply with the latest applicable versions of the relevant standards. The Bidder/Contractor shall be obliged to notify the Employer in writing, together with proposals, in case of:

- any inconsistency, contradiction, or violation with international standards,
- problems that may arise in implementation,
- matters that are deemed technically beneficial to amend,

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issues not specified in this Technical Specification or its annexes but necessary/mandatory for the manufacture of the system/equipment.

All the norms have to be with the version indicated in the current TSI LOC&PAS list; if the norm is not listed in the TSI list, has to be applied the version of the norm available at the signature of the contract.

The Bidder/Contractor should satisfy the specific standards indicated in Table 4. The latest version of the relevant standard will be valid.

Standard	Title
EN 45545	Railway applications - Fire protection on railway vehicles – Part 2
EN 50125-1	Railway applications - Environmental conditions for equipment Part 1: Rolling stock and on-board equipment
EN ISO 14040	Environmental management - Life cycle assessment - Principles and framework
TSI LOC&PAS 1302/2014	Technical Specification of Interoperability: Rolling Stock - locomotives and passenger rolling stock subsystem of the rail system in the European Union
TSI CCS 2023/1695	Technical Specification of Interoperability: Control Command and Signalling TSI
TSI Noise 1304/2014	Technical Specification of Interoperability: Noise
TSI SRT 1303/2014	Technical Specification of Interoperability: Safety in Railway Tunnels
EN 60529	Degrees of protection provided by enclosures (IP Code)
EN 14813-1	Railway applications - Air conditioning for driving cabs. Comfort parameters.
EN 14813-2	Railway applications - Air conditioning for driving cabs. Type Tests.
EN 15663	Railway applications. Definition of vehicle reference masses
EN 15085-3	Railway applications - Welding of railway vehicles and components - part 3: Design requirements
IEC 61133	Railway applications – Rolling stock – Testing of rolling stock on completion of construction and before entry into service
EN 50153	Railway applications - Rolling stock - Protective provisions relating to electrical hazards
IEC 61373	Railway applications – Rolling stock equipment – Shock and vibration tests
EN 60077	Railway applications. Electro technical components
ISO 3381	Railway applications. Acoustics. Measurement of noise inside railbound vehicles.
EN 50121-1	Railway applications. Electromagnetic compatibility
EN 50155	Electric equipment used on rolling stock
ISO 16890	Air filters for general ventilation – Part 1 to 4

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EN 50128	Railway applications - Communications, signaling and processing systems - Software for railway control and protection systems
EN61287-1	Railway applications. Power convertors installed on board rolling stock. Part 1: Characteristics and test methods
EN 50264	Railway applications - Railway rolling stock power and control cables having special fire performance
EN 50126-1	Railway applications - The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS)
EN 60721-3-5	Classification of environmental conditions – Part 3-5: Classification of mechanical conditions; Transport conditions

Table 4 – Applicable Standards

The Bidder shall review and confirm compliancy to the above list of applicable norms, any deviation shall be submitted to ADMINISTRATION for approval.

The Bidder/Contractor shall comply with the specific standards indicated; all norms shall be considered with the version indicated in the relevant TSI list. If a norm is not listed in the TSI list, the latest version available at the time of contract signature shall apply.

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4. TSI REQUIREMENTS AND RELATED DOCUMENTATION

4.1.1. TSI CERTIFICATION

The LOCO shall be certified according to current version TSI LOC/PAS, TSI NOI, TSI PRM, TSI SRT and TSI CCS by Notified Body (NoBo) / Designated Body (DeBo). LOCO shall be certified by the Designated Body (DeBo) in accordance with national legislation and national rules. The Contractor shall provide whole calculations, drawings, analysis, test reports and other kind of documentation which is requested by TSIs for the present Scope of Supply. Within the scope of Supply, Contractor Provide the documentation required for the compliance matrix to be created by NoBo.

The Contractor/Bidder shall provide the declaration of conformity of its Scope of Supply to the relevant technical specifications and applicable norms.

The declaration of conformity shall be in accordance to the EN17050 Norm and shall include also the following documents:

- Conformity declaration (The bidder shall submit it at Stage 1, see §12 Table 8)
- Conformity report with all conformity evidence (The Contractor shall submit it at Stage 3, see § 12 Table 10)
- Type test reports (The Contractor shall submit them at Stage 3, see § 12 Table 10)

3.1 certificates for the products according to EN 10204 (Contractor shall submit them in Stage 3, see § 12 Table 10) shall be submitted by the Contractor to the Administration.

The documentation presented by the Contractor/Bidder relevant to the Conformity report with all conformity evidences and test reports will be examined for approval by the NoBo/DeBo in charge of certification of the LOCO.

If there is a need for corrections to the documents or new documents are required depending on the examinations made by the NoBo/DeBo, the relevant documents will be provided by the Contractor. The Contractor is obliged to meet the documents that are not foreseen at the tender stage but are requested by NoBo later on.

4.1.2. EC CERTIFICATION OF CONFORMITY AS INTEROPERABILITY CONSTITUTE

N/A

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5. TECHNICAL SPECIFICATIONS

5.1. INTRODUCTION

This document defines the requirements for the design and test of HVAC Driver System.

A reference list will be given by Bidder, showing that the proposed equipment/system manufacturer's products are operated in minimum three railway projects and in commercial operations with a minimum of 120 km/h speed.

The figure below shows the configuration of HVAC interfaces with the air supply and air return ducts.

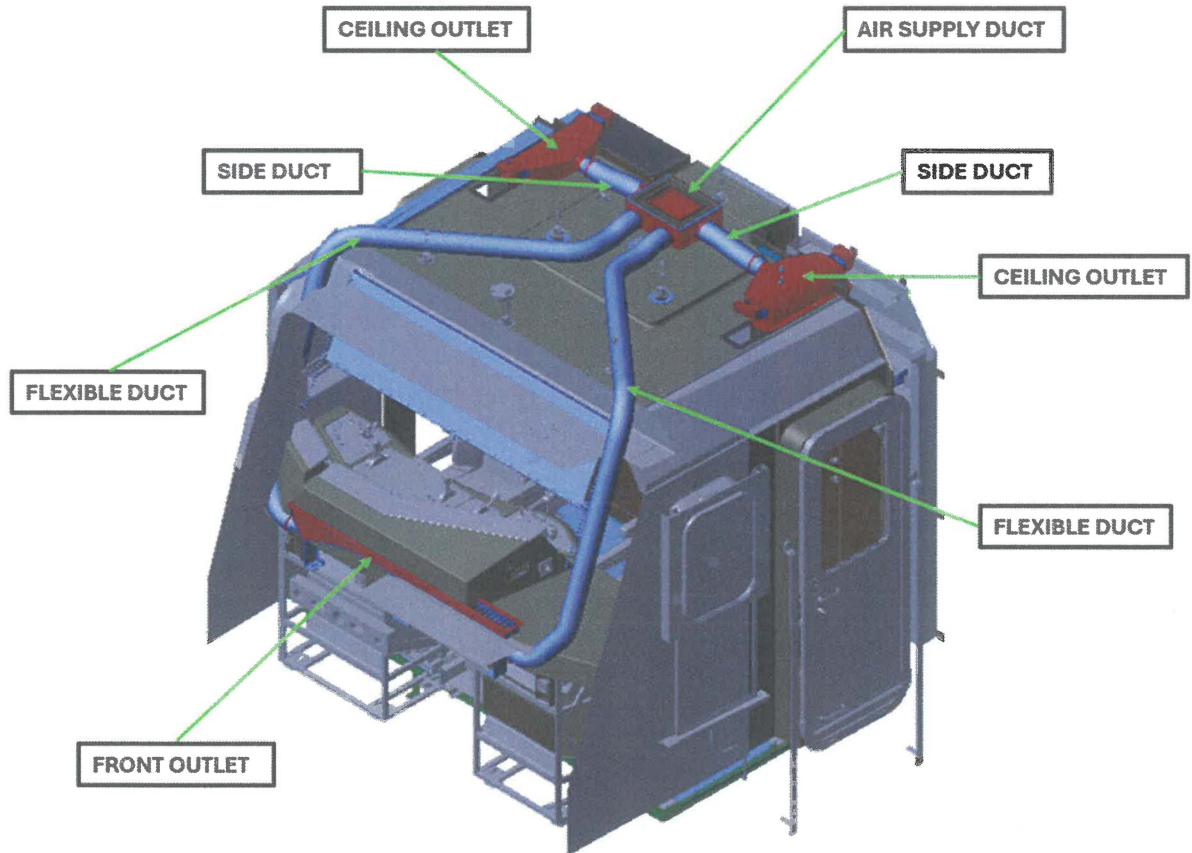


Figure 1 – Configuration of HVAC System (Example)

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5.2. PRODUCT DEFINITION

5.2.1. HVAC CABIN DEFINITION

For the Driver HVAC the main components to be considered inside each driver HVAC unit shall be:

- 1 Evaporator, air fan – power source 400Vac 3ph 50Hz and 110Vdc in emergency cases
- 1 compressors – power source 400Vac 3ph 50Hz
- 1 condensers – power source 400Vac 3ph 50Hz
- 1 sets of internal heaters – power source 400Vac 3ph 50Hz
- 1 HCUs – power source 110Vdc
- Piping
- Temperature sensors and relevant cables, inside the units
- H/L pressure switches
- Liquid tank (if any)
- All other needed equipment and/or components (like air dampers, air filters, valves, connectors, etc.).
- Internal exhaust air extractor fan 400Vac 3ph 50Hz

Compressors shall have independent gas cycles. All of these components above will be described in detail in next sections.

5.2.2. OPERATIONAL REQUIREMENTS

The following table describes the main requirements for the driver unit:

Reference standard for HVAC system	TSI LOC&PAS, EN14813-1-2 (Comfort A)	
HVAC unit number in one HVAC vehicle system	nr	1
Compressor type	(spiral) scroll	
Manual regulation (set point setup)	+- 2 C°	
Max internal difference	< 2 C°	
Heat transmission coefficient (K)	W/(m²K)	2.3
Communication protocol between HVACs (if any)	TBD by contractor and Administration	
External box material	Stainless Steel or Aluminium	
Number of passengers	nr	2
Winter Climatic Condition	-25° C	
Summer Climatic Condition	+45°C (30%RH)	

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Cooling Thermal Power	KW	6.0
Heating Thermal Power	KW	6.0
Minimum required massflow	m ³ /h	900
Design Massflow	m ³ /h	700
Minimum refresh air	m ³ /h	60
Solar radiation	W/m ²	800
Coolant	Type	R407C or R134

Table 5 - Main Requirement Driver HVAC Unit

Following the selected requirements used for Thermal Power evaluation are expressed. In addition, the Power of HVAC system both for Cooling and Heating are defined.

Parameters Driver Cabin

Cooling	External temperature [°C]	45
	External relative humidity [%]	30
	Internal temperature [°C]	27 (RH 60%)
	Fresh air [m ³ /h pax]	30
Heating	External temperature [°C]	-25
	Internal temperature [°C]	18
	Fresh air [m ³ /h pax]	30

Table 6 - Thermal Balance Results for Driver Cabin

5.2.3. ELECTRICAL MAIN FEATURES

Each HVAC unit is directly connected and powered from the vehicle MV and LV lines.

In following main voltages are reported:

MV

- Input Voltage $V_N = 400V_{ac}$
- Maximum tolerance for the input voltages $\pm 5\%$
- Main component frequency $50\text{ Hz} \pm 1\%$
- Maximum harmonic distortion 5%
- Number of phases 3
- Phase shift $120^\circ \pm 1^\circ$

LV

- Input voltage $110V_{dc}$ nominal
- Max ripple, at nominal power, with resistive load $1V_{pp}$

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The HVACs shall work automatically, without any external control (except ON/OFF switch, fire detection system and temperature set-up).

Main controlled functions of the HVAC shall be:

- Autostarts when MV and LV voltages are available and switch command in “ON” position” and Fire detection system is not in alarm mode (wired signal)
- Automatically stops when switch command is in “OFF” position
- Automatically stops if fire detection system is in alarm mode (wired signal)
- Auto manage the internal temperature of the cabin area following the required temperature conditions, based on the levels received from the temperature sensors (internal)
- Manage its loads (compressors, heaters, condensers, ...) in accordance to the best possible performances and automatically
- Automatically manage the spring/autumn function (means compressors and heaters working in parallel at same time)
- Manage the emergency ventilation in case of absence of MV during loco running (LOCO active)
- The coefficient of performance (COP) and the energy efficiency ratio (EER) of the HVAC units to be mounted on the proposed stock shall be higher than 1.6.
- Temperature and the CO2 value within the cabin, shall be used in the HVAC system and measured by dedicated sensors. The system will automatically determine its function mode, whether heating, ventilation or cooling, internal temperature, and external temperature detected by the relevant sensors.
- There shall be manual adjustment or a selection among setpoints needs to be done by the driver, and the HVAC unit shall automatically decide which mode and setpoints to operate.
- The temperature adjustment control inside the driver cab shall be easily accessible by the driver for the driver unit.
- The HVAC unit of the inactive driver cab shall operate in stand-by mode in order to reach the target in 3 minutes

In accordance to the required temperature (set from crew from the driver desk HMI), HVAC shall be able to guarantee to reach the set temperature automatically before the max time defined by relevant norms.

5.2.3.1. LV AND MV INPUT

LV source is provided from the loco batteries and battery charger, MV source is provided from auxiliary inverter output; Contractor shall guarantee full cooperation to the auxiliary inverter Contractor to solve any kind of problem relative to power management.

Each unit shall guarantee a maximum required power, on LV lower than 200W (fans excluded).

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5.2.3.2. PROTECTIONS

Shall be included following protections for the medium voltage systems, these protections shall be integrated inside each HVAC unit:

- A circuit breaker (magneto-thermic) protection for the evaporator fan
- A circuit breaker (magneto-thermic) protection for each compressor
- A circuit breaker (magneto-thermic) protection for each condenser
- A 1st level protection (thermostat + contactor) for each internal heater
- A 2nd level protection (thermostat + magneto-thermic) for internal heaters
- A 3rd level protection (thermostat + MV short circuit) for internal heaters
- A 1st level protection (thermostat + contactor) for each external heater

The above 3rd level protection shall open the main circuit breaker side protection of the relevant HVAC (this main circuit breaker is not in the scope of supply, inserted in the electrical cabinet of the car); an auxiliary contact shall be included into all the types of protection for diagnostic purpose.

An example of the protection layout in schemes is visible below:

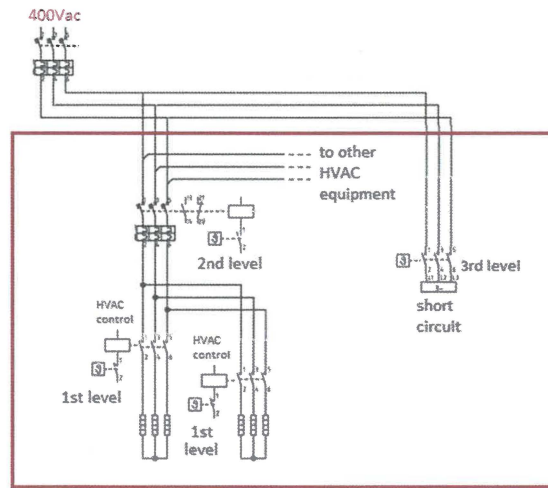


Figure 2 - Protection Installation (Example)

5.2.4. EVAPORATOR FAN

One evaporator fan shall be included into each HVAC unit, evaporator fan main power source shall be 400Vac 3 phase 50Hz.

Contractor shall declare the fan power and all other main characteristics considering the fan shall be fed correctly by the auxiliary inverter.

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Contractor shall also propose and include a solution to guarantee fan activity also in case of MV voltage absence but in presence of 110V at the control unit, function called “emergency fan” (DC-AC inverter, powered from loco batteries). Duration of emergency fan shall be recorded (According to TSI Pass Loc item 4.2.5.9 internal air quality) inside the HVAC control unit.

Evaporator fan shall automatically start in case of MV presence and in absence of the fire detection system alarm signal. All the other MV loads shall not be active if evaporator fan is stopped.

5.2.5. COMPRESSOR

A compressors shall be included into each HVAC unit, compressor main power source shall be 400Vac 3 phase 50Hz.

Compressor shall have independent gas cycle. Supplier shall declare the compressor power and all other main characteristics considering the compressor shall be fed correctly by the auxiliary inverter.

Compressor shall be controlled directly by the HCU unit; because of inrush current the starting of compressors at the same time will be prevented by control unit. The motor of compressors shall have soft starter or by-pass valve to reduce inrush current.

Compressors shall be equipped with protections against overcurrent, overheating, phase loss, and low oil pressure and avoid high vibrations.

5.2.6. CONDENSER

A condenser circuit shall be included into each HVAC unit, condensers main power source shall be 400Vac 3 phase 50Hz.

Contractor shall declare the condenser fans power and all other main characteristics considering the condenser shall be fed correctly by the auxiliary inverter.

Condenser shall automatically starts if required by the compressor. A signal shall be applied to HVAC unit for condenser freezing.

A G1 class filter shall be installed at the condenser air inlet in order to prevent the ingress of coarse particles (dust, leaves, insects, etc.) and to protect the condenser coil from clogging and performance degradation. The filter shall be of a removable and cleanable type, allowing maintenance without the need for any fastening elements or special tools. The design shall ensure easy access for regular cleaning and re-installation by maintenance staff.

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5.2.7. SETS OF INTERNAL HEATERS

A internal heater shall be included in each HVAC unit; these heater shall have the scope to heat the air moved by the evaporators.

The heater shall be connected to the MV line and shall be protected as in the dedicated section above. Power consumption of these heater shall be defined and calculated (an estimation of the calculation and relative values shall be provided during offer phase) by the contractor.

The heater shall be controlled directly by the HCU unit, control shall be managed with two steps. First step shall activate half of heaters and second step shall activate full of heaters, so at least 2 branches of heaters shall be considered in each sub-unit.

5.2.8. HCU

Each HVAC shall have its HVAC CONTROL UNIT, the HCU and the electrical switchboard shall be installed inside the HVAC unit; the HCU shall be able to completely manage all the HVAC functions and loads.

HCU shall be powered from LV line (110Vdc), max consumption of the board shall be 200W.

Each cabin shall have at least the following temperature sensors, these sensors are included in the scope of supply, so each HCU shall be connected to these temperature sensors:

- 1 internal ambient temperature sensors (inside the HVAC)
- 1 external ambient temperature sensor (directly on the inlet input external air)
- 1 internal temperature sensor (for produced air in each evaporator)
- 1 internal ambient temperature sensors and 1 CO₂ sensor (recirculation air duct)

The detection system of the internal temperatures shall be accurate ($\pm 1^{\circ}\text{C}$).

Each HCU unit shall be connected loco data bus (TBD), which managed by TCMS, on the vehicle. This connection shall be used by HVAC for:

- Diagnostics features
- Operating control – all the mode of work of the HVAC (cab unit) will be controlled by the driver desk TCMS HMI

Contractor shall cooperate with TCMS supplier for the communication issues to be made via the data bus (TBD).

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5.2.9. SET OF AIR EXTRACTORS

Each HVAC unit shall have a set of extraction fans, to be included into the units. For each car extracted air will be about 60 m³ / h (preliminary estimated value).

The extraction of the exhaust air shall be include for the driver unit.

5.2.10. PIPING AND INSTALLATION EQUIPMENT

A drainage system shall be installed in such a way that the water condensed and accumulated in the HVAC unit due to external influences such as rain and the washing unit will flow under the LOCO through an appropriate piping system. These drain pipes shall extend invisibly through the side walls to the bottom of the LOCO. Necessary precautions shall be taken against clogging, vacuum and reverse pressure at the outlets of the drain pipes.

The piping and fixing elements between HVAC and Carbody shall be in scope of supply. Detail of the piping and fixing elements shall be defined during design freeze. All equipment necessary for installation and operation (such as gaskets, fastening elements, etc.) shall be supplied by the Contractor.

5.2.11. SMOKE SENSORS

For a timely intervention in the event of smoke, one smoke sensor connected to the control unit is installed on each of the external air inlets. The smoke signal of the sensors will result in the immediate closing of the shutters on the air intake sockets and the communication to the main system in order to notify the driver that the dampers are closed.

In case of this event the air intake sockets shall be open automatically after 1 minute than the detector is no longer detecting the presence of smoke. It shall be possible to adjust this time by the LOCO crew.

5.3. DIAGNOSTIC

Each HVAC shall be equipped with a diagnostic system, continuously running, and able to verify the status of the main components and share, on the data bus, all the main failure and analogic data (such as internal and external temperature, high pressure and low pressure values) to guarantee immediate information to the crew (on the MMI monitors).

Diagnostic information shall be recorded in an opportune memory inside each HVAC; these data can be monitored and downloaded from maintenance personnel using a standard PC with dedicated diagnostic software (included into the scope of supply). In addition, these data can be monitored by maintenance staff via the TMS interface.

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A list for the address in the memory of the control unit variables and messages, related to communication used in system diagnostic, shall be prepared. User manual shall include communication protocol and details with this list.

Shall be recorded all kind of failures at LRU level, (including in each record the ambient data, such as temperatures, high pressure, low pressure, time, input voltage, input current, Etc., lot of these data are available on Data bus (TBD) from vehicle logic).

Minimum information to be managed for diagnostic:

- Failure of evaporator fans
- Failure of compressor 1
- Failure of compressor 2
- Failure of condenser 1
- Failure of condenser 2
- Failure of internal heaters – 1st set, 1st level
- Failure of internal heaters – 1st set, 2nd level
- Failure of internal heaters – 2nd set, 1st level
- Failure of internal heaters – 2nd set, 2nd level
- Failure of internal heaters – 3rd level
- Low pressure 1
- Low pressure 2
- High pressure 1
- High pressure 2
- Circuit breaker failures (all)
- On/Off failure for all control contactors
- High /Low pressure analogue value
- Temperature analogue value
- Damper status
- Emergency shutter status

Complete LRU list, maintenance troubleshooting and instructions shall be defined by the contractor.

Diagnostic data shall be available on an ethernet type connection or USB, also all the data shall be available on the data bus (TBD), to be managed in the local TMS diagnostic system.

TCMS supplier is the leader of implementing communication protocols; contractor shall provide requested documents and related address information of control unit according to defined parameters which are defined by TCMS supplier.

Contractor shall provide diagnostic codes with its corrective actions according to related communication protocol.

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In the electrical cabinet of each car, shall be included following led to be managed directly by each HCU. These LEDs are not scope of supply.

- HVAC failure status – high in case of no problem in the HVAC system
- Emergency ventilation ON – in emergency cases
- Evaporator ok – high in case of evaporator working
- Compressor 1 on – high in case of at least one compressor is working
- Compressor 2 on – high in case of at least one compressor is working
- Heaters on – high in case of at least one heater is working
-

5.4. WEIGHT

The contractor shall take into account the weight management carefully, in order to respect the weight target during the development of the project.

For the Driver HVAC the max weight is less than 125 kg.

5.5. MANUFACTURING

All the structural parts of the HVAC must be constructed of stainless steel or aluminium.

All parts that can be opened easily for maintenance must be locked with secure systems. The system must be protected against excessive operating temperatures.

The maintenance of HVAC must be only opening external panels without removing anything of internal parts.

The air filters should be in ISO Coarse $\geq$ 50% of TS EN ISO 16890. The air filters shall be possible to clean with air and water.

All the components shall be supplied complete with all the mechanical interfaces necessary to be fixed to the available “C-slots” on the roof.

The dimensioning of the fixing elements (screws, bolts, washers ...) shall be under contractor responsibility; all the not normalized elements necessary for the fixation of the equipment and components shall be considered under contractor scope of supply.

The weight as defined into section WEIGHT shall include also the necessary mechanical interfaces and elements as required above.

The contractor shall provide an aluminium label together with the HVAC unit, including the operating instructions and the service addresses and phone numbers to be used in case of failure.

The solid model of HVAC prepared by the contractor shall be checked in a 3D environment according to the locomotive interface, and if deemed necessary, the contractor may be requested to

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make changes to the model during the design phase. The contractor is responsible for making the relevant changes. During the tender stage, the contractor shall provide a letter of commitment stating that it will implement any such change requests that may arise.

The HVAC unit shall be fully compatible with the installation area. At the tender stage, the Contractor may examine in detail the solid model of the installation area at the relevant department of TURASAS. All bidders submitting a tender shall be deemed to have accepted to supply a product compatible with the installation area. After the contract stage, the solid model of the installation area shall be shared with the Contractor, provided that the required confidentiality documents have been signed.

Before proceeding with the production of the air conditioning unit, the contractor must submit the preliminary design 3D STEP files showing the unit's external dimensions, connection interface, and air inlets/outlets, as well as the electrical interface between units to be provided by the contractor, to the administration for approval during the preliminary evaluation phase.

In system selection, easy access to system components in case of failure and maintenance criteria will be taken into consideration.

The components used in the climate control unit shall be made of stainless steel.

There will be a viewing window on the cooling circuit through which the condition of the cooler can be observed.

5.6. INTERFACE SPECIFICATION

5.6.1. MECHANICAL INTERFACE

The preliminary Driver Unit layout is shown next images; it will have to be defined at a later stage. The outlet and recirculation interfaces shall have different shape. It would be appropriate that the air outlets (HVAC vents) are designed in coordination with the Contractor.

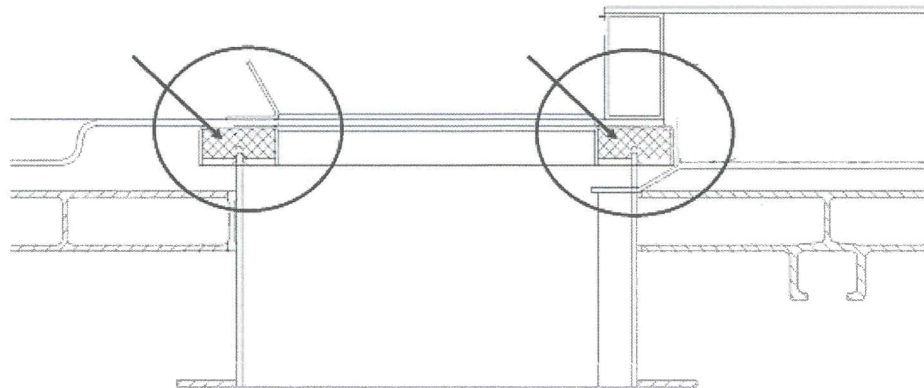


Figure 3 – HVAC gasket layout – duct interface

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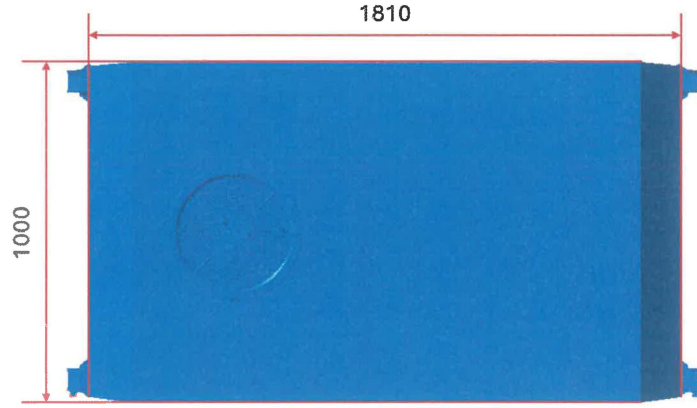


Figure 4 - HVAC Cabin Unit max dimensions

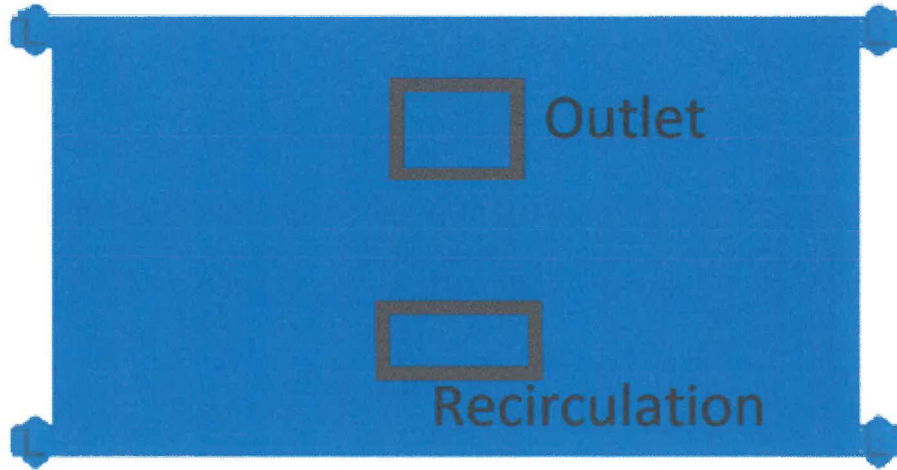


Figure 5 - HVAC Cabin Unit Duct Interface dimensions

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5.6.2. ELECTRICAL INTERFACE

Each HVAC unit shall include a series of connectors, with at least following functions:

- 1 connection for MV power
- 1 connection for LV signals
- 1 connection for LV power (for emergency fan)
- 1 connection for data bus

All connections will be done via Harting type connectors (male and female, fixing or mating). Contractor shall define and include into the scope of supply all the necessary connectors (male and female, fixing/mating). The connection shall be minimum IP65.

5.6.3. DIGITAL AND/OR ANALOGUE INPUTS/OUTPUTS

As preliminaries are at least required:

Output – compressors activation; will indicate the activation of at least one compressor:

- “1”, 2 seconds before the start of the compressor up to the end of transient period
- “0”, in all the other conditions

Input – degraded mode, managed as:

- “1”, normal mode active
- “0”, degraded mode active

Input – Air inlet flow control management: in case of entering a tunnel, system shall be able receive a command to close the fresh air inlet valves in the HVAC systems and reopen them leaving the tunnel

Input – fire detection

Input – ON/OFF command

Output – a free contact shall be considered to inform about the HVAC status, if the HVAC is in working, the contact shall be open, when the HVAC is stopped, the contact shall be closed

5.7. EARTHING

For protective provisions relating to electrical hazards on railway vehicles EN 50153 - standard is valid and shall be obeyed.

All equipment causing an electric shock shall be protected against direct contact.

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All conductive surfaces of electrical equipment on the vehicle shall be connected to an earthing point for equalization of the electrical potential.

This includes conductive surfaces of cubicles, doors and covers.

Exceptions are small items of interior trim in an environment otherwise protected by bonding to car body and/or insulation (e.g. grips, coat hooks, etc.).

All equipment operating at AC-voltage >25V or at DC-voltage >60V shall be earthed for safety.

Each earthing point of the equipment shall be designed as follows: the earthing points shall be of good electrical conduction to ensure low touch voltage, the earthing points shall have large contact surface and shall be able to carry a possible short circuit current.

A design according to EN 60529, min IP20 (>12,5mm) is required for cubicles containing Band III voltages.

The min IP20 shall be achieved when there are situations when the cubicle is open and Band III voltage is live.

Each earthing point shall be easily accessible for assembly.

The Contractor shall provide an earthing diagram of its equipment including earthing bonds and shields.

The Contractor shall indicate which cables of his system will be shielded.

Cable shielding may only be used for shielding purposes and NOT as signal, ground or reference wires.

If Contractor does not request different connection, cable shields shall be grounded on both ends in order to obtain high shielding efficiency against electric and magnetic fields.

This requires potential equalisation between both grounding points, e.g. through chassis or appropriate structural components.

Grounding of cable shields shall be made with low impedance (large contact surface, preferably over 360 deg. circumference).

Grounding by means of sheath wires (pig tails) or connector pins is NOT permitted.

The Low Voltage 0V level in the cars is floating, so shall be avoided an internal connection in the equipment between metallic chassis and the 0V connection; grounding connections in the equipment shall not be connected to car Low Voltage DC power supply.

5.8. ENVIRONMENTAL CONDITIONS

5.8.1. CLIMATIC CONDITION

The system object of the present document specification shall work properly in the specified climatic conditions (temperature, rain, snow, ice, dust, wind and so on) in particular, ice, sand and snow shall not be cause of malfunction.

General climatic conditions, following the EN 50125-1, are reported in the mentioned General Technical Specification.

5.8.2. NOISE, VIBRATION AND SHOCK

General noise, vibration and impact conditions are reported in General Technical Specification and Noise Requirement document.

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For shock and vibration the Contractor shall be able to demonstrate that the HVAC equipment is tested and validated according to IEC61373.

To be respected in accordance to the relevant norms.

Vibration capability modules

IEC 61373 Cat1 Class B

Contractor shall perform vibration test for subassembly of equipment according to IEC 61373. If no shock and vibration test is performed and similar components are already being used in other projects, the Contractor can submit FEM calculation and conformity explanation with similar products, which are in operation, instead of performing vibration test.

The noise level generated by the system must be such as to comply with the regulatory requirements. In detail, the equivalent noise levels expected within the vehicle, in accordance with the EN13470 standard, for external noise the noise outside the vehicle, in accordance with TSI NOISE 1304 2014. The maximum SWL value of the HVAC shall be 84 dBA.

The system shall be highly efficient, low-noise, and maintenance friendly and it shall be possible to adapt it various operating conditions. The noise level inside the cabin shall not exceed 62 dBA. Noise levels measured in a parked stock with active HVAC units shall be as indicated in the EN14813. The Contractor shall evaluate the acoustics performance of the HVAC Units in the acoustic chamber as preliminary indication of the noise level of the them. The target values shall be -2dBA respect then the above indicated value, in order to achieve the requirements.

The contractor shall conduct the relevant sound measurements at its own facilities and submit the measurement reports it approves to TÜRASAS upon product delivery.

5.8.3. PROTECTION (IP)

The equipment box(es), if mounted outside the vehicle, shall guarantee an IP level min IP65 for all the electronic equipment inside the box.

IP protection is under responsibility of the Contractor; if during exercise of the LOCO, declared IP level is not reached, it shall be under responsibility of the Contractor to retrofit the systems to reach the target IP level.

5.8.4. PAINTING

The Bidder/Contractor can propose its own painting specification to ADMINISTRATION. The usage of this painting specification is dependent on ADMINISTRATION approval. Concerning resistance to corrosion, design and processes shall take in account the effect of potential galvanic corrosion.

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The colours of products have to be defined by ADMINISTRATION during design meetings. The paint system of the HVAC unit shall be designed and selected to ensure corrosion protection under all operating and environmental conditions.

5.9. LOCO Fire Detection

The HVAC system must comply with the TSI standard. In particular, with reference to standard TSI, paragraph 4.2.10.4.2, the automatic shutdown of the HVAC system relating to the area affected by the detection must be guaranteed when the alarm is activated in the driver's cabin, to prevent the fire from spreading at higher speed. Shutdown of the HVAC unit shall be possible also manually.

5.10. ELECTROMAGNETIC COMPATIBILITY (EMC)

The supplied system and components shall be compliant to EMC requirements established by relevant norms and standards listed below:

- EN 50121-1 Railway Applications – Electromagnetic Compatibility – Part 1: General;
- EN 50121-3-1 Railway Applications – Electromagnetic Compatibility – Part 3: Rolling stock – Train and complete vehicle;
- EN 50121-3-2 Railway Applications – Electromagnetic Compatibility – Part 3: Rolling stock - Apparatus

5.11. SYSTEM AND COMPONENTS LIFE

The required life shall be equal or greater than 30 years.

5.12. MATERIAL REQUIREMENT

5.12.1. GENERAL REQUIREMENTS

Materials shall be suitable to allow the normal maintenance activities without need to adopt special protections including welding, cuts and so one. They shall be suitable for the waste disposal without need of particular care.

All information about safety and health shall be provided, even for consumables like glue and cleaning agents.

The choice of materials shall be done to prevent corrosion in every usage condition.

The Bidder/Contractor shall give the list of every material used together with their offer.

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5.12.2. FIRE RESISTANCE BEHAVIOUR

According to TSI LOC&PAS materials requirements for fire resistance behaviour are expressed through the index R(n) described in the standard EN 45545-2, "Table 5". To correctly define the requirements, it is necessary to know the hazard level of the LOCO that, in this case, is HL2.

These requirements for materials depend not only on the component intrinsic nature, but also on the position, shape and layout, surface exposure, relative mass and thickness of the material considered. To identify the relevant R (n) requirements, in "Table 2" of the standard EN 45545-2 several products and their position on the LOCO are listed.

In the table below the material requirements for the components of the cars are reported.

Applicable Product type (No)	Definition	Details	Requirement
EX5	External design features	External design features (e.g. steam lining parts, ventilation grills, flaps, skirts, coverings for HVAC systems, enclosures, etc.)	R7
IN13	Air filters	Materials for air filters used for equipment ventilation, heating and air conditioning.	R5
EL1A	Cables for interior	Cables not compliant with one of the standards EN 50306, EN 50264, EN 50382	R15
EL10	Small Electrotechnical products	Examples include low power circuit breakers, overload relays, contactors, contactor relay, switches, control or signalling switches, terminals, fuses	R26
EL9	Printed circuit boards	Printed circuit boards without any attached technical equipment	R24 or R25
IN12A	Air ducts – Interior surfaces	Interior surface of ducts which are installed on the interior of the vehicle and from which air flows into the vehicle interior	R1
IN12B	Air ducts – Exterior surfaces	Exterior surface of ducts which are installed on the interior of the vehicle and from which air flows into the vehicle interior	R1

Table 7 – Material Fire Behaviours

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Any material used, even if not included in Table above, must meet the requirements specified in chapter 4 of the EN 45545-2 standard.

The Bidder/Contractor shall give the list of the inflammable materials used with material type, quantity and fire resistance behavior tests.

The Bidder/Contractor shall adopt materials with required characteristic and also identify other materials not mentioned above. The above R(x) list is not definitive; the Bidder/Contractor shall complete it according the materials used in the Scope of Supply.

The documentation presented by the Bidder or the Contractor relevant fire performance will be examined for approval by the Notified Body / Designated Body in charge of certification of Project nominated by the ADMINISTRATION. The Contractor/Bidder shall be responsible to perform all necessary activities which are required by Notified Body / Designated Body.

5.12.3. SMOKE OPACITY AND TOXICITY

All the materials used do not emit toxic gases in such quantities as to be harmful.

The parameters taken as reference for the selection of materials, and the requirements they must meet, are described in "Table 5" of the EN 45545-2 standard with reference to the classification of the hazard level of the LOCO and the set of requirements R(n) to which the material is associated.

5.13. LABELS/MARKING

The system/equipment/components supplied shall be provided with technical markings, in order to fulfil requirements of electrical safety, and provide information to maintenance personnel.

Wherever required for health and safety purposes, including where necessary to comply with legislation, parts shall be fitted with suitable safety and warning signs.

In particular the parts supplied, including all replaceable parts, shall be identified by a label showing:

- Serial number;
- Data of manufacturer
- Date of manufacture
- Contractor's part number (if any)
- Revision level;
- Company's part number (if any)

Format and positioning of all labels/marking shall be subject to approval by TÜRASAS. Wherever possible, the position shall be such that any company information (Logo and brand etc) cannot be viewed when the relevant part is installed within the vehicle.

All labels shall be permanent and indelible.

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6. RELIABILITY, AVAILABILITY, MAINTAINABILITY AND SAFETY (RAMS) REQUIREMENTS

6.1. RELIABILITY, AVAILABILITY, MAINTENABILITY & SAFETY (RAMS)

The Contractor shall make RAMS analysis according to TB50165.

7. TRAINING AND MANUAL

7.1. TRAINING

Comprehensive training courses, covering the system/equipment supplied, shall be provided by the Contractor to TÜRASAS or Costumer/LOCO Operator personnel.

The level of training shall be congruent with the complexity and criticality of the system/equipment in object, therefore training performed by the Contractor shall be properly prepared in order to be efficient and effective.

This training shall give to the trainees a general overview of the system/equipment, of its performance, as well as sufficient knowledge for carrying out periodic maintenance of the system/equipment and its components, fault finding and repair and carrying out works both of preventive and of corrective maintenance. Additionally the Contractor shall give detailed training about assembly/disassembly of system/equipment.

Generally the training activities are divided in two steps; the first concerning a general description of the system/equipment and depth training for carrying out scheduled maintenance needed during the first 2 years of operation.

The second step completes the knowledge about all maintenance aspects with particular care to overhaul activities.

The Contractor shall provide training at the Administration's facilities for a minimum of 2 days and a minimum of 6 participants, and at the Final User's facilities for a minimum of 1 days and a minimum of 6 participants.

The training documentation shall be prepared in English and Turkish languages in number of participants by the Contractor. The language of the training shall be supplied in Turkish by the Contractor.”

The bidder shall propose and detail in the tender phase the training activity to be carried out.

Then ADMINISTRATION and the Contractors will discuss and agreed details pending on End Client requirements.

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7.2. MAINTENANCE MANUAL

7.2.1. MAIN FEATURES OF THE MANUAL

The Contractor shall prepare integrated manual for the operation and maintenance of its scope of supply equipment.

The manuals shall contain:

- supplied system/equipment description;
- preventive maintenance tasks description;
- corrective maintenance tasks description (repair instructions included)
- information in order to carry out the overhaul of the system/equipment and the heavy repair
- (if it is repairable and off Loco).

The manual will be used as the basis for LOCO operation and maintenance by End Client staff. The manual shall be prepared in electronic editable format and the language UK English and Turkish. The Contractor shall be responsible for ensuring that the maintenance manuals remain up-to-date, accurate, and applicable until the end of the general warranty period of the final delivered product. During this process, the opinions, requirements, and requests communicated by the ADMINISTRATION and/or the End User shall be taken into consideration. The ADMINISTRATION reserves the right to request modifications, corrections, or additions in case the submitted maintenance manuals are found insufficient during its review. The Contractor shall be responsible for carrying out the necessary revisions in a timely and complete manner in line with such requests.

7.2.2. CONTENTS OF THE MANUAL

The manual shall contain as minimum the following information/instructions:

- Description and Operation
 - General description and operation of system/equipment
 - Functional description and operation of all LRU's and components
 - Mechanical and electrical data sheets for all LRU's and components.
- Maintenance Activities
 - Preventive Maintenance Plan including the maintenance periodicity (frequency) table for system/equipment.
 - Reported information shall be the same of those described by the Preventive Maintenance analysis and be linked with detailed Maintenance Instructions.
 - Preventive Maintenance Plan shall report reference to specific/special tools needed for the maintenance works (if used).

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- Maintenance Instructions shall report step by step detailed description of each task of the maintenance plan in order to include all information necessary for carrying out the relevant work.
- The Preventive Maintenance Plan shall include all activities foreseen for the system/equipment from daily inspection up to major repair/overhaul.
- Preventive Maintenance card/instruction
Each maintenance instruction shall include:
 - task periodicity
 - safety warnings
 - cleaning materials
 - recommended lubricants
 - torque values
 - special tools (if any): as special tool is intended either a tool (hardware and/or software) that is exclusively produced by the Contractor and is essential for system/equipment maintenance, either a tool available on market but expensive, sophisticated, with long lead time and so on
 - step by step activity description with necessary schemes, drawings and illustrations, including:
 - scheduled activities (greasing, topping up, visual check, etc)
 - removal and refitting
 - off- LOCO overhaul
 - final functional check

The Contractor is responsible to update the maintenance instructions until the end of the general warranty period of the last supplied equipment.

- Corrective Maintenance card/instruction

Each maintenance instruction shall include:

- trouble shooting
- safety warnings
- torque values
- special tools (if any)
- step by step activity description with necessary schemes, drawings and illustrations, including:
 - removal and refitting
 - off- LOCO repair
 - failure diagnosis
 - final functional check

The Contractor is responsible to update the maintenance instructions until the end of the general warranty period of the last supplied equipment.

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7.2.3. FORMAT OF THE MANUAL

The format of the Maintenance Manual can vary according to the Administration and the End Client requirements, therefore here following are reported some rules generally applicable.

Specific requests shall be communicated when available.

- The Manual shall report/contain the same references, drawings, schemes, component codes, Part Numbers, definitions, descriptions, terminology and so on used in the system/equipment configuration and design documentation to guarantee a perfect correspondence and to avoid mismatching during tasks performance.
- In the manual, the parts should be shown by numbering on the exploded picture. Within the scope of this picture, there should be a list consisting of Part No, Stock or Part Code No, Part Name and Quantities
- It is highlight the importance for a correct identification of LRUs/components by utilizing the same identification name reported by the technical drawings.
- The Manual shall be transmitted by electronic means (CD copy) and in the final version a paper copy is also requested for each release.
- The documentation in electronic format shall be in a completely editable form (Office Word version TBD)
- The PDF format can be used as formal delivery of the documentation (in order to be used as official delivery towards End Client)
- Pictures and photos shall be inserted and not simply linked.
- Photos should be only JPEG format.
- Pictures should be only TIFF format.

Derogations from above listed issues can be discussed and agreed between ADMINISTRATION and the Contractors pending the respect of End Client requirements

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8. TESTING, INSPECTION AND ACCEPTANCE

The LOCO will be certified in accordance with the latest version of the TSI regulations. If all products and services (including hardware, software, system main and subcomponents) to be procured under the tender are evaluated within the scope of TSI requirements, the contractor will be responsible for all relevant certifications for the equipment to be provided to NoBo.

8.1. INTRODUCTION TO TEST AND INSPECTION

The Contractor shall perform the tests and the inspection in accordance with the Approved Test Procedure and the Approved Inspection Specification.

ADMINISTRATION and/or end Client have the right to witness any of these tests and inspections at any stage of test and inspection procedure.

Type test can be waived if system or components are already proven and confirmed to waive by end End Client. In that case, the Contractor shall provide old test report or certificate to submit for approval.

All test and inspection documents, as well as final reports—including the verification of design activities and the assessment of any improvements to the checklists, if applicable—shall be submitted to the ADMINISTRATION and shall only become valid upon approval by the ADMINISTRATION.

The following prescription shall be observed if the test is defined as a test in TSI:

- The procedure shall be shared by Contractor and approved by NoBo,
- The test, and relative documentation, shall be done in either an accredited lab, or with the NoBo attendance
- The test, that will be done on the vehicle, shall be planned in coordination with NoBo (attendance required), Contractor and ADM

8.2. TYPE TESTS

Type tests are required to verify that the components of the system object of the scope of supply, operate in accordance with the Approved Design Data.

Contractor shall perform Type Tests according to EN 14813-2 for Driver Unit. TL1 test level shall be considered. If the relevant tests do not meet the required conditions, the contractor shall make the necessary revisions to the climate control unit until the tests are successful.

Vehicle-level tests to be performed:

- Air velocity measurement tests according to EN 14813-2
- TL110-115 tests according to EN 14813-2 (if deemed necessary by the administration)

The Contractor shall perform Type Tests, in accordance with a test procedure approved by ~~Company~~ ADMINISTRATION and/or End Client participation.

During testing, the criteria shall be observed and recorded. All alterations, adjustments and maintenance works required by ADMINISTRATION shall be carried out by the Contractor.

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The Contractor has the responsibility for the success of mentioned Type Tests.

In the case components are already being used in similar projects or more severe conditions the Contractor shall submit to Company for approval a report explaining in detail the reasons for which it believes the tests need not be carried out, providing evidence of that.

The Contractor shall perform the following tests:

- Test that detects the power cooling and heating in a climatic chamber
- Sound transmission loss as defined in ISO 717-1 and ISO 10140-1
- Sound Pressure Level Test (external and internal)
- Mechanical strength test
- Measuring the flow rate of air and the prevalence of the fan
- Approval tests of electronic parts
- Tests of fire resistance of all parts not certified
- Test to determine the correct voltages and amperages of operation
- Smoke detection test

8.3. ROUTINE TESTS

Routine tests are required to verify that the components of the system object of the scope of supply have been built in such a way that it satisfies the requirements of the Approved Design Data as verified by the Type Test.

The Contractor shall perform routine tests in accordance with a test procedure approved by ADMINISTRATION under his responsibility, and, if necessary, with ADMINISTRATION participation.

During tests, the criteria shall be observed and recorded and necessary alterations, adjustments and maintenance works shall be carried out.

Records from Routine tests shall be kept by the Contractor and made available timely for ADMINISTRATION and/or end Client's inspection.

All copies of the approved routine test results shall be submitted. Additional copies of records of all tests/inspections results shall also be kept at the Contractor's work to be made available to ADMINISTRATION or their representative on demand.

This test shall include functional test, visual inspection and dimensional inspection, as a minimum. The test details shall be approved.

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8.4. FIRST ARTICLE INSPECTION

The Contractor shall perform a First Article Inspection (FAI) of the components of the system object of the scope of supply at the Contractor's factory with ADMINISTRATION and/or end Client participation in accordance with an inspection specification issued by ADMINISTRATION and/or end Client, prior to serial production in order to confirm that the hardware & software fully complies with the Contractor's scope of supply design and manufacturing process. Contractor shall submit FAI test procedure to ADMINISTRATION at least 4 weeks before FAI. If any changes are requested by ADMINISTRATION, Contractor shall comply with these requests.

During the First Article Inspection (FAI), the Contractor shall have available all pertinent documents related to the design and production process, test records, material certifications, etc. Any nonconformities identified during the FAI shall be considered a critical quality defect. If all requirements are not met, a Hardware Review shall be requested. The Contractor shall initiate a System Review process covering the hardware and associated software components, and shall implement the necessary corrective actions. Upon completion of the System Review, the FAI shall be repeated to verify that the nonconformities have been resolved. The System Review and the repeated FAI shall be carried out in such a manner as not to affect the project delivery schedule.

Upon acceptance of the FAI by ADMINISTRATION and/or end client, the Contractor is then free to proceed to manufacture all pertinent hardware. The hardware shall meet or exceed the quality standards set at the FAI, and must incorporate any comments made by ADMINISTRATION and/or end client at the FAI.

All domestic and international accommodation and travel expenses (including round-trip international airfare, accommodation, and transportation between workplaces) for all Administration personnel traveling to the Contractor's facilities for First Article Inspections (FAI) will be covered by the Contractor. Administration personnel will participate in First Article Inspections for a maximum of 3 personnel/ day.

8.5. CONTRACTOR TECHNICAL ASSISTANCE

The Contractor shall provide all necessary technical support and engineering services for the product covered by the technical specifications and the equipment and sub-components (hardware and software) that constitute this product during the initial installation and commissioning to be carried out at the ADMINISTRATION's facilities. The installation and commissioning procedures, instructions, and step-by-step checklists shall be available for verification and approval during this process, and details shall be finalized during the project process.

The Contractor's support shall cover, at a minimum, installation, connections, configuration, system verification, and commissioning/homologation activities.

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The Contractor shall actively participate in the installation of the products and sub-components (hardware and software) within the scope of supply on the first locomotive, in the initial system commissioning processes to be carried out at the ADMINISTRATION's facilities, as well as in track tests conducted on the national railway network, test tracks, and/or at the End Client's site. The Contractor shall monitor the performance of the supplied products and sub-components under field conditions and carry out verification/testing activities in coordination with the ADMINISTRATION.

8.6. COMMISSIONING

8.6.1. TYPE COMMISSIONING TEST

For the first prototype LOCO, the Contractor shall perform static (factory test on ADMINISTRATION workshop) and dynamic commissioning (on track) tests for the system to adequately demonstrate the requirements of this technical specification, in accordance with a test procedure to be prepared by the Contractor and approved by ADMINISTRATION, under ADMINISTRATION participation.

8.6.2. ROUTINE COMMISSIONING TEST

On the serial LOCOs, routine commissioning test for the system will be performed by ADMINISTRATION in workshop and service track under the Contractor's responsibility.

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9. AUTHORIZATION TO START PRODUCTION

The Administration will authorize the Contractor to start production according to the following stages.

9.1. DESIGN FREEZING

After the contract is signed, procurement scope Design Freeze meetings will be held with the participation of End Client, the Contracting Authority and the Contractor. The date and place of the meetings will be mutually agreed.

At the design freeze stage, the design data, interface definitions, technical drawings, and engineering calculations of all systems, subsystems, and components developed under the scope of this contract shall be finalized in compliance with the relevant specification clauses and the referenced national and international standards.

The design freeze process shall be carried out in accordance with the project schedule. The Contractor shall be responsible for submitting to the Administration, in a complete and timely manner, all documents required for the Design Freeze, including but not limited to the final design data, technical drawings, and interface definitions.

9.2. AUTHORIZATION TO START PRODUCTION

According to the final design criteria mutually agreed upon as a result of the design freeze meetings, the Contracting Authority will authorize the Contractor to manufacture the first product(s) within the scope of supply.

9.3. AUTHORIZATION TO START MASS PRODUCTION

The Contractor will be authorized by the Administration to start mass production after the FAI (First Product Inspection) is performed on the first product(s) produced by the Contractor after receiving the Authorization to Start Production.

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10. ACCEPTANCE

After the system has been installed on the locomotive by the contractor, it will be inspected by the contractor and the inspection and acceptance committee officials. These inspections will be carried out for the preliminary acceptance of the unit. Whether the unit meets the specified criteria will be recorded in a report; in case of any failure, a rejection report will be prepared.

The contractor shall make the necessary updates within 30 days and resubmit a new air conditioning unit for acceptance by performing the tests described below. Any losses resulting from delays shall be the responsibility of the contractor.

Final acceptance of the unit shall be based on the successful completion of the following vehicle level tests and NoBo's approval of the air conditioning unit's compliance with the TSI provisions. The contractor must comply with the mechanical interface defined for them in the annexes. If NoBo's participation is required during the tests necessary for the acceptance of the unit designed by the contractor as a prototype, the costs shall be borne by the contractor.

During inspection following criteria shall be evaluated:

- Visual inspection of the climate control unit
- Inspection of the documents to be delivered
- Heating and cooling function
- Inspection of the climate control unit maintenance software
- Functional inspection of switches
- Thermostat device range inspection

10.1. TEMPORARY ACCEPTANCE

Temporary acceptance report shall be issued by ADMINISTRATION after followings have been covered by the Contractor:

- All required components have been delivered.
- All documents have been delivered.
- Routine tests in ADMINISTRATION have been performed successfully (if required)

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10.2. FINAL ACCEPTANCE

Final Acceptance report shall be issued by Administration after followings have been covered:

- Complete delivery of the products and sub-components (hardware/software) within the scope of supply
- Demonstration of compliance with all standards and technical requirements defined in this technical specification and its annexes, supported by conformity declarations, inspection, and test reports
- Complete submission of documentation to the Administration by the Contractor;
- Successful execution of the locomotive system's on-track tests (commissioning type tests);
- Successful completion of the approval process by the NoBo/DeBo.

Acceptance of the first product shall not be construed as acceptance of the entire quantity requested. Each item of the contract shall be evaluated individually, and acceptance shall be carried out separately for each item.

11. PACKAGING AND STORAGE CONDITIONS

11.1. PACKAGING

The products and all their sub-components (hardware/software) shall be delivered in suitable packaging with sufficient strength to withstand impacts and transport damage, including effects from climatic conditions such as dust, rain, snow, sun, wind, etc.

Packaging boxes shall be stackable and suitable for lifting by forklift (where reasonably applicable) or overhead crane.

Even if the products cannot be mounted on the locomotive promptly and are stored for long periods (e.g., up to three years) without use, they shall be delivered in packaging that fully protects them from any damage.

All packaging and crates shall carry the following information in a clear, legible, and weather-resistant manner:

- Manufacturer's name, address, and registered logo
- Product name, part number, and technical specification number
- Serial number and manufacturing date (if applicable)
- Contract number and date
- Quantity of products in the package and serial numbers of components
- Batch number (if applicable)
- "Project No: XXXXXX" statement

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If a box contains multiple components:

- Each component shall be labeled separately
- A component list shall be included inside and outside the box/crate
- Lists shall be finalized with the ADMINISTRATION's approval

Systems/equipment/components:

- Shall be packaged in sets required for the production of one locomotive
- Packages shall be arranged separately for mechanical and electrical production lines
- Package lists shall be finalized upon the ADMINISTRATION's approval and a copy shall be provided to the ADMINISTRATION prior to shipment

Products and all their sub-components (hardware/software) shall be wrapped in appropriately thick bubble wrap, secured to wooden crates, and delivered on pallets. Crate weights shall not exceed 400–500 kg. Deliveries shall be made, at the Contractor's expense, to TÜRASAS Eskişehir Regional Directorate.

If packaging or delivery documents are missing or non-compliant, the situation shall be recorded in a report, and the products shall be returned to the Contractor without acceptance. If the returned materials are reshipped after the contractual delivery date, delay penalties shall apply. The Contractor shall not be entitled to any claims due to delays caused by packaging.

11.2. STORAGE CONDITIONS

The Contractor shall provide any useful information it is deemed necessary for the correct storage of the goods delivered.

In addition, the necessary conditions and procedures to be applied in order to prevent damage to the products stored in warehouses without being used for a long time will be delivered by the Contractor in detail.

11.3. MOUNTING AND HANDLING

All the components shall be supplied ready for installation and possibly already mounted and pre-regulated. Special care is requested to the Contractor to list all the necessary tools for mounting and maintenance.

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12. DOCUMENTS TO BE DELIVERED TO THE ADMINISTRATION ALONG WITH THE PRODUCT/EQUIPMENT

The following tables report the list of requested documents (with schedule) to be supplied to ADMINISTRATION.

Table 8 shows the documentation which shall be given by the Bidders in the offer phase.

Table 9 and Table 10, show the documentation which shall be provided by the Contractor for the Preliminary Technical Review and the Detail Technical Review respectively.

Id.	Stage 1 -OFFER Phase	Time Schedule	Language
1.1	Clause by Clause commentary of present Tech. Specification	With offer	Turkish and English
1.2	Scope of supply list		Turkish and English
1.3	General description of the proposed system, including all the characteristics and functionalities and technical documentation and information requested in this specification as preliminary		Turkish and English
1.4	Preliminary 3D models or installation drawings showing the main external space envelope		English
1.5	Preliminary applicable schemes		Turkish and English
1.6	Preliminary definition of main I/F characteristics with the other LOCO systems		Turkish and English
1.7	List of tests (FAI, routine, type, commissioning and homologation) that shall be performed on components and systems		English
1.8	Declaration of Conformity to applicable standards According to EN17050		English
1.9	IRIS Certification of the Bidder (If the Bidder is an agency of the manufacturer, the Bidder shall show the manufacturer's certificate) or ISO 9001 Quality Management System Certificate of Bidder (If the Bidder is an agency of the manufacturer, the Bidder shall show the manufacturer's certificate)).		English
1.10	List of special tools and test equipment		Turkish and English
1.11	Design schedule, in line with project milestones		Turkish and English
1.12	Sub Contractor List		English
1.13	Detailed part list		Turkish and English
1.14	Delivery time from order		English
1.15	Escalation formula for spare parts		English
1.16	Explanation on how to pack in pieces		Turkish and English
1.17	A certificate/letter confirming that the contractor will provide domestic service and spare parts support		Turkish and English

Table 8 – Stage 1 Offer Phase: list of requested documents and due date

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Id.	Stage 2 - PRELIMINARY Review	Time Schedule	Language
2.1	First level drawings with weight and centre of gravity indications in 3D and 2D formats	Within one month after signing the contract	English
2.2	Technical description of the system, with system characteristics and performance		English
2.3	Functional description (normal and degraded mode) of the system, included diagnostic description		English
2.4	Design justification analysis reports		English
2.5	Definition and specification of applicable I/F's characteristic (mechanical, pneumatics, electrical, signals, I/O data, etc.)		English
2.6	Certificates of the fire smoke behaviour of non-metal materials		English
2.7	Certificates of behaviour versus applicable emissions requirements		English
2.8	Preliminary applicable analysis reports (performance, consumptions, structural strength, etc.)		English

Table 9 – Stage 2 list of requested documents and due date

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Id.	Stage 3 - DETAIL Review	Time Schedule	Language
3.1	Definitive drawings with weight and centre of gravity indications in 3D and 2D format.	Within one month before FAI with product/ equipment delivery	English
3.2	Definitive schemes		English
3.3	Installation drawings		English
3.4	Installation instruction		Turkish and English
3.5	Detailed description of the supplied components or systems		Turkish and English
3.6	All the technical documentation and information requested during the project (including final version of documents of previous stages)		Turkish and English
3.7	Procedures of tests (FAI, routine, type, commissioning and homologation) performed on components and systems		Turkish and English
3.8	Available reports of tests (routine, type, commissioning and homologation) performed on components and systems		English
3.9	List of special tools and test equipment		Turkish and English
3.10	LRU list		Turkish and English
3.11	Spare Parts and Equipment List (including order codes)		Turkish and English
3.12	Servicing and lubricating table		Turkish and English
3.13	Final documentation for Certification		Turkish and English
3.14	EC Certification according to the TSI LOC&PAS 1302 if the scope of Supply is considered "Interoperability Constituent"		English
3.15	RAMS and LCC documentation: see dedicated paragraphs		Turkish and English
3.16	User Manuals		Turkish and English
3.17	Maintenance Manuals (including periodic maintenance Schedule) (including failure repair documentation)		Turkish and English
3.18	Calculations, tests and analysis reports requested by TSI		Turkish and English
3.19	3.1 certificates of the product/equipment according to EN 10204		English
3.20	Documents showing compliance to EN 45545-2 (Certificate of Conformity, Test Report etc.)		Turkish and English
3.21	Warranty documentation		Turkish and English

Table 10 – Stage 3 list of requested documents and due date

The Bidder/Contractor shall review and confirm the above lists of documents for all the phases of the project. Any deviation shall be submitted to ADMINISTRATION for approval.

In Stage 1, the IRIS document submitted by the Bidder will be examined by the Administration in terms of its compliance with the scope of the product/work subject to the tender.

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The documents specified in Stage 3 shall be delivered to the ADMINISTRATION both before the FAI and together with the product/equipment.

The documents to be delivered by the Contractor in Stage 1 and Stage 3 will be provided to the Administration in 2 (two) USBs.

Notes:

- All components, including their sub-elements (cables, connectors, etc.), shall be provided as complete 3D models in “.step” format. Connectors shall be prepared separately from the 3D model to allow their use in harness design.
- 2D drawings shall be provided in “.dwg or .dxf” format (plus PDF).
- Electrical schematics shall preferably be provided in EPLAN Electric P8 format; alternatively, in .dwg/.dxf format (plus PDF).
- All documents shall be provided in editable format as well as in PDF.
- In case both Turkish and English are used in the documents, the Turkish version shall be considered authoritative.
- Documents shall be delivered in a format compatible with the Administration’s PLM system.
- All documents shall be prepared electronically and delivered to the Administration via cloud-based storage with secure access. After each update, relevant parties shall be notified by email in accordance with the communication matrix. Alternatively, the digital documents may be delivered on two copies of portable storage media.
- 3D design of electrical equipment and cables shall be provided in Catia Electric format (plus PDF) and/or in EPLAN Pro Panel or EPLAN Harness format.

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13. INTELLECTUAL AND INDUSTRIAL PROPERTY ISSUES

- Any projects and documents shared with the Contractor within the scope of the work subject to the tender shall not be used for any other purpose. The Contractor shall share all technical information only with the Administration.
- Administration shall be authorized to use the products to be supplied by the Contractor (right of usage) – without prejudice to any mandatory legal provisions applicable and without any detriment to the Contractor’s dignity and reputation.
- In case of proven violation of an intellectual and / or industrial property rights by the Contractor, the Contractor shall be liable for any direct, reasonable and properly documented damages resulting directly from such violation. If the Administration faces legal sanctions, it is allowed to recourse such sanctions to the Contractor within the scope of liability of the Contractor mentioned above. Upon the request of the Administration, the Contractor is obliged to fully inform and certify to the Administration whether the service to be undertaken is a matter of intellectual and industrial property.
- This technical specification is a part of the contract between the Contractor and the Administration. The Contractor does not have the authority to distribute this document or any part of it to third parties without the approval of the Administration.
- If an official document is requested and mutual communication causes any mistake; all possible information requests and their responses shall be made in written format and via e-mail.

14. GUARANTEE

14.1. WARRANTY CONDITION

The Contractor shall warrant the quality of the products supplied under this Specification against failures, malfunctions, assembly and workmanship defects, except for cases arising from natural wear and tear and maintenance neglect; for a period of 400,000 km of operation or 24 months from the commissioning date of COCO LOCO, or 36 months from the delivery date of the products to the ADMINISTRATION, whichever expires first.

The responsibility of performing preventive maintenance on the normally used parts and the protective maintenance in cases where it is evidently clear that the root cause is not the own malfunctions of the unit, shall belong to ADMINISTRATION.

Throughout the warranty period, following the notification by ADMINISTRATION of any malfunction, the Contractor shall respond to that malfunction within two (2) working days and replace the malfunctioning parts and equipment or repair and fix the malfunction. The Contractor shall make available in Turkey throughout the warranty period the required service facilities in order

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to respond to the possible malfunctions and a sufficient number of spare parts or fully complete equipment within this time period.

Responsibility for making sure that none of the information, document, certificate, component, system, machine, software, technology and design the Contractor supplies to the Administration violates any brand, patent or third-party ownership rights belongs to the Contractor.

The contractor company shall provide a 10 (ten) year service and spare parts guarantee, valid from the end of the warranty period.

14.2. SYSTEMATIC FAULT / EPIDEMIC FAILURE

Upon commissioning of the Electric CoCo locomotive, any failures that occur repeatedly and in a non-random manner under specific conditions or inputs during the warranty period shall be considered systematic failures.

In addition, if mean time between failures (general average failure time) for the failures occurring in main components/parts used in all LOCO within annual periods during the guarantee term is shorter than guaranteed MDBF or MTBF value, such failure shall be deemed as an epidemic failure.

In case of confirmed systematic faults, proper investigations shall be done in order to define a proper technical solution or modification including Spare Parts modification or replacement.

Starting from the commissioning of the LOCO locomotive and during the warranty period, if a failure within the scope of the warranty occurs in more than 15% of the same part/component in the first 24 locomotives, or in more than 10% of the same part/component in the 25th and subsequent locomotives, due to the same reason, it shall be considered an “epidemic failure.”

Records of systematic failures shall be kept for a period of 24 months following the commissioning of the locomotive.

In addition, if mean time between failures (general average failure time) for the failures occurring in main components/parts used in all sets within annual periods during the guarantee term is shorter than guaranteed MDBF or MTBF value, such failure shall be deemed as an epidemic failure.

In case of confirmed systematic faults, proper investigations shall be done in order to define a proper technical solution or modification including Spare Parts modification or replacement.

In case systematic failures are confirmed, the necessary investigations shall be carried out in order to define an appropriate technical solution, including spare part replacement or modification, and a new warranty period for the solution defined within this scope shall be agreed with the Administration.

The Contractor shall perform, within the determined period, all necessary reinforcement, modification, material replacement, assembly and disassembly works at its own expense.

The expiration of the warranty period shall not relieve the Contractor of its obligations related to the subject matter of the contract. The Contractor shall remain responsible for remedying the systematic failures recorded by mutual agreement at the end of the warranty period.

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related to this situation shall be carried out by the Contractor without any charge. For problems characterized as epidemic, the root cause of the failure shall be found and the Administration shall be notified in writing.

If necessary, the Contractor shall send the relevant expert(s) to ADMINISTRATION, at its own expense, to ensure that such failures are eliminated and not repeated.

For systems / parts / components within the scope of epidemic failure; The warranty period from the taking of the necessary measures is limited to 30 months from the delivery of the products to ADMINISTRATION, and 24 months from the re-operation of the locomotives.

Epidemic Failure; If it does not prevent the locomotive from being put into service safely, the Contractor will repair the failure in the locomotive and / or replace the defective parts with new parts at its own cost within 30 calendar days at the latest from the date of receipt of this notice. In the event that the Contractor fails to fulfill its obligations within this period, the terms of the Administrative Specification and the contract shall apply.

15. OTHER ISSUES

1. For matters not specified in the technical specification, the administrative specification shall apply.
2. The Contractor is responsible for all transportation costs.
3. The Contractor is responsible for work accidents that may occur during the work of the Contractor personnel at ADMINISTRATION facilities.
4. The food and accommodation costs of the Contractor personnel belong to the Contractor.
5. The Contractor must comply with T.B. 2348 in its work within the boundaries of ADMINISTRATION facilities.
6. The Contractor must comply with the safety, protective safety, occupational health and safety instructions and provide the protective materials required by the work and follow their use.
7. The contractor must comply with all kinds of warnings, signs and writings within the boundaries of ADMINISTRATION facilities.
8. All software used by the contractor (Computer Aided Design Programs (CATIA, AutoCAD etc.), MS Office. FEM Analysis Programs etc.) will be licensed. All responsibility in this regard belongs to the Contractor.
9. The Contractor is responsible for all kinds of damages and losses to ADMINISTRATION or third parties in relation to the obligations fulfilled within the scope of the work subject to the tender.

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16. ANNEXES AND NOTES