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**Gaziray Commuter Train Project
Passengers & Driver Cab HVAC System
and Electrical Heaters
Technical Specification**

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III. LIST OF ACRONYMS & ABBREVIATIONS

ADD	Automatic Dropping Device
DeBo	Designated Body
EMU	Electrical Multiple Unit
FAI	First Article Inspection
HV	High Voltage
LRU	Last Replaceable Unit
LV	Low Voltage
MV	Medium Voltage
MVB	Multifunctional Vehicle Bus
N/A	Not Applicable
NoBo	Notified Body
TBC	To Be Confirmed
TBD	To Be Defined
TCMS	Train Control Monitoring System
TOR	Top of Rail

1 INTRODUCTION

1.1 SUBJECT

This document describes the technical requirements for the procurement of the Air Conditioning to be installed on the Electrical Multiple Units (hereafter called EMU) produced by Turkish Railway Vehicles Industry Inc. (hereafter called TÜRASAŞ).

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 TÜRASAŞ and the Supplier.

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

IMPORTANT NOTE:

The present document shall be examined by the bidder, together with following document:
TŞ-01.139–General Technical Specification
in order to know general applicable requirements established at train level.

This Technical specification and its annexes already prepared in Turkish and English language. The Turkish language shall be prevailing in case of any discrepancy among them.

1.2 DEFINITIONS

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

- “the End Client” means the Gaziantep Metropolitan Municipality (GAZİRAY)
- “the Administration” means the Turkish Railway Vehicle Industry Co. (hereafter called TÜRASAŞ)
- “the Designer” means BLUE Engineering that is the company responsible for the design EMU set
- “the Supplier” 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 magnetic or other format which is prepared by the Supplier 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

1.3 DOCUMENTS AND STANDARDS

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

European Standards: TSI, EN;
International standards: UIC; ISO; IEC;
System of units shall be SI.

Table 1 reports the Applicable Standards for the Scope of Supply.

Standard	Year	Title
EN 14750-1	2006	Railway applications. Air conditioning for main line rolling stock. Comfort parameters.
EN 14750-2	2006	Railway applications. Air conditioning for main line rolling stock. Type tests
EN 14813	+A1:2010	Railway applications - Air conditioning for driving cabs. Comfort parameters.
EN 14813	+A1:2010	Railway applications - Air conditioning for driving cabs. Type Tests.
EN 15663	+A1:2018	Railway applications. Definition of vehicle reference masses
UIC 566	Ed. 3	Loadings of coach bodies and their components
EN 15085-3	/AC:2009	Railway applications - Welding of railway vehicles and components - part 3: Design requirements
EN 50125-1	2014	Railway applications – Environmental conditions for equipment – Part 1: Equipment on board rolling stock
EN 50126	2017	Railway applications – The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS)
IEC 61133	2016	Railway applications – Rolling stock – Testing of rolling stock on completion of construction and before entry into service
EN 50153	2014	Railway applications - Rolling stock - Protective provisions relating to electrical hazards
IEC 61373	/AC:2017	Railway applications – Rolling stock equipment – Shock and vibration tests
EN 60077		Railway applications. Electro technical components
ISO 717-1	2020	Acoustics -- Rating of sound insulation in buildings and of building elements -- Part 1: Airborne sound insulation
ISO 3381	2011	Railway applications. Acoustics. Measurement of noise inside railbound vehicles.
EN 50121		Railway applications. Electromagnetic compatibility
EN 50155	2017	Electric equipment used on rolling stock
TSI LOC&PAS 1302	2014 +AR 2019/776 and	Technical Specification of Interoperability: Rollin stock - Locomotives and passenger rolling stock subsystem of

	2020/387	the rail system in the European Union.
EN 45545	1,3,4,5,6-2013 2-2020	Railway applications. Fire protection on railway vehicles. Requirements for fire behaviour of materials and components
EN 50122-1	2011	Railway applications. Fixed installations. Electrical safety, earthing and the return circuit. Protective provisions against electric shock
ISO 16890	2016	Air filters for general ventilation – Part 1 to 4
EN ISO 14040	/A1:2020	Environmental management - Life cycle assessment - Principles and framework
IEC 60529	+A1:2000 +A2:2013 +AC:2016 +AC:2019	Degrees of protection provided by enclosures (IP Code)
ISO 10140	2010	Acoustics - Laboratory measurement of sound insulation of building elements
UIC 345	2006	Environmental specifications for new rolling stock
EN 50128	2011	Railway applications - Communications, signaling and processing systems - Software for railway control and protection systems
EN61287-1	/AC: 2014	Railway applications. Power convertors installed on board rolling stock. Part 1: Characteristics and test methods
EN 50306	2020	Railway applications - Fire Cables - Thin wall
EN 50264	2008	Railway applications - Railway rolling stock power and control cables having special fire performance

Table 1 – Applicable Standards

If it is not differently specified, the applicable version of the standards mentioned in the text of the document is the one specified in Annex 1 of “TS-01.139 –General Technical Specification” or in the above table.

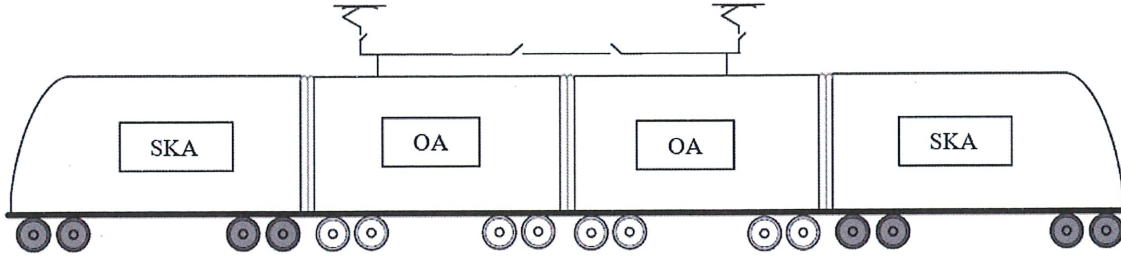
The Bidder shall review and confirm compliancy to the above list of applicable norms, any deviation shall be submitted to TÜRASAŞ for approval.

The Bidder shall declare if its system/equipment is compliant with other national/international or railroad administration standards not mentioned in the above list.

1.4 EMU TRAIN-SET CONFIGURATION

EMU is composed by:

- 4 cars: SKA car, OA car, OA car: SKA car



The types of car are hereafter:

SKA = Leading car with driver cab

OA = Intermediate car

The SKA vehicles will be interchangeable and the OA vehicles will be interchangeable.

The EMU will be fixed configuration Unit: the orientation of the different type of vehicles within a Unit is fixed.

The Unit wheel arrangement will be the following: Bo'Bo'+2'2'+2'2'+Bo'Bo'

1.5 EMU TRAIN-SET MULTIPLE CONFIGURATION

The configurations foreseen for the multiple unit operation are the following:

4 cars + 4 cars

4 cars + 4 cars + 4 cars

2 SCOPE OF SUPPLY

2.1 HARDWARE

The Supplier shall provide all relevant components related to manufacturing and assembly of HVACs but not to be limited to, as following:

The quantity of Passenger and Driver HVAC in coaches is in the following table:

Part Name	Per Car				Per 4 Car Train Set
	SKA	OA	OA	SKA	
Passenger HVAC Compartment	2	2	2	2	8
Driver HVAC Compartment	1	-	-	1	2

Table 2 – Material quantity

The supplier shall include in the offer a separate price list for the spare parts listed in the below table.

The contractor shall accept and guarantee to deliver the pieces /parts in this list to TÜRASAŞ if it is so required by the administration for a period of 10 (ten) years in return of due unit prices that are escalated according to the escalation formula given below:

$$P1 = P_0 \times (C1 / C_0) \times (0,10 + 0,35 \times (M1/M_0) + 0,55 \times (L1/L_0))$$

Where:

P1: Escalation unit price (in the currency of Turkish Lira or Euro or USD)

P₀: unit price specified in the final lists (in the currency of Turkish Lira or Euro or USD)

M₀, L₀: material (M₀) and labour (L₀) indexes applicable in the industry in the country of the contractor at the date 30 (thirty) days prior to signature date of the contract.

M₁, L₁: material (M₁) and labour (L₁) indexes applicable in the industry in the country of the contractor at the date 30 (thirty) days prior to placement of the purchase order.

If the currency indicated by P₀ is different than the currency of the country of origin where labour, and material indexes belonged, correction factor shall be used in calculation of escalated unit prices. Correction factor shall correspond to the foreign currency exchange rate applied by the Central Bank of the Republic of Turkey at the date indexes are applied.

C₀: the rate of exchange of foreign currency applied by the Central Bank of Turkey at the date 30 (thirty) days prior to the signing of the contract.

C₁: the rate of exchange of foreign currency applied by the Central Bank of Turkey at the date

30 (thir-ty) days prior to placement of purchase order.

Name of the part	Unit	Qty
Air conditioning system for driver cabin (complete)	Piece	1
Air conditioning system for passenger compartment (complete)	Piece	2
Compressor in passenger air conditioning unit	Piece	3
Fan (1 X Condenser Fan, 1 x Evaporator Fan of passenger HVAC)	Set	6

Table 3 – Spare Parts

Supplier shall separately provide the interface connectors of devices and equipment with their mating connectors including all accessories as complete 2 set connectors for contract. Interface connectors on the devices and equipment can be as board type (pcb type) connectors.

The HVAC system, for each car, shall consist of 2 air conditioning units for compartment and one for cabin to be installed on the roof with at least the following components:

- Housing and frame
- Fasteners (nuts, bolts, resilient mounts, etc.) required for mounting the HVAC unit to car
- Hardware to drain the condensed water
- Air filters
- Emergency 110 Vdc inverter
- All the electrical connectors (mating and fixed, with accessories belong to connectors) and connections (earthing items, including screws, nuts, washers, ...).
- Electrical switchboard (which includes HVAC control unit, emergency inverter, to be installed inside the HVAC unit)
- Air distribution ducts (rigid and flexible types) for connecting to carbody
- Gaskets for connections between vehicle body and the HVAC system
- Temperature and CO₂ sensors, inside the units and recirculation air inlet
- If any, special tools and test equipment
- All other needed equipment and/or components (this issue will be discussed during design phase)
- Emergency shutter

2.2 SOFTWARE

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

Supplier shall provide 6 sets of diagnostic software for maintenance staff free of charge.

2.3 SPECIAL TOOLS AND EQUIPMENT

The Bidder shall comply special tools and equipment according to TD-GZ.28.0038 (relevant section in RAMS Analysis) which is given in Annex.

2.4 CONFORMITY TO THE PROJECT REQUIREMENTS

The EMU train set shall be certified according to current version TSI PAS/LOC, TSI NOI, TSI PRM, TSI SRT and TSI CCS by Notified Body (NoBo) / Designated Body (DeBo). The Supplier shall provide whole calculations, drawings, analysis, test reports and other kind of documentation which is requested by TSIs for the present Scope of Supply.

The documentation presented by the Supplier/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 EMU.

2.5 EC CERTIFICATION OF CONFORMITY AS INTEROPERABILITY CONSTITUENT

N/A

2.6 SCOPE OF SUPPLY PROJECT MANAGEMENT

2.6.1 INTRODUCTION TO PROJECT MANAGEMENT

The Suppliers and their Sub-suppliers shall be responsible for the components and systems delivered. TÜRASAŞ reserves itself a right to request different solutions and/or modifications of a system or components in case they are necessary for reasons related to installation, operation, interfacing or other equivalent reasons. Such written requests shall be transmitted in direct contact with suppliers.

In case of direct contacts the minutes shall be drawn up and countersigned by the representatives of the parts participating the meeting.

Present document, is a part of the contract between the Supplier and TÜRASAŞ. The Supplier is not entitled to deal this document or part of it to a third party.

All generic information requests and answers shall be communicated in written form or through e-mail, if an official form is required, and in the case the exchanged communication preludes to any kind of action.

2.6.2 PROJECT MANAGEMENT AND PLANNING

The Supplier shall submit a Project Plan within one month of contract award.

This Project Plan reports the schedule for all main activities and key events, including submission of all information identified in this specification and delivery of all parts and documentation. The Plan shall be subject to approval of TÜRASAŞ, every time it is issued.

The Supplier shall attend regularly to the Project Progress Meetings according the established schedule proposed by TÜRASAŞ. The Project Plan shall be updated by the Supplier for each of these meetings.

2.6.3 MODIFICATIONS

All engineering changes made prior to FAI (First Article Inspection) shall be controlled by the Supplier's Quality Management System. Any engineering change made after FAI shall be supported by all relevant documentation and subject to written approval by TÜRASAŞ. Engineering changes shall be subject to all requirements of this specification and any supporting specifications.

The Supplier shall agree with TÜRASAŞ a Modification Implementation Plan detailing timescales and locations where the work shall be carried out. This shall include modifications to any relevant spare parts.

The Supplier shall, on the day of completing any modification, provide TÜRASAŞ with the date of modification, serial number of component modified, new modification level of component and location of component. In addition, the status of the modification level on the component shall be updated.

Modifications made to improve the product or production without any effect on performance or spare part exchange can be decided by the Supplier. Traceability of modifications shall be given by the Supplier to TÜRASAŞ.

In case of modifications due to Supplier design inaccuracy or whatever cause under its responsibility, the subsequent recovering modifications and whatever consequent actions shall be done by the Supplier free of charge.

2.6.4 Authorisation to start manufacturing

TÜRASAŞ will release to the Supplier the authorisation to start the manufacturing according to the following steps.

2.6.4.1 Design Freezing

After signing the contract, a dedicated meeting shall be held for freezing the design of the scope of supply between the End Client, the Administration, the Designer and the Supplier. The date and place of the meetings shall be agreed mutually.

2.6.4.2 Authorisation to start manufacturing for Train Sets

According to final design criterias which have been already decided in design freezing, TÜRASAŞ will issue the authorization to manufacture products/system/equipment. These products shall be used for type tests (according to item 4.4.1.1).

2.6.4.3 Authorisation to start serial production

After successful completion of tests in accordance with clause 4.4.1.1 and 4.4.1.3, TÜRASAŞ will release to the Supplier the authorization to start the serial production.

3 TECHNICAL REQUIREMENTS

3.1 INTRODUCTION

This document defines the requirement for the design and test of the HVAC Compartment and Driver for the Electrical Multiple Unit project.

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

3.2 HVAC COMPARTMENT AND CABIN DEFINITION

3.2.1 Main Components

The specification defines the technical characteristics and the basic concepts for the Passenger HVAC System. Main components to be considered inside each passenger HVAC unit shall be:

- 2 Evaporator, air fan – power source 400Vac 3ph 50Hz and 110Vdc in emergency cases
- 2 compressors – power source 400Vac 3ph 50Hz
- 2 condensers – power source 400Vac 3ph 50Hz
- 1 sets of internal heaters – power source 400Vac 3ph 50Hz
- 1 HCU's – power source 110Vdc
- Piping
- Temperature and CO₂ sensors and relevant cables, inside the units and in the recirculation air ducts
- H/L pressure switches
- Liquid tank (if any)
- All other needed equipment and/or components (like air dampers, air filters, valves, connectors, etc.).
- Emergency shutter (driver HVAC Unit)

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 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.).

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

Compartment HVAC Units shall be positioned at center of the car, while the driver unit will be positioned on the roof of the cabin, using a plenum in order to obtain the correct airflow distribution.

3.2.2 OPERATIONAL REQUIREMENTS

The following table describes the main requirements for compartment unit:

Reference standard for HVAC system		TSI LOC&PAS, EN14750-1-2 (Comfort B)
HVAC unit number in one HVAC vehicle system	nr	2
Compressor type		(Spiral) Scroll or Semi-Hermetic
Manual regulation (set point setup)		+ - 2 C°
Max internal difference		< 2 C°
Heat transmission coefficient (K)	W/(m ² K)	3.0
Communication protocol between HVACs (if any)		TBD by Supplier and TÜRASAŞ
External box material		Aluminium
Number of passengers	nr	265
Winter Climatic Condition		WII – EN14750
Summer Climatic Condition		SI – EN14750
Cooling Thermal Power (per car)	KW	60 < CTP < 65
Heating Thermal Power (including heating floor system) (per car)	KW	40 < HTP < 45
Minimum required massflow (per car)	m ³ /h	10500
Minimum refresh air	m ³ /h	2150
Solar radiation	W/m ²	800
Coolant	Type	R407C

Table 4 – Main Requirement Compartment HVAC Unit

For driver Unit:

Reference standard for HVAC system		TSI LOC&PAS, EN14813-1-2 (Comfort B)
HVAC unit number in one HVAC vehicle system	nr	1
Compressor type		(Spiral) Scroll or Semi-Hermetic
Manual regulation (set point setup)		+ - 2 C°
Max internal difference		< 2 C°
Heat transmission coefficient (K)	W/(m ² K)	3.0
Communication protocol between HVACs (if any)		TBD by Supplier and TÜRASAŞ
External box material		Aluminium
Number of passengers	nr	2
Winter Climatic Condition		WII – EN14813
Summer Climatic Condition		SI – EN14813
Cooling Thermal Power (per car)	KW	5
Heating Thermal Power	KW	6
Minimum required massflow (per car)	m ³ /h	900
Minimum refresh air	m ³ /h	60
Solar radiation	W/m ²	800
Coolant	Type	R407C

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 Compartment

Cooling	External temperature [°C]	40
	External relative humidity [%]	40
	Internal temperature [°C]	32
	Fresh air [m3/h pax]	10
Heating	External temperature [°C]	-10
	Internal temperature [°C]	17
	Fresh air [m3/h pax]	8

Table 6 – Thermal Balance Results for Passenger Compartment

Parameters Driver Cabin

Cooling	External temperature [°C]	45
	External relative humidity [%]	50
	Internal temperature [°C]	26
	Fresh air [m3/h pax]	30
Heating	External temperature [°C]	-20
	Internal temperature [°C]	18
	Fresh air [m3/h pax]	30

Table 7 – Thermal Balance Results for Driver Cabin

3.2.3 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 Vn = 400Vac
- Maximum tolerance for the input voltages ± 5%
- Main component frequency 50 Hz ± 1%
- Maximum harmonic distortion 5%
- Number of phases 3
- Phase shift 120° ± 1°

LV

- Input voltage 110Vdc nominal
- Max ripple, at nominal power, with resistive load 1Vpp

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 passenger ambient 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 train running (train 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 coach, dependent on the number of passengers, 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, based on the number of passengers, internal temperature, and external temperature detected by the relevant sensors.
- There shall not be any 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
- Open/close the emergency damper

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.

3.2.3.1 LV and MV Input

LV source is provided from the car batteries and battery charger, MV source is provided from auxiliary inverter output; supplier shall guarantee full cooperation to the auxiliary inverter supplier 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).

3.2.3.2 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
- A 2nd level protection (thermostat + magneto-thermic) 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 protection layout in schemes is visible below:

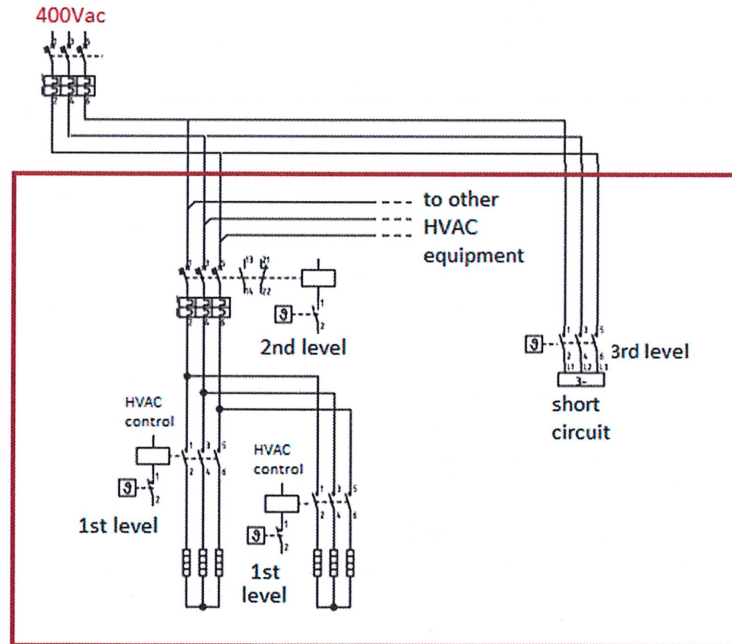


Figure 1 – Protection Installation Example

3.2.3.3 Evaporator Fan

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

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

Supplier 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 car 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.

For the driver unit one evaporator fan shall be included.

3.2.3.4 Compressors

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

Compressors 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.

Compressors 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.

For the driver unit one compressor shall be included.

3.2.3.5 Condensers

Two condensers circuits (included two condenser fans) shall be included into each HVAC unit, condensers main power source shall be 400Vac 3 phase 50Hz.

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

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

For the driver unit one condenser circuits shall be included.

Each condenser fan shall be enclosed in a protective cage for safety during maintenance.

3.2.3.6 Sets of Internal Heaters

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

DETAIL C
SCALE 1:2

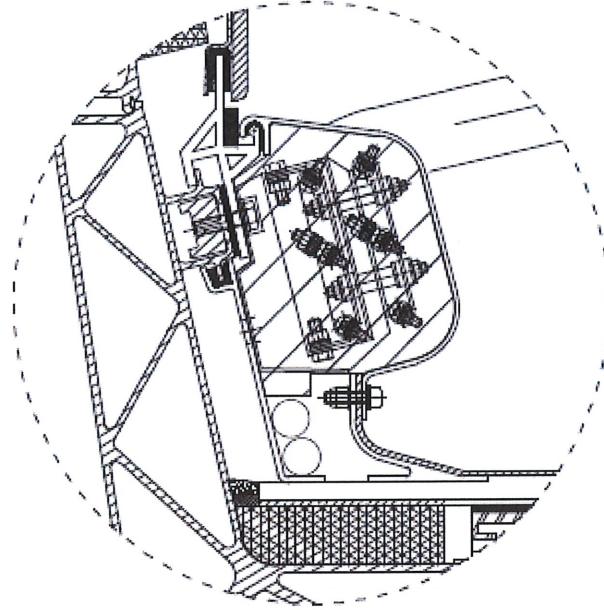


Figure 3 – Floor heaters section - Annex detail

The quantity of heaters for each car is specified in the table below. The detailed placement of the heaters is shown in Appendix 7. The heaters shall be of a single type and shall be 470 mm in length. The total thermal power shall be almost 8 KW for each car.

Part Name	Per Car				Per 4 Car Train Set
	SKA	OA	OA	SKA	
Heater	20	24	24	20	88

Table 8 – Heaters Breakdown - TBD

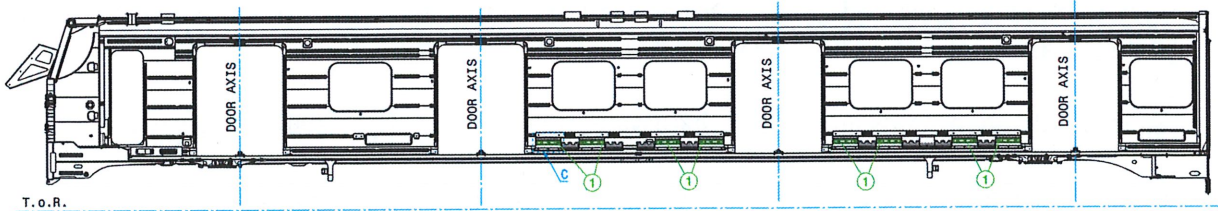


Figure 4 – Floor heaters layout SKA

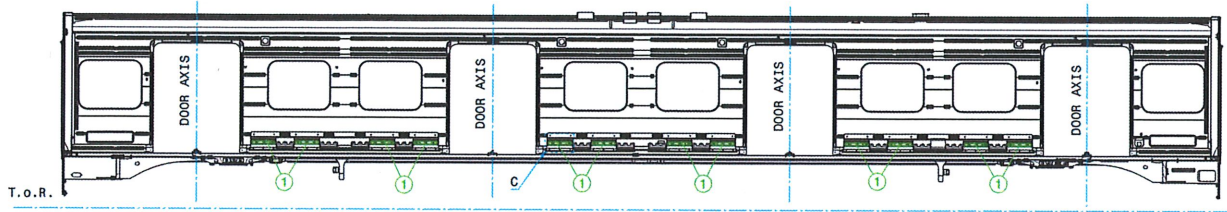


Figure 5 – Floor heaters layout OA

3.2.3.8 HCU

Each HVAC, both for passenger compartment and cabin, 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 HVAC shall have at least the following temperature sensors, these sensors are included in the scope of supply, so each compartment 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 car data bus (CAN Open), 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 HVACs (cab and compartment) will be controlled by the driver desk TCMS HMI

Supplier shall cooperate with TCMS supplier for the communication issues to be made via the data bus (CAN Open).

A HCU shall be included in the Driver Unit including the same characteristics in terms of sensors, diagnostic and communications.

3 spare hardware outputs and 3 spare hardware inputs on the HCU shall be reserved.

The data structure on the CAN bus and the communication protocol shall be compatible with those used in the vehicles previously manufactured under the Gaziray Commuter Train Set Project. Any requested modifications shall be mutually discussed and agreed upon during technical meetings between the Supplier and the Administration.

3.2.3.9 Set of Air Extractors

N/A

3.2.3.10 Piping

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 train through an appropriate piping system. These drain pipes shall extend invisibly through the side walls to the bottom of the train. 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.

3.2.4 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 train crew.

3.2.5 EMERGENCY SHUTTER

The compartment air duct system is connected by damper to cabin duct distribution to provide air in case of failure of the driver HVAC machine.

The delivery duct of the passenger compartment is connected by means of a flexible duct and an electric shutter controlled by the control units of the cabin HVAC machine and positioned between the cabin compartment boundary zone. In normal operation, with both HVACs in operation, the shutter is closed, giving independent operation of the two air-conditioned rooms through their own air distribution system. In the event of a fault or shutdown of the cabin HVAC, the shutter opens automatically, establishing a bleeding of the air duct from the delivery channel of the compartment providing ventilation to the cabin. The following figure shows a type of applicable damper.

The supplier shall assure the correct mechanical installation, while the control shall be actuated by driver HVAC Unit.

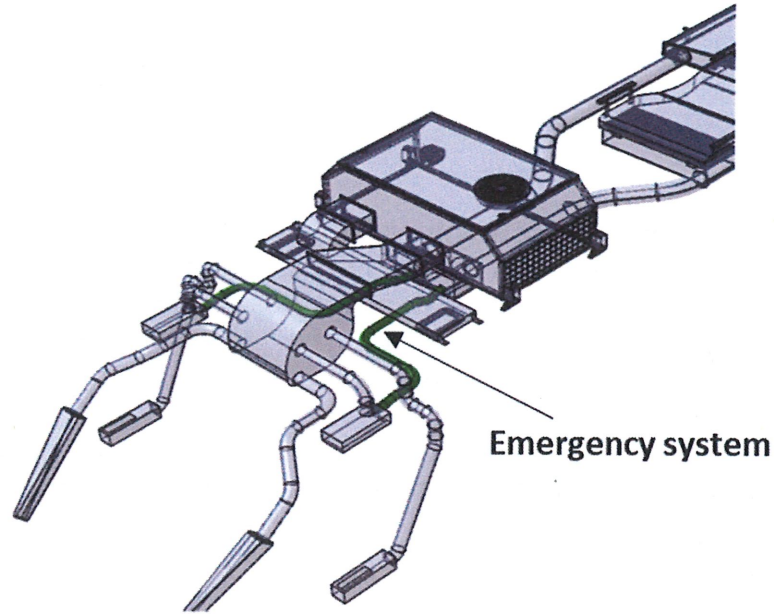


Figure 6 – Emergency duct system – TBD - for descriptive purposes only

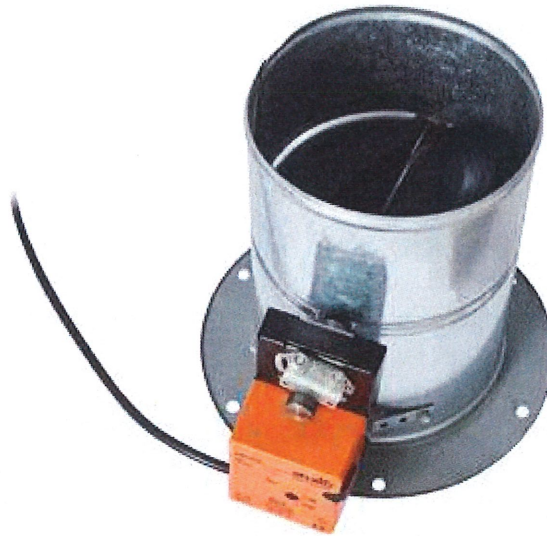


Figure 7 – Emergency electrical damper – typical element

3.2.6 DEGRADED MODE

A dedicated input shall be considered in each HVAC for the degraded function.

When this input signal is inactive ('0') the HVAC shall immediately enter into "degraded mode function" that means:

- Disable the "autumn/spring function" (not possible to use at the same time heaters and compressors)
- Only one compressor can be active at the same time in each unit

- Only a part of internal heaters can be active, floor heaters shall be off
- No actions required on condensers
- No actions required on evaporator fan

The degraded mode shall be maintained as a logic function until the “degraded mode function” signal is valid; when input signal become high ('1'), the HCU will restart softly the normal functions of the HVAC.

Independently from the degraded mode, it is not allowed to start at the same time 2 compressors in parallel, the compressors shall be activated sequentially to reduce as minimum as possible the inrush current. After the first compressor inrush time startup is ended, the second compressor can start.

3.2.7 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 oportune 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.

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 supplier.

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; supplier shall provide requested documents and related address information of control unit according to defined parameters which are defined by TCMS supplier.

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

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

3.3 WEIGHT

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

The maximum target weight of each HVAC unit shall be less than 600 kg.

For the Driver HVAC the max weight is less than 175 kg.

3.4 MANUFACTURING

All the structural parts of the HVAC must be constructed of 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 class G3 minimum of TS EN ISO 16890.

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 supplier responsibility; all the not normalized elements necessary for the fixation of the equipment and components shall be considered under supplier scope of supply.

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

3.5 PAINTING

The bidder can propose its own painting specification to TÜRASAŞ.

Concerning resistance to corrosion, design and processes shall take in account the effect of potential galvanic corrosion.

The colour of products is TBD by the TÜRASAŞ.

3.6 INTERFACE SPECIFICATION

3.6.1 MECHANICAL INTERFACE

The Passenger HVAC Unit shall be suitable with the car body structure. Supplier shall give confirmation for the Passenger HVAC Unit is designed according to track gauge. The HVAC Units shall be connected to the carbody dedicated roof slots be own bracket, avoiding substructures. The HVAC limit gauge and is referred to Annex [2]. The rail c-slot dimension is indicated in the Annex [6].

Maximum length for each passenger HVAC unit shall be less than 3200 mm.

The unit layout and related air inlet and outlets should be arranged as shown in Figure 8 and Figure 9. The equipment layout is shown in the Annex [3].

Air inlets/outlets through the carbody shall be arranged in order to interface to geometry depicted in Figure 10.

The fresh air inlet cross-section dimension on the car is 375x256 mm. The return air cross-section dimension is 665x321 mm. The coupling gasket between HVAC unit ducts and carbody shall be supplied by the supplier in accordance to Figure 10.

The preliminary Driver Unit layout is shown in the Figure 12, the duct interface shown in the Figure 12; they will have to be defined at a later stage.

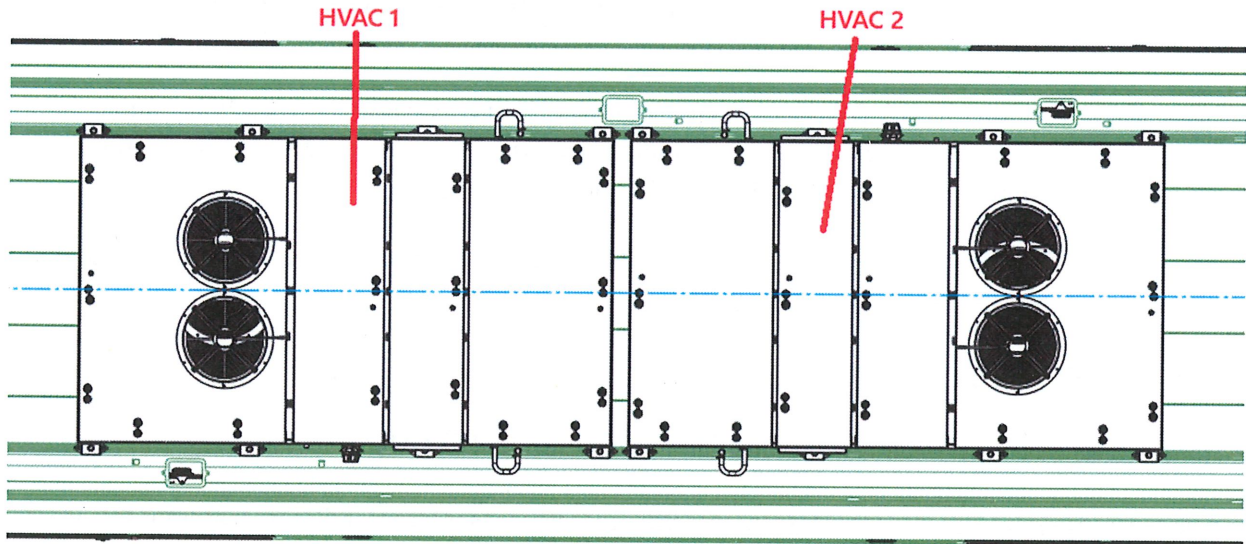


Figure 8 – Compartment HVAC – only for example - TBD

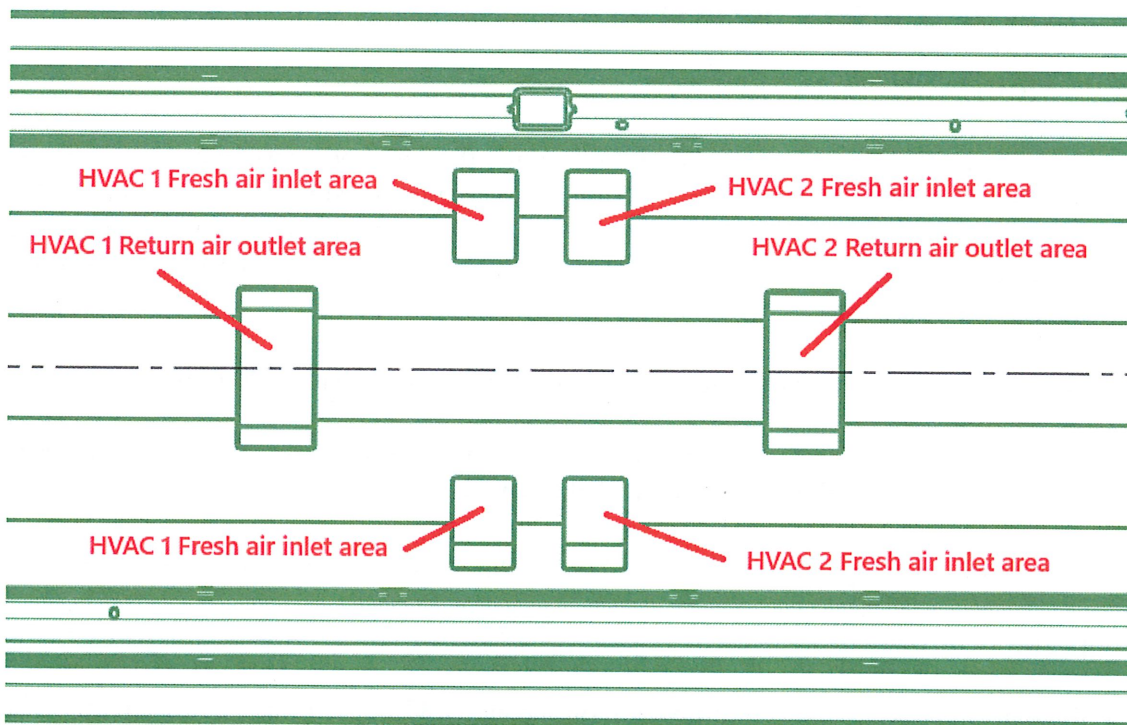


Figure 9 – Compartment HVAC preliminary inlet/outlet thought the carbody - TBD

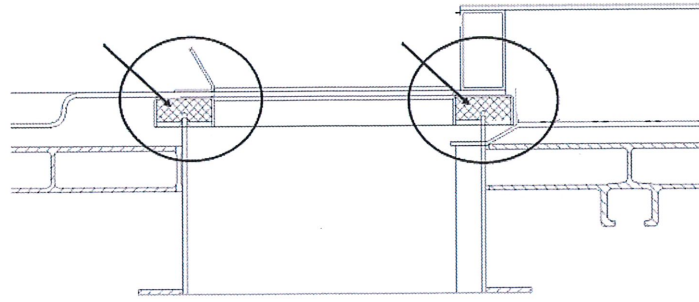


Figure 10 – HVAC gasket layout – duct interface

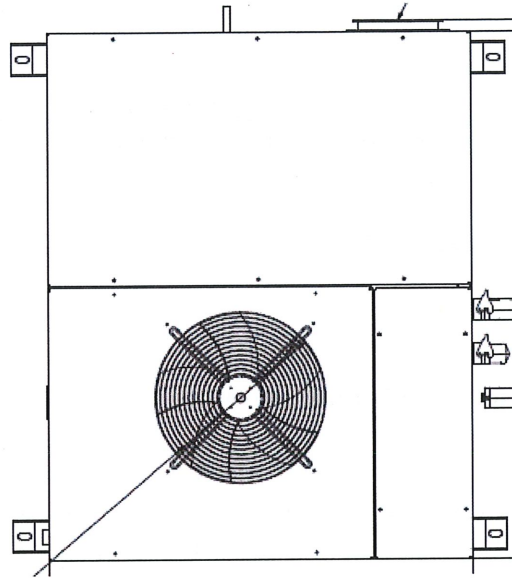


Figure 11 – HVAC Cabin Unit –TBD

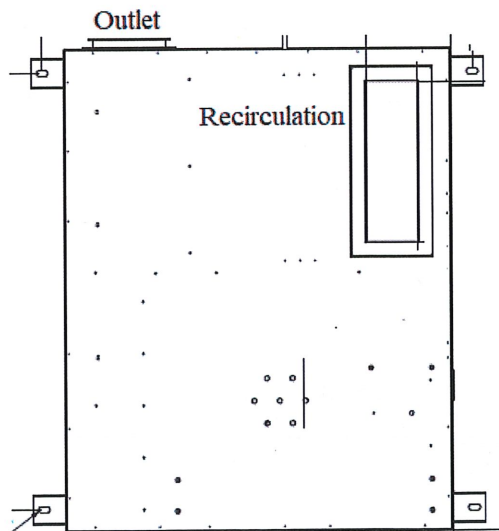


Figure 12 – HVAC Cabin Unit Duct Interface –TBD

Handwritten signature or initials in blue ink.

3.6.2 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). Supplier shall define and include into the scope of supply all the necessary connectors (male and female).

All electrical interfaces shall be compatible with the interfaces used in the vehicles previously manufactured under the Gaziray Commuter Train Set Project. Any requested modifications shall be mutually discussed and agreed upon during technical meetings between the Contractor and the Administration.

3.6.3 PNEUMATIC INTERFACE

Not applicable.

3.6.4 Digital and/or Analogue Inputs/Outputs

All digital and/or analog input/output (I/O) interfaces shall be compatible with the interfaces used in the vehicles previously manufactured under the Gaziray Commuter Train Set Project. Any requested modifications shall be mutually discussed and agreed upon during technical meetings between the Contractor and the Administration.

As preliminary 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

3.6.5 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. 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 Supplier shall provide an earthing diagram of its equipment including earthing bonds and shields.

The Supplier 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 supplier 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.

3.7 ENVIRONMENTAL CONDITIONS

3.7.1 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 and snow shall not be cause of malfunction.

General climatic conditions are reported in the mentioned TŞ-01.139 General Technical Specification.

Additionally, the equipment shall be defined in order to withstand with the following minimum environmental conditions:

Ambient temperature (continuous operation)	-25 ... +45°C
Ambient temperature (degraded mode) [*1]	+45 ... +55°C
Start-up temperature [*2]	-25 ... +70°C

*[*1] It means that equipment can reduce the performances in this range of temperature, if possible*

*[*2] Start up temperature means that the equipment, if equipped with a cooling system, shall be able to start also with +70°C, to try to reduce its temperature with the internal cooling system and so, after reaching the working temperature, start the correct functionalities*

3.7.2 Shock and Vibration

To be respected in accordance to the relevant norms.

Vibration capability modules IEC 61373 Cat1 Class B

Supplier 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 Supplier can submit FEM calculation and conformity explanation with similar products, which are in operation, instead of performing vibration test.

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

3.7.4 Noise

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 external noise in standstill condition testes in accordance with TSI NOISE 1304 2014 shall be maximum 57.5 dbA at 7.5 m.

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 65 dBA. Noise levels measured in a parked stock with active HVAC units at a height of 1.6 m from the floor anywhere within the stock shall not exceed the following values:

- When heating functions normally: 60 dBA
- When heating functions at maximum: 63 dBA
- When cooling functions normally: 63 dBA
- When cooling functions at maximum: 65 dBA

The supplier 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.

3.7.5 Fire Detection

The HVAC system must comply with the EN 45545 standard. In particular, with reference to standard EN 45545-6, paragraph 5.4.2.3.1, 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 or passenger area, to prevent the fire from spreading at higher speed. Shutdown of the HVAC unit shall be possible also manually.

3.7.6 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

3.8 SYSTEM AND COMPONENTS LIFE

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

3.9 MATERIAL REQUIREMENT

3.9.1 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 lubricants and cleaning agents.

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

The supplier shall give the list of every material used together with their offer.

3.9.2 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 train 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 train 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 referenced in 4.2c	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 9 – Material Fire Requirement

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/Supplier shall give the list of the inflammable materials used with material type, quantity and fire resistance behaviour tests.

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

3.9.3 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 train and the set of requirements R(n) to which the material is associated.

4 GENERAL REQUIREMENT

4.1 RELIABILITY, AVAILABILITY, MAINTENABILITY & SAFETY (RAMS)

The Supplier shall make RAMS analysis according to TD-GZ.28.0038 as mentioned in Annexes.

4.2 MAINTENANCE MANUAL

4.2.1 Main features of the Manual

The Supplier 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 Train).

The manual will be used as the basis for Train operation and maintenance by Final User staff. The manual shall be prepared in electronic editable format and the language UK English and Turkish.

4.2.2 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).
- 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 Supplier 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-Train overhaul
 - final functional check

The Supplier 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-Train repair
 - failure diagnosis
 - final functional check

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

Special tools

The use of special tools shall be avoided, nevertheless if they are essential for maintenance (upon Supplier and TÜRASAŞ agreement), following information shall be supplied in a dedicated section of the Maintenance Manual:

- descriptions and technical data (including SW if present)

- drawings
- 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

4.2.3 Format of the Manual

The format of the Maintenance Manual can vary according to the Company and the Final User 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.
- 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 Final User)
- 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 TÜRASAŞ and the Suppliers pending the respect of Final User requirements.

4.3 TRAINING

Comprehensive training courses, covering the system/equipment supplied, therefore shall be provided by the Supplier to TÜRASAŞ or Costumer/Train 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 Supplier 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 Supplier 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 Supplier shall give minimum 3 days training for 6 TÜRASAŞ/the End Client personnel in their own facility and also 3 days in TÜRASAŞ facility. The training documentation shall be prepared by the supplier in English and Turkish languages according to the number of participants. The training shall be done in Turkish language.

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

Then TÜRASAŞ and the Suppliers will discuss and agreed details pending on End Client requirements.

4.4 TEST

The supplier shall be responsible for TSI /1302/EU certification of HVAC Compartment and Driver and external electrical heaters.

4.4.1 INTRODUCTION TO TEST AND INSPECTION

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

TÜRASAŞ 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 Final User. In that case, the Supplier shall provide old test report or certificate to submit for approval.

All test and inspection specifications and reports including all repair activities and check-lists shall be submitted and approved by TÜRASAŞ.

4.4.1.1 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.

Supplier shall perform Type Tests according to EN 14750-2 for Compartment Unit and EN 14813-2 for Driver Unit.

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

The Supplier has the responsibility for the success of mentioned Type Tests. During testing, the criteria shall be observed and recorded in a logbook and necessary alterations, adjustments and maintenance works shall be carried out.

In the case components are already being used in similar projects or more severe conditions the Supplier 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 Supplier 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

4.4.1.2 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 Supplier shall perform routine tests in accordance with a test procedure approved by TÜRASAS under his responsibility, and, if necessary, with TÜRASAS 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 Supplier and made available timely for TÜRASAS 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 Supplier's work to be made available to TÜRASAS 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.

4.4.1.3 First Article Inspection

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

At the FAI, the Supplier shall make available all pertinent design and manufacturing process documentation, test records, material certifications, etc. Should all the requirements of the FAI not be met, then the inspection shall be considered at a Hardware Review.

Upon acceptance of the FAI by TÜRASAS and/or end client, the supplier 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 TÜRASAS and/or end client at the FAI.

4.4.2 Supplier Technical Assistance

The Supplier shall provide all the technical assistance necessary for the first installation of the system(s) at TÜRASAS.

Installation procedures and check lists shall be provided during this operation in order to be verified and validated. Details will be discussed during evolution of the project.

The Supplier shall attend to installation of equipment on the first train set, to commissioning in TÜRASAS and also to track test on Turkish Railway Network.

4.4.3 Commissioning

4.4.3.1 Type Commissioning Test

For the first train set, the Supplier shall perform static (factory test on TÜRASAS workshop) and dynamic commissioning (on track) tests for the system to adequately demonstrate the requirements of TS, in accordance with a test procedure to be prepared by the Supplier and approved by TÜRASAS, under TÜRASAS participation.

4.4.3.2 Routine Commissioning Test

On the serial train sets, routine commissioning test for HVAC Compartment and driver system will be performed by TÜRASAS in workshop and service track under the Supplier's responsibility.

4.5 WARRANTY

4.5.1 Warranty Condition

Supplier shall guarantee the quality of products within the scope of this specification against malfunctions, failures and assembly and workmanship defects.

While the warranty period is limited to 30 months starting with the date of delivery of the products to TÜRASAŞ, it is 24 months starting with the commercial commissioning of the EMU set.

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 TÜRASAŞ.

Throughout the warranty period, following the notification by TÜRASAŞ of any malfunction, the Supplier shall respond to that malfunction within three (3) working days and replace the malfunctioning parts and equipment or repair and fix the malfunction.

The Supplier shall make available in Turkey throughout the warranty period the required service facilities in order to respond to the possible malfunctions and a sufficient number of spare parts or fully complete HVAC Unit set within this time period.

4.5.2 Systematic Fault / Epidemic failure

If a failure covered by guarantee occurs during the guarantee period in more than 25% of the same parts/components, such failure shall be assumed as “epidemic failure”.

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.

4.6 ACCEPTANCE

4.6.1 Temporary Acceptance

Temporary acceptance report shall be issued by TÜRASAŞ after followings have been covered:

- All required components have been delivered.
- All documents have been delivered.
- If required, Routine tests in TÜRASAŞ have been performed successfully

4.6.2 Final Acceptance

Final acceptance report shall be issued by TÜRASAŞ after Track tests of system for first train set have been performed successfully.

4.7 PACKAGING, LABELLING AND STORAGE

4.7.1 Packaging

System/equipment/components shall be delivered in suitable packages with adequate strength to be resistant against shocks and transportation damages including effects of dust, rain, snow, solar, wind etc. in the climatic conditions foreseen by the TŞ-01.139 General Technical Specification.

Packing boxes shall be convenient for stacking one on another and shall allow easy lifting by fork-lift truck (where reasonably applicable) or travelling bridge-crane

Following information shall be reported on the package (in a legible, non-erasable and non-removable mean).

- Name, address and registered logo of the manufacturer.
- Assembly Part Number and applicable Tech. Specification reference.
- Date of manufacturing and serial number (if applicable).
- Date and number of the contract.

Furthermore, if the content of a box consists of more than one component, a components list shall be added inside and outside of the box and each individual component shall be labelled. Determination of the content of these boxes shall be performed with the participations of TÜRASAŞ. Lists of the boxes shall be finalized after approval of the lists by TÜRASAŞ. A copy of each list shall be sent to TÜRASAŞ at the beginning of the shipment.

4.7.2 Labels

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
- Supplier's part number (if any)
- Revision level;
- Company's part number (if any)

Format and positioning of all labels/markings shall be subject to approval by TÜRASAŞ. 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

4.7.3 Storage Conditions

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

4.7.4 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 Supplier to list all the necessary tools for mounting and maintenance.

4.8 DOCUMENTATION TO BE SUPPLIED TO TÜRASAŞ

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

Table 10 shows the documentation which shall be given by the Bidders in the offer phase.

Table 11 and Table 12 show the documentation which shall be provided by the Supplier 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	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
1.3	Preliminary 3D models or installation drawings showing the main external space envelope		English
1.4	Preliminary applicable schemes		Turkish and English
1.5	List of tests (FAI, routine, type, commissioning and homologation) that shall be performed on components and systems		English
1.6	IRIS Certification of the Bidder (If the Bidder is an agency of the manufacturer, the Bidder shall show the manufacturer's certificate)		English
1.9	List of special tools and test equipment		Turkish and English
1.8	Design schedule, in line with project milestones		Turkish and English
1.9	Reference list (Point 3.1 in Technical Spec.)		English
1.10	Spare part price list which is requested chapter 2.1		Turkish or English

Table 10 – Stage 1 Offer Phase: list of requested documents and due date

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	English

Id.	Stage 2 - PRELIMINARY Review	Time Schedule	Language
2.2	Technical description of the system, with system characteristics and performance	after signing the contract	English
2.3	First level schemes with definition of I/F with the train system		English
2.4	Functional description (normal and degraded mode) of the system, included diagnostic description		English
2.5	Design justification analysis reports		English
2.6	Definition and specification of applicable I/F's characteristic (mechanical, pneumatics, electrical, signals, I/O data, etc.)		English
2.7	Certificates of the fire smoke behaviour of non-metal materials and electric cables		English
2.8	Preliminary applicable analysis reports (performance, consumptions, structural strength, etc.)		English

Table 11 – Stage 2 list of requested documents and due date

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 After FAI	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	Reports of tests (FAI, routine, type, commissioning and homologation) performed on components and systems		English
3.9	LRU list		Turkish and English
3.10	Servicing and lubricating table		Turkish and English
3.11	Final documentation for Certification		Turkish and English
3.12	EC Certification according to the TSI LOC&PAS 1302 if the scope of Supply is considered "Interoperability Constituent"		English
3.13	RAMS and LCC documentation: see dedicated paragraphs		Turkish and English
3.14	User Manuals		Turkish and English
3.15	Maintenance Manuals		Turkish and English
3.16	Calculations, tests and analysis report requested by TSI for HVAC Unit System		Turkish and English
3.17	Spare Part List and Catalogue		Turkish and English

Table 12 – Stage 3 list of requested documents and due date

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

Notes:

- 3D models of all components shall be provided, shall be in ".step" format and shall be complete with all elements, connectors included. In the 3D model connectors can be separated from the model to be used for the harnessing design

- 2D drawings shall be provided in .dwg or dxf format (plus PDF).
- Electrical schemes shall be provided in .dwg or dxf format (plus PDF)..
- Other documents shall be provided in an editable format and in .pdf format.
- In the documentation, the Turkish version shall prevail in case of utilisation both Turkish and English languages.
- All documents in stage 1 shall be provided as hardcopy and softcopy in “CD” or “USB”

5 ANNEX

Annexed documents

1	TŞ-01.139	General Technical Specification
2	GZ90.03.00.00001	Equipment gauge
3	GZ90.00.00.00101	General layout
4	TD-GZ.28.0038	RAMS Analysis
5	TD-GZ.44.0152	Fire Classification Of The Unit
6	GZ90.03.00.00006	Main Section Overall Dimensions
7	GZ10.25.22.00000 GZ11.25.22.00000	SKA Car Floor Heaters Layout OA Car Floor Heaters Layout

END of DOCUMENT