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National Electrical Multiple Unit Project 225 km/h – General Technical Specification

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IV. LIST OF ACRONYMS & ABBREVIATIONS

AC	Alternating Current
ARB	Acquisition Review Board
BCU	Brake Control Unit
BP	Brake Pipe
CPU	Central Processing Unit
DC	Direct Current
DCU	Door Control Unit
DIN	Digital Input
DIS	Driver Information System
EB	Emergency Brake
ED	Electro Dynamic
EDB	Electro-Dynamic Brake
EMU	Electric Multiple Unit
EN	European Norm
ENV	European Norm Voluntary
ERTMS	European Rail Traffic Management System
ESRA	Electronic System for Railway Application
FAI	First Article Inspection
FEM	Finite Element Method
FPMK	Failure Per Million Kilometre
GPRS	General Packet Radio Service
GPS	Global Position System
HV	High Voltage
HVAC	Heating, Ventilation, & Air Conditioning
HSVB	High Speed Vacuum Breaker
I/O	Input / Output
IEC	International Electro-technical Commission
IGBT	Insulated Gate Bipolar Transistor
ISO	International Organization of Standardization
LED	Light Emitting Diode
MBP	Main Brake Pipe
MRP	Main Reservoir Pipe
MV	Multiple Vehicle
MVB	Multiple Vehicle Bus
RAMS	Reliability, Availability, Maintainability and Safety
PRM	Person with Reduced Mobility
SI	International System
ST	Standard
TBC	To be confirmed
TBD	To be defined
TCMS	Train Control & Monitoring System
TCU	Traction Control Unit
TI	Intermediate Trailer
TOR	Top of Rail
UIC	Union International Chemin de Fer
VCU	Vehicle Control Unit
WSP	Wheel Slide Protection
WTB	Wire Train Bus

1 INTRODUCTION

1.1 SUBJECT

This General Technical Specification defines the common technical requirements applicable to all systems/equipment/components installed on the National Electric Multiple Unit (225 km/h EMU) of the TÜRASAŞ

1.2 DEFINITIONS

Within this document, the following definitions are applied to the words reported below:

- “the Company” means the Turkish Railway Vehicles Industry Inc. (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.

2 STANDARDS AND REGULATIONS

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 will be SI.

To correctly address the design, punctual reference to applicable standards and regulations is done in this document and in all the Technical Specifications of systems/equipment.

Refer to the Annex 1 of present document for the list of main applicable norms with the applicable relevant version. If it is not differently specified, the applicable version of the norms mentioned in the text of the document is the one specified in Annex 1.

The applicable TSI are in the following:

- TSI RST 1302/2014 (LOC&PASS) merged with HS-RST
- TSI SRT 1303/2014 Safety in Railway Tunnels
- TSI CCS 14/2015 Control-Command and Signalling
- TSI NOI 1304/2014 Noise
- TSI PRM 1300/2014 Person with Reduced Mobility

unless otherwise specified.

The components/equipment listed in the ANNEX 4 shall be designed and tested according the TSI regulation updated as below indicated:

- Commission Implementing Regulation (EU) 2020/387 of 9 March 2020 amending Regulations (EU) No 321/2013, (EU) No 1302/2014 and (EU) 2016/919
- Commission Implementing Regulation (EU) 2019/776 of 16 May 2019 amending Commission Regulations (EU) No 321/2013, (EU) No 1299/2014, (EU) No 1301/2014, (EU) No 1302/2014, (EU) No 1303/2014 and (EU) 2016/919 and Commission Implementing Decision 2011/665/EU
- Commission Implementing Regulation (EU) 2019/774 of 16 May 2019 amending Regulation (EU) No 1304/2014
- Commission Implementing Regulation (EU) 2019/772 of 16 May 2019 amending Regulation (EU) No 1300/2014
- TSI RST 1302/2014 (LOC&PASS) not amended parts
- TSI SRT 1303/2014 (Safety in Railway Tunnels) not amended parts
- TSI NOI 1304/2014 (Noise) not amended parts
- TSI PRM 1300/2014 (Person with Reduced Mobility) not amended parts
- TSI CCS (EU) 2016/919 (Control-command and signaling) not amended parts
- CSM 2015/1136 (EU)

3 ENVIRONMENT

Each EMU shall be capable of continuous operation within the full range of ambient and environmental conditions which will be encountered in service as specified hereafter.

3.1 CLIMATIC CONDITION (EQUIPMENT)

The European Standard EN 50125-1 “Railway applications - Environmental conditions for equipment - Equipment on board rolling stock” shall be taken as reference for conception of all equipment installed on the vehicle. The climatic zone is the ranked “T3”

Table 1 collects main data while following paragraphs describe in detail the data reference.

Max. temperature inside of the coach	+ 55 °C
Max. external temperature	+ 45 °C
Min. internal/external temperature	- 25 °C
Max. internal cubicles temperature	+ 70 °C
Min. internal cubicles temperature	- 25 °C
Max wind speed	35 m/s
Exceptionally max wind speed	50 m/s
rain– rate	6 mm/min
max. external humidity– (average)	75 %
direct solar radiation on external– equip.	1120 W/m ²

Table 1 – Climatic conditions summary

All the components shall be able to ensure the service of the train-set whatever the external conditions may be. Moreover, they shall be designed so as not to abnormally degrade due to bad weather.

Each EMU shall be resistant to the effects of exposure to salt water spray.

Exposure to salt water spray shall not cause excessive corrosion or degradation of exposed surfaces, components and equipment.

Each EMU exterior, when all doors and windows are closed, shall prevent the ingress of snow, rain, wash plant spray, draughts, dust and leaves under all environmental conditions.

In the vicinity of externally opening windows and doors, all controls, equipment and enclosures shall be designed to ensure continued operation with no adverse effects of local ingress of water, dust, snow and leaves.

Each EMU shall be capable of operating normally through snow or flood water, up to the maximum depths for normal operation and thereafter (subject to speed restriction) up to the absolute maximum depths for operation, as established by the Train Operator

3.2 PASSENGER AND CREW CLIMATIC COMFORT

The following standards are applicable for passengers and crew climatic comfort:

- EN 13129-1 “Railway Applications – Air conditioning for main line rolling stock – Part 1 Comfort parameters”
- EN 14813-1 “Railway Applications – Air conditioning for driving cab – Part 1 Comfort parameters”

3.3 ALTITUDE

Max altitude for service is 1000 m above sea level (as per EN 50125-1 § 4.2 class A 2).

3.4 QUICK TEMPERATURE VARIATIONS

The considered quick outside temperature variations are of 3°C per second, with a maximum variation of 40°C, in accordance with paragraph 4.4 of standard EN 50125-1.

3.5 MAXIMUM PRECIPITATION (RAIN, SNOW, BLACK ICE)

Precipitation, rain: 6 mm/min, as per EN 60721-3-5 class 5 K3.

To complete the indications in paragraph 4.6 and 4.7 of standard EN 50125-1, the following shall be considered for more severe condition of snow, ice and hail according to TSI RST (LOC&PASS) LOC&PAS § 4.2.6.1.2 (3):

- Snowdrift (light snow with low water equivalent content), covering the track up to 80 cm continuously above top rail level.
- Powder snow, snowfall of large quantities of light snow with low water equivalent content. — Temperature gradient, temperature and humidity variation during one single run causing ice build-ups on the rolling stock.
- Combined effect with low temperature according to the temperature zone chosen as defined in clause 4.2.6.1.1.

To supplement the paragraph 4.8 of standard EN 50125-1, ice formation likely to occur on the stock or equipment, in temperatures under 0°C, shall not lead to any degradation prejudicial to the stock's or equipment's operation and to its utilisation (the nominal performances are to be maintained).

3.6 WINDS

Wind speeds to be considered shall be those defined in paragraph 4.5 of standard EN 50125-1.

Max wind speed: 35⁽¹⁾ m/s

- (1) = Exceptionally up to 50 m/s – in this condition equipment and/or vehicle performances may be temporarily affected, but not permanent damage shall occur.

Cross wind assessment in railway is described in EN 14067-6.

3.7 SUNLIGHT / EXPOSURE

The stock shall meet requirements laid down in paragraph 4.9 of standard EN 50125-1.

In addition, all trainset equipment shall be protected from ultraviolet rays (UV).

Maximum exposure period to the sun is 8 (eight) hours.

3.8 POLLUTION

Along with the weather conditions, it is necessary to take into account the solid and gas pollutants in ambient air.

Regarding above listed items, following standards shall be considered (only for polluting substances):

- Gas pollutants: the levels defined by the class 5C2 of standard EN 60721-3-5.
- Pollutant fluids: EN 60721-3-5 Class 5F2 (electric power motor) and EN 60721-3-5 Class 5F3 (thermal motor).
- Active biological substances: EN 60721-3-5 Class 5B2.
- Dust: EN 60721-3-5:1997 Class 5S2.
- Other: EN 60721-3-5:1997.
- Marine ambient: EN 60721-3-5:1997 Class 5C2.

3.9 TRAIN STORAGE CONDITIONS

The train could eventually be stored outside and uncovered for several weeks under the weather conditions described above. The Supplier shall clearly indicate the precautions to be taken, as well as the procedures to be followed.

3.10 CLEANING

The EMU and its equipment shall be studied and designed so as to be efficiently protected against corrosion. Special measures shall be taken to avoid any electrolytic corrosion (different-nature metal materials in contact with each other).

Outside cleaning shall be made either through a washing machine, or manually.

All the measures shall be taken to avoid water retention after washing.

The carbody shell, as well as the exterior elements such as access doors, gangways, fairings, boxes, hatches, windows, must not lead to any deterioration of the equipment, nor of the washing machine (bristles being pulled out).

It shall clearly indicate whether precautions are to be taken in order not to damage EMU's equipment and its components.

Specific objectives regarding the cleanability, if any, are clearly indicated in the technical specification of the concerned equipment.

For elements in contrasting colours as per TSI PRM requirements (access, gripping elements,...), these shall have a service of life of at least 5 years.

3.11 AERODYNAMIC LOADS & SEALING AGAINST PRESSURE WAVES

Operating speed of the national EMU trainset is 225 km/h. The EMU will run in high speed railway networks including tunnels. Aerodynamic loads and pressure variations due to the crossing with another train in tunnel or open track shall be accounted during the design of the trainset and all the equipment which are mounted to trainset.

The aerodynamic load shall be in according UIC 660: 2002, par 4.5.4: 280 km/h: +3000 Pa – 5100 Pa

The Sealing requirements shall be in according

- UIC 660 4.6.2.1, applicable limit values at maximum speed, in passenger compartment for comfort
- UIC 660 4.6.4, applicable to components that are equipped with active sealing systems. Passive sealing systems shall be proposed by suppliers for components. Active sealing systems can be proposed by the supplier only if deemed as strictly necessary for technical reasons. The acceptance of active sealing systems is under Company scope.
- UIC 651 2.9.1, applicable limit values in driver cab

4 EMU MISSION PROFILE AND TRACK LINES CHARACTERISTIC

4.1 MISSION PROFILE

In the following tables are reported the EMU foreseen mission for the two versions Intercity and Regional:

EMU “Intercity” (8 car configuration)		
Yearly mileage	420000	km/year
Operating days per year (90%)	328	day/year
Daily average time under power	16	hrs/day
Daily average running time	14	hrs/day
Daily average mileage	1.280	km/day
Average speed (powered -up time)	80	kph
Average speed (running time)	91	kph
Yearly time under power	5248	h/year
Yearly running time	4592	h/year
Operating days per month	27	day/month
Train service life	30	years
Maximum Speed	225	kph

Table 2 – EMU Intercity version mission profile

4.2 TRACK INFORMATION

4.2.1 Minimum Radius

The following prescriptions for minimum radius are applicable:

- Single Car: 80 m
- Train Set
 - Depot: 100 m
 - Service Line: 150 m

4.2.2 Track and circulation characteristics

Concerning other information about track curves and circulation characteristics not explicitly mentioned in this document, refer to UIC 527-1 “Coaches, vans and wagons – Dimensions of buffer heads – Track layout in S-curve”

4.2.3 Applicable Routes

The following routes are to be accounted for train-set performance evaluation.

	GEBZE- ALİFUATPAŞA	GEBZE-HALKALI	POLATLI- KONYA
Data start	km 0	km 0	km 0
Data end	km 112+574.00	km 76+813.00	km 213+032
Distance	km 112	km 76	km 213
Delta Altitude	85m	101	393m
Max slope	13.22 ‰	18 ‰	16.03 ‰
Curves' data	ND	ND	ND
Speed limits	250 km/h	100 km/h	250 km/h
Stations	4	6	2

Table 3 – Routes Characteristics

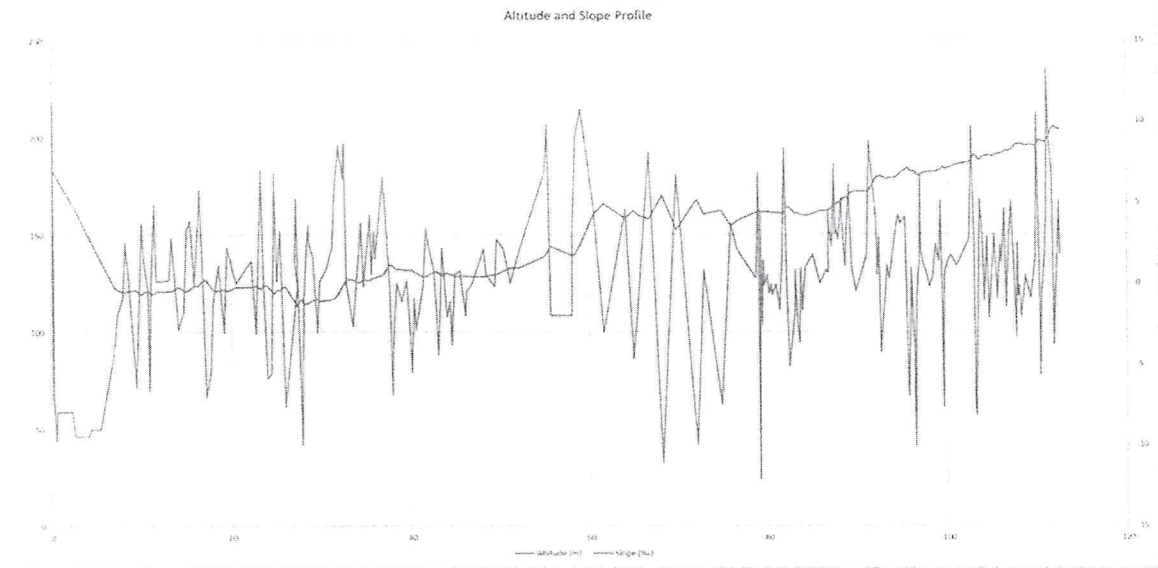


Figure 1 – GEBZE-ALİFUATPAŞA route – altitude profile

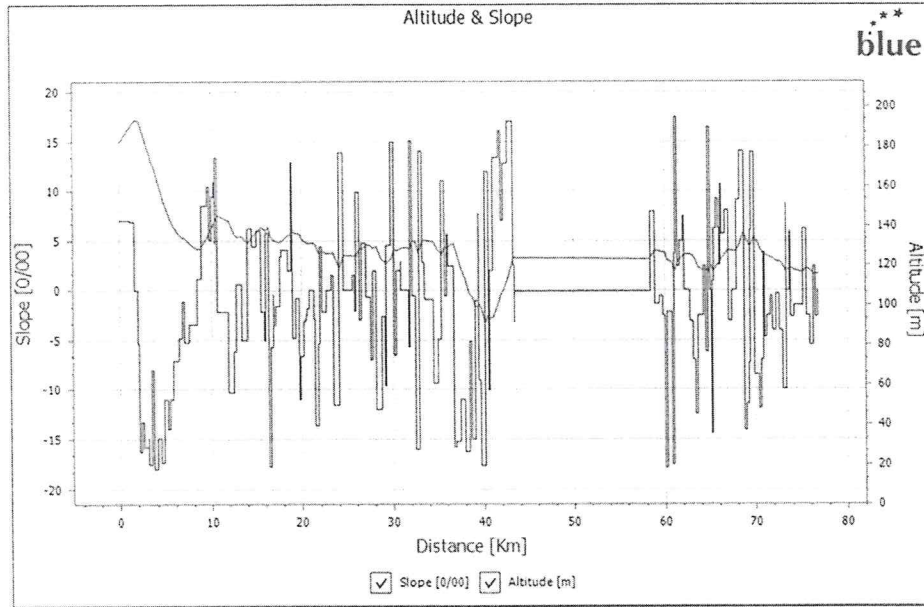


Figure 2 – GEBZE-HALKALI route – altitude profile

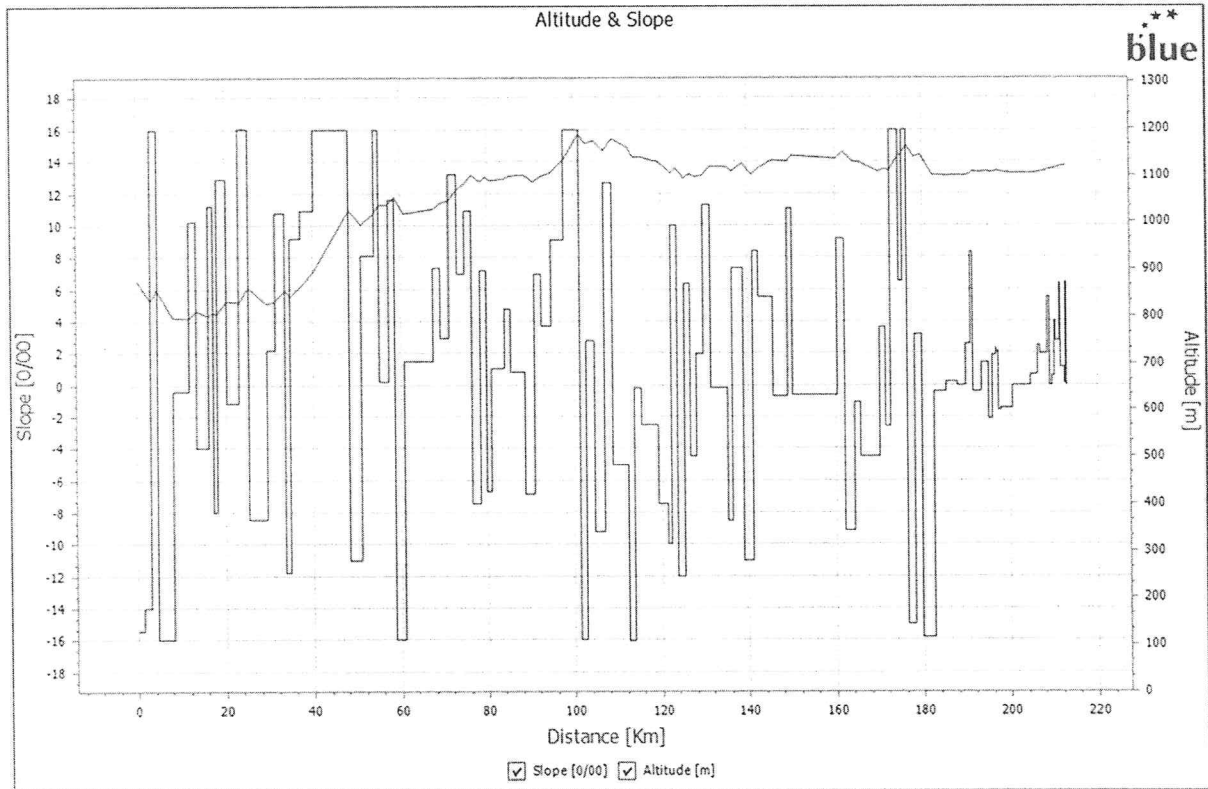


Figure 3 – POLATLI-KONYA route – altitude profile

More details of routes for calculation are available in Excel format.

4.3 GAUGES

The following gauges are applicable for the body:

- track gauge is 1435 mm
- Static Gauge: TCDD Gauge (TCDD document 39994863-408.99-E.24476)
- Kinematic gauge: EN15273-1 G2.

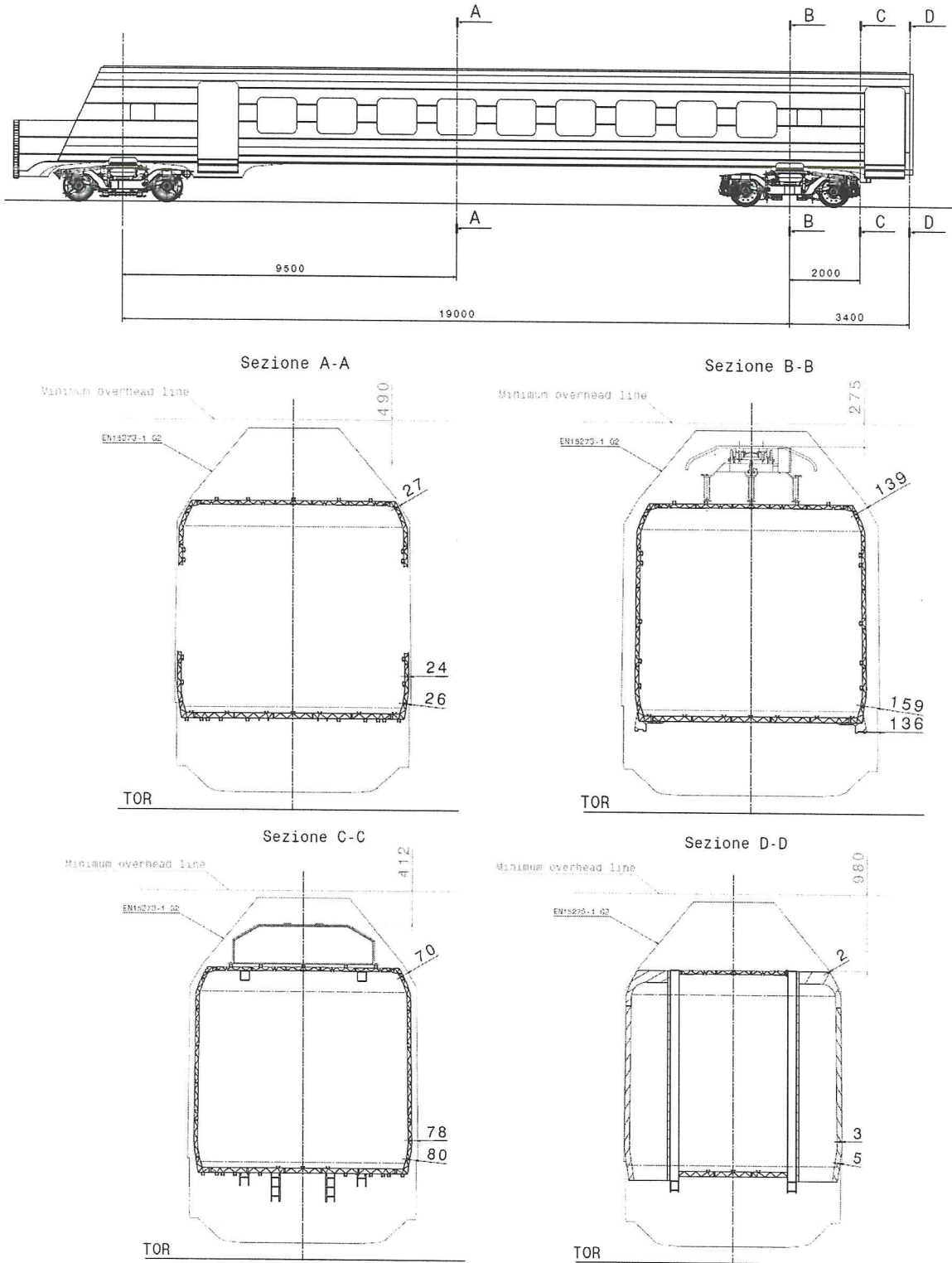
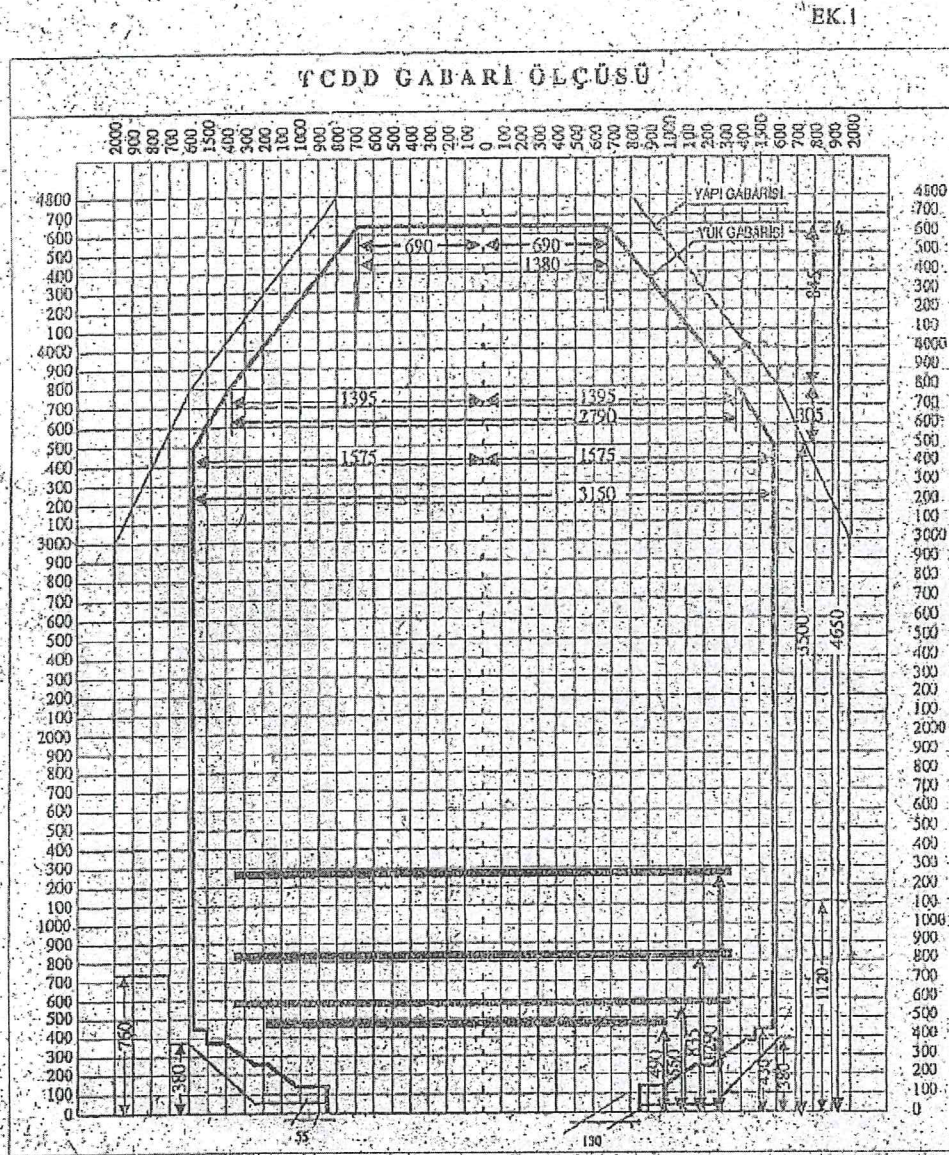


Figure 4 – Kinematic Gauge Verification

The following gauge is applicable as low gauge for the bogie:

- Static Gauge: TCDD Gauge (see following TCDD picture dated on 8.3.1999)
- Kinematic gauge: EN15273-1 GIC2.



- TCDD hatlarında bu gabari uygulanır.
- Kapıkule-Edirne arası için EK.2'ye bakınız.
- Edirne-Halkalı arası için EK.3'e bakınız.
- Van-Kapıköy arası için EK.4'de bakınız.

Figure 5 – TCDD applicable static low gauge

5 EMU BASIC REQUIREMENTS

5.1 EMU CONFIGURATIONS

The Electric Multiple Unit (EMU) will be built in one configuration of 8 cars.

Intercity EMU is composed by:

- SKA1+OA1+OA1+OA4+OA1+OA2+OA3+SKA2

The types of car are listed hereafter:

- SKA1 = Leading car with driver cab and standard toilet
- SKA2 = Leading car (enlarged passengers seats) with the driver cab and standard toilet
- OA1 = Intermediate car with a "Alaturca" standard toilet
- OA2 = Intermediate car with a standard toilet and a bistro point
- OA3 = Intermediate car with universal toilet, a food vending machine point, a Person with Reduced Mobility (PRM) area and two PRM lift devices nearby
- OA4 = Intermediate car with a standard toilet

The EMU train-set is a fixed configuration train and therefore the position and orientation of the different type of cars is fixed as well.

5.1.1 8 CAR Train-set dimensions

In the following table are reported the principal dimensions of the 8 car Intercity EMU:

ITEM	DIMENSION [mm]
Train set length over coupler	214860
End car (SKA) length over couplers	27630
Intermediate car (AO) length over couplers	26600
Total width	2825
Roof height of car body from top of rail	3770
Total height over equipment (above rail level)	4475
Floor Height (above rail level)	1250
Nominal clear height inside cars	2200
Coupler height in cab ends (above rail level)	1040
Coupler height in intermediate ends (above rail level)	940
Wheel Diameter (new/worn)	870/790
Bogie centre distance	19000
Track gauge	1435

Table 4 – Train set main dimensions of 8 car Inter-city EMU

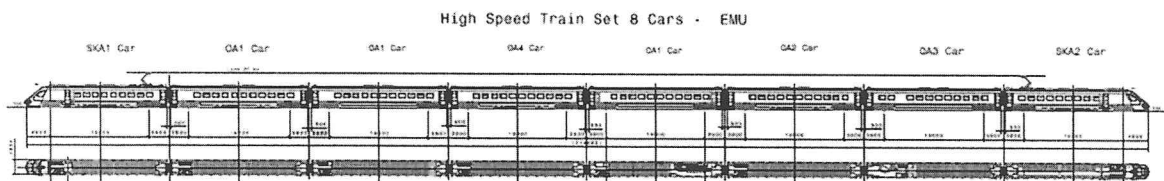


Figure 6 – 8 car Intercity EMU layout

5.2 EMU CAPACITY

The required capability shall be:

Train set Passenger	Coaches	NL	EL stand 4p/m2	Total Capacity
Train set car 8-INTERCITY -	SKA1+OA1++OA1+OA4+OA1+OA2+OA3+SKA2	582	568	1150

Table 5 – Passenger capacity 8 car composition

5.3 AXLE LOAD

The maximum allowed axle load is 18 t.

5.4 EMU CAR MASSES

EMU cars masses shall respect the allowed axle load.

A preliminary mass evaluation for each car (WO, NL, EL conditions) is reported for information in the following table.

Every systems/equipment shall respect the established weight target reported in the Technical specifications.

5.4.1 EMU Mass Tables

In the following the EMU preliminary masses are depicted per car, per train-set and per axle.

Train set	Coaches	WO [Kg]	NL [Kg]	EL [Kg]
Train set car 8-INTERCITY -	SKA1+OA1++OA1+OA4+OA1+OA2+OA3+SKA2	426933	475029	521109

Table 6 – EMU train-set Masses

AXLE LOAD (single axle)	SKA1		OA1		OA2		OA3		SKA2		OA4	
	Trailer Bogie	Motor Bogie	Trailer Bogie	Motor Bogie	Trailer Bogie	Motor Bogie	Trailer Bogie	Motor Bogie	Trailer Bogie	Motor Bogie	Trailer Bogie	Motor Bogie
WO [Kg]	15263	14125	12449	12598	13314	14661	12432	12488	15085	13777	13295	13887
NL [Kg]	16387	15977	14141	14522	14784	15366	13310	14265	15834	14964	14994	15644
EL [Kg]	17495	17430	15531	15851	16154	16557	15794	15781	17117	16721	16384	16974

Table 7 – Axle Loads

SECONDARY LOAD (total on bogie)	SKA1		OA1		OA2		OA3		SKA2		OA4	
	Trailer Bogie	Motor Bogie	Trailer Bogie	Motor Bogie	Trailer Bogie	Motor Bogie	Trailer Bogie	Motor Bogie	Trailer Bogie	Motor Bogie	Trailer Bogie	Motor Bogie
WO [Kg]	23592	19535	17963	16480	19692	20607	17928	16260	23235	18839	19745	19240
NL [Kg]	25840	23239	21347	20328	22633	22018	19685	19816	24734	21213	23053	22574
EL [Kg]	28055	26144	24127	22988	25372	24398	24653	22847	27299	24728	25233	25233

Table 8 – Secondary suspensions loads

5.4.2 Weight and Installation Requirement

The weights, as defined into relevant sections in the dedicated technical specification of the components, shall include also the necessary mechanical interfaces and elements as required below:

- For external equipment, Suppliers shall consider all the components need to be supplied complete with all the mechanical interfaces necessary to be fixed to the available “C-slots” as defined in the drawing EM90.03.00.00005 Main Section Overall Dimensions.
- In case, on the roof, the 2 available “C-slots” will not be enough (as in case the component to be installed is very small and cannot be fixed using the 2 available “C-slots”) it will be welded only another “C-slots” (the same type already available) in a position based on the supplier requirement. In case of multiple components to be supplied, the Supplier shall guarantee homogeneity between the methodologies of installation of the components, to avoid necessity to considered different new “C-slots” to be welded.
- 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.

5.5 FLOOR HEIGHT

The floor height is fixed in 1250 mm from top of rail.

5.6 INTERCAR GANGWAYS

Gangway are be used to allow passenger transit between two adjacent vehicles
The centre line of the gangway shall be coincident with cars centre line.



Figure 7 – Gangway Disposition

The gangway shall provide a safe passageway, free from protrusions, finger traps and tripping hazards, for passengers and crew, under all operating conditions.

5.7 COUPLING

5.7.1 Front vehicle head coupler (automatic)

The automatic coupler shall be of Type 10. The following train connections shall be ensured through automatic couplers:

- - b/w two EMU's: pneumatic + mechanical + electrical LV signals (no LV/MV/HV power)
- - b/w and other different EMU's: only pneumatic and mechanical, no electrical

Moreover, it has to be considered the relative rescue coupler that enables the hauling and propelling of a failed train unit or train-set by another vehicle, equipped with different coupling design (i.e. UIC draw hook).

5.7.2 Semi-permanent coupler (between cars)

The semi-permanent coupler, as a fixed coupler, links two intermediate cars of the EMU.

The tractive and compressive loads are transmitted from one car to the next car through two semi-permanent coupler halves. Coupling and uncoupling operation are completely manual.

5.8 RESCUE

In emergency condition the EMU shall be in condition to be hauled by using the universal operator's hauling coupling tool.

6 EMU PERFORMANCE

6.1 EMU POWER SUPPLY AND USED VOLTAGE

6.1.1 Overhead Line characteristics

Following Table 9 reports the line Power Supply System characteristics.

Type of Power Supply System	25.000 V ac 50Hz
Nominal voltage	25.000 V (EN 50163)
Minimum working voltage	19.000 V
Maximum working voltage	27.500 V
Minimum abnormal voltage	17.500 V
Maximum Instantaneous Abnormal Voltage (10 s)	30.000 V
Maximum Distance between TOR from contact wire	6200 mm
Minimum Distance between TOR from contact wire	4750 mm

Table 9 – Line Power Supply System Characteristics

6.1.2 Operational Characteristics

Used voltages on train are:

- HV (High Voltage) 25.000 V ac
- MV (Medium Voltage) 400 Vac, 3p 50 Hz
- LV (Low Voltage) 110 V dc

6.1.3 Pantograph widths admitted in reference track lines

There are two pantographs in all train configurations and pantograph width shall be 1600 mm. The pantograph shall be compatible to a current collector arc of 1950 mm.

6.2 TRACTION PERFORMANCE REQUIREMENTS

The requirements concerning the traction performance are listed in the following.

1. Nominal Continuous Traction Power shall be defined according to UIC 614
2. The minimum traction «nominal» power shall be :
 - 342 kW at wheel
3. The Traction Power Package shall allow to all EMU configurations the following performance:
 - Payload applied: EL
 - Maximum Service Speed: 225 km/h @ 0 ‰
 - Minimum Design Speed: -225 km/h @ 0 ‰
 - Minimum residual acceleration (225 km/h): 0.05 m/s²
 - Maximum adhesion limit: 25% (Service Mass)
4. The braking Power Demand shall be defined for the following requirements:

- Payload applied: EL
 - Average deceleration: 1 m/s²
 - Adhesion limit: 15 %
5. The following route shall be taken into account for Traction and Braking Systems design:
- Gebze-Alifuatpaşa
 - Gebze-Halkali
 - Polatli-Konya
6. For tender proposals the bidder shall perform traction calculation applying the following:
- Equivalent rotating mass Trailer/Motor bogie: 1760/1550 kg
- $$\text{Resistance [kN]} = 6.4 * \text{Mass} + 129 * \text{AxisNumber} + 0.091 * \text{Mass} * \text{Speed} + CX * \text{FluidDensity} * \text{FrontArea} * (\text{Speed} / 3.6)^2$$

Where Mass in ton

- Speed in km/h
- FrontArea in m²
- CX dimensionless
- FluidDensity in Kg/m³

The supplier shall validate the proposed traction performance during the detail design phase by considering the final train characteristics.

6.3 EMU BRAKING PERFORMANCE REQUIREMENTS

The EMU train-set shall be provided with:

- ED: Electro Dynamic (Regenerative)
- EP: Electro Pneumatic
- UIC Pneumatic (indirect or automatic brake)
- Parking Brake (spring applied and pneumatic released)

Braking performances are considered in Exceptional Load (all people seated + 4 passengers per square meter).

6.4 OPERATIONAL CONFIGURATION

6.4.1 Operational Configuration Times

The operational departure time is used to verify the capability of the train during service to restart after a complete system shut off excluding the case of critical failures (Note: this time is not the time needed to put in service the train from depot that includes the preparation tests).

Each EMU shall have an operational departure time of no more than 5 minutes including any time required to set up cab systems such as the passenger information system.

Each EMU shall be capable of reversing at terminating stations and sidings, both involving changing of driving position to the opposite end of the Unit, in no more than 10 minutes excluding door open/close times and any walking time between ends.

To meet the specified targets for minimising service interruptions, the EMU design shall provide the driver with the capability to reset any system which could affect the start-up or reversing of a unit in normal service and to the achievement of rapid recovery from faults.

Resetting of EMU control and other systems shall be achievable from the operating cab.

6.4.2 Operational Modes

7 Stabling

Vehicle stabled, battery power off, no compressed air, parking brakes applied.

8 Normal operation

Battery power on, one driver's cab activated, all functions are available. The unit can either operate alone, in multiple units as a master or in multiple units as a slave.

9 Parking mode

The trainset is ready for operation, with minimum energy consumption.

The vehicle is in the following state: parking brakes applied, HVAC in operation in an energy saving mode, traction is inhibited, doors can be operated and train-sets can be coupled.

10 Change of driving cab

The change of cab mode is identical with the parking mode with the exception that the traction motors remain on at idle speed and the HVAC equipment remains in normal operation (instead of energy saving mode).

11 Operation as a driving trailer

In the case that an EMU cannot perform traction it must be possible to use another EMU as a driving trailer.

As long as auxiliary power for air conditioning is available, the train can remain fully operational (with passengers).

The capacity of the battery must be dimensioned in order to allow such driving trailer operation during 90 minutes without charging of the battery.

12 Towing

It must be possible to tow the EMU using another traction vehicle, i.e. the pneumatic brakes of the EMU are controlled by the main brake pipe and the spring loaded parking brakes of the EMU must be released.

12.1 CAPACITIES BETWEEN SERVICING

Some systems installed in the EMU will require regular servicing, such as toilets and clean water supplies. The capacity of these systems influences the servicing intervals and thus the maintenance costs, whilst also influencing vehicle weight.

The train design shall seek solutions which maximize the intervals between servicing, whilst not adversely affecting the mass of the train or requiring excessive storage capacity.

For purposes of design and servicing planning, the maximum daily utilization shall be taken as reported by the Mission Profile reported in this document.

13 RELIABILITY AND SAFETY¹

13.1 RELIABILITY

13.1.1 Design for Reliability

It is expected that the EMU train-set design incorporates appropriate system functions, levels of redundancy and degraded modes of operation to achieve the reliability outputs expected by the Train Operator.

Where the system design incorporates component redundancy as method of reducing the consequences of single point failure, such redundancy does not allow hidden faults to remain undetected.

Each EMU train-set shall have the ability to be moved with an onboard failure to the next station where passengers can be detrained except where the failure is of a major mechanical component.

The EMU shall be fitted with self-monitoring diagnostic equipment that will advise the driver and eventually ground based operations and maintenance staff on failures of any car subsystem.

The EMU design shall minimize the risk of complete train-set pneumatic and mechanical brake system out of service due to loss or lack of air.

In particular, vulnerable air pipes, valves, cocks and other equipment shall be protected from trackside damage and isolation cocks shall be strategically located to allow isolation of leaking sections to prevent complete fault of pneumatic system.

The EMU traction system shall redistribute the available power amongst the remaining operational traction sub systems, within the system limits, in the event of one or more traction subsystem failures, so that the impact on performance is minimized.

The same concept will be applied in case of failure of auxiliary converters and battery chargers.

13.1.2 Failure Classification

The proposed classification of failure rates reported hereafter helps to identify the type of failure, and to define relevant Reliability targets to be allocated to Suppliers systems/equipment/components.

Level A failure rate

It is intended as "Level A failures" all failures which interrupts the "Completion of a Scheduled train Course" and require the hauling of the train with passenger transfer.

Level B failure rate

It is intended as "Level B failures" all failures which cause an "immediate or at the Next Station Passenger Transfer" and train comes back to the depot in degraded mode condition (light running).

Level C failure rate

¹ For more details see Annex 3

It is intended as "Level C failures" all failures which cause a "Delay of the train" for a duration exceeding 5 minutes during the service.

Level D failure rate

It is intended as "Level D failures" all failures which cause an interruption of "Completion of a Scheduled train Course" and require an "End of Course" return of train to the depot.

Level E failure rate

It is intended as "Level E failures" all failures which do not affect the time-keeping of scheduled train course, but which requires corrective maintenance either by earliest possible withdrawal of a train from service or by deferral to a more convenient time (unscheduled maintenance intervention)

The inherent reliability failure rates are the basis for the evaluation of Corrective Maintenance, while the Service Affecting Failures (SAF) alias critical failures, alias mission failures, give indication how systems/equipment/components can affect the revenue service.

Failures belonging to categories A, B, C, D are the SAFs, while the Category E includes the inherent failure rate.

13.1.3 Not Chargeable Failures

The calculation of the Reliability failures does not include the unreliability due to failures of the EMU which are not directly caused by systems/equipment failure as:

- Repeated same failure due to same cause will be charged once in the calculation, if the involved part has not been yet substituted promptly;
- Consequential failure due to another failure (secondary failure);
- Failure due do accident or vandalism, by proven infrastructure defects and by other 3rd parties, e.g. suicide damaging a vehicles are excluded
- Failure due to improper action of driver or operator;
- Failure due to not respecting maintenance manual;
- Failure due to completion of service life of a component and train-set operator failed to respect the required action specified in the maintenance manual.
- Failure due to public action or careless omission like forgetting to oil
- Failure due to the equipment out of the supply contract.

13.1.4 Systematic Fault

Systematic faults are considered the identical failure on a part/component which occurs on identical parts/components with the same function on the EMU's fleet with the following occurrence:

- Number of part/component in each train 1 to 4 = 10%
- Number of part/component in each train 5 to 10 = 8%
- Number of part/component in each train >10 = 4%

The records of failure are done within 24 months starting from the commercial commissioning of the EMU set, after an initial period of fault debugging (infant mortality period). The fleet is assumed to be composed by 10 trains.

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.

13.1.5 Interchangeability

Exchange capability of the parts and mechanical assemblies shall be assured by mean of following listed ways:

- the use of machining taken from the ISO limits-and-fits systems
- the use of limit gauging for the checking of tolerance dimensions
- the use of ISO threading system

It is intended that the Suppliers shall be responsible for the standardization of all small equipment, materials, and devices for the work and they shall arrange and perform the necessary coordination work with their subcontractors for the same task.

All like parts shall be fully interchangeable with no necessity of modification or adjustment.

All systems, equipment, parts and elements of mass production shall be standardized. All equipment shall be interchangeable in separated parts.

Such items for equipment, parts and elements include, but limited to the following:

- Motors;
- Pumps;
- Flanges;
- Fasteners;
- Valves and Flow meters;
- Gauge and Detectors;
- Electrical Instruments and Measuring Devices;
- Terminals and Terminal Boxes;
- Contactors, Fuses and Switches;
- Lamps, Bulbs, Sockets, plugs, push Buttons, etc
- Lubricants.

13.2 SAFETY

13.2.1 Safety General Overview

The provision of a safe, secure and pleasant environment in which passengers travel in safety and comfort is an essential objective.

Safety is defined as freedom from unacceptable risks or harms, i.e. from these conditions that can cause death, injury, occupational illness or damage to or loss of equipment or property.

Safety performance shall be assessed by a dedicated approach following the methodology of the mentioned standard EN 50126.

A program based on EN 50126 methodology shall be part of the RAMS Plan describing the Safety policy to follow during the evolution of the project including a management process for identifying and resolving hazards, certification prior to revenue service, and timely investigation, analysis and reporting of accidents and incidents.

Reference to Safety-related standards shall be also kept into account considering: following norms where applicable as already stated:

- IEC 61508 - Functional safety of electrical/electronic/programmable electronic safety-related systems
- EN 50128 - Railway applications – Software for railway control and protection system
- EN 50129 Railway applications. Communication and processing systems. Safety related electronic systems for signalling

The design of the interior body-side windows and glazed surfaces shall optimise passenger safety in all foreseeable circumstances.

All interior areas of the EMU which facilitate standing or walking passengers shall be fitted with appropriate means of support to maximise the safety of passengers in all normal and emergency modes of operation.

Appropriate signage solutions should be utilised to ensure that luggage is stowed in complete safe manner, in accordance with the Train Operator's requirements.

The door system shall provide an optimised method of obstruction detection that ensures the safety of boarding and alighting passengers.

The access door must incorporate an opening and closing system which guarantees passenger safety.

Emergency exits must be provided and indicated.

An emergency lighting system of sufficient intensity and duration is compulsory on board vehicle. The EMU must be equipped with a public address system which provides a means of communication to the public from on-board staff.

In the event of danger, devices must enable passengers to inform the driver and accompanying staff to contact him.

Each area intended for passengers (with the exception of toilets) shall be equipped with a clearly visible and indicated alarm device to inform the driver in the event of danger.

13.2.2 Active Safety Requirements

The active safety shall be achieved by the implementations of specific design provisions that are reported by relevant Technical Specifications of EMU systems/equipment and components, applying relevant standards and regulations.

Specific safety care in design shall be applied to:

- Braking System
- Passenger entrance door
- Passenger Alarm System
- Dead Man Device
- External Lighting System
- Emergency Lighting System
- Emergency Communication System
- Fire Detection System
- Train Safety Loop

- Signalling (on board devices)

13.2.3 Passive Safety Requirements

The passive safety shall be achieved by the implementations of specific design provisions that are reported by relevant Technical Specifications of EMU systems/equipment and components, applying relevant standards and regulations.

Specific safety care in design shall be applied to different systems equipment functions

- Car-body structure about resistance to compression, vertical load and crash (energy absorption of collision)
- EMU dynamic behaviour (against derailment and/or overturning as worst case and passenger comfort as normal characteristic)
- EMU's external body parts and fittings about harms to travellers and pedestrians
- EMU's interiors about potentials harms to passengers
- Guard iron
- Event Data Recorder
- Driver Cab protection and Driving Desk layout
- Resistance to vandalism acts and aggressions

13.2.4 Fire Safety

The EMU could operate in tunnel sections and the approach to the design, in respect of fire risk mitigation and management, shall reflect that and demonstrate an appropriate level of safety through the application of appropriate fire engineering techniques.

Therefore EMU shall comply with the Safety in Railway Tunnels Technical Standard for Interoperability 1303/2014 and meet the specific requirements of fire safety category A.

The EMU shall include systems capable of controlling the air flow in and out of the vehicle to minimise the effects of smoke and toxic fumes on the safety of passengers and crew, ensuring that their ability to escape is not impaired. Installed systems shall also be required to provide alarm information to the driver to assist in the management of fire incidents.

The walls, floor and roof construction of the cars shall be designed and manufactured to have sufficient resistance to fire penetration by an external fire to car interior for a period consistent with the safe evacuation of all passenger in full load condition according to the applicable requirements.

Interiors material and furniture installed in the car shall have sufficient resistance to fire propagation for a period consistent with the safe evacuation of a full load passenger's condition.

14 EMU FUNCTIONS

14.1 NOISE

The noise of the train-set shall be measured on good quality track in order to comply with the requirements of TSI standard “Interoperability of the trans-European conventional rail system”:

- The measurement of interior noise shall be made according to EN ISO 3381
- The measurement of exterior noise shall be made according to EN ISO 3095

INTERNAL - Stationary train (4)		Maximum Level [dB(A)]
Passengers saloon		≤ 65 (1)
Cabins (close to driver ear)		≤ 68 (1)
Cabins acoustic alarm		≤ 95 (1)
INTERNAL - Running train (4)		
Passengers saloon		≤ 75 (3)
Passengers saloon tunnel		≤ 82 (3)
Cabins (close to driver ear)		≤ 78 (3)
Cabin tunnel		≤ 82 (3)
EXTERNAL - Stationary train		
distance: 7.5 m from track axis, 1,2 m ± 0,2 m above TOR level		≤ 68 (1)
distance: 1.8 m from platform edge, 1,5 m ± 0,2 m above TOR level		≤ 65 (1)
distance: 7.5 m from track axis, (1,2 m ± 0,2 m above TOR level)		≤ 75 (2)
EXTERNAL - Running train (225 km/h)		
distance: 7.5 m from track axis, (1,2 m ± 0,2 m above TOR level)		≤ 93.5 (3)

Table 10 – Noise levels

Notes:

- 1 The levels are considered with all the systems working in full capacity (included the HVAC system)
- 2 Train ready to start with all systems working in full capacity (included the HVAC system)
- 3 External noise level at maximum stabilized speed 225km/h, all equipment working in full capacity (included the HVAC system)
- 4 The exact points of measurements for internal noise will be agreed during the project.
- 5 Cabin noise level must comply with UIC 651 Clause 2.10 and TSI NOI

14.2 VIBRATIONS AND IMPACTS

Concerning vibration and impact and relevant issues the following standard shall be applied:

- EN 12663-1 Railway Application Structural requirements of vehicle bodies
- EN 61373 Railway applications - Rolling stock equipment - Shock and vibration tests.

14.3 EMC

Concerning the electromagnetic compatibility of the complete EMU and of its systems/equipment the following standard shall be applied:

- EN 50121-1 Railway applications - Electromagnetic compatibility Part 1: General.
- EN 50121-3-1 Railway applications - Electromagnetic compatibility Part 3-1: Rolling stock - Train and complete vehicle.
Not forgetting Part 3-2 and Part 3-3 where applicable.

14.4 RECYCLABILITY AND FORBIDDEN MATERIALS

The EMU shall be designed for optimal recyclability. It is expected to have a recyclability level not less than 80%.

The equipment/systems materials shall not affect both safety and health of crews and maintainers or the environment.

Reference Norms are the following:

- The European regulation REACH RG 1907/2006
- UIC leaflet 345: Environmental specifications for new rolling stocks
- EN ISO 14040: Environmental management - Life cycle assessment -- Principles and framework.

14.5 ELECTRIC GENERAL REQUIREMENT

The Low Voltage 0V level in the cars is floating, so shall be avoided any 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.

15 GENERAL EMU DESIGN

15.1 EMU's CAR DESIGN (BODYSHELL)

The carbody shell shall be extrusion in Aluminium alloy. Bodyshell shall be designed in accordance with the requirements of EN12663 Category P-II and EN15227 C-1.

15.1.1 Passenger Windows

The passenger windows shall be designed to play a multiple role, as described below:

- protect the users from the environment, in terms of passive safety.
- protect the users from the environment, in terms of passive comfort.
- protect the materials inside the vehicle against harmful solar radiation.

The windows shall have innovative contents, for the attainment of objective described above and for the image of the EMU, as well as for purposes of quick, facilitated maintenance.

15.2 EMU's DRIVER CAB DESIGN (GRP STRUCTURE)

The following norms shall be applied for the EMU driver's cab design:

- TSI LOC&PASS
- UIC 651 OR – “Layout of driver's cabs in locomotives, railcars, multiple units trains and driving trailers”
- UIC 612 – “Driver Machines Interfaces for EMU/DMU, Locomotives and driving coaches - Functional and system requirements associated with harmonized Driver Machine Interfaces”.

15.3 EMU BOGIES

The EMU is fitted with two type of bogie: the motor bogie and trailer bogie.

The following scheme shows the bogies in the train-set with fitted components.

15.3.1 Motor bogie main characteristics

Axle load [t]	18
Track Gauge [mm]	1435
Max speed [km/h]	225
Gear unit	Half suspended
Pneumatic brakes	4 discs installed on wheel case
Primary suspension	4 coil springs
Secondary suspension	2 air springs
Motor Power [kW]	See dedicated paragraph
Wheelbase [mm]	2500
Nominal wheel diameter [mm]	870
Wear on radius [mm]	40
Weight with bolster [kg]	9900
Frame shape	H
Material	S355J2 according to EN 10025

Wheel Profile	TCDD drawing 02.029
Axlebox condition monitoring	EN 15437-2

Table 11 - Motor bogie main characteristics

15.3.2 Trailer Bogie Main characteristic

Axle load [t]	18
Track Gauge [mm]	1435
Max speed [km/h]	225
Pneumatic brakes	6 discs installed on two axle
Magnetic track brake	Pneumatic actuation
Primary suspension	4 coil springs
Secondary suspension	2 air springs
Wheelbase [mm]	2500
Nominal wheel diameter [mm]	870
Wear on radius [mm]	40
Weight [kg] (SKA/OA) without bolster	7455/7050
Frame shape	H
Material	S355J2 according to EN 10025
Lubrication device	Spray type
Wheel Profile	TCDD drawing 02.029
Axlebox condition monitoring	EN 15437-2

Table 12 - Trailer Bogie Main characteristic

15.3.3 Bogie Detection System

The EMU's bogies shall be equipped with detection systems designed to evaluate and monitor the state of the bushing axles and the onset of instability in the bogies.

The monitoring of temperature shall detect the value above which damage will occur the bearing and/or its functionality.

The monitoring of instability bogie shall used to detect the presence of faults in some bogie components critical to vehicle stability, and to resolve between different fault types.

The diagnostic data will be transmitted to the TCMS to the driver for information.

The monitoring function is a stand-alone on-board unit system fitted in one rack mechanics. One of the system units is installed in each coach.

15.4 EXTERIOR REQUIREMENTS

Metallic and non-electrified equipment mounted on the roof shall be connected to the vehicle frame. In addition, appropriate earthing precautions shall be taken against electrical discharges which may be generated by catenary system and pantographs.

16 SYSTEM FUNCTIONS

16.1 TRACTION

16.1.1 Traction general requirements and redundancy level

The EMU traction system shall not generate interaction with the power supply system that would result in voltage fluctuations or harmonic currents exceeding the limits of EN 50163, and it shall meet the requirements set out herein.

The total power consumption for each train set shall be measured and recorded on board by the TCMS and Energy Meter, this data shall be downloadable.

For an optimized weight distribution all traction system components shall be distributed along the train.

The traction system of the EMU shall allow high level of redundancy as required by TCDD and TÜRASAŞ.

The traction system shall have functional redundancies to completely recover or reduce the effect on performances due to the failures listed hereafter:

- (1) loss of one pantograph
- (2) loss of one HSVB (High Speed Vacuum Breaker)
- (3) loss of the complete traction system on single car (each car shall have its traction system)

In cases (1) and (2) relevant single failure shall not affect in any way EMU performances

Only in case (3), the train is allowed to operate in degraded conditions; the train shall reach next convenient station or service depot without assistance.

Stop in line due to traction shall be reasonable.

16.1.2 Electro Dynamic Braking (Regenerative)

The EMU shall be fitted with a traction system that allows the regenerative (electro-dynamic) braking.

The electrical energy generated during the ED braking phase shall be returned to supply line. Traditional “rheostat” braking system is not allowed.

When regenerative braking is not available (at low speed) pneumatic (friction) brake shall be used.

16.1.3 Main traction and electrical components arrangement on EMU

The traction system of the EMU shall be composed by the following:

- 1 transformer unit mounted on the underframe of
 - each SKA1/SKA2 cars
 - each OA2 /OA4 cars
- 1 traction converter with integrating cooling unit in each car

- 2 traction motors each motor bogie with 1 motor bogie each car (bogie suspended with forced air cooling)
- 1 traction motor cooling unit each motor bogie
- 2 surge arrester kit + earthing switch for each SKA (at train-set whatever configuration)
- 1 Vacuum Breaker for each SKA
- 2 Pantographs (at train-set whatever configuration)
- 2 disconnectors with earthing point, one in the OA2 and one in the OA4
- 1 voltage sensor, in the roof of the OA4

16.2 AUXILIARY POWER SUPPLY

16.2.1 MV (Medium Voltage) and LV (Low Voltage) power generation and distribution

An auxiliary inverter will be installed in each car, to supply the required power to loads connected to the MV line (400V AC 3ph 50Hz).

Auxiliary Power Supply includes Battery Charger device.

16.2.2 Battery Box

Each car type shall have its own battery box, identical for all the vehicle typology.

It is assumed that the battery box is composed by the following main components:

- Battery box frame
- Battery elements
- Refill system
- Temperature sensor
- Battery Box Heater

16.3 ENERGY METER

An energy meter device shall be implemented in the EMU on the Ska cars to measure the consumed and regenerated active or reactive energy; in compliance with EN50463-2.

In detail, the functions to be performed shall be:

- volt measurement (VMF)
- current measurement (CMF)
- energy calculation (ECF);

16.4 CABLES

Cables used on each car shall be comply railway regulation.

16.5 BRAKING SYSTEM

The EMU brake systems shall be composed by following functional sub-system:

- ED: Electro Dynamic (Regenerative)
- EP: Electro Pneumatic
- UIC Pneumatic (indirect brake)
- Parking Brake (spring applied and pneumatic released)

The brake systems shall guarantee the following functions:

- Service brake (ED + EP blended)
- (EP) Stopping and Holding brake, also managing the rolling back condition
- UIC indirect brake (brake pipe and distributors)
- Emergency brake i.e. EP by Emergency Loop + UIC by emergency valves and ERBD (Electro-valve Rapid Discharge Brake)
- Parking brake (EP + manual release)
- Passenger Emergency Brake (EP, according to TSI RST Loc&Pass - 4.2.5.3)
- Dead man and Vigilance System (according to UIC 641)
- Wheel-Slide protection system

16.6 PASSENGER DOOR SYSTEMS

16.6.1 External Passenger door

The passenger door shall be a sliding and plug door type, electrically powered and shall be compliant with the TSI Loc&Pass, TSI PRM and the EN 14752 and the UIC 560/ UIC 660.

The design speed shall be taken in account regarding pressure impulse and relative tightness following the Annex C on EN 14752 and paragraphs 4.5.4/4.6.2 on UIC 660

Whatever EMU car shall have 4 passenger doors, 2 doors each side, and are admitted two different type of door having left and right opening. This is valid also for the SKA car (leading vehicle), where the driver can access to the driving cab through the closest passenger door, entering in the vestibule first, then in the cab.

All passenger doors shall provide with sliding steps to help passengers to board the train. Provisions to access to the train from ballast by the driver with the first door of the SKA shall be taken.

16.6.2 Internal Passenger Door Characteristics

Internal doors between passenger areas (saloon) and vestibules and connections doors between gangway passage and vestibules shall be sliding electrically powered.

- Number of saloon/vestibule doors: 2 each car (3 saloon door for OA2 car)
- Number of gangway/vestibule doors: 1 each SKA1 and SKA2; 2 each remaining cars

16.7 HEATING VENTILATION AND COOLING

The heating, ventilation and cooling capability shall be performed by the HVAC system, with the support of independent heaters in both saloon and driver cabs where deemed necessary.

The HVAC system shall be satisfy the UIC 660 4.6 and UIC 651 2.9.

The air conditioning system of EMU shall be based on the following architecture:

- 2 roof mounted saloon HVAC units (full redundancy)
- air distribution ducts
- 2 electronic controllers for the units and the compartment heaters
- temperature sensors
- heaters in the compartments
- 1 independent HVAC unit for each driver cabin

All HVAC systems shall take in account the design speed in order to prevent presson drop.

16.8 EXTERIOR LIGHTS

Head, tail and marker lights shall be in full accordance with TSI Loc&Pass section 4.2.7.1 and EN 15153-1

16.9 INTERIOR LIGHTING

The EMU train-set shall use high efficiency lighting to provide interior illumination levels in accordance with applicable standard EN 13272 and TSI RST Loc&Pass.

The interior lighting distribution in the passenger saloon, vestibule and gangways shall be arranged to create a safe, secure and pleasant environment.

Interior Lighting shall be based on LED lighting and perform an indirect illumination.

16.10 PASSENGER INFORMATION AND COMMUNICATIONS

16.10.1 Passenger Information and Communication general features (PIS-PAS)

The PIS-PAS system shall be designed in order to allow and manage following types of communication:

- 2-way communication between the driver and Train Traffic Control (TTC), Centre Movement Train Depot, other drivers (TBC if it shall be foreseen)
- Communication of General Announcement 1-way from the driver to the passengers inside and outside the train.
- 2-way communication by the TTC to passengers when enabled by the driver through the radio and the system of general announcement.
- 2-way communication between the driver and passengers through the emergency communication system.

In case of emergency, in order to realize the 2-way communication between the driver and the passengers, specific emergency call devices shall be located in each vestibule and passenger compartment:

- The passenger emergency device (emergency brake lever) shall be integrated with the internal communication system and shall be located in each vestibule and passenger compartment
- A 2 way communication between driver and conductor via handset in each car and swan neck microphone in driver desk.
- A 1 way communication of general announcement between the conductor and passengers (inside and outside train) via an amplifier system with handset in each car.

16.10.2 Route information and announcements system (part of PIS-PAS)

The main features of the route information and announcements system are listed hereafter:

- The driver shall be able to start automatically via a track code the system
- The driver can update the system by setting a new path providing the codes of the first and last stations
- If special visual and voice announcements are recorded in the system the driver can communicate them wishes to spread, shall be able to act through codes to begin automatically spreading.

- The system PAS / PIS shall be "user friendly", it will have a large capacity memory such that in case of necessity the operator can enter new information (ads) voice / visual and the card can be replaced.
- The changes and additions that will be made on the voice files / visual system shall be possible on a laptop via links through your computer's USB or standard systems as "Memory Stick" (USB memory), memory card (SD Memory Stick)
- Internal displays shall be provided:
 - to display maps of the system
 - to be positioned at distances such as to be visible by passengers in any position
- External screens shall be provided:
 - LED or LED flip-dot type
 - Shall be visible without fogging in any weather and light
 - To be coordinated with the internal communication system and linked to the central DB
 - The information shall be in real time and updated according to the current and next train positions (stations)
- Screens for visual information must be according to applicable TSI and UIC 176.
- The visual information is to be through the following:
 - In each coach SKA a front screen (to be seen from outside)
 - On each side of each intermediate car: 2 external displays (to be seen from outside)
 - In each passenger areas a sufficient number of screens (to be seen from inside)

A communications control panel shall be placed on the driver desk of each cabin to manage and integrate all the PIS-PAS system functionalities and I/F all the devices as:

- Radio communication function
- Passengers emergency devices
- General announcement system devices
- Drivers communication devices
- The voice information for passengers shall be realized through loudspeakers arranged equidistantly along the vehicle. These should preferably be integrated with devices on the ceiling and must be hidden. They shall be used also for entertainment sound diffusion (if required by the driver)

16.10.3 Other Functions and Characteristics

- System network shall use an Ethernet type communication

16.10.4 Display/Screen for Visual Information

To diffuse visual information displays shall be part of the PAS-PIS system, they shall be in accordance with TSI Loc&Pass and UIC 176.

16.11 CCTV SYSTEM

The operation CCTV system shall allow the driver to monitor passenger flow through the doors during boarding un-boarding operation as well as to have good visibility of both side of the train and internal passenger compartments.

16.12 TRAIN MANAGEMENT SYSTEM

16.12.1 TCMS System Overview

The control/monitoring and diagnostic system shall be a smart entity which, acquiring and transmitting information and controls, manages the operation of most of devices installed on the train.

- Monitor and control devices directly interfaced with the system TCMS.
- Achieve operational functions necessary to manage the train with the level of performance, safety and reliability requirements.
- Provide support for the operation of the train (crew)
- Provide support for centralized maintenance
- Implemented through design and simulation tools to optimize time and cost of design and validation.
- Be designed in a modular way in order to be reused in whole or in different configurations.
- Provide a historical data with detailed information about operating the equipment and device.

The TCMS system is directly related to the information of the subsystems connected with it, following are schematically shows the main link.

The number of information available in the diagnostic system is very high; as a consequence, to enhance effective acquisition and use of information by personnel, a differentiated management is required.

To this purpose, three groups of information are displayed on the monitor in each driving cab on SKA vehicles (placed on driver's side of the control desk), depending on the user they are addressed to:

- Driving crew (diagnostic/control monitor and instrument monitor).
- Staff personnel (diagnostic/control monitor).
- Maintenance personnel (diagnostic/control monitor).

The Control/Monitoring and Diagnostic System is developed with redundancy characteristics necessary to increase its reliability.

16.12.2 TCMS Main Tasks

Main tasks of Command & Control shall be the following:

- supervise functions and manage decision at system level, by adjusting the operation of apparatuses monitored according to the general operating situation
- perform starting procedures and give controls during normal operation
- provide for proper measures and cut-offs in case of malfunctions

Main tasks of diagnostics shall be the following:

- find faulty apparatuses and sub-assemblies to reduce the repair time and increase average availability of vehicle
- provide for an operator's guide, to precisely specify operations to be performed during any malfunction on duty
- organise the collection of information to support any statistic management off-board concerning the type of malfunctions per operating hours of single apparatuses

The system hardware allows differentiated interfacing with various on-board apparatuses according to needs (serial or parallel) to be defined during the development of definite project plan.

16.13 TRAIN FUCTIONALITIES

16.13.1 Main Wired Functions

The at least following functions shall be implemented using wired commands:

- Fire detection system
- Emergency Braking management
- Main Circuit Breaker (VACUUM) management
- Internal Light on passengers compartment
- External lights
- Door Open/Close command
- Passengers Information system (Intercommunication)

16.14 EVENT RECORDER

An event recorder shall be installed in each OA3 car and shall be active when the train is active. Event record is a device designed to acquire and store the status coming from other on-board devices, to record driver activities.

16.15 WARNING HORNS AND WHISTLE

Horns (audible warning device) shall be in full accordance with TSI Loc&Pass section 4.2.7.1 and EN 15153-2. Operation of the horn shall not cause noise discomfort to the driver.

Warning horns shall be fed by an air pressure circuit and shall be commanded either by a push button or by a pedal.

The warning whistle shall be controlled electronically and powered by the battery line.

16.16 WINDSCREEN WIPER AND WASHING SYSTEM

The EMU shall be fitted with a wiper and windscreen washing system in accordance with applicable standards and in particular to assure the driver visibility as per UIC 651.

The windscreen wiper system shall be electrical type and include intermittent wipe facility. It shall assure good performance and functionality in all the weather condition as specified in this document and at maximum train speed.

16.17 FLANGE LUBRICATING SYSTEM

The EMU shall be equipped with efficient and reliable spray type flange lubricating system.

16.18 SANDING SYSTEM

The EMU shall be equipped with efficient and reliable sanding system.
The sanding device shall be located on axles 1, 3, 4 of SKA cars.

16.19 FIRE DETECTION SYSTEM

The EMU shall comply with the Safety in Railway Tunnels Technical Standard for Interoperability and meet the specific requirements of fire safety category A.

The fire detection system shall perform following basic functions:

- Fire detection;
- Warning, controls and diagnostics.

17 SIGNALLING AND TRAIN COMMUNICATIONS

17.1 RADIO

EMU will adopt ASEL SAN radio equipment for train infrastructure radio communication. Additionally, GSM-R radio shall be used on ETCS lines.

17.2 ATS

EMU shall adopt Automatic Train Stop system type ATS 101 E by Company SAVRONİK (including West and East Type Magnets). The related items shall be installed in the train set in accordance to the requirements of the system Supplier.

17.3 ERTMS / ETCS

EMU will adopt ERTMS / ETCS system standard Level 1 and Level 2.

The related items will be installed in the train set in accordance to the requirements of the system Supplier.

18 MAINTENANCE AND OPERATIONS

18.1 DESIGN FOR MAINTENANCE

LRU policy shall be widely apply in order to have quick repair of EMU train-set by substitution of failed components and the repair of them later on in dedicated workshop. This reduces the stay of the car in the workshop increasing the availability.

Each EMU shall be designed:

- to facilitate maintenance, servicing, cleaning and reparability; this shall include the design of interior panelling and other items prone to vandalism. All main equipment and wear parts must be easy accessible and exchangeable
- to incorporate features which enable maintenance and repairs to be carried out quickly and effectively
- to minimize the length of time when the train-sets are out of service for maintenance, overhaul and repair
- to accommodate maintenance activity in times that are outside of the peak service requirement
- To incorporate simple to change modular equipment with simple to manage diagnostics, condition monitoring and train data systems
- to ensure the long term availability and quality of all spare parts and consumables for the life of the train-set

In particular:

- all EMU component and sub system parts including interior panelling and exterior trim shall be uniquely coded and labelled so that replacement parts can be easily identified
- suitable test and condition monitoring software and equipment to allow testing, fault diagnosis and repair of EMU sub systems shall be provided
- all necessary of train software and equipment required to send, receive, process, configure, print and interpret EMU sub system data shall be provided.
- EMU external service connection points shall be located to ensure that only a minimum of trackside servicing points are required regardless of the orientation of the train-set. Connection points shall be safe, durable, simple and quick to use and capable of repeated use in the harsh conditions to be expected at servicing locations. They shall be capable of being changed easily and quickly, in the event of failure.

Utilization of “special tools” must be avoided, and when this is not possible, relevant technical justifications shall be supplied.

Dedicated requirements and details about maintenance shall be inserted into the system/equipment technical specification to be passed to their relevant Suppliers.

Dedicated maintenance regime (Maintenance Intervals) shall be identified, keeping into account the EMU mission profile and the foreseen revenue service characteristics.

18.2 UNIT REPAIRS

Each EMU train-set shall be designed and constructed so that the time required to repair exterior collision damage is minimised, this is particularly important for front and rear ends damage, as already written in a previous paragraph.

In particular the EMU shall be designed and constructed so that:

- the time to repair vandalism and to replace damaged interior components is minimised
- body-side windows shall be exchangeable within 3 hours, including any curing time
- body-side door windows shall be exchangeable within 5 hours, including any curing time
- it shall be possible to replace failed exterior lamps within 15 minutes
- the time required to replace all major components shall be minimised

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ANNEX 1 – APPLICABLE NORMS

Com,	STD No	Year	Other info	Complete name	TITLE
EN	3-3	1996		EN 3-3:1996	Portable fire extinguishers. Construction, resistance to pressure, mechanical tests
EN	3-6	1995		EN 3-6:1995	Portable fire extinguishers. Provisions for the attestation of conformity of portable fire extinguishers in accordance with EN 3 Part 1 to Part 5
EN	3-7	2004	+A1:2007	EN 3-7:2004 +A1:2007	Portable fire extinguishers. Characteristics, performance requirements and test methods
EN ISO	286-1	2010	/AC:2013	EN ISO 286-1:2010 /AC:2013	Geometrical product specifications (GPS) - ISO code system for tolerances on linear sizes - Part 1: Basis of tolerances, deviations and fits - Technical Corrigendum 1 (ISO 286-1:2010/Cor 1:2013)
EN	286-3	1994		EN 286-3:1994	Simple unfired pressure vessels designed to contain air or nitrogen - Part 3: Steel pressure vessels designed for air braking equipment and auxiliary pneumatic equipment for railway rolling stock
EN	286-4	1994		EN 286-4:1994	Simple unfired pressure vessels designed to contain air or nitrogen - Part 4: Aluminum pressure vessels designed for air braking equipment and auxiliary pneumatic equipment for railway rolling stock
EN	288	1992		EN 288:1992	Specification and approval of welding procedures for metallic materials
EN	292-1	1991		EN 292-1:1991	Safety of machinery. Basic concepts, general principles for design. Basic terminology, methodology
EN	349	1993	+A1:2008	EN 349:1993 +A1:2008	Safety of machinery. Minimum gaps to avoid crushing of parts of the human body
EN	410	2011		EN 410:2011	Glass in building. Determination of luminous and solar characteristics of glazing
EN	485-1	2008	+A1:2009	EN 485-1:2008 +A1:2009	Aluminum and aluminum alloys. Sheet, strip and plate. Part 1: Technical conditions for inspection and delivery
EN	485-2	2013		EN 485-2:2013	Aluminum and aluminum alloys. Sheet, strip and plate. Part 2: Mechanical properties
EN	485-3	2003		EN 485-3:2003	Aluminum and aluminum alloys. Sheet, strip and plate. Part 3: Tolerances on dimensions and form for hot-rolled products

Com,	STD No	Year	Other info	Complete name	TITLE
EN	485-4	1993		EN 485-4:1993	Aluminum and Aluminum alloys. Sheet, strip and plate. Part 4: Tolerances on shape and dimensions for cold-rolled products
EN	486	2009		EN 486:2009	Aluminum and Aluminum alloys. Extrusion ingots. Specifications
EN	515	1993		EN 515:1993	Aluminum and Aluminum alloys. Wrought products. Temper designations
EN	572-2	2012		EN 572-2:2012	Glass in building. Basic soda lime silicate glass products. Part 2: Float glass
EN	572-4	2012		EN 572-4:2012	Glass in building. Basic soda lime silicate glass products. Part 4: Drawn sheet glass
EN	573-1	2004		EN 573-1:2004	Aluminum and Aluminum alloys. Chemical composition and form of wrought products. Part 1: Numerical designation system
EN	573-2	1994		EN 573-2:1994	Aluminum and Aluminum alloys. Chemical composition and form of wrought products. Part 2: Chemical symbol based designation system
EN	573-3	2013		EN 573-3:2013	Aluminum and Aluminum alloys. Chemical composition and form of wrought products. Part 3: Chemical composition and form of products
EN	673	2011		EN 673:2011	Glass in building. Determination of thermal transmittance (U value). Calculation method
EN ISO	717 (series)	2013		EN ISO 717 (series):2013	Acoustics - Rating of sound insulation in buildings and of building elements (ISO 717:2013)
EN	717-1	2004		EN 717-1:2004	Wood-based panels. Determination of formaldehyde release. Part 1: Formaldehyde emission by the chamber method
EN	755-1	2008		EN 755-1:2008	Aluminum and Aluminum alloys. Extruded rod/bar, tube and profiles. Part 1: Technical conditions for inspection and delivery
EN	755-2	2013		EN 755-2:2013	Aluminum and Aluminum alloys. Extruded rod/bar, tube and profiles. Part 2: Mechanical properties
EN	755-3	2008		EN 755-3:2008	Aluminum and Aluminum alloys. Extruded rod/bar, tube and profiles. Part 3: Round bars, tolerances on dimensions and form
EN	755-4	2008		EN 755-4:2008	Aluminum and Aluminum alloys. Extruded rod/bar, tube and profiles. Part 4: Square bars, tolerances on dimensions and form
EN	755-5	2008		EN 755-5:2008	Aluminum and Aluminum alloys. Extruded rod/bar, tube and profiles. Part 5: Rectangular bars, tolerances on dimensions and form
EN	755-6	2008		EN 755-6:2008	Aluminum and Aluminum alloys. Extruded rod/bar, tube and profiles. Part 6: Hexagonal bars, tolerances on dimensions and form

Com,	STD No	Year	Other info	Complete name	TITLE
EN	755-7	2008		EN 755-7:2008	Aluminum and Aluminum alloys. Extruded rod/bar, tube and profiles. Part 7: Seamless tubes, tolerances on dimensions and form
EN	755-8	2008		EN 755-8:2008	Aluminum and Aluminum alloys. Extruded rod/bar, tube and profiles. Part 8: Porthole tubes, tolerances on dimensions and form
EN	755-9	2008		EN 755-9:2008	Aluminum and Aluminum alloys. Extruded rod/bar, tube and profiles. Part 9: Profiles, tolerances on dimensions and form
EN	779	2012		EN 779:2012	Particulate air filters for general ventilation - Determination of the filtration performance
EN	811	1996		EN 811:1996	Safety of machinery. Safety distances to prevent danger zones being reached by the lower limbs
EN	1325-1	1996		EN 1325-1:1996	Value management, value analysis, functional analysis vocabulary. Value analysis and functional analysis
EN	1363-1	2012		EN 1363-1:2012	Fire resistance tests - Part 1. General requirements
EN ISO	1520	2006		EN ISO 1520:2006	Paints and varnishes. Cupping test (ISO 1520:2006)
EN	1563	2011		EN 1563:2011	Founding - Spheroidal graphite cast irons
EN	1816	2010		EN 1816:2010	Resilient floor coverings - Specification for homogeneous and heterogeneous smooth rubber floor coverings with foam backing
EN	1993	2004		EN 1993:2004	Eurocode 3: Design of steel structures
EN	1993-1-9	2005	EUROCODE 3/AC:2009	EN 1993-1-9:2005 EUROCODE 3/AC:2009	Eurocode 3: Design of steel structures - Part 1-9: Fatigue
EN	1999	-	EUROCODE 9	EN 1999:- EUROCODE 9	Eurocode 9: Design of Aluminum structures
EN	1999-1-1	2007	/A2:2013	EN 1999-1-1:2007 /A2:2013	Eurocode 9: Design of Aluminum structures - Part 1-1: General structural rules
EN	1999-1-3	2007	/A1:2011	EN 1999-1-3:2007 /A1:2011	Eurocode 9. Design of Aluminum structures. Part 1-3: Structures susceptible to fatigue
EN ISO	2081	2008		EN ISO 2081:2008	Metallic and other inorganic coatings - Electroplated coatings of zinc with supplementary treatments on iron or steel (ISO 2081:2008)
EN ISO	2162-2	1996		EN ISO 2162-2:1996	Technical product documentation - Springs - Part 2: Presentation of data for cylindrical helical compression springs (ISO 2162-2:1993)
EN ISO	2409	2013		EN ISO 2409:2013	Paints and varnishes - Cross-cut test (ISO 2409:2013)
EN ISO	2624	1995		EN ISO 2624:1995	Copper and copper alloys. Estimation of average grain size (ISO 2624:1990)
EN ISO	2808	2007		EN ISO 2808:2007	Paints and varnishes. Determination of film thickness (ISO 2808:2007)

Com,	STD No	Year	Other info	Complete name	TITLE
EN ISO	2812-1	2007		EN ISO 2812-1:2007	Paints and varnishes. Determination of resistance to liquids. Immersion in liquids other than water (ISO 2812-1:2007)
EN ISO	2813	2014		EN ISO 2813:2014	Paints and varnishes. Determination of gloss value at 20 degrees, 60 degrees and 85 degrees (ISO 2813:2014)
EN ISO	3095	2013		EN ISO 3095:2013	Acoustics - Railway applications - Measurement of noise emitted by railbound vehicles (ISO 3095:2013)
EN ISO	3381	2011		EN ISO 3381:2011	Railway applications - Acoustics - Measurement of noise inside railbound vehicles (ISO 3381:2005)
EN ISO	3506 (series)	2009		EN ISO 3506 (series):2009	Mechanical properties of corrosion-resistant stainless steel fasteners (ISO 3506:2009)
EN ISO	4042	2000		EN ISO 4042:2000	Fasteners. Electroplated coatings
EN ISO	4624	2003		EN ISO 4624:2003	Paints and varnishes. Pull-off test for adhesion
EN ISO	4628 (series)	2005		EN ISO 4628 (series):2005	Evaluation of degradation of coatings
EN ISO	4892 (series)	-		EN ISO 4892 (series):-	Plastics - Methods of exposure to laboratory light sources
EN ISO	5817	2014		EN ISO 5817:2014	Welding - Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) - Quality levels for imperfections (ISO 5817:2014)
EN ISO	6270-1/2	2001 (1); 2005 (2)		EN ISO 6270-1/2:2001 (1); 2005 (2)	Paints and varnishes - Determination of resistance to humidity (ISO 6270-1:1998; ISO 6270-2:2005)
EN ISO	6272	2011		EN ISO 6272:2011	Paints and varnishes - Rapid-deformation (impact resistance) tests (ISO 6272:2011)
EN ISO	6506-1	2014		EN ISO 6506-1:2014	Metallic materials - Brinell hardness test - Part 1: Test method (ISO 6506-1:2014)
EN ISO	8501-1	2007		EN ISO 8501-1:2007	Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness - Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings (ISO 8501-1:2007)
EN ISO	9227	2012		EN ISO 9227:2012	Corrosion tests in artificial atmospheres - Salt spray tests (ISO 9227:2012)
EN ISO	9692-1	2013		EN ISO 9692-1:2013	Welding and allied processes - Types of joint preparation - Part 1: Manual metal arc welding, gas-shielded metal arc welding, gas welding, TIG welding and beam welding of steels (ISO 9692-1:2013)
EN	10002-1	2001		EN 10002-1:2001	Tensile testing of metallic materials. Method of test at ambient temperature

Com,	STD No	Year	Other info	Complete name	TITLE
EN	10021	2006		EN 10021:2006	General technical delivery conditions for steel products
EN	10025 series	-		EN 10025 (series):-	Hot rolled products of structural steels
EN	10029	2010		EN 10029:2010	Hot-rolled steel plates 3 mm thick or above - Tolerances on dimensions and shape
EN	10089	2002		EN 10089:2002	Hot-rolled steels for quenched and tempered springs - Technical delivery conditions
EN	10210	2006		EN 10210:2006	Hot finished structural hollow sections of non-alloy and fine grain steels - Part 1 and 2
EN	10250 (series)	1999		EN 10250 (series):1999	Open die steel forgings for general engineering purposes
EN	12080	2007	+A1:2010	EN 12080:2007 +A1:2010	Railway applications - Axleboxes - Rolling bearings
EN	12081	2007	+A1:2010	EN 12081:2007 +A1:2010	Railway applications - Axleboxes - Lubricating greases
EN	12082	2007	+A1:2010	EN 12082:2007 +A1:2010	Railway applications - Axleboxes - Performance testing
EN	12258-1	2012		EN 12258-1:2012	Aluminum and Aluminum alloys. Terms and definitions. Part 1: General terms
EN	12299	2009		EN 12299:2009	Railway applications - Ride comfort for passengers - Measurement and evaluation
EN	12373-1	2001		EN 12373-1:2001	Aluminum and Aluminum alloys. Anodizing. Part 1: Method for specifying decorative and protective anodic oxidation coatings on Aluminum
EN	12373-4	1998		EN 12373-4:1998	Aluminum and Aluminum alloys. Anodizing. Part 4: Estimation of loss of absorptive power of anodic oxidation coatings after sealing by dye spot test with prior acid treatment
EN	12373-7	2002		EN 12373-7:2002	Aluminum and Aluminum alloys. Anodizing. Part 7: Assessment of quality of sealed anodic oxidation coatings by measurement of the loss of mass after immersion in phosphoric acid/chromic acid solution with prior acid treatment
EN	12663 (series)	2014		EN 12663 (series):2014	Railway applications - Structural requirements of railway vehicle
EN ISO	12944 (series)	-		EN ISO 12944 (series):-	Paints and varnishes - Corrosion protection of steel structures by protective paint systems
EN	13103	2009	+A2:2012	EN 13103:2009 +A2:2012	Railway applications - Wheelsets and bogies - Non-powered axles; Design method
EN	13104	2009	+A2:2012	EN 13104:2009 +A2:2012	Railway applications - Wheelsets and bogies - Powered axles; Design method
EN	13129-1	2002		EN 13129-1:2002	Railway applications - Air conditioning for main line rolling stock - Part 1: Comfort parameters

Com,	STD No	Year	Other info	Complete name	TITLE
EN	13129-2	2004		EN 13129-2:2004	<i>Railway applications - Air conditioning for main line rolling stock - Part 2: Type tests</i>
EN	13260	2009	+A1:2010	EN 13260:2009 +A1:2010	<i>Railway applications. Wheelsets and bogies. Wheelsets. Products requirements</i>
EN	13261	2009	+A1:2010	EN 13261:2009 +A1:2010	<i>Railway applications. Wheelsets and bogies. Axles. Product requirements</i>
EN	13262	2004	+A2:2011	EN 13262:2004 +A2:2011	<i>Railway applications. Wheelsets and bogies. Wheels. Product requirement</i>
EN	13272	2012		EN 13272:2012	<i>Railway applications - Electrical lighting for rolling stock in public transport systems</i>
EN	13298	2003		EN 13298:2003	<i>Railway applications - Rubber suspension components - Rubber diaphragms for pneumatic suspension spring</i>
EN	13523 (series)	-		EN 13523 (series):-	<i>Coil coated metals. Test methods.</i>
EN	13597	2003		EN 13597:2003	<i>Railway applications. Rubber suspension components. Rubber diaphragms for pneumatic suspension springs.</i>
EN	13715	2006	+A1:2010	EN 13715:2006 +A1:2010	<i>Railway applications - Wheelsets and bogies - Wheels - Tread profile</i>
EN	13749	2011		EN 13749:2011	<i>Railway applications - Wheelsets and bogies - Methods of specifying structural requirements of bogie frames</i>
EN	13775-1	2003		EN 13775-1:2003	<i>Railway applications - Measuring of new and modified freight wagons - Part 1: Measuring principles</i>
EN	13775-2	2003		EN 13775-2:2003	<i>Railway applications - Measuring of new and modified freight wagons - Part 2: Freight wagons with bogies</i>
EN	13775-3	2003		EN 13775-3:2003	<i>Railway applications - Measuring of new and modified freight wagons - Part 3: Freight wagons with 2 wheelsets</i>
EN	13775-4	2004		EN 13775-4:2004	<i>Railway applications - Measuring of new and modified freight wagons - Part 4: Bogies with 2 wheelsets</i>
EN	13775-5	2004		EN 13775-5:2004	<i>Railway applications - Measuring of new and modified freight wagons - Part 5: Bogies with 3 wheelsets</i>
EN	13775-6	2004		EN 13775-6:2004	<i>Railway applications - Measuring of new and modified freight wagons - Part 6: Multiple and articulated freight wagons</i>
EN	13802	2013		EN 13802:2013	<i>Railway applications - Suspension components - Hydraulic damper</i>
EN	13848-1	2003	+A1:2008	EN 13848-1:2003 +A1:2008	<i>Railway applications - Track - Track geometry quality - Part 1: Characterization of track geometry</i>
EN	13906-1	2013		EN 13906-1:2013	<i>Cylindrical helical springs made from round wire and bar - Calculation and design - Part 1 : Compression springs</i>

Com,	STD No	Year	Other info	Complete name	TITLE
EN	13913	2003		EN 13913:2003	Railway applications - Rubber suspension components - Elastomer-based mechanical parts
EN ISO	13920	1996		EN ISO 13920:1996	Welding - General tolerances for welded constructions - Dimensions for lengths and angles - Shape and position (ISO 13920:1996)
EN	13979-1	2003	+A2:2011	EN 13979-1:2003 +A2:2011	Railway applications - Wheelsets and bogies - Monobloc wheels - Technical approval procedure - Part 1: Forged and rolled wheels
EN	13981-1	2003		EN 13981-1:2003	Aluminum and Aluminum alloys. Products for structural railway applications. Technical conditions for inspection and delivery. Part 1: Extruded products
EN	13981-3	2006		EN 13981-3:2006	Aluminum and Aluminum alloys. Products for structural railway applications. Technical conditions for inspection and delivery. Part 3: Castings
EN ISO	14040	2006		EN ISO 14040:2006	Environmental management - Life cycle assessment - Principles and framework (ISO 14040:2006)
EN	14067-1	2003		EN 14067-1 :2003	Railway applications - Aerodynamics - Part 1: Symbols and units
EN	14067-4	2013	+A1:2009	EN 14067-4:2013 +A1:2009	Railway applications - Aerodynamics - Part 4: Requirements and test procedures for aerodynamics on open track
EN	14067-5	2006	+A1:2010	EN 14067-5:2006 +A1:2010	Railway applications - Aerodynamics - Part 5: Requirements and test procedures for aerodynamics in tunnels
EN	14067-6	2010		EN 14067-6:2010	Railway applications - Aerodynamics - Part 6: Requirements and test procedures for cross wind assessment
EN	14198	2004		EN 14198:2004	Railway applications - Braking - Requirements for the brake system of trains hauled by a locomotive
EN	14363	2005		EN 14363:2005	Railway applications - Testing for the acceptance of running characteristics of railway vehicles - Testing of running behavior and stationary tests
EN	14531-1	2005		EN 14531-1:2005	Railway applications - Methods for calculation of stopping distances, slowing distances and immobilization braking - Part 1: General algorithms
EN	14535-1	2005	+A1:2011	EN 14535-1:2005 +A1:2011	Railway applications - Brake discs for railway rolling stock - Part 1: Brake discs pressed or shrunk onto the axle or drive shaft, dimensions and quality requirements

Com,	STD No	Year	Other info	Complete name	TITLE
EN	14535-2	2011		EN 14535-2:2011	<i>Railway applications - Brake discs for railway rolling stock - Part 2: Brake discs mounted onto the wheel, dimensions and quality requirements</i>
EN	14535-3	2015		EN 14535-3:2015	<i>Railways applications - Brake discs for railway rolling stock - Part 3: Brake discs, performance of the disc and the friction couple, classification</i>
EN	14742	2015		EN 14742:2015	<i>Characterization of sludge. Laboratory chemical conditioning procedure</i>
EN	14752	2015		EN 14752:2015	<i>Railway applications - Body side entrance systems for rolling stock</i>
EN	14813-1	2006	+A1:2010	EN 14813-1:2006 +A1:2010	<i>Railway applications - Air conditioning for driving cabs. Part 1: Comfort parameters.</i>
EN	14813-2	2006	+A1:2010	EN 14813-2:2006 +A1:2010	<i>Railway applications - Air conditioning for driving cabs - Part 2: Type tests</i>
EN	14817	2006		EN 14817:2006	<i>Railway applications. Suspension components. Air-spring control elements</i>
EN	14865-1	2009	+A1:2010	EN 14865-1:2009 +A1:2010	<i>Railway applications - Axlebox lubricating greases - Part 1: Method to test the ability to lubricate</i>
EN	15020	2006	+A1:2010	EN 15020:2006 +A1:2010	<i>Railway applications - Rescue coupler - Performance requirements, specific interface geometry and test methods</i>
EN	15049	2007		EN 15049:2007	<i>Railway applications - Suspension components - Torsion bar, steel.</i>
EN	15085 (series)	2007		EN 15085 (series):2007	<i>Railway applications - Welding of railway vehicles and components</i>
EN	15085-1	2007	+A1:2013	EN 15085-1:2007 +A1:2013	<i>Railway applications - Welding of railway vehicles and components - Part 1: General</i>
EN	15085-2	2007		EN 15085-2:2007	<i>Railway applications - Welding of railway vehicles and components - Part 2: Quality requirements and certification of welding manufacturer</i>
EN	15085-3	2007	/AC:2009	EN 15085-3:2007 /AC:2009	<i>Railway applications - Welding of railway vehicles and components - Part 3: Design requirements</i>
EN	15085-4	2007		EN 15085-4:2007	<i>Railway applications - Welding of railway vehicles and components - Part 4: Production requirements</i>
EN	15085-5	2007		EN 15085-5:2007	<i>Railway applications - Welding of railway vehicles and components - Part 5: Inspection, testing and documentation</i>
EN	15152	2007		EN 15152:2007	<i>Railway applications - Front windscreens for train cabs</i>
EN	15153-1	2013	+A1:2016	EN 15153-1:2013	<i>Railway applications - External visible and audible warning devices for trains - Part 1: Head, marker and tail lamps</i>

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EN	15153-2	2013		EN 15153-2:2013	<i>Railway applications - External visible and audible warning devices for trains - Part 2: Warning horns</i>
EN	15220-1	2008	+A1:2011	EN 15220-1:2008 +A1:2011	<i>Railway applications - Brake indicators - Part 1: Pneumatically operated brake indicators</i>
EN	15220-2	2008		EN 15220-2:2008	<i>Railway applications - Brake indicators - Part 2: Electrical operation brake indicators</i>
EN	15227	2020		EN 15227:2020	<i>Railway applications - Crashworthiness requirements for railway vehicle bodies</i>
EN	15273	2013		EN 15273:2013	<i>Railway applications. Gauges</i>
EN	15273-1	2013		EN 15273-1:2013	<i>Railway applications - Gauges - Part 1: General - Common rules for infrastructure and rolling stock</i>
EN	15273-2	2013		EN 15273-2:2013	<i>Railway applications - Gauges - Part 2: Rolling stock gauge</i>
EN	15273-3	2013		EN 15273-3:2013	<i>Railway applications - Gauges - Part 3: Structure gauges</i>
EN	15302	2008	+A1:2010	EN 15302:2008 +A1:2010	<i>Railway applications - Method for determining the equivalent conicity</i>
EN	15327-1	2008		EN 15327-1:2008	<i>Railway applications - Passenger alarm subsystem - Part 1: General requirements and passenger interface for the passenger emergency brake system</i>
EN	15328	(2008)		EN 15328:(2008)	<i>Railway applications - Braking - Brake pads</i>
EN	15427	2008	+A1:2010	EN 15427:2008 +A1:2010	<i>Railway applications - Wheel/rail friction management - Flange lubrication</i>
EN	15437-1	2009		EN 15437-1:2009	<i>Railway applications - Axlebox condition monitoring - Interface and design requirements - Part 1: Track side equipment and rolling stock Axlebox</i>
EN	15551	2009	+A1:2010	EN 15551:2009 +A1:2010	<i>Railway applications - Railway rolling stock - Buffers</i>
EN	15566	2016		EN 15566:2016	<i>Railway applications - Railway rolling stock - Draw gear and screw coupling</i>
EN	15595	2009	+A1:2011	EN 15595:2009 +A1:2011	<i>Railway applications - Braking - Wheel slide protection</i>
EN ISO	15614 (series)	-		EN ISO 15614 (series):-	<i>Specification and qualification of welding procedures for metallic materials - Welding procedure test</i>
EN	15663	2009	/AC:2010	EN 15663:2009 /AC:2010	<i>Railway applications - Definition of vehicle reference masses</i>
EN	15686	2010		EN 15686:2010	<i>Railway applications. Testing for the acceptance of running characteristics of railway vehicles with cant deficiency compensation system and/or vehicles intended to operate with higher cant deficiency than stated in EN 14363:2005, Annex G</i>
EN	15892	2011		EN 15892:2011	<i>Railway applications - Noise Emission - Measurement of noise inside driver's cabs</i>

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EN	16019	2014		EN 16019:2014	Railway applications. Automatic coupler. Performance requirements, specific interface geometry and test method
EN	16286-1	2013		EN 16286-1:2013	Railway applications. Gangway systems between vehicles. Part 1: Main applications
EN ISO/IEC	17050-1	2010		EN ISO/IEC 17050-1:2010	Conformity assessment - Supplier's declaration of conformity (ISO/IEC 17050-1:2004)
EN	25030			EN 25030:	
EN	25035			EN 25035:	
EN	30042	1994		EN 30042:1994	Arc-welded joints in Aluminum and its weldable alloys. Guidance on quality levels for imperfections (ISO 10042:1992)
EN	45014	1998		EN 45014:1998	General criteria for supplier's declaration of conformity (ISO/IEC Guide 22:1996)
EN	45545 (series)	2013		EN 45545 (series):2013	Railway applications. Fire protection on railway vehicles
EN	45545-1	2013		EN 45545-1:2013	Railway applications - Fire protection on railway vehicles - Part 1: General
EN	45545-2	2013	+A1:2015	EN 45545-2:2013 +A1:2015	Railway applications - Fire protection on railway vehicles - Part 2: Requirements for fire behavior of materials and components
EN	50121 (series)	-		EN 50121 (series):-	Railway applications. Electromagnetic compatibility
EN	50121-1	2015		EN 50121-1:2015	Railway applications - Electromagnetic compatibility. Part 1: General
EN	50121-2	2015		EN 50121-2:2015	Railway applications - Electromagnetic compatibility. Part 2: Emission of the whole railway system to the outside world
EN	50121-3-1	2015		EN 50121-3-1:2015	Railway applications - Electromagnetic compatibility railway applications - Electromagnetic compatibility. Part 3-1: Rolling stock - Train and complete vehicle
EN	50121-3-2	2006		EN 50121-3-2:2006	Railway applications - Electromagnetic compatibility railway applications - Electromagnetic compatibility. Part 3-2: Rolling stock - Apparatus
EN	50121-4	2015		EN 50121-4:2015	Railway applications - Electromagnetic compatibility. Part 4: Emission and immunity of the signaling and telecommunications Apparatus
EN	50122-1	2011		EN 50122-1:2011	Railway applications. Fixed installations - Part 1: Electrical safety, earthing and the return circuit. Protective provisions against electric shock
EN	50124	2001		EN 50124:2001	Railway applications - Insulation coordination

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EN	50124-1	2001		EN 50124-1:2001	<i>Railway applications. Insulation coordination - Part1: Basic requirements. Clearances and creepage distances for all electrical and electronic equipment</i>
EN	50124-2	2001		EN 50124-2:2001	<i>Railway applications - Insulation coordination - Part 2: Overvoltage's and related protection</i>
EN	50125-1	2014		EN 50125-1:2014	<i>Railway applications - Environmental conditions for equipment - Part 1: Rolling stock and on-board equipment</i>
EN	50126 (series)	-		EN 50126 (series):-	<i>Railway applications - The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS)</i>
EN	50128	2011		EN 50128:2011	<i>Railway applications - Communications, signaling and processing systems - Software for railway control and protection systems</i>
EN	50129	2003		EN 50129:2003	<i>Railway applications - Communication, signaling and processing systems - Safety related electronic systems for signaling</i>
EN	50153	2002		EN 50153:2002	<i>Railway applications - Rolling stock - Protective provisions relating to electrical hazards</i>
EN	50155	2007		EN 50155:2007	<i>Railway applications - Electronic equipment used on rolling stock</i>
EN	50159-1	2001		EN 50159-1:2001	<i>Railway applications - Communication, signaling and processing systems - Part1: Safety related communication in closed transmission systems</i>
EN	50159-2	2001		EN 50159-2:2001	<i>Railway applications - Communication, signaling and processing systems - Part 2: Safety related communication in open transmission systems</i>
EN	50163	2004		EN 50163:2004	<i>Railway applications - Supply voltages of traction systems</i>
EN	50200	2006		EN 50200:2006	<i>Method of test for resistance to fire of unprotected small cables for use in emergency circuits</i>
EN	50206-1	2010		EN 50206-1:2010	<i>Railway applications. Rolling stock. Pantographs. Characteristics and tests. Pantographs for main line vehicles</i>
EN	50215	2009		EN 50215:2009	<i>Railway applications - Testing of rolling stock after completion of construction and before entry into service</i>
EN	50238	2003		EN 50238:2003	<i>Railway applications - Compatibility between rolling stock and train detection systems</i>
EN	50264	2008		EN 50264:2008	<i>Railway applications - Railway rolling stock power and control cables having special fire performance</i>

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EN	50265-2-1	1998		EN 50265-2-1:1998	Common test methods for cables under fire conditions. Test for resistance to vertical flame propagation for a single insulated conductor or cable. Part 2-1: Procedures. 1 kW pre-mixed flame. 1 kW pre-mixed flame
EN	50274	2002		EN 50274:2002	Low-voltage switchgear and control gear assemblies. Protection against electric shock. Protection against unintentional direct contact with hazardous live parts
EN	50305	2002		EN 50305:2002	Railway applications - Railway rolling stock cables having special fire performance - Test methods
EN	50306	2003		EN 50306:2003	Railway applications - Fire Cables - Thin wall
EN	50317	2012		EN 50317:2012	Railway applications. Current collection systems. Requirements for and validation of measurements of the dynamic interaction between pantograph and overhead contact line
EN	50343	2014		EN 50343:2014	Railway applications. Rolling stock. Rules for installation of cabling
EN	50355	2013		EN 50355:2013	Railway applications. Railway rolling stock cables having special fire performance. Guide to use
EN	50367	2012		EN 50367:2012	Railway applications. Current collection systems. Technical criteria for the interaction between pantograph and overhead line (to achieve free access)
EN	50382	2008		EN 50382:2008	Railway applications. Railway rolling stock high temperature power cables having special fire performance
EN	50388	2012		EN 50388:2012	Railway Applications. Power supply and rolling stock. Technical criteria for the coordination between power supply (substation) and rolling stock to achieve interoperability
EN	50463	2007		EN 50463:2007	Railway applications. Energy measurement on board trains
EN	50500	2008		EN 50500:2008	Measurement procedures of magnetic field levels generated by electronic and electrical apparatus in the railway environment with respect to human exposure
EN	60310	2004		EN 60310:2004	Railway applications - Traction transformers and inductors on board rolling stock (IEC 60310:2004)
EN	60349-2	2010		EN 60349-2:2010	Electric traction - Rotating electrical machines for rail and road vehicles - Part 2: Electronic converter-fed alternating current motors (IEC 60349-2:2010)
EN	60651	1994		EN 60651:1994	Specification for sound level meters
EN	60721 (series)	-		EN 60721 (series):-	Classification Of Environmental Conditions

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EN	60721-3-5	1997		EN 60721-3-5:1997	<i>Classification of environmental conditions. Part 3-5: Classification of groups of environmental parameters and their severities. Ground vehicle installations</i>
EN	61287-1	2006		EN 61287-1:2006	<i>Railway applications. Power converters installed on board rolling stock. Part 1: Characteristics and test methods (IEC 61287-1:2005)</i>
EN	61310-1	2008		EN 61310-1:2008	<i>Safety of machinery. Indication, marking and actuation. Part:1 Requirements for visual, acoustic and tactile signals (IEC 61310-1:2008)</i>
EN	61377-3	2002		EN 61377-3:2002	<i>Railway applications. Rolling stock. Combined testing of alternating current motors, fed by an indirect convertor, and their control system</i>
ERAAS		1992		ERAAS :1992	<i>European recommendations for Aluminum alloy structures: fatigue design; 1st edition 1992</i>
IEC	77	-		IEC 77:-	<i>Rules for Electric Traction Equipment</i>
IEC	60034-1	2010		IEC 60034-1:2010	<i>Rotating electrical machines - Part 1: Rating and performance</i>
IEC	60034-14	2007		IEC 60034-14:2007	<i>Rotating electrical machines - Part 14: Mechanical vibration of certain machines with shaft heights 56 mm and higher - Measurement, evaluation and limits of vibration severity</i>
IEC	60068 (series)	-		IEC 60068 (series):-	<i>Environmental testing</i>
IEC	60068-2-3	1969		IEC 60068-2-3:1969	<i>Basic environmental testing procedures - Part 2-3: Tests - Test Ca: Damp heat, steady state</i>
IEC	60068-2-11	1981		IEC 60068-2-11:1981	<i>Basic environmental testing procedures - Part 2-11: Tests - Test Ka: Salt mist</i>
IEC	60077 (series)	-		IEC 60077 (series):-	<i>Railway applications. Electric equipment for rolling stock.</i>
IEC	60077-1	1999		IEC 60077-1:1999	<i>Railway applications - Electric equipment for rolling stock - Part 1: General service conditions and general rules</i>
IEC	60077-2	1999		IEC 60077-2:1999	<i>Railway applications - Electric equipment for rolling stock - Part 2: Electrotechnical components - General rules</i>
IEC	60077-3	2001		IEC 60077-3:2001	<i>Railway applications - Electric equipment for rolling stock - Part 3: Electrotechnical components - Rules for d.c. circuit-breakers</i>
IEC	60099-4	2014		IEC 60099-4:2014	<i>Surge arresters - Part 4: Metal-oxide surge arresters without gaps for a.c. systems</i>
IEC	60099-6	2002		IEC 60099-6:2002	<i>Surge arresters - Part 6: Surge arresters containing both series and parallel gapped structures - Rated 52 kV and less</i>

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IEC	60228	2008		IEC 60228:2008	Conductors of insulated cables
IEC	60310	2015 PRV		IEC 60310:2015 PRV	Railway applications - Traction transformers and inductors on board rolling stock
IEC	60322	2001		IEC 60322:2001	Railway applications - Electric equipment for rolling stock - Rules for power resistors of open construction
IEC	60332-1 (series)	2004		IEC 60332-1 (series):2004	Tests on electric and optical fibre cables under fire conditions - Part 1: Test for vertical flame propagation for a single insulated wire or cable
IEC	60332-3 (series)	2000	+AMD1:2008 CSV	IEC 60332-3 (series):2000 +AMD1:2008 CSV	Tests on electric and optical fibre cables under fire conditions - Part 3: Test for vertical flame spread of vertically-mounted bunched wires or cables
IEC	60494	2013		IEC 60494:2013	Railway applications - Rolling stock - Pantographs - Characteristics and tests
IEC	60529	1989	+AMD1:1999+AMD2:2013 CSV	IEC 60529:1989 +AMD1:1999+AMD2:2013 CSV	Degrees of protection provided by enclosures (IP Code)
IEC	60571	2012		IEC 60571:2012	Railway applications - Electronic equipment used on rolling stock
IEC	60623	2001		IEC 60623:2001	Secondary cells and batteries containing alkaline or other non-acid electrolytes - Vented nickel-cadmium prismatic rechargeable single cells
IEC	60664	2007		IEC 60664:2007	Insulation coordination for equipment within low-voltage systems
IEC	61000-4-4	2012		IEC 61000-4-4:2012	Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test
IEC	61000-4-5	2014		IEC 61000-4-5:2014	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test
IEC	61133	2006		IEC 61133:2006	Railway applications - Rolling stock - Testing of rolling stock on completion of construction and before entry into service
IEC	61373	2010		IEC 61373:2010	Railway applications – Rolling stock equipment – Shock and vibration tests
IEC	61375-1	2012		IEC 61375-1:2012	Electronic railway equipment - Train communication network (TCN) - Part 1: General architecture
IEC	61508 (series)	2010		IEC 61508 (series):2010	Functional safety of electrical/electronic/programmable electronic safety related systems.
IEC	61992-5	2006		IEC 61992-5:2006	Railway applications - Fixed installations - DC switchgear - Part 5: Surge arresters and low-voltage limiters for specific use in d.c. systems

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IEEE	519	2014		IEEE 519:2014	IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems
ISO IEC	17025	2005		ISO IEC 17025:2005	General requirements for the competence of testing and calibration laboratories
ISO	140 (series)	-		ISO 140 (series):-	Acoustics -- Measurement of sound insulation in buildings and of building elements
ISO	140-1	1997		ISO 140-1:1997	Acoustics - Measurement of sound insulation in buildings and of building elements - Part 1: Requirements for laboratory test facilities with suppressed flanking transmission
ISO	140-3	1995		ISO 140-3:1995	Acoustics - Measurement of sound insulation in buildings and of building elements - Part 3: Laboratory measurements of airborne sound insulation of building elements
ISO	178	2010		ISO 178:2010	Plastics - Determination of flexural properties
ISO	179	2010		ISO 179:2010	Plastics - Determination of Charpy impact properties
ISO	281	2007		ISO 281:2007	Rolling bearings - Dynamic load ratings and rating life
ISO	527	2012		ISO 527:2012	Plastics - Determination of tensile properties
ISO	604	2002		ISO 604:2002	Plastics - Determination of compressive properties
ISO	717-1	2013		ISO 717-1:2013	Acoustics - Rating of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation
ISO	844	2014		ISO 844:2014	Rigid cellular plastics - Determination of compression properties
ISO	898	2013		ISO 898:2013	Mechanical properties of fasteners made of carbon steel and alloy steel
ISO	1043-1	2011		ISO 1043-1:2011	Plastics - Symbols and abbreviated terms - Part 1: Basic polymers and their special characteristics
ISO	1172	1997		ISO 1172:1997	Textile-glass-reinforced plastics. Prepregs, moulding compounds and laminates. Determination of the textile-glass and mineral-filler content. Calcination methods
ISO	1183	2004		ISO 1183:2004	Plastics - Methods for determining the density of non-cellular plastics
ISO	1514	2004		ISO 1514:2004	Paints and varnishes - Standard panels for testing
ISO	1519	2011		ISO 1519:2011	Paints and varnishes. Bend test (cylindrical mandrel)
ISO	1629	2013		ISO 1629:2013	Rubber and latices - Nomenclature
ISO	1922	2012		ISO 1922:2012	Rigid cellular plastics - Determination of shear strength
ISO	1940	2003		ISO 1940:2003	Mechanical vibration - Balance quality requirements for rotors in a constant (rigid) state

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ISO	2041	2009		ISO 2041:2009	<i>Mechanical vibration, shock and condition monitoring - Vocabulary</i>
ISO	2859-1	1999		ISO 2859-1:1999	<i>Sampling procedures for inspection by attributes - Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection</i>
ISO	3864-1	2011		ISO 3864-1:2011	<i>Graphical symbols - Safety colours and safety signs - Part 1: Design principles for safety signs and safety markings</i>
ISO	4287	1997		ISO 4287:1997	<i>Geometrical Product Specifications (GPS) - Surface texture: Profile method - Terms, definitions and surface texture parameters</i>
ISO	5348	1998		ISO 5348:1998	<i>Mechanical vibration and shock - Mechanical mounting of accelerometers</i>
ISO	7001	2007		ISO 7001:2007	<i>Public information symbols</i>
ISO	7193	1985		ISO 7193:1985	<i>Wheelchairs - Maximum overall dimensions</i>
ISO	7438	2005		ISO 7438:2005	<i>Metallic materials - Bend test</i>
ISO	7724-1/2/3	1984		ISO 7724-1/2/3:1984	<i>Paints and varnishes - Colorimetry</i>
ISO	9000 (series)	2015		ISO 9000 (series):2015	<i>Quality management systems - Fundamentals and vocabulary</i>
ISO	9001	2015		ISO 9001:2015	<i>Quality management systems - Requirements</i>
ISO	9614	1993		ISO 9614:1993	<i>Acoustics - Determination of sound power levels of noise sources using sound intensity</i>
ISO	11469	2000		ISO 11469:2000	<i>Plastics - Generic identification and marking of plastics products</i>
ISO	14520 (series)	2006		ISO 14520 (series):2006	<i>Gaseous fire-extinguishing systems - Physical properties and system design</i>
ISO	14731	2006		ISO 14731:2006	<i>Welding coordination - Tasks and responsibilities</i>
UIC	176	2001	Ed. 1	UIC 176:2001 Ed. 1	<i>Specifications for passenger information displayed electronically in trains</i>
UIC	345	2006	Ed. 1	UIC 345:2006 Ed. 1	<i>Environmental specifications for new rolling stock</i>
UIC	413	2008	Ed. 10	UIC 413:2008 Ed. 10	<i>Measures to facilitate travel by rail</i>
UIC	438-1	2004	Ed. 3	UIC 438-1:2004 Ed. 3	<i>Identification marking for passenger rolling stock</i>
UIC	505-1	2006	Ed. 10	UIC 505-1:2006 Ed. 10	<i>Railway transport stock - Rolling stock construction gauge</i>
UIC	505-5	2010	Ed. 3	UIC 505-5:2010 Ed. 3	<i>History, justification and commentaries on the elaboration and development of UIC leaflets of the series 505 and 506 on gauges</i>
UIC	510-2	2004	Ed. 4	UIC 510-2:2004 Ed. 4	<i>Trailing stock: wheels and wheelsets. Conditions concerning the use of wheels of various diameters</i>
UIC	510-5	2007	Ed. 2	UIC 510-5:2007 Ed. 2	<i>Technical approval of monobloc wheels - Application document for standard EN 13979-1</i>
UIC	511	1987		UIC 511:1987	<i>Trailing stock - Wheelbase</i>

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UIC	512	1979		UIC 512:1979	<i>Rolling stock - Conditions to be fulfilled in order to avoid difficulties in the operation of track circuits and treadles</i>
UIC	513	1994		UIC 513:1994	<i>Guidelines for evaluating passenger comfort in relation to vibration in railway vehicles</i>
UIC	515-0	2001	Ed. 2	UIC 515-0:2001 Ed. 2	<i>Passenger rolling stock - Trailer bogies - Running gear</i>
UIC	515-1	2003	Ed. 2	UIC 515-1:2003 Ed. 2	<i>Passenger rolling stock - Trailer bogies - Running gear - General provisions applicable to the components of trailers bogies</i>
UIC	515-4	1993	Ed. 1	UIC 515-4:1993 Ed. 1	<i>Passenger rolling stock - Trailer bogies - Running gear – Bogie frame structure strength tests</i>
UIC	515-5	1994	Ed. 1	UIC 515-5:1994 Ed. 1	<i>Powered and trailing stock - Bodies - Running gear - Tests for axles-boxes</i>
UIC	518	2009	Ed. 4	UIC 518:2009 Ed. 4	<i>Testing and approval of railway vehicles from the point of view of their dynamic behavior - Safety – Track fatigue - Ride quality</i>
UIC	522	1990		UIC 522:1990	<i>Technical conditions to be fulfilled by the automatic coupler</i>
UIC	522-2	2002	Ed. 2	UIC 522-2:2002 Ed. 2	<i>Conditions for the acceptance of draw-only automatic couplers</i>
UIC	532	1979	Ed. 9	UIC 532:1979 Ed. 9	<i>Trailing stock - Signal lamp brackets - Coaches - Fixed electric signal lamps</i>
UIC	534	2002	Ed. 4	UIC 534:2002 Ed. 4	<i>Signal lamps and signal-lamp brackets for locomotives, railcars and all tractive and self-propelled stock</i>
UIC	540	2014	Ed. 6	UIC 540:2014 Ed. 6	<i>Brakes - Air brakes for freight trains and passenger trains</i>
UIC	541-1	2013	Ed. 6	UIC 541-1:2013 Ed. 6	<i>Brakes - Regulations concerning the design of brake components</i>
UIC	541-3	2010	Ed. 7	UIC 541-3:2010 Ed. 7	<i>Brakes - Disc brakes and their application - General conditions for the approval of brake pads</i>
UIC	541-5	2006	Ed. 4	UIC 541-5:2006 Ed. 4	<i>Brakes - Electropneumatic brake (ep brake) - Electropneumatic emergency brake override (EBO)</i>
UIC	541-6	2010	Ed. 1	UIC 541-6:2010 Ed. 1	<i>Brakes - Electropneumatic brake (ep brake) and Passenger alarm signal (PAS) for vehicles used in hauled consists</i>
UIC	544-1	2014	Ed. 6	UIC 544-1:2014 Ed. 6	<i>Brakes - Braking performance</i>
UIC	545	2014	Ed. 10	UIC 545:2014 Ed. 10	<i>Brakes - Inscriptions, marks and signs</i>
UIC	546	2014	Ed. 6	UIC 546:2014 Ed. 6	<i>Brakes - Specifications for the construction of various brake parts - High power brakes for passenger trains</i>
UIC	550	2005	Ed. 11	UIC 550:2005 Ed. 11	<i>Power supply installations for passenger stock</i>
UIC	550-1	1990	Ed. 1	UIC 550-1:1990 Ed. 1	<i>Electrical switch cabinets on passenger stock</i>

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UIC	550-3	2005	Ed. 1	UIC 550-3:2005 Ed. 1	Power supply installations for passenger stock - Effect on electrical installations outside passenger coaches
UIC	553	2004	Ed. 6	UIC 553:2004 Ed. 6	Heating, ventilation and air-conditioning in coaches
UIC	556	2009	Ed. 5	UIC 556:2009 Ed. 5	Information transmission in the train (train bus)
UIC	558	1996	Ed. 1	UIC 558:1996 Ed. 1	Remote control and data cable - Standard technical features for the equipping of RIC coaches
UIC	560	2002	Ed. 12	UIC 560:2002 Ed. 12	Doors, footboards, windows, steps, handles and handrails of coaches and luggage vans
UIC	561	1991	Ed. 8	UIC 561:1991 Ed. 8	Interconnecting gangways for coaches
UIC	562	1991	Ed. 5	UIC 562:1991 Ed. 5	Space for baggage racks, coat-hooks and lockers; measures to prevent baggage theft
UIC	563	1990	Ed. 8	UIC 563:1990 Ed. 8	Fittings provided in coaches in the interests of hygiene and cleanliness
UIC	564-1	1979 (reprint 1990)	Ed. 6	UIC 564-1:1979 (reprint 1990) Ed. 6	Coaches; windows made from safety glass
UIC	564-2	1991	Ed. 3	UIC 564-2:1991 Ed. 3	Regulations relating to fire protection and firefighting measures in passenger carrying railway vehicles or assimilated vehicles used on international services
UIC	565-3	2003	Ed. 2	UIC 565-3:2003 Ed. 2	Indications for the layout of coaches suitable for conveying disabled passengers in their wheelchairs
UIC	566	1990	Ed. 3	UIC 566:1990 Ed. 3	Loadings of coach bodies and their components
UIC	567	2004	Ed. 2	UIC 567:2004 Ed. 2	General provision for coaches
UIC	580	1990	Ed.6	UIC 580:1990 Ed.6	Inscriptions and markings, route indicators and number plates to be affixed to coaching stock used in international traffic
UIC	581	1983	Ed. 1	UIC 581:1983 Ed. 1	Wagons - Lifting - Rerailing
UIC	608	2003	Ed. 3	UIC 608:2003 Ed. 3	Conditions to be complied with for the pantographs of tractive units used in international services
UIC	612-0	2009	Ed. 1	UIC 612-0:2009 Ed. 1	Driver Machines Interfaces for EMU/DMU, Locomotives and driving coaches - Functional and system requirements associated with harmonized Driver Machine Interfaces
UIC	612-01	2011	Ed, 1	UIC 612-01:2011 Ed, 1	Display System in driver cabs (DDS) - General requirements, set up and technical specifications
UIC	612-03	2011	Ed, 1	UIC 612-03:2011 Ed, 1	Display System in Driver's Cab (DDS) Technical and Diagnostic Display (TDD)
UIC	614	1990	Ed. 3	UIC 614:1990 Ed. 3	Definition of the rated output of electric locomotives and motive power units

Com,	STD No	Year	Other info	Complete name	TITLE
UIC	615-0	2003	Ed. 2	UIC 615-0:2003 Ed. 2	<i>Tractive units - Bogies and running gear - General provisions</i>
UIC	615-1	2003	Ed. 2	UIC 615-1:2003 Ed. 2	<i>Tractive units - Bogies and running gear - General conditions applicable to component parts</i>
UIC	615-4	2003	Ed. 2	UIC 615-4:2003 Ed. 2	<i>Motive power units - Bogies and running gear - Bogie frame structure strength tests</i>
UIC	627-2	1980	Ed. 2	UIC 627-2:1980 Ed. 2	<i>Filling devices for diesel stock</i>
UIC	640	2003	Ed. 3	UIC 640:2003 Ed. 3	<i>Motive power units - Inscriptions, marks and signs</i>
UIC	641	2001	Ed. 4	UIC 641:2001 Ed. 4	<i>Conditions to be fulfilled by automatic vigilance devices used in international traffic</i>
UIC	642	2001	Ed. 2	UIC 642:2001 Ed. 2	<i>Special provisions concerning fire precautions and fire-fighting measures on motive power units and driving trailers in international traffic</i>
UIC	644	1980	Ed. 2	UIC 644:1980 Ed. 2	<i>Warning devices used on tractive units employed on international services</i>
UIC	648	2001	Ed. 4	UIC 648:2001 Ed. 4	<i>Connections for electric cables and air pipes on headstocks of locomotives and driving trailers</i>
UIC	651	2002	Ed. 4	UIC 651:2002 Ed. 4	<i>Layout of driver's cabs in locomotives, railcars, multiple-unit trains and driving trailers</i>
UIC	660	2002		UIC 660:2002	<i>Measures to ensure the technical compatibility of high-speed trains</i>
UIC	797	2000	Ed. 1	UIC 797:2000 Ed. 1	<i>Coordination of electrical protection substations-traction units</i>
UIC	813	2003	Ed. 2	UIC 813:2003 Ed. 2	<i>Technical specification for the supply of wheelsets for tractive and trailing stock - Tolerances and assembly</i>
UIC	822	2003	Ed. 5	UIC 822:2003 Ed. 5	<i>Technical specification for the supply of helical compression springs, hot or cold coiled for tractive and trailing stock</i>
REACH	1907	2006		REACH 1907:2006	
TSI CCS	14	2015		TSI CCS 14:2015	<i>TSI CCS on the technical specification for interoperability relating to the control-command and signalling subsystems of the trans-European rail system - Commission Decision amending Decision 2012/88/EU</i>
TSI CCS	88	2012		TSI CCS 88:2012	<i>TSI CCS on the technical specification for interoperability relating to the control-command and signalling subsystems of the trans-European rail system</i>
TSI CCS	696	2012		TSI CCS 696:2012	<i>TSI CCS on the technical specification for interoperability relating to the control-command and signalling subsystems of the trans-European rail system - Commission Decision amending Decision 2012/88/EU</i>

Com,	STD No	Year	Other info	Complete name	TITLE
TSI LOC&PAS	1302	2014		TSI LOC&PAS 1302:2014	<i>TSI LOC&PAS on the technical specification for interoperability relating to the 'rolling stock - locomotives and passenger rolling stock' subsystem of the rail system in the European Union</i>
TSI NOI	1304	2014		TSI NOI 1304:2014	<i>TSI NOI concerning the technical specifications of interoperability relating to the subsystem 'rolling stock - noise'</i>
TSI PRM	1300	2014		TSI PRM 1300:2014	<i>TSI PRM concerning the technical specification of interoperability relating to accessibility of the Union's rail system for persons with disabilities and persons with reduced mobility</i>
TSI SRT	1303	2014		TSI SRT 1303:2014	<i>TSI SRT concerning the technical specification of interoperability relating to 'safety in railway tunnels' of the rail system of the European Union</i>
TSI SRT	2008	2015		TSI SRT 2008:2015	<i>Technical specification for interoperability relating to the rolling stock subsystem of the trans-European high-speed rail system referred to in Article 6(1) of Council Directive 96/48/EC</i>

ANNEX 2 – REFERENCE DRAWINGS

Code	Drawing Description
EM90.03.00.00005	Main Sections Overall Dimensions
FT90.00.00.00001	Trainset configuration layout
FT90.00.00.00010	Trainset Equipment Layout

ANNEX 3 – RAMS REFERENCE TABLE

					Inherent reliability		Mission reliability (Critical Reliability)	
					RAMS targets required to suppliers in technical specifications		RAMS targets required to suppliers in technical specifications	
FTB Project 225 km/h - RAMS Tracking log								
	System / Equipment / Component	RAMS Requirement Technical Document		Rev. No	fpmh [1/10 ⁶ hrs]	MTB F [hrs]	fpmh [1/10 ⁶ hrs]	MTB F [hrs]
	Motor bogie monoblock wheel	TD-EM00.44.0008	National Electrical Multiple Unit Project RAMS Analysis Requirements for Motor Bogie Monoblock Wheel	Rev. 03	N/A	N/A	N/A	N/A
	Trailer bogie monoblock wheel	TD-EM00.44.0009	National Electrical Multiple Unit Project RAMS Analysis Requirements for Trailer Bogie Monoblock Wheel	Rev. 03	N/A	N/A	N/A	N/A
	Motor bogie axle	TD-EM00.44.0010	National Electrical Multiple Unit Project RAMS Analysis Requirements for Motor bogie axle	Rev. 03	N/A	N/A	N/A	N/A
	Trailer bogie axle	TD-EM00.44.0011	National Electrical Multiple Unit Project RAMS Analysis Requirements for Trailer bogie axle	Rev. 03	N/A	N/A	N/A	N/A
	Axle box	TD-EM00.44.0012	National Electrical Multiple Unit Project RAMS Analysis Requirements for Axle Box	Rev. 02	0,40	2,50E +06	0,016	6,25E +07
	Current return device	TD-EM00.44.0013	National Electrical Multiple Unit Project - RAMS Analysis Requirements for Current return device	Rev. 00	0,60	1,67E +06	N/A	N/A
	Elastic element for axle box	TD-EM00.44.0014	National Electrical Multiple Unit Project RAMS Analysis Requirements for Elastic element for axle box	Rev. 03	0,50	2,00E +06	N/A	N/A
	Motor bogie electric motor elastic joint	TD-EM00.44.0015	National Electrical Multiple Unit Project RAMS Analysis Requirements for Motor bogie electric motor elastic joint	Rev. 03	0,20	5,00E +06	N/A	N/A
	Trailing rod assembly	TD-EM00.44.0016	National Electrical Multiple Unit Project RAMS Analysis Requirements for Trailing rod assembly	Rev. 02	0,25	4,00E +06	0,001	1,00E +09
	Rocker arm elastic element	TD-EM00.44.0017	National Electrical Multiple Unit Project RAMS Analysis Requirements for Rocker Arm Elastic Element	Rev. 03	0,25	4,00E +06	0,001	1,00E +09
	Shock absorber	TD-EM00.44.0018	National Electrical Multiple Unit Project RAMS Analysis Requirements for Shock absorber	Rev. 03	1,50	6,67E +05	N/A	N/A

					Inherent reliability		Mission reliability (Critical Reliability)	
					RAMS targets required to suppliers in technical specifications		RAMS targets required to suppliers in technical specifications	
FTB Project 225 km/h - RAMS Tracking log								
	System / Equipment / Component	RAMS Requirement Technical Document		Rev. No	fpmh [1/10 ⁶ hrs]	MTB F [hrs]	fpmh [1/10 ⁶ hrs]	MTB F [hrs]
	Rolling support	TD-EM00.44.0019	National Electrical Multiple Unit Project RAMS Analysis Requirements for Rolling support	Rev. 03	0,20	5,00E +06	N/A	N/A
	Primary suspension elastic disc	TD-EM00.44.0020	National Electrical Multiple Unit Project RAMS Analysis Requirements for Primary Suspension Elastic Disc	Rev. 03	0,20	5,00E +06	N/A	N/A
	Motor and trailer bogie primary suspension (air spring)	TD-EM00.44.0021	National Electrical Multiple Unit Project RAMS Analysis Requirements for Primary suspension	Rev. 03	1,00	1,00E +06	0,10	1,00E +07
	Motor and trailer bogie secondary suspension (air spring)	TD-EM00.44.0022	National Electrical Multiple Unit Project RAMS Analysis Requirements for Secondary suspension (air spring)	Rev. 02	1,80	5,50E +05	0,200	5,00E +06
	Bogie suspension dampers	TD-EM00.44.0023	National Electrical Multiple Unit Project RAMS Analysis Requirements for Bogie SECONDARY Suspension Dampers (Vertical)	Rev. 02	0,21	4,76E +06	N/A	N/A
	Bogie suspension dampers	TD-EM00.44.0023	National Electrical Multiple Unit Project RAMS Analysis Requirements for Bogie SECONDARY Suspension Dampers (Transversal)	Rev. 02	0,51	1,96E +06	N/A	N/A
	Bogie suspension dampers	TD-EM00.44.0023	National Electrical Multiple Unit Project RAMS Analysis Requirements for Bogie PRIMARY Suspension Dampers (Vertical)	Rev. 02	0,38	2,63E +06	N/A	N/A
	Bogie suspension dampers	TD-FT00.B24.201.0 001	National Electrical Multiple Unit Project RAMS Analysis Requirements for Bogie ANTI YAW Suspension Dampers	Rev. 02	0,45	2,22E +06	N/A	N/A
	Tie rod for anti roll bar	TD-EM00.44.0024	National Electrical Multiple Unit Project RAMS Analysis Requirements for Tie rod for anti roll bar	Rev. 03	0,60	1,67E +06	0,001	1,67E +09
	Anti roll bar	TD-EM00.44.0025	National Electrical Multiple Unit Project RAMS Analysis Requirements for Anti-Roll Bar	Rev. 03	N/A	N/A	N/A	N/A
	Automatic Coupler	TD-FT00.S05.201.0 001	National Electrical Multiple Unit Project RAMS Analysis Requirements for Automatic Coupler	Rev. 03	4,20	2,381 E+05	0,75	2,00E +07
	Semi-permanent Coupler	TD-FT00.S05.201.0 002	National Electrical Multiple Unit Project RAMS Analysis Requirements for Semi-permanent Coupler	Rev. 02	1,20	8,33E +05	0,25	4,00E +06

					Inherent reliability		Mission reliability (Critical Reliability)	
					RAMS targets required to suppliers in technical specifications		RAMS targets required to suppliers in technical specifications	
FTB Project 225 km/h - RAMS Tracking log								
	System / Equipment / Component	RAMS Requirement Technical Document		Rev. No	fpmh [1/10 ⁶ hrs]	MTB F [hrs]	fpmh [1/10 ⁶ hrs]	MTB F [hrs]
	Gangway	TD-FT00.S05.201.003	National Electrical Multiple Unit Project RAMS Analysis Requirements for Gangway	Rev. 02	7,00	1,43E+05	N/A	N/A
	PRM Lift device	TD-EM00.44.0029	National Electrical Multiple Unit Project RAMS Analysis Requirements for PRM Lift device	Rev. 01	32,30	3,10E+04	7,70	1,30E+05
	Wheel Flange Lubrication Device	TD-EM00.44.0031	National Electrical Multiple Unit Project RAMS Analysis Requirements for Wheel Flange Lubrication Device	Rev. 03	8,30	1,20E+05	N/A	N/A
	Pneumatic Brake System and Air production	TD-FT00.M09.201.0001	National Electrical Multiple Unit Project RAMS Analysis Requirements for Brake System	Rev. 01	1190,00	8,40E+02	80,00	1,25E+04
	Fire Protection System	TD-FT00.E90.201.0023	National Electrical Multiple Unit Project – RAMS Analysis Requirements for Fire Protection System	Rev. 01	72,00	1,39E+04	6,50	1,54E+05
	Drive Cabin Windscreen	TD-EM00.44.0034	National Electrical Multiple Unit Project RAMS Analysis Requirements for Drive Cabin Windscreen	Rev. 01	1,00	1,00E+06	0,300	3,33E+06
	Drive Cabin Lateral Windows (Safety window)	TD-EM00.44.0035	National Electrical Multiple Unit Project RAMS Analysis Requirements for Drive Cabin Lateral windows (Emergency window)	Rev. 00	1,20	8,33E+05	0,20	5,00E+06
	Windscreen wipers and washing system	TD-FT00.E90.201.0012	National Electrical Multiple Unit Project RAMS Analysis Requirements for Windscreen Wipers and Washing System	Rev. 02	16,80	5,95E+04	2,70	3,70E+05
	Dead man vigilance device	TD-FT00.E90.201.0024	National Electrical Multiple Unit Project - RAMS Analysis Requirements for Dead-man's Vigilance Device	Rev. 02	20,00	5,00E+04	4,00	2,50E+05
	Master controllers	TD-FT00.E90.201.0026	National Electrical Multiple Unit Project - RAMS Analysis Requirements for Master Controllers	Rev. 03	3,70	2,70E+05	0,50	2,00E+06
	PA, PIS and CCTV Procurement Technical Specification	TD-FT00.E90.201.0021	National Electrical Multiple Unit Project RAMS Analysis Requirements for PAPIS and CCTV	Rev. 01	100,00	1,00E+04	25,00	4,00E+04
	Auxiliary Inverter Procurement Technical Specification	TD-EM00.44.0040	National Electrical Multiple Unit Project RAMS Analysis Requirements for Auxiliary System	Rev. 02	28,60	3,50E+04	11,3	8,80E+04

FTB Project 225 km/h - RAMS Tracking log

	System / Equipment / Component	RAMS Requirement Technical Document		Rev. No	fpmh [1/10 ⁶ hrs]	MTB F [hrs]	fpmh [1/10 ⁶ hrs]	MTB F [hrs]
	Battery System Procurement Technical Specification	TD-FT00.E90.201.0 020	National Electrical Multiple Unit Project RAMS Analysis Requirements for Battery System	Rev. 03	5,00	2,00E +05	0,50	2,00E +06
	Passenger external doors	TD-FT00.F90.201.0 002	National Electrical Multiple Unit Project RAMS Analysis Requirements for Passenger External Doors	Rev. 01	30,00	3,33E +04	5,00	2,00E +05
	Passenger compartement windows	TD-EM00.44.0043	National Electrical Multiple Unit Project RAMS Analysis Requirements for Passenger compartement (vasistas)windows	Rev. 00	0,80	1,25E +06	N/A	N/A
			National Electrical Multiple Unit Project RAMS Analysis Requirements for Passenger compartement (standard)windows		0,30	3,33E +06	N/A	N/A
	Motor cooling ducts and bellows	TD-EM00.44.0044	National Electrical Multiple Unit Project RAMS Analysis Requirements for Traction Motor Cooling Bellows	Rev. 01	N/A	N/A	N/A	N/A
	Traction motor and Gearbox	TD-FT00.E90.201.0 013	National Electrical Multiple Unit Project RAMS Analysis Requirements for Traction Motor and Gearbox (traction motor with sensors)	Rev. 00	4,20	2,38E +05	2,00	5,00E +05
	Traction motor and Gearbox	TD-FT00.E90.201.0 013	National Electrical Multiple Unit Project RAMS Analysis Requirements for Traction Motor and Gearbox (motor coupling)	Rev. 00	0,60	1,67E +06	N/A	N/A
	Traction motor and Gearbox	TD-FT00.E90.201.0 013	National Electrical Multiple Unit Project RAMS Analysis Requirements for Traction Motor and Gearbox (gearbox)	Rev. 00	2,20	4,55E +05	0,80	1,25E +06
	Traction and Electrodynamic Braking	TD-EM00.44.0046	National Electrical Multiple Unit Project RAMS Analysis Requirements for Traction and Electrodynamic Braking	Rev. 02	36,40	2,75E +04	17,00	5,88E +04
	Power System Equipment	TD-FT00.E90.201.0 025	National Electrical Multiple Unit Project RAMS Analysis Requirements for Power System Elements	Rev. 03	28,60	3,50E +04	11,30	8,80E +04
	Traction motor cooling system	TD-EM00.44.0048	National Electrical Multiple Unit Project – RAMS Analysis Requirements for Traction motor cooling system	Rev. 00	4,50	2,22E +05	0,50	2,20E +05
	Pantograph Procurement Technical Spec.	TD-FT00.E90.201.0 019	National Electrical Multiple Unit Project RAMS Analysis Requirements for Pantograph	Rev. 03	15,40	6,50E +04	4,50	2,20E +05

(Handwritten signatures and initials)

				Inherent reliability	Mission reliability (Critical Reliability)			
					RAMS targets required to suppliers in technical specifications	RAMS targets required to suppliers in technical specifications		
FTB Project 225 km/h - RAMS Tracking log				Rev. No	fpmh [1/10 ⁶ hrs]	MTB F [hrs]	fpmh [1/10 ⁶ hrs]	MTB F [hrs]
	Transformer Procurement Technical Spec.	TD-FT00.E90.201.0 011	National Electrical Multiple Unit Project RAMS Analysis Requirements for Transformer	Rev. 03	5,90	1,70E +05	1,70	5,90E +05
	Train Control and Monitoring System (TCMS)	TD-FT00.E90.201.0 027	National Electrical Multiple Unit Project - RAMS Analysis Requirements for TCMS (Train Control & Monitoring Systems)	Rev. 03	430,0 0	2,33E +03	25,00	4,00E +04
	Signaling System	TD-FT00.E90.201.0 015	National Electrical Multiple Unit Project - RAMS Analysis Requirements for Signalling System	Rev. 01	TBOffered	TBOffered	TBOffered	TBOffered
	Signaling System	TD-FT00.E90.201.0 018	National Electrical Multiple Unit Project - RAMS Analysis Requirements for Repeater	Rev. 01	4,00	2,50E +05	N/A	N/A
	Driver HVAC System	TD-FT00.F28.201.0 001	National Electrical Multiple Unit Project RAMS Analysis Requirements for Driver HVAC System	Rev. 02	5,90	1,70E +05	N/A	N/A
	Passengers HVAC System & Electric Heaters	TD-FT00.F28.201.0 001	National Electrical Multiple Unit Project RAMS Analysis Requirements for Passengers HVAC System & Electric Heaters (single HVAC package Reliability targets)	Rev. 02	51,30	1,95E +04	18,00	5,55E +04
	Passengers HVAC System & Electric Heaters	TD-FT00.F28.201.0 001	National Electrical Multiple Unit Project RAMS Analysis Requirements for Passengers HVAC System & Electric Heaters (floor electric heaters Reliability targets)	Rev. 02	19,00	5,30E +04	N/A	N/A
	Driver Seat	TD-EM00.44.0057	National Electrical Multiple Unit Project - RAMS Analysis Requirements for Driver and Assistant Seat (Driver Seat Reliability targets)	Rev. 02	3,60	2,80E +05	1,40	6,90E +05
	Driver Seat	TD-EM00.44.0057	National Electrical Multiple Unit Project - RAMS Analysis Requirements for Driver and Assistant Seat (Assistant seat Reliability targets)	Rev. 02	1,30	7,69E +05	N/A	N/A
	Passenger Compartment Internal doors	TD-EM00.44.0058	National Electrical Multiple Unit Project - RAMS Analysis Requirements for Passenger Compartment Internal doors	Rev. 01	12,80	7,80E +04	N/A	N/A
	Intercommunicating gangway door	TD-EM00.44.0059	National Electrical Multiple Unit Project - RAMS Analysis Requirements for Intercommunicating gangway doors	Rev. 00	8,20	1,22E +05	N/A	N/A
	Passenger Seats and Tables	TD-EM00.44.0060	National Electrical Multiple Unit Project - RAMS Analysis Requirements for Passenger Seats	Rev. 00	N/A	N/A	N/A	N/A

FTB Project 225 km/h - RAMS Tracking log

				Inherent reliability	Mission reliability (Critical Reliability)			
				RAMS targets required to suppliers in technical specifications	RAMS targets required to suppliers in technical specifications			
System / Equipment / Component	RAMS Requirement Technical Document			Rev. No	fpmh [1/10 ⁶ hrs]	MTB F [hrs]	fpmh [1/10 ⁶ hrs]	MTB F [hrs]
Impulse Tachometer	TD-EM00.44.0061	National Electrical Multiple Unit Project RAMS Analysis Requirements for Impulse Tachometer		Rev. 01	5,00	2,00E+05	0,50	2,00E+06
Internal Lighting System (driver' cab and passenger area)	TD-FT00.E90.201.0 016	National Electrical Multiple Unit Project – RAMS Analysis Requirements for Internal Lights Systems (Driver's Cab and Passengers Area)		Rev. 01	13,00	7,69E+04	0,10	1,00E+07
External Lights system	TD-FT00.E90.201.0 014	National Electrical Multiple Unit Project – RAMS Analysis Requirements for External Lights system		Rev. 01	10,10	9,90E+04	0,10	1,00E+07
Universal and Standard Toilet System	TD-EM00.44.0064	National Electrical Multiple Unit Project – RAMS Analysis Requirements for Standard and Universal Toilet System		Rev. 01	87,10	1,15E+04	37,00	2,70E+04
Universal and Standard Toilet System	TD-EM00.44.0065	National Electrical Multiple Unit Project - RAMS Analysis Requirements for Integrameter		Rev. 01	18,20	5,50E+04	N/A	N/A
Thermal and Noise Insulation Provisions and materials	TD-EM00.44.0066	National Electrical Multiple Unit Project – RAMS Analysis Requirements for Thermal and Noise Insulation		Rev. 01	N/A	N/A	N/A	N/A
Bistro System (interiors and equipments) and vending machine	TD-EM00.44.0067	National Electrical Multiple Unit Project - RAMS Analysis Requirements for Bistro Equipment		Rev. 01	N/A	N/A	N/A	N/A

ANNEX 4 – COMPONENTS/EQUIPMENT UPDATE

ID	SUPPLY
1	BOGIE SUSPENSION DAMPERS (ANTIYAW) FOR NATIONAL ELECTRIC MULTIPLE UNIT PROJECT
3	PANTOGRAPH SYSTEM EQUIPMENT FOR NATIONAL ELECTRIC MULTIPLE UNIT PROJECT
4	DRIVER CAB HVAC SYSTEM & ELECTRIC HEATERS, PASSENGERS HVAC SYSTEM & ELECTRIC HEATERS, NON RECURRING COST FOR NATIONAL ELECTRIC MULTIPLE UNIT PROJECT
5	TRAIN CONTROL AND MONITORING SYSTEM, NON RECURRING COST FOR NATIONAL ELECTRIC MULTIPLE UNIT PROJECT
6	GANGWAY NON RECURRING COST FOR NATIONAL ELECTRIC MULTIPLE UNIT PROJECT
7	EXTERNAL LIGHTS FOR NATIONAL ELECTRIC MULTIPLE UNIT PROJECT
8	PASSENGER EXTERNAL DOORS, NON RECURRING COST FOR NATIONAL ELECTRIC MULTIPLE UNIT PROJECT
9	TRACTION CHAIN SYSTEM, NON RECURRING COST FOR NATIONAL ELECTRIC MULTIPLE UNIT PROJECT
10	BRAKE SYSTEM FOR NATIONAL ELECTRIC MULTIPLE UNIT PROJECT
11	WIPER SYSTEM FOR NATIONAL ELECTRIC MULTIPLE UNIT PROJECT
12	FIRE SYSTEM FOR NATIONAL ELECTRIC MULTIPLE UNIT PROJECT
13	MASTER CONTROLLER FOR NATIONAL ELECTRIC MULTIPLE UNIT PROJECT

14	CAB MASK
15	PASSENGERS AND EMERGENCY WINDOWS
16	WINDSCREEN
17	BOGIE MONITORING SYSTEM
18	ETCS

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