TENDER No. 51403

for

the Supply and Maintenance of

Electric Multiple Units

Volume B

Technical Specifications

March 16th, 2016
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<tr>
<td>AAR</td>
<td>Association of American Railroads</td>
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<tr>
<td>AC</td>
<td>Alternating current</td>
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<td>a/c</td>
<td>Air conditioning</td>
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<td>AFB</td>
<td>Automatic Drive-Brake-Control</td>
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<td>ATC</td>
<td>Automatic Train Control</td>
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<td>ATP</td>
<td>Automatic Train Protection</td>
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<td>CAN bus</td>
<td>Controller Area Network bus</td>
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<tr>
<td>CCITT</td>
<td>Comité Consultatif Internationale Télégraphique et Téléphonique</td>
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<tr>
<td>CCTV</td>
<td>Closed-Circuit Television System</td>
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<td>DC</td>
<td>Direct current</td>
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<tr>
<td>DD</td>
<td>Double-Deck Unit</td>
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<tr>
<td>DDHC</td>
<td>Double-Deck Handicapped Coach equipped for handicapped passengers</td>
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<tr>
<td>DDPC</td>
<td>Double Deck Pilot Coach</td>
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<td>DDTC</td>
<td>Double-Deck Trailer Coach</td>
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<td>DMA</td>
<td>Direct Memory Access</td>
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<td>DMI</td>
<td>Driver Machine Interface</td>
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<td>EBO</td>
<td>Regulations for Railway Construction and Operation in Germany</td>
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<td>EMC</td>
<td>Electromagnetic compatibility</td>
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<td>EMF</td>
<td>Electromagnetic Field</td>
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<td>EN</td>
<td>European Norm</td>
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<td>EP-brake</td>
<td>Electro-pneumatic Brake</td>
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<td>ETCS</td>
<td>European Train Control System</td>
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<td>FKM</td>
<td>Guidelines for calculated stress analysis for machine components</td>
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<td>GPS</td>
<td>Global Positioning System</td>
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<td>HMI</td>
<td>Human-Machine Interface</td>
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<td>HPL</td>
<td>High Pressure Laminated Linings</td>
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<td>HVAC</td>
<td>Heating, Ventilation, Air conditioning</td>
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<td>H.V. Network</td>
<td>High Voltage network</td>
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<td>IEC</td>
<td>International Electrotechnical Commission</td>
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<tr>
<td>IETM</td>
<td>Interactive Electronic Technical Manual</td>
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<td>IGBT</td>
<td>Insulated Gate Bi-polar Transistor</td>
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<td>ISO</td>
<td>International Organization for Standardization</td>
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<td>IS</td>
<td>Israeli Standard</td>
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<td>ISR</td>
<td>Israel Railways Ltd.</td>
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<td>ITU</td>
<td>International Telecommunication Union</td>
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<tr>
<td>LAHT</td>
<td>Low Alloy High Tensile</td>
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<td>LCC</td>
<td>Life Cycle Costs</td>
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<tr>
<td>LED</td>
<td>Light-Emitting-Diode</td>
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<tr>
<td>LZB</td>
<td>Continuous Automatic Train Control System with Cab Signalling</td>
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<td>MBP</td>
<td>Main Brake Pipe</td>
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<td>MB</td>
<td>Data Sheet</td>
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<tr>
<td>MDBF</td>
<td>Mean Distance Between Failures</td>
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<tr>
<td>MDBSF</td>
<td>Mean Distance between Sub-System-Service-Failures</td>
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<tr>
<td>MDT</td>
<td>Mean Down Time</td>
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<td>MG-brake</td>
<td>Magnetic Track Brake</td>
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<td>MOT</td>
<td>Israeli Ministry of Transportation</td>
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<td>MSL</td>
<td>Mean Sea Level</td>
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<tr>
<td>MTBF</td>
<td>Mean Time between Failures</td>
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<td>MTTM</td>
<td>Mean Time To Maintain</td>
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<tr>
<td>MTTR</td>
<td>Mean Time To Repair</td>
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<td>MRB</td>
<td>Manufacturing Record Book</td>
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<tr>
<td>MU</td>
<td>Multiple Unit</td>
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<td></td>
<td>Same as “trainset”</td>
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<tr>
<td>MVB</td>
<td>Multifunction Vehicle Bus</td>
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<tr>
<td>NTP</td>
<td>IPO</td>
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<tr>
<td>PAS</td>
<td>Passenger Alarm System acc. to UIC 541-6</td>
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<td>PA-System</td>
<td>Public Address System</td>
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<td>PIS</td>
<td>Passenger Information System</td>
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<td>PP</td>
<td>Push-Pull</td>
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</tr>
<tr>
<td>RAM</td>
<td>Reliability – Availability – Maintainability</td>
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<tr>
<td>RAMS</td>
<td>Reliability – Availability – Maintainability - Safety</td>
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<tr>
<td>RIC</td>
<td>Agreement for the exchange and use of coaches in international traffic (RIC)</td>
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<tr>
<td>RT</td>
<td>Railtrack Standards, UK</td>
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<tr>
<td>SD</td>
<td>Single-Deck</td>
</tr>
<tr>
<td>SDPP</td>
<td>Single Deck Push Pull trailer coach</td>
</tr>
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<td>SDPP-PC</td>
<td>Single Deck Push Pull Pilot Coach</td>
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<tr>
<td>SPM</td>
<td>Suspended Particle Matter</td>
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<td>TCN</td>
<td>Train Communication Network, according to IEC 61375</td>
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<td>TEN</td>
<td>Trans European Network</td>
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<td>TL</td>
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<td>TOR</td>
<td>Top of Rail</td>
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<tr>
<td>TSI</td>
<td>Technical Specification for Interoperability</td>
</tr>
<tr>
<td>UIC</td>
<td>Union Internationale de Chemins de Fer</td>
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<tr>
<td>VDE</td>
<td>Federation for Electrical and Electronic Engineering and Computer Science, Germany</td>
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<tr>
<td>WTB</td>
<td>Wire Train Bus</td>
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<td>Expression</td>
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<tr>
<td>ALARP</td>
<td>As Low As Reasonably Practicable</td>
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<tr>
<td>Adhesion</td>
<td>Coefficient of: During rolling contact, the ratio between the longitudinal tangential force at the wheel-rail interface and normal force.</td>
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<tr>
<td>Approved</td>
<td>Where approval is required the Supplier must apply for specific written review and must receive specific written approval from the ISR.</td>
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<tr>
<td>Availability</td>
<td>The percentage of fleet vehicles readily available for service at any given time.</td>
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<tr>
<td>Disk Braking</td>
<td>Friction brake effort produced by the spring applied / electrically-released brake system.</td>
</tr>
<tr>
<td>Driver</td>
<td>Israel Railways personnel responsible for vehicle and train operation, used synonymously with &quot;Operator&quot;.</td>
</tr>
<tr>
<td>Dynamic Braking</td>
<td>Braking effort produced by traction motors.</td>
</tr>
<tr>
<td>Emergency Braking</td>
<td>Combined braking effort produced by dynamic braking, disk braking and magnetic track braking.</td>
</tr>
<tr>
<td>Friction Braking</td>
<td>The brake effort produced by disc braking and magnetic track braking.</td>
</tr>
<tr>
<td>Indusi</td>
<td>Inductive Train Control System</td>
</tr>
<tr>
<td>Interface</td>
<td>The points where two or more subsystems, systems, persons or firms must meet to assure continuity of the project.</td>
</tr>
<tr>
<td>Jerk</td>
<td>Time rate of change of acceleration and deceleration, equal to the second derivative of velocity. The normal units are meters per second cubed.</td>
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<tr>
<td>Multiple Operation</td>
<td>Trainsets are designed so that several of them can be coupled together to be operated as one single train.</td>
</tr>
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<td>Expression</td>
<td>Explanation</td>
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<tr>
<td>Multiple Unit</td>
<td>Self-propelled trainset consisting of several vehicles which have passenger capacity each.</td>
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<tr>
<td>Operator</td>
<td>Used interchangeably with vehicle driver</td>
</tr>
<tr>
<td>prove</td>
<td>The Bidder and/or Supplier, as applicable, must provide evidence that the requirement is fulfilled, respectively a description of the method used to verify that the requirement is fulfilled.</td>
</tr>
<tr>
<td>proved</td>
<td></td>
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<tr>
<td>proven</td>
<td></td>
</tr>
<tr>
<td>Redundancy</td>
<td>The existence in a system of more than one means of accomplishing a given function.</td>
</tr>
<tr>
<td>Reliability</td>
<td>The probability of performing a specified function, without failure in relation to a reference time period intended under actual operating conditions.</td>
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<tr>
<td>Service Braking</td>
<td>Normal variable braking effort available to the operator through the use of the master controller resulting from a combination of dynamic and friction brakes.</td>
</tr>
<tr>
<td>Slide, Wheel</td>
<td>During braking, the condition existing when the rotational speed of the wheel is less than that for pure rolling.</td>
</tr>
<tr>
<td>Slip, Wheel</td>
<td>During acceleration, the condition existing when the rotational speed of the wheel is greater than that for pure rolling.</td>
</tr>
<tr>
<td>Slip/Slide Syst.</td>
<td>System used to direct and correct wheel slide and wheel slip.</td>
</tr>
<tr>
<td>Subsystem</td>
<td>A subsystem is any of the major hardware groupings which in combination form a complete vehicle. The subsystems are carbody, bogies, propulsion system, friction brake system, air-comfort system.</td>
</tr>
<tr>
<td>Magnetic Track Brake</td>
<td>Electro-magnetic braking device used during emergency braking, independent from the coefficient of friction between wheel and rail.</td>
</tr>
<tr>
<td>Train</td>
<td>A train is composed of one or more units. If a train is composed of more than one unit, the units are mechanically and electrically coupled and the control of the train is performed from one driver's cabin.</td>
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<td>Expression</td>
<td>Explanation</td>
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<tr>
<td>Unit</td>
<td>Shall mean a Short Unit and/or a Long Unit, whether ordered under the Initial Purchase Order or under an Additional Purchase Order in accordance with the terms and definitions of Tender Documents.</td>
</tr>
<tr>
<td>Vehicle</td>
<td>A vehicle is the smallest part in a Unit (=single vehicle); it features an individual body shell lying on its own sets of wheels or sharing them with adjacent vehicles.</td>
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0 Introduction

This Technical Specification describes the requirements for design, technical performance, manufacture, delivery and maintenance of new Double Deck Electrical Multiple Short and Long Units (Unit) for Israel Railways. A mixed configuration of SD and DD vehicles of a proven design solution by Bidders will also be accepted. This specification describes ISR’s requirements concerning the characteristics and equipment of an Unit with an electric propulsion system running on a new build 25 kV, 50 Hz catenary system in Israel. This overhead network system is currently under construction.

In the Technical Proposal, all articles of this Technical Specifications shall be explicitly, definitely, traceably and fully responded in writing (tabular form preferred) in the same order as in this Specification. Relevant drawings, sketches, curves or other technical documentation shall be highlighted in the written respond and completely enclosed.

Bidder shall offer a Unit which is based on a proven design and meets the specified requirements. The Technical Proposal shall include the maintenance of the Unit over a defined service period - as specified in the Agreement in section 19.2-. The realisation how these requirements are fulfilled shall be explained in the Technical Proposal.

Bidder must fulfil all the requirements of the Technical Specifications. Nevertheless, the Bidder may propose alternative solution which provides the same or better level of performance. In any event ISR is not obliged to accept the alternative provision.
1 General Requirements

1.1 Operational Characteristics
The Unit shall be designed for universal operation on the electrified tracks of the ISR network.

The Unit shall be bi-directional vehicle with driver cabs on both ends.

A train speed of 160 km/h shall be reached under maximum load and operation conditions.

The Unit is used in regional service as well as for intercity comparable passenger traffic. The journey distances are varied from a few kilometres up to about 300 km. The distance between the stations can be as short as 2 km.

The Unit shall provide full performance operation under the environmental conditions in Israel.

The Unit shall be suitable for a daily average operation time of at least 18 hours with a running performance of 175,000 km/year with scheduled maintenance according to the Supplier’s instructions.

The Supplier has the sole responsibility to observe and comply with all relevant functions and parameters which are required for safe and reliable operation within ISR.

Operation and monitoring of the Unit by a single driver shall be warranted.

1.1.1 Vehicle Concept
Two different configurations of Unit shall be offered according to this technical specification:

The Short Unit shall be composed of

- Unit consisting of 4 vehicles with an adequate number of motor vehicles to meet traction power performance requirements
- One vehicle meeting the requirements for the transport of wheel chair users according to TSI PRM;
- Driver’s cabs on both ends of the unit.

The Long Unit shall be composed of

- Unit consisting of 6 vehicles with an adequate number of motor vehicles to meet traction power performance requirements
- One vehicle meeting the requirements for the transport of wheel chair users according to TSI PRM;
- One vehicle shall be equipped with a bistro section for passenger service;
- Driver’s cabs on both ends of the unit.
Both configuration types shall be designed so that the units have an optimum of possible redundancy, especially for the traction and auxiliary system as well as the train control. Respective studies shall be provided in the offer. The different types of vehicles within the unit shall be minimized while a maximum level of unification regarding interchangeability of vehicles, parts and consumables shall be envisaged.

The Unit’s shall be designed in a way that

- The Short Unit can be extend by an additional vehicle
- The Long Unit can be extending by an additional vehicle.

The two ends of the unit shall feature an automatic coupler, allowing the mechanical, electrical and pneumatic coupling without the necessity for manual assistance. Coupling shall be easily possible during normal operation (see chapter 2.4.1).

The following configuration in multiple unit operation shall be possible in revenue service:

- up to three (3) Short Units
- Up to two (2) Long Units
- One (1) Long Unit plus up to two (2) Short Units

Operational flexibility in regard to coupling different units shall at least be achieved with twelve (12) vehicles in a train set consist. The list of applicable standards shall be prepared by the Supplier during the design process.

Following summary of general design topics shall be ensured:

- Passenger friendly seat configuration and alignments, sufficient aisle width and a modern and clean compartment interior design
- Provision of sufficient space for person with reduced mobility, bicycles, baby carriage and luggage

### 1.2 Design Targets

The vehicles shall be designed according to the current state-of-the-art and have to fulfil the requested requirements of the Technical Specification for Interoperability TSI LOC PAS.

Design verification shall be demonstrated by stress analysis, engineering calculations, comparative analysis and tests. The following chapter outlines the minimum design criteria and applicable standards. The list of applicable standards shall be prepared by the Supplier during the design process.

Design and construction of the offered Units have to fulfil best practice quality standards and corresponding references shall be provided.
- Provision of real time passenger information, communication systems and emergency signalisation systems
- As best as possible barrier free clearance between ISR’s station platforms and Unit entrance area and at the Unit interior including toilet access
- All applicable safety standards shall be met
- The Unit shall be reliable and energy-efficient on the ISR’s operation conditions
- The Unit shall support the interference-free feeding back of break energy into the public power grid via the catenary system
- The arrangement of equipment and assemblies shall allow easy access in case of repair and maintenance
- Sufficient and easy access to all major components and assemblies at the whole Unit (e.g. drivers’ cabs, equipment cabinets, roof sections, underfloor area) shall be ensured
- It shall be possible to lift out large assemblies preferably upwards through easily removable roof hatches and side walls
- Forklifting shall be used for lateral removal of components or modules
- To avoid electrical hazards in relation to any handling or work at the Unit a safe grounding regime covering all electrical components of the Unit shall be provided
- Identical components, equipment, and assemblies must be interchangeable without restrictions between the Units
- Standard components and fasteners shall be applied as far as possible
- The need of special tools and equipment shall be minimized

Considering the requirements of environment protection and the state-of-the-art, the Unit shall be integrally optimised according to the following design targets (most important first):

- Overall passenger comfort satisfaction, passenger seat friendly configuration and alignments and seating capacity optimized
- Minimum maintenance effort
- Maximum reliability and high availability
- Maximum total efficiency including energy recuperation
- Optimum running quality and low track stress impact
- Optimum transmission of tractive effort between wheel and rail in the entire speed range
- Low noise emission according to the applicable standards
• Ergonomically well designed driver's cab

1.3 Climatic Conditions

For the functionalities of the Unit and its components and parts, the climatic conditions which are listed below have to be respected (see also Appendix D.1):

Range of ambient temperatures: -5 °C to +45 °C (with temperature changes of up to 20°C per hour)
Altitude of operations: -400 m to +800 m above MSL
Cross winds: 5 m/s with gusts of wind of 50 m/s in duration of 1s per gust of wind
Snowfall no particular requirements
Rainfall 400-800 mm/years
Relative humidity: 10% to 90%
UV radiation 360-600 MJ/m² per year
Sunny hours per year: 3300 h
Contamination of the atmosphere: refer to Appendix D2
Sea salt concentration in the atmosphere: refer to Appendix D3

It is specifically emphasised that no performance degradation shall result from any "worst case" combination of the environmental conditions defined in this specification.
Special attention shall be paid to the local sunlight intensity and resulting heat transfer by radiation.
Worst case cross wind characteristics shall be considered and characterised by the elaboration as specifically described in Section 1.10.

1.4 Applicable Standards

All applicable laws, standards and rules shall be met with respect to the order as listed below, even if they are not explicitly listed in this Technical Specification. In general and related to the publication date of the tender the latest published versions of the dedicated standards and rules are to be used.
The applied laws, standards and rules applicable to each section shall be explained in the bid.
Generally the most restrictive requirements as given by law, standard or rule shall be applied.
In cases of contradictions between any of the above mentioned laws, standards or rules, the most superior requirement according to the hierarchy below shall be applied.

The design and production of the offered Unit must be in compliance with the applicable standards of the following hierarchically listed standard families (descending order):

1. Israeli Legislation, ISR homologation demands
2. Israel Technical Rules, Norms and Standards
3. TSI
4. EN/IEC Norms and -Standards
5. UIC Leaflets
6. Other norms and standards

For the removal of doubt the design requirement in regard to the fire safety relevant standard approach will be as described in Chapter 6.

Even if applicable standards are mentioned in the individual sections of this specification it is to be noted that such references or listings are not exclusive.

If changed or new standards come into force after award of the Contract, the Supplier shall give notice to ISR and if this would cause unexpected efforts, submit proposals for compliance.

In the event that

- ISR determines that compliance is required, and
- the proposals for compliance constitute a variation,

then a Variation Order shall be negotiated.

### 1.5 Characteristics of the Unit

#### 1.5.1 Basic Technical Data

**Interior**  
Second class, non-smoking interior design

**Seats**  
at least 100 seats in average per vehicle including folding seats within a unit; folding seats not more than 10% of the total seat quantity

**Standees**  
at least 100 standees in average per vehicle (4 passenger per m²) within a unit

**Loading Gauge**  
DE2 according to EN 15273-2

**Catenary System**  
AC 25 kV, 50 Hz according to EN 50163  
($U_{\text{min1}} = 49.017.5$ kV lowest non-permanent voltage/ short time minimum voltage, $U_{\text{min2}} = 17.519.0$ kV lowest permanent voltage/ continuous minimum voltage, $U_n = 25.0$ kV / nominal voltage, $U_{\text{max1}} = 27.5$ kV highest permanent voltage/ continuous maximum voltage, $U_{\text{max2}} = 29.0$ kV/(10 min.) highest non-permanent voltage/short time maximum voltage)
Power

The continuous power of the Unit (long version as well as short version) shall be sufficient to reach a trip time between Tel Aviv and Jerusalem of less or equal to 27 minutes according to the procedure and boundary conditions as described in Appendix B.

This performance must be provided at catenary voltages between 22.5 kV and 27.5 kV.

In accordance with EN 50388 the power shall be linearly reduced down to 22.5 kV and quadratic reduced from 22.5 kV to 17.5 kV catenary voltage. The power factor cos φ shall be min. 0.98.

One Unit under design mass under exceptional payload condition (according to EN 15663, payload for passenger trains other than high speed and long distance trains) shall be in a position to accelerate a second, identical unit also under design mass under exceptional payload-the same loading condition on an ascending slope of 30 ‰.

Acceleration

The maximum acceleration and deceleration of the Unit as the basis for the design of the slip/slide control shall be 1.5 m/s².

Drive System

AC three-phase asynchronous driven by state of the art converters fed from intermediate DC voltage circuit.

Braking System

1. Regenerative brake, dependent on overhead voltage, with a brake force limited which is freely adjustable up to the maximum traction effort value (primary brake, related to 4 axles)
2. Automatic UIC conform indirect-acting air brake as secondary backup service brake for the entire train
3. Computer controlled Direct-acting air brake for the Unit
4. Spring-loaded air-released parking brake; the parking brake shall be dimensioned with a safety coefficient of at least 1.5 against rolling away on a 40 ‰ slope
5. Emergency brake override according to UIC 541-6
6. A blending system shall automatically assure that the friction brake of the Unit is only applied if the electric brake cannot provide the brake demand
7. MG-brake for reducing the emergency braking distance shall be provided

Braking performance

Mode P: min. 120 brake weight percentages (UIC 544-1)
Mode R: min. 140 brake weight percentages (UIC 544-1)
Mode R+Mg: min. 200 brake weight percentages (UIC 544-1)

Additionally, in pneumatic braking mode R+Mg the Units shall provide a brake distance below 900 m with new wheels from initial
speed of 160 km/h considering all compositions as defined in section 1.1.1.

The thermal capabilities of the Unit shall allow the operation with maximum speed downhill from Jerusalem to Tel-Aviv via the new A1 line as well as on flat levelled lines with mean station distances down to 2 km.

Maximum Axle Load ≤ 22.5 t

Wheelset Shall be in accordance with EN 13260
Wheels Shall be in accordance with EN 13262 and EN 13979-1
Wheel Profile Wheel profile shall be S1002 in accordance with EN 13715
Axles Shall be in accordance with EN 13261 and EN 13104
Nominal Track Gauge 1,435 mm
Max. Speed 160 km/h (must be possible to be reached with worn wheels)

All basic technical data of the Unit (except loading gauge) as well as the traction programme apply for the whole range of the above-mentioned overhead line voltage and – if not stated otherwise – for half-worn wheels.

1.5.2 **UIC-Track Classification**

The Units shall be homologated for operation on railway lines of class D2 according to UIC-700 EN 15528.

1.5.3 **Additional Requirements**

The minimum negotiable curve radius at \( v = 5 \) km/h has to be 8990 m. This shall also apply for S curves with a curve length of < 175 m as well as for double S curves with linear intermediate section.

With the running gear in regular condition, it has to be possible to tow the Unit at maximum speed. Potential restrictions shall be specified, including required safety measures. The brake equipment, including control devices, has to be designed in such a way that allowable operator control actions (e.g. emergency brake application) do not cause any damage to the vehicle under any conditions. The Unit shall be equipped with basic tools, spare parts like lamps and fuses. Furthermore, the Unit shall be featured with connection cables as far as necessary for multiple traction or rescue operation.

The vehicle shall be featured with a lockable conductor train master box.
1.5.4 Start-up/- Shutdown Procedure

The Unit shall be equipped with an user friendly control for the start-up and shut-down of the Unit when operating the Unit in single and in multiple operation service.

A description of the start-up and shut-down procedure which will be implemented in the Unit together with the duration times for the execution of the related procedures shall be defined by the Bidder.

1.5.5 Operation Modes

Unit shall provide at least the following operation modes which shall be:

- Driving Modes (Master / Slave)
- Parking Mode
- Washing Mode
- Towing Mode
- Emergency and Rescue Operation Modes
- Coupling mode (if necessary)
- Test / Depot mode (in order to perform periodic checks in standstill and to allow moving in depot under control of ATP systems with limited performances)

1.5.5.1 Parking Mode

Parking Mode shall allow the parking of the vehicle with living catenary power supply. At least the following functions shall be available:

- Unit is safely braked at slope up to 40 \( \% \)
- Air conditioning in parking mode (to hold temperature on pre-defined value)
- Interior and exterior lighting is operational (i.e. it can be switched on or off)
- Automatic coupling to any Unit shall be possible
- It shall be possible to start the parked unit after coupling from the active train.

The parking mode shall feature an energy management system in order to minimize the energy consumption of the unit when parked.

Starting up from the Parking Mode shall be possible within 2 minutes. The specified time is the technical turnaround time, including the execution of the necessary safety checks.

In case of interrupted power supply the discharging of the vehicle’s batteries shall be minimized by controlled deactivating of all consumers except those with safety relevance.
Starting up a parked train by the maintenance or cleaning personnel in order to allow them to perform their specific tasks shall easily be possible.

1.5.5.2 Washing Operating Mode

Washing operating mode shall be implemented as follows:

- The Unit speed shall be automatically hold at a low speed (of 2-3 km/h).

1.5.5.3 Emergency Operation

It must be possible to tow a Unit with a locomotive without main reservoir pipe. By means of suitable measures it shall be possible to feed the air suspension by such locomotive without main reservoir pipe.

The Bidder shall indicate/describe the following:

- Maximum rescue speed
- Rescue procedure

1.6 Vehicle Gauge

The construction gauge of the Unit shall be dimensioned based on the pertinent rules of the different parts of EN 15273 (successor of UIC 505).

The Unit shall be compliant with the kinematic reference gauge profile DE2.

The coefficient of flexibility has to be in compliance with EN 15273.

A calculation sheet and the related drawing showing the analysis and the kinematic envelope shall be submitted in the bid documents by the Bidder.

1.7 Vehicle Weight

The vehicle weights shall be defined according to EN 15663. The Unit shall be categorized in the vehicle group: “Passenger vehicles other than high speed and long distance trains”.

The Bidder shall list the values of following masses including the specific axle loads of the Short Unit as well as the Long Unit:

- Dead mass
- Design mass
  - Design mass, in working order
  - Design mass under normal payload
  - Design mass under exceptional payload
- Operational mass
  - Operational mass, in working order
  - Operational mass under normal payload
in its offer.

Low axle loads under the worst loading condition should be aimed.

In its offer, the Bidder shall submit a comprehensible calculation including all applied parameters.

## 1.8 Infrastructure

### 1.8.1 General

The following chapters outline the key aspects with regard to the ISR infrastructure. Further information concerning the infrastructure are listed in Appendix.

The Unit shall comply with all listed aspects / requirements.

### 1.8.2 Platform Height and Length

The current height of the passenger platforms in the railway stations is between 760 – 1060 mm above TOR, see Appendix A.4. ISR is going to implement an unified standard platform height at 760 mm height in the long term. The Unit's design to be offered shall reflect ISR station platform height in the range of 760 to 960 mm.

The Unit shall be designed to enable an almost step-less boarding level access to the train set from the platform height of 760 mm. According to the terms in TSI PRM.

The standard design length of platforms, is being considered with 325 m. Parts of the platforms in stations are situated in curved areas.

Respective studies regarding exterior dimensions for the proposed train and door and step arrangement/location optimizing the seating capacity and being in compliance with TSI PRM shall be provided in the offer.

Furthermore, the Bidder shall indicate door location and door arrangement solutions for the transition period of platform height adjustment to the ISR new defined standard height. At all platform heights the dedicated requirements of TSI PRM shall be met. Deviations or non-compliances of the design solution shall be explained in the bid. Consequently, sliding steps or an lift and means to mitigate the entrance at 760 mm, 960 mm as well as 1060 mm for wheel chairs shall be provided, if required.

The Bidder shall consider and comply with TSI PRM recommendations described for train sets arriving at 760 mm platform. TSI PRM described “Specific Case Germany 'P' for all trains intended to stop in normal operation at platforms of 960 mm height” shall be elaborated. Movable steps / bridging plates and or other suitable measures shall be offered to mitigate risks caused by different horizontal gabs from the external door sill to the platform edge following the recommendation as described by TSI PRM.
1.8.3 Tunnels
The Units have to run in tunnels with a length of about 12 km. The Units shall be defined as category B in accordance with TSI SRT and built in accordance with pertinent norms regarding the fire safety.

The Bidder shall submit evidence showing the Unit is suitable for operation in these tunnels with the maximum operation speed of 160 km/h considering train crossing.

1.8.4 Line and Track Parameter
The main track parameters and track geometry are given in Appendix A. The Bidder shall familiarise himself with the track conditions.

1.9 Noise Emissions

1.9.1 General
In all possible configurations the noise characteristics of the Units shall fulfil the related requirements of TSI NOI.

1.9.2 Interior Noise Passenger Compartment
Due to the fact that the TSI NOI does not define the permissible interior sound levels for the passenger compartment, the Bidder shall provide interior sound level values below the following levels:

- **Unit at Standstill in seating area** max. 60 dB(A).
- **Unit at Maximum Speed in seating area** max. 68 dB(A).
- **Unit at Maximum Speed in entrance area** max. 70 dB(A).
- **Unit at Maximum Speed in a Tunnel**: max. 73 dB(A).

Interior noise in the passenger compartment shall be measured and checked in accordance with EN ISO 3381 - Measurement of Noise inside Railbound Vehicles.

The related operation condition shall be in line with the conditions as defined in the TSI LOC PAS related to the interior noise within the driver’s cab in standstill (without signal horn) and maximum speed.

1.10 Pressure Protection, Aerodynamic
As described in the TSI LOC PAS the aerodynamic effects caused by pressure shocks or cross winds acting at the vehicle and its components in open environment or due to train crossings or entering / leaving of tunnels are to be considered. The maximum speed of the oncoming train is 160 km/h. The dedicated health and comfort related requirements as defined in TSI LOC PAS, EN
14067, UIC 651, UIC 660 as well as UIC 779-11 shall be applied accordingly. Requirements which are specifically related to high speed trains shall be applied considering its main requirements on the impact onto the passengers, the train as well as the staff.

The cross wind impact risk shall be demonstrated for the offered vehicles considering the most demanding configuration. The evaluation shall be made in accordance with EN 14067 or DB RIL 807 04 aiming to indicate the speed relevant restriction vs different potential cross wind speed conditions for the purpose to ensure safe service operation.

Both, the driver’s cab as well as the passenger compartments shall be protected against impacts of pressure shocks considering its structural as well as health aspects.

The pressure protection concept shall be described as part of the technical offer; the detail design and -calculation shall be submitted during the design phase after NTP.

The aerodynamic drag coefficient cw of the Unit shall be minimized down to the practically reasonable level.

1.11 Running Safety and Running Dynamics

1.11.1 General
The safe running in all operation states shall be proven according to the dedicated test methods as described in EN 14363 as well as UIC 518. The boundary conditions as described in Appendix C, chapter 1.5 and in the following shall be considered additionally to the general requirements as specified in the aforementioned standards related to vehicles for operation at the TEN (Trans European Network).

1.11.2 Running Dynamics Calculations
Mathematical evidences on the dynamic behaviour of Units shall be provided with the bid. The evidence for the condition at delivery and the deviations which are judged to be admissible by the manufacturer from a technical point of view shall be proved concerning an alteration of the wheel flange profile due to wear, loss of compensation force, maximal deviations of wheel load and axle load.

1.11.3 Dynamic Testing
The Unit dynamic testing and homologation as part of the required type tests shall comply with the requirements in EN 14363 and UIC 518. The Bidder shall define necessary tests in accordance with mentioned standards. The test runs shall be executed based on a maximum vehicle speed of 160 km/h and a maximum cant deficiency of 150 mm. It shall be taken into account that during these test runs both parameters; the maximum speed as well as the maximum cant deficiency; are to be increased by 10 % according to the requirements of the mentioned standards.
1.11.4 Comfort of Ride
Considering a track quality QN1 as defined in EN 14363 the ride comfort value $N_{MV}$ according to EN 12299 at a maximum speed of 160 km/h shall be smaller than 2.5 in all passenger compartments.

In case of a failed air spring system the operation shall still be possible by means of suitable emergency springs. In this condition the running comfort might be reduced. In their offer the Bidder shall indicate the comfort impact as well as the maximum permitted speed in this degraded operation mode.

The Bidder shall submit comfort of ride calculation for Short Unit and Long Unit based on the aforesaid conditions.

1.12 Electromagnetic Compatibility
All equipment and testing shall comply with EN 50121 and EN 50155. This requirement applies to the Unit under all operating conditions and in all possible states.

The Supplier has to ensure that all components on the Units are designed and built that they work regularly and undisturbed in their electromagnetic environment and do not exert any impermissible influence on other equipment or the environment. At the beginning of the design stage, the Supplier shall submit to ISR a detailed EMC validation plan to verify that all measures are taken which are required to ensure appropriate operation of all equipment and to demonstrate its compliance with the above mentioned standards. This validation plan shall specifically include a complete type testing program according to EN 50121. Approval of the validation plan by ISR does not relieve the Supplier from his obligation to take additional actions like e.g. further testing or design modifications if the requirement should arise during later stages.

The Supplier has the sole responsibility to request all information required from Suppliers of other equipment such as, for example, overhead power supply, and signalling or telecommunication equipment.

1.13 Interference with Signalling and Telecommunication Systems
The interference immunity levels shall be defined according to the applicable parts of the standard EN 50121 such that electromagnetic compatibility (EMC) among all equipment within the Unit as well as compliance with emission levels to the exterior and stray radiation levels from the exterior is warranted.

This does not only apply for regular operation of the Unit, but also in case of degraded operation modes.

In order to minimise the risks of unacceptable interferences, harmonics or distortions testing according to EN 50238: Railway applications – compatibility between rolling stock and train detection systems - has to be conducted.
The harmonic current limits shall be based on the psophometrically weighted levels in accordance with the European Standard EN 50121-3-1 concerning the protection of telecommunication lines against harmful effects from electrified railway lines.

The Supplier shall submit a safety case to demonstrate the compatibility between the traction vehicles and the infrastructure during the design phase. It is the sole responsibility of the Supplier to request all information required to carry out the safety case from ISR or the manufacturers of other equipment.

1.14 Health and Safety Impact of EMF on Passengers/ Train Crews

Passengers and train crews shall be protected against electromagnetic fields. In the passenger compartment and the driver's cab, the emission limits defined in the following standards have to be met:

- European directive 2013/35/EU related to the electromagnetic field radiation with respect to its impact on workers.
- 1999/519/EC on the limitation of exposure of the general public to electromagnetic fields additional in all passenger areas,
- Compliance shall be demonstrated by application of EN 50500.

1.15 Precautions against Pollution, Damage and Water

In order to prevent an affection of functionalities or a failure of devices and appliances, they shall be protected against damages and penetration of dirt, water and snow. This shall be realised by measures on the device itself, or by encapsulation, or by protective shields in their environment.

By means of appropriate tests as rinsing tests or water jet tests according to EN 60529 the Supplier shall prove resistance against the penetration of water.

By adequate shaping and arrangement, provisions have to be made to prevent an accumulation of dirt, water and ice, affecting the functionality, e.g. on the running or powered gear or on the roof equipment.

By an appropriate design of the air grilles it shall be ensured that sand and dust are separated from the inlet air. Such elements shall be of proven design considering the specific Israeli environment (cleaning method, humidity, dust, salty air, ...). The cooling elements shall as well be designed in such a way that they are not inclining to congestion by sand and dust. Cleaning measures during scheduled preventative maintenance intervals shall be ensured by easily access to the cooling elements without any further disassembly of the ventilation equipment before Unit’s maintenance revision/overhaul interval.

Exterior cleaning of the vehicle from all sides, from the top as well as from the bottom with an automatic washing plant, as well as a cleaning of the underframe with warm suds (up to 60°C),
shall be possible with a pressure of 8 bars without special protection measures and without a damage to the components and subsystems. The penetration of cleaning water in particular into control boxes, bearings, gear boxes, engines and sand distributors shall be prevented by constructive design measures.

All parts of the vehicle that get in touch with water and the usual chemical and mechanical cleaning agents including painting, rubber, plastics and other non-metallic materials may not be altered by the cleaning in a way that their appearance or their functionality are negatively affected. The equipment and materials must be chosen to withstand cleaning procedures.

Not sufficiently resistant devices shall be installed in air proof and dust tight chambers or cabinets.

Windows, doors and car body parts have to prevent the penetration of rain and cleaning water, sand and dust under special consideration of the environmental climatic conditions according to Appendix D.
2 Mechanical and Pneumatic Equipment

2.1 General Design Principles
For all decisions regarding the construction design, special care has to be taken concerning wear-freeness or limitation of wear, resistance against operational demands on the envisaged railway lines, cost-efficient maintenance and technical treatment in long intervals and of short duration.

All materials and technologies used shall be chosen according to the environmental and operating conditions in Israel, so that long-lasting reliable operation is guaranteed.

The construction of the Unit shall be designed for a total kilometric performance of at least 7.5 million km and / or a lifetime of at least 30 years.

2.2 Carbody
The carbody shall be of a modular design allowing the maximum utilisation of identical parts, such as windows, interior linings etc. The framing, sheathing and other related structure of the carbody shall form an integrated unit, which is able to resist all the loads inherent in this type of service without deformation. The specific damages shall be easy to repair, e.g. by changing panels or modules.

In its offer, the Bidder shall submit its carbody concepts (documentation, identification of same components to be used, drawings, description of carbody and vehicle, etc.).

The dimensioning of the car body shall be adapted according to the specific requirements for Unit of EN 12663 (category “P-II”). The carbody as well its attachments shall be designed according to endurance fatigue life.

The vehicle body of the Unit shall be designed and built as crash-optimised construction and fulfil the pertinent requirements of EN 15227 (category C-I). The crash concept shall consider minimum repair costs at minor potential collision events.

The crash concept shall be comprehensibly described in the bid.

All parts of the vehicle structure have to resist against the horizontal/ longitudinal and the vertical/ transverse accelerations, as specified in EN 12663

Concerning the evenness of the surfaces, the following values shall be respected:

- For side walls 1.5 mm / m,
- For the underframe 3 mm / m
2.2.1 Design

Low Alloy High Tensile (LAHT) steel, stainless steel, aluminium alloys or combinations of these materials should be utilised for the prime structure. It shall be a welded structure, including the entire underframe, sides, front and rear ends as well as the roof. Alternative structural connection methods such as rivets or bolts should be proposed, if an adequate service experience under similar conditions can be demonstrated. Non-structural members such as skirts and car-ends can be designed from fibreglass reinforced plastic materials of approved quality.

Special care shall be taken to avoid streaming of water over the car ends when the car is accelerating or decelerating. Rain gutters shall be provided above the passenger doors in order to protect the passengers when boarding and alighting.

The passenger compartment shall have an effective thermal insulation according to EN 13129.

Thermal insulation shall be selected in order to guarantee:

- Best performance at minimum weight
- Good corrosion protection
- No condensation between interior linings and structure.

2.3 Running Gear

2.3.1 General

The running gear shall be designed in such a way that the limiting criteria for driving safety, wear of infrastructure and dynamic behaviour and ride comfort according to EN 14363, UIC 518 and EN 12299 are not exceeded.

The connection of the running gear to the carbody shall allow lifting of the car with the running gears attached. It shall however be easy to separate the bogies from the car by simple tools.

The motor bogies and the trailer bogies shall be identical as far as technically reasonable. The front running gear and the rear running gear shall be interchangeable as much as possible.

The motor and the trailer bogies should be based on the same concepts and utilize a maximum of identical components such as axle box, primary suspension and secondary suspension.

The Bidder shall submit its bogie concepts as documentation, identification of same components to be used, etc. with the offer.

2.3.2 Structural Design of Bogie Frame

TSI LOC PAS shall be considered regarding the structural bogie design. The structural integrity of the bogie, all attached equipment and body to bogie connection shall be demonstrated and tested according to EN 13749, EN 12663-1, EN 15827 and UIC 515-4.
Box sections of the bogie frame shall be fully sealed by welds to prevent corrosion. All supports for a proper function of the bogie, shall be machined to guarantee a free interchangeability of the connected elements.

The assessment of the welds regarding strength (static and fatigue) shall include the overview of all relevant welding drawings and the used welding classes. The stress evaluation shall be based on an established railway-proven endurance strength assessment method as e.g. DVS 1612 or FKM guideline considering the welding classes in accordance to EN 15085. The evaluation method to be used during the design phase shall be highlighted in the offer.

2.3.3 Wheel Set and Journal Bearings

The design of the wheelsets shall be in accordance with the dedicated European standards as e.g.:

- EN 13260 Railway applications – Wheelsets and bogies – Wheelsets – Product requirements
- EN 13261 Railway applications – Wheelsets and bogie – Axles – Product requirements
- EN 13262 Railway applications – Wheelsets and bogies – Wheels – Product requirements
- EN 13103 Railway applications – Wheelsets and bogies – Non powered axles – Design Method
- EN 13104 Railway applications – Wheelsets and bogies – Powered axles – Design Method
- EN 13715 Railway applications – Wheelsets and bogies – Wheels – Tread profile

Furthermore the TSI LOC PAS shall be fulfilled.

The wheel profile shall be the S1002 according to EN 13715. Different wheel profiles may be proposed, if advantages in regard to ride quality or wear reduction can be demonstrated.

The surface treatment of the axles shall be to top class 2 as specified in EN 13261. The wheels shall be treated as defined in EN 13262.

It shall be possible to re-profile the wheelsets on an underfloor wheel lathe without dismantling the bogies from the carbody.

Each wheelset shall be equipped with a label for wheelset identification. The wheelset identification shall be easy visible from the pit without disassembling any components form the wheelset or bogie. The label shall be resistant against dust and scratch. The corrosion protection of the wheelset shall not be damaged due to the mounting of the label.
Standard cartridge journal bearings according to UIC 515 and EN 12080, approved for speeds up to 160 km/h shall be used. The axle bearings shall be made by “SKF-Group” or “FAG Kugelfischer AG”.

The wheelset bearings shall be grease-lubricated bearing units. The bearing unit, in conjunction with the bearing box, shall be electrically insulated; the return current shall not be passed through the rollers.

In accordance with TSI LOC PAS the axle bearing condition shall be monitored by on-board detection equipment.

### 2.3.4 Sanding System

A suitable number of proven sanding devices shall be installed for improving the outer wheelset of each front bogie force transmission between wheels and rail under poor friction conditions. The nozzles of the sanding pipes shall be as close as possible to the contact point wheel/rail and shall be adjustable.

The sand reservoirs shall be installed in the vehicle body and it must be possible to replenish them from outside. The shape of the sand reservoirs shall allow the sand to pour out continuously until the reservoirs are completely empty.

The sanding reservoirs shall be equipped with a heating device in order to keep the sand dry.

The sanding control shall be equipped with an automatic mode, which activates the system dependent on related signals from the traction and brake control systems.

The manual controls within the driver’s reaching area must allow “short sanding” in the unlatched position and “continuous sanding” in the latched position.

According to the requirement in TSI CCS the maximum sand flow rate shall be:

- $400 \text{ g} + 100 \text{ g} / 30 \text{ s}$, at speeds $< 140 \text{ km/h}$
- $650 \text{ g} + 150 \text{ g} / 30 \text{ s}$, at speeds $\geq 140 \text{ km/h}$

A minimum sand flow rate of $400 \text{ g} / 30 \text{ s}$ shall be achieved at all speeds.

### 2.3.5 Flange Lubrication

The Unit shall be equipped with a state of the art flange lubrication system according to EN 15427.

The system shall be sensitive on the running direction and distance-controlled. The lubricant quantity per lubricating impulse shall be adjustable.

The lubricating device shall guarantee an efficient lubrication of the wheel flange during operation of the vehicle, except for standstill and speeds below 5 km/h. Any adhesion reducing contamination of the running surfaces by the lubricant as well as excessive application of lubricant shall be avoided.
The lubricant capacity shall be compatible with the scheduled inspection intervals. The reservoir shall be easily accessible to be refilled from outside the vehicle and not from a pit. The reservoir shall be fitted with a grease filter and an easily readable level gauge (optic or electronic).

The distance between lubrication impulses (depending on distance and curves) shall be adjustable within a range from 200 m to at least 2000 m. However, this adjustment shall not be individually done by the driver, but by general setup via software based diagnostic tool.

### 2.4 Coupling Devices

The Bidder shall conduct an assessment in regard to consider ISR’s specific track alignment condition as described in Appendix A to analyse potential operational or speed restriction of the Units in single and multiple operation.

#### 2.4.1 Automatic Coupling Devices at the front Ends

An A “type 10” automatic coupler as described in TSI LOC PAS and EN 16019 shall be installed at both front ends of the unit.

This coupler shall allow a fully automatic mechanical, electrical and pneumatic coupling. A service proven coupling systems shall be provided.

Automatic coupling between two Unit’s Units for multiple unit operation shall be remote controlled from one drivers cab. After coupling the coupled Unit shall be in the same operation condition as the Unit occupied with driver (e.g. enabling door’s operation). The Bidder shall indicate the coupling time required and to describe the tasks to be realized for the Unit operational readiness.

Uncoupling of two Unit’s shall be possible from the active drivers cab at any position of the train. The required time for uncoupling shall be indicated by the Bidder. The parking brake of the uncoupled and therefore unoccupied unit(s) shall automatically be applied and this unit(s) shall be automatically placed into the parking mode.

Furthermore the Bidder shall specify the radius of curves where an automatic coupling of Unit’s is possible. This shall be done for radius of C-curves and radius of S-curves.

#### 2.4.1.1 Emergency Coupler

A rescue coupler in accordance with EN 15020 and recommendations defined in the TSI LOC PAS shall be provided in order to allow towing of a failed Unit by other vehicles.

The rescue coupler shall:

- Be stored easily accessible on the respective end vehicles;
- Be designed to allow the rescue at a speed of at least 30 km/h on railway lines which comply with the TS INF;
- Be secured after mounting onto the recovery unit in a way that prevents it coming off during the rescue operation;
- Withstand the forces due to the intended rescuing conditions;
- Be designed such that it does not require any human presence between the recovery unit and the unit to be rescued whilst either one is moving;
- Neither the rescue coupler nor any braking hose shall limit the lateral movement of the hook when fitted onto the recovery unit.

The Bidder shall indicate the maximum possible speed level for towing a failed unit.

### 2.4.2 Coupling Device in-between Vehicles

The vehicles within the unit shall be connected by a well proven coupling system according to EN 15566 and EN 15551 or by suitable service proven semi-permanent couplers. The dedicated requirements of TSI LOC PAS shall be fulfilled.

### 2.4.3 Gangways / Gangway Facilities

A gangway in accordance with UIC 561 shall be proposed. It shall provide a safe and unobstructed circulation between the vehicles for the passengers under all operating conditions including reverse curves. The connection shall be completely sealed and must provide good thermal and acoustic insulation. The gangways shall be of a robust type suitable both for “pull” and for “push” operation. They shall permit free movement on horizontal and vertical curves. The control cable connectors between the vehicles shall be inside the intercar connection or otherwise protected against potential damages caused by stone strikes or other environmental influences.

Flexible, easy to install, end covers must be placed near the intercar connection in case when no car end doors are provided for single vehicle transfer and parking.

### 2.5 Driver’s Cab

#### 2.5.1 Design

The design of the driver’s cab structure shall be consistent with the requirements concerning crash performance as specified in paragraph 2.2.

For the design of the driver’s cab, the regulations of UIC 651 shall be applied. Furthermore the ergonomic requirements stated in UIC 617-54, UIC 617-6-5 and UIC 625-2 und 625-5617-6 shall be taken into account. In order to determine the body sizes as a basis for the ergonomic parameters UIC 651 shall be used. Due to increasing body sizes, it must be aimed to consider the maximum physical dimensions.

All materials and technologies applied in the driver’s compartment have to provide reliable function under all Israeli environmental and operational conditions.
The shape and surface design of the components of the driver’s cab (control panel, control elements, floor covering, lagging, windows) have to allow an easy cleaning and shall be sufficiently resistant against usual detergents.

2.5.2 Driver’s Seat

The arrangement of the driver’s seat shall be in compliance with the leaflet UIC 651 and shall observe the ISR left side operation. The seat shall be situated in centre or at left hand side position with no preference. The Unit driver’s seat shall be adjustable for height as well as along the longitudinal axis including the seat and backrest. The positioning of the seat and the adjustability has to allow for a quick leaving of the seating position and must not hamper the transition to a standing position of the Unit driver at the control panel. Furthermore, the arm-rests on both sides shall be foldable in order to secure easy access. An absorbing system, adapted to the oscillation characteristics of the Unit and adjustable according to the driver’s weight, has to keep vehicle vibration from the Unit driver.

The driver’s seat shall be fixed or adjustable in order to not constrain operational and maintenance works in the driver’s cab.

An additional seat or folding seat shall be provided such that from this seat the observation of the track and to the most important controlling devices is possible.

2.5.3 Driver’s Desk and Operating Elements

The arrangement of controlling devices and displays on the driver’s desk shall be divided into areas of different importance and functionality. The dedicated requirements and recommendations of UIC 651 as well as UIC 612 shall be met.

The operational control devices shall be grouped in order to allow ana one-man operation.

By means of a mock-up or by other suitable three-dimensional presentation the seat arrangement and position of controlling devices shall be offered during the design phase. In any case the design is to be agreed with ISR.

Further requirements are:

- All controlling devices necessary for operation of the Unit during its run are arranged within a radius of max. 820 mm from the body centre of the upright sitting Unit driver.

- All information like overhead line current and voltage as well as time shall be transmitted as operation data shall be presented via the diagnostic display.

- The possibility of installing an additional display, usable for “electronic timetable sheet” shall be provided.

- All displays shall be well readable – contrast 1:10 – and glare-free in all lighting conditions, especially at darkness.
- The labelling of control elements shall be lighted. They shall be arranged so as to be illuminated glare-free without reflexing in the front windows.

- One or several shelves with an appropriate area and volume for timetable documents shall be provided.

- It shall be possible to activate the horn by hand and by a pedal operated switch.

The arrangement of the driver’s desk and the operation elements shall be described in the offer. The final design shall be agreed with ISR during the design phase.

### 2.5.4 Driver’s Cab Access

The design of the driver’s access shall be in accordance with all applicable requirements of TSI LOC PAS and / or UIC 651. Thus, the access by separate lateral driver cab doors as well as via the passenger compartment is accepted.

The arrangement of the access doors shall be described by the Bidder.

Following requirements shall be met for both access possibilities according to TSI LOC PAS and / or UIC 651:

- An internal escape door to the passenger compartment shall be provided. It shall be possible to exit from the driver’s cab safely and without any difficulty over the specified distance. Height and width of escape route shall be considered. Furthermore, it shall be possible to open the door in opposite direction of the driver’s cab with the body, e. g. with crossbar and two levers. The related lock shall be designed as a panic lock for a quick opening of the door.

- The driver’s cab and its access shall be designed so that the train crew is able to prevent the cab being accessed by non-authorised persons, whether the cab is occupied or not, and so that a cab occupant is able to go outside of a cab without having to use any tool or key.

- Access to the driver’s cab shall be possible without any energy supply available on board. Cab external doors shall not open unintentionally.

- The entrance doors shall be equipped with a second handle with lock at the bottom of the door, in case external doors are proposed.

### 2.5.5 Visibility

The visibility from the driver’s cabin for the Unit driver has to comply with TSI LOC PAS and the referenced UIC 651.

### 2.5.6 Windscreen and Equipment

The windscreen shall fulfil the dedicated requirements of TSI LOC PAS as well as EN 15152.
Windscreens shall be equipped with an electric windshield heating in order to avoid misting. The specific heating power shall be dimensioned such that misting or/ and icing is reliably avoided under all mentioned environment conditions.

The windshield wiper and washing system must work reliably under all operating conditions up to the top speed including a headwind speed of 100 km/h. In cases of train crossings and tunnels a blowing over of wiper blades shall be reliably avoided.

The drives of the windshield wiper must be adjustable stepless or with smooth-step intervals.

The water level shall be easily readable without the need for initial removing of covers. The refilling interface and the tank volume capacity shall consider the operation regime and be presented to ISR for reviewing and approval. The Unit driver has to be informed in time about the low water level. The tank capacity shall be as big as technically reasonable. The maximum volume shall be listed in the technical proposal.

All windscreens shall be fitted with light-reflecting sun blinds which must cover the entire window surface when fully closed.

### 2.5.7 Side Windows, Destination Sign Windows and Rear-View Device

The driver's side windows (on both sides of the driver's cab) shall be fitted with a suitable opening mechanism which allows to:

- Communicate with anyone outside the car
- Provide ventilation

Double glazed tinted toughened safety glass shall be used for all windows with the exception of the destination sign window.

The side windows shall be designed as framed double glass windows.

Windows made of framed double glass windows or single pane windows shall be installed by means of an elastomeric profile for easy replacement. Solutions, where an outer frame is bonded to the structure, are permitted.

All windows shall be fitted with an effective, robust sun protection (shutter).

Locks shall be unlocked and locked automatically by opening and closing the window.

Clear safety glass of an adequate thickness of shall be utilised for the destination signs on the front of the car.

Each Unit cab shall be equipped with established state of the art video based rear-view devices, which provide the rear view on both sides of the Unit.
2.5.8 Lighting
The lighting within the driver’s cab shall fulfil all dedicated requirements of the TSI LOC PAS.

At a normal seat position of the driver, lighting of markings of control elements has to be glare-free without reflexions in the windscreen.

By a minimum voltage relay and/or a time-lag relay, it shall be ensured that the interior lighting switches off in time to enable a preparation for service and to prevent a total discharge of the battery.

2.5.9 Comfort Features (Thermo-Box, Wardrobe)
Each driving cab shall be equipped with:

- One combined device of refrigerator (min. 10 l) and hotplate/hotbox
- An easily accessible 230 V/50 Hz power socket for cleaning equipment and a coffee machine
- Two coffee cup or beverage holders
- A closed wardrobe for clothes and personal belongings and another appropriate wardrobe sufficiently ventilated shall be available
- A closed drawer for tools, extra bulbs and fuses
- A lightened timetable holder at the driver’s desk
- A waste box and an ashtray for the driver
- The floor shall be suitably structured to prevent slipping.

2.5.10 Emergency Equipment
Provisions shall be made in the driving cab to carry the following items of emergency equipment:

- In the driver’s cabin a megaphone and a searchlight, both connected to chargers, shall be provided
- Racks shall be provided in the driving cab for carrying the first aid box, such as medicine, first aid equipment etc. The dimension has to be finally approved by ISR.

In parallel, the dedicated requirements as defined in TSI LOC PAS shall be fulfilled.

2.6 Vehicle Interior Design

2.6.1 General
The Bidder shall co-ordinate the overall appearance of the Unit in consultation with ISR.

The vehicle interior design shall be approved by ISR.
The vehicle’s interior shall be fully compliant with TSI PRM. The interior of the vehicle shall be pleasing in appearance, and shall be free of sharp corners or edges to reduce the possibility of injury in either normal operation or collision.

The interior shall be resistance against tampering and shall be graffiti proof. Smoking areas shall not be provided.

Per each seat (excluding folding seats) 0.2 m³ volume as average per unit for luggage shall be foreseen. It shall be possible to hang up clothes at the seat place. The seat arrangement shall provide sufficient comfort considering the cross section of the vehicle.

Materials used in the vehicle interior design shall meet the following requirements:

- Long life;
- No deterioration due to normal use (passengers, cleaning materials etc.);
- No discoloration due to light impact (ultraviolet radiation);
- Fire safety standard requirements;
- Design optimization in regard to the acoustics to reduce reverberation and resonance noise.
- Non-soiling and easy to clean by means of a simple cleaning procedures which shall generally be provided.

2.6.2 Passenger Areas

In minimum the vehicle shall fulfil all dedicated requirements of TSI LOC PAS and TSI PRM as far as the exclusions are described explicitly in this document.

The Bidder shall offer the Unit interior design arrangement in the technical proposal bid in respect to meet the following interior layout design requirements: (Long and Short Unit):

- The Unit shall be equipped with 2nd class compartments only, with a min of 100 seats / 100 standings (4 p / m²) in average per vehicles in a unit;
- AOne vehicle to accommodate awith multi-purpose area
- At least 2 wheel chair posts per 4 / 6 vehicle Unit configuration;
- At least 1 Universal universal Toilet per 4 / 6 vehicle unit; The other vehicles shall be equipped with and in addition one standard Toilet toilet per Short Unit and three standard toilets per Long Unit;
- A Bistro section at the 6-vehicle unit configuration;
- Emergency and security equipment at all vehicles;
- Local area wireless internet access to passengers;
• Passenger information and automatic announcement system;

### 2.6.3 Vehicle Capacity, Arrangement of Seats and Tables

The default arrangement shall consist of vis-à-vis seats with a seat pitch facing dimension of at least 1750 mm. It shall be possible to store luggage between the seat backs of adjacent vis-à-vis seats. Row seat arrangements characterized by a pitch of 850 mm can be provided supplementary. Folding seats shall be limited to less than 10% of the total number of seats in all possible train configurations.

Not less than 10% of priority seats per fixed Unit shall be designated for the use of people with reduced mobility according to TSI PRM.

The design and configuration of seats and tables shall be at least in accordance to TSI PRM, UIC 566 and UIC 567.

The design arrangement shall be described within the technical proposal to explain the considerations in regard to offer an optimized arrangement as best for the ISR.

The passenger seats shall be aesthetically pleasing and be designed in accordance with recognised ergonomic criteria. The seats shall feature head rests with easily replaceable paper or fabric covers as well as arm rests; the arm rest between two individual seats shall allow retracting. The design and the use of materials shall be described in order to explain the material properties in regard to the life cycle and to support a simple cleaning procedure. The seats shall be mounted to the side walls in a way that an easy cleaning of the floor is possible.

The design of the tables shall support the easy cleaning of the vehicle e.g. by means of cantilever based designs. The Bidder shall propose a suitable table designs for the different seating arrangements (e.g. integrated in the side armrest or in the back of the seat).

Metallic hooks for plastic trash bags shall be installed under each table.

### 2.6.4 Vestibule Areas

The vestibules shall allow easy and comfortable boarding and alighting. The floor in the entrance shall be covered with dirt-mats to protect the floor covering in the passenger compartments. The door sills on the passenger doors shall be slip-resistant over the life of the vehicles.

The entrance areas shall be designed free of tripping edges and shall be equipped with an adequate number of stanchions or handholds.

The requirements in regard to support persons with reduced mobility according to TSI PRM have to be taken into account.

Waste container in an adequate size shall be installed in the vestibule area.
2.6.5 Sanitary Facilities

2.6.5.1 General
The toilet design shall be of a proven type and follow at least the recommended design as described by TSI PRM. The sewage shall be collected in a sealed container, which shall be easily emptied from both sides of the vehicle. The capacity of the waste tank shall be of adequate size to ensure a long as possible operation without the need for emptying.

A fresh water tank with an adequate capacity, with filling capabilities from both sides of the train, shall be installed. The filling socket shall be as defined in UIC 563. The capacity of the fresh water tank shall be of adequate size to ensure a long as possible operation without the need for filling up.

For both tank design capacities the Bidder shall estimate the time to refill or to deplete the sew-ages under normal condition. The capacities shall allow at least a complete daily operation without need of refilling / depletion considering the boundaries as defined in UIC 563.

The ISR water quality is listed in Appendix E.

2.6.5.2 Standard Toilet
The Short Unit shall be equipped with one standard toilet; the Long Unit shall be equipped with three standard toilets unless one vehicle which is dedicated to fit for persons with reduced mobility needs. TSI PRM design recommendations shall be considered.

All sanitary rooms shall feature:

- Toilet bowl made of stainless steel
- Water flush control: foot released triggered by a bowl mounted, hermetically sealed push-button switch and solenoid valve and time relay
- Clothing hooks
- Stainless steel wash basin with infrared operated water tap, solenoid valve and time relay
- Mirror
- Electrically operated hand dryer
- Toilet paper roll holder
- Soap dispenser
- Waste paper container

2.6.5.3 Toilet for People with reduced Mobility
One universal toilet as defined in TSI PRM shall be provided in each train configuration of Short and Long Unit.

Beyond the recommended design requirements of the TSI PRM, the universal toilet shall be equipped with:
• a foldable baby changing table
• suitable handles for disabled passengers
• a powered sliding door to provide an easy access for wheelchairs
• 2-conductor two train master call buttons, one approx. 30 cm above the floor, the second in seat height

2.6.6 Multi-Purpose-Area
The space shall be designed to accommodate for the following purposes under the condition to utilize the available space by the priority of the person with reduced mobility:

- Universal Toilet (for person with reduced mobility),
- two wheel chair post and / or,
- two baby buggy post and / or,
- six bicycles and / or,
- tip-up seat arrangement
- Space for heavy luggage and bulky goods.

The sectional area shall be equipped with tip-up seat arrangements.

2.6.7 Bistro
The 6-vehicle Unit shall be equipped with a Bistro section suitable to serve the passengers with cold / hot drinks and snacks by a dedicated train crew member. The area shall be designed with appropriate seat arrangements.

Consideration shall be given to meet the requirements in regard to save food storages during the Unit's stabling time and in inspection services in the operation free period.

The bistro design concept and the arrangement within the vehicle shall be offered in the bid.

2.6.8 Roller Blinds
Roller sun blinds shall be provided on each window. They shall be designed in a way to allow stopping and holding the roller blind in every position.

2.6.9 Ceiling
It shall be integrated with the interior lighting, the loud-speakers of the public address (PA) system as well as the diffusers of the air-comfort system. The ceiling panels shall be applied and fastened in a manner to permit ready removal for maintenance, but avoiding passenger access.
2.6.10 Floor
Details of the design shall be described within the technical offer. The floor shall at least comply with the following:

- Floor shall be suitably structured to prevent slipping
- An adequate thermal and acoustically insulation of the floor shall be provided.
- If floor-hatches will be designed, they shall be flush with the floor (no trip-edges) and sealed
- The door sills on the passenger doors shall be slip-resistant over the life of the vehicles.

2.6.11 Interior Stairs
Interior stairs shall be conceived in a way to:

- Allow easy access to the bottom and the top floor
- Provide minimum obstruction with regard to passenger flow
- Minimize the risk of accidents by suitable measure like anti-slip surfaces, suitable design of edges, handrails as well as sufficiently optical contrasts.

Staircases shall comply with TSI PRM.

2.6.12 Interior Lighting Equipment
The interior lighting for the passenger area shall be in accordance with:

- EN 13272
- EN 50121
- UIC 555

2.6.13 Baggage Racks
The vehicles shall provide following basic areas for luggage storage:

- Between the backrests of adjacent seats (for heavy pieces),
- An overhead luggage rack system along both entire side walls of the compartment first and second floor area

Baggage racks shall be according to UIC 562. Coat Hooks shall in accordance with UIC 562 shall be provided.

2.6.14 Electric Outlets for Utilities
Two service proven 230 V AC sockets and personal on/off lights for passenger’s use shall be installed above each passenger table.
The 230 V AC outlets for utilities, e.g. the cleaning machines, shall be installed at each end of the compartment and in the entrance vestibule; they shall be of a service proven heavy duty type.

The applicable requirement of UIC 550 shall be fulfilled considering a socket design in accordance with Israeli standard SI 32.

### 2.6.15 Emergency Equipment

The vehicles shall be provided with sufficiently sized and correspondingly marked boxes for the first aid kits. The first aid kits itself, its dimension of the box as well as the preferred location shall be provided by Supplier during the design phase for ISR’s approval.

Each end-vehicle shall be equipped with one folding stretcher stored inside the drivers cab (total two stretchers per unit). The locking device should be RIC.

An additional locked box for life saving tool equipment (defibrillator) shall be provided, one per unit. The dimensions and the arrangement have to be clarified with the ISR.

Each vehicle of a unit shall be equipped with evacuation equipment supporting emergency ladder for disembarking to ground level as far as necessary for a safe evacuation process.

### 2.7 Windows

#### 2.7.1 General

As far not differently specified in this specification, double glazed tinted toughened safety glass, in accordance with EN 12150 and UIC 560 shall be used for all windows. The light transmittance of the tinted windows in the passenger compartment shall be of about 50%. Solar protections measures are allowed. The Bidder shall propose graffiti / scratch proof window glass or a solution with anti-scratch-film as an option.

#### 2.7.2 Passenger Side Window

Each third window on each side and level shall be provided with opening facilities of the upper part, in case of air conditioning failure. The opening mechanism ensures an opening by staff only. They shall be closed with a RIC-square lock.

#### 2.7.3 Door Windows

The windows in the passenger doors shall be of the same material as the side windows. Single or double layer glazing shall design will be provided accepted.

#### 2.7.4 Emergency Exit Window

Depending on the vehicle concept, windows might be used as emergency exit windows according to EN 45545. In case emergency exit windows have to be foreseen, number and design of emergency exit windows shall be in compliance with EN 45545.
2.8 Doors and Entrances

2.8.1 General

The doors shall be designed in accordance with EN 14752, TSI LOC PAS, TSI PRM and UIC 560. Minimum two external doors per vehicle, per side shall be foreseen. External door design width shall ensure to short passenger dwell time at the station. The Supplier shall provide a dwell time simulation at station under the condition of 50 % and 75% passengers boarding and egress vehicle. Generally, a maximum dwell time of 2 minutes must not be exceeded considering normal operational payload according to EN 15663.

The minimum door width shall be 1 200 mm. At both platform levels at 760 and 960 mm the clear entrance height shall be at least 1 900 mm. The accumulation of dirt in the guiding rails and under seals shall be prevented.

Door mechanisms and cabling shall be covered by appropriate linings in the open and closed position of the doors. The door design shall be fitted for emergency exit function.

2.8.2 Door Control

The external doors shall be electrically operated and controlled as defined in EN 14752 and shall be in compliance with TSI LOC PAS and in TSI PRM.

2.8.3 Opening of Doors

Following requirements shall be considered for opening of the doors:

- An automatic sliding step / bridging plate as per TSI PRM, controlled in coordination with the doors, shall be considered to mitigate the gap between the vehicle and the platform. The edge to the step shall feature high visibility colour scheme.
- The doors shall stay closed until the train comes to a complete standstill and the “release” signal has been activated. The release shall be side-selective.
- After the door release signal is activated by the driver, the door can be opened by pressing a push-button on the entrance section near to each door.

2.8.4 Closing of Doors

Following requirements shall be considered for closing of the doors:

- It shall be possible to set a local door closing command by a switch or button in the entrance area inside the vehicle.
- The closing of all doors shall be possible from any door by a standard RIC-key switch actuated by conductor/train master. As an exception, only the door where the key was actuated
stays open. Alternatively, the doors can be closed by deactivation of the door release signal by the driver.

- An automatic door closing mode shall be designed. The time to activate the automatic closing operation shall be recommended by the Bidder. In any case the time must be adjustable in a simply way. The Bidder shall list the possible range in which this time can be adjusted.

2.8.5 Emergency Opening

Following requirements shall be considered for emergency opening of the doors:

- Each access door shall be equipped inside with a concealed manual opening feature, so that a train in standstill can be left even without electric power.
- The doors shall be provided with an individual internal and external emergency-opening device in conformity with the TSI LOC PAS recommendation.
- The requirements of EN 14752 shall be fulfilled.

2.8.6 Obstruction Detection

The obstruction detection shall fulfil the requirements of EN 14752 and as specified in TSI LOC PAS-

2.8.7 Door Isolation

It shall be possible to isolate each individual door mechanically with a standard RIC-key. In this state, the door control shall be switched off and the door shall not be considered any more in the central supervision.

2.8.8 Surveillance of open Doors

Traction power shall be applied only when all doors are closed and locked. This shall be ensured through an automatic door-traction interlock system. The door-traction interlock system shall prevent traction power being applied when not all of the doors are closed and locked.

The traction interlock system shall be provided with a manual override, intended to be activated by the driver in exceptional situations, to apply traction even when not all of the doors are closed and locked.

An indication of not completely closed and interlocked doors shall be provided to the activated driver's cabin.

2.8.9 Internal Passenger-Inter-Vehicle Doors

Electrically operated single or double leaf inter-vehicle doors shall be provided to separate compartments if necessary. The free opening of the door shall be at least
800 mm according to UIC 560. Furthermore the requirements of TSI LOC PAS and TSI PRM shall be met.

Seals or brushes must be provided to ensure that the doors are tight when closed. The tightness of the doors must be such that the operation of the air conditioning system is not impaired under all operational conditions.

2.9 Brake System

The Unit shall be equipped with electrodynamic brake as well as friction brake. The brake system shall be conform with TSI LOC PAS.

The performance of the overall braking system shall be designed in a way that a continuous operation of the Unit in the whole ISR network is possible also if the electrical energy feedback to the catenary system is not possible. A state of the art computer controlled blending system shall assure that the brake application will mainly be done via the wear free electric brake system dependent on the requested brake demand via the combined traction-brake controller as defined in UIC 612.

The electrodynamic brake shall be able to decelerate the Unit with the highest possible braking force down close to standstill without uncomfortable jerk levels. Reversing of running direction shall be definitely excluded.

The pneumatic brake shall be an UIC conform automatic multiple-release high-performance load-dependent air brake, which shall be supplemented by an electro-pneumatic control (EPC)-controlled direct brake. The pneumatic brake shall correspond to mandatory points of UIC 540, UIC 541-1, UIC 541-3, UIC-541-056, UIC 543, UIC 544-1, UIC 545, UIC 546 and TSI LOC PAS. The electro dynamic brake shall have priority in operational braking modes.

Considering that the UIC leaflets are focused on coaches adaptations related to specific design aspects of DDEMUs are accepted. Alternatively, the application of EN 16185 is accepted considering the requirement of a fully UIC conform pneumatic backup service-brake as well as the specified functional requirements.

The Unit shall be equipped with the following braking devices:

- Computer controlled direct-acting electro-pneumatically controlled air brake
- Indirectly working automatic pneumatic brake including the necessary controlling and supervision equipment (indirect brake) with continuous main air reservoir pipe and brake couplings at both ends of the vehicle as backup brake
- An emergency brake override device with electro-pneumatic brake control (emergency brake override/ electro-pneumatic) including the necessary controlling and monitoring equipment according to UIC 541-6, as well as the internationally unified EP-brake control line (electro-pneumatic-power supply 110 V, 700 W; 9-pole UIC standard plug).
related specific implementation details of the EP-brake as well as the emergency override functions are function is to be agreed between the Supplier and ISR during the project phase.

- Adjustable non-wearing electro dynamic brake with recuperation capabilities (feeding back into catenary network).
- Spring-loaded parking brake (air-released) with the related application, controlling and emergency release equipment and display device. The status of the system shall be indicated via MMI/MHI.
- Pneumatic disc brake with automatic adjustment according to the wear of braking discs and brake pads.
- Equipment to provide the activation of the brake equipment for running under automatic traction/brake control (automatic traction/brake control for keeping the speed constant)
- Electronic/pneumatic anti-slide system for the protection of the wheels
- Magnetic Track brake according to UIC 541-06

The labels for type of brake and braked weight shall be designed according to UIC 640 which refers to UIC 545.

Safety systems such as automatic train protection or driver’s vigilance system shall directly evacuate the main brake pipe through a dedicated emergency brake valve.

It shall be possible for the driver to override activation of the emergency brake by the passengers with a filling stroke of the main brake control following UIC 541-6.

In case of failure of the electronic control, a pneumatic control shall be provided as redundancy, which ensures a safe operation of the brakes.

For the dimensioning of the brake, in particular the dedicated UIC data sheets and EN standards shall be respected (among others, UIC 540, UIC 541-1, UIC 541-3, UIC 541-5, UIC 541-6, UIC 544-1, UIC 648, EN 13452-1 or EN 15595).

2.9.1 Magnetic Track Brake

Due to the high demand on the braking distances magnetic track brakes according to UIC 541-06 shall be provided. The Bidder shall consider the number of magnetic track brakes to be installed according to its brake calculations based on ISR network data and relevant standards. Depending on that the trailing bogies and/or the motor bogies shall be equipped with railway proven magnetic track brake systems.

Besides the UIC 541-06 the following, German extra guideline shall be considered as well:

Ergänzungsregelung Nr. B 012 für die technische Gestaltung der Magnetschienenbremse in Schienenfahrzeugen, German version: EBA, Rev. 5.4, 22.05.2012

This guideline can be downloaded via the link:
2.9.2 Brake Calculation

The braking performance of Units, including the Short Unit, the Long Unit as well as the Short Unit and Long Unit with additional vehicles shall be in accordance with TSI LOC PAS.

The braking performance shall be determined by calculation as defined in EN 14531-6 and UIC 541 and shall considering the following:

- Level track;
- Calculation for wheel diameters corresponding to new, half-worn and worn wheels;
- Wheel rail adhesion level according to TSI LOC PAS;
- Friction brake equipment to be justified according to EN 14531-1;
- Braking performance calculation for emergency brake and maximum service brake;

The braking performance calculation shall be submitted as part of the technical proposal and validated during the homologation process as required in the TSI LOC PAS;

The maximum average deceleration developed with all brakes in use, including the brake independent of wheel/rail adhesion, shall be designed lower than 2.5 m/s².

This requirement is linked to the longitudinal resistance of the track in order to comply with the infrastructure as defined by TSI INF.

2.9.3 Calculation of Thermal Capabilities

A thermal brake simulation shall be submitted by the technical offer following the terms given in the TSI LOC PAS considering the specific Israeli environment.

In addition, an associated simulation shall be exercised considering the worst case which follows from the network specific requirements of ISR as mentioned in the following paragraph. The brake disks shall be classified according to EN 14535-3 (or the related prEN if the EN should still not be published).

2.9.4 Requirements with regard to ISR Network

The braking system of the Short Unit, the Long Unit and the Short Unit and Long Unit in their different multiple operation configurations shall be designed in regard to the ISR track layout.

- Distance of advance signals and main signals of 1000 m;
- Track characteristics such as track gradients (max. 30 ‰ inclination level tangent track) and further infrastructure details (see Appendix A);

and considering the as well:
- Different Unit versions (Long and Short) as well as its multiple operation configuration
- Different load conditions as defined according TSI LOC PAS
- The thermal capabilities of the Unit being in compliance with TSI LOC PAS allowing the operation with maximum speed downhill from Jerusalem to Tel-Aviv via the new express line (alignment see Attachment) as well as the unlimited operation on flat lines with mean station distances down to 2 km and dwell times of 2 minutes.
- Service braking, emergency braking and parking brake and the use of different brake types such as magnetic track brake, dynamic brake, friction based brake, etc.

2.9.5 **Compressed Air Supply**

All elements of the pneumatic system shall be designed according to the technical state-of-the-art. The technical design of the pneumatic and braking equipment shall be based on the regulations of the European Pressure Equipment Directive 97/23/EC as well as the dedicated legislation and standards. Additionally the Israeli Standard IS 4295 shall be considered.

The tubes of the pneumatic system shall be made of stainless steel. Application of other material property and composition shall be explained in regard to withstand corrosion over the service life period. All connections shall be designed and built as to prevent galvanic contact with fittings made of non-stainless steel. Further, the pneumatic equipment shall be protected against cavitation. The air has to be dehumidified. Generally, the service life of all tubing material shall correspond to the useful life of the Unit. Nevertheless, the design shall ensure easy maintainability.

The following main elements of the production, processing and storage of compressed air shall be provided:

The compressed air quality concerning particles, remaining humidity and residual oil contents shall correspond to ISO 8573-1:2010 as follows:

- Compressed air purity for particles: Class 3;
- Compressed air purity for humidity and liquid water: Class 2;
- Compressed air purity for total oil: Class 2

2.10 **Visual and Acoustic Signalling System and Lighting**

2.10.1 **Exterior Lighting**

The exterior lighting shall be in line with the following standards/ regulations:

- TSI LOC PAS,
- EN 15153-1
2.10.1.1 Lamp Controls

It shall be possible for the driver to control the head, marker and tail lamps of the unit from the normal driving position; this control may use independent command or combination of commands.

The driver shall have the possibility to choose between dim light and high beam on the head light. The high beam shall be indicated on the driver's desk.

Within the range of the seated driver it shall be possible to activate emergency signal lighting (3x red) on all end vehicles. The activated emergency signal shall be indicated on all driver's desks in the train. The high beam on the headlight shall be indicated on the operator's console.

All exterior lights shall be connected as directly as practicable to the battery circuit. Head and tail lights shall be controlled automatically in dependence of the status of the train and the concerned vehicle:

- Train switched off / switched on
- Parking mode
- Occupation of the cab
- Detection of rear of train

2.10.2 Acoustic Signalling

The acoustic signalling shall be in line with:

- TSI LOC PAS
- EN 15153 and
- UIC 644.

2.11 Painting, Labelling and Corrosion Protection

The Unit and its components shall be corrosion protected taken into account the environmental conditions in Israel.

The corrosion protection and painting of the vehicle determines the useful life to a high degree. As a design principle, overlapping and hollow structures shall be avoided as far as possible. Components or portions, which are not accessible after assembly, shall receive an adequate corrosion protection before assembly.

A state of the art surface preparation, priming and painting shall be applied, which shall match the proposed carbody construction method.
The technical proposal shall submit the general design approach and the material property considered to be applied. 

The service life of the exterior paint shall not be less than 6 years during which only limited touch-up, due to e.g. scratches or accidents, shall be necessary.

Special attention shall be paid on safety relevant parts and related risks caused by corrosion and crevice corrosion which are constructively to be avoided. Thereby, UIC data sheets 842-2, 842-5, 842-6 and 842-96 shall be considered accordingly. Corrosion protection to any part or component shall be ensured up to 10 years of service operation.

In order to get a high quality paint system the products for corrosion protection, priming and final coat shall be checked with regard to its compatibility and shall come from the same Supplier. The specific conditions of the Israel environment with the high sun load and high temperatures have to be taken into account. The corrosion protection and painting system shall be approved by the ISR during the design phase.

The exterior painting shall be sealed or covered by an anti-graffiti final coat. The exterior paint scheme and markings shall be agreed with ISR during the design phase.

2.12 Air Conditioning

2.12.1 General

The Units shall be equipped with an integrated Heating, Ventilation and Air Conditioning system covering the whole passenger areas as well as the driver’s cab by a separate system.

The HVAC units have to be designed such that:

- An environment-friendly refrigerant shall be used. From the current point of view, R 134a will be accepted with no objection.
- The energy consumption shall be as low as possible taking into account the compliance of the required comfort parameters.
- Being completely replaceable in minimum time and being repairable outside of the train and defective components can be easily identified and replaced.

2.12.2 HVAC System for the Passenger and Entrance Area

The HVAC system for the passenger area shall fulfil the requirements of EN 13129-1 and EN 13129-2 as well as the mandatory ISR adaptations (see Appendix F.1). The compliance with the requirements shall be demonstrated by the Supplier by means of tests.

Each vehicle shall be equipped with at least two independent HVAC units, each one of them providing at least 60% of the total necessary cooling capacity, with a suitable layout reserve. In case of a failure in the cooling circuit the ventilation system shall continue its function of circulating the compartments air and the supply of fresh air. Furthermore, each HVAC system shall be capable to
provide cooled air to whole vehicle. Thus the remaining HVAC system(s) can provide a certain cooling on a degraded level. The Bidder shall explain the related boundaries and the possible performances.

Thermal insulation of the passenger area has to be dimensioned such that the average heat transmission coefficient $K_{ges}$ does not exceed 2.50 W/m² K according to EN 13129-1.

Features have to be implemented in the HVAC system in order to minimize the energy consumption (e.g. waste heat recovery, passenger dependent fresh air inlet).

The Bidder shall describe the arrangement of interior grills, the delivery of warm/ chilled air and the concept for heating/ cooling in the offer.

Special attention shall be given to prevention of condensate water from entering the cooling ducts. The design shall consider the easy access in order to change air filters. In addition the installation of the HVAC units shall be optimised from the point of view of maintainability. It shall have a diagnostic interface as well as be connected to the central diagnostic system (see also chapter 3.9)

The HVAC system shall be easily activated or deactivated separately for each vehicle through an ON/ OFF hardware switch on the central vehicle control panel.

Fresh air intakes shall be placed in a way to avoid aspiration of bad odours of the toilets or of the friction brakes. The air intake grilles shall be designed and arranged in a way to avoid ingress of water and debris.

Design requirement in regard to comply with TSI SRT and to comply with the relevant fire safety standard shall be implemented.

Adequate exhaust of the surplus air shall be provided.

### 2.12.3 Control System

The vehicle shall be provided with an automatic control system, including the necessary thermal sensors. A manual control shall allow the conductor/train master to set certain operation modes in case of system malfunctions.

The air-conditioning system shall start to operate automatically, as soon as the power supply of the vehicle is available. The conductor/train master shall have the possibility to switch HVAC system on and off. The conductor/train master shall be in a position to set the compartment temperature in the central electric locker by +/-3 K (the range of available adjustment depends on the HVAC capacity at extreme outside climate conditions).

The operation modes of the HVAC control shall be:

- Pre-conditioning (heating and cooling)
- Regular HVAC mode
- External power supply
- HVAC snoozing mode (hold interior temperature on pre-defined value, i.e. 10 °C in winter and 30 °C in summer) with existing power supply.

- HVAC emergency stop

The control system shall include a self-test mode. If reasonable these modes may be combined with related modes of the HVAC of the driver’s cab.

Pre-cooling or pre-heating the HVAC system shall be implemented by means of energy efficient solutions (e.g. by smart use of external, internal air). The respective times are given in Appendix F.1.

In case of fire in a tunnel, the HVAC shall be controlled in line with the pertinent requirement of TSI SRT. Besides the fulfilment of these minimum requirements, any fire or smoke related danger of passengers or staff shall be limited to the reasonable minimum.

The Bidder shall explicitly describe the related control functions.

2.12.4 HVAC System of the Driver’s Cab

All driver’s cabs of the Unit shall be equipped with state-of-the-art, service-proven air HVAC systems which are totally independent from the HVAC of the passenger compartments. The HVAC system of the driver’s cab shall be designed and proven according to EN 14813 with respect to the modified requirements as given in Appendix F.2.

The following specific requirements shall be met additionally:

- The Bidder shall propose predefined operation modes of the HVAC system. These modes shall allow an easy handling as well as an energy efficient operation. If reasonable those operation modes shall be coupled with dedicated operation modes of the HVACs in the passenger compartments.

- For ventilation of the driver’s cab, the flow of fresh air in ventilation mode as well as in air-conditioning mode shall be adjustable to at least 400 m³/h. This value must not change by more than ± 20% at any running speed and also in reverse running. The driver shall be able to adjust the air flow continuously according to his requirements.

- The air nozzle facing the driver shall have a maximum air flow of 30 cm/s. Furthermore, the direction and flow through these nozzles shall be adjustable.

- The fresh air should only blow from the front and from both sides into the cabin; blowing on the driver’s back shall be avoided.

- Under normal operation conditions, a slight overpressure shall be provided in the cab.

- The cooling capacity shall be sufficient to provide the required minimum comfort parameters under all operation conditions.
• An environmentally friendly, approved halogen-free refrigerant shall be used. From the current point of view, R 134a will be accepted with no objection.

• The heating shall be designed in such a way that the temperature within the driver’s cab does not fall below +18 °C even at an outside temperature of -5 °C and at maximum speed of the Unit.

• The heating also shall generate temperatures within a limited range of 21 ± 3 °C down to an outside temperature of -5 °C. The temperature differences between floor (10 cm above floor level) and face level (180 cm above floor level) must not exceed 23 °C.

• Additionally, a separately switchable and adjustable floor heating shall be installed.

• The thermal insulation shall be dimensioned in such a way that the average heat transmission coefficient \( k_{\text{ges}} \) does not exceed a value of 2.3 W/m² K at maximum speed.

• It shall be possible to power the driver’s cab HVAC via the external power supply interface.

• The HVAC shall be quickly removable and easy to maintain.
3 Electric Equipment

3.1 Traction System Concept

The Unit shall be designed for the 25 kV/50 Hz AC networks of ISR.

The Bidder shall design the traction equipment such that the required performance can be fulfilled in the environment conditions as specified in Appendix D.

In its offer, the Bidder shall describe the maximum power (inclusive the related time constant), the continuous power as well as the power factor of the offered Unit with respect to the nominal and the aforementioned extreme boundaries.

The traction system shall have a state of the art design with three-phase traction technology, with a modern traction control system for the envisaged traction program. No more than two traction motors shall be supplied by a common inverter.

The traction system of the Unit shall ensure a well concerted redundancy architecture. The system design shall assure maximum reliability and availability as well as sufficient degree of safety, in particular for the traction and braking systems.

The Bidder shall provide a technical description of the traction system in the offer, including the properties of the redundancy concept.

In order to reduce the total energy consumption of the Unit, the traction system shall be optimized to regenerate power back to the overhead line. The total energy consumption of the Unit should be minimized with other suitable features (e.g. primary voltage dependent control of the traction converter intermediate circuit, switch off of systems during partial load). The Bidder shall propose corresponding solutions in the offer.

In general, the following standards for the traction system have to be considered:

- EN 50388 regarding the technical criteria for the coordination between power supply and the unit. The restriction of the line current and the power in function of the line voltage according EN 50388 shall be demonstrated by measurements on the ISR net by the Supplier. Neither in the traction nor in the braking mode electrical oscillations or protective shut down shall occur which interfere with the operation of the train.

- EN 50163 regarding Supply voltages of traction systems. The fulfilment of the requirements of EN 50163 shall be demonstrated by measurements by the Supplier in his test bench or on a test track.

The Bidder shall specify in the offer the values of the overall efficiency factor (catenary – wheel) and the power factor (catenary supply) for the following operating points, each defined by speed and tractive/brake effort:

- Speed: maximum speed of 160 km/h, 80 km/h and 40 km/h
• Traction mode with 25, 50, 75, 100 % of the max. tractive effort
• Electro dynamic brake with 25, 50, 75, 100 % of the max. electro dynamic braking force

Consequently, for each speed 8 pairs of parameters considering different tractive / braking effort are to be provided.

The values shall be indicated at nominal contact line voltage. The consumption of the auxiliaries' and HVAC system is excluded.

After the delivery of the train the compliance of the indicated values shall be demonstrated on the ISR's power supply by the Supplier.

The installation of the electrical equipment in the vehicles shall be in a way to prevent any transmission of vibration or noise into the passenger compartments.

3.2 Primary Voltage Circuit

3.2.1 Power Supply and Overhead Line System

The catenary system of ISR will be designed and constructed in accordance with the pertinent European standards, especially EN 50119, EN 50367 and EN 50388.

The nominal supply voltage will be 25 kV, 50 Hz and will be kept in the limits specified by EN 50163.

The characteristics for the overhead line system are as follows:

• Distance between the top of rail to the contact wire along the right of way will be kept in the limits:
  a) Nominal  5 500 mm
  b) Maximum  6 500 mm
  c) Minimum  5 100 mm (exception compared to EN 50367 in Table 2)

• Distance between the top of rail to the contact wire in rail stations will be 5 500 mm
• Maximum lateral deviation of the contact wire from the track centre line under action of cross wind +/- 555 mm

More details in regard to the overhead line system and power supply to be installed in ISR network shall be provided and communicated during the Unit’s design phase.

3.2.2 Pantographs, Main Switches, Roof Cables and Earthing Switches

The Bidder shall make sure, that the Unit is fully compatible with the electrification of ISR's catenary system.

Each Unit shall be equipped with at least two single-arm pantographs with a pantograph head width of 1950 mm according to Figure B.2, Type 1 in EN 50367 including a device for rapid lower-
ing by automatic monitoring of the pantograph contact strip. The pantograph shall fulfil the dedicated requirements of EN 50367 as well as EN 50206.

The type of pantograph which will be used shall be service-proven in the overhead line system of the purchaser at the specified speeds and environmental conditions. In view of series-related optimisation of pantographs, an aerodynamically neutral behaviour of pantographs shall be ensured. Furthermore, the necessarily stronger contact force at higher speeds shall be assured either through a speed-depending pressure control or a sufficiently high static contact force.

The material of the contact strip shall be made of hard carbon material as usual for catenary systems fed by alternating current.

When operating in multiple operation (multiple operation: directly coupled Units), running at maximum speed shall be allowed.

The pantograph’s carbon strips shall have an operational durability of at least 60,000 km per each pantograph.

The target time for raising the pantograph shall be within 6 to 9 s, for lowering 4 to 5.5 s. However, marginal deviations (approx. 1 to 2 s) can be accepted.

- Static contact force: 60 N to 90 N, statically adjustable
- Dynamic characteristics: fulfilment of the dedicated requirements of TSI Energy

Testing of the lowering facilities shall be possible from the machine room a location which is easily accessible from inside the vehicle.

If the automatic lowering of the pantograph is triggered after sequenced activation, the main switch of the Unit shall -turn off through the signal of the pushbutton. This is to avoid that the overhead line and the pantograph will be damaged through arcs during the lowering process under electric power. In addition, the pantograph magnet valve shall receive the signal “pantograph down”.

During the operational lifting of the pantograph, the function of the pushbutton shall switched ineffective through a time relay. Thereby, the main switch release by the automatic lowering of the pantograph contact strip only shall become effective after a programmed time (approx. 15 to 20 s).

If the pipe between high-speed lowering valve and contact strips breaks, the automatic lowering supported by the shut-off cock can be put out of operation. Open connections shall be closed in a watertight manner.

In case of multiple operations also the not failed pantographs shall be lowered through an additional electrically driven high-speed lowering valve.

By means of suitable design features the Unit shall remain operable when one pantograph fails due to mechanic or electric faults. The design solution applied shall be described.

A contactor differing between four positions (both pantographs, pantograph 1, pantograph 2, no pantograph connected) in the high-voltage system shall be provided.

The quantity of roof equipment shall be reduced to a minimum and shall be aerodynamically optimised. An earthing switch shall be installed on the overhead wire voltage side.
The Unit shall be equipped with a main switch for network-synchronous operation including a vacuum switching tube that is proved and tested by an UIC railway under similar operating conditions. The design shall allow at least 50,000 operating cycles without the need for service and maintenance or adjusting work. After 50,000 operating cycles, it shall only be necessary to readjust the contact distance. Minor maintenance work including an exchange of the vacuum chamber shall just fall due after 100,000 operating cycles at the earliest. The main switch shall have a mechanical durability of 250,000 switching mechanisms. These values shall be achieved by 90% of the switches.

The electric system must be dimensioned in such a way that no inadmissible overhead voltages will be generated when switching off. An overvoltage concept shall be presented in the bid. All roof equipment devices shall be explosion-proof.

3.2.2.1 Automatic Power Control System to support the passing of a neutral Zone

The Bidder shall offer an electric interface which allows the passage of phase separation sections or neutral sections without need of special handling by the driver to release the power of the Unit to zero and to switch off / on the main circuit breaker. The required track side information will be generated by balises transmitting the signal to a receiving unit installed at the Unit. The required details on the interface are to be agreed during the project phase.

The receiver equipment and the interface design requirement will be delivered from the manufacturer MORS SMITT to the Supplier. The installation of the equipment, design coordination in regard to the DDEMU Units and operational testing is up to the Supplier’s responsibility.

3.2.3 System Perturbation and Energy Counter

The watt-less power shall be 0 or slightly capacitive. A facility to adjust the watt-less power shall be provided. The total power factor $\lambda = g \cos \varphi$ shall be >0.9 from $1/4$ of the nominal power and >0.95 from $1/2$ of the nominal power with all current converters working.

For separate analyses, it shall be enabled to display and record the values of each energy supply, energetic recovery, total energy consumption and energy consumption of the train bus bar. This shall be done in a minute cycle in a separate energy consumption menu with a memory depth of 7 days. The referring data shall be originated from appropriate and reliable data sources with adequate precision (margin of error max. 1 %).

The energy metering device shall be fully in compliance with TSI LOC PAS and EN 50463, providing measurements of catenary current and catenary voltage shall be installed.

3.2.4 Transformer

The transformer shall be in accordance with the requirements of EN 60310.

A common state of the art cooling agent, as e.g. used in modern European Units shall be applied.
An indicator for the cooling agent level and Buchholz relay shall be installed. *Other adequate railway proven transformer protecting safety devices will be accepted.*

In the event of underframe installation, the transformer shall be designed in such a way that in a derailment, the transformer does not touch the track. Due to a particularly strong bottom construction of the transformer and / or hoop guards, it shall be ensured that in several assumed cases of average no cooling agents will leak when touching the track. The secondary windings shall be electrically insulated (no sleazy circuits).

All windings shall be short-circuit-proof until activation of the corresponding protection device.

The transformer casing shall be designed in such a way that repeated opening is possible without its reconditioning.

The windings, as well as their insulation and fixings shall be dimensioned so that no scheduled maintenance is envisaged during the nominal useful life of the Unit.

### 3.3 Propulsion System

#### 3.3.1 Power Converter

The power converter shall fulfil the requirements of EN 61287. Its design shall be based on high-performance IGBT modules. For cooling of these IGBT phase modules, an environment-friendly service water cooling system with supply line and drainage by self-sealing quick couplers shall be chosen. By employing IGBT components in a panel cell form, the advantages of large surface pressure contacting without additional solder and bond wire connections shall be used. The power semiconductors shall be integrated with a complete triggering in modules as smallest exchangeable units.

The equipment shall be designed to be maintenance-free according to the state-of-the-art (control and power electronics) and shall be dimensioned such that no overload will result from operation resp. from the exhaustion of the performance envelope of the unit.

Power electronics shall be refrigerated by a separated cooling circuit. The system must be designed such that no damage results if the cooling system is deactivated after the unit has been in operation.

#### 3.3.2 Electric Brake

The electric brake shall produce the highest possible braking force at any speed corresponding to the overall dimensioning of the electric equipment.

The electro dynamic brake shall be of regenerative design which allows the energy feed back to the catenary system. In general the electric braking energy shall be fed back into the overhead network.

It shall be possible to prevent the use of the regenerative brake.
Whenever possible the electric brake shall take over whole required brake force. The regenerative brake shall comply with the requirements of EN 50388 as well as EN 50163. For contact line voltages higher than \( U_{\text{max}2} \), no braking energy shall be fed back to the overhead line. For contact line voltage between \( U_{\text{max}1} \) and \( U_{\text{max}2} \), the braking energy fed back to the overhead line shall be reduced linearly. In case of a short-circuit in the network, the electric brake shall be switched off within 50 ms.

Adjustments to appropriate constant braking force shall be made such that fluctuations of overhead voltages are balanced. It shall be possible to prevent the use of the regenerative brake.

In order to optimise the overall energy consumption the electric braking energy shall be used also to supply the auxiliaries of the unit. The Bidder shall provide corresponding description of the proposed solution in the offer.

### 3.3.3 Traction Motor and Gear

Three-phase asynchronous traction motors shall be used. Including gears and torque transmission, the traction motors have to be dimensioned such that the performance requirements are met. Special attention shall be paid to reach an optimised efficiency factor of motor and gear. Oscillations resulting from operation at the limit of friction or caused by other reasons must be considered.

The installation shall be optimized for an easy dismounting and mounting of the traction components in maintenance.

The connection of the traction cables and the cooling air ducts (if present) shall be easily accessible from a pit from the vehicle side.

Leakage of lubricant into the environment or into the interior of the traction motors has to be excluded.

Traction motor and drive bearings shall have a durability in conformity with a major maintenance service interval but at least not less than 1.5 million km. The actual durability values of the offered Unit shall be indicated in the bid. The design and sizing of the seat of the bearing has to be dimensioned such that it will presumably not require any work during the vehicle’s whole life. Independently from that, the necessity of a correction of bearing seats may not lead to an exchange of gear housings.

### 3.3.4 Propulsion Control

The structure of the power supply control system must be well balanced to the applied power electronics of the propulsion system and has to take in account the required reliability for the trainset. The Bidder shall describe the control system in the tender.

The Bidder shall describe in the technical proposal the restrictions concerning the admissible differences between the rolling circle diameters of the wheel sets. The required adaptation in order to
3.4 DC On-board Network

3.4.1 General
A low voltage DC Network for charging the battery and to supply various consumers, as emergency lighting, command and controls, public address system, etc. shall be installed. The nominal voltage of the DC on-board Network shall be 110 V. The power supply has to be designed according to EN 50155 as well as the applicable requirement of UIC 550. Each vehicle shall be equipped with its own battery and the arrangement of the battery charger shall be of a redundant design.

All Unit auxiliary- and control circuits shall be protected by individual circuit breaker. Double-pole circuit breakers shall be provided. The rated trip current and other characteristics of circuit breakers shall be clearly marked near the mounting location of the device.

Discharging of the battery due to a loss of the overhead line voltage shall be minimized by a suitable energy management which deactivated non-necessary consumers.

3.4.2 Batteries
A state of the art railway proven nearly maintenance-free battery with a nominal voltage of 110 VDC shall be used.

The definition of the required battery capacity shall depend on the completing of the used and assigned electrical components, considering also to provide sufficient capacity for rescue operation in an emergency event of missing 25 kV network supply and shall be defined by the Supplier.

Design life of 5 years has to be guaranteed. The end of battery lifetime (life utility) is reached when in consequence of aging the capacity of the battery amounts to only 80% output of the nominal capacity. No degradation in performance or lifetime must result from any worst-case combination of the environmental conditions specified.

3.4.3 Battery Charger
The vehicle shall be equipped with an efficient state of the art battery charging device. The output of the charging device must be dimensioned such that all consumers can be supplied from the charging device and, simultaneously, a sufficient charging current for recharging the discharged battery is available.

Caution has to be taken that, if either the battery charger or the battery fails, no faults or interruption of operation will occur in any devices powered by this network. If both the battery charger and the battery fail, this shall not cause any permanent damage to any device.
The battery system shall be charged while the main circuit of the unit or the external power supply is in operation.

The charging system shall control the charging process and provide a charging mode which optimizes the lifetime of the battery.

The fault status of the battery charger shall be supervised by the monitoring system.

### 3.5 On Board Power and Auxiliary Power Supply

A 230 V/400 V power line shall be envisaged in the unit to supply:

- Power plug sockets in the passenger compartment for public use (230 V/50 Hz). The power demand per vehicle depends on the arrangement of the passenger compartment. The Bidder shall provide in the offer which the available power per vehicle is available.
- Power plug sockets for the vacuum cleaner (230 V/50 Hz, 2 kVA per plug at least).
- Other consumer of the auxiliaries as air conditioning equipment, cooling ventilation.

The applicable requirements of UIC 550 shall be fulfilled.

Further requirements regarding the distribution as well as the design of the power plug sockets are described in chapter 2.6.14.

### 3.6 Cooling / Ventilation Technical Cabinets

The cooling system shall be designed in a way that the operation under the conditions in Israel is warranted.

Whenever possible, all venting systems shall be designed in such a way that all technical cabinets of the Unit have an internal overpressure to avoid or minimize dust intrusions.

The fresh air required for cooling shall be aspirated by centrifugal force separator grids (FSA-fan grids) in the upper area of the side walls. The fan grids shall be designed for separation of dust and water as well as powder-coated.

The fan grids shall be arranged in such a way that water, snow and melt water as well cannot enter into the equipment rooms. Behind the fan grids, corrosion-resistant drains shall be installed for separating water and dirt particles.

Sufficient cooling up to an ambient temperature of +45 °C shall be guaranteed.

All technical cabinets shall be ventilated in such a way that the temperature does not exceed +6070 °C at an ambient temperature of +45 °C, when the fans are running in service.

The installed cooling air system must work homogeneously in both running directions of the train. Attention shall be paid for a good maintainability and an easy replacement of the cooling units and the filter components.
Air flow capacity and thermal balance calculations for all ventilation circuits shall be provided by the Supplier during the design phase.

3.7 External Power Supply
At least on both sides of each end-vehicle, coupling sockets for external power supply with AC 400 V, 50 Hz, 3~, 63 A for lighting, battery charging as well as operating the HVAC systems of the driver's cabs shall be installed.

The design of the electric system shall correspond to UIC 554-1. The sockets shall be executed according to EN 60309 with a sufficient protection class of at least IP65.

Suitable protection measures to avoid any dangerous overvoltage of different power sources shall be provided.

3.8 Train Control Monitoring System (TCMS)

3.8.1 General
A comprehensive control system, managing information on train level, on vehicle level and on level all subsystem (e.g. propulsion, brake system, auxiliary, HVAC, doors control, etc.) shall be provided. The control concept and its components shall correspond to the state-of-the-art and to the expected operational conditions. The entire control system shall ensure redundant architecture. The system design shall assure maximum reliability and availability as well as sufficient degree of safety (in particular for the traction and braking systems).

The principle of the control philosophy shall be the high reliability. To achieve the highest reliability, very clear interfaces between the vehicle control and the subsystems should be defined. These interfaces shall be as simple as possible. The Supplier shall have full responsibility for all systems and subsystems installed on the train.

The Supplier shall demonstrate the safety of the TCMS in accordance to EN 50126, EN 50128 and EN 50129.

Operational relevant parameters (e.g. opening time for all doors within the train) should be easy adjustable. The Bidder shall provide a proposal for the capabilities for parameterisation of such parameter.

The Bidder has to describe the bus system and the control structure in the tender.

3.8.2 Software
All applied software shall fulfil all the requirements as defined in TSI LOC PAS as well as in EN 50126, EN 50128 and EN 50129.

Generally, all Unit's related software considering operation, monitoring, diagnosis and maintenance and updates together shall be provided with unlimited licences.
The Supplier shall provide free updates during the first 5 years. Afterwards the Supplier shall only be required to provide free software updates if safety relevant software failures should have been identified by the Supplier or by any other party.

The same requirements are to be applied for the equipment and subcomponents of the Unit.

The Supplier shall provide a software management tool, which allows the easy handling of the current software version inclusive its history. This tool shall also provide a simple access to the modifications which has been included in the different releases.

The source code of the current software version shall be provided in escrow.

Additionally the specific requirements as described in the further chapters of this document shall be fulfilled.

### 3.8.3 Control Levels within the Trainset

A modern bus system shall be proposed. The bus architecture shall be well structured and shall comprise two bus levels for the train and vehicle control:

- Train Bus (Data transmission train wide)
- Vehicle Bus (Data transmission within one vehicle)

**Train control level includes:**

- Multiple unit operation according to the unit/ train configurations specified in chapter 1.1.1:
- Automatic starting up, automatic brake test (incl. all vehicles in the entire train), coupling/uncoupling with automatic coupler
- Train control function
- Describe the state of each vehicle (relevant condition of subsystems, active faults) of the entire train

**Vehicle control level includes:**

- All vehicle control functions
- The integrated diagnostics

The train bus shall support variable trainset configurations. If the trainset configuration changes, an automatic train configuration of the entire train formation takes place. A sufficient galvanic insulation between the bus coupling and bus line shall be implemented.

As a third level, the control of the different subsystems has to be foreseen. All functions and the operation of one subsystem (e. g. setting a temperature value) must be part of the subsystem and of its control system. Therefore, in case of failure, the source of failure can be detected by testing the interfaces and diagnostics data.
For the connection of safety related equipment to the used bus systems in the trainset the standard IEC 62280:2014 has to be considered.

All individual clocks on the train shall be coordinated by a master clock. A radio controlled master clock shall be provided.

As train bus / vehicle bus also railway proven Ethernet based buses are accepted as far all safety and redundancy related aspects are covered and clearly data transfer rates are provided.

The Bidder shall describe and characterise the applied bus system in its offer. Furthermore, the service proven state of a potentially offered Ethernet based bus system shall be provided with the offer.

### 3.8.4 Diagnosis and Control Functions

Two types of data transmission within the Unit and between coupled units in regard to the control and subsystems have to be determined:

- Function-relevant signals
- Diagnostic-relevant signals

Both classifications differ regarding data volume and requirements on reliability of data transmission:

- Function-relevant signals – only some signals with highest requirements on reliability
- Diagnostic-relevant signals with high data volume and lower requirements on reliability of data transmission

Due to this difference, diagnostics data of the most important subsystems have to be transmitted through bus interfaces. Thus, a high data volume can be transmitted for diagnostics purposes and wire expense can be saved.

If necessary, safety-relevant data should be transmitted by dedicated wires and not only by bus systems.

### 3.8.5 Speed Measurement

Speed signals have to be provided at the vehicle control level consistently for all client applications, including the ATP actual speed, and have to be processed redundantly.

The speed measurement system and the tachograph must have a minimal accuracy of 1 % under all conditions.

### 3.8.6 Drive / Brake-Control

The basic control instructions for the drive control shall be derived from the drive/brake control input given from the driver’s cab, from the multiple unit control or from the automatic speed control.
The set values have to be corrected according to the operating status of the Unit and restrictions e.g. by continuous automatic train-running control and the given force/speed-diagram, and have to be transmitted to the components through the vehicle-bus. Control of the propulsion system shall be affected continuously. Input for tractive and braking effort shall be continuous by a controller.

### 3.8.7 Automatic Speed Control

The Unit shall be equipped with an automatic speed control system. This system takes charge of the speed of the Unit and controls to the speed target value which is given by the driver in the frame of efficiency of drive and electric brake. The use in multiple unit configurations has to be possible. The speed control system shall be able to split the needed brake effort between the pneumatic and the dynamic brake. Priority has to be given to the dynamic brake.

### 3.8.8 Adhesion Control

For operation under unfavourable adhesion conditions between wheel and rail, the Unit must be equipped with a self-adapting friction control system (adaptation of slip to the changing dependency of the maximum friction connection from the slip). The functionality of the friction control system has to be designed such that the following characteristics are assured:

- Automatic adjustment to different rail conditions
- Automatic adjustment to different vehicle loads
- Automatic adjustment to altering wheel set diameters after changing of wheel sets
- Effective limitation of slip

### 3.8.9 Automatic Brake Test

An automatic brake test mode shall be provided.

The indication of a successful brake test on the driver's desk must adhere to the common safety standard.

The Bidder shall describe the sequence and procedure for the automatic brake test. The automatic brake test shall also be possible for multiple operation configurations as described in chapter 1.1.1 from the active driver's cab.

### 3.8.10 Multiple Unit Control

Multiple unit operation shall be possible as defined in chapter 1.1.1. Therefore the train control must be able to control all functions in the various modes in the entire trainset.

The starting up of the entire trainset must be activated on any of the driver's cab within the trainset.
3.9 Diagnostic / Fault System

3.9.1 General
A comprehensive diagnostic/fault system shall be installed, which comprises all of the subsystems in the train. Purpose of the system:

- To assist the driver and the conductor\train master in order to accomplish their duty in normal operation and in the case of relevant disturbances/faults which have an impact on the operation and the service of train;
- To provide the necessary support to the maintenance personnel.

The diagnostic/ fault system shall support all possible train configurations as described in chapter 1.1.1.

The diagnostic concept is intended to provide comprehensive information about the trainset and the condition of the train, especially the diagnostic system shall be designed in a way that the faulty subsystem or component can be identify and the occurred faults in the trainset (incl. the train/ vehicle control and all subsystem) can be found easily and fast. The diagnostic system shall be able to locate a fault on the level of the smallest exchangeable unit, as far as this is possible with the available sensors.

In the case of faults the diagnostic/ fault system shall control the subsystem in a way, that the train can continue the service with a minimum of impact.

The Bidder shall describe the proposed fault message and diagnostic system in the tender in detail.

3.9.2 Structure of the Diagnostic System
The diagnostic is structured as follows:

- Train/ vehicle diagnostic (central diagnostic)
- Subsystem diagnostic (local diagnostic)

3.9.2.1 Train / Vehicle Diagnostic (central Diagnostic)
The central diagnosis accomplishes the following functions:

- Collecting of all available status and malfunction messages in train, including all subsystems and functions independent how their design (realised by computer, electronic device, conventional electric).
- Combining and concentrating all available information such that the indication and the memorization can be executed in a suitable and required kind.
- Storing all of the relevant events in a non-volatile memory.
Recognition and indication of faults which require action.

Displaying/ indication of the malfunction messages in a suitable way.

Providing relevant information during the entire service, supporting the driver and the conductor train master for a reliable and safe operation. Supporting the train staff in the event of faults by providing messages and recommendations to be taken in each individual case.

Providing information about possible causes of malfunction in order to support the maintenance staff.

Providing information in order to control the maintenance.

Monitoring and analysing the technical condition of the train in an efficient way.

Providing a suitable access to the stored events.

Providing functionality for download of the event memory.

Providing functionality for offline evaluation of the event memory.

Remote access capability.

In normal operation the diagnostic system displays the relevant status of the subsystems. In case of any relevant irregularities or faults suitable information must be generated by the diagnostic system in order to give the driver, conductor train master or the maintenance staff a maximum of information. All malfunction messages have to be displayed in a suitable way and stored in non-volatile memory.

Three classes of access levels shall be defined:

Access for the driver: only the relevant messages from point of view of the driver have to be displayed;

Access for the conductor train master: only the relevant messages from point of view of the conductor train master have to be displayed;

Access for maintenance: In this mode the maintenance personnel can download the very detailed diagnostic information from the fault memory. It should be possible to download the data for all vehicles in the entire train via a serial link of the on board diagnostic system. Within the train, the diagnostic data shall be transmitted by train bus.

Remote access capability.

The following Human Machine Interface (HMI) for the diagnostic shall be installed on the train:

One display in each driver's cab

At least one additional display in a short unit, located on a panel with access by the train crewsmaster.
At least two additional display in a long unit, located on a panel with access by the train
crewmaster

All HMI (display and keyboard) shall be conform with the protection class IP54 according to IEC 60529. The design shall be in accordance with UIC 557, type III display.

The text shall be available in Hebrew and English. The language shall be selected by the user on each HMI. The HMI is a colour display. For operation purposes a touch-sensitive keyboard is integrated to the front plate.

The diagnosis events shall be displayed on the HMI in the fault classes 3, 2, 1 (A, B and C acc. to UIC 557)

- Very critical event, immediate action required
- Critical event, action required before next maintenance
- Event, action required at next maintenance
- Information (e.g. switch on of the train)

The events that are relevant to the driver shall be shown on the display in the cab.

All in the central diagnostic system stored events shall be displayable. In the normal mode the list of all active and relevant events are displayed. The user shall be enabled to switch to a mode in which all stored events are displayed, sorted by date and time.

The requirements for the displays are specified in chapter 2.5.3.

Each alarm which is shown in the diagnostic display shall be assigned to an explanation or instruction for the driver or the conductor.

Details to the scope of the diagnostic data, the processing and the display of the diagnostic information shall be elaborated in a close cooperation between the Supplier and the design stage of the project.

**Additional to the current version of UIC 557 the UIC 557:1998 shall be applied in considering aspects which are not covered anymore in the current version.**

### 3.9.2.2 Diagnosis of Subsystems

Each subsystem shall execute a self-test procedure just after its start up. The self-test also includes a check of the signals supplied by other subsystems or all sensors with verification of their plausibility. Sensors which feature special test facilities (e.g. test windings) shall also be automatically tested.

Each subsystem can have an additional diagnostic system which is designed with focus on the subsystem’s specific functionality. In each of the electronic and computerised subsystems the following diagnostic functions are expected:

- Collecting of all available status and malfunction messages of the subsystem.
- Performing and evaluating of a self-test after start up.
- Combining and concentrating all the available information such that the indication and the memorization can be executed in a suitable and required kind.
- Storing all of the relevant events with additional subsystem-specific process data in a non-volatile memory.
- Recognition and indication of faults which require action.
- Displaying/ indication of the malfunction messages in a suitable way.
- Providing a suitable access to the stored events in the subsystem.

3.9.2.3 Condition Monitoring

Each subsystem shall monitor its relevant components. For each monitored component, the number of occurred relevant overloads (e.g. overcurrent, overvoltage etc.) shall be transmitted to the central diagnostic and shall be stored.

The real time monitoring shall be possible by wireless data transmission

In the case of maintenance sensitive components, the relevant load cycle data shall be transmitted from the subsystem (e.g. number of door opening cycles, operation time of the HVAC, etc.) to the central diagnostic and shall be stored.

The scope of the data which shall be stored in the central diagnostic shall be corresponding to state of the art diagnosis capabilities. During the design phase the scope of data shall finally be agreed with ISR.

In the offer the Bidder shall clearly describe the related features of the offered system.

3.9.2.4 Isolation of defective Parts

In case of defects, the defective part of the drive system shall automatically be isolated including the corresponding auxiliary circuits or the driver must be able to isolate them on the basis of displayed help texts. The isolation shall be limited on the defective parts so that a maximum of tractive effort and auxiliary power is still available or a minimum of operation functions in the train are affected by the isolation. The isolation of defect systems must be possible from the activated driver's desk in the trainset and shall support all possible train configurations as described in chapter 1.1.1.

3.9.2.5 Quality of the Diagnostics

The maximum admissible percentage of false messages of the diagnostic system is limited to:

- 10\% at the time of reception of the vehicle,
- 5\% after 1 year of operational experience.

The diagnostic system shall be able to detect the following percentage of failures:

- 90\% at the time of reception of the vehicle,
3.9.2.6 Tools, Maintenance Support System

The TCMS has to be designed in such a way that the access to process and diagnostic data by the maintenance staff is possible. The system should be user-friendly.

It shall be possible to connect a portable computer on the central diagnostic system, at least in each driver's cab.

The data transfer shall be possible via typical standardised wired interfaces like -LAN and USB by using of public transfer protocols.

Additionally a wireless interface shall be provided.

All required software licenses shall allow unlimited use by ISR.

The Bidder shall propose a system which is able to broadcast failure messages/logs to the dedicated ISR involved departments as OCC Operation Control Centre, Maintenance facilities, e.g. (refers also to 4.103.9.2.3).

In its offer, the Bidder shall describe how the mentioned requirements will be met by the provided TCMS.

3.10 Accessibility of Indicators and Control Elements

Control elements and indicators which are to be handled by the train crew shall be concentrated in cabinets at related suitable, ergonomic and well accessible locations in the train. The reading of the display information in these cabinets shall be possible without opening of a cabinet door.

All devices and components shall be mounted in a way that the accessibility for the maintenance staff is guaranteed.

3.11 Safety devices

3.11.1 Automatic Train Protection & Control Systems

The Unit shall be equipped with a design proven ETCS level 2 train protection system. The software shall be of baseline 2, software version 2.3.0d with the opportunity to be upgraded to Baseline 3, software version v.3.4.0 or v3.5.0. The Unit shall be featured with a System Transmission Module (STM) which allows the safe operation with the trackside infrastructure of the INDUSI I60R as the currently used automatic train protections system of ISR.

The Supplier shall consider the software modification and the required testing and homologation to adopt the standard STM to the specific existing ISR INDUSI I 60 R functionality and dependency.
The Supplier is required to provide the relevant tasks to implement the ETCS Level 2 train protection functionality after the ISR track side ETCS installation has been completed at the ISR network. The train protection system magnets of the INDUSI I60 R shall be fixed taken into account the instructions of THALES (ALCATEL) design. The height must be adaptable to different wheel diameters.

The Bidder shall provide the design concept to integrate the light indication, speed indicator, switch and buzzer to be implemented as part of the ETCS Level 2 standard arrangement on the driver’s desk.

The input of the relevant train parameters for the ATP system must be possible from the driver’s cab.

The Supplier’s responsibility is to provide a fully ISR compatible system integration test to demonstrate the functionality at the ISR network.

ISR track will be featured with axle counters of Type AzLM from Thales manufacturer where the design is fully in compliance with EN standards. The Unit shall be compliant with related requirements of the standard family EN 50238.

### 3.11.2 Driver’s Safety Device (DSD)

Time-dependent DSD (vigilance system) with time control according to UIC 641 (Conditions to be fulfilled by automatic vigilance devices used in international traffic) should be envisaged and integrated into the main control system.

### 3.11.3 Emergency Warning Provisions

For acoustic signalling, horns according to UIC 644 shall be installed.

High beam of the headlights shall also be useable as a signal without switched-on exterior lighting.

### 3.12 Train Radio

The Unit shall be equipped with a VHF-radio system - MOTOROLA APX 7500 according to the requirements of ISR including antenna of type KATHREIN and an additional hand microphone.

The Supplier is fully responsible to install the MOTOROLA APX 7500 radio system including the system integration function demonstration during the acceptance test procedures.

Additionally the Unit shall be equipped with a fully operable GSM-R train radio system which shall be compliant with the TSI CCS. The Supplier shall consider the system on-side commissioning and homologation tasks to be performed at the time when the ISR infrastructure has been installed for operation purposes.

Up to this date the Unit’s MOTOROLA APX 7500 radio equipment will be the leading communication system. After the GSM-R network infrastructure completion it will further remain on-board operable for redundancy issues.
The Supplier shall support the design installation of the ISR specific public cellular communications network (MIRS) at the driving cab. The M710 type system has been designed by Motorola.

The system allows personal calls and group calls with PTT (Push to Talk) services. The specific Supplier’s support shall be– the system integration into the driver's cab considering the space for rugged case, flashing light, speaker, a 12 VDC power source and the antenna installation.

Details of the design integration shall be clarified during the design phase.

### 3.13 Passenger Information System

#### 3.13.1 General

State of the art and proven passenger information systems shall allow providing audio and video information about journey (train position, estimated arrival time, next stop announcements and connections), generic information, news and advertisements. The system shall be equipped with real time data (e.g. changed schedules, delays, connections, distortions …) update functionality.

The system shall support all possible train configurations. Portion Working in multiple unit operation (e.g. operational uncoupling of units in station, partition of the train in order to run each unit to different destination) shall also be supported.

The public address system shall allow the dissemination of pre-recorded messages. A GPS based public address system shall be provided in order to inform the passenger real time.

The Supplier shall provide all parameters and software which is required to define and modify the ISR specific data like pre-recorded messages and track related data.

The procedure for updating as well as modification of schedules, timetables etc. shall be carried-out in a user-friendly and simple way. The update of the revised PIS data to the vehicle system must be possible per USB disk and laptop, respectively. Additionally, a wireless based communication channel shall be provided.

All the necessary tools for updating and maintaining the data (adding/changing stations, adding changing messages etc.) shall be part of the delivery scope.

A description of the passenger information system shall be provided by the Bidder in the offer, incl. a description of the updating procedure.

#### 3.13.2 Visual Information Facilities

The information system shall permit the display of information regarding the train's destination, the current date and time and the next station, all in Hebrew, Arabic and in English. Displays shall be located in the interior of the train in passenger area spaces and vestibules, and shall be placed in clearly visible places.
The destination shall also be displayed on the exterior, one per each two access doors and on the front of the unit. The character size should be not less than 100 mm. The signs shall be legible under all visual conditions. They can be integrated into the side wall of the vehicle or in the door panel.

An additional display in the passenger’s compartments shall indicate the toilet “occupied/ unoccupied”.

For the selection and the disposition of the devices the dedicated requirements of the TSI LOC&PAS and TSI PRM shall be met.

The number of displays as well as their placement shall be offered by the bid and will be subject to approval by ISR in the design stage.

### 3.13.3 Audible Information Facilities

The acoustic information system shall meet following requirements:

- **Requirements Functional requirements** according to UIC 568.
- Adjustable volume and sound.
- Internal communication *call opportunity* between train driver and *staff* *train master from each vestibule area of the vehicles*.
- Alarm signals.
- Passenger alarm signal to the *conductor* *train master* from the wheelchair areas and the *Universal* toilet for handicapped.

The system shall include the possibility to be selected for operation in an automatic, semi-automatic or manual mode. The system shall use pre-recorded messages. In the automatic mode, the audible messages shall be released on a time, location, distance and door closing basis, while in the semi-automatic mode the *conductor* *train master* shall activate it from any vehicle or by the driver from the driver’s cabin. By overriding the pre-recorded messages, the *conductor* *train master* shall be able to add or introduce any voice message. Automatically released messages have minor priority in contrast to announcements released manually.

Playback of announcements shall be realized in two ways:

- Automatically released announcements (triggered).
- After activating the automatic announcement system the messages shall start. The next station shall be announced approx. 2 km before arriving the next station by means of GPS coordinates.
- Manually released announcements.
The conductor shall have the choice to choose prepared and stored messages at the control terminal and to release them.

In multiple unit operation the system shall include the possibility to perform the announcement in the passenger compartment unit-selected. This control feature shall be available for the driver (operable on the driver’s desk) and the train crewmaster.

3.13.4 Passenger Emergency Communication
An emergency communication post shall be installed in each vestibule. This system shall allow communication of the passenger with the train driver in case of emergencies. It shall be conceived in a way to allow utilisation by impaired persons (blind, deaf).

The passenger emergency communication system shall adhere to the requirements of the TSI LOC PAS.

3.14 Communication Facilities

3.14.1 Mobile Communication
The vehicles shall feature the required devices which allows an acceptable communication by mobile phone for the passengers. The Bidder shall propose a technical solution.

3.14.2 Internet Communication
The vehicles shall feature the necessary receivers and hot spots for wireless internet access. The Bidder shall propose a technical solution.

3.15 Passenger Counting System
A passenger counting system in the Unit shall be offered. The proposed system shall be state of the art, well proven, robust and easy to use. The system shall support all possible train configurations. The system shall cover each exterior passenger door for monitoring purposes.

The Bidder shall describe the opportunities to elaborate the collected database in real time mode and the storage methods for later assessments.

The system shall be described in the technical proposal.

3.16 Passenger Reservation System
The Unit Fixed seat installations of individual vehicles of the Units shall be equipped with a state of the art electronic passenger reservation system.

One passenger vehicle of the Short Unit with the largest fixed seating capacity and two passenger vehicles with the largest seating capacity within the Long Units shall be assigned for passenger reservation services.
The reserved seats shall be indicated by a suitable displays. The display shall show the reserved seat number(s) as well as the affected line section.

### 3.17 Interior CCTV System

For security purposes and determent against vandalism, the Bidder shall propose the installation of a state of the art interior closed-circuit television system (CCTV) with a storage capacity of 15 days.
4 Design and Workmanship

4.1 Mechanical Equipment
General workmanship shall be of the highest quality and manufacture shall follow best modern practice for high grade equipment. Parts shall conform to the dimensions shown on, and shall be built in accordance with approved drawings.

The surface finish of parts and components shall be in conformity with the respective strength, fit and service requirements. Adjoining surfaces shall be worked to ensure proper alignment and matching.

Holes for bolts shall be drilled and accurately located by templates. Joints, datum surfaces and mating components shall be machined and all castings shall be spot faced for nuts. Machined finishes shall be shown on the approved drawings.

In order to be able to freely exchange parts and components during the vehicle maintenance, the individual fitting of parts during manufacturing shall be avoided.

All fits, bolt-hole patterns etc. have to be performed with the use of appropriate jigs and templates. The ISO-System for fits shall be adopted.

4.2 Electric Equipment
In general, the electric equipment shall be protected against overload and short-circuits as e.g. required in EN 50343. Protection against dangerous current and electric shocks due to direct or indirect contact shall be implemented according to the relevant European standards as e.g. EN 50153.

Protection requirements of EN 50388 have to be met for the primary voltage circuit.

The installation of cabling shall comply with EN 50343.

The cables shall be completely free of halogens and shall comply to the relevant standards EN 45545 series, IEC 60754-1, IEC 60332 and IEC 60811-1-1.

All electrical and electronic devices shall comply to the standard EN 50125-1 and EN 50125-3.

All electronic units shall conform to EN 50155 and as EN 50121-3-2. Electronics boards shall be mounted in suitable EMC-proof racks or housings. All removable boards must be prevented from being confused.
5 RAMS

5.1 General
The Reliability, Availability, Maintainability and Safety (RAMS) specification, described by the Standard EN 50126 shall be applied to demonstrate the relevant design and performance issues in detail.

Additional recommendations are given in the following paragraphs so to fulfil the technical requirements and special ambient conditions in Israel with respect to the demanded reliability, availability, maintainability, safety and LCC-demands.

The minimum RAMS requirements as defined in this chapter are to be met both by Short Units and by Long Units separately. Consequently, all requested documentation and data shall be provided separately for the Short and Long Unit.

5.2 System Assurance Plan
The Supplier shall submit a ‘System Assurance Plan’ complying with requirements according to EN 50126, EN 50128 and EN 50129 and shall prepare a ‘Safety Program Plan’ for the project execution no later than 3 months after the Commencement Date.

The purpose of these plans are to get a proper analyses methodology, resources of data, data modifications, calculations content analyses and actions for correction. The aim shall be moving people and goods safely, securely and efficiently. This process, known as system safety, is a management and engineering discipline that address these needs and shall be the first element of a formal process for applying its principles. It is the basis to identify any and all hazards related to the operation and maintenance of the Unit.

5.3 Demonstration of Reliability, Availability, and Maintainability
The Supplier shall demonstrate and prove the Reliability, Availability, and Maintainability values as stipulated in this chapter considering the Short and Long Units as a common amount. For the combined consideration the threshold values will be calculated by the offered characteristics for the specific Unit configuration in Short and Long design versions using a fix ratio values of 25 / 75 %.

The verification shall be carried out per delivery batch by a joint team together with the Supplier and led by ISR during the warranty period starting 3 months after the delivery of the first Unit of the corresponding batch. This consideration shall include all Units of the corresponding batch as soon as they have successfully finished their trouble fault free running in revenue service.

The demonstration of the Maintainability only needs to be demonstrated for the first batch except in case there is a deviation between the batches with impact on the maintainability values. In this case at least the affected Maintainability aspects shall be demonstrated again.
The Supplier shall recommend and describe a detailed verification procedure considering the boundaries and requirements as defined in this specification.

5.4 Reliability Requirements

Reliability requirements addressed are the probabilities that the Unit or one of its systems fulfill all requested functions under existing conditions in a defined time period. The definition of ‘Reliability’ corresponds to EN 50126.

The scheduling of the normal maintenance activities shall be compatible with the operational conditions of ISR, which specifically include:

- Routine services such as cleaning of interior, refilling of the fresh water tanks, emptying of the waste tanks and emptying of trash bins.
- Periodic inspections involving operational checks, minor adjustments, replacement of worn parts, cleaning, lubrication.
- Overhauls carried out in specialized workshops at larger operational intervals.

All guaranteed RAMS values are to be monitored and assessed with ISR on daily, monthly and yearly basis during the warranty period and shall consider the performance of the Unit in different configuration.

The definitions are:

**MDBF ->** Mean Distance Between Failures is a mean distance in kilometres travelled by the Unit in good working order between two failure events.

**MTBF ->** Mean Time Between Failures is the elapsed time between inherent failures of a system or component during operation. The MTBF can be considered as a typical part of an item which assumes that the failed system is immediately repaired (MTTR), the system reliability is strongly influenced by the MTBF.

The assumed failures for the MDBF refer to the failure categories described later on.

5.4.1 Reliability Performance

The reliability is characterized by the Mean Distance Between Failure which is to be guaranteed by the Supplier and shall be verified in revenue service. It is defined as the distance of failure free operation in average over the delivered fleet of Units per each failure category. Verification shall be done per delivery batch of Units in different configuration by a joint team, together with the Supplier and led by ISR during a time frame defined by the beginning of the warranty period of the first Unit until the end of the warranty period of the last Unit of the delivery batch. This consideration shall include design comparable Units of the corresponding batch as soon as they have successfully finished their fault free running in revenue service.

The relevant failure categories are defined in the Table below.
Failure Category | Failure Description
--- | ---
**significant** | The Unit cannot reach its scheduled destination and must be taken out of service for corrective maintenance.

The following events belong to this category:
- A failed train power supply or a reduced traction performance loss of more than 50% traction power or traction effort belongs to this category
- A loss of > 25% of passenger transporting capacity (e.g. breakdown of the HVAC)
- A failure in a safety-related system (e.g. train protection system, Vigilance System, Brake system)

**Critical** | The Unit caused a disruption of service but could reach its scheduled final destination. The following events belong to this category:
- a significantly reduced traction performance (equal or more than 50% traction power or traction effort are still available)
- a loss of a maximum of 25% of passenger transporting capacity (e.g. breakdown of the HVAC)

Typically, the Unit must be taken out of service before the end of the day for corrective maintenance.

**uncritical** | The Unit failure caused reduced performance of the traction performance or of a sub system but could reach its final destination.

Typically, the Unit can remain in service till the end of the day, and thereafter must be taken out of service for corrective maintenance.

**negligible** | The Unit failure caused minor comfort and/or performance loss but remains safe to operate with no minor performance loss.

The failure can be rectified during the next scheduled maintenance stop-over.

table 5-1 | Definition of Failure Categories

The Supplier has to ensure for each category the following maximum number of failures in average per Unit within 1 000 000 km travel distance. **Unit configuration based differences in terms of failure quantities shall be indicated individually**.

Bidder shall indicate the values for each failure category below for Short and Long Unit separately:

<table>
<thead>
<tr>
<th>Category</th>
<th>Average number of failures</th>
</tr>
</thead>
<tbody>
<tr>
<td>significant</td>
<td>5</td>
</tr>
</tbody>
</table>
### ReliabilityRequirements related to the Unit

<table>
<thead>
<tr>
<th>Category</th>
<th>Average number of failures</th>
</tr>
</thead>
<tbody>
<tr>
<td>critical</td>
<td>20</td>
</tr>
<tr>
<td>uncritical</td>
<td>30</td>
</tr>
</tbody>
</table>

The Bidder shall indicate the Negligible failure category average number of failure which will be achievable by the Unit design.

For the following major systems of the Unit in different configuration the Bidder shall stipulate the MDBF (Mean Distance Between Failures) values achievable in its offer considering all failure categories with exception of the negligible failures.

<table>
<thead>
<tr>
<th>No.</th>
<th>Principal main product assemblies</th>
<th>MDBF/km</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Running gear:</strong> Consisting of bogies and suspension, wheelsets / wheels, bearings, axles, dampers, etc.</td>
<td>........</td>
</tr>
<tr>
<td>2</td>
<td><strong>Traction system, incl. the corresponding high voltage system:</strong> Consisting of pantographs, MCB, switches, overvoltage protection devices, sensors, transformer, traction converter, traction motor, gearbox, drive system and corresponding cooling systems, traction control</td>
<td>........</td>
</tr>
<tr>
<td>3</td>
<td><strong>Train control and monitoring system (TCMS):</strong> Consisting of Unit and train control incl. train safety and monitoring systems as well as diagnostic systems, and train radio equipment.</td>
<td>........</td>
</tr>
<tr>
<td>4</td>
<td><strong>Passenger information system</strong></td>
<td>........</td>
</tr>
<tr>
<td>5</td>
<td><strong>HVAC (air-conditioning and ventilation)</strong></td>
<td>........</td>
</tr>
<tr>
<td>6</td>
<td><strong>Brake system:</strong> Consisting of the brake control system, air supply and distribution, pneumatic / hydraulic equipment incl. piping</td>
<td>........</td>
</tr>
<tr>
<td>7</td>
<td><strong>Train supply system:</strong> Consisting of converter for train supply, train power line, external connections and switches</td>
<td>........</td>
</tr>
<tr>
<td>8</td>
<td><strong>Battery system, incl. battery charger and battery</strong></td>
<td>........</td>
</tr>
<tr>
<td>9</td>
<td><strong>External door system,</strong> including the equipment for gap bridging (e.g. sliding steps)</td>
<td>........</td>
</tr>
<tr>
<td>10</td>
<td><strong>Internal door system</strong></td>
<td>........</td>
</tr>
<tr>
<td>11</td>
<td><strong>Toilet system</strong></td>
<td>........</td>
</tr>
<tr>
<td>12</td>
<td><strong>Automatic coupling system</strong></td>
<td>........</td>
</tr>
</tbody>
</table>

*MDBF values to be defined by the Supplier*
5.5 Availability Requirements

From the viewpoint of the vehicle operator, the operating availability of the Unit is relevant as a key category. This availability calculation of the offered Units must be provided in the offer and shall be verified in commercial operation as described above.

5.5.1 Availability

The availability definition and monitoring shall be distinguish between a delivered batch of Units where ISR will be responsible to perform the maintenance and a batch delivered where a Supplier has taken over the full maintenance responsibility.

The Availability definition as outlined below shall be applied to the delivery batch where ISR is in charge of maintenance.

The Availability effective for Supplier Maintained Fleet is described in the Maintenance chapter, Maintenance regime, in Annex 10.

\[
\text{Availability} = \frac{\text{Total operation time period} - \text{Total time of non-availability}}{\text{Total operation time period}}
\]

Total operation time period: Quantity of units which are part of the considered fleet or sub-fleet multiplied with the daily operation and the considered operation days within the considered calendar time period.

Total time of non-availability: Sum of non-available time of all units within the considered fleet or sub-fleet.

Units of the considered fleet at which the overhaul work is executed shall be deducted from the calculation during this period. Nevertheless the allocated down time due to overhaul shall be submitted.

In its offer the Bidder shall provide the calculated availability considering the indicative defined operational data as listed in table 5-4. This calculation must detail the time allocated for all relevant work and activities of preventive maintenance as stipulated in the submitted maintenance plans, the estimated values for corrective maintenance and any other foreseen activity.

It is hereby clarified that the values of the different parameters in the operational data specified below shall not be construed as a representation and/or an undertaking by ISR with respect to the effective values that will be in force from time to time. The operating hours and/or the number of annual operation days may be modified by ISR in accordance with its operational needs and constraints. Furthermore, the annual number of kilometres travelled by any or all Units and at the average may exceed the number of kilometres specified below.
Operational Data

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating lifetime</td>
<td>30 years</td>
</tr>
<tr>
<td>Annual operation days</td>
<td>270 days</td>
</tr>
<tr>
<td>Average daily operation time</td>
<td>18 hours</td>
</tr>
<tr>
<td>Unit maintenance overhaul intervals</td>
<td>To be specified by the Supplier</td>
</tr>
<tr>
<td>Average annual mileage (estimated)</td>
<td>175,000 km</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 5-4 Operational data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating lifetime</td>
</tr>
<tr>
<td>Annual operation days</td>
</tr>
<tr>
<td>Average daily operation time</td>
</tr>
<tr>
<td>Unit maintenance overhaul intervals</td>
</tr>
<tr>
<td>Average annual mileage (estimated)</td>
</tr>
</tbody>
</table>

As result the assured values of the monthly availability, considering 30 calendar days and yearly availability at 365 calendar days as guiding average value over the whole operating lifetime shall be submitted separately by following categories:

- Short Units;
- Long Units.

During the whole operating lifetime of the units the following availability thresholds shall be met as a minimum:

<table>
<thead>
<tr>
<th>Availability Thresholds</th>
<th>Calendar Time Period</th>
<th>Threshold value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly Availability $A_M$</td>
<td>30 days</td>
<td>$\geq 96.5%$</td>
</tr>
<tr>
<td>Yearly Availability $A_Y$</td>
<td>365 days</td>
<td>$&gt; 96.5%$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 5-5 Availability Thresholds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly Availability $A_M$</td>
</tr>
<tr>
<td>Yearly Availability $A_Y$</td>
</tr>
</tbody>
</table>

Remark:
The first valid monthly and yearly value shall be calculated when the considered time interval reached the specific Calendar Time Period.

The verification of the offered availability values shall be carried out per delivery batch by a joint team together with the Supplier and led by ISR during the warranty period as soon as the Units have successfully finished their fault free running in revenue service. The determined actual availability values shall not be smaller than the offered values during the verification period.
5.5.2 Maintainability Requirements

The definition of Maintainability is according to EN 50126.

The maintainability includes the MTTR -> Mean Time To Repair and refers to the average time required for maintenance due to relevant faults of a system on the Unit. MTTR refers to repairable units only as a part of system availability.

The expected effective maintenance time shall cover:

- Time after receiving the faults notification by the maintenance personnel, including the provision of necessary maintenance equipment, tools or spare parts at the shop or site to start maintenance work on the Units.

- The accumulated time needed for preparing (any work before detecting), detecting (the procedure of locating the defective unit in order to repair efficiently), changing (time needed for replacing the defective unit with spare part), assembling (time needed for fastening and securing the new replaced spare parts), adjusting (action of adjusting the new replaced spare parts), and inspecting (confirmation of fault corrected and system back to normal operation).

The time for transporting the defective Unit to the repair workshop and interruptions of maintenance work of more than 15 min shall not be included in this time.

5.5.3 Maintainability Performance

The basic parameters that characterise the maintainability of the Unit are:

**MTTR** Mean Time To Restore

**MTTM** Mean Time To Maintenance. This shall take into account the mean time required to maintain the Unit for both preventive and corrective maintenance, but not including the time for logistical and administrative activities.

**MDT** Mean Down Time, is the average time that a particular system is non-operational.

The specified maintainability values shall be verified by physical demonstration on specific Units selected by ISR. The purpose of these verifications is to assure that the requirements of this specification are met and also to verify stipulated values submitted by the Supplier in its maintenance manuals.
Minimum requirements for maintenance activities shall be:

<table>
<thead>
<tr>
<th>Maintainability</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTTM for the Unit for any system, subsystem or component. (preventative and corrective intervention, excluding Unit’s overhaul tasks)</td>
<td>≤ 16.0 hours (average)</td>
</tr>
<tr>
<td>Maintainability MTTR for the Unit (average over the fleet)</td>
<td>≤ 6.0 hours</td>
</tr>
<tr>
<td>MTTM for the individual Overhaul levels *)</td>
<td>maximal 30 calendar days</td>
</tr>
<tr>
<td>Basic Inspection Interval</td>
<td>≥ 20 000 km</td>
</tr>
<tr>
<td>Accumulated running distance All systems and components of high voltage, electronics and traction chain, including wheels and wheelsets, shall not have any overhaul intervention or replacement within this period (Re-profiling of wheels excluded).</td>
<td>minimum 750,000 km</td>
</tr>
</tbody>
</table>

*) The MTTM overhaul values for Units in different configurations shall be submitted considering potential different levels of overhaul over the 30 year rolling stock assumed operating period. The Bidder shall offer the values as described in Table 5-6 above with its offer.

5.6 Safety

The technical equipment of the Unit must be in compliance with the safety requirements in railway operation as defined by EN, TSI (incl. TSI-SRT, Safety in Railway Tunnels) and ISR standards, as well as National Israel standards where applicable. Failures which might occur in the systems of the Units must always lead to a safe state of the Unit and never to a safety risk in operation. The EN 50126 describes the characteristic of safety and shall be applied.

The Supplier shall guarantee a safe operation of the Units, and must provide an assessment of possible critical failures. The objectives of the required safe design shall ensure that no failure or deficiency will result in a catastrophic or critical accident.

To this purpose, it is necessary that the Supplier shall submit ‘Safety Targets’ by referring to attachment D.3 of EN 50126, assuming that the Unit would be operated with 1000 passengers. The submitted ‘Safety Analysis’, if approved by ISR, serves as the acceptance standard for the quantified risk evaluation. In the “Safety Analysis”, the equivalent fatality per person and per year shall be adopted for working staff and non-railway personnel as a counting unit.
The Safety Analysis and its design verification covering the offered Unit shall be provided prior to the final design review. This shall be demonstrated by a satisfactory ‘Hazard Analysis and Failure Mode’, a ‘Risk Matrix and Effects Analysis’ (FMEA) as a systematic technique for failure analysis used in the early design phase.

A hazard control program shall be a part of the design of operational procedures and shall be provided in the course of the Unit design.

The severity levels and consequences described in the table above shall be the framework of the assessment.

### 5.7 LCC Analysis

In its offer the Bidder shall provide separate LCC-calculations for the Short Unit as well as the Long Unit based on the following model, considering the operational boundaries as described in Table 5-4, in paragraph 5.5.1 above, covering the following major cost items:

- Total cost of Unit subcomponents to be replaced during the lifecycle period.
- Total maintenance costs:
  
  Total costs for preventive and corrective maintenance over a 30 years period shall be calculated based on the submitted maintenance schedules and manuals, including the labour and material costs for each inspection and overhaul interval, considering an annual 3% inflation rate as well as the disposal and recycling costs of used materials. An average value of 1 200 ILS/day shall be taken for all labour costs, and the material costs shall be taken from the price list for strategic spare parts as to be submitted by the Bidder, if available. It shall be assumed that all scheduled and unscheduled tasks would be conducted in ISR workshops with ISR personnel based on the manufacturer specifications.
• Total energy costs shall be calculated considering:
  - the operational mass and operational payload as defined in EN 15663;
  - ambient temperature of 30 °C and 50 % humidity;
  - nominal catenary voltage.

• The needed auxiliary power for the Unit shall be included and highlighted separately.

• Energy costs of 0.60 ILS/kWh are to be used.

<table>
<thead>
<tr>
<th>Daily load cycle (in %) (assumption)</th>
<th>Power P at the wheels and defined train speed</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>P = 100%, 160 km/h</td>
<td>Full traction power</td>
</tr>
<tr>
<td>18</td>
<td>P = 75%, 120 km/h</td>
<td>Partial traction power</td>
</tr>
<tr>
<td>22</td>
<td>P = 30%, 80 km/h</td>
<td>Partial traction power</td>
</tr>
<tr>
<td>50</td>
<td>P = 0%, 0 km/h</td>
<td>Idling</td>
</tr>
</tbody>
</table>

The calculated energy consumption figures shall be verified by means of a suitable type test which simulates each of the above mentioned operation modes (4 modes for short and long unit, each).
6 Maintenance

6.1 General Issues

The requirements referring to the Unit must not induce any exceptional maintenance effort (e.g. premature exchange or replacement).

The following requirements shall be fulfilled:

- Basic interval between inspections: ≥ 20,000 km or integral multiple of the interval between inspections.
- Interval between maintenance interventions ≥ 100,000 km or an integral multiple of the interval between inspections.
- Overhaul of the running gear ≥ 1,200,750,000 km or an integral multiple of the interval between maintenance interventions.
- Overhaul of the vehicle ≥ 2,000,000 km or an integral multiple of the interval between large overhauls of the running gear.

Differences in regard to Short Unit and Long Unit shall be indicated. The Bidder shall provide the related maximum down times which are required for the different maintenance actions as listed before together with the considered boundaries.

6.2 Modular Design

In the design, a modular principle for all assemblies (mechanical, electrical, compressed air circuit etc.) shall be implemented. The attachment of these modules and their electric or air respectively cooling agent connections (protected, safe multi-pole electric connectors, qui connectors for cooling agents and compressed air) shall be designed such that replacement of all modules can be executed as fast as possible. Every module shall be provided with appropriate lifting points.

The devices located within the modules shall be easily accessible and replaceable.

Traps, covers and flaps (if possible with identical dimensions), which cover the parts or devices to be inspected, shall be fitted with simple and safe quick-release fasteners. Access to parts which are energised above 1000 V shall be hampered by special locking mechanisms. Parts which are particularly difficult to access or to maintain shall be designed in a way that warrants a lifetime of 30 years without requiring major maintenance due to corrosion or ageing. This applies especially for carboy, bogies, running gear and pipework / wiring / cabling.

6.3 On-Board Tools and Accessories

The on-board tool and accessories kit shall be suggested by the Supplier and agreed with ISR. For its placement, an easily accessible and well illuminated location shall be provided. Tools shall be stored in a cabinet well-arranged and safely. By an exact predetermination of the arrangement of the tools and accessories in the cabinet, it shall be warranted that the absence of parts is recognised at once.
7 Fire Protection

7.1 General Issues
The Unit shall meet the dedicated requirements defined by standards and specifications allowing safe passenger operation at the specific characteristics and alignment of the ISR network especially in regard to tunnel length up to 20 km.

The following regulations shall be complied with:

- TSI SRT Technical Specification of Interoperability relating to "Safety in railway tunnels", (Category B rolling stocks)
- TSI LOC PAS
- EN 45545 part 1 to 7 "Fire protection in rail vehicles"
- UIC leaflets 564-2 and 642

In case of contradictions within the aforementioned rules and standards, the hierarchy as defined in paragraph 1.4 is to be applied.

The Bidder shall provide the general fire safety concept of the offered Unit design. This description shall also describe resulting consequent actions to the operation of the propulsion and venting system, dealing with fire-barriers and assumed evacuation measures.

The design consideration in order to prevent, detect and extinguish potential fire events and smoke spreading within the passenger compartments and machine cabinets shall be described in the offer.

Supplier shall support ISR with additional safety assessments, if so required in the future, with respect to specific tunnel design issues relevant to the interface to the rolling stock design.

Additionally to the obligatory fire detection system a fire distinguishing exinguishing system shall be provided in all pertinent technical areas in order to minimize the subsequent risk to the passenger and train staff and to the rolling stock equipment.

The fire distinguishing system shall be designed to be operated automatically.
8 Environment Protection and Ecology

The design of the Unit shall comply with the legal prescriptions concerning environment protection for its operation, maintenance and disposal/recycling.

In generally, the UIC “Environmental Guideline for the Procurement of new Rolling Stock-July 2003” shall be fulfilled.

All components and subsystems in the vehicle containing polluting liquids must dispose of respective retention trays.

The used materials, their components and compounds shall be chosen with regard to the useful lifetime, subsequent otherwise use or recycling and finally to the environmentally compatible disposal.

The classification of the materials shall be as follows:

- Type and mass of materials, that can be recycled
- Mass of the electric scrap
- Mass of the electronic scrap
- Mass of combustible materials
- Mass of the materials to deposit

The masses of the material classes as classified before shall be listed in the technical proposal considering the Short Unit as well as the Long Unit.

The following materials shall be used:

- Materials with low or no toxic content (e.g. isolation without asbestos, PVC)
- Durable products / materials
- Recyclable respectively maintainable materials with a diversity as small as possible
- Noise emissions are also a part of the considerations regarding environmental protection.
9 Design, Development and Technical Documentation

9.1 General
This chapter outlines the logistic support requirement, which will be provided as part of the contract. Different Unit configuration design in providing four and six vehicle unit shall be considered:

- Technical documentation
- Training
- Technical support

9.2 Project Control Plan
Not later than 30 days after NTP\textsuperscript{1}, the Supplier shall submit the project control plan for the realization of the contract. The plan shall include, as a minimum, the following:

1. Contract performance and progress schedule, including a graphical timeline (bar chart or schematic diagram). It shall show mandatory milestone dates and specified times of delivery of specified items.

2. Program for basic design development, subsystem selection, and system engineering and testing requirements for the subsystems.

9.3 Progress reports during Production Phase
The Supplier shall submit to ISR monthly progress reports during the production phase, the assembly phase and during the testing and supply periods.

9.4 Technical Documentation
The documentation to be provided by the Supplier shall be at least but not limited following the requirement and description outlined by TSI LOC PAS, Item 4.2.12 – Documentation for Operation and Maintenance.

The Supplier shall develop a master plan and a schedule for the development and completion of all the documents to be provided to ISR as described in Section 9.2.

A full set of The design draft documents, including those provided to the Supplier by Subcontractors, shall be submitted for ISR review no more than at least 6 months after NTP\textsuperscript{1}.

ISR approved "as-build" drawings shall be the requisite to commence the manufacture process of train sets. Design documents shall be reviewed to become the status "as-build" for further activity. The Supplier shall submit the documents "as-build" drawings in electronic format.

The language of the documentation shall be:

- Drawings, test reports, certificates, etc. English
- Manuals, operations instructions, etc.  English

However, upon ISR’s request the Supplier shall provide a Hebrew language version of the documentation for no additional costs.

- Software version shall be in English and in Hebrew

Three months before issuance of the Acceptance Certificate for a Unit under the Contract, the Supplier shall submit the electronic documentation considering the Short and Long Unit configuration in an approved format of IETM. The final version of the IETM shall be delivered after remedy of the open items no later than one year after acceptance of the first Unit in different configuration.

ISR shall get free licenses for using and updating the IETM during the whole lifetime of the Unit.

9.5 Configuration Control

9.5.1 General
The Supplier shall provide a Configuration Management Plan to outline the requirements as described in sections 9.5.2, 9.5.3 and 9.5.4 which are also to be applied for the software in use.

9.5.2 Technical Documentation
The Supplier shall maintain technical documentation records, which allow:

(a) Identification of any part of any level of the system;
(b) Identification of the next assembly drawing number of any equipment
(c) Tracing the associated documents for each part such as:
- Specification control drawings
- Source control drawings
- Sub-Contractor, vendor or Supplier part number

9.5.3 Records
The Supplier's documentation shall be capable of identifying changes and of retaining the record of superseded configuration requirements affecting items which have been formally accepted.

The configuration control system shall allow the clear identification of the "as-built" condition of every individual vehicle, even when design changes have been introduced during series production on part of the vehicles. This information shall be included in the vehicle log-book.

The Supplier shall employ a system of identifying numbers for specifications, drawings and associated documents which will ensure that parts, assemblies and installations are uniquely identifiable with regard to form, fit and function.
9.5.4 Submittal of changed Documents

During the warranty period, the Supplier shall resubmit any changed drawing, report or document in an appropriate and transparent format.

9.6 Development and Design Approval

The Supplier shall submit for ISR review in electronic and hardcopy format—no later than six months after NTP:

- All assembly and major component drawings
- Calculations
- Electrical diagrams
- Catalogue documents
- Test reports.

The ISR review is to verify general conformity of the design with the specification and does not relieve the Supplier of any responsibility.

All drawings and documents shall be presented in the English language. However, upon ISR’s request the Supplier shall provide a Hebrew language version of all the drawings and documents for no additional costs.

The ISR review is to verify general conformity of the design with the specification and does not relieve the Supplier of any responsibility.

All information shall be submitted within the time specified enabling ISR to verify before manufacturing of the relevant parts will start, so that in case of non-conformity the Supplier can take steps to remedy this situation.

All computer calculations shall be presented in such a way that the results can be checked by means of none-programmed calculations, based on generally accepted methods.

Design approval can be in the form of design reviews, organized by the Supplier. The process ends with the design approval by ISR and design freeze.

9.7 Documents with the Start Point offor Manufacturing Inspection-Supervision

9.7.1 General

The following documents shall be supplied concurrent with the start point of the manufacturing of the Unit:
9.7.1.1 Mechanical Drawings
Detailed drawings of the carbody, bogie structure and all other components with its bills of material shall be provided by means of electronic documents.

9.7.1.2 Calculations
Calculations related to the structure, assembling, mechanisms and electric components shall be supplied by means of electronic documents.

9.7.1.3 Electrical system documents
Electrical system data as electronic files shall consist of:

- Block diagram.
- Single line diagrams and functional/logical descriptive text explaining all the functions of the control system and its components.
- Detailed circuit diagrams of the electrical system.
- Guide for fault-finding
- Mechanical diagrams showing all electrical components layout on the Unit.
- Component layout and internal wiring diagrams of all cubicles, panels, controllers, control consoles and the like.
- Terminal diagram - interconnection wiring diagrams, showing the connections of all components and devices complete with number of conductors and wire numbering.
- Unit wiring diagrams showing the internal wiring of shop-made mounting units, e.g., a circuit-breaker, a relay set or a regulator (no “Black Boxes” are permitted. No unit may be left without information as to their purpose content and interior connection).
- Conduit, cable layout drawings, drawn to scale.
- Cable list.
- Electric machines test certificate, load testing and measurements results, dial settings of the potentiometers and the measurements in all test points.
- Full test data on the cubicles and electric modules.
- Recorder charts of test runs for all train functions.
- List of components giving detailed and complete information on technical data, manufacturer’s address and ordering reference and the purpose of the component in the equipment.
- Program listing and software media of the control software.

9.7.1.4 Data Sheets
Performance charts of the Unit and all its major components.
9.8.1 Documents to be Submitted Before Acceptance of the Unit

9.8 Document Development and Submission

9.8.1 General

The Supplier shall provide the documentation delivery planning at least 3 months after NTP1 IPO.

The planning shall define the delivery date of the documents to be delivered by the Supplier. The delivery data milestones of the documents shall consider the ISR effort to perform the labour training to the operation and maintenance related tasks and preparation tasks to implement the Units.

The documentation shall include the delivery of technical literature including:

- System Descriptive Manual
- User Handbook / Operator’s Manual,
- Maintenance Manuals.

9.8.2 General Specification of the Unit type

The provision made by TSI LOC PAS item 4.8 and the provision made to register authorized types of railway vehicle in accordance with Directive 2011/665/EU to define the main technical characteristics of the Unit types in different configurations shall be used to provide the Unit type registering document accordingly for further MOT action to register the Unit into the National Israeli Rolling stock Register.

9.8.3 Manuals

Operating and maintenance manuals and parts catalogues for the Unit and all its mechanical and electrical equipment documentation and detail descriptions, shall be submitted in electronic and in hardcopy format. The operating and maintenance manuals shall be presented in English language versions.

However, upon ISR’s request the Supplier shall provide a Hebrew language version of operation and maintenance manuals for no additional costs.

9.8.4 Documentation and manuals concept

The documentation mentioned above shall be comprehensive to the extent that in the event of a failure of a working part of any manufactured component, maintenance personnel will be able to refer the parts data books to obtain the model number of the component and order the required part without being compelled to dismantle the component.

These books will be utilized in training inexperienced personnel for operation and maintenance and shall be based on the following operation, maintenance and illustrated spare parts catalogue manuals specification as described in the following paragraphs.
9.8.49.8.5 Operating Instructions – Driver’s Manual Manuals

The documents to be provided by the Supplier shall follow at least, but not limited, the below requirements described by TSI LOC PAS:

- Item 4.2.12.4 – Operating Documentation
- Item 4.2.12.5 – Lifting Diagram and Instruction
- Item 4.2.12.6 – Rescue related description.

In detail, it shall outline the following paragraphs:

- Pre-operation check-out.
- Start-Up procedure.
- Operation procedure (operation limitations should be stated clearly and in bold letters).
- General data on the Unit and description of the structure, drives and auxiliary systems.
- Detailed description of all the control in the cabs and other control stations - their functions limitations and interlocking.
- Shut-down procedure.
- Emergency and rescue procedures.
- Troubleshooting

9.8.5.1 Operating Manual Document Structure

The Operating Manual shall follow closely the structure as described below:

- Front cover page.
- Opening pages (list of revisions, table of contents, list of figures, list of tables, abbreviations and acronyms, safety conventions etc.)
- Chapter 1 – General Description: Scope, Overview, System Introduction, General Structure, Theory of Operation, General Block Diagram, Functional Description, Interfaces, Technical Data.
- Chapter 2 – Detailed Description: Detailed description per sub-system and assembly, including general information, general structure, main functions, technical data.
- Chapter 3 – Controls, displays and HMI.
- Chapter 4 – System Operation: All operating sequences, steps before placing the system in service, system operation, system shutdown and steps after taking the system out of service.
- Chapter 5 – Maintenance Guidelines: Includes Maintenance Activities Policy, Operator / Crew Level Maintenance Activities Policy.
- Chapter 6 – Troubleshooting: For both BIT and symptom-based troubleshooting, includes all troubleshooting instructions, charts etc.
9.8.59.8.6 Maintenance Documentation and Procedures

The TSI LOC PAS, Item 4.2.12.3 describes in detail the requirement of documents to be provided to the operator by the Supplier in regard to maintenance activities intending to keep a functional unit in, or to restore it to, a state in which it can perform its required function, ensuring continued integrity of safety systems and compliance with applicable standards (definition as per standard EN 13306).

9.8.519.8.6.1 Maintenance Principle and Methods

In accordance to TSI LOC PAS Item 4.2.12.3.1 the Supplier shall provide at least but not limited:

- Precedents, principles and methods used to design the maintenance of the unit
- Utilization profile: Limits of the normal use of the unit (e.g. km/month, climatic limits, authorized types of loads etc.)
- Relevant data used to design the maintenance and origin of these data (return of experience)
- Tests, investigations and calculations carried out to design the maintenance.

9.8.5.29.8.6.2 Maintenance Strategy

In accordance to TSI LOC PAS Item 4.2.12.3.2 the Supplier shall provide the description how maintenance shall be conducted. As outlined by TSI definition the maintenance activities include all activities necessary such as inspections, monitoring, tests, measurements, replacements, adjustments, repairs.

Maintenance activities shall be split into:

- Preventive maintenance; scheduled and controlled,
- Corrective maintenance

The tasks are to be described separately.
The General maintenance target requirement described by chapter 6 – Maintenance shall be considered as a min requirement.

9.8.5.39.8.6.3 Maintenance Tasks Description

As in detail described by TSI the maintenance document shall outline:

- The component hierarchy and functional description
- Schematic circuit diagrams, connection diagrams and wiring diagrams
- Parts list containing the technical descriptions of the spare parts and their references, in order to allow identification and procurement of the correct spare parts, The list shall include
all parts specified for changing on condition, or which may require replacement following electrical or mechanical malfunction, or which will foreseeable require replacement after accidental damage.

- The limit values for components which shall not be exceeded in service shall be stated; the possibility of specifying operational restrictions in degraded mode (limit value reached) is permitted.
- The structured set of tasks that include the activities, procedures, means proposed by the applicant to carry out the maintenance task.
- The description of the maintenance activities.
- Disassembly/assemble instructions drawings necessary for correct assembly/disassembly of replaceable parts.
- Maintenance criteria.
- Checks and tests.
- Tools and materials required to undertake the task.
- Consumables required to undertake the task.
- Personal protective safety provision and equipment.

The documentation shall contain the Suppliers own equipment and parts of the rolling stock system and the delivery from the subsidiaries.

The Supplier shall provide equipment list and the main specification of them to be procured from the open market in preparation to execute the light and heavy maintenance at the rolling stock at the ISR facilities. The document delivery shall be indicated as part of the delivery planning as described by Section 9.8.1.

9.8.6.4 Maintenance Manual Document Structure

The maintenance manual document shall follow closely the structure as described below:

- Front Cover Page.
- Opening Pages (list of revisions, table of contents, list of figures, list of tables, abbreviations and acronyms, safety conventions etc.)
- Chapter 1 – General Description: Scope, Overview, System Introduction, General Structure, Theory of Operation, General Block Diagram, Functional Description, Interfaces, Technical Data.
- Chapter 2 – Detailed Description: Sub-system and assembly, including general information, general structure, main functions, theory of operation, General Block Diagram, Functional Description), interfaces, technical data.
Chapter 3 – Maintenance Guidelines: Includes Maintenance Activities Policy, Crew Level Maintenance Activities Policy.

Chapter 4 – Troubleshooting: Both BIT and symptom-based troubleshooting, including all troubleshooting instructions, screens, charts, fault diagnosis and use of any special maintenance tools or testing equipment.

Chapter 5 – Maintenance: Includes all maintenance activities for Preventive Maintenance and Corrective Maintenance, such as inspections and maintenance tasks, repair procedures, material used, procedures for removal and installation etc.

### 9.8.69.8.7 Illustrated Part Catalogue

The parts catalogue shall be detailed to an extent of part breakdown and indicate the numbering system as outlined below.

### 9.8.69.8.7.1 Parts Breakdown

Illustrated parts breakdown, including any of the subcontractor’s items with a set of section drawings or axonometric/”blow-up” drawings and a list for each one of the drawings including the following data elements:

- Item number on the drawing.
- Item’s name.
- Subcontractor’s part number.
- Subcontractor name.
- Quantity per assembly.

### 9.8.69.8.7.2 Part Numbers Index

Index of all part numbers appearing in the catalogue in P/N sequence having the following data elements:

- Part number.
- Drawing number.
- Drawing index number.

The parts breakdown will also include drawings of the subcontractor’s items.

### 9.8.79.8.8 Document delivery format

The documents shall be delivered in electronic format, where the format shall be as follow:

- Operator’s and Maintenance Manuals:

b. PDF files (unlocked and data-copy-enabled).

c. Source templates approved by ISR, and provided to ISR if required. It is advised to approve a general template (appearance, styles, fonts etc.) before the documentation process.

- Images format:

d. Images will be linked inside the WORD file and stored in a Graphics directory.

e. Vector files in PDF, CorelDraw, Adobe Illustrator etc.

f. 300 dpi GIF files, to be linked inside the WORD files.

g. Font for balloons and numbers is ARIEL 12.

- Printing preferences:

h. A4 or A5 page sizes, mirror printing, different even and odd headers.

- Schemes:

i. Pneumatic, electrical, fuel and oil schemes and circuits will be provided in color and with vector source files.

9.9 Interactive Electronic Technical Manual – IETM

Concurrent with the final acceptance of the first Unit, the Supplier shall provide the technical documentation as an interactive electronic technical manual (IETM), namely as a high-quality database product. This IETM will allow for multiple methods of accessing the data including full-text and fielded searching, visual access and table of contents (TOC) access, as well as for interactive cross-reference within each publication, and between different but related publications (e.g. cross-references between Maintenance Manual and Parts Catalogue). The IETM user interface shall be in English.

However, upon ISR’s request the Supplier shall provide a Hebrew language version of IETM user interface for no additional costs.

The Supplier shall make proposals regarding the type of system to be implemented.

The IETM will support the following features (non-comprehensive list):

- End-user access control

- Annotations and bookmarks (annotations will support Hebrew)

- Easy navigation between documents titles and sub-titles

- Combined Boolean full-text and fielded searches.
Nested querying - up to 4 nesting search levels

Compound documents viewer (text, tables, raster/vector images, audio, video, etc.)

Multi-target hyperlinks

External executable links

Exporting images in their native format; exporting text

Temporary Revisions and Updates

9.10 Lubrication Charts

The Supplier shall prepare framed plastic-coated lubrication charts for all systems, showing all points to be lubricated, type of lubricant to be used at each location and recommended frequency of lubrication.

In order to enable usage of lubricants available in the Israeli market, the Supplier shall provide, three months after signature of the contract, a list of recommended lubricants for approval by the Israel Railways and only the approved lubricants will be used during the construction and assembly of the train and will appear on the lubrication charts.
10 Operation and Maintenance Training

10.1 General
Supplier shall develop and provide a training program supported by appropriate tools and training material state-of-the-art like 3-D models, cut views, animations, videos e.g. for knowledge transfer that accurately and completely reflects the requirements of the manuals, and be structured and implemented so that the ISR operator and maintainer have access to all necessary resources to properly and successfully operate, maintain and administer the vehicles as required to keep the fleet operable on a high reliability level.

Supplier's first step: The training program document delivery planning shall be indicated following the terms as described in Section 9.8.1. However, the first training program considerations and draft documents shall be delivered within 6 months period from IPO for ISR review.

All relevant documents shall be provided both in softcopy and hardcopy formats.
The documentation shall be provided in English and Hebrew language.

10.2 Training Program Planning
The Supplier's training program to be developed and submitted to ISR for approval shall consist of the following detail program issues to be trained to ISR staff ensuring an efficient learning process:

- Training rational and method
- Detailed Syllabus
- Competencies to be acquired per each course or module
- Training Duration / schedule
- Certification route
- Evaluation process (exams)
- Trainer's qualification process
- Training and evaluation Materials (tools, practical and theoretical lesson material and examination format
- Training aids and simulating tools
- Trainee per course quantity

Training of personnel shall be provided for a minimum of three categories of ISR personnel:

- Driver's Instructors
- Train master's instructors
- Electricians and technicians maintenance instructors
The training courses shall be provided to twelve (12) driving instructors and four (4) train master instructors.

The training program of ISR’s maintenance personnel shall be conducted to two separate groups with at least 6 electricians and 6 mechanics maintenance instructors.

Each training cycle shall include no more than 6 trainees at a time, unless otherwise agreed upon between ISR and the supplier in advance.

10.3 Training Scheduling and Locations

Training of personnel by the Supplier shall be scheduled to take place ensuring ISR staff is qualified to take over the Units in its own responsibility after the first Unit has passed the Final Acceptance Test.

Optionally the Supplier shall be prepared to provide additional programs to training the ISR personnel during the defined operation implementation period.

Supplier’s maintenance staff training shall be provided to qualify ISR staff being capable to identify the rolling stock critical performance condition and availability relevant issues at the Units which are under the supplier’s maintenance responsibility.

Furthermore, ISR staff shall be qualified by sufficient training to perform the daily service relevant checks and tests on the Unit’s readiness for service operation at ISR’s operational overnight stabling areas.

Upon ISR’s request, Supplier shall provide the full maintenance training program and exercise the training to ISR staff.

Supplier shall provide dedicated training courses in the Manufacturer’s facilities for driver instructors, when ISR will prepare its own exercise of the Unit’s maintenance.

The maintenance instructors shall be trained in ISR’s training facility.

The courses shall cover operational and maintenance aspects of the system or in the Supplier’s Maintenance Depot location.

Training shall be conducted by the Supplier’s instructors, combining theoretical lessons with practical “hands-on” lessons and demonstrations at the Units and its subcomponents and systems.

Training of personnel shall be provided for a minimum of three types of ISR personnel: drivers, electricians and technicians.

Training of personnel by the Supplier shall be scheduled to take place at least 2 months before the first system is received by ISR, in order to allow the ISR Training Department to prepare and train its labour.

Optionally the Supplier shall provide a program to training the ISR drivers on site during the defined operation implementation period.
The Supplier shall provide 3D cut views and 3D models in a format that allows ISR to use and develop further animations and products that are based on 3D model of the system.

The 3D model shall be provided in ".xt" "Step" or other solid-based format. These types of files allow the Supplier to provide only a surfaces model, without giving the engineering knowledge of the design and the manufacturing. ISR can help and provide further advice and aid in order for the Supplier to fulfil this requirement.

The Supplier shall provide images folder that will cover all the systems and specially parts and assemblies (such as racks and circuit breakers) that are located within cabinets or enclosed area that denies the possibility to take proper pictures once the equipment is installed. The image-picture folder shall cover all the maintenance tasks and operational task. Images will be given in open source file format for further editing.

10.2  Class Room Training

Class room training shall consist of basic theory of the Unit systems and their operation in normal, emergency and rescue operation condition.

10.3  On-the-Job Training

On-the-job training which shall include:

- Operation of the Unit types in different configurations for at least 2.5 operating hours for each operator instructor, but at least to an extent where the operator instructor will be able to operate the Unit safely.

This training shall be provided to four driving ISR’s driver instructors, which will then instruct the other operators of the ISR. All training aids which will be used during the training will be left for the ISR’s use.

The on-the-job training of the and the train master instructors shall be executed before undergo the final acceptance test completion and the handing over of the first Unit in each configuration.

10.4  Maintenance Instruction

The Supplier shall develop a Maintenance dedicated training plan and the courses in the manufacturing facilities. If required, additional individual training documents shall be foreseen to an extent allowing to perform the preventative and corrective tasks be provided as part of the inspection and overhaul on the rolling stock and with respect to the fact that ISR will implement a portion of Units into its own maintenance system later on. first operational service implementation.
10.4 Upon ISR's written demand, the Training Material; Content and Formats

The training of ISR's maintenance personnel documentation shall be conducted by Supplier and shall be instructed to two separate groups:

- Mechanical systems technicians
- Electrical systems technicians

10.4.1 Class Room Training

Class room instruction consider the theoretical and practical training shall contain courses specific knowledge transfers.

10.4.1 Theoretical lessons document content structure and information

The documentation structure shall closely follow the below format:

- Front Cover Page
- Opening Pages with list of revisions, table of contents, abbreviations and acronyms, safety conventions, lessons management, required tools and materials etc.
- Slides - slides shall only include images, diagrams and special operational and maintenance notes.
- Note Pages (bottom section) – shall include the instructor information for class management, theoretical information and special notes.

Theoretical Training materials shall incorporate advanced training technologies such as:

- Videos 2D and 3D simulations
- Courseware / CBT (computer based training)

10.4.2 Practical lessons document content structure and information

The documentation structure shall closely follow the below format:

- Front Cover Page
- Opening Pages with list of revisions, table of contents, abbreviations and acronyms, safety conventions, lessons management, required tools and materials etc.
- Practical Modules to address aspects such as operation, scheduled maintenance, troubleshooting and corrective maintenance and include observation pages and evaluation pages.

Training Aids should include the following:

- System theory
- Maintenance Job aids, pocket manuals, drawings and schematics organization instructions cards – for each type of personnel in the ISR (Drivers, Train master, Technicians).
- Wall charts and interpretation posters allowing quick access information to perform a task.
• Equipment familiarization

• Maintenance tasks performance which will include:
  o Periodic inspections
  o Corrective task and Trouble shooting

• Replacement and adjustment work (heavy and light Log books, maintenance) forms etc. as required for the system.
• On-System components or component models for demonstration and exercise

10.4.3 Examination and Evaluation Documents

The documentation structure shall closely follow the Job below format:

• Front Cover Page.
• Theoretical Modules: 50 (multi-selection) theoretical questions per module plus a table of correct answers.
• Practical Modules: Practical test modules, for proper and correct operation and maintenance per target audience and specific modules based on the operational components

10.4.210.4.4 Training video/audio taping

On the job training ISR shall have the right to videotape and/or audiotape each one of the theoretical and practical hands on.

10.4.3 Duration and Location for Training

The Supplier shall recommend the duration and location of the training sessions. The Supplier shall be responsible to certify given by the knowledge transfer level to the extent which is required to perform the work in a safe manner supplier.
11 Technical Support

The Supplier shall provide ISR with technical support as follows:

An electrical engineer, a mechanical engineer and a software engineer (“Technical Support Team”) shall be present in Israel for a period of 12 months, commencing the service from the final acceptance date of the first Unit in any configuration.

The members of the Technical Support Team shall be experts with hands on familiarity with the Unit design, preferably, members of the Units design or development team.

The Technical Support Team shall perform as follows:

- It shall coach and instruct ISR personnel in all aspects of carrying out Driver instructors’ service for the Unit, including troubleshooting activities. Such coaching and guidance shall be in addition to the training services detailed in the Technical Specifications.

- It shall support ISR engineering teams and servicing staff in identifying potential faults and malfunctions which are to be addressed to the Supplier’s warranty Teams activities.

It is hereby clarified, that the activities of the Technical Support Team shall not in any way derogate from the Suppliers obligations regarding the Warranty Team.
12 Warranty of the Supplier

Adequate and appropriate manufacturing of all assemblies shall guarantee the following warranty periods according to the design:

- 3 years in general
- 6 years in respect to Endemic Failures
- 6 years for painting, labels
- 10 years for entire corrosion protection
- Warranty for the specified design lifetime for the vehicle body of the Unit and the bogie frames

Extension of the warranty period:

- Extension by one year if one of the specified below RAM target values are violated by more than 10 % for all Units of an specific configuration before expiration of the warranty the delivery batch of Units. Different target figures based on configuration will be considered.

<table>
<thead>
<tr>
<th>RAM Criteria</th>
<th>Target</th>
<th>Deviation recorded entitling ISR with extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability – Significant failure</td>
<td>5 per 1.000.000 km</td>
<td>&gt;= 6 per 1.000.000 km</td>
</tr>
<tr>
<td>Reliability – Critical failure</td>
<td>20 per 1.000.000 km</td>
<td>&gt;= 22 per 1.000.000 km</td>
</tr>
<tr>
<td>Availability</td>
<td>≥ 96.5 %</td>
<td>&lt;= 86.85 %</td>
</tr>
</tbody>
</table>

| table 12-1 | RAM Targets * The above values will be amended for monitoring purposes based on the offer of the bid. |

- Non-recurring extension by one year for the entire delivery if failures of the same subject matter occur at least three times impairing the operational capability of the Units.
- Non-recurring extension by one year for individual parts if failures of the same subject matter occur at least three times without significant impact on the operational capability of the Units.
- Non-recurring extension by one year for individual Units failing to meet one of the targets by more than 50%, even though the targets are met on average by the entirety of all Units.
- Non-recurring extension by the relevant warranty period for parts or for painting if rectification of defects in the scope of the warranty or replacement were required.
13 Manufacturing Record Book MRB

For each vehicle of a Unit to be manufactured under this Contract, the Supplier shall prepare a Manufacturing Record Book MRB which shall contain all relative documents and information in regard to the specific vehicle. This logbook shall stay with the vehicle during the manufacturing process and shall be continuously updated by the Supplier. It shall be properly structured and be in durable form, so that it can be used by the ISR after delivery of the vehicle during its entire service life. The vehicle MRB’s shall be formed to an Unit consist to be handed over after the Unit’s final acceptance.

The MRB shall be structured as follows:

- Table of contents
- Summary sheet with Vehicle Data
- Manufacturing History
- Quality Records
- Configuration List
- Certificate of Completion of Factory Tests
- Final Acceptance Certificate and Test Report
- Fault Free Service Running Certificate
14 Acceptance Test

Acceptance tests comprise the type tests as well as routine testing including the final acceptance test regarding the proper function and performance of the Units and its sub-components, individually in different configuration design.

Thus besides the quality assessment of materials, parts, components and assemblies the general performance and safety of the 4 and 6 vehicle Unit consist design shall be demonstrated by tests.

According to the pertinent requirements of EN 50215 the Supplier shall provide a test plan which shall also include the internal testing and commissioning program of the Supplier.

A first version of this test program shall be submitted during the design phase for reviewing and approval by ISR. During the project execution this test plan can be modified in consultation with ISR.

The type tests shall completely demonstrate the suitability for operation on the Trans European Network (TEN) as well as with the special demands of ISR.

Thus the vehicle shall be tested as necessary for reaching an approval for operation within the TEN and in regard the ISR infrastructure. Existing test results and homologations following the European Directive 2008/57/EC will be taken into account based on the European “Cross Acceptance” procedure. For ISR’s review the related test documentation and homologation documents are to be provided.

In this regard a Notified Body will be accepted when registered at the European Commission ERA website: (http://ec.europa.eu/enterprise/newapproach/nando/index.cfm).

If the Supplier plans to use this option he shall create a recommendation table which lists the requirement categories (A, B and C) with the following meaning:

Category “A”: Contains internationally accepted harmonized standards, like UIC leaflets or EN. Once checked, they do not need re-checking.

Category “B”: Contains standards where there is uncertainty (checked in one country and might be accepted in another). If so it will become a category “A”.

Category “C”: Contains undisputable, essential and necessary rules and requirements for a country, which will always require checking before use i.e. requirements of the relevant infrastructure.
15  Fault-free Running

Each Unit shall undergo fault-free running in revenue service for 5000 km to commence the warranty period as specified in Section 16.5 to the Agreement.

16  Supplier’s Maintained Fleet – General Provisions

16.1  General

The provisions set forth herein shall not derogate from any of the provisions set forth in the Agreement including the Attachments therein. For the removal of doubt the order of precedence between different documents is as specified in Section 2 to the Agreement.

ISR decided to outsource the maintenance of certain amount of Units to the Supplier. Bidder is required to specify its proposed maintenance plan in the "Proposed Maintenance Services".

The Units shall be maintained over the maintenance contract period following a scheduled preventative and corrective maintenance concept where the key elements of ISR’s service operation boundaries and the interface relevant information are outlined and described in the sections above. The Units where the Supplier takes over the responsibility to perform the maintenance during the contractual period shall be maintained at the Supplier’s Maintenance Depot.

Supplier shall perform the maintenance activities at the Supplier’s Maintenance Depot. Nevertheless, Supplier shall be prepared whenever required to perform certain minor repair activities as described in the TSI LOC PAS at ISR’s stabling areas where the daily servicing checks are performed by ISR staff.

16.2  Key Objectives of the Rolling stock maintenance under the Supplier’s provision

The Supplier’s work execution in providing the different maintenance levels shall consider the following key objectives of the rolling stock maintenance which has to be implemented to ensure a safe working environment.

- Considering the principle of Safety first in all Supplier’s related maintenance action;
- Sustain a standard of rolling stock fleet safety through a qualified maintenance program by regular inspection, preventative maintenance and component repair and replacements;
- Occupational health and safety in full compliance with the Israeli laws to be applied by organizing and execution of any maintenance tasks;
- Delivering of the rolling stock individual train set units on a daily basis to achieve or exceed the availability and reliability target values established;
• Demonstrating quality of workmanship and maintenance procedure excellence complying with latest industrial standards;
• Making sure the Supplier meets the passenger satisfaction standards;
• Implementing a continuous improvement management process to gain the cost efficient maintenance and quality of the maintenance procedures.

The Bidder is requested to describe in its Proposed Maintenance Services the potential measures on how to achieve the key objectives as described above.

16.3 Maintenance Quantities
The Supplier shall take over the full responsibility to provide the maintenance for the Units delivered to ISR as part of the delivery contract.

The quantity of Units to be maintained by the Supplier under the terms of maintenance contract shall be as defined in the Supplier’s Maintained Fleet, Section 19 to the Agreement:

• 18 Units in 6 - vehicle configuration;
• 6 Units in 4 – vehicle configuration.

The Supplier shall take into account a maintenance capacity flexibility considering an extended quantity extension of up to 75% of the 46 Units to be maintained without major depot layout design modifications in the scope of work as described below.

16.4 Maintenance Concept
The maintenance concept to be developed and to be implemented by the Supplier shall aim to keep the Units in operational, safe, reliable condition and to ensure passenger’s satisfaction which shall be in compliance with the terms and descriptions defined in this Technical Specifications.

The Operational data in section 5.5.1, Table 5-4 to be used to establish the key boundaries of the maintenance planning. Supplier shall adjust the planning in the event that ISR is required to update the operational data over the Unit’s service period in order to meet the passenger transport volumes demand.

The Supplier shall be responsible to verify and update the maintenance planning established whenever design modifications are implemented to the Units over the maintenance service period.

The maintenance interval minimum target values specified in Section 6.1 above shall be considered while offering the Proposed Maintenance Services.

The Bidder shall describe any deviation or potential risk to implement such maintenance concept in the Proposed Maintenance Services.
16.5 Scope of Maintenance Work
The Supplier shall provide the following maintenance activities over the defined maintenance contract period including without limitation:

- Supplier shall be prepared to perform minor repair activities necessary to ensure safe operation, as described in the TSI LOC PAS, at ISR’s stabling areas where daily servicing checks are performed by ISR;
- Preventative light maintenance related inspections;
- Unscheduled corrective actions due to faults;
- Rolling stock wheel set re-profiling;
- Scheduled heavy maintenance overhaul tasks to the rolling stock and its components;
- Passenger comfort related component’s preventative and corrective works;
- Rolling stock refurbishment work;
- Daily service relevant tasks including for the removal of doubt the interior cleaning whenever the Units are in maintenance events at the Supplier’s managed Depot.

The regular daily servicing of Unit in regard to the cleaning and toilet servicing and check-ups will be performed by ISR in their facilities according to the scope of work as described by TSI LOC PAS.

For the removal of doubt, Unit’s exterior car wash is excluded from the Supplier’s obligations.

At ISR’s request Supplier shall be required to conduct Unit’s refurbishment work (enhancement of performance) in its Maintenance Depot using installed facilities. The terms and scope for the performance of such work shall be agreed between the parties on a case by case basis.

In addition to the Maintenance Services Supplier shall provide Excluded Repair Works as defined in section 6 to the Maintenance Chapter to the Agreement for cases such as vandalism or accidents which require corrective actions or rectifications of the Unit or its components.

16.6 Maintenance Contract Duration
The Maintenance Period, commencement, duration and options for extension are defined in the Agreement in Section 19.2.

16.7 Management Task Preparation
The Bidder shall describe in its Proposed Maintenance Services a preliminary management and labour mobilization planning.

This planning shall contain management organization structure and a job description of the key work position within the organizational team structure.
The Proposed Maintenance Services shall describe the preliminary consideration to achieve the local content of maintenance staff to be employed and the training and qualification measures required allowing continuously increasing the competence to perform work in a qualified manner at the necessary level.

16.8 Maintenance Work Execution

16.8.1 Mobile Maintenance Service

The Supplier shall perform a mobile corrective maintenance service to the Units to rectify any fault at ISR’s maintenance facilities, ISR’s servicing and stabling areas or wherever the Unit stranded due to an technical fault at ISR’s network.

The Supplier shall prepare the organizational pre-requisites and to qualify maintenance staff accordingly to perform such kind of services and provide road-based supporting equipment allowing to access the site in short time as reasonably possible.

The Bidder shall describe the planned consideration to meet the above requirement.

16.8.2 Stationary Work Execution at Maintenance Depot

The Supplier shall perform the entire scope of scheduled preventative and un-scheduled corrective maintenance work in its own Maintenance Depot over the maintenance contract period.

16.9 Depot Development

Supplier is referred to Attachment F1 of the Agreement with respect to the responsibility allocation between ISR and Supplier regarding to the design-built obligations and erection of the Depot.

The Depot design layout planning shall consider all functional requirements to execute the maintenance work to the Units within the scope of maintenance services in the aspect of an proven workflow, including all functional required supporting work arrangements as track alignments, stabling areas, warehouse and storages, cleaning sections, road access etc.

The design of the Depot shall follow the requirements as defined by European standards and good workmanship considering specific Israeli requirement as well as to ensure the interface compliance to the standards applied to design of the Units.

The offered depot design shall be verified by a safety concept document to proof the arrangements fit for the environmental and technical based regulations and shall support safe work execution.

Bidder shall submit the concept Depot design layout, as part of the Proposed Maintenance Services, in order to allow ISR to crosscheck the proposed depot design concept in terms of technical reliance and economic efficiency.

The Bidder shall explain in detail the concept design consideration in regard to the functional Depot areas.
ISRAEL RAILWAYS LTD. REQUEST FOR PROPOSALS

The concept design layout planning shall identify the mandatory functional areas to be provided to execute the Units different maintenance levels;

The overhaul specific depot facility requirements and milestones to be ready for services shall be defined.

Bidder shall provide the preliminary calculations to elaborate the required maintenance pit quantity and dimensional size, the number of tracks in the stabling area, the space and size estimation to different maintenance component shop areas and to other work and social accommodations.

16.9.1 Depot Facility and Equipment Delivery
For the removal of doubt, Supplier’s responsibility shall be to deliver the full depot facility installation, maintenance equipment and tools required to carry out the inspection and maintenance work at different maintenance levels as defined over the contract period.

The Bidder shall submit in the Proposed Maintenance Services a preliminary equipment and tool list identifying the planned delivery and estimated installation milestones and the quantity to be utilized in regard to the maintenance levels to be performed over the contract period.

The Bidder shall identify the critical equipment and tool items in regard to the delivery lead time being available on site to perform the work.

16.9.2 Maintenance Workflow
The Bidder shall describe in its Proposed Maintenance Service concept the general maintenance workflow and key maintenance work steps to be applied to the Units and sub-components in different maintenance levels.

16.9.3 Depot Maintenance Arrangement and Capacity
The overall Maintenance Depot capacity shall be described by suitable calculation considering the workflow arrangements proposed and the scope of work to be provided.

The Bidder shall provide in the Proposed Maintenance Service a simplified sequenced annual maintenance scheduling to the fleet over the maintenance contract period considering:

- The quantity of Units in service and under the maintenance contract terms;
- The contract delivery schedule of Units supplied to ISR to service
- Planned annual average mileage of the Units in service;
- The maintenance plan to be applied to the Units;

The Bidder shall describe in the Proposed Maintenance Service the preliminary planning concept to perform scheduled preventative maintenance tasks in ISR’s operation free daily time period.

The Unit’s downtime to stay in preventative maintenance services at different service levels shall be identified.
The preliminary workload planning information shall identify the below specified issues:

- Daily work regime of the labour involved in maintenance tasks;
- Direct labour quantity estimate required to execute such work program;
- Daily work load distribution to the labour;

The above workload planning information shall be in consistency with the information to be provided following the RAMS chapter instruction, in Section 5.7 – LCC – Analysis.

The Bidder shall submit in the Proposed Maintenance Service potential consideration in regards to balancing the maintenance planning by optimizing the overall availability of the fleet and considering the daily and weekly workload distribution to the labour in its long term social responsibility.

### 16.10 Maintenance Material and Spare Parts Management

The Supplier’s responsibility shall be to provide the full maintenance material logistic to organize a proper material planning procedure, timely delivery of the material to the site for its maintenance purposes and safe warehouse and on site storages of the maintenance material considering the Israeli environment condition and the regulation established in regard to dangerous material properties as well.

The Supplier’s responsibility in regard to maintenance material provision shall cover any material items as classified to be:

- Standard material
- Consumable parts
- Replacement parts
- Assemblies and Subcomponents

The scope of work shall be provided to the entire fleet which will be in service operation up to the time of its disposal and defined as the Supplier's Maintained Fleet.

The material service shall be available from the first day of Unit's service operation.

The Supplier shall offer the warehouse activities from its own managed Maintenance Depot.

The Bidder shall describe in the Proposed Maintenance Service the preliminary consideration in regard to the maintenance material management logistic concept to define:

- Management organisation and key personal;
- Performance indicators measuring the efficiency and service level;
- Material planning and consumption recording procedures and instruments;
- Material supply chain approach and logistics;
- Warehouse design requirements and storages size estimates.
16.11 Maintenance Engineering and Reporting

16.11.1 Units Technical Documentation
The Supplier shall be responsible to remain the Unit’s technical documentation up to date at any time within the Agreement period.

The Supplier’s responsibility and obligation will be to submit any design update or design modification relevant technical information to ISR considering the operational relevance as well.

The Bidder shall describe in its Proposed Maintenance Service the consideration in regard to implementation of a design configuration management system.

16.11.2 Maintenance Management Information System (MMIS) and Maintenance Records
Supplier shall be required to implement sufficient and structured MMIS as part of the maintenance services allowing to collect all relevant maintenance information in regard to the tasks scheduling, work content, maintenance material definition and property, material consumption estimates in scheduled and corrective action, technical relevant design information and performance parameter generated by maintenance tests to demonstrate Unit’s readiness for service and finally the recording of all maintenance activities performed to the specific Units to detail the labour’s work hour consumption and the material consumed.

The comprehensive utilization of the MMIS shall be used to provide evidence that the maintenance work is planned and being realized in an efficient and well-coordinated manner.

For the recordings to be generated the SAP software system shall be applied which is already implemented at ISR’s maintenance organization. The records shall be made available and integrated into ISR’s SAP systems for further retention.

The Bidder shall submit in its Proposed Maintenance Service the preliminary consideration to customize the system configuration and a preliminary implementation approach.

16.11.3 Manufacturing Record Book
The Supplier’s responsibility shall be to hold the manufacturing record books per Unit up to date in order to record activities performed during the maintenance levels.

16.11.4 Fault Recording and Analysing
The Supplier’s engineering shall be responsible to implement a monitoring to the Unit’s ability to provide services and to the performance quality of the Unit systems taking further action by means of appropriate analysis to identify and implement the design or maintenance based improvement measures.
A FRACAS process (Failure Reporting Analysis and Corrective Action System) implementation shall be used to report to ISR the investigation results of any faults reported and recording by train set born system and to offer the measures to stabilize the design or processes.

Bidder shall offer in the Proposed Maintenance Service the preliminary consideration on how such FRACAS process will be implemented.

16.12 Maintenance Planning and Corrective Action Advise
Supplier will be required to delegate sufficient qualified staff permanently to ISR’s operation and maintenance control centre (OMCC) to support ISR’s management to coordinate and arrange:

• Unit's scheduled maintenance planning considering the service operation availability requirements and the rolling stock circulation at the network;

• To provide engineering advises in real time to the train driver and / or train master operating the Unit in service operation when fault records will be triggered for their actions

The Bidder is requested to describe in the Proposed Maintenance Service its considerations to meet the tasks to support ISR staff in charge at the OMCC.

16.13 Maintenance Contract Performance Indicator
The maintenance contract execution performance will be measured to identify:

• The Reliability of the train sets to perform an uninterrupted service under best passenger comfort condition

• Availability of train sets to be ready for operation service as scheduled by planning

Details to measure the performance indicators of the reliability and train set availability are established and outlined in Annex 10 of the Maintenance Chapter.

The Bidder shall offer in the Proposed Maintenance Service the measures to be implemented to meet the performance criteria over the Maintenance Period.
A Appendix A: Rail Types, Lines and Track Quality

A.1 Rail Types
The standard track gauge is 1,435 mm (nominal).
Rails on main lines are continuous welded except for the Beit – Shemesh – Jerusalem line in which rails on curves with radius ≤ 170 m are connected with fish plates.
The following rail types are being used on the ISR network:
- UIC 60, UIC 60 320Cr, UIC 54, U 50, S 49, U 33, BS 37
The rails are installed with an inclination of 1 in 40, 1 in 30 and 1 in 20.
Present types of sleepers are concrete monoblock, Franko-bagon and Wooden.
The minimal numbers of sleepers per km track is 1667.

A.2 General Criteria for Track Maintenance

Allowed tolerances:

<table>
<thead>
<tr>
<th>Speed [km/h]</th>
<th>Rank</th>
<th>Twist</th>
<th>Surface</th>
<th>Gauge</th>
<th>Superelevation</th>
<th>Alignment</th>
</tr>
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<tbody>
<tr>
<td>1 120 - 160</td>
<td>B</td>
<td>4.5</td>
<td>8</td>
<td>-5 +8</td>
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<td>6</td>
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<tr>
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<td>C</td>
<td>9.0</td>
<td>15</td>
<td>-5 +20</td>
<td>8</td>
<td>9</td>
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<tr>
<td></td>
<td>D</td>
<td>12</td>
<td>20</td>
<td>-7 +30</td>
<td>12</td>
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<td>2 80 - 120</td>
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<td>-5 +10</td>
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<td>C</td>
<td>11</td>
<td>18</td>
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<td>D</td>
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<td>22</td>
<td>-7 +31</td>
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<td>3 40 - 80</td>
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<td>13</td>
<td>-5 +15</td>
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<td>9</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>14</td>
<td>22</td>
<td>-6 +30</td>
<td>15</td>
<td>14</td>
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<tr>
<td></td>
<td>D</td>
<td>16</td>
<td>24</td>
<td>-7 +32</td>
<td>21</td>
<td>19</td>
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<td>4 0 - 40</td>
<td>B</td>
<td>10</td>
<td>18</td>
<td>-5 +20</td>
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<td>12</td>
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<td>C</td>
<td>17</td>
<td>28</td>
<td>-7 +30</td>
<td>20</td>
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<tr>
<td></td>
<td>D</td>
<td>18</td>
<td>30</td>
<td>-9(-11) +35</td>
<td>28</td>
<td>25</td>
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</table>

Table A-1: Tolerances for Track Maintenance

Remark:
Deviations below "B": Track accepted condition – measuring values are less or equal to "B"
Deviations from "B" up to "C": Alert limit– measuring values are greater than “B” and less than or equal to “C” - Regular planned maintenance operation
Deviations above "C": Intervention limit – measuring values are greater than “C” and less than or equal to “D” – Corrective maintenance required

Immediate action limit is given by measuring values greater than or equal to “D”. This would either require reducing of the line speed or closing the track.

### A.3 Line and Track Parameters

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<th>Parameter</th>
<th>Unit</th>
<th>Value</th>
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<td>Standard track gauge</td>
<td>[mm]</td>
<td>1,435</td>
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<tr>
<td>Gauge widening in tight curves</td>
<td>[mm]</td>
<td>≥300 → 0</td>
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<tr>
<td>(in addition to standard 1,435 mm gauge dimension)</td>
<td></td>
<td>250-299 → 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>200-249 → 10</td>
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<tr>
<td></td>
<td></td>
<td>&lt;200 → 15</td>
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<tr>
<td>Horizontal Geometry</td>
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</tr>
<tr>
<td>Curve radius on main lines</td>
<td>[m]</td>
<td>≥190</td>
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<tr>
<td>Exceptional curves radii:</td>
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<td>1 curve on Beit-Shemesh-Jerusalem</td>
<td>[m]</td>
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<td>56 curves Beit-Shemesh-Jerusalem</td>
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<td>200–150</td>
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<td>1 curve on Rosh-Ha'ain line</td>
<td>[m]</td>
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<td>some curve on secondary line</td>
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<td>120</td>
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<td>Minimum S-curves radius with short tangent section</td>
<td>[m]</td>
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<td>(6m) and without tangent</td>
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<td>190+190</td>
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<td>Minimum radius in depot track</td>
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<td>Vertical Geometry</td>
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<tr>
<td>Maximum gradient along the length of existing lines</td>
<td>%</td>
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<td>(Beit-Shemesh-Jerusalem line)</td>
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<td>Maximum gradient along the length of future lines</td>
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<td>Minimum vertical curve radius on lines</td>
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<td>(concave /convex)</td>
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<td>Cant (superelevation)</td>
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<tr>
<td>Maximum cant</td>
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<td>Maximum cant deficiency for conventional trains</td>
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<tr>
<td>Maximum cant in special cases(ballast-less track)</td>
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<tr>
<td>Transition curves are always cubical parabolas</td>
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<tr>
<td>Minimum transition curve length</td>
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<td>L - length h = cant</td>
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<tr>
<td>V = speed</td>
<td>[mm]</td>
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<td>Cant is introduced at a regular rate along such</td>
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<tr>
<td>transitions curves</td>
<td>[km/h]</td>
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<tr>
<td>Distance between Centres of Tracks</td>
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<th>Value</th>
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<td>$v \leq 160$ km/h</td>
<td>[m]</td>
<td>$&gt; 4.5$</td>
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<td>$160$ km/h &lt; $v &lt; 220$ km/h</td>
<td>[m]</td>
<td>$&gt; 4.7$</td>
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<tr>
<td>rail cant</td>
<td></td>
<td>1:30</td>
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<tr>
<td>equivalent conicity from wheel profile and track</td>
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<td>0.12 - 0.24 at 3 mm lateral movement of the wheelset, max. single value 0.45</td>
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Table A-2: Main Line and Track Parameters

### A.4 Platforms Dimension and Data

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<th>Radius (m)</th>
<th>End (KM)</th>
<th>Beginning (KM)</th>
<th>Track number</th>
<th>Maximum height of platform (CM)</th>
<th>Distance between axis of the track and platform (CM)</th>
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<td>Beginning (KM)</td>
<td>Track number</td>
<td>Maximum height of platform (CM)</td>
<td>Distance between axis of the track and platform (CM)</td>
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* - according to the project

Table A-3: Platform dimension and data
B Appendix B: Specification of the Trip Time Calculation

B.1 Methodology
This appendix shall be a recommendation for the calculation of trip times by the Contractors in order to receive comparable results. It shall be a basis for internal discussions.

For generating comparable trip time calculations the important parameters are to be clearly defined. Besides the track data (inclination, curve radiuses, station positions, maximum speed) and the operation data (environmental data, station positions, residence time), the driving resistance data of the electric multiple unit are the necessary parameters.

The driving resistance of the EMU $F_{\text{WEMU}}$ should be considered by the use of equation 1, but if the Contractor has a more precise equation he may use it (differences shall be explained).

The curve radius resistance is to be respected according to equation (2).

Resistance force multiple unit:

$$ F_{\text{WEMU}} = f_{\text{WEMU0}} G_{\text{EMU}} + F_{\text{WEMU1}} \left( \frac{v}{v_{00}} \right) + F_{\text{WEMU2}} \left( \frac{v + \Delta v}{v_{00}} \right)^2 [\text{kN}] \quad (1) $$

$G_{\text{EMU}}$: weight of fully loaded EMU [kN]
$v$: velocity [m/s or km/h]
$\Delta v$: velocity addition [m/s or km/h] (headwind)
$v_{00} = 100$ km/h respectively 27.778 m/s: velocity constant

$f_{\text{WEMU0}}, F_{\text{WEMU1}}, F_{\text{WEMU2}}$: vehicle specific parameter which are to be defined by the Bidder

Curve radius resistance (according to Röckl):

$$ F_R = \frac{k}{R - \Delta R} \cdot G_{\text{EMU}} [\text{kN}] \quad (2) $$

$R$: curve radius [m]
$R < 300\text{m}$: $\Delta R = 30\text{m}$; $3000 > R \geq 300\text{ m}$: $\Delta R = 55\text{ m}$

$R < 300\text{m}$: $k = 0.500\text{ m}$; $3000 > R \geq 300\text{ m}$: $k = 550.65\text{ m}$

(for reference see: Fahrdynamik des Schienenverkehrs; Dietrich Wende; 1. Auflage 2003)

For vehicle comparison the trip time Tel Aviv Hagana – Jerusalem Binyanei Hauma without intermediate stops will be used.
The following table shows the parameters that are to be used for the calculation.

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<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value</th>
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<td>Train configuration:</td>
<td>EMU consist as offered</td>
<td>Both 4-vehicle and 6-vehicle configuration</td>
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<td>Weight of train</td>
<td>Weight in configuration as offered as defined by EN 15663</td>
<td>“Design mass in working order” (EN 15663 2.1.2.1) plus “Exceptional under exceptional payload” (see section 2.1.2.3 of EN 15663) considering “Payloads for passenger vehicles other than high speed and long distance trains” (see section 6.2, table 4 of EN 15663 6.1 Table 3 with 4 passenger per square meter in standing areas)&quot;</td>
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<td>slope; distance, curve radius, limit speed; etc.</td>
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<td>see track data</td>
<td>see table</td>
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<td>25 kV @ 50 Hz</td>
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Table B-1: Relevant data of reference train for calculating the trip times

The Contractor shall provide the used traction braking effort curves as well as the used efficiency and energy consumption curves.

All calculations must be presented and explained in a way which is comprehensible and fully enables recalculating and reproducing all data.

For track data for the calculation please refer to the following table.
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Table B-2: Horizontal plan
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<tr>
<td>12603.36</td>
<td>25.03</td>
</tr>
<tr>
<td>1201.54</td>
<td>18.96</td>
</tr>
<tr>
<td>1349.43</td>
<td>30</td>
</tr>
<tr>
<td>511.38</td>
<td>13.1</td>
</tr>
<tr>
<td>499.7</td>
<td>2.02</td>
</tr>
</tbody>
</table>

Jerusalem Binyanei Hauma

Table B-2: Vertical plan
### B.4 Speed Profile:

<table>
<thead>
<tr>
<th>V-max (km/h)</th>
<th>Length (m)</th>
<th>Begin absolute location (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>1493.19</td>
<td>0</td>
</tr>
<tr>
<td>80</td>
<td>709</td>
<td>1493.19</td>
</tr>
<tr>
<td>150</td>
<td>3501.15</td>
<td>2202.19</td>
</tr>
<tr>
<td>140</td>
<td>123.3</td>
<td>5703.34</td>
</tr>
<tr>
<td>100</td>
<td>400</td>
<td>5826.64</td>
</tr>
<tr>
<td>150</td>
<td>2926.54</td>
<td>6226.64</td>
</tr>
<tr>
<td>100</td>
<td>5424.46</td>
<td>915318</td>
</tr>
<tr>
<td>160</td>
<td>37560.87</td>
<td>14577.64</td>
</tr>
<tr>
<td>120</td>
<td>818.09</td>
<td>52138.51</td>
</tr>
<tr>
<td>100</td>
<td>636.42</td>
<td>52956.6</td>
</tr>
<tr>
<td>70</td>
<td>130.08</td>
<td>53593.02</td>
</tr>
<tr>
<td>50</td>
<td>651.42</td>
<td>53723.1</td>
</tr>
<tr>
<td>0</td>
<td></td>
<td>54374.52</td>
</tr>
</tbody>
</table>

Table B-3: Speed Profile
C Appendix C: Running Dynamics
Safety - Track fatigue - Ride quality

Amended threshold values for test runs according to EN 14363. The values are only applicable as far as they are part of the measurement method which has to be chosen in compliance with EN 14363.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Limiting Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΣY</td>
<td>Sum of guiding forces</td>
<td>Prud'homme 1)</td>
</tr>
<tr>
<td>ΣH</td>
<td>Sum of lateral forces at axle boxes</td>
<td>Prud'homme 2)</td>
</tr>
</tbody>
</table>

1) due to existing track quality, the factor $k_1$ is 0.85 (instead of 1.0)

2) due to existing track quality, the factor $k_2$ is 0.80 (instead of 0.9)

Table C-1: Running Dynamics
D Appendix D: Environmental Conditions

D.1 Climate and Environmental Conditions

Max. Ambient temp. 45 °C (shade)
Min Ambient temp. Minus 5 °C
Relative humidity 10% to 90%
Altitude - 400 m to +800 m
Sunny hours per year 3300 h
UV Radiation MJ/m² per year 360 - 600
Rainfall mm/year 400 - 800

D.2 Dust Concentrations in the Atmosphere

<table>
<thead>
<tr>
<th></th>
<th>Maximum Half-hour Value</th>
<th>Maximum Daily Value</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>1064</td>
<td>560</td>
<td>71</td>
</tr>
<tr>
<td>SO2</td>
<td>780</td>
<td>260</td>
<td>21</td>
</tr>
<tr>
<td>O3</td>
<td>312</td>
<td>143</td>
<td>84</td>
</tr>
<tr>
<td>Suspended Dust</td>
<td>-</td>
<td>350</td>
<td>100</td>
</tr>
</tbody>
</table>

All values in micrograms per m³ atmosphere
Particle Size to 0.5 - 1 micron

Table D-1: Suspended Particle Matter (SPM)
Special attention shall be paid to potential contamination by chalk dust from the track-bed.

D.3 Sea Salt Concentrations in the Atmosphere

<table>
<thead>
<tr>
<th>Salt Element</th>
<th>Na</th>
<th>Cl</th>
<th>SO4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position</td>
<td>Season</td>
<td>Season</td>
<td>Season</td>
</tr>
<tr>
<td></td>
<td>Dry</td>
<td>Wet</td>
<td>Dry</td>
</tr>
<tr>
<td>Sea Air at Coastline</td>
<td>7.3</td>
<td>16.0</td>
<td>12.0</td>
</tr>
<tr>
<td>600 m from Shore</td>
<td>3.1</td>
<td>4.8</td>
<td>4.2</td>
</tr>
<tr>
<td>6000m from Shore</td>
<td>1.1</td>
<td>1.4</td>
<td>1.5</td>
</tr>
</tbody>
</table>

All values in micrograms per m³ atmosphere

Table D-2: Salt Concentrations in the Atmosphere
### Appendix E: Water Quality

<table>
<thead>
<tr>
<th>No.</th>
<th>Parameter</th>
<th>Unit</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hardness</td>
<td>ppm</td>
<td>220-450</td>
</tr>
<tr>
<td>2</td>
<td>pH</td>
<td></td>
<td>6.4-7.5</td>
</tr>
<tr>
<td>3</td>
<td>Chlorides</td>
<td>ppm</td>
<td>20-400</td>
</tr>
<tr>
<td>4</td>
<td>Alkalinity</td>
<td>ppm</td>
<td>100-300</td>
</tr>
<tr>
<td>5</td>
<td>Ca</td>
<td>ppm</td>
<td>45-100</td>
</tr>
<tr>
<td>6</td>
<td>Cr</td>
<td>ppb</td>
<td>approx. 3</td>
</tr>
<tr>
<td>7</td>
<td>Cu</td>
<td>ppb</td>
<td>approx. 3</td>
</tr>
<tr>
<td>8</td>
<td>Fe</td>
<td>ppb</td>
<td>approx. 68</td>
</tr>
<tr>
<td>9</td>
<td>K</td>
<td>ppm</td>
<td>2-5.7</td>
</tr>
<tr>
<td>10</td>
<td>Mg</td>
<td>ppm</td>
<td>20-30</td>
</tr>
<tr>
<td>11</td>
<td>Mn</td>
<td>ppm</td>
<td>approx. 6</td>
</tr>
<tr>
<td>12</td>
<td>HCO3</td>
<td>ppm</td>
<td>110-400</td>
</tr>
</tbody>
</table>

**Table E-1: Typical Water Quality in Israel**
### Appendix F: Air Conditioning Performance

#### F.1 HVAC Passenger Area


<table>
<thead>
<tr>
<th>Clause</th>
<th>Existing Text</th>
<th>Modification</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>air temperature according to Annex A</td>
<td>air temperature according to ISR adapted of Annex A</td>
</tr>
<tr>
<td>4</td>
<td>air speed according to Annex B</td>
<td>air speed according to ISR adapted Annex B</td>
</tr>
<tr>
<td>4</td>
<td>relative humidity according to Annex C</td>
<td>relative humidity according to Annex C</td>
</tr>
<tr>
<td>5.1</td>
<td>The comfort conditions shall be satisfied between the limits of the external conditions given in Annexes E.1 and E.2.</td>
<td>The comfort conditions shall be satisfied between the limits of the external conditions given in ISR adapted Annexes E.1 and E.2.</td>
</tr>
<tr>
<td>5.2</td>
<td>5 K below the minimum values and 5 K above the maximum values specified in Annex E</td>
<td>5 K below the minimum values and 5 K above the maximum values specified in ISR adapted Annex E.</td>
</tr>
<tr>
<td>5.2</td>
<td>if they are placed under the under-frame, 10 K above the maximum values specified in Annex E.</td>
<td>if they are placed under the under-frame, 10 K above the maximum values specified in ISR adapted Annex E.</td>
</tr>
<tr>
<td>6.1.1</td>
<td>The contractual specifications shall define a regulation curve which shall be within the limits of the zone shown in Annex A.</td>
<td>The regulation curve is defined in the ISR adapted Annex A.</td>
</tr>
<tr>
<td>6.6</td>
<td>The air speed in the comfort areas shall be in the zones defined in Annex B according to prEN 13129-2.</td>
<td>The air speed in the comfort areas shall be in the zones defined in ISR adapted Annex B according to prEN 13129-2.</td>
</tr>
<tr>
<td>6.7.1</td>
<td>The total volume of fresh air added by forced ventilation to the comfort areas shall be in accordance with the values defined in Annex F.</td>
<td>The total volume of fresh air added by forced ventilation to the comfort areas shall be in accordance with the values defined in ISR adapted Annex F.</td>
</tr>
<tr>
<td>6.7.2</td>
<td>A re-circulated air system shall ensure the operation (even in a degraded condition) if the design of the vehicle can permit the fresh air intakes to be temporarily blocked.</td>
<td>In case of a failure in the cooling circuit, the ventilation system will continue it’s function of circulating the cabin air and supplying fresh air.</td>
</tr>
<tr>
<td>7</td>
<td>Within the performance defined in clause 8, it shall be possible to vary the temperature setting in each comfort area independently of the other areas by means of a control device that gives a minimum range of regulation of ± 2 K (+ 2 K and - 4 K for couchette coaches and sleeping cars) around the temperatures specified in clause 6.</td>
<td>Within the performance defined in clause 8, it shall be possible for the crew to vary the temperature setting in each comfort area independently of the other areas by means of a control device that gives a minimum range of regulation of ± 3 K.</td>
</tr>
<tr>
<td>8.1</td>
<td>The preheating time is a question of exploitation which shall be specified by</td>
<td>ISR requires a preheating time of 30&lt;85 minutes from 0°C to 18°C.</td>
</tr>
<tr>
<td>Clause</td>
<td>Existing Text</td>
<td>Modification</td>
</tr>
<tr>
<td>--------</td>
<td>---------------</td>
<td>--------------</td>
</tr>
<tr>
<td>8.2</td>
<td>At the minimum external temperature for the climatic zone (see Annex E) defined in the contractual specifications, the mean interior temperature shall be greater than or equal to +22 °C in commercial service without passengers and solar radiation.</td>
<td>At the minimum external temperature (see ISR adapted Annex E), the mean interior temperature shall be greater than or equal to +22 °C in commercial service without passengers and solar radiation.</td>
</tr>
<tr>
<td>8.3</td>
<td>The precooling time is a question of exploitation which shall be specified by the operator.</td>
<td>ISR requires a precooling time of 30&lt;100 minutes from 40°C to 27°C.</td>
</tr>
<tr>
<td>8.4</td>
<td>At the maximum exterior temperature of the climatic zone (see Annexes E.1 and E.2) defined in the contractual specifications, the mean interior temperature (Tim) shall be equal to the normal interior temperature setting (Tic) specified in 6.1.1 in commercial service with all seats occupied and solar gain.</td>
<td>At the maximum exterior temperature (see ISR adapted Annexes E.1 and E.2), the mean interior temperature (Tim) shall be equal to the normal interior temperature setting (Tic) specified in 6.1.1 in commercial service with all seats occupied, solar gain and 2 standees/m2.</td>
</tr>
<tr>
<td>9.1.1</td>
<td>The coefficient k for the vehicle shall be less than or equal to the values according to Table 1:</td>
<td>The coefficient k for the vehicle shall be less than or equal to 2.0 W/m2K at standstill.</td>
</tr>
<tr>
<td>9.4</td>
<td>With stationary vehicles, the overall level of noise generated by the air conditioning installation alone in the comfort areas, shall not exceed the values in Table 2:</td>
<td>With stationary vehicles, the overall level of noise generated by the air conditioning installation alone in the comfort areas shall be quoted by the Bidder in the tender documents.</td>
</tr>
<tr>
<td>9.7</td>
<td>When the contract specification requires it, the vehicle and its air conditioning unit shall be fitted in a manner that undue tympanic pressure variations do not occur).</td>
<td>Required</td>
</tr>
<tr>
<td>9.9.1</td>
<td>The value of MDBF (Mean Distance Between Failures) shall be as defined in the contract specification of the air conditioning installation.</td>
<td>The value of MDBF (Mean Distance Between Failures) shall be quoted by the Bidder at the time of tender.</td>
</tr>
</tbody>
</table>

Annex A  
Refer to EN13129-1  
Replace with ISR adapted Annex A

Annex B  
Refer to EN13129-1  
Replace with ISR adapted Annex B

Annex C  
Refer to EN13129-1  
Identical to EN13129-1

Annex D  
Refer to EN13129-1  
Identical to EN13129-1

Annex E.1  
Refer to EN13129-1  
Table E.1 – Winter  
Minimum exterior temperatures 0-5°C
<table>
<thead>
<tr>
<th>Clause</th>
<th>Existing Text</th>
<th>Modification</th>
</tr>
</thead>
</table>
| Annex E.2    | Refer to EN13129-1             | Table E.2 – Summer
Maximum exterior temperature = 45°C
Relative humidity at 45°C = 10%
Design Point 1 Temperature = 37°C
Design Point 1 Rel. Humidity = 60%
Design Point 2 Temperature = 30°C
Design Point 2 Rel. Humidity = 70%
Equivalent solar load (En) = 1050 W/m² |
| Annex F      | Refer to EN13129-1             | Replace with ISR adapted Annex F                                            |

Table F-1: Clause by Clause Comments EN 13129-1

---

Annex A
Regulation curve for the interior temperature setting

![Diagram](image_url)

Figure F-1: ISR Adapted EN 13129-1:2002(E) Annex A
Figure F-2: ISR Adapted EN 13129-1:2002(E) Annex B
Clause by clause Modification to EN 13129-2:2004(E) : Railway applications - Air conditioning for main line rolling stock - Part 2: Type tests

<table>
<thead>
<tr>
<th>Clause</th>
<th>Existing Text</th>
<th>Recommended Modification</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.4.2.1</td>
<td>The tests shall be carried out at the temperatures given in Table 1:</td>
<td>The tests shall be carried out at the following temperatures:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 °C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+10 °C</td>
</tr>
<tr>
<td>6.4.3.1</td>
<td>The tests shall be carried out at the external climatic conditions given in</td>
<td>The tests shall be carried out at the external climatic conditions given below:</td>
</tr>
</tbody>
</table>

Note: ISR requirement is based on full seating occupancy and 4 standees/m².
Table 2: 

<table>
<thead>
<tr>
<th>Dry bulb temperature</th>
<th>Relative humidity</th>
<th>Equivalent solar radiation ($E_n$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>°C</td>
<td>% RH</td>
<td>W/m²</td>
</tr>
<tr>
<td>30</td>
<td>70</td>
<td>1050</td>
</tr>
<tr>
<td>37</td>
<td>60</td>
<td>1050</td>
</tr>
<tr>
<td>47</td>
<td>10</td>
<td>1050</td>
</tr>
</tbody>
</table>

8.4 The measurement of noise and vibration shall be carried out on a stationary vehicle with the air conditioning installation functioning at a level which corresponds to the maximum performance conditions of the customer's specification.

Table F-2: Clause by Clause Comments EN 13129-2
### F.2 HVAC Driver’s Cab

Modifications to AC-Standard of driving cabs:

Clause by clause modification to EN 14813-1:2006+A1:2010(E):

<table>
<thead>
<tr>
<th>Clause</th>
<th>Existing Text</th>
<th>Modification</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Driving cab classification</td>
<td>The driver’s cab shall be designed in accordance with the requirements for category A.</td>
</tr>
<tr>
<td>7.2</td>
<td>preheating time to be defined in agreement</td>
<td>Preheating of the driver’s cab at minimum exterior temperature as defined in Appendix D to $T_{im}$ as defined in 7.1 shall not take more than 30 minutes</td>
</tr>
<tr>
<td>7.3</td>
<td>maximum interior temperature</td>
<td>The maximum interior temperature under all climatic conditions as defined in Appendix D with solar load, at full speed and with two occupants shall not exceed 27 °C</td>
</tr>
<tr>
<td>7.4</td>
<td>precooling time to be defined in agreement</td>
<td>Precooling of the driver’s cab at maximum exterior temperature and maximum solar load as defined in Appendix D to 27 °C shall not take more than 30 minutes</td>
</tr>
<tr>
<td>7.5</td>
<td>stand by operation to be defined in agreement</td>
<td>A parking mode feature of the driver’s cab air conditioning system shall be provided keeping the maximum interior temperature at 30 °C under the conditions as defined in 7.4 and the minimum temperature at 10 °C under the conditions as defined in 7.1</td>
</tr>
<tr>
<td>8.2</td>
<td>interior temperature settings</td>
<td>The temperature control shall relate to the exterior temperature as defined in paragraph 8.2.3 of EN 14813-1</td>
</tr>
<tr>
<td>9.5</td>
<td>air speed</td>
<td>The air speed nozzles, facing the driver, shall not exceed 0.3 m/s</td>
</tr>
<tr>
<td>9.6.1</td>
<td>the minimum fresh airflow rate of 30 m³/h/person is sufficient</td>
<td>The minimum fresh airflow rate shall be 60 m³/h</td>
</tr>
<tr>
<td>Clause</td>
<td>Existing Text</td>
<td>Modification</td>
</tr>
<tr>
<td>--------</td>
<td>--------------</td>
<td>--------------</td>
</tr>
<tr>
<td>10.1</td>
<td>heat transfer coefficient (k) &lt; 2.3 W/m²/K for the vehicle at standstill</td>
<td>heat transfer coefficient (k) &lt; 2.3 W/m²/K for the vehicle at full speed</td>
</tr>
<tr>
<td>Annex D</td>
<td>Table D.1 – Definition of climatic zones - Winter</td>
<td>Table D.1 – Winter Minimum exterior temperature -5 °C</td>
</tr>
<tr>
<td>Annex D</td>
<td>Table D.2 – Definition of climatic zones - Summer</td>
<td>Table D.2 – Summer Maximum exterior temperature = 45°C Relative humidity at 45°C = 10% Design Point 1 Temperature = 37°C Design Point 1 Rel. Humidity = 60% Design Point 2 Temperature = 30°C Design Point 2 Rel. Humidity = 70% Equivalent solar load (En) = 1'050 W/m²</td>
</tr>
</tbody>
</table>

Table F-2: Clause by Clause Comments EN 14813-1:2006+A1:2010(E)
Appendix G: System Requirements

G.1 System layout

Figure G-1: Actual Passenger Network of Israel Railway
G.2 Distances between Passenger Stations

<table>
<thead>
<tr>
<th>INTERCITY SERVICE</th>
<th>STATION</th>
<th>DISTANCE m</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAHARIYYA - HAIFA - TEL AVIV - BEN-GURION AIRPORT</td>
<td>NAHARIYYA</td>
<td>8770</td>
</tr>
<tr>
<td></td>
<td>ACCO</td>
<td>10371</td>
</tr>
<tr>
<td></td>
<td>GIRIYAT MOTZKIN</td>
<td>2309</td>
</tr>
<tr>
<td></td>
<td>GIRIYAT HAIM *</td>
<td>1925</td>
</tr>
<tr>
<td></td>
<td>HUTZOT HAMIFRATZ *</td>
<td>2377</td>
</tr>
<tr>
<td></td>
<td>LEV HAMIFRATZ</td>
<td>5137</td>
</tr>
<tr>
<td></td>
<td>HAIFA MERKAZ</td>
<td>1720</td>
</tr>
<tr>
<td></td>
<td>HAIFA BAT GALIM</td>
<td>5733</td>
</tr>
<tr>
<td></td>
<td>HAIFA HOF HACARMEL</td>
<td>11581</td>
</tr>
<tr>
<td></td>
<td>ATLIT *</td>
<td>20705</td>
</tr>
<tr>
<td></td>
<td>BINYAMINA</td>
<td>3289</td>
</tr>
<tr>
<td></td>
<td>GESYRY'A-PARDES HANNA *</td>
<td>7688</td>
</tr>
<tr>
<td></td>
<td>HADERA MAARAV *</td>
<td>13757</td>
</tr>
<tr>
<td></td>
<td>NETANYA *</td>
<td>6470</td>
</tr>
<tr>
<td></td>
<td>BE YEHOUSHUJA *</td>
<td>11605</td>
</tr>
<tr>
<td></td>
<td>HERZLIYYA *</td>
<td>6985</td>
</tr>
<tr>
<td></td>
<td>T.A. UNIVERSITY</td>
<td>2318</td>
</tr>
<tr>
<td></td>
<td>T.A. MERKAZ</td>
<td>1290</td>
</tr>
<tr>
<td></td>
<td>T.A. HASHALOM</td>
<td>2337</td>
</tr>
<tr>
<td></td>
<td>T.A. HAHAGANA</td>
<td>9615</td>
</tr>
<tr>
<td></td>
<td>BEN-GURION AIRPORT</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL</strong></td>
<td><strong>135'982</strong></td>
</tr>
</tbody>
</table>

| TEL AVIV - BE'ER SHEVA | T.A. MERKAZ | 1290 |
| T.A. HASHALOM | 2337 |
| T.A. HAHAGANA | 16576 |
| LOD | 42334 |
| GIRIYAT GAT |  |
| BE'ER SHEVA |  |
| TZAFOIN UNIVERSITY | 40221 |
| BE'ER SHEVA MERKAZ | 5270 |
| **TOTAL** | **108'030** |

Remarks:
1. Some of the intercity trains may be stoppin in stations marked with *
2. Intercity train Nahariyya - Be'er Sheva Merkaz total distance 230.770 km

Table G-1: Distances between passenger stations
H Appendix H: Technical Requirements for Electronic Equipment

H.1 Ambient Temperature (supplementary to EN 50155, Paragraph 2.1.2)

Electronic devices must be dimensioned and produced thus the entire specified operating requirements on the operations behaviour will be met for a temperature class added to EN 50155. The values are specified in the following table:

<table>
<thead>
<tr>
<th>Category</th>
<th>Column 1 Outside ambient temperature</th>
<th>Column 2 Inside cabinet temperature</th>
<th>Column 3 Inside cabinet excess temperature 10 min</th>
<th>Column 4 Temperature of ambient air of printed circuit board assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tx</td>
<td>-5... +45°C</td>
<td>-5... +70°C</td>
<td>15°C</td>
<td>-10... +85°C</td>
</tr>
</tbody>
</table>

Table H-1: Ambient Temperature

Devices which are arranged at the exterior of the Unit and such which are required for putting the Unit into service must additionally fulfil the following conditions:

- Temperature area of -10 to -15 °C, short-time operation (10 min) without observing tolerances.
- Deviations should be with impact to the safe side.
- Temperature area of -15 to -20 °C – no irreversible damages at switched-off devices

H.2 Special Service Conditions (supplementary to EN 50155, Paragraph 2.2)

Atmospheric influences:

In dependence on the position and arrangement in the Unit, the devices have to work even in case of wind, sand storm, rainfall and shower water, pollution of the ambient air by dust, smoke, aggressive gases and steaming, salt mist, etc. Moreover impacts of plant and animal microbes have to be considered, if so, a filtration is to be envisaged.

H.3 Testing

Dimension testing according to EN 50155:
The dimension testing has to evaluate whether the fitting dimensions are within the tolerance of the specified nominal size.

The following has to be tested:

- outer dimensions
- dimensions of connectors and fittings (mechanical interfaces, except for component)