

**Request for Information
(RFI)**

Concerning Dual Locomotives

February - 2019

Request for Information (“RFI”)
Concerning Dual Locomotives

Introduction

Israel Railways Ltd. (“ISR”) hereby requests information regarding the manufacturing and supply of Dual Locomotives.

ISR seeks such information from Manufacturers and Suppliers of Dual Locomotives, including information regarding the procurement, operation and maintenance of Dual Locomotives, all as generally defined in Appendix A attached hereto (the “Technical Attachment”) and as further described below.

In case of slight deviation from the Technical Attachment, Participant is still invited to submit its proposal.

Objective of RFI

The objective of this RFI is to enable ISR to explore the option of acquiring the proposed Dual Locomotives, as well as to review and estimate to costs involved.

This RFI is not to be considered as a request for proposals or as a tender and the provisions of neither the Israeli *Mandatory Tenders Law 5752-1992* nor the Government Procurement Agreement shall apply hereto.

Notwithstanding the aforesaid, ISR may, as a result of this RFI, at its sole and absolute consideration, approach one or more of the Respondents to this RFI and/or to any other party, in order to obtain additional information.

Notwithstanding the aforesaid, ISR may, as a result of this RFI, at its sole and absolute consideration, conduct an additional procedure, *inter alia*, tender procedure, and may use, at its sole consideration, any of the information provided in this RFI.

This RFI shall not, under any circumstance, constitute any commitment on ISR's part to negotiate with any or all interested parties, nor to enter into any agreement for the acquisition of the Dual Locomotives abovementioned.

Response

The Respondent is invited to submit ISR data and any technical and commercial information regarding the project. The information should be delivered in accordance with the Technical Requirements specified in Appendix A.

Language of Response

Responses shall be in English or in Hebrew only.

Submission of Response

Responses shall be submitted in writing, to the attention of Ms. Mirela Halfim, no later than **February 28, 2019**, at the following address and/or by email mirelah@rail.co.il.

Israel Railways Ltd. - Procurement and Contracting Division

Yoseftal 1, Lod

736801, Israel

Additional Information

Should Respondent require clarifications relating to this RFI, or if any questions arise with respect thereto, respondent may contact, in writing only, Mrs. Mirela Halfim - International Procurement Coordinator, via e-mail: - mirelah@rail.co.il .

General

- i. This RFI shall not be construed under any circumstances as a pre-requisite or pre-qualification procedure.
- ii. This RFI is merely for the purpose of obtaining any relevant information for consideration purposes only, and ISR shall not be construed as having taken any commitment to enter in a contractual relationship, nor to publish any tenders or any other further procedure.
- iii. ISR may, as a result of this RFI, approach, at its sole discretion, one or more of the Respondents and/or any other party, in order to obtain additional information, commercial proposals and/or to conduct negotiations with respect to the technical and/or commercial terms, and enter into a contractual relationship with one and/or more Respondents or any other party it finds suitable to conduct any other procedure it deems necessary.
- iv. It is hereby clarified that ISR shall not be obligated to engage in any contract on the basis of this RFI and that any information presented and/or submitted to ISR through this RFI is provided voluntarily. ISR shall not be charged in any manner for the submission of information in accordance with this procedure and every Respondent shall bear its own costs with respect to this RFI.
- v. Moreover, to preclude any doubt, it is emphasized that ISR shall have the right to reject, in whole or in part, any opinion, conclusion or information delivered to it through this RFI. ISR shall also have the right to use the information presented and/or submitted to it for the purpose of planning and preparing a tender or any other procedure, should ISR decide to implement one.

- vi. ISR may at its sole discretion, request from any of the Respondents, additional information, details, approvals, recommendations and/or certificates, as required by ISR.
- vii. ISR may ignore any Response which lacks information or has unclear details.
- viii. ISR shall not be bound to accept and/or consider any Response and it does not undertake herein any commitment whatsoever towards any of the interested parties.
- ix. ISR reserves the right, at any time and at its sole discretion, to amend this RFI or any aspect thereof, as well as to extend the date for submittal of the Responses. In addition, ISR reserves the right to cancel this RFI in its entirety at its sole discretion, without providing the Respondent(s) any (or no) reason or explanation.
- x. This RFI process is undertaken by ISR for the purpose of receiving data and information, and it does not create any obligation on ISR's part to commence, continue or complete any purchase procedure and/or to act in any other method of acquisition, and ISR shall act at its sole and absolute discretion in this respect.
- xi. ISR reserves the right to accept, in future stages, information and/or any commercial proposals from entities which did not participate in this RFI process, as ISR shall deem fit.
- xii. ISR reserves the right, as a result of this RFI, at its sole consideration to conduct an additional procedure, including, inter alia, tender procedure, and may use, at its sole consideration, any of the information provided in this RFI.

Request for Information (RFI)
Procurement, operation and maintainance
Dual Locomotives for ISR

No. 1001

Version 00 : 15/01/19

Revision 1	Name	Date	Signature
Prepared	Roi Gigi	15/01/2019 (00)	
Checked	Amir Itskovich		
Approved	Avi Zalman		

Table of Contents

1.	Introduction	6
2.	Objectives of RFI	6
3.	General requirements	6-27
4.	Appendixes	27-33

Introduction

Israel Railways Company Ltd. ("ISR") is entering the era of electrification when it would have to operate trains on diesel and electrical train lines alternately.

As a result of ongoing railways network electrification, Israel Railways Company Ltd. ("ISR") hereby requests information concerning the procurement, operate and maintain Dual locomotives (the "Project") from Railway Rolling Stock Manufacturers, Railway Companies, Maintenance Companies working for Railway Companies of passenger trains (all together "Respondents").

1. Objectives of RFI

The target is gather all the required information in order to decide if a existing dual locomotive is comply to ISR's current and future needs on the electrification's era.

The locomotive must be with a proven operation experience and totally compliance to the updated European regulation : TSI – Loc&Pas standards and norms.

2. General requirements

This RFI covers the ISR's requirements concerning the characteristics and equipment of new or used Dual-Locos with an electric propulsion system suitable to a new build 25 kV, 50 Hz catenary system in Israel and existing diesel network.

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

The respondent shall offer an Dual Locomotive which is based on a proven design and meets the specified requirements. The realisation how these requirements are fulfilled shall be explained in the responding.

The respondent must fulfil the technical requirements. Nevertheless, the respondent may propose alternative solution which provides the same level of performance or better.

0.1. General Operating Conditions

The dual locomotive (Dual-Loco) shall be designed for universal operation on the electrified tracks of the ISR network and diesel network. The Dual-Loco shall be suitable for operation with ISR's existing coach fleet consisting of single and double deck push pull coaches - including control cab cars as well as for multiple unit operation with at least two dual-Locos of the same type or two push-pull trains in any arrangement.

The Dual-Loco shall be a full body width concept with driver's cabs on both ends. It shall be a modular design concept for the ease of maintenance.

A train speed of 160 km/h shall be reached for passenger service under maximum load conditions. In freight service a maximum operation speed of 120 km/h shall be possible.

The Dual-Loco shall be suitable for daily operation of at least 20 hours with a running performance of 250,000 km/ year with scheduled maintenance according to the manufacturer's instructions.

The Dual-Loco shall be suitable for operation on the ISR railway network under the environmental conditions in Israel.

The Respondent 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 Dual-Loco by a single driver shall be warranted.

Single and multiple locomotive compositions shall run in push-pull control mode. The signal transmission shall be realised in the train unit by multi conductor reversible control lines.

The Dual-Loco shall be equipped with the obligatory interfaces as used in ISR's Rolling Stock. These interfaces are the push-pull-interface including at Appendix H.

The train control line as well the train power supply. Both latter ones are special designs which are not in line with the UIC standard interfaces.

Additional design compatibility shall be provided to operate the Dual-Loco with coaches equipped with UIC based standard connector interfaces for train heating, EP-brake and train control.

In the RFI offer, operation in the following kinds of trains is to be considered:

- Up to 8 double deck push-pull coaches - Bombardier manufacturer
- Up to 10 single deck push-pull coaches (SDPP-trains)- Siemens manufacturer
- Up to 3,600 tons freight trains in multiple traction configuration.

Moreover, the dual locomotives shall be featured with multiple unit operation capabilities (two trains, or up to two locomotives). The following configurations shall be possible without any modification at the existing fleet:



Figure 1; Double-Deck Push-Pull trains up to 8 coaches



Figure 2; Consists of up to two Double-Deck Push-Pull trains



Figure 3; Single-Deck Push Pull train from Siemens up to 10 coaches



Figure 4; Triple traction of up to 2 locomotives with heavy freight trains

The Dual-Loco shall meet all dedicated requirements of TSI SRT for operation in tunnel length up to 20 km. Thus e.g. the emergency brake override function is to be provided.

0.2. General characteristics

0.3. Passenger Service

- Train weight of a loaded train 600 tons (including Dual-Loco)
- Speed 160 km/h
- Up to 10 coaches
- Elevation up to approx. 800 meters

0.4. Freight Trains for

- Train weights up to 3,600 tons in multiple traction configuration.
- Speeds up to 120 km/h;
- Elevation up to approx.800 meters at gradient 1%

0.5. Design Targets

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

Standards:

- EN 12663 "Railway applications – Structural requirements for railway vehicle bodies"
- EN 15227 "Railway applications – Crashworthiness requirements for railway vehicle bodies"
- EN 13749 "Railway applications – Methods of specifying structural requirements of bogie frames".

0.6. Climatic Conditions

For the functionalities of the Dual-Loco and its components and parts, the climatic conditions which are listed below have to be respected (see also Appendix D)

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/m ² per year
Sunny hours per year:	3300 h
Contamination of the atmosphere:	refer to Appendix D
Sea salt concentration in the atmosphere:	refer to Appendix D

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.

0.7. Chapter A : Fire Protection requirements

General Issues

The following regulations shall be complied with:

- TSI SRT Technical Specification of Interoperability relating to "safety in railway tunnels",
- EN 45545 part 1 to 7 "fire protection in rail vehicles"
- UIC leaflets 564.2 and 642 ,

0.8. Technical requirements

0.9. Basic Technical Data

Loading Gauge G1 according to EN 15273-2..

Catenary System AC 25 kV, 50 Hz according to EN 50163.

($U_{\min 1} = 17.5$ kV lowest non-permanent voltage/ short time minimum voltage, $U_{\min 2} = 19.0$ kV lowest permanent voltage/ continuous minimum voltage, $U_n = 25.0$ kV / nominal voltage, $U_{\max 1} = 27.5$ kV highest permanent voltage/ continuous maximum voltage, $U_{\max 2} = 29.0$ kV/(10 min.) highest non-permanent voltage/short time maximum voltage).

Power The respondent will check if the continuous power of the Dual-Loco 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 $\cos \phi$ shall be min. 0.98.

In the offer the respondent shall describe the continuous power as well as the power factor of the offered Dual-Loco with respect to the nominal and the aforementioned extreme boundaries.

Acceleration	The maximum acceleration and deceleration of the Dual-Loco as the basis for the design of the slip/slide control shall be specified.
Drive System	AC three-phase asynchronous driven by state of the art converters fed from intermediate DC voltage circuit beside the mechanical power.
Braking System	<ol style="list-style-type: none"> 1. Regenerative brake, dependent on overhead voltage, with a brake force limited which is freely adjustable up close to the maximum traction effort value (primary brake, related to 4 axles). 2. Automatic indirect-acting air brake as secondary service brake for the entire train. 3. Direct-acting air brake for the Dual-Loco only. 4. Spring-loaded air-released parking brake (50% of all brake cylinders, one per wheelset); the parking brake shall be dimensioned with a safety coefficient of at least 1.5 against rolling away on a 40‰ slope <p>The parking brakes in accordance with provisions of UIC543, paragraph 2.2 and UIC544-1 shall be of the spring-applied, air-released type. A manual release override shall be provided from both sides of locomotive. The maximum gradient on which it shall be possible to hold the locomotive. The maximum gradient on which it shall be possible to hold the locomotive shall be 3%. The constructor shall indicate the number of axles to be braked by the parking brake.</p> <p>Any applied parking brake in the locomotive shall be displayed to the driver.</p> <ol style="list-style-type: none"> 5. EP-brake and emergency brake override according to UIC 541-5 as well as UIC 541-6. 6. A blending system shall automatically assure that the friction brake of the Dual-Loco is only applied if the electric brake cannot provide the brake demand
Braking performance	<p>Mode G: min. value of brake weight percentages according UIC 544-1 will be delivered by the respondent.</p> <p>Mode P: min. value of brake weight percentages according UIC 544-1 will be delivered by the respondent.</p>

Mode R: min. value of brake weight percentages according UIC 544-1 will be delivered by the respondent.

Additionally, in braking mode R the Dual-Loco shall provide a brake distance below 1,000 m with new wheels from initial speed of 160 km/h.

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

Coupling/ Uncouplnug

The Dual-Loco shall be equipped with standard UIC coupler and hook comply UIC 826 1MN EN 15566 and UIC 520. Buffers comply EN 15551 and shall compatible with all existing rolling stock with Israel Railways.

Pneumatic coupling is performed by standad UIC compatible hoses and fittings. The control and command lines are connected as defined on that RFI.

Operational (EN 15663)	Mass in ton (in accordance with EN 15663 and advice in paragraph 1.6) inclusive the maximal value in kg reserve for potential later upgrades.
Maximum Axle Load	22.5 t at operational mass defined before
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
Wheel Diameter	The wheel diameter shall be new: 1,250 mm / worn: 1,170 mm
Axles	Shall be in accordance with EN 13261 and EN 13104
Nominal Track Gauge	1,435 mm
Max. Speed	160 km/h (must be reached with worn wheels)
Traction Effort	Continuous traction effort with new wheels shall be close to electrically available starting tractive effort of ≥ 300 kN down to power hyperbola

One Dual-Loco shall be in a position to accelerate a passenger train as defined in section 3.1 on an inclination of 27%.

All basic technical data of the Dual-Loco (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.

The Dual-Loco shall be designed to achieve the following requirements:

The respondent shall indicate the available traction power at

- Maximum ambient temperature 45 ° C
- Relative humidity 80%
- Height: 100 m above sea level

Number of axles\Locomotive type	Co-Co according to UIC 650
Power of the diesel engine, at UIC conditions	>2450 kW
Available traction power , at UIC conditions	>2000 kW
Bogies type	Frame design and produce according to EN 13749
Maximum Speed	160 km/h
Starting traction effort	>295 kN
Max weight	Max 130 Ton
Length over buffers	Max 23500 mm
Width	Max 3000 mm
Height	Max 4400 mm
Standard track gauge	1,435 mm (nominal) As specified on RFI
Fuel tank capacity (usable)	Min 4000 Liters
No of cabins	2

Comfort requirements

1. Interior noise

The interior noise in the driver's cabin shall be in accordance with TSI_CR_noise.

The interior noise in the engine room with the engine in idle condition shall be lower than 115 dBA.

Interior noise shall be measured and checked in accordance with ISO 3381:"Measurement of Noise inside Railbound Vehicles".

The interior sound level in the driver's cab when running in a tunnel shall not exceed a value, 5 dB(A) higher than the values on open track.

The values stipulated are exclusive of audio signals, radio and loudspeaker system.

2. Comfort of ride

The ride comfort for the driver shall be lower than $N_{MV}=2.5$, measured in accordance with the "Mean Comfort Standard Method" and on track with quality 1B in accordance to Attachment A.3 (which is equivalent to QN1 in accordance with EN 14363). EN 12299 "Railway applications- Ride comfort for passengers- Measurement and evaluation" shall apply.

Locomotive comfort according ENV 12299 (UIC513) is medium, assuming a rail quality according to EN 14363 Annex B.

The evaluation of human exposure to longitudinal and transversal vibration accelerations for driver is such that fatigue time is superior to 8 hours according to ISO 2631-1.

0.10. UIC Track Classification

The Dual-Loco shall be homologated for operation on railway lines of the classes D2 according to UIC 700.

0.11. Additional Requirements

The minimum negotiable curve radius at $v = 5$ km/h has to be 120 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 Dual-Loco at maximum speed. Potential restrictions shall be specified, including required safety measures. When switching to towing mode, the spring loaded brake shall be automatically released.

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 Dual-Loco shall be equipped with basic tools, spare parts like lamps and fuses as well as connection cables to wagons.

The Dual-Loco shall provide a sufficiently sized and correspondingly marked box for the first aid kit.

The Dual loco will be equipped with two compressed air horns with electro-pneumatic control, compliance high and low pitch tones according to UIC 644.

Vehicle Gauge

The maximum loading gauge of the Dual-Loco shall be dimensioned based on the pertinent rules of the different parts of EN 15273 (successor of UIC 505). The ISR infrastructure is conform to the kinematic reference gauge profile GC. Nevertheless,

the Dual-Loco shall be compliant with the more restrictive kinematic reference gauge profile G1.

The ability to pass humps is not required. The minimum vertical curve radius of ISR's existing infrastructure is of 3,000 m, but 400 m shall be aimed at in order to limit damages on parts of the running gear which are due to insufficient liberty of movement.

The coefficient of flexibility "s" shall not exceed $s = 0.15$ and has to be in compliance with the leaflet UIC 608. '.

A calculation sheet and the related drawing showing the analysis and the kinematic envelope shall be submitted in the respondent's documents by the respondent.

Weights

Considering the definition above, the maximum static axle load referring to the operational mass according to EN 15663 must not exceed 22.5 t, considering all fitted equipment and tolerances. A reserve of at least 500 kg shall be provided for later additions required during the design stage and for future retrofits by the ISR, so that the weight is not exceeded in any case.

The railway standard EN 15663 -Definition of vehicle reference masses-; must be fulfilled regarding the related design masses. The respondent shall list the values of dead mass, design mass as well as the operational mass in its offer.

Brake System

The brake system shall be designed in accordance with the following:

Pneumatic brake according UIC 541-05, compressed air.

The brake system shall at least provide the braking modes G, P and R.

The minimum brake performance of the Dual-Loco shall be as follows:

Mode G: min. 80 brake weight percentages according to UIC 544-1

Mode P: min. 105 brake weight percentages according to UIC 544-1

Mode R: min. 140 brake weight percentages according to UIC 544-1

Additionally, in braking mode R the Dual-Loco shall provide a brake distance below 1,000 m with new wheels from initial speed of 160 km/h.

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

- A state of the art blending system shall assure that the brake will mainly be done via the wear free electrodynamic brake.
- In all braking scenarios wheel slip shall reliably be avoided by means of a high quality anti slip system.

Air reservoirs will be design and produce according to EN 286.

Noise Emissions

The Dual-Loco shall be characterised by a minimum of inside and outside noise as well as vibration emissions. Tonal noises shall not be audible.

The Dual-Loco shall at least meet all related requirements of TSI Noise. In this sense all limit values, measurement procedures and required proof tests are clearly defined.

The actual noise values of the offered Dual-Loco based on the measurement procedures of TSI noise shall be indicated in the offer.

The Dual-Loco shall not cause ground borne vibrations outside of the limits as defined in ISO 14837-1.

Environmental impact

The Dual-Loco shall be designed in accordance with the state-of-art for minimum environmental impact.

The diesel engine shall have state-of-art low emissions.

The Dual-Loco shall be fitted with an exhaust gas purification system.

The engine shall meet the UIC III A requirements as defined in UIC leaflet 624, Appendix A (And fitted with provisions for III B) or the US equivalent. It shall comply with the requirements of the European Directive 2004/26/EC.

Safety of Running and Running Dynamic

The safe running in all operation states shall be proven according to the dedicated test methods as described in EN 14363 as well as in UIC 518. The boundary conditions as described in the following conditions and in Appendix C 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).

0.12. Line and Track Parameters

The essential main parameters of track and track geometry are given in Appendix A.

0.13. Running Dynamics Calculations

Mathematical evidences on the dynamic behaviour of vehicles shall be provided with the proposal. 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).

0.14. Dynamic Testing

The dynamic testing and homologation are part of the required type tests and to be executed according to EN 14363 and UIC 518. 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 tests 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.

Electromagnetic Compatibility

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

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 Dual-Loco as well as compliance with emission levels to the exterior and stray radiation levels from the exterior is warranted.

The harmonic current limits shall be based on the psophometrically weighted levels in accordance with the European Standard EN 50121-3-1 and the CCITT/ITU Directives concerning the protection of telecommunication lines against harmful effects from electrified railway lines.

Electromagnetic locomotive emissions and electromagnetic protection are according with EN 50121, EN 50155 and EN 50500.

Furthermore locomotive is according to UIC 512 to assure rail track circuits compatibility.

Radio and signalling systems

The radio system and the signalling system to be provided on the Dual-Loco shall be compatible with the existing systems with Israel Railways. The responded shall be responsible for the seamless interface of the equipment.

Provision for a radio system equipped with a VHF according to the requirements of ISR.

Health and Safety Impact of Electromagnetic Fields on Workers

The Dual-Loco shall fulfil the requirements of the European directive 2013/35/EU related to the electromagnetic field radiation with respect to its impact on workers.

Pressure Wave Resistance, Aerodynamical Shape

As described in the TSI CR LOC PAS the aerodynamic effects caused by pressure shocks or cross winds acting at the vehicle and its components 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 aerodynamic drag coefficient c_w of the Dual-Loco including the first coach (single-deck or double-deck coach as in operation with ISR) in the train sets shall be minimized down to the practically reasonable level.

Precautions against Pollution, Damage, 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.

Check the possibility of 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. The penetration of shower water (in particular into control boxes, bearings, gear boxes, engines and sand distributors) shall be prevented by constructive 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.

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 shower water, sand and dust under special consideration of the environmental climatic conditions according to paragraph 1.10. as well as Appendix D. In the machine room, pluggable water drains shall be foreseen at the lowest points for cases if limited wet cleaning becomes necessary (e.g. for removal of extinguishing agents residues or for dumping of escaped cooling agent).

Driver's Cab

0.15. Design

The design of the driver's cab 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 -Layout of driver's cabs in locomotives, railcars, multiple-unit trains and driving trailers- shall be applied. Furthermore the ergonomic requirements stated in UIC 617-5, UIC 617-6, and UIC 625-2 und 625-5 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 (see paragraph 1.7 and Appendix D).

The operational control devices shall be grouped in order to allow a one-man operation. The Dual-Locodriver's chair shall be adjustable for height as well as along the longitudinal axis including the seat and backrest. The positioning of the chair 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 Dual-Locodriver 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 Dual-Locond adjustable according to the driver's weight, has to keep vehicle vibration from the Dual-Locodriver.

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

The design of the driver's seat shall comply at least with the design recommendation specified in UIC 651 and the foreseen design to be delivered shall be submitted to ISR for approval.

An additional seat (no folding seat) shall be provided such that from this seat a (if so, restricted in regard to field of vision according to UIC 651) view to the tracks and to the most important controlling devices is possible.

Further requirements are:

- The general design of the driver's desk shall be in line with the dedicated requirements of UIC 612. By means of a mock-up or by other suitable three-dimensional presentation the seat arrangement and position of controlling devices shall be precisely presented. In any case the design is to be agreed with ISR.
- All operational information (except information of the operational state) analogue descriptions on displays shall be preferred. That also especially applies for the indication of running and target speed as well as for total values of tractive and brake forces.
- All information like overhead line current and voltage as well as time shall be transmitted as operation data to the diagnostic display.
- The possibility of installing an additional display, usable for "electronic timetable sheet" shall be provided. The display shall be well readable – contrast 1:10 – and glare-free in all lighting conditions, especially at darkness.

- The shape and surface design of the components of the driver's cab (control panel, control elements, floor covering, lagging) have to allow an easy cleaning and shall be sufficiently resistant against usual detergents.
- The driver's cab depth (in the vehicle's longitudinal axis) – measured at eye level of the seating driver– must be at least 2,000 mm between inside surface of the windscreen and the closest fixed item (wall, cabinet, door). This dimension shall be respected over a width of at least 2,000 mm.
- Each driver's cab shall be equipped with driver's doors at the left as well as the right side.
- The entrance doors shall be equipped with a second handle with lock at the bottom of the door.
- Handrails at the entrance doors shall preferably be recessed; alternatively not recessed handrails can be used, if this is the only way to fulfil the requirements according to UIC 651, paragraph 2.5.
- For all Dual-Locos, a suitable locking system shall be provided.
- The dimensions of the external doors shall be designed to comply with UIC 651.
- It must be possible to open the entrance doors inwards in direction to the driver's cab back wall.
- The door to the machine room shall be fitted as escape door with an opening mechanism which enables to open the door with the body, e. g. with crossbar and two levers.
- It shall be possible to open the door of the machine room in direction of the machine room; the related lock shall be designed as a panic lock for a quick opening of the door.
- The vehicle shall be equipped with handrails and steps as listed in the following:

- Distance of handrails of the entrance doors: 700 to 850 mm (depending on the door width)
- Diameter of handrails 30 to 38 mm (round or flat round)
- Minimum width of step treads and rail of door: 300 mm
- Minimum depth of step treads of door: 150 mm

0.16. 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. It shall be considered that all controlling devices necessary for operation of the Dual-Locoduring its run are arranged within a radius of max. 820 mm from the body centre of the upright sitting Dual-Locodriver.

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. 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.

0.17. Visibility

The visibility from the driver's cabin for a sitting Dual-Locodriver has to comply with UIC leaflet 651, paragraph 3.

Front windows shall be made of laminated distortion-free glass without colour-purity error in easily mountable frames. Alternatively glued windows can be considered, if rapid exchanging within 8 hours (including hardening time of the filling material) is possible. Tinted glass is not allowed and reflections shall be avoided.

The impact strength of front window shall fulfil the requirements of EN 15152.

Front window panes must 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 windscreen 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 opposing trains and tunnels a blowing over of wiper blades shall be reliably avoided.

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

Water capacity for the wiper system shall be at ~ 30 litres per driver's cab. The volume defined based on ISR's experience operating rolling stock on at least 20 hours/day under specific climate condition.

The water reservoir shall be located in the equipment room, made out of corrosion-resistant transparent material. The water level shall be easily readable without the need for initial removing of covers.

The refilling interface shall be presented to ISR for reviewing and approval.

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

0.18. External signalling and lighting

Signal lamps will be according to EN 15153-1.

0.19. Pressure Protection

The pressure protection of the driver's cab needs to ensure that an artificially created internal pressure of $\pm 4,000$ Pa does not decrease below $\pm 1,000$ Pa within a time of 50 seconds, while the air conditioning devices in the driver's cab is in operation and the pressure-tightening is closed.

The pressure protection shall be designed in such a way that in the driver's cab, on the occasion of pressure waves occurring at train crossings in tunnels. The dedicated requirements of UIC 651 shall be met.

The resistance of the design shall be taken into account with the effect of the occurring pressure waves (elastic deformations).

The routing of air flow shall be ensured via the pressure protection fans and channels. The possibility of congestions of supply air as well as air discharge openings shall be excluded.

The effect of the pressure protection fans shall be adjusted by coordination of the supply air and exhaust air flows in order to avoid dangerous pressure conditions in the driver's cab.

In case of a failed pressure protection fan, the air protection shall be turned off automatically and the air routing shall be ensured via alternative channels.

It shall be possible to turn off the pressure protection without affecting the functionality of the air conditioning.

0.20. Windows and Rear-View Device

Double glazed tinted toughened safety glass shall be used for all windows (with the exception of the windshield). The optical characteristics shall be:

- Visible light transmission min 0.42
- Solar transmission approx. 0.26

The side windows shall be designed as framed double glass windows. The space between the two glass sheets shall be filled with inert gas.

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.

The windshield shall meet the requirements as per EN 15152. An approved bonding method for the mounting of the windshield to the front end structures shall be used. Provisions shall be made in order to facilitate cleaning of the windshield by the operator, such as steps and handholds.

Clear safety glass of a minimum thickness of 8 mm shall be utilised for the destination signs on the front of the car.

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

Opening and closing of the side windows shall be possible with one hand. Locks shall be unlocked and locked automatically by opening and closing the window.

Operation forces for opening and closing of the side windows must not exceed 80 N. It shall be possible to latch the side windows in the opened position sleeplessly or with several steps.

Each Dual-Lococab shall be equipped with established state of the art video based rear-view devices, which provide the rear view on both sides of the Dual-Loco.

0.21. Comfort Features (Thermo-Box, Wardrobe)

Each driving cab shall be equipped with:

- One refrigerator (min. 10l) and one hotplate
- An easily accessible 220 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 drivers desk
- A waste box and an ashtray for the driver
- Megaphone and searchlight, each with corresponding charger and rechargeable battery

Activation of the lighting in all compartments shall be possible when the main battery switch is switched off.

The floor shall be suitably structured to prevent slipping.

Limits of Wear

For all parts (mechanical, electrical, pneumatically) whose lifetime is limited by wear or aging effects, the related operating limits shall be identified and submitted to the ISR.

All parts to be considered as wearing parts shall be specially highlighted in the spare parts catalogues or shall be listed in a separate wearing parts list respectively.

RAMS - Requirements

This part of the specification is based on the Standard EN 50126 “Railway applications - The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS)”, 2011.

Spare Parts & Special Tools

ISR’s request from the future supplier of the Dual Locomotives:

- A. The supplier shall deliver spare parts specified lists.
The lists include full detailed description, OEM names and its part numbers.

Mechanical parts description by definition will include dimensions, materials, pressure ranges its design for, standard according its made of.

Electrical/electronic parts description by definition will include Amp, Voltage, power ranges and standard according its made of.

Each Item / assembly include its weight, its package weight, its volume and package volume.

- B. The supplier shall deliver BOM (Bill Of Materials) shall include components, assemblies, and parts the system made of.

It's will be provides a display of all items that are in parent-children relationships (system through assembly through sub assembly through all its internal items).

The BOM will be supplied as excel file type table.

- C. Maintenance plan of the dual-locomotive

The supplier shall deliver a detailed maintenance plan for each system on the locomotive. The maintenance plan will specify all the technical tasks the maintainer will have to perform sort by maintenance interval.

All the maintenance processes for each system / sub system / item will be supply to ISR included all the spare parts, tools the maintainer will have to use in order to maintain the locomotive as it's designed to. With out any missing information.

- D. The supplier shall deliver spare parts specified list/s complies to the maintenance intervals appear on the maintenance plan.

The Supplier shall deliver list/s of spare parts as requested on point A above sort by the maintenance interval as following:

A – Parts which must to be replace during the maintenance interval complies to the maintenance plan of the locomotive.

B – Parts which the maintainer must check and replace it if necessary complies to the maintenance plan of the locomotive.

C – Parts which the maintainer could repair/overhaul by it's own means base on technical maintenance instructions that will be supply by the respondent.

- E. The supplier shall supply all the lists of special tools and dedicated tools required for maintenance and overhaul the locomotive and it's assemblies. All the tools will appear at maintenance instructions that shall supply by the supplier.
- F. List of all required tools included full detailed description of the tool, OEM names and part numbers system made of will be supplied to ISR. The list of tools will be supplied as excel file type table.
- G. The supplier guarantees of availability of spare parts for a period of minimum 25 years. If a spare part is no longer available on the market the supplier will offer an adequate substitute by deliver approved technical ECO of each component no longer available to supply.

Warranty period

24 months minimum including for each unit supplied from the date it complete acceptance tests.

During the warranty period will be included:

- Warranty team for maintain the locomotives during warranty period.
- Professional advice/support via E-mail or telephone.
- Software support by remote maintenance via ISDN, VPN or modem.
- Sending of professional team to customer site if necessary, within 5 working days after receiving fault report form ISR.
- The supplier shall be stock available in Israel for spare parts for all the warranty period.

- The supplier shall provide all the special tools which are needed for maintenance for all the warranty period.

Documentation & Drawings

Set of documents should will be deliver from supplier side included the following:

- Technical specification for all components & systems – included production drawings.
- Pneumatic schemes.
- Electrical circuit diagram.
- Description of the main operator panel including connections diagrams and drawings.
- BOM (Bill Of Materials) as prescribe on section 2.6.1 above.
- The BOM for each brake system supplied will included serial number of each component on the system.
- Spare parts catalogues of supplier & subcontractors includes supplier's original catalos numbers (OEM), full descriptions and part numbers.
- Three dimentional (3D) models: The supplier shall supply 3D model files in STEP (or same) format. Supplier shall supply to ISR , 3D simplified model (STEP format), It should include car contour (outfit) with external elements as buffers, wheel-sets and roof contour.
- Trouble-shooting procedures – which specify what are the operations the maintainer/ operator must follow for each malfunctions/failures may happened.
- Training guide which explain and describe the system operation mode and it's each components description.
- Training technical materials for the operator/ driver and maintainer.
- Driver's manual shall supply to ISR. The driver's manual is a guide for the personnel who is in charge of driving Dual-locomotive.
- Working safety regulations.
- Calibration Instructions – Protocol which specify the technical instructions needed to fulfil in order to calibrate the system.
- Full installation instructions – which specify the technical instructions needed to fulfil technically in order to install the new brake system.
- Testing and validation protocols which specify all the tests.
- Maintenance and overhaul instructions for the system. The instructions will specify the operations needed to perform by the maintainer according period of time or km accumulated.
- The maintenance schedule/ plan should ensure satisfactory locomotive operation and economical maintenance cost where average load factors and average climatic conditions are encountered.
- Master piping – all the technical data specify technically all the piping the brake system made of included relevant standards each piping should withstand.
- Master Wiring - all the technical data specify technically all the wiring the brake system made of included relevant standards each wire should withstand.

- Risk management which included scenarios that may develop during the validation and operation with the system installed.
- The respondent shall provide the interior and exterior cleaning specifications, including MSDS of all recommended cleaning materials.

All the documentation describe above shall be in Hebrew or English language.

If there is any changes in design / instructions between the locomotives planed to the perform on the installations its will be included on the documentations above.

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:

	Speed [km/h]	Rank	Twist ¹⁾ [mm]	Surface ¹⁾ [mm]	Gauge [mm]	Superelevation [mm]	Alignment ¹⁾ [mm]
1	120 - 160	B	4.5	8	-5 +8	5	6
		C	9.0	15	-5 +20	8	9
		D	12	20	-7 +30	12	12
2	80 - 120	B	5.0	10	-5 +10	7	7
		C	11	18	-5 +25	11	11
		D	14	22	-7 +31	15	15
3	40 - 80	B	7.0	13	-5 +15	10	9
		C	14	22	-6 +30	15	14
		D	16	24	-7 +32	21	19
4	0 - 40	B	10	18	-5 +20	13	12
		C	17	28	-7 +30	20	18
		D	18	30	-9(-11)+35	28	25

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

Parameter	Unit	Value
Standard track gauge	[mm]	1,435
Gauge widening in tight curves (in addition to standard 1,435 mm gauge dimension)	[mm]	$\geq 300 \rightarrow 0$ $250-299 \rightarrow 5$ $200-249 \rightarrow 10$ $< 200 \rightarrow 15$
Horizontal Geometry		
Curve radius on main lines	[m]	≥ 190
Exceptional curves radii: 1 curve on Beit Shemesh-Jerusalem 56 curves Beit Shemesh-Jerusalem 1 curve on Rosh-Ha'ain line some curve on secondary line	[m]	141 200 – 150 191 120
Minimum S-curves radius with short tangent section (6m) and without tangent	[m]	150+150 190+190
Minimum radius in depot track	[m]	80
Vertical Geometry		
Maximum gradient along the length of existing lines (Beit Shemesh-Jerusalem line)	‰	21
Maximum gradient along the length of future lines)	‰	30

Parameter	Unit	Value
Minimum vertical curve radius on lines (concave /convex)	[m]	3,000
Cant (super elevation)		
Maximum cant	[mm]	150
Maximum cant deficiency for conventional trains	[mm]	130
Maximum cant in special cases(ballast-less track)	[mm]	150
Transition curves are always cubical parabolas		
Minimum transition curve length L - length h = cant V = speed Cant is introduced at a regular rate along such transitions curves	[m] [mm] [km/h]	$L = 0.006 * h * V$
Distance between Centres of Tracks		
$v \leq 160$ km/h	[m]	> 4.5
$160 \text{ km/h} < v < 220$ km/h	[m]	> 4.7
rail cant		1:30
equivalent conicity from wheel profile and track	0.12 - 0.24 at 3 mm lateral movement of the wheelset, max. single value 0.45	

Table -1: Main Line and Track Parameters

Running Dynamics

Safety - Track fatigue - Ride quality

Threshold values for test runs according to EN 14363:

Parameter	Description	Threshold	
		normal	
	Running Safety		
ΣY	Sum of guiding forces	$k1 = 0.85$	1)
Y/Q	Y/Q ratio per wheel	0.8	2)
	Track Fatigue		
Q	Maximum Vertical Wheel Force	190 kN	
Yqst, lim	Quasi-static lateral force in curves Yqst	60 kN	
Qqst, lim	Quasi-static vertical force in curves Qqst	145 kN	
	Ride quality		
v*lim	Accelerations in the carbody (F1=0.15% and F2=99.85%)	2.5 m/s ²	
z*lim		2.5 m/s ²	
sylim	Weighted r.m.s values sy and sz of the accelerations Y* and z*	0.5 m/s ²	
szlim		1.0 m/s ²	
y*qst, lim	Quasi-static lateral acceleration y*qst	1.5 m/s ²	

1) due to existing track quality, factor k1 in Prud'homme formula is 0.85 (instead of 1.0)

2) effect of "worst case" combination of cross wind, stochastic track irregularities and uncompensated lateral acceleration to be considered.

Table C-1: Running Dynamics

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/m ² per year	360 - 600
Rainfall mm/year	400 - 800

D.2 Dust Concentrations in the Atmosphere

	Maximum Value	Half-hour Maximum Value	Daily Maximum Value	Average
NO _x	1064	560	560	71
SO ₂	780	260	260	21
O ₃	312	143	143	84
Suspended Dust	-	350	350	100

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

Salt Element	Na		Cl		SO ₄	
	Season		Season		Season	
	Dry	Wet	Dry	Wet	Dry	Wet
Sea Air at Coastline	7.3	16.0	12.0	22.0	5.3	7.0
600 m from Shore	3.1	4.8	4.2	7.9	1.9	2.0

Salt Element	Na		Cl		SO4	
	6000m from Shore	1.1	1.4	1.5	1.7	1.3

all values in micrograms per m³ atmosphere

Table D-2: Salt Concentrations in the Atmosphere