ISRAEL RAILWAYS LTD.
INFRASTRUCTURE DIVISION

Technical Specification for

ON-TRACK ULTRASONIC RAIL FLAW DETECTION TEST SERVICE

No. E-07-0002

September 2012
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1. **SCOPE**

1.1 This document sets out the request for ultrasonic rail flaw detection test service ("the service") by ultrasonic rail flaw detection vehicle ("UDV") and manual verification, based on the technical specification hereinafter.

1.2 The service shall be carried out in three stages as defined in section 4.3.

1.3 The ultrasonic rail flaw detection system ("test system") shall be designed to enable majority detection of rail defects level A and maximum possibility of detection rail defects level B as defined in UIC725.

1.4 The test supervisor shall perform manual testing verification using his professional decision and according to the system test results, to ensure correct allocation of the defect types to the defined category in accordance with UIC725, table 1 – "category of measures depending of defect size".

2. **REFERENCE DOCUMENTS (*)&

<table>
<thead>
<tr>
<th>Document</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIC 712</td>
<td>Rail Defects</td>
</tr>
<tr>
<td>UIC 725</td>
<td>Treatment of rail defects</td>
</tr>
<tr>
<td>EN 473</td>
<td>Non-destructive testing - Qualification and certification of NDT personnel - General principles</td>
</tr>
<tr>
<td>SNT-TC-1A</td>
<td>Personnel Qualification and Certification of Non-destructive Testing</td>
</tr>
<tr>
<td>EN 14033-1</td>
<td>Railway applications - Track - Railbound construction and maintenance machines - Part 1 - Technical requirements for running</td>
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<tr>
<td>EN 14033-2</td>
<td>Railway applications – Track – Railbound construction and maintenance machines - Part 2 - Technical requirements for working</td>
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<tr>
<td>EN 14033-3</td>
<td>Railway applications - Track - Railbound construction and maintenance machines - Part 3 - General safety requirements</td>
</tr>
<tr>
<td>EN 15746-1</td>
<td>Railway application - Track - Road - rail machines and associated equipment - Part 1 - Technical requirements for running and working</td>
</tr>
</tbody>
</table>
3. **DEFINITIONS**

**Calibration Rail:** 54E1 (UIC54) or 50E6 (U50) Rail R260 grade with simulated defects. It will be delivered to ISR possession by the contractor.

**Contractor:** The winning bidder in ISR tender. The contractor is solely responsible for the ultrasonic rail flaw detection test service performances and reports of testing results.

**Contractor Crew:** The contractor team which includes at least one driver, one test supervisor.

**Rail defect:** Identification and classification of flaws as defined in UIC712.

**Defect Types:** 6 groups of rail defects: transversal crack in rail head, longitudinal horizontal crack, longitudinal vertical crack, head-checking, squat and bolt hole cracks as defined in UIC725.

**Defect Level:** 4 class of rail defects detection efficiency: A, B, C and D as defined in UIC725.

**Defect Category:** 4 groups of maintenance deadlines to be respected: 0, I, II and III as defined in UIC725.

**Driver:** An employee of the contractor, who is:

1) at least 2 years experience with driving the UDV or similar vehicle on track,

2) Duly qualified for driving on track by a competent railway authority/company.

3) Duly qualified to operate and maintain the UDV by manufacturer or contractor.

**IPM:** ISR project manager or his representative.
ISR: Israel Railways Ltd.

Pilot: An employee of ISR who will:

1) Accompany the UDV Driver, in charge of track possessions and communication with ISR dispatcher.

2) Accompany the Test supervisor when manual rail defect verification is performing on track, in charge of on track safety.

Service Shift: The defined time for carried out the service, daily, during track position time, day and/or night.

Test System: All the equipment installed on the UDV to enable carrying out the ultrasonic rail flaw detection test service.

Test Supervisor: An employee of the contractor who is

1) Suitably qualified and at least 3 years experienced in ultrasonic rail flaw detection testing.

2) Who is certificated for level 2 by a certification body all in accordance with SNT-TC-1A or EN473

3) In charge of inspecting and approving the service results.

4) Responsible for the reliability of the results

UDV: The contractor's ultrasonic self propelled on track vehicle or Hi-Rail vehicle installed with all the equipments for ultrasonic rail flaw detection tests as specified in this technical specification.
4. **ULTRASONIC RAIL FLAW DETECTION TEST SERVICE REQUIREMENTS**

4.1 The service shall be carried out by the UDV which will be driven and operated by the contractor crew, and will be used on the ISR track network for detection of rail defects.

4.2 Each service shift shall be carried out with three stages by the contractor crew:

- **Stage One** - On-track continuously testing of rails for defects with ultrasonic rail flaw detection equipment installed on the contractor self propelled on track /Hi-Rail vehicle with a testing speed not less than 40 km/h on rails.

- **Stage Two** – Manual ultrasonic rail defect verification shall be carried out by the test supervisor according to the system test results and his professional decision.

- **Stage Three** – the contractor shall submit reports to the ISR on inspections carried out and rail defects detected.

4.3 The service shall be carried out continuously with ultrasonic rail flaw detection system on two rails simultaneously along the entire km length in accordance with working plan, including level crossing and rails in switches (not including frogs). The service contractor must report to the ISR regarding sections that weren't tested.

4.4 During the service operation the UDV shall not be operated or driven at any time unless the driver is accompanied by the pilot.

4.5 The latest edition of UIC codes: UIC712 and UIC 725 must be in the position of the test supervisor during service time.

4.6 The ultrasonic rail flaw detection system operating shall be done by a computerized system to ensure all the testing functions in real time. Full data record shall be saved and provided to ISR.

5. **ULTRASONIC RAIL FLAW DETECTION SYSTEM REQUIREMENTS**

5.1 The test system shall operate to give efficient results at average speed not less than 40 km/h on rails with different surface quality and roughness with surface defects and with different rail profiles and grades.
5.2 The test system shall be able to adapt to speed change to guarantee a high reliability of the flaw detection.

5.3 The test system shall be designed to assess majority detection of rail defects level A and maximum possibility of detection rail defects level B as defined in UIC725. If applicable, the test system shall be designed to assess rail defect level C.

5.4 The test system shall be equipped with at least 7 piezoelectric transducers for each rail.

5.5 The test system shall guarantee quality control and assurance of calibration and flaw detection in accordance with test system manufacturer practice code.

5.6 The test system shall be designed such that the minimum size of defect can be adjusted. Calibration steps size shall be equal or smaller than ±1 [dB].

5.7 The test system minimum standard setting would be as follows:
- Transverse cracks and head checking in the rail head – Ø4 mm;
- Longitudinal horizontal cracks - 8 mm (Horizontal cracks of 8 mm transversely in reference to the rail profile);
- Bolt hole cracks – 12 mm.

5.8 The test system shall be designed to enable detection of defects in new rails and in used rails with wear in accordance to the following table:

<table>
<thead>
<tr>
<th>Maximal horizontal wear [mm]</th>
<th>Maximal vertical wear [mm]</th>
<th>Minimal height of the rail [mm]</th>
<th>Height of the new rail [mm]</th>
<th>Type of rail (EN 13674-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>13</td>
<td>140</td>
<td>153</td>
<td>50E6 (U-50)</td>
</tr>
<tr>
<td>17</td>
<td>14</td>
<td>145</td>
<td>159</td>
<td>54E1 (UIC-54)</td>
</tr>
<tr>
<td>18</td>
<td>17</td>
<td>155</td>
<td>172</td>
<td>60E1 (UIC-60), 60E2</td>
</tr>
</tbody>
</table>

Attention: Surface of the wear rail head can be different and roughed from the original standard rail profile.

5.9 The test system carriage shall be designed and will be capable of position compensating in reference with rail cant and track gauge variations automatically or quickly by manual means from within the vehicle to ensure high quality of the acoustic contact.
5.10 The test system shall be integrated with the UDV systems or other systems to ensure the continuous UDV longitudinal coordinate in reference to the track km-posts. The test system shall be designed to enable localization of the defect with longitudinal location accuracy of up to ±1 meter.

5.11 Where two or more defects are detected within one meter of each other, the actual separating distance shall be measured and recorded.

5.12 The test system shall be designed and equipped with sufficient amount of probes to detect the following defect types:

5.12.1 Transversal cracks at rail head:
The test system must be able to detect the following rail defects through all rail head profile area in exception to the area of 3 mm under the rail head surface and 8 mm from each side of the center line of the rail profile (dead zone):

111/211 – Progressive transverse crack
411/421 – Transverse cracking of the profile

The test system shall be designed to sort the identified defects to categories and output it in the report:

<table>
<thead>
<tr>
<th>Category I</th>
<th>Category II</th>
<th>Category III</th>
</tr>
</thead>
<tbody>
<tr>
<td>defect&gt;25mm</td>
<td>10mm&lt;defect≤25mm</td>
<td>4mm≤defect≤10mm</td>
</tr>
</tbody>
</table>

5.12.2 Longitudinal horizontal cracks:
The test system must be able to detect the following rail defects through the rectangle area – the width of rail web and the height of the rail profile not include 5 mm from the top and from the bottom.

112/212 – Horizontal cracking at the rail head.
1321/2321 – Horizontal cracking at the web-head fillet radius.
1322/2322 – Horizontal cracking at the web-foot fillet radius.
239 – Lap.
412/422 – Horizontal cracking of the web.
The test system must include with back wall echo monitoring (not more than 10 [mm] from foot of the rail).

The test system shall be design to sort the identified defects to categories and output it in the report:

<table>
<thead>
<tr>
<th>Category I</th>
<th>Category II</th>
<th>Category III</th>
</tr>
</thead>
<tbody>
<tr>
<td>defect&gt;200 mm</td>
<td>50mm&lt;defect≤200mm</td>
<td>8 mm≤defect≤50 mm</td>
</tr>
</tbody>
</table>
5.12.3 **Longitudinal vertical cracks:**
The test system must be able to detect the following rail defects through the rectangle area – the width of rail web and the height of the rail profile not include 5 mm from the top and from the bottom.

The test system must include with back wall echo monitoring (not more than 10 [mm] from foot of the rail).

The test system shall be designed to sort the identified defects to categories and output it in the report:

<table>
<thead>
<tr>
<th>Category I</th>
<th>Category II</th>
<th>Category III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defect visible</td>
<td>Defect not visible &gt;50mm</td>
<td>8 mm ≤ defect ≤ 50 mm</td>
</tr>
</tbody>
</table>

5.12.4 **Head checking:**
The test system must be able to detect the rail defect through all rail head profile area in exception to the area of 3mm under the rail head surface and 8 mm from each side of the center line of the rail profile (dead zone):

2223 – Head checking/ Fissuring/ Scaling at the gauge corner.

The test system shall be designed to sort the identified defects to categories and output it in the report:

<table>
<thead>
<tr>
<th>Category I</th>
<th>Category II</th>
<th>Category III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defect in rail head center &gt;4 mm</td>
<td>5 mm ≤ defect in rail head side ≤ 20 mm</td>
<td>4 mm ≤ defect in rail head side ≤ 5 mm</td>
</tr>
</tbody>
</table>

5.12.5 **Squat:**
The test system shall be designed to detect the rail defect through all rail head profile area in exception to the area of 3mm under the rail head surface and 8 mm from each side of the center line of the rail profile (dead zone):

227 – Squat/ Cracking and local depression of the running surface

The test system shall be designed to sort the identified defects to categories and output it in the report:

<table>
<thead>
<tr>
<th>Category I</th>
<th>Category II</th>
<th>Category III</th>
</tr>
</thead>
<tbody>
<tr>
<td>defect depth &gt; 25 mm</td>
<td>10 mm ≤ defect depth &lt; 25 mm</td>
<td>defect depth &lt; 10 mm</td>
</tr>
</tbody>
</table>
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| or defect length > 200 mm | or 50 mm < defect length ≤ 200 mm | or defect length ≤ 50 mm |

5.12.6 **Oblique cracks (mainly around bolt holes)**

The test system must be able to detect the following rail defects through the rectangle area – the width of rail web and the height of the rail profile with 10 mm from the top and from the bottom.

- 135 – Star cracking of fishbolt holes.
- 235 – Cracking around holes other than fishbolt holes.
- 236 – Diagonal cracking away from any hole.

<table>
<thead>
<tr>
<th>Category I</th>
<th>Category II</th>
<th>Category III</th>
</tr>
</thead>
<tbody>
<tr>
<td>defect &gt; 100 mm</td>
<td>40 mm &lt; defect ≤ 100 mm</td>
<td>12 ≤ defect ≤ 40 mm</td>
</tr>
</tbody>
</table>

6. **MANUAL ULTRASONIC RAIL DEFECT VERIFICATION**

6.1 The manual ultrasonic rail defect verification shall be carried out by the test supervisor according to the system test results and his professional decision.

6.2 The manual ultrasonic rail defect verification shall be carried out during the same track possession time of ultrasonic rail flaw detection test.

6.3 The manual ultrasonic rail defect verification can't be carried out unless the test supervisor is accompanied by the pilot or the IPM.

6.4 On the basis of the test results, additional manual ultrasonic rail defect verification may be performed after the end of the service shift if it is requested by the IPM or by test supervisor, without additional payment.

6.5 The verified defects shall be part of the test reports to be provided to ISR.

6.6 The equipment shall be calibrated in accordance with the manufacturer instructions. The manual ultrasonic rail defect equipment must have a valid calibration certificate.

6.7 V1 and/or V2 calibration blocks must be in the position of the test supervisor during all the service time.
6.8 When a rail defect is detected and verified the test supervisor must paint a mark on the rail web indicating the exact location of the defect.

7. **TEST REPORTS**

7.1 The test supervisor must inform the IPM immediately by SMS and E-mail when he detects a defect category 0 or I.

7.2 The signed reports shall be filled in after each service shift by the test supervisor and shall be signed by him and shall be submitted in an electronic copy to the IPM no later than 24 hours from the end of service shift. The electronic copy shall be suitable for inclusion in a database.

7.3 The test supervisor shall submit the following reports:

7.3.1 'Daily ultrasonic rail flaw test report',
7.3.2 'Daily defects detected list report',
7.3.3 'Daily full test datalog report'.

7.4 'Daily ultrasonic rail flaw test report'. The report shall include at least the following parameters:

7.4.1 Report chronological number (synchronized with 'Daily defects detected list report' number)
7.4.2 Date of test service,
7.4.3 Track section Name,
7.4.4 Line number,
7.4.5 Traveling start point in km and meters,
7.4.6 Traveling end point in km and meters,
7.4.7 Total meters traveled,
7.4.8 Testing from start point in km and meters,
7.4.9 Testing to end point in km and meters,
7.4.10 Total meters tested,
7.4.11 Total meters not tested,
7.4.12 Test supervisor name,
7.4.13 Pilot name,
7.4.14 IPM name,
7.4.15 UDV – daily activity list (e.g. meeting time, start moving time, enter mainline time, arrive at site time, testing start, maintenance time, reasons for delay etc.),
7.4.16 Test supervisor signing of test system calibration the test system in accordance with manufacturer instructions,
7.4.17 Test supervisor signing of manual test equipment calibration in accordance with manufacturer instructions.
7.4.18 The total number of categories 0 and I defects detected.
7.4.19 The time the SMS and E-mail of categories 0 and I defects was sent.

7.4.20 Test supervisor signature.

7.5 'Daily defects detected list report'. The report shall include at least the following parameters:

**UDV test system Parameters:**

7.5.1 Report chronological number (synchronized with 'Daily ultrasonic rail flaw test report' number)
7.5.2 Date of test service,
7.5.3 Track section name,
7.5.4 Line number,
7.5.5 Left/Right rail,
7.5.6 Defect position on rail profile,
7.5.7 Defect location on track in kilometers and meters
7.5.8 Defect position (e.g. on track, on/near switch, near level crossing, on bridges),
7.5.9 Rail defect number,
7.5.10 Defect size,
7.5.11 Defect category,
7.5.12 Probe used to detect the defect,
7.5.13 Test supervisor name,
7.5.14 Pilot name,
7.5.15 IPM name,
7.5.16 A-Scan and B-Scan print screen display for each detected defect including calibration setting.

**Manual test equipment Parameters:**

7.5.17 Manual test equipment type,
7.5.18 Manual test equipment Manufacture serial number,
7.5.19 Manual test equipment Probes used to verify the detected defect,
7.5.20 Rail defect number verified by manual test equipment,
7.5.21 Defect size verified by manual test equipment,
7.5.22 Defect category verified by manual test equipment,
7.5.23 Defect position on rail profile verified by manual test equipment,
7.5.24 Defect A-Scan print screen display including calibration setting for each defect verified by manual test equipment,
7.5.25 Test supervisor detection signature,

The final structure of the reports shall be submitted for ISR's prior approval.
7.6 'Daily full test datalog report'. The report shall be submitted after every shift in an electronic copy with full testing data record. It will be the basis for the service payment.

7.7 Where the surface condition of the rail is such that transmission is restricted or interference occurs at the interface signal, a report shall be provided. The report shall clearly identify the location, length of rail affected and reason for a restricted or ineffective test.

7.8 The contractor must deliver viewer software or other relevant software with at least 3 unlimited time licenses to enable ISR employees access to all of the submitted testing data.

8. UDV REQUIREMENTS

8.1 The UDV shall be designed for full continuously operation in accordance with Israel railways track superstructure, specified in appendix B – 'Israel railways tracks data'. The UDV engine, transmission, suspension and braking systems shall be designed to enable safe operation and braking when the fuel tank is full and water tank is fully loaded/ half loaded or empty with maximum traveling speed and with gradient of up to 30%o.

8.2 The UDV shall be designed in accordance with the relevant EN standards: EN 15746 parts 1 and 2 and/or EN 14033 parts 1-3 and/or any other relevant EN standards or equivalent standards, to guaranty safety working and running on track.

8.3 The driver visibility, while sitting in driver seat facing traveling direction, shall be in accordance with the requirements of UIC 651 regulation.

8.4 All the UDV systems shall be designed to operate in hot and dusty environment as specified in appendix A – 'Israel climate and environmental conditions'.

8.5 The UDV shall be designed to keep the environment protection of: noise; pollution; etc. in accordance with the relevant regulation.

8.6 The UDV shall be designed to operate continuously on track with electric system and electronic signaling. The UDV track wheels diameter shall be 330mm or greater.
8.7 The UDV shall be designed to operate continuously without interfering with the axle counters. The UDV must be fully recognized at any speed by the axle counter when getting into track section and when getting out. See appendix E – 'The technical description of ISR axle counters'.

8.8 The UDV will have the following basic operating characteristics:

<table>
<thead>
<tr>
<th>Operation Characteristics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>8.8.1 Track gauge nominal</td>
<td>1435 [mm]</td>
</tr>
<tr>
<td>8.8.2 Track gauge maximum</td>
<td>1470 [mm]</td>
</tr>
<tr>
<td>8.8.3 Track gauge minimum</td>
<td>1426 [mm]</td>
</tr>
<tr>
<td>8.8.4 Travel speed – self propelled on track</td>
<td>60 [Km/h]</td>
</tr>
<tr>
<td>8.8.6 testing speed enable detecting defects categories 0, I, II and III on rails (*)</td>
<td>not less 40 [km/h]</td>
</tr>
<tr>
<td>8.8.7 Max gradient</td>
<td>30 ‰</td>
</tr>
<tr>
<td>8.8.8 Min curve radius</td>
<td>140 [m]</td>
</tr>
<tr>
<td>8.8.9 Max superelevation</td>
<td>180 [mm]</td>
</tr>
</tbody>
</table>

(*) Rails with different rail profiles, surface quality and roughness, and with surface defects.

8.9 The UDV shall be designed to work on single and double track/s as well as between station platforms, according to Appendix D – 'Israel railways loading gauge'.

8.10 The UDV shall be designed and shall have efficient capacity of water to operate continuously during at least 8 hours net, (not including break time).

8.11 The UDV with all equipment shall be provided and maintained in a suitable condition to permit test to be safely and effectively carried out without exaggerated delay.

8.12 If the UDV is designed to be towed it shall have buffers at height of 1060 mm, draw gear pneumatic system all in accordance with UIC and EN standards.

8.13 The contractor shall be responsible for maintaining the UDV. The contractor crew shall be suitably qualified and experienced to operate and maintain the UDV. The contractor shall be responsible for operators complying with all work safety regulations.
8.14 The UDV shall have adequate traction and braking (maximum 1000 meters) to permit a safe operation in all speeds, gradient and weather conditions.

8.15 The UDV shall comply with all relevant and applicable EN regulations or equivalent regulations to ensure efficient and safe operation on track.

8.16 The UDV shall be equipped with at least the following safety accessories:
8.16.1 2 Rotating beacons (one to each direction);
8.16.2 2 Electro-pneumatic warning horns (one to each direction);
8.16.3 Fire extinguishers containing dry powder;
8.16.4 Fire alarm system with Temperature and smoke detectors.

8.17 The UDV shall be equipped with adequate interior and exterior lighting to enable it effectively and safely travel and test in darkness, without unduly effecting normal train running.

8.18 If the test supervisor and the driver are sitting separately, the UDV shall be equipped with proper devices to enable reliable continuous communication.

8.18.1 The UDV frame shall be equipped with 4 lifting hooks.

8.19 If the UDV is a self propelled on track vehicle the following specification shall be included:
8.19.1 The UDV shall be equipped with Coupling and Buffers as follows
- Each headstock shall be fitted with UIC type coupling system and buffers, namely:
  - 1 central Draw Gear to UIC 520 with an elastic draw system;
  - 1 Draw Hook to UIC 520 OR with a breaking force of 1,000KN;
  - 1 Screw coupler to UIC 520 OR with a breaking force of 850KN
  - 2 side buffers with a stroke of 105 mm to UIC 526-1;
  - 1 brake hose with valve.

8.19.2 The UDV transmission and the braking systems shall be designed to enable traveling in train formation.
9. **CONTRACTOR CREW APPROVAL**

9.1 Names of contractor crew personnel who will be engaged in the performance of this contract shall be submitted to the ISR for approval prior to the commencement of services.

9.2 The qualifications and experience of each operator in Non-destructive testing, rail testing, and copy of certifications shall be submitted.

9.3 ISR shall check the information and approve the contractor crew to work.

10. **TEST SYSTEM APPROVAL**

10.1 The bidder shall submit the information and certificates on the ability to detect rail defects with the emphasis on the following technical specification sections: 1.3, 5.1, 5.4, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 6.6. ISR shall check the information and approve the test system to operate on ISR tracks.

10.2 If a new test system shall be operated, the bidder shall submit manufacturer test system certificate. And that UDV has manufactured in accordance with the relevant EN standards or equivalent.

10.3 If a used test system shall be operated, the bidder shall submit manufacturer test system certificate and UDV working certificate from railway authority or railway company.

10.4 **TEST SYSTEM APPROVAL PROCESS**

10.4.1 The bidder shall submit calibration rail with simulated defect drawing for ISR approval.

10.4.2 The bidder shall deliver the approved calibration rail to ISR possession.

10.4.3 ISR shall install the calibration rail in track.

10.4.4 The UDV shall be driven and the test system shall be operated at 30-40 km/h over the calibration rail 5 times in both directions (total of 10 passes). The simulated defect detection must be at the repeatability of 95% or higher.

10.4.5 The winning bidder shall drive the UDV and operate the test system near to its maximum speed on track section with distance of 3 km.
The section will be examined twice and printed report of the test results will be submitted. It is noted that the testing results must be matching, and the quality of the acoustic contact shall be at least 90% of repeated test from the rail base (back-echo).
ISR will perform repeated manual ultrasonic test of those sections by ISR sub-contractor according to the test results from the ultrasonic rail flaw detection track vehicle. The flaws detection reliability must be at least 80% by comparing it with the repeated manual test.

11. **VEHICLE PERMIT**
11.1 The vehicle technical description shall be submitted, including technical drawing.

11.2 The vehicle running check approval certificates shall be submitted.

11.3 The vehicle history information shall be submitted, (e.g. duty time, countries in which operate, client reference list, maintenance and overalls, etc.).

11.4 The UDV operation, driving, maintenance and safety manuals shall be submitted.

**APPROVAL PROCESS**
11.5 ISR shall check and approve towing abilities in regards with ISR regulations (based on EN and UIC norms).

11.6 ISR shall check and approve braking abilities in regards with ISR regulations (based on EN and UIC norms).

11.7 ISR shall check and approve proper operating near axle counters.
APPENDIX A - ISRAEL CLIMATE AND ENVIRONMENTAL CONDITIONS

A.1 Climate and Environmental Conditions
Max. ambient temperature 50 °C (shade)
Min. ambient temperature -5 °C
Relative humidity 10 to 90 %
Altitude -400 to +800 meter
Sunny 3300 hours per year
UV Radiation 360 to 600 MJ/m² per year
Rainfall 400 to 800 mm/year

A.2 Dust Conditions 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>

*(Microgram per m³ atmosphere)

A.3 Suspended Particulate Matter (SPM)
Particle size to 0.5-1 micron

A.4 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>Dry</td>
<td>Wet</td>
<td>Dry</td>
</tr>
<tr>
<td>Sea Air at Coast Line</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>6000 m from Shore</td>
<td>1.1</td>
<td>1.4</td>
<td>1.5</td>
</tr>
</tbody>
</table>

*(Micrograms per m³ atmosphere)
APPENDIX B – ISRAEL RAILWAYS TRACKS DATA

ISRAEL RAILWAYS TRACK SUPERSTRUCTURE

B.1. ISR railway network has CWR track with flash-butt and aluminothermic welds, and tracks with insulated joint rails and fishplates.

B.2. Rail profiles: 50E6, 54E1, 60E1, 60E2 and 50E6 in accordance with EN13674-1:2011.

B.3. Rail grades: R220, R260, R350HT.

B.4. Switches: 1/8, 1/9, 1/12, 1/20, scissor-crossovers, double slips and expansion joints.

B.5. Standard track gauge: 1435 mm (-2, +5).


B.7. Type of sleepers: Universal monoblock concrete sleepers, Frank-vagon sleepers, wooden sleepers, steel sleepers.

B.8. Minimum number of sleepers of one km of track: 1667.

B.9. Minimum horizontal curve radius:
   ➢ Main line: 141 m.
   ➢ Secondary line: 120 m.

B.10 S-Curve: In some lines there are S-curves with short tangent section (6 m) and there are some without tangent.

B.11 Minimum vertical curve: 3000 m.

B.12 Vertical geometry: Maximum gradient 30‰.

B.13 Maximum cant (superelevation): 150 mm.

ISRAEL RAILWAYS TRACK LOAD


B.15. Maximum traffic speed: 160 km/h.

### APPENDIX C – DEFECTS DETECTION LEVELS ACCORDING UIC725

<table>
<thead>
<tr>
<th>UIC leaflet 712 defect code</th>
<th>Ultrasonic inspection level</th>
</tr>
</thead>
<tbody>
<tr>
<td>111</td>
<td>B</td>
</tr>
<tr>
<td>112</td>
<td>AB</td>
</tr>
<tr>
<td>113</td>
<td>BC</td>
</tr>
<tr>
<td>121</td>
<td>C</td>
</tr>
<tr>
<td>122</td>
<td>C</td>
</tr>
<tr>
<td>123</td>
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<td>124</td>
<td>D</td>
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<td>125</td>
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<td>127</td>
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<td>1321</td>
<td>B</td>
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<td>1322</td>
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<td>C</td>
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<td>2252</td>
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<td>2321</td>
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<tr>
<td>2322</td>
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<td>302</td>
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<td>472</td>
<td>C</td>
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<tr>
<td>481</td>
<td>B</td>
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</table>
APPENDIX D – ISRAEL RAILWAYS LOADING GAUGE
APPENDIX E – THE TECHNICAL DESCRIPTION OF ISR AXLE COUNTERS

Axle counter Zp30C-NT
Figure 4 – Rail contact
Axle counter AZL70
2. AXLE COUNTER AZL 70 GENERAL ARRANGEMENT

The basic units of the AZL 70 are:

- the outdoor equipment (Detection Point ZP30) with one or more detection points

- the transmission path (2-wire transmission)

- the indoor equipment (evaluation and relay interface)

Fig. 1 General Arrangement
3.2 Rail Mounting Holes

It is important that the mounting holes are drilled in the correct position. If this is not the case, it may not be possible to correctly adjust the Tx heads. As can be seen overleaf, the position "a" of the mounting holes depends largely on the rail height.

Approximation formula:

\[ a = (0.467 \cdot h) - k \]

\[ h = \text{height of rail (in unworn condition)} \]
\[ k = 6 \text{mm} \]
\[ b = 13 \text{mm} \pm 0.2 \text{mm} \]
\[ c = 148 \text{mm} \pm 0.2 \text{mm} \]

Tolerance for \( a \) ±1mm
APPENDIX F - LIST OF DOCUMENTS TO BE SUBMITTED
WITH BIDDER'S PROPOSAL

F.1 The service contractor company profile, including duration of
operation in the ultrasonic rail testing field on track, and current and
previous ultrasonic rail testing contracts.
The bidder shall provide on track service projects reference list. It
shall include names of clients, projects durations, length of rail
tested as part of the project, reference letters from the project
manger client.

F.2 Full description and certificates on the ability to detect rail defects
with the emphasis on the following technical specification sections:
1.3, 5.1, 5.4, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 6.6.

F.3 For new test system, the bidder shall submit manufacturer test
system certificate. And that the UDV has manufactured in
accordance with the relevant EN standards or equivalent standards.

F.4 For used test system shall be operated, the bidder shall submit
manufacturer test system certificate and UDV working certificate
from railway authority or railway company.

F.5 The bidder shall submit all the UDV technical description and
working procedures Including:
F.5.1 Maximum travelling speed on rail in forward and reverse
directions.
F.5.2 Maximum testing speed in forward and reverse directions.
Maximum gradient.
F.5.3 Any limitations to travelling or testing speeds.
F.5.4 Any limitations to on and off tracking (only for Hi-Rail).
F.5.5 Water capacity, total and per km in maximum speed.
F.5.6 The minimum number of personnel who will be engaged
on the UDV at any time and information on their duties and
minimum qualifications.
F.5.7 The UDV drawings.
F.5.8 The UDV loading gauge drawing.
F.5.9 The UDV design to operate in hot and dusty environment
as specified in appendix A – 'Israel climate and
environmental conditions' certificate.
F.5.10 The UDV braking system technical specification and
abilities.
F.5.11 The UDV towing ability.
F.6 The vehicle running check approval certificates shall be submitted.

F.7 The vehicle history information shall be submitted, (e.g. duty time, countries in which operate, client reference list, maintenance and overalls, etc.).

F.8 The final structure of the reports shall be submitted for ISR approval.

F.9 The contractor crew passports documents, experience in Non-destructive testing, rail testing and copy of certifications.

F.10 Full description of the testing equipment on the UDV, including number, angles, frequencies and beam width of the probes per rail, centralizing features and any special features, and working procedures Including:

F.10.1 Calibration step size.
F.10.2 Minimum standard setting.
F.10.3 Longitudinal location accuracy.
F.10.4 Ability to detect and record two or more defects within one meter.
F.10.5 The probes actual dead zone.

F.11 Quality control and assurance of flaw detection including calibration in accordance with test system manufacturer practice code.

F.12 Full description of the manual verification equipment including number, angles, frequencies and beam width of the probes and any special features.

F.13 The manual ultrasonic rail defect equipment must have valid calibration certificate

F.14 The bidder shall provide Calibration rail drawing including simulated defects. The draw shall include table indicate the reference between the simulated defects and the rail defects in accordance with UIC 712 and UIC 725.

F.15 The UDV operation, driving, maintenance, calibration and safety manuals shall be submitted.
F.16 The manual test equipment operation, calibration and safety manuals shall be submitted.

F.17 The bidder shall submit probes arrangement for detection of every rail defect types mention in section 5.11

F.18 The bidder shall submit explanation how he intends to detect rail defects: 113, 213 and 227.

F.19 Details on any limitations in the testing equipment, e.g. inability to test any section of track or to detect any type of defect.

F.20 Full description of the output data and record documentation system.

F.21 The UDV not interfering with the axle counter operation signed certificate.

F.22 A statement of conformance to and/or details of any variations from this technical specification.

F.23 Any other relevant information.