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REJ TECHNICAL SPECIFICATIONS

1. SCOPE

These Specifications define the quality and manufacturing conditions of the materials used in the production of Rail Expansion Joints (REJ), as well as the design and acceptance criteria for said REJs.

1.1. Qualification of the REJ Manufacturer/Supplier

The manufacturers and material suppliers from whom REJs and REJ components are procured must be certified in accordance with the following standards:

ISO 9001:2008	
ISO 14001:2004_OHSAS 18001:2007	
EN 13232 – Series 2 through 9	
EN 10204	All materials must have at least a 3.1 Inspection Certificate.

2. GENERAL

2.1. REJs shall be used in cases where the longitudinal movement caused by the structural movement of bridges and viaducts cannot be accommodated by the rail cross-section and/or when it is necessary to make a break in a continuously welded rail.

2.2. All REJs used in the Project shall comply with the applicable editions of EN 13230, EN 13231, EN 13232, EN 13674, EN 13481, EN 14587, EN 13803, EN 50126-1, EN 16273 and other relevant European standards in force as of the date of issuance of the Tender Documents, unless a different edition is expressly specified in the Contract.

2.3. The REJ will be designed according to the horizontal and vertical alignment of the section where it will be installed (whether it is on a curve or a transition curve).

2.4. The REJs to be used will be designed to allow for bidirectional traffic. During track installation, they will be designed—and incorporated into the project plans—with the assumption that trains will pass over the heel section of the REJ, based on the generally used direction of traffic.

2.5. The expansion gaps of the REJs will be determined by experts experienced in the design of high-speed railway bridges in accordance with EN and UIC standards during the preparation of the superstructure designs, and the REJ capacity will be determined based on the results of these calculations.

2.6. The REJs to be used will be designed as either "Movable from Both Sides" or "Movable from the Support Rail" in accordance with the calculation report.

2.7. As specified in the EN 13232-8 standard, the reference point indicating the neutral position on the REJ will be permanently marked as deemed appropriate by the Authority and specified in the project documents.

2.8. On the side wall of the section of the viaduct where the expansion joint is located, a ruler-shaped profile will be installed to monitor displacement, and a reference point will be placed to measure movement.

2.9. All project documents, test reports, and other documentation to be submitted must be provided to the Authority in both English and Turkish. All submitted documents must specify for which project the REJs are intended.

2.10. A report prepared in accordance with the requirements of the EN 50126-1 RAMS (Reliability, Availability, Maintainability, and Safety) standard, taking into account the most challenging conditions on the line, regarding the REJs and their components to be used during the design phase, will be submitted to the Authority for approval. The RAMS Report will be prepared in accordance with Section 9.

2.11. The Contractor shall submit to the Authority reference letters from the relevant authorities confirming that the REJs to be used in the Project have been successfully installed and operated on high-speed railway lines.

2.12. The REJs will be laid in accordance with the track laying method prepared by the manufacturer and approved by the Authority. Approved welding and stress relief procedures for each REJ type will be prepared and submitted to the Construction Inspector.

2.13. REJs shall be designed so that the Drilling and Regulator Machines can be operated without any disassembly (de-mounting) procedures.

2.14. The Contractor shall submit a report for the Authority's approval regarding the REJ designs, which shall include the material specifications to be used in manufacturing, technical drawings, manufacturing project details (tongue rail, support rail, standard brackets, pads, bolts, nuts, washers, etc.), and other technical information. All parts to be used shall be numbered and shown in the legend. The Authority reserves the right to request modifications to the specifications contained in the aforementioned report to ensure compliance with its specifications and relevant European standards. In such cases, the Contractor shall make the necessary modifications and resubmit the report for the Authority's approval. Where such modifications are necessary to

remedy non-compliance with the Contract requirements or applicable standards, the Contractor shall make the necessary modifications at its own cost. All REJ components shall be operational at ambient temperatures ranging from –50 °C to +50 °C, as specified for our country in the IEC 60721-2-1 international standard, and a signed guarantee to this effect shall be provided to the Authority by the REJ manufacturer.

2.15. The connection system to be used shall meet the requirements specified in Article 4 of the Technical Specifications for Scissor Connection Materials and the related articles linked to this article. Test reports for the connection elements in accordance with the EN 13481 standard shall be submitted to the Authority. The materials comprising the rail, cross-ties, and connection system used in the submitted reports shall be described in detail. In addition to the system's static stiffness, the static stiffness of the rail pads used shall also be determined during the approval tests.

2.16. Where low longitudinal restraint fastenings are required for the selected REJ arrangement, the longitudinal restraint shall be determined in accordance with EN 13146-1 and shall be within the range of 0 to 5 kN per fastening assembly, unless otherwise justified in accordance with EN 13232-8 and the approved design.

2.17. Crossbeams using connection elements with a longitudinal resistance between 0 and 5 kN will be connected to each other at a minimum of two points using additional rails or profiles, forming a support panel in a manner that does not obstruct the track.

2.18. For each type of REJ to be used, the test specified in Section 6 of the EN 13232-8 standard shall be conducted under the supervision of the Authority to determine the longitudinal resistance of the complete system, and the report shall be submitted to the Authority.

2.19. All tests shall be conducted at an accredited laboratory or at a university deemed appropriate by the Authority.

2.20. The design of the REJs to be used shall ensure uninterrupted rail-wheel contact.

2.21. Steel ballast retainers shall be used and mounted on bridges/viaducts to provide the necessary clearance based on the REJ's movement capacity. If the track section where these retainers are to be installed has a superelevation, the design shall take the superelevation into account. The ballast retainers shall be galvanized in accordance with the TS EN 1461 standard.

2.22. In cases where the maximum value of the span between sleepers is exceeded and/or vertical and horizontal angular deflections are present, the permissible stress value on the rail may be exceeded; to meet these values, the rail cross-section will be reinforced with gussets, and stress on the rail as well as horizontal and vertical angular deflections will be reduced by using auxiliary load-distributing rails, auxiliary beams, and elastic supports.

2.23. An Installation and Maintenance Manual detailing installation and maintenance procedures for all types of REJs will be prepared and submitted to the Structural Inspection Officer. The Authority will be provided with comprehensive training on all aspects of maintenance.

2.24. The scissor jack used to position the REJs horizontally and vertically will comply with the criteria specified in the Machine Technical Specifications.

2.25. Prototype approval will be conducted with all components fully assembled for each type of REJ. Prototype approval will not be granted if any materials are missing.

2.26. During the geometric inspections of the REJ, the use of parts and loose materials (shims, plates, etc.) in the horizontal and/or vertical planes to bring the REJ into compliance with project criteria will not be permitted under any circumstances.

2.27. On the REJ tongue section, the gauge values for each traverse will be indicated by the manufacturer in the project documentation. Standard track gauge values will be measured over a section of at least 10 meters at the REJ's entry and exit points. These values will meet the requirements of EN 13231-1.

2.28. The delivery of welded and forged sections in REJs will be carried out in accordance with the Rail Welding Technical Specifications.

2.29. A digital gauge-gauge measurement device will be used for local measurements of the REJ geometry (including prototype approval).

2.30. The Track Laying Conformity Report will be prepared by the manufacturer before the second-stage ballast is laid, and the Final REJ Report will be prepared after all manufacturing is completed; both reports will be submitted to the Authority with signatures.

2.31. REJ gaskets shall be designed to be located at least 3 meters from the machined portions of the bearing and tongue rails and/or at least 1 meter from the auxiliary intermediate rails toward the track.

2.32. The Authority's representative shall be authorized to observe all inspections conducted at the start of production and during the production process. This

representative shall be authorized to monitor production methods during both day and night shifts, verify that the materials used in REJ production comply with the specifications, be present during all tests, and review the results obtained from these tests.

3. GENERAL TECHNICAL REQUIREMENTS

General Technical Specifications for REJ:

- Rail Profile : 60E1 / 60E2, corresponding to the adjoining running rail profile specified in Annex G6 – Rail Technical Specification.
- Tongue Rail : 60 E1A1, 72.97 kg/m, R350 HT (EN 13674)
  60 E2A2, 72.78 kg/m, R350 HT (EN 13674)
  60 E1F1 / 60E2F2 R350 HT (EN 13674)
- Rail Steel : R350 HT for the specified REJ rail components, subject to compatibility with the adjoining running rails and approved welding procedures.
- RGC Rail Gradient : Entire length has a 1/40 gradient.
- Track Gauge : 1436 mm (+2 mm, -1 mm)
- RGC Static Stiffness : Will be equal to that of the Normal Line. ±15%
- Sleeper : Concrete Sleepers (EN 13230-4)
- Distance between sleepers : 60 cm
- Axle Load : Minimum 25 metric tons

3.1. The specified rail inclination shall be provided by the rail supporting and fastening arrangement.

3.2. The REJs to be used shall be suitable for forming a continuously welded track.

3.3. All rails to be used shall comply with the Technical Specifications for Switch Rails.

3.4. All rail gaskets must be solid and designed to allow for the subsequent installation of an insulating gasket or welding. If insulating gaskets are used, they will be installed by the contractor at no additional cost in accordance with the signaling design. Gaskets will be arranged as standard between the centers of two sleepers. The location of the insulated gaskets will be indicated on the layout plan. Assembly will be performed in a factory setting before delivery to the construction site. The

materials to be used, the construction procedure, and the test reports specified in the Insulated Gasket Technical Specifications will be submitted to the Authority.

3.5. All bolts, pins, screws, and nuts used on the REJ shall be manufactured so as not to fall out or loosen due to vibrations.

4. LANGUAGE SECTION

4.1. The tongue shall be weld-free.

4.2. The support rail will be manufactured from a standard rail profile, and the side of the tongue that rests on it will be properly machined.

4.3. The shims used between the rails shall comply with the EN 1563 standard (spheroidal graphite cast iron), and the material type shall be EN-GJS-400-18-LT or EN-GJS-500-7. If the Authority deems it appropriate, a different material with better mechanical properties may be used. Material approval tests and routine tests will be conducted in accordance with this standard as specified in the table below.

No.	Inspection	Qualification (Approval) Tests	Routine Test
1	Dimensional Ins-	15 products	1 product per 100 units
2	Surface Characteris-tics Inspection	From the sample products in No. 1 15	
3	Tensile Strength	From the sample products in No. 2 5	At least 1 per casting, with 1 product per 500 pieces
4	Elongation at Break		
5	Yield Strength		
6	Impact Energy	5 samples from the products	
7	Hardness (HBW)	5 samples from the products	

4.4. There shall be no unused holes in the REJ rails.

4.5. The area where the standard rail profile is applied to the end of the tongue rail profile will be subjected to heat treatment. For the REJs to be procured under this project, the procedure approval tests for the forged section will be conducted in accordance with the EN 16273 standard. Acceptance tests conducted up to three years prior to the date of manufacture will be valid; otherwise, the acceptance tests will be repeated.

4.6. The routine tests to be performed on the forged region of the tongue rails in accordance with the EN 16273 standard are as follows:

Test	Test Frequency	Results (EN 16273)
Visual Inspection	To be performed on each part.	Section 7.4.2.
Surface Roughness	To be performed on each part.	Section 7.4.3.
Geometry	To be performed on each part.	Section 8.1.2.
MT (PT)	To be performed on each part.	Section 7.4.4.
UT	To be performed on each part.	Section 7.4.5.
Hardness	Shall be performed on the first and last parts produced within a single day.	Section 8.1.3.
MT = Magnetic Particle Test, PT = Liquid Penetrant Test UT = Ultrasonic Testing		

4.7. The length of the forged section shall be at least three times the height difference between the two rail profiles. (LT = min. 3xHD)

4.8. According to EN 16273, the standard rail profile length (if not welded) of the forged section (LF) shall be at least 60 cm.

4.9. No welding is permitted on the tongue or bearing rail.

4.10. Rail drawings, which also indicate the holes to be drilled on the REJ according to the project, shall be submitted to the Authority as a separate sheet, and the drilled holes shall be chamfered at an angle of 60–90° and a depth of 1–2 mm.

5. RAIL CONNECTION

5.1. The thickness and strength of the steel plates to be used must be designed to accommodate vertical movements resulting from the elasticity provided by the elastomer pads.

5.2. The connection system to be used shall meet the requirements specified in EN 13481. The Contractor shall submit all tests, results, and reports pertaining to the connection system to the Authority for approval. The Authority may conduct or witness tests and inspections required under the Contract and applicable standards.

The costs of such tests and inspections, including any retesting required due to non-compliance, shall be borne by the Contractor.

5.3. The REJ manufacturer must have a reference for an REJ fastening system that has been used on high-speed rail lines.

6. REJ CONCRETE SLEEPERS

The REJ ties to be used shall comply with the relevant sections of the Technical Specifications for Prestressed-Pre-tensioned Concrete Ties.

7. TOLERANCES

The tolerances specified in the drawings and technical delivery specifications shall apply to dimensions. Unless otherwise specified in the specifications, dimensional tolerances for all manufactured parts shall comply with the “m” class of the ISO 2768 standard.

8. MARKING

All markings (on the rails) that may be required during REJ installation shall be made using metal plates. The metal plates shall be affixed by adhesive and designed to remain legible for at least 5 years.

9. PREPARATION OF THE RAMS REPORT

Systems Assurance (SA) refers to the activities that must be demonstrated to ensure the reliable functionality of the REJ subsystems. The supplier is required to demonstrate the implementation of systems assurance and to guarantee that the contract requirements and the EN 50126-1 standard are strictly adhered to throughout the contract period, including any design-related changes.

The Supplier is obligated to comply with the Systems Assurance (SA) requirements specified below for all work within the scope of the supply.

9.1. Systems Assurance Plan (SAP) and RAM Plan

The Supplier must prepare the SAP and RAM plans and submit them to AYGM for approval.

The SAP and RAM plans must define the management and technical activities that demonstrate that RAMS requirements are met and maintained throughout the project lifecycle. These plans shall include, at a minimum, the following:

- Objective, scope, and standards used,
- Evaluation of SA activities and results in conjunction with the REJ design,
- The approach, methods, and programs to be used to manage SA and RAM activities throughout the project lifecycle,
- A definition of all internal and external interfaces within the scope of procurement,
- A definition of RAMS verification and validation processes and activities.

9.2. RAMS Report

The RAMS Report must include at least the following requirements:

9.2.1. Hazard Analysis (HA)

The Hazard Analysis (HA) must be applicable to all functions and must be evaluated down to the lowest level of the REJ's safety process. The Hazard Analysis (HA) must consider the hazards that may arise in each subsystem separately. The results of the Hazard Analysis (HA) must be used to develop the hazard record.

9.2.2. Maintainability Analysis (MA)

The supplier shall perform the Maintainability Analysis (MA) by taking into account the details of any decline in the functional level of all equipment subject to maintenance. The supplier must calculate the Mean Time to Restore (MTTR) for the RGC systems within the scope of supply using Corrective Maintenance (CM) Analysis, in accordance with the methods specified in EN 50126-1.

The Supplier shall also prepare a Preventive Maintenance (PM) Analysis to calculate the maintenance requirements needed throughout the service life of the REJ to be used in the project.

9.2.3. Failure Mode, Effects, and Criticality Analysis (FMECA)

The supplier must perform a Failure Mode, Effects, and Criticality Analysis (FMECA) on all REJ subsystem units to analyze the impact of a single failure that could occur in any of the REJ subsystems on the higher levels of the line operation system in terms of safety and reliability. The FMECA must include the identification of the causes of the assumed failure modes and all anticipated failure modes. The analysis will be recorded in the FMECA worksheets.

9.3. Hazard Log

The hazard log must be maintained throughout all project phases. The log must include all identified hazards and track these hazards through to the final phase. Hazards must be entered into the hazard log for tracking, even if they were identified through the Hazard Identification Process, design activities, or other means.

10. TECHNICAL DELIVERY REQUIREMENTS

10.1. The REJ supplier shall prepare a detailed final inspection report confirming that there are no errors, defects, or deficiencies in the REJ components or assembly that would affect the warranty coverage prior to the line being put into operation. The inspections performed shall be repeated after the first maintenance run, and any identified deficiencies shall be rectified.

10.2. The correct and actual positions of the selets will be marked on the outer rails with colored paint. The Authority reserves the right to subject the REJs to a final inspection at the port of acceptance or on the construction site.

10.3. Spare REJs will be shipped manufactured 1 meter longer than their standard length, and acceptance will be conducted accordingly.

11. WARRANTY

All materials supplied are warranted for a period of 2 years from the date of final acceptance.

Within this period, if any complete REJs or their parts, as well as concrete REJ sleepers, are removed from service due to defects, the contractor shall provide replacements free of charge within 2 months or reimburse the costs. If the contractor provides replacements, it shall also cover customs duties and shipping costs.

12. PATENT RIGHTS

The contractor shall be responsible for matters related to patent rights, and the Authority shall be exempt from any claims regarding such rights.

13. TRAINING

For each REJ type, the manufacturer shall provide at least 4 days of on-the-job training on installation and maintenance.

14. MAINTENANCE

The contractor shall perform protective grinding of the REJ rails free of charge 6 months after the line becomes operational. Detailed training on grinding and REJ

maintenance, lasting at least 1 week (minimum 40 hours), will be provided to the Authority by the manufacturer free of charge. All gauges and equipment to be used in grinding operations and inspections will be delivered to the Authority in three sets, each fully calibrated.