



भारतसरकार
रेलमंत्रालय

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

FUNCTIONAL REQUIREMENT SPECIFICATION (FRS) OF RAIL EARTH
CLAMP FOR EARTHING AND BONDING OF OVERHEAD TRACTION
EQUIPMENT

SPECIFIATION No.TI/OHE/2024/REC/.....
ISSUED BY
Traction Installation Directorate
RESEARCH DESIGNS & STANDARDS ORGANISATION
MANAK NAGAR, LUCKNOW- 226 011

Prepared By SSE/TI	Checked By ADE/TI-2	Recommended By JD/TI-2	Approved By PED/TI

SPECIFIATION No. TI/OHE/2024/REC/.....	Issuedon.....2024	Page2of12
--	-------------------	-----------

**FUNCTIONAL REQUIREMENT SPECIFICATION (FRS) OF RAIL EARTH CLAMP
FOR EARTHING AND BONDING OF OVERHEAD TRACTION EQUIPMENT**

Index

Table of Content

1 SCOPE:.....3

2 DEVIATIONS FROM SPECIFICATION.....3

3 ENVIRONMENTAL REQUIREMENTS:.....3

4 PROFILE OF EXISTING RAIL CORSS SECTION:.....3

5 REFERENCE SPECIFICATION:.....4

6 GENERAL CONDITIONS:.....5

7 MATERIAL SPECIFICATION.....6

8 ELECTRICAL FEATURES.....6

9 TECHNICAL LITERATURE, DATA AND DRAWINGS:.....6

10 TESTS.....7

11 TEST METHODS:.....9

12 PACKING AND MARKING.....11

SPECIFICATION No. TI/OHE/2024/REC/.....	Issued on.....2024	Page 3 of 12
---	--------------------	----------------------------

FUNCTIONAL REQUIREMENT SPECIFICATION (FRS) OF RAIL EARTH CLAMP

1 SCOPE:

- 1.1 This specification covers the requirements for Rail Earth Clamp (REC). This equipment provides an electrical connection from the rail base to mast/structure without harming the rail itself while allowing for free movement of rail traffic and unhindered track maintenance.
- 1.2 The "Make in India" Policy of Government of India shall be applicable.
- 1.3 This FRS is made for development of REC through EOI only. After successful examination of all offered design of REC and its prototype testing, Specification, STR and Drawing shall be finalized. Indian Railway is not responsible for any further supply order from any Zonal Railway based of participation in this EOI.

2 DEVIATIONS FROM SPECIFICATION

- 2.1 Any deviation from this specification, proposed by the manufacturer, intended to improve the performance, utility and efficiency of the REC, will be given due consideration provided full particulars of the deviation with justification thereof are furnished.
- 2.2 In such a case the manufacturer shall quote according to this Specification and indicate the deviations separately in a "Statement of Deviations".

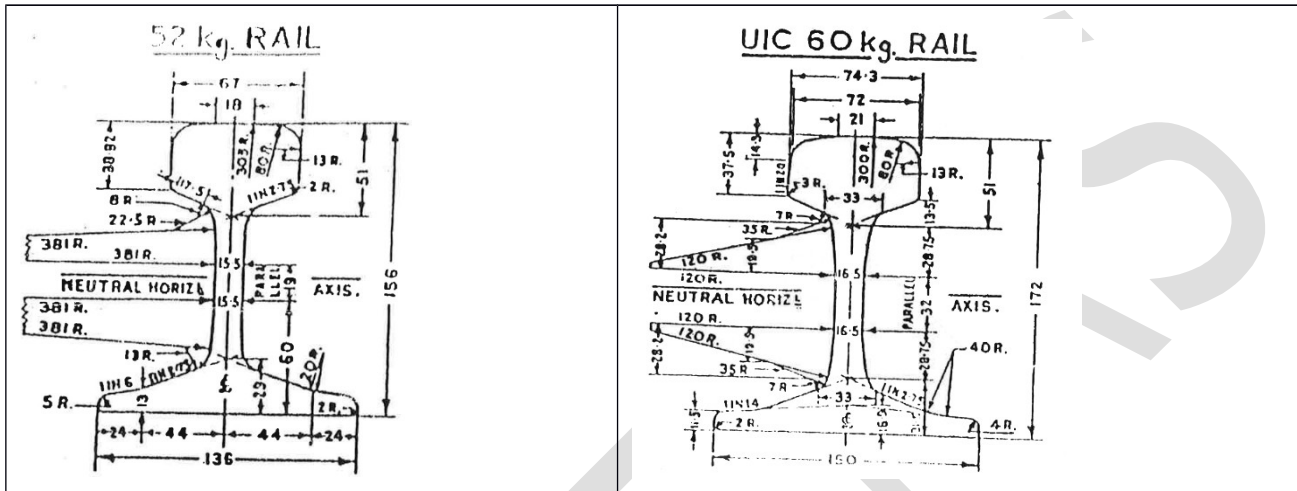
3 ENVIRONMENTAL REQUIREMENTS:

- 3.1 The Rail Earth Clamp shall be used in varying atmospheric and climatic conditions as tabulated below:

SN	Conditions	Value
1	Ambient air temperature range	-5°C to (+)55°C
2	Max. temperature of rail in sunlight	75°C
3	Min. temperature of rail in winter	-5°C
5	Max. relative humidity	100%
6	Average annual rainfall	Raining from 1750 to 6250 mm
7	Basic wind pressure	216kgf/m ²
8	Maximum altitude	2500 m
9	Corrosion	Heavy corrosion prone areas, saline environment
10	Shock & Vibration	Frequent high amplitude shock & vibration due to operation of train on track at higher speed
11	Maximum speed of train on rail	250 kmph
12	Other working condition	Ballast of track will hit REC during train operation

4 PROFILE OF EXISTING RAIL CROSS SECTION:

- 4.1 The Profile of Rail Earth Clamp shall fit for rail type 52 kg per meter and 60kg per meter.
- 4.2 Rail Earth Clamp shall retain proper connection to the rail of following profile over its designed lifetime. It shall not loosen its grip and resist any kind of vibrations caused by passage of trains.



5 REFERENCE SPECIFICATION:

- 5.1 REC shall, unless otherwise specified, conform to the following Indian, International and 'RDSO' standards / specification (latest version) which shall be applied in the manner altered, amended or supplemented by this specification.

1	IS:2062-2011	Steel for general structural purposes
2	IS:1608-2005	Metallic materials - tensile testing at ambient temperature
3	IS:2004-1991	Carbon steel forging for general engineering Purposes
4	ETI/OHE/13 (4/84) with A & C Slip 1 to 4	Hot dip zinc coating on steel masts (rolling and fabricated), tubes and fittings, used on 25 kV A.C. OHE
5	TI/SPC/OHE/ Fasteners/0120 Rev 1	Steel and Stainless steel bolts, nuts and washers.
6	IS:3195-1992 (Re-affirmed 2001)	Steel for the manufacture of volute and helical springs (For Railway Rolling stock)- specification. (Third Revision)
7	IS:6396-2000 (Re-affirmed 2018)	Method of measuring decarburized depth of steel. (Second Revision)
8	IS:7739 Part 5-1976 (Re-affirmed 2018)	Code of practice for preparation of metallographic specimen, Part 5 iron and steel and their examination.
9	IS: 3703:2023	Recommended practice for magnetic particle flaw detection. (Third Revision)

SPECIFICATION No. TI/OHE/2024/REC/.....	Issued on.....2024	Page 5 of 12
---	--------------------	----------------------------

10	IEC 61373	Shock and Vibration tests
11	ISO 683-1 part 1	Heat-treatable steels, alloy steels and free-cutting steels (Non-alloy steels for quenching and tempering)
12	ISO 683-2 Part 2	Heat-treatable steels, alloy steels and free-cutting steels — (Alloy steels for quenching and tempering)
13	ISO 683-3 Part 3	Heat-treatable steels, alloy steels and free-cutting steels — (Case-hardening steels)

5.2 In case of any conflict or disparity between the contents of the above governing specifications and this specification, the latter shall prevail.

6 GENERAL CONDITIONS:

- 6.1 There shall be no connection method between clamp and rail used such as drilling, cutting or welding or any other method that may harm the structural integrity of the rail.
- 6.2 No power tools shall be necessary to mount or dismount the REC. Hammering the REC onto the rail shall pierce the oxidized surface of the rail thus ensuring a reliable electrical contact. The attachment procedure shall not harm the structural integrity of the rail.
- 6.3 REC shall be connected to the rail base in such a way that trains and track maintenance vehicles cannot damage the clamp or prevent it from functioning.
- 6.4 Manufacturer's initials, lot number, production year and part number shall be clearly etched/embossed on each REC. The letters/figures shall be at least 3 mm in height. Indian Railway Property shall also be etched/embossed on REC.
- 6.5 Mounting and removal of the REC shall be possible by one person only.
- 6.6 All components of the assembly shall be freely interchangeable between each other.
- 6.7 REC shall be reusable without the need of maintenance. Manufacturer shall provide the expected life of REC and expected number of installation and removal during its life.
- 6.8 REC shall be produced from a rectangular steel bar.
- 6.9 There shall be a fastener and washer surrounded by a flat surface to make the electrical connection to the bond. The washers shall have a toothed surface for gripping the bond.
- 6.10 All the fasteners including bolts, screw, nuts, locknuts and pins shall be made of stainless steel and conform to RDSO's specification No. TI/SPC/OHE/Fasteners/0120 (Rev 1) or latest. It shall be outsourced from CORE approved source directly or can be manufactured in house.
- 6.11 The total weight of the complete assembly shall not exceed 1 kg.

SPECIFICATION No. TI/OHE/2024/REC/.....	Issued on.....2024	Page 6 of 12
---	--------------------	----------------------------

- 6.12 The clamp surface shall have a smooth finish appropriate to the manufacturing process applied and shall be free from defects, deformations and flaws. There should not be any sharp edge on REC, which may harmful during its installation.
- 6.13 It should be possible to install/remove the REC on/from rail with the tool already provided to the keyman in Indian Railway. No special tools shall be required for installation of REC.
- 6.14 The development/ product/process is original and there is no infringement of Patent Rights. Indian Railways shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, use of similar components in the design & development of this item and any other factor not mentioned herein which may cause such a dispute. The entire responsibility to settle any such disputes/matters lies with the manufacturer/supplier.
- 6.15 Manufacturer shall submit the technical details of machinery and equipment used during manufacturing and testing of REC. Accordingly, STR for the development of the vendor shall be finalized in due course.
- 6.16 All the provisions contained in RDSO's ISO procedure and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor/ vendors in the contracts floated by Railways to maintain quality of the products supplied to Railways.

7 MATERIAL SPECIFICATION

- 7.1 REC shall be produced from corrosion free spring steel. The steel bar shall be manufactured in accordance with ISO 683-1/2/3 Heat-treatable steels, alloy steels and free-cutting steels.
- 7.2 Material of REC should not develop corrosion on rail in worst environmental condition during its life time of 35 years.
- 7.3 All fasteners are made of stainless steel.
- 7.4 Rail Earth Clamp shall be surface coated with zinc as per RDSO specification no. ETI/OHE/13 (4/84) with A & C Slip 1 to 4.

8 ELECTRICAL FEATURES

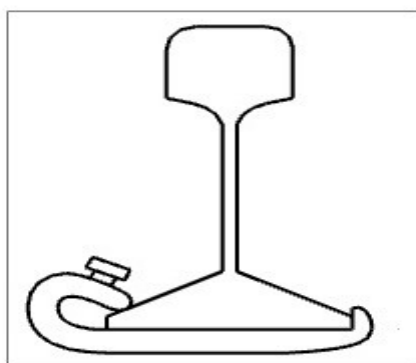
- 8.1 REC shall withstand a short term short-circuit with an effective current of 20,000 Amp rms for 200 milli seconds.
- 8.2 REC shall be able to conduct a continuous current of 200 Amp rms at an ambient temperature of 50°C without exceeding the maximum absolute temperature limit of 70°C in saturated condition.
- 8.3 The contact resistance between clamp and rail shall be lower than 5 Milli Ohm.

9 TECHNICAL LITERATURE, DATA AND DRAWINGS:

- 9.1 The manufacturer shall furnish the schedule of guaranteed technical particulars of the REC.

SPECIFICATION No. TI/OHE/2024/REC/.....	Issued on.....2024	Page 7 of 12
---	--------------------	----------------------------

- 9.2 The manufacturer shall also furnish a detailed installation and maintenance manual and a detailed list of spare parts which are required for replacement during service.
- 9.3 The manufacturer shall submit the assembly drawing of REC for scrutiny, in minimum size of 210 mm x 297 mm or bigger. It shall indicate major dimensions, tightening torque of fasteners and suitability for rail types.
- 9.4 Each drawing shall carry the tabulation for item reference, item's name, drawing number, material compositions, material specification with grade, quantity and weight etc. Salient technical particulars of the assembly/components shall also be mentioned in the respective drawings. A block as indicated below shall be provided on each drawing for approval by Director General/TI, RDSO, Lucknow.
- 9.5 Only after all the design and drawings have been approved and clearance given by purchaser/RDSO to this effect, the manufacturer shall take up manufacture of the prototype for RDSO's inspection. It is to be clearly understood that any changes required to be done in the prototype as required by RDSO shall be done expeditiously.
- 9.6 After successful prototype testing of REC, limited quantity of REC shall be installed at different-different locations of IR for field trials. Based on the performance of the REC during field trials, drawing of the REC shall be standardized for further vendor development.
- 9.7 A symbolic drawing of REC is given below for reference only.



10 TESTS

- 10.1 Prior to take up the proto type testing, the internal test results for all the tests specified in clause 10.8 shall be furnished by the successful manufacturer to the Purchaser/ Director General (Traction Installation)/ Research Designs & Standards Organisation, Manak Nagar, Lucknow - 226 011.
- 10.2 Any changes required in the process of manufacture or the prototype as desired by the Director General (Traction Installation)/Research Designs & Standards Organization (RDSO) shall be carried out expeditiously by the manufacturer.

SPECIFICATION No. TI/OHE/2024/REC/.....	Issued on.....2024	Page 8 of 12
---	--------------------	----------------------------

- 10.3 Prior to giving a call to the Purchaser/Director General (Traction Installation) / Research Designs & Standards Organization for inspection and testing of the prototype, the manufacturer shall submit a detailed test schedule consisting of schematic diagrams for each of the tests and the number of days required to complete all the tests at one stretch. Once the schedule is approved, the tests shall invariably be done accordingly. However, during the process of type testing or even later, the purchaser/RDSO reserves the right to conduct any additional test(s) besides those specified herein, to his satisfaction or for gaining additional information and knowledge. In case any dispute or disagreement arises between the manufacturer and representative of the Director General (Traction Installations) / RDSO during the process of testing as regards the procedure for Type Tests and/or the interpretation and acceptability of the results of Type Test, it shall be brought to the notice of the Director General (Traction Installation) /RDSO as the case may be, whose decision shall be final and binding.
- 10.4 All the tests specified in the specification shall be carried out at the manufacturer's works. The manufacturer shall arrange all the necessary machinery, apparatus, labour and assistance required for conducting/witnessing the tests by Purchaser/RDSO without any extra cost.
- 10.5 **TYPE TESTS:** Type tests shall be carried out to demonstrate the suitability of the design, materials and method of construction and the capability of the manufacturer to produce the REC in accordance with the specification. All such tests shall be witnessed by RDSO representative. The cost of samples or components destructed during type testing shall be borne by the manufacturer. The rails required for testing shall be arranged by the manufacturer at his own cost.
- 10.6 Unless otherwise specified, each type test shall be conducted on three assemblies. All the assemblies shall satisfy the requirements of relevant clauses.
- 10.7 **Acceptance tests:** Only after clear written approval communicated by RDSO to firm, the manufacturer shall be taken up bulk manufacture of the Rail Earth Clamp assemblies. Bulk manufacturing shall be done strictly with the same material and process as adopted for the prototype testing. In no circumstances shall the material other than those approved in the design/drawings and/or the prototype be used. Acceptance tests shall be conducted by manufacturer in the presence of Inspecting Authorities. Each acceptance test shall be conducted on three assemblies, unless otherwise specified. The assemblies are taken at random from lots offered for acceptance. Only if there is no failure at all, the lot shall be accepted. If any failure occurs the entire lot shall be rejected. Test record shall be maintained by manufacturer and produced, if required by the purchaser/ testing authority.
- 10.8 **Routine tests:** Routine tests shall be conducted by manufacturer. Each routine test shall be conducted on all assemblies offered for acceptance. All assemblies shall satisfy the requirements of relevant clauses. These tests shall be carried out by manufacturer in the presence of Inspecting authorities. Test record shall

SPECIFICATION No. TI/OHE/2024/REC/.....	Issued on.....2024	Page 9 of 12
---	--------------------	----------------------------

be maintained by manufacturer and produced, if required by the purchaser/testing authority.

10.9 Test Table: The following Type tests, Acceptance tests and Routine tests shall be conducted on the components and assemblies.

SN	Name	Type Test	Acceptance Test	Routine Test
1	Visual examination of components	Yes	Yes	Yes
2	Dimensional verification	Yes	Yes	No
3	Interchangeability of components	Yes	Yes	No
4	Reusability	Yes	No	No
5	Physical and chemical tests on casting and forging	Yes	Yes	No
6	Radiographic examination of castings	Yes	No	No
7	Liquid dye penetration test for casting and forging	Yes	Yes	Yes
8	Test on Fasteners	Yes	Yes	No
9	Chemical analysis of components	Yes	Yes	No
10	Salt spray test	Yes	No	No
11	Short circuit test	Yes	No	No
12	Continuous current and contact resistance test	Yes	No	No
13	Shock and Vibration test	Yes	No	No
14	Field Performance test	Yes	No	No

11 TEST METHODS:

11.1 Visual examination: All components of the assembly shall be carefully examined to see that they are free from defects, deformations, flaws and have smooth surface finish.

11.2 Dimensional verification: The dimensions shall be within the limits specified in manufacturer's drawings approved by RDSO.

11.3 Interchangeability of components: If any of the component selected at random permits their assembly without any further machining or forming operations with other matching components, the requirement of this test shall be deemed to have been complied with.

11.4 Reusability: The clamps shall be mounted onto the rail base and then dismounted as per manufacturer's manual. These steps of mounting and dismounting shall be performed as specified by manufacturers. Three clamps each shall be tested on rail types 60kg and 52kg. After completion of the test, the dimensions and other parameters of the REC shall be checked and verified.

11.5 Physical and chemical tests on casting and forging: For each material used for ferrous/non-ferrous castings and forgings etc the manufacturer shall test one of the two test bars from each melt/lot for physical properties and chemical

SPECIFICATION No. TI/OHE/2024/REC/.....	Issued on.....2024	Page 10 of 12
---	--------------------	-----------------------------

composition. Only if the test results are in conformity with relevant standards the fittings/components from that melt/lot shall be utilized and offered for acceptance otherwise the lot shall be re-melted.

11.6 The second test bar shall be tested by the inspector for each lot of fittings/components from each melt/lot for physical properties only. If the requirements of physical properties are not met with, the particular lot shall be rejected and fittings/ components broken or re-melted in the presence of the Inspector. If the requirement of physical properties is met with the lot shall be accepted.

11.7 **Radiographic examination of castings:** Radiographs of the castings (ferrous and Non-ferrous) selected for the purpose shall be taken and evaluated by RDSO for inclusions, blow holes, cavities, cracks, porosity etc. if the casting fail in radiographic examination, the lot shall be rejected and destroyed in the presence of inspecting authority. The accepted radiographs shall be retained by RDSO.

11.8 **Liquid dye penetration test for casting and forging:** All the castings and forgings (ferrous and non-ferrous) shall be tested for cracks, porosity etc. by the liquid penetrate flaw detection method in accordance with IS 3658:1999(2000) and shall satisfy the requirements of the specification.

11.9 **Test on Fasteners:** Fasteners used in assembly shall be tested for visual examination, dimensional measurement, gauging of threads, tensile and elongation test, head sound test, proof load test and hardness tests for their conformity to Specification No. TI/SPC/OHE/Fasteners/0120 or latest.

Clause 11.9 is applicable for those manufacturers which are manufacturing fasteners in house. If fasteners are purchased by the firm from CORE/RDSO approved source then testing is not required but TC and invoice of RDSO/CORE approved source is required.

11.10 **Chemical analysis of components and fittings:** The clamp material shall be chemically analyzed. The chemical composition shall be in accordance with ISO 683 and the specification mentioned in the approved drawings. The provided material test certificate shall be produced in accordance with EN 10204:2004 or ISO 10474:2013.

11.11 **Salt spray test:** The clamps shall be pre-conditioned in a salt spray chamber for ageing purposes before being subjected to a short circuit test. The clamps shall be mounted onto the rail base as per manufacturer's manual. Three clamps each shall be tested on rail types 60kg and 52kg. The mounted clamps including the rail shall then be subjected to a salt spray test in accordance with ISO 9227:2017. After completion of the salt spray test, the clamps shall not be removed from the rail or tampered with in any way until the subsequent short circuit test has been performed.

The following test parameters shall be applied:

Parameter	Value
Test Method	Neutral Salt Spray (NSS)

SPECIFICATION No. TI/OHE/2024/REC/.....	Issued on.....2024	Page 11 of 12
---	--------------------	-----------------------------

Concentration of sodium chloride	NaCl (50 ± 5) g/l
Temperature	35 ± 2°C
Relative humidity	100 %
Duration	500 h

- 11.12 Short circuit test:** Before commencing the short circuit test, the clamps must be pre-conditioned in a salt spray chamber for ageing purposes. After completion of the salt spray test, the clamps shall not be removed from the rail or tampered with in any way until the short circuit test has been performed. Three clamps each shall be tested on rail types UIC60 and 52kg. A short term short-circuit with an effective current of 20,000 A rms for 200 milli seconds. During the test, the required current should flow through the rail to REC. The test shall be considered as passed if there is no current interruption during the test time. Maximum temperature rise of the REC shall be measured immediately using thermo vision camera for record and further investigation purpose.
- 11.13 Continuous current and contact resistance test:** The clamps shall be mounted onto the rail base as per manufacturer's manual. Three clamps each shall be tested on rail types 60 kg and 52kg of one meter length. The test set-up and arrangement shall be the same as in the short-circuit test. A continuous current of 200 Arms shall be applied to the clamp and rail for the duration of 150 minutes at an ambient temperature of 50°C. No additional cooling shall be applied to the arrangement. After the duration of 150 minutes and while the continuous current of 200 Arms is still applied, an infrared camera shall be used to locate the hottest surface area on the clamp. The test shall be considered as passed if the hottest surface area on the clamp does not exceed a temperature of 70°C.
- 11.14 Field test:** RECs of limited quantity decided by RDSO after prototype testing shall be installed by the manufacturer in different-different Zonal Railways for field trial of minimum twelve months. REC shall be tested on rail types 60kg and 52kg both. After completion of twelve months from the date of installation, the performance report of the REC shall be sent to DG/TI RDSO Lucknow by the Zonal Railway.
- 11.15 Zonal Railways** shall be provided a video recording to RDSO, wherein a track tamping machine (ballast tamper) is seen during active tamping process at the installation location of the clamp. This shall provide evidence that the clamp assembly is not damaged or prevented from functioning in any way by the tamping process.

12 PACKING AND MARKING

- 12.1** The components shall be suitably packed to prevent damage during transit/handling. Every box shall be labelled with the following information:
- Manufacturers trade name and brand mark
 - Number of components packed
 - Consignee's address

SPECIFICATION No. TI/OHE/2024/REC/.....	Issued on.....2024	Page 12 of 12
---	--------------------	-----------------------------

- iv. Contract/purchase order number with date
- v. Date of inspection and inspecting authority
- vi. Any other particulars specified by the purchaser

- 13 All the provisions contained in RDSO's ISO procedures laid down in Document No. QO-D-8.1-11 Version 3.1 date effective 20.11.2024 or latest (Document Title: Vendor Changes in approved status) and "subsequent versions/amendments thereof, shall be binding and applicable on the successful vendors in the contracts floated by Railways to maintain quality of products supplied to Railways".

DRAFTERS