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भारत सरकार GOVERNMENT OF INDIA
रेल मंत्रालय Ministry of Railways

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SPECIFICATION NO.TI/SPC/OHE/MRI/0143

8-व्हीलर टॉवर कारों पर मापने और रिकॉर्डिंग उपकरण के रेट्रोफिटेड के लिए तकनीकी विनिर्देश
TECHNICAL SPECIFICATIONFOR MEASURING AND RECORDING INSTRUMENTATION TO BE RETROFITTED ON 8-WHEELER TOWER CARS

(AUGUST , 2025)

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TECHNICAL SPECIFICATION FOR MEASURING AND RECORDING INSTRUMENTATION TO BE FITTED/RETROFITTED ON 8-WHEELER TOWER CARS.

SPECIFICATION NUMBER: TI/SPC/OHE/MRI/0143

Amendment Number	Specification no. Amendment/Revision	Total pages including drawings	Date of Issue	Reasons for Amendment/Revision
0	No. TI/SPC/OHE/MRI/0140 Technical Specification for Measuring and Recording Instrumentation to be Retrofitted On 8-Wheeler Tower Cars.	15	First issue 17.03.2016	-
1	No. TI/SPC/OHE/MRI/0140(11/2019) Rev.01 Technical Specification for Measuring and Recording Instrumentation to be Retrofitted On 8-Wheeler Tower Cars.	16	11.11.2019	As per Directive of Railway Board letter No. RE(S)/11/2015/0001(DETC with MRI)/7/5, dated 14.03.2019
2	No. TI/SPC/OHE/MRI/0142 Technical Specification for Measuring and Recording Instrumentation to be Retrofitted On 8-Wheeler Tower Cars.	24	27.09.2023	As per recommendation of nominated committee (CEDE/NR, CEE/D&Q, DMW and EDTI/RDSO) Report on on review of MRI Specification no. TI/SPC/OHE/MRI/0140 rev.1 (Nov, 2019) for provision of measuring & recording instrumentation (MRI) on Tower Car.
3.	No. TI/SPC/OHE/MRI/0143 Technical Specification for Measuring and Recording Instrumentation to be Retrofitted On 8-Wheeler Tower Cars	25		During a meeting for the review of progress of OHE condition monitoring systems and PLW projects including MRI at Railway Board on 28.07.2025, it was discussed to study the proven systems under commissioning i.e. DFCCIL, DMRC etc. and review the existing MRI specification to ensure better reliability and performance with improved accuracies including data connectivity for real time integration with the existing system of TDMS.

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Chapter - I

GENERAL CONDITIONS

1.1 SCOPE:

1.1.1 This specification covers the Design, manufacture, supply, testing &retro-fitment/commissioning of OHE Parameter Measuring & Recording instrumentation on existing self-propelled 8-Wheeler Diesel Electric Tower Car and self-propelled 8-Wheeler Diesel Hydraulic Tower Car operating on broad gauge (1676mm) electrified (25 kV A.C.) routes of Indian Railways. The work involved is to design & development, manufacture, supply, testing of instrumentation and retro-fitment/commissioning of these instruments on 8-Wheeler Diesel Electric and Diesel Hydraulic Tower Cars. The Retro-fitment work on existing Tower Car shall be done during periodical overhauling (POH) or any other suitable schedule. Supply of new 8-Wheeler Tower Car shall be made duly fitted with measuring & recording system as per Specification; wherever specified.

1.2 CLIMATIC CONDITIONS:

1.2.1 The instrumentation shall be in continuous operation under the following atmospheric and climatic conditions: -

1.	Atmospheric temperature	Metallic surface temperature under Sun: 75°C maximum and in shade: 55°C max. Minimum temperature: -10°C (Also snow fall in certain areas during winter season).
2.	Humidity	100% saturation during rainy season.
3.	Reference site conditions	i) Ambient Temp.:-20°C to50°C ii) Humidity: 100% iii) Altitude:2000m above mean sea level.
4.	Rain fall	(i) Ranging from 1750 mm to 6250 mm. (ii) Number of rainy days/annum 120
5.	Atmosphere during hot weather	Extremely dusty and desert terrain in certain areas. The dust concentration in air may reach as high as of 1.6 mg/m³. In many iron ore and coalmine areas, the dust concentration is very high affecting the filter and air ventilation system.
6.	Coastal Area	Instrumentation shall be designed to work in coastal areas in humid and salt laden atmosphere with maximum pH value of 8.5, sulphate of 7mg per liter, max. concentration of chlorine 6 mg per liter and maximum conductivity of 130 micro Siemens/cm.
7.	Vibration	The equipment, sub-system and their mounting arrangement shall be designed to satisfactorily withstand the vibration and shocks encountered in service as specified in clause 1.2.2. Further High level of vibration and shocks in order of 50 g. Accelerations over 500 m/s² have been recorded at axle box levels for long periods during run. Vibrations during

		wheel slips are of even higher magnitude.
8.	Wind Speed	High wind speed 55m/sec in certain areas, with wind pressure reaching 216 kgf/m²
9.	Operation time	Day & Night
10.	Operation Duty	All measuring devices installed shall be suitable for continuous working on live or non-live OHE under all atmospheric conditions throughout the year.
11.	Nominal system Voltage of Overhead contact wire.	25kV AC. single phase, 50Hz

1.2.2 The equipment and their arrangement shall withstand satisfactorily, the vibration and shocks normally encountered in service which are mentioned in Clause 1.2.1 and as below:

(a) Maximum Vertical Acceleration 3.0g
(b) Maximum Longitudinal Acceleration 5.0g
(c) Maximum Transverse/lateral Acceleration 3.0g
Where g=Acceleration due to gravity

The equipment and their arrangement shall withstand satisfactorily, the vibration and shocks test as per as per IEC: 61373 (latest version).

1.2.3. **GOVERNING SPECIFICATIONS:**

S. N.	Specification No.	Description
1.	IEC 60571-2012	Railway Applications: Electronic equipment used on Rolling Stocks.
2.	IEC 61373-2010	Railway Applications: Rolling Stock Equipment.
3.	IEC 61000	EMI/EMC compatibility
4.	IEC 61000-4-5 (2017)	Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test.
5.	IEC 61000-4-2 (2008-12)	Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic Discharge immunity test.
6.	IEC 61000-4-4 (2012-04)	Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test.
7.	IEC 61000-4-3 (2020-09)	Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test.
8.	IEC 60529 (2013-08)	Degree of protection provided by enclosures(IP code)
9.	IEC 60068 (2013-10)	Environmental testing
10.	IEC 61000-4-6 (2023-06)	Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – immunity to conducted disturbance induced by Radio frequency

		fields.
11.	IEC 61000-4-8 (2009)	Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency, magnetic field immunity test.
12.	IEC 60077-1 (2017)	Railway Applications: Electric equipment for Rolling Stock. Part-1: General service conditions and general rules.
13.	ISO/IEC 17011:2017	Conformity assessment — Requirements for accreditation bodies accrediting conformity assessment bodies.
14.	ISO/IEC 17025:2017	General requirements for the competence of testing and calibration laboratories.
15.	IS: 696-1972	Code of practice for general engineering drawings.
16.	BS EN 50121-2:2017	Railway applications- Electromagnetic compatibility Emission of the whole railway system to the outside world

Note: Latest version of the above specifications/standards shall be applicable and should be available with the manufacturer/supplier.

1.3 **EXAMINATION OF THE TENDER OFFER:**

1.3.1 **Compliance of the Specification:** The certificate of compliance to the Technical Specifications to be submitted by the bidder.

In case of any remark/deviation from tender Specification, the suppliers shall submit the Statement of Deviation from Technical Specification with clause wise details. The clauses not mentioned in the Statement of Deviation shall be treated as complied, in toto.

1.3.2 Details of all Measuring Instruments, covering all technical and functional requirements, given in the Specification, shall be brought out by the supplier, while quoting. List of Measuring Instruments shall be furnished along with the offer by the supplier for scrutiny.

1.3.3 In the event a supplier is unable to comply, either partially or fully, to any of the stipulations made in this specification, it must be brought to the notice of purchaser with full particulars of the deviations, technical details, cost implications and past service performance, etc.

1.3.4 The "Make in India" policy of Government of India shall be applicable.

1.4 **DESIGN DEVELOPMENT:**

1.4.1 The successful supplier (hereafter called as contractor) shall develop the design based on the details given in this specification and on sound engineering practices. The entire design shall be submitted to RDSO for approval before commencing fitment/retro fitment of instrumentation system.

The supplier may use any of the proven technology or combination of technologies (AI, Lidar, Radar etc) to achieve the measured parameters to the desired accuracy & reliability.

1.4.2 The design shall be based on S.I. Units.

1.4.3 From the information given in this specification and instructions of RDSO, the contractor shall prepare a full set of engineering drawings for fitment/ retro-fitment of instruments for monitoring vital OHE parameters and submit the same to RDSO for approval.

1.4.4 Material specifications, manufacturing tolerances and other details, such as jigs & fixtures which are necessary for retro-fitment of instruments shall be indicated in the drawings. For jigs & fixtures and fittings required for retro-fitment should be of rust/corrosion free material preferably stainless steel.

1.4.5 Supplier shall inspect the existing self-propelled 8-Wheeler Diesel Electric & Diesel Hydraulic Tower Cars available on Indian Railways for space availability, locations for fixing instruments/equipment and to develop the suitable instrumentation for fitment/ retro-fitment and also control cubicles for recording and monitoring.

1.5 **APPROVAL OF DRAWINGS**:

1.5.1 "Approval" to the drawing means the in-principle approval to the general adaptability of the design features. The contractor shall be wholly and completely responsible for all these variables. RDSO shall not be responsible for the correctness of dimensions on the drawings, materials used, strength or performance of the components. The contractor, when submitting proposals or designs for approval of the RDSO, shall draw attention to any deviation or departure from the specification involved in his proposals or drawings.

1.5.2 Drawing for approval shall be submitted in standard size (s) as per IS: 696 along with main calculation details in triplicate.

1.6 **PRINTS:**

Three sets of hard copies of approved drawings and also soft copies (CAD as well as PDF format) in DVD/Pen drive or any other suitable media shall be provided to RDSO/ Purchaser with each system supplied for reference and record.

1.6.1 Diagram sheets showing the overall dimensions of the instrumentation, weights and the relation of overall dimensions to the space in the Tower Car.

1.7 **CONTRACTOR'S RESPONSIBILITY:**

1.7.1 The contractor shall be entirely responsible for the execution of the contract strictly in accordance with the terms of this specification and the conditions of contract, notwithstanding any approval which RDSO or the Inspecting officer may have given:

(a) Of the detailed drawing prepared by the contractor.
(b) Of the sub-contractors for materials.
(c) Of other parts of the work involved by the contractor.
(d) Of the tests on instrumentation either by the contractor or by the RDSO or the Inspecting Officer.

1.8 **WARRANTY:**

Warranty shall be as per IRS standard conditions of contract.

1.9 **DRAWINGS AND STANDARD SPECIFICATION**:

1.9.1 The Contractor shall prepare all the drawings for installation of instrumentation on Diesel Electric/Diesel Hydraulic Tower Car for approval.

1.9.2 Indian Railways Standard (IRS) Specifications and Schedules of Maximum Moving Dimensions may be obtained on payment from the Manager, Government of India Publications, Civil Lines, Delhi 110 006 (INDIA).

1.9.3 Indian Standard Specifications (ISS) are available from Bureau of Indian Standards, 9-Bahadur Shah Zafar Marg, Delhi 110 002.

1.10 SERVICE ENGINEERS:

1.10.1 The Contractor shall arrange for the supervision of commissioning of the instrumentation immediately after their receipt at ultimate destination. He is also required to carry out joint check of the receipt of components regarding short shipment or transit damages.

1.10.2 The performance of instrumentation shall be demonstrated by the contractor after its successful commissioning at the consignee's works.

1.10.3 The contractor shall provide and ensure servicing facilities in India throughout the warranty period. After the warranty period is over, he shall, on call, give service support for troubleshooting and for obtaining spare parts.

1.11 **TRAINING:**

1.11.1 The Contractor shall arrange to provide training in operation & maintenance of the instrumentation at their manufacturing works/training centre for two men for five working days for each set of instrumentation supplied for each Tower Car. The training material shall be supplied by the contractor.

(This clause is indicative. Please refer tender conditions in the tender document for details.)

1.12 **SERVICE MANUALS AND SPARE PARTS CATALOGUE:**

1.12.1 Detailed Maintenance & Service Manuals including the manual for trouble shooting & operational requirement, spare parts catalogues for the operator and maintenance staff with each set of instrumentation supplied with each Diesel Electric or Diesel Hydraulic Tower Car shall be prepared and three copies supplied free of cost.

1.12.2 In addition, three copies each of the Maintenance/Service and troubleshooting manual shall be supplied to RDSO.

1.13 **OUTSOURCING ACTIVITY FOR MATERIALS:**

Any outsourcing activity for materials/work shall have prior approval of RDSO.

1.14 **SPARE PARTS**:

1.14.1 Unit exchange of spare parts shall be indicated. However, final decision to buy these will rest with the purchaser.
(This clause is indicative. Please refer tender conditions in the tender document for details.)

1.14.2 The prices for these spares shall be quoted separately. These spares shall be for each set of instrumentation supplied.
(This clause is indicative. Please refer tender conditions in the tender document for details.)

1.14.3 The supplier shall be responsible to ensure subsequent availability of the spare parts for the normal life of the respective instrument.

1.15 **QUALITY ASSURANCE PLAN:**

1.15.1 The contractor should possess valid ISO-9001:2000 certificate for his work's address. The contractor shall formulate Quality Assurance Plan (QAP) detailing the methodology proposed to be followed for manufacturing, fitment/retro-fitment, testing & commissioning of instrumentation on Tower Car.

1.16 **ANNUAL MAINTENANCE CONTRACT (AMC):**

(The details given below in the paras are indicative. Please refer tender conditions in the tender document for details.)

1.16.1 The supplier shall quote for CAMC (Comprehensive Annual Maintenance Contract) of all Equipment/Components of Measuring & Recording System such as Transducers, Load Cells, Strain Gauges, High Resolution Camera, On Board Computers/Laptop, Laser Printers, UPS and other Interface Equipment. All items in the BOQ as per suppliers need to be covered in the CAMC.

1.16.2 The Annual Maintenance shall be for 5 years after warranty period is over. All materials, spare parts, consumables and labor requirement shall be arranged by the successful supplier at his own cost during the course of warranty &CAMC.

1.16.3 The AMC shall be comprehensive for all Equipment of Measuring & Recording System covering scheduled as well as break down maintenance. The supplier shall keep adequate spares in stock accordingly. AMC shall be inclusive of replacement of parts, if required, either due to breakdown or due to regular wear and tear.

1.16.4 Supplier shall submit various maintenance schedules such as Daily/Weekly, Monthly, Quarterly, Half yearly and Yearly schedules of all Equipment at design approval stage.

1.16.5 During the warranty period, scheduled maintenance of Measuring Equipment/Components shall be done by the successful contractor for which no extra cost shall be paid by the Railways.

1.16.6 After expiry of the Warranty period, the successful contractor shall have to maintain all the instrument/Components of the Measuring System during the AMC period of 5 years.

1.16.7 The CAMC agreement shall be entered separately with each Zonal Railway as per the accepted rate of the Contract.

1.17 **INFRINGEMENT OF PATENT RIGHTS:**

1.17.1 Indian Railway shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, components used in design, development

and manufacturing of complete system and any other factor, which may cause any such dispute. The responsibility to settle any issue lies with the manufacturer.

1.17.2 In this regard, the manufacturer has to submit an affidavit (on non-judicial stamp paper of appropriate value as applicable in the respective state and duly notarized & witnessed) as per format attached as Annexure-2.

**

CHAPTER – II

MEASURING & RECORDING SYSTEM

2.1 The instrumentation shall be able to measure and record the required parameters in the speed range 0-110kmph, when running in self-propelled mode/coupled to a train.

2.2 The system requirement shall facilitate simultaneous recording, storing and processing of data in real time. In this setup, video recording of the OHE shall be carried out with independent camera having storage device and shall process data in real time with on board computer/Laptop kept in the Tower Car to process the necessary information of the OHE geometry parameter as mentioned in the clause 2.7.1 (a) to (e). System should be capable to transmit Processed report / Exceptional Report of OHE geometry from the on-board computer/Laptop to the nominated Railway Official sitting at the Remote Control Centre through internet ~~shall be transmitted~~. The type and details in Report shall be finalized at the designs approval stage. The data/report generated by the system should be made available in the format as approved by RDSO. The same data/report shall be transferred to the cloud server as offered by CRIS for further processing.

2.3 The tender shall give offer with complete technical details including processing software for analysis of OHE Geometry and report generation. The software shall be capable to support opening of files in MS Excel or similar spreadsheet software.

2.4 The measurements shall be made under live and non-live condition of the OHE, during day and night.

2.5 The pantograph of Tower Car may be fitted with instrumentation such as transducers, accelerometer, load cells and strain gauges etc. as required but such fitment shall not materially affect the static/dynamic performance of the Tower Car pantograph. The sensors are to be installed on the roof of tower car or on pantograph of tower car. The transducers shall be properly protected against mechanical, environmental and electrical interferences. The cameras shall have high resolution high frequency suitable for capturing of images at the specified speeds. The cameras and other equipment shall be protected for ingress of dust and water with IP -67 Protection.

For parameters like contact wire height, stagger, setting distance (implantation) and Thickness/diameter of contact wire contact/contact-less measurement system employing state of the art proven technology working in any Railways/Metro System worldwide shall be acceptable conforming to environmental standards. The system shall be designed according to electromagnetic compatibility, Shocks vibrations and shall have no moving parts, completely sealed and rugged construction.

The communication between exterior/roof mounted and interior instruments on board Hardware computer/laptop shall be made by an Ethernet Network and physical connection is made by optical fiber. All cables on the roof of tower car which are connected to ground level shall be put in a metallic grounded protection pipe.

The system shall be precise and needs less frequent calibrations.

The supplier shall submit a detailed scheme of the proposed system with technical details including dimensional requirement of the system.

2.5.1 The system shall have protection against open circuit and short circuit of the sensor as well as of cable used.

2.5.2 All material used in equipment shall have fire retardant property.

2.5.3 Real-time monitoring of measured parameters will enable timely interventions and preventive maintenance, thereby reduce failures and increase the OHE availability.

2.6 FITMENT/ RETRO-FITMENT OF MEASURING SYSTEM:

2.6.1 All processed information shall be made available in the Laptop/Desktop at the suitable location in the Dome Area or Staff Cabin of Tower Car. The connections from instrumentation on the roof of the car to the place inside the Tower Car shall be rigid enough to avoid any failure due to poor connectivity during movement of Tower Car due to vibrations. Necessary minor modification work for keeping Laptop/Desktop, UPS, Printer and power supply arrangement for Laptop/Desktop, Printer shall be in the scope of supply. The detailed Layout for installation of measuring and recording equipment (Laptop/Desktop, UPS, Printer etc.) in existing Tower Car to be submitted during design approval stage. The system should be designed to make it suitable for working in Indian subcontinent environment.

2.6.2 The electric supply shall be made available from 10 kVA DG set, 440V, 3-phase supply provided with Tower car. The supplier shall draw single phase supply from DG Set for supply to UPS. The UPS shall have a backup of at least one hour in the event of failure of DG Set and UPS shall be in the scope of supply of MRI instrument supplier. The capacity of the battery with UPS shall be furnished while submitting the design for approval of RDSO.

2.7 PARAMETERS TO BE MEASURED:

2.7.1 The system should be able to measure parameters with desired accuracy levels for speed up to 110 kmph. However, speed limit may be reduced up to 10 kmph for measuring OHE parameters at Turnout/Crossovers.

Principles/methods used for the measurements as indicated in each of the following clauses are indicative and the successful supplier should employ state-of-art proven technology existing/ working worldwide in railways System capable of high accuracy and precision in measurement and recording.

All corrections/ compensations due to bogie, body and pantograph oscillations shall be built into the measurement system for giving better accuracy/precision in measurement and recording.

The parameters which are required to be measured and monitored by MRI system are detailed as under:

a) **HEIGHT OF CONTACT WIRE:**

(i) The height of the Contact Wire is vertical distance of its underside from the rail level and it varies from 4500 mm to 7800mm based on the type of OHE i.e. normal or high rise OHE.

(ii) The height measurement should be corrected for car-body movement and required compensations shall be provided. Height of contact wire may be measured using any contact/ non-contact measurement methodology.

(iii) The MRI system shall be able to measure heights of two contact wire of main line OHE and additional lines pertaining to Turnout/crossover with range 4500 to 6000 mm with an accuracy level of ± 10 mm for normal OHE and up to 7800 mm with an accuracy level of±15 mm for high rise ~~OHE to ensure a gap of 50 mm at support points at obligatory structures (out of run OHE to be higher than main line OHE). This is essential to avoid pantograph entanglement with OHE. Continuous measurement of main line and Turnout OHE is required at such locations. The range of measurement is tabulated below for better appreciation:~~

(iv) Horizontal and vertical separation of two OHE at overlap and turnout locations should also be recorded by the system with an accuracy level of ± 10 mm.

The range of measurement is tabulated below for better appreciation:

S.N.	Type of OHE	Range	Accuracy	Sampling Distance
1.	Normal/Conventional	4500 mm to 6000 mm	± 10 mm	200 mm
2.	High rise	up to 7800 mm	±15 mm	

b) **STAGGER OF CONTACT WIRE:**

Stagger is defined as the distance of the contact wire from the center-line of the pantograph, measured transverse to the track. (Suitable cant compensation shall be made for transverse oscillations of the locomotive/OHE car which affect the centerline of the pantograph from the vertical). The system employed should enable measurement of stagger of two contact wires simultaneously (at overlaps, turnouts and crossover) up to a limit of ± 500 mm. Suitable audio visual alerts shall also be provided, if stagger goes beyond ±300 mm. The stagger of contact wire may be measured using any contact/non-contact measurement method. The accuracy of stagger measurement should be minimum ±10mm. Sampling distance for Stagger measurement shall be minimum 200 mm.

c) **MEASUREMENT OF SETTING DISTANCE (IMPLANTATION):**

Setting Distance is distance measured from centre line of track to the inner face of traction mast. This varies in the range of 2100 mm to 6000mm. System should be able to measure the setting distance in accuracy level of ± 10 mm. System should be able to have data storage of at least 10 lakh masts and transfer it for printing of reports.

d) **GRADIENT (SLOPE) AND RELATIVE GRADIENT OF THE CONTACT WIRE:**

The gradient of the contact wire is the rate of change of height expressed in mm/m of distance. For relative gradient this may be calculated based on variation in height of contact wire and distance traveled. Any other suitable design suggested by the supplier can also be considered, subject to meeting the requirements. The accuracy of gradient (slope) and relative gradient of the contact wire measurement should be minimum ±1.0 mm per 50 meter.

Gradient/relative gradient can be calculated by software from measured height of contact wire and location.

e) Measurement of Contact Wire Thickness:

Thickness implies the diameter of Contact Wire. The contact wire sizes under use in Indian Railways along with their condemning limits are tabulated below:

Contact Wire Size (mm^2)	Diameter (mm)	Condemning diameter (mm)
107	12.24	8.25
150	14.50	8.25
193	16.40	8.89

The measurement of diameter of contact wire may be made using any non-contact measurement method. The accuracy of contact wire thickness measurement should be minimum 0.5mm. Sampling distance should be minimum 100 mm.

In reports generated by system, accuracy of measurement system for this parameter should be mentioned and note for the condition stated above should be incorporated in report. Decision for replacement of contact wire is to be taken by Zonal Railway after measurement of actual wear of contact wire in static condition. Suitable audio visual alerts shall also be provided, if diameter of contact wire goes lower than threshold value, which is configurable and shall be decided by concerned railway

2.7.2 **MAST IDENTIFICATION SYSTEM:**

(i) The GPS receiver shall identify the location of OHE masts co-relating with measured data. Global positioning system shall be utilized for the mast identification along the track. The GPS/optical mapped data is in text file and shall be required to be correlated with the software of the measuring instrument system so that the location of the measured data is automatically displayed/printed along with the event recorded. Accordingly, chart recorder/ report output shall indicate the exact location of recorded event, giving the mast number.

(ii) Alternatively, an optical identification system can also be employed to detect the Catenary Wire support (Mast) along the track continuously. The Optical Mast Identification system shall be active where GPS is not visible such as through tunnels and other critical locations.

(i) GPS data shall be transferable to PC/Laptop using suitable software and accessories. The GPS data shall be provided by the Railways. Antenna of sufficient cable length shall also be provided.

(ii) The accuracy required for mast location shall be minimum± 4meter.

2.8 RECORDING AND PRESENTATION OF TEST RESULTS:

2.8.1 All processed results shall be presented with reference to the specific mast location on the track and kilometrage. It should be possible to initialize the reference kilometers by the operator at any stage. All distance measurements after initializing the kilometer shall be with reference to kilometer so entered till the next initializing by operator.

2.8.2 The exact format for presentation of reports over computer monitor and plotter/printer shall be mutually decided after award of the tender. Such presentation may take the form of continuous display correlated with the mast location and recorded parameters and kilometric progressive over a suitable scale and also the form of reports generated on the basis of exceedance of certain threshold values. The processing software shall take care of the requirement of IR gauge and OHE for the purpose.

2.9 RECORDING FACILITY:

2.9.1 All parameters shall be recorded and archived on a suitable multi-channel recorder as per system requirement & configuration. The storage media shall be solid state drive (SSD) of capacity not less than 5TB. The storage space shall be adequate for storing information for a cumulative run of minimum 3000 kms on FIFO basis.

2.9.2 All measured and recorded data shall be converted from analog to digital form, classified, analysed and stored on an On-Board computer based data acquisition and analyzer system. It shall be possible to generate suitable reports involving simple logic from the database.

2.9.3 It shall be possible to print out all or any of the parameters in juxtaposition as a function of distance or mast location without any classification, if desired. Normally the data shall be required to be printed after classification and analysis as specified.

2.9.4 Suitable recorder is to be provided for recording all parameters in juxtaposition for off-line processing. The resolution of the parameters recorded shall be commensurate with the variation of the recorded value.

2.10 EMI REQUIREMENTS:

2.10.1 The instrumentation shall work under 25 kV, 50 Hz, OHE System environment. Electronic signals generated inside the measuring equipment, inverters shall work without any adverse performance.

2.10.2 The tracks over which the offered system will work may be equipped with DC track circuits, 83-1/3 Hz track circuits as well as track circuits at higher frequencies. Harmonics generated by the measuring equipment should not affect signaling gears like audio frequency track circuits and axle counters which work in the range 0-5 kHz with a limit of 400 mA. On the communication network, control circuits, tele-printer circuits,

as well as VHF/UHF and microwave circuits are employed. The Psophometric voltage induced on the communication circuit running by the side of track should not exceed 1 mV.

2.10.3 The electric and electronic equipment used in the measuring & recording instrumentation System shall comply with emission and immunity aspects of EMC to CENELEC standard EN-50121-3-2. The internal EMC shall cover a combination of earthing, shielding and isolation of interference sources so that conducted and radiated noises are properly segregated or suppressed and no other equipment is affected due to operation of measuring equipment. The following interference current in the output current waveform shall not be exceeded at any point in the operating envelope of the Car:

Psophometric Current<=5 A
100 Hz - 400 mA
1700 ± 50 Hz - 300 mA
2000 ± 50 Hz - 300 mA
2300 ±50 Hz - 300 mA
2600 ±50 Hz - 300 mA
5100 ± 50 Hz - 100 mA

2.10.4 Emission from Tower Car to outside world shall be limited to level specified under CENELEC standard 50121-2 and EN 50121-3-1 namely "Railway application - Electromagnetic Compatibility Part 3-1: Rolling Stock-Train and complete vehicle. The supplier shall submit the simulated values of these interference currents in their offer.

2.11 INSPECTION & TESTING OF MEASURING & RECORDING INSTRUMENTS:

2.11.1 Prototype test: Prototype test shall be conducted at the works of the Supplier as per requirement of the equipment of the approved design. Tests to be conducted are tabulated below:

Table-1

SN	TESTS	CLAUSE NO.	TYPE TEST	ROUTINE TEST/ACCEPTANCE TEST
I.	Visual Inspection	2.11.2.1	✓	✓
II.	Performance test	2.11.2.2	✓	✓
III.	Voltage variation test	2.11.2.2(a)	✓	--
IV.	Supply Interruption Test	2.11.2.2(b)		
V.	Cold Start Test	2.11.2.3	✓	--
VI.	Temperature rise test (Dry heat)	2.11.2.4	✓	--
VII.	Temperature rise (damp heat cyclic)	2.11.2.5	✓	--
VIII.	Supply over voltage test	2.11.2.6	✓	--
IX.	Test for Electromagnetic Compatibility	2.11.2.7	✓	--
X.	Surges test	2.11.2.8	✓	--
XI.	Electrostatic discharge test (ESD)	2.11.2.9	✓	--
XII.	Electrical Fast Transient/Burst	2.11.2.10	✓	--

SN	TESTS	CLAUSE NO.	TYPE TEST	ROUTINE TEST/ACCEPTANCE TEST
	Immunity Test			
XIII.	Radio Frequency, Electromagnetic Field Immunity Test	2.11.2.11	✓	--
XIV.	Power frequency Test	2.11.2.12	✓	
XV.	Insulation test	2.11.2.13	✓	✓
XVI.	Voltage withstand (Dielectric) test	2.11.2.14	✓	✓
XVII.	Salt mist test	2.11.2.15	✓	--
XVIII.	Vibration and shock test	2.11.2.16	✓	--
XIX.	Ingress Protection Test	2.11.2.17	✓	--

2.11.1.1 Tests mentioned at (I), (II), ~~(XII) and (XIII)~~ (III), (IV) and (XVI) in *Table-1* are to be conducted at works of manufacturer. Remaining tests, shall be conducted in reputed government laboratory or NABL accredited laboratory or any other suitable laboratory accredited by accrediting agencies as per criterion given below:

(i) Should be full member and signatory to Mutual Recognition Agreement (MRA) of ILAC (International Laboratory Accreditation Cooperation) & APLAC (Asia Pacific Laboratory Accreditation Cooperation).
(ii) Should have established an accreditation system in accordance with ISO/ IEC (International Electro Technical Commission) 17011:2004 or latest version as applicable.
(iii) Carry out assessment and accreditation of LABS in accordance with ISO/IEC 17025.
(iv) Should be Government Controlled.

2.11.1.2 Type Test protocol for complete integrated system shall be submitted by supplier for approval of purchaser/RDSO before offering for inspection as per relevant standards. On new developed item, Type testing shall be carried out by RDSO.

2.11.1.3 After successful prototype testing, the system shall be subjected to extensive field trials under 25 kV AC Traction lines of Indian Railway for minimum 1000 Running Track Kilometer as per Clause 2.11.3 of this specification.

2.11.1.4 If there is any change in design or source of supply of any components/sub-components/assembly, units made to the changed design or from new source, shall be treated as new item and require conducting re-type tests.

2.11.1.5 Tests will be carried out on the prototype unit as per relevant IEC specifications or mutually agreed test program. Vendor will bear the expenses of the tests.

2.11.2 DETAILS OF TESTS:

2.11.2.1 **VISUAL INSPECTION:**
Visual inspection shall be carried out to ensure that the equipment under test is of acceptable workmanship and in conformity with manufacturers design specification based on this specification and accepted by RDSO/purchaser. The following parameters sha11 be checked during inspection:

(a) The equipment is free from defects
(b) Equipment is as per approved drawing
(c) Bill of materials.
(d) Make, rating of equipment, subassemblies as per approved design document.
(e) All the important dimensions will be measured
(f) Cable marking and identification
(g) Equipment mounting arrangement

2.11.2.2 **PERFORMANCE TEST:**

Test shall be carried out at the ambient temperature.

The performance test shall be carried out on individual subsystem as well as on complete integrated MRI system with all accessories after assembly to assess the performance and functionality of the System as per functional requirement of this specification in lab environment in simulated conditions. The software functionality shall also be assessed during integrated testing. For this purpose, suitable arrangement shall be made by supplier in their manufacturing works to validate the system before going in to the field.

Performance test procedure/protocols shall be submitted by the vendor for approval.

These tests are carried out to check and ensure that the performance of the equipment is in order.

This type test shall include the following:

(a) VOLTAGE VARIATION TEST:
This test shall be carried out as per clause 12.2.3 (a) of IEC 60571-2012 and Clause 5.3.3.2 of IEC 60077. Upper and lower limit of voltage variations for test shall be, Nominal voltage+10% and -15% respectively.

(b) SUPPLY INTERRUPTION TEST:
This test shall be carried out as per Clause 5.1.1.3 and Clause 12.2.3 (b) of IEC 60571-2012.

No degradation of the performance of the system & malfunctioning should be allowed during or after the test.

2.11.2.3 **COLD START TEST:**

This test shall be carried out as per clause 12.2.4 of IEC 60571-2012.
Temperature values shall be taken from table-1 of IEC 60571-2012 for TX class ambient temperature.

Test acceptance requirements will be as per Clause 12.2 of IEC 60571-2012

2.11.2.4 **TEMPERATURE RISE TEST (DRY HEAT):**

This test shall be carried out as per clause 12.2.5 of IEC 60571-2012.The temperature of the equipment will be raised to 85ºC at the rate of 1ºC at 1.5

minute and to be kept at that temperature for 6 hours. In this test equipment shall be in energized condition and working of the system will be checked.

Insulation test, Dielectric test at 85% voltage of the previous test and performance test will be carried out after the recovery period of 3 hrs. This test can be performed without battery with similar rating of power supply as per battery parameters connected to device.

Test acceptance requirements will be as per Clause 12.2.5 of IEC 60571-2012.

2.11.2.5 **TEMPERATURE RISE (DAMP HEAT):**

This test shall be carried out as per clause 12.2.6 of IEC 60571-2012.Damp heat test shall be done keeping the equipment in de-energized condition. It is to be ensured that the RH of the oven should be between 80 to 100% during the above test. The temperature of the equipment is to be raised from ambient to 55ºC in 2 hours and kept at that temperature for 6 hours. The temperature of the equipment 55ºC should be brought down to ambient (recovery period) in 3 hours.

Temperatures	+ 55 °C and + 25 °C
Number of cycles	2 (respiration effect)
Time	2 × 24 hrs

The cycle is to be repeated two times and carry out insulation test, Dielectric test at 85% voltage of the previous test and performance test.

Test acceptance requirements will be as per Clause 12.2.6 of IEC 60571-2012.

2.11.2.6 **SUPPLY OVER VOLTAGE:**

The test shall be conducted as per Clause 12.2.7of IEC-60571-2012.

Test acceptance requirements will be as per Clause 12.2.7 of IEC 60571-2012.

2.11.2.7 **TEST FOR ELECTROMAGNETIC COMPATIBILITY:**

The complete system shall be designed such that there will not be any Electromagnetic Interference and the test shall be conducted for EMI/EMC with relevant clauses of IEC 61000 as under clause 2.11.2.9, 2.11.2.10, 2.11.2.11 &2.11.2.12:

2.11.2.8 **SURGE TEST:**

The test shall be carried out as per IEC: 61000-4-5. Installation Class: 4.
Test level: 4 KV

Test acceptance requirements will be as per para 9 (a) of IEC 61000-4-5.

2.11.2.9 **ELECTROSTATIC DISCHARGE IMMUNITYTEST:**

The test shall be carried out as per IEC: 61000-4-2. Level-3.

a) Level : 3 (As per IEC 61000-4-2)
b) Test voltage for contact discharge : +/- 6kV
c) Test voltage for air discharge : +/- 8kV
d) Polarity : Positive & Negative
e) No. of discharge : 10 at each point

Test acceptance requirements will be as per para 9 (a) of IEC 61000-4-2.

2.11.2.10 **ELECTRICAL FAST TRANSIENT/BURST IMMUNITY TEST:**
The test shall be carried out as per IEC: 61000-4-4

	Power lines	Communication and signal lines
Pulse repetition rate	5 KHz	5 KHz
Voltage peak	4 KV	2 KV

The complete system in simulated condition shall be put for the test specified in IEC.

During test the equipment shall be watched for malfunctioning or Communication between both units shall be observed for proper functioning of equipment.

Evaluation of test result will be done as per Para 9(a) of IEC 61000-4-4.

2.11.2.11 **RADIO-FREQUENCY, ELECTROMAGNETIC FIELD IMMUNITY TEST:**

a. Radiated emission immunity as per IEC:61000-4-3

Frequency Range: 80 MHz to 1000 MHz
Amplitude: 10V
Amplitude modulation: 80% at 1 KHz sinusoidal

b. Conducted disturbance immunity as per IEC: 61000-4-6.

Frequency Range: 0.15 MHz to 80 MHz
Amplitude: 10V
Amplitude modulation: 80% at 1 KHz sinusoidal

Test Acceptance requirements will be as per Para 9(a) of IEC 61000-4-6.

2.11.2.12 **POWER FREQUENCY TEST**:-

This test shall be conducted as per IEC 61000 - 4 – 8. The complete system in simulated installed condition shall be put for the test. The recommended test severity level is level 5. The Power Frequency Magnetic Field of defined severity shall be applied on system in all X, Y& Z planes.

Frequency: 50 Hz
Amplitude: 100 A/m continuous Level 5 for 60 seconds in each planes.
During test the equipment shall be watched for malfunctioning or any erratic behavior.

Test Acceptance requirements will be as per Para 9 (a) of IEC 61000-4-8.

2.11.2.13 **INSULATION TEST:**

This test shall be carried out as per clause 12.2.10 of IEC-60571.

The insulation resistance of the system between earth and current carrying parts shorted together shall be more than 20 Mega ohms at an ambient temperature of 55ºC measured with 500V Insulation Tester (megger). The test will be carried out between all the Digital and analog Inputs and Outputs shorted together and the enclosure.

Test Acceptance requirements will be as per Para 12.2.10.2 of IEC 60571.

2.11.2.14 **Voltage Withstand Test (DIELECTRIC TEST):**

The test shall be carried out as per clause 12.2.10.3 of IEC-60571.

After the insulation measurement test the Di-electric test shall be carried out. The test voltage shall be applied between all the digital & analog inputs and outputs shorted together and the enclosure earth for 1 minute. The test voltage shall be according to nominal battery voltage given in 12.2.10.3 of IEC 60571.

Test Acceptance requirement: Neither disruptive discharge nor flash over shall occur

2.11.2.15 **SALT MIST TEST:**
The test is to be carried out on complete MRI as per clause 12.2.11 of IEC-60571. Duration of the test shall be for 96-hours.

Test acceptance requirements will be as per para 12.2.11 of IEC 60571.

2.11.2.16 **VIBRATION AND SHOCK TEST:**

The test shall be carried out as per IEC 61373:2010 or latest. Following tests shall be performed:

a) Functional Random test as per Clause no. 8.0, Table 1, category 1, Class B of IEC 61373:2010 or latest.
b) Simulated long life test as per Clause no. 9.0, Table 2, category 1, Class B of IEC 61373:2010 or latest.
c) Shock testing as per Clause no. 10.0, Table 3, category 1 Class B of IEC 61373:2010 or latest

Test Acceptance requirements will be as per para 13 of IEC 61373-2010.

2.11.2.17 **INGRESS PROTECTION TEST:**

This test shall be carried out as per provision in IEC 60529.
For ~~Indore~~ Indoor equipment: IP54.
For equipment mounted on roof/outdoor: IP67

2.11.3 **FIELD VALIDATION**:
After successful prototype testing, the system shall be subjected to extensive field trials under 25 kV AC Traction lines of Indian Railway for minimum 1000 Running Track Kilometer.

2.11.4 **ROUTINE/ACCEPTANCE TESTS**:
After completion of type test clearance and approval of purchaser, the subsequent systems shall be subjected to Routine/Acceptance tests as mentioned in *Table-1.*

2.11.5 Successful supplier shall arrange all facilities to conduct performance tests of the measuring instruments as per the required features of the instrument.

2.11.6 Supplier shall give complete details of tests schedule for conducting tests to assess the capability of all measuring equipment. The test shall preferably be conducted in 25 kV Traction or similar environment to establish compliance of the measuring capability of OHE parameters.

2.11.7 **CALIBRATION OF MEASURING EQUIPMENT**:

The measuring and recording equipment (MRI)shall be calibrated by the supplier at the time of commissioning in presence of the Railway Engineers. The calibration of measuring devices shall also be carried out periodically during the Annual maintenance.

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Annexure-1

Details to be submitted for Measuring and Recording Instrumentation (MRI) along with the tender offer:

The following data shall be supplied with the tender offer:

1. Details of the measuring and recording instrument (MRI), covering all technical and functional requirements, given in the Specification, shall be brought out by the Supplier, while quoting. List of Measuring Instruments shall be furnished along with the offer by the Supplier for scrutiny.

2. List of Measuring Instruments and type, for measurement of parameters mentioned in Chapter-II (Clause 2.7) shall be furnished along with the offer by the Supplier. Brief detail regarding measurement philosophy for each parameter also to be submitted.

3. The supplier shall submit a detailed scheme of the proposed system with technical details including dimensional requirement.

4. The firm/vendor shall give offer with complete technical details including data processing software for analysis of OHE Geometry and report generation. The software shall be capable of exporting data to MS office for analysis.

5. Electromagnetic Emission from Tower Car to the outside world shall be limited to level specified under CENELEC standard 50121-2. The supplier shall submit the simulated values of these interference currents in their offer.

Annexure-2

(To be submitted on non-judicial stamp paper of appropriate value as applicable in the respective state and dully notarized & witnessed)

UNDERTAKING FOR INFRINGEMENT OF IPR FOR ALL THE ITEMS/ PRODUCTS DEVELOPED BY THE VENDORS WHICH ARE IN THE PROCESS OF APPROVAL

I, son of …… aged about ….... Years resident of …….. do hereby solemnly affirm as under –

1. That the deponent is the Authorised signatory of ***(Name of the Sole Proprietorship Concern/ Partnership Firm/ Registered Company/ Joint Venture).***

2. That the deponent declares on behalf of ***(Name of the Sole Proprietorship Concern/ Partnership Firm/Registered Company/Joint Venture)*** that:

a) 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 manufacture/supplier.

b) Details/design/documents given are not infringing any IPR and we are responsible in absolute and full measure instead of railways for any such violations. Data, specifications and other IP as generated out of interaction with railways shall not be unilaterally used without the consent of RDSO and right of Railways / RDSO on such IP is acceptable to firm.

c) No confidential information has been provided to RDSO and as such no claim shall be made against RDSO for infringement or leakage of any information.

DEPONENT

VERIFICATION

I declare that the contents of Para 1 to 2 above are true as per my knowledge and nothing has been hidden.

DDEPONENT