



Government of India

भारत सरकार
रेल मंत्रालय

Technical Specification
For
Hot Axle box Hot Wheel Detector System

Specification No. RDSO-SPN-RE-HAHW-2017(Rev.2)
January 2022
(Final Draft)

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ABBREVIATIONS

AC	Alternating Current	IRPWM	Indian Railways Permanent Way Manual
CAMC	Comprehensive Annual Maintenance Contract	NABL	National Accreditation Board for Testing and Calibration Laboratories
HAHW	Hot Axle box Hot Wheel	RFID	Radio Frequency Identification
ICD	Interface control document	TCP/IP	Transmission Control Protocol/Internet Protocol
IR	Indian Railway	UPS	Uninterruptible power supply

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1.0 Introduction:

Hot Axle box Hot Wheel Detector (HAHW) is an automated wayside detection system for detecting hot axle boxes & locked wheels by monitoring temperature of the axle box bearings, wheel rim/discs and brake discs. The purpose of this specification is to spell out the functional and technical requirements of a HAHW system. Apart from user settable alarm levels, the system shall provide temperature measurement for root cause analysis of wheel, axle box and brake disc (if applicable).

2.0 Scope of supply:

The HAHW system shall be supplied on turnkey basis. The HAHW system shall include all equipment by the side of the track, electric cables, access to server computer, website, audio-visual alarm display, client computer/laptop, modem, SMS delivery system, software of the track-side equipment and software of the central server and any other element necessary for optimal functioning of the system. The scope shall include complete HAHW site equipment along-with concomitant accessories, maintenance toolkit etc. for fully functioning system.

2.1 Installation at site- Installation of the system should be done by and under the supervision/direction of firm's Engineers. It shall include the following: -

- 2.1.1 Provision of cabin/enclosure to house accessories/ auxiliaries (to be installed at site along with the supplied system) will be under the scope of supply of supplier.
- 2.1.2 Laying of power cables including trenching & associated works from the site to the main power distribution box where the consignee has made the availability of electrical power of 230 V, 50 \pm 3 Hz.
- 2.1.3 The installed system should be capable of transferring data from the HAHW site to webserver via trackside cabin or enclosure.
- 2.1.4 Post processing display of reports and audio-visual alarms from site of installation to centralized location/response centers should be designed for consignees. The internet connectivity during warranty from the date of commissioning shall be in the scope of successful bidder.

2.2 Web-server – The supplier shall launch and maintain an internet web –server at any location (in India) with following features-

- 2.2.1 Multiple User password protected log-in
- 2.2.2 Differential access and usage rights to multiple level of users e.g. write-only, read-only, administrator rights.
- 2.2.3 Facility to export data in other data base formats e.g. MS-Excel and XML and on demand software based transfer of data to other railway applications. Firms shall also provide ICD (Interface control document) for system database.
- 2.2.4 Adequate capacity to handle data transfer for all authorized users (to be controlled by providing username and password) who shall access through public internet.

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2.3 **Ownership and confidentiality of data and software-** All the data being generated by the HAHW equipment, website, servers etc. with respect to Indian Railway operations shall be the property of Indian Railways.

2.3.1 The data shall be compiled, stored in a medium, transferred and made available in a format as finally decided by Indian Railways in consultation with final supplier in suitable database (exportable to MS-Excel at present but other formats may be accepted later by consignee if found suitable). Data Localization rules of the government of India shall be applicable for the system.

2.3.2 The data shall not be divulged by the supplier to anyone other than consignee and to those authorized by consignee.

Apart from the details mentioned in this documents, any other accessory/component/system(s) essentially required for proper functionality of the HAHW system, will fall under the scope of supply of the tenderer.

3.0 Technical Requirements:

3.1 HAHW system should be compatible with various types of axle box bearings and brake systems deployed on the rolling stock being used on IR. As guidance, the currently used wheel diameter, axle box size and brake disc size are as under: These values are indicative only.

Parameter	Minimum (in mm)	Maximum (in mm)
Wheel Diameter	770	1100
Axle box Size	220	320
Brake Disc Size	350 (Inner dia.)	921 (outer dia.)

Further, It is the responsibility of bidder to acquaint himself with the existing bearings, wheel, brake disc, etc. of various type of rolling stock used in Indian Railways before offering the system.

3.2 Temperature measurement range and tolerance requirements: Temperature beyond measurement range should be indicated as "Excess of range". Accuracy of sensors will be validated within range of concern.

S.N	Parameter	Measurement Range	Resolution	Accuracy										
1.	Axle box temperature	0 – 180 °C (Minimum)	± 2 °C or better	<table border="1"> <thead> <tr> <th>Temperature Range</th> <th>Accuracy</th> </tr> </thead> <tbody> <tr> <td>0 °C – 15 °C</td> <td>±10 °C</td> </tr> <tr> <td>16 °C – 20 °C</td> <td>±5 °C</td> </tr> <tr> <td>21 °C – 90 °C</td> <td>±3 °C</td> </tr> <tr> <td>91 °C - 180°C</td> <td>±5 °C</td> </tr> </tbody> </table>	Temperature Range	Accuracy	0 °C – 15 °C	±10 °C	16 °C – 20 °C	±5 °C	21 °C – 90 °C	±3 °C	91 °C - 180°C	±5 °C
Temperature Range	Accuracy													
0 °C – 15 °C	±10 °C													
16 °C – 20 °C	±5 °C													
21 °C – 90 °C	±3 °C													
91 °C - 180°C	±5 °C													
2.	Wheel & Brake disc temperature	0 – 550 °C (Minimum)	± 5 °C or better	± 10°C or better										

Ref: Accuracy of axle boxes in the range 0 to 120°C has been taken from EN 15437-1: 2009.

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3.3 It should conform to following technical/operational requirements.

S.N	Technical/Operational parameters	Requirements
1.	Scanner response time	upto 2 ms (millisecond)
2.	Operating speed	0 - 200 Kmph
3.	Train length	upto 1000 Axles
4.	Train headway	3 minutes between trains having upto 1200 axles each.
5.	Degree of protection for electronics	IP 66
6.	Degree of protection for optics	IP 66
7.	Wheel detector (trigger) sensors	IP 67
8.	Ambient temperature range	0° to 70°C
9.	Relative humidity	upto 100%

3.4 The system should have multi-beam scanners per site as detailed below mounted suitably on a specially designed sleeper or structure to cover a wide range of wheelset designs.

No. of Scanners	Position	Purpose
02 (Each with 8 beams)	Outside rail guage (Placed on both sides)	To scan axle bearings temperature.
02 (Each with 4 beams)	Inside rail guage	To scan wheels & brake discs temperatures. (The orientation/direction of beams shall be user adjustable/configurable. The target area focus of the beams shall be decided by consignee at the time of commissioning of the system).

3.5 Necessary sensor mounting arrangement that can be easily disassembled / reassembled shall be provided by the firm. The drawings of mounting arrangement of sensors to be submitted along with the offer.

3.6 In case, disc brakes are not fitted on the rolling stock, then sensors designed for measurement of temperature of disc brakes shall remain in idle/off condition.

3.7 Each 8-beam axle box scanner should be able to measure thermal radiation emitted from target zone of rolling stock, which have a minimum target area length of 100 mm as specified in EN 15437-1:2009.

3.8 The bearing scan zone should cover Inboard Seal region, Inboard Raceway region, Spacer Ring region and Outboard Raceway region.

3.9 The scanner/sensor should be capable of measuring radiations in the wavelength ranging between Long Wavelength Infrared (8 – 14 microns) or Medium Wavelength Infrared (3 – 5 microns) or any combination of such sensors to achieve parameters as in para 3.2.

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- 3.10 It should function in either direction of movement of train.
- 3.11 Remotely triggered multi point auto calibration functionality with redundant temperature sensor should be inbuilt into the system, details of which shall be submitted along-with the offer. All calibration activities should get logged in the data frame.
- 3.12 Time between passing of the train and communication to the central control server should not exceed 5 minutes. Standby data transfer channels may be planned if required to achieve assured data transfer.
- 3.13 The system should be capable of automatic detection of approaching train along-with identification of type of rolling stock (Locomotives, Wagons, ICF or LHB Coach, BV, etc), automatic switching-on of relevant sensors, automatic measurement of temperatures while the train is in motion, automatic transmission of data, alarms and reports and automatic switching off of relevant sensors to conserve electrical power.
- 3.14 The bidder should refer typical track profile – As per IRPWM 2004 amended from time to time. The bidder shall acquaint himself with the existing track geometry, installation etc. before offering the system.
- 3.15 The relevant National/International standards are given below. The equipment should conform to the relevant clauses of the applicable standards.

S.N	Norms & regulations	Application areas
1.	EN 15437-1:2009	Axle box condition monitoring – Interface and design requirements.
2.	EN 50121- 4	Railway applications – Electromagnetic compatibility – Part 4: Emission and immunity of the signalling and telecommunications apparatus.
3.	EN 50125- 3	Railway applications – Environmental conditions for equipment – Part 3: Equipment for signalling and telecommunications.
4.	EN 60950- 1	General safety requirement for the information technology equipment.
5.	ISO 14837-1	General guidance on mechanical vibration for ground-borne noise and vibration arising from rail systems.
6.	EN 61000-4-9:1993/A1:2001	Electromagnetic compatibility (EMC) - Part 4-9: Testing and measurement techniques - Pulse magnetic field immunity test
7.	EN 50128	Railway applications - Communication, signalling and processing systems - Software for railway control and protection systems
8.	2006/95/EC	Electrical equipment designed for use within certain voltage limits

In addition to above, the system should also comply with any other national/international standard which is relevant to the technology for similar application in the railway domain.

- 3.16 The system should be modular and remotely maintainable.

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- 3.17 The system should be equipped with robust, networked, alert-management software with full suite of graphical analysis and diagnostic tools. Full TCP/IP support should be inbuilt into the system to facilitate smooth integration into all existing railway data networks.
- 3.18 The system should be able to withstand shock and vibration generated produced during train operation.
- 3.19 The system should have provision for interfacing with RFID based automatic vehicle identification module.
- 3.20 The system should have capability to integrate with 3rd party system for which Interface control document (ICD) will be provided by Indian railways. Firm will supply the ICD for the HAHW System to the Indian railways.

4.0 Functional requirements:

- 4.1 Train parameters to be acquired: - Temperature of axle boxes, wheels rim and brake disc and speed of a wheel set of identified stock.
- 4.2 System shall log the date of train passing, time of train passing, speed of train, direction of train, number of axles passed, total number of vehicles in the rake and type of stock and ambient temperature.

5.0 Installation requirements:

- 5.1 The HAHW system shall not infringe dimensions as per envelope drawing given in annexure-I.
- 5.2 AC power 230V, 50 +/-3Hz. shall be made available at installation site by consignee. The maximum load on the power supply system should not exceed one KVA.
- 5.3 UPS system having at least 8 hours backup power.
- 5.4 Suggested site Selection criteria – The site for HAHW system should be selected preferably in consultation with DRM/Mechanical.
 - 5.4.1 Straight and level track on either side of equipment where trains do not normally require heavy braking applications.
 - 5.4.2 Away from track joints & switches.
 - 5.4.3 At least 100 meter away from any grade crossings.
 - 5.4.4 Track structure should be stable and well maintained.
 - 5.4.5 Site should be preferably within 1 km from the main power distribution box. In case, the system is beyond 1 Km, the additional cost of the cable shall be paid on actual cost basis against proof of purchase of cable.

6.0 Software requirements:

- 6.1 The trackside equipment shall have the capability to record and locally store raw captured data for last up to 500 trains and the processed reports for upto 5000 trains.
- 6.2 The supplier shall be responsible for providing required software for collecting data, storage and graphical and tabular presentation of reports sent by the

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trackside equipment. The database Management shall also be carried out by the supplier at regular intervals.

7.0 Safety Requirements:

- 7.1 The system shall be designed on fail-safe principles and adequate safety margins must be incorporated in the design for systematic and random failures. No single failure results in an un-safe condition. Unsafe condition shall not develop due to any type of fault i.e. hardware, software, electrical, mechanical, etc. in the system, to other systems, or danger to personnel.
- 7.2 A fault must be detected and cleared quickly to avoid the probability for another fault to occur simultaneously which can lead to unsafe condition.
- 7.3 The equipment shall not fail on wrong side due to harmonic interference generated by thyristors, chopper controlled tap changer/ drives or other such technologies in rolling stock.
- 7.4 The system shall be protected from external EMI/EMC/RFI interferences, electrified OHE (Over Head Equipment).
- 7.5 The system shall be so designed that it shall not hamper signalling, track, communication, electrical systems, etc. in service in IR.
- 7.6 The functioning of the system shall not get affected by the environmental and site conditions like vibrations from passing trains, track maintenance vehicles/equipments, heavy rain and water, lightning, animal trespassing, direct sunlight on the sensors and heat from the sunlight.
- 7.7 The system should be adequately protected from waste discharge from the coaches.
- 7.8 System shall be designed and installed in such a way that it should be well protected from damages (during train operation, maintenance) and it should not be prone to theft.
- 7.9 Train passing events are often associated with dust laden environments. Therefore, the system should be adequately protected and designed to faithfully collect information in dusty environment.
- 7.10 The system shall have suitable sensor cleaning arrangement to get optimum results in case of dust or moisture entrapment.

8.0 Output requirement:

- 8.1 The supplier shall launch, operate and maintain an internet-based website during warranty and during comprehensive maintenance period for making available the train reports to remote users authorized by consignee. The website shall have the following features: -
 - 8.1.1 Password based access so that only authorized personnel by consignee can enter/edit/view/download data and reports.
 - 8.1.2 Differential privileges to different levels of users to access the resources of the website.
- 8.2 The supplier shall supply a desktop computer/ laptop at nominated place by consignee of the configuration as specified in the clause on concomitant accessories.

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- 8.3 The system output shall consist of data reports. Data acquired by the system shall be sent to a web server and the following reports shall be available to the users on demand.
- 8.4 Detailed report: - This report shall be in detail showing all parameters as acquired by the remote wayside detector.
- 8.5 Exception report: - This report shall be an abridged version of the detailed report showing only the list of axles where the parameters have exceeded the prescribed limits.
- 8.6 Alarms report through SMS: - Reports for alarms based on parameters exceeding the prescribed limits shall be sent to users through SMS. In case of delay in transmission of full reports, the system shall have the capability to send SMS directly to limited number of users. The delay shall be deemed to have occurred if the data is not dispatched within 5 minutes from the passage of last wheel of the train.
- 8.7 Alarms report through App: - The firm should develop a mobile application for the user to get various alerts along with relevant positions through push notifications.
- 8.8 Diagnostic reports: - The system shall be capable of running self-diagnosis programs and report the result through the website and by SMS.
- 8.9 Alarms: - Parameters exceeding the specified limits require alarms to be sent to users. These alarms should be sent in the form of SMS message beyond the passage of the last axle of the said train. These messages will convey the following minimum data:
- 8.9.1 Vehicle RFID identification (if available/ provided on the Rolling Stock)
 - 8.9.2 Vehicle type
 - 8.9.3 Date / time of train
 - 8.9.4 Direction of movement
 - 8.9.5 Vehicle position from start of train
 - 8.9.6 Axle number, side of axle bearing/wheel/disc brake where the parameters found out of range.
 - 8.9.7 Short description / error code as per reporting scheme developed
- In case of error in recording or any system failure, alarms shall be generated and transmitted similarly.
- 8.10 Basis of alarms: - It should be possible to raise graded alarms, at least for the following conditions:
- 8.10.1 When the temperature of the axle box or the wheel or brake disc exceeds the specified temperature (80°C for bearings, 250°C for wheels and Brake Disc). These should be of multiple level thresholds and user settable.
 - 8.10.2 When the temperature of the axle box exceeds beyond a certain limit, currently 20°C above the ambient temperature, or that of wheel or brake disc by 200°C above ambient temperature.

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8.10.3 When the difference in temperatures of the axle boxes on the same axle is different beyond a certain limit (currently 20°C).

8.10.4 In case, IR decides to include new types of alarms in the system, then supplier shall modify the software within a reasonable time at no extra cost to Indian Railways.

8.10.5 Threshold limits for graded alarms shall be user settable and will be decided by consignee in view of varying site conditions.

8.11 Captured Data Reports: The report of the data captured by the system shall be relayed by the wayside device via suitable communications media to a secured web server on the internet within 5 minutes after the passage of the last axle. The server shall be maintained and operated by the bidder. These servers shall be capable of storing and displaying (on demand) parameter reports for up to last 5 years. The access of these reports shall be provided by web based clients optimized for use from desktops / laptops / notebooks and smart phones. Users of the systems shall be provided logins / passwords for accessing the data.

9.0 Type of Tests:

Inspection and testing of the equipment shall include all inspections, tests, checks, procedures etc., whether mechanical, electrical or software related as required to ensure that the equipment supplied meets the technical & functional requirements stipulated in the specification. The tenderer shall submit details of test plan for proposed system for each level of testing. However any addition/deletion/modification in the test plan can be considered on mutually agreeable basis. The successful bidder shall depute team of engineers to perform all level of testing and ensure availability of testing facilities, typing tools and spare parts in adequate quantity for these tests. All the instruments, apparatus, devices, sensors etc. used during all levels of inspection and testing should have valid calibration certificate issued by an independent authority/component supplier/ institute approved by NABL/IR or accredited lab.

9.1 Factory Acceptance Test – All technical and design features shall be inspected and witnessed by nominated inspection agency at the firm’s premises. During the factory acceptance test, firm shall demonstrate the capability of the system to sense temperature at designated speed mentioned in specification. Test scheme shall be finalized by inspecting/ tendering agency jointly with the firm. Necessary consumables rigs, calibrated gauges / equipment etc. may be provided by firm at its premises for FAT.

9.2 Proving-out tests at site – All Functional requirement will be checked at installation site of IR by consignee/ Zonal Railway as per test protocol finalized by consignee/ Zonal Railway in consultation with the supplier. The supplier and consignee shall conduct the following proving out tests after commissioning: -

9.2.1 The trackside equipment shall be calibrated by a black-body source or other method (to be elaborated by the tenderer in the offer). The accuracy of sensor should be as defined in clause 3.2. The system should be calibrated by the supplier at every six months or earlier if requested by consignee.

9.2.2 All the trains should be correctly recorded with regard to direction of motion, date and time of passing, speed, no. of axles, no of locomotives, no of

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vehicles other than locomotives and type of rolling stock (Locomotives, Wagons, ICF or LHB Coach, Brake Van, etc.).

- 9.2.3 The complete data report (without missing any axle) including temperatures for at least 98% of the axles passed shall be generated.
- 9.2.4 Since the trackside equipment's sensors are specially designed to take measurement of temperatures while the train is in motion at a high speed, normal methods e.g. hand-held non-contact pyrometers may not be used for direct correlation of temperatures of axles and wheels taken by HAHW system. Therefore, some of the indirect methods which can be used for verification of temperatures recorded (for each train) by the HAHW equipment are as under:
- 9.2.4.1 The ambient temperature reported by the HAHW equipment and any other thermometer is $\pm 2^{\circ}\text{C}$.
- 9.2.4.2 The temperature of axle boxes and wheels are not below ambient for each train.
- 9.2.4.3 There should be correlation of at least 75 % between measured temperature of left side and right side (excluding the Axle Boxes/ Wheels/ Brake Discs for which there is some abnormality reported by HAHW equipment).
- 9.2.4.4 Indirect verification of temperatures reported by the HAHW system by measurement of temperatures of the axle boxes and wheels within 30 minutes of train stopping using hand-held pyrometers (supplied as concomitant accessory) at convenient station/yard. At least 75% correlation in the time spaced readings of the same Axle Box/ Wheel/ Disc should be achieved
- 9.2.5 Any other test as suggested by the supplier and agreed to by consignee. The tenderer shall provide details in the offer.
- 9.3 If in IR's opinion, instruments, apparatus, devices, etc. used by the supplier need calibration or re-calibration, then such instruments, apparatus, devices, etc. shall be calibrated by an independent authority or institute approved by NABL/Govt. or accredited labs.

10.0 Warranty:

The supplier shall confirm warranty of complete system for a period of at least 24 months from date of successful commissioning i.e date of start of field trial.

11.0 Comprehensive Annual Maintenance Contract (CAMC):

The bidder shall also submit the offer for comprehensive annual maintenance contract (CAMC) of the system for 03 years. The period of CAMC of the system will start after competition of warranty period.

12.0 Training:

The supplier shall provide training for minimum 30 man days per installation at factory premises and training for minimum 40 man days per system installed at different locations in the premises of consignee or mutually agreed location/ facility in following areas.

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- 12.1 Operation of HAHW system
- 12.2 Calibration of HAHW system
- 12.3 Trouble shooting and Maintenance of HAHW system
- 12.4 Reading and interpretation of reports, alarms and SMS's etc.

13.0 Submission of documents:

- 13.1. **Test certificates:** Test records, test certificates, test certificates for conformance of EN standards & IP ratings, sensor's data sheet and it's warranty, performance curves, tables, etc., of all inspections and tests, whether or not witnessed by IR personnel , shall be supplied as soon as practicable after performance of each inspection or tests. One sets of above mentioned documents shall be supplied properly bound in books. The softcopies of the said documents should also be provided by the firm.
- 13.2. All test certificates shall be endorsed with sufficient information for identification of the equipment and material to which the certificates refer.
- 13.3. **Literature:** The supplier shall provide following literature in two copies to consignee along with the delivery of HAHW system.
- 13.3.1. Complete drawings
 - 13.3.2. Operating manual
 - 13.3.3. Maintenance manual
 - 13.3.4. Spare part catalogue

The tenderers shall provide a list of literature to be supplied with the machine in his offer.

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STANDARD DIMENSIONS OUT OF STATIONS
TO SUIT 25 KV.A.C. TRACTION SCHEDULE-I-CHAPTER-I

DIAGRAM NO. 1C
1676 mm GAUGE

