Government of India

भारत सरकार
रेल मंत्रालय

Technical and Functional Requirements for Indigenous Wheel Impact Load Detector System

Specification No. RDSO-SPN-RE-WILD-2023 (Ver.0)

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ABBREVIATIONS

AC	Alternating Current	ANOVA	Analysis of Variance
API	Application programming interface	BV	Brake Van
CMM	Coaching Maintenance Management	CICD	Continuous integration and continuous delivery
EMC	Electromagnetic compatibility	EMI	Electromagnetic interference
FAT	Factory acceptance test	FMM	Freight Maintenance Management
ICD	Interface control document	ICF	Integral Coach Factory
ILF	Impact Load Factor	IR	Indian Railway
IRPWM	Indian Railways Permanent Way Manual	JSON	JavaScript Object Notation
LHB	Linke Hofmann Busch coach	MDIL	Maximum Dynamic Impact Load
MeitY	Ministry of Electronics and Information Technology	NABL	National Accreditation Board for Testing and Calibration Laboratories
RFID	Radio Frequency Identification	RFI	Radio-frequency interference
TCP/IP	Transmission Control Protocol /Internet Protocol	SLAM	Software for Loco Asset Management
UPS	Uninterruptible power supply	OHE	Over Head Equipment
VB	Vande Bharat design of Coaches	WILD	Wheel Impact Load Detector

1.0 Introduction:

1.1 Railway Board vide letter No.:2017/Dev.Cell/IGRI/8, Dated: 4.01.2023 advised RDSO to float an Expression of Interest (EOI) for the development of indigenous sources of WILD equipment to expedite future proliferation. At present WILD Systems are being procured as a bundled wayside system conforming to COFMOW Specification No. COFMOW/IR/WILD/2013.

1.2 The Wheel Impact Load Detector (WILD) is a wayside detection system which is used to identify the wheels with potential tread defects such as flat spots, built-up treads, Shelled tread as well as defects in suspension (springs, shock absorbers etc.) that result in high impact loads, causing damage to the vehicle and bogie components, and to the track structure.

1.3 WILD Systems were deployed for the first time over Indian Railways following research association with IIT Kanpur using Strain gauge based technology. It is worthwhile to mention that presently various WILD systems based on different technologies like strain gauges, accelerometers and Fibre Bragg grating etched on Fibre optic cables are installed over Indian Railway network in various stages of technological maturity. Additionally other technologies and configuration using Rayleigh back scattering and load cells appear promising.

1.4 The purpose of this specification is to spell out the functional and technical requirements of an indigenously developed and manufactured Wheel Impact Load Detector (WILD) system for deployment on Indian Railways using one or more competing technologies. The technical and operational aspects related with Site Selection for installing the equipment, System Operating Parameters, Detector technologies in use, Data Communication, System thresholds, existing Protocol on Indian Railways to handle rolling stock generating high impact loads, calibration and maintenance requirements etc. are also covered in this specification for guidance of the system manufacturers / suppliers.

2.0 Scope of supply:

2.1 The indigenous WILD system shall be supplied on turnkey basis. The system shall include all equipment by the side of the track, camera based automatic vehicle identification module, RFID Reader capable of reading RFID tags as per CRIS specification for RFID tags No. 2016/CRIS/NDLS-ITPI/WS-C/POLICY/RFID/0101/PT-1 dated 05.10.2018 or latest, electric cables, access to server computer, website, client computer/laptop, audio-visual alarm display, modem, SMS delivery system, software for the track-side equipment and software for the central server and any other element necessary for optimal functioning, reporting of alarm and recording of feedback of the system. The scope shall include supply of:

2.1.1 WILD site equipment with concomitant accessories and services (inferred items)

2.1.2 Spares

2.1.3 Literature

2.1.4 Material, as required for civil engineering work

2.1.5 Site safety apparatus, tool kit and accessories required for maintenance and periodic calibration.

2.1.6 Software including Information Technology equipment and for analysis and Integration with IR system.

2.1.7 CICD (Continuous Integration and continuous delivery) including software upgrade as may be required.

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

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

2.2.1 Civil engineering and other allied works (if required) such as construction of hut of suitable size to house UPS, batteries, electronic and electrical equipment, power system etc., grouting supports for steel enclosures/equipment, control box, battery box etc., necessary work e.g. trench etc. for power cables.

2.2.2 AC power 230V, 50 +/-3Hz. shall be made available at main power distribution box by consignee. From this point the tenderer shall bring power supply to the site of installation by laying suitable power cable. The maximum load on the power supply system should not exceed five (5) KVA.

2.2.3 Provision of mobile connection and internet connection for transfer of data and display of reports and audio-visual alarms from site of installation to centralized location as finalized by consignee. The recurring expenditure on mobile connectivity during warranty from the date of commissioning shall be borne by the supplier during the warranty period. Subsequent expenditure shall be borne as a part of AMC by Indian Railways for which the necessary arrangements shall be done in advance by consignee.

2.3 **Web-server:** The supplier shall launch and maintain an internet web-server at any location (in India) or use MeitY empanelled cloud services with following features:

2.3.1 Multiple User password protected log-in

2.3.2 Differential access and usage rights to multiple levels of users e.g. write-only, read-only query design and administrator rights.

2.3.3 Facility to export data in MS-Excel, CSV (Comma Separated Value) format at present but other formats may be accepted later by consignee if found suitable and on demand software based transfer of data to other railway applications. All the transfer must be over secured network and electronic transfer must be authenticated based on tokens and shall be properly logged for audit and tracking. Firms shall also provide ICD (Interface control document) for system database.

2.3.4 The supplier shall offer at least two designs for web-user interface for selection.

2.3.5 The web server shall have adequate capacity to handle data traffic with fast data transfer rate for all authorized users who shall access through public internet.

3.0 **Technical Requirements:**

The system should conform to following technical/operational requirements.

S.N	Technical/Operational parameters	Requirements
1.	Operating speed	30 - 160 Kmph
2.	Train length	upto 1000 Axles
3.	Train headway	3 minutes between trains having upto 1000 axles each.
4.	Degree of protection for electronics (embedded microprocessor system)	IP 66
5.	Degree of protection for trackside/rail mounted sensors housed in enclosure, Wheel detector (trigger) sensors	IP 67
6.	Degree of protection for optics	IP 66
7.	Ambient temperature range	(-) 10 °C to 55 °C

8.	Rail temperature range	(-) 20°C to 70°C
9.	Relative humidity	upto 100%
10.	Track Structure	Rail Section and profile: 52kg/60kg (UIC 60 or 60 E1) as per Para 203 of IRPWM, June 2020. Rail Grade: 880/ R260/ R350 PSC Sleeper with 600mm spacing Ballast Cushion Depth: 200mm to 350mm
		Typical track structure and track geometry shall be as per IRPWM- June 2020 (amended from time to time)
		1. Inter Sleeper Spacing: 600 mm for ballasted Deck. 2. Ballastless track structure: As per guidelines issued vide RDSO letter No. CT/EF/BLT-IFS dated: 04.01.2019.
11.	Operating Parameters	Type of Operation: All types of rolling stock being used in Indian Railways. Freight, Passenger (Mixed Traffic)
		Range of Wheel Diameter: 710 mm to 1250 mm
		Wheel Coverage - 100%
12.	Resolution	0.05 ton or better
13.	Impact load calibration	The system reported impact load should be within ± 5% of test load reported by a calibrated device.
14.	Impact Load measurement capability	Upto 60 Ton. The impact measurement capability shall be demonstrated for different impact loads upto 30 tonne at site.
15.	Detection Technology	Strain gauges / Accelerometers / Optical Fibre Sensors / Load Cells etc.
16.	System Thresholds	User Settable (Multiple Alerts- Maintenance Alert & Critical Alert)
17.	System Activation	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, Vande Bharat etc),

		automatic switching-on/off of relevant sensors, automatic measurement of Maximum impact load, Average dynamic load, Impact Load factor (ILF) etc. as specified in the specification while the train is in motion, automatic transmission of data, audio-visual alarms and reports and automatic switching off of relevant sensors to conserve electrical power.
18.	Vehicle Identification	OCR (Optical character recognition) photo tag/ camera based automatic vehicle identification module should be installed and integrated for automatic Vehicle Identification/ individual vehicle IDs. This system can be withdrawn after 100% proliferation of RFID tags in due course on IR.
		RFID Reader should be installed and integrated with the proposed indigenous WILD system. These RFID readers should be capable of reading the RFID Tags tagged on IRs rolling stocks. [For details of RFID tags, CRIS specification no. 2016/CRIS/NDLS-ITPI/WS-C/POLICY/RFID/0101 /PT-1 dated 05.10.2018 or latest may be referred.]
19.	Calibration	The system should be calibrated as recommended by OEM. Details of calibration methodology shall be submitted along-with the offer and system should be calibrated half yearly or earlier if requested by consignee. All calibration activities should get logged in the data base or dash board.
20.	Maintenance	Minimum two times per year or earlier if requested by consignee.
21.	Self-diagnostics	System should be equipped with Self-diagnostic feature capable of routinely checking the operating condition / heath of individual components of the WILD system and to automatically detect and report sensor failures, including on-site processing and back office system failures. All activities and diagnostic checks should get logged in the data base and displayed on dash board.
22.	Integration	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. Necessary communication protocols and details required for integration (including third party interfacing) should be provided by the WILD system manufacturer to Indian Railways. Purpose of this communication protocol is to ensure that the data generated by the system can be exchanged with other Railway's applications (Existing/upcoming). System shall be capable of communicating over https protocol with external application. System shall support JSON (JavaScript Object Notation) format for information exchange. Also it shall support multiple integration points at the same time. System shall be capable of handling security requirements of the communication including encryption and authentication.
23.	Interface Control Documents (ICD)	Interface Control Documents (ICD) shall be shared by CRIS at the time of integration with vendors and Indian Railway.
		Data must mandatorily be shared with Indian Railway's maintenance platforms like CMM/FMM/SLAM for record and for cross verification of Rake Marshalling order from the PVIS/RFID data with the Brake Power Certificate. Please note that multiple data formats shall have be supported by the system.
24.	Norms & regulations	The equipment should conform to the relevant clauses of the applicable standards.

S.N	Norms & regulations	Application areas
1.	EN 15654-1:2018	Railway application- Measurement of vertical forces on wheels and wheelsets. Part1: On-track measurement sites for vehicles in service
2.	EN 15654-3:2019	Railway application- Measurement of vertical forces on wheels and wheelsets. Part3: Approval and verification of on track measurement site for vehicles in service
3.	EN 50121- 4	Railway applications- Electromagnetic compatibility – Part

			4: Emission and immunity of the signalling and telecommunications apparatus.
		4.	EN 50125 - 3	Railway applications – Environmental conditions for equipment – Part 3: Equipment for signalling and telecommunications.
		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.	

4.0 **Functional Requirements:**

The WILD system is expected to run 24x7 (available round the clock) without any human intervention. The system should be programmed for at least one self-check daily. The result of self-tests shall be displayed on central server and dashboard.

Following information is required to be captured and displayed in reports by the WILD System:

S.N	Information Required
1	Date and Time of collected data / Passing Train
2	Site Name
3	Direction of passing train (UP/Down)
4	Train Speed
5	Total number of axles passed and total number of vehicles in the rake
6	Total number of defective wheels (Maintenance & Critical)
7	Identification of rolling stock and their position from engine
8	Average Dynamic Wheel Load of each wheel (Left & Right) *(Average dynamic wheel load is the wheel weight considering components of dynamic forces associated with wheel at operational speeds of train. This is different from the synthesized wheel weight (or equivalent wheel weight) in the static condition.)*
9	Maximum/Peak Dynamic Wheel Load of each wheel (Left & Right) *(The peak/maximum vertical load exerted by wheel on rail in dynamic condition)*
10	Impact Load Factor (ILF) / Dynamic Ratio for each Wheel (Left & Right) *(The ratio between the Maximum/Peak Dynamic Wheel load and the Average Dynamic Wheel load for a given wheel)*

11	Type of Train – Freight or Passenger (LHB / ICF/ Vande Bharat) or Locomotive
12	Type of rolling stock : Locomotives, Coaches (LHB, ICF), Wagons, Train set/ Vande Bharat, DEMU, MEMU, Brake Vans

5.0 **Installation Requirements:**

5.1 The WILD system shall not infringe IRSOD and shall be installed in consultation with authorized Railway Engineer.

5.2 The WILD systems shall be installed such a way that they do not either require or cause slowing down/ stoppage of train traffic when they are functioning/not functioning/under breakdown/under maintenance except as stipulated elsewhere in this document.

5.3 Necessary sensor mounting arrangement that can be easily disassembled in two hours and reassembled in less than four hours shall be provided by the firm (with 48 hour advance notice for movement of trained manpower to site). The drawings of mounting arrangement of sensors may be submitted along with the offer.

5.4 The instrumented area shall be maintained manually with proper demarcation under the guidance of engineering supervisor.

5.5 UPS or alternate power back-up for at least 8 hours with auto switch-over functionality shall be provided by the WILD system supplier alongwith necessary surge protection.

5.6 **Suggested site Selection criteria** – The site for WILD system should be selected in consultation with consignee (IR). The supplier may get in touch with DRM (Mechanical) in this regard.

5.6.1 Sensor/ Instrumented Zone: upto 13 meter of clear tangent track.

5.6.2 Straight and level track on either side of equipment of minimum 250 m length including approaches to the site and where trains do not normally require heavy braking applications. There should be no Cross level/Twist in the approach track upto 30 meters from sensorized zone measured on the basis of stations at every 3 meters.

5.6.3 Away from track joints switches and transition zones.

5.6.4 At least 100 meter away from any grade crossings.

5.6.5 Track structure should be stable and well maintained with proper drainage system.

5.6.6 Site should be preferably within 1 km from the main power distribution box.

5.6.7 The system should be installed on main line in block section near an LC gate but not at it to avoid damage and pilferage. It should have proper road approach for transporting the material and for patrolling for safety.

5.6.8 The site shall not be very close to any station or other location having any permanent speed restriction or at the approach of a signal to avoid acceleration/deceleration or braking over the sensing zone.

5.6.9 The next train examination point after WILD should be at least 40 km away from the site so that there is adequate time for the report to reach the C&W control and organize interception and inspection of vehicle in case of alarms.

6.0 **Software Requirements:**

6.1 The supplier shall have to provide documents explaining the methodology and logic used to develop the algorithm for the WILD system to get the required output. Any information/ explanation deemed proprietary may be indicated in the technical bid for comparison with other offers. Unless indicated, it shall be presumed that the tenderer has no limitation in sharing any information on logic/ methodology used.

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

6.3 The system should be able to record the dynamic impact load of each passing wheel measured by individual sensor and picking up the maximum dynamic load for that wheel. The average of these impact load values should be worked out for each wheel and stored as normal dynamic wheel load, accordingly the system should be able to calculate the impact load factor (ILF) i.e. ratio between maximum impact load and average wheel load.

6.4 The WILD server must have capacity to store the history of impacts of each vehicle at least for the preceding 12 months.

6.5 The WILD server must have software for trending of the impact history of Wheels of vehicles. The bidder should submit details of what minimum functional features of trending software are being offered. Some minimum desirable examples are – the software should be capable of generating an alert if a vehicle has any parameter (as measured by the one or more detectors) repeatedly over threshold limits. Further improvements as per the direction of RDSO shall be incorporated by the contractor at no extra cost.

6.6 System should be capable of integrating with FMM (Freight Maintenance Management)/CMM (Coaching Maintenance Management)/SLAM (Software for Loco Asset Management) for reflecting the measurements done by WILD

with respective rolling stock. For this purpose, successful bidder shall be required to send processed data in JSON format using restful API with token based authentication. The details of the API shall be provided by CRIS and JSON format will be decided based on the data generated by WILD systems.

6.7 Scheme of identification/numbering of individual axle/ wheels to be followed as specified by Railways for different types of coaches, wagons and locomotives for the purpose of location of alert.

7.0 Safety Requirements:

7.1 The system shall be protected from external EMI/EMC/RFI interferences, electrified OHE (Over Head Equipment).

7.2 The system shall be so designed that it shall not hamper or interfere with signalling, track, communication, electrical systems, etc. in service in IR.

7.3 The functioning of the system shall not get affected by the usual environmental and site conditions like vibrations from passing trains, track maintenance vehicles/ equipment not involved in pre-advised and scheduled maintenance activity at the site, heavy rain and water, animal trespassing and heat/sunlight.

7.4 The system shall be designed on fail-safe principles and adequate safety margins must be incorporated in the design for systematic and random failures.

7.5 The system should be adequately protected from waste discharge from the coaches and other ambient conditions including moisture and dirt.

7.6 System shall be designed and installed in such a way that it should be well protected during accident free train operation and routine maintenance and should have reasonable anti pilferage mechanism as per good industry practices.

7.7 The system shall be designed and installed in such a way that it should be fire resistant, non-corrosive & electrically non-conductive.

7.8 The system functionality shall not be affected by lightning and power surge. Suitable lighting arrestors/ earthing of the system may be planned for suppression of power line surges, spikes, transients to protect electronic circuits and equipment.

8.0 Output Requirements:

8.1 Data Communication:

8.1.1 All the data being generated by the WILD equipment, website, servers etc. with respect to Indian Railway operations shall be the exclusive property of Indian Railway and the firm shall not use it for any other purpose without express written permission of IR.

8.1.2 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. At the end of the contract, or as and when required by Indian Railways, firm shall hand over the complete data set to IR and must destroy any left-over data. Indian Railway shall be free to use data for any use during the contract as well as after the contract period. Any alternate use of such data by the firm shall only be done with the expressed permission of IR.

8.1.3 WILD system can communicate within its on-site components and other remote parts using different technologies such as GPS-based communications, Optical fibre, Radio or Modem based systems. The protocols and communication methods should be reliable and integrated through the entire system.

8.1.4 The report of the data captured by the system shall be relayed by the wayside device via suitable communications media to a secure web server on the internet within 5 minutes after the passage of the last axle. Standby data transfer channels may be planned, if required, to achieve assured and timely data transfer.

8.1.5 The trackside equipment shall have the capability to record and locally store raw captured data for at least last 500 trains and the processed reports for upto 20000 trains with typical length of 260 axles.

8.1.6 The backend server systems shall be maintained and operated by the system provider. These servers shall be capable of storing data and shall be able to display parameter reports and its graphical/ tabular representation (upon demand) and for up to 1 year after transferring it to appropriate Maintenance database of railways like CMM/FMM/SLAM.

8.1.7 The access to the report shall be provided by a standard web browser that works on various devices such as desktops/laptops/notebooks and smart phones. Users of the systems shall be provided logins / passwords for accessing the data

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

8.2 **Report Generation:**

8.2.1 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: -

8.2.1.1 Password based access so that only authorized personnel by consignee can enter/edit/view/download data and reports.

8.2.1.2 Differential privileges to different levels of users to access the resources of the website. Minimum 3 access/ privilege levels may have to be designed.

8.2.2 The supplier shall supply a desktop computer/ laptop at nominated place by consignee of the configuration as specified by tenderer for each WILD site.

8.2.3 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.

8.2.4 Detailed report: This report shall be in detail showing all parameters as acquired by the remote wayside detector.

8.2.5 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. It should be possible to directly obtain prior exceptions reported for the same wheel/axle/rolling stock during last one year.

8.2.6 Rake and Rolling Stock number type based queries for a selected period, time or parameter value (MDIL or ILF) for one or more sites.

8.3 **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.

8.4 **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. The application should be designed for Android and IOS both.

8.5 **Diagnostic reports:** The system shall be capable of running self-diagnosis programs and report the result through the website and by SMS. It should log all system errors such as main power failure, network failure or poor network speed and events like train passing & system reboot etc.

8.6 System should have provision of recording and analyzing the feedback of action taken by the field staff on alerts generated by WILD, including provision of entry of false negatives cases. For this purpose, standard Feedback messages may be provided in a dropdown menu besides a category for 'Other' defects feedback allowing detailed write-up of upto 50 Characters.

8.7 In the reports, the system shall be able to highlight the wheel having the high impact in different colors as per different thresholds for easy identification.

8.8 The system should be able to identify and count no of engines, coaches/wagons or brake vans, and also should be able to relate each axle with engine or coach/ wagon or brake van and its position from the locomotive.

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 after passage of the last axle of the said train. These messages will convey the following minimum data:

8.9.1 PVIS/RFID vehicle identification (if available/ provided on the Rolling Stock or reconstructed based on CMM/ FMM data)

8.9.2 Vehicle type Passenger(ICF,LHB,VB),Freight, Locomotive

8.9.3 Date / time of train

8.9.4 Direction of movement

8.9.5 Vehicle/Wheel position from start of train

8.9.6 Axle number where the parameters are found out of range.

8.9.7 Short description / error code: 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 user settable graded alarms, at least for the following conditions:

8.10.1 When the maximum dynamic wheel load exceeds the specified load. This should be of multiple level thresholds.

8.10.2 When the impact load factor exceeds the specified threshold. This should have multiple level thresholds.

8.10.3 When both (maximum dynamic wheel load and impact load factor) exceeds the specified threshold. This should be of multiple level thresholds.

8.10.4 In case, IR decides to include any new types of alarms based on the data already being gathered than maximum two new types of additional alarms may be added by the supplier. The supplier shall modify the software within a reasonable time at no extra cost to Indian Railways.

8.11 The data generated shall be downloadable by user in MS Excel sheet for any time duration from date of commissioning of equipment, using a user – settable data filter in the dash board. User should be able to apply any or all of the following filters on database simultaneously or otherwise as per

requirement to retrieve MDIL, Average Load & ILF values of both left & right wheels of rolling stock for further analysis

8.11.1 From …date to …date

8.11.2 Freight/LHB rake/ICF/VB rake type wise

8.11.3 Impact History of a particular rake or individual Rolling Stock type /Id for a predefined period in a single table

8.11.4 Speed range band wise-should be user selectable

8.11.5 Direction wise-user selectable

8.11.6 Summary of alerts –month wise, year wise-user selectable

8.11.7 WILD site wise alert analysis-more than one sites at a time user selectable

8.11.8 MDIL range wise-user selectable range

8.11.9 ILF range wise-user selectable range

8.11.10 Average Load range wise-user selectable range

9.0 **Inspection and Testing:**

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 supplied system 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 towards compliance of this specification. 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 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.

Validation of atleast first two systems shall be carried out by RDSO and further supply schedules may be planned only after satisfactory commissioning/ acceptance of Prototype System(s).

9.1 **Factory Acceptance Test:** All technical and design features shall be inspected and witnessed by nominated inspection agency at the firm's premises prior to dispatch. All individually tested sub-systems should be integrated in a fully functional manner and offered for inspection. During the factory acceptance test, firm shall demonstrate the capability of the system to accurately measure impact load mentioned in specification. Test scheme shall be finalized by inspecting/ tendering agency jointly with the firm. Necessary facilities, equipment, tools and gauges, duly calibrated shall be provided by firm at its premises for FAT.

9.2 **Calibration test:** The system should be calibrated before offering for proving-out test at site. Details of calibration methodology shall be submitted

along-with the offer. All calibration activities should get logged on the data base or user dashboard.

9.3 **Proving-out tests at site:** The supplier and the consignee shall conduct the following proving out tests after installation and calibration of the system at site:

9.3.1 **Consistency with regard to data capture functionality:**

9.3.1.1 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 vehicles other than locomotives. Minimum acceptance shall be at 100% over a period of 4 days of normal operation of trains as per prescribed speed.

9.3.1.2 The complete data report (without missing any axle) including maximum dynamic wheel load, average normal dynamic wheel load, impact load factor & speed of a wheelset of the trains passed shall be generated. The report should be successfully generated for at least 98% of the trains in a calendar day. A successful train report generation shall mean all wheels/ axles in the train within the prescribed speed range being correctly recorded.

9.3.2 **Impact load measurement capability:** The supplier should demonstrate the impact load measurement capability of the system producing known reference impacts at different locations in the measuring zones of sensors using suitable jigs, fixtures, impact hammers or other equipment duly calibrated with valid calibration certificate issued from a Govt. certified agency for metrological traceability. The impact measurement capability shall be demonstrated for different impact loads upto 30 tonne at site. For this, the necessary jigs/fixtures/hammers/calibration equipment should be provided by supplier.

The error tolerance shall be calculated as per table 1(a) of Annexure 1 and the maximum error tolerance should not exceed ± 5%.

9.3.3 **Weighing accuracy at crawling speed:** System should have weighing accuracy in range of ± 4% of known /stamped weight (calibrated) of wagon/coach/loco at crawling speed.

The weighing accuracy shall be calculated as per table 1(b) of Annexure 1.

9.3.4 **Repeatability Test with regard to Average dynamic load:** The reliability of the system should be observed with the repeatability of axle load recorded. If the same rolling stock passes with the same speed, the axle load recorded by the system should be approximately

same or within the range of ± 5% of the average load of minimum 5 passes at same speed.

The axle load variation shall be calculated as per table 1(c) of Annexure-1.

9.3.5 Repeatability of wheel Impact Load measurement at different speed of the system should statistically satisfy ANOVA Test with 95% confidence level.

9.3.6 The reliability of the system to measure impact load in dynamic condition should be observed using fault seeded stocks / Test specials. The fault seeded stocks should be logged under alerts conditions by the system. False positive and false negative reports shall be validated with seeded defects and should be not more than 15% and 10% respectively considering all passes of test train.

9.3.7 **Speed:** The average speed calculated by the system and speedometer of loco should approximately lie within ± 5 Kmph.

9.3.8 **Vehicle Identification System:** The system should be able to correctly identify the unique vehicle numbers of at least 75% stock in the train that passes the WILD site through combination of inputs from PVIS & RFID system. If required, marshaling order provided in CMM/FMM/SLAM data may also be used to ensure identification of unique vehicle numbers beyond 75 % of composition. For remaining unidentifiable Rolling Stocks, the system shall store the vehicle image files that can be viewed by the operator. The same should be demonstrated by supplier during prove-out at site.

9.3.9 **RFID Reader:** RFID readers should be capable for reading all working RFID Tags tagged on IRs rolling stocks. The extent of vehicle identification/ tag reading should be in line with the guidelines issued by CRIS in due course.

9.3.10 **Data Validation:** Wheel impact load detectors must be maintained such that each rail has at least 70% of vertical circuits active. If less than 70% of the circuits are active on a rail, then the data from that rail does not meet the validation requirements and hence, the data and reports for the rails shall not be utilized for any purpose and suitable comments shall be logged to distinguish as invalid report.

10. Warranty:

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

11. Training:

The supplier shall provide training for minimum 10 man days per site installation at factory premises and training for minimum 30 man days per site installation at different locations in the premises of consignee or mutually agreed location/ facility in following areas:

11.1 Operation of WILD system

11.2 Calibration of WILD system

11.3 Trouble shooting and Maintenance of WILD system

11.4 Reading and interpretation of reports, alarms and SMS's etc.

12. Submission of documents/ICD:

12.1 Test certificates: Test records, test certificates, evidence for conformance to this specification & IP ratings of enclosures, sensor's data sheet, performance curves from OEM (if applicable) and it's warranty etc. Results of all inspections and tests, whether witnessed or not by IR personnel, shall be supplied as soon as practicable after performance of each inspection or tests. One set of above mentioned documents shall be supplied properly bound in books. The softcopies of the said documents should also be provided by the firm.

12.2 Firm will supply the ICD (Interface Control Document) for the WILD System to the Indian railways.

12.3 Literature: The supplier shall provide following literature in two copies to consignee along with the delivery of WILD system:

12.3.1 Complete drawings and system architecture.

12.3.2 Operating manual

12.3.3 Maintenance manual

12.3.4 Spare part catalogue

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

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Annexure: 1

1(a). Impact load measurement capability: The error tolerance shall be calculated as per table given below and the maximum error tolerance should not exceed ± 5%.

Sensor No. - S_n (at various positions of measuring/sensing zone)			
S.N	**Applied Load (Wa)** (by known reference equipment)	**Measured/ Recorded Load (Wm)**	**% Error** *(Measured Load – Applied Load)/ Applied Load}*100*
x	Wa_x	Wm_x	$(Wm_x - Wa_x)/ Wa_x*100$

1(b). Weighing accuracy at crawling speed: Weighing accuracy at crawling speed shall be calculated as per table given below and should be in range of ± 4% of known /stamped weight (calibrated) of wagon/coach/loco.

Rolling Stock	**Stamped Weight (W)**	**Axle No.**	**Axle load recorded at crawling speed (Wac)** = (Average Dynamic Left wheel load + Average Dynamic Right wheel load of same axle)	**Weight of Wagon at crawling speed (Wc)** = Sum of average dynamic load recorded for all 4 axles	**Variation in weighting accuracy at crawling speed V_i**
			Speed - V_i		
Wagon - x	W_x	Axle no. 1	Wc_{xa1}	$Wc_x = (Wc_{xa1}+Wc_{xa2}+Wc_{xa3}+Wc_{xa4})$	$(Wc_x-W_x)/ W_x*100$
		Axle no. 2	Wc_{xa2}		
		Axle No. 3	Wc_{xa3}		
		Axle No. 4	Wc_{xa4}		

1(c). Repeatability Test with regard to Average dynamic load: The axle load variation shall be calculated as per table given below and the maximum variation should not exceed ± 5%.

Rolling Stock	**Axle Load** = (Average Dynamic Left wheel load + Average Dynamic Right wheel load of same axle)	**Speed (Kmph)** Direction of motion				**Average/ Mean (M) axle load of all runs** $M = [\sum_{i=1}^{N} Wi]/ N$ (Where, W_i =Axle load for particular run, N=no. of runs)	**Axle Load Variation % with respect to Average/ Mean** [(Wi-M)/ M*100]			
		Run 1	Run 2	--	Run N (N≥5)		Run 1	Run2	--	Run N
RS - X	Axle-X1	W_{x11}	W_{x12}	--	W_{x1N}	$(W_{x11}+ W_{x12}+ ...+W_{x1N}) / N$	$(W_{x11}-M) /M*100$	$(W_{x12}-M) /M*100$	--	$(W_{x1N} -M)/ M*100$
	Axle-X2									
	Axle-X3									
	Axle-X4									