

ISO 9001:2008	Document No: TM/IM/341	Version No:1.0	Date effective: 13.03.2014
Technical Specification for Procurement of one Laser based contact-less sensor Track Geometry Measurement System			



सत्यमेव जयते

**GOVERNMENT OF INDIA
MINISTRY OF RAILWAY
RESEARCH DESIGNS AND STANDARDS ORGANISATION
Manak Nagar, Lucknow-226011**

**Technical Specification for Procurement
of one LASER based contact-less sensor
Track Geometry Measurement System**

SPECIFICATION NO. TM/IM/341

(Approved vide Railway Board letter no. 2010/Track-III/MC/2
dated 26.02.2014 and dated 14.01.2015)

January-2015

TRACK MACHINE & MONITORING DIRECTORATE

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SUPPLY, INSTALLATION AND COMMISSIONING OF

TRACK RECORDING SYSTEM

1.0 DEFINITIONS & ABBREVIATIONS :

IR	- Indian Railway
RDSO	-Research, Designs and Standards Organisation, Lucknow, India.
Purchaser	- RDSO, Ministry of Railways, India
System	- Track Recording System
TRC	- Track Recording Car
UPS	- Uninterrupted Power Supply System
VDU	- Video Display Unit
ALD	- Automatic Location Device
LVDT	- Linear Variable Differential Transformer
SD	- Standard Deviation

2.0 SCOPE:

- 2.1 The specifications given below are meant to broadly bring out the functional and technical requirements of track recording system. The tenderer shall furnish compliance or deviations, if any, for each clause and sub-clause of the specification along with technical explanations/details. In case of any ambiguity in any clause or sub clause, bidder is free to seek clarification before submitting the bid. The clarifications may be sought from Executive Director Track Machine, TMM Directorate, RDSO, Manak Nagar, Lucknow – 226011, Fax – 91-522-2450294 or through email at edtmrds@gmail.com.
- 2.2 The design, manufacture, lab validation and supply of the system shall be completed within the time period specified in the contract. Subsequently, the installation, field validation and commissioning of the system shall be completed within 03 months from the date of receipt of material in RDSO.

3.0 GENERAL:

- 3.1 The track recording system with all related instrumentation / electronic system shall be installed in an IR Broad Gauge (1676 mm) Coach which will be supplied by the Purchaser. The coach will consist of a LHB shell mounted on FIAT bogies provided with hooks and buffer for attachment to other rolling

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stocks of IR. The layout drawing of coach and bogie will be supplied along with tender document.

3.2 The coach along with track recording system, hereinafter called TRC, shall be capable of recording track geometry, rail wear & vehicle ride parameters, performing real time processing, analysis and reporting as detailed in this document.

3.3 All Transducers/Sensors, Sensor beam and their mounting arrangements shall be installed within the Maximum Moving Dimension (MMD) envelope of IR as per Schedule of Dimension (SOD)-2004 and latest correction slips. The same is available at <http://www.indianrailways.gov.in>.

3.4 SERVICE CONDITIONS

System should be able to work under following service conditions:

- i. Ambient temperature - 0°C to 55°C
- ii. Rail temperature - $(-)\ 10^{\circ}\text{C}$ to $(+)\ 65^{\circ}\text{C}$
- iii. Humidity - 100%
- iv. Rain fall - Fairly heavy
- v. Atmospheric condition - Very dusty, Heavy fog

3.5 On IR network the electrified traction consists of overhead electric system of either 25000 V AC or 1500 V DC with residual return current passing through one of the rails in the track. System and accessories having part of electronic train running safety system such as Train protection warning system (TPWS), Audio frequency track circuit (AFTC), Digital axle counter, DC track circuiting shall not affect the accuracy of track recording results in any manner due to the induction effect of the above stated electric traction and signaling systems.

3.6 The system shall be capable of recording the track parameters in a speed band of 20 km/h to 200 km/h.

3.7 The TRC shall be capable of recording in both forward and reverse directions accurately to avoid need for turning of coach.

3.8 The TRC shall be capable of doing track recording on all types of track structures prevalent on IR viz continuous welded / short welded panels / fish plated track comprising of concrete / steel trough / CST-9 / wooden sleepers and 65 kg / 60 kg / 52 kg rails. The System shall be capable of identifying the type of rail automatically.

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- 3.9 All the transducers/sensors and measuring frame/sensor beam/mounting arrangement for sensors and system shall be supplied and installed in the coach by the supplier. However, prior approval for the design & drawing of measuring frame/sensor beam and its mounting arrangement shall be taken from the purchaser.
- 3.10 Suitable metallic / wooden racks, panels etc for installation of hardware, computers, monitors, power supplies and printers etc. in the inspection room of TRC shall be provided and installed by the supplier.
- 3.11 The furnishing of the instrumentation room will be done by providing and fixing required furniture for operators and inspecting officials along with 01 working bench and chair for carrying out minor repair. The furniture shall be got approved from purchaser before supply.
- 3.12 The layout of system shall be such that adequate space is available for maintenance of system and movement of IR officials. Prior approval from the purchaser shall be taken for the layout. The finish and workmanship shall be to the best international standards and shall give a decent appearance with durability and serviceability. All surfaces liable to frequent handling shall be finished with materials suitable for periodical washing or cleaning and shall be of colours matching with the interior of the coach. The material used shall be suitable for use under all climatic conditions and shall be fire retardant, non-hygroscopic and vermin & rot proof.

4.0 SALIENT TECHNICAL FEATURES:

- 4.1 Inertial principle of measurement with laser based contact-less sensors shall be followed for measurement of vertical and lateral profiles of both left & right rails with appropriate correction for roll and yaw. Gauge shall be measured with laser based contact-less sensors.
- 4.2 System shall have the ability to record track irregularities having wavelengths of 3.0 m and above up to 100 m. Speed independent, spatial low pass and high pass filters shall be used for the same.
- 4.3 The system shall be capable of storing raw data (Transducer/Sensor signals), profile/chord in ASCII/Binary and processed data in ASCII/Database format in separate files for 10,000 km of track recording. An additional mirror image disk of the same capacity shall also be provided to guard against possible loss of data in case of hard disk crash. Option to record or not to record various types of data shall be selectable by the operator through user interface. The system shall also be capable of uninterrupted recording and storage of above-mentioned data for 1,000 km.

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- 4.4 System shall have the capability for real time reporting of the following peak information to TMS server, Divisional control and Sr. Section Engineer/ Section Engineer of the concerned section through cellular communication network/ Wireless Broadband or Satellite communication.
- 4.4.1 Peaks exceeding High limit mentioned in para-607(2) of Indian Railway Permanent Way Manual for all track parameters. Facility to change the limits shall also be available.
- 4.4.2 Acceleration peaks exceeding 0.15g or/and 0.20g. Facility to change the limits shall also be available.
- 4.5 System shall be capable of recording track features along with track geometry, rail wear and vehicle ride parameters accurately using previously prepared route feature location file (wherever available) and TRC's navigation system, in data files and marking of same in graphical and digital exception reports.
- 4.6 Sampling distance for recording shall be user selectable from 0.20 to 0.60 meter in steps of not more than 3 mm
- 4.7 System shall have the facility for wheel wear compensation to enable accurate measurement and recording of speed & distance and also ensure constant sampling distance with new as well as worn wheel.
- 4.8 System shall have facility to automatically pause the recording in case of TRC's movement in reverse direction. The system shall also be able to correctly measure the reverse movement and compensate for the same on forward movement of TRC, so as to restart the recording from the point where recording was paused.
- 4.9 The System shall be capable of real time (during recording) processing, analysis, storage, reporting and printing of the recorded data/reports. During recording the digital reports and analogue chart shall be displayed on separate VDUs and printed on separate printers. Two copies of exception report and one copy of analogue report shall be printed during recording. Option to take or not to take the print of exception report and analogue report shall be available to user.
- 4.10 Adequate number of minimum, 21 inch flat, thin LCD based VDU shall be provided in the inspection room of TRC. In addition, required number of minimum 17 inch LCD based VDUs for operator interface, display of digital exception reports and analogue chart shall also be provided near operator console.

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4.11 The facility shall be provided for communication and data transfer from TRC to R.D.S.O and head quarters of Zonal Railways. This facility shall be based on GSM /GPRS network.

4.12 A PC base portable system for creation of track feature location file in the format specified in the subsequent paras of these specifications shall be supplied with the system. The system shall be capable of recording latitude and longitude of all track features accurately using a high precision GPS along with its code and distance from last Kilometer post. The accuracy of the GPS system shall be better than 2.8 CEP. The system shall also have the capability to do the post processing of the track recording data.

5.0 PARAMETERS TO BE RECORDED:

5.1 The System shall be capable of measuring / recording the following parameters.

- i) Absolute vertical profile of left and right rail on two user selectable **band pass** filters in the range of 3 m to 100 m in steps of 1m.
- ii) Unevenness of left and right rail on two user selectable chords in a range of 2 m to 20 m simultaneously with actual chord length being an even multiple of sampling distance. While recording on chord, only one band pass filter is to be selected for acquiring the vertical profile in the range of 3 m to 100 m in steps of 1m.
- iii) Absolute lateral profile of left and right rail on two user selectable **band pass** filters in the range of 3 m to 100 m in steps of 1m.
- iv) Alignment of left and right rail on two user selectable chords in a range of 2 m to 20 m, simultaneously with actual chord length being an even multiple of sampling distance. While recording on chord, only one band pass filter is to be selected for acquiring the lateral profile in the range of 3 m to 100 m in steps of 1m.
- v) Gauge (measured 14mm below rail table) at every sampling point.
- vi) Super elevation or Cant at every sampling point.
- vii) Twist on two user selectable bases in a range from 2 m to 20 m from cross level and from dynamic cross level (difference of left and right rail absolute profiles). Option to select either of the methods shall be available. Individual defect will be represented as the amplitude from the zero line to the peak value.
- viii) Curvature at every sampling point. (To be measured in degrees. Degree is defined as $1750/R$, where R is the radius of the curve).

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- ix)
 - a) Internal Rail Profile
 - b) Lateral wear (Horizontal gauge side wear)
 - c) Vertical wear
 - d) 45⁰ internal rail profile wear
- x) Vertical and Lateral acceleration on bogie pivot of TRC and in Loco/Test Vehicle in a band pass of 0-16 Hz or 0-8 Hz. Option to select either bands shall be available.
- xi) Vertical & lateral acceleration at axle box level on both sides of axle on a user selectable band pass filter in the frequency range of 0 to 48 Hzs.
- xii) Marking of 24 route features through route feature information file and dedicated key pad by punching single key assigned for each feature during recording along with distance.
- xiii) Speed of recording
- xiv) Distances for relevant features

5.2 The accuracy of measured track parameters in terms of repeatability and reproducibility shall be in accordance with the limits laid down in European code EN 13848-2. The reproducibility shall be tested and confirmed in the speed band of 40 to 160 Kmph as per the limits laid down in European code EN 13848-2.

5.3 The accuracy of wear in terms of repeatability and reproducibility shall be measured in terms of SD of sample to sample variation for a block of 200 m and the 95 percentile values shall be within the limits given below

Lateral wear (Horizontal gauge side wear)	0.2 mm
Vertical wear	0.2 mm
45 ⁰ internal rail profile wear	0.2 mm

5.4 Route Feature Information and Synchronisation:

5.4.1 Route Feature location file is a data file for each route of IR. This file is in ASCII format containing the location of various route features viz. turnout, level crossing, bridges, station etc. in terms of distance from the previous km post along with latitude and longitude of the route feature. Sample of such file is attached as Annexure-1. This data file will be supplied by the purchaser.

5.4.2 The system shall be installed with RFID based Automatic Location Detector (ALD) for location synchronization as per technical details given below:

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RFID based Automatic Location Detector (ALD) comprises of two parts, one passive ground transponder installed in track and one active unit installed in TRC to detect the ground transponder. The active unit (Reader) of ALD sensors shall be suitable to be fitted underneath the coach body & shall be rugged enough to withstand field conditions. Reader is to be supplied by the supplier. The passive unit (Tags) of ALD shall be installed on track by purchaser. For the purpose of validation of the RFID system supplied, 5 sample tags shall be supplied along with the system. Installation of the same will be carried out by the supplier with the assistance of the purchaser. The supplier will install the RFID reader compatible with RFID tag of open protocol and will provide the names of at least three manufactures of compatible tag along with make and model number.

RFID based ALD should be generic in nature and based on open protocol i.e. it will not require any proprietary interface protocol between RFID tags and RFID Readers. Both reader and tag shall be suitable for reliable working up to 200kmph capable of handling minimum 144 bits of user information along with minimum 48 bits of error checking code. To obviate interface, the RFID tags installed would be capable of storing stamp data to indicate its purpose so that discrimination among tags used for TRC purpose and those for any other Railway application such as Automatic Train protection systems on any part of Indian Railway can be made. The location of RFID tags installed in the track will be made available in the route feature location file. While recording, when the reader detects a RFID tag on the track, its current location should be updated/corrected as per the location stored in the route feature location file. The design and mounting of the automatic location detector should be such that it can sense the ground target without infringing the IR Maximum Moving Dimension envelope. The method of incorporation and combining of these shall be got approved in advance from purchaser.

The successful tenderer will be required to provide the user manuals of RFID Readers including the information containing air-gap interface protocols between RFID tags and RFID Reader as well as interface protocols between RFID reader and TRC integration within 3 month of award of contract.

5.4.3 System shall be capable to record route features with its distance from previous kilometer post accurately using previously prepared route feature location file & manually entered route features by event marker key pad using TRC's navigation system and incorporate the same in the exception and analogue reports along with storing the same in data files. The TRC's

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navigation system comprises of tachometer, ALD, event marker keypad and associated processing hardware and software. The method of incorporation and combining of these shall be got approved in advance from the purchaser.

5.4.4 In addition to Route feature location file, system shall also provide for manual entry of various route features by the operator using a dedicated event marker keypad having one key for each of the following features. It should be possible to mark, print & record track features from keypad while recording with route tape.

1. Km post,
2. TP/OHE Mast,
3. Pt.& Crossing,
4. Level Crossing,
5. Switch Expansion Joint,
6. Buffer rails,
7. Road Over Bridge,
8. Bridge (Steel Girder) In,
9. Bridge (Steel Girder) Out,
10. Bridge (Others) In,
11. Bridge (Others) Out,
12. Curve In,
13. Curve Out,
14. Tunnel In,
15. Tunnel Out,
16. Cutting In,
17. Cutting Out,
18. Siding/loop In,
19. Siding/loop Out,
20. Speed Restriction In,
21. Speed Restriction Out,
22. Three Spare keys as user options

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5.4.5 The system shall have the facility to detect transponder (fixed at a known location) and synchronize the distance with respect to the actual location of the ground transponder stored in the route feature location file. In case a transponder is not detected or missing, then synchronization should take place on next transponder. It should not synchronize the route tape on detection of false ground targets such as points & crossings, level crossings approach etc. In addition, facility for manual synchronization by punching the kilometer switch of keypad shall also be provided.

5.4.6 The speed shall be accurately recorded using an optical or any other suitable encoder connected to one of the axles of the TRC. The speed shall be displayed in digital form inside the TRC at two suitable locations. A spare tachometer shall be provided duly connected with another axle as standby.

6.0 HARDWARE :

The digital and analogue hardware shall meet all requirements of the specification, keeping the following in view.

- 6.1 The system shall be so designed that the same is capable of up-gradation in future.
- 6.2 All data acquisition and amplifier cards used in the system shall be properly secured from all sides in such a way that these do not get loose in their sockets due to vibration of the coach.
- 6.3 The latest and new industrial quality digital and analogue hardware, capable of withstanding the service conditions stipulated in clause no. 3.4 and vertical & lateral accelerations of upto 0.8 g at coach floor level and upto 1.0 g at the Measuring Frame/Sensor Beam fixed to the axle box/ Bogie shall be provided. Axle box mounted accelerometers shall be capable of withstanding acceleration occurring on IR track. Transducers/Sensors used shall be of rugged quality and well protected against flying objects, debris, shocks, vibrations etc. and shall be properly secured.
- 6.4 Flexible good quality shielded cables and connectors capable of working reliably in dynamic condition prevailing on IR System shall be used.
- 6.5 System shall be such that results are not affected by electronic noise, spikes, surges of the generator, power line and EMI generated by over-head electric traction lines, return current & track circuiting currents in the rails etc. Adequate shielding, line filters with surge suppressors etc. shall be provided.
- 6.6 Suitable resilient mounting arrangement shall be provided for accelerometers mounted on the measuring frame.

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- 6.7 The system shall be compact with minimum loose links, so that during recording runs the problem of loose connection & loose link shall not be encountered
- 6.8 The system shall be modular in design so that in the event any unit / card / transducer going defective, it can be replaced with ease during run.
- 6.9 A patch panel shall be provided to enable monitoring the signal of any transducer /Sensor and power supply to facilitate calibration/trouble shooting. Facility and equipments for monitoring of individual transducer, conditioned output of the signal and the frequency/voltage/wave pattern of the power supply by the operator, shall be provided.
- 6.10 A system of indicating the functioning of transducers in the form of dancing lights or on separate VDU shall be provided.
- 6.11 The system shall be provided with good quality UPS of proper rating and reputed make. The entire system will be powered via this UPS, with back up time of at least 60 minutes. Stand by constant voltage transformer (CVT) shall also be provided in addition to UPS.
- 6.12 Adequate number of Laser/Dot Matrix Printers shall be supplied to print various on-line reports e.g. exception reports, rail profile report, acceleration report, curvature report and various analog report. The Laser/Dot Matrix printers should also be compatible with system for printing digital exception report.
- 6.13 The system shall be provided with CD/DVD writer for down loading of the TRC data.
- 6.14 The supplier shall take prior approval of the hardware / software design from the purchaser before actual adoption.

7.0 SOFTWARE:

7.1 DATA PROCESSING AND REPORTING DURING RECORDING:

- 7.1.1 The software shall be so designed that it should be possible to use the same in upgraded versions of operating systems and PCs i.e the source code shall not be dependent on the operating system.
- 7.1.2 The software shall be user friendly and menu driven. It shall be capable of measurement, recording and storage of raw data i.e. transducer signals, profile/chord data and processed data for all the parameters covered in clause 5 of this specifications.

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7.1.3 The software shall have option to select either profile or chord mode. In case of profile mode, the software shall be capable of recording the profiles on two user selectable bands of wavelengths in the range of 3m to 100m. In case of chord mode there shall be a single band of wave length in the range of 3m to 100m with processing of data on two user selectable chords in the range of 2 m to 20 m, with actual chord length being an even multiple of sampling distance.

7.1.4 Software shall be able to generate the following from the profile and chord data. The formats will be finalized and provided by the purchaser.

- i) Evaluation of SD for all track parameters for each block of 200m length in a kilometer, except for the last block, length of which may be less or more depending upon the length of the kilometer. However, if the distance in the last block is more than 250m, the SD of excess length above 200m shall be calculated and reported as sixth block. A kilometer can have variable number of blocks depending on the length of the kilometer.
- ii) Evaluation of average gauge (for blocks of 200 meter), calculated from absolute gauge and measured above specified gauge entered at the start of run.
- iii) For SD evaluation and peak information/distribution, variation of gauge over moving average (with specified length of moving window) shall be taken.
- iv) Evaluation of two SD based indices separately for all track parameters for each block, as per the formula supplied by RDSO.
- v) Evaluation of minimum one SD based composite indices for each block as well as for the whole km, as per the formula supplied by RDSO.
- vi) Recording & printing of route features along with distance from km post in exception reports and analogue charts being printed during recording and offline.
- vii) Evaluation and reporting of peak distribution for both profile and chord modes according to various predefined limits / bands.
- viii) Categorization of track for each parameter in minimum four categories based on the predefined criteria to be supplied by the purchaser.
- ix) Evaluation and reporting of maintenance instructions as per predefined limits of SD values for various parameters.

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- x) Determination and storage of one highest value peak for all parameters including acceleration for every 50 meter length of track and reporting of 10 worst peaks out of the determined total no of peaks in decreasing order of magnitude along with distance from the last km post. The logic of zero crossing shall be used for determination of peaks.
- xi) Determination and storage of one highest value peaks for vertical & lateral acceleration at axle box level for both left & right end.
- xii) Determination of number of peaks above two and three predefined threshold for vertical and lateral acceleration at bogie pivot of coach, left side axle box, right side axle box and in locomotive.
- xiii) SD value of vertical and lateral acceleration for every 200m of block on left and right side of axle box.
- xiv) Facility to make any parameter(s) non recorded during recording run without pausing the system.
- xv) Evaluation of the average speed, block wise and km wise.
- xvi) Generation and printing of exception report for wear above the predefined limit in the format given by RDSO.
- xvii) Generation and printing of curvature report in the format given by RDSO.
- xviii) Evaluation of vertical and lateral Sperling Ride Index for vertical and lateral acceleration for every 200m block except for the last block, length of which may be less or more depending upon the length of the kilometer. However, if the distance in the last block is more than 250m, the SD of excess length above 200m shall be calculated and reported as sixth block. A kilometer can have variable number of blocks depending on the length of the kilometer. Formula for ride index shall be given by RDSO.

7.1.5 System shall be able to display analog / graphical output comprising of any eight user selectable parameters on VDU and print the same on laser printer. Analog output of each kilometer shall be printed on one page. The system shall also have the capability to store the analog output in suitable format for it's future viewing, processing and printing. The graphical / analog output shall also include following for each kilometer.

- i) Two level lines for each parameter as per predefined limits.
- ii) Vertical lines at every 100 or 200 meter distance.

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- iii) Average speed for every 100 or 200 m section.
- iv) Route Features
- v) Header details e.g. Railway, Section, Section speed, Kilometer, Date of recording, file name in which analog data has been stored etc.

7.2 POST PROCESSING OF DATA:

7.2.1 The post processing of the Track Recording Results are to be carried out in office environment. Any additional hardware except PCs, required for post processing of data shall be supplied with the system.

7.2.2 The post processing software module shall be capable for regeneration of graphical chart and exception reports being generated during recording from the stored raw data (Transducer signals), profile or chord offset data along with display on PC's VDU. The software module shall have the facility to make any user defined parameter non- recorded by making SD values and peak values zero for the defined parameter.

7.2.3 The post processing software module shall be capable for generation viewing and printing of following reports from the stored processed data (exception report values). The reports are required to be generated both for profile and chord mode.

- (i) Recording run summary, Section wise summary and various other reports using different peak based, SD based and indices based exception limits. The formats of reports will be provided by purchaser after award of contract.
- (ii) Reports for comparison of two recording results as per formats provided by the purchaser after award of the contract. The comparison software shall also indicate the improvement or deterioration among various recordings.

The purchaser (RDSO) will provide the formats of reports after award of contract. The data of all reports shall also be stored in comma separated ASCII files. For section wise summary, the software shall be capable of storing the data in file or data base in the desired format. The purchaser will provide the file/data base after award of contract.

- (iii) The software shall be capable of generating analogue output of raw data (transducer signal) for the selected patch of track.

7.2.4 The software should also be able to generate reports compatible with IR's TMS for the various inputs required by TMS from TRC.

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8.0 CALIBRATION, DIAGNOSTICS AND SIMULATION RUN:

- 8.1 Design of the System shall be such that it is self-calibrating and self-balancing to the extent possible.
- 8.2 Detailed procedures and periodicities of different types of calibrations required to be done viz. lab, field, quick, detailed etc. shall be given for various components, cards, transducers, sub-systems etc. The daily calibration should be possible in minimum possible time, preferably within 15 minutes.
- 8.3 The calibration procedure shall be easy and should require minimum adjustments.
- 8.4 System shall be designed with diagnostic features. It shall have facility to check various transducers, modules etc. and communication between various sub-systems and peripherals etc.
- 8.5 The system shall be provided with features to facilitate trouble shooting at module level. Status of various parameters of modules/ transducers shall be displayed on system VDU with reference and limiting values for identification of faulty modules. System shall have facility / modules for generation of simulated signals and speed required for testing of system when in stationary condition. All specialized tools and equipments required for calibration, diagnostics, repair and simulation shall be supplied as a part of the system. The list of all such items to be supplied shall be furnished as a part of the technical bid.

9.0 ACCEPTANCE TESTS:

- 9.1 The system shall be subjected to both laboratory and field validation tests, before acceptance. **Supplier shall submit detailed lab and field validation schemes after award of contract for approval.** The decision of the purchaser regarding validation and testing of the system shall be final and binding on the supplier. Inspection, validation and acceptance of the system (laboratory & field) will be done by the nominated officials of RDSO.

9.2 LABORATORY VALIDATION TESTS:

- 9.2.1 The laboratory validation tests shall include detailed testing of various components, transducers, sub-systems, assemblies etc. of the system as per the approved lab validation scheme. The lab validation shall also include feeding of simulated signal of known amplitude and frequency for various simulated speeds in the range of 20kmph to 200kmph in the system and output will be compared with input signal after accounting for transfer function.

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9.2.2 The laboratory validation tests shall be carried out, prior to shipment at firm's premises. Firm shall make available all facilities required for laboratory validation tests. The firm will inform the purchaser at least 10 weeks prior to the date when system will be ready for laboratory validation tests.

9.2.3 If laboratory validation/tests show any deficiency in the system from the specifications, the supplier shall rectify the deficiencies within a reasonable period. The travel, Boarding and other expenses to be incurred for subsequent inspection should be borne by the supplier.

9.3 FIELD VALIDATION TESTS:

9.3.1 Field validation shall be done on short stretches of up to 10 km as well as on long stretches of 500 to 1000 km consisting of any type of track (CWR, SWR, fish plated or mixed) in well maintained and/or run down track including straight, curves, bridges and station yards.

9.3.2 In case of short stretches, the system will be tested for repeatability and reproducibility as per the provisions mentioned in para 5. 2 and 5. 3 in the speed band of 40 to 160 Kmph at 04 speeds.

9.3.3 The magnitude of the defect peaks/exceedences recorded at various speeds will be compared with that measured by IR's existing TRCs and/or actual field measurements. The variation in results shall be within a reasonable accuracy to the satisfaction of the inspecting engineers of the purchaser.

9.4 The supplier shall submit detailed laboratory and field validation test schemes based on the aforementioned stipulations within 3 months of award of contract, for the approval of the purchaser. The decision of purchaser regarding the lab and field validation schemes to be adopted shall be final and binding.

9.5 If field validation/tests show any deficiency in the system from the specifications, the supplier shall rectify the deficiencies within a reasonable time to complete the commissioning in the specified period.

9.6 The supplier shall be required to supply and install free of cost all the equipments, components, PCB cards, ICs, cables, transducers, connectors, spares and consumables which may fail, malfunction, become defective or required for uninterrupted working of testing car during field trial and commissioning of system.

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10.0 DOCUMENTATION:

- 10.1 Installation, Calibration, operation, maintenance, service, and troubleshooting manuals shall be prepared in sufficient detail to the satisfaction of purchaser and supplied in three copies each.
- 10.2 Documentation of system hardware including transducers shall be supplied comprising of details of circuit diagrams, electrical and electronics designs with descriptions, component materials/part number, equivalent international part number, component specifications etc. along with explanatory notes and comments where ever necessary.
- 10.3 System software flow chart, algorithms, source code, etc. shall be supplied. Source code and executable files of the software shall also be supplied on CD/DVD as well as in hard copy.
- 10.4 Installable version of system software along with procedure to install the same from scratch in case of failure of hard disk shall be provided on CD/DVD & portable hard disk.
- 10.5 Complete filter design, it's equations, transfer functions and plots/graphs for filter's response shall be provided.
- 10.6 Licensed copy of operating systems, compilers or assemblers for the language used in writing the software shall be supplied.

11.0 WARRANTY:

- 11.1 The contractor shall ensure that system supplied including all parts, components, etc. used is free from defects and faults in design, material, workmanship and shall be of the highest quality and in conformity with the contract specifications.
- 11.2 The warranty of system shall be for 18 (Eighteen) months from the date of acceptance i.e. from the date of issue of commissioning certificate by RDSO except in respect of complaints, which are lodged before the expiry of the 18 months.
- 11.3 The supplier shall also supply and keep sufficient spare parts required to maintain and keep the system operational during warranty period to minimise system down time. The list of such spare parts shall be provided to the purchaser.
- 11.4 The supplier shall be required to supply and install free of cost all the equipments, components, PCB cards, ICs, cables, transducers, connectors, spares and consumables which may fail, malfunction, become defective or required for uninterrupted working of testing car during the currency of

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Warranty Period except stationary, ink cartridges and floppies/CDs required for printing etc. of the recording results and reports. The supplier shall also keep adequate stock of such components, spares, consumables and modules which are critical and may require repairs/replacement from time to time for ensuring un-interrupted working of the System & TRC during the Warranty Period. List of such components, spares, consumables and modules, proposed to be stored by the supplier during warranty period, shall also be furnished along with their minimum number required by the tenderer in his offer.

- 11.5 Instrumentation system shall require removal after about 24 months for periodic overhauling (POH) of the coach of the TRC. Within the commissioning and warranty period one or more such removal and reinstallation shall take place. The supplier shall associate and provide necessary technical supervision for ensuring proper removal and reinstallation of System. This will in no way affect the warranty liability of the supplier for the system.
- 11.6 The supplier shall provide at his own expenses the services of competent engineers during the warranty period as and when required. The system shall be attended to by the Service Engineer within 48 hr of receipt of communication regarding failure at the station where the system becomes defective or any other place found convenient by the purchaser. The system shall be rectified and commissioned for operation with in 5 days of the date service engineer attends in case no import of spares is required and within 10 days in case import of part is needed.
- 11.7 In case service engineer fails to attend the system within 48 hrs. of communication of failure, a penalty of Rs. 10,000/- per additional day taken to attend by service engineer shall be levied. Further, a penalty of Rs. 10,000/- per additional day shall be levied for the period lost beyond permissible period for rectification as specified in clause 11.6.

12.0 SPARE PARTS:

- 12.1 The supplier shall furnish list of components/spare parts which are expected to be required for trouble free operation and maintenance of the car for a period of 5 years after the warranty period (expected annual recording of 60,000 Kms), indicating their description, part number, equivalent international part number, quantity and price. The price so quoted shall be valid for at least two years after the expiry of warranty period. The manufacturer shall also undertake to ensure availability of all required spare components to ensure trouble free service for at least ten years after warranty.

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12.2 Supplier shall ensure availability of all consumable stores in local market or through agent for 10 years.

12.3 For the parts from the market, imported or indigenous, the sources and details shall be provided.

13.0 TOOLS:

13.1 All tools including measuring equipments required for diagnostics/fault finding and normal maintenance/repair shall be supplied as a complete kit. The list of such tools and equipments proposed to be supplied with system shall be furnished as part of technical details of offer.

14.0 TRAINING:

14.1 Supplier shall provide the training to four RDSO officials for four weeks in calibration, operation, fault diagnosis, repair and maintenance of the system at his premises. In case of indigenous supplier, if certain parts/sub-assemblies is imported, the required training shall also be provided at the premises of such foreign manufacturer/supplier. The following shall be included in the training schedule.

- a) Hardware: This training shall include calibration, operation, fault diagnosis, repair and maintenance of hardware supplied upto module level. The interconnectivity of the modules/subsystems shall be explained in detail.
- b) Software: The training should be so imparted that any subsequent minor changes in processing software for indices calculation and reporting as desired by IR in future can be incorporated. This training shall include the explanation of flow charts, source code of the processing software supplied including algorithms.

14.2 The theoretical part of the training regarding fault diagnosis, repair and maintenance including explanation of algorithms, flow charts and source code of the processing and reporting software shall be completed before commencement of lab validation. The training shall be given on the system to be supplied.

14.3 During commissioning of the system, four RDSO officials shall be trained in operation and maintenance of the system for a period of six weeks by the supplier.

14.4 Training notes and suitable reading material (in soft and hard copies) shall be provided to each trainee official before commencement of each spell of training.

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14.5 The charges for providing the training per official shall be separately quoted by the tenderer and payment for training shall be based on the number of officials actually trained. However, the cost of traveling, boarding and lodging for IR officials will be borne by the purchaser.

15.0 SCHEDULE OF QUANTITIES:

15.1 Supplier shall quote the prices in Annexure-1 or Annexure-2 of section-III of Part-I of Bid documents for the following items.

SNo.	Item	Quantity
1.	Track Recording System with LASER based contact-less sensors as per specification no. TM/IM/341 with complete hardware and software (1 set)	1 Nos.
2.	Cost of training (as per clause 14.0 of this specification)	
3.	Cost of spares (as per clause 12.0 of this specification) in profarama of ann-XX	L.S.

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TGMS Ver 1.0,Route Information Route No: 0151 Reversed

USER 1

USER 2

South Central

BPQ-WRE

16,1,

0198,0998,1,

0199,0162,10,

0199,0480,2,

0199,0690,24,

0199,0748,25,

0199,0843,11,

0199,1001,1,

0200,0042,10,

0200,0827,11,

0200,0850,26,

0200,0997,1,

0201,0135,2,

0201,0162,10,

0201,0279,24,

0201,0340,25,

0201,0353,11,

0201,0403,10,

0201,0578,2,

0201,0603,11,

0201,0606,47,

0201,0684,40,

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0201,0725,40,

0201,0800,47,

0201,0981,1,

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0202,0142,2,

0202,0432,26,

0202,0485,26,

0202,0550,10,

0202,0588,47,

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0202,0702,40,

0202,0702,40,

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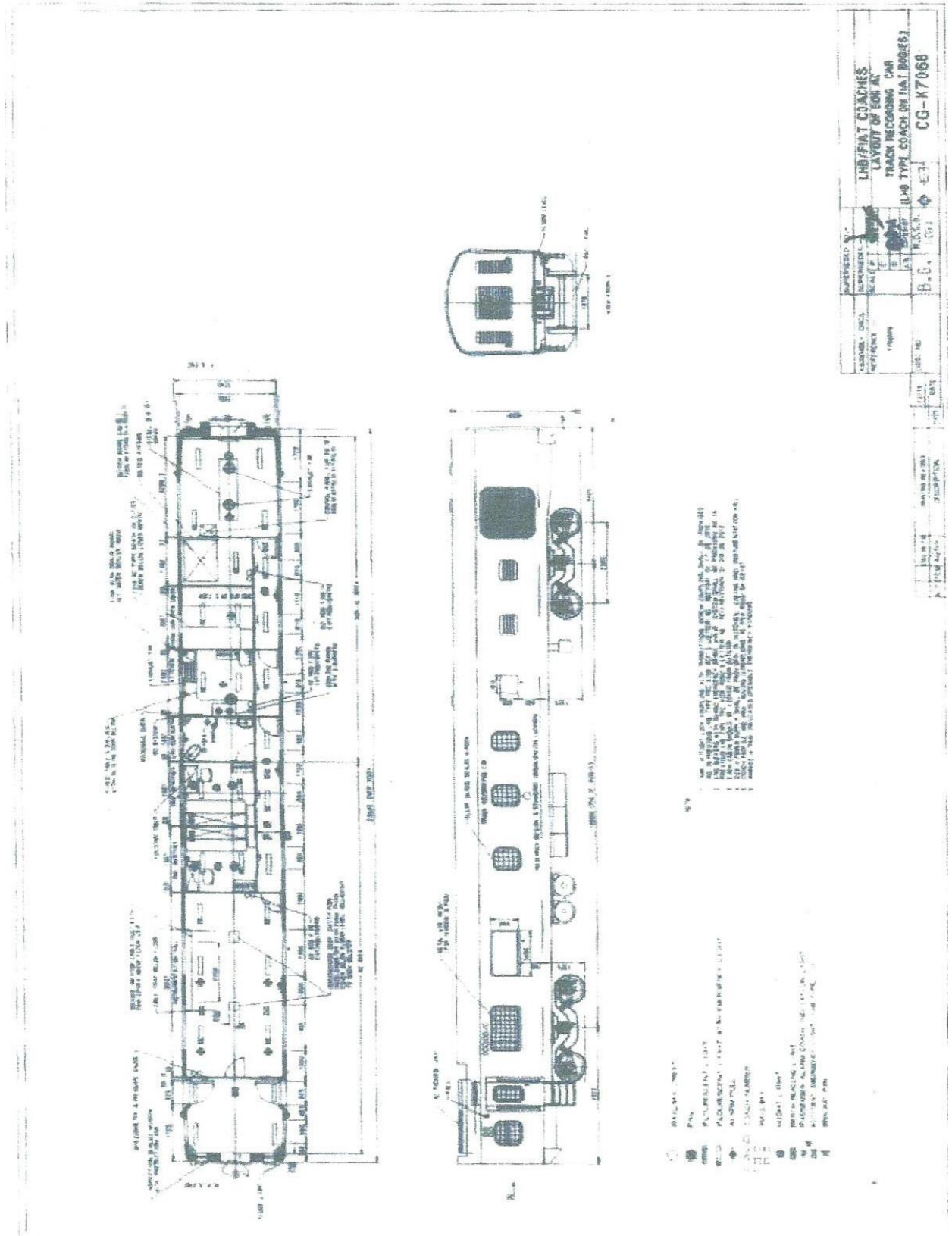
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List of Track feature with codes used in Route Data File

Feature No.	Details	Feature No.	Details
1	KM	50	BUFFER RAIL
4	Signal	60	CUTTING IN
10	CRV IN	61	CUTTING OUT
11	CRV OUT	70	PERM SR IN
20	G BR IN	71	PERM SR OUT
21	G BR OUT	72	TEMP SR IN
24	BR IN	73	TEMP SR OUT
25	BR OUT	77	TRANSPONDER
26	L XING	88	USER 1
40	Pt XING	89	USER 2
47	SEJ	2	TP

229823

Annexure-2



Annexure-3

