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Document Title: Specification for PC Based Oscillation Monitoring System (PC-OMS)			



**SPECIFICATION
FOR
PC Based Oscillation Monitoring System
(PC-OMS)
(Revision, February 2021)**

Version - 05

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**Track Machines & Monitoring Directorate
RESEARCH DESIGNS & STANDARDS ORGANISATION
LUCKNOW - 226011**

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LIST OF AMENDMENTS

S. No.	Amendment Date	Version	Details
1.	Dec. 2004	Ver. 1	Inclusion of specs. for transducer / conditioner module.
2.	Jan 2006	Ver. 2	Inclusion of DVD / CD Combo drive in laptop specs.
3.	March 2012	Ver. 3	Revision of specification of data acquisition module, provision of online printing facility and incorporation of user feedbacks. Effective from March 12 th 2012
4.	September 2013	Ver. 4	Issued after validation trials to incorporate changes in clauses 4.6, 6.5, 6.7, 6.9, 6.12, 6.15, 6.18, 7.3, 8.0 and annexures A, B & F.
5.	February 2021	Ver. 5	

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1.0 Scope

- 1.1 This document sets for the general, operational, technical and performance requirements for PC based Oscillation Monitoring System.
- 1.2 Whenever this specification is referred by number only, without mentioning the year of issue, the latest issue of the specification is implied.
- 1.3 This specification is intended chiefly to cover the technical, material and functional requirements with testing details provisions only and does not cover the necessary provisions of a contract. In this specification PC based Oscillation Monitoring System will be termed as “OMS”.
- 1.4 **Preference to make in India** compliance of the instruction contained in public procurement (preference to make in India) order -2017 “Make in India” shall be ensured.
- 1.5 **All the provisions contained in RDSO’s ISO procedures laid down in Document No. QO-D-8.1-11 dated 12.09.2018 (titled Vendor–Changes in approved status”), subsequent versions / amendments there of shall be binding, and applicable on the successful manufacturers/suppliers in the contracts floated by Railways to maintain quality of products supplied to Railways.**
- 1.6 The OMS shall be capable of recording location referenced Vertical and Lateral accelerations of Railway Rolling Stock, running on the track.

2.0 Materials, Processing and Workmanship

- 2.1 OMS Unit shall be designated as a PWI’s tool and thus it shall be portable, compact in size, light & of robust design. The weight of the unit, including battery, should be as less as possible & shall not be more than 20 Kgs. except optional item. It shall be a portable unit which can be easily carried.
- 2.2 The Oscillation Monitoring System covered in this specification shall be of robust, rugged and compact construction and shall be easily portable.
- 2.3 The OMS shall be of natural air cooled type and shall be suitable for use on Railway Rolling Stock.
- 2.4 The OMS covered under this specification shall work satisfactorily, meeting all prescribed parametric requirements, on in-built rechargeable battery, sufficient to work continuously for at least six (06) hours without charging.

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3.0 Terminology & Abbreviations

Abbreviation	Full Form / Description
AC	Alternating Current
DC	Direct Current
LED	Light Emitting Diode
OMS	Oscillation Monitoring System
RI	Ride Index.
TP/KM Switch	Telegraph Pole / Kilometer Switch
MIPS	Multi Input Power Supply
SMPS	Switched Mode Power Supply.
KM	Kilometer

4.0 General Requirements

- 4.1 System shall be universally suitable for all types of sections of Indian Railways like single line, double line, twin single line, multiple lines etc.
- 4.2 System shall be suitable for all types of electric and diesel locomotives EMUs/ MEMUs/ DEMUs coaches, wagons, Guard van and any other self-propelled vehicle treated as train.
- 4.3 System shall be capable of working in all types of electrified as well as non-electrified territories.
- 4.4 System shall be suitable for train speeds up to **160 KMPH**.
- 4.5 Each unit shall be shielded to prevent any Electromagnetic interference of any type. No false peaks should be observed if handheld walky-talky equipment used in Rlys. is operated beyond the vicinity of **4 meters**. No false peaks should be observed in case of charging / operating from the coach supply during operation.
- 4.6 Each unit shall be provided a user manual and a technical manual both for hardware and software.

5.0 Functional Requirements

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5.1 OMS shall have following Functions:

- Calibration Check - To calibrate the system in static mode and display a message after completion
- Configuration - To configure Train no., Coach No., Railway, Direction, Transducer Placement, Recording mode, No. of Section, Section Details, TP Odd/Even/ Continuous, Lower and Higher threshold values of Vertical and Lateral accelerations. All these configurations are to be displayed on the monitor.
- RUN - During this function, vertical & lateral acceleration values and RI values shall be displayed, stored and simultaneously printed (If printer is connected).
- Section Data Entry - To enter all the data of the particular section
- Diagnostic - To check various hard ware related diagnostic functions such as, printer test, event marker test, Tacho test, Display and storage of static values of lateral and vertical transducers test.
- Utilities - The System shall provide utilities for printing the stored data, Executive Summary and Exception Report of a particular Run. In Executive summary the peaks per KM should be calculated as per the limits entered by the user for lateral & vertical peaks and RI after deducting Non Recorded Km.
- Exit - To enable the user to close the program.

5.2 Error Messages

The system should be capable of generating certain error messages with possible causes and indicate possible remedies to enable a user to rectify minor defects/errors.

6.0 System Requirement

6.1 Oscillation Monitoring System (OMS) will be a Lap Top PC with accessories for monitoring the Parameters to be recorded & displayed during the Run in real time mode shall consist of the following:

- i. Block No. of a running kilometer in Tacho Mode.
- ii. Vertical and lateral RI of the block.
- iii. Continuous display of the vertical /lateral acceleration. Grid lines for 0.15g & 0.20g should be shown on graph on display in different colors. It should Identify and

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- record exceedances of vertical / lateral acceleration above a Lower threshold value.
- iv. It shall also give distance in meters from any predetermined reference point (Generally a km post) in tacho mode. & time of occurrence of exceedances in non tacho-mode.
 - v. Average Speed in non tacho mode /Instantaneous speed in tacho mode. System should show the speed of last 5 Kms. also on screen.
- 6.2 Speed, distance / time and location shall be computed from data taken directly from the tacho unit, if connected or elapsed time from last km in non tacho mode.
 - 6.3 Vertical and lateral accelerations, within a bandwidth of 0-10 Hz shall be measured with the help suitable transducers/accelerometers.
 - 6.4 The system shall measure these acceleration value at least once in every 10 millisecond, display instantaneously peaks at the interval of one second continuously (even below Lower threshold value), compare with a predetermined value, find exceedances thereof and identify the location of occurrence by distance in tacho mode and elapsed time in non tacho mode.
 - 6.5 These occurrences shall then be stored in the system and print both the acceleration values above lower threshold and distance from last km post in tacho mode and elapsed time in non tacho mode on an on-line printer in real time. The acceleration values above Higher threshold shall be printed in BOLD during Run. (If Printer is connected).
 - 6.6 All the peak values of vertical and lateral accelerations measured during every stretch of 200 meters run shall be taken to calculate the Ride Indices (R.I), using the Sperling Index formulae. This shall be displayed and stored.
 - 6.7 At the end of the run, it shall be possible to take out an executive summary and exception report as well as copy of "ON LINE" running data report of the whole stretch tested, to get locations of all the spots where acceleration value recorded are more than any desired threshold value, in descending order.
 - 6.8 In off line mode, utility software shall be provided to convert data recorded in time mode to distance in meters as per Annexure 'F'.
 - 6.9 Auto calibration Facility at site to calibrate both vertical and lateral channels automatically to be provided by placing the transducer box at zero position and then at '1g' position (by turning the transducer box to 90⁰) on a spirit level table. If calibrated successfully a message to be displayed only then the system should go into RUN Mode, otherwise it should display "Out of Cal" and should not go Run Mode. The values obtained during this exercise to be stored and displayed on the monitor. Auto Calibration shall be performed before starting every RUN. Hence, if during the RUN, equipment gets reset, there shall be an option to continue the RUN without fresh calibration.
 - 6.10 Type of Input signals:

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- **Digital Inputs** : Provision to accept at least 8 digital inputs for event marking such as for km post, bridge, level crossing, points and crossing, telegraph post, curve in, curve out and SEJ to signify various track features and one digital input from tachometer to measure the distance for speed calculation.
- **Analog Inputs:** There shall be two analog inputs from the accelerometer signal conditioner and one analog input from battery voltage for monitoring battery status.

6.11 GUI Based Data Acquisition and Analysis Software

Tailor Made Software for data acquisition and analysis is required for on line data acquisition and real time analysis in mobile laboratory housed in a railway coach or at site lab for Railway R&D works. The software should operate under windows environment.

The software should have graphic user interface. It should be possible to display data in the form of digital values & analog indicator in real time.

Application program should be provided with installation CD / DVD on window based system (lap top). A hard / soft copy to user manual should be provided with each system.

6.12 Data Acquisition and Application Software

The Data Acquisition and application Software shall have following:

i)	The software shall be industry standard complete for full development system like VC++, which shall be able to work on the Laptop computer system and shall have the basic features as described below: The System Application Software shall be uniquely identifiable by means of Checksum etc.
ii)	It should be possible to exchange data between this software and other windows based applications.
iii)	It should be possible to display data in X/Y or Y/t modes in different colors.
iv)	Software should be modular, menu driven and user interactive.
v)	Application Software (OMS): The firm should supply set up (installer) CD with each OMS. The set up (installer) CD should contain: a) Set up programme for installation. b) The OMS software. c) All connecting / concerned drivers. It should spell out the minimum requirement of hardware and software of the system.

Built in diagnostics and function routine for accelerometer calibration and other functions for checking the health of other hardware including battery condition check should be provided in software.

Following are initial parameter setting to be supplied by user at the start of run.

- Railway

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- Train No.
- Coach No.
- Tacho Connected or not (if connected)
 - tacho factor to be entered i.e. wheel diameter correction factor)
 - Rout Tape Y/N If Yes
 - Route Code File Name
- No. of sections. (maximum 5 sections can be provided) Following details for each section to be provided:
 - Section Name
 - Section Speed
 - Run Speed
 - Direction
 - Start Km
 - End Km.
 - Electrified
 - TP Odd/Even/Continuous
- Transducer Placement: Leading/Trailing
- Lower and upper threshold values of accelerations

All the initial parameters should be stored as last entered which shall be user defined and can be changed by user as and when required for new configuration.

Following parameters are not user defined and should be taken from the system

- Machine number to identify its record.
- Offset and calibration values of vertical and lateral accelerometers with date and time.
- Run No. with date and time.

- 6.13 Each 10 m sec interrupt data for lateral & vertical accelerations will be collected and stored in a suitable buffer. The storage of acceleration peaks above lower threshold values and all Ride Index data irrespective of speed in tacho mode shall be stored in comma delimited single file for further processing. The typical format of the file for Time and Tacho Mode will be as per annexure 'G' & 'H' respectively. The description of record type for OMS data file format will be as per Annexure 'I'.

Vender shall not change the structure of this file without prior approval of RDSO.

- 6.14 Each sample will also be tested for peak. If sample is a peak it will be stored in a buffer for RI computation. In Time Mode Ride Index of all blocks to be calculated after completion of a kilometer indicated by entering of Km, on the basis of elapsed time read, by dividing it in five blocks. In Tacho Mode RI to be calculated for every block of 200m.

In both cases RI of all the blocks to be printed after completion of KM. In case of Tacho mode number of blocks can be less than or more than 5, also depending upon the length

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of the kilometer. However, in case of time mode it will be assumed that the km is of 1000m and the number of blocks will be 5. All the peaks on a 200 meter length will be used for RI computation by using following formula:

$$R.I = 0.896 \times \sqrt[10]{\sum_{i=1}^n \left\{ \frac{b_i^3}{f_i} \times F(f_i) \right\}^{\frac{1}{n}}}$$

Where

- n = no. of completed half waves (cycles)
- b_i = Peak value of amplitude for the ith half-wave
- f_i = Frequency of the ith half wave = 1/(2T₁); T₁ = Time of ith half cycle
- F(f_i) = Correction factor for the ith half wave.

Correction factors for various frequency values are as follows:

For vertical mode	For lateral mode
0 for f < 0.5 Hz	0 for f < 0.5 Hz
0.325 f ² for 0.5 ≤ f < 5.4 Hz	0.8 f ² for 0.5 ≤ f < 5.4 Hz
400/f ² for 5.4 ≤ f ≤ 20.0 Hz	650/f ² for 5.4 ≤ f ≤ 20.0 Hz
1 for > 20 Hz	1 for > 20 Hz

- 6.15 In off line mode, utility software shall be provided to delete those Kms which have been recorded on less than desired speed and a memo indicting deleted Kms. Printed in the report.
- 6.16 Printing format for output of run data in time and tacho mode shall be as shown in Annexure – A & B respectively.
- 6.17 Printing format of Ride Index and Executive summary shall be as shown in Annexure – C & D respectively.
- 6.18 The OMS shall work in non-tacho as well as in tacho mode. In tacho mode working, the route information can also be fed through a route tape. In case the system hangs or shuts down due to power failure or due to any reason, when starting the system it should have the option to record data in the same run/ new run.
- 6.19 In tacho mode if route tape of section is provided, the software shall read events from route Tape file in place of manual event marking. A method of synchronizing of route tape with Selected ground feature shall be provided in software.
- 6.20 All the track events such as Curve In, Curve Out, Point & Crossing, Bridge, Level Crossing etc. received from the event marker should be printed / recorded against time/distance in the file as and when user presses the event key. Recording of TP in electrified section should be in odd/even No. as per the operator selection. For non-electrified, TP should be continuous in increasing order. TP should be printed on the occurrence of peak.

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- 6.21 Provision for generating the exception report should be available to user by defining the threshold of both acceleration and RI values. Format of the exception reports for Non Tacho Mode and Tacho Mode is given in the Annexure-E-I & E-II respectively.
- 6.22 Option for PWI/ Section wise summary should be available.
- 6.23 Option to generate exception report from the recorded file as per the user Configuration of speed, Ver (TH), Lat(TH), Ver (RI) and Lat(RI).

7.0 Technical Requirements

Oscillation Monitoring System should be a Lap Top based system. The equipment should be portable and light weight as far as possible so as to facilitate carriage by single person. The system should consist two acceleration sensors (lateral as well as vertical), a signal conditioner with suitable low pass filter and data acquisition system. Suitable interfacing to be done to connect all these sub systems to get the desired parameters on Lap Top, which shall be recorded, analyzed displayed and stored for later analysis of the data. The OMS system shall be capable of printing the run data in real time while recording simultaneously up to the train speed of 160 Kmph. If printer is connected, it should also be able to print on line reports on the run.

7.1 Lap Top Computer Specifications

- **CPU:** 2.4 G Hz. Or better
- **HDD:** 160 GB or more.
- **RAM:** RAM of minimum 2 GB capacity.
- **DVD Writer / DVD combo Drive:** should have one DVD Writer / DVD Combo Drive.
- **Display:** 14” or more. LED backlit with anti-glare.
- **Pointing device:** Touch pad, one additional compatible external mouse to be provided.
- Lap top should be protected with anti-dustcover.
- **Key Board:** Standard spill proof Keyboard.
- **Pen drive:** 8GB or more.
- Licensed Windows Operating system
- Licensed MS office.
- Latest and Licensed Antivirus software of reputed supplier with **two** years subscription.
- **Power Adapter:** Should be able to work with normal AC supply of 230 volts and supply available in Indian Railway coaches (110V AC/DC). Power cord (Min. 2 Mtr. of length) suitable for the same to be provided. Battery backup of the Lap top should be for about 6 hours duration for which an external battery may be used.
- Carrying case

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7.2 Data Acquisition system:

The desired Data Acquisition system should be of latest technology. This should be compatible with laptop supplied. System should be able to acquire all the field signals both analog as well as digital. Setup CD / Program of the data acquisition system for installation on laptop should be provided.

- **Sampling rate :** Minimum 1000 samples per channel per sec.
- **Sensor Range : 0.01g to 1.0g**
- **Counter/ Timer:** At least 1

- **Interfacing Module and interconnecting cable for field connections**

Interfacing Module and interconnecting cables as per the following description shall be provided along with data acquisition system.

- The interfacing module is required to function as a link between the data acquisition card and the field connections. This module should be portable type.
- Suitable interface cable should be provided for connecting signal cable from field, i.e. from two transducers / acceleration sensors.
- Suitable interface should be provided in the module for connecting external event marker.
- The cable assembly will be of suitable length having matching connector mounted at both ends compatible to data acquisition board and the terminal block respectively.

7.3 Transducer, Signal conditioner cum Power pack unit:

Transducer & Signal Conditioner: The transducer / acceleration sensor for system shall have adequate range of measurement of vertical and lateral accelerations. It should be mounted in true horizontal and vertical positions; the mounting arrangements of the transducer / acceleration sensor should be properly designed to produce true electrical output proportional to acceleration. The unit shall also have required amount of signal conditioning circuit with built in initial off set voltage adjustment of accelerometer to make it compatible to data acquisition system (DAQ). This unit should have provision of suitable low pass filter (10 Hz.).

The acceleration sensor should be housed in a metallic box, preferably, the battery (maintenance free) should be housed in the acceleration sensor box to give stability so that it does not change its position during run due to vibration.

Operation of handheld Walky-Talky sets as used in Rlys, mobile sets etc. in the vicinity beyond 4 meters from the equipment should not result into false peaks being registered by equipment. No false peaks should be observed in case of charging / operating from the coach supply during operation.

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Power Supply: An SMPS based Multi Input / output Power Supply (MIPS) system with input ranging from 90-260V AC/DC and one DC output to run the system & other DC output for charging the battery pack of adequate capacity shall be provided. The MIPS output for running the system shall be regulated with in ± 5 % of nominal voltage from no-load to full load condition. However the battery charging output which shall be used for charging the battery in Off line condition can have ± 10 % regulation. No false peaks should be observed in case of charging / operating from the coach supply during operation of the system.

Power Supply to the circuitry other than Laptop shall be provided either by battery pack or by MIPS output. The battery pack shall be of sealed maintenance free type of adequate capacity to provide working back up for at least 6 hours. Two LED indicators shall be provided to indicate the battery status. One for fully charged and the other for low battery.

Tacho Meter Assembly: It shall comprise of a rugged sensing unit interconnected through a proper-shielded cable mounted inside the inspection coach / coach provided with facility to connect speed indicator, tacho etc. through flexible shaft attached with wheel axle assembly of the coach. This unit shall provide adequate number of pulses per revolution of wheel and send to the Data Acquisition System through terminal block for computation of distance. It shall be housed in a robust metallic enclosure.

7.3 External Event Marker

Provision of one External Event Marker to record various track features such as km post, bridge, level crossing, points and crossing, telegraph post, curve in, curve out and SEJ shall be a part of the system. The cable length should be minimum 2.5 meters.

Beside this External Event Marker, all events shall be displayed in icon form on the monitor and it shall be possible to operate by clicking the desired event so that event can be marked by either of these facilities.

In Tacho/Distance mode all the 24 track features as per Annexure 'J' shall be used through route tape, printed and stored in data file.

7.4 Printer (Optional)

For optional on Line Printing one minimum 40 column Dot Matrix Printer shall be provided.

8.0 Documents required from supplier

Manufacturer shall provide Operating and Maintenance manual consisting of following details:

i) Brief description of the system and its sub-assemblies with suitable block diagram &

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circuit diagram.

- ii) Technical Manual, Installation and maintenance guide (Hard copy and softcopy).
- iii) Static calibration procedure, Diagnostic procedure, system commands including trouble shooting charts.
- iv) User's Manual (hard copy and Soft copy) for operating the system & offline analysis of acquired data.

9.0 Spare Parts and Tools

9.1 Tools to be supplied

- a) Tool kit required for maintenance and operation.
- b) Spirit level table- One No.
- c) Other tools as recommended by OEM

9.2 Spares to be supplied

- a) For all leads/cords used in the system - 1No..each
- b) Other spares as recommended by OEM

10.0 Warranty & AMC

All the material supplied should have a warranty for at least **two** year from the date of commissioning.

- 10.1 During procurement of the OMS, railways should go post-warranty AMC with the supplier for a pre-determined period as decided by the purchaser railway as per Comprehensive Guidelines on Procurement, Operation, Maintenance and Repair of Small Track Machine Repot no TM 227. This may be incorporated in the tender document as a condition of contract/Tender/Supply.

11.0 Tests & Verification

Type test shall be conducted on Prototypes at the time of initial approval. The manufacturer/ supplier shall produce **two prototype samples** before inspecting officials for type tests. The cost of type tests shall be borne by the manufacturer/supplier. All arrangement to conducts type tests shall be made by manufacturer/supplier.

11.1 Dynamic Calibration

Dynamic calibration shall be done in any NABL accredited agency for its performance. The read values of the acceleration of 90% samples taken in the frequency range of 2Hz, 3Hz, 4Hz, 5Hz & 6Hz and acceleration range of 0.1g, 0.2g, 0.3g, 0.4g should be within limit of $\pm 10\%$ of the applied input acceleration.

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11.2 Makers test certificate for out sourced item

- a) Test and Dynamic calibration certificate of system as per clause 11.1.
- b) Test and calibration certificate for transducers.
- c) Test certificate for Tachometer.
- d) License of Windows Operating system
- e) License of MS office
- f) License of Antivirus software of reputed supplier with two years subscription.
- g) Warranty of the Laptop supplied.

11.3 Test at the time of initial approval (Type test)

Following test shall be conducted at the time initial approval. The following shall constitute routine test and shall also be conducted by the manufacturer on every equipment/sub units and test results along with certificate shall be submitted during inspection.

- (i) Visual inspection as per format approved by RDSO
- (ii) System level functional test as per format approved by RDSO

11.4 Acceptance Test (Test at the time of supply)

Inspecting authority shall carry out acceptance tests on all the equipment/sub units. The following shall comprise Acceptance test:

- (i) Visual inspection as per format approved by RDSO
- (ii) System level function tests as per acceptance test format approved by RDSO.

11.5 Visual Inspection:

The equipment shall be visually inspected to ensure followings–

- i. General workmanship.
- ii. Quality of soldering and component mounting.
- iii. Legend printing.
- iv. Green masking.
- v. Indications and displays.
- vi. Mounting, fitment and clamping of connectors.
- vii. Proper housing of cards.
- viii. Painting, labeling and marking as per clause 4.10.
- ix. Availability of stipulated documents and certificates.

11.6 Field Trials:

Short stretch of field trials, as far as possible in hot condition, as practicable and in electrified section shall be done for the OMS under test to assess the working of the system in field conditions & in electrified section. Interference due to use of walky-Talky and switching of MIPS/charging needs to be seen during inspection field trial.

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11.7 Testing/Inspection

The testing/Inspection of the OMS system shall be done by RDSO. The cost of inspection and testing shall be borne by the manufacturer/supplier.

12.0 Marking And Packing:

12.1 All sub units shall have names marked. All the markings / indications shall be easily legible and durable. Where the marking is by use of labels, the labels shall be metallic and shall be firmly fixed and shall not be easily removable by hand.

12.2 The word 'INDIAN RAILWAY PROPERTY' shall be indelibly etched /engraved /embossed/painted at a conspicuous position on the units. All units shall be aesthetically painted/ Powder Coated except the Lap Top.

12.3 Each unit shall be supplied with a suitable carrying case which should be strong enough to handle, with provision of rollers for porting & carrying.

12.4 The system shall be so packed that it can withstand bumps and jerks encountered in a road/rail journey including handling during its transit.

12.5 The machine shall be legibly and indelibly marked with:

- i) Name, initials, contact no. and trade-marks of manufacturer.
- ii) Serial number of OMS.
- iii) Month & year of supply.

13.0 Training and commissioning:

The firm should provide training for operating the application software, installation of software and on various reports generation to the consignee.

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RUN DATA IN TIME MODE

Machine No 123456
Run No 543
Run Date 31-03-2011
Run Time 11:02:49
Cal Date 31-03-2011
Cal Time 10:59:08
OgV/value -0.02
OgL/value 0.00
1gV/value 4.46
1gL/value 4.49
Railway NR
Train No 12002
Coach No ER12345
Tacho No
L Ver (Th) 0.15
L Lat (Th) 0.15
H Ver (Th) 0.30
H Lat (Th) 0.30
Transducer Leading
No of Sections 1

ANNEXURE-A
(Page 1 of2)

SAMPLE COPY

Section Name LKO-CNB
Direction UP
Start Km 01
End Km 80
Section Speed 100
Run Speed 100
Electrified No
TP Continuous

Time	Ver Peaks	Lat Peaks	Events

mm:ss:mss	SEC1	LKO-CNB	
00:03:080	0.17		TP1
00:03:190	0.21		TP1
00:03:370	0.16		TP1
00:03:400		0.23	TP1
00:07:470		0.24	TP2
00:07:640		0.31	TP2
00:07:760		0.16	TP2
00:08:000		0.16	TP2
00:08:580		0.15	TP2
00:08:720		0.16	TP2
00:08:990		0.19	TP2
00:09:110		0.16	TP2
00:09:250		0.16	TP2
00:09:640	0.32		TP2
00:09:650		0.15	TP2
BLK	VER RI	LAT RI	
****	*****	*****	
1.	2.89	4.42	
2.	3.26	3.65	
3.	2.82	3.94	
4.	3.60	3.78	
5.	2.27	4.13	
Km Avg RI	2.96	3.98	2 km, avg speed 60.19 KMPH

JRE/SSRE	ADE/DTM/EDTMR	PED/TM	Page no.17 of 32
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00:03:490		0.24	TP1
00:03:620		0.19	TP1
00:03:740		0.19	TP1
00:03:850	0.18		TP1
00:03:980		0.25	TP1
00:04:100		0.22	TP1
00:04:220		0.17	TP1
00:04:320		0.16	TP1
00:04:450	0.19		TP1
00:04:560		0.22	TP1
00:04:680		0.19	TP1
00:04:780		0.16	TP1
00:04:900		0.18	TP1
00:05:000		0.20	TP1
00:05:130		0.19	TP1
00:05:240		0.22	TP1
00:07:360	0.18		TP2
00:08:360	0.16		TP2
00:08:590	0.19		TP2
00:09:710	0.17		TP2
00:11:430		0.19	TP2
00:11:550		0.16	TP2
00:16:440			BR
00:16:660	0.23		TP3
00:17:570			LX
00:18:840			PC
00:19:040		0.15	TP4
00:19:580		0.18	TP4
00:19:860			C-OUT
00:20:100		0.17	TP4
00:20:270		0.26	TP4
00:20:430		0.30	TP4
00:20:580		0.28	TP4
00:20:730		0.24	TP4
00:20:870			LX
00:21:070	0.18		TP4
00:22:930	0.18		TP4
00:23:580	0.15		TP4
00:23:710	0.21		TP4
00:25:830		0.18	TP5
00:25:840	0.20		TP5
00:25:970	0.15		TP5
00:26:590	0.18		TP5
00:26:700	0.16		TP5
00:27:700	0.23		TP5
00:27:680		0.19	TP5
00:28:000		0.16	TP5
00:28:190		0.21	TP5
00:28:340		0.27	TP5
00:28:460		0.29	TP5
00:28:590		0.39	TP5
00:28:700		0.31	TP5
00:28:820		0.21	TP5
00:29:490		0.22	TP5

User stopped acquisition

ANNEXURE- A
(Page 2 of 2)**SAMPLE COPY**

JRE/SSRE	ADE/DTM/EDTMR	PED/TM	Page no. 18 of 32
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RUN DATA IN TACHO MODE

Machine No 12345
 Run No 550
 Date 31-03-2011
 Time 11:28:53
 Cal Date 31-03-2011
 Cal Time 10:59:08
 0gV/Value -0.02
 0gL/Value 0.00
 1gV/Value 4.46
 1gL/Value 4.49
 Railway NR
 Train No 14127
 Coach No ER12345
 Tacho Yes
 Tacho Factor 1650
 Route Tape No
 LVer (Th) 0.15
 LLat (Th) 0.15
 HVer (Th) 0.30
 HLat (Th) 0.30
 Transducer Leading
 No of Sections 1

**ANNEXURE B
 (Page 1 of 2)**

SAMPLE COPY

 Section Name LKO-CNB
 Direction UP
 Start Km 01
 End Km 80
 Section Speed 100
 Run Speed 60
 Electrified No
 TP Continuous

 Dist (meter) Ver Peaks Lat Peaks Spd Events

SEC 1 LKO-CNB

*****Dist =0m, km = 1 Spd = 59.796 Non Recording Mode is Starts Here*****

*****Dist=55.00m, km = 2 Spd = 61.340 Non Recording Mode is ends Here*****

55.60	0.18		61	TP1
55.93		0.20	61	TP1
156.43	0.14		61	TP2
258.08	0.23		61	TP3
559.07	0.21		61	TP6
660.39	0.19		61	TP7

BLK VER RI LAT RI

**** *****

1.	2.89	4.42	
2.	3.26	3.65	
3.	2.82	3.94	
4.	3.60	3.78	
5.	2.27	4.13	
Km Avg RI	2.96	3.98	3 km, avg speed 60.19 KMPH

JRE/SSRE	ADE/DTM/EDTMR	PED/TM	Page no.19 of 32
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ANNEXURE B
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490.21	0.17	64	TP5	
497.64	0.22	64	TP5	
501.10	0.22	64	TP6	
514.23		64	C-in	
520.08		0.30	64	TP6
522.39		0.32	64	TP6
525.03		0.37	64	TP6
540.21		0.36	64	TP6
544.66	0.15	64	TP6	
545.82		0.22	64	TP6
545.82	0.32	64	TP6	
548.13	0.24	64	TP6	
547.96		0.21	64	TP6, PC
561.99	0.18	64	TP6	
565.62	0.20	64	TP6	
569.41	0.21	64	TP6	
569.74		0.15	64	TP6
576.67	0.15	64	TP6	
596.64		0.15	64	TP6
599.94		0.18	64	TP6
602.91		0.19	64	TP7
616.60	0.20	64	TP7	
620.73	0.15	64	TP7	
628.15	0.16	64	TP7	
651.42	0.15	64	TP7	
692.83		0.18	65	TP7
694.48		0.29	65	TP7
697.29		0.32	65	TP7
699.27		0.32	65	TP7
702.24		0.30	65	TP8
704.22		0.26	65	TP8
756.85		0.21	65	TP8, PC
761.14	0.17	65	TP8	
761.31		0.16	64	TP8
765.10	0.17	64	TP8	
768.73	0.18	64	TP8	
992.14	0.16	61	TP10	

SAMPLE COPY

BLK	VER RI	LAT RI	
****	*****	*****	
1.	2.89	4.42	
2.	3.26	3.65	
3.	2.82	3.94	
4.	3.60	3.78	
5.	2.27	4.13	
Km Avg RI	2.96	3.98	4 km, avg speed 62.37 KMPH

18.65	0.16	60	TP1
96.19	0.19	60	TP1
128.54	0.17	60	TP2
132.49	0.17	60	TP2
136.29	0.17	60	TP2

*****Dist=535.26m, km = 4 Spd = 59.000 Non Recording Mode is Starts Here*****
 *****Dist=705.54m, km = 4 Spd = 59.952 Non Recording Mode is ends Here*****

JRE/SSRE	ADE/DTM/EDTMR	PED/TM	Page no.20 of 32
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RIDE INDEX

Machine No 12345
 Run No 543
 Date 31-03-2011
 Time 11:02:49
 Railway NR
 Train No 14127
 Coach No ER12345
 Tacho No

ANNEXURE C
 (Page 1 of 1)

 BLK VERRI LATRI
 ***** ***** *****

SEC 1LKO-CNB

1.	3.12	2.43
2.	3.27	4.38
3.	2.56	2.66
4.	2.77	2.67
5.	2.62	2.74
Average RI	2.86	2.97

2km,avg speed 61.01KMPH

1.	2.89	3.42
2.	3.26	3.65
3.	2.82	3.94
4.	3.60	3.78
5.	2.27	4.13
Average RI	2.96	3.78

3km,avg speed 60.19KMPH

1.	2.43	2.68
2.	2.63	2.52
3.	3.07	2.93
4.	2.78	2.15
5.	3.21	3.09
Average RI	2.82	2.68

4km,avg speed 60.54KMPH

1.	3.79	3.82
2.	2.56	2.40
3.	3.30	2.95
4.	3.22	3.28
5.	2.56	3.25
Average RI	3.08	3.14

5km,avg speed 61.55KMPH

SAMPLE COPY

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EXECUTIVE SUMMARY

RUNNO :543
DATE : 31-Mar-2011
SECTION : SEC 1 LKO-CNB
START KM 1
END KM 5
VER PEAK MIN : 0.15
VER PEAK MAX : 0.50
LAT PEAK MIN : 0.15
LAT PEAK MAX : 0.50
VER RI MIN :2.50
VER RI MAX :5.00
LAT RI MIN :2.50
LAT RI MAX :5.00

ANNEXURE D
(Page 1 of 1)

Acc limit No of Ver Peaks

>0.15 62
>0.20 21
>0.25 7
>0.30 1
>0.35 0
>0.40 0
>0.45 0

Vertical Average peak per Kilometer : 15.50

Acc limit No of Lat Peaks

>0.15 55
>0.20 24
>0.25 10
>0.30 2
>0.35 1
>0.40 0
>0.45 0

Lateral Average peak per Kilometer: 13.75

RI limit No of Ver RI Blocks

>2.50 16
>2.75 14
>3.00 9
>3.25 5
>3.50 2
>3.75 1
>4.00 0
>4.25 0

Vertical Average RI per Block : 3.03

RI limit No of Lat RI Blocks

>2.50 14
>2.75 13
>3.00 10
>3.25 8
>3.50 7
>3.75 6
>4.00 3
>4.25 2

Lateral Average RI per Block: 3.28

SAMPLE COPY

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EXCEPTION REPORT TIME MODE

Machine No 12345
 Run No 543
 Date 31-03-2011
 Ver (Th) 0.20
 Lat (Th) 0.20
 Ver RI(Th) 2.50
 Lat RI(Th) 2.50

 Section Name LKO-CNB
 Start Km 1
 End Km 3
 Speed (Th) 60

ANNEXURE E-I
 (Page 1 of 2)

TIME	Ver Peaks	Lat Peaks	Events
mm:ss:mss			
00:02:780		0.27	TP1
00:02:840		0.21	TP1
00:02:990		0.27	TP1
00:03:620		0.20	TP1
00:03:850		0.21	TP1
00:03:980		0.25	TP1
00:04:100		0.22	TP1
00:04:220		0.21	TP1
00:04:320		0.26	TP1
00:04:450		0.29	TP1
00:04:560		0.22	TP1
00:05:000		0.20	TP1
00:05:130		0.20	TP1
00:05:240		0.22	TP1
00:07:360	0.20		TP2
00:08:360	0.21		TP2
00:08:590	0.22		TP2
00:09:710	0.22		TP2
00:16:440			BR
00:16:660	0.23		TP3
00:17:570			LX
00:18:840			PC
00:19:580		0.22	TP3
00:19:860			COUT
00:20:100		0.21	TP3
00:20:270		0.26	TP3
00:20:430		0.30	TP3
00:20:580		0.28	TP3
00:20:730		0.24	TP3
00:23:710	0.21		TP3
00:25:830		0.21	TP4
00:25:840	0.20		TP4
00:27:700	0.23		TP4
00:28:190		0.21	TP4
00:28:700		0.31	TP4
00:28:820		0.21	TP4
00:29:030		0.20	TP4
00:29:150		0.21	TP4
00:29:270		0.24	TP4
00:29:370		0.25	TP4
00:29:490		0.22	TP4
00:45:010	0.22		TP7

SAMPLE COPY

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ANNEXUREE-I
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BLK	VER RI	LAT RI	
****	*****	*****	
1.	2.89	4.42	
2.	3.26	3.65	
3.	2.82	3.94	
4.	3.60	3.78	
5.	2.27	4.13	
Km Avg RI	2.96	3.98	3km,avg speed 60.19KMPH

TIME	Ver Peaks	Lat Peaks	Events
------	-----------	-----------	--------

mm:ss:mss		0.21	TP3
00:12:350			
00:14:340		0.24	TP3
00:20:810		0.27	TP4
00:21:430	0.20		TP4
00:21:460		0.27	TP4
00:48:990		0.21	TP8
00:49:730		0.17	TP8
00:50:000	0.27		TP8
00:50:050		0.28	TP8
00:51:460		0.21	TP8
00:51:590	0.22		TP8
00:54:140		0.24	TP8
00:54:190		0.25	TP8

BLK	VER RI	LAT RI	
****	*****	*****	
2.	2.63	2.52	
3.	3.07	2.93	
4.	2.78	2.15	
Km Avg RI	2.82	2.53	4km,avg speed 60.54 KMPH

TIME	Ver Peaks	Lat Peaks	Events
------	-----------	-----------	--------

mm:ss:mss			
00:00:250	0.21		TP1
00:03:530	0.21		TP1
00:03:690	0.21		TP1
00:04:850	0.23		TP1
00:04:850		0.21	TP1
00:05:550	0.26		TP1
00:05:830	0.23		TP1
00:06:390	0.22		TP2
00:06:490	0.21		TP2
00:06:680		0.21	TP2
00:19:760		0.23	TP3
00:20:800	0.22		TP3

BLK	VER RI	LAT RI
****	*****	*****
1.	3.79	3.82
2.	2.56	2.40
3.	3.30	2.95
5.	3.22	3.28
Km Avg RI	3.22	3.11

SAMPLI

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EXCEPTION REPORT TACHO MODE

Machine No 12345
 Run No 543
 Date 31-03-2011
 Ver (Th) 0.20
 Lat (Th) 0.20
 Ver RI (Th) 2.50
 Lat RI (Th) 2.50

ANNEXUREE-II
 (Page 1 of2)

 Section Name LKO-CNB
 Start Km 1
 End Km 5
 Speed (Th) 60

Dist (mtr)	Ver Peaks	Lat Peaks	Spd (Kmph)	Events

***** 5.26		0.27	65	TP1
5.45		0.21	65	TP1
5.79		0.27	65	TP1
7.45		0.20	65	TP1
8.56		0.21	65	TP1
8.99		0.25	65	TP1
9.02		0.22	65	TP1
9.26		0.21	65	TP1
9.78		0.26	65	TP1
10.45		0.29	65	TP1
10.89		0.22	65	TP1
11.96		0.20	65	TP1
12.45		0.20	65	TP1
12.89		0.22	65	TP1
13.13	0.20		65	TP1
13.56	0.21		65	TP1
13.89	0.22		65	TP1
14.23	0.22		65	TP1
15.56			65	TP1,BR
15.89	0.23		65	TP1
16.02			65	TP1,LX
16.45			65	TP1,
16.52				PC
16.78		0.22	66	TP1
17.56			65	TP1
17.72				COUT
18.89		0.26	65	TP1
19.23		0.30	65	TP1
19.56		0.28	65	TP1
19.96		0.24	65	TP1
21.56	0.21		65	TP1
21.89		0.18	65	TP1
22.56	0.20		66	TP1
23.45	0.23		65	TP1
24.96		0.21	65	TP1
26.65		0.31	65	TP1
28.24		0.21	65	TP1
29.87		0.24	65	TP1
30.45		0.25	65	TP1
30.68		0.22	65	TP1
31.86	0.22		65	TP1

SAMPLE COPY

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ANNEXURE E-II
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BLK	VER RI	LAT RI	
****	*****	*****	
1.	2.89	4.42	
2.	3.26	3.65	
3.	2.82	3.94	
4.	3.60	3.78	
5.	2.27	4.13	
Km Avg RI	2.97	3.98	3km,avg speed 60.19 KMPH

Dist (Mtr)	Ver Peaks	Lat Peaks	Spd (Kmph)	Events

12.22	0.21		65	1
12.45	0.24		65	1
14.03	0.27		65	1
14.56	0.20		65	1
14.98	0.27		65	1
17.45	0.21		65	1
17.56		0.17	65	1
18.02	0.27		65	1
18.56	0.28		65	1
18.99		0.21	65	1
19.12	0.22		65	1
19.56	0.24		65	1
20.12	0.25		65	1

BLK	VER RI	LAT RI	
****	*****	*****	
2.	2.63	2.52	
3.	3.07	2.93	
4.	2.78	2.15	
5..	3.21	3.09	
Km Avg RI	2.92	2.67	4km,avg speed 60.54 KMPH

SAMPLE COPY

DIST (Mtr)	Ver Peaks	Lat Peaks	Spd (Kmph)	Events
5.12	0.21		65	TP1
6.98	0.21		65	TP1
7.45	0.21		65	TP1
7.99	0.23		65	TP1
8.12		0.18	65	TP1
8.45	0.26		65	TP1
8.99	0.23		65	TP1
9.12	0.22		65	TP1
9.56	0.21		65	TP1
9.99	0.21		65	TP1
13.45	0.23		65	TP1
13.96	0.22		65	TP1

BLK	Ver RI	Lat RI
1	3.79	3.82
2	2.56	2.40
3	3.30	2.95
5	3.22	3.28
Km Avg RI	3.21	3.11

JRE/SSRE	ADE/DTM/EDTMR	PED/TM	Page 26 of 32
Prepared By:	Checked By:	Approved By:	

ISO 9001-2015	Document No.: TM/SM/476	Version No.05	Date Issued :-/--/----
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TIME TO DISTANCE

Machine No 12345
 Run No 56
 Date 31:03:2011
 Time 11:02:49
 Cal Date 31:03:2011
 Cal Time 10:59:08
 Ogvval 0.00
 Oglval 0.00
 lgvval 4.50
 lglval 4.50
 Railway NR
 Train No 4127
 Up/Dn Up
 Tacho No
 Ver (Th) 0.15
 Lat(Th) 0.15
 Ver RI (Th) 2.50
 Lat RI (Th) 2.50
 Transducer Trailing
 RI Blk/Km 5
 No of Sections 1

ANNEXURE F
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SAMPLE COPY

 Section Name LKO-CNB
 Start Km 1
 End Km 50
 Speed Limit 100
 Run Speed 100
 Kilometer Increment
 Electrified No

Dist V Pks L Pks Event Speed

SEC 1 LKO-CNB				
294.2	0.17		TP3	72
301.9	0.16		TP4	72
305.6		0.23	TP4	71
713.5		0.24	TP8	73
729.7		0.29	TP8	72
764.1		0.16	TP8	71
858.6		0.19	TP9	72
883.5		0.16	TP9	71
920.7	0.19		TP10	73
921.7		0.15	TP10	73
1000.0				
46.5		0.17	TP1	74
54.3		0.26	TP1	74
60.5		0.19	TP1	74
76.2		0.22	TP1	73
79.9		0.16	TP1	73
87.6		0.22	TP1	73
123.1	0.18		TP2	73
139.8	0.16		TP2	72
143.6	0.19		TP2	72
162.3	0.17		TP2	72
191.1		0.19	TP2	71

2km,avg speed 72.34 KMPH

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ANNEXURE F
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193.1		0.16	TP2	71	
274.9			BR		
278.5	0.23		TP3	70	
293.8			LX		
315.0			PC		
318.3		0.15	TP4	69	
327.4		0.18	TP4	69	
332.1			C-out		
336.1		0.17	TP4	69	
338.9		0.26	TP4	69	
348.9			PC		
352.3	0.18		TP4	69	
394.2		0.15	TP4	68	
431.9		0.18	TP4	69	
432.0	0.20		TP4	69	
444.6	0.18		TP4	70	
463.1	0.23		TP4	70	
462.8		0.19	TP4	69	
473.8		0.27	TP4	70	
481.9		0.21	TP4	70	
487.4		0.19	TP4	70	
494.7		0.18	TP4	70	
752.5	0.22		TP8	70	
775.0	0.18		TP8	70	
790.2	0.17		TP8	70	
910.9	0.16		TP9	70	
1000.0					3km,avg spd 70.1 Kmph
207.7	0.21		TP3	70	
241.2	0.24		TP3	70	
247.4	0.18		TP3	69	
325.4	0.16		TP4	69	
349.5	0.18		TP4	69	
350.0	0.27		TP4	69	
360.4	0.20		TP4	70	
360.9	0.27		TP4	70	
361.6	0.16		TP4	70	
369.3	0.16		TP4	70	
373.0	0.18		TP4	69	
823.1	0.19		TP9	69	
823.9	0.21		TP9	70	
835.9	0.15		TP9	70	
836.4	0.17		TP9	71	
840.9	0.27		TP9	71	
841.7	0.28		TP9	71	
865.5	0.18		TP9	71	
867.6	0.18		TP9	71	
910.5	0.16		TP10	71	
911.4	0.17		TP10	71	
1000.0					4km,avg spd 70.5 Kmph
8.4		0.21	TP1	70	
21.4		0.17	TP1	70	

SAMPLE COPY

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Annexure-G

Data File format for OMS in Time Mode

98,1243,
 96,2,
 95,543,
 94, 12:42:56,
 93,12,09,2011,
 99,12229,
 92, 1,
 90,2,
 80,1,
 81,2,2,
 72,ER12345,
 91, CNB-ALD,ALD-MGS,
 83,100,90,
 84,80,100,
 64,100,250,
 65,249,500,
 97,1,
 70,1,2,
 87, 12,09,2011,
 88, 12:42:56,
 89,-0.02,0.01,4.46,4.49,
 85,0.10,0.15,
 86,0.30,0.30,
 60,23,24,
 61,23,01:12:23,0.15,0.17,
 61,23,01:12:24,0.0,0.18,
 61,23,01:12:25,0.18,0.17,
 61,23,01:12:26,0.0,0.17,
 61,23,01:12:27,0.15,0.17,
 71,23, 01:12:24,26,
 71,23,01:12:24,1,
 62,23,1,2.45,2.25,
 62,23,2,2.45,2.25,
 62,23,3,2.45,2.25,
 62,23,4,2.45,2.25,
 62,23,5,2.45,2.25,
 60,24,25,

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Data File format for OMS in TACHO MODE

98,1243,
 96,1,
 82,1650,
 95,543,
 94, 12:42:56,
 93,12,09,2011,
 99,12229,
 92, 1,
 90,2,
 80,1,
 81,2,2,
 63,1234,
 72,ER12345,
 91, CNB-ALD,ALD-MGS,
 83,100,90,
 84,80,100,
 64,100,250,
 65,249,500,
 97,1,
 70,1,2,
 87, 12,09,2011,
 88, 12:42:56,
 89,-0.02,0.01,4.46,4.49,
 85,0.10,0.15,
 86,0.30,0.30,
 60,23,24,
 61,23,55.60,0.15,0.17,
 61, 23,55.93,0.0,0.18,
 61, 23,56.43,0.18,0.17,
 61, 23,58.08,0.0,0.17,
 61, 23,59.07,0.15,0.17,
 71,23,100.44,26,
 71,23, 1000.00,1,
 62,23,1,2.15,2.25,
 62,23,2,2.35,2.25,
 62,23,3,2.45,2.45,
 62,23,4,1.45,1.85,
 62,23,5,2.45,2.55,
 60,24,25,

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Annexure-I

Description of record type for OMS data file format in Tacho and Time mode

Record No	OMS Data	Drop Down Menu									
96	Recording Mode	1- Tacho	2- Time								
92	Railway	0-CR	1-ER	2-WR	3-NR	4-SR	5-SC	6-NE	7-SE	8- NF	9-ECR
		10-NCR	11-WCR	12-NWR	13-SWR	14-SEC	15-ECO	16-KRCL	17-Others		
80	Transducer Placement	1-Leading	2- Trailing								
90	No. of Section	1	2	3	4	5					
81	Run Direction	1-UP	2-DN	3-SL	4-3 rd LINE	5-Others					
70	Section electrified	1-Yes	2-No								
97	TP Counting	1- Odd	2- Even	3-Continuous							

Taken from the System

98	Machine No.	Machine No.									
95	Run no	Run no									
94	Run Time	hh:mm:ss									
93	Date of Run	Day	Month	Year							
87	Calibration Date	Day	Month	Year							
88	Calibration Time	hh:mm:ss									
89	Calibration Values	1- 0g V	2- 0g-L	3-1gV	4- 1g L						

Entered by the User

99	Train No.	Train No.									
72	Coach No.	Coach No.									
82	Tacho Factor	Tacho Factor									
63	Route Code	Route Code									
91	Sections Name	Section1	Section2	Section3	Section4	Section5	(No. of entries depends upon the no. of sections.)				
83	Section Speed	Speed1	Speed2	Speed3	Speed4	Speed5	(No. of entries depends upon the no. of sections.)				
84	Run Speed	Speed1	Speed2	Speed3	Speed4	Speed5	(No. of entries depends upon the no. of sections.)				
64	Section Start Km	Section1	Section2	Section3	Section4	Section5	(No. of entries depends upon the no. of sections.)				
65	Section End Km	Section1	Section2	Section3	Section4	Section5	(No. of entries depends upon the no. of sections.)				
85	Lower Threshold value										
	For acceleration peaks	1-Vert	2-Lat								
86	Higher Theshold value for acceleration peaks	1-Vert 2-Lat									

Recorded Data

61	Peak above threshold Details	1-KM	2-Time/Dist	3-Vert Peaks	4-Lat Peaks	(0.0 for no peak Vert/Lat above threshold)					
62	RI	1-Km	2-Block No.	3-VertRI	4- Lat RI						
71	Event	1-Km	2-Distance/time	3-Code							
60	KM	From	To								

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List of Route Feature codes

Annexure-J

S.No	Route Feature	Route Code
1	Km post,	1
2	TP/OHE Mast,	2
3	Pt.& Crossing,	40
4	Level Crossing,	26
5	Switch Expansion Joint,	47
6	Buffer rails,	50
7	Road Over Bridge,	22
8	Bridge (Steel Girder) In,	20
9	Bridge (Steel Girder) Out,	21
10	Bridge (Others) In,	24
11	Bridge (Others) Out,	25
12	Curve In,	10
13	Curve Out,	11
14	Tunnel In,	68
15	Tunnel Out,	69
16	Cutting In,	60
17	Cutting Out,	61
18	Siding/loop In,	72
19	Siding/loop Out,	73
20	Speed Restriction In,	70
21	Speed Restriction Out,	71
22	Transponder	77

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