



सत्यमेवजयते

**भारतसरकार (GOVERNMENT OF INDIA)
रेलमंत्रालय (MINISTRY OF RAILWAYS)**

**Specification
of
End-of-Train Telemetry (EoTT) System
For Indian Railways**

**Specification No.RDSO/2021/EL/SPEC/0144, Rev. '1'
Issued on: XX.03.2022**

Approved by	Signature
PEDSE	

**ELECTRICAL DIRECTORATE
RESEARCH DESIGNS AND STANDARDS ORGANISATION
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STATUS OF REVISION

S. N.	Date of Revision	Page No.	Revision	Reasons for Revision
1.	-	All	0	First Issue
2.	XX.03.2022	4,7,14,15,17,18 20,21,23,28,31, 33,39,40	1	Second Issue

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Chapter 1

GENERAL

1.1 Introduction:

- 1.1.1 Railway Board vide it's letter number 2018/Elect(Dev)/181/4 dated 20.8.2018 had advised RDSO to finalize the specification of End of Train Telemetry (EoTT) project.
- 1.1.2 Since EoTT was not in use over IR, hence FRS no. RDSO/2019/EL/FRS/0025 Rev '0 dated 25.6.2019 prepared & issued by RDSO. This FRS covers constructional features, technical requirements and testing procedure for EoTT for Indian Railways. RDSO has issued the Specification No. RDSO/2021/EL/SPEC/0144 Rev.-0 dated 11.05.2021 based on FRSno. RDSO/2019/EL/FRS/0025 Rev '0 dated 25.6.2019.
- 1.1.3 Developmental orders were placed by ECoR & BLW based on FRS & Field Trials have been started on IR.
- 1.1.4 This specification is revised prepared based on FRSno. RDSO/2019/EL/FRS/0025 Rev '0 dated 25.6.2019 & little experience gained during Field trials with EoTT on IR.

1.2 Definition of terms:

The following terms and abbreviations are used throughout the Specification.

AAR	-	The Association of American Railroads
AB	-	Air Brake
ALP	-	Assistant Loco Pilot
AMC	-	Annual Maintenance Contract
APN	-	Access Point Name
API	-	Application Program Interface
BLW	-	Banaras Locomotive Works, Varanasi
BP	-	Brake pipe
CLW	-	Chittaranjan Locomotive Works, Chittaranjan
CU	-	Cab Unit. It is another name used for Head of Train (HoT) unit.
DFCC	-	Dedicated Freight Corridor Corporation of India Limited
DPWCS	-	Distributed Power Wireless control System
DTWL	-	Disabled Train Warning Light
DU	-	Display Unit. It is part of HoT device that is fitted in the locomotive. One display unit will be provided in each cab of the locomotive. Total two display units will be provided as part of HoT. Either two identical display units can be provided or one Master & one slave display unit can be provided.
EoT	-	End of Train unit. It comprises of SBU, Radio transmitter & Receiver, battery, Air turbine for battery charging, GPS device etc. It transmits and receives information to/from HoT device fitted

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		in the locomotive. It is also referred as Rear Unit (RU).
EOTT	-	End-of-Train Telemetry system. It comprises of Head of train (HoT) device mounted in the locomotive and End of train (EoT) device mounted on the rear end of rearmost vehicle of the train along with other fittings and accessories complete as per this specifications.
FP	-	Feed pipe
FRS	-	Functional Requirements Specification
GAGAN	-	GPS Aided Geo Augmented Navigation
GNSS	-	Global Navigation Satellite System
GPRS	-	General Packet Radio Service
GPS	-	Global Positioning System
GSM	-	Global System for Mobile Communication
HoT	-	Head of Train device. It is also referred as Cab Unit (CU).
HVML	-	High Visibility Marker Light- The marker light portion of the EoT device, flashing light to mark the End of Train (EoT).
IEC	-	The International Electro-technical Commission
IR	-	Indian Railways
KPA	-	Kilo Pascal- (1KPA = 0.145 psig, 1 psig = 0.0704 Kg/cm ²)
LP	-	Loco Pilot. Term ‘Driver’ is also used for Loco Pilot.
LTE, LTE-R		Long Term Evolution LTE for Railways
MMD	-	Maximum Moving Dimensions
RDSO	-	Research Designs And Standards Organisation
RU	-	Rear Unit. It is another name used for End of Train (EoT) unit.
SBAS	-	Satellite-Based Augmentation System
SBU	-	Sense and Brake Unit. It is part of EoT. It is capable of determine status of Brake pipe pressure.
SMS	-	Short Message Service
TFR	-	Transnet Fright Rail
WPC	-	Wireless Planning & Coordination wing of Ministry of Communications & IT

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1.3 Contractor's Responsibility:

The contractor's responsibility will extend to the following:

- 1.3.1 Supply installation & commissioning of the equipment. For this purpose, the supplier shall depute his engineers/supervisors to CLW/DLW/Sheds/Workshops/Production Units (PUs) for installation of the equipment on locomotive.
- 1.3.2 Provide required instrumentation and carry out detailed tests and field trials jointly with RDSO.
- 1.3.3 Provide special tools and instruments separately which may be required for maintenance.
- 1.3.4 Details of input & output and corresponding locomotive cable numbers will be provided by RDSO and the same should be incorporated in manual supplied by the firm.
- 1.3.5 Supply the user's manual for maintenance and trouble shooting.
- 1.3.6 Providing Warranty support and AMC support.
- 1.3.7 Providing 24x7 helpline post commissioning during the warranty & AMC period.

1.4 SCOPE OF SUPPLY:

This specification covers design, development, manufacturing, testing and supply of End-of-Train Telemetry (EoTT) System for Electric/Diesel Locomotives. Electric Locomotive has a DC supply of 110 Volts, whereas Diesel Locomotive have a DC supply of 74 Volts. EoTT system must be compatible to work with both type of Locomotives. Quantity per locomotive is one set. The detail is given under Chapter 5.

1.5 TRAINING:

Firm shall arrange for demonstration of equipment and adequate training to Railway personnel of IR in field of its operation, routine checking/testing and in understanding fault diagnostics etc. Training modules shall be first approved by nominated agency of Indian Railways before they are executed by the firm.

1.6 Warranty:

- 1.6.1 The vendor shall be responsible for carrying out improvements and modifications at his own expense on all the equipment during the period of warranty provided such modifications/improvements are decided to be necessary for meeting the requirements of reliability, performance and safety etc.
- 1.6.2 The firm is required to give root cause analysis of all the failures and their corrective actions. In case of any modification (hardware and software), the necessary approval shall be obtained from RDSO.
- 1.6.3 For the purpose of technical decisions on improvements/modifications etc. on equipment, the final authority from the purchaser's side will be RDSO.
- 1.6.4 During warranty period all charges related to server/cloud service, data transfer etc. shall be paid by vendor.

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1.6.5 Charges for AMC beyond warranty period shall also be specified by the vendor and shall include the charges related to server/cloud service, data transfer etc.

1.6.6 Warranty period shall be as per IRS condition of contract.

1.7 ANNUAL MAINTENANCE CONTRACT (AMC):

1.7.1 Firm has to quote for Comprehensive AMC - including Data charges, Cloud Service/Server maintenance, spares, necessary **upgradation (will not impose by IR but if necessary due to absolute technology also)** and manpower required to keep the equipment operational at all times.

1.7.2 The firm shall also submit their bid for Comprehensive AMC of the EoTT for a period of 7 years after expiry of warranty period. Indian Railways may, based on its experience of the service offered and reliability of equipment, operate the AMC for less than 7 years in which case payment for the AMC will be made on pro rata basis.

1.7.3 The EoTT fitting and taking down at sheds shall be included in AMC.

1.7.4 ~~RDSO will issue the detailed conditions of Comprehensive AMC separately. Detailed conditions of Comprehensive AMC can be referred in RDSO's Special Maintenance Instruction No. RDSO/2021/EL/SMI/0329 Rev '0' dt. 21.05.2021 or latest. SMI is attached as Annexure-XII. Latest revision is to be referred.~~

1.8 FIELD TRIAL:

1.8.1 Field trial shall be done to check EoTT reliability under rigorous environmental and actual train operating condition since this equipment has direct bearing on safety.

1.8.2 After successful completion of type tests, EoTT equipments (~~five numbers~~) shall be subjected to field service trials ~~for a minimum period of six months, provided the system should atleast complete 50000 kms of field trials. For completion of successful field trial, following conditions shall be met, whichever is later :~~

(a) Two to Six sets of EoTT should be put under field trial and at least twelve equipment months of field trial should be completed.

(b) All the EoTTs under field trial shall earn at least 25,000 kms during field trials cumulatively.

1.8.3 The ~~five numbers~~ of trial EoTT equipments and venue shall be as agreed between the purchaser and the supplier. Locomotives provided with all ~~five~~ EoTT systems on field trial locomotives shall be preferably based at one loco shed for the ease of monitoring and after sales support.

1.8.4 Detailed trial scheme shall have to be drawn up by the supplier jointly along with RDSO. Tentative Field Trial Scheme is attached as Annexure-X. Tests that can not be performed during Field trials, should be performed during prototype testing. Firms must ensure inclusion of these tests into prototype test schedule.

1.9 Approval For Design:

The design shall be developed based on the requirements given in this Specification and sound engineering practices. Approval of design means the approval of general design

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features. Notwithstanding the approval, the vendor shall be wholly responsible for the performance and reliability of the complete system.

1.10 Documentation:

The firm shall submit following information for the design approval of EoTTin printed form and in digital format:

- (a) Details of HOT module, EOT module power supply module& other subassemblies
- (b) System design of EoTT
- (c) Schematic Circuit/Block diagram
- (d) Functional Description
- (e) Protection scheme
- (f) BOM (Bill of Material), Data sheets for components/devices and other equipment proposed for use.
- (g) Mechanical interface diagram (Outline General Arrangement), assembly drawings of complete unit, mounting arrangement and weight.
- (h) Clause by clause compliance of specification.
- (i) Test protocol with procedure of testing.
- (j) Details of Backup data memory size and battery backup size along with calculations.
- (k) Colour co-ordinates, specified operating parameters as per the specification and minimum guaranteed values achieved by the manufacturer,
- (l) Any other information as deemed fit from user's point of view.

1.11 Important Documents Referred In This Specification:

1.	IEC-60571: 2012-09	General requirements and tests for electronic equipment used on Rail vehicles.
2.	IEC-60077-1: 2017-07	Railway applications – electric equipment for rolling stock Part 1: General service conditions and general rules
3.	IEC-60529: 2013-08	Degrees of protection provided by enclosures (Code IP)
4.	IEC-61373: 2010-05	Railway applications – Rolling stock equipment – Shock and vibration tests
5.	UL 60950	for Safety of mains powered equipment
6.	AAR standard S-9152 . V2.1	AAR Manual of Standards and Recommended Practices – Locomotive Electronics and Train Consist System Architecture – End of Train Communications

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7.	TFR BBB 1776 Ver. 4 Rev-'0'	Transnet Freight Rail specification 'Telemeter/End-of-Train (EoT) Equipment for Air and Vacuum Brake Trains
8.	Annexure A to BBB 1776	EOT Protocol Changes and Clarifications
9.	TFR BBF 0334V5	Transnet Freight Rail Annexure B to Specification BBB 1776 Interface requirements Telemeter/EoT and Train Communication system (TCS).
10.	TFR BBD 5420V3	Transnet Freight Rail Specification Telemeter Rear Unit GPRS Tracking document.
11.	TFR BBF 0872 V3	Transnet Freight Rail Specification Fixed Repeaters.
12.	ELRS/SPEC/SI/001 5 OCT '2001 (or latest)	Reliability of electronics used in rolling stock application
13.	IEC-60812:2018-08	Failure modes and effects analysis (FMEA and FMECA)
14.	IEC-61000-4-6	Electromagnetic compatibility (EMC) - part 4-6: Testing and measurement techniques - immunity to conducted disturbances, induced by radio-frequency fields
15.	BS-1376:1974	Specification for colours of light signals
16	EN-50155:2017	Railway applications - Rolling stock -Electronic equipment
17	EN 300 113-1:2011	Electromagnetic compatibility and Radio spectrum Matters (ERM); Land mobile service; Radio equipment intended for the transmission of data (and/or speech) using constant or non-constant envelope modulation and having an antenna connector; Part 1: Technical characteristics and methods of measurement

Note : Latest versions of all the standards referred will be used.

1.12 Infringement Of Patent Rights:

Indian Railway shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, use of similar components used in design, development and manufacturing of EoTT device and any other factor not mentioned here in

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which may cause such a dispute. The entire responsibility to settle any such dispute/matters lies with the vendor.

Details/design/documents given by the vendors are not infringing any IPR (Intellectual Property Rule) and they are responsible in absolute and full measures instead of Indian Railways for any such violations. Data specifications and other IP (Intellectual Property) as generated out of interactions with Indian Railways shall not be unilaterally used without consent of RDSO and right of Indian railways/RDSO on such IP is acceptable to them.

- 1.13** All the provisions contained in RDSO's ISO procedures laid down its Document No. QO-D-8.1-11 dated 01.07.2020 (titled "Vendor Changes in approved status") and subsequent versions/ amendments thereof, shall be binding and applicable on the successful vendor/ vendors in the contracts floated by Railways to maintain quality of products supplied to Railways.

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Chapter -2

Functional requirements

2.1 Main Functions of EoTT

- 2.1.1 To provide display of BP pressure of the last vehicle of the train to LP in the cab of the locomotive.
- 2.1.2 To apply emergency brakes from the last vehicle of the train remotely by LP in the cab of the locomotive.
- 2.1.3 To check & detect train integrity. Train parting shall be identified by the EoTT.
- 2.1.4 To broadcast location of EoT device to other trains equipped with EoTTin case of emergency like train parting, derailment etc., on command by LP.
- 2.1.5 To indicate passage of complete train over a particular location when desired by LP.
- 2.1.6 To indicate the GPS location of EoT&HoT over the map on the website.
- 2.1.7 To provide rear end 'High Visibility Marker Light'.
- 2.1.8 To provide rear end 'Disabled Train Warning Light'.

2.2 Functions Required to be performed by EoTT

- 2.2.1 The display for the train driver should display the air pressure in the format-NN.n kg/cm² i.e. upto one place of decimal.
- 2.2.2 It should be possible to do Emergency brake application from the rearmost wagon using EoT device through SBU in case of train parting. The HoT device should have provision of activating such an event as a positive act by the locomotive crew.
- 2.2.3 EoTT shall have provision of application of emergency brake through EoT device using function programmed into the HoT device if the train driver desires to invoke such function.
- 2.2.4 EoTT should Alert Driver when BP pressure levels of last vehicle move outside specified limits.
- 2.2.5 EoTT should Alert Driver in case of low battery power of the SBU (below 25%) or other alarms or telemetry system failure of any nature.
- 2.2.6 The EoT and HoT devices must monitor their own health status and immediately show an alarm on the DU screen as well as by means of a red flashing LED on the HoT device so as to catch the attention of the train driver of any malfunction.
- 2.2.7 The EoT device and HoT device must do hand shaking during run with each other so as to acknowledge safe working of the system.
- 2.2.8 Logging of performance of the EoT device and HoT device at nominally every 60 seconds. The same should be stored internally for at least 30 days.

2.2.9 Train Integrity Operation

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- a. A ‘Train Integrity Function’ is required, in order to assist the driver in ascertaining/ confirming whether the train is “complete” (i.e. has not become “parted”). This may be achieved by employing GPS units in the HoT&EoT and by continuously monitoring the speed and displacement differences between the front & rear of the train.
- b. The following shall be displayed to the driver:
 - “Train OK” - When the system detects no evidence of the train being parted
 - “Caution” - In cases where there is (temporary) doubt of train completeness
 - “Train Error” - When the system detects that the train has become parted
 - “Move” or “Stop” as per AAR S-9152.
 - Speed of the HoT and Speed of the EoT (RU)
 - “Length” / Displacement at start-up, plus relative Deviation (+ or -)
- c. The display should therefore preferably be divided into 2 areas: One for the standard pressure & battery status information, and the other for the Train Complete, speed, distance, etc. information.
- d. The GPS information (from the EoT) to be used for this function is to be transmitted in additional message data blocks after the standard ones as per AAR S-9152. The message format /structure will be as per Annexure A of TFR BBB1776 version 4 (or latest).
- e. After initial switch-on of the EoTT, when both HoT and EoT GPS equipments have satellite fixes, the displacement in meters between the front and rear units shall be displayed to the train driver as “Train Length xxxx m?”, whereupon if acceptable to the driver, the value may be accepted by pressing the Enter>Select button. (If not acceptable, the driver should wait for further updates). This value must then be stored, and used as reference for future displacement readings, which are to be displayed as the stored value, together with a deviation (+/-).
- f. Similarly, the RU and CU speeds are to be stored, averaged and compared (10 second moving averages are proposed).
- g. The above 2 parameters are to be monitored as follows:
 - If speeds differ by <10 kmph, AND displacement deviation <100 meters: TRAIN OK
 - If speeds differ by >10 kmph, OR displacement deviation >100 meters: CAUTION
 - If speeds differ by >10 kmph, AND displacement deviation >100 meters: TRAIN ERROR
- h. However, for TRAIN OK, the Pressure must be above the alarm levels, or else CAUTION must be displayed, but TRAIN ERROR must be displayed irrespective of the Pressure levels. The train driver will have to take all factors into account in this case.
- i. The above indications are to be given with a very high degree of integrity, and a very low incidence of false alarms. Vendors are to provide full details of their proposed system, as well as its level of integrity.

2.2.10 Emergency Brake application from Rear by LP

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- a. The functionality of braking from rear shall be provided as per clause 3.0 of AAR S-9152.V2.1 (or latest).
- b. The EoTT system shall have capability of applying the brakes, restoring normal brake operation, transmission of status information and testing the communication channel on receipt of command.
- c. The rear emergency valve is regarded as a backup device and not a braking performance improvement device.
- d. A failure of the system shall not cause application of the emergency brakes.
- e. The cab unit shall provide the additional capability of applying the emergency brakes at the rear end of the train via an emergency air dump valve, activated by remote control. The capability of requesting transmission of status information from the rear unit and of testing the communication channels shall also be provided as per clause 3.8 of AAR S-9152.V2.1 (or latest).

f. Manual Emergency Brake Activation:

The cab unit will have a switch that when activated, will initiate a front to rear transmission containing an emergency brake application command. On receipt of this command, the brakes will be applied in the rear unit. The switch, distinctively labeled '*Emergency*' will be protected so that there will exist no possibility of accidental activation.

g. Automatic Emergency Brake Activation:

The front to rear transmission and rear-of-train equipment shall provide for application of train emergency air brakes upon emergency train brake application by the loco pilot in the cab.

- h. Delay between receipt of the command to apply rear emergency brakes and the rear valve's activation shall be 1 second or less.
- i. The rear unit on receipt of a properly coded command, will open a valve in the brake line and hold it open for a minimum 15 seconds. This opening of the valve shall cause the brake line to vent to atmosphere.
- j. The valve opening shall have a minimum diameter of 3/4inch, and the internal diameter of hose shall be 5/8 inch, minimum to effect an emergency brake application.
- k. Restoring of the brake function (recharging of the air brake system) shall be enabled automatically by the rear equipment, no more than 2 minutes after it has initiated an emergency.

2.2.11 **Disabled Train Warning Light (DTWL)**

It will be provided as per clause 4.15 of AAR S-9152.V2.1. In the event a train suddenly becomes disabled, such as from an undesired emergency brake application, this option would add a light to warn approaching trains of this situation. This warning light would be illuminated either automatically when train brakes applied in emergency or manually by the loco pilot using a cab control switch/menu option. The light would be reset by a control

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switch/menu option. This warning light would not replace the rear end marker device, nor shall the marker device serve this function.

2.2.12 Authorization for Two way Telemetry system

Two way telemetry system authorization will be as per clause 3.10 of AAR S-9152.V2.1.

It is to provide additional security to prevent unauthorized application of emergency braking feature by a party or parties external to the control cab of train.

2.2.13 Repeater function

- a. In certain situations it may be necessary to repeat the signal between HoT and EoT, by means of an On Train repeater, or by means of Track Side (Fixed) repeaters. Both versions are to display at least the following when messages are repeated: EoT ID number, and Time (hh:mm:ss) with at least the last 5 messages being continuously displayed.

b. On-Train Repeater

In this case the HoT is to be configured such that during switch-on / powering up, the HoT may be switched into “repeater mode”. The user shall thus have the option of selecting either normal “HoT” or Repeater” mode so that a HoT may either function as a cab unit, or as a repeater when required. The repeater shall also be “matched” to the EoT in the same way as the HoT, and shall only repeat valid messages from its matched EoT or HoT, after a delay of 500 milliseconds.

Vendors are to clearly and in detail indicate how their repeater is to function, so as to ensure that secure and reliable repeated communications are to be effected, without communication collision problems (e.g. between paired HoT/EoTs, OR with other HoTs, EoTs or repeaters). The “switch-on /start-up” procedure must also be fully described, and must be easy to perform, bearing in mind the possible logistical problems due to long distances between equipment units.

c. Track-Side / Fixed Repeater

This repeater function may also be incorporated in the HoT software, and only be activated in the Sheds/workshop when required. In this case, the matching function is not required, but only valid messages from the HoT or EoT are to be repeated, after a 500 millisecond delay. 2G (GSM) / 4G (LTE/LTE-R for Indian Railways)/Latest technology tracking functionality is also required as an option, to allow remote monitoring of operation.

Vendors are to clearly and in detail indicate how their repeater is to function, so as to ensure that secure and reliable repeated communications are to be effected, without communication collision problems (e.g. between paired HoT/EoTs, OR with other HoTs, EoTs or repeaters).

- d. **Technical Circular for General Guidelines of Fixed/Track side Repeater for End of Train Telemetry (EoTT) system No. RDSO/2022/EL/TC/0157 Rev '0' dated 14.02.2022 is attached as Annexure-XIV. Latest revision is to be referred.**

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2.2.14 Alarms

An audible alarm, together with an appropriate flashing message display and red indicator light must be provided in the display unit to indicate following:

- a. Pressure alarm must be sounded and displayed on the DU when pressure drops below 3.0Kg/cm².
- b. Communication alarm must be sounded and displayed on the DU to indicate loss of radio communication as defined in AAR S-9152.
- c. Battery alarm must be sounded and displayed on the DU to indicate available battery power less than 25% in either HoT or EoT.
- d. Train Integrity alarm; when GPS derived parameters are outside the defined range.
- e. Complete Passage Alarm to indicate passage of complete train over a particular location.
- f. Train Integrity alarm shall be latched on until acknowledged. The other audio alarms will be for 5 seconds.
- g. Audio Alarm volume must be adjustable and adequate to be heard in noisy environment of the locomotive. **Alarm to make loud enough that it make attention on working loco condition. Provision of Suitable external speaker may be provided.**
- h. The visual alarm message display must continue until the pressures/parameters are within the specified range, or reception is restored or the unit is switched off.
- i. Alarm can be acknowledged by the LP using specified key. It will suppress the current audible alarm but the visual display will continue till the values normalize. When the alarm values change.
- j. **Emergency Broadcast alarm must be sounded and displayed on the DU to indicate the obstruction on nearby track**

2.2.15 Logging of Alarms and Performance on both HoT and EoT

- a. The EOTT performance must be continuously monitored and logged by the EoTT against time & GPS position (latitude, longitude), and stored in memory, so as to be available for down-load at the end of the trip via the USB port or other means. Both HoT&EoT must make use of a GPS unit so as to track its position against real (GPS) time.
- b. All communication messages received by the HoT, as well as alarms, are to be logged versus time & GPS position (latitude, longitude).
- c. The HoT time must be synchronised with that of the EoT and GPS time.
- d. Other data / parameters to be recorded are:
 - Start Up / Switch On date & time
 - Position and ID/Serial Numbers of EoT and HoT at start up
 - During the trip, periodic readings of pressure, battery voltages and alarms, e.g.
 - Low Battery
 - Low BP pressure
 - Communication Failure.
 - Emergency brake application from rear
 - Train parting etc.

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- Speed
- Train stopped
- Train moving
- Received signal strength, if possible

2.2.16 Web Server/Cloud Service

- a. In order to provide a tool for the effective asset management of EoTT equipment, tracking of both EoT&HoT by means of 2G/4G(LTE)/GPRS is required.
- b. EoTT device data, alarms and performance& GPS position of both EoT&HoT will be transmitted to web server/cloud at approximate interval of every 1 minute for HoT& after every 15 minutes for EoT (in normal operation when battery supply is available to HoT and Air generator supply is available to EoT). Data has to be transferred to server at approximate interval of every 20 minutes for HoT and 1hour for EoT (when battery/Air generator supply not available) subject to availability of 2G (GSM) or 4G (LTE/LTE-R) coverage. If no GSM/LTE coverage is available, then the un-transmitted data shall be transmitted as soon as GSM/LTE coverage is obtained. For transferring data from device to server/cloud, both devices (EoT&HoT) shall be equipped with SIM cards and use 2G/4G/Latest technology for data transfer. Atleast one SIM card (2G/4G/latest technology) in EoT and atleast two SIM cards(2G/4G/latest technology) of different operators for HoT shall be used for data transfer. Preferably, Embedded SIM (e-SIM) may be used instead of commercial SIMs for better reliability and ease of use.

Data generally to be transmitted (not exhaustive) to cloud/server is tabulated below:

SN	For HoT Device	For EoT Device
1.	HoT Commands	
a)	EBA	
b)	Emergency Broadcast	
c)	DTWL	
d)	Fog Condition	
2	Performance	
a)	CU ID or Loco ID	RU ID
b)	Date & time	Date & time
c)	Latitude & Longitude	Latitude & Longitude
d)	Speed of CU	Speed of RU
e)	BP Pressure	BP Pressure
f)	Train integrity status	HVML status
g)	Communication status	% Battery
3.	Alarms	
a)	Low BP	
b)	Low Battery	
c)	Train Integrity	
d)	Communication loss	
e)	ODO meter	

Train length and preferably total distance covered from last paring and life time data for (Emergency Brake Counter, Total Hrs of operation and total Run in Km) will also be transmitted.

c. Vendor Server& Website:

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- (i) There shall be mandatory provision of EoTT server in India by the vendors to access data under MeitY guidelines. For this purpose, vendor shall adopt/procure GI cloud services under Meghraj policy of MeitY, Government of India for the data of EoTT system.
- (ii) Public Cloud/Virtual Private Cloud(VPC) model suitable to Indian Railways(IR) shall be selected. Vendor will comply the policy guidelines of Meghraj policy and shall describe compliance of the same during design approval stage. Cloud hiring agency may be hired based on security assessment of data and requirements. Vendor shall incorporate relevant SLA (service level agreement) in their contractual agreements with CSP's (cloud service providers) to take care of the risks & challenges associated with procurement & consumption of third party cloud service.
- (iii) Proper training will be imparted by Vendor to IR to use data to the fullest. There shall always be a flexibility to accommodate more data to the system as and when more locomotives are fitted with EoTT system. Provision shall be there for integration of cloud data to the respective application of CRIS for centralized access by the Govt. for its strategic use.
- (iv) Change of Cloud Service Provider(CSP) due to any reason, the associated expenses shall be borne by the vendor.
- (v) **Server Server data is sole property of IR and vendor is only maintainer. It should not be share or destroy without written permission.**
- d. Webpage layout of the vendor for accessing the EoTT data will also be approved by RDSO. Dashboard approach will be followed to list all the locomotives/HoT/EoT at a glance. Filtering based on the Holding Railway/Shed and working Railway/sheds shall be possible. Detailed information will be available after selecting a particular locomotive/HoT/EoT. Locomotive/HoT/EoT position shall also be displayed on map.
- e. It shall also be possible to access the information by specifying unique ID of EoT/HoT/train number /locomotive number/ crew ID.
- f. Webpage will have some colour coding for identifying the systems which are running, stopped and in dead condition.
- g. Authorized users can access the EoTT device information through internet by connecting to vendor server through their own desktop/laptop/mobile devices.
- h. Railway Server: Railway may decide to setup its own server/CRIS Server for accessing the EoTT information of locomotives. It shall be possible to configure the EoTT device to transmit data to Railway server if required. Vendor shall provide communication protocol from EoTT device to server and other necessary details to transfer EoTT data from device to Railway server. It shall also be possible to transfer GPS data to Railway/CRIS server only and stopping the data transmission to vendor server if required by Railways.

2.2.17 Reliability & Availability

- a. The system must work reliably on a train of up to 200 wagon or 2.5 km length and train travelling at a speed of up to 120 kmph on straight track free from obstructions (like rocks, tunnels etc.) in clear weather conditions.
- b. All functions are to be performed with an extremely high degree of reliability, and must not result in unnecessary train delays or stoppages.

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- c. The equipment must be extremely reliable, with a minimum mean time between failures (MTBF) of 10000 hours per system/equipment pair. The integrity of the equipment must be such that the probability of a “Train OK” indication being false is less than one in 10^7 .
- 2.2.18 Maximum weight of the EoT with associated devices like couplers, pressure transducers, internal battery and air turbine/generator etc. fitted shall not exceed 12.5 kg.
- 2.2.19 Fixing arrangement of the EoT device should be quick to fit with adequate vandal-proofing arrangements to the satisfaction of Indian Railways.
- 2.2.20 Locking arrangement of the EoT device should be theft proof and should be pre-approved by nominated agency of Indian Railways before supply. **Firms are advised to provide a additional lock and chain arrangement to avoid falling of EoT unit on track in case locking arrangements fails.** Any modifications to be done in the same, based on service experience, shall be at the cost of the supplier upto a period of six months from the date of first supply including modifying those units which have already begun service in the field.
- 2.2.21 If a locomotive has to be detached from a working train and taken to haul another train, then the EoT shall be carried to the locomotive and if required, shall be put on charging on the Locomotive itself. In locomotives, DC supply (110V in electric loco & 74V in Diesel loco) is available. So EoT charging facility has to be provided in the locomotive by Firms. EoT device and HoT device need to be designed to cater to this mode of working. For interoperability, it is desirable that all makes of EoT devices can be charged in the locomotive with same connection. For this, it is advised that EoT device can be connected in the locomotive to locomotive battery for charging with Bayonet type circular connector with crimped pins (similar to connector no. 97B-3106A10SL-4P4S & 97B-3100A10SL-4S4P or equivalent). 24 V dc supply to be provided to connector & EoT battery to be charged at 24Vdc. This 24V supply for EoT charging may be either converted from available DC supply in locomotive or may be taken from HoT if available. Suitable protection shall be provided by firms for converters to be used to step down locomotive DC supply to 24 Volts. Dummy receptacle for charging plug will also be provided in the locomotive. Equivalent Charging socket, cover for active socket and dummy receptacle for cover may be provided on the EoT. It will be standardized during design approval stage.
- 2.2.22 The design and layout of the DU including the operating keys which shall be preferably built into it shall have to be approved by nominated agency of Indian Railways before supplying the same. Basic sketch of HoT front including display & other keys Layout is shown in Annexure-XI. However provision of switches as mentioned in sketch is mandatory.
- 2.2.23 The software programs of the EoTT shall be on a non-volatile reprogrammable storage on both devices HoT & EoT.

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- 2.2.24 In case of failure of either the HoT device or the EoT device or the radio communication module or all three systems, the system shall not interfere with the safe working of the train. The EOTT system shall not cause any damage to the equipment and systems connected to it on either the locomotive or the train. Failure Mode Effects and Criticality Analysis of the equipment shall have been done during equipment's design process as per IEC 60812 or similar standard and same should be available for scrutiny by nominated agency of IR.
- 2.2.25 In the operational event of using an intermediate locomotive for hauling long-haul trains, the HoT device of the intermediate locomotive should have the capability to be used as a repeater HoT device and the system architecture and programming should be designed accordingly.
- 2.2.26 The complete EoT device including the integrated air generator should be compliant to IP 54, antennae to IP 66 & remaining equipment like connectors etc. shall be compliant to AAR S-9152 except for the minimum temperature which should be reckoned as -10°C.
- 2.2.27 In case of mishap of train like derailment etc., it should be possible to give a command from HoT device by LP to EoT device to broadcast an Emergency message from EoT device which shall be received by all makes of HoT devices of other trains within the range of radio communication and displayed on their Display Unit indicating distance from the disabled last vehicle which shall be calculated based on GPS coordinates of disabled last vehicle. EoT device of disabled last vehicle shall continue to broadcast the message every 10 seconds to other HoT devices till the emergency mode is reset either automatically by build up of BP pressure(above 3 Kg/Cm²) or manually by a reset switch on EoT or by a command from LP through paired HoT. Protocol of communication for this shall be as per norms specified by AAR/TFR and will be submitted to RDSO. The detailed working of this system shall have to be submitted.
- 2.2.28 When the EoT device has to be taken off and carried on the locomotive, suitable arrangement has to be made on the locomotive so that the EoT device, when stowed on the locomotive, is put on trickle charge. The stowing arrangement of the EoT device on the locomotive must be compatible with the locking arrangement already built into the EoT device for fixing it to the last vehicle's coupler of the train. This system shall be pre-approved by nominated agency of Indian Railways before supplies are initiated by the qualified supplier(s). It will be desirable if EoT device can also be fixed on the locomotive CBC to drawing no. SK.DL-3430 and SK.62724 in addition to fixing on the CBC of the wagons.
- 2.2.29 The EoTT shall be required to check if the Last Vehicle has cleared the Fouling Mark/Caution order location. It shall then be possible for the driver to query the EoTT device for this information and the EoTT device shall send appropriate message to DU of HoT device if the Fouling Mark is "Cleared" or "Not Cleared" by displaying the same on the

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DU of HoT device. Necessary hardware and software shall be built into the EoT device and HoT device for achieving this functionality. ~~This feature will be an aid to Loco Pilot.~~ Firm may utilize signal from SPM junction box of the locomotive (except HHP Diesel Loco) to achieve the functionality accurately. However, their EoTT system should be compatible with all makes SPM arrangement in locomotive. Firm has to provide fuse of suitable rating inside the junction box before taping point of speed signal to protect the PG. Mounting & clamping of fuse must be rigid enough.

2.3 Other Functional requirements of EoTT

- 2.3.1 The EoTT shall work satisfactorily on Electric/Diesel Locomotives which have electrical and electronic equipment complying with following specifications:-
 - a. UL 60950 - for Safety of mains powered equipment.
 - b. IEC: 60571 – Rules for Electronic Equipment used on Rail Vehicles.
 - c. ELRS/SPEC/SE/0015: - Reliability of electronics used on Rolling Stock application.
- 2.3.2 The EoTT shall be used on Electric/Diesel Locomotives on electrified and non-electrified sections. Therefore EoTT shall be capable of working in 25KV and 2 X 25 KV electric traction and non-electrified system of Indian Railways.
- 2.3.3 EoTT brake interface module shall be capable of interfacing with air brake circuits of diesel and electric locomotive and shall not interfere with the operational braking initiated by driver. Firms should design methodology to detect emergency brake application in the locomotive as per Annexure-VIII.
- 2.3.4 EoTT brake interface shall not adversely affect the brake application and release timings.
- 2.3.5 Brake application and release characteristics in each mode of operation of EoTT with standard parameters and details of brake testing and reliability of brake equipment should be submitted to RDSO for verification and validation. Final clearance of fitment of braking unit on loco from RDSO would be essential.
- 2.3.6 A status indication of the EoT device marker light is also required to be displayed on the DU of HOT as per AAR S-9152. (Marker light ON, OFF or Defective).
- 2.3.7 EoTT equipment shall be designed for a service life (Codal life) of 12 years. One of the governing documents for such design shall be AAR S-9152. The air turbine of the SBU shall also be designed as per AAR standard S-9152.

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2.3.8 The rear unit shall be fitted onCentre Buffer Coupler of wagons to drawing no. WD-81010-S-03.

2.4 Activation of HoTfor Active cab only:

Firms shall ensure thatHoT of non working cab shall remain inactive so that it can be operated through working cab only.

2.5 Train Error Feature for TCAS:

All the prospective suppliers shall have the provision for NO/NC contactvoltage signal in HoT to communicate train integrity status to TCAS. As per the operational requirement, there should be three conditions (1. HoT Off- Low signal, 2. HoT ON & Train Healthy- High-Low-High-Low pulse, 3. HoT ON & Train Unhealthy- High signal)for which signal should be communicated to TCAS.

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Chapter -3

Technical details

3.1 End of Train Telemetry (EoTT) System:

- a. The EoTT system shall have features of self-test, diagnostic and corrective actions built in the design to ensure the reliability and safety level to run the train with such electronic equipment.
- b. All software must be installed on non-volatile reprogrammable memory via suitable port .
- c. The GPS modules used in EoTT shall support Multi GNSS and SBAS (GAGAN) and shall have position accuracy of approximately 10 meter.
- d. Unique ID of EoT/HoT, GPS location information, time stamp and speed will be included in GPS data packets transmitted to the server.
- e. EoTT system shall be suitable for working under 25 kV AC and 2 x 25 KV AC traction systems.
- f. EoTT system shall be suitable for working on Indian Railway Tracks as well as DFCC tracks and shall be within MMD. MMD of Indian Railways is given in Annexure – I. MMD for Eastern Corridor of DFCC is given in Annexure II. MMD for Western Corridor of DFCC is given in Annexure III.
- g. Antenna modules of EOTT shall have IP 66 protection and other modules (EoT/HoT) shall have IP 54 protection.
- h. Adequate provisions shall be made in the design for suppression of internal transients, spikes and to withstand external transients, spikes and surges as per limits laid down in IEC-60571 ed-3 or latest.
- i. In the electronic equipments to be supplied to this specification, the vendors shall use industrial grade components, backup battery and systems of high reliability, suitable in every way for the application on rolling stock. In this connection, vendor is advised to refer to "Rules for Electronic Equipments used on Rail Vehicles IEC-60571".
- j. Minor deviations from the specification if any, can be mutually sorted out with RDSO during development stage if supported by justification on ground of cost and/or technical superiority.
- k. All electronic components and ICs used shall be selected after proper burn in and screening tests and shall be adequately rated to withstand the service requirements. A quality assurance scheme shall be submitted by the vendor for approval of RDSO. All the connecting wires, cables used on PCB in the sub units should be properly laid out with suitable connector. The cable used inside the sub unit shall be properly supported with stiffeners. No soldering shall be done on the PCB for inter connection.
- l. System shall have real time clock for recording date & time which is updated from GPS system.
- m. The device shall function satisfactorily under 25 kV and 2 X 25 kV ac electric traction. It shall not be susceptible to malfunction due to interference from overhead traction power

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supply lines or under abnormal conditions such as overloads and faults in the electrical traction circuits of the locomotives. EoTT system shall not cause undesirable communication interference with system of other trains and other fixed track & signal structure.

- n. IP address to which EoTT system shall transmit its data shall also be configured through its keypad/port/Over the air (OTA) by authorized persons.
- o. Each unit of EoTT will comprise of the following:-

3.2 Head of Train (HoT) device or Cab Unit (CU):

- 3.2.1 Location of installation of HoT device shall be finalized and standardized by RDSO after development.
- 3.2.2 HoT device is part of EoTT to be provided in the locomotive. It will comprise of two display units equipped with suitable keyboard, Radio transmitter and receiver, GPS module, GSM/LTE/latest technology module etc. Both the display units can be identical or can be in Master-Slave mode. If the two units are in master-slave mode then Radio transmitter, receiver, GPS module, GSM/LTE/latest technology module may be in master only. Slave may receive information from master.
- 3.2.3 Locomotive number shall be the unique identifier for the HoT device. It must be programmable by the user shed, so that a HoT unit can be shifted from one locomotive to another if required.
- 3.2.4 Train number and crew ID can also be fed on the display unit by the LP for monitoring of the train and further analysis on website.
- 3.2.5 HoT device should be securely fitted in both cabs in the locomotive and shall be designed to work with locomotive battery (nominally min. 50V DC, nom. 110V DC and max. 137.5V DC). HoT device should not go blank or malfunction when OHE are shut down. The relevant reference documents are IEC60571 & AAR S-9152.
- 3.2.6 Fixing arrangement of the HoT including electrical wiring shall be discussed and finalized by the firm in consultation with RDSO.
- 3.2.7 Suitable Ethernet/USB port shall be provided on HoT for its programming. USB Port will be provided for downloading the data directly to the pen drive. HoT device consists of following units.

3.2.8 Display unit (DU)

- a. The Display icons, display numbers and display fonts on the DU should be readable by the locomotive crew.
- b. The display unit (DU) must have an integrated industrial grade display panel / **touch screen** to display all the requisite information in bright daylight (Daylight readable) as well as in the night.
- c. Train status function like brake pipe pressure readings at the last vehicle, speed of the last vehicle, train integrity information, integrity of the radio communication, health of

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the SBU and DU, battery percentage of both the cab unit and rear units, etc. shall continuously be displayed on DU.

- d. Provision shall be made for entry of the rear unit identification code by Loco Pilot each time a new rear unit is installed on the rear of train as per clause 2.2.7 of AAR S-9152.
- e. Provision shall also be made for entry of the Train number and Crew Id for further analysis.
- f. Automatic & manual backlight brightness adjustment of display is required.
- g. Integrity checking of the display is required.
- h. It will have required number of keys to carry out the assigned functions.
- i. The operating keys interface of EoTT shall be AAR S-9152 compliant barring the minimum temperature clause that should be reckoned as -10°C.
- j. Following parameter will be shown in HoT display, when no EoT device is paired with HoT device.
 - a. Loco Number (up to 6 digits numeric value)
 - b. Train Number (up to 10 digits alpha-numeric value)
 - c. Crew ID (up to 10 digits alpha-numeric value)
 - d. Date & time of HoT device
 - e. Speed of locomotives
 - f. Battery percentage of HoT
 - g. Status of EoT pairing (not connected to any EoT)
- k. Following parameter will be shown additionally in HoT display, when an EoT device is paired to HoT device:
 - a. Unique ID of EoT paired
 - b. BP Pressure of rear wagon
 - c. Battery Status in (%) percentage/hours of EoT
 - d. Speed of EoT
 - e. Date & time of EoT device
 - f. Various Alarm Status & messages sent by EoT
 - g. Status of HVML& DTWL
 - h. Train Length
 - i. Train Integrity Indication
 - j. Integrity of the radio communication

3.2.9 GPS/GSM/LTE Module

GPS system of EoTT shall have Position accuracy of approximately ±10 Meters.

3.2.10 Antenna for HoT

- a. The radio antenna shall be placed outside the driver cabin and shall be designed and fitted in such a manner so as not to infringe the Maximum Moving Dimensions (MMD) of Indian Railways & DFCC.
- b. Combo antenna may be used for GPS & GSM/LTE antenna.

3.3 End of Train (EoT) device or Rear Unit (RU)

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- 3.3.1 It comprises of suitable housing, pressure transducers, associated electronics, SBU, Radio transmitter & Receiver, battery, Air turbine for battery charging, GPS device, GSM device, brake pipe coupling, ON/OFF switch, visual ON/OFF indication, High Visibility Marker, suitable display etc. It transmits and receives information to/from HoT device fitted in the locomotive and to the web server.
- 3.3.2 An illuminated display is required on rear unit, which at switch on must display atleast software version number, battery voltage and brake pipe pressure readings.
- 3.3.3 Rear unit must be designed for continuous duty service on rear of the train where it will be subjected to severe vibration and shocks. EoTT will be tested for Shock and Vibration levels specified in clause 2.1.4.4 of AAR S-9152.V2.1.
- 3.3.4 Each EoT device shall have a unique ID which will be assigned by the RDSO and will be programmed in the EoT. This unique ID will be used for pairing EoT with HoT.
- 3.3.5 The unique identification code or address shall be as per clause 2.1.7 of the AAR S-9152. It shall be in the range 00000 to 99999 and be established in the rear unit electronics by permanent and secure means. The identification code shall also be indicated on the exterior of the rear unit enclosure.
- 3.3.6 The unique identification code will be transmitted along with the data to the cab unit. This code ensures that only data transmitted from the assigned unit will be accepted by the cab unit. In this way, rear unit messages from adjacent trains will be rejected by the cab unit.
- 3.3.7 In order to maintain the interchangeability between rear unit and cab units, the identification code must be reported and selected at the cab unit prior to start of any trip.
- 3.3.8 The EoT device shall be designed *as portable as light weight as small as possible* which may be easily carried by one person by suitable handle.
- 3.3.9 EoT must be able to withstand rough handling / tampering and must be robustly constructed.
- 3.3.10 EoT must be splash proof, impervious to ingress of dust and moisture and suitable for mounting on rear coupler of the train.
- 3.3.11 EoT must be capable of withstanding high levels of shocks and vibrations.
- 3.3.12 Suitable Ethernet/USB port shall be provided on EoT for its programming. USB Port will be provided for downloading the data directly to the pen drive.
- 3.3.13 The rear unit must incorporate following 3 power modes:
- ‘ON’ : Full functionality available
 - ‘Sleep’: Radio transmission OFF, Pressure transducer ON, Radio Receiver ON, GPS ON, GPRS ON, Functionality of High Visibility Marker Light and Disabled Train Warning Light will be available during sleep mode.
 - ‘OFF’: All electronics switched off with no drain on battery.
- 3.3.14 **Following ON/OFF functionality is required :**
- a. The Rear Unit must only switch ON when in the vertical position, irrespective of pressure value. When the ON button is pressed the system may switch ON but it will switch off once the button is released if the EoT is not in vertical position.
 - b. Must switch to Sleep Mode (by means of a “tilt-switch”) after 15 minutes when moved to the horizontal position, provided that the pressure is zero, *or when connected to a charger*.
 - c. Whilst upright, and the pressure drops below 20 kPa (0.2 Kg/cm²) The Rear Unit must switch to Sleep Mode after a 15 minute delay, *but should first update the Cab Unit*.

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- d. When the pressure rises to above 20 kPa (0.2 Kg/cm²), the rear unit must automatically switch its transmitter ON again.
- e. Additionally, whilst in “Sleep Mode”, normal transmission must resume when a button of either the Cab Unit or the Rear Unit is pressed.
- f. However, if disabled train warning light is not activated and the pressure continues to remain below the above-mentioned limits, the Rear Unit must switch OFF completely after 10 hours.
- g. When the pressure is above the specified limits, it must not be possible to switch the Rear Unit off.
- h. The Rear Unit must protect itself against damage to its battery due to deep discharge by switching itself OFF if the battery voltage drops too low, but should first send an appropriate message to the Cab Unit.

3.3.15 The rear unit must be mounted on the last vehicle of the train in a manner such that:

- It can fit any vehicle without adapter brackets for mounting purposes, and by means of a simple procedure without requiring any special tools.
- The risk of theft and vandalism is minimized.

3.3.16 The Rear Unit must be designed such that it may be locked in place so as to minimize the risk of it being stolen or vandalized while mounted on the last wagon of the train. An integral lock with captive key is the preferred option, to prevent removal by means of readily available tools or spanners. If a separate / loose lock is proposed, the lock, key and attaching chain or cable, etc. must be included as part of the equipment. The key and lock must be pre-approved by RDSO.

3.3.17 The RU must be supplied complete with flexible connecting air pipes/hoses, suitable for air-brake. The coupling mechanism shall also cater for airbrake connections on wagons, and loose components or adapters are not acceptable. The pipe & coupler must be attached to the Rear Unit body with a 3/4" BSP thread. It must also be available as a separate item.

3.3.18 Sense and brake unit (SBU)

- a. Automatically and continuously, monitor BP pressure of the locomotive as well as the last vehicle on train every 60±5 seconds and to provide its accurate readings within ±0.21 kg/cm² to driver at regular randomized intervals of 60±5 seconds with randomization as per clause 2.1.2 of AAR S-9152.V2.1. If there is any change in BP pressure then reading should be immediately displayed in CU
- b. The SBU must have provision to go into sleep mode in case the system is not receiving brake pipe pressure for more than 15 minutes. Upon getting the brake pipe pressure thereafter, the SBU must wake up and resume its full functional state within 60 seconds.
- c. Rear Unit must be Capable of measuring the brake pipe pressure on the rear vehicle from 0 – 6.5 kg/cm² and display the same to the one place of decimal with least count of 0.1kg/cm² using sensor level output and not using software interpolation.

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- d. A means of locally inspecting the brake pipe pressure outside of the enclosure is required. Either an integral air pressure indicating device or quick-disconnect coupling for an external indicating device could be used as per clause 2.1.1.2 of AAR S-9152.V2.1.
- e. At the test bench, the accuracy of the measurement should be $\pm 0.21\text{Kg/cm}^2$ and it should be demonstrated that variations in brake pipe pressure of $\pm 0.21 \text{ Kg/cm}^2$ can be measured and displayed.
- f. In case of having to take off the SBU while there is sufficient pressure in the brake pipe of the train, suitable design arrangement must be made without compromising the safety of the train.
- g. An internal failure of the measurement device shall not cause an undesired emergency brake application.

3.3.19 Air Turbine/Generator unit

- a. Air Turbine/Generator unit is required for EoT unit battery charging when locomotive is attached to the train.
- b. Air Turbine/Generator is to consume no more than 2.5 cubic feet per minute (at 80 PSI) from brake pipe air as per clause 4.17.1 of AAR S-9152.V2.1.
- c. The Air Turbine/Generator equipped bit will be set to indicate that the EoT on the train is equipped with an Air Turbine/Generator as per clause 4.17.2 of AAR S-9152.V2.1.

3.3.20 GPS/GSM Module

GPS system of EoTT shall have Position accuracy of approximately ± 10 Meters.

3.3.21 Antenna for EoT

- a. The antenna shall be of such type that when fitted, they shall not infringe the MMD (Maximum Moving Dimensions) of the Indian Railways & DFCC.
- b. Combo antenna may be used for GPS & GSM antenna.

3.4 Battery for EoTT system

- a. Both HoT&EoT devices must be supplied with integrated rechargeable sealed batteries.
- b. EoTT should have continuous charging facility of End of Train Unit by an established method of charging using Air Turbine/Generator unit for rear unit battery charging when locomotive is attached to the train. Similarly HoT battery will be continuously charged from locomotive battery.
- c. Suitable protections like overvoltage, over current, short circuit, over charge & over discharge, surge, incorrect insertion of connector, over temperature etc. shall be provided in charging/discharging circuit.
- d. The battery must be protected against irreversible damage due to excessive deep discharges.

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- e. A battery status indication shall be provided for both EoT&HoT units in the display unit to continuously indicate the remaining capacity of the batteries in percentage/hours. The battery status information transmitted by the EoT unit must be used to determine the remaining battery life and display in percentage in cab unit. It will also be transmitted to the server/cloud.
- f. If the battery charging facility of HoT fails but locomotive battery is available, then even after the failure of the charging unit the battery of HoT must ensure normal EoTT working ~~for at least 48 Hours~~.
- g. If locomotive battery is not available, than EoTT functionality of HoT will not be required, but GPS monitoring of dead locomotive is required. Battery backup of the HoT device shall be adequate such that it can work for at least 20 days when locomotive is in dead condition(HBA in OFF condition).
- h. If the battery charging facility of EoT fails, then even after the failure of the charging unit the battery of EoT must ensure normal EoTT working for at least 36 hours.

S. No.	Parameters	Operating period
1.	Minimum normal battery life with built in battery upto low battery indicator (LBI), with charging disconnected, for a continuously operated marker device with normal working of EoTT.	\geq 24 Hours
2.	Min. operating battery life after low battery indicator (LBI) with charging disconnected.	\geq 12 Hours
	Total	\geq 36 Hours

- i. No deterioration in illumination is permitted during normal battery life. For specified minimum operating battery life after low battery indicator (LBI), 25% drop in illumination from its original value is permitted.

3.5 HighVisibilityMarker light (HVML)

- a. End of Train device should also perform the task of High Visibility Marker light (HVML)flasher device as per Indian Railways requirement.
- b. Automatic switching ON & OFF of HVML is required based on the ambient light condition.
- c. Power requirements of HVML shall have minimal impact on battery life of EoT unit.
- d. A status indication of HVML on Display unit in locomotive cab is also required as per clause 4.1.3.5 of AAR S-9152.V2.
- e. Colour Co-ordinates: Red Aspect: Class 'C' of BS: 1376,

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S. No.	Parameters	Flashing Red Aspect
1.	No. of flashes per second	$2 \pm 10\%$ for foggy weather ≤ 4 for normal weather
2.	Pulse duty cycle	$\geq 38\%$ for foggy weather $\geq 20\%$ for normal weather
3.	Minimum illumination measured at 1.5m in axial direction (LUX)	110
4.	Radiating area (Approx.)	3850 sq. mm
5.	Dispersion angle	4^0 to 7^0
6.	Number of LEDs used	shall not be less than 6 with display area of about 70 mm dia.
7.	Visibility :	1.6 Km along longitudinal axis and 100 m at 6 degree angular displacement from longitudinal axis. For testing, Tail lamp to be placed 1.5 m above rail level and viewed at local sun set time under condition of clear weather.

- f. Illumination shall be measured in steady mode. To enable the measurement in steady mode, suitable provision/switch shall be provided in the lamp housing which shall not be visible or easily accessible to the user. Normally lamps shall be provided with flashing colour aspect and steady mode shall be operated for measurement only.
- g. Loco Pilot will activate the fog condition from HoT either by way of switch or through menu option.

3.6 Disabled Train Warning light (DTWL)

- a. End of Train device shall also perform the task of Disabled Train Warning Light (DTWL).
- b. Power requirements of DTLW shall also have minimal impact on battery life of EoT unit.
- c. A status indication of DTLW on Display unit in locomotive cab is also required.
- d. Colour Co-ordinates: Amber yellow colour with dominant wave length of 590 to 595

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nano meters shall be used for DTWL.

S. No.	Parameters	Flashing Amber colour Aspect for DTWL
1.	No. of flashes per second	0.66 flashes per second or 40 ± 5 flashes per minutes
2.	Pulse duty cycle	$\geq 38\%$ for foggy weather $\geq 20\%$ for normal weather
3.	Minimum illumination measured at 1.5m in axial direction (LUX)	110
4.	Radiating area (Approx.)	3850 sq. mm
6.	Number of LEDs used	shall not be less than 6 with display area of about 70 mm dia.
7.	Visibility :	1.6 Km along longitudinal axis and 100 m at 6 degree angular displacement from longitudinal axis. For testing, Tail lamp to be placed 1.5 m above rail level and viewed at local sun set time under condition of clear weather.

- e. Illumination shall be measured in steady mode. To enable the measurement in steady mode, suitable provision/switch shall be provided in the EoTT housing which shall not be visible or easily accessible to the user. Normally DTWL shall be provided with flashing colour aspect and steady mode shall be operated for measurement only.
- f. Loco Pilot will activate the fog condition from HoT either by way of switch or through menu option.
- g. This warning light will be illuminated either automatically when train brakes applied in emergency or manually by the loco pilot using a cab control switch/menu option.
- h. This warning light will reset automatically when brake pipe pressure of EoT is greater than 3Kg/cm^2 .
- i. This warning light will also reset by a control switch on EoT.
- j. This warning light will also reset by a command given by Loco Pilot from paired HoT either by way of a switch or menu option.
- k. When this warning light is illuminated, HVML will go in OFF condition.
- l. When this warning light is reset, HVML will illuminate automatically based on the ambient conditions.

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m. DTWL and HVML can either be in same enclosure or in different enclosures.

3.7 Two way Communication between HoT to EoT

- 3.7.1 To ensure interoperability requirement for EoTT device (i.e. any EoT device can be paired with HoT device of any make), radio specification and communication protocols between EoT&HoT needs to be standardized. For this purpose, radio specification shall be compliant as per clause 2.3 of AAR S-9152 and communication protocols between EoT&HoT shall be compliant with AAR S-9152 & TFR BBB1776 except the radio frequency used for radio communication.
- 3.7.2 Messages as per AAR S-9152 transmitted from the rear end unit to the cab unit must include the following:
- Rear unit Identification code.
 - Rear unit battery status.
 - Brake pipe pressure.
- 3.7.3 In addition, GPS & other data in 2 additional data blocks will be as per Annexure A of TFR BBB1776.
- 3.7.4 ~~Indian Railways is operating DPWCS at frequency of 406 to 407 MHz, which is likely to be shifted to 424 to 430MHz. EoTT devices shall use the frequency range between 424-430 MHz~~ It is proposed that EoTT devices shall also use same frequency spectrum allotted to Indian Railway for DPWCS. The radio shall be designed in such a way that same radio can operate in frequency band (400 to 430 MHz) in future without any hardware changes.
- 3.7.5 Communication between HoT device and EoT device inside tunnels/cuttings shall be assisted using repeaters / leaky coaxial cable so as to ensure seamless transmission and reception between HoT device and EoT device. Provision of leaky coaxial cable shall be done by Indian Railways. However Specification for Leaky Co-axial cables shall be provided by the bidder along with the technical offer.
- 3.7.6 Radio equipment shall be designed to transmit power less than or equal to 10Watts and selected Radio should be listed with WPC (Wireless Planning & Coordination wing), Ministry of Communications & IT, India. Exact frequency of radio shall be given to suppliers once the same is allocated to Ministry of Railways at the time of implementation of the equipment.
- 3.7.7 It has to be a proven digital communication method that will communicate upto2.5 kilometer range with an external antenna on the locomotive.
- 3.7.8 Reliable communication is expected to be maintained by the equipment in all possible terrains including deep cuttings, tunnels, forests, hilly track called “Ghats” in IR terminology and densely occupied yards & station sections. IR will provide the Leaky Cables/Repeaters at required locations. Firms must specify the specific terrain conditions for which EoTT shall need Leaky Coaxial cable system. Firms must also specify standards to which such Leaky Coaxial Cable system should be designed/laid and its collateral use for other communication works pertaining to Railway applications.

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3.7.9 Pairing between EoT device and HoT device shall be done as per AAR- S 9152.

3.7.10 Manual Communication Test

Means shall be provided for manual initiation of an end-to-end test of the front to rear communication link with a visual/audible indication of success or failure of the test as per clause 3.8.3 of AAR S-9152.V2.1.

3.7.11 Automatic Communication Test

The availability of front to rear communication link shall be checked automatically every 2 minutes as per clause 3.8.4 of AAR S-9152.V2.1.

3.7.12 Emergency Valve Test

Means shall be provided to confirm availability and proper functioning of the emergency valve as part of both manual and automatic communication tests as per clause 3.8.5 of AAR S-9152.V2.1.

3.7.13 Rear to front communication failures

Rear to front communication failures will be declared as per clause 3.8.6 of AAR S-9152.V2.1. The cab unit shall declare a rear to front communication failure on rear to front radio link failures lasting for a duration of 5 minutes or greater. Rear to front radio link failures lasting less than 5 minutes shall not be declared as rear to front communication failure. Display or indication of front to rear communication failure shall take precedence over rear to front communication failure.

3.7.14 Front to rear communication failures

Front to rear communication failures will be declared as per clause 3.8.7 of AAR S-9152.V2.1. The cab unit shall declare a front to rear communication failure on front to rear radio link failures lasting for duration of 16 minutes 30 seconds or greater. Front to rear radio link failures lasting less than 16 minutes 30 seconds shall not be declared as front to rear communication failure. This alarm will be cleared by the next successful front to rear /rear to front confirmation cycle (automatically or manually initiated). Minimum polling of at least once every 2 minutes must be maintained or as often as necessary to minimize loss of front to rear communications exceeding the 16 minutes 30 seconds limit. Front to rear communication failure shall also be tested and declared during an attempted emergency activation.

3.7.15 Front to Rear Message Retries

Front to Rear Message Retries shall be handled as per clause 3.8.8 of AAR S-9152. For emergency brake application commands, the retries will continue until a status update indicates that the rear unit has received the command by setting the confirmation bit in the update. Thereafter, if the rear brake pipe pressure has not been reduced to a level below 5

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psi within 4 seconds, another retry will be made and again the confirmation bit looked for. This process will repeat up to a maximum time of 2 minutes after the last emergency switch activation. If a confirmation bit has not been received within 15 seconds of the initial or 4 seconds retry emergency command, front to rear communication failure will be declared.

For manually initiated status information update requests, the cab unit will not transmit any retries automatically nor cause a communication failure indication.

3.7.16 Front to rear communications

Front to rear communications protocols and data message formats shall be as per clause 3.9 of AAR S-9152 & TFR BBB1776 except the radio frequency used for radio communication.

3.7.17 Rear to front communications

Rear to Front communications protocols and data message formats shall be as per clause 3.7 of AAR S-9152 & TFR BBB1776 except the radio frequency used for radio communication.

3.7.18 Failure of communication in unit of time, incidences &location and unique ID or serial number of EoT device, between EoT device &HoT device must be logged for 30days.

3.7.19 Logging of alarms and performance of both HoT device and EoT device:

- The EOTT performance must be continuously monitored and logged by the EoT against time & position [GPS Coordinates] along the line, and stored in memory, so that the same is available for download at the end of the trip (through the USB port/Serial port). To achieve this EoT device must make use of a GPS unit so as to track its position against real (GPS time).
- All communication messages received by the HoT device, as well as alarms, are to be logged versus time and GPS Coordinates. The HoT device time must be synchronized with that of the EoT device. Syncing of Real Time Clock (RTC) with GPS should be done at least once in 24hours. Data downloading from Master HoT through USB port/Serial port.

3.7.20 Same single frequency shall be used for front to rear and rear to front communications for help in implementing repeater functionality in HoT.

3.7.21 RDSO may issue communication protocol and other technical details separately for standardization of EoTT. RDSO has issued detailed communication protocols for standardization of EoTT vide RDSO's letter no. EL/4.2.15/EoTT dated 14.02.2022 as Technical Circular No. RDSO/2022/EL/TC/0156 Rev '0' dated 14.02.2022 or latest.TC/0156 is attached as Annexure-XIII. Latest revision is to be referred.

3.8 Capturing and transmission of data by EoTT (HoT&EoT) Devices to server/cloud

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3.8.1 When Locomotive battery supply is available to HoT (HBA is in ON) and HoT battery is charging

- a. End of Train Telemetry functions will continue as defined in various paragraphs.
- b. GPS data shall be captured every 05 seconds by the GPS device of HoT.
- c. Data transfer shall be every 60 seconds(1 minutes)or less to the server.
- d. If due to any reason, data transfer to server is not successful, the data shall be stored in the HoTmemory and will be transferred to the server at the earliest opportunity.

3.8.2 When Locomotive battery supply is available to HoT (HBA is in ON) and HoT battery is not charging (charging system of HoT fails)

- a. End of Train Telemetry functions will continue as defined in various paragraphs.
- b. GPS data shall be captured every 20 minutes by the HoT device and transferred to the server.
- c. If due to any reason, data transfer to server is not successful, the data shall be stored in the HoT memory and will be transferred to the server at the earliest opportunity.
- d. For the remaining period GPS device will be in sleep mode for conserving the battery and will wake up every 20 minutes to capture and transfer GPS data. During sleep mode GPS will be active but no data transfer shall be carried out.

3.8.3 When Locomotive battery supply is not available to HoT(HBA is in OFF)

- a. If battery supply is not available, locomotive cannot function and hence End of Train Telemetry function will also not be required. However, GPS functionality is required to trace the dead locomotive.
- b. GPS data shall be captured every1 hour by the HoT device and transferred to the server.
- c. If due to any reason, data transfer to server is not successful, the data shall be stored in the HoT memory and will be transferred to the server at the earliest opportunity.
- d. For the remaining period GPS device will be in sleep mode for conserving the battery and will wake up every1 hour to capture and transfer GPS data. During sleep mode GPS will be active but no data transfer shall be carried out.

3.8.4 When Air Turbine/Generator unit supply is available to EoT

- a. End of Train Telemetry functions will continue as defined in various paragraphs.
- b. GPS data shall be captured every 05 seconds by the GPS device ofEoT.
- c. Data transfer shall be every15minutesor less to the server.
- d. If due to any reason, data transfer to server is not successful, the data shall be stored in the EoT memory and will be transferred to the server at the earliest opportunity.

3.8.5 When Air Turbine/Generator unit supply is not available to EoT

- a. End of Train Telemetry function will continue as defined in various paragraphs.
- b. GPS data shall be captured every 1 hour by the EoT device and transferred to the server.

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- c. If due to any reason, data transfer to server/cloud is not successful, the data shall be stored in the EoT memory and will be transferred to the server at the earliest opportunity.
- d. For the remaining period GPS device will be in sleep mode for conserving the battery and will wake up every 1 hour to capture and transfer GPS data. During sleep mode GPS will be active but no data transfer shall be carried out.

3.9 Memory for the system :

- 3.9.1 Both EoT & HoT Device shall have the capacity to store the data for at least 30 days.
- 3.9.2 Vendor server shall have capacity to store the data for at least 90 days.
- 3.9.3 Calculations of data packet size to be provided by the vendor.

3.10 Web Page Functional Overview

- 3.10.1 The webpage layout developed by the firm will be approved by RDSO to ensure uniformity.
- 3.10.2 The webpage shall display the EoTT data, alarms, messages & GPS location of HoT & EoT.

3.11 LV Marking on EoT

'LV' of suitable size(as per drawing at Annexure- IX)shall be written on the EoT with retro reflective material. Since, EoT also works as Tail lamp(TL)/Last Vehicle(LV) board; therefore, the external appearance of the EoT should be of Post Office RED colour.

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CHAPTER - 4

ENVIRONMENTAL CONDITIONS

4 The climatic and environmental conditions prevailing in India in the area of operations are the following:

A. Atmospheric temperature	<ul style="list-style-type: none"> • Maximum temperature: 50 $^{\circ}\text{C}$ • Maximum touch temperature of metallic surface under the Sun: 75 $^{\circ}\text{C}$ and in shade: 55 $^{\circ}\text{C}$ <p>Maximum temperature near electronic cards in un-energized condition of locomotive standing under direct sunlight during summer: 70 $^{\circ}\text{C}$</p> <ul style="list-style-type: none"> • Maximum temperature near electronic cards in working condition of locomotive during summer: 65 $^{\circ}\text{C}$ • Minimum temperature: - 10 $^{\circ}\text{C}$ <p>(Also snow fall in certain areas during winter season)</p>
B. Solar radiation	1 kW/m ²
C. Humidity	100% saturation during rainy season
D. Altitude:	1776 m above mean sea level
E. Rain fall:	Very heavy in certain areas.
F. Wind speed	High wind speed in certain areas, with wind pressure reaching 150 kg/m ²
G. Atmospheric conditions	Extremely dusty and desert terrain in certain areas. The dust concentration in air may reach a high value of 1.6 mg/m ³ . In many iron ore and coal mine areas, the dust concentration is very high affecting the filter and air ventilation system. The system shall be able to work at the maximum specified ambient temperature inside the locomotive without any pre-cooling requirement.
H. Coastal area	<ul style="list-style-type: none"> • Humid and salt laden atmosphere with maximum pH value of 8.5, • Sulphate of 7 mg per liter, • Maximum concentration of chlorine 6 mg per liters and • Maximum conductivity of 130 micro siemens / cm
I. Vibration & Shock	The equipment shall be designed to withstand the vibrations and shock encountered in service satisfactorily as specified in Clause 2.1.4.4 of AAR S-9152 V2.1. The vibration test shall be done as mounted in the actual operating condition.
J. Electromagnetic Pollution	High degree of electromagnetic pollution is anticipated in locomotive machine room, where the equipment will be mounted. Necessary precaution should be taken in this regard. The equipment shall be design to cater to the EMC/EMI requirements as per IEC 61000 -4-6 (latest).

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CHAPTER-5

SCOPE OF SUPPLY

- 5.1** Scope of the specification is Supply, commissioning and installation of the EoTT device along with Antenna unit and associated wiring.
- 5.2** Installation, commissioning and maintenance (during warranty period) is in the scope of supply.
- 5.3** The following will be the scope of supply:-

SN	Items	Quantity per locomotive
I.	HoT device along with Display Units (DU) Power Supply cables, mounting brackets, etc.	01 set
II.	EoT unit along with Sense & Brake Unit (SBU), Air Turbine/Generator for SBU etc.	01 set
III.	Antennas, connectors, couplings mounting brackets, power supply, Mounting brackets, etc.	As per requirements.
IV.	Battery charging arrangement for charging EoT device while being stowed and transported on locomotive (in the event of having to run locomotive without the attached train)	01 No.
V.	All necessary parts and accessories that will be required to attach the equipment to the locomotive and last vehicle of the train.	As per requirements
VI.	Any other item, hardware, software etc. as required to achieve functionality as per clause 2.1.5as well as making the supply fully functional and operational as per this specification.	As per requirements
VII.	Cables for connecting EoTT device to loco battery	01 set
VIII.	Cables for connecting Antenna unit to EoTT device (if applicable, in case of external antenna).	01 set
IX.	Installation, Operation& Maintenance Manual	01 set
X.	Spares Catalogue in print	01 set
XI.	Above mentioned documents in s.n. (IX),(X) on software media preferably as PDF document suitably cross-linked/hyperlinked with short tutorial videos/animations.	01 set
XII.	Track-Side / Fixed Repeater unit may also be supplied as per requirement. Requirement of track side/Fixed Repeater will be clearly specified in Tender. Quantity also to be specified in tender as per requirement.	Qty to be specified in tender as per requirement
XIII.	Data extraction unit (Laptop) (Minimum Requirement: Processor-Intel Core i5 or equivalent, OS-Microsoft Windows 10, Memory-8 GB RAM, Storage-500 GB internal , Display-14" LCD with carrying bag)	1 no. against every 25 sets of EoTT

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CHAPTER-6

INSPECTION&TESTING

6.1 INSPECTION:

- 6.1.1** The system shall be tested generally in accordance with the IEC: 60571:2012-09 (or latest). Dry Heat test of the Electronics shall be carried out at 85° C as per IEC: 60571. All optional tests mentioned in various standards shall also be carried out. Details shall be worked out during design approval. Type tests shall be carried out by the vendor at his own responsibility and cost.
- 6.1.2** The vendor shall formulate and submit a type test protocol / plan at design approval stage for approval of RDSO before undertaking manufacturing. It shall, however, be open for RDSO to waive some of tests in case of equipment and sub-assemblies, where the vendor can establish it for the requirements of this specification that such tests have already been carried out earlier on the same equipment and where equipment has been proved in prolonged service.
- 6.1.3** Modifications found necessary as a result of the tests/trials shall be incorporated by the vendor at his own cost in the locomotives in a manner approved by the Purchaser. Drawings incorporating the modifications found necessary, as a result of tests and trials, shall be submitted to RDSO for final approval.
- 6.1.4** The vendor shall offer all the testing facilities free of charge to inspecting authority. Testing of equipment and fittings shall, as far as possible be carried out at the works of the vendors. Testing of bought out components may also be carried out at sub-vendor's premises, if so required. The vendor shall provide free of charge, such materials or fittings as may be required for testing whether at his own or his sub vendor's premises. The test for which facilities are not available may be carried out at RDSO or any other approved laboratory for which the testing charges shall be payable by the vendor.
- 6.1.5** All the equipments and the fittings required for testing shall be selected by the inspecting officer and the tests shall be carried out in his presence.
- 6.1.6** No material shall be packed or dispatched until it has been passed by the inspecting officer but the vendor's responsibility for its efficiency in every way, shall remain the same as if the work had been manufactured and tested by himself.
- 6.1.7** Should any part require alteration or any defect appear during the testing or trial, the vendor shall without any extra charges make such alteration or rectify the defects to the satisfaction of the inspecting authority.
- 6.1.8** Copies of Maker's test certificate, guarantee the performance of the equipment shall be supplied in duplicated along with the delivery of each unit.
- 6.1.9** The inspecting authority shall:-
- 6.1.9.1** Visit at any reasonable time and without previous notice, either vendor's works or his sub-vendor's works to inspect the vendors and the quality of the work at any stage.
- 6.1.9.2** Reject any materials or fittings that do not conform to the relevant standard/ specifications or have not been manufactured in accordance with the approved practices. The rejected

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materials or fittings shall be marked in a distinguishable manner and shall be disposed on in such manner as the inspecting officer may direct to avoid its inadvertent use in the product order as per this specification.

6.2 CATEGORIES OF TEST:

6.2.1 Type test:

- a. Type test as per scheme enclosed below shall have to be carried out by the firm in their premises and their results shall have to be submitted to IR along with equipment:

S. No.	Item description	Testing standard
1	HoT and EoT unit	IEC 60571,
2	Antenna assembly unit	IEC 60571
3	Radio Modem	EN 50155, EN 300 113-1
4	Operating keys	IEC 60571, TFR BBF0334 V5
5	For testing effect of working environmental conditions	AAR S-9152
6	High Visibility Marker Light (HVML),	AAR S-9152&RDSO SPECN No. RDSO/SPN/200/2010 Rev. 2
7	Disabled Train Warning Light (DTWL)	AAR S-9152 & RDSO SPECN No. RDSO/SPN/200/2010 Rev. 2

- b. After the type tests, the EoTT shall continue to work but it shall then not be deployed in service and it will not be supplied to Railways. Such type tested device maybe used for demonstration and training purposes by the firm.
- c. Type test shall be carried out on equipment of the approved design. If there is any change in design or source of supply of any components/sub-components/assembly, units made to the changed design or from new source shall be treated as new item for the purpose of conducting type tests.
- d. Type tests are to be repeated in case of any major change is made. In case of minor changes, i.e. change in type, rating of component etc., special test/tests as agreed by user and vendor are to be conducted to ensure their suitability and effectiveness of the modifications.
- e. Tests will be carried out on the prototype unit as per relevant IEC specifications or mutually agreed test program. Vendor will bear the expenses of the tests.

6.2.2 Routine test:

- a. Following routine tests besides other tests, as deemed fit to ensure quality, reliability and compliance of this specification shall be done by the manufacturer on all the units. Parameters measured after Burning-in test shall be recorded and enclosed with every unit:
 - i. Visual inspection of each unit as feasible through visual inspection.
 - ii. Performance Parameters and

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- Low battery indication test
- iii. Verification of marking
 - iv. Insulation test
 - v. Voltage withstand (Dielectric) test
 - vi. Reverse polarity test (For HoT only)
- b. Test record shall be properly maintained with traceability to lot/samples tested, which may be verified by inspecting officials.
- c. Manufacturer shall maintain proper accountal of LEDs, switches and all electronic components being used. The record shall include various details like source of supply, procurement invoice no. and date, quantity, incoming rejection, lot-wise consumption etc. which may be verified by inspecting officials.
- d. The tests to be carried out are given in the following table, together with the clause number of IEC 60571 ed-3 2012-09.

SN	TESTS	IEC CLAUSE NO.	TYPE TEST	ROUTINE TEST/ACCEPTANCE TEST
I.	Visual Inspection	12.2.2	✓	✓
II.	Performance test	12.2.3	✓	✓
III.	Voltage variation test	12.2.3	✓	--
IV.	Cooling Test (Cold Start Test)	12.2.4	✓	--
V.	Temperature rise test (Dry heat)	12.2.5	✓	--
VI.	Temperature rise (damp heat cyclic)	12.2.6	✓	--
VII.	Supply over voltage test	12.2.7	✓	--
VIII.	Surges test	12.2.8.1	✓	--
IX.	Electrostatic discharge test (ESD)	12.2.8.2	✓	--
X.	Transient burst susceptibility test	12.2.8.3	✓	--
XI.	Radio Interference test	12.2.9	✓	--
XII.	Insulation test	12.2.10.2	✓	✓
XIII.	Voltage withstand (Dielectric) test	12.2.10.3	✓	✓
XIV.	Salt mist test	12.2.11	✓	--
XV.	Vibration and shock test	As per clause 2.1.4.4 of AAR S-9152.V2.1	✓	--

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SN	TESTS	IEC CLAUSE NO.	TYPE TEST	ROUTINE TEST/ ACCEPTANCE TEST
XVI.	Water tightness test for external units like EoT/HoT , Antenna etc.	12.2.13	✓	
XVII.	Reverse polarity test (For HoT only)	--	✓	✓
VIII.	Special tests		✓	

6.2.3 DETAILS OF TESTS:

a. VISUAL INSPECTION:

The object of visual inspection is to check that the equipment is free from defects and the equipment is as per approved drawing. Bill of materials will be submitted. The make, rating of equipment, subassemblies will be checked with the details as per approved design document. If a change is needed in make or rating of important equipment, sub-assemblies, it should be intimated and should have proper approval of RDSO.EoTT device with modified equipment, subassemblies will be given separate revision number. All the important dimensions will be measured and should be in permissible tolerance. Visual inspection is to mainly verify cable marking, cable clearance, creepage distance etc. Bill of material is also to be verified.

b. PERFORMANCE TEST:

Measurements shall be carried out at the ambient temperature.

The performance test shall consist of a comprehensive series of measurements of the characteristics of the equipment to check that its performance is in accordance with the functional requirements of the particular equipment concerned, including any special requirements of its individual specification, and general requirements of this standard. Performance test procedure will be submitted by the vendor for approval.

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

c. VOLTAGE VARIATION TEST:

This test shall be carried out as per clause 12.2.3 of IEC 60571. During the test, system voltage shall be as per clause 3.2.5of chapter 3.

d. COOLING TEST:

This test shall be carried out as per clause 12.2.4 of IEC 60571.Bring down the temperature of the equipment to $-10^{\circ}\text{C} \pm 2$ and keep it at the temperature for 2 hours. In this test equipment shall be in energized condition and the working of the system will be checked. Insulation test, Dielectric test at 85% voltage of the previous test and performance test will be carried out after the recovery period of 3 hrs.

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e. TEMPERATURE RISE TEST (DRY HEAT):

This test shall be carried out as per clause 12.2.5 of IEC 60571. The temperature of the equipment will be raised to 85°C at the rate of 1°C at 1.5 minute and to be kept at that temperature for 6 hours. In this test equipment shall be in energized condition and working of the system will be checked. Insulation test, Dielectric test at 85% voltage of the previous test and performance test will be carried out after the recovery period of 3 hrs. This test can be performed without battery with similar rating of power supply as per battery parameters connected to device.

f. TEMPERATURE RISE (DAMP HEAT):

This test shall be carried out as per clause 12.2.6 of IEC 60571. Damp heat test shall be done keeping the equipment in de-energized condition. It is to be ensured that the RH of the oven should be between 80 to 100% during the above test. The temperature of the equipment is to be raised from ambient to 55°C in 2 hours and kept at that temperature for 6 hours. The temperature of the equipment 55°C should be brought down to ambient (recovery period) in 3 hours. The cycle is to be repeated at least two times and carry out insulation test, Dielectric test at 85% voltage of the previous test and performance test.

g. SUPPLY OVER VOLTAGE, SURGES AND ELECTROSTATIC - DISCHARGE TEST:

The test shall be conducted as per IEC-60571.

h. OVER VOLTAGE TEST:

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

i. SURGE TEST:

The test shall be conducted as per clause 12.2.8.1 of IEC-60571. The surge pulse shall be 2 kV, 1.2/50 micro Second.

j. ELECTROSTATIC DISCHARGE TEST:

The test shall be conducted as per clause no. 12.2.8.2 of IEC-60571.

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

k. TRANSIENT BURST SUSCEPTIBILITY TEST:

This test shall be conducted as per clause no. 12.2.8.3 of IEC-60571. The complete system in simulated condition shall be put for the test as specified in IEC.

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During test the equipment shall be watched for malfunctioning or Communication between both units shall be observed for proper functioning of equipment.No degradation of the system & malfunctioning should be allowed during or after the test.

I. RADIO INTERFERENCE TEST:

This test shall be conducted as per clause no. 12.2.9 of IEC-60571.

Electronic Equipments provided on locomotives conform to IEC:60571 and have been tested to meet the environmental requirement including that of EMI & EMC as per IEC:61000-4. The limit of radiation which the system on the locomotive can withstand are:-

- a. Radiated emission immunity 10V/m (in range of 80 Mhz to 1GHz) as per IEC:61000-4-3
- b. Conducted disturbance immunity as per IEC:61000-4-6.

m. INSULATION TEST:

This test shall be carried out as per clause 12.2.10 of IEC-60571. Insulation resistance shall be measured with megger of 500V. The time of the meggering shall not be less than 60 Sec.

n. Voltage Withstand Test (DIELECTRIC TEST):

The test shall be carried out as per clause 12.2.10.3 of IEC-60571. Applied voltage shall be of sine wave, 50 or 60 Hz for one minute between the terminals that interface with locomotive short circuited and the metallic frame of the assembly box.

o. SALT MIST TEST:

The test is to be carried out on complete EoTT device as per clause 12.2.11 of IEC-60571. Duration of the test shall be for four hours.

p. VIBRATION AND SHOCK TEST

The test is to be carried out as per clause 2.1.4.4 of AAR S-9152.V2.1.

a) Vibration

- i. Vertical & lateral:
1Hz to 15 Hz, 0.5 g peak to peak
15Hz to 500 Hz, 5g peak to peak
- ii. Longitudinal:
1Hz to 15 Hz, 3g peak to peak
15Hz to 500 Hz, 5g peak to peak

b. Shock:

10g peak for 10 ms in any axis.

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After the test there shall be no resulting damage, abnormality in the operation of equipment. After completion of mechanical endurance test, vibration and shock tests, the equipment shall again be subjected to dielectric test and performance test.

q. WATERTIGHTNESS TEST:

This test will be done for EoTTdevice as per IEC 60529.

r. REVERSE POLARITY TEST:

The equipment shall be tested to verify the reverse polarity protection by making the connection to reverse polarity and unit shall work normal after restoring the connection to correct polarity.

6.2.4 SPECIAL TESTS

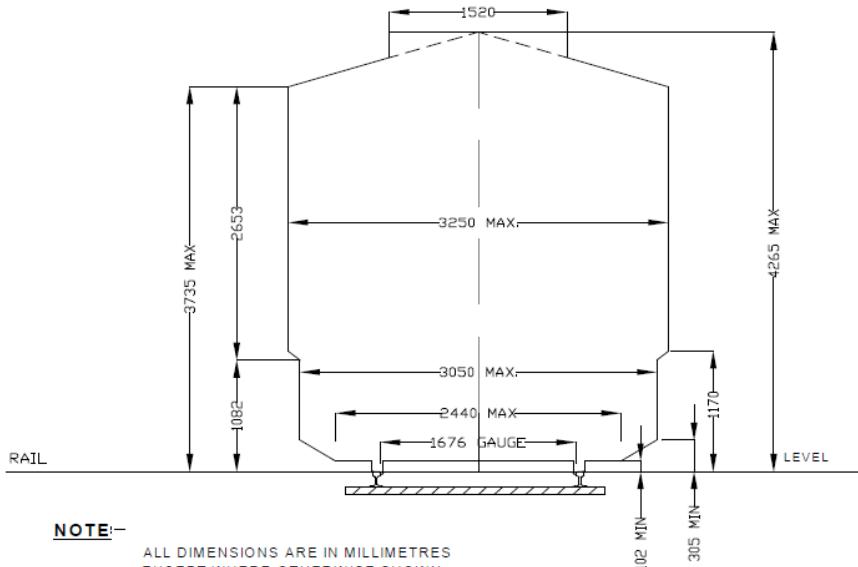
- a. **Drop Test:** The test lamp including the complete SBU shall withstand free drop from a height of 1.5 meters above an RCC platform on 75 mm thickness or on a steel plate 12 mm thick. For the purpose of the drop test, the complete units shall be powered up and after dropping the same twice, the units shall continue to function effectively, satisfy all parameters. Appearance of cracks on the body shall not be deemed as disqualification as long as units continue to function. The units, however, shall not disintegrate upon falling.
- b. Vendor shall submit make, grade and data sheet of all major electronic components and switches for verification during type testing of EoTT. Vendor shall also submit chemical composition and relevant IS or international specification of all metallic components used and housing of marker device.
- c. IP Protection Tests: Testing will be carried on EoT and HoT for IP 54 protection and on antennae for IP66 protection as per IEC 60529.
- d. Visibility test of HVML & DTWL.
- e. Illumination level Test for HVML & DTWL.

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ANNEXURE - I

Addendum & Correction Slip (ACS) No. 14 to Indian Railways Schedule Of Dimensions (B.G.) 2004

DIAGRAM No. 1D (EDO/T-2202)
1676mm GAUGE

MAXIMUM MOVING DIMENSIONS

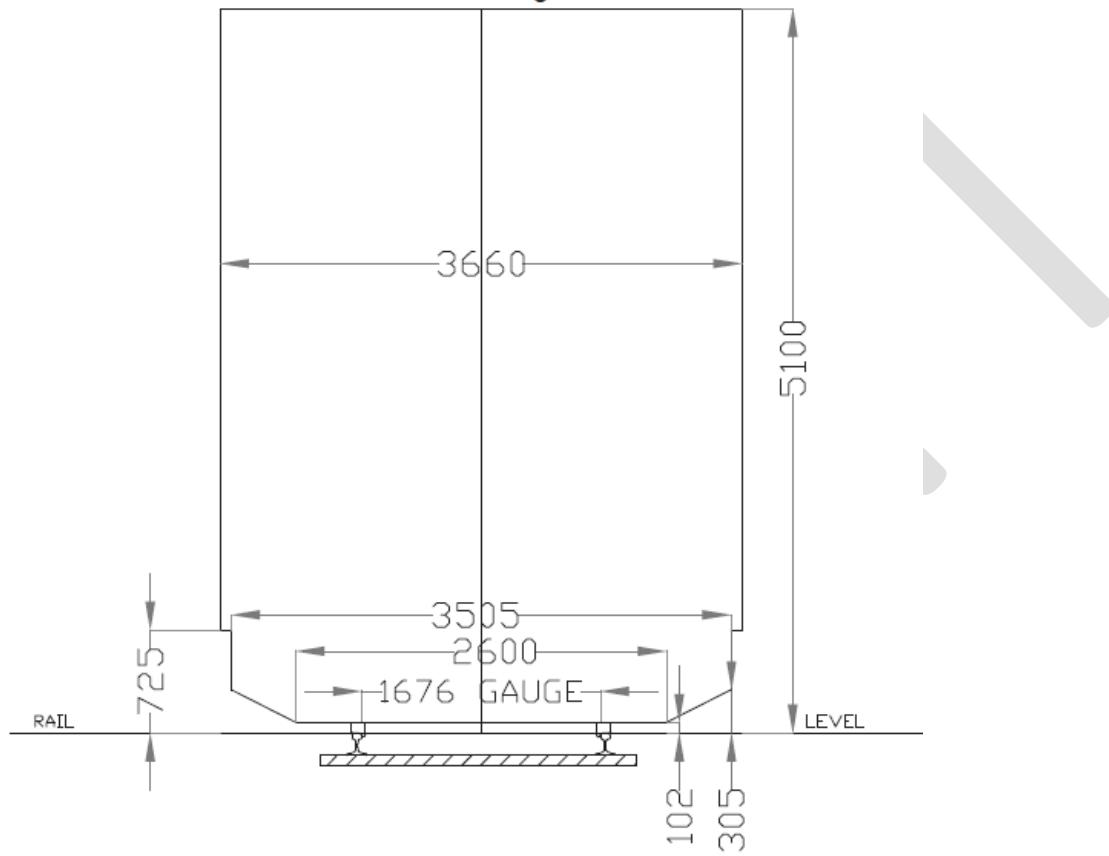
Railway Board's letter no. 2012/CEDO/SD/IRSOB/O/03, dated 18.11.2013

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ANNEXURE-II**DIAGRAM No. - 4
1676mm GAUGE****MMD OF DFC FOR EASTERN CORRIDOR**

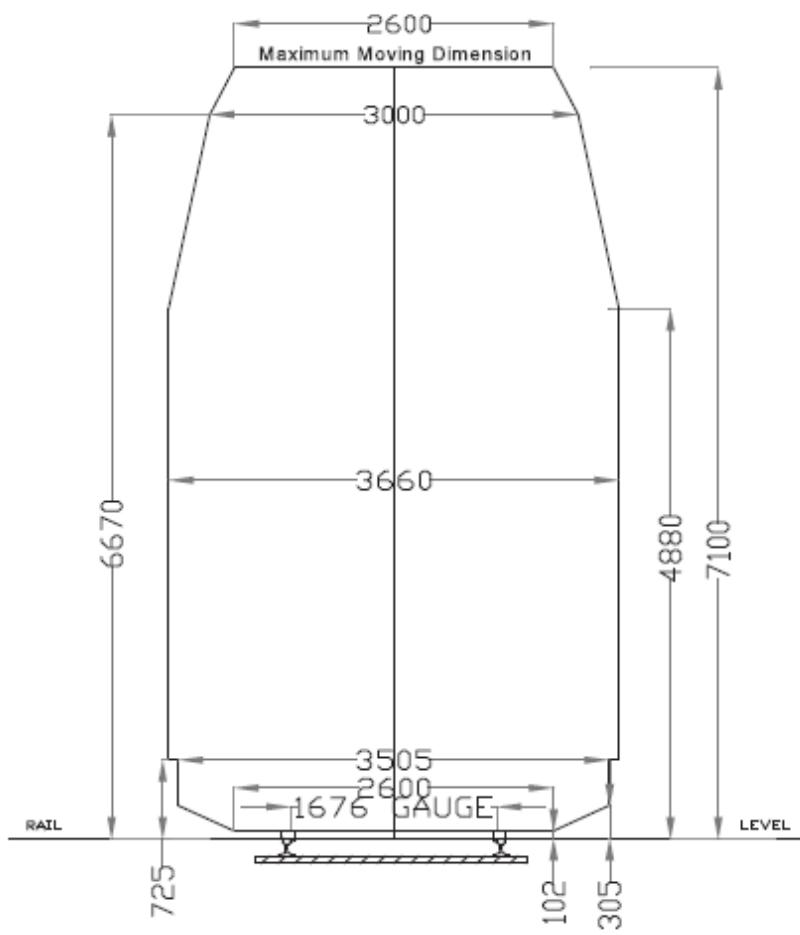
Maximum Moving Dimension

**NOTE :-**

ALL DIMENSIONS ARE IN MILLIMETERES
EXCEPT WHERE OTHERWISE SHOWN.

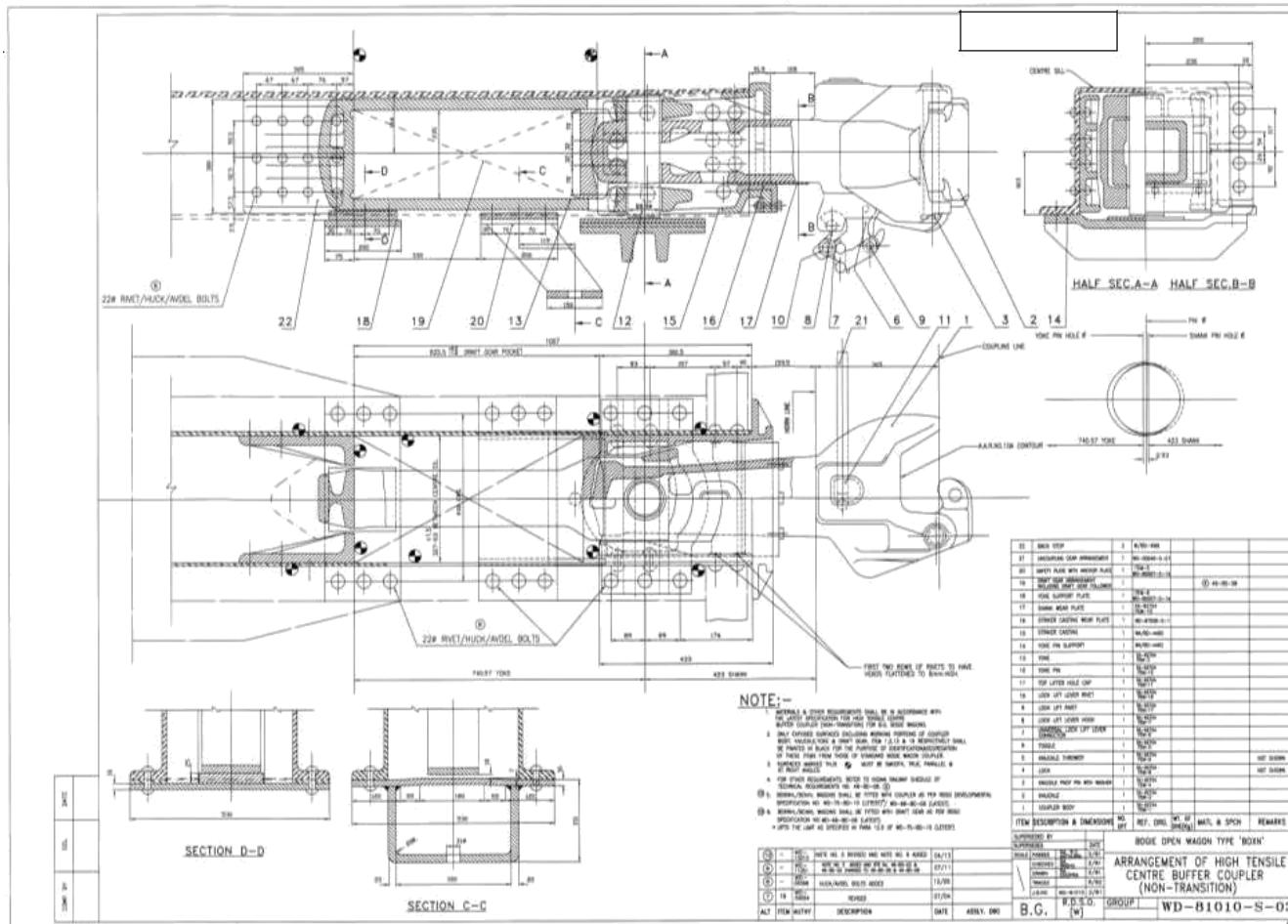
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ANNEXURE- III

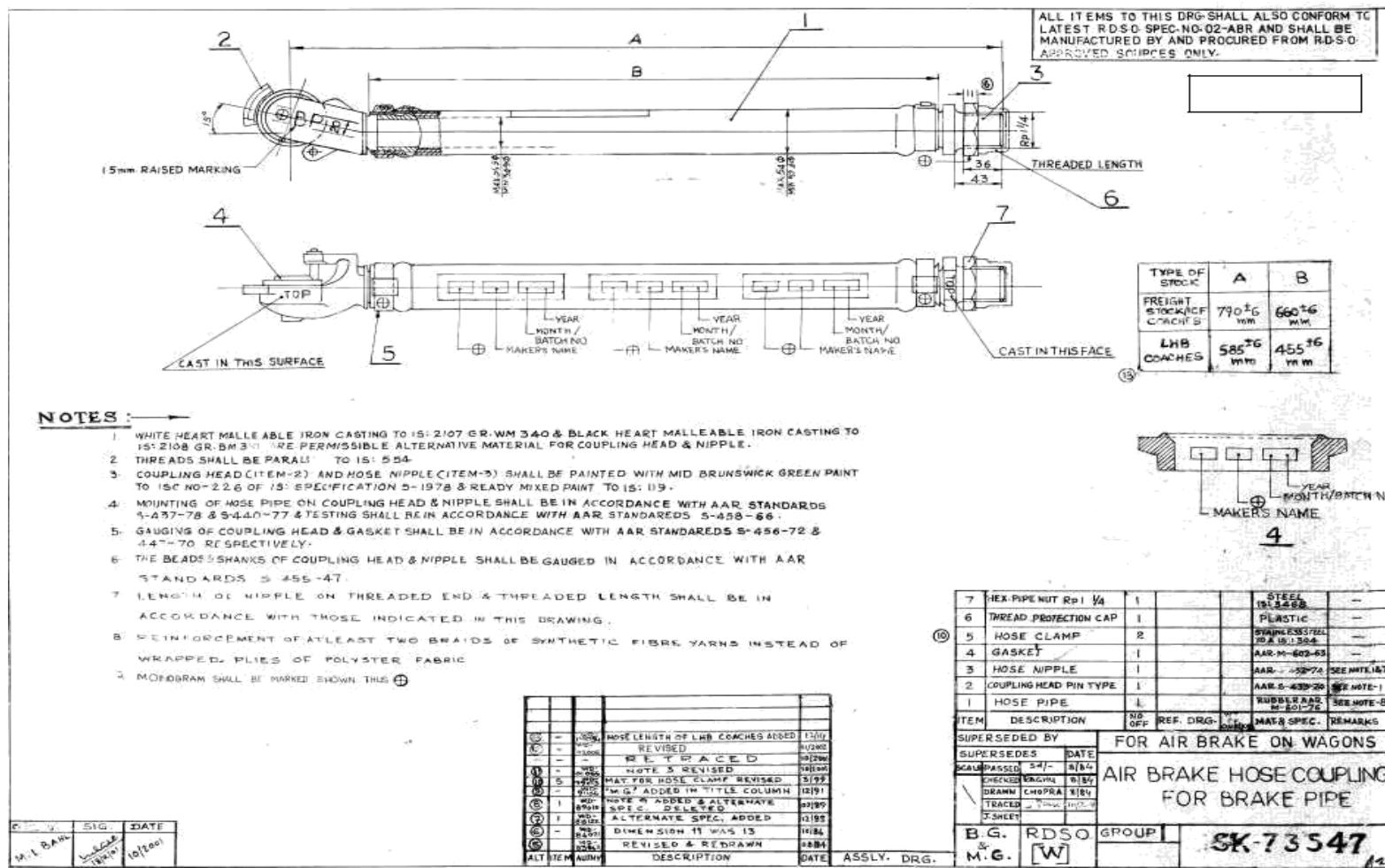


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ANNEXURE - IV

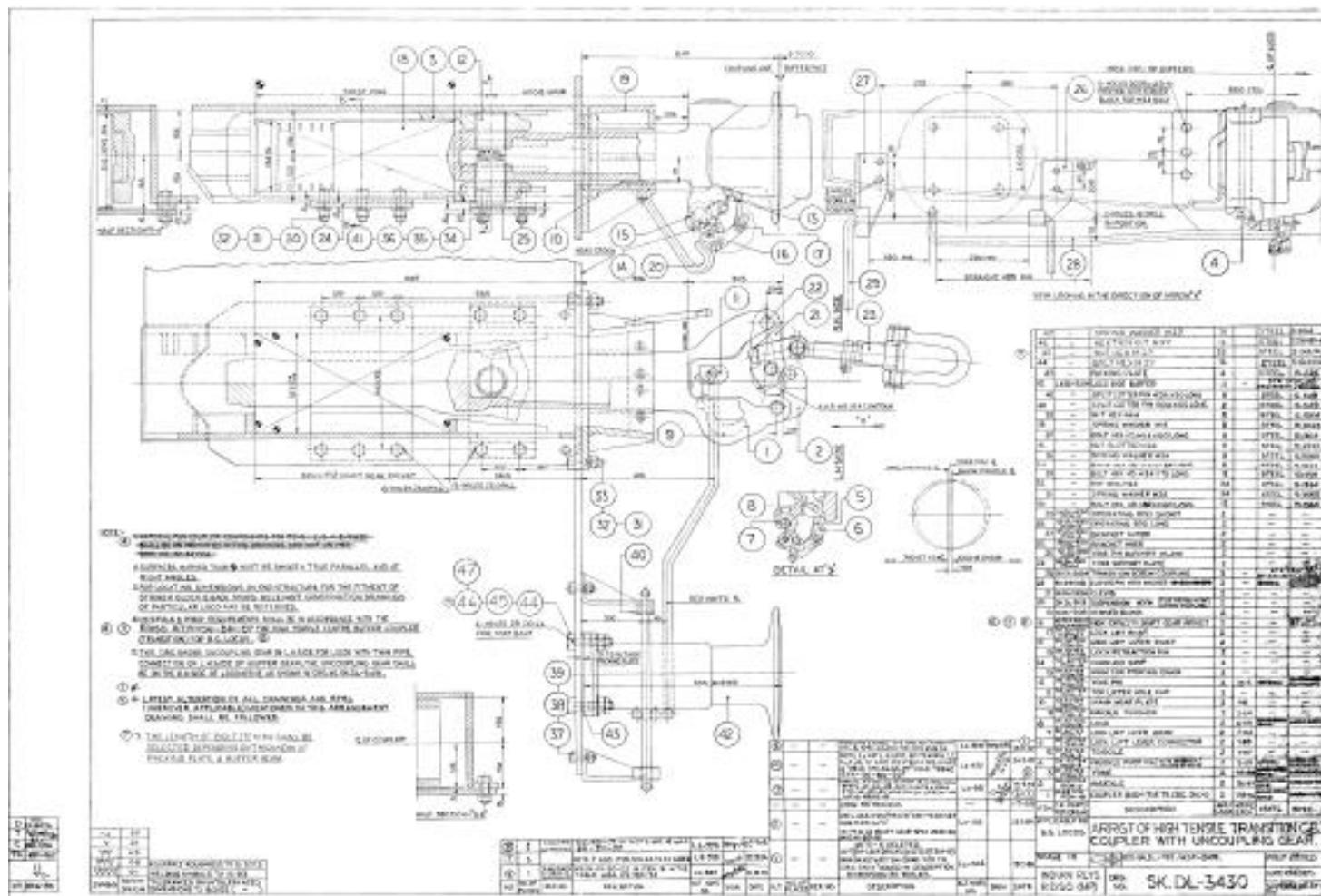


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ANNEXURE - V

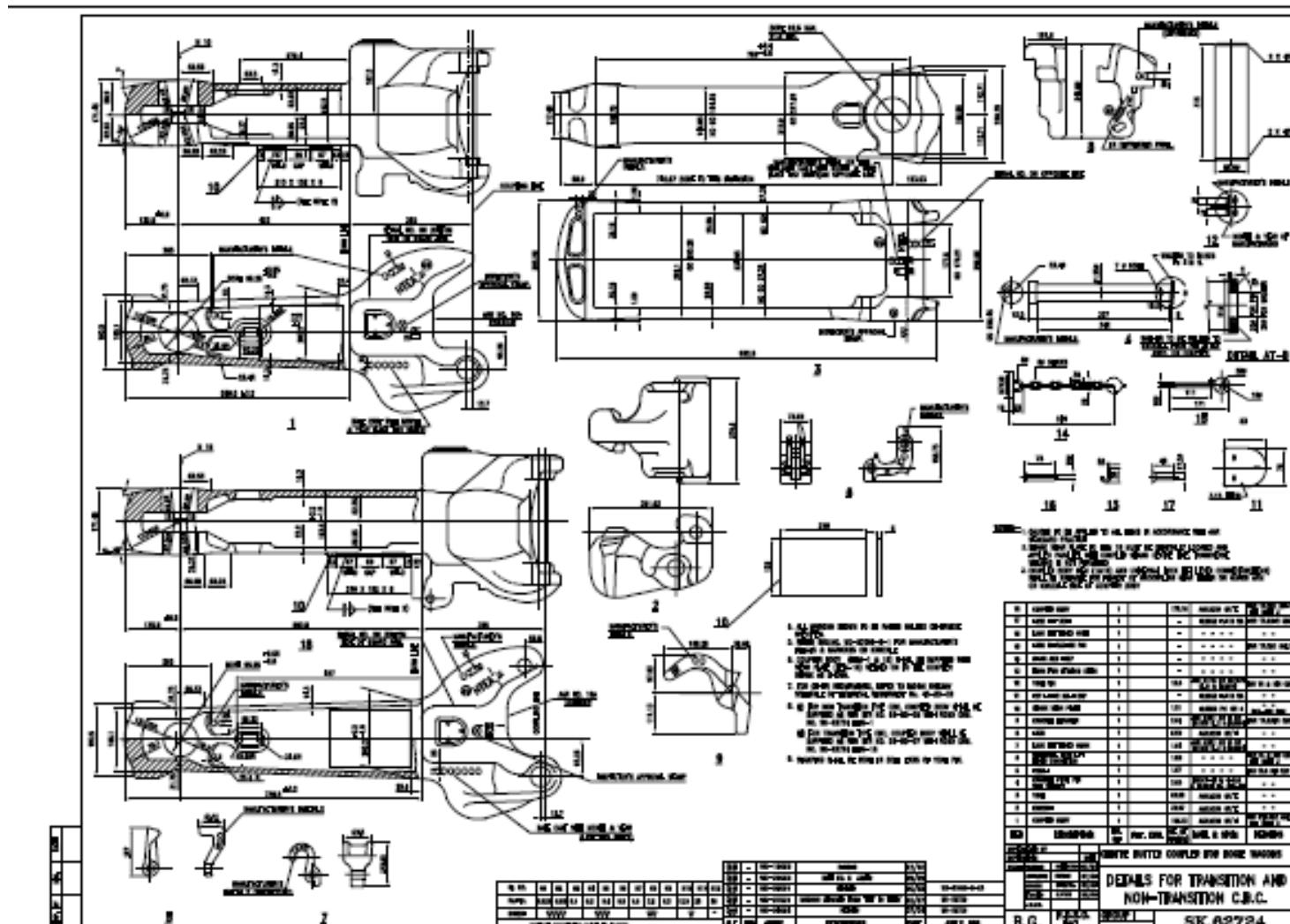
Prepared by	Checked by	Issued by

ANNEXURE – VI

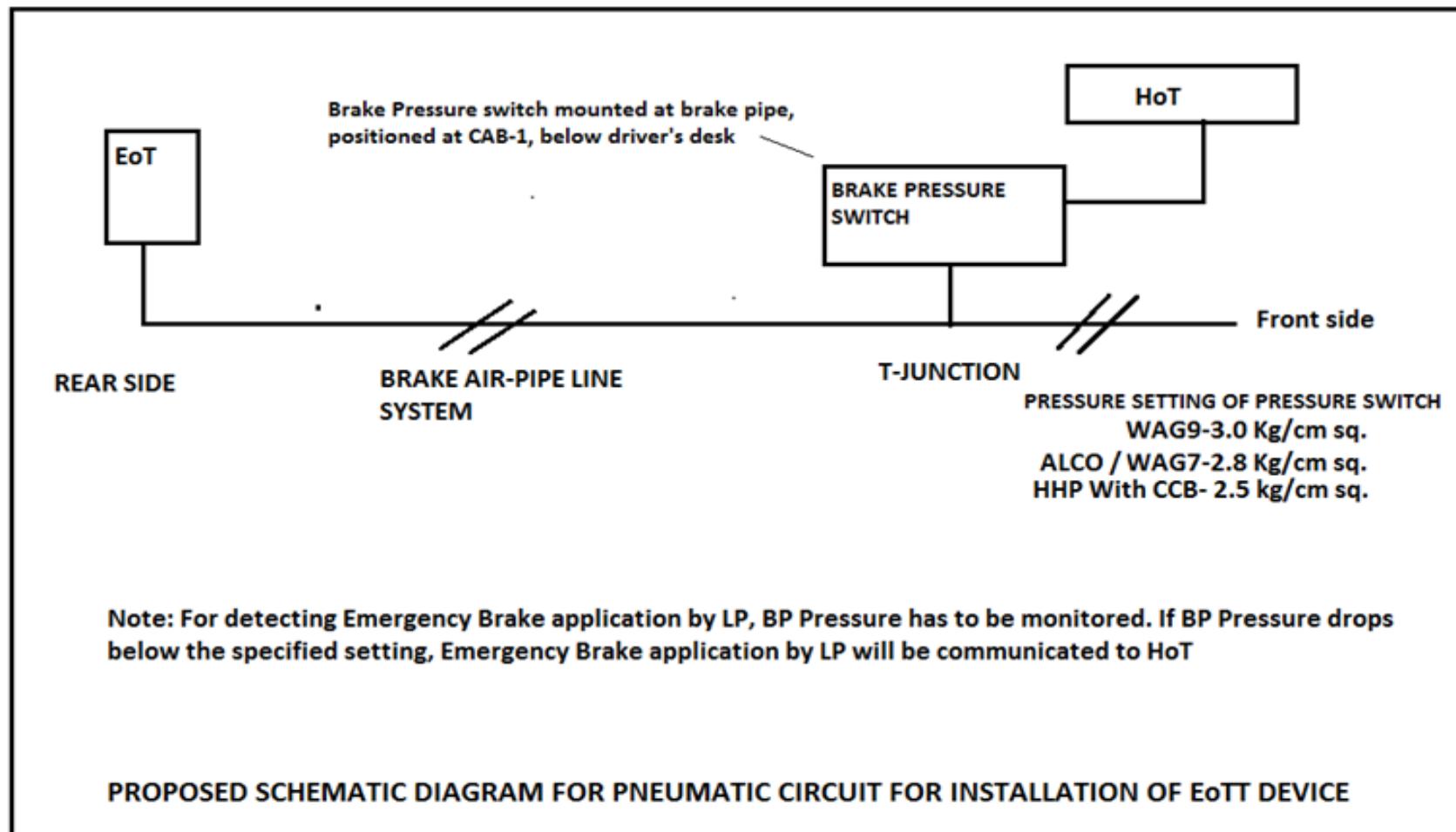


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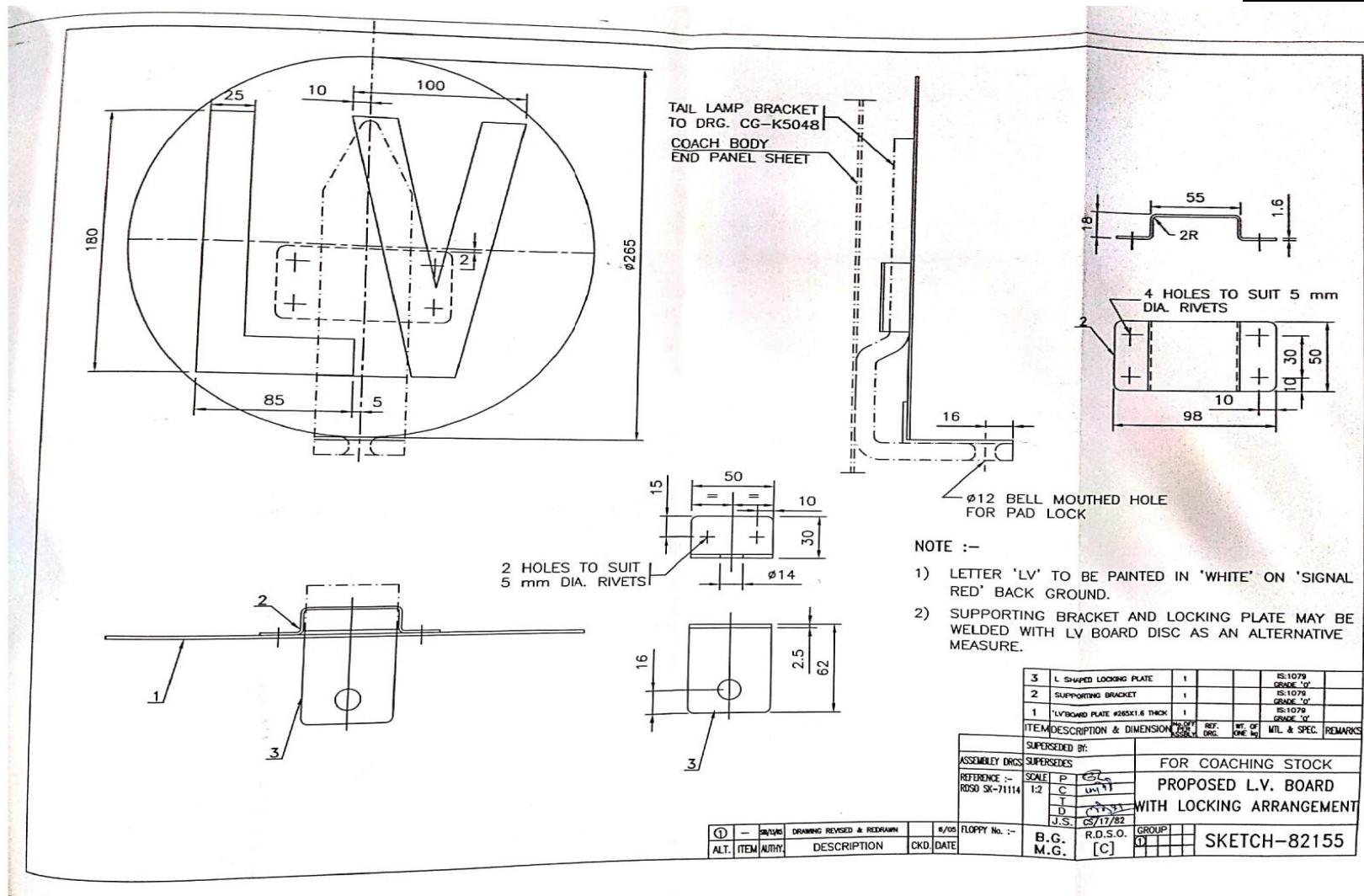
ANNEXURE – VII



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ANNEXURE-VIII

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ANNEXURE-IX

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ANNEXURE-X

Tentative EoTT Field Trial Format			
M/s			
RDSO Test Proforma		Date:	Total Pages-12
Note- EOTT contains two parts namely HOT (To be fitted in Loco Cab) & EOT (To be fitted in CBC of Wagon). Configuration & Testing Procedure is to be started from EOT device first.			
HOT No. (Master)		HOT No. (Slave)	EOT No.
Sl. No	Item to be checked	Standard value if any	Observation
A. Physical Inspection:-			
1	Physically inspect the EOT	No damage or broken parts.	
2	Operate the coupler mount of EOT.	No defects on the clamping gear & free movement	
3	Check the air hose assembly of EOT for any damage.	No damage	
4	Ensure the availability of locking arrangement (lock, Key & chain) of EOT	Intact	
B. Initial Sequence of Testing of EOT unit:-			
1	Power ON:- power on by power/function pushbutton	EOT device will Power ON. Upon Power ON Software version , battery voltage , EOT unique id will be displayed	
2	Unique ID: <u>Note down the 05 digit EOT unique ID or read from 'Marking plate'. It is required for pairing with HOT.</u>	05 digit EOT unique ID : "nnnnn" format.	
3	EOT Battery:- <u>Read the battery voltage and hours of charge left</u>		
4	HVML Testing:- <u>Verify that the HVML is functional and flashing.</u>		
a)	Automatic switching ON & OFF of HVML is required based on the ambient light condition		
b)	Colour Co-ordinates: Red Aspect.		
c)	Nos of flashes per seconds.	$2 \pm 10\%$ for foggy weather ≤ 4 for normal weather	
d)	Number of LEDs used	Shall not less than 6 with display	

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		area of about 70 mm diameter	
e)	Provision of activating Fog condition through switch or MENU option in HOT		
f)	Status indication of HVML shall be available on HOT		
g)	Visibility of HVML from 1.6 Km.	For testing, Trial lamp (EoT) to be placed 1.5 m above rail level and viewed at local sunset time under clear weather condition.	
Sl. No	Item to be checked	Standard value if any	Observation
5	<u>Photo cell mode of HVML</u> :-Check the Photocell mode of HVML by blocking the sun light to HVML display (Day time) or shining a light source(Night time)		
6	<u>EOT without Air</u> :- Check EOT without air pressure & lying down horizontally or when connected to a charger	The unit will switch to sleep mode. The HVML and display will be available in sleep mode.	
7	<u>Display of BP pressure in EOT</u> :-Fit the EOT with CBC &connect its hose to BP pipe.	Pressure display on the EOT measurement accuracy is within ± 0.21 Kg/cm ²	
8.	<u>Check for Three Power Modes</u> <i>On Mode: full functionality available</i> <i>Sleep Mode:Radio transmission off: Pressure transducer on, Radio receiver on, GPS on; GPRS ON; Functionality of HVML and DTWL</i> <i>OFF Mode; all electronics switch off with no drain on battery.</i>		
9			
i	<i>EOT must only switch on in vertical position irrespective of pressure value</i>		
ii	<i>15 minutes after going into horizontal position,EOT must switch to sleep mode(provided pressure is zero or connected to charger)</i>		
iii	<i>Whilst upright, and the pressure drops below 20 kPa (0.2 Kg/cm²)</i>		

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	The Rear Unit must switch to Sleep Mode after a 15 minute delay, but should first update the Cab Unit.		
iv	<i>EOT must automatically switch its transmitter on when the pressure rises to 0.2 kg/cm²</i>		
v	<i>EOT must resume in normal position from sleep mode when a button either in HOT or EOT pressed.</i>		
vi	However, if disabled train warning light is not activated and the pressure continues to remain below the above-mentioned limits, the Rear Unit must switch OFF completely after 10 hours		
vii	<i>Switching off the EOT Unit must not be possible when pressure is above the specified limit.</i>		
viii	The Rear Unit must protect itself against damage to its battery due to deep discharge by switching itself OFF if the battery voltage drops too low, but should first send an appropriate message to the Cab Unit.		
10	<u>Sense and Brake Unit (SBU)</u>		
i	Automatically and continuously, monitor BP pressure of the locomotive as well as the last vehicle on train every 60±5 seconds and to provide its accurate readings within ±0.21 kg/cm ² to driver at regular randomized intervals of 60±5 seconds		
ii	The SBU must have provision to go into sleep mode in case the system is not receiving brake pipe pressure for more than one hour. Upon getting the brake pipe pressure thereafter, the SBU must wake up and resume its full functional state within 60 seconds.		
iii	Rear Unit must be Capable of measuring the brake pipe pressure on the rear vehicle from 0 – 6.5 kg/cm ² and display the same to the one place of decimal with least count of 0.1 kg/cm ² using sensor level output and not using software interpolation		
iv	At the test bench, the accuracy of the measurement should be ± 0.21 Kg/cm ² and it should be demonstrated that variations in brake pipe pressure of ± 0.21 Kg/cm ² can be measured and displayed		
v	In case of having to take off the SBU while there is sufficient		

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	pressure in the brake pipe of the train, suitable design arrangement must be made without compromising the safety of the train.		
11.	<p><u>DTWL Testing:- Verify that the DTWL is functional. (2.2.11)</u></p> <ul style="list-style-type: none"> a) ColourCo-ordinates: b) No. of flashes per seconds. c) Number of LEDs used. d) Radiating area (approx.) <p>Provision of activating Fog condition through switch or MENU option in HOT</p> <ul style="list-style-type: none"> a) Status indication of DTWL on HOT b) DTWL illumination either automaticallywhen train brakes applied in emergency or manually using cab control switch. c) Warning light will reset automatically when BP of EOT is greater than 3 kg/cm^2 d) This warning light will also reset by a control switch / menu option on EoT e) This warning light will also reset by a command given by Loco Pilot from paired HoT either by way of a switch or menu option f) When this warning light is illuminated, HVML will go in OFF condition. g) When this warning light is reset, HVML will illuminate automatically based on the ambient conditions. h) Visibility of DTWL from 1.6 Km 	<p>Amber yellow 40 ± 5 flashes/minutes shall not be less than 6 with display area of about 70 mm dia.</p> <p>For testing, Trial lamp (EoT) to be placed 1.5 m above rail level and viewed at local sunset time under clear weather condition.</p>	
C. Initial sequence of Testing of HOT unit:-			
1	<u>Power ON the HOT:</u> Power ON the HOT in loco active cab. HOT display will be ON.		
2	Feeding of following Parameter on the display unit by the LP		
	1. Train number 2. crew ID		
3	Suitable Ethernet/USB port shall be provided on HoT for its programming/ downloading the data directly to the pen drive		

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4	Provision of Automatic & manual backlight brightness adjustment of display		
5	<u>Entry of EOT Unique ID:-</u>	Enter the EOT unique number noted earlier using key pad. Then, Press Enter/YES.	

Sl. No	Item to be checked	Standard value if any	Observation
D. Pairing Sequence of HOT &EOT:-			
1	<u>Initiate Pairing:-</u>	If the EOT and HOT are successfully armed/paired to each other, then:- • ARMED , EOT ID paired will be displayed	
2	<u>EOT Information on HOT display:-</u> (On successful RF communication/pairing of HOT & EOT)	<ul style="list-style-type: none"> • BP Pressure of EOT, • HVML status(HVM ON/OFF), • Train Length • Train integrity indication • Battery status of EOT • SPEED of EOT and HOT 	
3.	<u>HoT Display Unit:</u> <u>A. Parameters</u> Following parameter will be shown in HoT display, when no EoT device is paired with HoT device. j. Loco Number (up to 6 digits numeric value) k. Train Number (up to 10 digits alpha-numeric value) l. Crew ID (up to 10 digits alpha-numeric value) m. Date & time of HoT device n. Speed of locomotives o. Battery percentage of HoT p. Status of EoT pairing (not connected to any EoT). q. Battery voltage of HOT Following parameter will be shown additionally in HoT display, when an EoT device is paired to HoT device:		

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	<ul style="list-style-type: none"> a. Unique ID of EoT paired b. BP Pressure of rear wagon in the format-NN.n kg/cm² i.e. up to one place of decimal. c. Battery Status in (%) percentage of EoT d. Speed of EoT e. Date & time of EoT device f. Various Alarm Status & messages sent by EoT g. Status of HVML& DTWL h. Train Length i. Train Integrity Indication j. Integrity of the radio communication 		
	<p>GPS in EOT & HOT:</p> <p>Check Position accuracy of GPS</p>	<p>GPS system of EoTT shall have Position accuracy of approximately ±10 Meters</p>	
E	<p>2-Way communication between HOT & EOT:</p> <p>1. Messages as per AAR S-9152 transmitted from the rear end unit to the cab unit must include the following:</p> <ul style="list-style-type: none"> • Rear unit Identification code. • Rear unit battery status. • Brake pipe pressure <p>2. GPS & other data in 2 additional data blocks will be as per communication protocol issued by RDSO</p> <p>3. Digital communication method that will communicate upto2.5 kilometer range with an external antenna on the locomotive.</p> <p>4. Manual Communication Test</p> <p>5. Automatic Communication Test</p> <p>6. Emergency valve test</p> <p>7. Rear to front communication failure</p> <p>8. Front to rear communication failure</p> <p>9. Front to rear messages retries.</p> <p>10. Front to rear communication</p>		
	<p>F. Emergency Brake Test (Manual Mode):-</p>		

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1	Application:- EMERGENCY switch to be made ON on the HOT. (2.2.2 & 2 2 3) (2.2.10)	Emergency brake will be applied by opening a valve in EOT and the brake pipe pressure will come to Zero within 15 seconds.	
2	Release:- Brake function will be restored automatically within 02 minutes after it has initiated an emergency.	Valve will be closed and pressure will start increasing	
G. Emergency Brake Test (Auto Mode)(2.2.10)			
1	Application:- simulate emergency brake application by driver by making the pressure switch open contact closed	Emergency brake will be applied by opening a valve in EOT for minimum 15 seconds.	
	a. A failure of the system shall not cause application of the emergency brakes.		
	b. Delay between receipt of the command to apply rear emergency brakes and the rear valve's activation shall be 1 second or less.		
	c. The valve opening shall have a minimum diameter of $\frac{3}{4}$ inch, and the internal diameter of hose shall be $\frac{5}{8}$ inch, minimum to effect an emergency brake application.		
H. Train Integrity Function Test:- As per FRS clause no. 2.2.9			
	Train Integrity Function Test:-	To confirm the train is complete	
	<p>a. This may be achieved by employing GPS units in the HoT&EoT and by continuously monitoring the speed and displacement differences between the front & rear of the train.</p> <p>b. The following shall be displayed to the driver:</p> <ul style="list-style-type: none"> • “Train OK” - When the system detects no evidence of the train being parted • “Caution” - In cases where there is (temporary) doubt of train completeness • “Train Error” - When the system detects that the train has become parted • “Move” or “Stop” as per AAR S-9152. • Speed of the HoT and Speed of the EoT (RU) • “Length” / Displacement at start-up, plus relative Deviation (+ or 		

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	-)		
	c. After initial switch-on of the EoTT, when both HoT and EoT GPS equipments have satellite fixes, the displacement in meters between the front and rear units shall be displayed to the train driver as "Train Length xxxx m?", whereupon if acceptable to the driver, the value may be accepted by pressing the Enter>Select button. (If not acceptable, the driver should wait for further updates). This value must then be stored, and used as reference for future displacement readings, which are to be displayed as the stored value, together with a deviation (+/-).		
	d. the RU and CU speeds are to be stored, averaged and compared (10 second moving averages are proposed).	.	
I. Air Generator & Odometer Testing:-			
1	<u>Testing of Air generator battery charging:-</u>	Air generator charging bit indication	
	Air Turbine/Generator is to consume no more than 2.5 cubic feet per minute (at 80 PSI)from brake pipe air		
K	<u>Testing of battery</u>		
	4.1 Battery for EoTT system		
	j. Both HoT&EoT devices must be supplied with integrated rechargeable sealed batteries.		
	k. Suitable protections like overvoltage, over current, short circuit, over charge & over discharge, surge, incorrect insertion of connector, over temperature etc. shall be provided in charging/discharging circuit.		
	l. The battery must be protected against irreversible damage due to excessive deep discharges.		
	m. A battery status indication shall be provided for both EoT&HoT units in the display unit to continuously indicate the remaining capacity of the batteries in hours. The battery status information transmitted by the EoT unit must be used to determine the remaining battery life and display in percentage in cab unit. It will also be transmitted to the server.		
	n. If the battery charging facility of HoT fails but locomotive		

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	battery is available, then even after the failure of the charging unit the battery of HoT must ensure normal EoTT working for at least 48 hours.		
	o. If locomotive battery is not available, than EoTT functionality of HoT will not be required, but GPS monitoring of dead locomotive is required. Battery backup of the HoT device shall be adequate such that it can work for at least 20 days when locomotive is in dead condition(HBA in OFF condition).	GPS data shall be captured every 1 hour by HOT device and transferred to the server.	
	p. If the battery charging facility of EoT fails, then even after the failure of the charging unit the battery of EoT must ensure normal EoTT working for at least 36 hours.		
	S. No.	Parameters	Operating period
	1.	Minimum normal battery life with built in battery upto low battery indicator (LBI), with charging disconnected, for a continuously operated marker device with normal working of EoTT.	≥ 24 Hours
	2.	Min. operating battery life after low battery indicator (LBI) with charging disconnected.	≥ 12 Hours
	Total		≥ 36 Hours
	No deterioration in illumination is permitted during normal battery life. For specified minimum operating battery life after low battery indicator (LBI), 25% drop in illumination from its		

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	original value is permitted.		
--	------------------------------	--	--

Sl. No	Item to be checked	Standard value if any	Observation
L. ON RUN Monitoring:-			
1	Display of BP Pressure of EOT in HOT Rear Pressure in display		
2	HVML Working Status (High Visibility Marker Light)		
3	Radio Communication Status indication in HOT		
4	EOT is moving with Train - status is to be displayed		
5	EOT is NOT moving with Train or train is stopped on signal, then status is to be displayed.		
6	Armed status in HOT		
7	Disarmed status in HOT		
8	To indicate passage of complete train over particular location as desired by LP (Clearing the Fouling Mark):-		
	Odometer function		
	Fouling mark clearance		
9	36 hour back up battery charge in EOT is to be checked		
10	To broadcast location of EoT devices to other trains equipped with EoTT in Emergency		
11	To indicate the GPS location of EoT&HoT over map on website		
12	Monitoring of own health status of HoT& EOT		
13	The EoT device and HoT device must do hand shaking during run with each other so as to acknowledge safe working of the system. (2.2.7)		
14	Logging of performance of the EoT device and HoTdevice (2.2.8)	At nominally every 60 seconds. The same should be stored internally for at least 30 days.	
15	2 The visual alarm message display must continue until the pressures/parameters are within the specified range, or reception		

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	<p>is restored or the unit is switched off.</p> <p>3 Alarm can be acknowledged by the LP using specified key. It will suppress the current audible alarm but the visual display will continue till the values normalize. When the alarm values change.(2.2.14 h&i)</p>		
16	The system must work reliably on a train of up to 200 wagon or 2.5 km length and train travelling at a speed of up to 120 kmph on straight track free from obstructions (like rocks, tunnels etc.) in clear weather conditions.		
17	Charging of EoT in Locomotive as per FRS cl no. 2.2.21		
18	It shall then be possible for the driver to query the EoTT device for this information and the EoTT device shall send appropriate message to DU of HoT device if the Fouling Mark is "Cleared" or "Not Cleared" by displaying the same on the DU of HoT device. Necessary hardware and software shall be built into the EoT device and HoT device for achieving this functionality. This feature will be an aid to Loco Pilot. (2.2.29)		
19	A status indication of the EoT device marker light is also required to be displayed on the DU of HOT as per AAR S-9152. (Marker light ON, OFF or Defective). (2.3.6)		
20	<p>Parameters to be recorded are:</p> <ol style="list-style-type: none"> 1. Start Up / Switch On date & time 2. Position and ID/Serial Numbers of EoT and HoT at start up 3. Periodic readings of pressure, battery voltages and alarms, e.g. <ul style="list-style-type: none"> • Low Battery • Low BP pressure • Communication Failure. • Emergency brake application from rear • Train parting etc. • Speed • Train stopped 		

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	<ul style="list-style-type: none"> • Train moving • Received signal strength, if possible 		
21	(i) Brake application and release characteristics in each mode of operation of EoTT with standard parameters and details of brake testing and reliability of brake equipment should be submitted to RDSO for verification and validation. Final clearance of fitment of braking unit on loco from RDSO would be essential. (2.3.5)		
	(ii) The software programs of the EoTT shall be on a non-volatile reprogrammable storage on both devices HoT&EoT. (2.2.23)		
	(ii) it should be possible to give a command from HoT device by LP to EoT device to broadcast an Emergency message from EoT device which shall be received by all makes of HoT devices of other trains within the range of radio communication and displayed on their Display Unit indicating distance from the disabled last vehicle which shall be calculated based on GPS coordinates of disabled last vehicle (2.2.27)		
M. Online Alert System/Alarm for CLI/Crew:- (2.2.14)			
1	<ul style="list-style-type: none"> • Failure of communication, • Emergency brake • Battery (Low[below 25%]/Dead) (2.2.5) • Pressure drops below 3.0 Kg/cm²(2.2.4) 		
2	<ul style="list-style-type: none"> • HVML ON/OFF, • Armed/Disarmed, • Motion Sensor- MOV/STP; • Start/Completion of pairing 		
3	<ul style="list-style-type: none"> • Pairing/Arming request received from EOT 		
4	<ul style="list-style-type: none"> • Pressure changed by 0.2 Kg/cm² or more; • complete Passage Alarm • Train Integrity alarm, (2.2.14 d&f) • To check Audio Alarm volume must be adjustable 		
N. Operation from Slave HOT unit:			

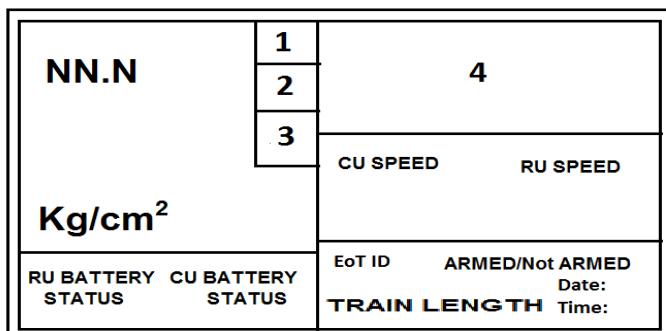
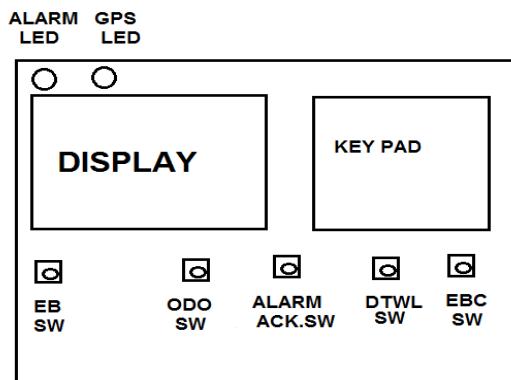
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O. Disarming / Unpairing the HOT/EOT at the END of Journey:-**Tentative Format for submitting performance feedback by Railways****Name of Shed/ Railways.....**

SN	EoT No. & make	HoT No. & make	Loco No.	DOC	DOF	Reason for failure	Remarks

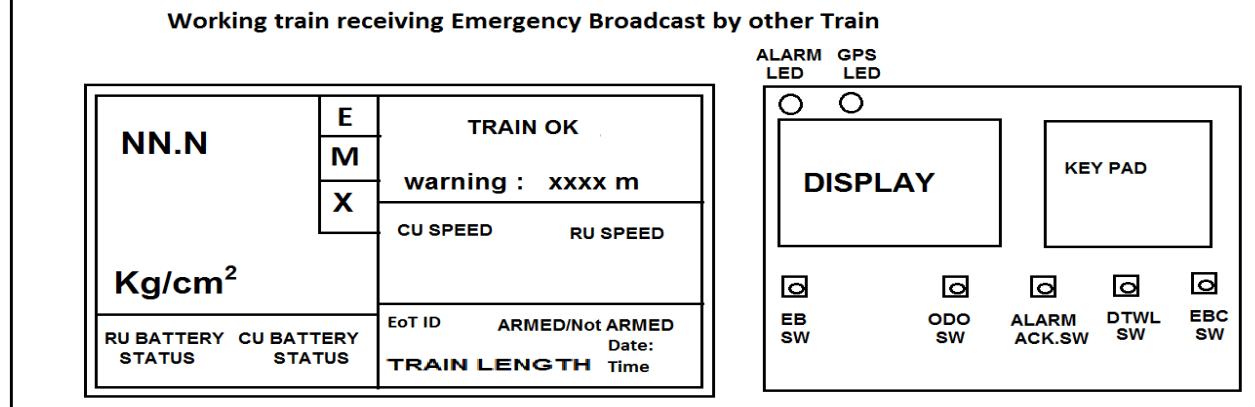
DOC- Date of Commission**DOF- Date of Failure**

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ANNEXURE-XI**HoT Display Screen****HoT Front**

Note: ALARM LED & GPS LED MAY BE PUT AT ANY LOCATION

For Place 1	Indication	For Place 2	Indication
HVML in Normal Condition	H	EoT in Motion	M
HVML in Foggy Condition	h	EoT in Stop Condition	S
DTWL in Normal Condition	W	For Place 3	
DTWL in Foggy Condition	w	EoT (SBU) valve is closed	
In case of receiving Emergency Broad cast message	E	EoT (SBU) valve is open	
For Place 4			
All parameter are OK	Train OK		
Pressure level below from specified	Caution		
In case of Train parting or else	Train Error		
In case of any miss happening of working train	Emergency Broad cast	Receiving HoT will show	Warning: XXXX m

Working train receiving Emergency Broadcast by other Train**DISPLAY SCREEN****HoT FRONT**

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		.

ANNEXURE-XII

सत्यमेव जयते

भारत सरकार—रेल मंत्रालय
अनुसंधान अभिकल्प और मानक संगठन
लखनऊ— 226011
e-mail: dsetm@rdsd.railnet.gov.in
Telephone : 0522-2465716

Government of India - Ministry of Railways
Research, Designs & Standards Organization,
LUCKNOW – 226011
Fax: 91-0522-2452581



No. EL/4.2.15/EoTT

Date: 21.05.2021

SPECIAL MAINTENANCE INSTRUCTION NO. RDSO/ 2021/EL/SMI/0329 {REV. '0'}**1.0 Title :**

Special Maintenance Instructions No. RDSO/2021/EL/SMI/0329 Rev '0' for guidelines of Comprehensive Annual Maintenance Contract for End of Train Telemetry (EoTT) system on IR.

2.0 Brief History :

2.1 Railway Board vide letter number 2018/Elect(Dev)/181/4 dated 20.08.2018 had advised RDSO to finalize the Specification of End of Train Telemetry (EoTT) project. RDSO had prepared Functional Requirement Specification No. RDSO/2019/EL/FRS/0025 Rev '0' dated 25.06.2019 for End of Train Telemetry (EoTT) System for Indian Railways. ECoR and BLW has placed the developmental orders for use of EoTT on IR. Final Specification for EoTT No. RDSO/2021/EL/ SPEC/0144 Rev '0' dated 11.05.2021 has been issued.

2.2 As per clause 1.7.2 of the above Specification, the firm shall submit their bid for Comprehensive AMC of the EoTT for a period of 7 years after expiry of warranty period.

2.3 As per condition laid down in Specification a need is felt to provide a uniform guidelines for Comprehensive Annual Maintenance Contract (AMC) of EoTT system over IR. Zonal Railways have also requested to follow uniform guidelines in this respect

3.0 Object:

Special Maintenance Instructions No. RDSO/2021/EL/SMI/0329Rev '0' for guidelines of Comprehensive Annual Maintenance Contract for End of Train Telemetry (EoTT) system on IR.

4.0 Modified Instructions:

Guidelines of Comprehensive Annual Maintenance Contract for End of Train Telemetry (EoTT) system on IR is attached as Annexure.

5.0 Application:

All Electric & Diesel Locomotives (Conventional & 3 phase)

6.0 Agency of Implementation:

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All PUs, POH Workshops and Electric/Diesel Loco Sheds.

7.0 Periodicity of Implementation:

As and when required maintenance

Encl.: As above


(Anurag Agarwal)
for Director General/Electrical

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सत्यमेवजयते

भारतसरकार (GOVERNMENT OF INDIA)
रेलमंत्रालय (MINISTRY OF RAILWAYS)

**GUIDELINES FOR COMPREHENSIVE ANNUALMAINTENANCE CONTRACT
FOR**

**End-of-Train Telemetry (EoTT) System
For Indian Railways**

Total no of pages:14
Issued on: 21.05.2021

ELECTRICAL DIRECTORATE
RESEARCH DESIGNS AND STANDARDS ORGANISATION
LUCKNOW-226011

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1.0 General

This annual maintenance contract covers the comprehensive maintenance requirement of End Of Train Telemetry System for Electric/Diesel locomotives and the agreement is required to be entered between OEM/ supplier of End Of Train Telemetry System and Zonal Railways on behalf of president of India for use and operation by the Zonal Railways at Headquarter/ divisional level. These guidelines shall be read in conjunction with Clause 1.7 of the Specification No. RDSO/2021/EL/SPEC/0144, Rev'0' (or latest) of End of Train Telemetry(EoTT) System for Indian Railways.

2.0 Definitions

Throughout this document, the terms:

- a) 'EoTT' means End of train telemetry system.
- b) 'IR' means government of India. Ministry of Railways, Railway Board, New Delhi or its nominees.
- c) 'RDSO' means Research Design & Standard Organization.
- d) "Tendered" Means the firm/company submitting the offer for annual maintenance of distributed power wireless control system fitted on three phase freight locomotives.
- e) **Contract** ' means the contract for annual maintenance of End Of Train Telemetry system fitted on three phase freight locomotives proposed to be entered into between IR and the firm, against the tender.
- f) **Contractor**' means the firm/ company or its wholly owned subsidiary in India on whom the order form annual maintenance of End Of Train Telemetry system fitted on three phase freight locomotive is to be placed.
- g) **Sub-contractor**' means any person firm or company from whom the contractor may obtain any services for maintenance.
- h) '**User Railway**' means the Zonal Railway or divisional Railway which has placed the contract on firm in terms of this agreement.
- i) **Designated shed**- shall be the shed so designated by the user railway, within the zone of the user railway, where the locomotives shall be brought for maintenance.



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- j) '**Nominated Officer**' means the person nominated by user Railway for the purpose of execution of contract.
- k) '**Loco month**' is the total number' of hours in service/ breakdown over a period of one month.
- l) '**GCC**' shall mean general conditions of contract (Works) contract, of the concerned zonal Railway.

3.0 SCOPE

3.1 The AMC contract shall begin when:

- a) Immediately w.e.f next day when the warranty period expires.
- b) In case if the AMC is awarded beyond the warranty period, the joint inspection& OEM/ supplier recommended rectification, if any at the cost of IR shall be required before the commencement of AMC.

3.2 The contract shall be comprehensive in nature wherein preventive as well as Breakdown Maintenance of EOTT is to be attended by the contractor including the arrangement of spares, tools, consumables, technical expertise and manpower. The replaced consumables, tools items will be contractor's property. Contractor shall remove the same from the shed's premises with due authority.

All maintenance activity shall be carried out as per maintenance schedule approved by IR. Loco shall be made available to the contractor within +/- 7 days of the scheduled periodicity.

3.3 The Maintenance and support by the contractor shall consist of Preventive checks as per the preventive maintenance schedule of the EOTT as prescribed by the OEM/Supplier and shall also include all the extra and out of course attentions including breakdown, if any required.

3.4 Annual maintenance contract (AMC) shall not cover the failures due to external circumstances to the EOTT such as fire, accident explosion floods etc.

3.5 Availability and Downtime

3.5.1 The contractor shall ensure that during the billing period (three months) combined downtimes of all the locomotives covered under the contracts on account of out of course repair and online failures of equipment under AMC covered under the scope of work, does not exceed 1.5% of total loco hours for the locomotives covered in the contract, downtime accountal shall be carried out every month and the contractor has to ensure not less than 98.5% availability on account of equipment under AMC.



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- 3.5.2 The contractor shall ensure that downtime on account of out of course repairs and online failures of equipment under AMC covered under the scope of works, does not exceed an amount equivalent to 5% of individual loco hours for each of the locomotives covered in the contracts. Downtime accountal shall be carried out by the contractor every month and the contractor shall ensure not less than 95% availability of each loco on account of equipment under AMC. The down time calculation for para 3.5.1 and 3.5.2 above shall be as under.
- a. Downtime on out of the course repair shall start from the time when the stipulated maintenance schedule of the locomotive is completed but waiting for the repair or the loco exclusively on account of equipment under AMC.
 - b. Downtime on account of online failures shall be from the time, loco fails on line and reported to the contractor till the loco is given ready for service. If the time taken from the reporting of inability to repair at site till handing over of the locomotive to the contractor at nearest shed (Including trip shed) is more than 24 hours, the time above 24 hours shall not be considered for calculating the downtime occurred due to that failure. If the locomotive breakdown complaint is given for online failure, the service engineer shall proceed by road or rail from designated shed with necessary spares & tools within two hours of receipt of complaint and will attend the loco at the earliest opportunity. If the contractor confirms in writing after checking the loco that the problem can not be attended online, loco may be moved to the nearest maintenance shed/ trip shed for repair. If the loco is not handed over to contractor within 24 hours from the time contractor has expressed inability to repair/ attend online or at failed site, the extra time taken is beyond the contactor scope and hence shall not be taken as down time till the loco is handed over to contractor for repair/ attention.
- 3.5.3 All the penalties shall be calculated on the entire fleet covered under this contract.
- 3.5.4 In case any loco is held up in shed for repairs/ want of material (other than related to equipment under AMC) for more than 30 days, the same shall be communicated to the contractor in writing and the complete held-up period shall be excluded from the availability figures and hence no payment shall be made for that period. The contractor shall not remove



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any material from the loco without prior written consent from Railway authorities.

- 3.5.5 The comprehensive AMC will include maintenance of server/cloud service/Data by the firm.

4.0 PLACE OF WORK

The locomotives are based/ proposed to be based at Electric/Diesel Loco sheds under various Zonal Railways. However, contract shall cover any other place nominated during the currency of the contract. The contractor shall arrange required men and material at the designated sheds with immediate effect or maximum within 2 weeks of information of Railways.

The maintenance/breakdown repairs shall be carried out by the contractor through its nominated Service Engineers at designated shed, or at any location within that zonal Railway including trip sheds. If it is not possible to bring the loco to the designated sheds, the contractor's Service Engineer shall reach the spot immediately by means of transport on receiving the advice from the shed with necessary travel authorizations for the service engineer to undertake such travel from the respective zonal Railways. After examination of the loco at out station, in case, the loco can not be repaired/attended the locomotive can be moved to shed for further attention. Necessary support and resources required shall be provided by the shed.

5.0 AUTHORITY FOR OPERATION OF CONTRACT

Based upon this agreement the contract shall be signed by the user loco shed at zonal HQ and shall be executed under the overall supervision of Zonal Railway.

The user Railway shall nominate an officer who shall operate the contract for maintenance of the equipment and who shall be responsible for making the contract (Liaison) firm at the defined address by telephone/ telex/ fax or in person immediately when the preventive maintenance breakdown is to be attended to as required. The nominated Railway officer shall also responsible for supervision of the contractor's works for the verification of contractor's bill for payment.



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6.0 RESPONSIBILITIES OF PARTIES

Following are the responsibilities of Railways and the contractor.

6.1 RAILWAYS

- 6.1.1 The Railway authority shall permit the contractor to work on End of Train Telemetry System fitted on locomotives under preventive maintenance or break down.
- 6.1.2 User Railways shall nominate the officer/supervisor for supervision of the work done by the contractor under the contract.
- 6.1.3 The user Railway shall issue the necessary identity card, road permit and other related statutory forms/ documents to facilitate movement of materials and man (Even if temporary) to the working staff/ service engineer for their entry on the platform and other railway premises.
- 6.1.4 The necessary space, electricity and water connection shall be provided by Railway free of cost as required, at the nearest possible point of the site. In addition, a lockable room to store the tools and tackles shall be provided free of cost by the IR to the contractor.
- 6.1.5 The user Railway shall make the locomotives available for the maintenance.
- 6.1.6 Railway shall mention the details of the locomotives including the locomotive nos. covered under AMC for the reference of both the parties. In case, the base maintenance designated shed of the locomotive is shifted to any other location, than that specified in the scope, the scope of AMC shall accordingly shifted to new site/ base after as mutually agreed between firm & Railways.
- 6.1.7 The nominated railway officer shall intimate the firm by Telephone/ Fax or in-person mentioning the loco numbers and location of the locos along with the time of call. He shall maintain the register of such calls made for reference of both the parties.
- 6.1.8 The user railway shall extend necessary infrastructure support to service engineer of contractor like crane, fork lift, other material handling & storage facilities suitable for repair & maintenance of equipments.

6.2 CONTRACTOR

All the work including checks shall be carried out on the stable conditions at the designated shed.

- 6.2.1 The contractor shall post adequate no. of qualified service engineers/ backup engineers and arrange required materials exclusively for the



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execution of this contract at the designated shed/ sheds with immediate effect.

- 6.2.2 Service engineer shall carryout preventive maintenance on locos at all days and times including Sundays and Gazetted Holidays depending upon availability of locomotive in the shed.
- 6.2.3 Normally service engineer shall be available in the shed during normal working hours to attend breakdown calls/ preventive maintenance. A backup engineer shall be located at one of the contractor's office and shall be available at the designated shed if required to attend the complaints in case of absence of service engineer at the designed shed
- 6.2.4 The service engineer shall report within two hour at the designated shed to the nominated officers of Railway, if breakdown call is given during 06:00hrs to 22:00hrs and within three hours if breakdown call is given during 22:00hrs to 06:00hr on all days of the week.
- 6.2.5 The contractor shall keep all the necessary tools, testing equipment/ spare parts, sub- assemblies & consumables in the ready stock in the firm's premises at the location of the designated shed of maintenance or at their workshop or in the nearest office. IR shall, however, provide a lockable room to the contractor at the designated shed.
 - 6.2.5.1 All components/ materials required for effective and timely execution of this AMC contract may have to be moved by contractor from their warehouse of any other location. Risk of loss or damage during such movement will be to the account of the contractor.
 - 6.2.5.2 "Contractor" must keep adequate stocks of the components/materials received from their warehouse or any other location in order to ensure minimize down time in the execution of this AMC contract. Materials kept in the stock-point for the AMC relating to the particular shed cannot be removed by the contractor from the stock-point except for use in this AMC entered into by the Contractor with any other loco sheds.
 - 6.2.5.3 Subject to clause- 6.2.5.2 above, title in the components used in the AMC will remain with contractor until it passes to the Railways by accretion in the execution of the AMC.
 - 6.2.5.4 Documents for movement of components/ materials from contractor's warehouse or any other location to the stock- points: The documents employed for the inter-state movement of the components/ materials required for the execution of the present AMC must make explicit reference to the particular AMC contract apart from the locomotive reference for which the AMC is entered into.

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- 6.2.6 The contractor shall furnish the standard (OEM recommended) list of spares, consumable & tools to be stocked by the contractor at the designated shed.
- 6.2.7 It shall be responsibility for contractor to keep the adequate spares consumable and tools (that may be required to service the AMC) to avoid any delay in repair time. The Railway official can check the stock of spares if so desired.
- 6.2.8 The service engineer nominated for the repair on the shed duty shall observe all safety and security rules prevailing at the pace of work.
- 6.2.9 Some maintenance spares for the equipment under AMC may be available at the contractor's premises at the location of the designated shed of maintenance of their workshop or in the nearest office of the electric loco sheds. These can be utilized by the contractor (The assessment is to be made by the contractor before quoting). However any such spares used by the contractor from the stock is the IR property and shall be replaced by new/ repaired ones within 3 months of their uses at no extra cost. However if such spares are used for correcting damages caused by external reasons (e.g. accident cattle over run etc.) the same need not be replenished.
- 6.2.10 The contractor shall maintain all such records/ log-books as mutually agreed by the Railway& firm, and produce for inspection by the Railway whenever required.
- 6.2.11 The contractor shall arrange required men and material at the designated sheds with immediate effect. However for new service locations a reasonable time frame of 3 months shall be provided.
- 6.2.12 whenever any locomotive has had an adverse incident/ unusual occurrence or failure online or in shed, the contractor has to submit a detailed repair report to the user railway official within two weeks from the date of completion of repairs. Failures investigation report based on troubleshooting, data analysis and primary failure analysis shall be provided by the contractor within 60 days from the date of completion of repairs. Any modifications required to improve reliability shall be carried out free of cost by the contractor with prior approval to Railway.

7.0 VALIDITY OF CONTRACT

The Comprehensive AMC of the EoTT (with rates and terms & conditions) shall be valid for a period of 7 years after expiry of warranty period. Indian Railways may, based on its experience of the service offered and



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reliability of equipment, operate the AMC for less than 7 years in which case payment for the AMC will made on pro rata basis.

8.0 **RATES**

The rates to be quoted for comprehensive AMC covering both the break down & preventive maintenance (including spares and service) per locomotive per year consisting EOTT in figures and in words. Firm has to quote for Comprehensive AMC - including Data charges, Cloud Service/Server maintenance, spares and manpower required to keep the equipment operational at all times.

The rates under this contract shall be in INR and exclusive of all applicable taxes and will be charged at actual during the execution of the contracts. The "Contractor will have to keep the Railways indemnified for any consequences that the Railways may be exposed to as a result of the omission on the part of the contractor to discharge such liability. The gross amount paid by the Railways to the contractor for the execution of the present AMC contract will be inclusive of such central sales tax and exclusive of applicable service tax.

9.0 **OWNERSHIP OF THE REJECTED & OLD COMPONENTS.**

The ownership of the rejected or defective replaced components/ parts vests with the contractor against the replacement made by them on equipment supplied to make it operative.

10.0 **PENALTY:**

For smooth execution of AMC by contractor, Zonal Railways/PUs may include suitable penalty clause as special condition of contract for AMC. However sample penalty clauses are given as under for guidance of Zonal Railways/PUs.

10.1 **PENALTY FOR COMBINED DOWNTIME OF ALL THE LOCOMOTIVE (ref Clause 3.5.1):**

For this purpose, downtime shall be calculated as percentage of total downtime hours for the month to the total loco hours of all the locos covered under the AMC. In case the contractor fails to maintain the contracted availability requirements, a penalty shall be levied.

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Down Time Penalty**1.5% or less:** NIL**>1.5%-5%** : 02% of the total monthly proportionate bill**>5%-10%** : 5% of total monthly proportionate bill**>10%** : 10% of the total monthly proportionate bill**10.2 PENALTY FOR DOWNTIME OF INDIVIDUAL LOCOMOTIVE (ref. Clause 3.5.2):**

For this purpose downtime shall be calculated as percentage of individual downtime hours for the month of a loco to the individual loco hours of the same loco covered under the AMC. In case the contractor fails to maintain the contracted availability requirements, a penalty shall be levied.

Individual loco downtime % penalty Rate**5% or less :** NIL**>5%** : 5% of the individual loco's monthly proportionate bill.

10.3 Overall liability in any case shall not exceed 10% of the contract value.

11.0 PAYMENT

11.1 The total yearly payment shall be made in four equal installments and such installments of the payment shall be made against the bill by the contractor every quarterly which is certified by the nominated officer for completion of maintenance and after calculation of penalties as stipulated in para 10.0, 10.1, 10.2, 10.3, 10.4. On account of penalty or non- performance of a planned scheduled maintenance, such dues, if any be deducted as above.

11.2 The bills submitted by the firm for payment must accompany:

11.2.1 The certificate of maintenance of the locomotives issued by nominated officer.

11.2.2 The above bill shall bear the individual locomotive number of the locomotives maintained by the firm for each quarter covered under this AMC.

12.0 PAYING AUTHORITY

The payment against this contract shall be made by the user Electric Loco shed. Any taxes including income tax required to be deducted at source



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shall deducted and certificate to that effect shall be issued to the contractor as prescribed under the rules.

13.0 CONTRACT PERFORMANCE GUARANTEE

The contractor shall submit performance guarantee for amount equivalent to 5% of contract agreement. The Performance Guarantee shall be submitted by the successful bidder after the Letter of Acceptance (LOA) has been issued, but before signing of the contract agreement. This P.G. shall be initially valid up to the stipulated date of completion plus 60 days beyond that. In case, the time for completion of work gets extended, the Contractor shall get the validity of P.G. extended to cover such extended time for completion of work plus 60 days. This performance guarantee shall be in the form of Bank guarantee. The user railway may forfeit the B.G in case of the failure of firm in execution of the contract or in the event of breach of any terms and conditions of contract by the contractor.

14.0 FORCE MAJEURE CLAUSE

Force majeure shall comprise the occurrence beyond the control of the railways and the firm as the case may be. This shall include but not limited to the events such as explosion, flood, fire, major power failure, accident, breaches, act of God, act of public enemy, wars, riots, sabotage or any law of state or ordinance or the order or regulation of govt. or local public authority. In such situation, either party shall promptly notify the other party in writing about such event with evidence of happening, where possible and mentioning that it is beyond their control to carry out obligation of this contract and agree for mutually acceptable course of action. The penalties shall also not be applicable during this period.

15.0 ARBITRATION

15.1 In the event of any question, dispute or differences arising under the condition of this contract which can not be resolved by mutual discussions, such dispute can be referred to the sole arbitrator nominated by the General Manager of user Railways. The sole arbitrator appointed by the General Manager in this case shall be Gazetted Railway officer. However the person shall not be one of those who have dealt with the matter related to or who in the course of their duties as railway servant have expressed views on all or any of the matter under dispute or differences. The award of the sole arbitrator shall be final and binding on both the



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parties to this contract. Subject as after said, the arbitration act 1996 & the rule of their under and any statutory modifications thereof for the time being in force shall be deemed to apply to the arbitration proceeding under this clause.

- 15.2** Where the arbitral award is for the payment of money no interest shall be payable on whole or any part of the money for any period till the date on which the award is made.

16.0 LAWS GOVERNING THE CONTRACT.

The contract shall be governed by the Laws of India for the time being enforced irrespective of the place of performance or payment under the contract.

17.0 JURISDICTION OF THE COURTS

The courts of the place where the contract has been entered into by the user railway and the firm shall alone have the jurisdiction to decide any dispute arising out of or in respect of the contract.

18.0 FAILURE

If the contractor fails in the performance of the contract (except in case of force majeure & having been allowed a reasonable time to complete the obligation), the user Railway may without prejudice to his other rights, cancel the contract or a portion thereof and if it so desires, to enter into another contract for fulfillment of the obligation for the remaining period at the risk and cost of the contractor.

19.0 SUBLetting AND ASSIGNMENT

The contractor shall not, save with the previous consent in writing of the user Railway, sublet, transfer or assign the contract or any part thereof or interest therein or benefit or advantage thereof in any manner whatsoever. In the event of the contractor's subletting or assigning this contract or any part thereof without any such consent, this shall be deemed as the breach of contract and the user railways shall be entitled to cancel the contract without prejudice to Railways right to recover damages and taking any action including legal action as deemed fit by Railways.

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20.0 OTHER CONDITIONS

In the proposed contract for the condition not specified therein, General Conditions of contract with the latest amendments shall apply. The execution of works covered by the tender shall be governed by the general conditions of contract (GCC) of Indian Railways with all the latest amendments up to date. By signing the contract it would be deemed that the contractor has kept himself informed of the provisions of the general conditions of contract including all corrections and amendments issued up to date a copy of GCC shall be enclosed to the agreement and which shall from part and parcel of the agreement.

21.0 CONTRACT ISSUING AUTHORITY

- 21.1 This contract is issued on M/s Firm & shall remain valid for a period of seven years. However Railways may vary the period before going into contract as per their requirement
- 21.2 For the conditions not covered in this document, General conditions of contract shall apply. This concludes the contract and issued for and on behalf of the president of India.

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ANNEXURE-XIII

भारतसरकार—रेलमंत्रालय
अनुबंधानअभियान्त्रियां और मानवसंगठन
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No. EL/4.2.15/EoTT

Date: 15.02.2022

Principal Chief Electrical Engineer,

i)	Central Railway, Mumbai CST-400001	प्रधानमुख्य विद्युत अभियंता, मध्य रेलवे, मुम्बई, सीएसटी-400001
ii)	East Central Railway, Hazipur-844101	पूर्व मध्य रेलवे, हाजीपुर-844 101
iii)	East Coast Railway, Chandra Shekhpur, Bhubaneshwar-751017	पूर्व तटीय रेलवे, चन्द्रशेखरपुर, भुबनेश्वर-751 017
iv)	Eastern Railway, Fairlie Place, Kolkata - 700 001.	पूर्व रेलवे, फेरली प्लॉस, कोलकाता-700 001
v)	North Central Railway, Block-A, Subedarganj, Allahabad- 211 033	उत्तर मध्य रेलवे, ब्लॉक ए-2, सुदेदारगंज इलाहाबाद — 211 033
vi)	Northern Railway, Badoda House, New Delhi-110001	उत्तर रेलवे, बडोदा हाउस, नयी दिल्ली — 110001
vii)	North Western Railway, Jaipur- 302 006	उत्तर पश्चिम रेलवे जयपुर- 302006
viii)	North Eastern Railway, Gorakhpur-273001	उत्तर पूर्व रेलवे गोरखपुर- 273001
ix)	North East Frontier Railway, Maligaon, Guwahati-781011	उत्तर पूर्व फेन्टीयर रेलवे मालीगाँव गुवाहाटी-781011
x)	South Central Railway, Secunderabad - 500371	दक्षिण मध्य रेलवे, रेल निलायम, सिंकंदराबाद-500 371
xi)	South East Central Railway, Bilaspur - 495004	दक्षिण पूर्व मध्य रेलवे, विलासपुर — 495 004
xii)	South Eastern Railway, Garden reach, Kolkata-700043	दक्षिण पूर्व रेलवे, गार्डनरीच, कोलकाता-700 043
xiii)	Southern Railway, Park Town, Chennai - 600003	दक्षिण रेलवे, पार्क टाउन, चेन्नई-600003
xiv)	South Western Railway, Hubli- 580020	दक्षिण पश्चिम रेलवे हुबली-580020
xv)	West Central Railway, Jabalpur-482001	पश्चिम मध्य रेलवे, जबलपुर — 482001
xvi)	Western Railway, Churchgate, Mumbai- 400 020	पश्चिम रेलवे, चर्चगेट, मुम्बई— 400 020
xvii)	Chittaranjan Locomotive Works, Chittaranjan-713331(WB)	चित्तराजन रेल इंजन कारखाना, चित्तराजन — 713331
xviii)	Banaras Locomotive Works, Varanasi - 221 004	बनारस रेल इंजन कारखाना, वाराणसी—221004
xix)	Diesel Modernisation Works, Patiala (Punjab)-147003	डीजल आधुनिकरण रेल कारखाना, पटियाला (पंजाब)-147003

TECHNICAL CIRCULAR NO. RDSO/2022/EL/TC/0156 Rev. '0' dated 15.02.2022

Sub.: Communication Protocol for End of Train Telemetry (EoTT) System on Indian Railways.

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1. Introduction

As per Para 3.7.21 of RDSO specification No.RDSO/2021/EL/SPEC/0144. Rev '0' dt 11.05.2021, RDSO has to issue communication protocols and other technical details separately for standardization and communication protocol which are based on association of American Railroads (AAR) standard S-9162.V2. 1 (for latest) and TFR specification BBB 1776 for End of train Telemetry (EoTT) system. For interoperability within different make EoTs. It is essential to comply the radio specification as per clause 2.3 Aar S-9152 V2.1 and communication protocol as per AAR S-9152. V2.1 and TFR BBB 1776. RDSO has finalized communication protocols document No. CO/EoTT/0001 Version 01 dt. 13.05.2021 and issued vide RDSO's letter no. EL/4.2.15/EoTT dated 13.05.2021 after detailed deliberation with all stake holders.

2. Radio Specification

- i) As per Clause 2.3 of Aar S-1952.V2.1(or latest), the minimum radio specification for head of train (HoT) device & end of train (EoT) device shall be as per table 2.1 except the radio frequency.
- ii) Synchronous transmission.
- iii) Modulation/Demodulation technique: continuous phase fast frequency shift keying (FFSK).
- iv) Modulating frequencies shall be as per Clause 2.3.2.2 of AAR S-9152.V2.1 (or latest).
- v) Transmit rate shall be as per clause 2.3.2.3 of AAR S-9152.V2.1(or latest).
- vi) Data reporting rate shall be Clause 2.3.3 of AAR S-9152.V2.1(or latest).

3. Front to rear Radio Communication

3.1 General format for Each Data Block as per clause 3.9.6 of AAR S-9152. V2.1

Data Blocks	Bits	Special Notes
Bit Sync	456	
Frame Sync	24	
Data Block	63	
Odd parity bit	1	
Data Block (repeat#1)	63	
Odd Parity bit	1	
Data Block (repeat #2)	63	
Odd Parity bit	1	
Total length	672	

3.2 General Format for each data Block (63 bits) as per clause 3.9.7 of AARS-9152.V2.1

Data Blocks	Bits	Special Notes
Chaining bits	2	Always 11
Messagetype identifier	3	000= Manual communication Test 111= Automatic Communication Test

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Id	17	EoT ID (Paired)
Command Word	8	Comprises different HoT Commands
BCH code	33	Packet Error detection checksum
Total length	63	

Note: As per Clause 3.13.14'e' of FRS, Whilst in Sleep Mode, normal transmission must resume when a button on either the Cab Unit or the Rear Unit is pressed.

It would make sense for the EOT to wake up on receipt of a Communications test from the HOT sent by the loco-pilot, but since the HOT sends an "automatic" communication Test every 2min, this would mean the EOT would never go to sleep during automatic communication test. See AAR [S-9152.V2.1] clauses 3.8.3 "Manual Communications Test" and 3.8.4 "Automatic Communications Test".

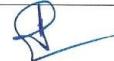
So we need to distinguish between Manual communication test & Automatic communication test.

For this purpose, Message Type Identifier bits of HOT communication Block are modified as above to discriminate between Manual and Automatic Communications Tests:

- a. Sending "000" would indicate a Manual Communications Test.
- b. Sending "111" would indicate an Automatic Communications Test.

3.3 Description of existing command as per clause 3.9.8.6 of Aar S-9152.V2.1 and new Command words as per RDSO FRS/0025.

words Command	Binary code	Hexadecimal code
Status update command	01010101	0x55
Emergency Brake command	10101010	0xAA
Emergency broadcast disabled,Foggy weather disabled and DTWL disabled	11110000	0xF0
Emergency broadcast disabled, Foggy weather disabled & DTWL enabled	11110001	0xF1
Emergency broadcast disabled, Foggy weather enabled & DTWL disabled	11110010	0xF2
Emergency broadcast disabled, Foggy weather enabled & DTWL enabled	11110011	0xF3
Emergency broadcast enabled, Foggy weather disabled & DTWL disabled	11110100	0xF4
Emergency broadcast enabled, Foggy weather disabled & DTWL enabled	11110101	0xF5
Emergency broadcast enabled, Foggy weather enabled & DTWL disabled	11110110	0xF6
Emergency broadcast enabled, Foggy weather enabled & DTWL enabled	11110111	0xF7



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Note: In above proposed command word, a single dedicated bit is assigned to each function. This would allow simultaneous change of statuses with a single transmission in future. It will also fulfill the requirement as mentioned in Clause 2.2.11 & 2.2.27 of FRS.

4. Rear to Front communication

4.1 General format for Basic Data Block clause 3.7.1 of Aar S-9152.V2.1

Field	Bits	Compliance	Clarification
Bit Sync	69	AAR S-9152 2.3.6.1	Shall Always start with a 0 bit, such As : bit 0<010101001010> bit 68
Frame Sync	11	AAR S-9152 2.3.6.1	Send as specified MSB <01001000111>LSB
Chaining bit	2	AAR S-9152 2.3.6.2	Send as specified
Device Battery	2	AAR S-9152 2.3.6.3	Send as specified
Message Identifier	Type 3	AAR S-9152 2.3.6.4	'000'=Indicates positive air pressure '111'= Rear Brake ARM request '110'=Emergency Broadcast
Rear unit address code	17	AAR S-9152 2.3.6.5	Send as specified
Rear Brake Pipe Status & Pressure	7	AAR S-9152 2.3.6.6	Unsigned binary integer Air Brakes: 0 to 125 psig.
Marker Light foggy	1	Command from HOT IR Requirement	0 = Marker Light & DTWL Normal 1= Marker Light & DTWL Foggy
%Battery Charge used	7	AAR S-9152 3.7.2.3	Send % battery charge depleted. 0000000=Fully charged (e.g. 12.8V) 1100100=Fully depleted (e.g. 1010.8V) Calculations must be based on 48 hour standby.
Valve circuit status	1	AAR S-9152 2.3.7.2.1	To be used for EBA confirmation
Confirmation indicator	1	AAR S-9152 3.7.2.2	Send as specified
Air Turbine/Generator Equipped	1	AAR S- 9152 2.3.6.9	Send as specified This only indicates Air Turbine equipped battery condition & Status must be used to determine whether Air

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Motion detection	1	AAR S-9152 2.3.6.8	turbine has failed or not.
DTWL Status	1	IR Requirement	Send as specified 0 = DTWL OFF 1 = DTWL ON (if pressure drops below 0.5 KGC/ command from LP) (Reset to 0 either pressure increase above 3 KGC or command from LP)
Marker light status	1	AAR S-9152 2.3.6.10	Send as specified
Basic Block BCH code	18	AAR S-9152 2.3.6.11	Send as specified
Trailing bit	1	AAR S-9152 2.3.6.12	Send as specified
Total Length	144		

Note: 1. The blocks are sent starting with the bit sync and ending with the trailing bit, sending LSB first for each field as defined by the AAR.

2. Battery status : The accuracy of “ % battery charge depleted” which is transmitted shall be such as to enable the CU to display the “Remaining Battery Hour” to an acceptable accuracy (+/-10%).
3. When sent from a Repeater, the Trailing Bit Shall be “0”.
4. **“Emergency broadcast Message” will be a standard EoT messages as defined by AAR & TFR protocol documents (i.e, Basic block+1st Additional block+ 2nd Additional block), but with Message Type Identifier set to “110”. This will allow the HoT that activated the “Emergency Broadcast Message” to confirm that its EoT is actively transmitting this Broadcast message, while also allowing remote HoT’s to identify the message as an “Emergency Broadcast Message”.**

Whenever any communication from EoT is received by HoTs of neighboring trains, HoT will first check the Rear Unit Address Code to confirm that message is from paired EoT or not. Then HoT will check the Message Type Identifier Bits whether it is ‘110’ or not. If it is ‘110’ then HoT (either paired or otherwise) will acknowledge the message as emergency broadcast message and act accordingly.

4.2 First Additional “GPS Latitude” Data Block as per BBB1776.

Field	Bits	Description	Clarification
Bit Sync	69	AAR S-9152 2.3.6.1	Shall always start with a “0” bit such as: bit 1 <010101....01010> bit 69. The “0” bit shall be sent directly after the AAR block Trailing bit.
Frame Sync	16	Use the AAR S-9152 2.3.6.1 frame sync by padding with ‘01010’	MSD > 0100100011101010>LSD

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Chaining Bit	2	AAR S-9152 2.3.6.2	Send as specified
Sleep Mode Status	2	IR Requirement	<p>‘10’= EoT preparing to sleep ‘00’= EoT not preparing to Sleep (The Sleep Mode bit should be sent 5 min before the EoT enters into sleep mode to avoid the possibility of missing single packet by HoT. After receiving at least one messages from the EOT containing the “Sleep Mode” bits set to “10” the HOT will start a timer that will wait 5min before indicating that the EOT is in sleep mode. Upon receiving an EOT message with the “Sleep Mode” bits set to “00” the HOT will clear the sleep indicator.)</p>
Message Format	4	This is a 4 bit message ‘0001’ identifying the block	“0001”= Latitude block “1000”= Longitude block
Latitude (GPS)	32	Floating point number	MSD< XYYYYYYYYYYYYYYYYYYYY>LSD X=1 bit indicating sign Y= 8 bit Exponent T= 23 bit Mantissa.
Speed (GPS)	8	Unsigned binary integer	0 to 255 km/h GPS speed e.g. MSD<00110111>LSD=55km/h
Time (GPS)	8	Unsigned binary integer	0 to 59 seconds GPS seconds e.g. 0 sec to 59 sec MSD <0011011>LSD
CRC	16	16 Bit CCIT standard	X^16+X^12+X^5+1 Initial value+FFFFh All payload data from the EOT Basic Block, EOT Latitude Block and EOT Longitude Block are Used (in the sequence as mentioned in Annexure ‘A’) to calculate the CRC for the Latitude Block. same CRC value as used for the EOT Longitude Block.
Trailing Bit	1	AAR S-9152 2.3.6.12	

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Total Bits	158
------------	-----

- Note:** 1. The blocks are sent starting with the be Sync and ending with the Trailing Bit, sending LSB first for each field.
2. All GPS data such as Latitude , Speed & Time are sent as zeros if there is not GPS fix
 - 3.The Sleep Mode bit should be sent 5 min before the EoT enters into sleep mode to avoid the possibility of missing single packet by HoT.
 4. After receiving at least one messages from the EOT containing the "Sleep Mode" bits set to "10" the HOT will start a timer that will wait 5min before indicating that the EOT is in sleep mode.
 5. Upon receiving an EOT message with the "Sleep Mode" bits set to "00" the HOT Will clear the sleep indicator

4.3 Second Additional “GPS Longitude” Data Block as per BBB1776.

Field	Bits	Description	Clarification
Bit Sync	69	AAR S-9152 2.3.6.1	Shall always start with a "0" such as: bit 1 <010101..0101 0> bit 69 the '0' bit shall be sent directly after the Latitude block trailing bit.
Frame Sync	16	Use The AAR S-9152 2.3.6.1 Frame sync by padding with "01010"	MSD> 0100100011101010>LSD
Chaining Bit	2	AAR S-9152 2.3.6.2	Send as specified
Manufacturer's Code	2	A 2 bit code "00" to identify the manufacturer	
Message format	4	This is a 4 bit message "1000" identifying the block	MSD < 1000 > LSD = Longitude block New values to be approved by TFR.
Longitude (GPS)	32	Floating point number	MSD<XXXXXXXXYYYYYYYYTTTTTT TTTTTTTTTTTTTTTT>LSD X=1 bit indicating sing Y= 8 bit Exponent T= 23 bit Mantissa.
Odometer	16	Unsigned binary Integer	O to 65536 meters since last reset MSD<0000000000000001> LSD 1. The odometer is updated every second by calculating distance from the GPS speed.



			<ol style="list-style-type: none"> 2. If the time elapsed is between 1 and 10 seconds, the speed at that moment is multiplied by the seconds elapsed. 3. If the time elapsed is > 10 sec, the latest latitude & longitude coordinates are used to update the odometer. 4. The odometer only counts UP, 5. When the speed is zero software must filter out the jitter to prevent odometer counting up/incrementing. 6. The odometer must overflow to zero. 7. The odometer must reset when the rear unit is horizontal.
CRC	16	16 Bits CCIT standard	$X^{16}+X^{12}+X^5+1$ Initial value= FFFFh all payload data from the EOT Basic Block, EOT Latitude Block and EOT Longitude Block are used (in the sequence as mentioned in Annexure 'A') to calculate the CRC for the Longitude Block. (This should be the same CRC value as used for the EOT Latitude Block.)
Trailing bit	1	AAR S-9152 2.3.6.12	Send as specified
Total Bits	158		

Note: 1. The Blocks are sent starting with the Bit Sync and ending with the Trailing Bit, sending LSB first for each field.
2. All GPS data such as Latitude, Speed & Time are sent as zeros if there is not GPS fix.
3. The Latitude and Longitude blocks shall always be attached to the AAR block.



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Annexure-ACalculation of CRC Bits for Latitude & Longitude Block:

As per TFR Annexure 'A' to BBB1776, EOT Latitude Block uses data from the Chain Bits up to the Time bits to calculate the CRC for the Latitude Block. Similarly EOT Longitude Block uses data from the Chain Bits up to the OdO bits to calculate the CRC for the Latitude Block. So CRC is only calculated across a single Data Block. There is no way to distinguish system-A's First & Second Additional Blocks. It can happen that two or more EoTs transmit at the same time & are very near. There will be a possibility that the receiving HoT can confuse system-A and system-B's additional blocks.

So to mitigate the above problem, All payload data from the EOT Basic Block, EOT Latitude Block and EOT Longitude Block are used in the sequence below to calculate the CRC for the Latitude Block & Longitude Block. CRC for both Latitude Block & Longitude Block will be same. there is no modification to the protocol apart from how the CRCs are calculated.

EOT	Bits	1 st Block used for CRC
Bit Sync	69	
Frame Sync	11	
Chaining Bits	2	Data Bits used for CRC calculation
BattInd	2	Data Bits used for CRC calculation
Message type	3	Data Bits used for CRC calculation
Unit Address	17	Data Bits used for CRC calculation
Pressure	7	Data Bits used for CRC calculation
Spare	1	Data Bits used for CRC calculation
%Batt	7	Data Bits used for CRC calculation
Valve Status	1	Data Bits used for CRC calculation
Confirmation	1	Data Bits used for CRC calculation
Air Gen	1	Data Bits used for CRC calculation
Motion	1	Data Bits used for CRC calculation
Spare	1	Data Bits used for CRC calculation
Light Status	1	Data Bits used for CRC calculation
BCH	18	
Trail	1	

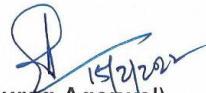
EOT	Bits	2 nd Block used for CRC
Bit Sync	69	
Frame Sync	16	
Chain Bits	2	Data Bits used for CRC calculation
Manufacturer Code	2	Data Bits used for CRC calculation
Message Format	4	Data Bits used for CRC calculation
Latitude	32	Data Bits used for CRC calculation
Speed	8	Data Bits used for CRC calculation
Time	8	Data Bits used for CRC calculation
CRC	16	
Trail	1	



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EOT Longitude Block	Bits	3 rd Block used for CRC
Bit Sync	69	
Frame Sync	16	
Chain Bits	2	Data Bits used for CRC calculation
Manufacturer Code	2	Data Bits used for CRC calculation
Message Format	4	Data Bits used for CRC calculation
Longitude	32	Data Bits used for CRC calculation
Odo	16	Data Bits used for CRC calculation
CRC	16	
Trail	1	

Note: CRC is calculated using all data highlighted in Bold in sequence as above.



(Anurag Agarwal)

for Director General/Electrical

Enclo: Nil

Copy to :

1. Secretary (Traction), Railway Board, Rail Bhawan, New Delhi-110001- for kind information please.
2. Managing Director, DFC Corporation of India Limited, 5th Floor, Pragati Maidan Metro Station Building Complex, New Delhi-110001-for kind information please.



(Anurag Agarwal)

for Director General/Electrical

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ANNEXURE-XIV

भारतसरकार-रेलमंत्रालय
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लखनऊ- 226011
E-mail: dsetm@rdsorailnet.gov.in
Telephone : 0522-2465716

Government of India - Ministry of Railways
Research, Designs & Standards Organization,
LUCKNOW – 226011
Fax: -0522-2452581



No. EL/4.2.15/EoTT

Date: 15.02.2022

Principal Chief Electrical Engineer,

प्रधानमुख्य विद्युत अभियंता,

i)	Central Railway, Mumbai CST-400001	मध्य रेलवे, मुम्बई, सीएसटी-400001
ii)	East Central Railway, Hazipur-844101	पूर्व मध्य रेलवे, हाजीपुर-844 101
iii)	East Coast Railway, Chandra Shekarpur, Bhubaneshwar-751017	पूर्व तटीय रेलवे, चन्द्रशेखरपुर, भुबनेश्वर-751 017
iv)	Eastern Railway, Fairlie Place, Kolkata - 700 001.	पूर्व रेलवे, फेरली प्लेस, कोलकाता-700 001
v)	North Central Railway, Block-A, Subedarganj, Allahabad- 211 033	उत्तर मध्य रेलवे, ब्लाक ए-2, सुबेदारगंज इलाहाबाद - 211 033
vi)	Northern Railway, Badoda House, New Delhi-110001	उत्तर रेलवे, बडोदा हाउस, नयी दिल्ली - 110001
vii)	North Western Railway, Jaipur- 302 006	उत्तर पश्चिम रेलवे जयपुर- 302006
viii)	North Eastern Railway, Gorakhpur-273001	उत्तर पूर्व रेलवे गोरखपुर- 273001
ix)	North East Frontier Railway, Maligaon, Guwahati-781011	उत्तर पूर्व फेन्टीयर रेलवे मालीगाँव गुवाहाटी-781011
x)	South Central Railway, Secunderabad - 500371	दक्षिण मध्य रेलवे, रेल निलायम, सिंकंदराबाद-500 371
xi)	South East Central Railway, Bilaspur - 495004	दक्षिण पूर्व मध्य रेलवे, बिलासपुर - 495 004
xii)	South Eastern Railway, Garden reach, Kolkata-700043	दक्षिण पूर्व रेलवे, गार्डनरीच, कोलकाता-700 043
xiii)	Southern Railway, Park Town, Chennai - 600003	दक्षिण रेलवे, पार्क टाउन, चेन्नई-600003
xiv)	South Western Railway, Hubli- 580020	दक्षिण पश्चिम रेलवे हुबली-580020
xv)	West Central Railway, Jabalpur-482001	पश्चिम मध्य रेलवे, जबलपुर - 482001
xvi)	Western Railway, Churchgate, Mumbai-400 020	पश्चिम रेलवे, चर्चगेट, मुम्बई- 400 020
xvii)	Chittaranjan Locomotive Works, Chittaranjan-713331(WB)	चित्तराजन रेल इंजन कारखाना, चित्तराजन - 713331
xviii)	Banaras Locomotive Works, Varanasi - 221 004	बनारस रेल इंजन कारखाना, वाराणसी-221004
xix)	Diesel Modernisation Works, Patiala (Punjab)-147003	डीजल आधुनिकरण रेल कारखाना, पटियाला (पंजाब)-147003

TECHNICAL CIRCULAR NO. RDSO/2022/EL/TC/0157 Rev. '0' dated 15.02.2022

Sub.: General Guidelines of Fixed/Track side Repeater for End of Train Telemetry
(EoTT) System on Indian Railways

Page 1 of 6

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1. Introduction:

RDSO has finalized Specification No. RDSO/2021/EL/SPEC/0144, Rev'0' dt.11.05.2021 and General Guidelines of Fixed/Track side Repeater dt. 26.10.2021 after detailed deliberation with all stake holders.

In the Specification, Clause 2.2.13(c), it was clearly mentioned that "Vendors are to clearly and in detail indicate how their repeater is to function, so as to ensure that secure and reliable repeated communications are to be effected, without communication collision problems (e.g. between paired HoT/EoTs, OR with other HoTs, EoTs or repeaters)".

However, for better understanding, following operational, type & routine test, power supply and installation requirement are suggested.

2. Operational Requirement

- i) The repeater should be equipped with a radio on the same frequency as the EoTT to be repeated.
- ii) The repeater should be able to receive EoT and HoT messages and repeat these messages.
- iii) The repeater should comply with the AAR S-9152, TFR BBB1776 and RF communication protocol issued by RDSO (latest).
- iv) The matching function is not required, but only valid messages from the HoT or EoT are to be repeated as per following:
 - a) EoT to HoT transmissions should be repeated approximately 100 ms after receiving the complete message.
 - b) HoT to EoT transmissions should be repeated approximately 2 sec after receiving the complete message
- v) The repeater shall limit the number of repeated EoTs and their matched HoTs to five(5) EoTT sets to reduce RF congestion.
 - a) The frequency of repeated messages will scale according to the number of units being repeated.
 - a.1) If only One EoT is within reception range of the repeater, every message from the EoT will be repeated.
 - a.2) If Two EoTs are present, every 2nd message will be repeated.
 - a.3) If Three EoTs are present, every 3rd message will be repeated.
 - a.4) If Four EoTs are present, every 4th message will be repeated.



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- a.5) If Five EoTs are present, every 5th message will be repeated.
- b) Arming sequence message will override the messages scaling function.
- vi) The repeater display should display the EoT ID number of the repeated message and time at which the message was repeated. At least the last 5 messages repeated should be displayed.
- vii) HoT device update request from EoT: The repeater must capture the Front to Rear message, and if NO response is detected from the RU, the message must then be repeated by the repeater to the EoT within 2 sec. If the RU responds to the HoT request, then the repeater must NOT repeat the message, but record the EoT message and then repeat it back to the CU or HoT device.
- viii) HoT Rear Brake activation request: exactly same as for item vii above.
- ix) Press EoT button to ARM the unit: The repeater must record the EoT message and repeat it to the CU or HoT, device.
- x) Equal priority must be given to the following messages: a) Arming b) Rear Brake activation Command, c) CU to RU Update Requests
- xi) Data logging: The repeater must log each message in a circular buffer and store at least 7 days of logging information. Data to be logged at least: a) Rear unit ID Number (e.g. RU 12345), b) GPS date and time, c) GPS position when RU message sent, d) Speed when RU message sent, e) Pressure/Vacuum when RU message sent.
This information must also be displayed at least for the last 5 messages repeated on the LCD display by means of an auto scrolling method for maintenance and fault finding purposes. A USB port will be provided for data downloading in line with standard arrangement in HoT&EoT.
- xii) GPRS: GPRS to be implemented as per Indian Railway requirement/condition.

3. Type Test & Routine Test

The Type & Routine tests to be carried out are given in the following table, together with the clause number of IEC 60571 ed-3 2012-09.

SN	TESTS	IEC CLAUSE NO.	TYPE TEST	ROUTINE TEST
I.	Visual Inspection	12.2.2	✓	✓
II.	Performance test	As per Clause 3 of this document	✓	✓
III.	Voltage variation test	12.2.3	✓	--
IV.	Cooling Test (Cold Start Test)	12.2.4	✓	--
V.	Temperature rise test (Dry heat)	12.2.5	✓	--
VI.	Temperature rise	12.2.6	✓	--

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	(damp heat cyclic)			
VII.	Supply over voltage test	12.2.7	✓	--
VIII.	Surges test	12.2.8.1	✓	--
IX.	Electrostatic discharge test (ESD)	12.2.8.2	✓	--
X.	Transient burst susceptibility test	12.2.8.3	✓	--
XI.	Radio Interference test	12.2.9	✓	--
XII.	Insulation test	12.2.10.2	✓	✓
XIII.	Voltage withstand (Dielectric) test	12.2.10.3	✓	✓
XIV.	Salt mist test	12.2.11	✓	--
XV.	Water tightness test for external units like EoT/HoT , Antenna etc.	12.2.13	✓	
XVI.	Reverse polarity test (For HoT only)	--	✓	✓

Note: Water tightness test for Repeater and Antenna shall be conducted as IP 54 and IP 66 respectively.

4. Performance Test on Fixed/Track side Repeater

Following performance tests are to be conducted on Fixed/Track side Repeater.

SN	Test/Functionality description	Functionality to be checked	Result/observation
1.	Repeat of EoT RF messages	Confirm that the repeater repeats EoT messages using the following rules by activating 5 EoT units one by one. a. One unit on- Repeat every message. b. Two units on- Repeat every 2 nd message c. Three units on- Repeat every 3 rd message d. Four units on - Repeat every 4 th message e. Five units on- Repeat every 5 th message	
2.	Repeat of HoT RF messages	Confirm that repeater repeats HoT messages after 500 millisecond	
3.	HoT Emergency Brake activation command	Confirm that the repeater repeats HoT Emergency Brake activation command	
4.	EoTT arming	Confirm that the repeater repeats EoTT arming sequences even when more than one EoT is on.	
5.	Repeater Display	Confirm that the EoT ID and time of at least the last 5 messages are displayed.	

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5. Power Supply Requirement

- i) Typically, 230 V AC power supply outlet shall be made available at the repeater site by the consignee. EoTT manufacturer shall design their fixed /track side repeater.
- ii) Provision of chargeable Battery shall be made to Fixed/track side repeater. Battery back-up of the Repeater shall be adequate such that it can work for at least 12 hours when failure occurs of either 230 V AC or its charging facility. Preferably, Repeater shall be powered by 230 V AC to 24V/12 V DC(30 watt) regulated power supply.

6. Mounting Arrangement

In World –wide Railways, there are two types of mounting arrangement of fixed/track side repeaters:

- i) A wall mounted cabinet is used if the repeater is to be locked up.
- ii) A wall mounted bracket is used if the repeater is to be monitored.

Antenna is to be generally mounted on the pole.

Depending upon site/location of fixed repeater, these mounting arrangements including civil work will be provided by the consignee.

7. Scope of Supply of Fixed/Track side Repeater

SN	Item	To be supplied by
1.	Fixed/track side repeater with battery back up, Antenna, other associated cabling & connectors, supply, erection & commissioning. Antenna shall be as per requirement of the site condition. Site details have to be provided by Railways.	EoTT/Repeater manufacturer
2.	230 V AC power supply, Mounting Arrangement for Repeater & Antennai.e. bracket, pole and associated civil work, if any	Consignee

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Note: If any supplier uses HoT as a fixed repeater after making only software changes, then there is no need to repeat the prototype tests which were already done with HoT.



15/02/2022

(Anurag Agarwal)
for Director General/Electrical

Enclo: Nil

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1. Secretary (Traction), Railway Board, Rail Bhawan, New Delhi-110001- for kind information please.
2. Managing Director, DFC Corporation of India Limited, 5th Floor, PragatiMaidan Metro Station Building Complex, New Delhi-110001-for kind information please.



15/02/2022

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