

ISO 9001: 2015	Document No.: TM-TL - 119	Revision 03 of 2022	Date Effective from: 24/05/2022
Document Title: Specification of Continuous Rail Thermometer			



**SPECIFICATION OF
CONTINUOUS RAIL THERMOMETER
(No.TM-TL-119)**

(Revision 03 of 2022)

Track Machines & Monitoring Directorate

**RESEARCH DESIGNS AND STANDARDS ORGANISATION
Manak Nagar, Lucknow-226011**



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1.0 Scope:

This specification covers the essential functional and technical requirements, inspection and testing of the Continuous rail thermometer. This device is used for continuously displaying rail temperature, storing the data at pre-set interval and transferring this data to PC through USB port of PC, using Data Transfer Module. This device should also be compatible with machine to machine communication (Examp.-telemetry device etc.).

2.0 Reference:

Following codes/documents have been referred to in this specification. The updated copy of latest version with correction slip/amendments shall be followed and available at the firm's works.

- i) IS: 104-1979 (Re-affirmed 2004): Ready mixed paint, brushing, zinc chrome, priming.
- ii) IS: 2074-1992 (Re-affirmed 2002): Ready mixed paint, air drying, red oxide, zinc chrome, priming-Specification.
- iii) IS: 9000 (Pt. XI)-1983 Re-affirmed-2004): Basic environmental testing procedures for electronic and electrical items: Part II Salt mist test.
- iv) IS: 9000 (Pt. XV)/Sec.7-1982 (Re-affirmed-2004): Basic Environmental Testing Procedures for Electronic and Electrical Items - Part XV: Sealing Test.
- v) IS: 2932-2003: Enamel, Synthetic, Exterior: (a) Undercoating (b) Finishing – Specification.

3.0 Materials, Processing and Workmanship:

- 3.1 The quality of materials of all the component parts of the device shall conform to relevant paragraphs as mentioned in this specification. Strength and other essential physical properties of all the parts of the device shall be adequate for the purpose intended and shall be fabricated accurately to ensure the satisfactory performance of the device.
- 3.2 All components used in the device shall be free from manufacturing defects. All metal surfaces shall be properly finished and rough / sharp edges shall be removed. All the components used in Measurement, Display and Storage Unit such as sensor, LCD indicator etc. shall be of reputed make.
- 3.3 The responsibility for obtaining the raw material of quality and reputed make required for the manufacture of device shall rest entirely with the supplier. The manufacturer shall issue a certificate regarding quality and grade of raw material used in manufacturing of components / parts of the device.
- 3.4 All surfaces of the Device shall be powder coated with anticorrosive coating or shall be painted with one coat of zinc chromate primer to IS: 104-1979 followed by one coat of red oxide/zinc chromate primer to IS: 2074-1992 and two coats of synthetic enamel to IS: 2932-2003 or other approved painting system.

4.0 Functional Requirements:

- 4.1 Continuous rail thermometer shall be compact, rugged, shock, dust and water proof, electrically shielded and capable of functioning reliably in field conditions normally encountered in Indian Railway system including on electrified section with High Tension overhead line. Overall weight of the device shall be 10 Kg (maximum) excluding cable.

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4.2 Data Logger:

- 4.2.1** This unit can be placed at nearby cabin to continuously monitor and store the rail temperature. This device shall have the following features
- 4.2.2** The Device shall be capable of continuous operation during the varying atmospheric and climatic conditions as follows:
- Ambient temperature : 0 to 55 deg. C
 - Altitude : Sea level to 700 m
 - Maximum rail temperature : 85 deg. C
- 4.2.3** Non-volatile memory which shall be capable to store data up to 18 months on hourly basis. Data storing time shall be varied depending on the recording interval time.
- 4.2.4** An Optically Isolated Data port (open collector type) shall be provided on data logger to interface it with machine to machine (such as telemetry Device). This port should generate data every minute in the following ASCII format for other devices with which it is communicating; **1<space>RRRR<space> DDDD<space>SSSS**
2<space>DD/MM/YY<space> HH:MM<space>STT.T<space> Deg<space>C
 where **RRRR** is name of Railway, **DDDD** is name of Division and **SSSS** is name of Station up to 4 alphabets maximum, **DD/MM/YY** is date, month and year, **HH:MM** is time, **S** is sign of temperature in + or - and **TT.T** is the value of temperature recorded. Thus data sent for telemetry device will be in following format:
1 RRRR DDDD SSSS
2 11/08/12 05:00 +30.2 Deg C
- 4.2.5** There shall be provision to display all logged data output mentioned below on LCD display directly by scrolling.
- (a) Logged data for the given stipulated period.
 - (b) Maximum and minimum temperature recorded per day for the given stipulated period in accordance with the time stamp.
 - (c) Maximum and minimum temperature attained over the given stipulated period in accordance with the time and date stamp.
- 4.2.6** Data logger shall have an independent power source called AC Power Supply cum Battery Charger Module. The Module shall be competent to run on AC mains and charge SMF (Sealed Maintenance Free) or similar rechargeable battery simultaneously. Battery backup should be at least 72 hours. The battery should have life period of minimum 36 months.
- 4.2.7** Suitable terminals for providing external 12 volt battery shall also be made in the Device by manufacturer if demanded by the purchaser.
- 4.2.8** While changing/ replacing the battery, there shall be no loss of stored data.
- 4.2.9** There shall be no interruption in temperature recording while transferring data to Data Transfer Module or display of various readings.
- 4.2.10** Data logger shall support Temperature Sensor fitted on rail through cable of suitable size and length up to 100 meters.
- 4.2.11** Data logger shall have menu based and user friendly man machine dialogue by using keyboard and LCD display which enables:
- Setting of date and time.

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- Setting of time interval between two readings of temperature.
 - Setting of warning alarm can be done for the desired maximum and minimum value of temperature.
- Setting of name of Railway, Division & Station upto 4 alphabetical characters.
 - Setting/ selecting of time period for which data is to be displayed as per user's choice on LCD display.
- Data Logger will transfer the data to Data Transfer Module to its full capacity by default (To facilitate proper filing and compiling of records for at least 5 years as per clause 2.2.1 of LWR manual).
 - Display of name of Railway, Division & Station.
 - Display of sampling interval setting.
 - Display of upper temperature alarm setting.
 - Display of lower temperature alarm setting.
 - Display of today's maximum/ minimum temperature.
 - All above said setting should be altered by inserting user password only.

4.2.12 Data logger shall have following Audio (15 minutes duration)/ Visual indications:

- Visual indication at power ON/Battery Charging.
- Visual indication at the time of temperature recording.
- Audio-visual indication in case of failure of temperature sensor fitted on rail or disconnection/ fault in wire laid between temperature sensor (at rail) and Data Logger (at nearby cabin).
- Visual indication at the time of transferring data to Data Transfer Module.
- Audio alarm whenever temperature exceeds its programmable limit.
- Audio alarm at the time of battery low.

4.3 Data Transfer Module

This module is used for transferring data from Data Logger to Personal Computer (PC) through USB Port of PC. Data transferred in Computer should create a file in ASCII format compatible to TMS software as given below:-

1. **Location record format: I <space> RRRR <space> DDDD <space> SSSS** where **I** is **1** for this type of record, **RRRR** is name of Railway, **DDDD** is name of Division and **SSSS** is name of Station up to 4 alphabets maximum.
2. **Temperature record format: I<space>DD/MM/YY<space>HH:MM <space>STT.T<space>Deg<space> C** where **I** is **2** for this type of record, **DD/MM/YY** is date, month and year, **HH:MM** is time, **S** is sign of temperature in + or - and **TT.T** is the value of temperature recorded.
3. **Hourly maximum Temperature record format: I<space> DD/MM/YY<space> HH:MM<space> STT.T<space>Deg<space> C<space>HR<space>MAX** where **I** is **3** for this type of record, **DD/MM/YY** is date, month and year, **HH:MM** is time, **S** is sign of temperature in + or - and **TT.T** is the value of maximum temperature recorded hourly.

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4. **Hourly minimum Temperature record format: I<space> DD/MM/YY<space> HH:MM<space> STT.T<space>Deg<space> C<space>HR<space>MIN** where **I** is **4** for this type of record, **DD/MM/YY** is date, month and year, **HH:MM** is time, **S** is sign of temperature in **+** or **-** and **TT.T** is the value of minimum temperature recorded hourly.
5. **Absolute maximum Temperature record format: I<space> DD/MM/YY<space> HH:MM<space> STT.T<space>Deg<space> C<space>AB<space>MAX** where **I** is **5** for this type of record, **DD/MM/YY** is date, month and year, **HH:MM** is time, **S** is sign of temperature in **+** or **-** and **TT.T** is the value of maximum temperature during the whole day.
6. **Absolute minimum Temperature record format: I<space>DD/MM/YY<space> HH:MM<space> STT.T<space>Deg<space> C<space>AB<space>MIN** where **I** is **6** for this type of record, **DD/MM/YY** is date, month and year, **HH:MM** is time, **S** is sign of temperature in **+** or **-** and **TT.T** is the value of minimum temperature during the whole day.

Thus file generated on PC will be in following format:-

```

1 RRRR DDDD SSSS
2 11/08/11 00:00 +30.8 Deg C
2 11/08/11 01:00 +29.8 Deg C
2 11/08/11 02:00 +30.1 Deg C
2 11/08/11 03:00 +30.3 Deg C
2 11/08/11 04:00 +30.2 Deg C
2 11/08/11 05:00 +30.0 Deg C
2 11/08/11 06:00 +29.5 Deg C
2 11/08/11 07:00 +29.6 Deg C
2 11/08/11 08:00 +29.6 Deg C
2 11/08/11 09:00 +31.3 Deg C
2 11/08/11 10:00 +30.1 Deg C
2 11/08/11 11:00 +30.4 Deg C
2 11/08/11 12:00 +30.7 Deg C
2 11/08/11 13:00 +31.6 Deg C
2 11/08/11 14:00 +31.0 Deg C
2 11/08/11 15:00 +31.8 Deg C
2 11/08/11 16:00 +31.5 Deg C
2 11/08/11 17:00 +30.9 Deg C
2 11/08/11 18:00 +30.6 Deg C
2 11/08/11 19:00 +30.3 Deg C
2 11/08/11 20:00 +30.0 Deg C
2 11/08/11 21:00 +30.0 Deg C
2 11/08/11 22:00 +29.8 Deg C
2 11/08/11 23:00 +29.7 Deg C
3 11/08/11 15:00 +31.8 Deg C HRMAX
4 11/08/11 06:00 +29.5 Deg C HR MIN
5 11/08/11 14:42 +32.0 Deg C AB MAX
6 11/08/11 05:44 +29.2 Deg C AB MIN

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This data can also be further accessed in EXCEL files. The supplier shall provide a software on CD (compact disc) for both the functions.

This Module shall be designed in such a way that it can be fitted easily in data logger and does not contain any power source or battery. Dimensions of this module should be maximum 7.0 cm X 6.0 cm X 2.6 cm.

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4.4 Temperature Sensor

It is used for measuring rail temperature and shall be designed in such a way that it can be installed on the web of all type running rails without interrupting traffic on it. It shall be of suitable size and shape for proper fitment in the rail web. Accuracy and performance of the sensor shall not be affected by cable length, noise, dust, rain water etc. during operation. Sensor should be made of good quality material, water & dust proof. All the exposed surfaces shall be powder coated with anti- corrosive material.

The temperature sensing element should be of digital IC type. This IC should be in thermal contact with rail web to read the temperature and give digital output which should be transmitted digitally to avoid any calibration changes due to change in length or any joint in the transmission cable. No resistive or thermocouple type analog sensors will be accepted.

4.5 AC Power Source cum Battery Charger Module

It shall run on 220V \pm 10%, 50 Hz AC main supply and give suitable output to run the Device and simultaneously charge the battery based on constant voltage current limited method which can charge battery in 8 hours. In case the supply voltage is very low, the battery shall take over automatically.

5.0 Technical Features

- i) Alphanumeric LCD display size: (minimum: 97mm X 22mm) of 2 line with 16 characters each.
- ii) Resolution: 0.1 deg. C
- iii) Accuracy: \pm 1 deg. C
- iv) Measurement Range: -05 to 85 deg. C
- v) Memory: Non-volatile up to 18 months on hourly basis.
- vi) LCD Display pattern: 29/08/11 (Space) 14:23
 (Date) (Time)
 25.4 deg. C
 (Temperature)
- vii) (a) Both of the terminals of Optically Isolated Data port should be galvanically isolated from this device.
 (b) Parameters for serial transmission through Optically Isolated Data port: Baud rate 9600, Data bits 8, Parity none, Stop bit 1.
 The 'MARK' state of the serial transmission is specified by the 'Signal' terminal being in open state, while the 'SPACE' state is specified by 'Signal' terminal being at the potential of 'Common' terminal.
 (c) 3.5 mm stereo jack (35RAPC series of M/s Switchcraft, U.K. or similar) is to be provided to interface this device with other machines such as telemetry device having 3.5 mm stereo plug (35HD series of M/s Switchcraft, U.K. or similar).
 (d) Tip and middle contact of the stereo plug provided on Telemetry device are 'Signal' and 'Common' terminals respectively. Connections on the stereo jack provided in this device should be terminated accordingly.

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6.0 TESTS:

6.1 Accptance Test : Following tests shall be carried out as acceptance tests

- i) Visual and dimensional check.
- ii) Dry heat test on sensor.
- iii) Water immersion test on sensor
 - a) In clean water.
 - b) In salty water.
- iv) Accuracy Test
- v) Test for measuring range of the device
- vi) Field Test

6.1.1 Visual and dimensional check

Various parts/components of the device shall be checked visually along with dimensional parameters. The device shall be examined for its proper shape, soundness in appearance and free from any defects, which can be detected visually. If desired by the Inspecting authority, all the internal components shall be visually verified for its make, proper shape, positioning etc. by opening the data logger unit.

6.1.2 Dry heat test on sensor

Dry heat test shall be carried out on sensor in an oven up to a temperature of $85 \pm 2^\circ\text{C}$ for a period of four hours after stability in the oven chamber has been reached. The sensor shall be kept in an oven chamber when the temperature has stabilized and remained active during the test. After completion of test, the equipment shall be subjected for recovery of two hours. After recovery, the equipment shall be checked visually for any apparent damage or deterioration. Necessary standard oven from any Govt. or Govt. recognized test house shall be arranged by the manufacturer.

6.1.3 Water immersion test for sensors:

Water immersion test shall be carried out in clean water as per IS: 9000(Pt. XV)/ Sec.7-1982 and in salty water as per IS: 9000(Pt. XI)-1983 under 40 cm water head.

6.1.4 Accuracy Test

- (i) The Device shall be checked for its accuracy at 05, 20, 40, 60 & 70 degree centigrade with the help of standard calibrated thermometer and a comparator bath. Necessary calibration certificate for the standard thermometer with a least count of 0.1 deg. C, issued by a Govt. or Govt. recognized reputed test house shall be produced by the manufacturer before commencing the test.
- (ii) For the purpose of testing of Device, a testing bath shall be used. Following procedures shall be followed:
 - The temperature of the bath shall be adjusted such that the standard thermometer reads 20 deg. C
 - The Temperature Sensor of the device to be tested shall be dipped in the comparator bath.
 - The temperature shall be then readjusted (if required) such that the Device is to be tested for 20 deg. C.
 - The reading of the standard thermometer shall be compared with that recorded by the sample device.
 - Above test shall be repeated for temperatures of 40, 60 & 70 deg. C respectively.

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6.1.5 Test for Measuring Range of Device

Arrangement shall be made by the manufacturer to test a temperature range of 0 to 85 deg. C with a least count of 1 deg. C. The sensor of Continuous rail thermometer shall be placed in testing medium along with a standard and pre-calibrated thermometer in such a way that only the bulb get in contact with the medium. The temperature range shall be tested for both ascending and descending order and the results obtained shall be compared with those of the standard thermometer. Such tests shall be carried out twice with an interval of one hour in between two tests. No test certificate shall be acceptable for temperature range test as the test shall be carried out at the factory premises of the firm who will arrange necessary equipment etc. required for the test. Arrangements for creating a temperature of 0° C shall be done by the manufacturer.

6.1.6 Tests for the aspects mentioned in 4.3 shall also be checked.

6.1.7 Field test: Following tests shall be carried out in field:

- i) The sensor of the device shall be checked for its proper, easy and effective fitment on the web of different rail sections.
- ii) The sensor shall be fitted to a rail section along with 100 m cable outside the building in open place for four hours. Measurement of temperature taken from the device and by a standard calibrated thermometer at an interval of half hours shall be noted. These respective measurements taken by both the instruments shall be compared and there shall be no variation in readings.
- iii) The sensor shall be fitted in a service rail outside the building in open place and data logger is attached suitably by the cable for 24 hours. Data logger is to be set for 30 min. sample interval time. All the display facilities and module functions of the device shall be verified after 24 hour recordings.

7.0 Inspection:

7.1 The Inspection during procurement of the Continuous Rail Thermometer against Railway's purchase order shall be carried out by the purchaser zonal railway or any representative/agency authorized by CTE of zonal railways at the manufacturer's premises. Minimum level of the inspecting official shall be SSE (Senior Section Engineer). Necessary facilities shall be arranged by the manufacturer for conducting the tests properly as mentioned in clause no. 7.2. Prior to giving a call to the authorized inspecting official for inspection and testing of Device, tenderer / manufacturer shall ensure that all the Continuous rail thermometer are ready in all respect and in assembled condition after testing by manufacturer themselves.

7.2 05% or min. 2 nos. of the device per lot/PO (randomly selected) shall be subjected to the acceptance tests as per clause 6.1 If the samples satisfy all the test prescribed as per acceptance criteria, the lot is accepted, otherwise lot is rejected.

7.3 The manufacturer shall issue certificate in respect of each device that the same conform to the stipulated dimensions, accuracy and other requirements mentioned in this specification and the quality/ grade of the raw materials used in manufacturing the device conforms to the stipulations mentioned in the specification. The manufacturer shall produce all relevant documents as proof for conformity of quality of all the raw materials used as well as procurement source if desired by the inspecting officials.

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8.0 Warranty & AMC:

- 8.1** The supplier shall warranty the material covered by the specification to be free from defects in materials and workmanship under ordinary use and service. His obligation under this warranty shall be limited to replace free of cost those parts, which shall be found defective within one year for manufacturing & material defects from the date of receipt by the consignee except the battery for which warranty period will be 36 months.
- 8.2** During procurement of continuous rail thermometer railways should go post-warranty AMC with the supplier for a pre-determined period as decided by the purchaser railway. This shall be incorporated in the tender document as a condition of contract/Tender/Supply. For procurement of CONTINUOUS RAIL THERMOMETER with AMC, Comprehensive Guideline on Procurement, Operation, Maintenance and Repair of Small Track Machines (report No.TM-227) may be referred.

9.0 Service Facility and Spare Parts (including tools):

- 9.1** The supplier/manufacturer shall provide service of competent service engineers free of cost during commissioning and warranty period. The service engineer shall guide the operating and maintenance staff during commissioning and warranty period of the continuous rail thermometer for proper operation and handling.
- 9.2** The manufacturers/supplier shall have good service network throughout the country for quick and easy access to the users. A prompt response to the call of the customers is expected in case of any problem experienced in field.
- 9.3** The manufacturer/supplier shall be responsible for subsequent availability of the spare parts to ensure trouble free service for the thermometer for its five year normal life.

10.0 Documentations:

- 10.1** Detailed operating manual shall be prepared and supplied along with each Device.

11.0 Training and Commissioning:

- 11.1** Adequate training in operation of the machine shall be imparted to Rly-operators during commissioning/ demonstration of the Device by the supplier. Service engineer shall be available for providing training/ instructions to the operating staff.
- 11.2** After the continuous rail thermometer has been supplied at consignee premises, the supply shall be considered as complete only after field training is provided by the supplier as per para 11.1.

12.0 Marking and Packing:

- 12.1** The device shall be supplied in proper packing as per best trade practice.
- 12.2** The equipment shall be legibly and indelibly marked with;
- i) Name/Trade mark of manufacturer.
 - ii) Serial No. of equipment.
 - iii) Month and year of supply.

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13.0 Supplier is fully responsible to maintain the quality of product supply to Indian Railways.

14.0 Preference to Make in India:

The Government of India policy on ‘**Make in India**’ shall be applicable and compliance of the instruction contained in public procurement (preference to make in India) order -2017 “Make in India” shall be ensured.

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