

REVISION OF SPECIFICATION / STR

Ref:Current Spec. No. RDSO/2013/CG-07 Specification for Hand Held, Low Temperature Non-Contact type Optoelectronic Infrared Radiation (IR) Thermometer (Tentative).

1. RDSO is reviewing the specification/STR to cater to the latest technological developments in the field, modify clauses not relevant in the present context and making them more enabling with focus on functional requirements.
2. It is requested that your comments / suggestions with regard to improvements / modifications in specification / STR of this item may be submitted in the following format alongwith the justification for the changes required.

Part A: Basic Information

SN	Particulars	Information
1	Name	
2	Designation	
3	Professional Qualification	
4	Organization / Firm's Name	
5	Address for Correspondence	
6	Contact No.	
7	Email ID	
8	In case of Firm / Individual: Manufacturing experience of item (or similar Item) on which comments are offered	
9	Where relevant: Whether any technical document to support suggested changes is available / enclosed for better appreciation	

Part B: Comments / suggestions on the specification

SN	Clause No. of RDSO STR / Spec	Clause, as exists in RDSO STR / Spec	Clause , as it should read after incorporation of comments / suggestions in the RDSO Spec / STR	Justification for changes

Comments may be sent to:

Director/SS/Carriage
Annexi-1, Carriage Directorate,
Research Designs and Standards Organization
Manak Nagar, Lucknow – 226011

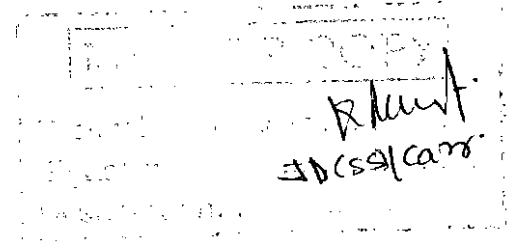
Email: edcar.rdso@gmail.com Or dirsrdsdo@gmail.com

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INDIAN RAILWAYS



सत्यमेव जयते



**SPECIFICATION FOR
HAND HELD, LOW TEMPERATURE
NON CONTACT TYPE OPTOELECTRONIC INFRARED RADIATION (IR)
THERMOMETER
(Tentative)**

S.No.	Month / Year of issue	Revision / Amendment	Page No.	Reason for Amendment
1.	December - 2013	Nil	-	First Issue


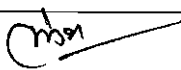
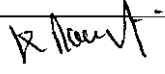
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Carriage Directorate
RESEARCH DESIGNS AND STANDARDS ORGANISATION
(Ministry of Rlys.)
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0.0 FOREWORD

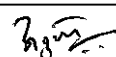
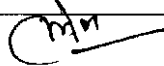
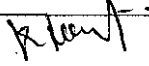
- 0.1 This specification covers the general technical requirements/provisions for supply and use of hand held, low temperature, non-contact type optoelectronic infrared radiation Thermometer for measurement of axle box temperature of Indian Railways rolling stock and does not include all the necessary provisions of contract.
- 0.2 This specification provides general guidelines for the use of hand held, low temperature, non-contact type optoelectronic infrared radiation thermometers. The purpose of this specification is to provide a basis for users to make more accurate measurements, to understand the error and to reduce the error in measurement.
- 0.3 This specification covers about the hand held, low temperature, non-contact type optoelectronic instrument intended for measurement of temperature by detecting intensity of thermal radiation exchanged between the object subjected to measurement and the sensor of the instrument.

1.0 REFERENCES

- i. ASTM E2758-10 – Standard guide for selection and use of wideband, low temperature infrared thermometers.
- ii. IEC/TS 62492 – 1 – Industrial process control devices– Radiation thermometers- Part-1: Technical data for radiation thermometers.
- iii. IEC 60947 – 1 – Annexure C – Degree of protection of enclosed equipment (IP code).
- iv. IEC 62262- Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code).
- v. Handheld Digital Infrared Thermometer by Ryen Hansgen, fall 2008-spring 2009.
- vi. Technical specification of IR thermometers from user railways and prospective sources of supply.

2.0 SCOPE

This specification covers general and technical requirements of hand held, low temperature, non-contact type optoelectronic infrared radiation Thermometer for measurement of axle box temperature of Indian Railway's rolling stock.

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3.0 SCOPE OF SUPPLY


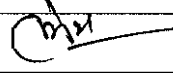
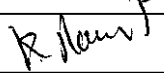
- 3.1 The scope of supply of Hand held, low temperature, non-contact type optoelectronic infrared radiation Thermometer for each set shall include the following unless otherwise stipulated in the tender:

S. No.	Description	Qty.
1.	Hand held, low temperature, non-contact type optoelectronic infrared radiation thermometer	01
2.	Standard size rechargeable battery as per manufacturer's recommendation	02 sets*
3.	Battery charger	01
4.	Protective Boot and storage holster	01
5.	Operation manual in bilingual (i.e. Hindi and English)	01
6.	Factory calibration certificate	01

* One set battery with IR Thermometer and one set spare.

4.0 TERMINOLOGY

- 4.1 **Infrared (IR):** It refers to electromagnetic radiation with a wavelength of nearly 0.7 to 30 μm .
- 4.2 **Infrared Thermometer:** An optoelectronic instrument used for non-contact measurement of temperature of an object by utilizing thermal radiation exchange between the object and sensor. These thermometers are generally known as IR thermometers.
- 4.3 **Low Temperature:** For radiation and Infrared thermometry, any temperature measured below 660°C is known as low temperature IR thermometer.
- 4.4 **Wide Band:** Referring to the situation where the spectral range of an instrument is at least 1/10 of its center wavelength. The most hand held, low temperature, non-contact optoelectronic Thermometer are wide band instruments. The most common spectral range for wide band IR Thermometer is 8 to 14 μm .
- 4.5 **Spectral Range:** The parameter which gives the lower and upper wavelength range over which the IR Thermometer operates. This is also referred to as bandwidth. These limits are generally defined as the wavelengths where the power or signal is attenuated by a defined amount.
- 4.6 **Sensor:** It is a device designed to respond to infrared radiations and simultaneously convert that response into electrical signal.



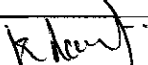
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- 4.7 **Emissivity:** The emissivity of the surface is the ratio between the radiation emitted from the surface under measurement and the radiation emitted by a blackbody at same temperature or the ability to emit energy is known as emissivity.
- 4.8 **Emissivity Setting:** An adjustment on an IR Thermometer to compensate for an emissivity of non-unity. In most measuring situation an IR Thermometer is used on a surface with an emissivity less than one. For this purpose thermometers have possibility of adjusting the emissivity to get automatically correct temperature measurement.
- 4.9 **Repeatability:** It is twice the standard deviation of measurement repeated under same conditions within a very short time span (The degree of accord between two successive readings with a Thermometer is its repeatability). Loss of repeatability results from permanent or temporary changes to the resistance characteristics of the element and may be caused by exposing the Thermometer to temperatures at or beyond the endpoints of its specified range.
- 4.10 **Distance Ratio (D:S):** Distance to spot ratio is referred as the ratio of measuring distance to the diameter of the field-of-view when the target is in focus. This has a profound impact on the accuracy or precision of the reading. For example if the target is 100 mm in size, and infrared radiation Thermometer has a D:S of 10:1, then the maximum distance will be 1000 mm for reliable measurement of temperature of the target.
- 4.11 **Field-of-view:** Usually an object of circular/flat surface under measurement of temperature from which the IR Thermometer receives radiation. The other synonymous terms used for the field-of-view are target area, target size and measurement field.
- 4.12 **Response Time:** The time interval between the instant of an abrupt change in the value of the object temperature/radiation (input parameter) and the instant from which the measured value of the infrared radiation Thermometer (output parameter) remains within the specified limits of its final value.

5.0 BASICS OF IR THERMOMETER

- 5.1 An IR Thermometer can be used in a number of applications for measurement of temperature. An IR Thermometer can be used on any sort of object, big or small and determines its temperature. Due to portability and non-contact feature, temperature measurement can be done easily in confined hard to reach area.
- 5.2 The quickness of measurement and the ability to measure temperature of an object subjected to measurement makes it more desirable instrument for

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temperature measurement. An IR Thermometer measures thermal radiation in a given spectrum range for which it has been designed. The IR Thermometer determines the relationship between the measured thermal radiation and temperature. The thermal radiation depends upon emissivity of surface under measurement. Thermopiles are generally used as sensor in IR thermometers.

6.0 BASIC COMPONENTS OF IR THERMOMETER

6.1 Following are the main components of a hand held, low temperature, non-contact type optoelectronic infrared radiation thermometer:

- MCU (Microcontroller unit)
- Laser Pointer
- Infrared radiation Sensor (IR Sensor)
- LCD Display
- Battery

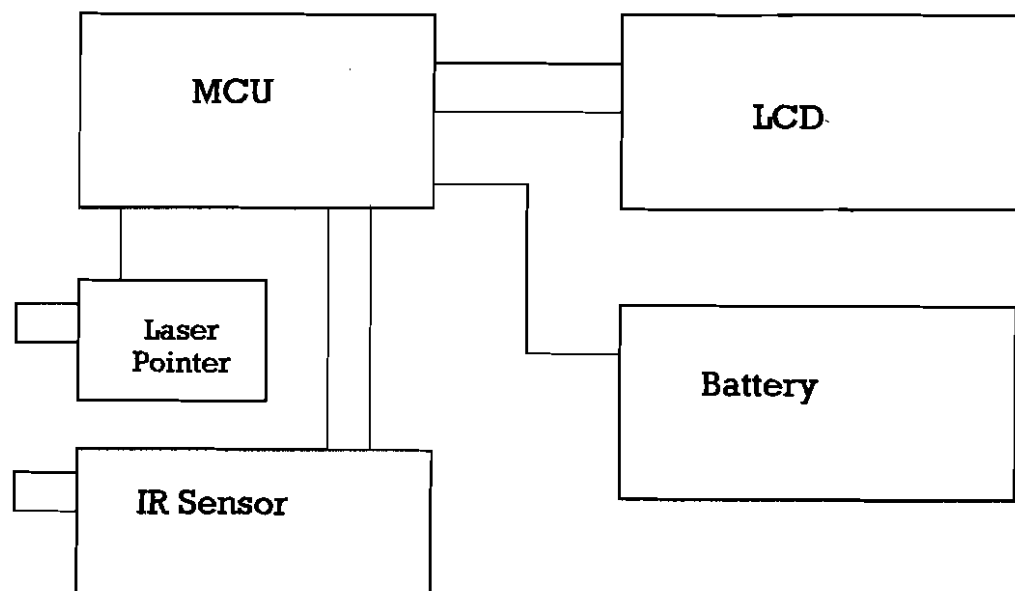


Fig-1 Basic Design Layout of IR Thermometer

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7.0 BASIC WORKING PRINCIPAL OF IR THERMOMETER

The basic layout of hand held, low temperature, non-contact type IR Thermometer is shown in Fig-1. The IR sensor measures the energy being radiated by the object whose temperature is under measurement. The microcontroller will then read and process the output from the IR sensor, interpret the signals, do calculation and finally display the results on LCD for user. The laser pointer helps the user to determine the exact location that they intend to measure. The battery will allow infrared radiation Thermometer to be portable.

8.0 BASICS OF MEASUREMENT BY IR THERMOMETER

- 8.1 Before starting for temperature measurement, it is best to allow IR Thermometer to attend thermal equilibrium (if there is abrupt change in environmental condition).
- 8.2 Most hand held IR thermometers have trigger/button to start and stop the measurement. To make a measurement, the IR thermometer's laser light shall be pointed at the center of the object being measured by pulling the trigger/pressing the button. The trigger/button shall be held at least as long as infrared radiation thermometer's response time specified by the manufacturer.
- 8.3 Fig-2 below shows that how much area an IR Thermometer can measure and Fig-3 shows how much area is needed for temperature measurement when considering the IR thermometer's spot size.

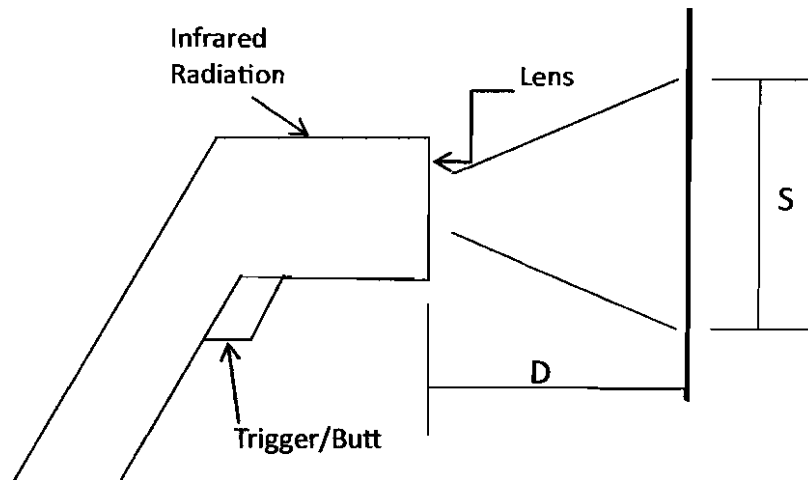


Fig-2 Basic IR Thermometer

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8.4 In Fig-3, the part (A) labeled as 'Poor' shows a situation where the object being measured is smaller than the spot size, this situation gives an inaccurate temperature measurement. The part (B) of Fig-3 labeled as 'OK' shows a situation where the object being measured is slightly larger than the spot size such situation should give acceptable temperature measurement. The part (C) of Fig-3 labeled as 'Better' is the ideal situation where object being measured is significantly larger than the spot size. This is recommended situation of measurement to get best temperature measurement result.

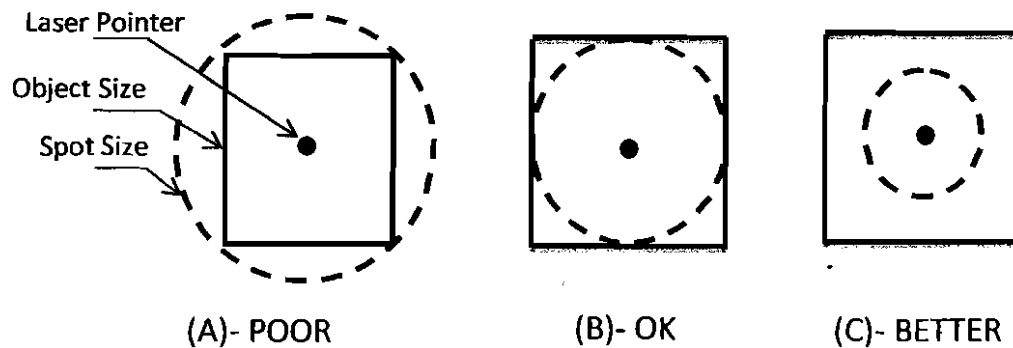


Fig-3 Different positions of object to spot size

8.5 There are other considerations which influences the measurement of temperature by IR thermometers. Most hand held low temperature IR thermometers are wide band instruments which facilitate the measurement of temperature of different material having different emissivity. The most common spectral range for wide band, low temperature non-contact type infrared radiation Thermometer is 8 to 14 μm . However, some wide band, low temperature, non-contact type IR thermometers have a spectral range of 5 to 20 μm .

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9.0 TECHNICAL REQUIREMENTS OF HAND HELD IR THERMOMETER

9.1 The IR Thermometer shall be able to measure axle box temperature of Indian Railway's rolling stock satisfactorily under following operating conditions of Indian Railway:

- Ambient temperature : -4° C to 50° C
- Altitude : Sea level to 2500m
- Max. temperature under Sun : 70° C
- Relative humidity : 40% to 95%even up to 100% during rainy season
- The rainfall is fairly heavy.
- During dry weather, the atmosphere is likely to be dusty.
- Indian Railway's rolling stock operates in coastal areas also.

9.2 The hand held IR Thermometer shall fulfill following technical requirements:


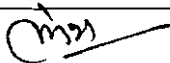
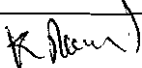
9.2.1 The IR Thermometer shall be portable and light in weight. Without battery the weight of IR Thermometer shall not be more than 375 grams.

9.2.2 The housing material of IR Thermometer shall have adequate mechanical strength and shall be able to protect minimum external mechanical impact equivalent to IK 06.

9.2.3 The housing of the IR Thermometer shall provide IP 65 equivalent protection against ingress of foreign particles and liquid.

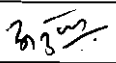
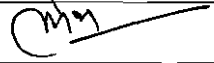
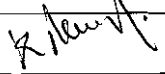
9.2.4 The IR Thermometer shall have provision of a trigger/button to start and stop the measurement. After every measurement the data recorded shall be displayed on the LCD of IR Thermometer and shall auto hold (auto freeze) the measured data for a minimum period of 7 seconds to enable to take readings. The next trigger within 7 second shall not allow user to take next measurement.

9.2.5 The IR Thermometer shall have at least four digit LCD temperature displays with provision of back-lit to enable the readings of measured values in poor light conditions. The display resolution shall be at least one digit of decimal. The displayed temperature unit on LCD shall be selectable either in °C or °F.

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- 9.2.6 For ensuring exact targeting of object, IR Thermometer shall be equipped with single offset, class II visible laser light.
- 9.2.7 For power supply to IR thermometer, standard size leak proof rechargeable battery shall be used. In fully charged condition, battery of IR Thermometer shall give a minimum power backup of 10 hours when equipment operating with all sub-systems in ON-CONDITION. The condition of battery i.e. fully charged/discharged shall be displayed on LCD and shall relay an audible alarm of low battery for easy access to user.
- 9.2.8 The power supply to IR Thermometer shall automatically shut down within 8-15 seconds after release of trigger/button of IR Thermometer.
- 9.2.9 The IR Thermometer shall be low temperature, wide band non-contact type with an accuracy of $\pm 2\%$ of reading measured or $\pm 2^{\circ}\text{C}$ whichever is greater.
- 9.2.10 The repeatability of IR Thermometer shall be $\pm 0.5\%$ of measured value or $\leq \pm 1^{\circ}\text{C}$ whichever is greater.
- 9.2.11 The emissivity of the IR Thermometer shall be preset (fixed) to 0.95 and shall not change during measurement.
- 9.2.12 The response time of IR Thermometer shall be less than one seconds.
- 9.2.13 The IR Thermometer shall have Distance to Spot ratio (D: S) of at least 10:1 and shall be displayed on LCD. The IR Thermometer shall give an error alarm if the object under measurement is beyond the D: S ratio of IR thermometer.
- 9.2.14 The IR Thermometer shall have provision of audio and visual alarm to alert the user when the measured temperature exceeds the programmed limit.
- 9.2.15 The IR Thermometer shall have sufficient memory to auto save at least 200 last temperature readings of axle box with a provision to readout/download stored data (compatible with PC/laptop) as and when required. Provision should also be made for extension of memory.
- 9.2.16 The IR Thermometer shall be accredited by any notified/reputed national/international conformity assessment body/agency regarding compliance with all relevant "essential requirements" (e.g. safety, health, environmental protection requirements). The supplier/vendor shall submit conformity certificate of their product to the consignee with the supply.
- 9.2.17 Factory calibration certificate of IR thermometer/(s) shall be submitted by supplier /vendor to the consignee with the supply of IR Thermometer.

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10.0 Acceptance Test

10.1 IR Thermometer should be tested for the following parameters as per test method given against them.

TABLE 1

S.No	Property	Required value	Test Method
1.	Calibration Accuracy	$\pm 2\%$ of reading measured or $\pm 2^\circ\text{C}$ whichever is greater	As per ASTM E1256-11a
2.	Repeatability	$\pm 0.5\%$ of measured value or $\leq \pm 1^\circ\text{C}$ whichever is greater	As per ASTM E1256-11a
3.	Response Time Test Method	<u>Less than one second</u>	As per ASTM E1256-11a

10.2 The supplier shall submit a Test Certificate from Govt. approved/ NABL accredited laboratory.

11.0 GUARANTEE/WARRANTY AND REPLACEMENT

The supplier/vendor of IR Thermometer shall be fully responsible for satisfactory functioning of IR thermometer/(s). The guarantee/warranty period for IR Thermometer (exclusive battery) shall be 24 months from the date of receipt of supply. The supplier/vendor shall replace the items/equipment rejected due to their noncompliance with the requirements of this specification and/or the products those are failing or providing unsatisfactory service due to defective design, material or workmanship within warranty period by product/(s) complying with the requirements, free of cost within a period of two weeks.


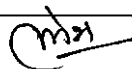
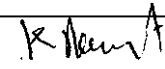
12.0 MARKING

Each IR Thermometer shall be legibly marked to indicate the followings:

1. Name and code of the manufacturer
2. Month and year of manufacture.
3. Identification marks, i.e. Part Number, Batch Number, etc.

13.0 PACKING

The supplier/vendor shall ensure proper and adequate packing of IR Thermometer in assembled condition before dispatch to prevent damage in

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transporting, handling and storage. The IR Thermometer shall be housed in a suitable rigid container.

14.0 TRAINING


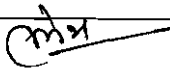
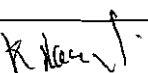
The supplier/vendor shall arrange free of cost training to Indian Railway's personnel in operation, maintenance and trouble shooting of IR thermometer. The venue and period of training should be mutually agreed between supplier/vendor and purchaser/consignee.

15.0 INFRINGEMENT OF PATENT RIGHT

The vendors seeking are required to give undertaking on "INFRINGEMENT OF PATENT RIGHTS". The undertaking shall be as under:

Indian Railways shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, use of similar components in the design & development of this item and any other factor not mentioned herein which may cause such a dispute. The entire responsibility to settle any such disputes/ matters lies with the manufacturer/ supplier.

Details / design/documents given by them are not infringing any IPR and they are responsible in absolute and full measure instead of railways for any such violations. Data, specifications and other IP as generated out of interaction with railways shall not be unilaterally used without the consent of RDSO and right of Railways / RDSO on such IP is acceptable to them.

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