सत्यमेव जयते

GOVERNMENT OF INDIA

(भारत सरकार)

MINISTRY OF RAILWAYS

(रेल मंत्रालय)

Annexure – E3

Specification of Kavach (The Indian Railway ATP)

Cab Roof Top Antenna

द्वारा

सिग्नल एवं दूरसंचार निदेशालय

अनुसंधान अभिकल्प एवं मानक संगठन

DOCUMENT DATA SHEET		
Annexure-E3		**Version 1.0**
Title of Document Specification of Kavach (The Indian Railway ATP)- Cab Roof Top Antenna		
Authors See Document Control Sheet		

Document Control Sheet

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References

S. No.	Document no.	Title/Document name
1.	CLW/ES/03/0646	Set of Harnessed Cables for WAG-9H and WAG-7 Three Phase Locomotives
2.	EDPS 304	Locomotive Power Cable
3.	EN 45545-2	Railway applications. Fire protection on railway vehicles Requirements for fire behaviour of materials and components
4.	EN 50153	Railway applications - Rolling stock - Protective provisions relating to electrical hazards
5.	EN 50121-3-2	Railway applications - Electromagnetic compatibility - Part 3-2: Rolling stock - Apparatus
6.	EN 61373	Railway applications. Rolling stock equipment. Shock and vibration tests
7.	ELRS/SPEC/ELC/0019 (Rev. 4)	Indian Railways technical Specification for Thin walled flexible Elastomeric Cables with copper conductors for working voltage (i) upto 750V.
8.	IEC 60068-2-5	Environmental testing - Part 2-5: Tests - Test S: Simulated solar radiation at ground level and guidance for solar radiation testing and weathering
9.	IEC 60332	Tests on electric and optical fibre cables under fire conditions
10.	IEC 60571	Railway applications – Electronic equipment used on rolling stock
11.	IEC 62236-3-2	Railway applications – Electromagnetic compatibility- Part 3-2: Rolling stock – Apparatus
12.	IS 9000 series of Environmental Standards	Basic Environmental Testing
13.	RDSO/SPN/144/2006	Safety and Reliability Requirement of Electronic Signalling Equipment

Cab Rooftop Antenna

1 Scope

1.1 This section of the document contains general requirements, technical requirement, features and functionality of Cab Rooftop Antenna of Kavach (The Indian Railway ATP) to be used for Indian Railways.

2 General

2.1 Cab Rooftop Low Profile Antenna shall work on the spectrum assigned for 406-470 MHz

2.2 The mechanical dimension shall be such that it meets mounting requirements on the Cab Rooftop of Indian Railways for electrified and non-electrified sections, Sub urban sections, bridges, tunnels etc.

3 Technical Specification

SN	Parameter	Values
Antenna Details		
(i)	Antenna configuration	Transmitter or Receiver
(ii)	Frequency (MHz)	406-470 MHz, 425-430 MHz (best performance)
(iii)	Polarization	Vertical
(iv)	Typical VSWR	<2:1
(v)	Port Isolation	>15 dB
(vi)	Pattern	Omnidirectional
(vii)	Impedance	50Ω
(viii)	Gain (dBi)	Min 3 dBi
(ix)	Max Input Power (W)	Min 50 (Nominal working 7-10W)
(x)	Ports-Comms	N (female) - DC grounded
Housing Details		
(xi)	Maximum dimension (in mm)	L550× W392 × H100
(xii)	Mounting	i. Mounting arrangement shall be as per drawing provided by Indian Railway. ii. Mounting shall be installed in longitudinal position to the wind/driving direction.
(xiii)	Base Material	Aluminium (corrosion protected & powder coated)
(xiv)	Radome Material	Polycarbonate 1000 or better
(xv)	Radome Flame Retardance Rating	EN45545-2

4 Test Requirement

(Equivalent EN/IEC standards are acceptable)

4.1 Climatic Test

SN	Test Type	Equipment Condition	Severity	Specification
(i)	Dry heat test (Operation)	Operating	Temp: 70°C Duration: 16 hrs.	IS: 9000, Part III, Section 5
(ii)	Cold Test (Operation)	Operating	Temp. –10°C ± 3°C, Duration: 2 hrs.	IS: 9000, Part II, Section 4
(iii)	Change of Temperature (Temperature Cycling)	Operating	Lower Temp: -10 °C Higher Temp: 70-°C, Duration: 7 hrs at each temperature. Rate of change: 1°C/ Minute. No. of cycle: 03	IS: 9000, Part XIV, Section 2
(iv)	Damp heat test (steady state)	Operating	Temp:(40±2) °C RH: (93±3) % Duration = 4 days	IS: 9000, Part IV
(v)	Damp heat test (Cyclic)	Operating	Upper Temp. 40°C Lower Temp. 25°C RH 95% Duration: 12 + 12 = 24 hrs No. of cycles: 6	IS: 9000, Part V, Section 2

4.2 Vibration and shock test

SN	Type of test	Standard
(i)	Function Random vibration test	EN 61373 Cat.1B
(ii)	Increased Random Vibration	EN 61373 Cat.1B
(iii)	Shock test	EN 61373 Cat.1B

4.3 Salt mist test:

SN	Type of Test	Equipment Condition	Severity	Specification
(i)	Salt Mist	Non-operating	Exposure Duration: 2hrs Duration: 7 days Temp: (35± 3) °C RH: 90 to 95% No. of cycles: 04	IS: 9000, Part XI, Procedure 2

4.4 **EMC compliance:** EN 50121-3-2 or equivalent

4.5 **Solar Radiation**: IS/IEC 60068-2-5 or equivalent

4.6 **Protection against Flammability**: As per EN 45545 parts 1 and 2 or equivalent BIS/IEC or other specifications.

4.7 **Protection against Electrical Hazards**: As per EN 50153 or equivalent BIS/IEC or other specification.

4.8 **Pantographic Interference Tests**: RDSO/SPN/144/2006

4.9 **High Voltage/High Current protection**

4.9.1 Cab Rooftop Low Profile Antenna shall be Surge Protected from high voltage (25 KV) and high current (40kA/100ms) as per relevant IEC/EN or equivalent standards.

4.10 **Pressure:** Equipment mounted external to the train cab shall withstand the following physical conditions:

4.10.1 In-tunnel pressure pulses of 6 kPa (peak to peak) for up to 3 seconds.

4.10.2 Pressure gradients of up to 100 kPa/s.

4.11 **Ingress Protection:** The IP rating shall be IP67 or better

4.12 Test certificates issued by reputed International Agencies/NABL accredited lab ascertaining their performance of Onboard railway applications shall be submitted.

5 Cables and Connectors

5.1 **Co-axial Cables:** Co-axial Cable shall be compliant to IEC 60332-1, 60332-2 & 60332-3/ EN45545 for fire.

5.2 **Power Supply Cables:** Shall meet RDSO specification ELRS /SPEC/ ELEC /0019 Rev 4 or latest for non-diesel propulsion systems and meet EDPS 304 for diesel propulsion systems.

5.3 The Connectors provided shall be suitable for Rolling stock application of AMPHENOLI/PHOENIX/ ALLIED/HARTING or any other approved make from Electric Loco/ PS&EMU/ Motive Power directorates of RDSO.

5.4 The cable harnessing is to be carried out by vendors approved under 0646 spec of CLW or equivalent.

5.5 Ingress Protection for dust and water by providing gasket & sealing of cable entry/exit along with heavy duty industrial type lock and key. Lock and key & hinges shall be of Southco/EMKA/Dirak/Jin Tay make.

5.6 The vendors or their authorized system integrators shall be fully responsible for supplying and laying of all the concealed cables for communication, electrical connection along with their connectors conforming to various standards of rolling stock. Cables shall be provided with ferrule marking for easy identification or trouble shooting.

6 Approval process

6.1 KAVACH OEM shall process the approval of any make/module of antenna after ensuring compliance to the requirements and carryout field trial with proper integration.

6.2 Pantographic interference tests can be done as a part of field trials.

6.3 Performance of Antenna in Kavach equipped sections will be based on Standard Operating Procedure issued for approval of KAVACH entities.

6.4 The performance shall be considered for a cumulative distance of 5000 km for loco run including with minimum one existing other KAVACH OEM for interoperability.

6.5 The performance of antenna shall be verified from the log of onboard KAVACH as per below formulae and shall not be less than 98.5%.

$$\text{Performance \%} = \frac{\text{Total number of Radio packet Received}}{\text{Total number of Radio packet expected}} \text{X100}$$

7 Documentation

7.1 The antenna supplier shall provide all necessary documentation, including:

7.1.1 Antenna data sheet with detailed specifications

7.1.2 Installation and operation manual

7.1.3 Radiation pattern plots

7.1.4 VSWR and return loss curves

7.1.5 Warranty information