FRS No. ELRS/FRS/Noise Reduction/xx (Rev.0)

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

Functional Requirement Specification (FRS) for noise reduction in 25 KV Conventional AC Electric locomotive cabs (WAP4 & WAG7)

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Approved by	Signature

RESEARCH DESIGNS AND STANDARDS ORGANISATION
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Functional Requirement Specification (FRS) for noise reduction in the cabs of 25 KV conventional Electric Locomotive (WAP4 & WAG7).

1.0 Introduction:

1.1 The noise environment in a locomotive cab has been the focus of recent attention of Indian Railway. The loco pilot is exposed to the existing occupational noise in the locomotive cab. The noise exposure rule is expressed in terms of the A-weighted noise level and is consistent with OSHA limits set for general workplace noise exposure. Long exposure to high level of noise not only affects the efficiency of the loco pilot but also accelerate the time to reach the fatigue level.

1.2 The noise environment of a locomotive cab is the result of the contributions from many sources. Sound is transmitted to an operator's ears via an air-borne path and vibration is transmitted through the structure. A sealed window and door will break the sound path from airborne noise generated outside the cab, resulting in significant noise reduction

1.3 METHOD OF NOISE CONTROL IN LOCO CAB

The loco noise basically consists of high frequency and low frequency noise. These can be overcome by a combination of passive and active noise controls in the cab.

Active method: In active method sound signal is sampled, a signal of opposite phase is created and added the new signal to the sound to result in a cancellation. Since the most cases are complex and the incoming sound cannot be sampled adequately hence the cancellation may not be perfect, but reduction still can be attained through application of the technology.

Passive method: Passive method is effective over a broad range of frequencies and can be quite effective, especially in the range of 200 Hz to 10,000 Hz where the human hearing system is most sensitive. In passive method following technology can be used:

a. All doors, Windows should be sealed with suitable technique to make the cab air tight.

b. Use of damping panel made of acoustically absorptive material on walls of cab.

1.4 As per para 2.10.3 of UIC code 651 the measurement of noise level has been carried out on electric locomotives cab in running with all doors and window closed condition and found that noise level in the cab of conventional electric locomotives is found 4 to 5 dB (A) above from specified limit (85 dB (A)) as per Code of Federal Regulation (CFR-49).

2.0 Environmental conditions:

The Noise absorption material will be fitted in Cab of locomotives where the environmental condition will be:

a) Maximum temperature } Stabled Locomotive under sun : 70º C
} On board Working loco under sun : 55º C

b) Minimum temperature : 0º C

Humidity: Up to 100% during rainy season.

Altitude: Up to 1750 m above mean sea level.

Rainfall: Very heavy in certain areas. The equipment shall be designed suitably.

Atmospheric condition during hot weather:

Extremely dusty and desert terrain in certain areas. The dust concentration in air may reach a high value of 1.6 mg/m^3.

Coastal area:

The equipment shall be designed to work in coastal area in humidity and salt laden and corrosive atmosphere. The maximum values of the condition will be as follows:

a) Maximum pH value : 8.5
b) Sulphate : 7 mg per liter.
c) Max. Concentration of chlorine : 6 mg per liter.
d) Maximum conductivity : 130 micro siemens/cm

3.0 Scope:

3.1 This FRS will cover only passive method for noise reduction in cab of conventional electric locomotives to around 85 dB (A) average, measured as per para 2.10.3 of UIC code 651.

3.2 Air tightening of the cab by use of suitable rubber seal for doors and windows and plugging of all holes.

3.3 Damping panels of suitable thickness to be provided by screwing/pasting on the walls of cab for acoustic treatment.

3.4 It also specifies the major requirements as given below:-

- The raw materials for sound absorption material and their properties.
- Dimension of frames
- Quality of workmanship.

4.0 <u>Material:</u>

The properties of sound absorption material are tabulated below:

S. No.	Properties	Values	Test Method
1.	Density	Less than or equal to 15 Kg/m^3	IS:7888 1976 CI-4 or ASTM D 3574
2.	Thermal Conductivity	Less than 0.047 W/m°K at 24°C	ASTM C-518
3.	Sound Absorption/ Noise reduction Coefficient	Greater than 0.35 for 25 mm thickness	AS 1045/ ISO 354/ EN ISO 11654
4.	Fire & Smoke Characteristics	R1, HL	EN 45545-2

4 (i)	Lateral Spread flame CFE (minimum)	Minimum 20 kW/m2	ISO-5658-2
4 (ii)	Heat Release Rate (Cone Calorimeter Method) MARHE (max)	Maximum 60 kW/m2	ISO: 5660-1: 50 kW/m2
4 (iii)	Smoke generation Ds(4) Max	150 dimensionless	EN ISO: 5659-2 : 50 kW/m2
4 (iv)	Smoke Generation VOF4(Max)	300 min	EN ISO: 5659-2 : 50 kW/m2
4 (v)	Gas analysis in smoke chamber using FTIR technique CITG (4) (Max)	0.75 dimension less	EN ISO: 5659-2 : 50 kW/m2
5.	Limiting Oxygen Index	greater than 40%	ASTM D2863 /ISO 4589-2
6.	Smoke Index test	a) Exit Sign should be clearly visible throughout Test	ASTM D 2843
		b) Maximum Smoke density in percent light Absorption less than 2.0% after 4 minutes of continues burn	
		c) Time Curve/ Smoke Density Ratio = Less than 0.7%	
7.	Toxicity	Total Toxicity Index for combined 14 gases = Less than 3.0	NCD 1409/NES713/ASTM E-662

5. Methodology of development:

(i) Design, development and manufacturing of rubber seals of openings in the cab along with damping panels will be as per this Functional Requirement Specification (FRS).

(ii) This damping panel is proposed to be fitted on the existing design of loco cabs and it is advised to study the existing availability of space.

(iii) Manufacturer will have to submit Bill of Material to RDSO.

(iii) Fitment of damping panel in a locomotive cab for fitment trial to validate the design.

6.0 Freedom from defect:

6.1 The finished product should be sound and free from defects.

7.0 QAP and test Schedules:

7.1 Before prototype manufacturing, QAP and test schedules shall be submitted by the successful bidder to RDSO for approval.

8.0 Dimensions:

8.1 The frames for fitment of noise insulation should be prepared with such dimensions that there should be no obstruction during closure of doors/openings after fitment of sound insulation frames.

8.2 The dimensions for sound insulation frames fitted on doors are to be kept slightly smaller in size of doors openings so that the doors can be closed properly after fitment of sound insulation frames. Rubber seal should be fixed properly on the edges of doors so that the doors become completely sealed (noise proof) to control the noise.

9.0 Documentation & Record:

9.1 Tenderers must consult the purchaser with respect to detailed drawings, location of cab equipment and for any other dimension and tolerance. The colour of the material will be decided by the mutual agreement between purchaser and the tenderers. It would be better on the part of the tenderers to visit and physically assess the existing cab interiors for better appreciation of the work content.

9.2 The tenderers must submit complete manufacturing process for approval by Railways.

10.0 DEVELOPMENT OF PROTOTYPE UNIT:

10.1 Tenderers will develop one no. prototype unit to the dimension for prototype testing and approval by RDSO. This prototype unit shall be made after receipt of order and after clearance by RDSO, bulk supply will commence after installation of the prototype unit in locomotive. During the prototype testing the adjustments/alterations will have to be done by the tenderers as advised by Railways in consultation with RDSO.

11.0 Workmanship and finish:

11.1 After carrying out the modification work on the doors/openings of the machine room should be properly sealed to avoid noise leakage from the edges of the doors/opening. The damping panels provided should have aesthetic look and feel.

12.0. Marking:

(i) Name of Manufacturer
(ii) Month & Year of Manufacture e.g. 07/2015
(iii) Manufacturing Job Serial Number
(iv) Designation of Material

13.0. **Approval of Design:**

After successful completion of field trial for 06 month, and material checked for any defect & cracks. Further the decision regarding adoption of design on regular basis shall be taken on the basis of test results.

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