

(For official use only)
(केवल कार्यालय प्रयोग हेतु)



भारत सरकार
(रेल मंत्रालय)
GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

Technical specification for Mechanically Bonded Radiator for ALCO
type (2300, 2600, 3100, 3300 & 3600 HP) DE-locomotives and
4000/4500 EMD Locomotives

2300, 2600, 3100, 3300 एंवम् 3600 होर्सपावर के डीजल-इलेक्ट्रिक लोको
तथा 4000/ 4500 होर्सपावर के ई.एम.डी. लोको के मेकैनिकल बाण्डेड
रेडियेटर की तकनीकी विशिष्टी

Technical Specification No.-MP.0.0500.01 (Rev. 03),
MAY – 2009

तकनीकी विशिष्टी संख्या-चा०श० 0.0500.01 (Rev. 03),
मई – 2009

अनुसंधान अभिकल्प एवं मानक संगठन

मानक नगर, लखनऊ – २२६०११

RESEARCH DESIGNS AND STANDARDS ORGANISATION

MANAK NAGAR, LUCKNOW – 226011.

RDSO Technical Specification No - MP.0.0500.01 (Rev.-03), May 2009

1. **SCOPE:**
 - 1.1 This specification is for Mechanically Bonded Radiators fitted on ALCO TYPE WDM2/WDG3A/ WDM3A/ WDM3B/ WDM3D/ WDG3D/ WDP1, WDP3A & EMD WDP4 and WDG4 Locomotives.
2. **GENERAL:**
 - 2.1 The radiator is finned tube type of heat exchanger with water flowing inside and air flowing outside the tubes. Tubes are mechanically bonded with the header. The tenderer shall be an OEM for Mechanically Bonded Radiators for Diesel Electric Locomotive.
3. **DESCRIPTION:**
 - 3.1 There are two radiator assemblies on a locomotive. One is installed on the right and the other on the left side of the locomotive.
 - 3.2 Each radiator consists of two cores made of brass tubes and copper fins. Tubes are mechanically bonded with the header.
4. **ENVIRONMENT CONDITION:** See Annexure –I as enclosed.
5. **VIBRATION:**
 - 5.1 The radiator shall be designed to withstand the 3 g longitudinal, 1.5g laterals and 2g vertical acceleration shocks encountering during the locomotive operation.
6. **COOLANT TEMPERATURES AND PRESSURE:**
 - a) Temp: The coolant water temp. may be 5°C to 130°C under maximum 47°C ambient temp.
 - b) Pressure : 50 psi

Coolant: Coolant for EMD locomotives and Alco locomotives approved by RDSO is tabulated below:

Type of locomotive	Corrosion Inhibitor	P _H	Dosage	Concentration
EMD locomotives	Nalco 2100	9-10.5	26.4 ltrs	1000-1200 ppm as NaNo ₂
	ISC 7537	10.5-12.2	34 ltrs.	3400-4100 ppm as NaNo ₂
ALCo locomotives	Sodium Benzoate Nitrite (X- GT)	6 – 9	120 litres (10%)	(i) Nitrite: 2000 ppm - 2150 ppm as NaNo ₂ . (ii) Benzoate: 24000 – 24500 ppm as Sodium Benzoate.
	Carboxylate	7.5-9	36 litres (3%)	0.10 - 0.14 % or 1000 – 1400 ppm as carboxylate.

The concentration of nitrite / benzoate or carboxylate shall be maintained as prescribed above/ by the OEM in service.

7. **RADIATOR CORE CONSTRUCTION:**
 - 7.1 **Tube:** It should be high frequency welded red brass oval cross-section (18.5 X 3.5 mm nominal) and 0.4mm Thick.
 - 7.2 There shall be no of row of tubes in the core as specified to the type of radiator. The welded tube shall pre-soldered, and solder coating of 0.018 to 0.025 mm and confirming to ASTM UNS No. C23000.

- 7.3 **Fin:** Copper fin should be non-louvered confirming to ASTM: B 152 /M-00 and 0.08 thickness with +/- 0.005 mm tolerance.
- 7.4 **Header Plate:** Header Plate should be made out of high graded boiler quality steel, duly grounded and reamed and tube slot drilled on CNC machines, to achieve the required accuracy.
- 7.5 **Gasket:** Gasket should be made out of 2 mm BNA 2100, Asbestos free, compressed jointing sheeting material should be able to stay in radiator specified continuous operating conditions.
- 7.6 **Tube blockage:** Tubes located on edges of the core which have less than 50% contact with fin periphery, should be blocked off, so as to give support rigidity to the core structure as they will have no role to play in heat transfer.
 - 7.6.1 Additionally during production stage, maximum of 2 tubes per panel will be allowed.
 - 7.6.2 During warranty service period, maximum of 4 tubes per core will be allowed for blocking.
- 7.7 There shall be 9-10 fins per inch.
- 7.8 It shall be ensured that the tubes of the two cores are in line.

8. **Radiator Heat Dissipation Capacity :**

- 8.1 For ALCo locomotives radiator heat dissipation capacity and other technical parameters please see concerned DLW radiator drawings no. TPL -884, TPL-0891 /TPL-8601, applicable to class of locomotive. The air pressure drop through the radiators shall not exceed 2” water column at maximum airflow rate specified as above and the water pressure drop across the radiator should not exceed 10 psi.
- 8.2 For EMD locomotives see EMD radiator drg. No. 10631855/10631856 to DLW part No 17450408/17450410. There should not be air pressure drop across the radiator 1.40” water column at maximum airflow rate specified in the drawing. Under nominal operating condition of the engine at full load and speed, the maximum water pressure drop across the radiator shall be less than 13psi at maximum coolant flow rate i.e. 1125 GPM.
- 8.4 Any new manufacturer shall conduct on prototype sample core, Heat dissipation tests on a wind tunnel approved by RDSO and Technology and like wise for vibration test as per a test standard to be approved by RDSO. Performance shall meet stipulation, only after successful performance, further manufacturing shall be acceptable.

9. **GENERAL OPERATIONAL CONDITIONS:**

- 9.1 The radiators will be operational under cooling water temperature range 5°C to 130°C under max. ambient air temperature conditions. 55° C
- 9.2 The nominal working temperature of the radiators may be 112.78 5°C

10. **PERFORMANCE TEST:**

- 10.1 **Leakage test:** Each radiator shall be tested with air pressure of 75psi applied for atleast 10 minutes and there shall be no leakage of air during static testing.
- 10.2 **Heat dissipation test:** Heat dissipation conformance test shall be carried out of one prototype sample of the radiator core at firm’s premises on any other government-concerned institute. Performance shall meet stipulated requirements then only further manufacturing shall be acceptable.

11. **VENDOR QUALITY CONTROL:**

When production is established, it is expected that the supplier will check the following on a regular basis:

- Tube manufacturing quality.
- Tube to fin bond quality- this is one of the most critical areas for consistent performance of a radiator. The methodology in place for sample evaluation of tube to fin bond quality should be a very competent one, reflected clearly in the QAP approved by RDSO.
- Proper flux neutralization.
- Squareness of bake and assembly fixtures.
- Evidence of tool malfunction.

12. **PAINTING:**

12.1 Inside of tank/ headers of to be painted with rust preventive using zinc chromate Yellow /Orange primer.

12.2 Completed radiators to be painted suede gray using heat resisting synthetic enamel light gray except on the heat dissipation area i.e. core.

13. **FIELD TRALS:**

The prototype radiator(s) shall be subjected to field trials for one year. During this period, the performance of the equipment shall be closely monitored and evaluated by RDSO for its reliability, adequacy for locomotive operation and maintenance, and maintainability of the equipment. Any modifications if required necessary shall be carried out by the suppliers at his own cost. The bulk supplies permitted only after successful field trial.

14. **GUIDING SPECIFICATION:** Engineering Design and performance specification No. EDPS-082 is the guiding specification for manufacturing of Mechanically Bonded Radiators.

Annexure- I

ENVIRONMENTAL CONDITION:

1. The locomotive shall be in continuous operation under the following atmospheric and climatic conditions: -
 - i) Ambient temperature 47° C (occasional peak value of 52 ° C)
 - ii) Altitude may vary from 600 m to 3352.8 meters of sea level.
 - iii) Humidity-Upto 100%
 - iv) Maximum temperature 55° C

2. The radiators shall work satisfactorily in a dusty environment and can be exposed to the roadside dust, dirt or fibre of various organic materials that can be in the environment of the locomotive operation.
Dust may include the following materials:
 - a. Calcium Carbonate
 - b. Locomotive brake shoe dust.
 - c. Silica sand
 - d. Aluminum dust
 - e. Oil
 - f. Carbon black
 - g. Fibre or various organic materials.