(केवल कार्यालय प्रयोग हेतू)

भारत सरकार
(रेल मंत्रालय)

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

Technical specification for after cooler used on 16 Cylinder 4000/4500 Horse Power EMD Locomotives

4000/ 4500 *हॉर्सपावर के ई॰एम॰डी॰ लोको के आफ्टर कूलर की तकनीकी विशिष्टी*

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तकनीकी विशिष्टी संख्या-चा०श० 0.0500.03 (Rev. 00),
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1.0 Scope

This specification is issued to define the requirements, which must be satisfied to ensure adequate performance and reliable service of engine after coolers (charge air coolers) for EMD Engines.

2.0 Function of After Coolers (Charge Air Coolers)

The after cooler is finned tube type of heat exchanger with water flowing inside and air flowing outside the tubes. Tubes are mechanically bonded with the header plates. The after cooler is an air-to-liquid heat exchanger used to cool the charge air discharged from the engine turbocharger compressor, prior to admission to the engine air gallery/box. Cooling the compressed charge increases its density, and is beneficial to engine power production, fuel economy and reduction of certain emission species. The heat from the cooled charge is transferred to the after cooler liquid coolant, and is eventually rejected from the locomotive via the radiator assembly.

Governing Specification: EDPS –523 with the provision that stipulation in this specification shall override those in the said EDPS.

3.0 Reliability Requirements

The reliability goal established for the engine after coolers is a failure rate not exceeding 0.1% during a service period of 24 months.

4.0 Environment Condition:

4.1 Coolant Temperature and Pressure

- The after cooler shall be designed to tolerate continuous operation at coolant conditions of 70 PSIG and 110^0C.
- The after cooler shall withstand coolant temperature pressure cycles throughout its life. These cycles will have a maximum frequency of 15 cycles per hour at the 20-70 PSIG range and a maximum rate of water temperature change of 20^0C per minute.
- The after cooler will be exposed to occasional coolant temperature of 135^0C for 20 minutes at a nominal frequency of 10 times per year.

4.2 Air Temperature and Pressure

The after cooler shall be designed to tolerate continuous operation at air-side conditions of 35 PSIG and 220 °C.

4.3 Chemical Environment

The after cooler shall be compatible with the cooling water including presence of corrosion inhibitor and cleaning agents described below without any resultant corrosion or erosion leading to failure.

4.4 Cooling water

The condition of the cooling water for EMD locomotives may be as follows:

Description	EMD
Total Solids, Max.	340 PPM
Total Hardness Salts, Max.	170 PPM
Chlorides, Max.	40 PPM
Sulfates, Max.	100 PPM
Ph	>7

4.5 Cooling Water Corrosion Inhibitors

The basic borate-nitrate types of inhibitors most commonly used in EMD engine cooling systems.

*Borate-Nitrate Type Inhibitors for EMD locomotives only:
Borate-nitrate type inhibitors are furnished in the forms of powder, pellets, or liquid. The pH of these inhibitors, when mixed with water (2.5 - 3%), ranges from 9.0 to 10.5.

**If any change in cooling water corrosion inhibitor the after cooler needs to be tested again for its compatibility.*

4.6 **Cleaning**

The exterior/ interior cleaning of the after cooler may be done by a non-caustic solution. The cleaning solutions details may seen as per RDSO's latest MPMI No. 15 (Rev.-04), August 2009.

4.7 **Thermal Performance**

The after cooler must demonstrate the following minimum thermal and flow performance when installed in EMD engine mounting ductwork and operated at the following operating conditions with coolant:

Description	EMD
After cooler Part No.	40046710
Operating conditions:	
Air: Pressure (in Hg A)	90
Air: Mass Flow (lb./sec)	7.5
Air: Inlet Temperature (^{0}C)	177
Water : Flow Rate (GPM)	85
Water: Inlet Temperature (^{0}C)	79.5
Demonstrate Performance: (in counter flow configuration)	
Thermal Effectiveness (% min)	84
Heat Transfer (BTU/min.)	16,000
Air Pressure Drop (in H20 max.)	16
Water Pressure Drop (PSID max.)	4

5.0 **Construction**

5.1 **Tubes**

The tubes shall be of round cross section having a minimum internal diameter of ¼" and shall be of a material compound of 85% copper and 15% zinc. The common name for this material is red brass. Minimum tube wall thickness shall be 0.020 inches. The tubes shall be bonded to the core end header plates by a mechanical expansion process.

5.2 **Fins**

The fins shall be of copper construction and shall have a fin thickness of 0.010". Fin spacing shall not be closer than a pitch of 16 fins/inch. The fins shall be attached to the tubes by a mechanical bond achieved by internal expansion of the tube into contact with a collar formed at each tube hole on the fin. No solder shall be used to bond the fins to the tubes.

5.3 **Water Tanks**

Water tanks shall be of cast iron construction, and shall be of material with physical properties exceeding or equal to EMS Class 25 gray cast iron.

5.4 **Coolant Circuit configuration**

The water tanks shall contain interior partitions positioned so as to divide the tube bundle into groups of tubes offering parallel coolant paths perpendicular to the direction of airflow. Four such groups will be formed by the tank partitions, and the coolant shall be directed through these groups in sequence, forming a "four-pass" coolant path through the after cooler core.

6.0 **Vendor Quality Control**

Every aftercooler assembly shall be air pressure tested by the manufacturer to an internal pressure of 90 PSI and shall be shown to be free of leaks by inspection in a water immersion bath.

It is expected the manufacturer will check the following on a regular basis:

Tube manufacturing quality
Tube-to-fin bond quality
Tube-to-header bond quality
Evidence of tool malfunction

7.0 **Performance Test**

7.1 **Core Leakage test**

Each after cooler after manufacturing must pass through a leakage test. The manufacturer shall have the facility for testing the after cooler. The after cooler shall be tested with air pressure of 90 psi applied for at least 30 minutes and there shall be no leakage of air during static testing.

7.2 **Heat dissipation test**

Heat dissipation conformance test and thermal effectiveness shall be carried out of one prototype sample of the after cooler core at firm's premises or any other government-concerned institute in presence of RDSO representative. Performance shall meet the stipulated requirements, then only further manufacturing shall be acceptable.

7.3 **Vibration**

The firm shall have a facility of rig for vibration testing of the after cooler assembly. The prototype after cooler shall be subjected to vibration test as stipulated in the IEC 61373 category 1 Class A Body mounted. The after cooler should not fail during the testing.

It may be noted that in general the locomotive bears 3 g longitudinal, 1.5g laterals and 2g vertical acceleration shocks encountering during the operation.

7.4 **Erosion test**

This test for prototype, which can be waived by RDSO subject to submission of necessary technical document, shall be carried to establish the related provision in Para 1.5 of EDPS 523.

7.5 **Field Trials**

The prototype(s) after cooler shall be subjected to field trials for 12 months. During this period, the performance of the equipment shall be closely monitored and evaluated 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. Following successful prototype evalution, balance supplies shall undergo extensive field trial for minimum of six months. The bulk supplies shall be permitted only after successful field trial.

7.6 **Marking**

The after coolers shall have a nameplate affixed to the outer water tank in a position to be visible when the cooler is installed on an engine. The nameplate shall contain the manufacturer's name, and an identifying serial number. Additional preferred information includes EMD part number, corresponding manufacturer's part number, and coded date of manufacture. The markings of after cooler models introduced after the first issue date of this document shall contain all the above information.

Note:
Supplier: The following information is the property of RDSO and must be treated as privileged communication between supplier and customer.