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No. EL/3.2.176/2 **Date:** 15.06.2018

All Chief Electrical Engineers,

SPECIAL MAINTENANCE INSTRUCTION NO.RDSO/2016/EL/SMI/0287 (REV. '1'), Dated 15.06.2018

1.0 Title:

Special Maintenance Instruction for maintenance of Radiators of Oil Cooling Unit of 3- Phase Electric Locomotives.

2.0 Brief History:

Though the schedule of works for maintenance of three phase locos have been defined vide RDSO letter no. EL/3.1.35/16, dated 07.02.12.The details of maintenance to be carried out particularly for Radiators of oil cooling unit have not been specified in detail. Zonal Railways are following different practices in absence of clear guidelines. In summer season, the cases of high equipment temperature increases leading to failure of locomotives on line. It is of utmost importance to clean the Radiator of Oil cooling unit periodically for the following advantages.

(i) To maintain the designed heat transfer and cooling efficiency.

(ii) To ensure longer life of Oil Cooling Unit as the dirt/dust contaminating the surface is removed.

(iii) Lower oil temperature will ensure reliable functioning and increased life of transformer/converters & its components.

Therefore, detailed procedures for cleaning of Radiators of Oil Cooling Unit of 3-phase locos are chalked out issued in this Special Maintenance Instruction.

3.0 Object:

To provide Maintenance Instruction for cleaning of Radiators of Oil Cooling Blower (OCB) for 3- phase Electric Locomotives.

4.0 Assembly of Radiator of Oil Cooling Unit:

Construction of the cooler is made of Plate & Fins. It is a cross flow type Radiator horizontally mounted. On the air side, there are wavy fins through which the air coming from blower passes.

There are alternate layers of wavy fins through which air passes. In perpendicular direction of adjacent layer of wavy fins oil layer with offset fins exist. Thus the core consists of several alternate layers of oil & air.

The hot oil transfers the heat to offset fins on oil side. Thereafter heat is transferred to partition sheet which is brazed to offset fins. Thus heat gets transferred to wavy fins from where the cooled air picks up heat while passing through it.

This radiator cooler falls under category of "compact heat exchangers" and has heat transfer area per unit volume of 1043 m^2/m^3. Aluminum(Material specification AA3003) is a very versatile material with high thermal conductivity and from which complicated shaped fins can be manufactured and brazed to achieve such a high heat transfer area per unit volume.

Each passage is closed on either side by a closure bar as shown in the figure 2. When the entire assembly is brazed in vacuum furnace, the net result is a robust hollow construction of such a big size with extremely good mechanical resistance to vibration, load bearing capacity plus capacity to withstand mechanical and thermal stresses despite excellent heat transfer ability.

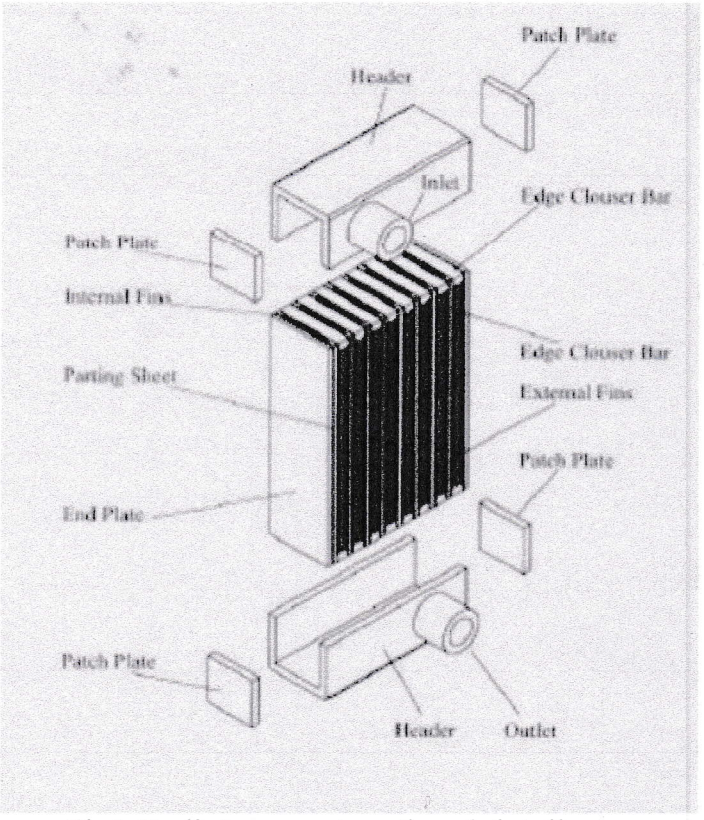


Fig1.Radiator constructional details

5.0 Cleaning of Radiator Assembly of Oil Cooling Unit:

(Note: The cleaning of radiator shall be carried out only after cleaning of filters of Oil Cooling Blower.)

5.1 Cleaning Procedure during IA/IB/IC/TOH/MOH/IOH Schedules

(i) Remove the cover of the service port of radiator.

(ii) Impurities adhering to the top of the cooler (flowerbuds, leaves etc.) should be removed with vacuum cleaner/compressed air. Cleaning of cooling air ducts (space in-between the fins of radiator) with compressed air (5 to 6 kg/cm^2)

should be done from the top of radiator downward. Whereas with industrial vacuum cleaner, cleaning may be done from top/bottom both side.

(iii) The cooler should be sprayed with a recommended (e.g. Auco-Alu B made by Messrs. Auco, Gerwigstrasse 24-26, D-78234 Engen) **OR** NULON R40 **OR** Afso clean AD-20 **OR** equivalent cold cleaning agent and left for 20 minutes.
For spraying the cleaning agent, a chemical spray tank (Approx. 12 litre) may be used as shown in Fig.2

Fig. 2: Chemical Spray Tank

(iv) Rinse through the cooling air ducts (Space in-between the fins of radiator) as specified below with the aid of a high-pressure hot water jet cleaner (water temp. 65°C-70°C).

- Use a pencil shaped nozzle water jet. Alternatively, fan shaped water jet with adequate support plates to reduce the pressure to 3 to 4 kg/cm^2 may also be used.
- The operating pressure of the high-pressure cleaner should be approx. 3 to 4 kg/cm^2.
- Slowly & systematically clean with water jet (temp. 65°C -70°C) applied perpendicularly to the cooling fins (from top of the radiator) till dust/dirt/debris from the fins are removed.
- Then blow compressed air (5 to 6 kg/cm^2) vertically through cooling air ducts for drying the radiators.

(v) Refix the cover on the service port.

5.2 Cleaning Procedure during POH

(i) Remove the radiator from locomotive.

(ii) Using Compressed air at pressure of 5 to 6 kg/cm^2, clean each external air fin passage to remove all loose dust and dirt particles. This will help in cleaning the air passages and will increase the cooling performance of the radiator.

(iii) Prepare a solution in cleaning tank in concentration (about 5%) with cleaning agent as specified under Para 5.1(iii).Capacity of tank should be adequate so that whole radiator can be immersed. For example, cleaning tank is shown in Fig. 3.

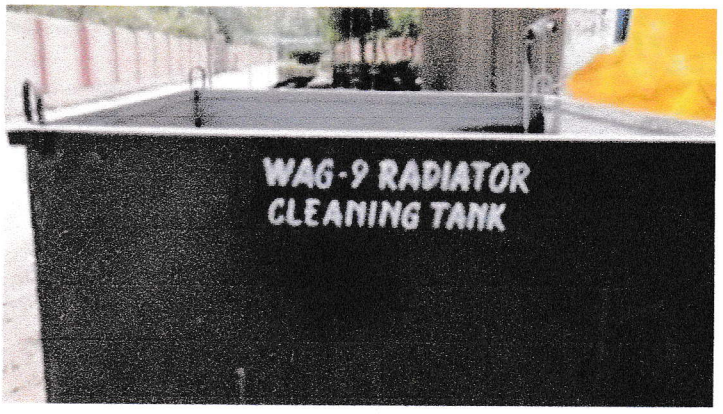


Fig. 3: Radiator Cleaning Tank

(iv) Dip whole oil cooler radiator in tank & keep inside the tank for at least one hour duration.

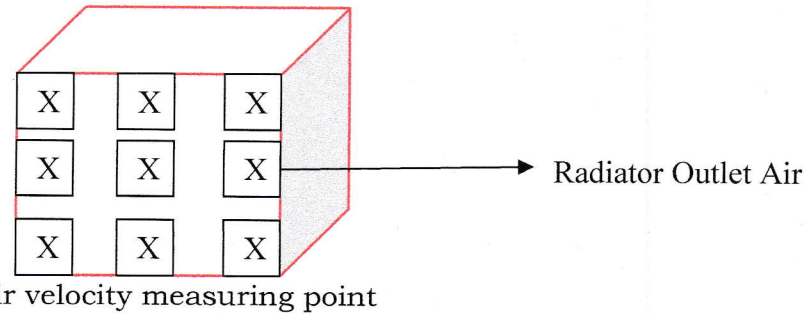
(v) Take out the radiator from Radiator cleaning tank. Clean the surface of the radiator fins with a water jet to remove all the collected dust and dirt. Ensure the water jet is at a pressure of 3 to 4 kg/cm^2 to create the cleaning effect. Clean with water jet for 20 to 30 min depending on the condition of the radiator & till all the chemical is washed out.

(vi) After cleaning the radiator with water jet, drain the water from each passage of the radiator by using an air blower or fan. Ensure the blower covers the entire surface area and capable to drain out all the residues of water. If blower / fan is not available then use air pressure of about 5 to 6 kg/cm^2 for this purpose.

(vii)The radiator shall be tested for leakage in accordance to Para 7.4.

6.0 Air Flow Measurement after cleaning

After cleaning of the radiator, air velocity at the outlet of radiator shall be measured at 9(Nine) points as shown in Fig. 4 and air velocity at each point shall not be less than 8 m/s. If the measured air velocity is less than 8m/s, further cleaning of OCB filter/radiator may be necessary.



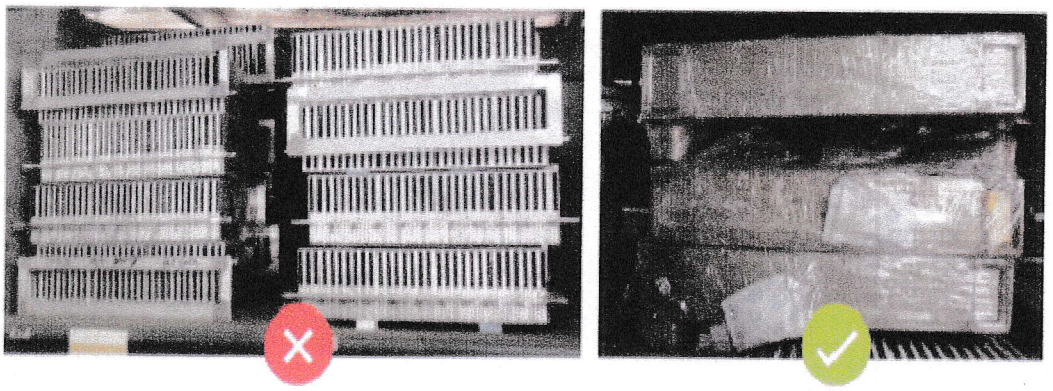
X: Air velocity measuring point

Fig. 4: Measuring points for Air Velocity at the outlet of radiator

7.0 Storage and Up-keeping of Radiators

7.1 Storage of Radiator on shop floor

The Radiators shall be stored in dry and clean place. The silica gel packets/bags shall be put in different locations and Radiators shall be wrapped (air tight) with moisture free plastic sheet. Radiators shall not be exposed to rain, water or humidity.



Incorrect Method Correct storage of Radiators

Fig.5: Storage of Radiator

If there are more numbers of Radiators, they should be kept in room with temperature maintained above 45°C so that no water condenses from atmosphere on the surface of Radiator.

7.2 Handling/Lifting/Moving of Radiator

The Radiator assembly shall be lifted using the lifting brackets provided for the purpose. Alternatively, suitable enclosure should be made by shed/shops for proper handling of Radiators as shown in Fig. 6 to avoid damage of Radiator fins during handling.

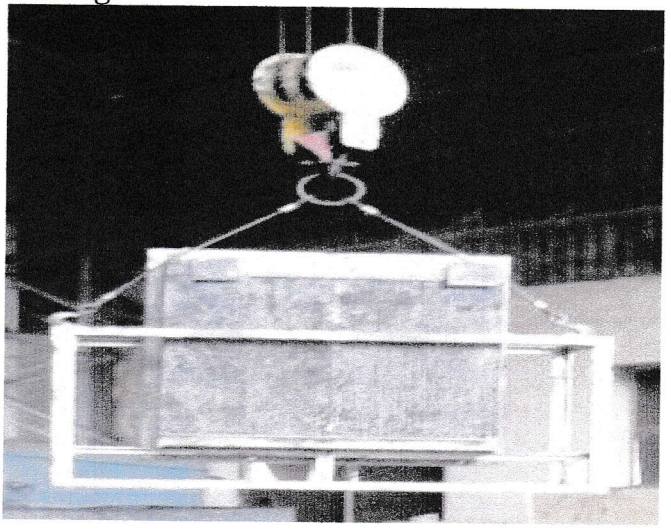
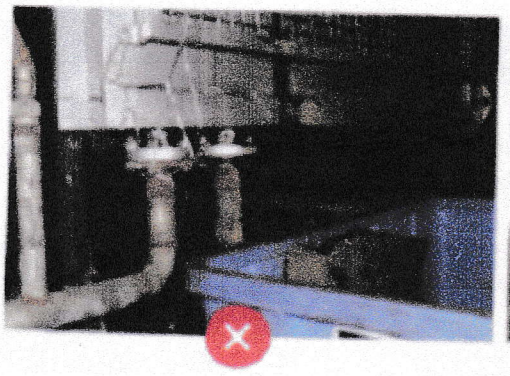


Fig. 6: Lifting of Radiator

7.3 Pipe Connection of Radiator

It shall be ensured that the connection to Radiator is through flexible pipe as shown in Fig. 8 to avoid stress concentration on Radiator frame.



Wrong way of rigid pipe connection
Fig.7

Proper piping with flexible hoses
Fig.8

7.4 Leakage Test of Radiator

Procedure recommended for the leakage testing of radiator

"The radiator shall be pressurized using the compressed air and put in a water tank to check leakage , formation of bubble in water indicate leakage in radiator".

8.0 Application to the Class of Locomotives:

Radiators of Oil Cooling Unit fitted in 3-phase locomotives viz. WAP5, WAP7 and WAG9/WAG9H.

9.0 Agency of Implementation:

All Electric Loco Sheds holding 3-phase Electric Locomotives and POH shops carrying out POH of 3-phase Electric Locomotives.

10.0 Periodicity of Implementation:

During schedule inspection/overhaul as mentioned under Para 5.1 & 5.2 above.

(A.K.Shukla)
for Director General Std./Elect.

Encl: Nil

Copy to: As per standard Mailing List No.EL-M-4.2.3-19(latest revision)

15/6/18
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Encl: Nil