M. I. 927
*Rev. C

ELECTRO-MOTIVE DIVISION • GENERAL MOTORS CORPORATION

SERVICE DEPARTMENT

MAINTENANCE INSTRUCTION

LUBE OIL COOLERS

INTRODUCTION

Hot engine lubricating oil is cooled by passing water from the engine cooling system through a system of tubes (core) within the oil cooler. The tubes are surrounded by a tank through which the hot engine oil flows. Heat from the engine oil is transferred to the cooler water by using the tube material as the. conductor.

There are basically two types of oil coolers, the fin-tube core type, and the tube bundle type. Although construction is different, the method of cooling the lube oil remains the same.

It should be noted that major servicing of the oil cooler should not be undertaken until need for such maintenance is definitely established by unsatisfactory operation.

FIN-TUBE CORE TYPE COOLER

DESCRIPTION, Fig. 1

Cooling water enters the cooler through each side of the upper header, Fig. 2, and is discharged through outlets in the lower header. The engine lube oil enters the cooler through one side of the lower header, and is discharged through an outlet on the opposite side of the lower header.
Fin-tube core type oil coolers are built with either a solder or mechanical type tube-to-header bond.

CLEANING

When it becomes necessary to clean the oil cooler, use the following procedure

1. Perform the following steps to remove tank from oil cooler core.

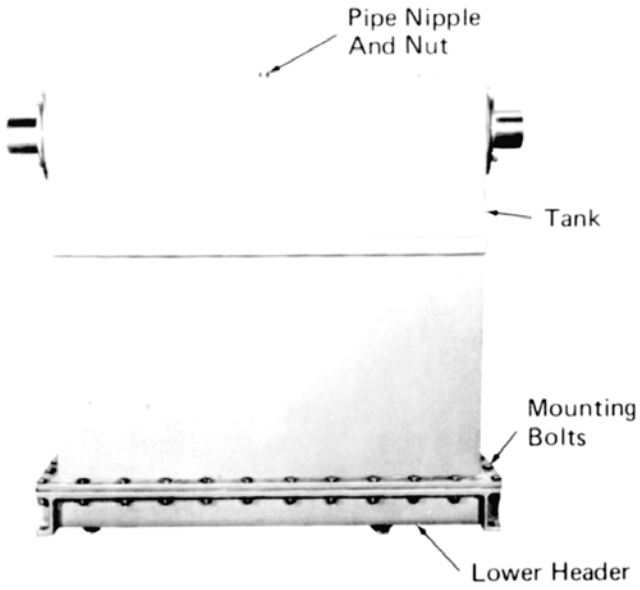


Fig. 1 – Fin-Tube Core Type Oil Cooler

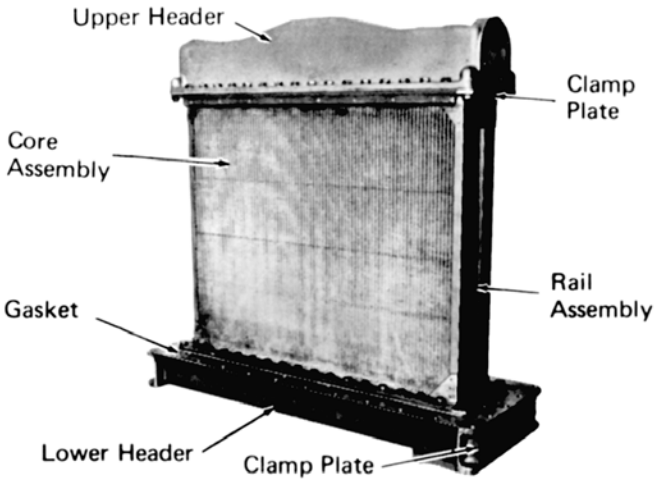


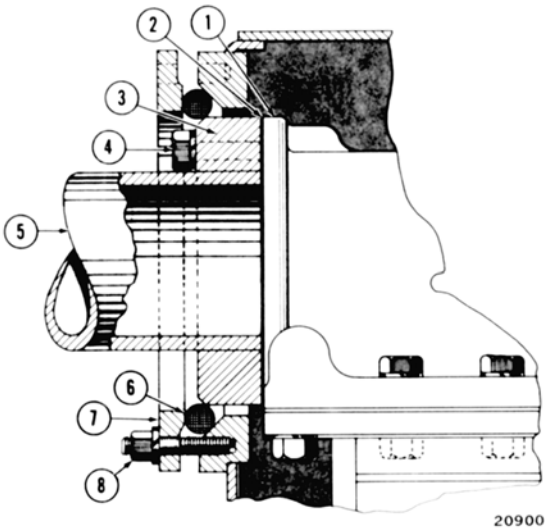
Fig. 2 - Cooler Core And Header Assembly

*NOTE: Information contained herein is applicable to equipment being produced as of the date of publication.

a. Remove water vent pipe nipple nut from top of oil cooler, Fig. 1.

b. Loosen and remove tank to lower header mounting bolts, nuts, and washers.

c. Remove clamping plate nuts and washers, Fig. 3. Remove clamping plate.



1. Oil Cooler Header
2. Gasket
3. Water Inlet Flange
4. Bolt
5. Water Inlet Fitting
6. "O" Ring Seal
7. Clamping Plate
8. Clamping Plate Nut

Fig. 3 - Oil Cooler Disassembly

d. Loosen and remove bolts and washers that secure the water inlet fitting to the oil cooler header. Remove water inlet fitting.

e. Remove tank from oil cooler.

NOTE: When reassembling renew "O" ring seal and all gaskets. Apply a coat of gasket sealing compound to the gasket sealing surfaces. Apply engine oil to "O" ring seal to prevent binding, thus easing assembly.

2. Remove upper and lower header assemblies from core.

3. If necessary, straighten header flanges, Fig. 4. Comb bent fins to ensure that flow is not reduced.

4. Clean gasket surfaces.

5. Fill a soak tank with an undiluted non toxic organic cleaner. See Service Data. Level should be sufficient to allow for complete submersion of the oil cooler.

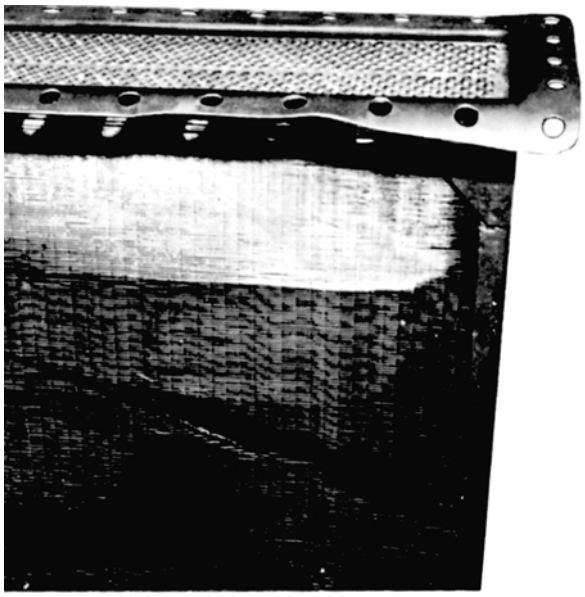


Fig. 4 - Damaged Header Flanges, Fins, And Rail Assembly

CAUTION: Use of caustic cleaners is not recommended. The fin-to-tube bonding solder will deteriorate with the use of caustic cleaners.

6. Soak core for three hours in a still tank, with tubes lying horizontally. If cleaning solution is agitated, cut soaking time in half.

NOTE: Cleaning is more effective in an agitated tank.

7. Rinse core using a steam-water mixture.

NOTE: Rinse core as soon as possible to prevent residue from hardening.

CORE TESTING

Oil cooler core failures, other than damage, can be categorized under three headings: fin-to-tube bond failures, tube failures, or tube-to-header bond failures. Repair limits for fin-to-tube bond and tube failures can be found under Service Data. If the failure is within the repair limits the core can be repaired, if not, repair is not feasible and the core should be scrapped.

FIN-TO-TUBE BOND CHECK

Loose fins will hinder heat transfer. Use the following steps to check fin-to-tube bond. The oil cooler should be scrapped if loose fin area exceeds limits under Service Data.

1. Using a suitable tool or probe, check the fin-to-tube bond by gently pressing against the fin collar, Fig. 5. If the fin moves and the tube is stationary, the fin is loose.

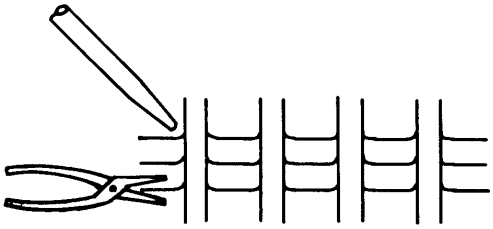


Fig. 5 - Checking Fin-To-Tube Bond

2. Repeat Step 1 for each fin and measure loose fin area.

NOTE: Repair of loose fin-to-tube bond is not possible.

LEAK TEST

Tube leaks or tube-to-header bond leaks can be accurately located using the following procedure:

1. Install a sealing plate or a tank on each header of the core.

2. Apply 345 kPa (50 psi) air pressure on the tube side with the core immersed in clean water at room temperature.

CAUTION: Avoid exceeding 345 kPa (50 psi) air pressure; higher pressures will damage core tubes.

3. Mark tubes and areas of the tube-to-header bonds that are emitting bubbles.

4. Qualify the oil cooler by using the repair limit information given under Service Data. The oil cooler should be scrapped if tube failure exceeds repair limits.

5. For repair procedures, refer to either Tube Repair or Tube-To-Header Bond Repair sections, depending on nature of leak.

TUBE REPAIR

Tube leaks are repaired by sealing each end of the defective tube with solder, thus eliminating it from service. Experience has shown that up to 2% of the total tubes can be sealed by this method without adversely affecting efficiency. Use the information given under Service Data as a guideline in determining whether the core is scrapped or repaired. The recommended heating tip for melting out old solder and applying new solder is listed under Service Data. Use this procedure for both solder and mechanical tube-o-header type bonds. Solder tubes closed using the following procedure:

1. Thoroughly dry inside of tubes to be repaired.

2. Pinch one end of each defective tube closed.

NOTE: Use brass plugs to close tubes on mechanical tube-to-header type bonded cores.

3. Clean tube with zinc chloride flux. See Service Data. When applying flux, play a medium flame on the fluxed surfaces. The heating will boil the flux thus improving its cleaning ability. Use a soft wire brush to scrub and clean the areas which are being prepared for soldering.

4. When the tube is thoroughly cleaned, solder the pinched (plugged) end of the tube with a 50% tin, 50% lead, soft solder and a 243° C (470° F) flame. See Service Data.

5. Flush each soldered tube to avoid trapping unused flux inside.

6. Thoroughly dry inside of tube.

7. Turn core and solder opposite end of tube as described above.

8. Clean and flush both headers with water.

9. Repeat Leak Test to assure that all leaks have been eliminated.

TUBE-TO-HEADER BOND REPAIR

The majority of tube-to-header bond leaks occur in the outer two tube rows along the long side of the header. Although less common, leaks at the middle tube rows are also possible.

NOTE: These procedures are intended to be used only on solder bond type oil cooler cores. Cores which have a mechanical tube-to-header bond are not repairable using this method.

Repair procedures are similar for both outer and middle tube rows. The primary difference being the area from which the old solder is melted out. Repair of outer tube rows requires solder removal from only the two outer tube rows on each side of the core, a total of four tube rows. Middle tube row failures require that the entire area of solder in the header be melted out. The recommended heating tip for melting out old solder and applying new solder is listed under Service Data.

While repairing tube-to-header bond failures, it is critical that the header be kept in a position which is square with the tubes. A cocked header will cause a load on the tube-to-header bond, causing premature failure.

When repairing an outer tube row failure, the header is held square by the solder which has not been removed from the middle tube rows. To repair a middle tube row failure a clamping fixture, Fig. 6, should be constructed to hold the header square while repairs are made.

OUTER TUBE ROW REPAIR

A leak detected within the first two outer tube rows may be repaired using the following procedure:

1. With the core resting on both header flanges and the tubes in the horizontal position:

   a. Melt the solder from the first two outer tube rows nearest the surface the core is resting on. The cross

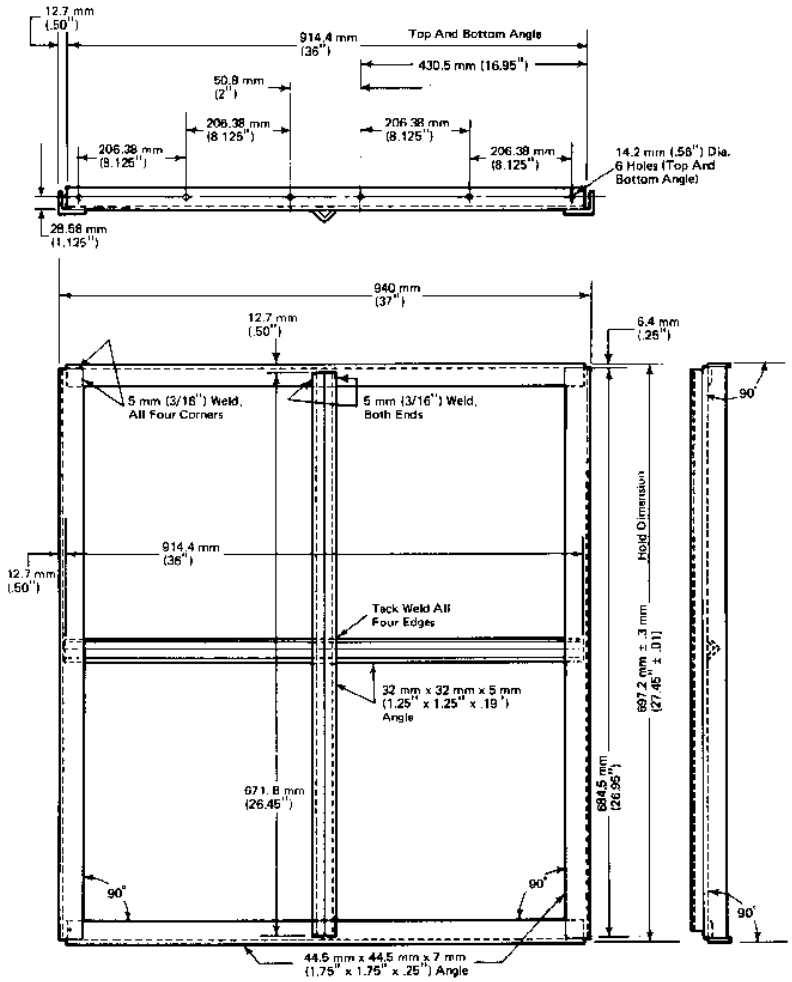


Fig. 6 - Header Clamping Fixture

hatching in Fig. 7 indicates the area from which solder is to be removed. Melt solder out by playing a 327° C (620° F) flame over the area. The melted solder will run out of the dish over the header flange and out.

b. Turn core over so that the two unmelted rows which were at the top are now nearest the surface that the core is resting on. Repeat Step a.

c. Clean all surfaces that are to be resoldered with zinc chloride flux. See Service Data: Use a syringe to ensure that all cracks, tubes, and header surfaces have been cleaned with flux.

NOTE: When applying flux, play a medium flame on the fluxed surfaces. The heating will boil the flux thus improving its cleaning ability. Use a soft wire brush to scrub and clean the areas which are being prepared for resoldering.

d. Repeat Step c using clean flux. This will remove any remaining dirty flux.

2. With the core resting on one header and the tubes in the vertical position:

a. Run a length of No. 7, 3.2 mm (1/8") diameter silver wire solder along each tube row. See Service Data. Use a 327° C (620F) flame to sweat this solder into the tube-to-header joints.

b. When solder stops running, use a small amount of flux and a wire brush to reclean the area. Reapply solder for the gap between the header and the first tube row.

c. Using 9.5 mm (3/8") TRIBAR puddle solder, see Service Data, and a 260° C (500° F) flame, build up a puddle with a minimum depth of 4 mm (5/32"). Blend it with increasing depth up to 6.4 mm (1/4") at the edge of the header dish.

d. Solder space between rows using a 3.2 mm (1/8") wire puddle solder, see Service Data, and a 260° C (500° F) flame.

e. Blend excess solder with a 260° C (500° F) flame carefully so that it runs and levels out. Make certain that the old and new puddle solder is well blended.

f. Remove all traces of flux by immersing core several times in cold water.

3. Repeat Leak Test to assure that all leaks have been eliminated.

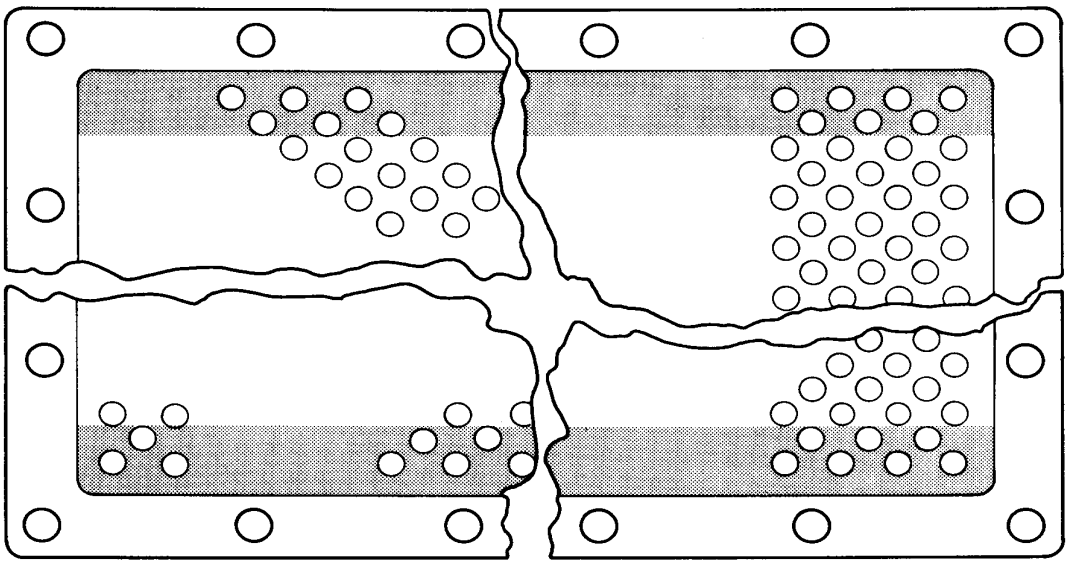


Fig. 7 - Oil Cooler Schematic

MIDDLE TUBE ROW REPAIR

Use the following procedure to repair leaks in the middle tube rows:

1. Construct a clamping fixture using the dimensions given in Fig. 6.

NOTE: The clamping fixture will keep the headers square while the core is being repaired.

2. Bolt each half of the clamping fixture to the core header flanges.

3. With the core resting on both header flanges and the tubes in the horizontal position:

   a. Melt out all solder from the tube-to-header bond. Melt solder by playing a 327° C (620° F) flame over the entire area of solder to be removed. The melted solder will run out of the dish over the header flange and out.

   b. When all solder has been removed, clean all surfaces that are to be resoldered with zinc chloride flux. See Service Data. Use a syringe to ensure that all cracks, tubes, and header surfaces have been cleaned with flux.

NOTE: When applying flux, play a medium flame on the fluxed surfaces. The heating will boil the flux thus improving its cleaning ability. Use a soft wire brush to scrub and clean the area which are being prepared for resoldering.

   c. Repeat Step b using clean flux. This will remove any remaining dirty flux.

4. Perform Steps 2 and 3 under Outer Tube Row Repair.

TUBE BUNDLE TYPE COOLER

DESCRIPTION, Figs. 8 and 9

The water used for cooling the lube oil enters through a flanged connection in one header, flows through the tubes, and is discharged through a flanged connection at the opposite end. The lube oil enters the shell space through a flanged connection near one end of the cooler, flows transversely around the tubes and the baffles, and is discharged through a flanged connection near the other end of the cooler. The water and lube oil flow through the cooler in opposite directions to produce the maximum cooling effect.

Fig. 8 – Tube Bundle Type Oil Cooler

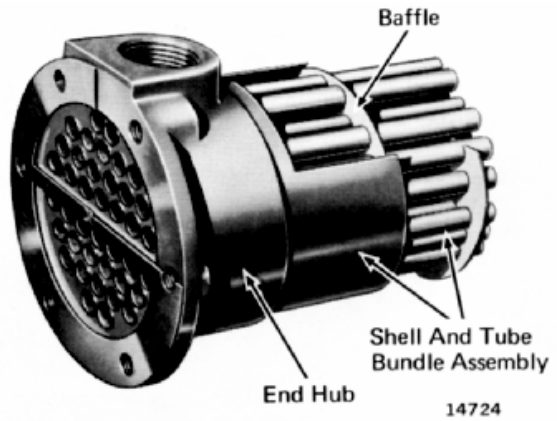


Fig. 9 - Cutaway View Of The Tube Bundle Type Oil Cooler

CLEANING

When it becomes necessary to clean the oil cooler, use the following procedure:

1. Remove header from each end of cooler.

CAUTION: Use of caustic cleaners is not recommended. Bonding solder will deteriorate with the use of caustic cleaners.

2. Fill a soak tank with an undiluted non toxic organic cleaner. See Service Data. Level should be sufficient to allow for complete submersion of the oil cooler.

3. Soak cooler for three hours in a still tank, with tubes lying horizontally. If cleaning solution is agitated, cut soaking time in half.

NOTE: Cleaning is more effective in an agitated tank.

4. Rinse core using a steam-water mixture.

NOTE: Rinse cooler as soon as possible to prevent residue from hardening.

TUBE LEAK TEST

Tube leaks can be accurately located using the following procedure:

1. Remove header from each end of cooler.

2. Seal off one of the lube oil inlet openings.

3. Apply low pressure air to the remaining lube oil inlet.

4. Immerse cooler into a tank containing clean water at room temperature.

5. Determine and mark which tubes are emitting air bubbles.

NOTE: Occasionally a leak will develop around the tube-to-end hub bond. If air bubbles emit from this area the cooler should be scrapped.

6. Qualify the oil cooler by using the repair limit information given under Service Data. The oil cooler should be scrapped if tube failure exceeds repair limits.

7. Refer to Tube Repair for repair procedure.

TUBE REPAIR

Tube leaks are repaired by sealing each end of the defective tube with solder, thus eliminating it from service. Experience has shown that up to 2% of the total tubes can be repaired by this method, without adversely affecting efficiency. Solder tubes closed using the following procedure:

1. Thoroughly dry inside of tubes to be repaired.

2. Clean defective tube with zinc chloride flux. See Service Data. When applying flux, play a medium flame on the fluxed surfaces. The heating will boil the flux thus improving its cleaning ability. Use a soft wire brush to scrub and clean the areas which are being prepared for soldering.

3. When the tube is thoroughly cleaned, insert a brass plug into each end of the defective tube.

4. Solder the plug and tube using a 50% tin, 50% lead soft solder, and a 243° C (470° F) flame. See Service Data.

5. Clean and flush cooler with water.

6. Repeat Tube Leak Test to assure that all leaks are eliminated.

SERVICE DATA

SPECIFICATIONS

FIN-TUBE CORE TYPE COOLER

FIN-TO-TUBE BOND

Loose Fin-To-Tube Bond - Total Area Not To Exceed . . . . . 9678 mm2 (15 sq. in.)

Loose Fin-To-Tube Bond - No Single Area To Exceed. . . . . 6452 mm 2 (10 sq. in.)

TUBE REPAIR

Maximum Number Of Adjacent Tubes Repaired 4

Maximum Percentage Of Total Number Of Tubes Repaired 2%

TUBE BUNDLE TYPE COOLER

TUBE REPAIR

Maximum Number Of Adjacent Tubes Repaired 4

Maximum Percentage Of Total Number Of Tubes Repaired 2%

EQUIPMENT

	PART NO.
Solder, Soft - 50% Tin, 50% Lead - 0.68 kg (1.5 lb.) Bar	3225762
Solder, TRIBAR - 40% Tin, 60% Lead - 11.34 kg (25 lb.) Bar	8478479
Solder, Silver Wire - 2.5% Tin, 97% Lead, .5% Silver - 3.2 mm (1/8") dia. No. 7, 11.34 kg (25 lb.) Spool	8478480
Solder, Puddle - 38% Tin, 62% Lead - 3.2 mm (1/8") dia. 11.34 kg (25 lb.) Spool	8486859
Flux, Zinc Chloride - 3.78 litres (1 Gallon) Can	500-FL-93

Cleaning Solutions - Quaker Solv Cleaner 76, Cecolene (trichlor Ethylene), Or Oakite No. 31

Heating Tip, Stainless Steel Tube - Available From National Cylinder Gas And Blow Pipe Company Under PN 700-27-813N