ELECTRO-MOTIVE

M.I. 927
*Rev. E

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.

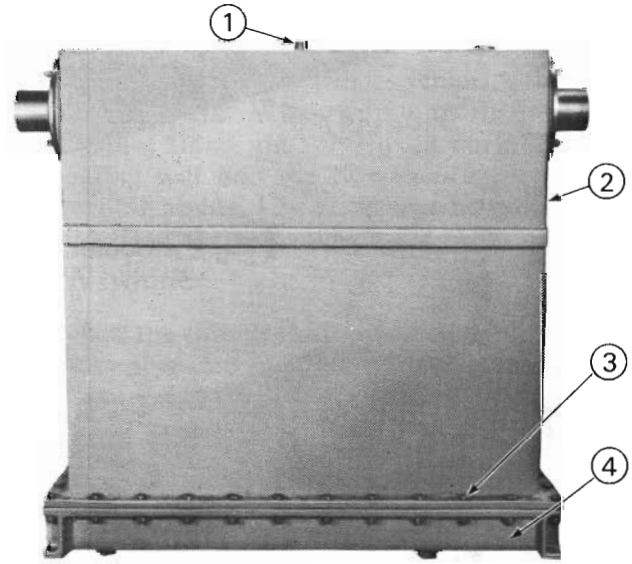
It should be noted that major servicing of the oil cooler should not be undertaken until need for such maintenance is definitely established by unsatisfactory operation.

FIN-TUBE CORE TYPE COOLER

Cooling water enters the fin-tube core type oil cooler, Fig. 1, through each side of the top header, Fig. 2. After passing through the tubes, the water is discharged through outlets in the bottom header.

Engine lubricating oil enters the cooler through one side of the bottom header, and is discharged through an outlet on the opposite side of the bottom header.

The oil cooler is provided with an inlet baffle and a baffle/relief valve assembly, Fig. 3. These baffles cause a uniform velocity of oil through the cooler core which improves performance and reduces the tendency of sludge to form on the tubes and fins.



1. Water Vent Pipe Nipple And Nut
2. Tank
3. Mounting Bolts
4. Lower Header

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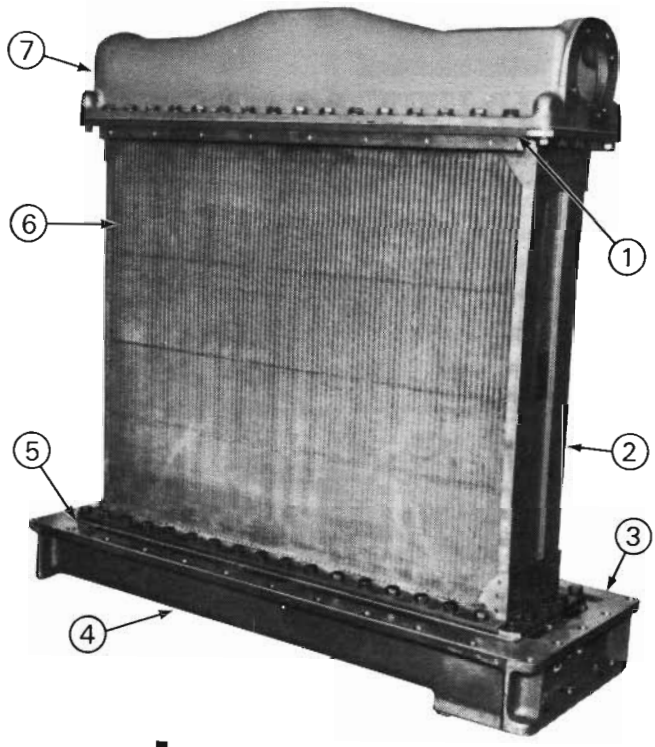
Fig.1 – Fin-Tube Core Type Oil Cooler

As shown in Fig. 4, the oil enters the cooler through an opening in the bottom header. The inlet baffle forces the oil flow to enter the core. The oil then exits on the opposite side of the core. The discharge baffle causes the oil to flow up and over the oil overflow dam.

If oil temperature is low, the increased oil viscosity will increase the pressure required to flow oil through the core. The baffle/relief valve opens when cold oil would cause too high an oil flow pressure through the oil cooler core.

*This bulletin is revised and supersedes previous issues of this number.
Areas of change are indicated by vertical bars.



1. Clamp Plate
2. Rail Assembly
3. Clamp Plate
4. Bottom Header
5. Gasket
6. Core Assembly
7. Top Header

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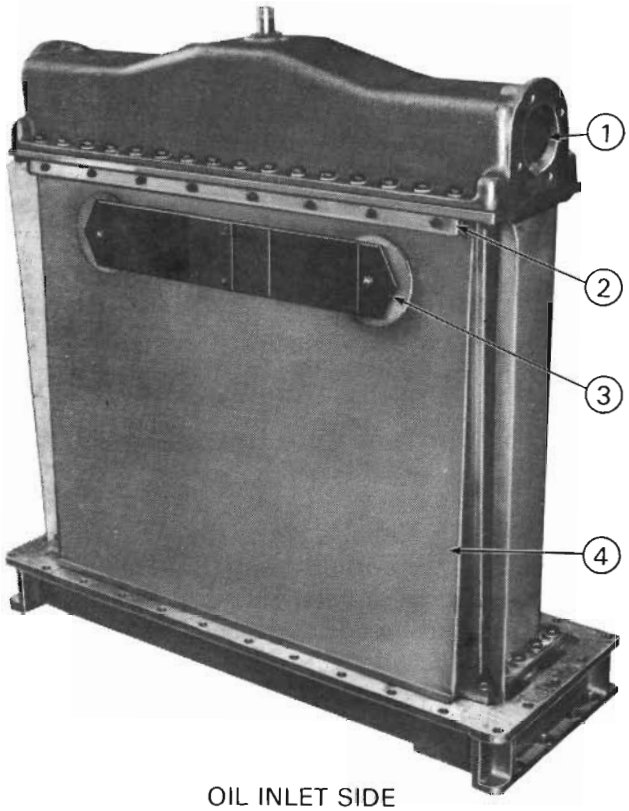
Fig.2 – Cooler Core And Header Assembly, Shown With Inlet Baffle Removed



OIL INLET SIDE

1. Cooling Water Inlet (Both Sides)
2. Inlet Baffle Mounting Strip
3. Baffle/Relief Valve Assembly
4. Inlet Baffle

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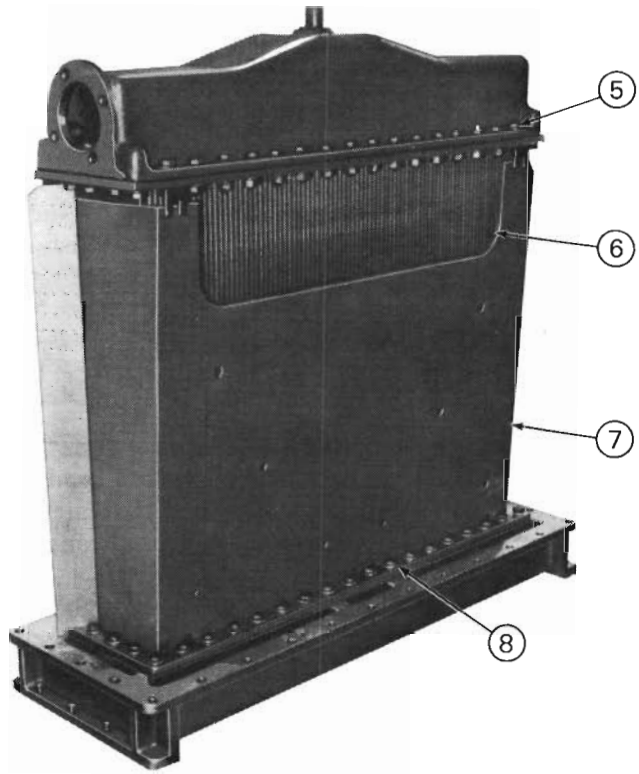

OIL OUTLET SIDE

5. Top Header To Core Mounting Bolts And Nuts
6. Oil Overflow Dam
7. Discharge Baffle
8. Core To Bottom Header Mounting Bolts

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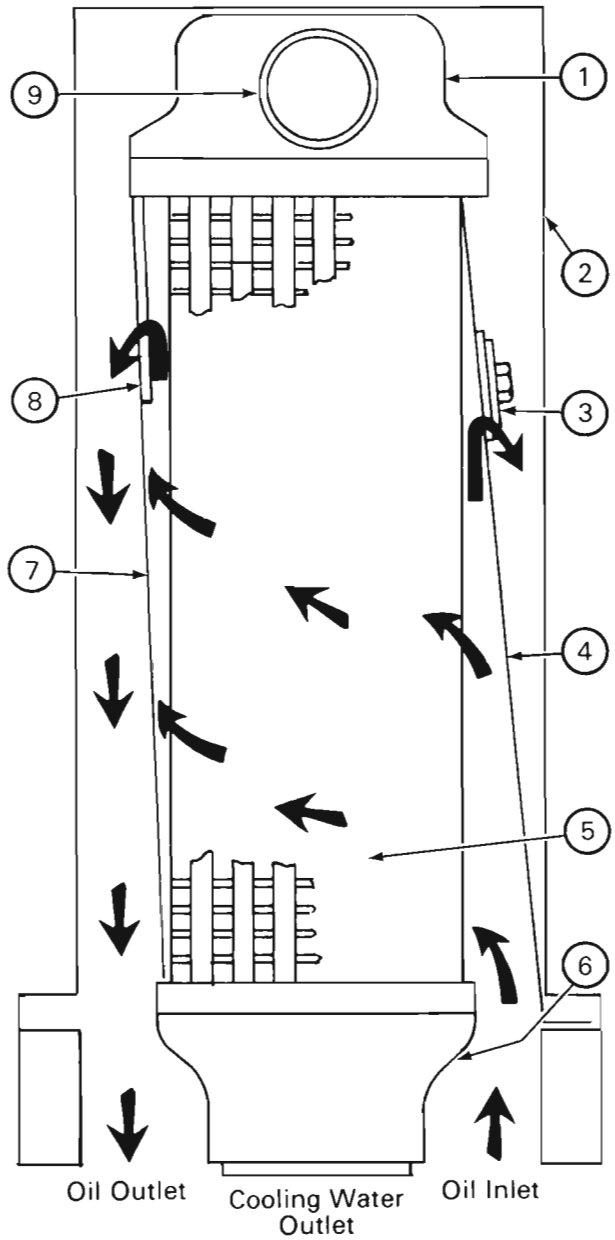
Fig.3 – Cooler Core And Header Assembly, Baffles Installed



1. Top Header
2. Oil Cooler Tank Assembly
3. Baffle/Relief Valve Assembly
4. Inlet Baffle
5. Oil Cooler Core
6. Bottom Header
7. Discharge Baffle
8. Oil Overflow Dam
9. Cooling Water Inlet

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Fig.4 – Simplified Fin-Tube Type Oil Cooler Cutaway View Showing Oil Flow

New locomotives are equipped with oil coolers that have mechanically rolled tube-to-header bond, Fig. 5. This mechanical oil cooler is interchangeable with the previous solder bonded oil cooler. The steel backing bars used with solder bonded cores are not used with the mechanically bonded cores.

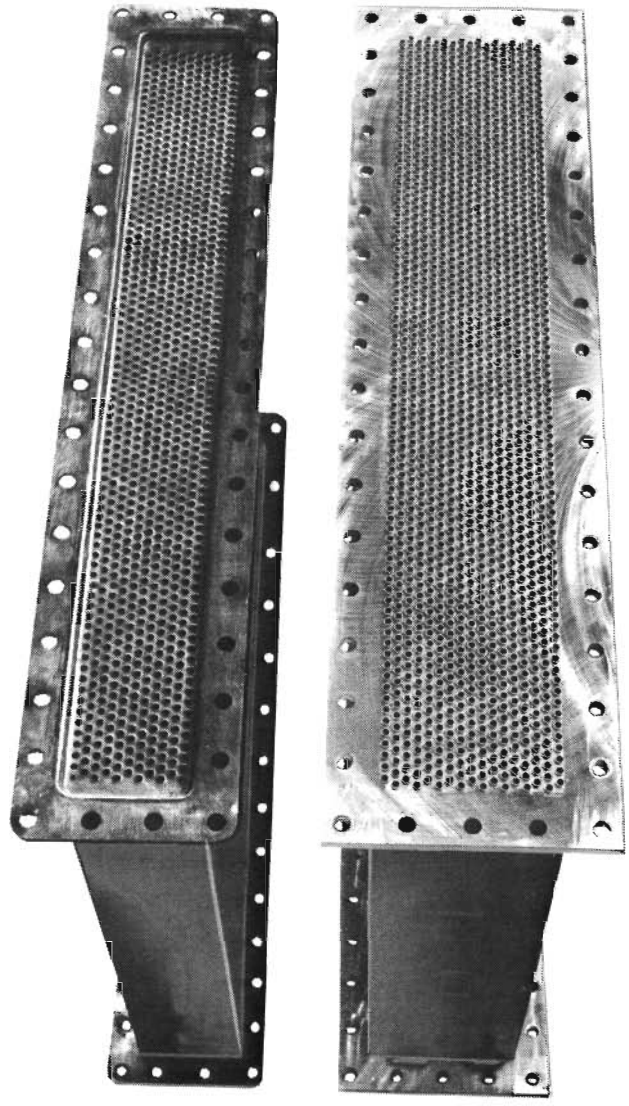

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Fig.5 – Fin-Tube Oil Cooler Core Tube-To-Header Bond

CLEANING

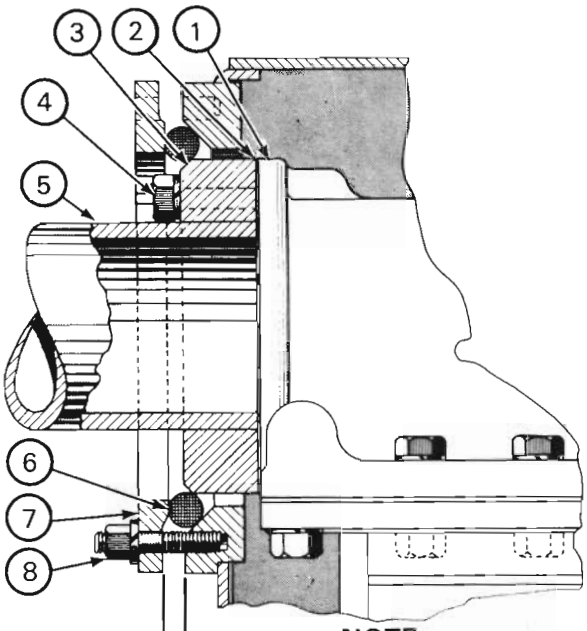
When it becomes necessary to clean the oil cooler, use the following procedure:

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

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

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

   c. Remove clamping plate nuts and washers, Fig. 6. 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

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Fig.6 – 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 assembly from oil cooler core.

2. Remove accessible top header to core mounting bolts and nuts and retaining clips. Remove accessible core to bottom header mounting bolts, Fig. 3. Remove discharge baffle.

3. Remove bolts that secure inlet baffle mounting strip. Remove inlet baffle.

4. The remaining top and bottom header mounting bolts are now accessible for removal. Remove top and bottom header assemblies.

5. If necessary, straighten header flanges, Fig. 7, on solder type cores. Comb bent fins to ensure that flow is not impeded.

6. Clean gasket surfaces.

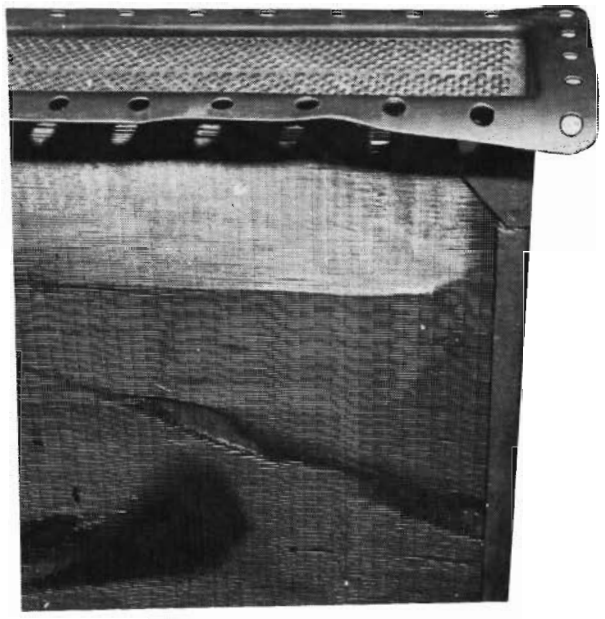

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Fig.7 – Damaged Header Flanges, Fins, And Rail Assembly

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

CAUTION

Do not use caustic cleaners. Caustic cleaners will damage the aluminum fin plates.

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

9. Rinse core using a steam-water mixture. 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. 8. If the fin moves and the tube is stationary, the fin is loose.

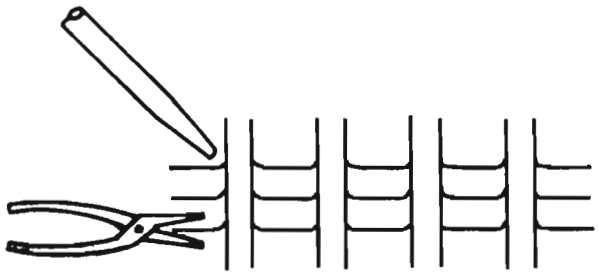

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Fig.8 - Checking Fin-To-Tube Bond

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 core header.

2. Apply 414 kPa (60 psi) air pressure on the tube side with the core immersed in clean water at room temperature.

CAUTION

Avoid exceeding 414 kPa (60 psi) air pressure; higher pressures may 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, thus eliminating it from service. Experience has shown that up to 2 percent of the total tubes can be sealed by this method without adversely affecting oil cooler efficiency. Use the information given in the Service Data as a guideline in determining whether the core is to be scrapped or repaired.

Two methods of sealing defective tubes are provided. The first method is to be used when repairing soldered headers. The second method is utilized when repairing mechanically bonded headers.

SOLDERED TUBE-TO-HEADER CONSTRUCTION

Tube leaks on oil cooler cores utilizing soldered tube-to-header construction are repaired by sealing the ends of the defective tube with solder. Solder tubes closed using the following procedure:

1. Thoroughly dry inside of tubes to be repaired. This precludes the possibility of remaining water freezing and thus bursting the tube.

2. Pinch one end of each defective tube closed.

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. The recommended heating tip for melting out old solder and applying new solder is listed in the Service Data.

4. When the tube is thoroughly cleaned, solder the pinched 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 ensure that all leaks have been eliminated.

MECHANICALLY BONDED TUBE-TO-HEADER CONSTRUCTION

Tube leaks on oil cooler cores utilizing mechanically rolled tube-to-header bond construction are repaired by sealing both ends of the defective tube with a tapered laminated phenolic plug. Refer to the following procedure:

1. Thoroughly dry inside of tubes to be repaired. This precludes the possibility of remaining water freezing and thus bursting the tube.

2. Using fine emery cloth or a deburring tool, remove sharp edge from inside end diameter of tube to be plugged. This prevents damaging of the phenolic repair plug.

3. Remove any remaining grit or filings from inside end of tube to be plugged, using compressed air and a magnetic probe.

4. Inspect repair plugs to ensure that they are not nicked, scratched, cracked, or otherwise damaged or deformed.

5. Insert the tapered plug into end of tube. Using a small hammer, drive the plug into the tube until an interference fit occurs. The plug is not designed to be driven completely into the tube.

6. Using a hacksaw, cut off the exposed portion of the plug flush with the header.

7. Turn core and repeat above steps for opposite end of tube.

8. Repeat Leak test to ensure that all leaks have been eliminated.

TUBE-TO-HEADER BOND REPAIR

Two methods of repairing the tube-to-header bond are provided. The first method is to be used when repairing soldered headers. The second method is utilized when repairing mechanically bonded headers.

SOLDERED TUBE-TO-HEADER CONSTRUCTION

The majority of tube-to-header bond leaks on soldered headers 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 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. 9, 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 hatching in Fig. 10 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 from the dish, over the header flange, and out.

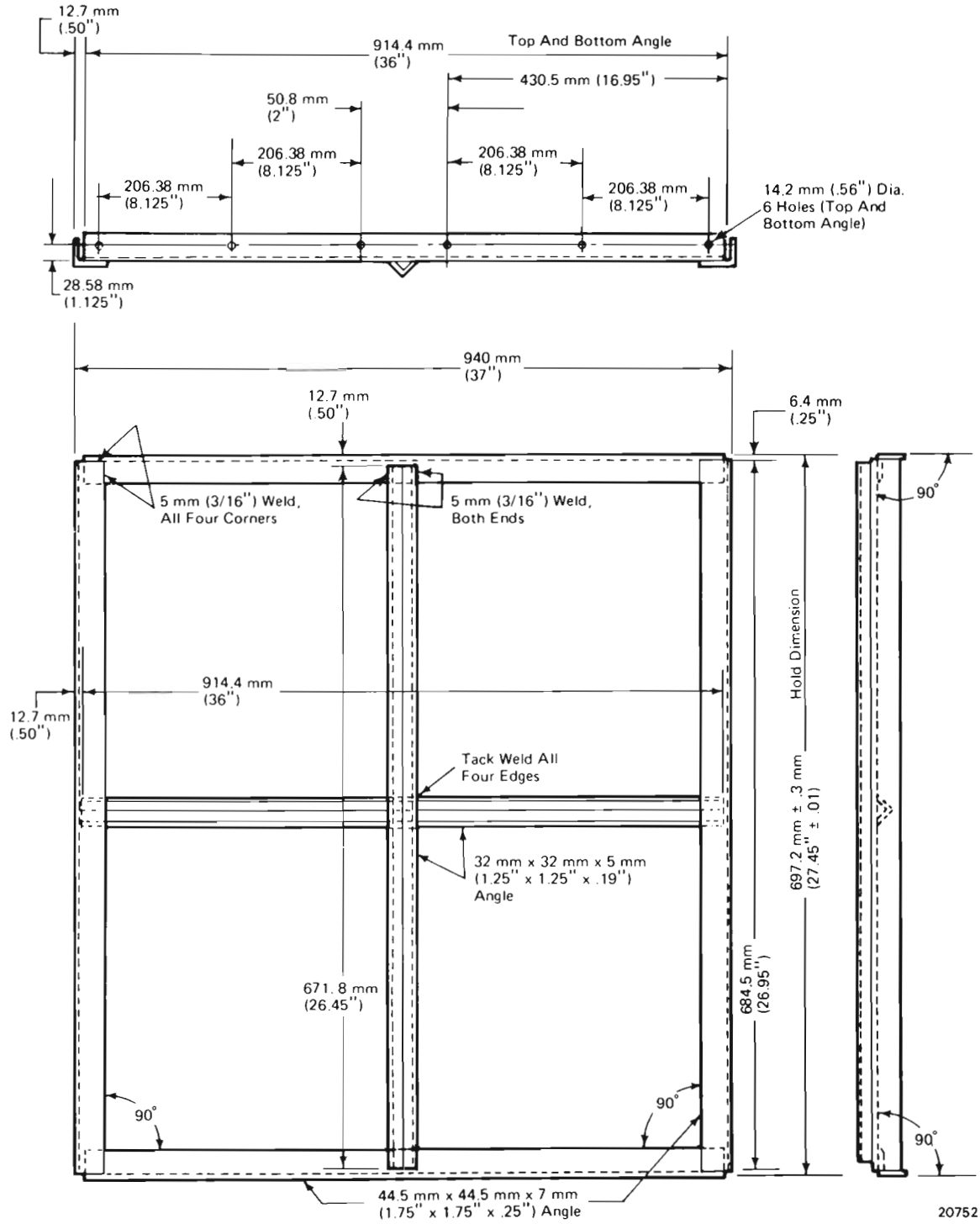

Fig.9 – Header Clamping Fixture

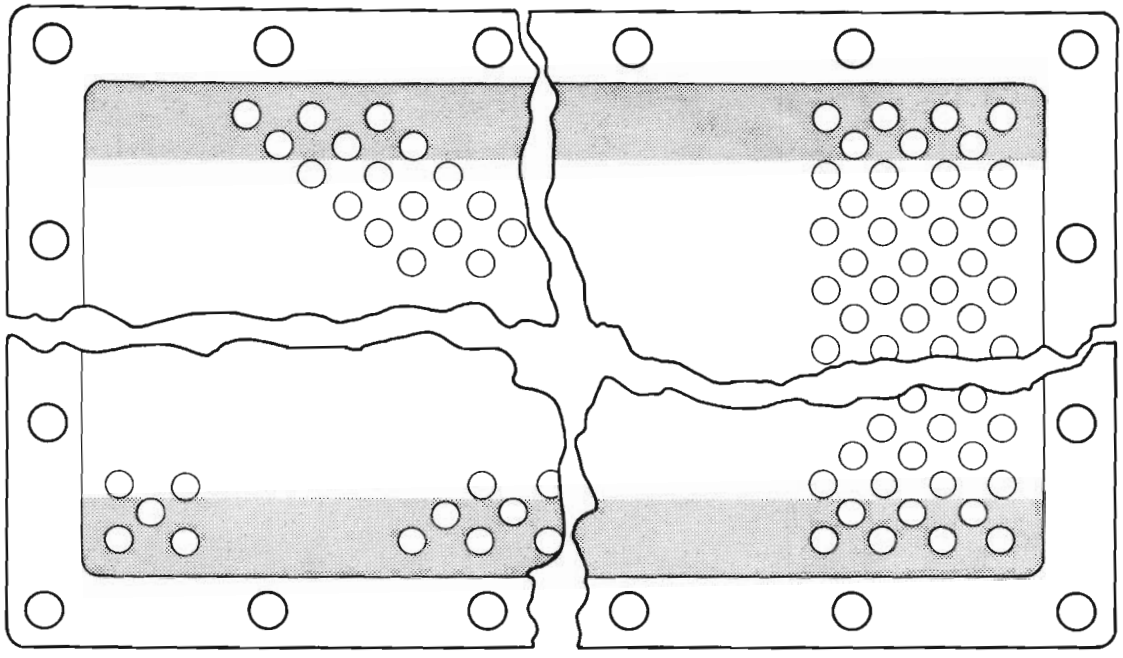

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Fig.10 – Oil Cooler Schematic

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 (620° F) 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 ensure that all leaks have been eliminated.

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. 9.

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 from 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 areas 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.

MECHANICALLY BONDED TUBE-TO-HEADER CONSTRUCTION

If a leak occurs between the tube and header on cores utilizing the mechanically rolled tube-to-header bond, the following procedure may be used to repair the defect.

1. Using a 9/32" diameter drill, drill out the brass tube for a depth of 1-1/2 times the header thickness.

2. After drilling, use compressed air and a magnetic probe to remove any chips, grit, or filings from header.

3. Using fine emery cloth or a deburring tool, remove any sharp edges from the drilled out tube holes in the header. This prevents damage to the phenolic repair plug.

4. Inspect repair plugs to ensure that they are not nicked, scratched, cracked, or otherwise damaged or deformed.

5. Insert the tapered plug into the drilled out tube hole(s) in the header plate. Using a small hammer, drive the plug into the header plate hole until an interference fit occurs. The plug is not designed to be driven completely into the hole.

6. Using a hacksaw, cut off the exposed portion of the plug flush with the header.

7. Turn core. If opposite end of tube is leaking, repeat Steps 1 through 6.

NOTE

A non-leaking tube end does not require drilling. Plugging will suffice.

8. Repeat Leak Test to ensure that all leaks have been eliminated.

REASSEMBLY

NOTE

Use only *new* gaskets and O-rings while performing the following procedures. New gaskets should be inspected and lightly coated with oil prior to installation.

Water Passage Gaskets and Tightening

1. Visually inspect the oil cooler core for tube blockage, bent fins, dented or punctured tubes, and gasket surface finish.

NOTE

A special fin comb is available for straightening bent fins. Refer to Service Data.

2. Visually inspect the gasket surfaces on both the bottom and top header castings, Fig. 11.

3. Ensure integrity and cleanliness of new gasket(s) to be used between the oil cooler core and the top or bottom header castings. Do not reuse gaskets after oil cooler disassembly.

4. Assemble the oil cooler core to the bottom header casting. Tighten the bolts in the sequence shown in Fig. 12, and torque to 102 N·m (75 ft-lbs).

5. Apply blanking plates and gaskets to the bottom header casting. Torque the 1/2"-13 hex head bolts to 102 N·m (75 ft-lbs).

6. Repeat Steps 2, 3, 4, and 5 for application of upper heading casting.

NOTE

The following *optional* step is highly recommended and is used by the manufacturer during rebuild procedures. However, Step 7

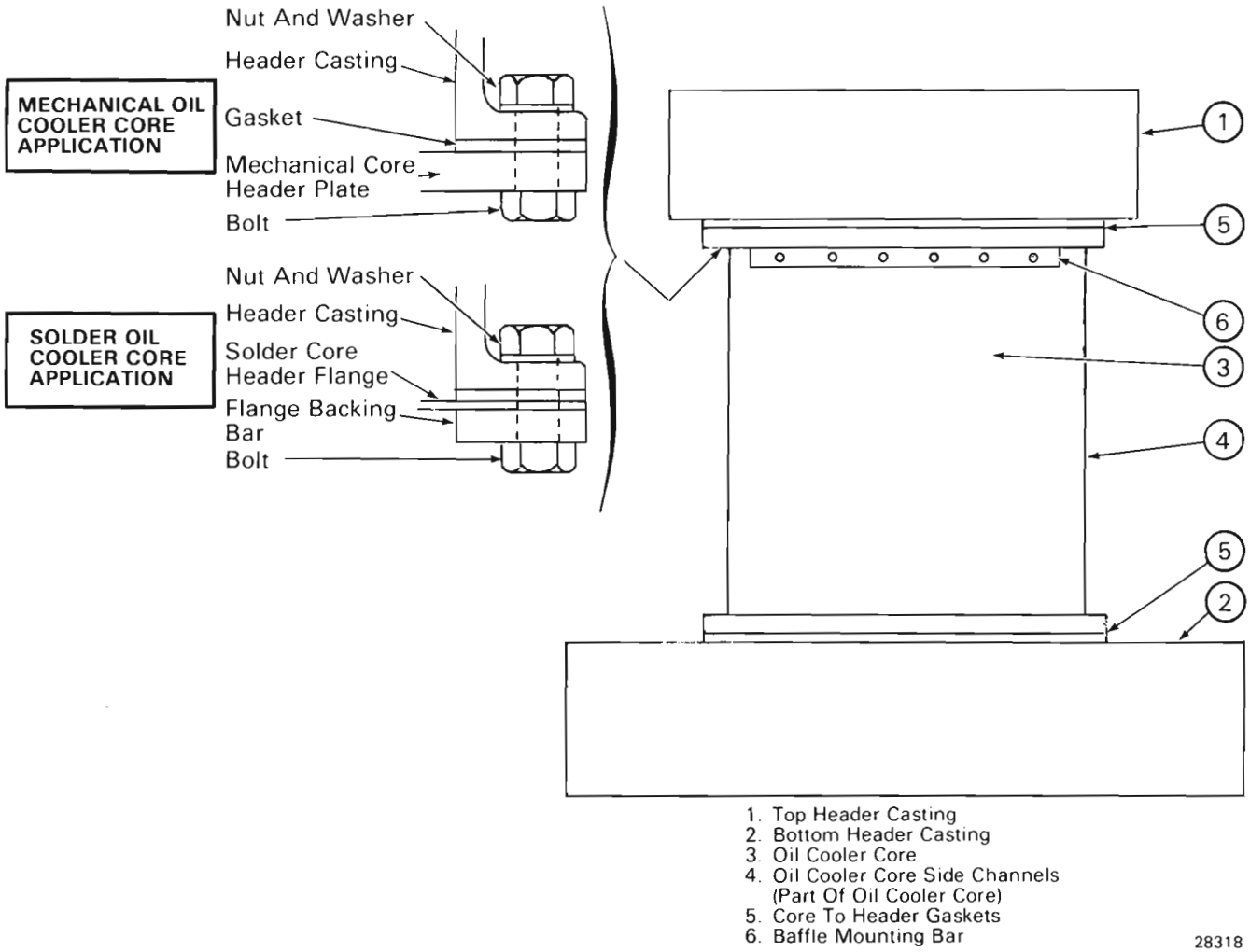


Fig.11 – Simplified Oil Cooler Core-To-Header Casting Applications

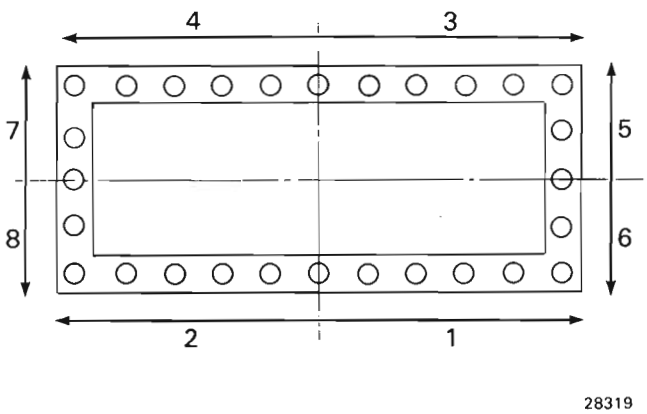


Fig.12 – Oil Cooler Bolt Tightening Pattern

may be impractical for customer rebuild facilities, and reliable assemblies are obtained through proper torquing alone.

Gasket Compression Acceleration Procedure (Optional)

7. Circulate a solution of hot water containing a rust inhibiting additive through the core and headers. Do not drain. Heat assembly to 100° C (212° F), and maintain this temperature for 15 minutes. (This interval allows the gaskets to plasticize adequately to ensure a good compression set.) After this interval has elapsed, retorque all the bolts to 102 N·m (75 ft-lbs) following the sequence shown in Fig. 12.

Water Passage Leak Test

8. Close the inlet and outlet water valves, and apply 414 kPa (60 psi) test pressure to assembly. Check for water leaks at core, header castings, and gaskets. No water leaks should occur.

NOTE

If a leak occurs at a gasket, check for improper bolt torque, a damaged gasket, or improper core or header casting surface finish. Absolutely no water leak in the core is acceptable.

9. If no water leaks are observed, relieve test pressure, drain the water, and remove the blanking plates.

Baffle and Baffle Relief Valve Application

CAUTION

It is imperative to properly fit the baffle to the core to ensure lube oil cooler performance.

10. Check inlet side of oil cooler core side rails and gussets. Remove any solder spatter or spot weld upsets from these surfaces.

11. Ensure that the lube oil inlet baffle sealing edges are free of all burrs, weld spatter, and foreign matter.

12. The bottom edge of the baffle may have a tendency to bow. If a bow is evident, it is preferable to have this edge bow *outward*.

13. Install the oil inlet baffle/relief valve as indicated in Fig. 13, and torque bolt (3) to 37 N·m (27 ft-lbs).

NOTE

The oil inlet baffle/relief valve is applied on the side of the core which is common to the shorter slot in the lower header casting.

The oil outlet baffle is applied to the side of the core which is common with the longer slot in the bottom header casting.

14. Support clips, Fig. 14, at lower end of baffle must be tight against the core. However, there should be a slight clearance between the clip and the clamp bar.

NOTE

If baffle does not conform, rework as required.

15. Carefully clamp lube oil inlet baffle to core.

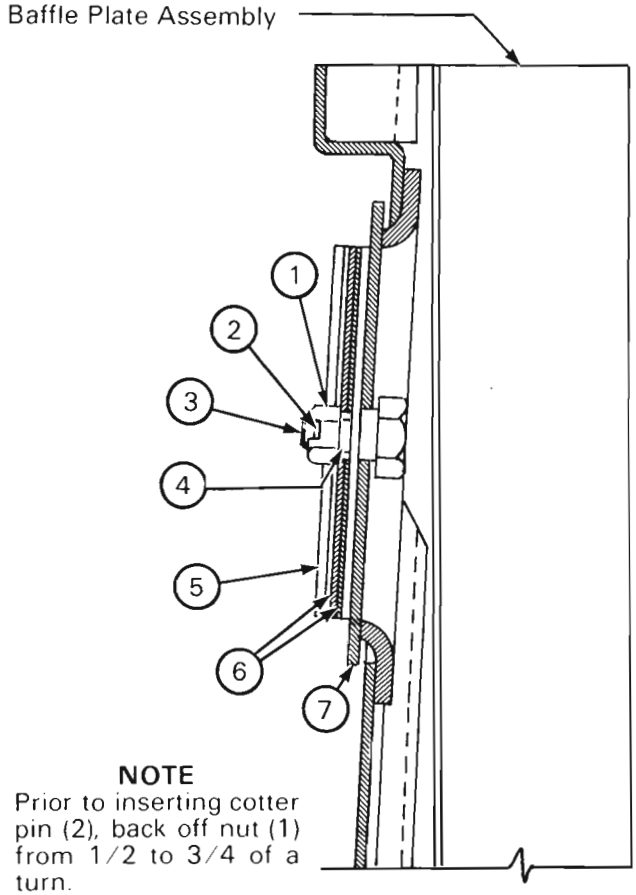


Fig.13 – Baffle/Relief Valve Assembly

CAUTION

Overtightening clamps may result in core damage.

16. Insert bolt, plain washer, and lockwasher (18) and tighten to lower header, Fig. 14. Torque to 102 N·m (75 ft-lbs).

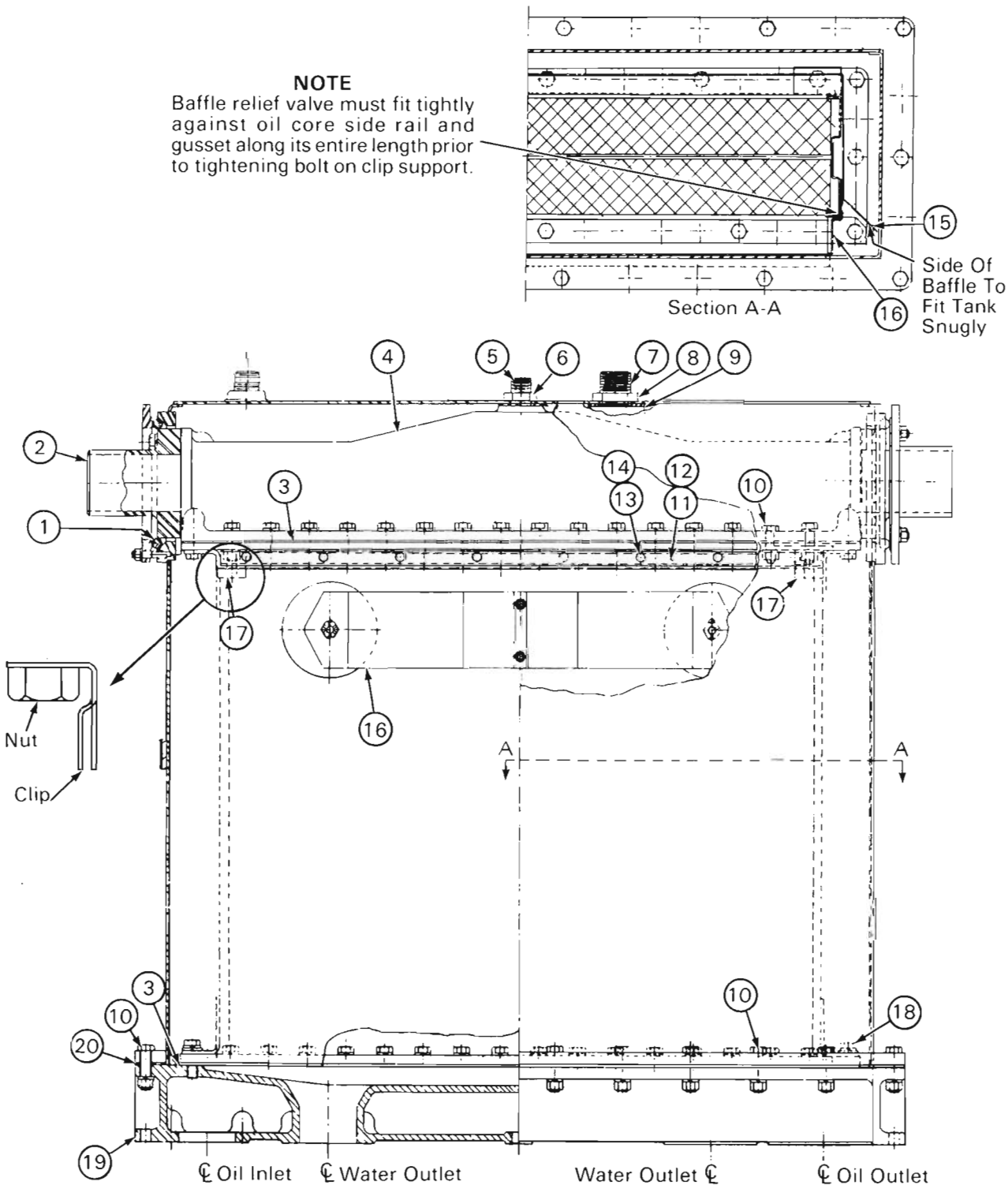
17. Apply strip (11), bolts (13), and spring lock washers (14) across top of baffle, Fig. 14. Torque to 9.5 N·m (7 ft-lbs).

18. Remove clamps.

19. Apply outlet baffle following the same general procedure given above.

Application of Tank Assembly

20. Install the 3/4"-2 nipple and gasket to the center tapped hole in the upper header casting, Fig. 14.



1. "O" Ring Seal
2. Adapter
3. Gasket
4. Header
5. 3/4"-2 Nipple
6. 3/4" Locknut
7. Nipple
8. 1-1/4" Locknut
9. Gasket
10. 1/2"-13 Hex Bolt, Spring Lock Washer, And Nut
11. Strip
12. Tapping Bar
13. 1/4"-28 Hex Bolt
14. 1/4" Spring Lock Washer
15. Baffle Plate Assembly
16. Baffle/Relief Valve Assembly
17. Clip Assembly
18. 1/2"-13 Hex Bolt, Spring Lock Washer, And Flat Washer
19. Oil Cooler Header
20. Gasket

Fig.14 – Baffle Application

21. Inspect the O-ring seal plates at the top of the tank and the gasket surface at the bottom flange of the tank for acceptable surface quality.

    Ensure that the surface finish is free from burrs, weld spatter, and other foreign matter.

22. Inspect the oil cooler tank to bottom header casting gasket. The gasket should be clean and undamaged.

NOTE

Do *not* reuse the gasket after oil cooler disassembly.

23. Apply the oil cooler tank and torque to 102 N·m (75 ft-lbs) in the sequence shown in Fig. 12.

24. Apply 3/4" locknut to nipple at top center of oil cooler tank and tighten to bring top of tank into firm contact with gasket at the top header casting.

CAUTION

Overtightening may result in the gasket being squeezed away from its sealing surface.

Application of Water Inlet Pipes (or Flange) to Upper Headers

25. Install two threaded guide pins into the two uppermost tapped holes around the water inlet openings of the upper header.

26. Inspect the new water inlet gasket. The gasket should be clean and undamaged.

NOTE

Do *not* reuse the gasket after oil cooler disassembly.

27. Install the water inlet gasket over the guide pins and place gasket against the gasket surface on the water side inlet header.

28. Visually inspect the inlet pipe assembly (or plate) gasket surface, and apply inlet pipe assemblies (or plate[s]) over the guide pins.

NOTE

Plates are used during storage. Refer to Rust Prevention section if applicable.

29. Install the pipe assembly bolts and tighten finger tight.

30. Remove the guide pins and install the remaining pipe assembly or flange bolts, again tightening finger tight. Ensure that the O.D. of the pipe assembly or flange is concentric with the I.D. of the tank inlet opening.

31. Torque pipe assembly bolts to 102 N·m (75 ft-lbs).

32. Repeat Steps 25 through 31 when applying the other water inlet opening.

Application of O-Ring Seals and Clamp Rings

33. Inspect O-rings for integrity and cleanliness.

34. Install the O-ring around the inlet pipe assembly or plate.

35. Apply the clamp ring. Hand tighten bolts making certain that the clamp ring contacts the O-ring on the entire circumference.

36. After ensuring proper O-ring seating, torque the clamp ring bolts in a diagonal or cross pattern. The clamp ring should compress the O-ring evenly, and the clamp ring should contact the tank seal frame.

NOTE

After tightening, visually inspect the O-rings for uniform compression around the entire circumference. The O-ring must not be cut or extruded out of the I.D. of the clamp ring.

37. Repeat Steps 34 through 36 for the other inlet O-ring seal and clamp ring.

Oil Passage Leak Test

38. Apply blanking plates or test fittings to the oil inlet and outlet openings in the bottom header casting, and the oil outlet opening in the side of the tank (if so equipped).

39. Apply a clear plastic stand pipe, Fig. 15, to the threaded female oil vent fitting on the top of the tank.

CAUTION

Do *not* mistake the center water vent fitting for the oil vent fitting.

40. Fill the oil cooler with water containing a rust inhibitor until the water level is 1 524 mm (5') above the top of the tank.

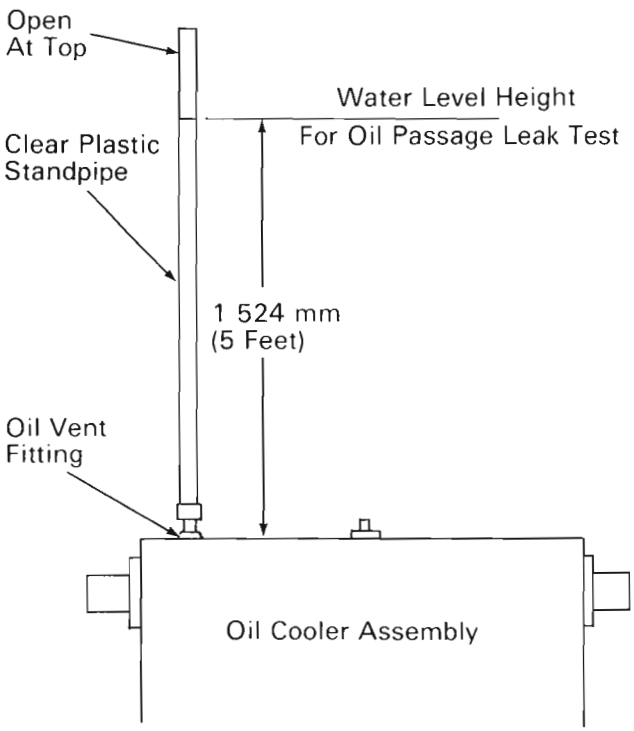


Fig.15 - Oil Cooler Oil Passage Leak Test

41. With the water level at the above height, inspect all gaskets, seals, fittings, castings, and tank welds for leaks.

NOTE

If any gasket or seal leaks are observed, check for improper bolt torque or damaged or improperly seated gaskets or O-rings. Correct as required. Absolutely no tank weld water leaks are acceptable.

TUBE BUNDLE TYPE COOLER

DESCRIPTION

The water used for cooling the lube oil enters through a flanged connection in one header, Fig. 16, 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, Fig. 17, and is discharged through a flanged connection near the outer end of the cooler. The water and lube oil flow through the cooler in opposite directions to produce the maximum cooling effect.

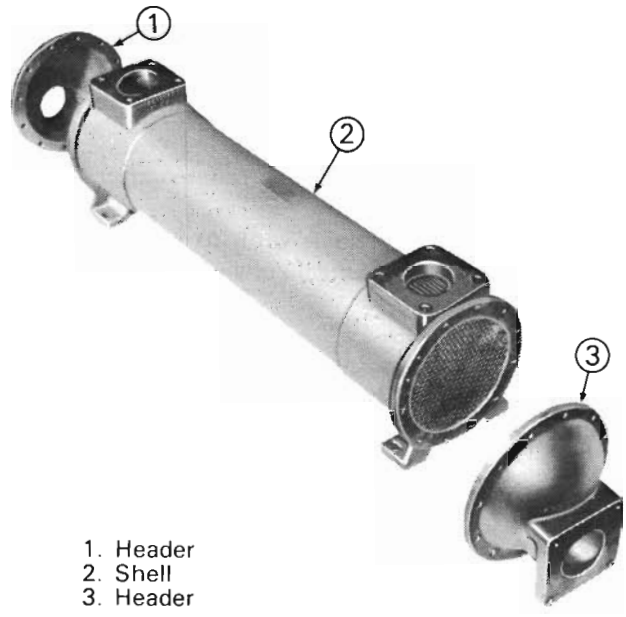


Fig.16 - Tube Bundle Type Oil Cooler

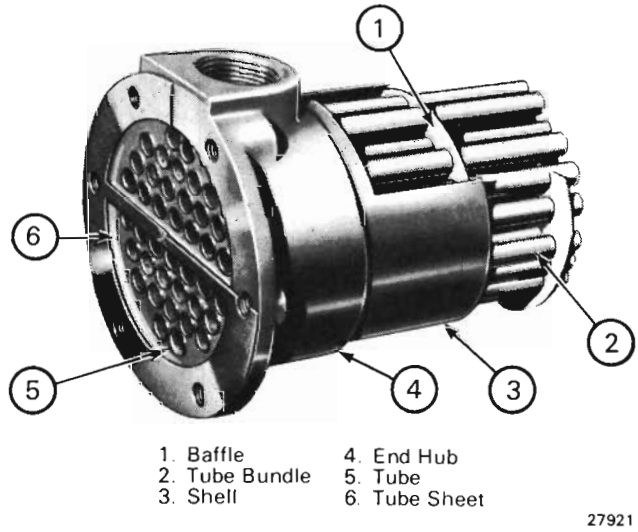


Fig.17 - Cutaway View Of The Tube Bundle Type Oil Cooler

New locomotives are equipped with mechanically rolled tube-to-header bond, and the soldered joint between the tube sheet and end hub has been eliminated. This mechanically bonded tube bundle type oil cooler is interchangeable with the previous design.

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. 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

If the leak test determines that a leak is caused by a circumferential crack between the tube sheet and end hub on solder construction type coolers, it is recommended that the cooler 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, thus eliminating it from service. Experience has shown that up to 2 percent of the total tubes can be sealed by this method without adversely affecting oil cooler efficiency. Use the information given in the Service Data as a guideline in determining whether the core is to be scrapped or repaired.

Two methods of sealing defective tubes are provided. The first method is to be used when repairing soldered headers. The second method is utilized when repairing mechanically bonded headers.

SOLDERED TUBE-TO-HEADER CONSTRUCTION

1. Thoroughly dry inside of tubes to be repaired. This precludes the possibility of remaining water freezing and thus bursting the tube.

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 ensure that all leaks are eliminated.

MECHANICALLY BONDED TUBE-TO-HEADER CONSTRUCTION

If a leak occurs between the tube and header on cores utilizing the mechanically rolled tube-to-header bond, the following procedure may be used to repair the defect.

1. Using a 9/32" diameter drill, drill out the brass tube for a depth of 1-1/2 times the header thickness.

2. After drilling, use compressed air and a magnetic probe to remove any chips, grit, or filings from header.

3. Using fine emery cloth or a deburring tool, remove any sharp edges from the drilled out tube holes in the header. This prevents damage to the phenolic repair plug.

4. Inspect repair plugs to ensure that they are not nicked, scratched, cracked, or otherwise damaged or deformed.

5. Insert the tapered plug into the drilled out tube hole(s) in the header plate. Using a small hammer, drive the plug into the header plate hole until an interference fit occurs. The plug is not designed to be driven completely into the hole.

6. Using a hacksaw, cut off the exposed portion of the plug flush with the header.

7. Turn core. If opposite end of tube is leaking, repeat Steps 1 through 6.

NOTE

A non-leaking tube end does not require drilling. Plugging will suffice.

8. Repeat Tube Leak Test to ensure that all leaks have been eliminated.

RUST PREVENTION

If long term storage is anticipated, it is necessary to seal the water and oil inlet and outlet openings with 11 gauge blanking plates. Follow the pattern shown in Fig. 12, when tightening down the fasteners.

SERVICE DATA

SPECIFICATIONS

FIN-TUBE CORE TYPE COOLER

FIN-TO-TUBE BOND

Loose Fin-To-Tube Bond - Total Area Not To Exceed	9 678 mm² (15 sq. in.)
Loose Fin-To-Tube Bond - No Single Area To Exceed	6 452 mm² (10 sq. in.)

TUBE REPAIR

Maximum Number Repaired Of Adjacent Tubes	4
Maximum Percentage Repaired Of Total Number Of Tubes	2%

TUBE BUNDLE TYPE COOLER

TUBE REPAIR

Maximum Number Repaired Of Adjacent Tubes	4
Maximum Percentage Repaired Of Total Number Of Tubes	2%

EQUIPMENT

	Part No.
Solder, Soft - 50% Tin, 50% Lead, - 0.68 kg (1.5 lb.) Bar	8225762
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
Tapered Laminated Phenolic Repair Plug For Mechanically Bonded Tube-To-Header Cores (Each)	9531516
Flux, Zinc, Chloride - 3.78 Liters (1 Gallon) Can	500-FL-93
Heating Tip, Stainless Steel Tube - Available From National Cylinder Gas And Blow Pipe Company Under PN 700-27-813N	
Fin Comb, 153 mm x 280 mm x 280 mm (6" x 11" x 11") such as the Watsco No. P8.	