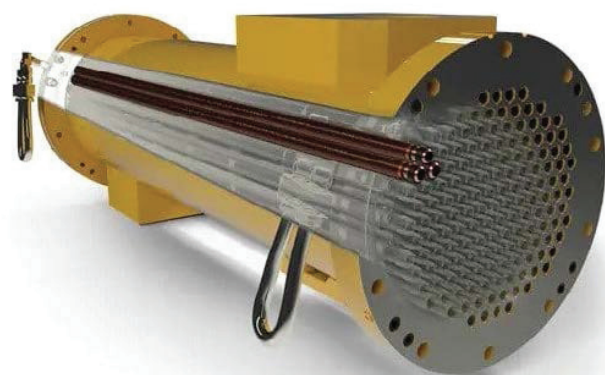


MESABI®

SERVICE MANUAL



SYSTEM PROTECTOR™ TUBE & SHELL COOLER

PLEASE READ AND FOLLOW INSTRUCTIONS AND WARRANTY CAREFULLY BEFORE PROCEEDING WITH ANY SERVICE WORK AND/OR REPAIRS. CONSULT FACTORY BEFORE PROCEEDING WITH ANY POSSIBLE WARRANTY CLAIMS. ONLY USE GENUINE MESABI™ PARTS.

ALWAYS CONSULT NAMEPLATE FOR MAX PRESSURE RATING.

IF YOU HAVE ANY QUESTIONS REGARDING THE PROCEDURES DESCRIBED IN THIS MANUAL, PLEASE CONTACT L&M RADIATOR, INC. AND ASK FOR CUSTOMER SERVICE.

L&M RADIATOR, INC. GENERAL WARRANTY

Consult L&M Radiator, Inc. before proceeding with warranty claims or repairs. Failure to do so may void this limited warranty. This limited warranty allocates the risk of failure of the product(s) between the Buyer and L&M Radiator, Inc. and is reflected in the purchase price.

L&M Radiator, Inc. warrants that MESABI® products will conform to the L&M Radiator, Inc. written quotation specifications and drawings. MESABI® framework components are warranted for 18 months from the date of invoice against defects in materials and workmanship during normal usage. The L&M Radiator, Inc. warranty against seal leakage during normal operation is stated in individual product literature.

L&M Radiator, Inc. liability is limited to the rework or replacement (at L&M Radiator, Inc. sole option) of products or parts manufactured by L&M Radiator, Inc. that are determined by L&M Radiator, Inc. to be defective in workmanship or material or do not meet L&M Radiator, Inc. quoted specifications.

The L&M Radiator, Inc. product warranty does not apply if the product has been subjected to abnormal use or conditions, unauthorized modifications or repair, corrosion, misuse, neglect, abuse, accident, improper installation, or other facts which are not the fault of L&M Radiator, Inc., including damage caused by shipping.

L&M Radiator, Inc. does not warrant products incorporated into L&M Radiator, Inc. products that are not manufactured by L&M Radiator, Inc. Buyer's sole recourse with respect to such products will be subject to the warranty of the individual manufacturer.

Other than as stated herein, L&M Radiator, Inc. makes no representation or warranty of any kind, expressed or implied, as to the merchantability or fitness for a particular purpose, or any other matters with respect to the sale of L&M Radiator, Inc. products(s) and all implied warranties of merchantability or fitness for a particular purpose are hereby disclaimed. In no event will L&M Radiator, Inc.'s liability include any special, incidental, consequential, or punitive damages, even if L&M Radiator, Inc. knew of the likelihood of such damages.

Any action or lawsuit for breach of the limited warranty in these L&M Radiator, Inc. terms and conditions must commence in Minnesota. This warranty supersedes all previously published warranties.

MESABI® SYSTEM PROTECTOR™ WARRANTY
MESABI® System Protector™ Tube & Shell Coolers are covered by the L&M Radiator, Inc. General Warranty along with the following Product Specific Warranty:
L&M Radiator, Inc. warrants MESABI® System Protector™ Tube & Shell Coolers against seal leakage during normal operation for 48 months from date of invoice on new coolers.

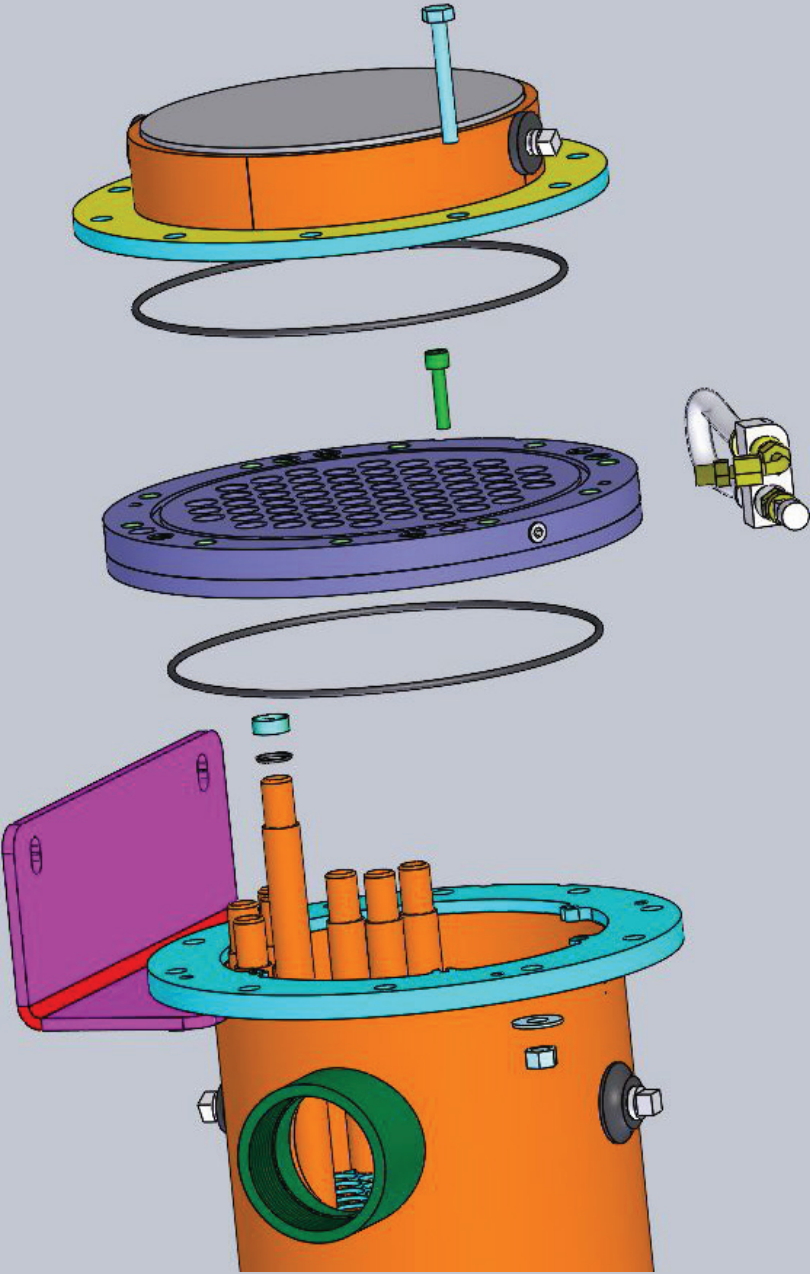
MESABI® HEAT EXCHANGERS ARE THE WORLD STANDARD FOR HEAT EXCHANGER RELIABILITY
If you have any questions regarding the procedures described in this Service Manual, please contact L&M Radiator Customer Service.

All information, illustrations, and specifications in this Service Manual are based on the latest information at the time of publication or posting online at www.MESABI.com. L&M Radiator reserves the right to make changes at any time without notice.

CONTENTS

WARRANTY	PAGE 01
GENUINE MESABI® PARTS	PAGE 02
STANDARD PARTS & TOOL LIST	PAGE 03
PRODUCT DESCRIPTION & OPERATION	PAGE 04
EXTERNAL CLEANING & DISASSEMBLY	PAGE 05
INTERNAL CLEANING	PAGE 07
TUBE RE-ASSEMBLY	PAGE 08
DUAL HEADER PLATE DESIGN DISASSEMBLY	PAGE 11
DUAL HEADER PLATE DESIGN RE-ASSEMBLY	PAGE 13
TESTING PROCEDURE	PAGE 15

STANDARD PARTS



When purchasing parts, contact L&M Customer Service to ensure correct genuine Mesabi® parts.

STANDARD PARTS & TOOL LIST



ASSEMBLY TOOLS

SEAL LUBE BRUSH #63451



HOLE CLEANING BRUSH #64092



TUBE POSITIONING TOOL #109695



SEAL INSERTION AND REMOVAL TOOL
#97892



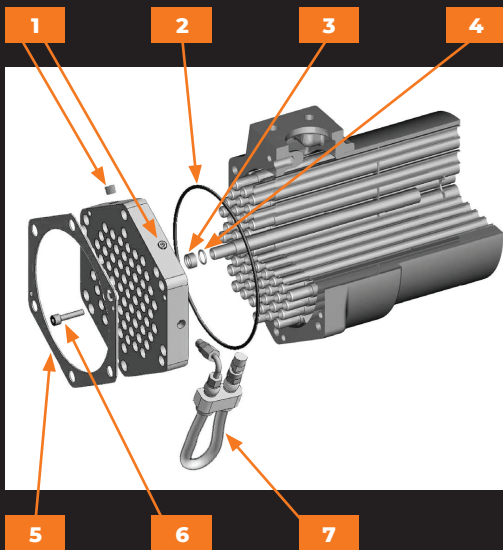
TUBE BREAKER TOOL #109805



PLASTIC ASSEMBLY BULLETS

5/8" #12311 3/4" #269871

(Used for assembly only. Determine by measuring the outside diameter of tubes *note be careful not to scratch the tubes.*)



REPLACEABLE COMPONENTS

1. BRASS PIPE PLUG #109605

2. SEAL (HEADER-TO-END-FLANGE) **SEE PARTS LIST***

3. SEAL, SYSTEM PROTECTOR **LS***

4. SEAL, SYSTEM PROTECTOR #102138

5. GASKET **SEE PARTS LIST***

ASSEMBLY LUBE 100276

ELECTRONIC SENSOR OPTIONAL **SEE PARTS LIST***

6. SOCKET-HEAD CAP SCREWS **SEE PARTS LIST***

7. SIGHT TUBE ASSEMBLY

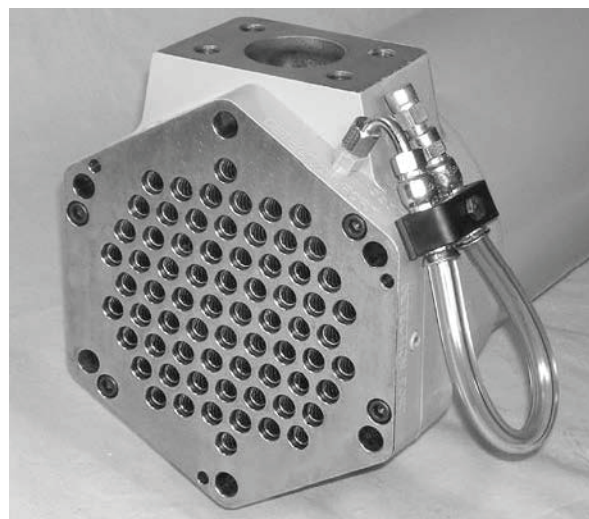
#113694 **RIGHT MOUNT** #113695 **LEFT MOUNT** (SHOWN)

*Parts vary per unit, contact L&M Customer Service with data tag information for parts specific to your unit, including torque specifications.

THE MESABI® SYSTEM PROTECTOR™ TUBE AND SHELL COOLER PROVIDES A DEPENDABLE SAFEGUARD FOR SYSTEMS UNDER CONSTANT OPERATION.

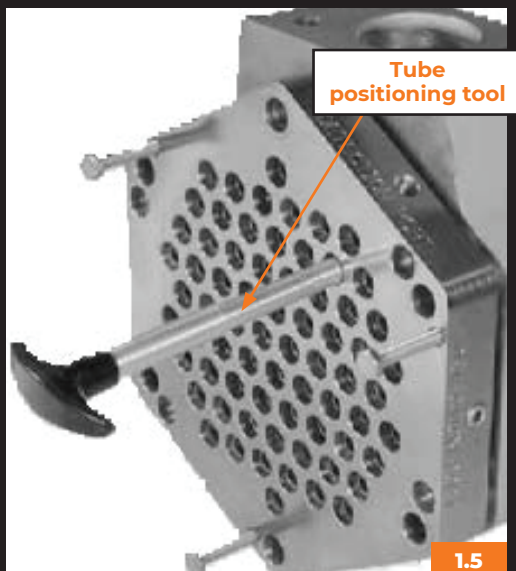
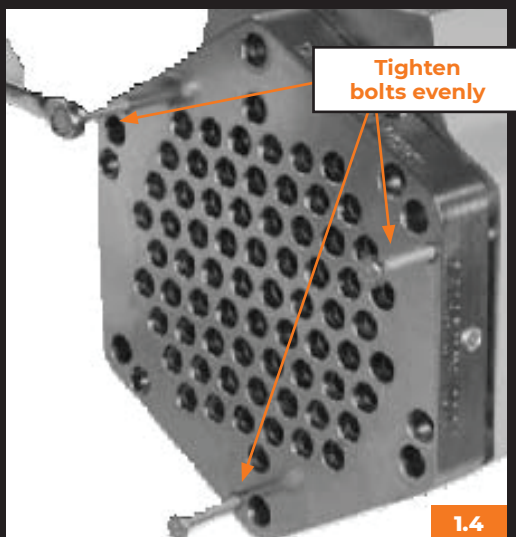
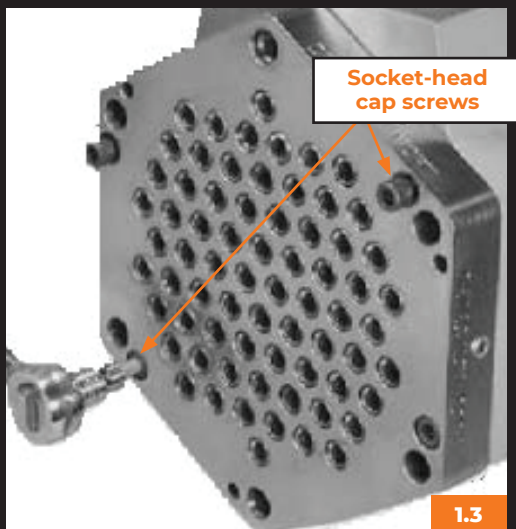
THE COOLER has individual copper tubes held in header plates with flexible rubber seals. Two seals at each tube end absorb thermal and mechanical stresses. A collection chamber between the seals in each header is maintained at atmospheric pressure to isolate the two heat exchanger fluids to avoid cross contamination. The collection chamber connects to external detection ports where a standard sight gauge system or optional electronic sensor can alert the operator to any fluid bypassing seals.

SYSTEM PROTECTOR™ coolers can be made in a variety of configurations of length and diameter for liquid and air heat exchange required by mobile and in-plant equipment. Coolers can also be designed and built to retrofit and use customer's existing end caps and piping.



- Protects equipment from downtime caused by cross-contaminated fluids.
- Alerts operator to leaking.
- Is field repairable.
- Helps preserve the environment.

EXTERNAL CLEANING & DISASSEMBLY



For external cleaning and internal flushing, use high-pressure hot water with or without degreaser. Cleaning the cooler before disassembly will make it easier to work on, and also help keep parts clean for reassembly.

1 DISASSEMBLY

IMPORTANT: System Protector cooler components require close tolerances and must be disassembled carefully as described below.

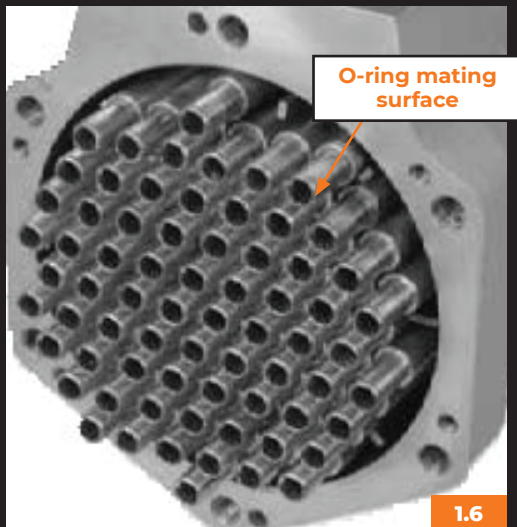
- 1.1** Before you begin disassembly, mark the location of the sight tube assemblies for re-installation. Remove the sight tube assemblies from both ends of the cooler.
- 1.2** Remove both end tanks if present. Remove and clean the old gaskets off the tank flanges and the header plates, being careful not to scratch the sealing surfaces. Socket-head cap screws and threaded holes around the perimeter of the header plate will now be exposed. The threaded holes will be used to back the header plate away from the shell, exposing the tubes.
- 1.3** Remove the socket-head cap screws that secure header plate to the shell flange.

NOTE: Also see parts list diagram
- 1.4** Install the appropriate back-out bolts into the threaded header holes (requires 3" of thread). Finger tighten each bolt until uniformly snug against the shell flange. Then use a wrench to turn in each bolt 1/2 turn at a time separating the header evenly from the shell.

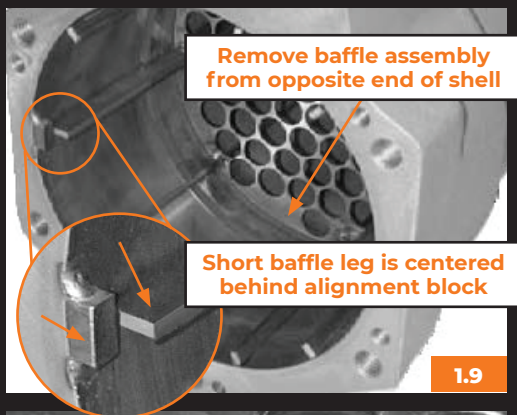
IMPORTANT: Tube damage may occur if the header plate is not backed away evenly.

- 1.5** Some tubes may pull out with the header plate as it separates and must be pushed back into the opposite header plate. When the header has separated 1/4" from shell flange, use the tube positioning tool #109695 to push any attached tubes back into the opposite header.

EXTERNAL CLEANING & DISASSEMBLY



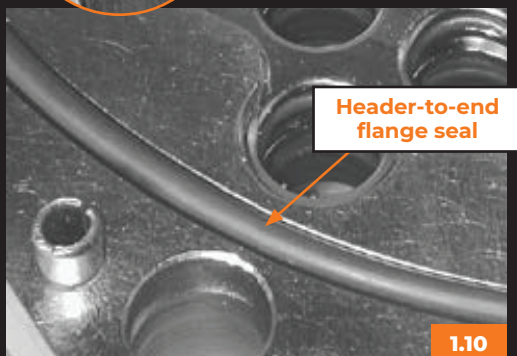
1.6 If the header is being removed during testing to repair a leak, it is important to keep the tubes engaged in the LS seals in the opposite header. Remove first header being careful not to scratch or dent O-ring mating surface on shell.



1.7 Remove the second header at the opposite end of the shell repeating steps 1.3 - 1.5.

1.8 Remove all the tubes from the baffle assembly. Check tube ends for any damage.

1.9 Remove the baffle assembly. (Not all baffle assemblies are removable.) Note its orientation in the shell. It will have to go back into the shell in the same orientation.



1.10 Remove the header-to-end-flange seal and clean all sealing surfaces. Be very careful not to mar any of these surfaces.



1.11 Use seal insertion and removal tool #97892 to remove all seals from headers. This includes both the seal #LS and seal #102138 (shown).

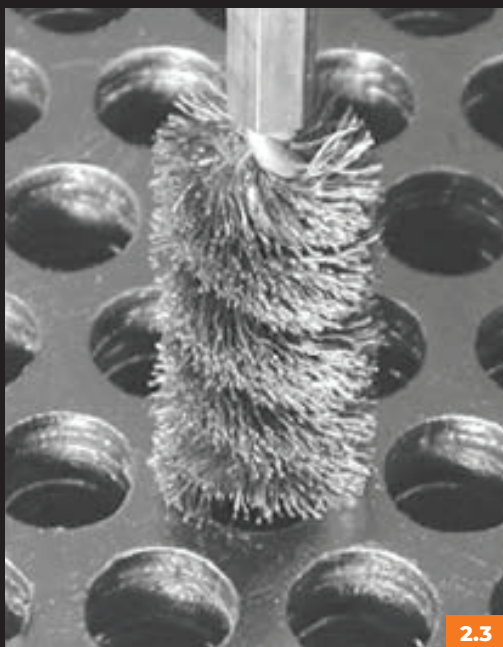


2 INTERNAL CLEANING

2.1 Prior to reinstalling original tubes, the tubes must be cleaned of all foreign material. A buffing wheel may be used to clean the tube ends but precaution must be taken when buffing to avoid marring the tubes sealing surfaces. Make sure tube ends are wiped clean prior to lubrication.

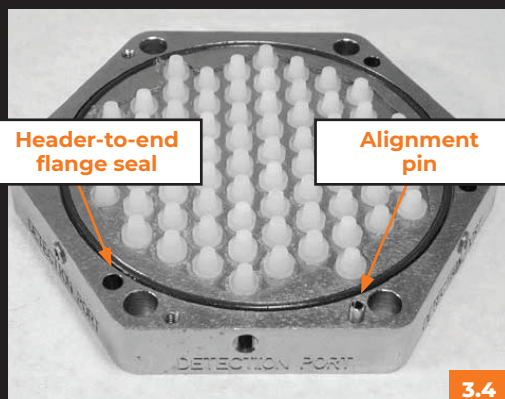
2.2 Also clean the header plates, shell, and baffle assembly. This can be done with a high pressure washer. Dry parts thoroughly when done.

2.3 If needed, clean the header plate holes with the hole cleaning brush #64092 in a drill. At full rpm, run the brush through all the header plate holes.



2.3

IMPORTANT: Use only the hole cleaning brush #64092, otherwise you may damage the sealing surfaces. After wire brushing all the holes, clean the plates and holes thoroughly with compressed air. Check the tube holes for brush bristles.



3 TUBE RE-ASSEMBLY

- 3.1** Carefully install new seals into the clean header plate holes. Seal #LS goes into the wide seal grooves and seal #102138 goes into the narrow inner seal grooves. Closely inspect the seals for proper seating in the grooves and for any debris that might prevent sealing.

NOTE: Look closely for seals that could have rolled on installation and are not seated properly.

- 3.2** After seals are installed in the headers, lube the seals with assembly lube #100276 using seal lube brush #63451. Seals should be adequately lubed, however do not use excessive amounts of lubricant.

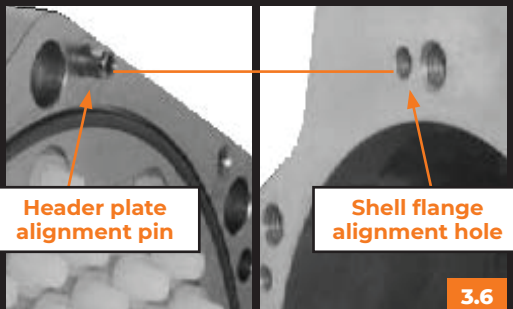
- 3.3** Lay the header plate down on a clean surface with the alignment pin, if equipped, facing up. Fig 3.4 Install lightly lubricated plastic assembly bullets #112311 or #269871 into all of the tube holes. Tapered ends of the bullets should go into the holes first.

- 3.4** Install a new header-to-end-flange seal into the header plate. Apply a small amount of assembly lube #100276 to hold the seal in place.

- 3.5** If your unit has a removable baffle assembly, properly orientate and install the baffle assembly into the shell.

IMPORTANT: The short leg of the longitudinal baffle bars must be centered behind the alignment block on the inside of the shell. See 1.9

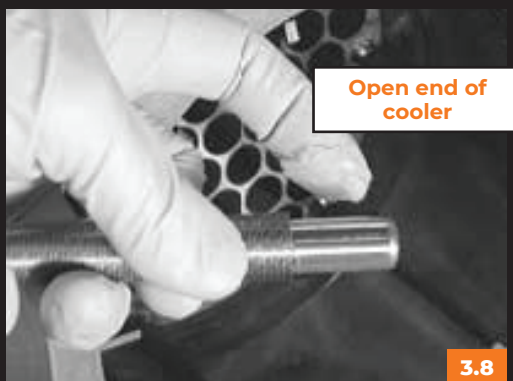
TUBE ASSEMBLY



3.6 If your header plate is equipped with an alignment pin it is important to ensure it mates with the alignment hole in the shell flange.



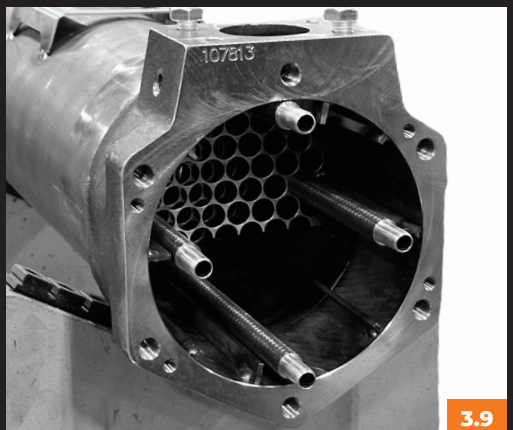
3.7 Properly orientate and position the first header plate onto the end of the cooler. Secure the first header to shell flange using the socket-head cap screws and torque to the recommended specification.



3.8 Proceed to tube installation by applying a light coat of assembly lube #100276 to both ends of each tube.

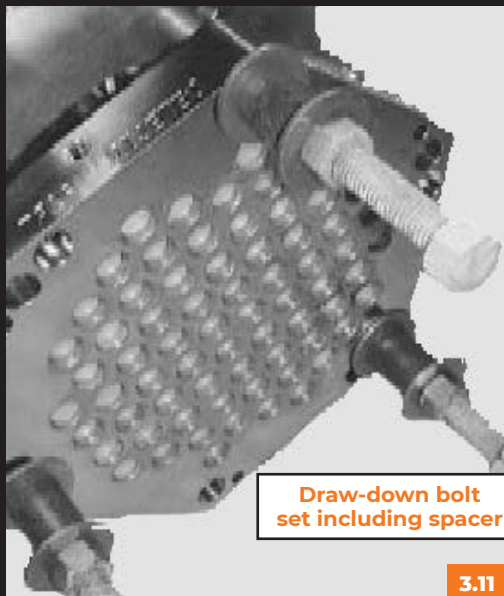
3.9 From the open end of the cooler, install the tubes through the baffle assembly. Push the tubes all the way into the baffle and through the seals on the opposite end until the tube shoulders bottom out on the first header plate.

IMPORTANT: Install 4 tubes first. One at the top, one at the bottom and one on both the right and left side. This will align baffle.



3.10 Collect, clean and re-lubricate the assembly bullets. Prepare the second header for installation by following the same assembly procedure as the first header, steps 3.1 - 3.4.

TUBE ASSEMBLY



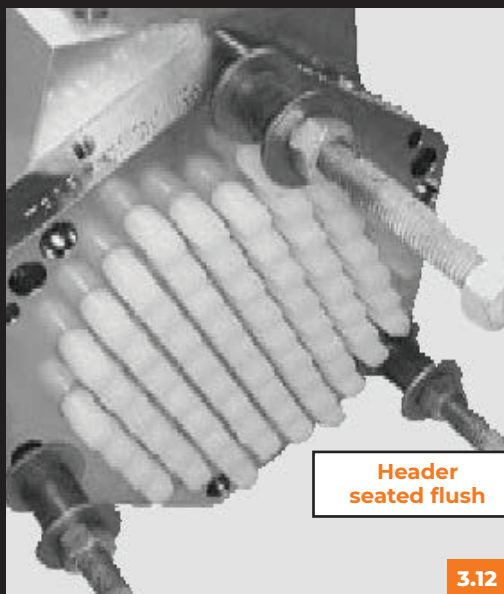
Draw-down bolt set including spacer

3.11

3.11 To install the second header plate, you must provide three draw-down bolt sets. To assemble the sets you will need the following components: 3 bolts with 5" of thread and 3 nuts with the same thread type as the shell flange bolts and 6 flat washers.

To prepare each bolt set, screw a nut on far enough to accommodate the spacer and two flat washers with 3 1/2" of free thread available to go through the header and into the shell flange.

Align the second header plate so that the alignment pin mates up with the alignment hole in the shell flange and the tubes mate properly with the assembly bullets. To hold the header in position, loosely install one draw-down bolt set into the uppermost shell flange bolt location. Next, loosely install the remaining two sets evenly around the perimeter. Using a wrench, tighten the bolts all the way into the shell flange. Then finger tighten the nuts until the spacers and washers are uniformly snug.

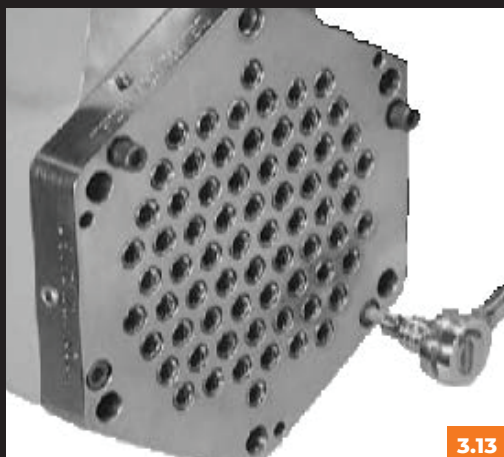


Header seated flush

3.12

3.12 The nuts on the draw-down bolts must now be uniformly wrench tightened by alternately tightening each nut around the perimeter exactly 1/2 turn at a time. Tighten until the second header is seated flush to the shell flange.

IMPORTANT: Tube damage may occur if draw-down-nuts are not tightened evenly to maintain the header parallel to the shell.

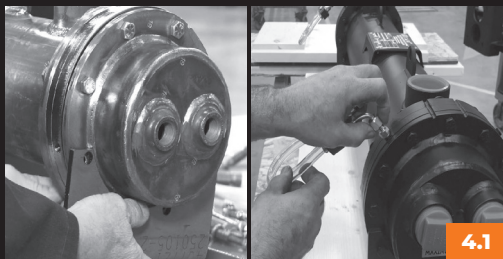


3.13

3.13 BEFORE removing draw-down bolts and nuts, thread the socket-head cap screws into the exposed holes in the header and into the shell flange to secure the header. Remove the draw-down bolts and install the remaining socket-head cap screws. Torque to recommended specifications.

IMPORTANT: Inspect tube holes in header for torn rubber seals. If there is a torn seal, it must be replaced.

DUAL HEADER PLATE DESIGN DISASSEMBLY



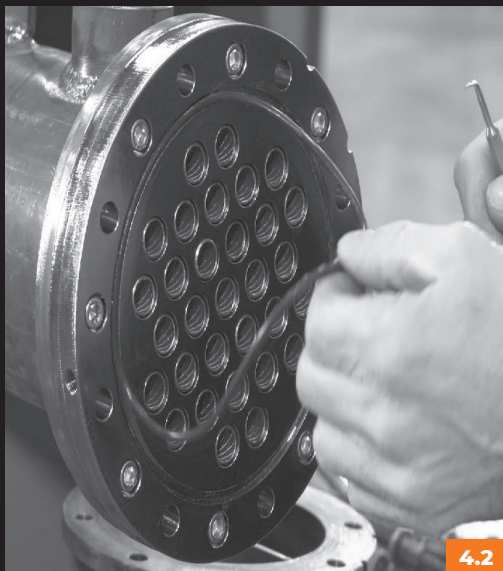
4.1

4 DUAL HEADER PLATE DESIGN DISASSEMBLY

EXTERNAL CLEANING

For external cleaning and internal flushing, use high-pressure hot water with or without degreaser. Cleaning the cooler before disassembly will make it easier to work on, and also help keep parts clean for reassembly.

IMPORTANT: System Protector cooler components require close tolerances and must be disassembled carefully as described below.



4.2

- 4.1** Before you begin disassembly, mark the location of the sight tube assemblies for re-installation. Remove the sight tube assemblies from both ends of the cooler. *note orientation notches, if equipped, of the header plates, end tanks, mounting feet, and shell flange for re-installation.

Remove tank end retainer bolts, nuts washer, and both end tanks.

NOTE: Mark each side that the tank ends come from as they may be different.



4.3

- 4.2** Carefully remove and clean the O-ring seal off header of tank end.

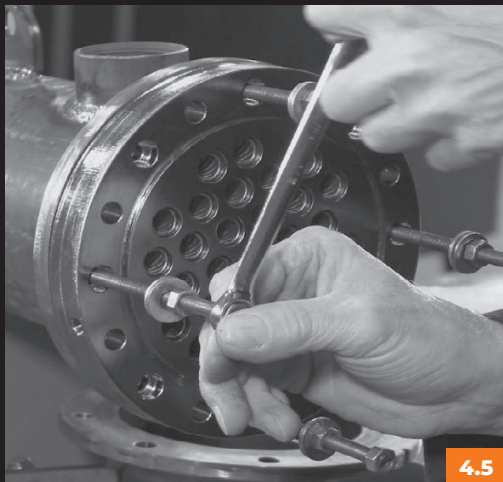
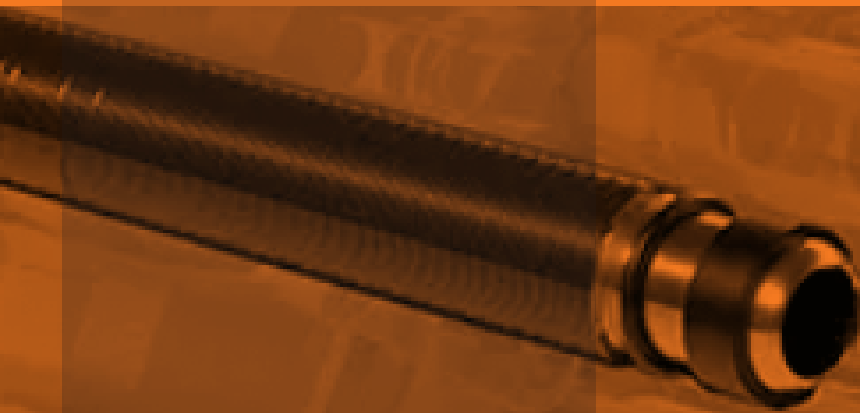
- 4.3** Remove the 1" and 1 1/4" header plate retainer bolts holding the header to shell flange.



4.4

- 4.4** Remove the 5/8" cap bolts holding the two header plates together.

DUAL HEADER PLATE DESIGN DISASSEMBLY



- 4.5** Place back out bolts into shell flange and thread into the back out hole. until tight against shell flange. Once the bolts are in contact with the end shell flange. Turn the back out bolts no more than one-half turn per bolt to remove header plate.



- 4.6** Remove header from shell flange.

NOTE: If tubes stay attached to the header use the tube driver tool to push them out of there seals and back into the baffle assembly.

Push the tubes from the remaining header by using the tool tube driver tool. Proceed by removing the last header plate as described in the 4.5. proceed by removing the tubes one at a time and placing them on a table or cart.

Separate the two peace headers to expose the inner seal. Using the Mesabi seal insertion and removal tool (#97892) remove the large O-ring seal and each individual tube hole seal. Be careful not to mar the sealing surface.

DUAL HEADER PLATE DESIGN RE-ASSEMBLY

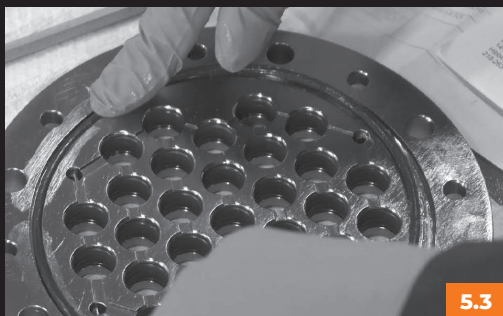


5 DUAL HEADER PLATE DESIGN RE-ASSEMBLY

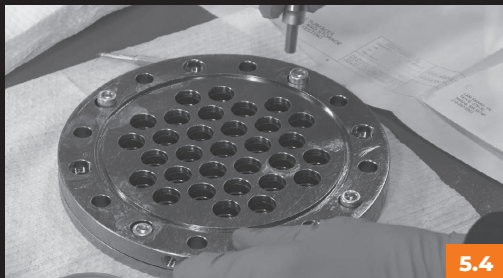
5.1 Clean tube ends so they are free of foreign material on sealing surfaces and on header plates and seal groves.



5.2 Clean the plate assembly, shell and baffles using a high pressure wash. Remember to dry them completely



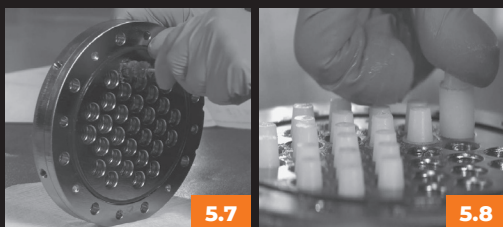
5.3 Lubricate and install large O-ring seal between header plates. Place other header on top and install the 5 5/8" cap bolts. do not tighten at this time.



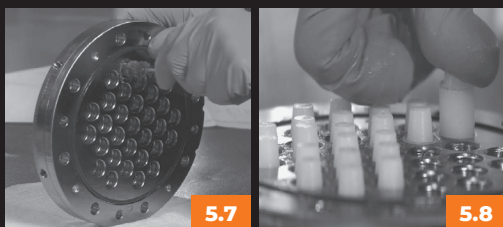
5.4 Install the 5 5/8" cap bolts. Do not tighten at this time.



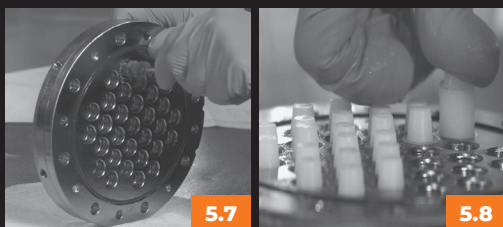
5.5 Carefully install new seals into clean headers.



5.6 Wider seals go into the wider seal groves and the narrower seals go into the inner seal groves.



5.7 Lube seals with a lubricant and brush specified in the system protector service manual. Be careful not to use too much.



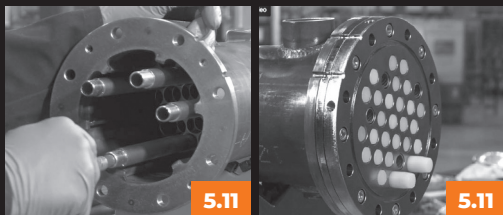
5.8 Lay both header plates down on a clean surface with the narrower O-ring groove facing up. Apply a thin layer of lubricant to the plastic assembly bullets and install them in all tubes holes in both header plates.

DUAL HEADER PLATE DESIGN RE-ASSEMBLY



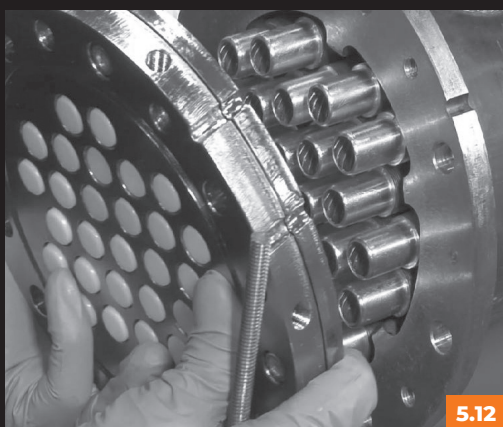
- 5.9** Install new header to end flange seals into the header plate. Add a slight amount of lube to keep the seal in place.

Install the header plate to one end of the cooler. Note the orientation notches on the header plate and the header flange be sure they are lined up.

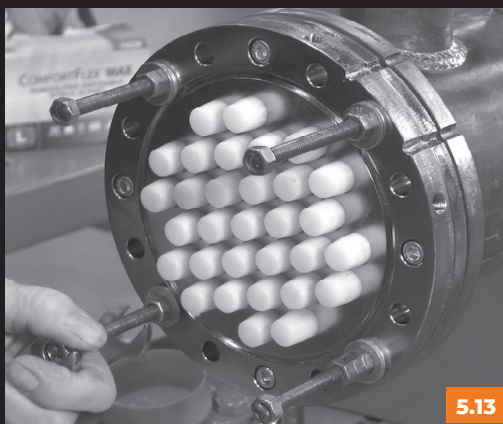


- 5.10** Install the header retainer bolts leave loose until all tube ends are pushed through the header plates.

- 5.11** Apply a light coat of assembly lube to clean tube ends. From the open end of the cooler install 4 tubes through the baffle assemble and into the attached header plate at 3, 6, 9, 12 O'clock positions to maintain baffle to header alignment. Using the tube driver tool push the tubes through the seals till the tube shoulders bottom out on the header plate this will push the plastic bullets through the other end of the tank. Continue to install the remaining tubes.

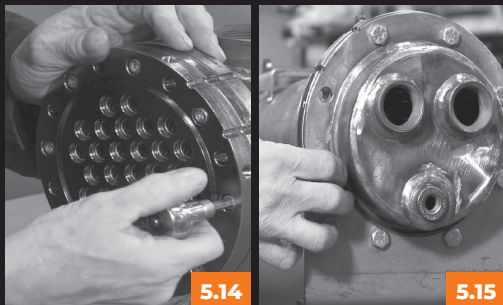


- 5.12** Align the second header plate tube holes with the tubes. Be sure that the orientation notches line up.



- 5.13** Insert the header plate draw down bolts into the header plate retainer bolt holes. Pull the header plate in place with the header plate draw down bolts do this uniformly by alternately tightening each bolt around the perimeter one half turn at a time. tighten till the header is tight to the shell.

Remove header plate draw down bolts and plastic assembly bullets. Install proper retainer bolts and torque each header to the recommended specification for your unit.



- 5.14** Inspect tube holes for reminiscences for torn rubber seals if necessary replace damaged seals.

Install the tank ends ensuring to line up the orientation notches. Insert bolts flat-washers and nuts.

- 5.15** Install the mounting feet in the same orientation as they were removed.

TESTING THE SHELL SIDE OF THE COOLER

(TYPICALLY THE OIL SIDE – SEE CHART BELOW)

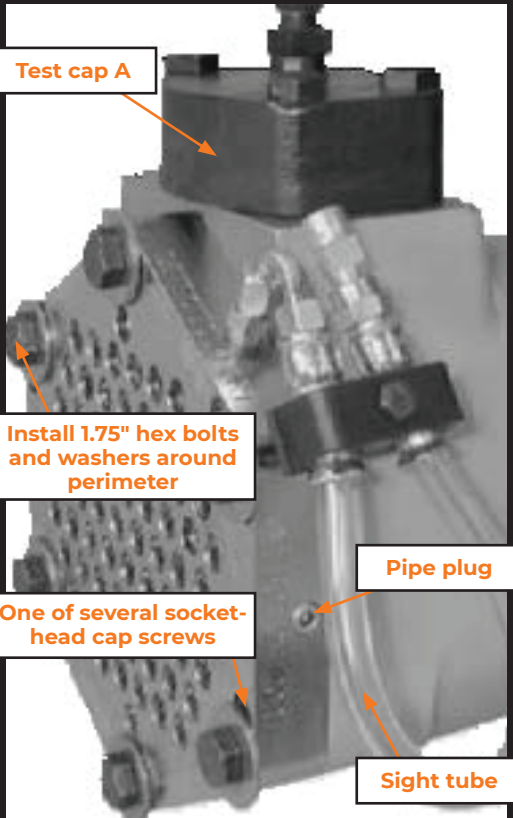
This test will determine if one of the following conditions exists:

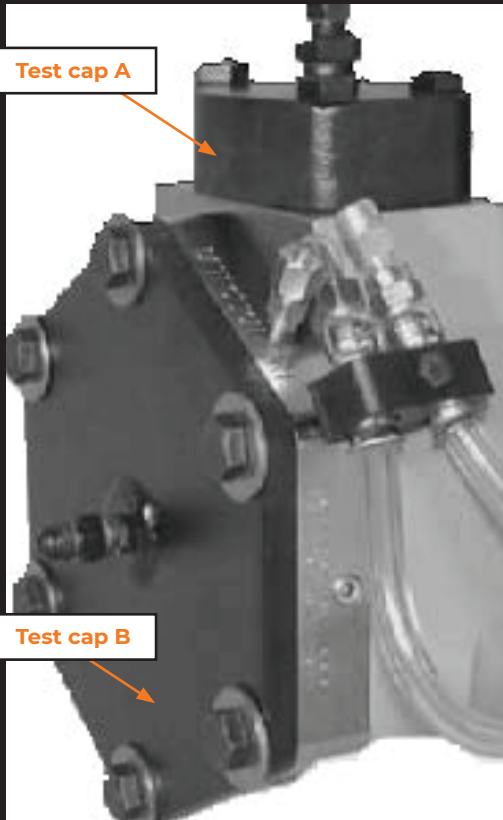
- Seal #102138 is twisted, chipped, missing, or contaminated.
- Cooling tube is damaged in the finned area.
- Cooling tube sealing surface is scratched or deformed.

1. Confirm that all socket-head cap screws are in place in both header plates and properly torqued.
2. Install sight tube assembly into desired detection port and install pipe plugs into all remaining detection ports.
3. Install test cap A (See NOTE 1) on both side ports.
4. Install 1.75" long hex bolts with flat washers in all locations on both header plates. These bolts will provide clamping during testing.
5. With the cooler under water, begin the shell side test sequence shown in the chart below. Check for leaks from the ends of the cooling tubes and the sight tube.
 - If a leak is detected coming from a cooling tube end, mark the tube and remove the header plate following steps 1.5, 1.6 and 1.9. Replace the damaged tube.
 - If a leak is detected in the sight tube, the source will be the seal #102138 or a tube with a damaged sealing surface or tube end. Remove the header plate following steps 1.5, 1.6 and 1.9. Replace the defective part.
6. Lubricate parts replaced, install the assembly bullets and the header plate following appropriate assembly instructions.
7. After any repair, restart the test sequence.

SHELL SIDE TEST SEQUENCE – TEST UNDER WATER

STEP	PRESSURE CYCLE TO BE APPLIED TO THE SHELL	TIME (MIN.)
1	RAISE TO 110 PSI	AS NEEDED
2	CYCLE 0- 150	10 MIN. AT 150
3	CYCLE 0- 150	5





TESTING THE TUBE SIDE OF THE COOLER

(TYPICALLY THE WATER SIDE – SEE CHART BELOW)

This test will determine if one of the following conditions exists:

- Seal #LS was damaged, is missing, or contaminated.
- Cooling tube sealing surface is scratched or deformed.

1. Keep test cap A in place and make sure there is no pressure in the unit. Remove all hex bolts that hold the header plates on.
2. Install test cap B (See NOTE 1) on both ends of cooler using appropriate length hex bolts and flat washers and tighten to proper specifications. NOTE: End tanks may be used for this purpose.
3. With the cooler under water, begin the tube side test sequence and check for leaks at the sight tubes.
4. If a leak is detected at a sight tube, remove the pressure and remove the test cap B.
5. Remove the sight tube and apply pressure to the detection port. Using soapy water, determine which seal is leaking and mark that seal and tube end.
6. Remove the header plate following steps 1.5, 1.6 and 1.9 and replace the leaking seal or damaged tube.
7. Lubricate parts replaced, install the assembly bullets and the header plate following appropriate assembly instructions.
8. Replace header plate, test cap B, and the sight tube and continue test sequence until no leaks are detected.

TUBE SIDE TEST SEQUENCE – TEST UNDER WATER

STEP	PRESSURE CYCLE TO BE APPLIED TO THE SHELL	TIME (MIN.)
1	RAISE TO 50 PSI	AS NEEDED
2	CYCLE 0-50	1
3	CYCLE 0-50	5

WORLD HEADQUARTERS / USA

L&M RADIATOR, INC.
1414 EAST 37TH STREET
HIBBING, MINNESOTA 55746 U.S.A.

TELEPHONE: 218.263.8993
TOLL FREE: 1.800.346.3500
FAX: 218.263.8234

WEB: mesabi.com
EMAIL: cool@mesabi.com

AUSTRALIA

L&M RADIATOR PTY.LTD.
245 STAR STREET
WELSHPOOL, WESTERN AUSTRALIA 6016

TELEPHONE: 011.61.8 92304400
FAX: 011.61.8 92304400

EMAIL: cool@mesabi.com.au

YANKTON

2204 WEST CITY LIMITS ROAD
YANKTON, SD 57078

TELEPHONE: 605.664.8993
TOLL FREE: 1.800.346.3500
FAX: 605.664.8234

CHILE

L&M INDUSTRIAL RADIATOR
SUDAMERICA LTDA.
AVENIDA ANTONIO RENDIC 6930,
ANTOFAGASTA- CHILE

TELEPHONE: +56 55 2 893231

EMAIL: ventas@mesabi.com



L&M QUALITY POLICY

The Quality Policy of L&M Radiator is to produce a quality engineered, quality manufactured product through continuous improvement that we deliver to the customer's satisfaction.

MESABI® Flexible Core Heat Exchangers are marketed on a factory-direct basis from four L&M Radiator plants around the world. L&M Radiator is able to give exceptional service to users and OEMs because all service is controlled at the manufacturer level. In emergencies, we can ship complete radiator cores or parts within 48 hours. On-site technical and engineering assistance is available nearly anywhere in the world within a few days notice. L&M Radiator is proud to provide both old and new customers around the world with products known for quality and dependability since 1957. L&M Radiator manufacturing facilities and parts depots are located in the countries listed above.

18-MONTH WARRANTY - MESABI® System Protector™ Tube and Shell Cooler

L&M Radiator warrants the MESABI® System Protector™ Tube & Shell Cooler manufactured by L&M for a period of 18 months from date of invoice. Under this warranty, our obligation is limited to the repair or replacement (at our option) of products or parts manufactured by L&M that are proven to be defective in workmanship or material. Damage or leakage due to accidents, misuse, or corrosion is not warranted. Warranty on components not manufactured by L&M Radiator shall be that of the individual manufacturers. L&M is not liable for consequential or incidental damages or costs. Consult factory before proceeding with warranty claims. This warranty supersedes all previously published warranties.

CSC™, ITS™, MESABI®, and RTTS® are registered trademarks of L&M Radiator, Inc.