CGThermal
Process Technology Solutions
for Harsh and Corrosive Process Streams

Umax SiC Advanced Ceramic Heat Exchanger

Installation, Operation, and Maintenance Instructions

Series LD, MD, HD, XD

CGThermal

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1470 Enterprise Pkwy, Twinsburg, Ohio 44087, USA
Phone: (330) 405-0844 – Fax: (330) 487-0304
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Proper safety precautions as detailed throughout this manual and as recommended by applicable codes, guidelines, and design societies should be exercised in the operation of all heat transfer equipment to prevent equipment damage or personal injury in event of operator error or mechanical failure.

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PRODUCT RECORD

Customer: _____

Model #: _____

Serial #: _____

Drawing #: _____

Date of Shipment: _____

Date received and tested: _____

Maintenance/Service Record	
Date	**Description**

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SECTION I: INTRODUCTION

1-1 SCOPE

This manual covers installation, operation, and maintenance instructions for the Umax SiC Advanced Ceramic shell and tube heat exchanger, manufactured by CG Thermal, LLC.

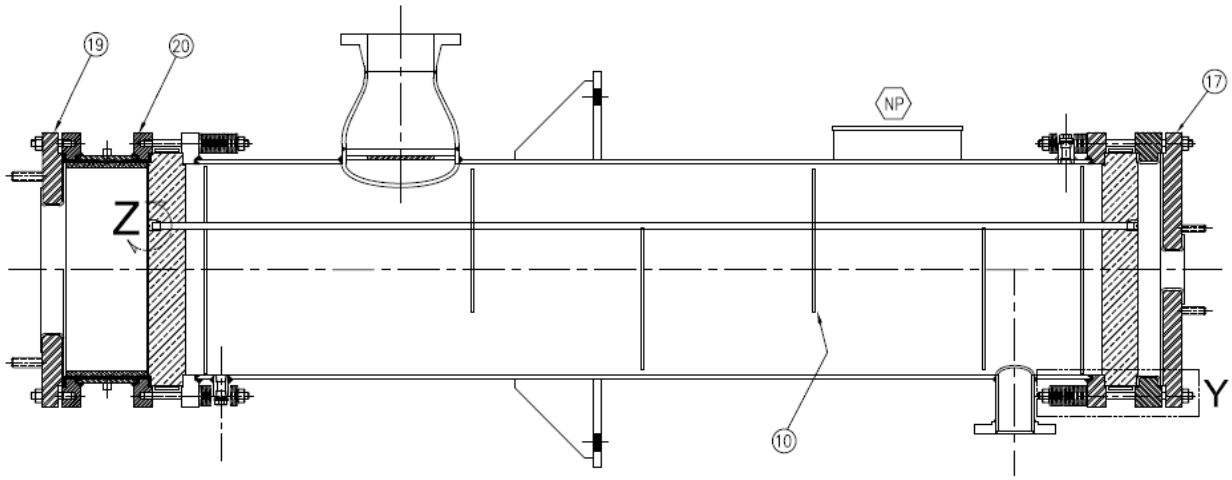
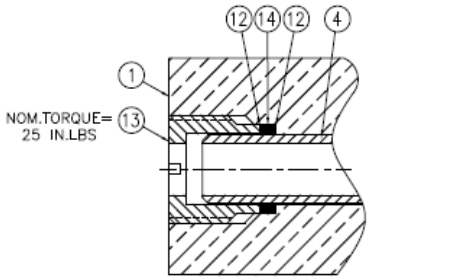
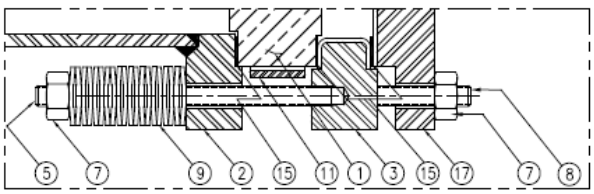


Fig. 1-1
General Arrangement

Item	Description
1	tube sheet
2	shell sub-assembly
3	bolting ring
4	tubes
5	stud
7	nut
8	stud
9	spring washers
10	baffle cage
11	tube sheet cover
12	back-up ring
13	tube nut
14	o-ring
15	gasket
17	clamp plate-right
19	clamp plate-left
20	optional spool
NP	name plate



DETAIL "Z"
O-RING ASSEMBLY ~(TYP. BOTH ENDS)



DETAIL "Y"

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1-2 DESCRIPTION & APPLICATION

The CG Thermal Umax Ceramic shell and tube heat exchanger is designed to handle nearly all corrosive liquids or gases. Umax Ceramic has excellent thermal conductivity with extreme resistance to corrosion and thermal shock. The CG Thermal Umax Ceramic shell and tube heat exchanger is completely field repairable with common tools when proper procedures are followed.

1-3 INSPECTION UPON RECEIPT

Heat exchangers can be damaged by handling during transit. For this reason, warranty provisions require that inspection of heat exchangers must be completed upon receiving.

Use the following instruction for inspections ***UPON RECEIPT:***

1. ***Immediately upon receipt and before removing the heat exchanger from the carrier vehicle:***

    a. Examine the skid and shipping covers for damage in transit.

    b. Remove covers and visually inspect all components for damage.

    c. Unit is shipped under 10 psig nitrogen. Read gauges prior to offloading and document gauge reading on receiving document.

2. If gauge reading shows no pressure:
    a. Check the compressed height of the disc springs at the shell flange and the torque loading of the tube side bonnet bolts. Compare them to what is listed on the general assembly drawings. Re-torque may be necessary due to gasket "settling" during transportation. Refer to your assembly drawing for the proper compressed disc spring height and torque value.
    b. Confirm torque setting of the clamp plate bolts matches the specification on the drawing sent with unit.

3. Please complete and sign an inspection report and return a copy to CG Thermal within one week of receipt to validate the equipment warranty. Contact a CG Thermal representative to obtain an inspection report if necessary.

4. If the inspection report is not completed and returned to CG Thermal within one week of receipt, any damage found later will be the responsibility of the customer.

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IMPORTANT: The carrier is responsible for equipment losses and damage during shipment. If any components are missing or damaged pressure cannot be maintained. Make note on the carrier's receiving documents and notify the carrier immediately and file an appropriate claim.

STORAGE AND MOVING INSTRUCTIONS

If the heat exchanger is not immediately installed, drain the test water completely to prevent freeze damage. Store the unit in a covered area to protect the components from moisture. Notify CG Thermal LLC immediately if any questions arise or if the heat exchanger is to be rejected and returned.

CAUTION

When moving the heat exchanger, all lifting points should be only on the shell, not on the bonnets, clamp plates, or wooden shipping cradles/skids. Slowly lower the heat exchanger to the ground completely. Do NOT drop the heat exchanger when lowering to the ground, as doing so could damage tubes or internal components.

CG Thermal LLC can provide experienced field advisory personnel to guide and instruct construction and maintenance supervisors in the techniques used in assembling, installing and maintaining the Umax Ceramic equipment. Contact CG Thermal to arrange for field advisory service.

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1-4 HYDROSTATIC TEST

If required, perform the shell side hydrostatic test according to the following procedure. Refer to assembly drawing for actual design and test pressures of your unit.

1. Install a blind flange on the lower shell side nozzle.
2. Fill the shell side with water using plant line pressure.
3. Loosely install a blind flange with test fixture on upper shell side nozzle.
4. Continue to fill unit until water comes out between fixture and shell nozzle (this allows the air to bleed out as the shell is filled). Then tighten the upper blind flange.
5. Attach the hydrostatic pump to the test fixture and bring the shell to the desired test pressure.
6. Check that there is no leakage from the blind flange gaskets. If there is, release pressure and tighten as required.
7. Using the hydrostatic pump, increase the pressure back to the test pressure. Do not exceed the design pressure shown on the assembly drawing.
8. If no external leak is present after 10 minutes, check the pressure.
9. It is not unusual for the initial pressure to drop off due to the water soaking into the gaskets and/or trapped air being absorbed into the water. If the pressure has dropped, bring the unit back to recommended test pressure as needed.
10. If a leak is noted between the tube sheet and shell flange, confirm that the disc springs are at the proper height or torque value.
11. If a leak is noted at the face of the tube sheets, there may be broken tubes. Remove the clamp plate and visually check for water along the inside of the tubes to isolate any damaged tubes. Refer to section 4-3 if a tube needs to be replaced.
12. If a leak is noted in the threads of the tube nut or between the ID of the tube nut and the OD of the Umax tube, the o-ring may not be sufficiently compressed. With the clamp plate removed, reduce the shell side pressure and torque the tube nut to the value stated on the assembly drawing. If a leak occurs, increase the torque by 5 in-lbs and retest. ***Do NOT*** exceed the specified value plus 5 in-lbs without prior approval from CG Thermal.
13. Again, pressurize unit to the proper test pressure. Once the unit is stabilized for an additional 10 minutes, please record the test pressure.

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Typically, it is only necessary to complete a shell side test for inspection. If a tube side test is performed, be certain to do so with the shell side filled to avoid dangerous sudden high pressure release if a tube were to fail. Always release pressure prior to tightening any hardware.

SECTION II: INSTALLATION

2-1 INSTALLATION LOCATION

Unless adequate provisions can be made for relocating the complete heat exchanger, it is recommended that sufficient clearance be allowed for dismantling the heat exchanger for maintenance and repair purposes. Tubes can be removed from either end of the heat exchanger. Therefore allow the length of the exchanger plus 1 foot (305 mm) from either end of the unit for removal.

2-2 FOUNDATION AND SUPPORTS

The heat exchanger should be mounted on a foundation or support structure adequate to prevent movement, vibrations, or settling. On horizontally mounted exchangers, one support has drilled mounting holes and the other support has slotted holes. Tighten the drilled bracket and use double nut at the slotted bracket so there is clearance between the bolts and slotted holes to allow the bracket to slide as the shell thermally expands and contracts.

2-3 SHELLSIDE PIPING REQUIREMENTS

Piping connections can be made to the steel shell using normal precautions for good practice in flange alignment. Steam lines should be properly trapped and provisions made to drain all water legs which might develop in the supply line on shutdown. Shell drain connection should be piped to allow shell to drain on shutdown. If automatic controls are used on the steam line, use slow opening valves to prevent water hammer. Automatic control valves, when closed or almost closed, can allow steam to enter the heat exchanger without providing enough pressure to discharge the condensate. Therefore, condensate lines should be arranged so there is no back pressure after the trap, and a vacuum breaker should be provided on the shell. This will permit condensate to drain by gravity.

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2-4 PROCESS PIPING REQUIREMENTS

Piping to the process nozzles should be studied and planned carefully to prevent any stresses from being transmitted to the heat exchanger. Flexible couplings, installed as close to the heat exchanger as possible, are recommended to isolate the heat exchanger from vibration, misalignment, thermal expansion of the piping, or other loads that can impose stress on the heat exchanger.

Observe the stated torque values on your assembly drawing for the process nozzles. Over-torque can put undue loading on the internal parts causing damage to the heat exchanger.

NOTE

Use gaskets that are easy to seal and require low torque values. Restructured PTFE gaskets, such as **GARLOCK® GYLON®** Style 3540 or GORE-TEX® GR, are recommended.

2-5 PRESSURE RELIEF DEVICES/THERMOWELLS

If the heat exchanger is to be operated under pressure, the installation of a pressure relief device is recommended. Refer to ASME Code Section VIII, Division I, for recommendations on these devices. Install them in process piping lines to minimize the number of openings in the heat exchanger.

For added convenience, thermowells can be installed on the inlet and outlet sides to permit rapid visual checks of exchanger operation at all times. In addition, installation of a bypass valve system on the heat exchanger piping will permit disassembly of the heat exchanger itself without shutting down the line.

2-6 DISC SPRINGS

Disc springs are used at the shell side flange bolting to keep the PTFE tube sheets under load. The disc springs allow for thermal growth and cold flow of the PTFE tube sheet while maintaining proper gasket compression. The correct compressed height or associated torque value for the disc springs is found on your specific assembly drawing.

DO NOT reduce the disc spring compressed height or torque below the recommended minimum. Replace damaged or defective disc springs. Reduction of correct disc spring compression or number will change the bolt load and can cause possible deformation of the PTFE tube sheet or leakage..

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SECTION III OPERATION

3-1 OPERATING PRECAUTIONS

Do NOT operate the heat exchanger at pressure or temperature conditions exceeding those specified on its nameplate. Exceeding the values could result in a catastrophic mechanical failure and serious bodily injury.

Do NOT blow out the heat exchanger with air if material normally handled is flammable. Spreading these materials could result in a fire and bodily harm.

Do NOT remove the bonnets, clamp plates, or the tube sheet bolting rings until all pressure is relieved and liquids are drained. Opening the heat exchanger while under pressure could result in explosive movement of the bonnets, clamp plates, the tube sheets, or internal parts and cause bodily harm.

Although Umax Ceramic itself is immune to thermal shock at temperatures encountered in chemical processing units, it is recommended to avoid thermal shock of the heat exchanger. Gradually bring the heat exchanger up to operating conditions as outlined in paragraph 3-2, Start-Up. Using the recommended start-up procedures will reduce the possibility of damage due to mechanical stresses resulting from rapid temperature changes.

The o-rings originally provided with the heat exchanger may use a material of construction selected for a specific chemical service. If the service of the heat exchanger is changed, a different o-ring material may be required.

3-2 START-UP

To start the heat exchanger, run the cold medium through first, then follow with the hot medium. Open valves slowly, flooding the heat exchanger and venting all air, before allowing full flow. The steam trap bypass valve should be open when starting up a steam-heated heat exchanger. This valve can be closed when a steady flow of steam has been attained.

Additionally, on steam-heated heat exchangers, it is important that the steam be shut off promptly whenever the flow of process fluid is stopped or interrupted. If the steam remains on, the stagnant process fluid will boil and create local pressure shocks that can damage the heat exchanger.

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SECTION IV HEAT EXCHANGER MAINTANANCE

4-1 INSPECTION AND CLEANING

Maintain a schedule of periodic inspection to check o-rings and gasket joints and to determine the need for cleaning the heat exchanger. Chemical cleaning, if it is effective for the scale involved, is the fastest and most convenient cleaning method. Any chemical cleaning solution can be used with the Umax Ceramic tubing. However, it should be confirmed that the cleaning solution is also compatible with PTFE, the clamp plate and shell side material of construction, and the elastomeric o-ring seal material.

If mechanical cleaning is required on the shell side, the tube bundle must be removed from the shell. Refer to paragraph 4-6 for the dismantling procedure and paragraph 4-7 for reassembly. We recommend contacting the factory before attempting complete bundle removal. Factory and field service personnel are available to assist as needed.

High pressure water-jet cleaning can be used, if required. Mechanical scraping or wire brushing of the Umax Ceramic tubing is acceptable (except for the o-ring sealing area) if it is done carefully to avoid breaking the tube.

4-2 GASKETS AND PACKING REPLACEMENT

Gasket and o-ring leaks should be sealed immediately to avoid corrosion or erosion damage to associated parts. Gaskets recommended as spare replacement parts are all made of restructured PTFE Sheet (such as GARLOCK® GYLON® Style 3540 or GORE-TEX® GR).

O-rings are made of elastomeric material. Always keep a supply of gaskets, o-rings, and back-up rings on hand. Refer to your assembly drawing for the sizes and types needed. Also refer to Section V, Recommended Spare Parts.

4-3 TUBE REPLACEMENT

Tubes can be replaced in the field without removing the bundle from the shell. Replacement will be easier with the heat exchanger in a horizontal position. Refer to Figure 4-1 for the details of tube sheet construction for tube replacement.

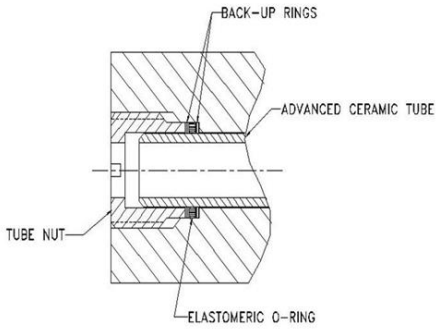

Fig. 4-1

Tube Seal

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4-3.1 Materials and Tools Required.

The following materials and tools are necessary to properly repair a tube:

a. Required quantity of Umax Ceramic tubes
b. Required quantity of replacement o-rings and back-up rings
c. Required quantity of replacement tube nuts
d. Required quantity of tube plugs (if tube is not replaced)
e. (2) clamp plate gaskets
f. Tool kit consisting of torque driver with nut bit, positioning tool, and Krytox 205 lubricant
g. A supply of cleaning rags
h. Acetone for cleaning tubes

Please refer to the parts list for the required quantity.

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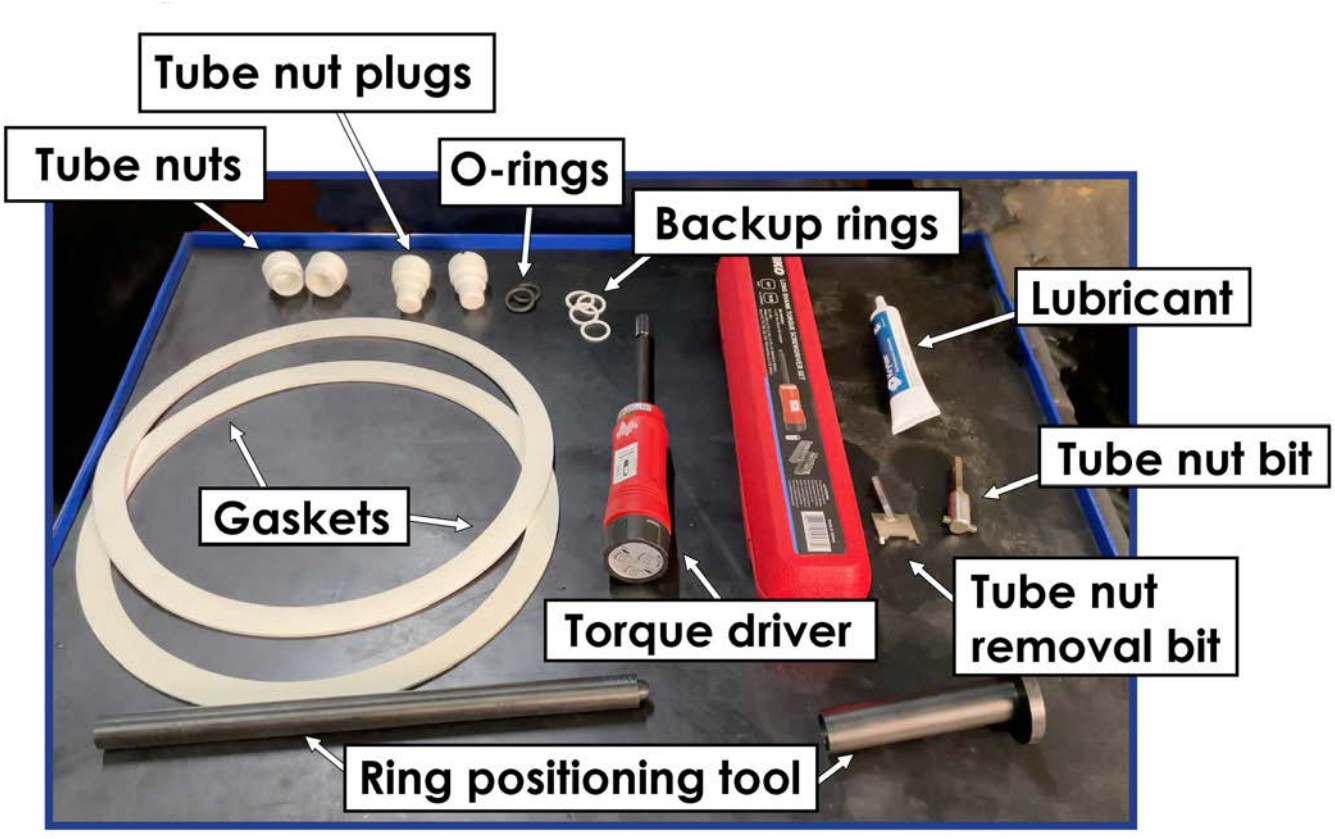
Spare Parts Box Kit for Umax



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4-3.2 Repair Procedure

1. Remove both clamp plates to allow access to the tube sheets by loosening the tube side bolting only. Do not loosen the shell side bolting or remove the tube sheet bolting ring.

2. Using the torque driver, remove the tube nuts from both ends of the Umax Ceramic tube being replaced.

3. Push the tube through one of the tube sheets with the rounded end of the positioning rod so it can be grasped at the other end and pulled from the heat exchanger. Remove the o-rings and back-up rings from the tube sheet gland.

4. Slide the new tube into place in the heat exchanger and clean the ends of the tube with acetone once it is in place.

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NOTE

It may be necessary to rotate the tube to get it into the tube sheet hole. In order to guide a tube into the tube sheet hole, insert the positioning rod through the tube sheet hole and into the I.D. of the tube.

5. If the old o-rings are to be reused, clean them in warm soapy water or a solvent compatible with the o-ring material. Inspect them for cuts and signs of wear, discarding any questionable ones. New back-up rings are recommended.

Many o-ring elastomers are not compatible with solvents such as acetone. Make sure the solvent used (if not soapy water) is acceptable. Always take care to avoid any ignition sources when using acetone.

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6. Apply Krytox 205 lubricant to approximately 2 inches of both ends of the new Umax Ceramic tube. Apply the lubricant to the o-rings also.

7. Place an o-ring between two back-up rings on the positioning tool and push them into the seat of the tube sheet hole. Repeat this for each hole.

8. To avoid cross-threading and damage to the tubesheet or nut, carefully thread each tube nut into the tubesheet by hand. Then, use the torque driver to tighten each to the torque value shown on the assembly drawing.

9. Test the repair by applying a shell side hydrostatic test.

   Do not exceed the design value stated on the assembly drawing.

10. If time permits, it is recommended that each tube sheet be warmed to 100°F to allow the o-rings to "set or flow" as required. Allow the unit to cool to room temperature. Then re-torque the tube nuts to the original value and reapply the shell side hydrostatic test.

11. Reinstall the clamp plates using the reverse tandem bolt tightening sequence shown in Figure 4-2.

12. Perform a tube side hydrostatic test being mindful not to exceed the design pressure shown on the assembly drawing.

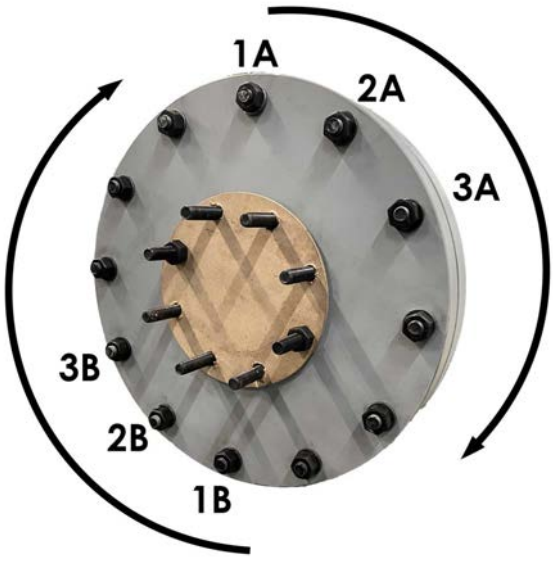

Figure 4-2. Reverse Tandem

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4-4 TUBE PLUGGING PROCEDURE

If replacement tubes are not available or if other conditions warrant, plug off the tubes in the following manner.

1. Follow the steps in the tube repair procedure, paragraph 4-3.2, to remove the tube from the shell.

2. Clean the o-rings per paragraph 4-3.2 or use new ones. Lubricate the back-up rings, o-rings and plug end with Krytox 205 lubricant. Install the o-ring between back-up rings on the shoulder of the tube plugs, as shown in the photo below.

3. To avoid cross-threading and damage to the tubehseet or tube plug, carefully thread each tube plug into the tubesheet by hand. Use the torque driver to torque them to the value shown on the assembly drawing. Test and reassemble the heat exchanger as outlined in paragraph 4.3-2.

4-5 TUBE SHEET AND CLAMP PLATE REPAIR

If it is found during heat exchanger disassembly, repair, or testing that the tube sheets, bonnets or clamp plates need repair, contact CG Thermal.

4-6 HEAT EXCHANGER DISASSEMBLY

For shell side mechanical cleaning or inspection, it will be necessary to disassemble the tube bundle from the shell. Refer to your assembly drawing for specific construction details and to Figures 1-1 for the general arrangement. It is recommended that you contact the factory prior to disassembly. Factory and field service personnel are available to assist.

Prior to disassembly, please note:

If rusted or frozen, shell side disc spring loaded fasteners are to be cut for removal, extreme care must be taken to prevent the fastener from becoming a projectile that can cause bodily harm.

Umax Ceramic tubing is strong but brittle and can suffer mechanical damage if mishandled, dropped, or subjected to bending loads. Therefore, take extreme care when disassembling the bundle from its shell.

It is not necessary to remove the bundle to replace the tubes. Refer to paragraph 4-3.2 for this procedure.

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4-6.1 DISASSEMBLY INSTRUCTIONS

1. If possible, move the heat exchanger to a convenient working area where hoist or crane facilities are available.

2. Remove both clamp plates by loosening the tube side bolting. ***Do not*** remove the tube sheet bolting ring at this time.

3. Remove all the PTFE tube nuts from both tube sheets.

4. Using the rounded end of the positioning tool, push all the Umax Ceramic tubing through the first tube sheet until they are past the backside of the first tube sheet.

5. Remove the tubesheet bolting ring on the first tube sheet by loosening the spring-loaded shell side bolting.

6. The first tubesheet and tubesheet cover can now be lifted off the heat exchanger.

7. Using the rounded end of the positioning tool, push each tube through the second tubesheet until the tubes are at the backside of the second tubesheet.

8. Remove the second tubesheet bolting ring by loosening the spring-loaded shell side bolting. Then, remove the second tubesheet and tubesheet cover from the shell.

9. Carefully remove each tube, one at a time, from the tube bundle. ***Do not*** apply any cantilever loads to the tubes as they are being removed.

10. Set the tubes aside in a protected area taking care not to drop them or chip or scratch the tube ends during handling. It is important to protect the ends of the tube from chipping, therefore, it is recommended that the tube ends be wrapped in masking tape.

11. Remove the baffle cage (subassembly of baffles and tie rods) from inside the shell.

12. Remove the o-rings and back-up rings from the tubesheet glands.

13. The disassembly is now complete. Clean or repair any of the shell side components, as required.

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4-7 HEAT EXCHANGER REASSEMBLY

After cleaning or repairs have been completed, the heat exchanger can be reassembled by completing the following steps. Always use new gaskets, o-rings, backup rings, and disc springs, as required, and clean all gasketed surfaces to ensure proper sealing.

1. Install the baffle cage inside the shell. Orientate the baffle cage in relation to the shell nozzles as shown on the assembly drawing.

2. Install the tubes, one at a time, into the baffle cage. Remove any tape that was used to protect tube ends. Clean the tube ends with acetone. Lubricate 2" of all tube ends with Krytox 205 lubricant.

3. Position the tubes so they are 1" inside the shell flange face of the second tube sheet end of the heat exchanger.

4. Set the second tube sheet in place on the shell making sure the tube sheet cover is in place.

5. Install the second tube sheet bolting ring and snug up the spring-loaded shell side bolting only enough to firmly hold the tube sheet.

6. Test the tube sheet orientation by sliding 8 to 12 Umax Ceramic tubes through the proper holes in the second tube sheet. If all the test tubes are not aligned, push any that are in place back through the tube sheet and bump or jog the tube sheet to reorient it in relationship to the tube bundle.

NOTE

It may be necessary to rotate the tube to get it into the tubesheet hole. In order to guide a tube into the tubesheet hole, insert the positioning rod through the tube sheet hole and into the ID of the tube.

7. When the proper orientation is obtained, tighten the shell side bolting to the stated spring height or torque value as shown on the assembly drawing using the reverse tandem pattern shown in Figure 4-2.

8. Slide all the tubing through the second tube sheet and position the ends at the first tubesheet 1" inside the face of the shell side flange.

9. Repeat steps 3 through 7 for the first tube sheet and position the tubes evenly inside the tubesheets.

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10. Apply the Krytox 205 lubricant to the new or cleaned o-rings and back-up rings.

11. If the old o-rings are to be reused, clean them in warm soapy water or a solvent compatible with the o-ring material. Inspect them for cuts or signs of wear, discarding any questionable ones. New back-up rings are recommended.

Many o-ring elastomers are not compatible with solvents such as acetone. Make sure the solvent used (if not soapy water) is acceptable.

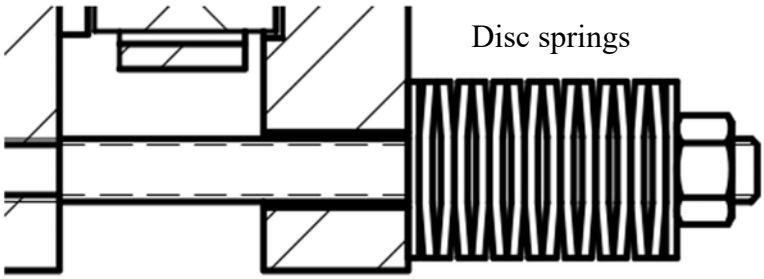
.

12. Place an o-ring between two back-up rings on the positioning tool and push them into the seat of the tube sheet hole. Repeat this for each hole.

13. Install the tube nuts using the torque driver to tighten each to the value shown on the assembly drawing

14. Test the heat exchanger by applying a shell side hydrostatic test being mindful not to exceed the value shown on the assembly drawing.

15. Install the clamp plates by tightening the tube side bolting to the torque value or spring height specified on your assembly drawing. It is important that all bolted joints be tightened uniformly using the reverse tandem pattern as previously illustrated in Figure 4-2.



16. Perform a tube side hydrostatic test, again not exceeding the design pressure indicated on the assembly drawing.

NOTE

If time permits, it is recommended that each tube sheet be warmed to 100°F to allow the o-rings to "set or flow" as required. Allow the unit to cool to room temperature. Then, re-torque the tube nuts to the original value and reapply the shell side hydrostatic test.

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SECTION V RECOMMENDED SPARE PARTS

When ordering spare parts, please refer to the heat exchanger drawing or serial number to ensure the parts ordered will be the correct items and materials of construction for your heat exchanger.

Normal recommended spare parts are:

U-max Ceramic Tubes
O-rings
Back-up Rings
Tube Nuts
Tube Plugs
Gaskets
Tool Kit

For replacement parts, field service, or heat exchanger rebuilding, contact:

CG Thermal, LLC
8950 Dutton Dr.
Twinsburg, OH 44087
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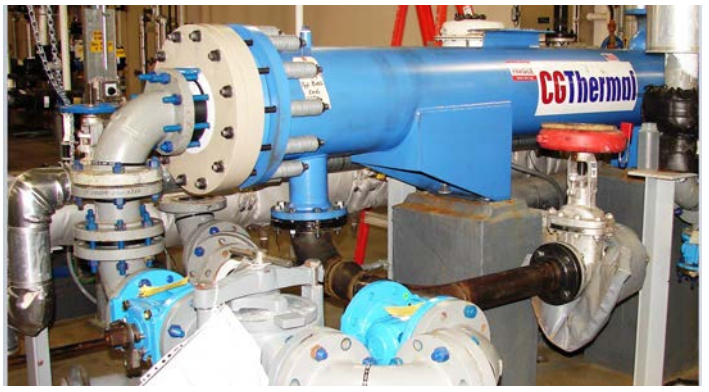
Umax SiC Advanced Ceramic Shell and Tube Heat Exchanger



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