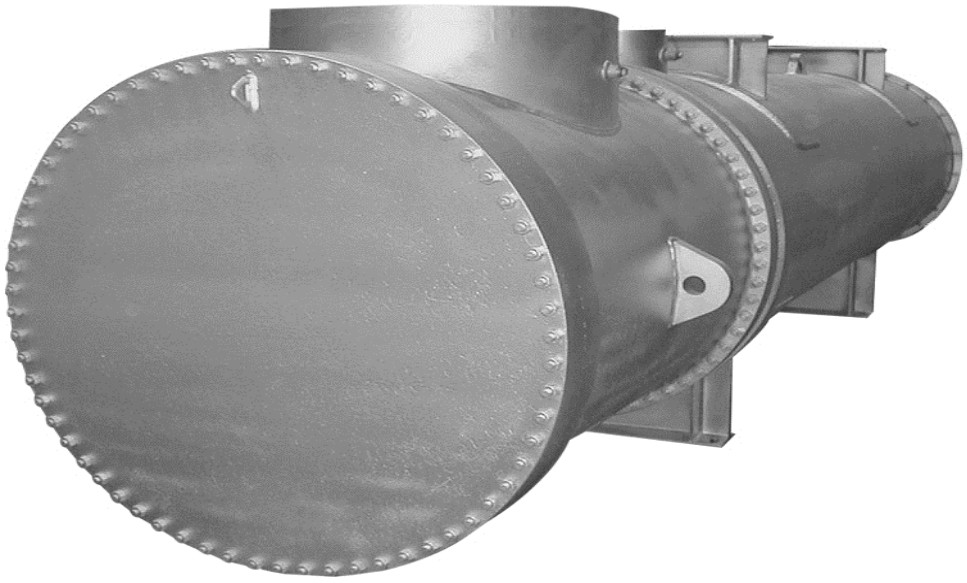
Installation, Operation,
and Maintenance Manual



Model OCT, OFT, SUT/WUT
Shell and Tube Heat Exchangers

Bell & Gossett
a xylem brand

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Introduction and Safety

Introduction

Purpose of this manual

The purpose of this manual is to provide necessary information for:

- Installation
- Operation
- Maintenance



CAUTION:
Read this manual carefully before installing and using the product. Improper use of the product can cause personal injury and damage to property, and may void the warranty.

NOTICE:
Save this manual for future reference, and keep it readily available at the location of the unit.

Safety



WARNING:

- The operator must be aware of safety precautions to prevent physical injury.
- Operating, installing, or maintaining the unit in any way that is not covered in this manual could cause death, serious personal injury, or damage to the equipment. This includes any modification to the equipment or use of parts not provided by Xylem. If there is a question regarding the intended use of the equipment, please contact a Xylem representative before proceeding.
- Do not change the service application without the approval of an authorized Xylem representative.



CAUTION:
You must observe the instructions contained in this manual. Failure to do so could result in physical injury, damage, or delays.

Safety terminology and symbols

About safety messages

It is extremely important that you read, understand, and follow the safety messages and regulations carefully before handling the product. They are published to help prevent these hazards:

- Personal accidents and health problems
- Damage to the product
- Product malfunction

Hazard levels



DANGER:
A hazardous situation which, if not avoided, will result in death or serious injury.



WARNING:
A hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION:
A hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE:

- A potential situation which, if not avoided, could result in undesirable conditions.
- A practice not related to personal injury.

Hazard categories

Hazard categories can either fall under hazard levels or let specific symbols replace the ordinary hazard level symbols.

These are examples of other categories that can occur. They fall under the ordinary hazard levels and may use complementing symbols:

- Crush hazard
- Cutting hazard
- Arc flash hazard

User safety

General safety rules

These safety rules apply:

- Always keep the work area clean.
- Pay attention to the risks presented by gas and vapors in the work area.
- Avoid all electrical dangers. Pay attention to the risks of electric shock or arc flash hazards.
- Always bear in mind the risk of drowning, electrical accidents, and burn injuries.

User safety



This product can expose you to Lead, which is known to the state of California to cause cancer and birth defects and other reproductive harm. For more info go to: www.P65Warnings.ca.gov

Safety equipment

Use safety equipment according to the company regulations. Use this safety equipment within the work area:

- Hard hat
- Safety goggles, preferably with side shields
- Protective shoes
- Protective gloves
- Gas mask
- Hearing protection
- First-aid kit
- Safety devices

NOTICE:
Never operate a unit unless safety devices are installed. Also see specific information about safety devices in other chapters of this manual.

Product Warranty

Coverage

Xylem undertakes to remedy defects in products from Xylem under these conditions: The faults are due to defects in design, materials, or workmanship.

- The faults are reported to a local sales and service representative within the warranty period.
- The product is used only under the conditions that are described in this manual.
- The monitoring equipment that is incorporated in the product is correctly connected and in use.
- All service and repair work that is done by Xylem authorized personnel.
- Genuine Xylem parts are used.
- Only Ex-approved spare parts and accessories that are authorized by an Ex-approved Xylem representative are used in Ex-approved products.

Product Warranty

Limitations

The warranty does not cover defects that are caused by these situations:

- Deficient maintenance
- Improper installation
- Modifications or changes to the product and installation that are made without consulting a Xylem authorized representative
- Incorrectly executed repair work
- Normal wear and tear

Xylem assumes no liability for these situations:

- Bodily injuries
- Material damages
- Economic losses

Warranty claim

Xylem products are high-quality products with expected reliable operation and long life. However, should the need for a warranty claim arise, contact your local sales and service representative.

Product Description

General description

Description

Bell & Gossett, Engineered Shell and Tube models OCT, OFT, OFI, SUT/WUT, IFH, IFH-B, and EFH heat exchangers are of the shell and tube type. Tube bundles can be fixed tubesheet, non-removable style as well as removable bundle style. Tube ends are roller expanded into the tubesheets. Baffles are stamped to close tolerances, minimizing the slippage of liquids or vapors between the baffles and shell wall. An expansion joint in the shell of fixed tubesheet styles can be provided for broad temperature differences between shell and tube side flows. The expansion joint compensates for varying expansion and contraction of shell and tube side materials. U-tube and floating tubesheet styles can compensate for differential expansion without the use of a shellside expansion joint.

Product Description

General description

Code Compliance

Heat exchangers are typically designed according to ASME Section VIII Division 1 requirements and include an ASME U-stamp. Options for TEMA design also.

Unit Performance

Successful performance of heat transfer equipment, length of service and freedom from operating difficulties are largely dependent upon:

1. Proper physical design.
2. Proper thermal design.
3. Storage practice prior to installation.
4. Manner of installation, including design of foundation and piping.
5. The method of operation.
6. The thoroughness and frequency of cleaning.
7. The materials, workmanship, and tools used in maintenance and making repairs and replacements.

Failure to perform properly may be due to one or more of the following:

1. Exchanger being dirty.
2. Failure to remove preservation materials after storage.
3. Operating conditions being different than design conditions.
4. Air or gas binding.
5. Incorrect piping connections.
6. Excessive clearances between internal parts due to corrosion.
7. Improper application.

Note: Before placing this equipment in operation, environment and service conditions should be checked for compatibility with materials of construction. Contact your nearest Xylem Heat Transfer representative if you are not sure what the actual materials of construction are.

Storage

Xylem heat exchangers are protected against the elements during shipment. If they cannot be installed and put into operation immediately upon receipt at the jobsite, certain precautions are necessary to prevent deterioration during storage. Responsibility for integrity of the heat exchangers must be assumed by the user. Xylem will not be responsible for damage, corrosion or other deterioration of heat exchanger equipment during transit and storage.

Good storage practices are important, considering the high costs of repair or replacement, and the possible delays for items which require long lead times for manufacture. The following suggested practices are provided solely as a convenience to the user, who shall make his own decision on whether to use all or any of them.

1. On receipt of the heat exchanger, inspect for shipping damage to all protective covers. If damage is evident, inspect for possible contamination and replace protective covers as required. If damage is extensive, notify the carrier immediately.

2. If the heat exchanger is not to be placed in immediate service, take precautions to prevent rusting or contamination.

3. Heat exchangers for oil service, made of ferrous materials, may be pressure-tested with oil at the factory. However, the residual oil coating on the inside surfaces of the exchanger does not preclude the possibility of rust formation. Upon receipt, fill these exchangers with appropriate oil or coat them with a corrosion prevention compound for storage. These heat exchangers have a large warning decal, indicating that they should be protected with oil.

4. The choice of preservation of interior surfaces during storage for other service applications depends upon your system requirements and economics. Only when included in the original purchase order specifications will specific preservation be incorporated prior to shipment from the factory.

5. Remove any accumulations of dirt, water, ice or snow and wipe dry before moving exchangers into indoor storage. If unit was not filled with oil or other preservative, open drain plugs to remove any accumulated moisture, then reseal. Accumulation of moisture usually indicates rusting has already started and remedial action should be taken.

6. Store under cover in a heated area, if possible. The ideal storage environment for heat exchangers and accessories is indoors, above grade, in a dry, low-humidity atmosphere which is sealed to prevent entry of blowing dust, rain or snow. Maintain temperatures between 70°F and 105°F (wide temperature swings may cause condensation and “sweating” of steel parts). Cover windows to prevent temperature variations caused by sunlight. Provide thermometers and humidity indicators at several points, and maintain atmosphere at 40% relative humidity or lower.

Storage

7. In tropical climates, it may be necessary to use trays of renewable desiccant (such as silica gel), or portable de-humidifiers, to remove moisture from the air in the storage enclosure. Thermostatically controlled portable heaters (vented to outdoors) may be required to maintain even air temperatures inside the enclosure.

8. Inspect heat exchangers and accessories frequently while they are in storage. Start a log to record results of inspections and maintenance performed while units are in storage. A typical log entry should include, for each component, at least the following:
    a. Date
    b. Inspector's name
    c. Identification of unit or item
    d. Location
    e. Condition of paint or coating
    f. Condition of interior
    g. Is free moisture present?
    h. Has dirt accumulated?
    i. Corrective steps taken

9. If paint deterioration begins, as evidenced by discoloration or light rusting, consider touch-up or repainting. If the unit is painted with our standard shop enamel, areas of light rust may be wire brushed and touched-up with any good quality air-drying synthetic enamel. Units painted with special paints (when specified on customers' orders) may require special techniques for touch-up or repair. Obtain specific information from the paint manufacturer. Painted steel units should never be permitted to rust or deteriorate to a point where their strength will be impaired. But a light surface rusting, on steel units which will be re-painted after installation, will not generally cause any harm (See Items 3 and 4 for internal surface preservation).

10. If the internal preservation (Items 3 and 4) appears inadequate during storage, consider additional corrosion prevention measures and more frequent inspections. Interiors coated with rust preventive should be restored to good condition and re-coated promptly if signs of rust occur.



CAUTION: Provide fire extinguishers, fire alarms or telephone to protect building and equipment against fire damage. Be sure that the building and storage practices meet all local, state, and federal fire and safety codes

Installation

Planning

1. On removable bundle heat exchangers, provide sufficient clearance at the stationary end to permit the removal of the tube bundle from the shell. On the floating head end, provide space to permit removal of the shell cover and floating head cover.

2. On fixed bundle heat exchangers, provide sufficient clearance at one end to permit removal and replacement of tubes and at the other end provide sufficient clearance to permit tube rolling.

3. Provide valves and bypasses in the piping system so that both the shell side and tube side may be bypassed to permit isolation of the heat exchanger for inspection, cleaning and repairs.

4. Provide convenient means for frequently cleaning the unit as suggested under “Maintenance.”

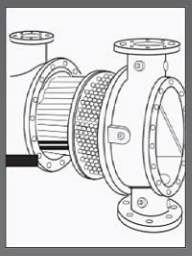
5. Provide thermometer wells and pressure gauge pipe taps in all piping to and from the heat exchanger, located as close to the heat exchanger as possible.

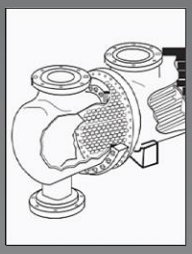
6. Provide necessary air vent valves for the heat exchanger so that it can be purged to prevent or relieve vapor or gas binding on both the tube side and shell side.

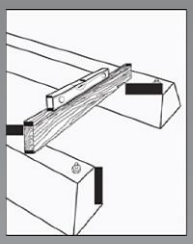
7. Provide adequate supports for mounting the heat exchanger so that it will not settle and cause piping strains. Foundation bolts should be set accurately. In concrete footings, pipe sleeves at least one pipe size larger than the bolt diameter slipped over the bolt and cast in place are best for this purpose as they allow the bolt centers to be adjusted after the foundation has set.

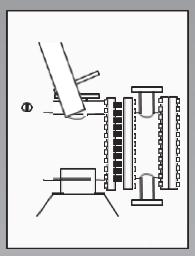


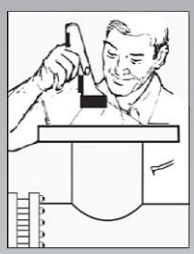
CAUTION: Dress properly for the job. You may need any number of special items – safety hat, shoes, goggles, gloves, ear protective devices, etc. for your own protection.











Installation

Planning

8. Install proper liquid level controls and relief valves and liquid level and temperature alarms, etc.

9. Install gauge glasses or liquid level alarms in all vapor or gas spaces to indicate any failure occurring in the condensate drain system and to prevent flooding of the heat exchanger.

10. Install a surge drum upstream from the heat exchanger to guard against pulsation of fluids caused by pumps, compressors or other equipment.

11. Do not pipe drain connections to a common closed manifold; it makes it more difficult to determine that the exchanger has been thoroughly drained.

At Jobsite

1. If you have maintained the heat exchanger in storage, thoroughly inspect it prior to installation. Make sure it is thoroughly cleaned to remove all preservation materials unless stored full of the same oil being used in the system, or the coating is soluble in the lubricating system oil. If the exchanger was oil-tested by Xylem and your purchase order did not specify otherwise, the oil used was a VSI 32, light-bodied oil which is soluble in most lubricating oils. Where special preservations were applied, you should consult the preservative manufacturer's product information data for removal instructions.

2. If the heat exchanger is not being stored, inspect for shipping damage to all protective covers upon receipt at the jobsite. If damage is evident, inspect for possible contamination and replace protective covers as required. If damage is extensive, notify the carrier immediately.

3. When installing, set heat exchanger level and square so that pipe connections can be made without forcing.

4. Before piping up, inspect all openings in the heat exchanger for foreign material. Remove all wooden plugs, bags of desiccant and shipping covers immediately prior to installing. Do not expose internal passages of the heat exchanger to the atmosphere since moisture or harmful contaminants may enter the unit and cause severe damage to the system due to freezing and/or corrosion.

5. After piping is complete, if support cradles or feet are fixed to the heat exchanger, loosen foundation bolts at one end of the exchanger to allow free movement. Oversized holes in support cradles or feet are provided for this purpose.

6. If heat exchanger shell is equipped with a bellows-type expansion joint, remove shipping supports per instructions.

Operation

1. Be sure entire system is clean before starting operation to prevent plugging of tubes or shell side passages with refuse. The use of strainers or settling tanks in pipelines leading to the heat exchanger is recommended.

2. Open vent connections before starting up.



CAUTION: A heat exchanger is a pressure vessel designed for operation at certain specific limits of pressure and temperature. The cooling or process system, which includes the heat exchanger, must be safeguarded with safety valves and controls so that these heat exchanger design conditions are not exceeded. All operating personnel should be made aware of these specific design pressures and temperatures.

3. Start operating gradually. See Table 1 for suggested start-up and shut-down procedures for most applications. If in doubt, consult the nearest Xylem representative for specific instructions.

4. After the system is completely filled with the operating fluids and all air has been vented, close all manual vent connections.



CAUTION: Many heat exchangers circulate fluids which are irritating or dangerous to the human system. These fluids could cause problems if bolted or threaded joints are not maintained in a leak-tight condition at operating pressures, temperatures and no-flow, ambient conditions. If fluids are not irritating or dangerous, a leak will at least cause a slippery situation on the floor below. Because one fluid in the heat exchanger is at higher temperatures, any leaks might cause burns.

5. Re-tighten bolting on all gasketed or packed joints after the heat exchanger has reached operating temperatures to prevent leaks and gasket failures. Standard published torque values do not apply to packed end joints.

Operation

6. Do not operate the heat exchanger under pressure and temperature conditions in excess of those specified on the nameplate.

7. To guard against water hammer, drain condensate from steam heat exchangers and similar apparatus both when starting up and shutting down.

8. Drain all fluids when shutting down to eliminate possible freezing and corroding.

9. In all installations there should be no pulsation of fluids, since this causes vibration and will result in reduced operating life.

10. Under no circumstances is the heat exchanger to be operated at a flowrate greater than that shown on the design specifications. Excessive flows can cause vibration and severely damage the heat exchanger tube bundle.

11. Heat exchangers that are out of service for extended periods of time should be protected against corrosion as described in the storage requirements for new heat exchangers.

12. Heat exchangers that are out of service for short periods and use water as the flowing medium should be thoroughly drained and blown dry with warm air, if possible. If this is not practical, the water should be circulated through the heat exchanger on a daily basis to prevent stagnant water conditions that can ultimately precipitate corrosion.



CAUTION: Every effort should be made to avoid subjecting the unit to thermal shock, overpressure, and/or hydraulic hammer, since these conditions may impose stresses that exceed the mechanical strength of the unit or the system in which it is installed which may result in leaks and/or other damage to the unit and/or system.

Operation

Recommended Start-Up and Shut-Down Procedures

TABLE 1

Heat exchanger type	fluid location & relative temp.				Start-up Procedure	Shut-down Procedure
	Shell Side		tube Side			
	type of fluid	rel. temp.	type of fluid	rel. temp.		
Fixed Tubesheet (Non-Removable Bundle)	Liquid	Hot	Liquid	Cold	Start both fluids gradually at the same time.	Shut down both fluids gradually at the same time.
	Condensing Gas (e.g., steam)	Hot	Liquid or Gas	Cold	Start hot fluid first, then slowly start cold fluid. Avoid temperature shock. (1)	Shut down cold fluid first, then hot fluid.
	Gas	Hot	Liquid	Cold	Start cold fluid first, then hot fluid.	Shut down cold fluid gradually, then hot fluid.
	Liquid	Cold	Liquid	Hot	Start both flows gradually at the same time.	Shut down both fluids gradually at the same time.
	Liquid	Cold	Gas	Hot	Start cold fluid first, then hot fluid.	Shut down hot fluid first, then cold fluid.
U-Tube Packed Floating Head Packed Floating Tubesheet Internal Floating Head (All these types have Removable Bundles)	Liquid	Hot	Liquid	Cold	Start cold fluid first, then start hot fluid gradually.	Shut down hot fluid first, then cold fluid.
	Condensing Gas (e.g., steam)	Hot	Liquid or Gas	Cold	Start cold fluid first, then start hot fluid gradually.	Shut down cold fluid first, then shut down hot fluid gradually.
	Gas	Hot	Liquid	Cold	Start cold fluid first, then start hot fluid gradually.	Shut down hot fluid first, then cold fluid.
	Liquid	Cold	Liquid	Hot	Start cold fluid first, then start hot fluid gradually.	Shut down hot fluid first, then cold fluid.
	Liquid	Cold	Gas	Hot	Start cold fluid first, then start hot fluid gradually.	Shut down hot fluid first, then cold fluid.

General comments:

1.) In all start-up and shut-down operations, fluid flows should be regulated so as to avoid thermal shocking the unit regardless of whether the unit is of either a removable or non-removable type construction.

2.) For fixed tubesheet (non-removable bundle) type units where the tube side fluid cannot be shut down, it is recommended that:

a) A bypass arrangement be incorporated in the system; and, **b)** the tube side fluid be bypassed before the shell side fluid is shut down.

3.) Extreme caution should be taken on insulated units where fluid flows are terminated and then restarted.

Since the metal parts could remain at high temperatures for an extended period, severe thermal shock could occur.

Maintenance

1. Clean exchangers subject to fouling (scale, sludge deposits, etc.) periodically, depending on specific conditions. A light sludge or scale coating on either side of the tube greatly reduces its effectiveness. A marked increase in pressure drop and/or reduction in performance usually indicates cleaning is necessary. Since the difficulty of cleaning increases rapidly as the scale thickens or deposits increase, the intervals between cleanings should not be excessive.

2. Neglecting to keep tubes clean may result in random tube plugging. Consequent overheating or cooling of the plugged tubes, as compared to surrounding tubes, will cause physical damage and leaking tubes due to differential thermal expansion of the metals.

3. To clean or inspect the inside of the tubes, remove only the necessary tube side channel covers or bonnets, depending on type of exchanger construction.



CAUTION: Do not remove channel covers, shell covers, floating head covers or bonnets until all pressure in the heat exchanger has been relieved and both shell side and tube side are completely drained.

4. If the heat exchanger is equipped with sacrificial anodes or plates, replace these as required.

5. To clean or inspect the outside of the tubes, it may be necessary to remove the tube bundle. (Fixed tubesheet exchanger bundles are non-removable).



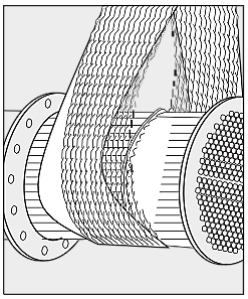
CAUTION: Since many of the removable components of the heat exchanger, particularly in the larger sizes, are too heavy for people to handle, care must be used to take this weight with proper rigging to avoid injury. Wear hard hats and safety shoes as required.

6. When removing tube bundles from heat exchangers for inspection or cleaning, exercise care to see that they are not damaged by improper handling.

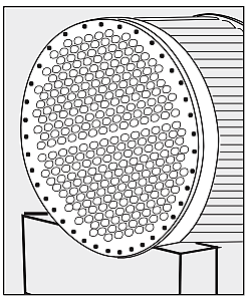
   - The weight of the tube bundle should not be supported on individual tubes but should be carried by the tubesheets, support or baffle plates or on blocks contoured to the periphery of the tube bundles.

   - Do not handle tube bundles with hooks or other tools which might damage tubes. Move tube bundles on cradles or skids.

Maintenance

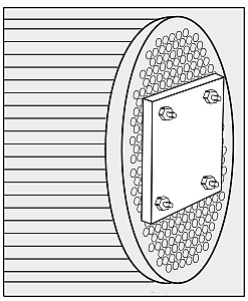


- To withdraw tube bundles, pass rods through two or more of the tubes and take the load on the floating tubesheet.
- Rods should be threaded at both ends, provided with nuts, and should pass through a steel bearing plate at each end of the bundle.
- Insert a soft wood filler board between the bearing plate and tubesheet face to prevent damage to the tube ends.



- Screw forged steel eyebolts into both bearing plates for pulling and lifting.
- As an alternate to the rods, thread a steel cable through one tube and return through another tube.
- A hardwood spreader block must be inserted between the cable and each tubesheet to prevent damage to the tube ends.

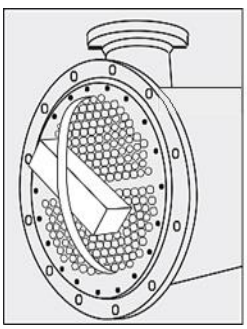
7. If the heat exchanger has been in service for a considerable length of time without being removed, it may be necessary to use a jack on the floating tubesheet to break the bundle free.



   - Use a good-sized steel bearing plate with a filler board between the tubesheet face and bearing plate to protect the tube ends.

8. Lift tube bundles horizontally by means of a cradle formed by bending a light gauge plate or plates into a U-shape. Make attachments in the legs of the U for lifting.

9. Do not drag bundles, since baffles or support plates may become easily bent. Avoid any damage to baffles so that the heat exchanger will function properly.





CAUTION: Do not thread rods or cables through tubes of a heat exchanger equipped with Amatran® tubes, or any with internal fins

Maintenance

10. Some suggested methods of cleaning either the shell side or tube side are listed below:

    - Circulating hot wash oil or light distillate through tube side or shell side will usually effectively remove sludge or similar soft deposits.

    - Soft salt deposits may be washed out by circulating hot fresh water.

    - Some commercial cleaning compounds such as “Oakite” or “Dowell” may be effective in removing more stubborn deposits. Use in accordance with the manufacturer’s instructions.



CAUTION: When the heat exchanger is cleaned, it is important that full characteristics of the fouling material and the cleaning agent be known and care exercised in handling them according to instructions. Use eye protection to prevent damage to your eyes. Wear a respirator when required.

11. Some tubes have inserts or longitudinal fins and can be damaged by cleaning when mechanical means are employed. Clean these types of tubes chemically or consult the nearest Xylem representative for the recommended method of cleaning.

    - If the scale is hard and the above methods are not effective, use a mechanical means. Neither the inside nor the outside of the tube should be hammered with a metallic tool. If it is necessary to use scrapers, they should not be sharp enough to cut the metal of the tubes. Take extra care when employing scrapers to prevent tube damage.

    - Do not attempt to clean tubes by blowing steam through individual tubes. This overheats the individual tube and results in severe expansion strains and leaking tube-to-tubesheet joints.



CAUTION: Do not blow out heat exchangers with air when the normal process fluids or the cleaning fluids being handled are inflammable.

Maintenance

12. Table 2 shows safe loads for steel rods and eyebolts.

TABLE 2

STEEL RODS			STEEL EYEBOLTS	
Tube Size	Rod Size	Safe Load Per Rod	Size	**Safe Load**
5/8”	**3/8**	**1,000 lbs.**	**3/4”**	**4,000 lbs.**
3/4”	**1/2”**	**2,000 lbs.**	**1”**	**6,000 lbs.**
1” or larger	**5/8”**	**3,000 lbs.**	**1-1/4”**	**10,000 lbs.**
			1-1/2”	**15,000 lbs.**

13. To locate ruptured or corroded tubes or leaking joints between tubes and tubesheets, the following procedure is recommended:

    • Remove tube side channel covers or bonnets.

    • Pressurize the shell side of the exchanger with a cold fluid, preferably water.

    • Observe tube joints and tube ends for indication of test fluid leakage.

14. With certain styles of exchangers, it will be necessary to buy or make a test ring to seal off the space between the floating tubesheet and inside shell diameter to apply the test in paragraph 13. Consult your nearest Xylem representative for reference drawings showing installation of a test ring in your heat exchanger.

15. To tighten a leaking tube joint, use a suitable parallel roller tube expander.

    • Do not roll tubes beyond the back face of the tubesheet. Maximum rolling depth should be tubesheet thickness minus 1/8”.

    • Do not re-roll tubes that are not leaking since this needlessly thins the tube wall.

16. It is recommended that when a heat exchanger is dismantled, new gaskets be used in reassembly.

    • Composition gaskets become brittle and dried out in service and do not provide an effective seal when reused.

    • Metal or metal jacketed gaskets in initial compression match the contact surfaces and tend to work-harden and cannot be recompressed on reuse.

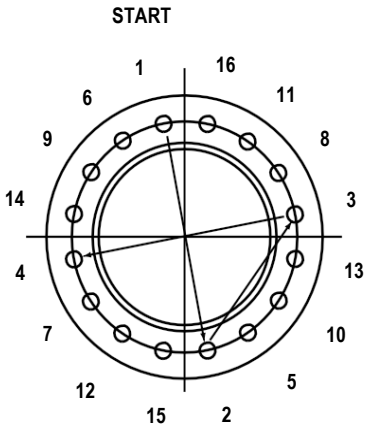
Maintenance

17. Use of new bolting in conformance with dimension and ASTM specifications of the original design is recommended where frequent dismantling is encountered.

18. When replacing heads with gaskets, use a torque wrench.* Tighten 1/2" diameter bolts to 40 ft. lbs. and 5/8" diameter bolts to 80 ft. lbs. If the gasket joint still leaks, tighten in 5 ft. lbs. increments until leak stops.

    * The above torque values apply to well lubricated nut bearing surfaces for typical compressed fiber style gaskets with alloy steel bolts. Consult factory for other gasket styles and materials of construction.

19. All bolted joints should be tightened uniformly and in a diametrically staggered pattern as illustrated below:



20. On heads with packing, tighten initially to 50 ft. lbs. If the packing still leaks, tighten in 5 ft. lbs. increments until leak stops. Do not exceed 100 ft. lbs. on the bolts for packed heads.

When ordering replacement parts give name of part, plus heat exchanger part number and factory serial number from nameplate

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Visit our Web site for the latest version of this document and more information

The original instruction is in English. All non-English instructions are translations of the original instruction.