

Shell & Tube Installation, Operation and Maintenance Guidelines

INTRODUCTION

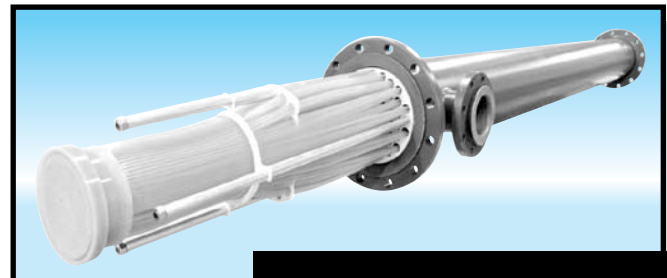
Several types of Fluoropolymer Shell & Tube Heat Exchangers are available. The CT-Series has an unlined carbon steel shell. These models require the corrosive fluid to be contained in the tubing. The LT-Series has a Fluoropolymer liner in the shell. With LT exchangers, the corrosive fluids may be processed either in the shell or in the tubing (or both). Both types are available in standard FEP or PFA tubing, or Q-Series tubing, a fluorocarbon resin containing a filler.

INSTALLATION

AMETEK Fluoropolymer Shell & Tube Heat Exchangers are shipped completely assembled and ready for installation. The following guidelines are suggested:

1. The nozzles and end caps are covered to protect internal parts against damage in shipping. Do not remove the covers until the piping is ready to be bolted to the exchanger.
2. The covers on the tubeside end caps are secured with bolts of the proper size, length, and material to connect the exchanger to a standard ANSI 150-lb. flange. Use these cover bolts or bolts of the same length to avoid bot-toming in the tapped blind holes of the end caps.
3. When the tubeside covers are removed, the end cap liners will be exposed. Care should be taken to prevent damage to these liners. If the intermediate flanges or shellside flange covers are removed, care should be taken to prevent damage to the shellside liner of LT units.

Under no circumstances should welding be done on the shell with the tube bundle in place as this may cause damage to the tube bundle or the shell liner if so equipped.



30-SERIES SHELL & TUBE

4. Do not perform operations which produce sparks or hot slag in the vicinity of the exchanger unless all openings are covered.
5. Exchangers may be mounted horizontally, vertically, or inclined. When low flow rates are involved [less than 50 GPM (11.4M³/Hour)] for 10" diameter units, either shell-side or tubeside, the units should be mounted inclined (12° minimum angle) or vertically to ensure a full vessel. Condensers are always mounted vertically or inclined.
6. *Mounting brackets are not included.* Suggested brackets are standard pipe riser clamps for vertical mounting or a cradle for horizontal installation. They are available from local suppliers.
7. To facilitate removal of the tube bundle for servicing, the exchangers should be installed with adequate working space at one end. A distance equal to the overall length of the exchanger plus one foot is required for removal of the tube bundle. This space may be provided at either end of the exchanger.
8. The exchangers are designed for single pass counter-current flow operation. Co-current is acceptable, but heat transfer performance may be reduced.

9. Isolation valves and/or bypasses should be installed in the piping systems. This allows the heat exchanger to be removed from service for inspection, cleaning, or repair.
10. Connection piping must be clean and free of rust, scale, and other debris to ensure that the exchanger does not plug with refuse. Thoroughly flush the piping system prior to connection of the exchangers to remove any refuse.
11. Ensure piping is supported and/or properly aligned. Misalignment can cause seal leaks due to uneven forces on the end caps.
12. If the fluid stream is not free of suspended solids, strainers or other solids-separation devices should be installed in the piping upstream of the exchanger. Strainers should be sized to retain all particles larger than 25% of the tubing inside diameter. If the process contains suspended solids that cannot be removed by simple strainers, consult your AMETEK Representative.

Maximum Model Number	Recommended Strainer Hole Size
180, 440, 2000	0.025" (0.64 mm)
80, 220, 1000	0.035" (0.89 mm)
40, 105, 525, 900	0.050" (1.27 mm)
218	0.075" (1.90 mm)

13. When the units are mounted vertically, a possible siphon effect can result. Use of a vacuum breaker on the shell outlet is recommended.

PERMEATION

Since Fluoropolymers are a polymeric material, permeation of some corrosive material through the tubing can occur. Generally rates are extremely low (1×10^{-6} lbs./hr./ft.²) and do not create operation problems. In closed loop systems, permeable materials can build up with time and may require treatment such as neutralization, blowdown or absorption.

STEAM HEATERS

CAUTION: Overpressurization will damage the tube bundle. Follow pressure ratings listed on the pressure/temperature curves (Figure 1) and maximum water flow rates.

1. In steam heating applications, a pressure relief valve should be installed in the steam supply piping to protect

the exchanger. The maximum inlet pressures allowable are:

	Tubing Material		
	FEP	PFA	"Q"
Shellside	20 psig (138 kPa)	20 psig (138 kPa)	25 psig (172 kPa)
Tubeside	30 psig (207 kPa)	42 psig (290 kPa)	50 psig (345 kPa)

The pressure relief valve should be set to activate at no more than 5 psig above the pressure listed above, i.e. for steam shellside with FEP tubing, the pressure setting should be 25 psig (172 kPa) maximum. For operating steam pressures below these maximums, a relief valve setting at 5 psig above the operating pressure is suggested. The set pressure tolerance (+ or -) of the valve should not exceed 2 psi (14 kPa). The valve should have sufficient capacity to discharge 125% of the steam flow for which the exchanger is rated.

2. Normally a pressure drop of 5 to 10 psi (35 to 69 kPa) will result when condensing steam. Steam traps should be sized taking this into consideration.
3. When more than one exchanger is being used in steam heating, each exchanger should be connected in parallel to the steam supply and be individually trapped. Steam flow through two or more exchangers in series is not recommended, even if tubeside flows are in series.
4. Maximum discharge of the condensate is important to proper operation. Steam traps should be mounted downstream from the unit and sized to at least 125% of the maximum discharge flow. Failure to provide adequate steam traps can cause poor heat exchanger performance. Contact the steam trap manufacturer to assure proper trap sizing.

TESTING

Shells are fabricated in accordance with ASME code specifications for unfired pressure vessels. The design pressure for the shell and end cap is 150 psig at 300° F. (1034 kPa at 150° C.)

The shell should not be hydrostatically tested at these pressures when the tube bundle is in place as the bundle will be damaged. Hydrostatic tests with the bundle in place should be conducted at pressures no greater than the maximum recommended operating pressures. (See Figure 1)

Do not allow liquid to freeze in the exchanger.

OPERATION

When the installation and testing is complete, the exchanger is ready for service.

1. During operation, the exchanger should not be exposed to pressures and temperatures that exceed the recommended operating limits (Figure 1). Note that the shellside limitation is to prevent tube collapse. Thus, when the tubeside is being operated under vacuum, that amount of vacuum must be subtracted from the external pressure curve to determine the maximum external operating pressure.
2. The preferred start-up method is to first start the flow of the coolant followed by the hot process fluid. This will assure adequate cooling if heat is generated by residual water in the tubes mixing with process fluids.
3. Air and other gases trapped in the shell may reduce efficiency. They should be removed from a CT unit by venting the shell through an opening in the intermediate flange on 10" and 14" shells, and the shell flanges on 4" models. LT units cannot be vented in this manner without destroying the liner integrity. Venting capability should be considered in piping and/or installation design.
4. Shellside liquid flows must be limited to rates that will not lead to hydraulic damage in the tubing bundle. In the absence of contrary information from AMETEK (Refer to Quotation), shellside flows should be limited to the following values:

Maximum Shell Diameter	Shellside Flow	
	GPM	M3/H
14" (356)	500	113.6
10" (254)	300	68.2
4" (102)	40	9.1
3" (76)	25	5.7

5. On shutdown, the hot process fluids should be shut off first, while leaving the coolant flow on until the heat exchanger's temperature approaches ambient or the coolant's temperature.

Under no circumstances should welding be done on the shell with the tube bundle in place as this may cause damage to the fluorocarbon tubing or shell liner (LT models) if so equipped.

MAINTENANCE

1. Tube leaks in AMETEK Fluoropolymer Heat Exchangers are readily repaired. Usually, it is not necessary to remove

OPERATING LIMITS

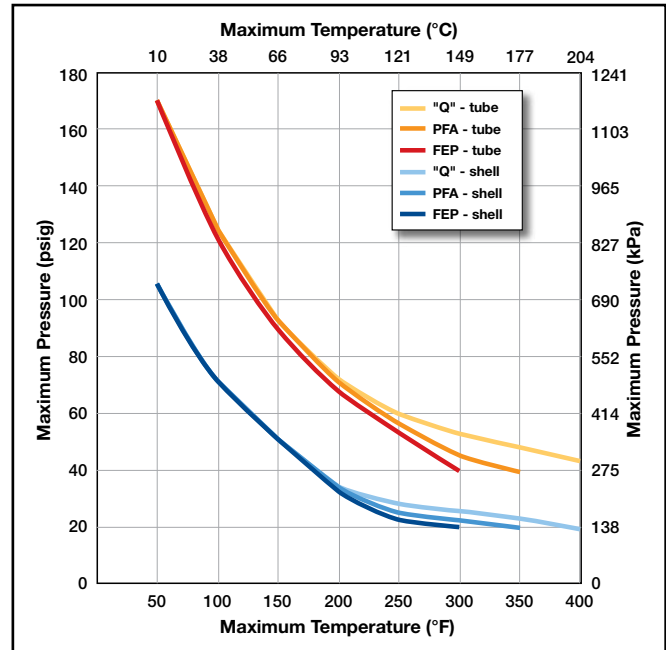


FIGURE 1

the tube bundle for repair of leaks, and the repairs can be accomplished in minutes after the leaking tube is identified. Leaking tubes can be sealed at the tube sheet faces or inside the bundle upon removal. Repair kits containing all the necessary items for tubing repair can be purchased from AMETEK. Personnel can be trained rapidly in tube repair techniques. A detailed procedure is included with each repair kit.

2. Seal leaks can be detected and corrected following the instructions below for the generation of exchanger you have (for generation, refer to the model number on the exchanger nameplate).

GENERATION CT-30 AND LT-30—For both models, seal leaks are detected by removing the weep hole plug in the seal ring and observing for shellside or tubeside liquid seepage. If found, the seal O-ring and envelope gasket should be replaced (refer to Figures 2 and 3).

CAUTION: When removing the weep hole plug, anticipate trapped pressure and the potential for liquid spray. Wear the appropriate safety equipment.

Seal kits containing the appropriate gaskets, O-Rings, and liners are available from AMETEK. Each kit contains detailed instructions for seal replacement; follow these closely during reassembly. Be sure to reference the exchanger's complete model number when ordering seal kits to ensure the correct components are provided.

3. Various techniques can be used to removed solids from the tubing of AMETEK Fluoropolymer Heat Exchangers. Backflushing and periodic introduction of compressed

air to promote turbulence are frequently used with good results. Consult your AMETEK Representative for advice on other techniques.

Do not attempt to clear tubes of deposits by inserting welding rod, wire, or other mechanical devices.

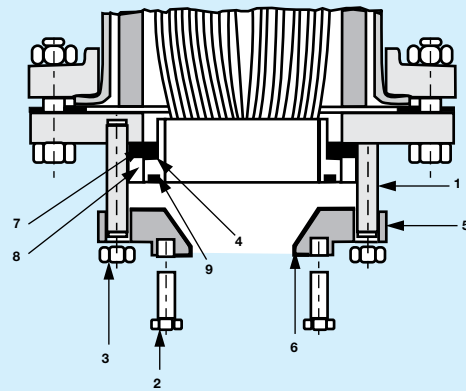
- If the exchanger has been disassembled, all gaskets and O-rings which have been disturbed should be replaced with new ones. Seal kits containing the appropriate seal components are available from AMETEK. When ordering seal kits, be sure to reference the exchanger's complete model number to ensure correct components are provided.
- After any repair, and to avoid possible damage to the exchanger's parts from corrosive fluids escaping past seals, seal integrity should be checked hydrostatically by pressurizing the exchanger shellside to 30 psig prior to start-up. Follow the seal leak detection guidelines described in item 2.

TUBE REPAIR INSTRUCTIONS

The detection and repair of tube leaks in AMETEK Fluoropolymer Heat Exchanger is not difficult and can usually be performed by on-site maintenance personnel.

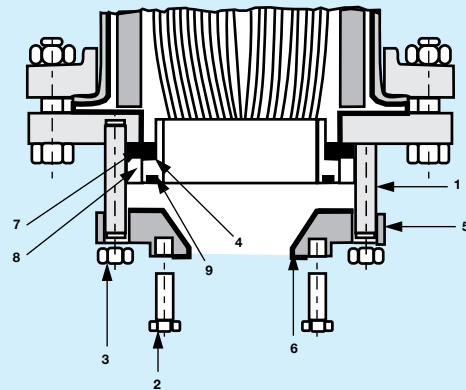
Repair kits may be purchased separately from AMETEK to assist in the repair of AMETEK Fluoropolymer Heat Exchangers. Detailed repair instructions are included with each repair kit.

FIGURE 2—CT-30



Item	Description
1	Stud
2	Hex Bolt
3	Hex Nut
4	Envelope Gasket
5	End Cap
6	Liner
7	Split Ring (2 Halves)
8	Seal Ring
9	O-ring

FIGURE 3—LT-30



Fluoropolymer resins are generally considered inert to most chemicals. Under certain conditions of pressure and temperature, or combinations of chemicals, fluoropolymer heat exchangers should not be used. Similarly, water or steam should be free of particulates and other materials which may cause impediments to flow and consequential damage to or failure of the exchanger. Please contact AMETEK for discussion of your specific process in or to be certain that our products are appropriate for your intended use.

Recommended instructions for safe handling of AMETEK Fluoropolymer Heat Exchangers are contained in the Installation, Operation, Maintenance Manual (IOM) provided with your unit. As with any manufacturing process, a periodic audit should be conducted to assure all safety and government regulations are met. Adequate ventilation should be used where Fluoropolymers are heated during tube repairs. Flu-like symptoms may occur from exposure to vapors evolved from Fluoropolymers at very high temperatures, up to 800°F or from smoking materials that contain particles of Fluoropolymers. Symptoms pass within 48 hours and are the only adverse effects observed in humans to date. Unheated Fluoropolymers are essentially inert and is nonirritating to the skin. Additional copies of the IOM Manuals or copies of Fluorocarbon Resins — Safety in Handling and Use can be obtained from AMETEK.

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