Installation, Operation and Maintenance – LOK-FLANGE ® Multitube Heat Exchangers
Brown Fintube ® LOK-FLANGE® Multitube Hairpin Heat Exchangers

I. INSTALLATION OF HEAT EXCHANGERS
A. HEAT EXCHANGER SETTINGS
   1) CLEARANCE FOR DISMANTLING
      Provide sufficient clearance at return bend cover end to permit withdrawal of the tube element.
   2) FOUNDATIONS
      Foundations must be adequate so that exchangers will not settle and cause the piping to transmit excessive strains to the nozzles of the exchanger. Foundation bolts should be set to allow for setting inaccuracies. In concrete footings, pipe sleeves, at least one size larger than bolt diameter slipped over the bolt and cast in place are best for this purpose, as they allow the bolt center to be adjusted after the foundation has set.
   3) LEVELING
      Exchangers must be set level and square so that pipe connections may be made without forcing.
B. CLEANLINESS PROVISIONS
   1) CONNECTION PROTECTORS
      All exchanger openings should be inspected for foreign material. Protective plugs and covers should not be removed until just prior to installation.
   2) DIRT REMOVAL
      The entire system should be clean before starting operation. Under some conditions, the use of strainers in the piping may be required.
   3) CLEANING FACILITIES
      Convenient means should be provided for cleaning the unit as suggested under “Maintenance”.
C. INSTALLATION PROCEDURE
   1) Mount the sections as shown in the recommended arrangement on the certified drawings. Be sure the shell nozzle gaskets are in place, but do not tighten the shell nozzle bolts or the shell support bracket bolts. Note the oblong holes in the brackets for alignment.
   2) Make sure the tube end flanges are in the same place.
   3) Re-tighten bolting on any tubeside return bend connectors. (Refer Para II B.4)
   4) Tack weld the inlet and outlet tube end flanges to the plant piping while the flanges are loosely bolted in place. Remove the piping and complete the pipe to flange welds.
   5) Re-assemble inlet and outlet flanges to unit, making sure the split rings and sealing rings are assembled as shown in Figure 1. Tighten all bolting evenly. (Refer Para II B.4)
   6) Re-tighten shell nozzle bolting and bracket bolts.
   7) Test, if required.
D. FITTINGS AND PIPING
   1) BY-PASS VALVES
      It may be desirable to provide valves and by-passes in the piping system to permit inspection and repairs.
   2) TEST CONNECTIONS
      Thermometer well and pressure gauge connections should be installed close to the exchanger in the inlet and outlet piping.
   3) VENTS
      Vent cocks should be provided so units can be purged to prevent or relieve vapor or gas binding.
   4) SURGE DRUMS
      In all installations, care should be taken to eliminate or minimize transmissions of fluid pulsations and mechanical vibrations to the heat exchangers.

II. OPERATION OF HEAT EXCHANGERS
A. DESIGN AND OPERATING CONDITIONS
      Equipment must not be operated at conditions which exceed those specified on the nameplate.
B. OPERATING PROCEDURES
      Before placing any exchanger in operation, reference should be made to the exchanger drawings, specification sheet, and name plate for any special instructions. Improper starting up or shutting down sequences may cause leaking of tube-to-tubesheet and/or bolted flanged joints.
   1) STARTING-UP OPERATION
      Exchangers with removable tube bundles may be placed in service by first establishing circulation of the cold medium, followed by the gradual introduction of the hot medium. During start-up all vent valves should be opened and left open until all passages have been purged of air and are filled with fluid.
   2) SHUTTING-DOWN OPERATION
      Exchangers with removable bundles, the units may be shut down by first gradually stopping the flow of the hot medium and then stopping the flow of the cold medium. If it is necessary to stop the flow of cold medium, the circulation of hot medium through the exchanger should also be stopped.
   3) TEMPERATURE SHOCKS
      Operation must be started gradually. Hot fluid must not be suddenly introduced when the unit is cold, nor cold fluid suddenly introduced when the unit is hot.
   4) BOLTED JOINTS
      a) Heat exchangers are hydrostatically tested before leaving the manufacturer’s shop in accordance with ASME Code requirements. However, normal yielding of gaskets will occur in the interval between hydrostatic testing in the manufacturer’s shop and installation at the jobsite. Therefore, all external bolted joints should be properly re-tightened after installation and, if necessary, after the exchanger has reached operating temperature.
      b) RECOMMENDED BOLT TIGHTENING PROCEDURE
         It is important that all bolted joints be tightened uniformly and in a diametrically staggered pattern as illustrated in Figure A.
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III MAINTENANCE AND HEAT EXCHANGERS

A. INSPECTION OF UNIT

At regular intervals and as frequently as experience indicates, an examination should be made of the interior and exterior condition of all tubes. Neglect in keeping all tubes clean may result in complete stoppage of flow through some tubes, which could cause severe thermal strains and/or leaking tube joints.

1) INDICATIONS OF FOULING

Exchangers subject to fouling or scaling should be cleaned periodically. A light sludge or scale coating on the tube greatly reduces its efficiency. A marked increase in pressure drop and/or reduction in performance usually indicates cleaning is necessary. The unit should first be checked for air or vapor binding to confirm that this is not the cause for the reduction in performance. Since the difficulty of cleaning increases rapidly as the scale thickness or deposit increases, the intervals between cleaning should not be excessive.

2) ACCESS TO TUBES

To inspect the inside of the tubes and the tube inserts (where used) and also make them accessible for cleaning, remove the tubeside flanges. Flange bolts should not be loosened until the unit has been completely depressurized, vented and drained. Tube inserts can be removed by removing wire retainers or breaking tack welds and sliding inserts out of tubes. If tube inserts are firmly corroded in place or held by accumulation of product or fouling, do not exert excess force to remove inserts as damage to tubes or inserts may occur.

3) LOCATING LEAKS IN TUBES

The following procedures may be used to locate perforated or split tubes and leaking joints between tubes and tubesheets. After removing flanges, the entire front face of each tubesheet will be accessible for inspection.

a) Remove tube end flanges and any tube return bend connections. These flanges can be removed without disturbing shellside seal because the center Lok-flange® flange has threaded bolt holes, allowing independent tightening of the separate shell and tube seals.

b) Apply hydraulic pressure to shellside.

c) The point where water escapes indicates a defective tube or tube-to-tubesheet joint.

4) Water for test should be at ambient temperature. Cold water may cause erroneous indications in humid atmospheres because of condensation on the cold metal surfaces.

B. TUBE BUNDLE REMOVAL

1) Remove return bonnet bolting and return bonnet.

2) Disconnect all tubeside inlet and outlet piping and any external tube return bend connectors. Note the match marks of the correctors for correct re-installation. Remove tubeside seal rings.

3) Remove shell closure flange nuts and pull Lok-flange forward to expose the split rings.

4) Remove split rings and shellside seal rings, making sure split ring valves are kept together and replaced in original position.

5) Pull tube element back through the shell using canvas sling or belt wrapped around u-bends.

6) Care should be exercised when removing a multi-tube element from the shell, otherwise the element and/or the shell may be damaged. The tube elements should always be supported on the baffles, tube support rings or tubesheets. Never support the element on the tubes.

7) Tube element should not handled with hooks or other devices which might damage the tubes. Elements should be supported on cradles or skids. Horizontal tube elements should be lifted by means of suitable slings. Baffles can be bent and damaged by dragging an element over a rough surface. All gaskets surfaces should be protected from accidental damage, since these areas are generally difficult to repair.

8) Removal of the tube elements from the shells can be more readily accomplished without disturbing either the shell or tubeside piping by placing flanged elbows between the tubeside piping and the sections to allow the forward movement needed to remove the tube end flanges.

B) CLEANING TUBE BUNDLES

1) CLEANING METHODS

The heat transfer surfaces of heat exchangers should be kept reasonably clean to assure satisfactory performance. Convenient means for cleaning should be made available. Heat exchangers may be cleaned by either chemical or mechanical methods. The method selected must be the choice of the operator of the plant, and will depend on the type of deposit and the facilities available in the plant. Following are several cleaning procedures that may be considered:

a) Circulating hot wash oil or light distillate through tubes or shell at high velocity will effectively remove sludge or similar soft deposits.

b) Some salt deposits may be washed out by circulating hot fresh water.

b) Commercial cleaning compounds are available for removing sludge or scale, provided hot wash oil or water is not available or does not give satisfactory results. Contact compound manufacturer for advice.

d) Tube cleaners for removal of deposits inside of tubes.

e) Scrapers, rotating wire brushes, and other mechanical means for removing hard scale, coke or other deposits.

f) Employ services of a qualified organization that provides cleaning services. These organizations will check the nature of the deposits to be removed, furnish proper solvent and/or acid solutions containing inhibitors, and provide equipment and personnel for a complete cleaning job.

2) CLEANING PRECAUTIONS

a) Tubes should not be cleaned by blowing steam through tubes, since this overheats the tube and results in severe expansion strain.

b) When mechanically cleaning a tube bundle, care should be exercised to avoid damaging the tubes. Removal of the tube inserts (if present) should be accomplished before beginning mechanical cleaning process. Sec III (A) (2) “ACCESS TO TUBES”

c) Cleaning compounds should be compatible with metallurgy of the equipment.

D. TUBE ROLLING

A suitable roller type tube expander should be used to tighten a leaking roller expanded tube-to-tubesheet joint. When a welded to tubesheet joint is present, repair of leaking tube to tubesheet joint should be performed with an acceptable welding process. A light contact tube expansion should then be performed taking care to maintain an appropriate distance from weld. Care should be taken to insure that tubes are not over-rolled.
E. GASKET REPLACEMENT
Gaskets and gasket surfaces should be thoroughly cleaned and should be free of scratches and other defects. Gaskets should be properly positioned before attempting to retighten bolts. It is recommended that when a heat exchanger is dismantled for any cause, it is reassembled with new gaskets. This will tend to prevent further leaks and/or damage to the gasket seating surfaces of the heat exchanger. Composition gaskets become dried out and brittle so that they do not always provide an effective seal when reused. Metal, or metal jacketed gaskets, when compressed initially, flow to match their contact surfaces. In so doing they are work hardened and, if reused, may provide an imperfect seal or result in deformation and damage to the gasket contact surfaces of the exchanger.

F. SPARE AND REPLACEMENT PARTS
For procurement of spare or replacement parts please refer to spare parts list and detail drawing, which have been previously furnished, or to the following typical parts list drawing.
Brown Fintube ® LOK-FLANGE® Multitube Hairpin Heat Exchangers

LOK-FLANGE® Closure.

This rugged economical closure has threaded bolt holes in the center Lok-Flange, allowing independent tightening of the separate shellside and tubeside seals. Inter-stream leakage through the seals is impossible. With the tube closure flange removed, full shellside hydrostatic test pressure can be applied for tube leak inspection. No test rings are required. Both gaskets seal on the tubesheet O.D., allowing use of more tubes in the tube bundle.

Parts List: LOK-FLANGE ® Multi-Tube Hairpin Heat Exchanger

When ordering parts, furnish serial number, as shown on the nameplate and designate parts required by number and name, as shown in the following table.

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
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<tbody>
<tr>
<td>1.) Shell Assembly</td>
<td>8.) Tube Return Bend Connector</td>
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<tr>
<td>2.) Tube Assembly</td>
<td>9.) Return Bonnet Bolts</td>
</tr>
<tr>
<td>3.) Return Bend Bonnet</td>
<td>10.) Tubeside Bolts</td>
</tr>
<tr>
<td>4.) Lok-Flange</td>
<td>11.) Shell Nozzle Flange Bolts</td>
</tr>
<tr>
<td>5.) Sealing Ring</td>
<td>12.) Bracket Bolts</td>
</tr>
<tr>
<td>6.) Split Rings</td>
<td>13.) Bonnet Gasket</td>
</tr>
<tr>
<td>7.) Tube End Flange</td>
<td>14.) Shell Nozzle Gasket</td>
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<td></td>
<td>15.) ANSI Flange (Optional)</td>
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</tbody>
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Recommended Spare Parts Inventory Per Section

- One cover gasket (13)
- Four sealing rings (5)
- Two split rings (6)

The preceding Installation, Operation and Maintenance instructions are as outlined in Standards of Tubular Exchanger Manufacturers Association, seventh edition 1988, except where they have been modified to specifically relate to Brown Fintube Company Lok-Flange Multi-Tube Heat Exchangers.

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