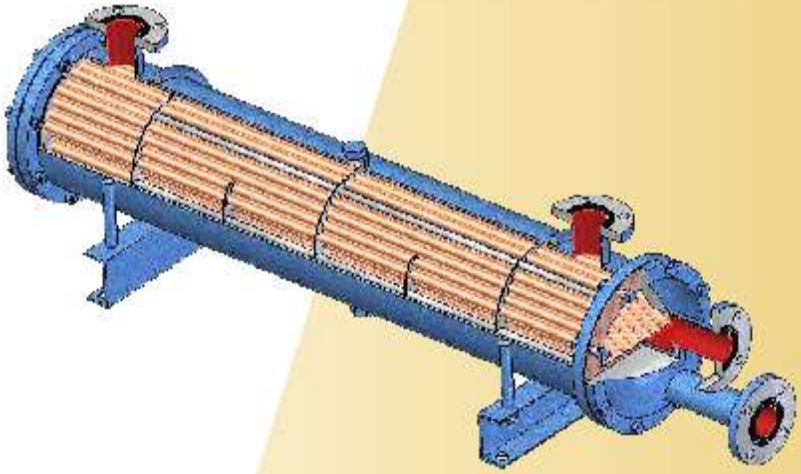
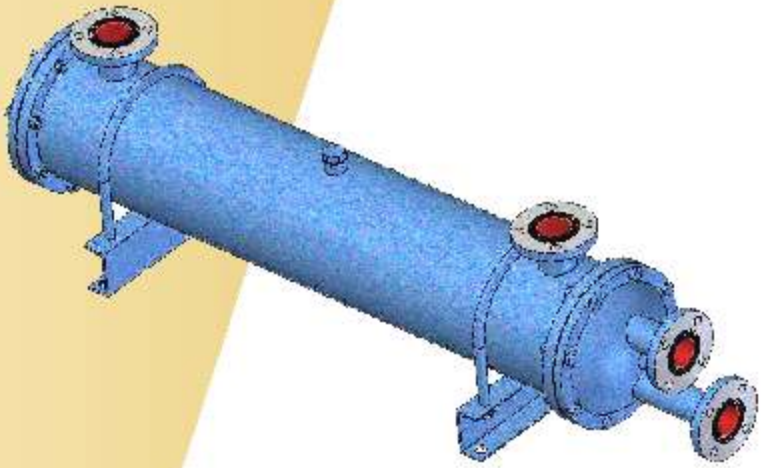
SUNRISE

ENGINEERING COMPANY



‘SUN’ HEAT EXCHAGERS

INSTALLATION & MAINTENANCE MANNUAL



WORKS : 170/A, G.I.D.C., MAKARPURA, BARODA - 10

Following consist's of Installation & maintenance manual for 'Sun' Heat Exchangers

Heat Exchangers consist's of Shell with fluid inlet & outlet connections, drain, vent & supports.
A Tube Bundle within the shell with tube-sheets, tubes and baffle plates, tie rods & spacers.
End covers with water inlet & outlet connections.

Operating Pressures:

The Heat Exchangers are tested on shell and tubes at the pressure indicated on the nameplate. The pressure should not exceed 70% of these values.

Installation:

The Heat Exchangers delivered from our works are always ready for operation. It is nevertheless advisable, before installing them look at the connections to see weather they have become dirty. If necessary, it must be cleaned using compressed air, or low pressure steam.

The Heat Exchangers can be mounted horizontally or vertically, depending on the preference specified at the time of ordering.

It is extremely important to install the Heat Exchangers so that the forces, especially vibration, extended upon them are minimum. Forces acting upon the Heat Exchangers may cause leaks or even tube failure. Heavy pipe connections should be properly supported and their weight should not be allowed to be taken up by the Heat Exchanger.

The erection personnel should check all Heat Exchanger Installations for compliance with design and for correct executions and good accessibility for the air vent, drain & thermometer connections.

Operation and Maintenance:

The Heat Exchanger should be fitted up on the shell and tube sides and the air should be vented off after the Heat Exchanger is full of the liquid flowing through it. For this the appropriate plugs should be opened and closed again, as soon as the liquid flows out. Similarly, appropriate plugs must be opened to drain the Heat Exchanger. Refer to the performance Data Sheet to be check the fluid that should be passed through the tubes and on the shell side.

Starting up the cold process fluid: Do not open the water valve until the process fluid temperature of about 30 C to 40 C is reached.

Starting up with warm process fluid: The circulation of cooling water must be established before hand or simultaneously. Where values are fitted on both inlet and outlet water connections, only the outlet valve should be used to adjust the circulating water quantity. The inlet valve should be kept fully opened. The process fluid and water quantities should be adjusted in accordance with the valves specified in the performance data sheet pertaining to the particular Heat Exchanger. The valve positions obtained by trail should be marked for operating guidance.

Important:

Clean treated water should be used as the coolant in the Heat Exchangers. The minimum quantity of water should be as indicated in **ANNEXURE 1.** Otherwise scale and dirt deposits on the Heat Exchanger tubes will result in lost efficiency.

It is generally not permissible to employ too small a water quantity then that specified i.e. to operate on too small or too large a water temperature rises. The former, on account of excessively high water speed may increase the rate of corrosion and erosion. The latter gives an unduly low water velocity with an increased tendency to fouling and deposit sedimentation.

Due to continuous operation for a long time, the Heat Exchangers become dirty especially on the waterside. This is indicated by a rise in temperature of process fluid, beyond the specified temperatures. An inspection, and if necessary, water side cleaning of the Heat Exchanger should be carried out before the process fluid temperature reaches the limiting value. The nature and degree of fouling depends primarily upon the quantity of the circulating cooling water, which can be determined only by experience and by observation of process fluid temperature during an extended period of operation.

It is advisable to order out thermometers and pressure gauges for temperatures and pressure measurements at inlet and outlet positions of both fluids. The thermometers should be fitted in the pipes where they are accessible, readily visible and protected from radiation & other influences, at least one-meter distance from the Heat Exchanger. The threaded connections on Heat Exchanger shell and the end covers may be used as measuring points in the absence of any better possibility.

If during operation, it is found that the Heat Exchanger no longer gives the design process fluid outlet temperature when the process fluid inlet and the cooling water inlet temperatures are at the design level then:

(a) Examine the cooling water to pump to ensure that it is delivering the specified quantity of cooling water. It is preferable to have a flow indicator in this line.

(b) An increase in the pressure drop of cooling water flow in the Heat Exchanger compared with established initial condition for the same rate of flow, would indicate that scaling might exist and that de-scaling is necessary.

If examination (a) & (b) do not divulge any causes of failure to attain the design capacity, check the tubes for any leakage due to deterioration of tubes.

This can be done as follows:

* Empty the Heat Exchanger.
* Fill up only the shell side with water and pressurise it to 125 psig.
* Remove one of the end covers so that the tube ends are visible.
* Water trickling out through them can detect leaky tubes.

Alternatively, low-pressure air can be used instead of water, soap bubbles can be seen at the leaky tube ends, when soap solution is applied.

Failures:

There is always the possibility of failure of a tube and it should be plugged, after proper detection, by means of a 1:20 conical plug of a wood, rubber or metal. Refrain from driving the plug in unnecessarily hard, to avoid damage to neighbouring expanded seats. These simple measures allow the Heat Exchanger to return to normalcy, without any further hindrance to operation. The reduction of cooling effect resulting from single tube is negligible. It is however necessary to ascertain the condition of other tubes, as fully as possible in the event of failure of tube. If for a example, a corrosion failure has taken place, it is probable, in view of the homogeneity of tube material, which today prevails, that all the tubes are in danger or already affected. If this situation is found, it is necessary to take steps to ensure that a spare Heat Exchanger or Tube Bundle *(tube bundle for removable tube bundle type Heat Exchanger only)* is on hand when it is required.

As a good maintenance practice, the following spares should be kept in stock:

* 20% of total number of tubes in cut length.
* 4 sets of gaskets for all joints.
* 4 nos. Synthetics rubber, (O) rings or Asbestos Ropes for floating head joint (if applicable)
* 4 sets of each size of nuts & bolts.
* Tube plugs for 20% of total tube holes.
* A spare Heat Exchanger or Tube Bundle *(tube bundle for removable tube bundle type Heat Exchanger only)* for immediate replacement.

Maintenance tools & repairs:

The following list of special tools required for the proper maintenance and repair of the Heat Exchangers.

* Collapsing Tool.
* Internal Tube Cutting Tool.
* Tube Puller.
* Drifter.
* Plug Puller.
* Wrenches.
* Tube Expander.
* Metallic Brushes.

Maintenance of Heat Exchangers consists principally in keeping the Heat transfer surface free of deposit. An increase in the pressure drop through the Heat Exchanger and in increase in outlet temperature is indication of fouling. By recording the initial 'clean' operating conditions, a departure from this will need for corrective action.

If at any time it becomes necessary to replace any tube, process as follows:

* Remove the end covers and expose the tube sheet on both sides.
* Collapse the tube ends using a collapsing tool and pull out the defective tube with help of tube puller.
* Insert a new tube through the tube-sheet and baffle assembly, allowing the end of the tube to extend the face of the tube-sheet by about 1/16".
* With the free end of tube securely held to prevent movement, roll the tube end into the tube-sheet with the expander and mandrel.
* Test for leakage by applying a hydraulic pressure of 125 psig. on the shell side.

Important Note:

When ordering parts for the Heat Exchangers, be sure to state the Serial number, which is on the Heat Exchanger nameplate. This will fully identify the items in our records and ensure the furnishing the proper parts.

ANNEXURE 1.

Recommended analysis of cooling water. All figures expressed in parts per million (ppm)

Total Solids.	95
Dissolved solids.	90
Silica as *AcCo3.*	26.8 x 0.835 = 22.4
Iron as *Fe.*	0.13
Calcium as *Ca.*	11.2
Magnesium as *Mg.*	. 5 x 4.12 (14.35 as *CaCao3*)
Sodium as *Na.*	11.2
Sulphate as *CaCao3.*	2.1 x 1.04 (2.39 as *CaCao3*)
Hardness total as *CaCao3.*	43.00
Hardness Temporary.	43
Hardness Permanent.	-----
Alkalinity to Methyl Orange.	54
Colour (A.P.H.A.)	10
Turbidity (Max. During Mansoon)	2.5
pH	7.7

Cleaning:

Water Side.

One of the following methods can be adapted.

Mechanical Cleaning.

Simple metallic brushes could be effectively used for removal of scales from inside the tubes, followed by rinse with clean water.

Chemical Cleaning.

* Make a 3% solution of Hydrochloric acid or an organic acid in water.
* Circulate the solution through the Heat Exchanger for sometime.
* Drain of the solution and rinse with clean water.
* The Heat Exchanger is now ready for efficient service.
* The Heat Exchangers should be cleaned regularly to prevent excessive fouling. The length of time required for soaking and for re-circulation is dependent on the condition of the Heat Exchanger and may vary.

Oil Side.

Under normal conditions of operation, depending on the Quantity of oil employed, it is necessary to clean the Heat Exchanger on the oil side, only if it is found, during an overhaul, that the entire oil system has become excessively dirty.

* Drain the Heat Exchanger on oil as well as water side.
* Remove the end covers.
* Remove the packing & rings and pull out the tube bundle from the stationary tube plate end.
* Inspect and if necessary clean them.

Washing does not removes sludge and oil film properly. Allowing a solvent to take effect for several hours should soften the fouling. Drain off the solution and clean with water, hot air or low-pressure steam. Finally circulate oil to remove traces of moisture.

Replacements.

The internal condition of a Heat Exchanger especially the tube, tube plates, rubber rings gaskets and end covers can be determined at each maintenance operation. It is not advisable to employ used and possibly deformed jointing a second time. The gaskets, 'O' rings & tubes should be kept in stock.

CROSS SECTIONAL VIEW OF SHELL & TUBE TYPE ‘SUN’ HEAT EXCHANGER