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| LONGONI ENGINEERING SRL | OPERATING AND MAINTENANCE | Ed. 10/2018 | Rev.3 |
| INSTALLATION, OPERATION AND MAINTENANCE OF HEAT EXCHANGER FINNED TUBE | | | |

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In the following pages you will find all the information necessary for the proper installation, use and proper maintenance of your heat exchanger

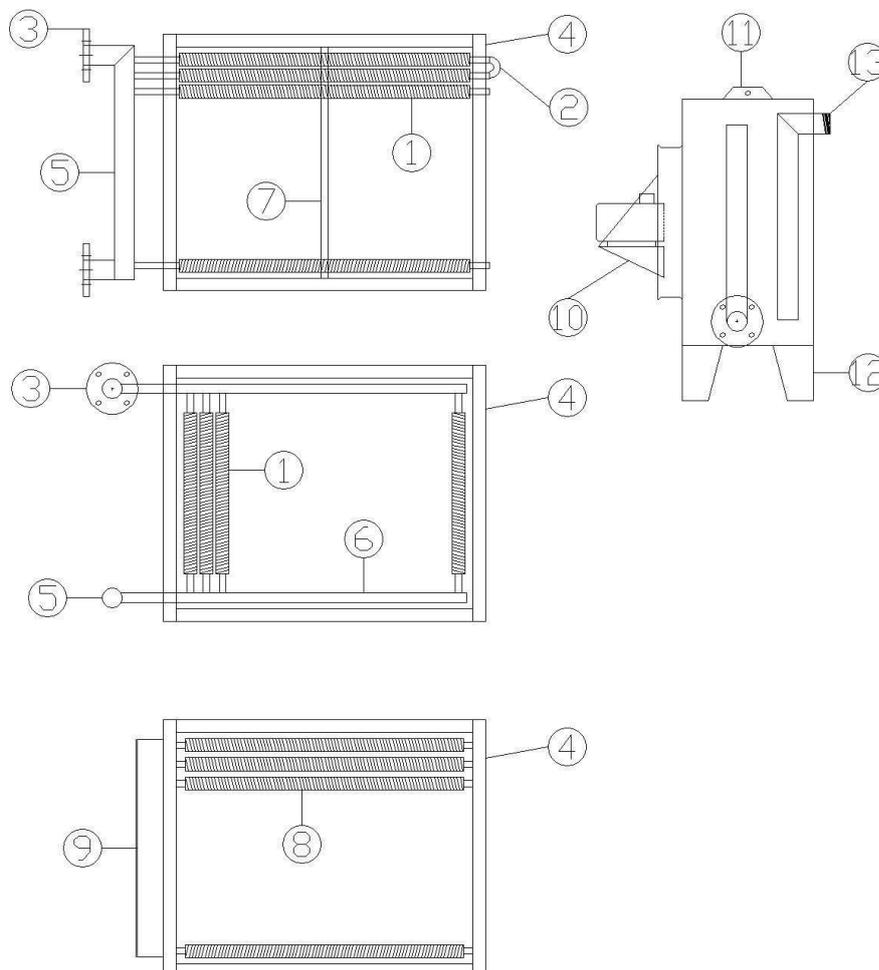
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1.1 CLASSIFICATION OF HEAT EXCHANGERS AND COMPONENTS

The following figure shows the nomenclature used to identify the main components of finned tube heat exchangers.

1.1.2 Type of heat exchangers and components

| | | | |
|---|-----------------------|----|---------------------|
| 1 | Finned tube | 9 | Wiring block |
| 2 | 180° Curve | 10 | Fan Group |
| 3 | Flange In/Out Fluid | 11 | Lifting eyebolts |
| 4 | Shell | 12 | Saddle support |
| 5 | Primary collector | 13 | Fillet In/Out fluid |
| 6 | Secondary collector | 14 | |
| 7 | Support tubes | 15 | |
| 8 | Electrical resistance | 16 | |



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1.2 PURPOSE AND SCOPE OF THE MANUAL

This manual is designed as a support and guidance for staff use and maintenance of heat exchangers with finned tubes

This manual should be read carefully before beginning installation of any heat exchanger in order to ensure proper implementation and better operation.

Please note that In this manual are given general guidelines. Customer care will be the responsibility of implementing the instructions, taking into account:

- the system in which the equipment will be installed
- the specific process
- The specific maintenance procedures

1.3 GENERAL INSTRUCTION

So how come our products are to be assembled with other machines to form a group in a single plant whose commissioning is forbidden until the complete system has been declared in conformity with the rules established in the State in which the 'plant is in service.

The performance efficiency of operation of heat transfer equipment, operating life and the absence of problems during the operation, depend in general on the following factors:

- Adequate thermal design and mechanical
- Adequate arrangements for installation, including plans for the supports and the piping connection
- Method of operation
- Accuracy of cleaning and maintenance

Performance problems can be attributed to one or more of the following factors:

- exchanger fouling
- Operating conditions different from those of project
- stagnation of air, gases or liquids
- Wrong connection of pipes
- Corrosion of internal components
- Application of incorrect or faulty storage before installation.

1.4 WARNINGS INSTALLATION

Upon receipt of the exchanger, check the integrity of same in order to verify that no damage occurred during transit, waiting for the installation to store the heat exchanger in an appropriate manner, preferably in a covered and heated area. If the heat exchanger remains stored for a period exceeding 30 days, you should take precautions to avoid oxidation, dirt and contamination by foreign bodies both internally and externally. Do not expose to the atmosphere the interior passages of the heat exchanger, as humidity and pollutants can penetrate into the heat exchanger and possible damage and / or failures. The battery operated electric fans and electric motors are more sensitive to moisture and liquids.

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After a long period of storage in the warehouse, an inspection is needed before installation of the heat exchanger in order to verify its integrity.

During the installation, set up in the heat exchanger in order to allow the connection of pipes without force. Before connecting the pipes, remove the protection of openings, carefully check all access openings to remove any debris. In order to allow the isolation of the heat exchanger in order to permit cleaning and maintenance, install the valves and by-pass on the pipes.

In order to prevent and / or remove any trapped air or gas, both to cloak the side pipes, you should install air release valves.

Connect the supply pipes, if not otherwise provided for special needs, so that the flow of two fluids appears to be upstream.

- The flow of dry heat comes from the output side of the heating fluid inlet side and exit from the heating fluid
- The flow of dry cool to come from the output side of the coolant and exits the input side of the coolant
- If the fluid in the tubes can generate steam is recommended to connect it so that the flow goes from bottom to top
- The steam coils the steam flow must always go from top to bottom regardless of airflow.

Achieving adequate support for mounting the heat exchanger to prevent sagging and deformations that may affect the mechanical efficiency of the heat exchanger. Fix the heat exchanger so that it has freedom of movement due to the lengthening of expansion.

Install the appropriate control devices, control and related devices and / or security alarms for under or over temperature, over pressure, etc.. In the heat exchangers and steam condensation usually occur the perfect drainage of condensate.

Exchangers heating with electric heaters, the first electrical connection, check that the power supply is compliant and that the type and cable size is adequate to operating temperature and current absorption. Place a circuit breaker on the power line. Installation and connection must be performed by qualified personnel.

If there was the presence of electric fans, adequate space for the intake and expulsion of air, put the device in a position which can not be extracted from the fan, small objects, check that the direction of rotation is correct .

The fans could have a noise level higher than 70 dB, if necessary provide appropriate noise abatement barriers, according to the limits allowed in the installation area

Because of the high temperature at which they can work some heat exchangers are recommended in the insulation of the same in order to prevent accidental contact with hot surfaces.

Connect the equipment to the ground.

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1.5 NOTES FOR OPERATIONS

Before the operation to ensure the cleanliness of the interior of the system to avoid clogging the pipes or the shell side. We recommend the use of settling tanks or filters installed on the supply pipes to remove debris.

Open the vents before starting, begin gradually put into operation in accordance with the procedures of starting and stopping that will be specified later. Once the system completely filled with process fluids close the vents. All the bolts with the seal of the joints, should be further tightened once the heat exchanger has reached operating temperature to avoid any losses from the seals.

Do not operate the heat exchanger at temperatures and pressures other than those listed on the nameplate or on the declaration of conformity. Do not use fluids other than those indicated, since the use of fluids other than those for which the equipment was designed and built could trigger corrosion or erosion that could affect the mechanical efficiency of the device.

In the event that one of the fluids is at a high temperature, always make sure that the cooling fluid passes through.

In heat exchangers that work in the condensation of hot fluids, to prevent water hammer, is starting down that the condensation must be drained completely by the heat exchangers. Avoid fluctuations in fluids in the exchangers, since these fluctuations could cause vibrations that could compromise the functionality of the device and the mechanical strength. At the time of the stop, drain all fluids, to avoid stagnation of fluids that may freeze in the cold or trigger corrosion.

With heat exchanger with electric fan running, do not approach with objects or loose clothing which could be drawn from the same fan in the presence of a safety net.

Use common sense and make any reference to procedures for commissioning of the plant where the device is inserted.

1.6 MAINTENANCE NOTES

To keep in perfect condition and ensure the best operating conditions of a heat exchanger is a good idea to carry out maintenance and cleaning. Trip times vary depending on the type of fluid, impurities or deposits present, the operating temperature, the user will have to adjust according to our experience and based on a few easily identifiable parameters, the yield of heat exchanger, which decreases or the pressure drop of the fluid increases are symptoms that indicate that the heat exchanger needs cleaning. Increasing the thickness of the deposits also increases the difficulty of pulizia. La not cleaning the tubes, and the resulting scale deposits can cause a different heat output of the tubes, also adjacent, and this can lead to different thermal expansion between tubes with a possible consequent breaking.

Never remove the flanges without first stopping the system, pressure device and completely removed without having emptied. For all maintenance and cleaning, use appropriate personal protective equipment based on the fluid contained in the heat exchanger and, if necessary ventilation.

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In case of removal of the heat exchanger at the time of replacement, consider replacing old gaskets with new gaskets, seals during assembly and are crushed and deformed during use tend to become brittle. E 'recommended the use of bolts and nuts to match the new specifications of existing ones.

2 PROCEDURE FOR STARTING AND STOPPING HEAT EXCHANGER

2.1 PURPOSE AND SCOPE

These procedures reflect the operating procedures necessary for starting up and stopping of the finned tube heat exchangers.

2.2 GENERAL PRECAUTIONS

All start-up and shutdown should be conducted, taking care to avoid exposing the heat exchanger and the system to the risk of:

- sudden and uncontrolled thermal excursions
- Day of sudden and uncontrolled pressure
- Water hammer

These conditions could exert stress on the heat exchanger, fittings or plant that could compromise the mechanical strength and thus cause serious damage.

2.3 ADDITIONAL INFORMATION

In all operations starting and stopping the flow of fluids should be adjusted so as to avoid sudden changes in temperature of the heat exchanger. You should not use ON-OFF valves but modular valves. You can start before the hot fluid and then the cold but avoiding the cold fluid in contact with hot surfaces tends to evaporate.

3.1 METHODS FOR REMOVAL AND CLEANING OPERATIVE

Dismantling and cleaning of heat exchangers is a simple task to be performed by qualified personnel using appropriate personal protective equipment and apply appropriate protection systems also based on the fluid in the heat exchanger.

3.2 INSTRUCTIONS FOR REMOVING HEAT EXCHANGER

These operations must be performed by qualified personnel equipped with the personal protective equipment and safely, you must use appropriate tools and lifting equipment are adequate to carry the weight of the heat exchanger. It 'a good idea to have before dismantling any parts to replace (gaskets, bolts, nuts, cables ...). Intervene with individual protective measures and another based on the fluid

Before carrying out any operation, check that:

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- The system is stationary
- That the valves feeding and discharge are closed
- Whether the unit is empty
- That the surfaces are cool
- What the fans are not working
- That there is no voltage
- Do not handle the 'unit with hooks or other tools that could damage the tubes or finned surfaces
- Balance the weight during handling
- Do not bend the tubes

3.3 INSTRUCTIONS FOR CLEANING HEAT EXCHANGER

The statements herein may be adopted for cleaning the shell side to tube side of heat exchangers. The soft deposits, depending on the type, can be removed with hot water, air, detergents, taking care of specific use according to the manufacturer's specifications, use only products which do not affect the material used to build the heat exchanger.

Do not use cleaning fluids, electrical appliances.

Where the action of detergents is not sufficient for the removal of scale, may be adopted mechanical cleaning methods. In the case of mechanical cleaning, avoid:

- Tap the tubes with metal objects that could damage
- Make uncontrolled maneuvers
- Do not damage the surface of the heat exchanger

Always use your common sense.

3.4 NOTES FOR ELECTRICAL BEAM

The deposit residue on the tubes can affect the operation of the same as reducing the thermal resistance and may overheat and burn.

Before carrying out any operation it is recommended to remove the power supply and disconnect the electrical wires. Avoid wetting the head of the resistance or the connection area in order to avoid possible short circuits to the reintegration of the voltage.