Summary

DANGER SIGNALS

The information provided in this manual concern the risks that may arise during the installation and use of MBS heat exchangers.

Risks can be described as belonging to two different categories:

Health and safety warnings: these risks may impair the staff's health. Read this manual carefully and follow the recommended indications.

The signal used to identify these situations is: 

Precautions to preserve the integrity of the exchanger: the risks indicated refer to possible damages to the equipment and/or consequent potential risks. Read this manual carefully and follow the recommended indications.

The signal used to identify these situations is: 

Further information:

Indications for the correct use of the equipment: Useful technical information is provided to install and use the exchangers correctly. Please read this manual carefully and follow the recommended indications.

The signal used to identify these situations is: 

RISK ANALYSIS

Risk assessment, in accordance with Directive 97/23/CE

Overpressure

Effect Breaking, permanent deformation

Fluid leakage, metal splinters

Comply with the maximum pressure values recommended on the rating plate and in this manual. Install a pressure relief valve.

Overheating

Effect Overpressure

Permanent deformation, breaking, fluid leakage

Comply with maximum and minimum pressure values recommended on the rating plate and in this manual.

Install a pressure relief valve to avoid overpressure and provide adequate temperature control means.

Operating temperature

Effect Hot metal surfaces

Contact injury, burns

Protect hot surfaces adequately: warn against danger with special signs.

Material volume

Effect Buckling

Permanent deformation, breaking, fluid leakage

Refer to the technical information showed on the present manual to place the exchanger on its support

Esternal events (wind, earthquake, fire and traffic)

Effect Breaking, permanent deformation

Fluid leakage

Install the heat exchanger in a suitable area

Charges

Effect Breaking, permanent deformation

Fluid leakage

Install the heat exchanger as recommended in this manual

Fatigue, cyclic strain

Effect Breaking

Fluid leakage

Keep records of the number of cycles of the heat exchanger.
Comply with the maximum number of cycles recommended in this manual.

Impact and dynamic reactions

Effect Breaking, permanent deformation

Fluid leakage

Provide adequately protect the heat exchanger from any possible impact.
Install a safety valve to prevent accidental water hammers.

Maintenance

Effect Incorrect pressure maintenance

Fluid leakage

Before carrying out any maintenance operations, cut the heat exchanger off.
Check that there is no hydrostatic pressure.
Consider the dangerousness of the fluids contained.

EQUIPMENT PACKAGING AND HANDLING

The equipment is shipped in a packing suitable to protect fragile surfaces from any damage.

Remove the protections carefully avoiding any scratch or dent.

The weight of a heat exchanger may be fairly high (check the technical data regarding the specific device you are handling).

Use suitable support means to avoid any damage to the operating staff or the equipment itself.

Place the exchanger onto the support frame or working plane so that it is stable and safe (no risk of falling); fasten it with the suitable means to prevent any movement and/or falling during installation operations.

Do not position the exchanger vertically, as its head surface may be damaged and accidental shocks may cause it to fall, with severe risks for the operating staff.

Perform all handling and installation operations with extreme care to avoid damaging the heads surfaces and the exchanger connections; keep the original protections as long as you can.

Never use iron brushes or any other abrasive tool to clean the pipe surfaces and/or tube plates, as they may be damaged severely.

PRECAUTIONS AGAINST CONTACT INJURY

During operation, the heat exchanger surfaces may reach high temperatures, either continuously or during specific duty cycles. In such cases, we recommend to protect these surfaces with suitable screens and place the appropriate warning signs.

PRECAUTIONS DURING MAINTENANCE OPERATIONS

Be advised that even when the flow has been stopped, the heat exchangers may contain fluids whose temperature, pressure or chemical conditions may be dangerous.

So, carefully check the exchanger conditions before carrying out any maintenance operation, and manually cut off any fluid delivery to the exchangers.

Before starting maintenance operations in case of high temperature duty, wait until the temperature of the echanger surfaces has dropped.

If one exchanger section contains a temperature-sensitive gas that causes the internal pressure to be increased (i.e. use of freezing gases), release the internal pressure by means of a manually-operated valve before opening any connection.

Caution: comply with all regulations in force as regards gas emissions in the environment.

The internal liquid must be drained by using the manual drain-valves when the internal fluid conditions allow that; otherwise, disconnect the coupling connections.

Use personal protection devices (goggles, helmet, gloves, working-shoes, apron, overall, etc.), according to the existing safety regulations/laws.

Identify all the operation areas correctly and then provide them with all the appropriate warning signs.

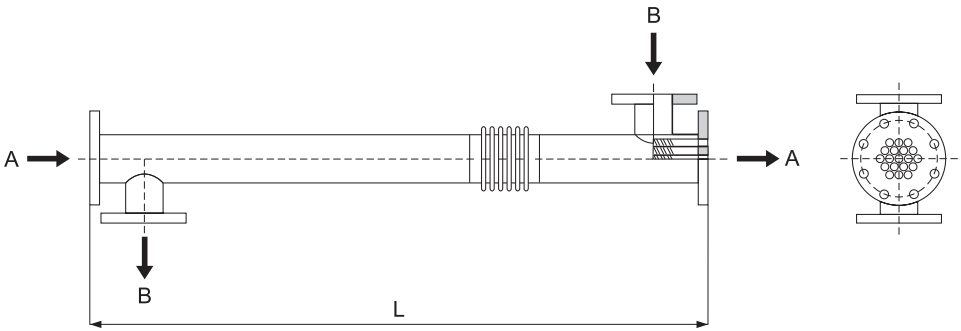
Fence off the working area with tapes or protection screens, if necessary, as prescribed by safety regulations in force in the plant.

PRECAUTIONS FOR THE USE OF FLUIDS

Use the exchanger for the fluids recommended during the dimensioning and sales offer phases, as shown in the Technical Data section of this manual.

TECHNICAL TERMINOLOGY

Product (A)	Fluid running through the section tube
Service (B)	Fluid running through the jacket
Pressure	Tube and jacket fluid pressures indicated in [bar]
Temperature	Tube and jacket fluid temperatures indicated in [°C],
Volume	Tube and jacket section volume indicated in [l]
Lenght	Exchanger lenght indicated in [m]



USE AND MAINTENANCE INSTRUCTIONS

In order to operate the Corrugated Tube Heat Exchangers in fully reliable and safe conditions, comply with the installation and use instructions specified below.

Exchanger Positioning

Install the exchanger/s in a place that can be easily accessed for maintenance and control operations.

Ensure sufficient space for the removal of the elements of the support frame.

Exchanger supporting

The Corrugated Tube Heat Exchangers can be supplied in different lenghts and usually come with an expansion compensator.

In any case, take extreme care in providing the most suitable support for the element to allow for the best operating conditions and fully reliable seal.

The following paramenters must be observed:

distance between consecutive support points: 2.5 m maximum;

because of the temperature, the exchanger lenght may slightly vary; **so we suggest using a support system that allows it to move along the exchanger axis.**

The linear thermal expansion of stainless steel is:

$\alpha = 16\ [\ 10^{-6} / °C\ ]$, then as a function of the exchanger lenght (L) and the maximum thermal excursion (δT), we can calculate maximum expansion (αL), which is: $\delta L = \alpha \times \delta T \times L$

Also consider the feeding tube expansion, which should never create loads onto the tube plate or the jacket side gates. We recommend the use of supports manufactured in plastic and/or rubber (suitable for jacket side operating temperatures) to be placed directly in contact with the exchanger.

This feature allows the vibrations generated by the flow to be reduced.

Interconnection between the exchangers

It is often necessary to connect more exchangers in series: in these cases, comply with the following installation instructions:

Install each exchanger horizontally, accurately check its positioning and eliminate any alignment or center distance difference so that no load is imposed onto the tube plates or gates.

Utilize full face gaskets

In order to ensure effective connection sealing, the connection piping between consecutive exchangers must be manufactured after rigidly positioning the exchangers.

Keep a center distance between exchangers to allow for easy disassembly.

Hydrostatic pressure test on the assembled system

An hydrostatic pressure test must be carried on the assembled system to verify the correct sealing of both product and service sides.

We suggest to use cold water and fill the system completely, feed with compressed air and cut off the system by a check valve for a period of 1-3 hours, avoiding pressure drops.

In case of pressure drops, perform a careful visual check to identify any leakage and stop it, if any. Repeat the test.

Hydrostatic test during operation

A pressure test should cyclically be carried out to check the seal both on the product and service sides.

PRECAUTIONS AGAINST OVERPRESSURE

In order to ensure operation of the heat exchangers in good and safe conditions, the appropriate precautions must be taken to prevent overpressure which may be generated inside the hydraulic system and damage and/or cause spills in the environment.

The pipework/system fitted to the exchanger must be checked in order to identify potential sources of system overpressure.

One of the most important features is the design of the exchanger/s feeding pump; a centrifugal pump will never exceed the maximum rated head, including when the system is closed, whereas a positive-displacement pump, expecially if it works with pistons (or a homogeniser), may generate dangerous overpressure peaks if the delivery circuit is accidentally closed.

In such a case, since the fluid is incompressible in itself, there is no elastic compensation and the generated overpressure is rigidly discharged onto the whole system.

Another condition that may cause overpressure is the lack of drainage in the system (tipically the service side) and keeping the circuit closed while the other side (the resident product) of the exchanger is heated.

In this case, the heating will cause the thermal expansion of the fluid in the closed circuit and/or the transition of the fluid to the vapour state, and thus increase pressure, even up to very high values, with the consequent breaking or leakage and severe risks for anybody in the surroundings.

The use of gases, especially of the freezing type, in the jacket side may generate overpressure if the circuit has not been built suitably.

As a matter of fact, these kinds of gases, which are normally used in low temperature and low pressure cycles, may expand due to the effect of the temperature and generate high pressure values. This may occur, for example, during washing cycles (or in other conditions where high-temperature fluids flow in the product (tube) side), if the jacket (service) side is not adequately drained (see precautions below).

Use all the necessary means to avoide these situations by installing suitable pressure-reducing valves, as per recommendations below.

Recommendations for protection against overpressure

Analyse the application of the heat exchangers carefully: if the potential risk exists that any situation like those mentioned above is created, especially as regards the breaking of control parts, failure of valves and switches, manual operation mistakes, etc., always fit a suitable relief-valve or safety device of the adequate materials and size to protect the system.

The safety valve opening must be set at the maximum rated pressure for the exchanger, as specified in this manual, and must allow for the inflow of the whole delivery without increasing the pressure.

Typically, this valve will have a pass section corresponding to the diameter of the feeding pipe.

The valve must be operated mechanically and not be affected by any electric signal control.

The relief valve must be fitted upstream the exchanger system. The relief must be piped safely in order to avoid any danger for the operating staff.

To avoid misuses, do not place any cut-off device between the exchanger and the relief valve.

If non-return or check valves are used in the system, more than one relief valve may be required to adequately protect all the system sections.

The effectiveness of the relief valve must be checked periodically on a test stand.

Installation of a suitable pressure transducer is also recommended, so that, in case of overpressure, the heat exchanger is no longer supplied and/or its feed piping is drained.

USE OF FLUIDS AT TEMPERATURES BELOW 0°C

The Corrugated Tube Heat Exchanger is widely and successfully used to cool the product down to low temperatures by using fluids at temperatures below 0°C. The most commonly used service fluid is a mixture of water and glycol or alcohol in the appropriate proportions.

The product temperature must not drop down to levels causing their change of state and consequent freezing during operation, stand-by or emergency conditions.

As a matter of fact, in most cases the solid state has a lower density, and therefore determines a volume increase that may break the exchanger tube/s or pipework.

The behaviour of the system should therefore be analysed as follows:

- the exchanger must be used in sufficiently safe conditions with respect to the product freezing point, taking into adequate consideration the variation induced by the system control devices;

- adequate product-side temperature control means should be provided, with safety devices set at thresholds preventing the freezing point from being reached;

- usually, the critical point is generated due to a lack of flow on the product-side – use adequate flow control means with safety thresholds set to ensure the minimum compatible flow.

The service-side thermal efficiency is often such as to lead the product-side to its freezing point even if both flows are missing; this is why this conditions must also be checked and the necessary prevention measures must be taken.

The system is protected by means of the product-size drainage and service-side cutoff, as soon as a potentially dangerous condition is detected.

In order to allow for this draining, remember that two different exits are required: one in a lower position, to discharge the fluid, and the other in an upper position, to introduce the air that will occupy the volume that was previously occupied by the fluid.

In certain cases, when drainage is difficult due to the physical arrangement of the circuit, the preferable option is to blow compressed air directly into the circuit to empty it.

Please, always refer to this manual (Technical Data), to check whether the exchanger complies with this kind of use.

USE OF STEAM AND GAS IN GENERAL

Water steam is widely used as a service fluid in the exchanger jacket to meet thermal exchange requirements.

Please, always refer to this manual (Technical Data), to check whether the exchanger complies with this kind of use.

If you are using a steam exchanger, consider the following precautions:

- Protect the steam line with a safety valve set at the maximum rated value specified in this manual and/or on the exchanger's rating plate.

- Install a suitable condensation drainage system with automatic air blowdown.

- Protect the product-side according to the recommendations provided to avoid overpressure, when needed.

- If the exchanger is installed in a position where the operating staff may casually come in contact with its parts, compulsorily protect the exchanger line and jacket with the appropriate protection means and indicate the danger with the adequate signs.

The water steam must be of good quality, according to the applicable safety regulations and laws. In particular, no suspended solid particles must be found, the water steam Ph must range between 7 and 8.5, and it must be provided in its dry saturated form to avoid water hammering inside the equipment.

WASHING

Start-up washing

After installation and before start-up, the heat exchanger must be accurately washed in order to eliminate any manufacture residual products.

Drain the fluid used for the first washing cycle downstream the exchanger to avoid contaminating the rest of the system.

Washing cycle

The Corrugated Tube Heat Exchangers are designed to be washed with a CIP cycle within the process of which they are a part.

Best results can be obtained by washing the exchanger product-side immediately after a production cycle, normally using soda and/or acid solutions, as indicated below.

The sterilisation cycle (whose parameters have to be defined based on the process) is carried out immediately before starting a new production.

Please, always refer to this manual (Technical Data), to check whether the exchanger complies with this kind of use.

Flow rate during the washing cycle

In order to wash the equipment effectively, a minimum flow rate should be ensured for the washing solution, so as to allow for a speed (on the product side) of at least 1.5 m/s.

This value may need to be increased in case of viscous products or high temperature cycles.

Water quality

The water used for both service and washing of the equipment must be drinkable water, according to Local and European EEC laws.

The water must have the following chemical features:

Ph 7.0 – 8.5

Chlorides max 30 ppm

Chlorine max 0,2 ppm

Iron max 002 mg/kg

Organic substances: none

Suspended solids: none

Water hardness should be checked as to Calcium, Silicon and Manganese, whose amounts should allow a hardness lower than 10 F.

Higher water hardness may generate calcareous deposits, that are difficult to remove, especially when high calcium concentrations combine with high temperatures.

Specific chemical cleaning treatments must be carried out only by specifically trained and skilled staff, taking all the most adequate precautionary measures and using the suitable types and concentrations of passivated acids.

Washing quality test

The quality of washing cycles must be checked according to two different procedures:

- chemical analysis of the rinse water after the washing cycle: this water should have a neutral Ph and no traces of suspended product;

- inspection of the exchanger: remove the heads and check that there is no trace of burnt or dry product, or product under any other form, on the head, in the seal locations and in the first segment of the pipework.

If results are unsatisfactory, the first recommended measure is to increase the time for each step; if this is not enough, slightly rise the temperatures and analyse the type of residue found in order to identify the most suitable cleaning agent to be used.

SYSTEM START-UP

Before starting the system up, make sure that:

all the operating staff has and is aware of the contents of this manual;

the operating staff is:

adequately skilled and trained to perform this kinds of operations;

is informed about the operating conditions required;

is informed about the potential risks connected with the use of the equipment.

Check that:

all pipes are perfectly welded;

all connections are perfectly sealed;

all feeding pipeworks, both product and service sides, are in good working conditions and, if necessary, protected;

all feeding pipeworks are provided with pressure and temperature gauges, and safety valves.

Start the system up according to the project requirements and check the operating conditions using the relevant tools and instruments; if the operating conditions do not comply with the above recommendations, stop the test and check compliance of all the circuits, equipment and accessories of the whole system.

FATIGUE STRENGTH

The exchanger is equipped with an expansion joint to be dimensiones at different sizes depending on pressure, temperature and number of cycles, as required by the 97/23/EC Directive.

The power stroke of the compensator must necessarily be checked against the range of possible operating temperatures between the product and service sides.

The number of cycles at the maximum temperature and pressure allowed by the technical data of this manual is:

axial stroke + 6 / -12 mm => 1000 cycles

axial stroke + 3 / -6 mm => 20000 cycles

axial stroke + 0 / -3 mm => 100000 cycles

SALES CONDITIONS

Shop inspection

All products manufactured by MBS are checked and tested in accordance with the 97/23/EC Directive and following amendments and/or integrations.

Warranty

All MBS products have a one year warranty period for manufacturing defects.

MBS cannot directly supply any warranty on purchased components but the Customer is entitled to require all the different warranties from the original manufacturers.

Responsability

MBS accepts no responsibility for product defects due to wear and tear, negligence, alterated duty conditions, inability to follow MBS' instructions (verbal or written), improper use, alteration or repairs to the goods without MBS' approval.

Damages during transport

The goods must be inspected by the Buyer upon their reception.

In case it is found not to be compliant with the delivery note or if the goods are damaged, the Buyer should inform MBS and the carrier within three (3) days by written notice.

Installed goods are automatically considered damage-free and no claim will be accepted, except for those included in the warranty clauses.

Repairs and/or return

The goods to be repaired must be sent to the MBS' facilities free of freight charges.

If the complaint is part of the warranty terms and MBS agrees to it, the goods will be repaired and shipped without any further cost for the buyer. Otherwise, the goods will be repaired and sent to the buyer at the customary sales conditions.

In accordance with the European Union's laws concerning health, safety and environmental protection, the customer-user who returns the exchanger for inspection and/or repair, shall provide the equipment clean and free from any poisonous or noxious substance or other dangerous fluids that may involve risks for the health and/or environmental safety.