HRS AQUA S

High Temp Shell & Tube Heat Exchanger

Operation and Maintenance Manual For Tubular Heat Exchangers.

HRS hevac

Head Office
10-12 Caxton Way, Watford.
WD18 8JY t. 01923 232335

North & Factory
No 1 Rosemount Works, Elland
HX5 0EE t. 01422 317070

mail@hrs.co.uk

www.hrshevac.co.uk

WARNING:

The manual must be read carefully before any installation or maintenance work is carried out and/or before using of the heat exchanger.
HRS shell and tube heat exchangers have been designed so that their operation will be risk free. In order to avoid damage and unforeseen risks the SAFETY NOTICES listed in this manual must be followed.
The unit delivered has been designed to work within a range of specific conditions (pressure and temperature) as marked on the manufacturer's nameplate and its use in extremely aggressive or corrosive conditions or with working conditions outside the design parameters could cause severe damage to the equipment.
IMPORTANT: Under no circumstances should the heat exchanger be connected into the final installation and fluids circulated through the unit before a thorough cleaning of the internal surfaces of the installation has been carried out.
If the user has any doubts or if a more complete explanation of any feature is required do not hesitate to contact the Technical Service Department of HRS HEVAC IIMITED.

1. Guarantee:

HRS guarantees that only materials of the highest quality free from defects or deficiencies have been used in the construction of its shell and tube heat exchangers. Providing that units have been used within he design conditions marked on the general arrangement drawing and nameplateand where applicable the CE Certificate of Conformity they are guaranteed for a period of 18 months from the dispatch date against any defects in materials or workmanship.

The guarantee will not apply to hose components which through normal wear or natural deterioration require renewal at predetermined intervals or to internal/external damage poduced by lack of care, omission or negligence on the part of the user. HRS will not hold itself liable for any damage caused by incorrect maintenance of the unit or by the use of inappropriate or contaminated fluids.

This guarantee will not cancel any other guarantees or clauses ageed during the processes of order negotiation or which have been previously ageed for specific contracts. The guarantee will only cover whichever component within the uni is found to be defective.

HRS will not hold itself liable for the cost of repairs, removal from he installaion, transport, loading and unloading and reinstallation when the reasons for the breakdown differ from a previously identified defect.

HRS will not hold itself liable for the costs of any essential repairs carried out by the buyer/end user without prior discussion with HRS to agree the necessity, extent and urgency of the repair work.

When units are delivered ex-works, the Transport contractor must be held liable for any damage or losses suffered during transport of the units and this should be reflected in any transport contract placed by the purchaser.

2. CE Mark and European Community Directive:

HRS shell and tube heat exchangers are designed and manufactured in accordance with the requirements of the following European Community Directive:

DIRECTIVE 97/23/CE of the European parliment and Council of Ministers of 29th May 1997 for the approximation of the legislation of Member States on Pressure Equipment.

To comply with current legislation each heat exchanger carries a nameplate on which the following data appears in a legible and indelible form:

- Name and address of the manufacturer.
- CE mark where applicable.
- Identification Number of the Notified Body where applicable.
- Identification of the model and serial number.
- Year of manufacture.
- Information required for safe operation (Maximum Allowable working pressures and temperatures, weights, volumes ect.)

In accordance with the European Directive on Pressure Equipment and depending on the design crieria specified in the contract the heat exchanger will fall into a Deirective Category which determines the level on Inspection and Design Scrutiny required. The nameplate includes the relevant data according to Directive 97/23/CE together with the identification number of the Notified Body which has carried out any necessary design appraisal and other controls.

3. Health and Safety Considerations:

Residual Risks

HRS shell and tube heat exchangers are designed and manufactured to ensure that in operation they will not pose any risk to the operator. In accordance with current legislation where a risk cannot be eliminated or guarded against appropriate warning notices must be given. In this section we have summarized the risks associated with the equipment and the corresponding warnings using as a reference the following legislation:

- Spanish Royal Decree 485/1997 of 14th April 1997 covering the minimum warning notice required for safe and health at work.
- European Directive 92/58/CEE of the Council of Ministers dated 241 June 1992 covering the minimum minimum warning notices required for safety and health at work.

In order to reduce geneal risks HRS recommends the following:

- Install the equipment in an area with adequate space and with a firm load bearing floor in order to avoid instability.
- Carry out appropriate maintenance at the recommended intervals.
- If any of the safety components develop faults do not start the equipment or if already operating, stop it immediately.
- Always keep the surrounding area clean and tidy.
- Maintain any earthing connections in good condition.
- Adequately train all operators in the operational and safety aspects of the equipment.

Burns

We recommend that the heat exchanger is thermally insulated with a good quality material of sufficient thickness (we recommend using rock wool for hot surfaces and expanded polyurethane for cold surfaces) to give surface temperatures below 60°C. This will not only reduce energy losses through radiation or heat gain but will also provide the personnel protection demanded by health and safety legislation. Where his is not possible appropriate guards must be fitted o prevent physical contact between the equipment and operating personnel and if this is also not possible then clearly visible WARNING notices must be attached to warn of the potential hazard.

If the heat exchanger has to be inspected internally or if any component has to be removed from the unit, appropriate precautions must be taken. The operator must always allow sufficient time for the heat exchanger to cool down (or heat up) to ambient temerature and the unit must be depressurized atmospheric pressure on both product and service fluid circuits before any connections are loosened or removed.

Always follow closely the instructions given in the section on servicing operations.

Hazardous Substance

Heat exchanged often work with fluids such as Sodium Hydroxide (NaOH) or Nitric Acid (NH03) which are hazardous in their liquid or vapor form and appropriate safety precautions must be taken by the operators whenever either of the operating fluids is classified as hazardous.

Static Electricity

Under certain operating conditions static electrical discharges can be prodouced which may be capable of igniting any flammable or explosive substances in the vicinity. In order to avoid this risk, HRS recommends that earthing strips are fited to all electrically conducting components which could become charged with static electricity. An appropriate connection to earth should be made by the user/installer from the heat exchanger supports where this has not been specified to HRS and provided with the unit.

Health and Safety Considerations

This Installation Operation and Mainenance manual contains important information on the hazards of operating hot or cold pressurized heat exchange equipment. Throughout the Manual you will find WARING notices. The user must take note of the appropriate WARNING notice before proceeding. Before unpacking the equipment or attempting to install or operate the unit the user must study the manual and pay close aention to all of the WARNING notices. Failure to do this could result in serious injury to personnel or damage to he equipment.

All operators must be adequately trained in both operational and safety aspects of he equipment and its use.

WARNINGS

These describe potential hazards to personnel including the risk of danger to life and of serious or minor personal injury. The WARNING will state the nature of the hazard and how it can be avoided.

4. Technical Description:

HRS Shell and Tube Heat Exchangers

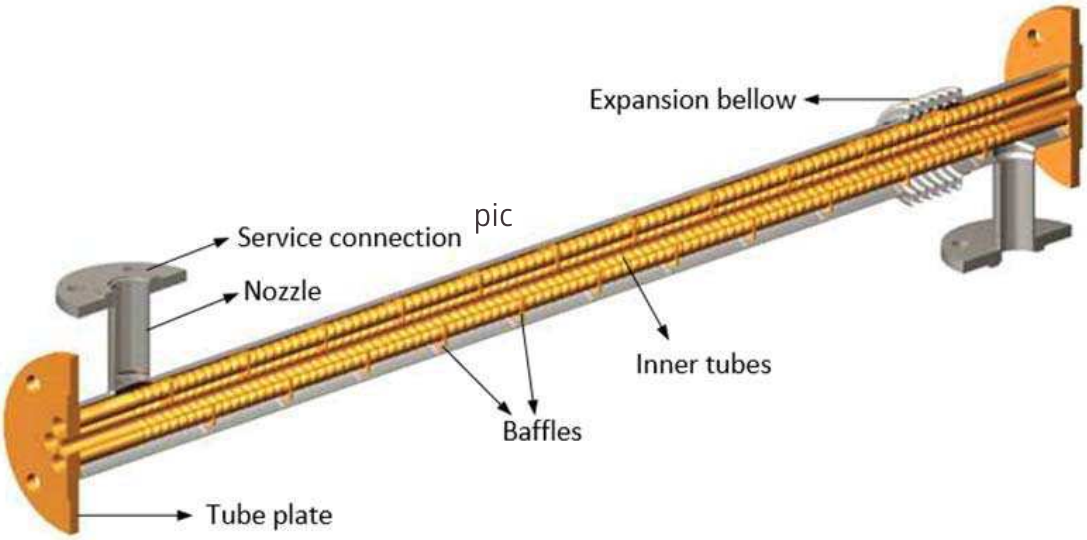
HRS shell and tube heat exchangers are all stainless steel units which are intended for food industry, pharmaceutical and industrial use depending on the mechanical design features and interconnection type. The units are normally manufactured from AISI 300 series stainless steel but can also be manufactured from a variety of other corrosion resistant materials to suit specific applications.

Details of the materials used can be found detailed on the General Arrangement Drawings issued for specific contracts.

The standard heat exchanger shell is manufactured from welded AISI 304 pipe and the internal heat transfer tubes from AISI 316L tubes conforming to ASTM A249. The removable tube plate models have a series of “O” ring seals for pressure containment and fixed tube plate units are normally fitted with a multiconvolution thin wall expansion bellows designed to absorb the differential expansion which occurs between the shell pipe and the tubes during normal service. The internal tubes are supported with baffles where necessary and the units can be fitted with hmultipass headers and/or welded supports when required by the installation. Connections can be fitted with food industry standard quick release clamps or flanges depending on the model type.

Heat Exchanger Components

The figure below shows the various components in HRS heat exchangers:



Shell:
The pipe containing the tubes and forming the pressure vessel for the shell side fluid, normally the service fluid which provides the source of heating or cooling for the unit.

Inner Tubes:

The heat transfer tubes are normally corrugated with a shallow spiral indentation extending along the length of the tube. The disruption of the boundary layer produced by he corrugated tube results in heat transfer coefficients up to several times higher than the coefficient achieved with a plain tube at the same fluid velocity. A significant benefit that the operator may also notice during heating services is that the scale formation can be retarded because of a reduction in the tube wall temperatures. If a layer of scale does form it is often much easier to remove because of discontinuities in he film.

Tube Plates:

The plate at each end of the tube bundle into which the tubes are welded. This plate also closes the pressure vessel for the shell side fluid and in the k series units acts as the connecting flange with an appropriate raised face, for the tube side fluid. The user must ensure that appropriate gaskets are always used on the connections suitable for the pressure and temperature of the installation and resistant to the working fluids.

Baffles:

When fitted baffles in shell and tube heat exchangers they perform two important functions.

- They provide tube support for tubes that would otherwise sag under their own weight and could vibrate under the action of fluids across them.
- They direct the shell side fluid across the tubes in order to maximize the heat transfer coefficient particularly when the flow rate on the shell side is restricted.

Shell Side Connections:

The heat transfer tubes are normally corrugated with a shallow spiral indentation extending along the length of the tube. The disruption of the boundary layer produced by the corrugated tube results in heat transfer coefficients up to several times higher than the coefficient achieved with a plain tube at the same fluid velocity. A significant benefit that the operator may also notice during heating services is that the scale formation can be retarded because of a reduction in the tube wall temperatures. If a layer of scale does form it is often much easier to remove because of discontinuities in the film.

Multipass Units

The standard HRS heat exchangers have a single tube side pass but if required for specific applications the units can be supplied as multi pass units with inlet/outlet headers and surround headers to give the appropriate tube side flow pattern. In this type of unit the tube side fluid passes two or more times along the tubes, depending on the header configuration. The headers are manufactured from AISI 316 stainless steel and carry internal division plates positioned to give the required number tube side passes which will cary with the contract requirements. All bolting is manufactured from stainless steel and gaskets are chosen to be suitable for the prssure and temperature of the installation and resistant to the working fluids.

Gasket Material

The following gasket material selection table is included for guidance only. Advice should be sought from a specialist gasket manufacturer for special applications and aggressive fluids.

Gasket Material	Temperature		Typical application
	Minimum	Maximum	
Silicone	-50°C	200°C	Food applications
Nitrile	-25°C	100°C	Oil based fluids
EPDM	-40°C	130°C	Water based fluids
Viton	-15°C	220°C	High working temperatures

Multiple Unit Designs

In order to achieve long 'thermal length' heat exchangers, the HRS shell and tube units can be connected together in series or parallel flow regimes in order to give the design characteristics required. When this type of multiple unit configuration is required all interconnections and a support frame can be supplied by HRS if required. Modules are interconnected on the shell side using welded, flanged or other type of interconnections, appropriate to the installation. All bolting is manufactured from stainless steel and gaskets are chosen to be suitable for the pressure and temperature of the installation and resistant to the working fluids.

Example of multiple heat exchangers mounted together in frame:

Standard Design Data

Manufacturer:	HRS Heat Exchanger SLU. C/Castillo de la concepcion, Nave 6. 30564 Lorqui (Murcia) Spain
Design Pressures:	Tube side: 10barg / full vacuum. Shell side: 10 barg / full vacuum.
Design Temperatures:	Tube side: 0/185° Shell side: 0/185°
Dimensions:	See www.hrs-he.com for product datasheets.
Tube corrugations:	Spiral indentation type corrugation along the lengh of the tube. Other types of corrugation are available on request.
Materials:	Standard materials: Shell side wetter surfaces: AISI 304 stainless steel. Tube side wetted surfaces: AISI 316L stainless steel. Other materials are available on request.
Pressure vessel:	All HRS shell and tube heat exchangers comply with. the requirements of the European Pressure Equipment Directive 97/23/EC, the category being determined on a contract specific basis depending on the unit volumes and the nature of the working fluids. The nameplate carries the details required under 97/23/EC for the unit as supplied.
Connections:	Industrial models: • Shell side: Flanged PN16 DIN2502. • Tube side: Flanged PN16 DIN2505. Hygienic models • Shell side: Flanged PN16 DIN2502. • Shell side: Quick release clamps.

5. Fluid Requirements:

Product Fluid Requirements

The HRS shell and tube heat exchangers can be used a wide variety of Product Fluids and it is important that the user has specified the fluid characteristics correctly during the design stage to ensure that the heat exchanger selection is appropriate for the working fluid(s) as well as ensuring that the required thermal performance will be achieved. The user must ensure that sound engineering practices are followed during the storage use and disposal of the fulids used with safety measures appropriate for the installastion.

HRS makes he following general recommendations for the product pluid circuits:

- Product fluids will normally be passed through the tube side of a heat exchanger unless central specific requirements make an alternative flow regime more appropriate.
- If the products carry particles it is important to ensure that the maximum inside diameter of the heat transtfer tubes is at least three times the maximum particle section.
- If the products are of high vescosity and/or have a tendency to freeze at ambient or working temeratures, a monotube style of heat exchanger is normally recommended to ensure that tube blockage can be easily monitored and corrective actions taken as necessary before damage occurs to either the heat exchanger or the system to which it is fitted.
- It is essential that the heat exchanger materials of construction are appropriate for the products being circulated. High salt content products partictulary can be highly aggressive to stainless steel and more resistant grades or duplex materials must be used with these products. If the end user has any doubts he should contact HRS or a specialist metallurgist for advice and confirmation of compatibility.
- Product fluids should be deaerated before passing through the heat echanger as any air hat is released during heating or cooling can accumualate within the heat exchanger and cause themal performance problems.

Service Fluid Requirements

The HRS shell and tube heat exchangers can be used a wide variety of service fluids to provide the source of heating or cooling for the proiduct. Typically the service fluids fall into one of three major categories which are described below but if other fluids are to be used for specific contracts the user must ensure that sound engineering practices with appropriate safety measures are followed during the storage use disposal of the fluids used.

General Requirements:

- Vertical mounting is strongly recommended in preference to horizontal mouning as this will normally guarantee the avoidance of damaging stresses even if the condensate removal system is not 100% effective.
- The steam supply must be good quality dry saturated steam free from solid particles air and water droplets with a maximum working pressure at the heat heat exchanger equal to or less than the value marked on the nameplate. Steam line drain traps and filters should be fitted in order to ensure that good steam quality is maintained we recommend hat a specialist company be contacted to advise on this requirement.
- The minimum steam line diameter should be that of the heat exchanger connection pipe the size of which will have checked by HRS to ensure hat the diamter is sifficient for the maximum volume of steam passing through the connection during normal service. If the control valve is smaller than the inlet connection the installer must supply transition pipe work before the heat exchanger to match the connection diameter.
- It is essential that the heat exchanger materials of construction are appropriate for the products being circulated. High salt content products partictulary can be highly aggressive to stainless steel and more resistant grades or duplex materials must be used with these products. If the end user has any doubts he should contact HRS or a specialist metallurgist for advice and confirmation of compatibility.
- Specialist advice should be sought by the installer to ensure that steam control valves etc. are sized correctly in order to give a constant and controllable pressure into the heat exchanger. We stronly recommend modulating controls in preference to on/off conrols which can cause damaging pressure shocks to the system.
- Manual shut off valves should be installed before and after the heat exchanger to ensure safety during servicing activities.
- A safety relief device should be installed between the maual shut off valves and the heat exchange,sized to ensure a pressure accumulation no greater than 10% of the maximum allowable working pressure marked on the nameplate of the heat exchanger under all foreseeable conditions.
- A pressure gauge sized in accordance with good practice should be fitted into the steam line immediately before the heat exchanger. Provision should be made to allow easy condensate drainage from the gauge line.
- The steam lines should always be insulated for personnel safety in order to enure that condensate does not form within the steam lines before the heat exchanger and for energy conservation.
- Before using the unit from cold it is important to ensure that all steam lines are drained correctly and brought slowly to full working pressure and temperature. Always use modulating valves to control the heat exchanger and open these valves slowly in order to allow the heat exchanger to reach its working temperatures without excessive thermal shock.
- Appropriate condensate traps should be fitted.
- The heat exchanger should be adequately insulated for both personnel safety and for energy conservation. If isulation is not possible appropriate guards and watning notices must be provided in accordance with current health and safety legislation.
- 

  WARNING: It is important to ensure that the condensate reoval system allows the condensate for- med within the heat exchanger to dran freely under all working conditions particularly under reduced pressure conditions resuling from a temperature control system and/or low load conditions. Failure to do this could damage the heat exchanger as an accumulation of condensate within the unit could result in damaging differential stresses.

Water

The cooling water source for heat exchanger use will vary with the installation but they can be broadly classified as follows:

- Raw water sources: it is important to monitor the chemical composition of the water source to ensure that it is suitable for use with the AISI 300 series stainless steels, particularly the quantity of chlorides. The water should be filtered through mesh filters to ensure that any solids carried through to the heat exchanger will not cause blockage. the user should bear in mind that there are environmental controls in force in most countries which limit the temperature of raw water sources returned to the environment.
- Fresh water sources: these are normally taken from mains supplied drinking water systems. The chloride levels in these sources are normally low but frequetly they will have high carbonate levels which will result in hard water scale formation when heated. The user must have facilities for hard water scale removal (normally using chemical methods) if it is intended to use for cooling services where temperatures are elevated.
- Chilled water sources: these are closed systems which can normally be assumed to be clean non-fouling supplies. It is unlikely that the working temperatures will cause carbonate scale precipitation so little fouling is likely over extended periods.

General Requirements:

- Regular chemical analysis should be used to determine the chloride and carbonate levels and appropriate actions taken if the quantities found rise above acceptable levels. Appropriate specialist advice should be sought to confirm that any water source is suitable for use with AISI 304/316 materials at the temperature levels likely to be experienced in service.
- Manual shut off valves should be installed before and after the heat exchanger to ensure safety during servicing activities.

- If the unit is using water as a cooling medium a safey relief should be installed between the maual shut off valves and the heat exchanger sized to ensure a pressure accumulation no greater than 10% of the maximum allowable working pressure marked on the nameplate of the heat exchanger under all foreseeable conditions. This especially important when the fluid being cooled is at high temperature which could cause a rapid rise in pressure within the cooling system in the event of a failure in the supply
- The user must ensure that the system and heat exchanger are fully vened of air before being put into service especially at first start up and servicing operations.

Glycol

Glycol cooling systems using glycol added to resh water are often used to provide a low temperature cooling system medium. There are two types of glycol commonly used in varying proportions.

- Ethylene glycol: A family of glycols commonly used in idustrial applications in proportions varying between 5% and 45%. It is important to realise when using Ethylene Glycols that under European Legislation they are considered to be dangerous fluids (they are toxic) and the categorization of the heat exchanger under the Eropean Pressure Directive 97/23/EC must take this into account.
- Propylene Glycol: A family of glycols commonly used in food processing applications in proportions varying between 5% and 45%. The Propylene Glycols are not toxic and the categorization of the heat exchanger under the Eropean Pressure Directive 97/23/EC should take this into account.

General Requirements:

Coolant quality is an important factor in determining heat exchanger service life and the user will maximise the life of the heat exchanger if the coolant quality is monitored to ensure that the system remains within specification. If other additives to prevent corrosion in other parts of the system are present it is essential that their corrosion characteristics relative to AISI 300 series stainless steel is checked with the supplier to ensure total compatibility.

- The user must ensure that an adequate supply of coolant is available to the heat exchanger.
- The flow rates required to achieve the design thermal performance will have been specified by the heat exchanger designer during the design phase.
- Regular chemical analysis should be used to determine the concentration levels and adjustments made as necessary.
- Manual shut off valves should be installed before and after the heat exchanger to ensure safety during servicing activities.
- A safety relief device should be installed between the manual shut off valves and the heat exchanger, sized to ensure a pressure accumulation no greater than 10% of the maximum allowable working pressure marked on the nameplate of the heat exchanger under all foreseeable conditions. This is especially important when the fluid being cooled is at high temperature which could cause a rapid rise in pressure within the cooling system in the event of a failure in the supply.
- The user must ensure that the heat exchanger is fully vented of air before being put into service especially at first start up after servicing operations.

6. Receiving the Heat Exchanger:

HRS shell and tube heat exchangers are not normally delivered in wooden crates designed to ensure that no damage can occur to the unit during transport and/or storage at its destination. If thee are any signs of mechanical damage to either the crate or the unit inside the crate the transport contractor should be contacted immediaely and made aware of the problem. For subsequent records and any later insurance claims we recommend hat photographs are taken to show the areas of concern.
The equipment consignment will contain a detailed packing note attacched to the transport packing and receiving personnel should ensure that the consignment is complete particularly if small removeable items such as support feet are shown on the packing list. Any shortages must be reported immediately to the trasport contractor and HRS with photographics evidence if appropriate to support any claim. Transport packing is not returnable but should be recycled or disposed of in accordance with current environmental legislation in the country of receipt.

Storage

If the unit is to be stored for any length of time the area for storage must be clean dry and heated and free from corrosive chemicals or any of the other substances likely to be damaging to the stainless steel surfaces of the heat exchanger .
If HRS has been notified of the intention to store the unit outside in very low temperatures (below freezing) the unit will have been drained and dried during preparation for dispatch but if this notification has not been given or if the unit has been transported unprotected in bad weather it is possible that there may be some water remaining inside the unit. It is essential for storage in low temperatures that the site personnel ensure that the unit has been completely drained of water.

Unloading/Unpacking/Transport

The nameplate on the unit the general arrangement drawings and the shipping documentation all show the empty weight of the unit. When planning the unloading, unpacking and site transport operations it is essential that this weight is taken into account. The centre of gravity of most units is the longitudinal centreline at the midpoint of the unit length but will be marked on the general arrangement drawings if it is unbalanced.
We recommend that small units are lifted using appopriate fabric slings around the shell of he unit. Large units will be provided with at least two lifting points and appropriate eye bolts should be attached to these lifting points.
If the heat exchanger is a multi-module unit mounted in a support frame the frame will have been provided with at least two lifting points so that the eye bolts can be fitted.

7. Installation:

Preparing the Site

Access to industrial areas is often limited and the installation engineer should check to ensure that the unit can be trasported within the installation site without meeting any obstacles or restricted entry points.
Heat exchangers should be mounted on stable firm supports with sufficient free area around the unit to allow easy inspection from all sides. In operation units that are working at elevated temperatures will experience significant growth and the supports must allow for this movement while the unit is heating or cooling.
Any pipe work which is prepared before the positioning of the heat exchanger should be left with a loose flange or firework section to ensure that there are no excessive pipe work loadings imposed on the unit when the firework is connected. it is essential that the installer realises that the heat exchanger cannot be used as an anchor or support point for pipe work as damaging loads could be imposed on the connections.
All pipe work, valves etc. must have appropriate supports and provision for thermal expansionunder all working conditions.

Personnel

Personnel involved in offloading and transporting the heat exchanger to its final position within the installation should be experienced and qualified under national health and safety legislation to organise and carry out lifting operations. Heat exchangers are often heavy and can easily be damaged if knocked against other equipment or the building structure.
Personnel used to install commission and operate HRS heat exchangers should be experienced in site work and trained to appreciate the importance of correct installation and operation of Pressure Systems. Heat exchangers often work at high pressure with very hot or very cold fluids which may be dangerous under the definitions given in the European Pressure Equipment Directive 97/23/EC and the installation and operating standards must meet the essential safety requirements required for this type of system.

Heat Exchanger Design Pressure/Pressure Relief Valves

In order to protect the heat exchanger from exceeding its design pressure, pressure relief valves must be installed in the pipe work, set at maximum of 10% above the design pressure. The pressure relief valve must be located between the heat exchanger and the first isolation valve, for both the shell and tube side pipe work, either upstream or downstream of the heat exchanger.

Positioning

Always refer to the general arrangement drawings prior to positioning the unit. It is essential for the unit to work correctly that the correct fluid flow pattern is used (normally counter flow) and that the necessary valves safety devices and instruments are correctly positioned. If not fitted onto the heat exchanger appropriate vent and drain points must be included in the firework. The fixed and sliding supports must be identified correctly to match to the firework expansion arrangements.

Installation Outdoors

The heat exchanger must be insulated in order to protect it from freezing of fluid inside both the shell and tubes during extremely cold weather. Insulated also reduces any heat loss o the atmosphere.

Tools

No special tools are necessary for the installation of the HRS shell and tube heat exchangers, connections are fitted with either food industry standard quick release clamps or flanged to DIN 2501 PN16 standards and a range of metric spanners will normally be sufficient.
Positioning should be carried out with the aid of an overhead or travelling crane if the unit is heavy in order to facilitate ease of movement and support.
Unless otherwise stated on the General Arrangement drawing it is assumed that the mounting position of the HRS shell and tube heat exchangers will be horizontal, so appropriate alignment and leveling devices such as a laser spirit level should be available to ensure correct firework alignment and level supports.

Connections

HRS shell and tube units can be mounted either horizontally or vertically. When a vertical mounting position is required supports welded to he shell are recommnded to prevent undue stress on connections. If these welded supports have not been requested please contact the HRS Service Department for advice on correct mounting .Under no circumstances should the weight of the unit be taken on the heat exchanger connections.

When the heat exchanger is correctly positioned on its supports, the product and service fluid pipe work can be connected. Gasket materials should be chosen according to the working pressures and temperatures and the fluids which will be in contact with them. It is important that the firework is not forced into position as this will impose unacceptable stresses on the heat exchanger connections and could cause mechanical damage or premature failure.
When the pipe work connections have all been completed and checked and the remaining system completed the installation should be thoroghly flushed through to enure that no loose debris remains in the system. It should also be subjected to a final pressure test to ensure pressure soundness of all flanged connections.
Note: if steam is the working fluid with a horizontally mounted unit it should be mounted with a slight slope (0,5-1%) towards the condensate connection end in order to encourage condensate to drain from the unit.

Commissioning

When the fluid flow and return lines are attached to the appropriate connections with fittings suited to the process operating temperatures and pressures the unit is ready to be put into service for the first time. The fluid pressures should be raised slowly and all connections rechecked for leak tightness. Special care should be taken when 'snap acion' valves are being used.
The operator must ensure that the heat exchanger is not subject to any sudden pressure suges when the pumps are switched on. The isolating valves fitted between the pump and heat exchanger should be closed when starting and opened progressively unit full working pressures have been achieved.
When steam is the working fluid the steam valve must always be opened with care to prevent condensate surges within the heat exchanger. To prevent water hammer the condensate should be fully srained from the heat exchanger before start up.
It is recommended that the cold fluid is always introduced first particularly when using steam, in order to minimize thermal shock. The system must be thoroughly vented through adjoining firework immediately after start-up to ensure that no trapped air remains within the system.

9. Shutting Down and Maintenance:

Shutting Down

After opening the appropriate bypasses within the system, the unit should be depressurized and isolated hot fluid first followed by the cold. If the unit is operating hot it must be allowed to cool to atmospheric temperature (or if operating cold allowed to heat up to atmospheric temperature) before any maintenance operations are carried out. when the unit has reached atmospheric temperature it should be drained completely if it is to be left idle for more than a short time.
Note: if the unit is thermally insulated it must be allowed to cool (or heat) for an extended period before any maintenance is undertaken to ensure that it is safe to touch. A metal temperature of less than 60°C (and greater than 0°C) is recommended under current health and safety legislation. If the unit is to be left idle for an extended period the internal surfaces should be blown dry after draining to ensure that no corrosion takes place whilst it is out of service.

Maintenance

Peiodic checks of performance in service are recommended to ensure that the unit is working as intended. Any reduction in heat exchange capacity or increase in fluid pressure losses may be due to a buildup of fouling deposits in one or both of the fluid circuits. These must be removed by CIP or mechanical cleaning to return the unit to its design capacity and to prevent possible long term corrosion damage.
CIP cleaning does not involve removal of the heat exchanger from the system but if mechanical cleaning is required the unit must be removed to a suitable workshop area for the cleaning operations.
A planned maintenance schedule is recommended for all equipment in order to maximize its performance and service life. For HRS heat exchangers the only periodic maintenance necessary is to carry out a visual examination to ensure that there are no leaking gaskets or mechanical damage which could cause later problems.

Note: In multi-module units fitted with interconnecting bends on the product circuit and/or interconnecting flanges on the service circuit it is important to follow good engineering practice and identify all matching flanges/fitings before removal to enable the units to be refitted in their original positions after servicing.
If any leakage is detected from any flange/fitting it should be retightened as necessary. It is important to note that gaskets and seals manufactured from elastomeric materials naturally deteriorate over time especially when subjected to elevated temperaures and pressues and must be periodically replaced. Gaskets in warehouse storage will also deteriorate in time due to the effects of light and ozone and should be stored away from natural light wherever possible in cleanand dry conditions away from chemical storage areas.
Note: After any maintenance has been carried out the unit should be pressure tested to the test pressure for each circuit marked on the unit nameplate before being returned to sevice.

10. Spare Parts:

There are no recommended spare parts for the HRS shell and tube heat exchangers other than spare connection gaskets and seals for multiple module units.
In the unlikely event of a tube leak on the unit, the leaking tube can be plugged at each end with an appropriately sized stainless steel taper plug driven into the tube with a slight reduction in performance capability. If this occurs, the material suitability should be rechecked and a replacement unit fitted at the earliest opportunity.

11. Trouble Shooting:

Symptom	Remedy
Change in heat transfer performance.	Check both fluid flow rates. Check operation of control valves. Check for fouling and clean the unit. Check working fluids are as design.
Change in pressure losses.	Check for fouling and clean the unit. Check fluid flow rates. Check operation of control valves. Check working fluids are as design.
Visable leakage.	Replace module. Repair leak by welding.
Product and service fluids mixing.	Replace module.

Important note: Whenever a fault occurs with the heat exchanger where the cause is not immediately apparent it is essential that the full system is checked to ensure that system faults are not imposing damaging forces, flows, pressures or temperatures onto the heat exchanger.If the user has any doubts over the operational safety of the equipment supplied or has any situation that he does not recognise or understand he should contact the HRS Service Department as soon as possible for advice giving details of the serial number of the unit and a description of the problem encountered.

12. Safe Disposal of Redundant Equipment / Materials:

In this section we givedetails of the materials of the materials used in the manufacture of the equipment which may need to disposed of at the end of the useful working life of the equipment. The reference codes are given according to current legislation (LER - Order MAM/304/2002 of 8th February 2002) which gives the operaions necessary for the evaluation and elimination of residues according to the Eauropean reference list.
It is important to note that it is the user of the equipment who is responsible for the correct management of any residue generated.

List of Residues

Remember that all residues generated must be seperated and stored by the user aking into account their classification according to the current legislation.

Material	L.E.R code
HRS shell and tube heat exchangers	
Gaskets and seals where fitted.	200139
Stainless steel (shell and tube)	200140