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**spirax**  
**/sarco**

**IM-P486-10**

CH Issue 1

**CSM-K**

**High Capacity Clean Steam Generator**

**Installation and Maintenance Instructions**

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# 1. Responsibility

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These Installation and Maintenance Instructions are intended to be as complete and up to date as possible. They cover the installation, operation and maintenance procedures for Spirax Sarco unfired steam generators (CSM-K high capacity clean steam generator). Spirax Sarco reserves the right to update these instructions and other product information concerning installation, operation, and/or maintenance, at any time and without obligation to notify product owners of changes.

Spirax Sarco is not responsible for inaccuracies in specifications, procedures and/or the content of other product literature, supplied by other manufacturers of components used in the construction of Spirax Sarco steam generators (i.e.: valves, pressure controls, gauges, etc.).

Spirax Sarco strives to use only the highest quality components in the building of our CSM-K series steam generators and will only be responsible for our own branded components. Spirax Sarco will not be responsible for other manufactures products as we have no direct control over their quality.

**Note:** The symbol  will denote a warning /caution.

 **Spirax Sarco is not responsible for injury to personnel or product damage due to the improper installation, operation and/or maintenance of Spirax Sarco unfired steam generators.**

All installation, operation and maintenance procedures should only be performed by trained/certified personnel. All personnel performing these procedures should completely and carefully read and understand all supplied materials before attempting the procedures. All personnel should pay strict attention to all Notes, Cautions, and Warnings that appear within the procedures detailed in this manual.

 **If Spirax Sarco supplies only the steam generator without the control products this manual applies, only, to the related supply. In this case the packaged unit and related manuals is the responsibility of the installer.**

## 2. Warranty information

All components used in Spirax Sarco steam generators are warranted for one year from start-up or eighteen months from the date of purchase, whichever comes first.

In some cases, extended warranties are available on an individual basis, at extra cost.

### General notes and warnings:

- This manual is intended to cover installation, operation, and maintenance procedures for Spirax Sarco CSM-K steam generators. Since each unit is built to meet customer specifications, instructions may, at times, seem general. Where procedures differ substantially between steam, diathermic oil or superheated water as the energy source for generating clean steam, specific notes will be given.  
If questions are not answered by this manual, or if specific installation, operation, and / or maintenance procedures are not clearly understood, contact Spirax Sarco for clarification before proceeding.
- All installation, operation, and maintenance procedures should be performed only by experienced, trained, and certified personnel. Personnel should be trained in correct piping and electrical procedures and methods, and should be experienced in working with steam and diathermic oil /superheated water systems.  
Spirax Sarco CSM-K steam generators are designed for indoor use only, unless otherwise required by design specifications. Each unit requires at least one meter of clearance around and above the unit. It should be located on a level surface (no more than ½° of slope), capable of supporting the total weight of the unit when filled to capacity. The unit should be mounted to the floor following applicable architectural and local code requirements for the specific installation site. In areas prone to seismic activity, it is recommended that the unit be mounted to the floor according to recommended procedures and codes for the site / location, to make the units less susceptible to seismic damage.
- Inspection procedures, suggested inspection intervals, troubleshooting and periodic maintenance, are detailed on pages 28 to 41 of this manual.
- CSM-K steam generators are available in a various range of operating pressures. For the specific ranges for your unit, refer to the design specifications and accompanying literature and drawings supplied with the unit.
- If the unit is damaged during installation operation, or maintenance, complete the following steps.
  1. Turn off the power to the unit.
  2. Turn off the energy source inlet (steam, diathermic oil or superheated water) valve(s).
  3. Turn off the energy source (steam, diathermic oil or superheated water) return valves.
  4. Turn off the clean steam and condensate outlet valves.
  5. Turn off feedwater inlet valves.
  6. Contact in-house maintenance personnel.

For all piping connections, the use and / or type of joint compound or sealer on the joints should be determined by referring to local codes, accepted standards, and / or the requirements of the installing contractor.

### Warnings

**As with any piece of equipment that utilises steam, diathermic oil or superheated water under pressure, as well as electricity, the potential exists for severe personal injury if proper installation, operation and maintenance procedures are not followed.**

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Listed on the following pages are specific warnings pertaining to Spirax Sarco CSM-K steam generators. In addition, throughout this manual, warnings are restated when procedures are described pertaining to areas of potential danger. All warnings should be carefully read and understood. All precautions contained in the warnings should be carefully followed to reduce the chance of injury.

All documentation for each major component has been included with the unit. It is strongly recommended that each document be reviewed before attempting any installation, operation, or maintenance procedures.

The documentation for each major component may also contain warnings and cautions identified by the manufacturer of each component.

These warnings and cautions may be specific for the particular component, and therefore not covered in this general Installation, Operation and Maintenance Manual.

They should also be carefully reviewed before attempting installation, operation or maintenance procedures.

### **⚠ Areas of potential danger:**

- 1. All steam/diathermic oil/superheated water lines, joints, valves and pressure regulators.**
- 2. All steam outlet lines, joints, valves and pressure regulators.**
- 3. All power connections and cables.**
- 4. All pneumatic (instrument air) lines and joints.**

### **⚠ Before attempting any installation, operation, or maintenance procedures pertaining to the unit:**

- 1. Make sure that the energy source (steam/diathermic oil /superheated water) has been turned off at the manual shut-off valve.**
- 2. If the unit has been in operation, allow the clean steam and water in the tank, as well as all components and surfaces (outlet steam lines, energy source inlet lines, etc.) to cool before starting the procedure;**
- 3. Make sure that all power has been shut off/disconnected before attempting any procedures.**
- 4. Make sure that all incoming and outgoing steam, condensate and energy source lines have been turned off at the manual shut-off valves.**
- 5. Make sure that the pneumatic (instrument air) source has been turned off and the pressure bled from the lines.**

**⚠ Steam, oil and high temperature water, present situations that can be very dangerous due to the fact they are under pressure and at very high temperatures within the unit. To avoid possible injury or death, use common sense and follow all accepted and recommended procedures when performing installation, operation and maintenance procedures.**

**⚠ The combination of electricity and water can pose a very dangerous situation. Make sure that all power has been shut off/disconnected before attempting any installation or maintenance procedures.**

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## 3. Safety information

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Safe operation of these products can only be guaranteed if they are properly installed, commissioned, used and maintained by qualified personnel (see paragraph 'permits to work' page 8) in compliance with the operating instructions. General installation and safety instructions for pipeline and plant construction, as well as the proper use of tools and safety equipment must also be complied with.

### **Safety note - Handling precautions**

#### **PTFE**

Within its working temperature range PTFE is a completely inert material, but when heated to its sintering temperature it gives rise to gaseous decomposition products or fumes, which can produce unpleasant effects if inhaled. The inhalation of these fumes is easily prevented by applying local exhaust ventilation to atmosphere as near to their source as possible.

Smoking should be prohibited in workshops where PTFE is handled because tobacco contaminated with PTFE will during burning give rise to polymer fumes. It is therefore important to avoid contamination of clothing, especially the pockets, with PTFE and to maintain a reasonable standard or personal cleanliness by washing hands and removing any PTFE particles lodged under the fingernails.

#### **VITON**

If Viton has been subjected to a temperature approaching 315°C (599°F) or higher it may have decomposed and formed hydrofluoric acid. Avoid skin contact and inhalation of any fumes as the acid will cause deep skin burns and damage the respiratory system.

Referring to the Installation and Maintenance Instructions, name-plate and Technical Information Sheet, check that the product is suitable for the intended use / application. This product complies with the European Pressure Equipment Directive 97/23/EC, and carries the **CE** mark when so required.

- i) This product has been specifically designed for use on steam, air or condensate, which are in Group 2 of the above mentioned Pressure Equipment Directive. The products' use on other fluids may be possible but, if this is contemplated, Spirax Sarco should be contacted to confirm the suitability of the product for the application being considered.
- ii) Check material suitability, pressure and temperature and their maximum and minimum values. If the maximum operating limits of the product are lower than those of the system in which it is being fitted, or if malfunction of the product could result in a dangerous overpressure or overtemperature occurrence, ensure a safety device is included in the system to prevent such over-limit situations.
- iii) Determine the correct installation situation and direction of fluid flow.
- iv) Spirax Sarco products are not intended to withstand external stresses that may be induced by any system to which they are fitted. It is the responsibility of the installer to consider these stresses and take adequate precautions to minimise them.
- v) Remove protection covers from all connections and protective film from all name-plates, where appropriate, before installation on steam or other high temperature applications.

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## European Pressure Equipment Directive classification

Spirax Sarco clean steam generators are classified under Table 5 of the European Pressure Equipment Directive. The CSM-K generator is a Category 3 or Category 4 product depending on size and pressure.

**Other component parts within the package comply with the relevant European Directives where necessary, please refer to product specific component literature for further details.**

### Access

Ensure safe access and if necessary a safe working platform (suitably guarded) before attempting to work on the product. Arrange suitable lifting gear if required.

### Lighting

Ensure adequate lighting, particularly where detailed or intricate work is required.

### Hazardous liquids or gases in the pipeline

Consider what is in the pipeline or what may have been in the pipeline at some previous time. Consider: flammable materials, substances hazardous to health, extremes of temperature.

### Hazardous environment around the product

Consider: explosion risk areas, lack of oxygen (e.g. tanks, pits), dangerous gases, extremes of temperature, hot surfaces, fire hazard (e.g. during welding), excessive noise, moving machinery.

### The system

Consider the effect on the complete system of the work proposed. Will any proposed action (e.g. closing isolation valves, electrical isolation) put any other part of the system or any personnel at risk?

Dangers might include isolation of vents or protective devices or the rendering ineffective of controls or alarms. Ensure isolation valves are turned on and off in a gradual way to avoid system shocks.

### Pressure systems

Ensure that any pressure is isolated and safely vented to atmospheric pressure. Consider double isolation (double block and bleed) and the locking or labelling of closed valves. Do not assume that the system has depressurised even when the pressure gauge indicates zero.

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## Temperature

Allow time for temperature to normalise after isolation to avoid the danger of burns and consider whether protective clothing (including safety glasses) is required.

**PTFE** - If PTFE has been subjected to a temperature approaching 260°C (500°F) or higher, it will give off toxic fumes, which if inhaled are likely to cause temporary discomfort. It is essential for a no smoking rule to be enforced in all areas where PTFE is stored, handled or processed as persons inhaling the fumes from burning tobacco contaminated with PTFE particles can develop 'polymer fume fever'.

**VITON** - If Viton has been subjected to a temperature approaching 315°C (599°F) or higher it may have decomposed and formed hydrofluoric acid. Avoid skin contact and inhalation of any fumes as the acid will cause deep skin burns and damage the respiratory system.

## Tools and consumables

Before starting work ensure that you have suitable tools and/or consumables available. Use only genuine Spirax Sarco replacement parts.

## Protective clothing

Consider whether you and/or others in the vicinity require any protective clothing to protect against the hazards of, for example, chemicals, high/low temperature, radiation, noise, falling objects, and dangers to eyes and face.

## Permits to work

All work must be carried out or be supervised by a suitably competent person. Installation and operating personnel should be trained in the correct use of the product according to the Installation and Maintenance Instructions.

Where a formal 'permit to work' system is in force it must be complied with. Where there is no such system, it is recommended that a responsible person should know what work is going on and, where necessary, arrange to have an assistant whose primary responsibility is safety.

Post 'warning notices' if necessary.

## Handling

Manual handling of large and/or heavy products may present a risk of injury. Lifting, pushing, pulling, carrying or supporting a load by bodily force can cause injury particularly to the back. You are advised to assess the risks taking into account the task, the individual, the load and the working environment and use the appropriate handling method depending on the circumstances of the work being done.

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## Residual hazards

In normal use the external surface of the product may be very hot. If used at the maximum permitted operating conditions the surface temperature of some products may reach temperatures of 192°C (377°F).

Many products are not self-draining. Take due care when dismantling or removing the product from an installation (refer to 'Maintenance instructions').

## Freezing

Provision must be made to protect products, which are not self-draining against frost damage in environments where they may be exposed to temperatures below freezing point.

## Disposal

This product may contain PTFE and Viton, special care must be taken to avoid potential health hazards associated with decomposition/burning of these materials. With the exception of the seal materials unless otherwise stated in the Installation and Maintenance Instructions, this product is recyclable and no ecological hazard is anticipated with its disposal providing due care is taken. However, all components should be checked individually to ensure they can be disposed of safely.

### PTFE:

- Can only be disposed of by approved methods, not incineration.
- Keep PTFE waste in a separate container, do not mix it with other rubbish, and consign it to a landfill site.

### Viton:

- Waste parts can be landfilled, when in compliance with National and Local regulations.
- Parts can be incinerated, but a scrubber must be used to remove Hydrogen Fluoride, which is evolved from the product and with compliance to National and Local regulations.
- Parts are insoluble in aquatic media.

## Returning products

Customers and stockists are reminded that under EC Health, Safety and Environment Law, when returning products to Spirax Sarco they must provide information on any hazards and the precautions to be taken due to contamination residues or mechanical damage which may present a health, safety or environmental risk. This information must be provided in writing including Health and Safety data sheets relating to any substances identified as hazardous or potentially hazardous.

# 4. General product information

## General information

These Installation, and Maintenance Instructions are designed as a procedural guide for Spirax Sarco CSM-K stainless steel high capacity clean steel steam generators.

## Product features and specifications

CSM-K family of unfired steam generators, employing the 'U-Bend' heat exchanger coil, are the most economical method of furnishing clean steam when steam, oil or high temperature water are used as the energy source. All Spirax Sarco unfired steam generators can be 'Packaged' and supplied ready for installation.

All components are sized, mounted, piped, and tested prior to shipment.

Each unit is built to exact customer design specifications and requires only connection to energy, water, power, and/or pneumatic sources to be ready for operation.

The 'Packaging' concept provides a compact size that is ideal for new installations, or for use as replacement of existing steam generators. The compact size requires less space for installation.

Each unit employs a stainless steel tank, providing years of trouble free service.

All components used in the construction of the unit are of the highest quality and meet or exceed all customer design specifications.

Each unfired steam generator is accompanied by these Installation and Maintenance Instructions, as well as all documentation of each major component. If any of these documents are missing, contact either Spirax Sarco or your authorized sales representative before attempting installation, operation or maintenance procedures.

## Energy and power sources for generating steam

Spirax Sarco unfired steam generators can be configured and manufactured to use one of three possible energy sources for generating clean steam:

- Steam.
- Diathermic oil.
- Superheated water.

**⚠ Note: Most Spirax Sarco unfired steam generators use steam as the energy source for generating clean steam. Therefore, procedures detailed in this manual will be geared towards the installation, operation and maintenance of steam powered units.**

When procedures differ substantially for the installation, operation, and/or maintenance of units powered by either diathermic oil or superheated water, notes will be included giving specific instructions for those units.

The following table lists the range of acceptable pressures and temperature at the inlet for each energy source.

Energy source	Maximum temperature (°C)	Maximum pressure bar g
Steam	200 to 220	7 to 12
Diathermic oil	300	6
Superheated water	200 to 220	7 to 12

**⚠ Note: Consult the design specifications including maximum pressure and temperature limits of the unit and all its components as well as the name-plate attached to the exterior of the tank and individual specification tags on pressure related components and controls, used in its construction.**

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## Controls

Spirax Sarco steam generators can be equipped with either electronically or pneumatically activated controls to regulate pressure (temperature) and water level. The electronic control panel used, depending on individual design specifications, can range in power requirements from 120 volt single phase to 400 V three phase.

Pneumatic controls, depending on individual design specifications, require instrument air in pressures ranging from 1 to 7 bar g (15 to 100 psi g). Consult the individual design specifications for the unit and controls for the exact requirements.

## Construction

All Spirax Sarco steam generators are constructed from superior materials and utilise only the highest quality components. All parts in contact with generated steam are stainless steel 316L. Each unfired steam generator meets or exceeds all applicable V.S.R code (Vessel Security Rules) regulations and are built to conform to the European Pressure Equipment Directive 97/23/EC.

Each Spirax Sarco steam generator is equipped with a **CE** approved safety/pressure relief valve and an external drain, providing a means to remove accumulated sediment.

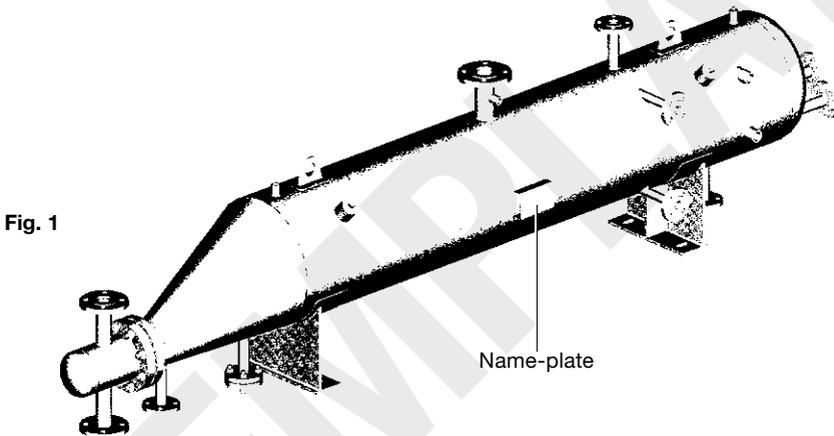


Fig. 1

## Name-plate

A name-plate, bears the model and serial numbers of the unit.

**⚠** These numbers should be included in all correspondence regarding the unit.

## Insulation

All Spirax Sarco unfired steam generators contain a layer of insulation between the tank and jacket.

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## Heat exchanger

The 'U-Bundle' heat exchanger is manufactured with stainless steel AISI 316L tubesheet, with a carbon steel cylindrical head that is the only component not in stainless steel AISI 316L.

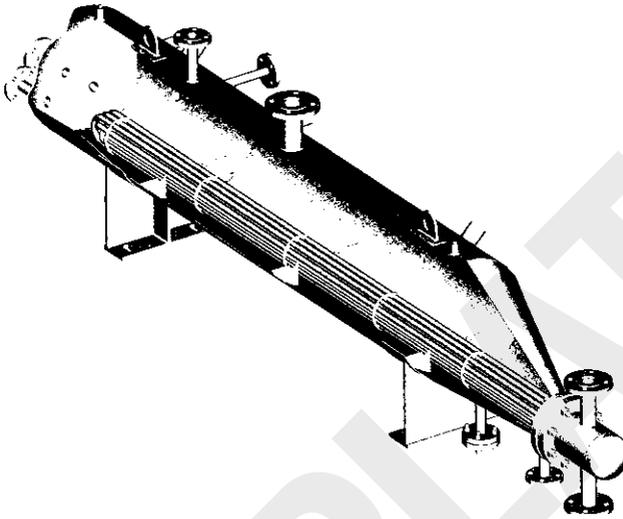


Fig. 2

## Components

All other components included in the CSM-K steam generators have been specifically selected to meet the individual design specifications of each unit.

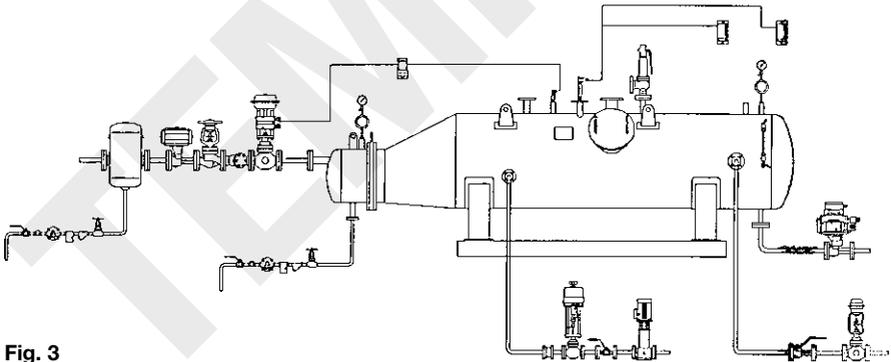


Fig. 3

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## 5. Installation

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### Transporting, unpacking and general installation information

Most unfired steam generators are crated, as necessary, at the factory. The crating is designed to provide protection for the unit during transportation, and to provide a safe means by which to lift and move the unit with a fork lift or hand truck. Larger horizontal units are shipped uncrated, but fitted with lifting lugs attached to the tank to provide a safe means for lifting and moving the unit.

 **The unit should only be lifted at the areas indicated on the crate, or by the lifting lugs provided. Improper lifting of the unit may result in damage to the unit.**

### Location requirements

CSM-K unfired steam generators are designed for indoor use only, unless otherwise required by the design specifications.

The unit should be located on a level surface (no more than 1/2° of slope), capable of supporting the total weight of the unit when filled to capacity.

If crated when shipped, once the unit has been set in place, the crating should be carefully removed.

### Examining the unit

After the unit has been set in place and uncrated, it should be carefully examined to make sure that neither the main unit nor any of the components have been damaged during shipping. If any evidence of damage is detected that could affect the safe operation of the unit, contact Spirax Sarco, or your authorized sales representative, to report the damage and to receive instructions on how to proceed.

After the unit and all components have been inspected for damage, it is suggested that all pressure and control components be checked to assure that they meet or exceed design specifications.

This can be done by reviewing the design specifications (included with the unit) and the specification tags/plates attached to each component. If any discrepancy is found (that is below design specifications), contact Spirax Sarco or your authorized sales representative, before proceeding with the installation.

### Mounting the unit

The unit should be mounted to the floor, following applicable local code requirements, or accepted standards for the specific installation site and for the unit purchased.

In areas prone to seismic activity, it is recommended that the unit be mounted to the floor, according to recommended procedures for the site, to make the units less susceptible to seismic damage.

## Preliminary procedures

Spirax Sarco packaged steam generators are installed following this simple procedure:

1. Connecting the feedwater source to the feedwater inlet - page 15.
2. Connecting the generated clean steam to the clean steam outlet - page 16.
3. Connecting the energy source (steam, diathermic oil or high temperature (superheated) water to the unit - page 17.
4. Connecting the condensate return line or diathermic oil/superheated water return lines to the recycling system - page 18.
5. Piping the safety/pressure relief valve to an acceptable vent and drain system - page 19.
6. Connecting electrically activated controls - page 20.
7. Connecting pneumatically activated controls - page 21.
8. Connecting the drain/blowdown line - page 22
9. Completing the installation - page 22

Each unit is supplied with drawings that indicate the location and specifications for each connection that must be made.

In addition, the drawings indicate the flow direction of both the steam and energy source

## Connecting the feedwater source and generated clean steam outlet

**⚠ Note: Before connecting the feedwater inlet or generated clean steam outlet to the unit, make sure that all piping is clean and free of foreign material or scale. This can usually be accomplished by 'blowing out' the pipe. Any foreign material or scale entering the unit can adversely affect operation and performance.**

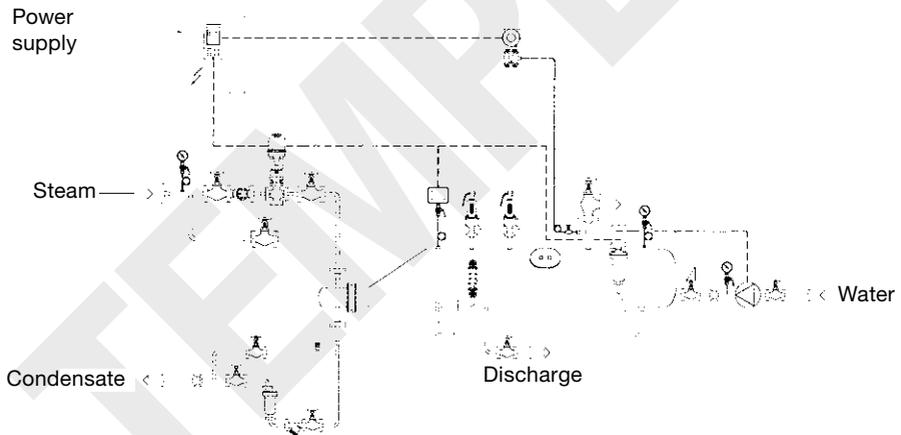


Fig. 4

**⚠ The schematic drawings displayed in this manual are typical examples. For the correct connections of the ordered unit always refer to the drawings attached to the supplied generator.**

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## 1 - Connecting the feedwater source to the feedwater inlet

The first step in the installation process is to connect the feedwater source to the feedwater inlet port.

The exact location of this port for the specific unit, as well as inlet pipe diameter and size, can be determined from the drawings supplied with the unit.

A manual shut-off valve should be installed upstream on the feedwater source as an isolation device.

The shut-off valve should be in the closed position and remain so until the installation is complete.

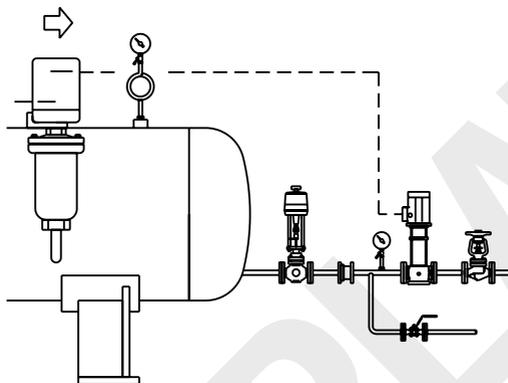


Fig. 5

**⚠ Note:** For all piping connections, the use and/or type of joint compound or sealer on the joint should be determined by referring to local codes, accepted practices or the requirements of the installing contractor.

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## 2 - Connecting the generated clean steam to the clean steam outlet

The next step in the installation process is to connect the generated steam system piping to the clean steam outlet port. The exact location of this port for the specific unit, as well as outlet pipe diameter or flange size, can be determined from drawing supplied with the unit.

A manual shut-off valve and automatic check valve should be installed downstream on the generated clean steam line as isolation devices in case the unit needs to be disconnected from the system.

The shut-off valve should be in the closed position and remain so until the installation is complete.

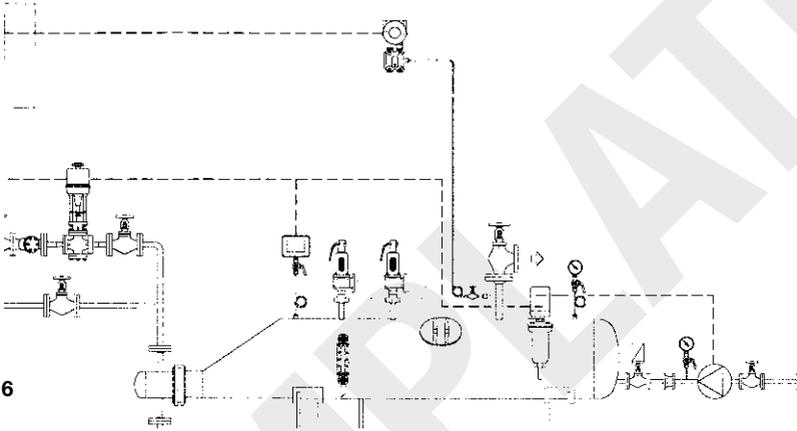


Fig. 6

**⚠ Note:** Refer to local codes and specifications for site specific shut-off and check valve requirements.

For all piping connections, the use and/or type of joint compound or sealer on the joint should be determined by referring to local codes, accepted practices or the requirements of the installing contractor.

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### 3 - Connecting the energy source (steam, diathermic oil or superheated water) to the unit

**⚠** Steam, diathermic oil or superheated water present situations that can be very dangerous because of the high temperatures and pressures within the unit. Use common sense and follow all accepted and recommended procedures when performing installation, operation and maintenance procedures to avoid possible injury or death.

Make sure that a manual shut-off valve is installed upstream in the steam, diathermic oil or superheated water line (energy source), and that it is functioning properly. If any doubt exists concerning the integrity of the shut-off valve, replace the valve before attempting installation. All energy source valves should be closed and remain closed throughout the installation process.

#### Connect the energy source to the line(s) leading to the pressure control valve.

The exact location of the pressure control valve for the specific unit, as well as energy source pipe diameter and thread size, can be determined from the drawing supplied with the unit.

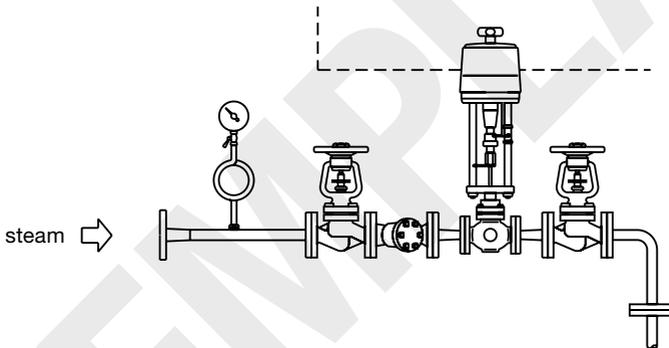


Fig. 7

**⚠** Note: Refer to local codes and specifications for site specific shut-off and check valve requirements. For all piping connections, the use and/or type of joint compound or sealer on the joint should be determined by referring to local codes, accepted practices or the requirements of the installing contractor.



## 5 - Piping the safety/pressure relief valve to an acceptable vented drain system

All Spirax Sarco unfired steam generators are equipped with safety/pressure relief valves for the tank. In most applications, the safety/pressure relief valve should be vented to a safe area at atmospheric pressure (generally through the roof). The piping used in the vent system must be of adequate size to handle the capacity of the safety/pressure relief valve and vent. The vent piping system should allow for condensate drainage and should be piped to a suitable drain. Piping the safety/pressure relief valve to a suitable vent and drain will prevent both water and heat damage to the unit, as well as reduce the risk of injury from released steam. All safety/pressure relief venting and piping should comply with local codes. It is the responsibility of the purchaser / installing contractor to make sure of this compliance.

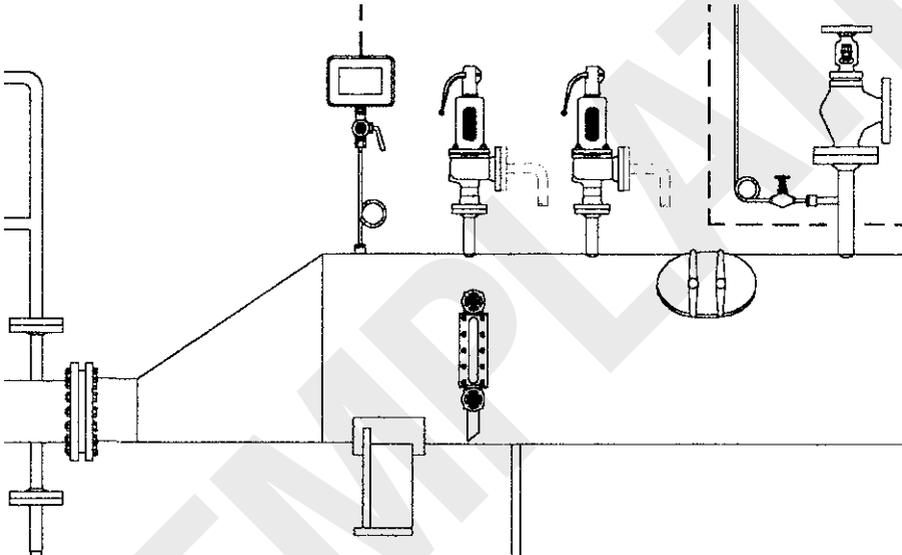


Fig. 9

**⚠ Do not install a valve between the safety/pressure relief valve and the vent or in the vent line. Doing so could cause serious injury or death if the pressure is released and the manual valve is closed. This would cause excessive build-up of pressure in the clean steam generator tank which could result in an explosion.**

## 6 - Connecting electrically activated controls

Spirax Sarco unfired steam generators can be equipped with electrically activated pressure and water level control valves, in this case connect the correct power source(s) .

**⚠ The combination of electricity and water can pose a very dangerous situation. Make sure that all electric power has been turned off before attempting any installation or maintenance procedures.**

Reference the wiring drawing that are included with the unit or the installation instructions contained in the Installation Manual for the component.

CSM-K steam generators are designed so that if a power failure or cut-off should occur, the unit will automatically shutdown.

This is accomplished through a 'safety system' incorporated in the unit. The safety system requires power to operate. If the power supply is disrupted, the safety system closes the energy source feedvalve.

If permitted by local codes, the steam generator can be wired into the site's emergency power system, to allow continued operation during a power failure.

Consult local codes before connecting the unit to an emergency power source to assure compliance.

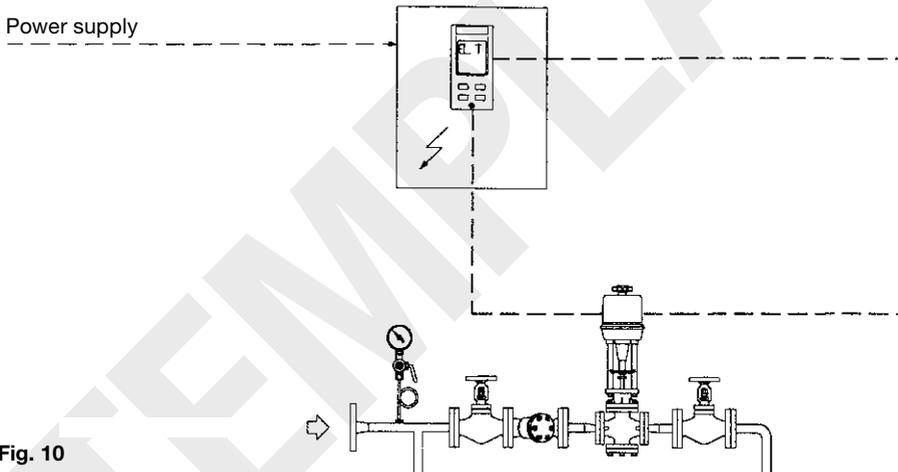


Fig. 10

**Note: All power connections should be performed by trained electricians.**

## 7 - Connecting pneumatically activated controls

Spirax Sarco unfired steam generators can be equipped with pneumatically activated controls. In most cases where pneumatically activated controls are used, they require instrument air with pressure ranges from 1 to 7 bar g (15 to 100 psi g). Refer to the supplied drawing, and specific installation and operation instructions for each component to determine its pressure/temperature limits.

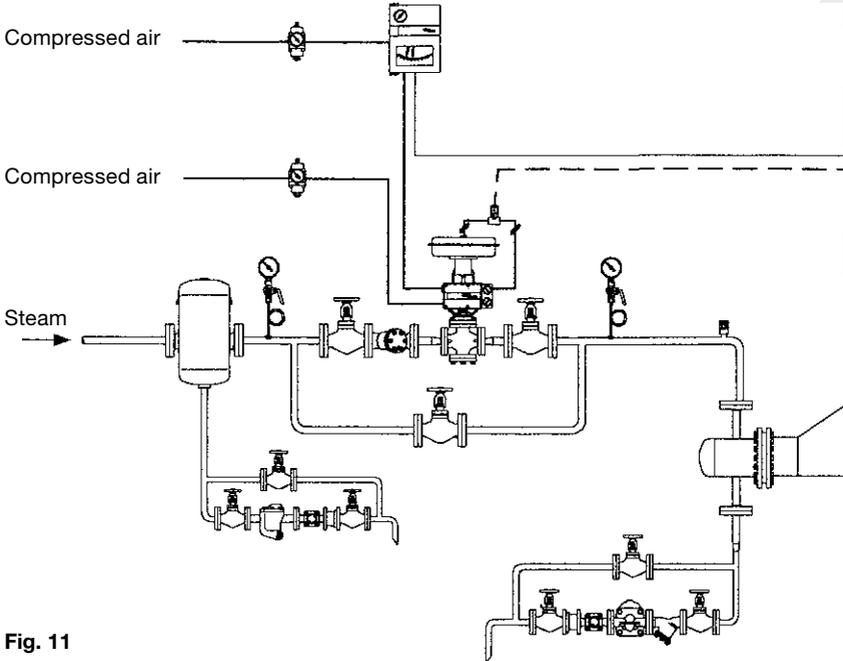


Fig. 11

**⚠ Make sure that the pneumatic feedline has been shutdown, and air pressure bled from the system by acceptable methods, before attempting any connections.**

Reference the drawings that are included or the installation data contained in the Installation and Maintenance Instructions for the specific component.

**⚠ Note: For all pneumatic connections, the use and/or type of joint compound or sealer on the joint should be determined by referring to local codes, accepted practices or the requirements of the installing contractor.**

## 8 - Connecting the drain/blowdown line

Spirax Sarco CSM-K steam generators are equipped with a drain/blowdown line. Each generator has one or more manual blowdown valves connected to the bottom of the vessel. The blowdown from these valves is at the pressure and temperature of the generated steam and can cause severe injury or death if not properly piped.

It is recommended that the blowdown lines be connected to a blowdown vessel / condensate cooler before being discharged to drain.

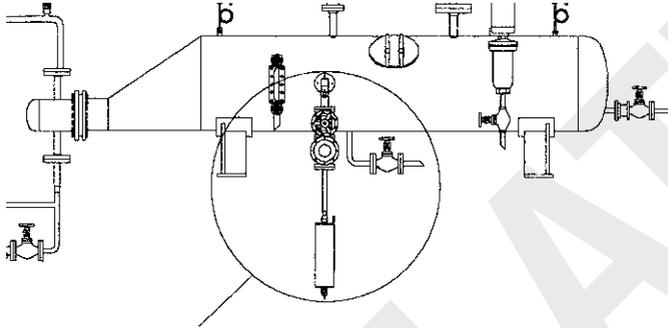


Fig. 12

**⚠ The blowdown from the steam generator can flash to steam when introduced to atmospheric pressure.**

It is recommended to equip steam generators with automatic blowdown valves. The blowdown from these valves should also be piped to the blowdown tank / condensate cooler as previously described.

The level controller line will have a blow-off valve at the low point for blowing off the level control piping.

This valve should also be piped to the blowdown tank as previously described.

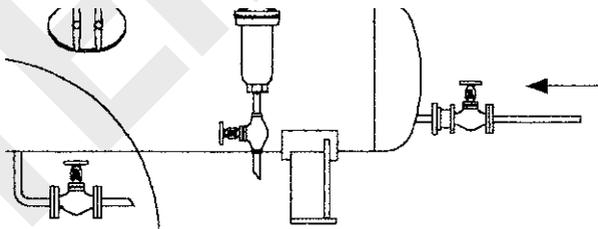


Fig. 13

## 9 - Completing the installation

Installation of the CSM-K unfired steam generator is now complete. All documentation supplied with the unit should be passed along to the maintenance personnel for future reference.

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## 6. Operation

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After all installation procedures have been completed, and all clean steam, feedwater, energy source, pneumatic joints, and power connections have been double checked, the unit is ready for operation.

As a precaution, it is strongly suggested that the following start-up and shutdown procedures be followed.

### Start-up procedures

1. Make sure that all manual shut-off valves on clean steam, feedwater, energy source, and pneumatic lines are closed.
2. Because the unit is equipped with a level controller, the power and pneumatic (instrument air) sources should be turned on to allow the controls to regulate filling operations.
3. Slowly open the manual shut-off valve on the feedwater inlet line, checking to make sure that there are no leaks at the valve or any joints.  
During initial filling, hold the safety/pressure relief valve open to allow air to bleed out of the tank. This will speed up the filling process.
4. The filling process should stop automatically when the correct water level has been reached.

This can be verified (if installed) via a gauge (level) glass.

The filling process should stop when water is visible in approximately the bottom one-third of the gauge glass. If the filling process stops before water is visible in the gauge glass, or before it fills the bottom third of the gauge glass, consult page 25 of this manual for instructions.

If the filling process does not stop by the time one-half of the gauge glass is filled, shut off the feedwater control valve, and turn off the power and instrument air sources. After turning off the feedwater, power, and instrument air, consult page 25 of this manual for instructions. If the unit has filled to the correct level, proceed to the next step.

5. Adjust the operating pressure control to the desired operating pressure. See the drawings and the operating pressure control component manual, included with the unit, for the exact location of the control and detailed adjusting procedures.
6. Set the high pressure limit at 0.4 to 0.7 bar g (6 to 10 psi g) above the desired operating pressure. See the pressure control manual, included with the unit, for the exact location and detailed adjusting procedures.
7. Open the condensate return valve or oil/superheated water return valve.
8. Slowly open the manual shut-off valves on the power source inlet and clean steam outlet lines, and create a load/demand situation of approximately 10% to 25% of the system design conditions. As the valves are being opened, check for leaks at all valves and joints.  
For pneumatically controlled valves, open the instrument air supply valve.

**Note:** This procedure is similar for both diathermic oil or superheated water energy sources.

**⚠ Steam, diathermic oil and water all present situations that can be very dangerous because of the high temperatures and pressures, which exist inside the unit. Use common sense and follow all accepted and recommended procedures when performing installation, operation and maintenance procedures, to avoid possible injury or death.**

9. As the unit is initially heating the water and creating clean steam, carefully reinspect the feedwater inlet, clean steam outlet, power source inlet (steam, oil or high temperature water), and condensate return lines and joints for signs of leakage.
10. If no leaks are found, slowly continue to open the manual shut-off valves on the power source inlet and clean steam outlet.

11. As the unit approaches the desired operating pressure, check that the pressure within the unit is within the desired range. If necessary, readjust the pressure control valve. See the drawings and the pressure control valve component manual, included with the unit, for the exact location of the valve and detailed adjusting procedures.
12. After the unit has reached operating pressure, reinspect all joints for signs of leakage. In addition, check all gauges and controls to verify that the clean steam and energy source pressures are within design specifications.
13. The unit is now ready for normal operation.

## Shutdown procedures

1. Close all valves in the energy source inlet line (steam, oil, superheated water).
2. Turn off all power to the electric controls, if so equipped.
3. Turn off the pneumatic (instrument air) source.
4. Where possible, relieve the pressure from the energy source line (steam, oil, or high temperature water), between the shut-off valve and the unit.
5. Close all remaining valves in the system in the following order:
  - i - The clean steam outlet line.
  - ii - The feedwater inlet line.
  - iii - The condensate return line (or oil/high temperature water return line).
6. Relieve the pressure within the unit by means of the pressure relief valve and vent system.
7. After the system has cooled, drain the unit by opening the tank drain valve and holding the pressure relief valve in the open position. This will prevent the formation of a vacuum and increase the drainage flow.
8. Proceed with the required maintenance or repairs.
9. After performing the required maintenance or repairs, return the unit to operation by following the start-up procedure detailed on page 25.

## Daily operation - Standard unfired steam generator

The clean steam and energy source pressures should be checked at the respective pressure gauges at least twice a day.

Depending on the options purchased with your CSM-K steam generator, two additional procedures may be required on a daily basis: blowdown and feedwater make-up.

If the unit has been equipped with an automatic feedwater make-up system or automatic blowdown timer and TDS sampling system, these procedures are automated and need not be carried out by operating personnel.

### Blowdown

Spirax Sarco unfired steam generators are equipped with a drain/blowdown line. Each generator has at least one manual blowdown valve connected to the bottom of the vessel.

**⚠ The blowdown from this valve is at the pressure and temperature of the generated steam and can cause severe injury or death if not properly piped.**

**It is recommended that the blowdown line be connected to a blowdown vessel before being discharged to drain.**

**⚠ The blowdown from the unfired steam generator can flash to steam when introduced to atmospheric pressure.**

---

Spirax Sarco recommend to equip the steam generators with automatic blowdown valves. The blowdown from these valves should also be piped to the blowdown vessel. The level controller line will have a blowdown valve at the low point for blowing off the level control piping.

This valve should also be piped to the blowdown vessel.

The build-up of scale and dirt within the unit can effect operation and shorten the life of the unit. The unit should be blown down a minimum of once a day.

#### **How to blow down the unit:**

1. Slowly open the blowdown valve located on the bottom of the unit.

**⚠ Steam and high temperature water present situations that can be very dangerous because of the high temperatures and pressures which exist inside the unit. Use common sense and follow all accepted and recommended procedures when performing blowdown activities. Failure to do so could result in possible injury or death.**

2. Observe the stream of water exiting the blowdown vessel. If scale or dirt is evident in the stream, allow the unit to continue to drain until the water runs clear.
3. Close the blowdown valve.
4. If the unit is not equipped with an automatic feedwater make-up system, follow the procedure detailed below to restore the desired water level within the unit.  
If the unit is equipped with an automatic feedwater make-up system, the water level within the unit will automatically return to the proper level. The water level can be checked via the gauge glass.

The frequency of necessary blowdown is directly effected by the minerals, chemicals, and contaminants contained in the feedwater.

**Depending on the water, the blowdown interval may need to be altered (either more or less frequently) for each site.**

#### **Feedwater make-up**

CSM-K unfired steam generators must be equipped with a level controller which will activate a feedwater valve or feedwater pump to maintain the correct water level in the generator.

The level controller will feed water to the generator when the level falls to a preset level and will stop feeding water when the water level reaches a higher preset point.

Normally there is a 3 to 5 cm water level change in the fill cycle.

The level controller also has a low water cut off position which will activate if the water falls approximately 3 cm below the water fill position.

If a low after condition occurs, the control valve for source steam will be closed and, if furnished, the alarm will sound.

**⚠ Steam and high temperature water, present situations that can be very dangerous because of the high temperatures and pressures which exist inside the unit.**

**Use common sense and follow all accepted and recommended procedures when examining the water level . Failure to do so could result in possible injury or death.**

**⚠ Note: As the feedwater level is being raised, pressure may be released from the safety / pressure relief valve to the atmosphere.**

**The feedwater level should be checked a minimum of twice a day.**

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## Unfired steam generator with optional equipment

No matter what optional equipment was included with the unit, the clean steam and energy source pressures should be checked at the respective pressure gauges at least twice a day.

The most important optional equipment available with unfired steam generators includes:

- Alarm bell.
- Remote control.
- Bottom blowdown timer.
- Automatic blowdown TDS control system.

The following is a short description of their function.

### Alarm bell

The alarm bell circuit sounds an alarm bell if the water level drops below a set level or if the pressure within the system exceeds the set limit. The alarm bell itself can be turned off, but a red warning light will remain lit until the detected condition is remedied.

### Remote control

The unfired steam generator can be fitted with a remote control that typically would activate or deactivate the control valve. This would turn the unit on or off.

### Bottom blowdown timer

The automatic blowdown timer is the unit by which the blowdown schedule can be set. It can be set in frequencies from 0 to 99 hours.

The main timer signals an interval timer that determines how long the blowdown will be.

The interval timer can be set for durations of 2 to 99 seconds.

### Automatic blowdown TDS control system

The automatic blowdown TDS control system serves two purposes.

First, it acts as a normal automatic blowdown timer.

Second, it samples the blowdown water and measures the level of solids (scale, dirt, chemicals, etc.) contained in the blowdown water.

If excess amounts of solids are detected, the system will keep the blowdown valve open until the level of solids detected in the water is within acceptable levels.

As can be seen from the preceding descriptions, the optional equipment available can directly affect the normal daily operation of the unit by automating many of its tasks.

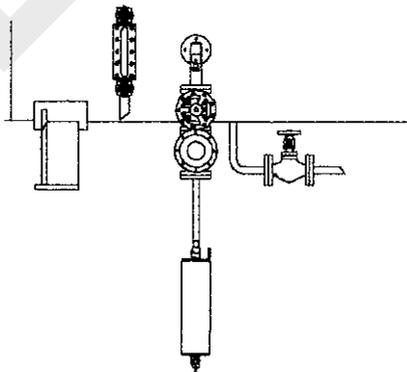


Fig. 14

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## 7. Parts list

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### Replaceable parts list

The following is a list of parts that are generally replaceable, by trained / certified personnel, on Spirax Sarco CSM-K unfired steam generators. The replaceable parts may vary, depending on the unit and the particular design specifications to which the unit was constructed. If there are questions concerning the replaceable parts for the unit, refer to the original design specifications, or contact Spirax-Sarco.

Please have the unit's model and serial number available when contacting Spirax Sarco.

### Replaceable parts

Spirax Sarco unfired steam generators - Vertical and horizontal

**Note: Replaceable parts may vary depending on design specifications of the unit.**

Pressure control valve

Coil and gaskets

Heat exchanger coil

Level controller

Pressure gauge - Clean steam

Pressure gauge - Energy source steam

Safety/pressure relief valve

Solenoid safety system

Strainer

Trap - Auxiliary

Trap - Main

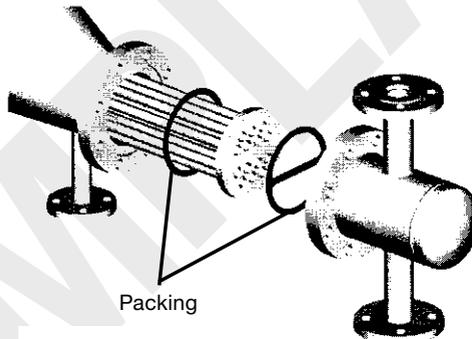


Fig. 15

### Suggested spare parts

#### For one year of duty

Because of the built-in quality and long life of CSM-K steam generators, there are no spare parts suggested for stock during the first year of service.

#### For five years of duty

It is recommended that the user stock a replacement heat exchanger coil unit and gaskets for possible replacement during the first five years of duty. If suggested maintenance procedures are performed, the heat exchanger coil should not need to be replaced during the first five years of duty.

For the replacement heat exchanger coil model number, refer to the name-plate mounted on the jacket of the unit.

## 8. Inspection

The following table summarizes the recommended time intervals for inspections of the unfired steam generator, components, feedwater inlet, clean steam outlet, energy source lines (steam, boiler water, or high temperature water), and power and pneumatic connections.

### Recommended inspections

To be inspected	As per product IMI	Daily	Weekly	Quarterly	Semi annually	Annually	Bi-Annually
Blowdown		• minimum					
Pressure control valves	•						
Feedwater level		• minimum					
Gauges - Pressure				•			
Heat exchanger							
Coil and gaskets							•
Level controller	• minimum						
Lines - Inlet/outlet and return				•			
Pneumatic connections				•			
Power connections				•			
Pressure - Clean steam and energy source		• minimum					
Safety/ pressure relief valve	•						
Shut-off valves - Manual			•				
Solenoid safety system					•		
Strainers				•			
Traps - Main and auxiliary						•	

If any problems are detected during inspections, refer to either the Troubleshooting (page 29 - 31) or Maintenance (page 31) sections of this manual for specific actions and instructions.

# 9. Troubleshooting

## Troubleshooting

The following table summarizes problems that may be encountered over the life of a CSM-K unfired steam generator, and the procedures to remedy those problems. The left-hand column lists the symptoms. The remaining columns are suggested procedures or 'remedies' that should be followed to identify and correct the problem. If a '•' appears in a remedy column, the corresponding procedure(s) should be followed to identify and correct the problem. These procedures/remedies (numbered 1 to 11) are listed on pages 30 and 31.

Symptom	Probable cause and remedy										
	1	2	3	4	5	6	7	8	9	10	11
Unfired steam generator does not maintain the required pressure at the rated capacity	•	•	•			•	•		•	•	
Feedwater level incorrect or inconsistent											•
Outlet pressure is too high	•		•		•		•				
Outlet pressure fluctuates widely		•	•		•		•		•		
Insufficient condensate returned			•						•		
Steam being discharged into the condensate drain										•	
Safety / pressure relief valve 'pops'					•		•	•			
Unfired steam generator shuts down at or too close to (above or below) the design clean steam outlet pressure								•			
A loud banging in the unfired steam generator, primary piping, or condensate / water return piping (not to be confused with a normal clicking noise made during operation)			•	•							

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## Probable cause and remedy

1. **The pressure gauge is not correctly sensing the clean steam pressure:**
  - Check the clean steam pressure with a pressure gauge that is known to be correct.
  - Replace the pressure gauge if it is found to be incorrectly sensing the clean steam pressure. Reference pressure gauge replacement procedure on page 35.
2. **Inlet energy source pressure is too low:**
  - Check the primary energy source pressure gauge.

If the reading is low, adjust the inlet pressure to meet the design requirements.

If there is a restriction in the primary energy source line, the gauge reading will drop excessively when the generator calls for full energy, even though the pressure seems to be normal during light demand.

If the primary pressure is correct, its pressure gauge reading should reach design pressure for energy source in the coil as the pressure in the steam generator approaches shut-off.
3. **The condensate/water return piping has not been installed properly, allowing the condensate/water to drain freely (by gravity); the condensate/water drain line is restricted; or the condensate/water check valve is leaking or has failed:**
  - Reconfigure the condensate/water return piping and check valve to allow for proper drainage. Check to make sure that there is no restriction in the condensate/water drain line. Replace the check valve if it is leaking or has failed. **Also**, check to make sure that there is no restriction in the condensate/water drain line.
4. **Primary/inlet steam line is not properly trapped (steam as energy source only):**
  - Reconfigure the primary/inlet steam line to allow main and auxiliary traps to function properly.
5. **The primary/inlet pressure control valve is not closing properly:**
  - See the adjustment and testing data contained in the supplied Installation and Maintenance Instructions for the specific temperature control valve installed on the unit. Replace the valve if necessary - Reference the replacement procedure on page 40.
6. **The primary/inlet pressure control valve is not opening properly:**
  - See the adjustment and testing instructions contained in the supplied Installation and Maintenance Instructions for the specific temperature control valve installed on the unit. Replace the valve if necessary - Reference the replacement procedure on page 40.
7. **The energy source pressure control system is not operating properly:**
  - See the adjustment and testing instructions contained in the supplied Installation and Maintenance Instructions for the specific pressure control system installed on the unit. Replace the valve if necessary - Reference the replacement procedure on page 40.
8. **The overpressure limit system is out of adjustment, or some component of the system has failed:**
  - Check the individual components of the system and repair or replace the failed component(s) as necessary.
9. **There is a leak in the heat exchanger coil or the condensate/water return line causing water to leak from the tank or energy source system:**
  - To verify the existence of a leak, shut off the primary energy source to the unit and carefully break a connection in the condensate/water return line.

**⚠ CAUTION: The system still contains the primary energy source, possibly under pressure, and could present a serious potential for injury.**

**Use extreme caution when breaking any connection in the system.**

Energy source steam condensate or boiler/high temperature water will drain from the coil initially, but the flow should stop after a short period of time. If the flow continues water is leaking from the tank into the coil. Disassemble, inspect, repair (if possible), or replace the heat exchanger coil and reassemble the unit - Reference the heat exchanger coil replacement procedure on page 32.

---

**10. The heat exchanger coil is heavily scaled or damaged:**

- Call Spirax Sarco, or an authorized sales agent, for instructions on repair or replacement. Refer to the name-plate for the model and serial numbers of the unit and heat exchanger coil. Include these numbers in all correspondence.

**11. The level controller is not functioning correctly or the floats within the controller have not retained their original position:**

- Shut down the system following the shutdown procedures on pages 24. Follow the maintenance procedures on page 34 to remove the level controller and to check for correct float positioning. Readjust the floats if they are determined to be out of position, or replace the level controller if found to be defective.

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## *10. Maintenance*

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The information contained in this section will detail service and maintenance procedures for the inspection and replacement of the components of CSM-K Spirax Sarco unfired steam generators. Remember, this manual may be general in some instances. If there are any questions concerning maintenance procedures that are not clearly explained in this manual, contact Spirax Sarco. Be sure to have the model and serial numbers of the unit and heat exchanger coil available before making contact.

**⚠ Note: Many of the maintenance procedures detailed in this section will require the unit to be taken off-line before the procedure is performed; and put back online after the procedure is completed. It is recommended that the maintenance personnel performing these procedures review the start-up and shutdown procedures, detailed on pages 23 - 24 of this manual, before attempting any maintenance procedure.**

Any component(s) directly connected or linked to the component being replaced should carefully be examined before maintenance procedures are started. If any of the related components show signs of wear or improper operation, they should be considered for replacement at the same time.

### **Power connections - Rewiring**

If any of the power connections must be rewired at the electrically activated controls or junction boxes, follow the steps listed below:

**⚠ The combination of electricity, steam, and water can pose a very dangerous situation. Turn off/disconnect all electric power before attempting any maintenance procedure.**

1. Follow Steps 1 through to 6 of the shutdown procedure (pages 24) to take the unit off-line before attempting any electrical service.
2. After making sure that the power supply has been turned off, disconnect and rewire the electrical connections in question.
3. Turn the power on and check that the component that has been rewired is functioning properly.

---

## Pneumatic (instrument air) connections - Refitting

If any of the pneumatic (instrument air) connections need to be refitted at the pneumatically activated controls, follow the steps listed below:

**⚠ Instrument air, at pressures as high as 7 bar g (100 psi g), can be required by pneumatically activated controls. Air pressure at this level can pose a very dangerous situation. Make sure that the air source has been shutdown and that the line pressure has been bled before breaking any pneumatic connection.**

1. Follow Steps 1 through to 7 of the shutdown procedure (page 24) to take the unit off-line before attempting pneumatic service.
2. After making sure that the air source has been turned off, break and redo the pneumatic connections in question.
3. Turn the air supply on and check that the component that has been reconnected is functioning properly.
4. Follow the start-up procedure on page 23 of this manual to return the unit to operation.

## Heat exchanger coil and gaskets - Inspection and replacement

The 'u - Bend' heat exchanger coil is the heart of the CSM-K unfired steam generator.

It should be removed and inspected every two years.

There are two gaskets, one between the tube face of the coil and the flange welded to the tank, and one gasket with a divider to fit between the head and the tubesheet.

**⚠ Clean steam and energy source steam, oil or high temperature water present situations that can be very dangerous because of the high temperatures and pressures within the unit. To avoid possible injury or death, use common sense and follow all accepted and recommended procedures when performing installation, operation, and maintenance procedures.**

**⚠ The combination of electricity, steam, and water can pose a very dangerous situation. Turn off/disconnect all electric power before attempting any maintenance procedures.**

1. Follow Steps 1 through to 7 of the shutdown procedure (pages 24) to take the unit off-line before attempting to remove and inspect the heat exchanger coil.
2. Make sure that the energy source, condensate/water return line, feedwater inlet, and clean steam outlet have been shut off; that the pressure has been bled from both the clean steam and energy source systems, that the tank has been completely drained; and that the steam, water, all components, and surfaces have cooled.
3. Carefully break the connections between the heat exchanger coil head and the energy source inlet and outlet lines - It may be necessary to break the lines at a second location, and for the lines to be rotated to allow clearance for the heat exchanger coil to be removed from the tank. If it is necessary, care should be taken to insure that in-line components are not damaged.
4. Remove the bolts and nuts that secure the heat exchanger coil head to the tank, and remove all bolts from the unit.
5. Carefully separate the heat exchanger coil head from the mounting flange and remove the coil assembly from the tank.

**⚠ There may still be residual steam condensate (or boiler/high temperature water), this residual condensate/water could present a danger of injury in the coil that can run out during removal of the coil from the tank if sufficient time has not been allowed for cooling.**

- 
6. Examine the heat exchanger coil for scale build-up and signs of leakage. If no leakage is detected, carefully clean the excess scale from the coils and prepare the heat exchanger coil for installation. If leakage is detected between the coils and water in the tank, either repair the leaking coil(s) or replace the heat exchanger coil.
  7. Remove the old gaskets and completely clean the mating surfaces. Install the two new gaskets: one between the tube face of the coil and the flange welded to the tank, and one gasket with a divider to fit between the head and the tubesheet.
  8. Carefully insert the heat exchanger coil into the tank. The coil should be installed so that the divider in the head lines up with the coil, and that the divider is parallel to the horizon.
  9. After making sure that the heat exchanger unit is correctly aligned, clamp the flanges together and proceed with the torque procedure detailed in Appendix A, page 42:
    - Lubricate the bolt threads and the nut faces with a suitable lubricant.
    - Insert the bolts through the flanges and finger tighten the nuts.
    - Number all bolts so that torquing requirements can be followed.
    - Apply torque in 20%,  $\frac{1}{5}$  steps of required final torque, loading all bolts at each step before proceeding to the next step.
    - Use rotational tightening until all bolts are stable at final torque level. Two complete times around is usually required.
  10. Reconnect the energy source inlet and clean steam outlet lines to the heat exchanger coil. If these lines were broken at an additional location to allow for removal of the coil, be sure to also tighten those connections. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the type of joint compound or sealer to be used for connections.
  11. Reconnect the small line leading to the energy source pressure gauge.
  12. Follow the start-up procedures (pages 23) to put the unit back on-line.
  13. Carefully check all connections for any sign of leakage.

---

## Level controller - Inspection and replacement

The level controller supplied on CSM-K unfired steam generators controls the level of the water within the unit, assuring that the unit will function safely and effectively. If the level controller must be removed for inspection, adjustment, or replacement, follow the steps detailed below:

**⚠ Clean steam and energy source steam, diathermic oil or superheated water present situations that can be very dangerous because of the high temperatures and pressures within the unit. To avoid possible injury or death, use common sense and follow all accepted and recommended procedures when performing installation, operation and maintenance procedures.**

**⚠ The combination of electricity, steam and water can pose a very dangerous situation. Turn off / disconnect all electric power before attempting any maintenance procedures.**

1. Follow Steps 1 through to 7 of the shutdown procedure (page 24) to take the unit off-line before attempting to remove and inspect the level controller.
2. Make sure that the energy source, condensate/water return line, feedwater inlet, and clean steam outlet have been shut off; that the pressure has been bled from both the clean steam and energy source systems; that the tank has been completely drained; and that the steam, water, all components, and surfaces have cooled.
3. If the level controller is not completely drained and bled, steam or boiling water may exit.
4. Disconnect the wires leading from the level controller.
5. Carefully break the joint at the top of the level controller and the top of the tank.
6. With the level controller secured or held in place by an assistant, carefully break the joint at the bottom of the level controller.

**Note: It may be necessary to break the lines at a second location to allow clearance for the level controller to be removed from the tank. If this is necessary, care should be taken to insure that in-line components are not damaged.**

7. After breaking both the top and bottom joints, continue loosening the connections until the level controller can be removed.
8. Examine the level controller for damage or incorrect positioning of the floats. For the exact procedure for examination or repositioning the floats, refer to the manufacturer's information included with the unit.  
If the unit is fitted with a Spirax Sarco level controller, refer to its Installation and Maintenance Instructions for the correct examination procedures.
9. To install the level controller, align the controller with the feed lines and start the fitting procedure. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the type of joint compound or sealer to be used for connections.
10. After assuring that the level controller is correctly aligned, tighten the fittings.
11. Follow the start-up procedures (page 23) to put the unit back on-line.
12. Carefully check all connections for any sign of leakage.

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## Inlet, outlet and condensate/water return line and manual shut-off valves - Replacement

If any of the inlet, outlet, return lines, or shut-off valves are damaged and must be replaced, follow the steps outlined below:

**⚠ The combination of electricity, steam and water can pose a very dangerous situation. Turn off / disconnect all electric power before attempting any maintenance procedures.**

1. Follow Steps 1 through to 7 of the shutdown procedure (page 24) to take the unit off-line before attempting to replace damaged lines or shut-off valves.  
**⚠ Whilst it may seem feasible to replace inlet, outlet, condensate/water return lines, and shut-off valves without shutting down the entire unit, it is not advised. Unless the unit is completely shutdown, and the clean steam energy source are isolated from the system, failure of manual shut-off valve during the replacement process could result in serious injury.**
2. Make sure that the energy source, condensate/water return line, feedwater inlet, and clean steam outlet have been shut off; that the pressure has been bled from both the clean steam and energy source systems; that the tank has been completely drained; and that all components and surfaces have cooled.
3. Carefully break the joint between the unit and the line or valve to be replaced.
4. Remove the section of line or valve to be replaced.
5. Replace the damaged section of line or valve.
6. Reconnect the line or valve to the unit. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the type of joint compound or sealer to be used for connections.
7. Follow the start-up procedures (page 23) to put the unit back on-line.
8. Carefully check all connections for any sign of leakage.

## Pressure gauge (energy source) - Replacement

If the pressure gauge for the energy source does not function correctly and must be replaced, follow the procedures outlined below:

**⚠ The combination of electricity, steam and water can pose a very dangerous situation. Turn off / disconnect all electric power before attempting any maintenance procedure.**

1. Follow Steps 1 through to 7 of the shutdown procedure (page 24) to take the unit off-line before attempting to replace the energy source pressure gauge.
2. Carefully disconnect the small line connecting the pressure gauge with the heat exchanger coil head from both the head and gauge.
3. Remove the gauge from its mounting.
4. Mount the new gauge.
5. Reconnect the small line to both the heat exchanger coil head and the gauge. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the type of joint compound or sealer to be used for connections.
6. Follow the start-up procedures (page 23) to put the unit back on-line.
7. Carefully check all connections for any sign of leakage.

## Pressure gauge (clean steam) - Replacement

If the pressure gauge for the water tank is not functioning correctly and must be replaced,

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follow the procedures outlined below.

**⚠ The combination of electricity, steam and water can pose a very dangerous situation. Turn off/disconnect all electric power before attempting any maintenance procedures.**

1. Follow Steps 1 through to 7 of the shutdown procedure (page 24) to take the unit off-line before attempting to replace the clean steam pressure gauge.
2. Carefully disconnect the small line connecting the pressure gauge with the tank. This line should only be disconnected at the gauge.
3. Remove the gauge from its mounting.
4. Mount the new gauge.
5. Reconnect the small line to the gauge. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the type of joint compound or sealer to be used for connections.
6. Follow the start-up procedures (page 23) to put the unit back on-line.
7. Carefully check all connections for any sign of leakage.

### **Safety/pressure relief valve (tank) - Replacement**

If the water pressure safety valve mounted on the tank is not functioning correctly and must be replaced, follow the procedures outlined below.

**⚠ The combination of electricity, steam and water can pose a very dangerous situation. Turn off/disconnect all electric power before attempting any maintenance procedure.**

1. Follow Steps 1 through to 7 of the shutdown procedure (page 24) to take the unit off-line before attempting to replace the water safety/pressure relief valve.
2. After making sure that the pressure has been relieved from the tank, disconnect the vent line leading from the safety/pressure relief valve to atmosphere (usually through the roof), and via a drip elbow, to drain.
3. Carefully unscrew the safety/pressure relief valve from the port in the tank.
4. Install the new valve by screwing it into the safety/pressure relief valve port in the tank. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the type of joint compound or sealer to be used for connections.
5. Reconnect the vent line leading from the safety/pressure relief valve to atmosphere and, via drip elbow, to drain.
6. Follow the start-up procedures (page 23) to put the unit back on-line.
7. Carefully check all connections for any sign of leakage.

## Safety system - Inspection and replacement

The safety system acts as a fail-safe for Spirax Sarco unfired steam generators. The system requires power to operate, therefore in the case of a power failure, the system will totally shutdown the unit. If it is mandatory that the unit remain in operation during power failures, it should be wired into the emergency power system.

Before this is done, it is the duty of the installer / operator to check local codes and requirements to make sure that this is an acceptable configuration.

When power is supplied to the solenoid safety system, the system allows the electrically operated controls to feed water to the system and generate clean steam. The system should be checked semi-annually. (See manufacturer's documentation for the solenoid safety system provided with the unit for specific inspection intervals and test routine). If the system is found to be malfunctioning and must be replaced, follow the procedure outlined on the following pages:

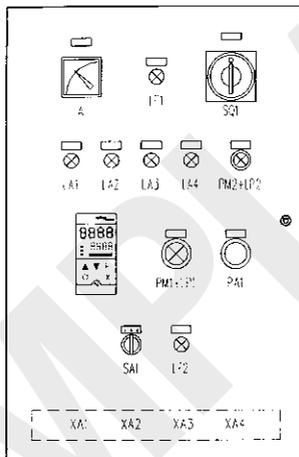


Fig. 16

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**⚠ Note: The exact location and configuration of the solenoid safety system can vary between units. See the drawing and design specifications supplied with the unit for the exact placement and configuration.**

**⚠ The combination of electricity, steam and water can pose a very dangerous situation. Turn off/disconnect all electric power before attempting any maintenance procedure.**

1. Follow Steps 1 through to 7 of the shutdown procedure (page 24) to take the unit off-line before attempting to replace the solenoid safety system.
2. Carefully disconnect the small line connecting the solenoid safety system to the energy source control valve. This line should only be disconnected at the safety system.
3. Carefully disconnect the small line connecting the solenoid safety system to the tank or clean steam outlet line. This line should only be disconnected at the safety system.
4. If the system is electrically activated, turn off the power and disconnect the electric leads from the safety system.
5. If the system is pneumatically activated, turn off the instrument air source and disconnect the pneumatic lines from the solenoid safety system.
6. Remove the solenoid safety system from its mounting.
7. Mount the new safety system.
8. Reconnect the small line from the tank or clean steam outlet line to the safety system. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the type of joint compound or sealer to be used for connections.

**Note: For steps 8 and 9, the use and type of joint sealer should be determined from local codes or the specifications of the installing contractor.**

9. Reconnect the small line from the energy source control valve to the safety system.
10. If any were disconnected, reconnect all electric and pneumatic lines and restore power and instrument air to the system.
11. Reference the manufacturer's documentation for the safety system that was supplied with your unit for additional installation/set-up instructions.
12. Follow the start-up procedures (page 23) to put the unit back on-line.
13. Carefully check all connections for any sign of leakage.

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## Strainers - Inspection and replacement

The strainers are installed upstream of the energy source shut-off valve for both the coil and the main traps. These strainers must be blown down periodically (approximately every three to six months) to prevent the build up of any sediment.

**⚠ The combination of electricity, steam and water can pose a very dangerous situation. Turn off/disconnect all electric power before attempting any maintenance procedures.**

1. Follow Steps 1 through to 7 of the shutdown procedure (page 24) to take the unit off-line before attempting to replace the energy source pressure gauge.
2. The exact location of the strainers can differ between units. Reference the drawing supplied with the unit to identify their location.
3. Carefully break the line connections on the inlet and outlet side of both strainers.
4. Remove and examine the strainers.
5. Remove any sediment that is present in the strainers. If they can not be satisfactorily cleaned, replace with new strainers.
6. Place the strainers back in-line in the system.
7. Reconnect the inlet and outlet lines to each strainer.  
Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the type of joint compound or sealer to be used for connections.
8. Follow the start-up procedures (page 23) to put the unit back on-line.
9. Carefully check all connections for any sign of leakage.

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## Pressure control valve - Inspection and replacement

The pressure control valve is installed upstream of the heat exchanger coil and must be interlocked with the high pressure cut-off. The manufacturer documentation included with the unit gives specifics for operation and maintenance of the control valve. The drawing included with the unit will give the exact location, as well as interlocks with other components. This information should be reviewed before removal/replacement of the temperature control valve.

**⚠ Steam, oil or high temperature water present situations that can be very dangerous because of the high temperatures and pressures within the unit. Use common sense and follow all accepted and recommended procedures when performing installation, operation and maintenance procedures to avoid possible injury or death.**

**⚠ The combination of electricity, steam and water can pose a very dangerous situation. Turn off/disconnect all electric power before attempting any maintenance procedures.**

1. Follow Steps 1 through to 7 of the shutdown procedure (page 24) to take the unit off-line before attempting to remove and inspect the temperature control valve.
2. Make sure that the energy source, condensate/water return line, feedwater inlet, and clean steam outlet have been shut off; that the pressure has been bled from both the steam and energy source systems; that the tank has been completely drained; and that all components and surfaces have cooled.
3. If the pressure control valve is electrically activated, turn off the power and disconnect the leads to the valve.
4. If the pressure control valve is pneumatically activated, turn off the instrument air source, bleed the pressure from the line, and disconnect the lines to the valve.
5. Carefully break the joints between the pressure control valve and feedwater valve, solenoid safety unit, and the auxiliary trap line.
6. Insure that in-line components are not damaged.

**⚠ Note: It may be necessary to break the lines at a second location, and for the lines to be rotated to allow clearance for the temperature control valve to be removed from the system.**

7. Remove the pressure control valve from the system.
8. Follow the supplied manufacturer instructions for inspecting the valve. If found to be malfunctioning, replace the valve.
9. Carefully replace the pressure control valve into the system by reattaching it to the energy source inlet line and the heat exchanger coil outlet line. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the type of joint compound or sealer to be used for connections.
10. Align the valve as it was situated before removal and tighten the connections. If lines were broken at an additional location to allow for removal of the valve, be sure to also tighten those connections.
11. Reconnect the pressure control valve to the feedwater valve, solenoid safety unit, and the auxiliary trap line.
12. Follow the start-up procedures (page 23) to put the unit back on-line.
13. Carefully check all connections for any sign of leakage.

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## Traps (main and auxiliary) - Replacement (steam systems only)

The main and auxiliary traps are installed upstream of the condensate shut-off valve on units that use steam as the energy source.

If the traps are not functioning properly and must be replaced, follow the procedures outlined below:

** The combination of electricity, steam and water can pose a very dangerous situation. Turn off / disconnect all electric power before attempting any maintenance procedures.**

1. Follow Steps 1 through to 7 of the shutdown procedure (page 24) to take the unit off-line before attempting to replace the main or auxiliary traps.
2. The exact location of the traps can differ between units. Refer to the drawing supplied with the unit to identify the location of the traps on the unit.
3. Carefully break the joint on the inlet side of both traps.
4. Carefully break the joint on the outlet side of the traps.
5. Remove and examine the traps.
6. If the traps are not functioning properly, replace them with new traps.
7. Place the traps back in-line in the system.
8. Reconnect the inlet and outlet lines to each trap. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the type of joint compound or sealer to be used for connections.
9. Follow the start-up procedures (page 23) to put the unit back on-line.
10. Carefully check all connections for any sign of leakage

# 11. Appendix A

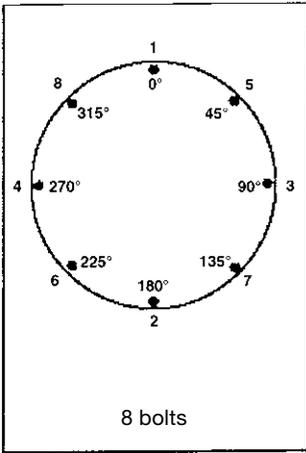


Fig. 17

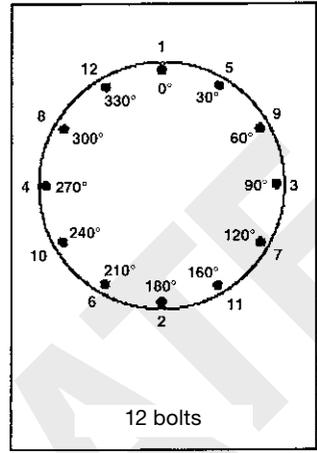


Fig. 18

## Bolt Torque Procedure

Sequential Order	Rotational Order
1 - 2	1
3 - 4	5
5 - 6	3
7 - 8	7
	2
	6
	4
	8

Sequential Order	Rotational Order
1 - 2	1
3 - 4	5
5 - 6	9
7 - 8	3
9 - 10	7
11 - 12	11
	2
	6
	10
	4
	8
	12

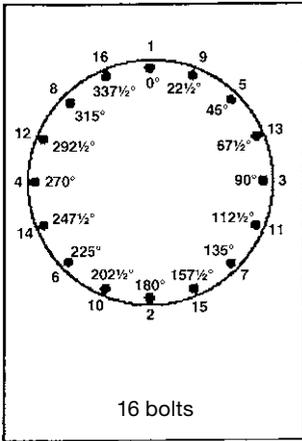


Fig. 19

**Bolt Torque Procedure**

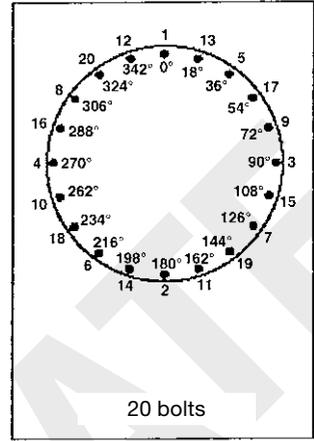


Fig. 20

Sequential Order	Rotational Order
1 - 2	1
3 - 4	9
5 - 6	5
7 - 8	13
9 - 10	3
11 - 12	11
13 - 14	7
15 - 16	15
	2
	10
	6
	14
	4
	12
	8
	16

Sequential Order	Rotational Order
1 - 2	1
3 - 4	13
5 - 6	5
7 - 8	17
9 - 10	9
11 - 12	3
13 - 14	15
15 - 16	7
17 - 18	19
19 - 20	11
	2
	14
	6
	18
	10
	4
	16
	8
	20
	12

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## 12. Repairs

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Should it be necessary to return the equipment for repairs please contact our nearest Branch Office or Agent or directly:

Spirax Sarco S.r.l.  
Ufficio Resi - Via per Cinisello,  
18 - 20054 Nova Milanese (MI)  
Tel. 0362-4917.1  
Fax 0362-4917307

### Loss of guarantee

Total or partial disregard of the above instructions involves loss of any right of guarantee.

Spirax-Sarco S.r.l.  
Via per Cinisello,  
18 - 20054 Nova Milanese (MI)  
Tel.: 0362 4917.1  
Fax: 0362 4917307