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CH Issue 4

# CSM-C (Steam-to-Steam) Compact Clean Steam Generator Management Installation and Maintenance Instructions

## HTM 2031 approved

The PED Directive 97/23/EC is repealed and replaced by the new **PED Directive 2014/68/EU** with effect from 19 July 2016.

# ATTENZIONE

## Lavorare in sicurezza con apparecchiature in ghisa e vapore
## *Working safely with cast iron products on steam*

Informazioni di sicurezza supplementari - *Additional Informations for safety*

### Lavorare in sicurezza con prodotti in ghisa per linee vapore

I prodotti di ghisa sono comunemente presenti in molti sistemi a vapore.

Se installati correttamente, in accordo alle migliori pratiche ingegneristiche, sono dispositivi totalmente sicuri.

Tuttavia la ghisa, a causa delle sue proprietà meccaniche, è meno malleabile di altri materiali come la ghisa sferoidale o l'acciaio al carbonio.

Di seguito sono indicate le migliori pratiche ingegneristiche necessarie per evitare i colpi d'ariete e garantire condizioni di lavoro sicure sui sistemi a vapore.

### Movimentazione in sicurezza

La ghisa è un materiale fragile: in caso di caduta accidentale il prodotto in ghisa non è più utilizzabile. Per informazioni più dettagliate consultare il manuale d'istruzioni del prodotto.

Rimuovere la targhetta prima di effettuare la messa in servizio.

### *Working safely with cast iron products on steam*

*Cast iron products are commonly found on steam and condensate systems.*

*If installed correctly using good steam engineering practices, it is perfectly safe.*

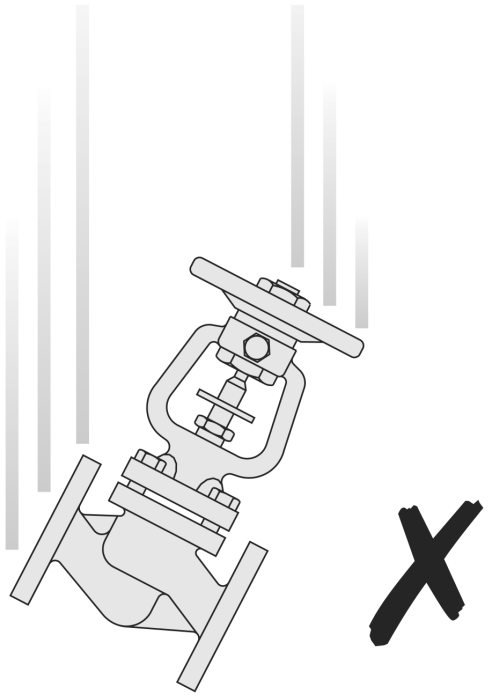
*However, because of its mechanical properties, it is less forgiving compared to other materials such as SG iron or carbon steel.*

*The following are the good engineering practices required to prevent waterhammer and ensure safe working conditions on a steam system.*

### *Safe Handling*

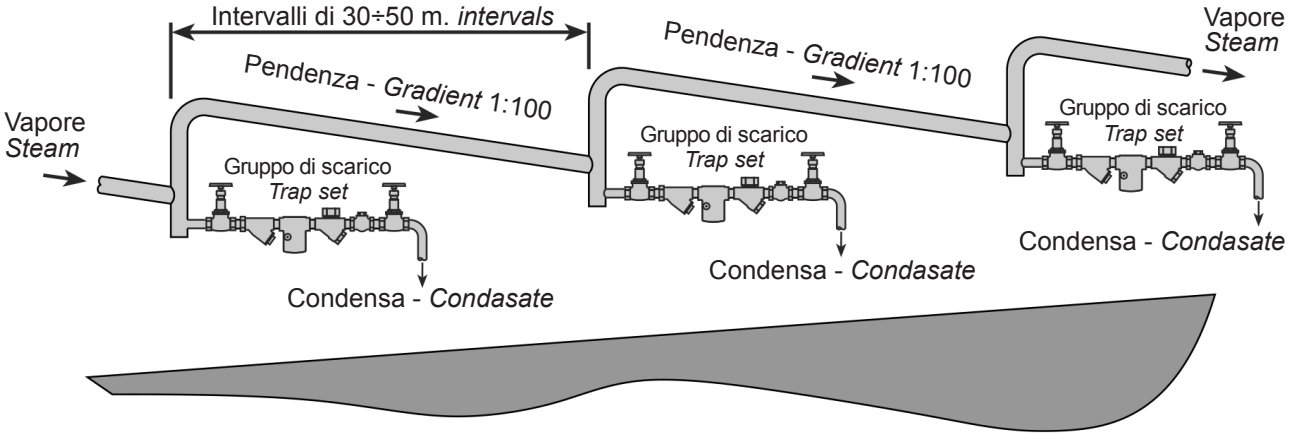
*Cast Iron is a brittle material. If the product is dropped during installation and there is any risk of damage the product should not be used unless it is fully inspected and pressure tested by the manufacturer.*

*Please remove label before commissioning*

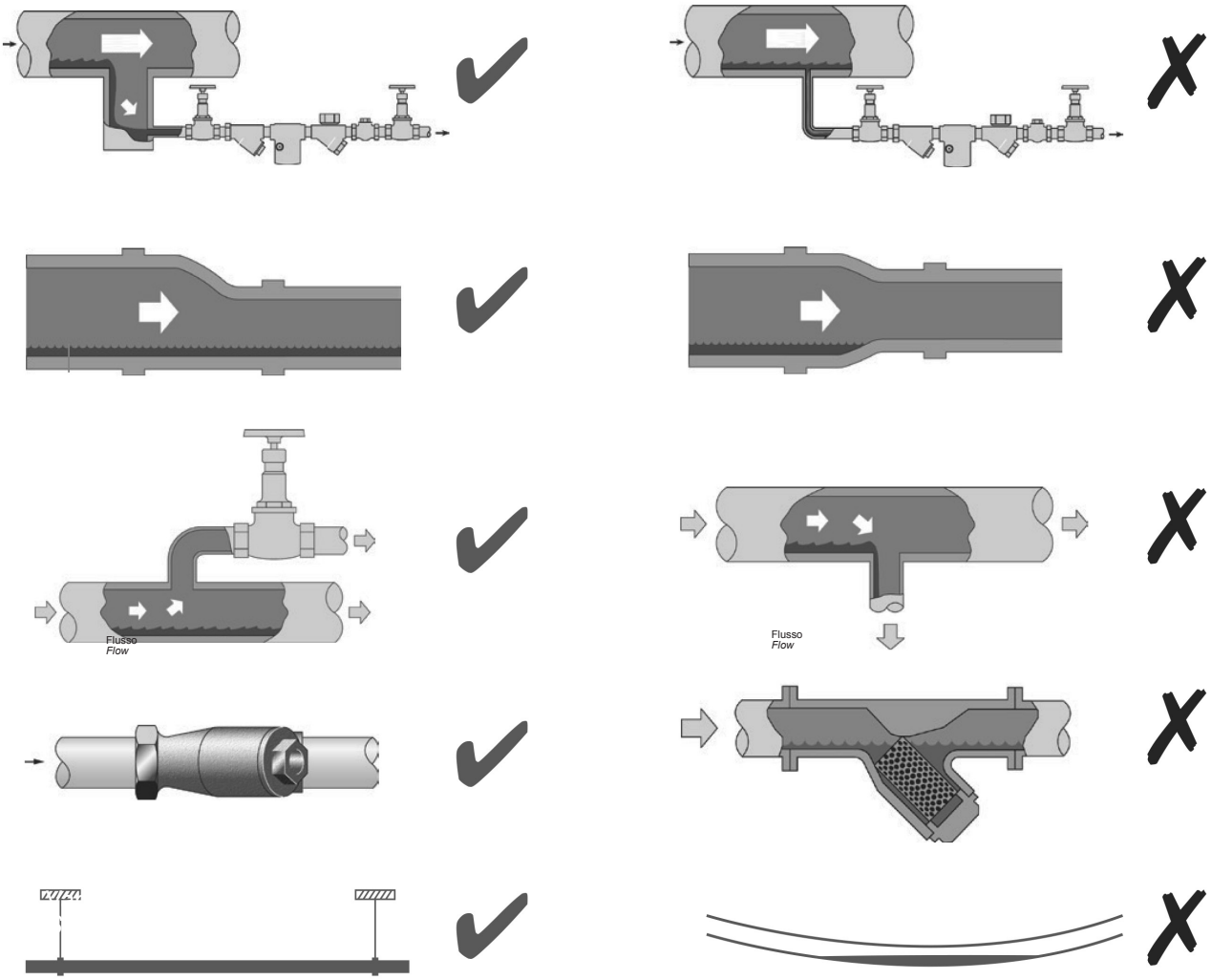


## Prevenzione dai colpi d'ariete - *Prevention of water hammer*

Scarico condensa nelle linee vapore - *Steam trapping on steam mains:*



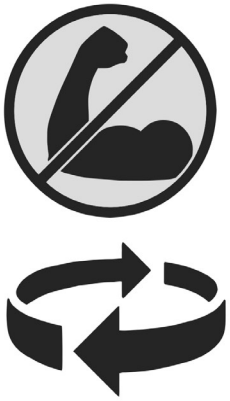

## Esempi di esecuzioni corrette (✔) ed errate (✗) sulle linee vapore: *Steam Mains - Do's and Dont's:*



# Prevenzione delle sollecitazioni di trazione
# *Prevention of tensile stressing*

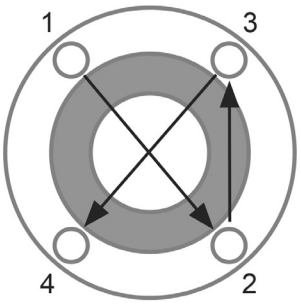
Evitare il disallineamento delle tubazioni - *Pipe misalignment:*

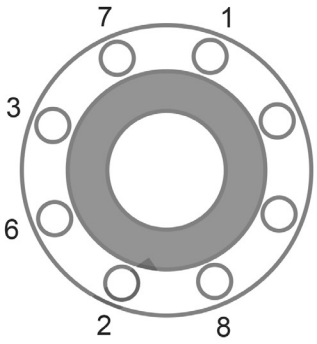
**Installazione dei prodotti o loro rimontaggio post-manutenzione:**
***Installing products or re-assembling after maintenance:***



Evitare l'eccessivo serraggio.
Utilizzare le coppie di serraggio raccomandate.

*Do not over tighten.*
*Use correct torque figures.*



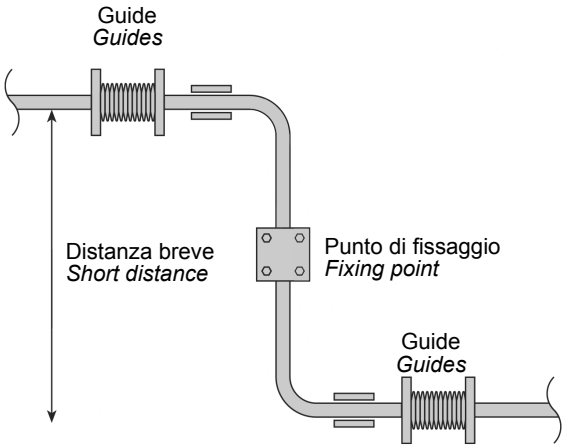

Per garantire l'uniformità del carico e dell'allineamento, i bulloni delle flange devono essere serrati in modo graduale e in sequenza, come indicato in figura.

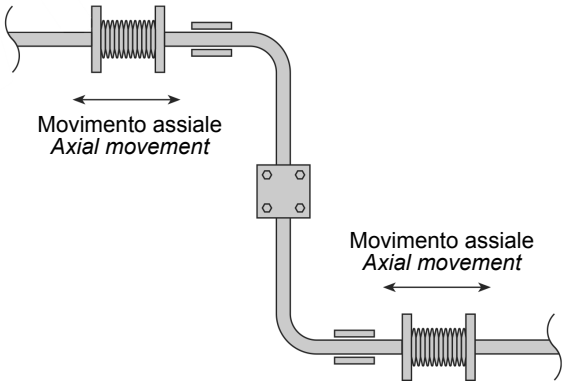
*Flange bolts should be gradually tightened across diameters to ensure even load and alignment.*

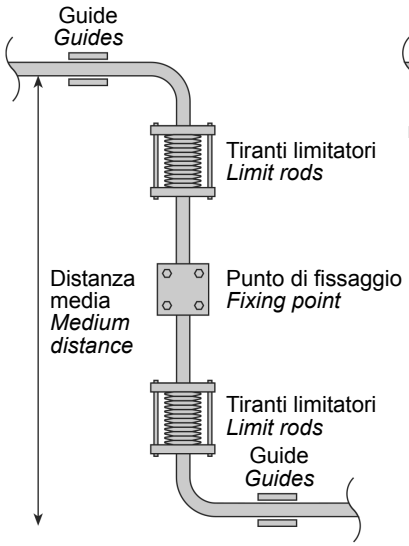
# Dilatazioni termiche - *Thermal expansion:*

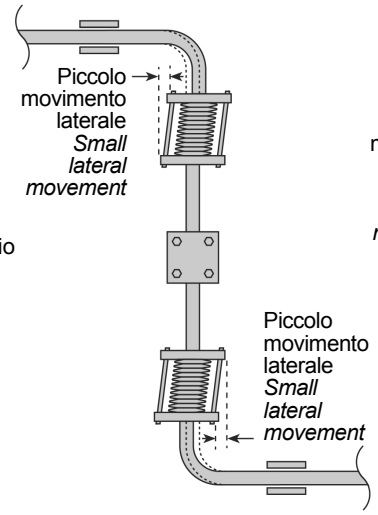
Gli esempi mostrano l'uso corretto dei compensatori di dilatzione. Si consiglia di richiedere una consulenza specialistica ai tecnici dell'azienda che produce i compensatori di dilatazione.

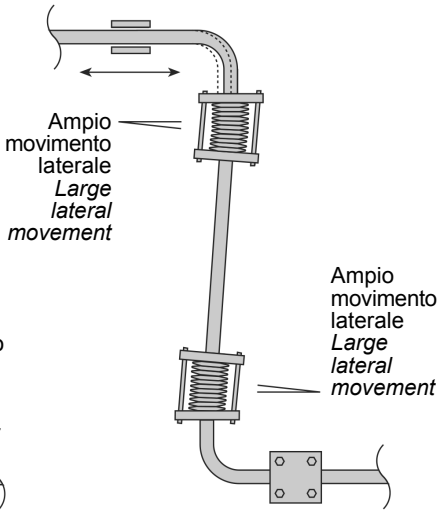
*Examples showing the use of expansion bellows. It is highly recommended that expert advise is sought from the bellows manufacturer.*



# Certification of HTM2031 Compliance

This is to certify that Honeyman Group Ltd reviewed the design and build of the

## SPIRAX SARCO ITALY

## CSM-C COMPACT CLEAN STEAM GENERATOR

to the requirements of Health Technical Memorandum 2031.

Tests on an installed unit demonstrated satisfactory levels of contaminants within steam condensate when tested to HTM2031 Clean Steam specification.

| | |
|---|---|
| ..... | ..... |
| **Marcus Booth** | **Gavin Ross** |
| **Validation Specialist** | **Process Validation Manager** |

All condensate analysis was tested independently by
Honeyman Group Analytical Services Department.
Full details of the review are included in Honeyman Group Ltd SSI-J001-001

**Honeyman Group Ltd**
**Harmire Enterprise Park**
**Barnard Castle**
**County Durham**
**DL12 8BN**

honeyman

Pharmaceutical Process Support

# Installation, Operation and Maintenance Manual
# Spirax Sarco Clean Steam Generators
# (CSM-C Series - Compact)

## Safety information

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 6) 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. The products listed in the table on page 5 comply with the requirements of the European Pressure Equipment Directive 97/23/EC, carry the CE mark when so required and fall within the Pressure Equipment Directive categories stated.

i) The products have 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.

## Pressure Equipment Directive Classification

Spirax Sarco Clean steam generators are classified under table 5 of the pressure equipment directive.

| Product | Group 2 Gases |
|---|---|
| CSM-C 300 | Cat 3 |
| CSM-C 600 | Cat 3 |

**Other component parts within the package comply with the relevant European directives where necessary, please refer to 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.

## 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 seals** - If seals made from PTFE have been subjected to a temperature approaching 260°C (500°F) or higher, they 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 tabacco contaminated with PTFE particles can develop 'polymer fume fever'.

**VITON seals** - If the Viton seat 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.

## 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 185°C (365°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.

## Responsibility

This Installation, Operation, and Maintenance Manual is intended to be as complete and up to date as possible. It covers the installation, operation, and maintenance procedures for Spirax Sarco Clean Steam Generators (CSM-C Compact Clean Steam Generator Series). Spirax Sarco reserves the right to update this manual 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 Spirax Sarco Steam Generators (i.e.: valves, pressure controls, gauges, etc.).

Spirax Sarco uses only the highest quality components in building the Compact Series Steam Generators; only in the supply of a full clean steam package will Spirax Sarco assume responsibility for the unit and the clean steam produced. Alternately Spirax Sarco will only be responsible for the products directly supplied.

**Note: The symbol Δ denotes warnings.**

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

## Information

This Installation, Operation, and Maintenance Manual is designed as a procedural guide for Spirax Sarco Compact Clean Steam Generators.

## Energy and Power Sources for Generating Steam

Spirax Sarco Compact Clean Steam Generators can be configured and manufactured to use one (1) of two (2) possible energy sources for generating clean steam: (HTM 2031).

**Steam:**
**Electricity**

**Δ Note: Most Spirax Sarco Compact Clean 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 with electricity, 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 / Degree Centigrade | Maximum pressure bar g |
|---|---|---|
| Steam | 184°C | 10 bar g |
| Electricity | Upon request | N/A |

**Δ Note: Consult the design specifications for the unit, as well as the nameplate attached to the exterior of the pressure vessel and individual specification tags on pressure related components and controls, for design specifications and maximum pressure for the unit.**

## Controls

Spirax Sarco Steam Generators are equipped with both electronically and pneumatically activated controls to regulate pressure (temperature) and water level. The electronic PLC control panel used, depending on individual design specifications, has a power requirement of 380 volt three phase. Pneumatic controls, depending on individual design specifications, require instrument air pressures of 8 bar g (120 psi). Consult the individual design specifications for the unit and controls for the exact requirements.

## Construction

All Spirax Sarco Compact Clean Steam Generators are constructed from superior materials and utilize only the highest quality components. All parts in contact with generated steam are S.S. 316L. Each Compact Steam Generator meets or exceeds all applicable V.S.R code (Vessel Security Rules) regulations and are built to conform to 97/23/CE Directive. Each Spirax Sarco Compact Clean Steam Generator is equipped with a CE approved safety valve and an external drain, providing a means to remove accumulated sediment.

## Nameplates

A nameplate, mounted to the generator body, bears the model and serial numbers of the steam generator unit, whilst a nameplate mounted on the skid bears the package number with CE approval (Fig. 1).

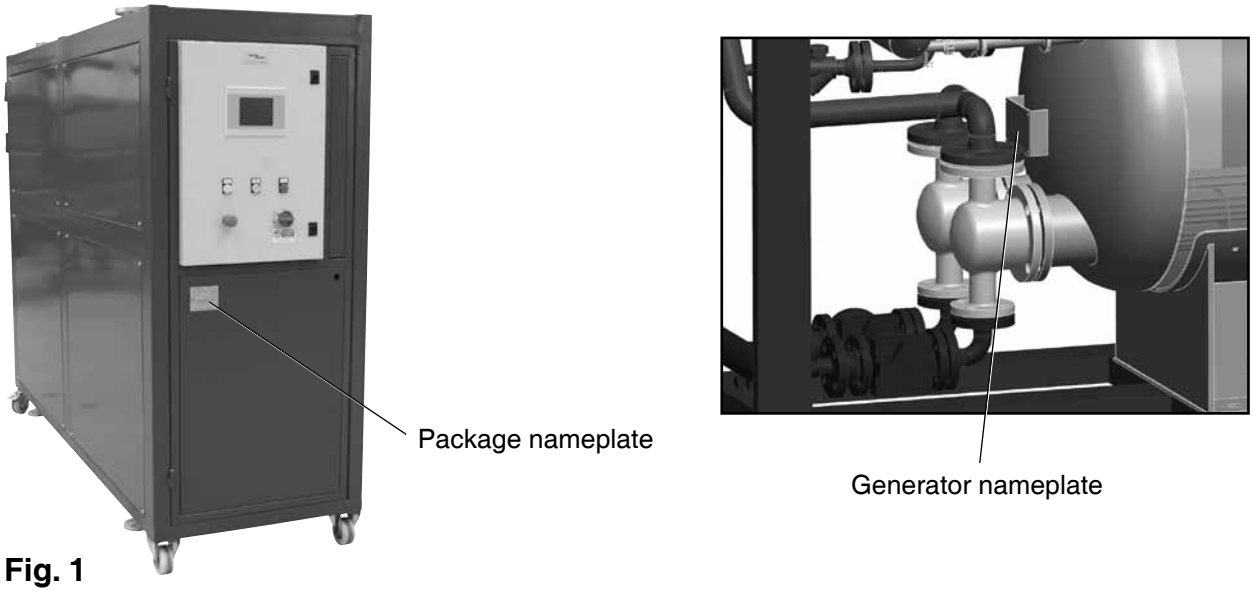



**Fig. 1**

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

## Insulation

All Spirax Sarco Compact Clean Steam Generators have insulation on the feedwater tank, generator shell and pipework.

## Heat Exchanger

The U-Bundle heat exchanger is manufactured with stainless steel AISI 316L tubesheet, the connection piece used to mount the U-bundle in the generator body is also constructed from AISI 316L.

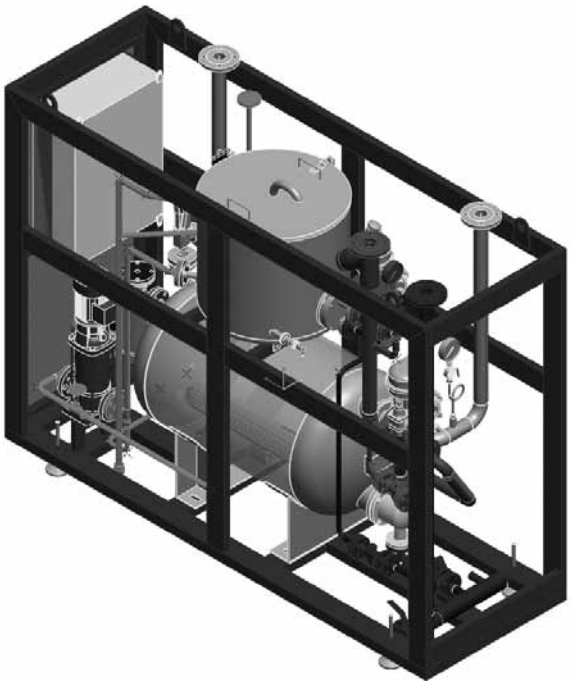


**Fig. 2**

## Components

All other components included in CSM-C Steam Generators have been specifically selected to meet the individual design specifications of each unit and HTM 2031.
Spirax Sarco has all components to control the steam generators and they are judged to be of the highest quality.

## Warranty Information

All components used in Spirax Sarco Steam Generators are warranted for one (1) year from commissioning or eighteen (18) months from date of delivery, 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-C Compact Steam Generators. 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 thermal oil/superheated water systems. Spirax Sarco CSM-C Steam Generators are designed for indoor use only, unless otherwise required by design specifications. Each unit requires at least one metre clearance at the front and rear, and 500 mm above the unit. It should be located on a level surface (no more than one-half degree [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.

- Fault finding and maintenance procedures are detailed starting on page 26.

- CSM-C Steam Generators are available in a various range of operating pressures and flow rates. For the specific ranges for your unit, refer to the design specifications and accompanying literature and drawings supplied with the unit.

- Should the unit be damaged during installation, operation, or maintenance, complete the following steps.
  1. Turn off the power to the unit.
  2. Turn off the primary supply inlet (steam) valve.
  3. Turn off the condensate water return valves.
  4. Turn off the clean steam outlet valve (if present).
  5. Turn off feed water inlet valves.
  6. Contact in-house maintenance personnel.

All pipework connections for clean steam and water should be flanged or sanitary design, type of gasket material should be suitable for clean steam applications.

## Δ Warnings:

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

Listed on the following pages are specific warnings pertaining to Spirax Sarco 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.

## Δ Areas of potential danger:

1. **all steam water lines, joints, valves;**
2. **all power connections and cables;**
3. **all pneumatic (instrument air) lines and joints.**

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

1. Ensure that the primary supply (steam) 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;
3. Ensure that all power has been shut off / disconnected;
4. Ensure that all incoming and outgoing steam, condensate, and energy source lines have been isolated at the manual shutoff valves;
5. Ensure that the pneumatic (instrument air) source has been isolated and the pressure bled from the lines.

**Δ Operating conditions can be very dangerous due to the fact that the steam is under pressure and at very high temperatures.**

**To avoid possible injury or death, follow all accepted and recommended procedures when performing installation, operation, and maintenance procedures.**

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

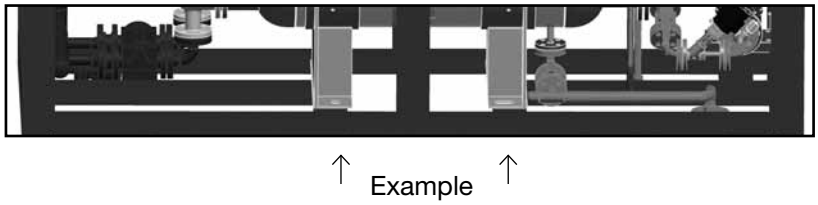
## Product Features and Specifications

CSM-C family of Steam Generators, employing the U-Bend heat exchanger coil(s), are the most economical method of furnishing clean steam when steam is used as the energy source. All Spirax Sarco Compact Steam Generators are Packaged and ready for installation. All components are sized, mounted, piped, and tested prior to shipment. Each unit is built to exact design specifications and requires only connection to energy, water, power, safety discharge, blowdown discharge line 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 feed water heating tank and generator body. All components used in the unit are of highest quality and meet all design requirements. Each Compact Steam Generator is accompanied by this Installation, Operation, and Maintenance Manual, 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.

## Installation Transporting and Unpacking the Unit

CSM-C Compact Steam Generators are usually shipped uncrated, the units can be lifted by means of a forklist truck, placing the forks on the underside of the frame structure, in a central position thus evenly distributing the units weight and providing a stable, balanced load, refer to Fig. 3.

**Fig. 3**




**Δ If crated when shipped, the unit should only be lifted at the areas indicated on the crate. Improper lifting of the unit may result in damage to the unit.**

## Location Requirements

CSM-C Compact 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 one-half degree [½°] of slope), capable of supporting the total weight of the unit when filled to capacity. If crated when shipped, the crating should be carefully removed. The unit can then be manoeuvered into place using the mounted wheels, safely installed and then secured using the four footmounts.

## Examining the Unit

After the unit has been set in place, it should be carefully examined to assure that neither the main unit nor any of the components have been damaged during shipping. If any evidence of damage is detected, 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 are to design specifications. This can be done by reviewing the design specifications (included with the unit) and the specification tags / plates attached to each component. Contact Spirax Sarco or your authorized sales representative, before proceeding with the installation.

## Mounting the Unit

The unit should be mounted to the floor using the four individual footmounts supplied, 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. Connect the feed water supply to the feed water inlet;
2. Connect the generated clean steam outlet to the clean steam outlet;
3. Connect the safety valve and discharge to a safe area;
4. Connect the primary supply (steam or high temperature water) to the unit;
5. Connect the condensate or return water line to the return pipework;
6. Connect the applicable power supply (if the unit is packaged with an electrically activated pressure or control component);
7. Connect the appropriate instrument (control) air supply;
8. Connect the Drain / bottom blowdown connection to the correct system pipework;

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 primary supply.

## Connecting the Feed Water Source and Generated Clean Steam Outlet

**Δ Note: Before making any connections of feed water inlet or generated clean steam outlet to the unit, assure that all pipework 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.**

**Δ The drawings used in this manual are only examples. For the connections of the ordered generator always refer to the drawings attached to the generator.**

## Feed Water Supply

The first step in the installation process is to connect the feed water supply to the feed water inlet connection (Fig. 4).
The exact location for this specific unit, as well as pipe diameter, can be determined from the drawings supplied with the unit.
A manual shutoff valve should be installed upstream on the feed water source as an isolation device. The shutoff valve should be in the closed position and remain so until the instalation is complete.

**Δ Note: All pipework connections for clean steam and water should be flanged or sanitary design, type of gasket material should be suitable for clean steam application.**

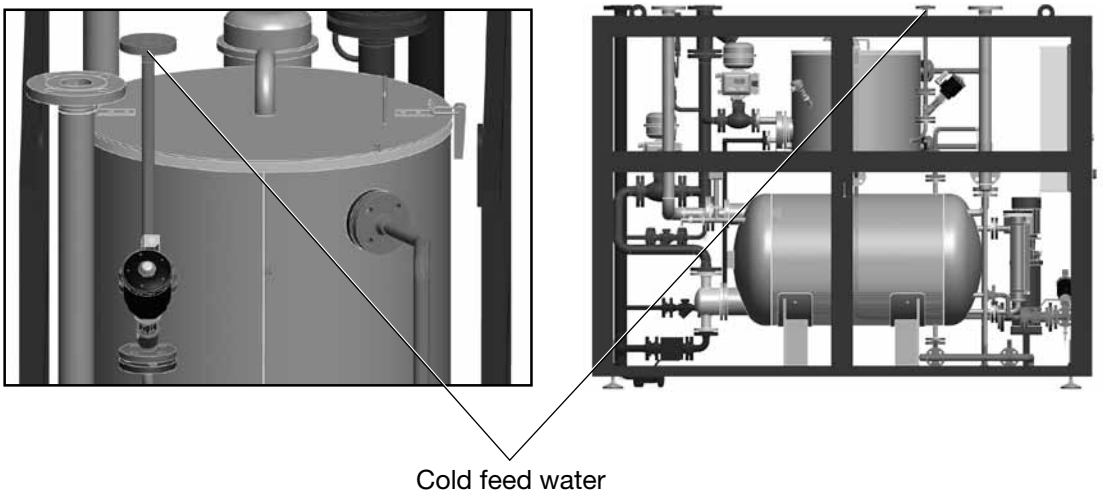



**Fig. 4**

## Generated Clean Steam Outlet

The next step in the installation process is to connect the generated steam system pipework 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 drawings supplied with the unit (Fig. 5). A manual shutoff valve should be installed downstream on the generated clean steam line for isolation purposes in case the unit must be disconnected from the system. The shutoff valve should be in the closed position and remain so until the installation is complete.

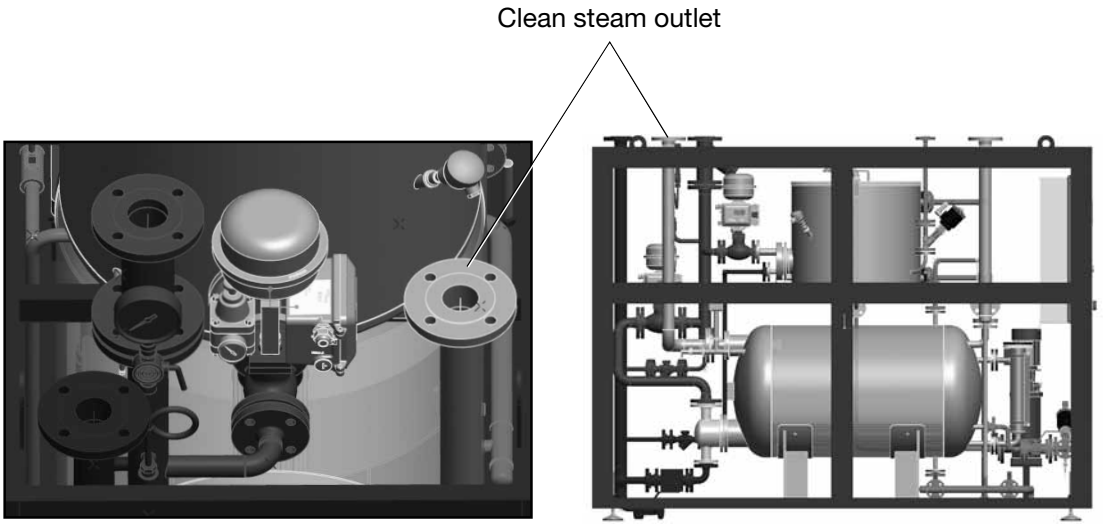



**Fig. 5**

**Δ Note: Refer to local regulations and specifications for site specific shutoff and check valve requirements.**

**Note: All pipework connections for clean steam and water should be flanged or sanitary design, type of gasket material should be suitable for clean steam application.**

## Ancillary Service

**Spirax Sarco recommends the installation of sample point throughout the system.**

HTM 2031 also specifies that throughout the process of generation, system sample points should be located at the followings points as a minimum.
These points will allow an easy sampling and testing system.

- Mains water
- Treated water (sample points between stages)
- Feed Water / Boiler water
- Steam generator water
- Steam at point of use

For further information contact Spirax Sarco.

## Connecting the Primary Supply (Steam)

**Δ Possible injury or death.**

Assure that a manual shutoff valve is installed upstream in the steam line (energy source), and that it is functioning properly. If any doubt exists concerning the integrity of the shutoff valve, replace the valve before attempting installation. All primary supply valves should be closed and remain closed throughout the installation process. Connect the primary supply to the line(s) leading to the pressure control valve (Fig. 6).
The exact location of the pressure control valve for the specific unit, as well as primary supply pipe diameter, can be determined from the drawing supplied with the unit.

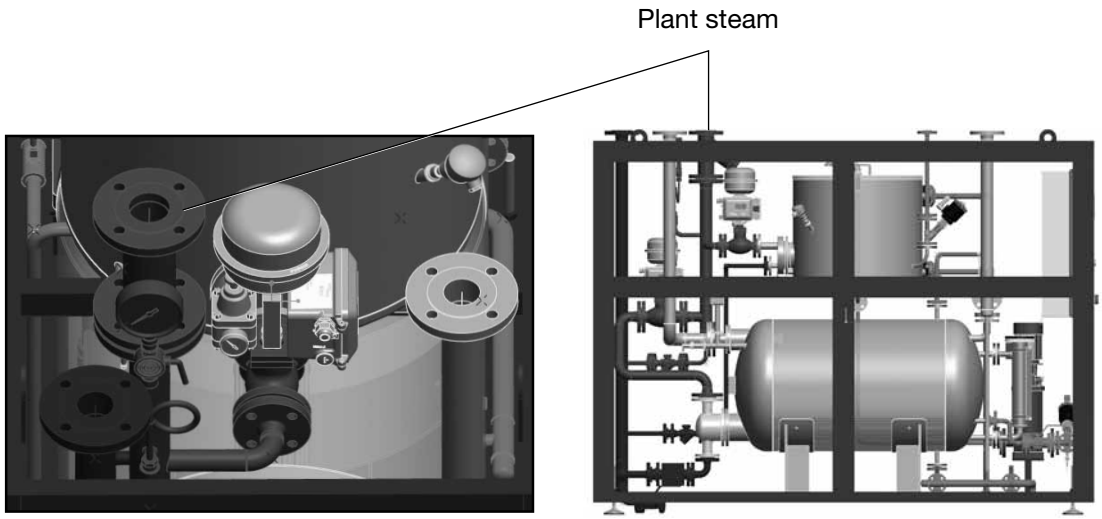



**Fig. 6**

**Δ Note: For all primary supply pipework 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.**

## Connecting the Condensate Return Line

## Condensate Return Line

As the heat is extracted from the energy source and transferred to the clean steam generating system, condensate will form.
The condensate return line should be connected to the unit at the condensate outlet connection.
The exact location of this port for the specific unit, as well as the condensate return pipe diameter and thread size, can be determined from the drawing supplied with the unit (Fig. 7).
The condensate line should be piped back into a condensate return system.
A manual shutoff valve should be installed downstream in the condensate return line to allow the unit to be isolated from the system.
The condensate shutoff valve will prevent back flow of condensate if the line is disconnected.

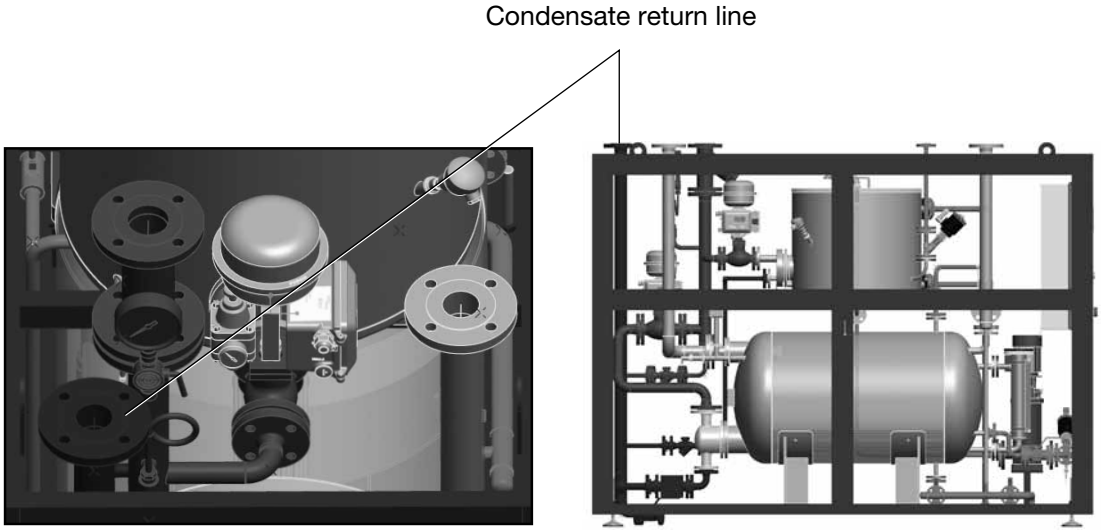



**Fig. 7**

## Piping the Safety Valve to Vent and drain

All Spirax Sarco Compact Steam Generators are equipped with a pressure safety valve. In most applications, the pressure safety valve should be vented to atmosphere (generally through the roof). The piping used in the vent system **must be of adequate size to handle the capacity of the pressure safety valve**. The vent piping system should allow for condensate drainage and should be piped to a to a suitable drain (Fig. 8). Piping the pressure safety 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 discharge pipework should comply with local codes. It is the responsibility of the purchaser / installing contractor to assure this compliance.
The exact location of the pressure control valve for the specific unit, as well as primary supply pipe diameter, can be determined from the drawing supplied with the unit.

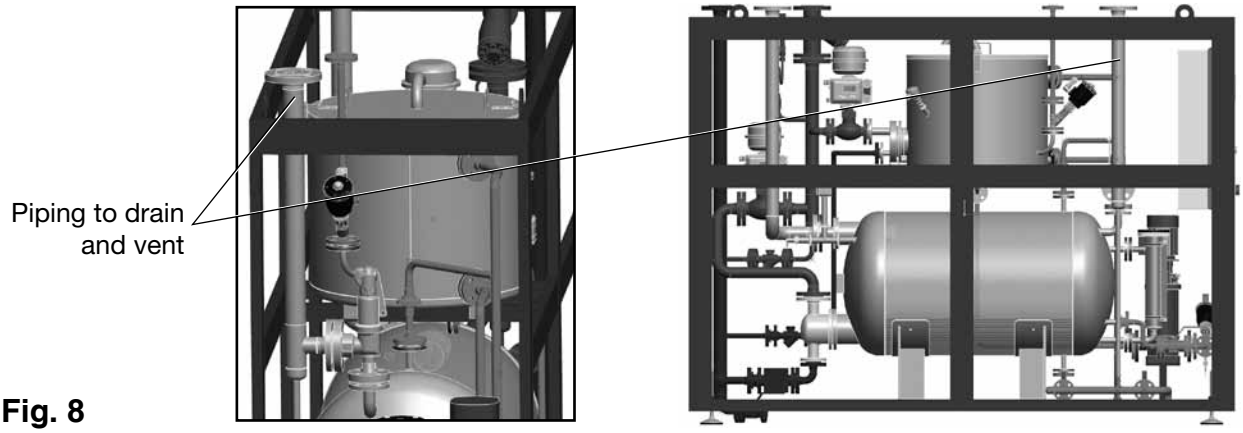



**Fig. 8**

**Δ Installation should be done according to local standards.**

## Connecting Electro-Pneumatically Activated Controls

Spirax Sarco Compact Steam Generators are equipped with pneumatically activated controls. In most cases where pneumatically activated controls are used, they require instrument air pressure supply of 8 bar g, 120 psi (Fig. 9). Refer to the supplied drawing, and specific installation and operation instructions for each component to determine the requirements for that component.

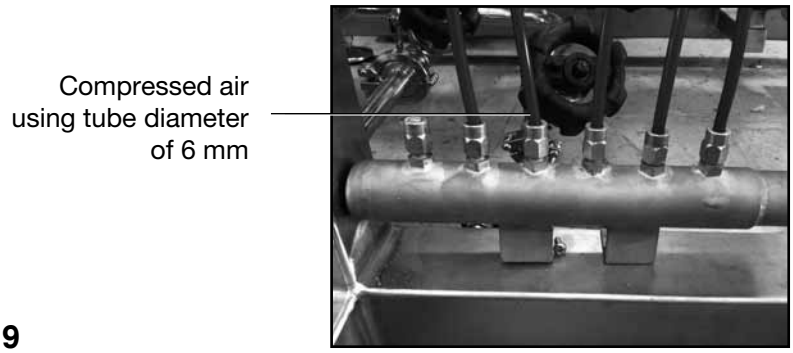



**Fig. 9**

**Δ Assure that the pneumatic feed line 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 instructions contained in the Installation Manual for the component, for specific piping instructions.

**Δ 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.**

## Connecting the Drain / Bottom Blowdown Line

Spirax-Sarco CSM-C Compact Steam Generators are equipped with a drain / bottom blowdown line. Each generator has an automatic blowdown valve connected to the bottom of the vessel (Fig.10). 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 lines be connected to a blowdown vessel or condensate cooler before being discharged to drain in accordance with local regulations or standard.

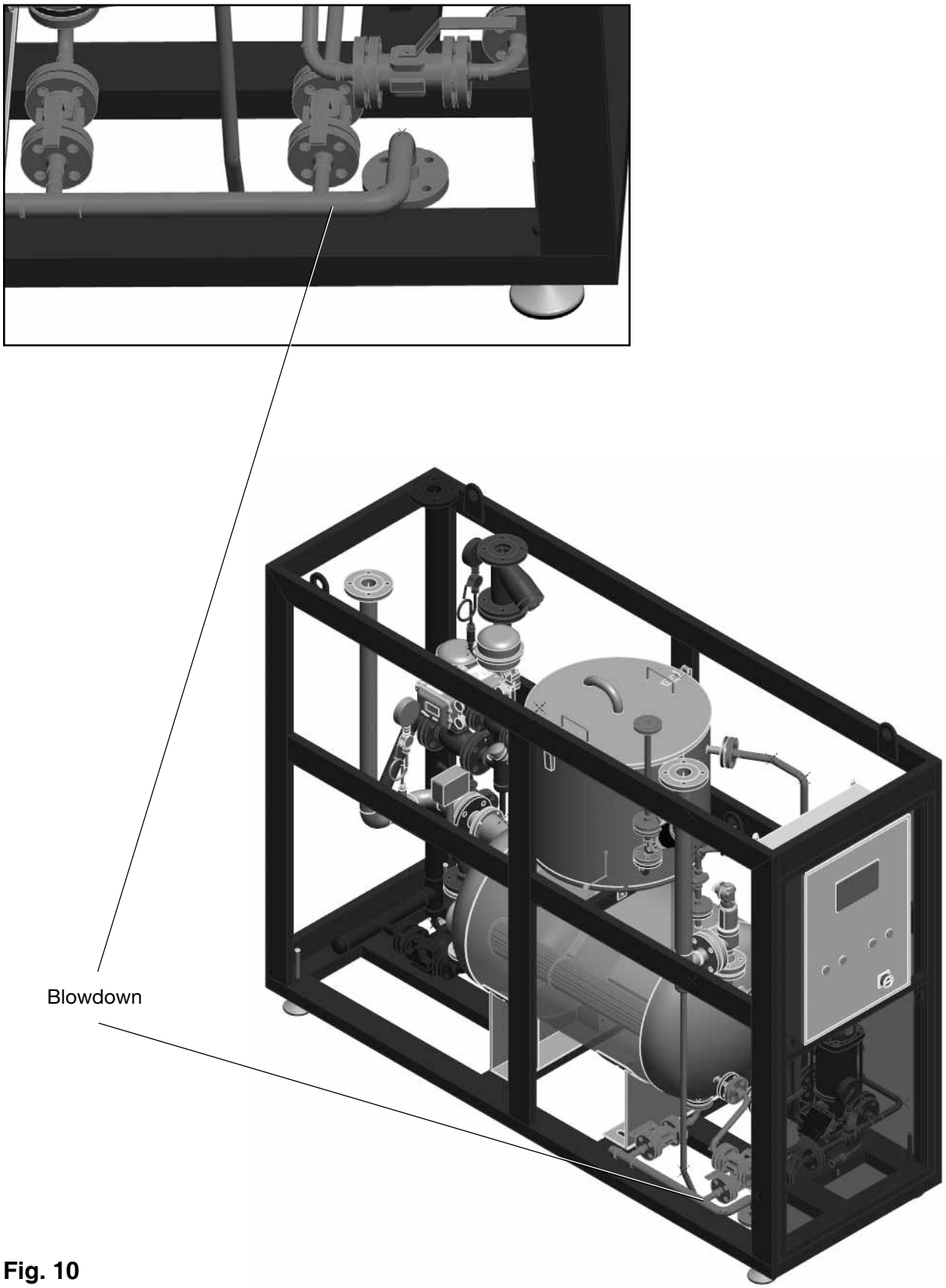



**Fig. 10**

**Δ Note: Blowdown connection should be performed in accordance to local codes, accepted practices, or the requirements of the installing contractor.**

## Main Power Supply

1 KW supply, 400 Vac, 50 Hz three phases (verify the electrical drawings).

| | |
|---|---|
| Output contacts: | Dry contacts NO/NC 220 Vac, 5 Ampere. |
| Input contacts: | Dry contacts NO/NC not powered, 5 Ampere. |
| Ambient temperature: | 0°C + 50°C (inside the control cabinet)* |
| Humidity: | 5% to 95% relative non condensing. |

**Δ Attention: the user is responsible for electrical connections to the package.**

**Δ Attention: do not route signal and control wiring with power wiring in the same conduit. This can cause interference with operation. Failure to observe this precaution could result in damage to, or destruction of, the equipment.**

**Δ Attention: a power disconnect device must be installed by the user, between the general power line and the cabinet. If the power disconnecting device is a circuit breaker, the circuit breaker must be able to trip 25 Amperes. It is important to verify that the main power will meet input power requirements of the control cabinet. Be sure that input power corresponds to the nameplate voltage and frequency.**

**Δ Attention: unused wires in conduit must be grounded at both ends to avoid a possible shock hazard caused by induced voltages.**

*** Note: if the environmental conditions bring the temperature inside the cabinet to overcome 50°C conditioning devices are available.**

**Please contact your nearest Spirax-Sarco branch or agency.**

## Grounding the cabinet

**Δ Attention: the user is responsible for conforming with all the applicable local, national and international codes. Failure to observe this precaution could result in damage to, or destruction of the equipment.**

**Use the following steps to ground**

**Step 1:** open the cabinet door.
**Step 2:** run a ground unbroken conductor from the control cabinet ground terminal PE to the earth ground (Fig. 11). Ground cable must be not less than 4 mmq.

**Fig. 11**

## Installing power inputs lines

**Use following steps to connect AC input power to the control cabinet.**

**Step 1:** wire the Ac input power leads by routing them in the cabinet unit through the plug.
**Step 2:** connect the 3 phase AC input + Neutral power leads to terminals R, S, T, N input on **Terminal board** (Fig. 12).
**Step 3:** tighten the AC input terminals.

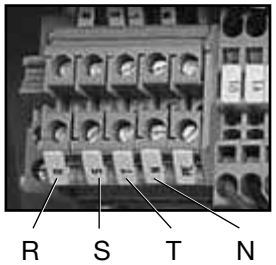



**Fig. 12**

## Installation Completion

Installation of the CSM-C Compact Steam Generator is now complete.

## Commissioning

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

## Commissioning Procedure

Commissioning may now be carried out in accordance with the following procedure.

NB: It is recommended that this procedure is always carried out with the presence of a qualified Spirax Sarco engineer.

### Installation Inspection

1. Ensure that unit has been installed in line with Spirax Sarco recommendations.
2. Ensure the blow down line and safety valve line are piped away to a safe location.
3. Ensure All Isolation Valves are closed (Primary Steam supply, Clean steam outlet, Feed Water inlet, Pneumatic supply, Condensate).

### Pre-Commissioning Inspection

4. Check all joints within the generator are tight.
5. Note Orientation of the feedtank level transducer (should be horizontal).
6. Check the Electrical connections.
7. Check Supply Voltage is correct.
8. Check Pneumatic supply is correct.

### Configuration parameters

To do this operation please consider the PLC control unit manual at the paragraph “Protected Parameters”.

### Manual Operation

Once completed the configuration steps, go on the manual check of the steam Generator To do this operation please consider the PLC control unit manual at the paragraph “Manual operations”.

### Notes

Durning the manual cycle check the correct rotation of the pump, and that is no cavitation. In case that the direction of the rotation is  no correct switch off the panel and invert two of the three supply phases of the pump.
In presence of pump cavitation perform purging. Please refers to the instruction manual pump in chapter 6.

### Automatic Operation

To do this operation please consider the PLC control unit manual at the paragraph “Auto operations”.

## Shutdown Operating Procedures

The following procedure must be followed when shutting down the unit for extended periods such as over weekend or for maintenance purposes.

**Stop the automatic cycle**

1. Close Plant Steam supply isolation valve.
2. Close RO feed water isolation valve.
3. Close condense outlet isolation valve.
4. Allow generator pressure to fall to the point pressing the manual command Clean Steam outlet valve closes.
5. Close Clean steam isolation valve.
6. Open manual drain valve and leave open until both the tank and generator are empty.
7. Close all Isolation valves and lock off.
8. Turn off electrical power.

## Emergency Shutdown Procedure

The following procedure must be followed in the event that an emergency shutdown is required.

The Emergency Shutdown procedure must only be used in the event of an unusual occurrence that requires the rapid isolation of the clean steam supply or in the unlikely event of a malfunction within the Clean Steam Generator.

1. Press Remote Stop Button either on front panel or remote location.
2. Close plant steam supply isolation valve.
3. Close clean steam output isolation valve.
4. Close all other isolation valves.

## Daily Operation - Steam Generator

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

The unit has been equipped with a Feed Water Makeup System and Bottom Blowdown Timer, these procedures are automated and need not be carried out by operating personnel.

## Bottom Blowdown

Spirax sarco Compact Steam Generators are equipped with a drain and bottom blowdown line. This valve can be automatic and it's connected to the bottom of the vessel.
It can be programmed by PLC to obtain discharges in subsequential intervals of time.

**$\Delta$ 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 lines be connected to a blowdown vessel before being discharged to drain.**

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

Spirax Sarco recommends the use of automatic blowdown valves with it's generators. The buildup of scale and dirt within the unit can effect operation and the quality of the clean steam and shorten the life of the unit. The unit should be blown down **a minimum of once a day**.

The frequency of necessary blowdown is directly effected by the minerals, chemicals, and contaminants contained in the feed water.
**Depending on the water, the blowdown interval may need to be altered (either more or less frequently) for each site.**

## Water Quality

Feedwater Pipework. The feedwater in the feedtank must be recirculated. The feedwater will be recirculated to minimise stagnant water within the system, and to assist in the removal of non-condensable gases. Water within the feedtank should be maintained above 80°C. HTM 2031 gives specifications for contaminants within the steam condensate, as identified in the table below:

| Determinand | Unit | Maximum Permitted Values HTM 2031 Clean Steam Condensate |
|---|---|---|
| **Acidity or Alkalinity** | - | NQ |
| **Degree of Acidity** | pH | 6 - 8 |
| **Ammonium, $NH_1$** | mg/lt | ≤ 0.2 |
| **Calcium and Magnesium** | mg/lt | NQ |
| **Total Hadness, $CaCo_3$** | mg/lt | < 2 |
| **Heavy Metals** | mg/lt | ≤ 0.1 |
| **Iron, Fe** | mg/lt | < 0.1 |
| **Cadmium, Cd** | mg/lt | < 0.005 |
| **Lead, Pb** | mg/lt | < 0.05 |
| **Heavy Metals** | mg/lt | ≤ 0.1 |
| **Chloride, Cl** | mg/lt | 0.5 |
| **Nitrate, $NO_3$** | mg/lt | 0.2 |
| **Sulphate, $SO_4$** | mg/lt | NQ |
| **Oxidisable Substances** | - | NQ |
| **Residue on Evaporation** | mg/lt | 30 |
| **Silicate, $SiO_2$** | mg/lt | < 0.1 |
| **Phosphate $P_2O_5$** | mg/lt | < 0.1 |
| **Conductivity at 20°C** | µS/cm | 35 |
| **Bacterial Endotoxins** | EU/ml | 0.25 |
| **Appearance** | | Clear, colourless |

## Feed Water (Fig. 13)

CSM-C Compact Steam Generators are equipped with a PLC level controller which will activate the feedwater valve and complement the feedwater recirculation pump. The PLC level controller will feed water to the generator when the level falls under the setpoint level and will stop feeding when the water level reaches the set point. The level controller also has a low water alarm position which will activate if the water falls below the predetermined alarm, set on the PLC.

**Δ Note: As the feed water level is being raised, pressure may be released from the pressure safety valve to the atmosphere.**


**Fig. 13**

## Water Temperature in Pre-Heating/Degassing Tank (Fig. 14)

Water temperature is revealed in pre-heating tank by a three wire heat-resistant temperature probe, fitted with a measure transmitter which is installed in mid-tank on the primary steam supply side. The temperature probe sends the 0-10 V signal (equivalent to 0÷100°C range) to PLC control unit, which elaborate it and consequently transmits the modulanting control signal to the piston control valve on the primary supply line to inlet steam into the steam generator tank.

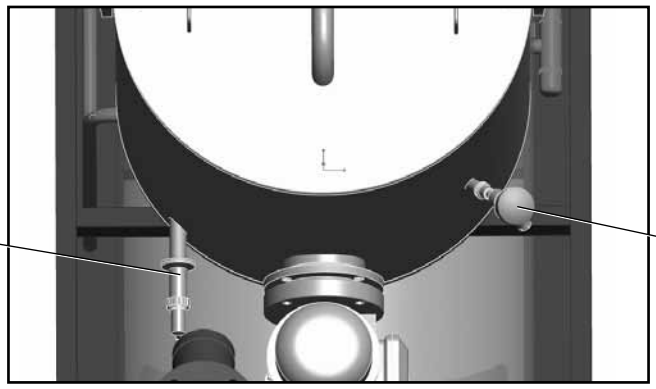



**Fig. 14**

## Water Level in Pre-Heating/Degassing Tank (Fig. 14)

The pre-heating tank water level is relieved by the level transmitter installed at the bottom of the tank.
The level transmitter sends the 0-10 V signal (equivalent to 0÷ 100 mbar range) to PLC control unit, which elaborates it and consequently transmits the ON-OFF control signal to the piston control valve on the feed water line, to inlet feedwater into pre-heating tank.

## Clean Steam Pressure (Figg. 15 and 16)

Clean steam pressure is relieved by the relevant pressure transmitter which is installed on the tank head of the boiler. The pressure transmitter sends the 0-10 V signal (equivalent to 0÷6 bar g range) to PLC control unit, which processes it with a PID algorithm and consequently transmits the adjusting control signal to the pneumatic control valve to modulating inlet of steam into heat exchanger coils integrated into the steam generator.

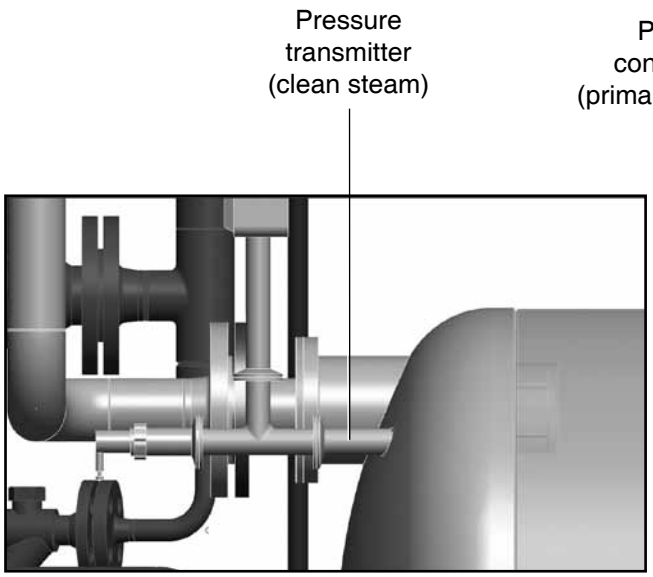



**Fig. 15**

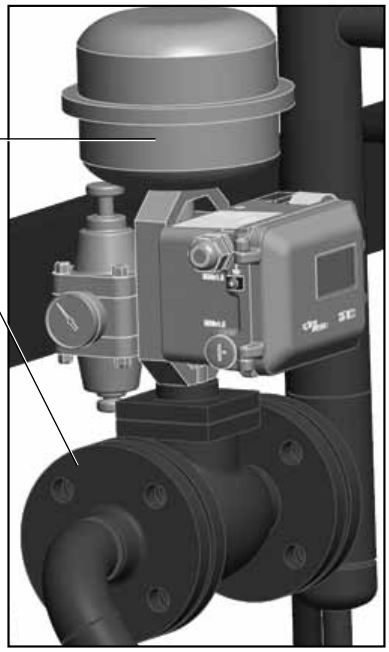



**Fig. 16**

# Fault Finding Procedure: CSM-C Compact Clean Steam Generator

## Fault Finding

The following table summarizes problems that may be encountered during the life of a CSM-C Compact Steam Generator, and the procedures to remedy those problems.

| Symptom | Cause | Remedy |
|---|---|---|
| Water Level in tank is too low. Tank is in alarm condition. | No feed water available. | Check that water supply treatment plant is running and that water is available.<br>Check that isolation valve is open. |
| | Water Feed PAV is not open. | Check that air supply pressure is correct.<br>Check that PAV solenoid valve is energised.<br>Operate manual override on solenoid valve to check operation of valve.<br>Manually operate valve via tank synoptic screen on controller. |
| | Water level transducer is damaged and giving false reading. | Replace level transducer.<br><br>Contact Spirax Sarco Service Department. |
| Water Level in tank is too high.<br>Tank is in alarm condition. | Water feed PAV has failed to close. | Isolate feed water system and inspect valve seat for damage (see appropriate instruction manual). |
| | Water supply pressure exceeds maximum differential pressure of valve. | Check water supply pressure. |
| | Water level transducer is damaged and giving a false reading. | Replace level transducer.<br><br>Contact Spirax Sarco Service Department. |

| Symptom | Cause | Remedy |
|---|---|---|
| Tank Temperature is too low. | Plant Steam is not reaching the PAV. | Check that plant steam supply is not isolated. |
| | Steam inlet PAV is not open. | Check that air supply pressure is correct.<br>Check that PAV solenoid valve is energised.<br>Operate manual override on solenoid valve to check operation of valve.<br><br>Manually operate valve via tank synoptic screen on controller. |
| | Water temperature transducer is damaged and giving a false reading. | Replace level transducer.<br><br>Contact Spirax Sarco Service Department. |
| Tank Temperature is too high. | Plant steam PAV has failed to close. | Isolate plant steam supply and inspect valve seat for damage (see appropriate instruction manual). |
| | Steam supply pressure exceeds maximum differential pressure of valve. | Check plant steam supply pressure. |
| | Water temperature transducer is damaged and giving false reading. | Replace temperature transducer.<br><br>Contact Spirax Sarco Service Department. |
| Generator Water Level is too low.<br>Generator is in alarm condition. | Feed water transfer pump is not running. | Check that pump control isolator is in the run position (RTK1).<br>Check pump overloads.<br>Check motor windings (see appropriate instruction manual).<br>Replace pump. See page 41 of this manual. |
| | Pump is running but develops no pressure. | Bleed pump. Follow procedure in instruction manual.<br><br>Adjust spill back line throttling valve so that sufficient pressure is developed. |

| Symptom | Cause | Remedy |
|---|---|---|
| Generator Water Level is too High. Generator is in alarm condition. | Water Feed PAV will not open. | Check that air supply pressure is correct.<br>Check that PAV solenoid valve is energised.<br>Operate manual override on solenoid valve to check operation of valve.<br>Manually operate valve via tank synoptic screen on controller. |
| | Water level transducer is damaged and giving false reading. | Replace water level transducer. See page 46 of this manual. |
| | Water feed PAV has failed to close. | Isolate feed water system and inspect valve seat for damage (see appropriate instruction manual). |
| | Water level transducer is damaged and giving a false reading. | Replace level transducer. See page 40 of this manual. |
| | Steam from a second generator is back feeding into generator shell and condensing. | Check that non-return valve is operating correctly.<br><br>Contact Spirax Sarco Service Department. |
| Generator Pressure is too low.<br>Low pressure alarm has activated. | Plant Steam is not reaching the Control Valve. | Check that plant steam supply is not isolated. |
| | Steam inlet Control Valve is not open. | Check that air supply pressure is correct.<br>Check that air is being supplied to actuator.<br>Manually operate valve via tank synoptic screen on controller. |
| | Condense is not being removed from heating coils. | Check that steam traps are operating correctly.<br>Check that condense isolation valves are open. |

| Symptom | Cause | Remedy |
|---|---|---|
| Generator Pressure is too low. Low pressure alarm has activated. | Generator pressure transducer is damaged and giving a false reading. | Replace pressure transducer.<br><br>Contact Spirax Sarco Service Department. |
| Generator pressure is too high. Generator is in alarm condition. | Steam inlet Control Valve has failed to close.<br><br>Steam supply pressure exceeds maximum differential pressure of valve.<br><br>Pressure transducer is damaged and giving false reading. | Isolate plant steam supply and inspect valve seat for damage.<br><br>Check plant steam supply pressure.<br><br>Replace pressure transducer.<br><br>Contact Spirax Sarco Service Department. |
| Controller Touch Screen is blank and does not respond when touched. | Power has failed. | Check electrical power is on.<br><br>Contact Spirax Sarco Service Department. |
| Generator is unable to maintain pressure when operating on full load conditions. | Primary Steam Pressure is too low.<br><br>Condense is not being removed from heating coils.<br><br>Heating coils are becoming scaled so heat transfer efficiency is reduced.<br><br>Clean steam load is exceeding design specification of generator. | Check that primary steam pressure is correct and doe not drop as generator load increases.<br><br>Check that steam traps are operating correctly.<br>Check that condense isolation valves are open.<br><br>Remove and examine coils as identified on page 31 of this manual.<br><br>Check actual steam load against original specification.<br><br>Contact Spirax Sarco Service Department. |

## Maintenance

The information contained in this section will detail service and maintenance procedures for the inspection and replacement of components used in Spirax Sarco Compact Clean 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.

**Δ 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 startup and shutdown procedures, detailed on pages 21 - 22 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.

**Δ 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 the shutdown procedure (page 22) to take the unit off-line before attempting any electrical service.
2. After assuring the power 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.
4. Follow the startup procedure on page 21 of this manual to return the unit to operation.

## Pneumatic (Instrument Air) Connections - Refitting

If any of the pneumatic (instrument air) connections must be refit at the pneumatically activated controls, follow the steps listed below.

**Δ Instrument air, at pressures as high as 120 psi, can be required pneumatically activated controls. Air pressure at this level can pose a very dangerous situation. Assure that the air source has been shutdown and that the line pressure has been relieved before breaking any pneumatic connection.**

1. Follow the shutdown procedure (page 22) to take the unit off-line before attempting pneumatic service.
2. After assuring the air source has been turned off, break and rework 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 startup procedure on page 24 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 CSM-C Compact Steam Generators. It (they) should be removed and inspected every two (2) years, dependant upon insurance requirements.
There are two (2) gaskets, one (1) between the tube face of the coil and the flange welded to the tank, and one (1) gasket with a divider to fit between the head and the tubesheet.

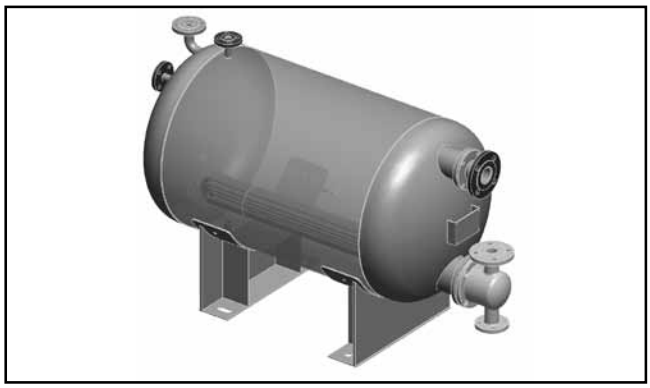


**Fig. 17**

**Δ Clean steam and energy source steam present situations that can be very dangerous because of the high temperatures and pressures. To avoid possible injury or death and follow all accepted and recommended procedures when performing installation, operation, and maintenance procedures.**

**Δ 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 the shutdown procedure (page 22) to take the unit off-line before attempting to remove and inspect the heat exchanger coil.
2. Ensure that the primary supply, condensate / water return line, feed water inlet, and clean steam outlet have been shut off; that the pressure has been relieved from both the clean steam and energy source systems; that the feedtank 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 ensure 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.

**Δ 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 buildup 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 (2) new gaskets: one (1) between the tube face of the coil and the flange welded to the tank, and one (1) 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 assuring that the heat exchanger unit is correctly aligned, clamp the flanges together and proceed with the torque procedure detailed in appendix A.
   a. Lubricate the bolt threads and the nut faces with a suitable lubricant.
   b. Insert the bolts through the flanges, then start and finger tighten the nuts.
   c. Number all bolts so that torquing requirements can be followed.
   d. Apply torque in twenty percent (20% [1/5]) steps of required final torque, loading all bolts at each step before proceeding to the next step.
   e. Use rotational tightening until all bolts are stable at final torque level. A minimum of two (2) rotations 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 manufacturers documentation, local codes, or accepted contractor practices as to the use and / or type of joint compound or sealer at the connections.
11. Reconnect the small line leading to the energy source pressure gauge.
12. Follow the startup procedures to put the unit back on-line. Carefully check all connections for any sign of leakage.

## Inlet, Outlet, and Condensate / Water Return Line and Manual Shutoff Valves - Replacement

If any of the inlet, outlet, return lines, or shutoff valves are damaged and must be replaced, follow the steps outlined below.

**Δ 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 the shutdown procedure (page 22) to take the unit off-line before attempting to replace damaged lines or shutoff valves.

**Δ While it might seem feasible to replace inlet, outlet, condensate / water return lines, and shutoff valves without shutting down the entire unit, it is not advised. Unless the unit is completely shutdown, and the clean steam and energy source are isolated from the system, failure of a manual shutoff valve during the replacement process could result in serious injury.**

2. Ensure that the primary supply, condensate / water return line, feed water inlet, and clean steam outlet have been shut off; that the pressure has been relieved 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. 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 use and / or type of joint compound or sealer at the connections.
6. Follow the startup procedures (page 21) to put the unit back on-line. Carefully check all connections for any sign of leakage.

## Pressure Gauge (Primary Supply) - Replacement (Fig. 19)

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

**Δ 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 the shutdown procedure 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 use and / or type of joint compound or sealer at the connections.
6. Follow the startup procedures to put the unit back on-line. Carefully check all connections for any sign of leakage.

## Traps (Main and Auxiliary) - Replacement (Fig. 18)

The main and auxiliary traps are installed upstream of the condensate shutoff 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.

**Δ 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 the shutdown procedure 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. Refere 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 and drain condensate line of the trap.
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, repair or replace replace them with a new component.
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 use and / or type of joint compound or sealer at the connections.
9. Follow the startup procedures to put the unit back on-line. Carefully check all connections for any sign of leakage.

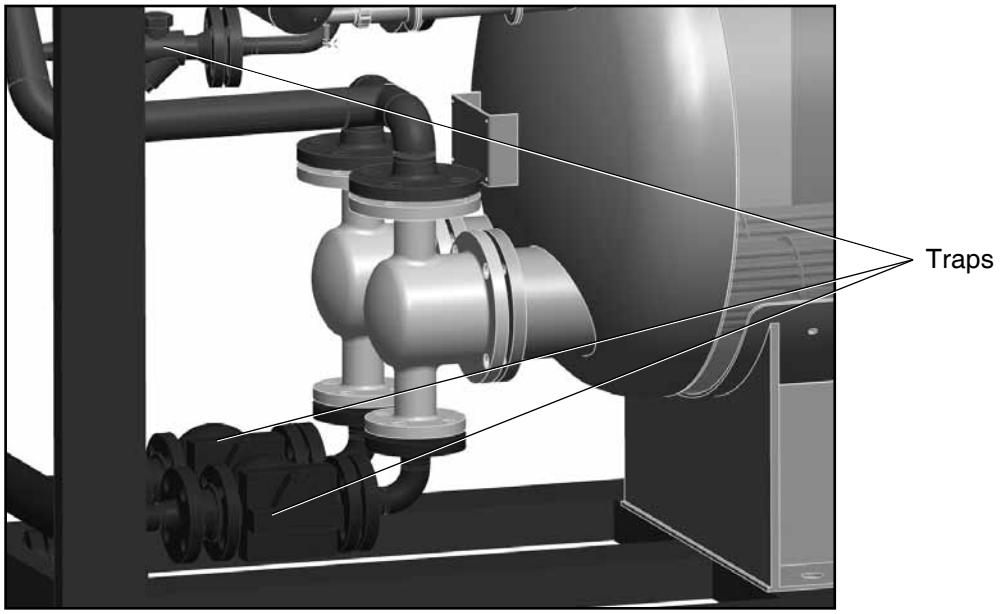



**Fig. 18**

## Strainer - Inspection and Replacement (Fig. 19)

Strainers are installed on the unit. These strainers must be checked and cleaned periodically (approximately every three (3) to six (6) months) to prevent the build up of any sediment.

**Δ 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 the shutdown procedure to take the unit off-line before attempting to replace the energy source strainer.
2. The exact location of the strainers can differ between units. Reference the drawing supplied with the unit to identify the location of the strainers on the unit.
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 use and / or type of joint compound or sealer atthe connections.
8. Follow the startup procedures to put the unit back on-line. Carefully check all connections for any sign of leakage.

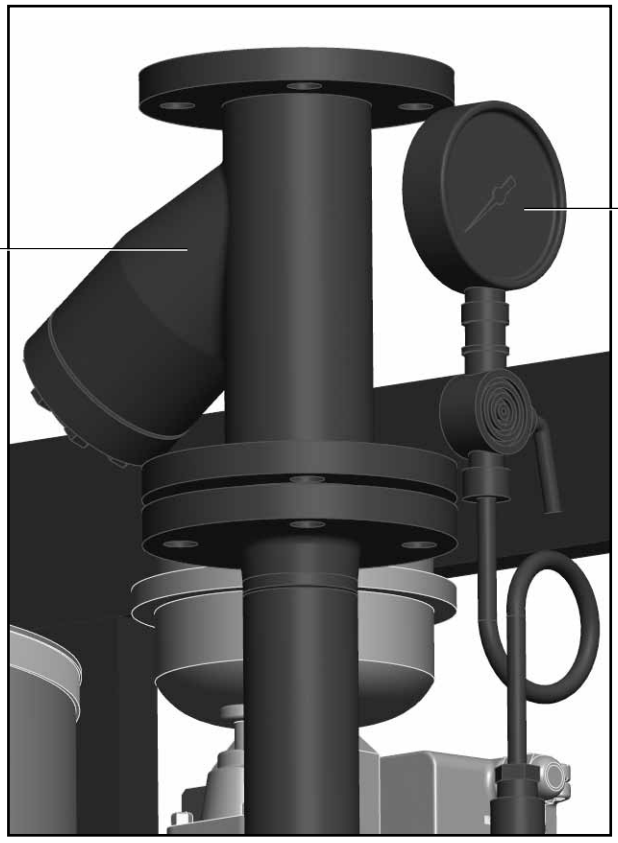



**Fig. 19**

## Clean Steam Components - Inspection and replacement

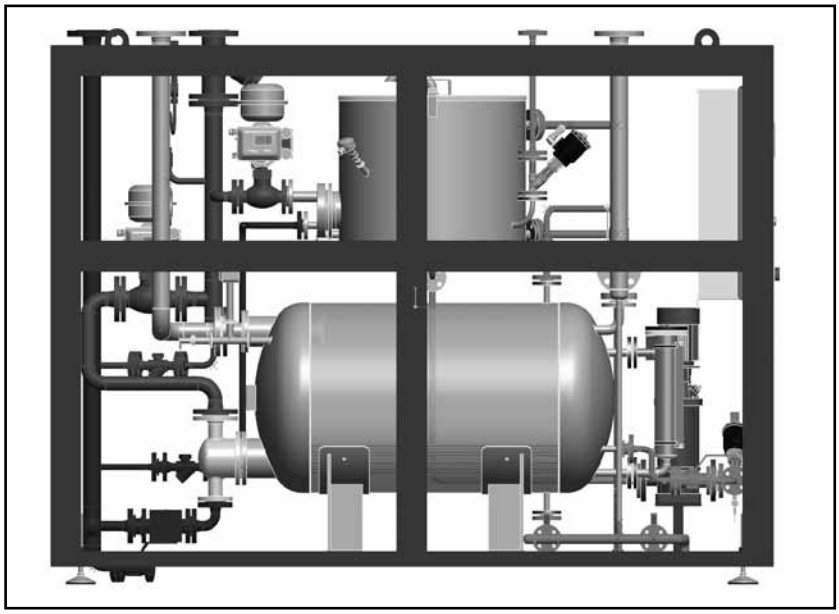


**Fig. 20**

## Pressure Safety switch - Replacement (Fig. 21)

**Δ Clean steam and primary supply steam situations can be very dangerous because of the high temperatures and pressures. To avoid possible injury or death and follow all accepted and recommended procedures when performing installation, operation, and maintenance procedures.**

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

The safety pressure switch acts as a fail-safe for Spirax Sarco Compact Steam Generators. The alarm and shut down for high pressure is set at a value lower than the set of the safety valve. If the pressure safety switch mounted on the tank is not functioning correctly and must be replaced, follow the procedures outlined below.

**Δ 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 the shutdown procedure to take the unit off-line before attempting to replace the safety pressure switch.
2. Ensure that the primary supply, condensate / water return line, feed water inlet, and clean steam outlet have been shut off; that the pressure has been bled from both the clean steam and primary supply systems; that the vessel has been completely drained; and that all components and surfaces have cooled.
3. Carefully Disconnect the wires leading from/to the control cabinet.
4. Loosening the connections until the pressure probe can be removed.
5. Examine the probes for damage or incorrect positioning. For the exact procedure for examination refer to the Spirax Sarco manual information included with the unit.
6. To install a new unit follow recommendations contained in the manufacturer's documentation.
7. After ensuring that the unit is correctly installed, tighten the fittings and sanitary connections. Any gasket used must be of sanitary type.
8. Follow the start-up procedures (page 21) to put the unit back on-line. Carefully check all connections for any sign of leakage.

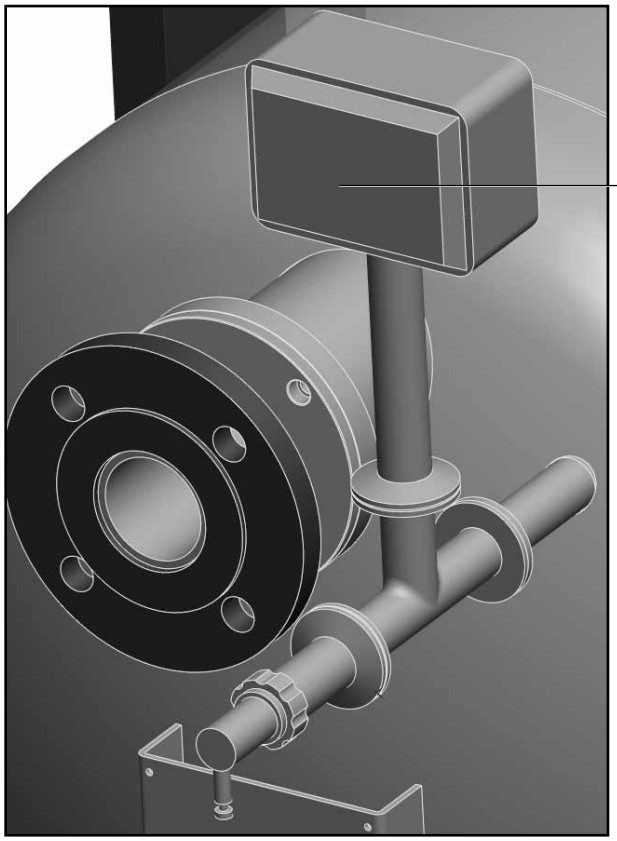



**Fig. 21**

## Steam Pressure transmitter - Replacement (Fig. 22)

**Δ Clean steam and primary supply steam or superheated water present situations that can be very dangerous because of the high temperatures and pressures. To avoid possible injury or death and follow all accepted and recommended procedures when performing installation, operation, and maintenance procedures.**

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

The steam pressure transmitter installed on the Spirax Sarco Compact Steam Generators supply the clean steam pressure to be used to control the primary steam valve position. If the pressure transmitter mounted on the tank is not functioning correctly and must be replaced, follow the procedures outlined below.

**Δ 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 the shutdown procedure to take the unit off-line before attempting to replace the steam pressure transmitter.
2. Ensure that the primary supply, condensate / water return line, feed water inlet, and clean steam outlet have been shut off; that the pressure has been bled from both the clean steam and primary supply systems; that the vessel has been completely drained; and that all components and surfaces have cooled.
3. Carefully Disconnect the wires leading from/to the control cabinet.
4. Loosening the connections until the transmitter can be removed. Examine the probes for damage or incorrect positioning. For the exact procedure forexamination refer to the Spirax Sarco manual information included with the unit.
5. To install a new unit follow recommendations contained in the manufacturer's documentation.
6. After ensuring that the unit is correctly installed, tighten the fittings and sanitary connections. Any gasket used must be of sanitary type.
7. Follow the start-up procedures (page 21) to put the unit back on-line. Carefully check all connections for any sign of leakage.

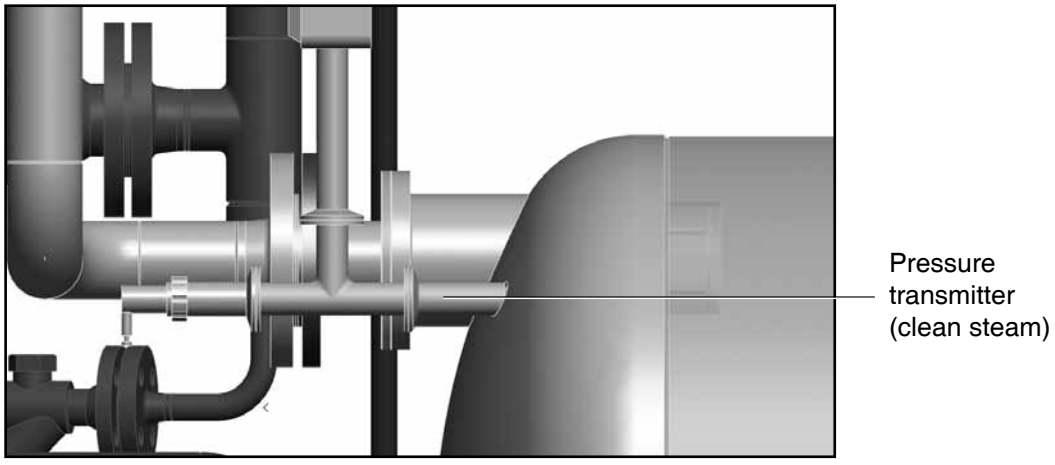



**Fig. 22**

## Pressure Safety Valve (Generator) - Replacement (Fig. 23)

The pressure safety valve acts as a fail-safe for Spirax Sarco Compact Steam Generators. The valve will open for high pressure to protect the system from explosion.
If the pressure safety valve mounted on the pressure vessel is not functioning correctly and must be replaced, follow the procedures outlined below.

**Δ 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 the shutdown procedure to take the unit off-line before attempting to replace the water pressure relief valve.
2. After assuring that the pressure has been relieved from the tank, disconnect the vent line leading from the pressure relief valve to atmosphere (usually through the roof), and via a drip elbow, to drain.
3. Carefully disconnect the pressure relief valve from between the generator vessel and feedtank.
4. Install the new valve. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the use of joint compound or sealer at the connections.
5. Reconnect the vent line leading from the pressure safety valve to atmosphere and, via drip elbow, to drain.
6. Follow the startup procedures to put the unit back on-line. Carefully check all connections for any sign of leakage.

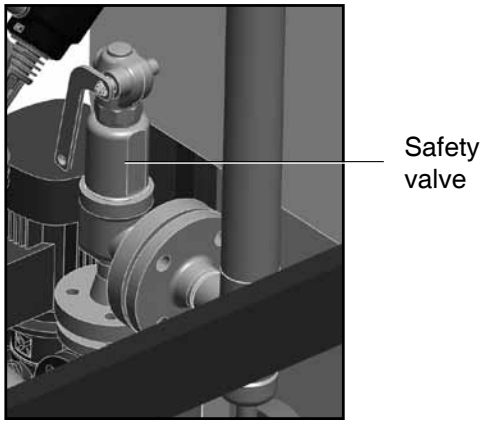



**Fig. 23**

## Pressure Gauge (Clean Steam / Clean Water) - Replacement (Fig. 24)

If the pressure gauges for the feedwater pipe or clean steam outlet water are not functioning correctly and must be replaced, follow the procedures outlined below.

**Δ 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 the shutdown procedure to take the unit off-line before attempting to replace the pressure gauge.
2. Carefully disconnect the pressure gauge from the pipework. This line should only be disconnected at the gauge.
3. Remove the gauge from its mounting.
4. Mount the new gauge.
5. Reconnect. Follow recommendations contained in the manufacturer's documentation.
6. Follow the start-up procedures (page 21) to put the unit back on-line. Carefully check all connections for any sign of leakage.

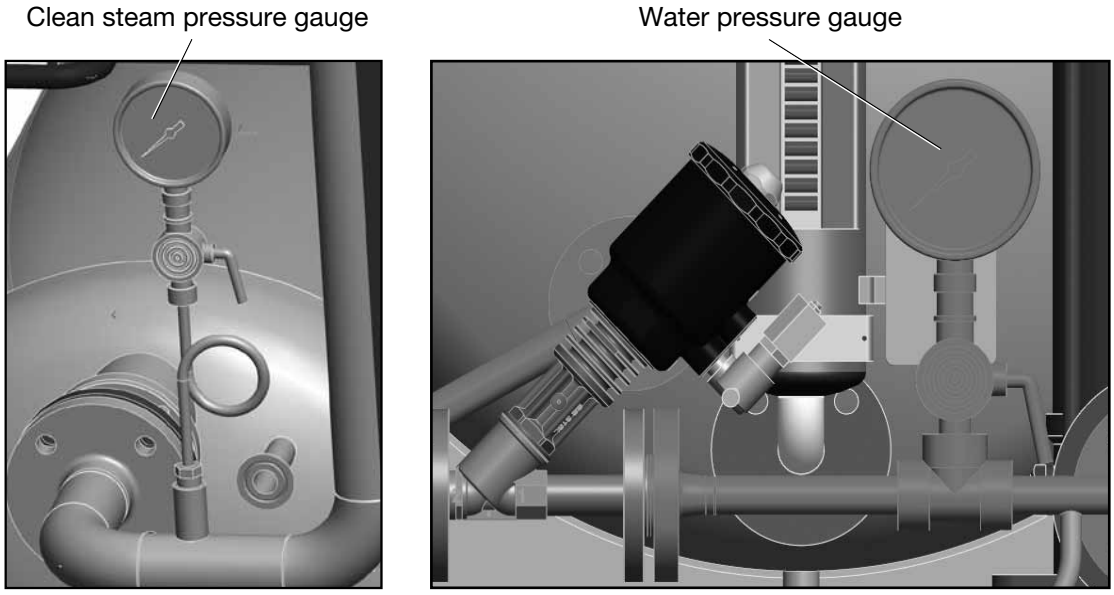



**Fig. 24**

## Level measurement - Inspection and Replacement (Fig. 25)

The level measurement supplied on CSM-C Compact 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:

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

**Δ 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 the shutdown procedure to take the unit off-line before attempting to remove and inspect the level controller.
2. Ensure that the primary supply, condensate / water return line, feed water inlet, and clean steam outlet have been shut off; that the pressure has been bled from both the clean steam and primary supply systems; that the vessel has been completely drained; and that the steam, water, all components, and surfaces have cooled.
3. If the the level measurement is not completely drained and bled, steam or boiling water may be discharged.
4. Disconnect the wires leading from the control cabinet.
5. Disconnect the level probes and level gauge.
6. Continue loosening the connections until the level probe / gauge can be removed.

7. Examine the level probes/gauge for damage or incorrect positioning. For the exact procedure for examination refer to the Spirax Sarco technical manual included with the unit.
8. To install the level probe/gauge, align with the feed lines and start the fittings. Follow recommendations contained in the documentation.
9. After ensuring that the level probe / gauge is correctly aligned, tighten the fittings.
10. Follow the start-up procedures to put the unit back on-line. Carefully check all connections for any sign of leakage.

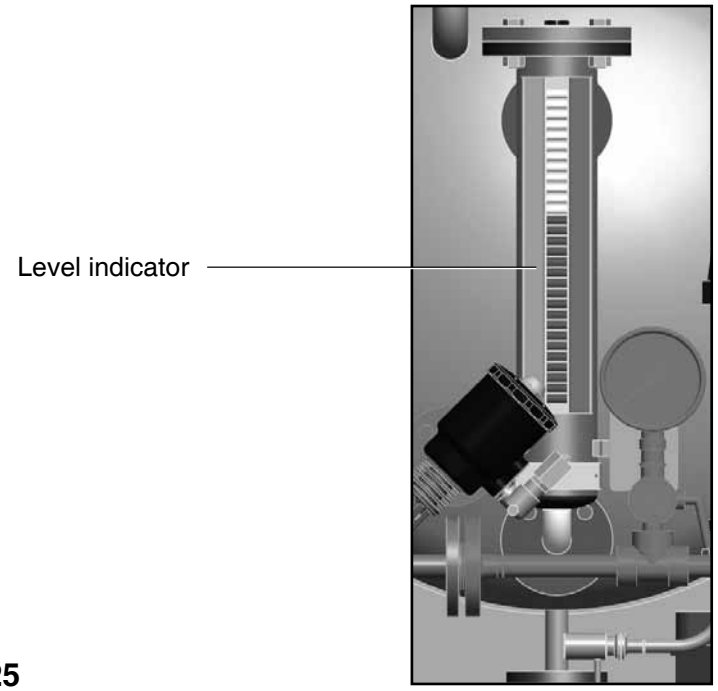



**Fig. 25**

## Clean feed water pump - Inspection and Replacement (Fig. 26)

The feed water pump is supplied on the Compact Steam Generator to supply the required pressure to the feedwater to fill the generator , assuring that the unit will function safely and effectively. If the pump must be removed for inspection, adjustment, or replacement, follow the steps detailed below:

**Δ Clean steam and primary source steam or superheated water present situations that can be very dangerous because of the high temperatures and pressures. To avoid possible injury or death and follow all accepted and recommended procedures when performing installation, operation, and maintenance procedures.**

**Δ 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 the shutdown procedure to take the unit off-line before attempting any work on the system.
2. Ensure that the primary supply, condensate / water return line, feed water inlet, and clean steam outlet have been shut off; that the pressure has been bled from both the clean steam and primary supply systems; that the vessel has been completely drained; and that the steam, water, all components, and surfaces have cooled.

3. If the pump is not completely drained, hot water may be discharged.
4. Disconnect the wires leading from/to the electric cabinet.
5. Disconnect the bolts.
6. Continue loosening the connections until the pump can be removed.
7. Examine the pump for damage or incorrect positioning. For the exact procedure for examination refer to the Spirax Sarco manual information included with the unit.
8. To install a new pump, align with the feed lines and start the fittings. Follow recommendations contained in the documentation.
9. After ensuring that the pump is correctly aligned, tighten the fittings.
10. Follow the start-up procedures (page 21) to put the unit back on-line. Carefully check all connections for any sign of leakage.

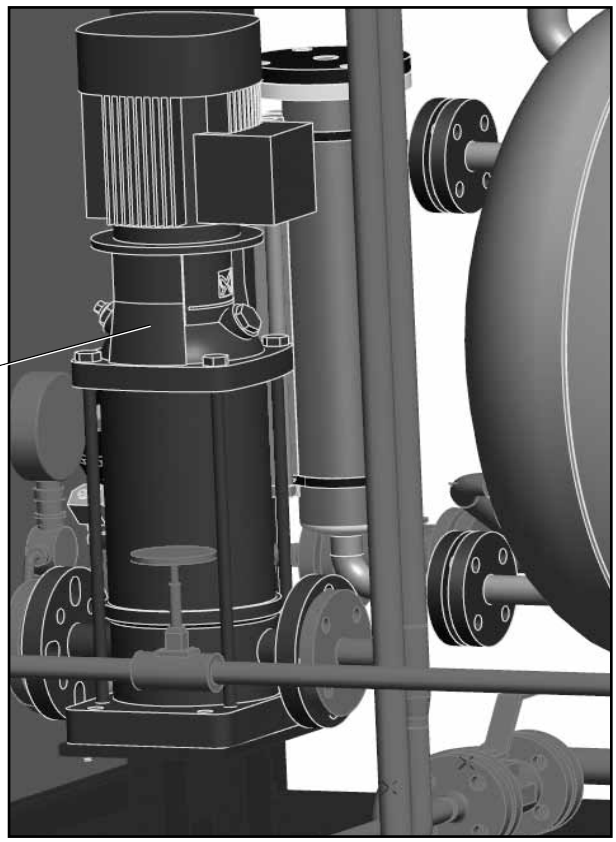



**Fig. 26**

## Piston Valves - Inspection and Replacement (Fig. 27)

The IMI documentation included with the unit gives specifics for operation and maintenance of all piston valves (Bottom Blowdown, Feedwater Inlet Tank and Generator, Feedwater Tank Preheating System and Clean Steam Outlet). The drawing included with the unit will give the exact location, as well as connection with other components. This information should be reviewed before removal / replacement any valves.

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

**Δ 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 the shutdown procedure to take the unit off-line before attempting to remove and inspect the valve.
2. Ensure that the primary supply, condensate / water return line, feed water inlet, and clean steam outlet have been shut off; that the pressure has been bled from both the steam and primary supply systems; that the tank has been completely drained; and that all components and surfaces have cooled.
3. If the unit is not completely drained and bled, steam or boiling water may be discharged.
4. Disconnect the wires leading from/to the electric cabinet, turn off the instrument air source, bleed the pressure from the line, and disconnect the lines to the valve.
5. Disconnect the bolts.
6. Continue loosening the connections until the valve can be removed.
7. Examine the Valve for damage or incorrect positioning. For the exact procedure for examination refer to the Spirax Sarco installation and maintenance manual included with the unit.
8. To install a new valve, align with the feed lines and start the fittings. Follow recommendations contained in the relevant IMI documentation.
9. After ensuring that the valve is correctly aligned, tighten the fittings.
10. Follow the startup procedures to put the unit back on-line. Carefully check all connections for any sign of leakage.

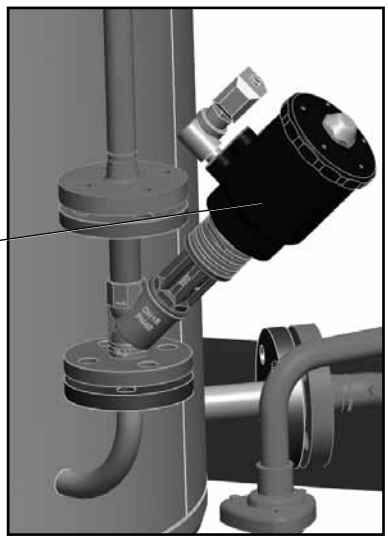



**Fig. 27**

## Actuator PN9000 Series - Inspection and Replacement (Fig. 28)

The Actuators are installed on the primary steam inlet side. The documentation included with the unit gives specifics for operation and maintenance of the Actuator. The drawing included with the unit will give the exact location, as well as the relation with other components. This information should be reviewed before removal / replacement of the valve.

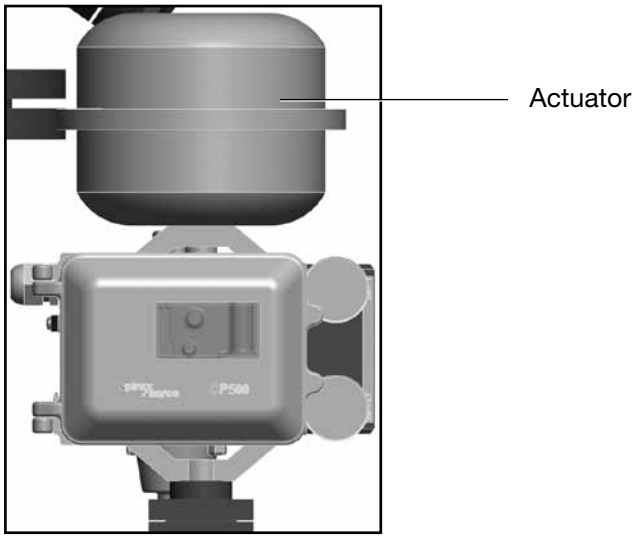



**Fig. 28**

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

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

The PN9000 series pneumatic actuators (and variants) are maintenance free. To ensure satisfactory operation it is strongly recommended that the control signal air is filtered and supplied dry and free of oil.

## Removing the actuator from the valve (document ref.: IM-P357-12)

1. Follow the shut down procedure to take the unit off-line before attempting to remove and inspect the Actuator.
2. Drive the actuator into approximately mid-travel position with the air supply.
3. Loosen and remove the clamp nuts and screws and the remove the valve adaptor (11).
4. Loosen and remove the actuator mounting nut and lift the actuator off the valve.
5. Reduce the air supply pressure until the housing is pressure free.
6. Disconnect the air supply from the actuator.

   Depending upon the type of repair / maintenance required all operations should now adhere to the procedures identified in the product IMI.

## Modulating Control Valve (Primary Side) - Inspection and Replacement

**(Fig. 29)**

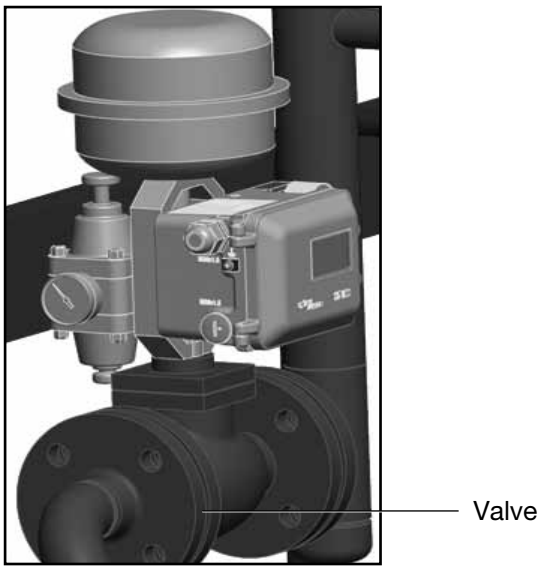



**Fig. 29**

The Modulating Valves are installed on the primary steam inlet side. The 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 the relation with other components. This information should be reviewed before removal / replacement of the valve.

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

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

## Routine maintenance procedures (document ref.: IM-S24-42)

### 24 hours operation

After 24 hours service check pipework connections and flange bolts for tightness. With valves having high temperature graphite packed gland seals the gland nut should be tightened by approximately ¼ of a turn taking care not to over tighten as this may cause excessive friction on the valve stem.

### 3 months operating intervals

After every 3 months normal service visually check gland seals for signs of leakage and if necessary take the following corrective action. Valves having chevron gland seals remove and replace the PTFE chevron seals. Valves having high temperature graphite packed gland seals tighten gland nut approximately ¼ of a turn taking care not to overtighten as this may cause excessive friction on the valve stem. If no adjustment remaining, replace the graphite gland seal as described in paragraph 5 of the product IMI.

### Annually

The valve should be inspected for wear and tear replacing any worn or damaged parts such as valve plug and stem, valve seat and gland seals. High temperature graphite packed gland seals are subject to wear during normal operation. It is therefore recommended that the graphite packing is replaced during this routine inspection to prevent premature failure of the gland seals during normal operation.

## Electric Pneumatic Positioner - Inspection and Replacement (Fig. 30)

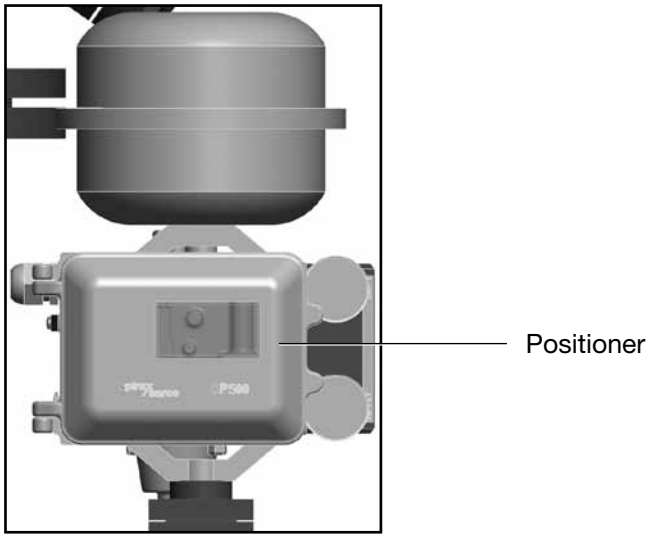



**Fig. 30**

The SP500 is installed on the primary steam inlet side (Valve/Actuator assembly). The documentation included with the unit gives specifics for operation and maintenance of the Actuator. The drawing included with the unit will give the exact location, as well as the relation with other components. This information should be reviewed before removal / replacement of the positioner.

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

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

## Maintenance (document ref.: IM-P343-16)

In normal working conditions bleed the air filter regulator on the supply air line daily, by holding the tap located on the bottom of the catch basin open until any water, oil or other impurities, which are the main cause of irregular operation, have completely drained away. No special maintenance is required.
If the output signal is too low or even non existent,it is necessary to clean the calibrated orifice located above the pneumatic amplifier. Loosen the screws and remove the identifying plate.
All detailed references can be found in the product IMI.
Loosen screw (E.7) and turn the lock plate (F.7). Extract the calibrated orifice (G.7), which is a push-fit, with the special extractor-cleaner (I.6), being careful not to loose the 'O' rings: clean the 0.35 mm calibrated hole using the suitable cleaner filament.
Reassemble checking the exact position of the 'O' rings (H.7).
For any other details please refer to the detailed product IMI.

## Control Cabinet - Inspection (Fig. 31)

The contol cabinet system allows the full control of the Compact 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 assure that this is an acceptable configuration.**

The system should be checked twice yearly (see documentation for the system provided with the unit for specific inspection intervals and test routine). If the system is found to be malfunctioning and it is not possible to identify the fault, the unit must be replaced. To replace the unit please follow the procedure outlined below:

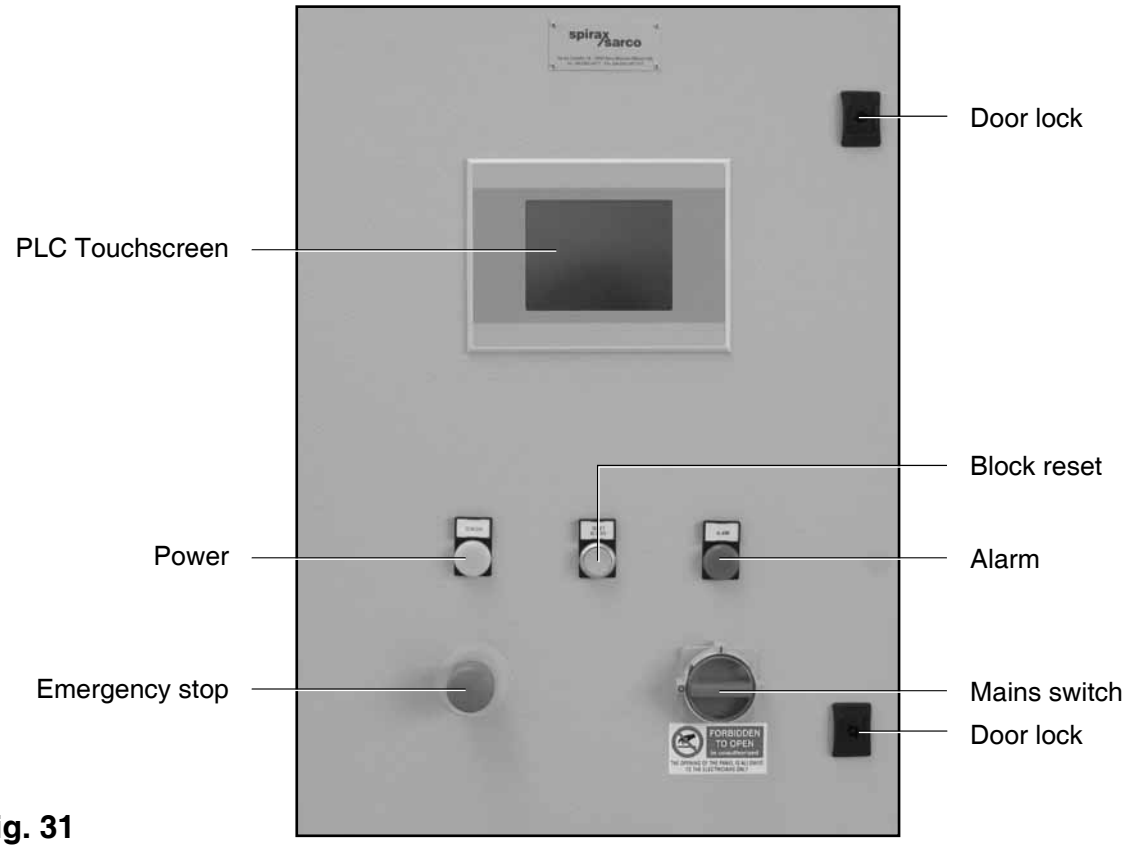



**Fig. 31**

**Δ 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.**

**Δ 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 the shutdown procedure (page 22) to take the unit off-line before attempting to change any part of the system.
2. Refer to Spirax Sarco technical department for repair or substitution.
3. Follow the start-up procedures (page 21) to put the unit back on-line. Carefully check all connections for any sign of leakage.

## Recommended Maintenance Schedule

| Description | 1 Month | 3 Month | 6 Month | 12 Month | 24 Month |
|---|---|---|---|---|---|
| Feed Tank | | | | | |
| Remove and inspect temperature probe. Refit and check calibration. | | | | √ | |
| Remove and inspect level pressure transducer. Refit with new gasket and check calibration. | | | √ | | |
| Remove, strip and inspect, steam inlet control valve. Replace all seals and refit with new gaskets. | | | | √ | |
| Remove, strip and inspect water inlet control valve. Replace all seals and refit with new gaskets. | | | | √ | |
| Replace filter. | | | | √ | |
| Remove and inspect primary steam coil. Refit with new gasket. | | | | √ | |
| **Generator** | | | | | |
| Remove and inspect level transducer. Refit and check calibration. | | | √ | | |
| Remove and inspect pressure transducer. Refit with new gasket and check calibration. | | | √ | | |
| Remove, strip and inspect water inlet control valve. Replace all seals and refit with new gaskets. | | | | √ | |
| Remove, strip and inspect, steam inlet control valve. Replace all seals and refit with new gaskets. | | | | √ | |
| Check operation of EP5. | | | √ | | |
| Remove, strip and inspect, bottom blow down control valve. Replace all seals and refit with new gaskets. | | | | √ | |
| Remove and inspect primary steam coil. Refit with new gasket. | | | | √ | |
| Remove, strip and inspect, clean steam outlet control valve. Replace all seals and refit with new gaskets. | | | | √ | |
| Remove and inspect generator air vent. Refit with new gaskets. | | | | √ | |
| **General** | | | | | |
| Remove and inspect all steam traps. Refit with new gaskets. | | | | √ | |
| Remove and inspect all pressure gauges. Refit with new gaskets. | | | | √ | |
| Remove and inspect steam supply strainer screen. Refit with new gasket. | | | | √ | |
| Check conductivity of water in generator. | √ | | | | |
| Carryout steam quality test. | | √ | | | |
| Check all electrical connections. | | | | √ | |
| Carryout full functional check, testing all alarms and operating parameters are correct. | | √ | | | |

The pump comprises a maintenance free mechanical seal. Therefore there are no specific maintenance requirements.
The Safety valve is factory set at a predetermined limit and requires no maintenance.

# Parts List

## Replaceable Parts

The following is a list of parts that are generally replaceable, by trained / certified personnel, on Spirax-Sarco Compact 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.

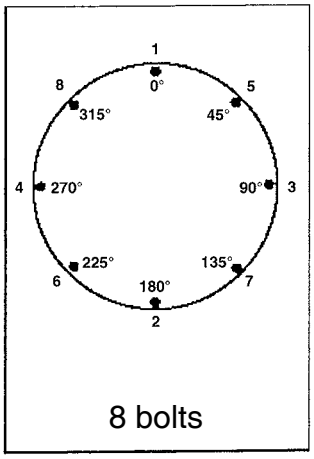
**Please have the unit's model and serial number available when contacting Spirax Sarco.**

## Replaceable Parts

**Spirax-Sarco** Compact Clean Steam Generators
**Note: Replaceable Parts may vary depending on design specifications of the unit.**

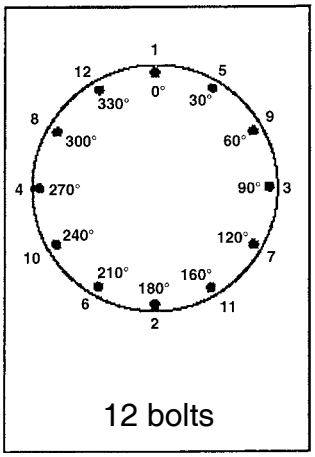
Pressure Control Valves
Gaskets - Coil
Heat Exchanger Coils
Level Controller
Clean Steam Pressure Gauge
Primary Supply Steam Pressure Gauge
Pressure Safety Valve
Control System
Strainer
Primary Inlet Steam Traps

## Appendix A




8 bolts

## Bolt Torque Procedure

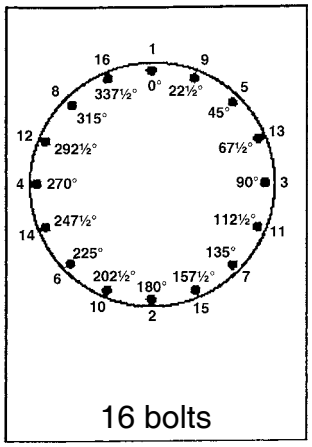



12 bolts

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

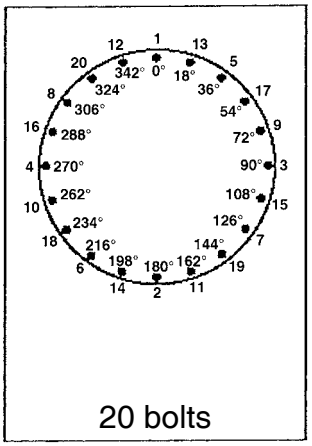
| Sequential Order | Rotational Order |
|---|---|
| 1 - 2 | 1 |
| 3 - 4 | 5 |
| 5 - 6 | 9 |
| 7 - 8 | 3 |
| 9 - 10 | 7 |
| 11 - 12 | 11 |
| | 2 |
| | 6 |
| | 10 |
| | 4 |
| | 8 |
| | 12 |

## Bolt Torque Procedure




16 bolts

| 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 |




20 bolts

| 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 |

***REPAIR***
*Please contact our nearest Branch Office or Agent, or directly Spirax-Sarco S.r.l.*
*Via per Cinisello, 18 - 20834 Nova Milanese (MB) - ITALY - Tel.: +39-362.82.22.*

***LOSS OF GUARANTEE***
***Total or partial disregard of the above instructions Involves loss of any right to a guarantee.***

**Spirax Sarco S.r.l.** - Via per Cinisello, 18 - 20834 Nova Milanese (MB) - Tel.: 0362 49 17.1 - Fax: 0362 49 17 307