

**CRU-S Series  
Stainless Steel  
Condensate Recovery Unit**

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1. Safety information
2. General product information
3. Installation
4. Commissioning
5. Storage, shutdown and equipment protection
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# 1. Safety information

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Safe operation of this product can only be guaranteed if it is properly installed, commissioned, used and maintained by qualified personnel (see Section 1.11) 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.

## General safety precautions

Please observe all site safety regulations and recommendations at all times.

Do not leave this equipment unattended with the controls enclosure door open and with the mains supply power switched on.

The open vent and overflow connections must not be fitted with isolation valves and must not be capped or plugged.

Under normal operating conditions this equipment will have hot external surfaces and will contain hot fluid at a temperature approaching 100°C (212°F). Do not install in locations, or in such a manner, where unauthorised personnel or members of the public can come into contact with the equipment.

Do not work on the installation whilst it is operating under pressure and / or at high temperature. Always ensure the installation and its fluid contents have cooled to a safe temperature and the equipment has been isolated from all incoming or return fluid flow and pressure sources.

Pump(s) must not be operated without water inside the collection vessel and until the pump has been fully filled with condensate, or water and purged of entrapped air. Do not run a pump with a closed suction valve or with an open end discharge pipe, or against a closed discharge valve for more than a few seconds. Never run a pump without water inside the casing and without fully flooding the pump shaft seal.

The equipment should be drained down to a safe location only and only when the fluid has cooled to the maximum allowable temperature for the drainage or sewerage system.

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## 1.1 Intended use

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 CRU-S Series fully complies with the requirements of the European Machinery Directive 2006/42/EC, European Low Voltage Directive 2006/95/EC and European Electromagnetic Compatibility Devices Directive 2004/108/EC. This product is not a pressurised vessel and is designed to operate at atmospheric pressure and is therefore outside the scope of the European Pressure Equipment Directive 97/23/EC.

- i) The product has been specifically designed for use on hot condensate. 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 over-pressure or over-temperature 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.

## 1.2 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.

## 1.3 Lighting

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

## 1.4 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.

## 1.5 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.

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## 1.6 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.

## 1.7 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.

## 1.8 Temperature

Allow time for temperature to normalise after isolation to avoid danger of burns.

## 1.9 Tools and consumables

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

## 1.10 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.

## 1.11 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.

## 1.12 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.

## 1.13 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 these products may reach temperatures of 100°C (212°F).

This product is not self-draining. Take due care when dismantling or removing the product from an installation.

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## **1.14 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.

## **1.15 Disposal**

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.

## **1.16 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 residue s 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.

## — 2. General product information —

### 2.1 Description

The Spirax Sarco CRU-S series of condensate recovery units are designed to handle hot condensate, which is commonly returned for use as boiler feedwater. The standard CRU-S series can handle quantities up to 10,000 kg/h, cascade control at 98°C with varying pump delivery heads. For higher duties please contact Spirax Sarco. The package comprises: receiver, frame, pumps, valves, level controls and prewired control panel.

#### Equipment function

Spirax Sarco CRU-S series condensate recovery units are supplied with two pump sets arranged to provide 'cascade' control. The units are designed for fully automatic operation. Standard control features incorporate; condensate level pump control, controls enclosure, incoming electrical supply door-interlocked isolator switch, 'Power On' indicator lamp, 'Pump Running' and 'Pump Tripped' indicator lamps for each pump and a pump selector switch with automatic changeover facility. Volt-free alarm terminals are provided for each 'Pump Tripped' and for 'High Condensate' alarm.

Condensate level pump control is by means of Spirax Sarco Colima Viscorol level indicators and SPDT level controls which provide on/off cascade pump operation.

The units are controlled by high and low condensate level pump control switches but additionally have the special 'cascade' level control feature to provide for automatic operation of both the 'duty pump' plus the 'stand-by pump' if that operational requirement arises. If a condition occurs which enables operation of the 'stand-by' pump, the corresponding 'Pump Running' lamp will indicate that status, clearing automatically when the condensate level falls and the pumps stops at 'Low' condensate level.

The units also incorporate duty cycle automatic changeover, the 'duty' and 'stand-by' pump operation alternating at the end of each condensate collection vessel emptying cycle. Additionally, a 3-position pump selector switch is incorporated to allow for selection of automatic pump changeover or single pump operation of either pump, 'Automatic' being the usual mode selected for normal operating conditions.

Units can be supplied with optional special alarm facilities to provide separate indication of high and/or low condensate levels and alarms. These operate independently of the normal pump level control. An independent 'High Condensate' alarm facility (optional) is enabled at a condensate level above that for the standard high condensate, {pump(s) on} switching levels, the alarm condition and signal being cleared automatically when the condensate level falls to the normal operating high level. The 'Low Condensate' alarm facility is enabled at a condensate level below that of the standard low condensate, {pump(s) off} switching level, the alarm condition and signal clearing when the condensate level rises to the normal high condensate level. All alarm facilities can be provided with both visual (indicator lamp) and volt-free terminals.

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## Receiver

Receivers are manufactured from 304 stainless steel fitted with an adequately sized vent, overflow, drain and two inlets, all with flanged PN16. Vessels are leak tested to 0.5 bar. A water level gauge is fitted as standard, with integrated level control and high alarm.

## Pumps

Pumps are constructed from fabricated 304 stainless steel and are designed for operation under conditions of low NPSH to handle hot condensate with the minimum of flooded suction. They are directly coupled to TEFC motors having class F insulation (class B temperature rise) motor enclosure rating IP54 minimum.

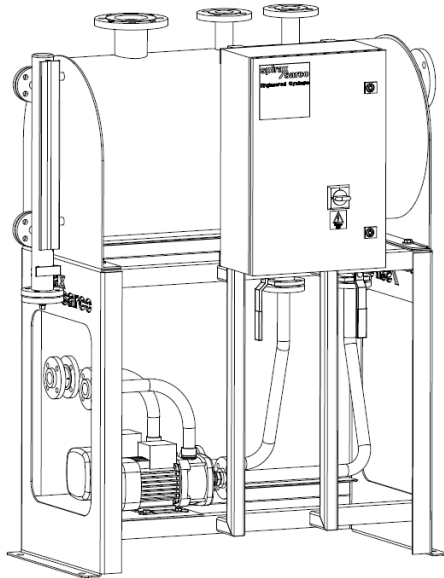


Fig. 1

## Pump fitment

The motors and pumps are mounted under the receiver and are each connected to suction pipework incorporating isolation valves. Each pump discharge is fitted with a non-return valve and terminates with a PN16 flanged connection.

## Control

Receivers are fitted with Spirax Sarco Colima Viscorol level indicators and SPDT level controls which provide on/off cascade pump operation.

The control panel incorporates electrical equipment suitable for 380 volt, 3 phase, 60 Hz, 4 wire supply. Control equipment is installed in a pre-wired IP54 rated metal enclosure. Connections for BMS interface are provided to monitor pump run or tripped condition.

## Standards

This product fully complies with the following requirements:

- European Machinery Directive 2006/42/EC.
- European Low Voltage Directive 2006/95/EC.
- European Electromagnetic Compatibility Devices Directive 2004/108/EC.

This product is not a pressurised vessel and is designed to operate at atmospheric pressure and is therefore outside the scope of the European Pressure Directive 97/23/EC.

## Certification

A declaration of conformity EN 10204 2.1 is available on request.

**Note:** All certification / inspection requirements must be stated at the time of order placement.

**Note:** For further product data see Technical Information Sheet TI-UK-CRU-S.

## 2.2 Dimensions (approximate) in mm

Model CRU-	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	S
S-200	1500	500	1280	1300	990	205	280	200	95	900	265	150	230	530	1056	20	65	400
S-500	1575	550	1310	2210	1910	505	500	300	95	980	315	175	280	350	1976	20	105	418

## 2.3 Inlet and outlet connections and weights (approximate) in kg

Model CRU-	Connections	V	W	X	Y	Z	Weight (dry)
		Outlet	Overflow	Vent	Inlet	Inlet	
S-200	PN16	DN25	DN50	DN80	DN40	DN40	185
S-500	PN16	DN40	DN80	DN100	DN50	DN50	300

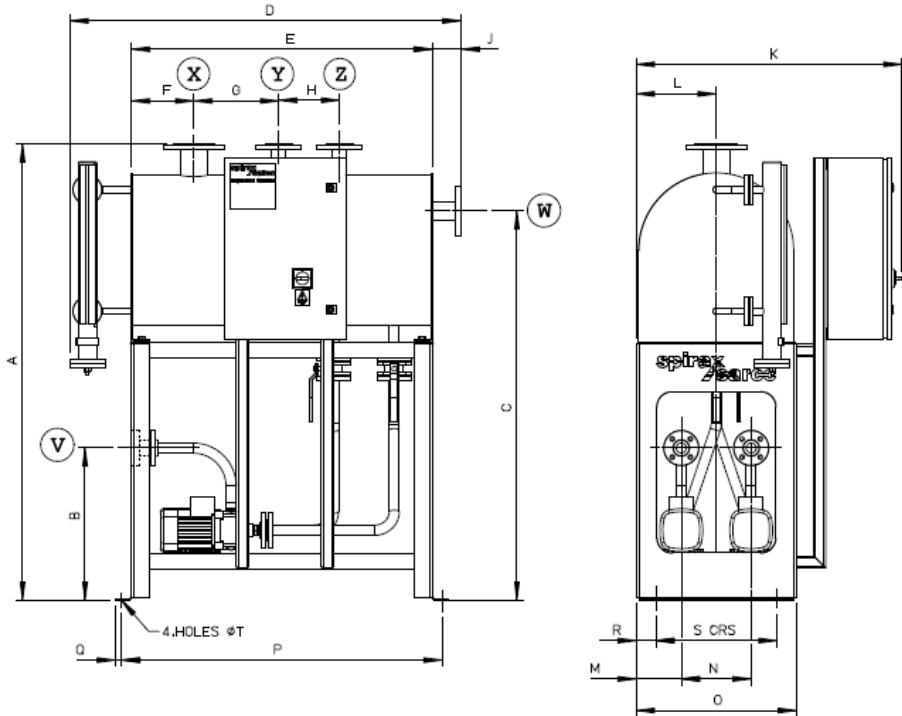


Fig. 2



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# 3. Installation

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**Note:** Before actioning any installation observe the 'Safety Information' in Section 1.

## 3.1 General installation

The CRU-S series condensate recovery unit is designed for open vented operation only and must be installed with an unrestricted open vent. The vent should be as short as possible and taken to a safe, high level location and a vent head may be installed providing no backpressure is induced at the condensate collection vessel.

The overflow connection should be provided with a 'U' water seal at the same size as the vessel connection and should always be piped away, unrestricted, to a safe drain point or gully. If the drain point connects to a public sewer system the maximum permissible discharge temperature into the public sewer system should be considered.

Overflow and vent connections must never be fitted with isolation valves or be capped off.

Before installing and making the final piping connections to and away from the condensate recovery and pump set, service piping must be fully purged to ensure foreign matter and installation debris has been removed.

If a potential exists for debris carryover into a condensate vessel, strainers can be considered for installation into the vessel inlet piping. It is essential that a correctly sized strainer is selected which offers minimal pressure loss; It is important that the strainer screens are cleaned regularly, ideally within the scope of a planned maintenance programme.

Do not connect a power supply to a CRU-S unit before first checking the voltage, frequency and electrical supply cable size making sure that the site electrical supply corresponds with the requirements stated for the panel.

Check the stated control circuits voltage corresponds with that required on site. Connection of this equipment to a site electrical installation should only be carried out by qualified and competent personnel and must comply with current electrical regulations and standards, after commissioning into service the controls enclosure must be closed and the door isolator switch security locked.

## 3.2 Thermal insulation and cladding

Spirax Sarco condensate recovery and pumping sets can be thermally insulated and clad to minimise heat losses and for protection against personal injury, due to contact with hot surfaces, providing the condensate temperature does not exceed the net positive suction head required (NPSHr) to prevent cavitation and pump damage (this will be evident during pumping by noise in the pump impeller casing).

### 3.3 CRU-S series wiring

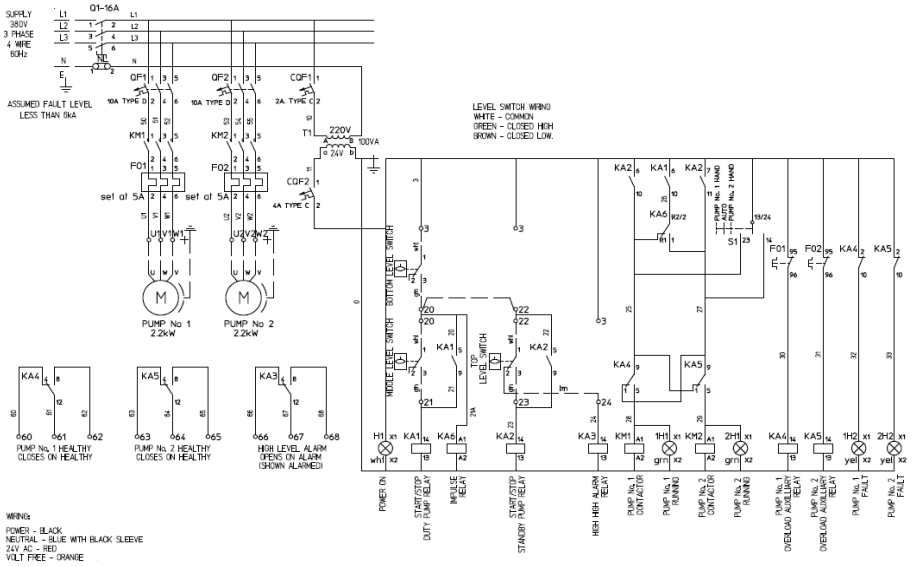


Fig. 3 CRU-S series wiring diagram

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## 4. Commissioning

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### 4.1 Start-up

After completion of all checks in Section 3 and connecting all piping and electrical services, fully open all isolating valves and allow the vessel to fill with condensate. If condensate cannot be made available and a unit has to be immediately commissioned, or functionally tested, the vessel can be pre-charged with clean, cold water. After testing however, if a unit is not to be left operating in normal service, the mains electrical supply to the controls enclosure should be switched off and the door interlocked isolator switch security locked to prevent inappropriate operation of the equipment.

Before turning on the electrical supply, check each pump has been fully flooded with condensate by opening the air vent on the pump casing. Refer to the pump manufacturer's hand-book for the correct procedure.

### 4.2 'Cascade' pump operation

To check the 'cascade' switching of the 'stand-by' pump and 'High Condensate' alarm function, the 3-position selector switch will need to be in the 'Automatic' position. Disable the 'duty' pump, by for example, tripping the overload. The 'duty' pump will fail to operate and the condensate level will rise to the second level switch and should then operate the 'stand-by' pump. The volt-free terminals will also be enabled to remote signal the condition if so connected. Both pumps would normally run then together (if the 'duty' pump has not been tripped out) until the condensate falls to 'Low' level. At 'Low' level both pumps will stop.

To carry out the above 'cascade' checking procedure for both pumps, the condensate level must be allowed to fall to the, 'pumps off' 'Low' level to enable the latching of the automatic pump changeover relay.

To return the set to fully automatic operation with pump automatic changeover, reset trip overloads and select 'Automatic' with the 3-position selector switch.

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## 5. Storage, shutdown and equipment protection

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As delivered, there may be residual water remaining in the pump piping and pump casing from the factory testing procedures. If the equipment is to be held in storage before installation ensure it is protected from sub-zero temperature conditions to prevent mechanical damage from freezing.

### Shutting down the equipment

1. Turn off the electrical supply and security lock the door interlocked isolator switch.
2. Close the pump suction and outlet valves.
3. If the CRU-S series is being taken out of service, protect the pumps from frost damage due to the residual condensate that is left inside the pumps.
4. Drain down the condensate collection vessel and piping to a safe drain point, using the drain nozzle provided.
5. Drain down pump casing as necessary, to a safe drain point, referring to the pump manual.



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## 6. Maintenance and repairs

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**Note: Before actioning any maintenance programme observe the 'Safety information' in Section 1.**

Only carry out maintenance and repairs with the electrical supply disconnected and not before a unit and its fluid contents have cooled to a safe temperature (below 25°C or 77°F) and with the set fully isolated from incoming and outgoing condensate flow and pressure.

If removing a pump for repair or maintenance and the set is to remain operational, the power must always be switched off at the mains supply and the cable terminations made safe before returning a set into service for single pump operation.

If a pump requires repair or servicing, refer to the pump manufacturer's manual. Contact Spirax-Sarco Ltd to order spare parts.

Periodical inspections of the level indicator and switch assembly are necessary to guarantee optimum efficiency of the unit. It is recommended that a check of the liquid fluidity is actioned to avoid any suspensions or deposits that can influence wetted parts. Also check the serviceability of the rollers / indicator. Please refer to IM-P329-02 for more information regarding the level indicator assembly.

### Pumps

#### Mechanical seals

Mechanical seal failure is usually indicated by fluid leakage from that area of the pump assembly. The usual cause is dry running the pump, lubrication of the seal being dependent upon the fluid being pumped. Multi-stage pumps have the shaft seal at the top of the casing and are especially vulnerable if the mechanical seal has not been fully flooded because improper pump casing venting.

#### Fluid cavitation

Cavitation occurs because of, (a) insufficient pump suction pressure for the liquid (condensate) temperature at the pump suction port, or, (b) because the condensate flowrate and discharge pressure does not correspond with the selected duty point on the pump performance curve, or a combination of (a) and (b). Simplistically, because there is insufficient suction pressure at the condensate temperature, the pressure in the pump casing can reduce sufficiently for the condensate to partly 'flash' into a vapour and condensate mixture, the total liquid state of the condensate not being sustainable at the reduced pressure and elevated temperature. The result is commonly known as cavitation, which if not corrected will damage the pump internals.

Cavitation invariably results in excessive operating noise inside the pump, will ultimately lead to a serious mechanical failure of the pump and/or impeller(s) and should always be eliminated.

If cavitation occurs, the following should be reviewed.

- i. The duty conditions specified for the pump selection and if the correct condensate pumping unit had been selected for the actual duty conditions.
- ii. Whether the actual condensate temperature at the pump suction port is higher than that specified for the pump selected.
- iii. Is the pump discharge pressure requirement less than that specified for the pump selected?
- iv. If the condensate temperature is significantly higher than that specified, check the condensate returns systems for high pressure/temperature condensate discharge from any item of plant and, especially, for faulty steam traps.

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- v. If regulating valve sets have been included in the condensate set package, check they have they been adjusted as recommended above.
  - vi. If regulating valves have not been included in the condensate set package, consider installing pump discharge flow/pressure regulating valve sets to control the condensate flow and discharge pressure at the selected pump duty point.

### **Pump fails to run or motor fault**

- i. Check that the main power supply and door interlocked isolator are switched on.
- ii. Check condensate is at a sufficient level.
- iii. Check that the full load current stated on the motor plate and overload setting are correct - adjust if necessary.
- iv. Check control circuit MCB or transformer fuses if the control circuit is low voltage - reset or replace. If repeated tripping or fuse failure occurs, the control system must be fully checked by a competent electrical engineer.
- v. Check each level control function - the pump will only run if both the high and the low level switches function correctly.
- vi. Check for electrical wiring fault or short circuit condition.
- vii. Check motor windings for integrity and, for phase motors loss.

