GS USP

GLOBAL STANDARD UPSTREAM PUMPING SUPPORT SYSTEM

Installation, Operation & Maintenance Instructions

1. General

1.1 Introduction

The Global Standard Upstream Pumping Support System (GS USP) may only be installed, commissioned and maintained by an authorized plant machinery specialist, paying close attention to these instructions and all other relevant regulations. Failure to do this relieves the manufacturer from any liability or warranties.

This Instruction Manual is provided to familiarize the user with the GS USP arrangements and their uses. The instructions must be read and applied whenever work is done on the GS USP and must be available to the operating and maintenance personnel.

These instructions will help to avoid danger and increase reliability. They should be used with the appropriate mechanical seal Instruction Manual.

The following important terms and definitions are used in this document.

1.2 European and/or UK Declaration of Incorporation (Machinery Directive 2006/42/EC, and UK SI 2008 No. 1597)

If appropriate this is attached.

1.3 European Declaration of Conformity Pressure Equipment Directive 2014/68/EU, and UK SI 2016 No. 1105

This directive is not applicable to the GS USP.

1.4 European and/or UK Declaration of Conformity (ATEX 2014/34/EU, and Equipment and UK SI 2016 No. 1107)

This directive is not applicable to the GS USP

2. Safety and Environment

The safety notes refer to the system supplied. They can never be exclusive, and must be used in connection with the relevant safety regulations for the machine, auxiliary equipment, plant and sealed product.

2.1 Warning symbols

The following symbols are used in this instruction manual to highlight information of particular importance:

Danger
Mandatory instructions designed to prevent personal injury or extensive damage.

Warning of electric current

ATTENTION Special instructions or information to avoid damage to the system or its surroundings.

NOTE Information for easy installation and efficient operation.

Environmental note

Compliance is required with any additional warning signs affixed to the system.

2.2 Safety instructions

ATTENTION

Every working practice that compromises personal safety is to be avoided. All safety requirements in this document must be strictly adhered to.

In the event of an operating problem, the machinery must be switched off immediately and made safe. Problems must be solved promptly.

Ensure suitable protective clothing is used when maintaining the system.

GS USP systems are commonly used with dual seal configurations to reduce the hazard potential from flammable, explosive, toxic or lethal process fluids. The intermediate, protective barrier fluid, in certain failure modes, may risk being contaminated by the process fluid. During any maintenance operation operators must thus assume they will be exposed to the liquid or gaseous properties of the process fluid and have suitable protective gloves, clothing, respirators, and equipment.

Note must be taken of the relevant guidelines for the electrical installations.

A slight leakage will occur during normal seal operation. Depending on the duty, this leakage can appear as a gas, a liquid or a solid. In case of a worn or defective seal the leakage will increase.

The leakage may be hazardous or toxic, and a safe collection system is required.

Surface temperatures above 60°C/140°F should be protected against accidental contact.

The equipment sealed by this seal system must be operated within its recommended design limits.

Compounds containing PTFE, fluorocarbons and perfluoroelastomers should never be burnt as the fumes and residues are highly toxic. If this accidentally occurs protective equipment should be worn as hydrofluoric acid may be present.

Additional equipment/flanges/joint seals used within the system are to be rated for the appropriate electrical and pressure requirements and are to be chemically compatible with the barrier fluid and process fluid.

During venting or draining of the barrier region it should be piped to a vent or reservoir where it can be safely contained or disposed.

For further information and safe operating limits contact John Crane.

All periodical maintenance checks have to be in accordance with local legislation and rules.

All welding or cutting operations are forbidden without permission from John Crane.

If you are in any doubt please contact your local John Crane office for further information before proceeding.

2.3 Environmental aspects

2.3.1 Company policy extract

"It is the policy of John Crane to manage its business activities in an environmentally responsible manner, comply with all relevant laws and regulations, prevent pollution, and continually improve its environmental performance, certification to the latest issue of ISO 14001 ensures compliance."

John Crane adopts the **'Design For the Environment' (DFE)** principle in making this product. Using this product will benefit the environment **directly** by:

- **Reducing waste** of precious resources through decreasing the risk of leakage and minimizing energy consumption

- **Preventing pollution** through controlling harmful emissions to the atmosphere and ground contamination
- **Preserving valuable materials** through the use of high quality durable materials

Every working practice which compromises personal safety is to be avoided. All safety requirements in this document must be strictly adhered to.

In the event of an operating problem the machinery must be switched off immediately and made safe.

Problems must be solved promptly.

Ensure suitable protective clothing is used when maintaining the system.

2.3.2 Recycling

Product refurbishment

This product has been designed for long life.

Disposal

When the product is considered to be beyond economical repair and potential reuse, it should be disposed of by **environmentally beneficial** means. The product can be disassembled with ease.

Scrapped components

These should be handled with extra care due to possible contamination. They should be **recycled** through **local** industrial recycling plants.

Packaging

All packaging materials used are made from **recyclable**, environmentally friendly materials.

When in doubt or for further information and advice on this subject, please consult **John Crane**.

3. Transportation and Storage

Transport and store the system where possible in its original packaging.

It is necessary to protect and preserve the integrity of the equipment between shipment and installation/start-up at site. This is particularly important when extended periods of storage are envisaged.

GS USP systems may be shipped first to the rotating equipment vendor to be mounted on the rotating equipment baseplate complete with the connecting pipework. In this event, follow the instructions as given in the rotating equipment IOM.

GS USP systems, which are to be mounted off the rotating equipment baseplate, shall be shipped directly to site and shall be packed in suitable crates or cases to protect them from damage during shipment. All openings to the system are closed and sealed for shipping. In this event follow the following instructions.

On arrival at site and before unloading for storage, a visual inspection of the crate/case should be carried out for signs of damage during shipment. In the event of any damage the crate/case must be opened, and the contents thoroughly examined for signs of equipment damage. If any seals are broken, then the system is assumed to be contaminated and shall be cleaned accordingly.

If the parts are considered acceptable with no visual signs of damage, the crate/case should be properly closed again prior to storage.

After checking for shipment damage, the following recommendations should be undertaken to prevent deterioration arising from long term storage.

- GS USP systems should be replaced in their original packaging and if possible, the crate/case should be stored away from direct sunlight in a well-ventilated building with a hard floor.
- Temperature control is not normally necessary, but large temperature fluctuations (>40°C/72°F) should be avoided.
- If stored outdoors, it is recommended that the crate/case be placed on square timber bearers resting on a concrete or similar hard surface.
- The crate/case must then be wrapped with waterproof tarpaulin to prevent ingress of water and dirt.
- Loose components or accessories in the case should be stored as above, after proper itemisation.
- A weekly visual external inspection of the protection and preservation should be undertaken, and any deficiencies noticed should be corrected without delay.
- The system must be stored far from backwater to avoid the MIC phenomenon (microbial corrosion).

NOTE Should water, condensation, sand, dirt or other contaminant enter the system, through package/tarpaulin damage or improperly positioned covers, the cause of the problem must be eliminated and the equipment thoroughly dried and cleaned before re-storing

If used system parts are to be transported to the manufacturer or a third party they have to be cleaned, decontaminated and require safe handling instructions externally attached.

The system normally does not require any preservatives; it is resistant against most environmental conditions.

ATTENTION Ensure preservatives and cleaning agents do not affect the elastomers.

4. Description of the System

Where rotating machines (pumps, fans or mixers) work with hazardous fluids, it is common practice to install dual mechanical seals which prevent leakage of the process fluid escaping into the surrounding environment.

Mechanical seals which include John Crane's propriety Upstream Pumping seal face technology is one method used to prevent this leakage.

This seal configuration comprises an inner seal to retain the process liquid and an outer seal to minimize leakage of the barrier fluid to the atmosphere.

The inner seal includes Upstream Pumping seal face technology which uses grooves that are etched into the seal face to "pump" low pressure fluid (normally water) from the seal cavity into a higher-pressure process fluid. For more info on Upstream Pumping seal face technology, please contact John Crane.

In order to remove heat from the seal area the liquid must circulate around the closed-loop system. One or a combination of alternative methods achieves flow:

- A positive flow inducer installed between the seals and driven by the shaft rotation. This is a requirement on API 682 specifications and with ATEX 2014/34/EU or UK SI 2016 No. 1107 pump services.
- Flow induced by the thermosyphon effect. This is achieved by the temperature difference in the supply and return pipework causing a variation in the specific gravity. Thermosyphoning does not require shaft energy to function and hence is used with lower shaft speeds. It can also provide circulation in positive flow induced systems when static. (Note: API 682 4th Edition prohibits reliance on a thermosyphon to maintain circulation during normal operation).
- A separate circulation pump installed in the supply line pipework.

In addition to supplying fluid to be "pumped" by the inner seal, the purpose of the GS USP system is to provide the mechanical seal with a clean supply of fluid at close to atmospheric pressure to lubricate and cool the seal faces.

4.1 System configurations

The GS USP is available in two configurations; a reservoir-based system and a direct connect system.

Reservoir System (GS USP-R)

The reservoir-based system consists of a reservoir of barrier fluid at atmospheric pressure which is automatically refilled by means of a float valve as the fluid is consumed by the mechanical seal or leaked to atmosphere. The system can optionally include an inline filter on the reservoir supply line to ensure that the fluid supplied to the seal is free of particulate. Downstream of the reservoir a non-return valve is included to provide containment in the case of upset operating conditions.

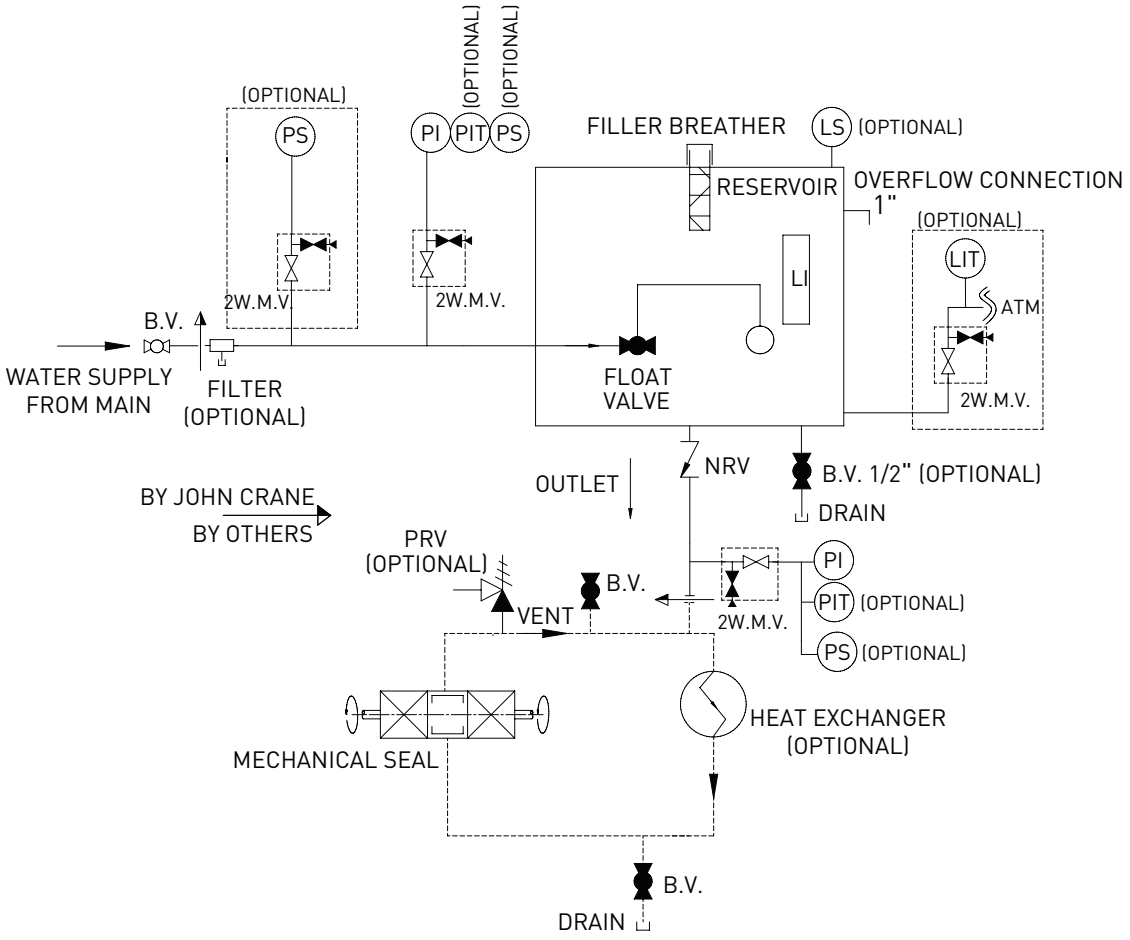
The reservoir is fitted with a level sight gauge as standard. Optional level monitoring instrumentation including level switches or transmitters are available upon request.

Pressure indicators are provided as standard to monitor the pressure supply to the system and the pressure in the interconnecting piping (circulating loop). Optional pressure monitoring instrumentation including pressure switches and transmitters are available upon request.

Upon request, a pressure relief valve may also be supplied loose for inclusion in the circulation loop to allow for automatic safe draining in the case of upset operating conditions.

An optional heat exchanger may be included in the loop if additional heat removal is required for the application.

GS USP-R



Direct Connect System (GS USP-D)

The Direct Connect system consists of a series of components used to provide low pressure barrier fluid (lower than seal chamber pressure) to the mechanical seal. The system is designed to be connected to a pressurized supply of the barrier fluid such as a mains water supply. A pressure reducing valve is included within the scope of the system to reduce the pressure as required by the seal (typically 0.3 to 3 barg/ 5 to 40 psig).

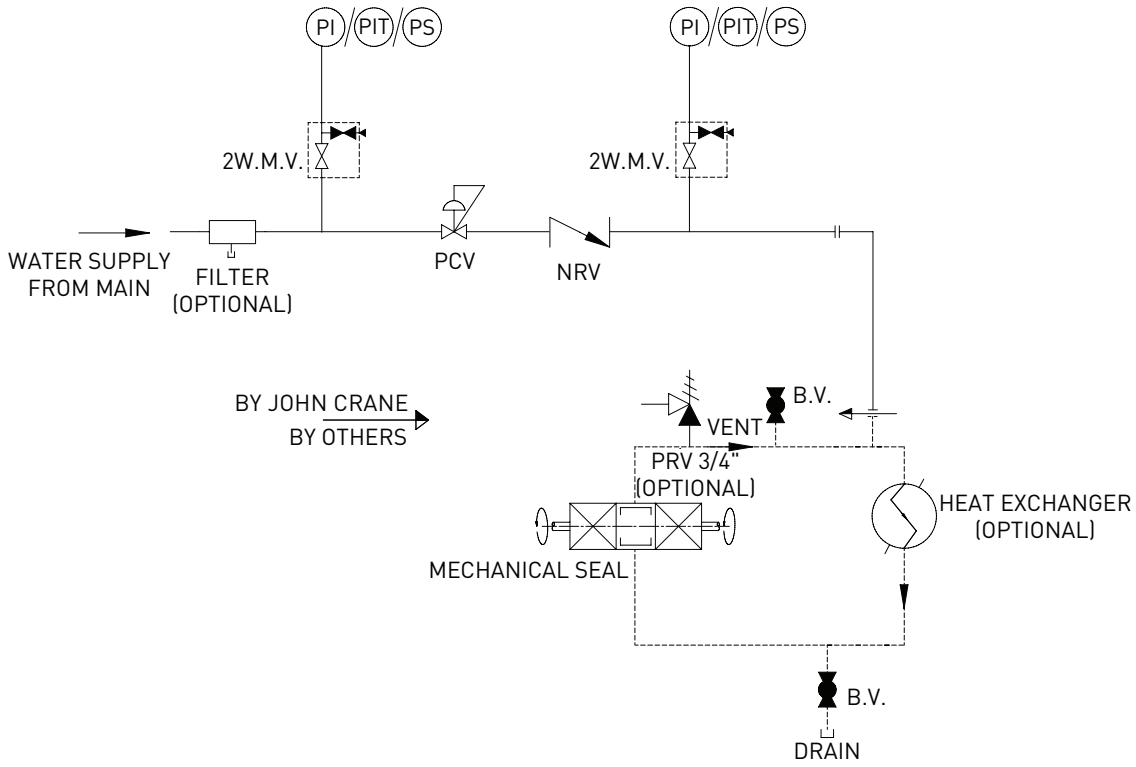
The system may also include an inline filter to ensure that the fluid supplied to the seal is particulate free.

Pressure indicators are provided as standard to monitor the pressure supply to the system and the pressure in the interconnecting piping (circulating loop). Optional pressure monitoring instrumentation including pressure switches and transmitters are available upon request.

Upon request, a pressure relief valve may also be supplied loose for inclusion in the circulation loop to allow for automatic safe draining in the case of upset operating conditions.

An optional heat exchanger may be included in the loop if additional heat removal is required for the application.

GS USP-D



4.2 Instrumentation and fittings

Reservoir System

The system is usually supplied with the following:

- Reservoir supply inlet (threaded)
- Reservoir outlet to seal (threaded)
- Overflow port (threaded)
- Drain (threaded and plugged)
- Pressure indicator (PI)
- Level indicator (LI)
- Float valve (FV)
- Filler/Breather (FB)
- Non-return valve (NRV)

And, upon request with the following options:

- Pressure switch (PS)
- Pressure indicating transmitter (PIT)
- Level switch (LS)
- Level indicating transmitter (LIT)
- Inline filter (F)
- Pressure relief valve (PRV) (loose supply)
- Heat exchanger (HX) (loose supply)
- Vent and drain valves (loose supply)

Direct Connect System
The system is usually supplied with the following:

- Supply inlet (threaded)
- Outlet to seal (threaded)
- Pressure indicator (PI)
- Pressure control valve (PCV)
- Non-return valve (NRV)

And, upon request with the following options:

- Pressure switch (PS)
- Pressure indicating transmitter (PIT)
- Inline filter (F)
- Pressure relief valve (PRV) (loose supply)
- Heat exchanger (HX) (loose supply)
- Vent and drain valves (loose supply)

4.3 Range of application

Barrier systems must be operated within their performance limits. The barrier liquid must be clean, with stable properties over the operating temperature and pressure conditions, and not constitute a hazard or introduce potential damage to the environment. The liquid should have good lubricating properties, a viscosity < 15cSt @ 40°C/104°F and be compatible with the process fluid. API 682 (4th Edition) also offers advice on the selection of barrier liquids. It is advised John Crane is contacted for more detailed advice on barrier liquids and a formal approval sought. Properties of barrier liquids may be the source of flammable or explosive hazards. In Europe and in the UK, barrier liquids classified as Group 1 in the Pressure Equipment Directive (2014/68/UE) or Pressure Equipment (Safety) Regulations 2016 (UK SI 2016 No. 1105), or described in regulation CE 1272/2008 (CLP), must not be used without formal approval from John Crane. If the process or operating conditions are changed from those referenced in this manual, John Crane must be consulted to ensure the sealing system is safe.

Ordinarily a pumping device in the containment chamber circulates the barrier liquid between the dual seals. Thermosyphonic flow should occur statically but dynamically this flow mechanism should only be used in EU/UK Ex zones 1, 2, 21, and 22 that have seal speeds below 2 m/s/ 6.5 ft/s (<12 barg/174 psig for unbalanced seals and <27 barg/392 psig for balanced seals). If the rating of the equipment on which the system is installed exceeds the seal system Maximum Allowable Working Pressure (MAWP) a pressure relief valve, vented to a safe area, should be included. If a safe vent is not possible, the outlet connection should be piped down to grade and appropriate warnings erected adjacent to the valve.

5. Installation Procedure

See System Installation Drawing for diagram.

5.1 Installation position

The location of the installation position is particularly important for the efficient operation of the system. Please pay attention to the following points:

- Easy access to the equipment for operation and maintenance (see Section 5.3 for height)
- Easy access to drain plugs/valves and connections
- Sufficient room for removal of the system (see dimensions in the installation drawing, Section 8)
- Practical installation of all inter-connecting lines (see Section 5.3)
- Visibility of instrument indicators
- If natural draft air coolers are included on the system, ensure minimal obstruction to air flow

5.2 Preparation for installation

Carry out the following steps prior to assembly:

- Examine system components for any damage caused during transport or storage
- Remove protection caps from pipes and connections
- Keep everything clean when assembling the system

5.3 Assembly

The system should be assembled using the Installation Drawings in Section 8 but considering the following:

- The normal liquid level in the reservoir should be installed 1.0 to 2.0 m/3.3 to 6.6 ft above the seal outlet. (GS USP-R only)
- Use the assembly bracket to fasten the system to a suitable stable point eg. a building wall, a plant frame, a specific pillar with support brackets. The support pillar must be able to support the weight of a filled reservoir (typically 100 to 180 kg/220 to 400 lbs) and be sturdy enough to withstand wind force and normal vibration conditions

No welding is allowed on either the components under pressure or the structural parts.

No load is tolerated on interface connections. All pipes connecting to the flushing system (to the pump, the drain and vent manifolds and the utilities) must be supported so that their weight is not on the system connections.

Flowrate predictions are based on inter-connecting pipework assumptions. The following recommendations must be applied:

- Piping or tubing to have a minimum bore of 13.0 mm/0.5"
- Stainless steel material
- The reservoir is < 1.0 m/3.3 ft horizontal distance from the seal assembly for induced circulation systems and < 500 mm/19.6" for thermosyphon systems (GS USP-R only)
- Pipework bends should have a minimum radius of 5xD. There should be a maximum of 6 bends in total
- Maximum total length of piping or tubing should be 5.0 m/16.4 ft
- Lines are horizontal or continuously rising (supply) and continuously rising (return) to aid venting
- Ensure air coolers are exposed to air or wind flow
- Isolating valves in the circulation lines must be full-bore type
- Do not include check valves in the circulation loop
- Flow indicators are not recommended. They may be used when a circulation pump is incorporated. If essential only use low resistance designs

A lower flowrate will reduce the effective cooling and raise the barrier temperature. This may provide an ignition source in a potentially explosive atmosphere.

Retained air or gas pockets will severely restrict flowrate and cause damage and overheating in the seal. Install venting devices if self-venting is impractical.

NOTE Due to the nature of thermosyphonic flow and it's relation to the system and seal design, it is not uncommon that the flow direction can differ between seemingly identical systems.

To assist in the promotion and maintenance of thermosyphonic flow, the warmer pipework leg can be lagged and/or trace heated.

- The cooling water connections (if required) must be made, adequately sealed and the flowrate checked and adjusted to the value recommended in the Installation Drawing or Operational Data Sheet. See section 8. The following recommendations must be applied:
  - Clean, cold and filtered fresh water is used
  - Isolating valves are lockable full-bore type and locked open
- The reservoir may be supplied with a valved drain connection (GS USP-R Only). It is also preferable, however, to install a drain valve at the lowest point in the inter-connecting lines to facilitate draining the seal barrier chamber and pipework, particularly if this is below the system level and/or isolation valves are fitted.

5.4 Electrical connection

Only authorized and qualified personnel are permitted to carry out work on electrical systems. International and local safety regulations must be followed in all cases.

Before connecting cables, check the electrical data on the name plate matches the available power supply and complies with the area hazard classification.

Refer to the diagrams in the terminal housing and the supplier's instruction manual for wiring instructions. Connect the electrical component using flexible conduit or armoured cable to assist removal of the component for maintenance purposes.

If passive switching elements are installed in potentially explosive areas you should add suitable protective devices, following the pertinent rules.

6. Commissioning and Decommissioning

6.1 Commissioning

Before starting the machine (pump or mixer) carry out the following operations:

ATTENTION Before commencing the start-up procedure, review and become familiar with all the available instructions concerning the equipment, especially the safety warnings.

Reservoir system (GS USP-R)

a) Open the vent valve in the system piping loop.

b) Open the supply isolation valve and allow the system to fill until the level reaches the normal liquid level. When this has been reached the float valve should be in the closed position.

c) If included in the system, check that the level transmitter/switch and pressure transmitter/switch set points are correctly set for the application. Refer to the table below.

TABLE 1. Alarm Signals

Alarm Name	Instrument	Purpose	Notes
Low Level Reservoir	Level Indicating Transmitter (LIT) or Level Switch (LS)	If the reservoir level drops below the minimum level on the nameplate	RECOMMENDED
High Level Reservoir	Level Indicating Transmitter (LIT) or Level Switch (LS)	If the reservoir level rises above the maximum level on the nameplate	RECOMMENDED
High Pressure Loop	Pressure Indicating Transmitter (PIT) or Pressure Switch (PS)	If the pressure downstream of the NRV rises above the maximum operating pressure on the nameplate	RECOMMENDED
Low Pressure Supply	Pressure Indicating Transmitter (PIT) or Pressure Switch (PS)	If the pressure upstream of the float valve drops below the minimum supply pressure on the nameplate.	OPTIONAL
High Pressure Supply	Pressure Indicating Transmitter (PIT)	If the pressure upstream of the float valve rises above the maximum supply pressure on the nameplate	OPTIONAL

d) Carefully check there is no leakage from any of the connections. In the event of a leak, tighten the flange, nut or connector. If the leak persists, replace the gasket or the connector.

e) Completely vent all lines and the chamber between the seals. Close the vent valve.

f) (If fitted) Open the vent connections of each of the instrument valves to vent the instrument lines. Close vent connections.

g) Check that any isolating valves in the circuit are locked fully open.

h) Check that all electrical instruments are correctly connected and in compliance with the area classification. **This should be carried out by a qualified electrician.**

i) Open the cooling circuit (if installed) and circulate the required amount of water.

j) Start the machine.

k) During initial start-up it is recommended that the liquid level in the reservoir and the pressures in the system are monitored for correct operation.

l) Check suitable flow circulation by measuring the barrier outlet line to confirm there is a suitable temperature rise above the inlet.

m) (If present) The cooling water outlet temperature should be < 49°C/ 120°F. If not, check that the cooling water inlet temperature is low and that the flowrate is correct.

n) The barrier settlement temperature when in service should typically be < 80°C/176°F.

ATTENTION Dry running of seal faces will cause excessive temperatures which may cause an explosive or flammable risk.

Direct connect system (GS USP-D)

a) Open the vent valve in the system piping loop.

b) Open the supply isolation valve and allow the system to fill.

c) If included in the system, check that the pressure transmitter/switch set points are correctly set for the application. Refer to the table below.

TABLE 2. Alarm Signals

Alarm Name	Instrument	Purpose	Notes
Low Pressure Supply	Pressure Indicating Transmitter (PIT) or Pressure Switch (PS)	The pressure upstream of the NRV falls below the minimum supply pressure on the nameplate	RECOMMENDED
Low Pressure Loop	Pressure Indicating Transmitter (PIT) or Pressure Switch (PS)	The pressure downstream of the NRV falls below the minimum supply pressure on the nameplate	OPTIONAL
High Pressure Loop	Pressure Indicating Transmitter (PIT) or Pressure Switch (PS)	If the pressure downstream of the NRV rises above the maximum operating pressure on the nameplate	RECOMMENDED

d) Carefully check there is no leakage from any of the connections. In the event of a leak, tighten the flange, nut or connector. If the leak persists, replace the gasket or the connector.

e) Completely vent all lines and the chamber between the seals. Close the vent valve.

f) (If fitted) Open the vent connections of each of the instrument valves to vent the instrument lines. Close vent connections.

g) Check that any isolating valves in the circuit are locked fully open.

h) Check that all electrical instruments are correctly connected and in compliance with the area classification. **This should be carried out by a qualified electrician.**

i) Open the cooling circuit (if installed) and circulate the required amount of water.

j) Start the machine.

k) During initial start-up it is recommended that the pressures in the system are monitored for correct operation.

l) Check suitable flow circulation by measuring the barrier outlet line to confirm there is a suitable temperature rise above the inlet.

m) (If present) The cooling water outlet temperature should be < 49°C/ 120°F. If not, check that the cooling water inlet temperature is low and that the flowrate is correct.

n) The barrier settlement temperature when in service should typically be < 80°C/176°F.

ATTENTION Before start-up, ensure that all personnel and assembly equipment have been moved to a safe distance and that any safety guards are refitted.

6.2 Normal running

The equipment shall be kept clean and free from debris to allow ease of access and reading of the instrumentation. Care should be taken to prevent damage to the system from accidental knocks and/or exposure to excessive sources or heat. Disconnection of any part of the system should not be undertaken without the appropriate authorisation and until all pressure has been completely discharged and system allowed to cool. All joints broken for maintenance should be plugged off to prevent ingress of contaminants.

Reservoir system (GS USP-R)

During normal operation the only attention required is to monitor; the barrier fluid level in the reservoir; the barrier fluid supply pressure to the system and the pressure in the loop downstream of the NRV. Periodic visual checking (at least every 48 hours) of the level/pressures within the system is recommended.

Direct connect system (GS USP-D)

During normal operation the only attention required is to monitor both the barrier fluid supply pressure and the pressure in the loop downstream of the NRV. Periodic visual checking (at least every 48 hours) of the system pressures within the system is recommended.

6.3 Decommissioning

Work on the seal or system must only be carried out when the machine is stationary, depressurized and secured against any unforeseen start-up. Isolation from connections to pressurization sources must be carried out.

Before carrying out any work on the seal or system, the equipment must be shut down and the barrier region must be fully depressurized. Once this has been done the barrier fluid supply to the GS USP can be isolated.

If the equipment has been used on toxic or hazardous fluids, ensure all precautions are taken to avoid personnel hazards such as correct decontamination when draining the barrier system and removal of any dangerous fluid remaining in the system. Remember fluid is often trapped during draining.

Do not isolate the barrier fluid supply before the pump is made safe. Once the barrier fluid supply is isolated carefully vent any residual pressure from the system and interconnecting pipe work and drain of any liquids before carrying out any maintenance.

If the pump/panel is to be removed cover any open tubing fittings/ connections to prevent contamination.

NOTE It is recommended that a leak test is carried out on the system after any repair and before operation on the equipment.

7. Maintenance

7.1 Routine maintenance

Check the following as part of regular site walk-around checks for trouble-free operation:

- If included on the system, check the condition of the inline filter element for contamination (see Section 7.3).
- Connections are leak-free
- Barrier liquid temperature
- Barrier liquid level. Compare with Low Level and High Level marks on the level indicator (GS USP-R Only)
- Barrier pressure. Compare with the alarm pressure on the nameplate
- Cooling water availability to the cooler (if fitted)
- Any abnormal leakage from the outer seal
- Condition of alarm signals (see Section 7.4)
- There is no accumulation of dust on any part of the GS USP. Remove any built up dust as required.

Never allow the barrier level to drop below the minimum mark on the reservoir, otherwise the flow will be interrupted and cause damage and overheating of the mechanical seal which could provide an ignition source in a potentially explosive atmosphere.

7.2 Barrier fluid maintenance

If the system is subject to reverse leakage (process fluid leaks across the inboard seal into the circulating loop), normally due to inboard seal damage, the system should be stopped and decommissioned (see Section 6.3). The system should then be thoroughly cleaned to remove all contaminants. Caution should be taken to use the correct PPE especially when the GS USP is used with toxic or lethal process fluids or contaminants (e.g. H2S). The contaminated barrier fluid should be disposed of in accordance with site policy and refilled with clean fluid as part of the system recommissioning process (see Section 6.1).

7.3 Filter

The filter mesh can be removed from the filter body for cleaning. Refer to the filter product documentation for specifics on the removal and cleaning process. Depending on which configuration of GS USP is being used, the cleaning process is as follows:

- For the GS USP-R, the pump can be kept running during the cleaning process. The supply to the system should be isolated before removing the filter element for cleaning.

The cleaning process and reinstallation of the filter must be completed before the reservoir volume reaches the low level. A maximum of 10 hours is allowed between isolation and reopening of the supply under normal operating conditions.

- For the GS USP-D, the pump must be shut down and made safe before the cleaning process can be complete (see Section 6.3). Once the system has been shut down, the filter can be removed, cleaned and reinstalled. The system should be recommissioned following the process in Section 6.1.

It is recommended that the element is checked after the first month of operation and if no contamination is detected thereafter at six monthly intervals. Irrespective of visual condition it is recommended that the filter element is replaced annually.

7.4 Signals and alarms

A sudden or noticeably steady increase in the fluid consumption should be considered abnormal and may indicate a deteriorating seal. The instrumentation on the system has the specific purpose of signalling eventual malfunction of the mechanical seals and/or system.

Possible alarm signals indicating a malfunction are as shown in the tables below.

Reservoir System (GS USP-R)

TABLE 3. Possible Alarm Signals

Effect	Instrument	Action	Cause
Falling Level	Level Indicator (LI) or Level Indicating Transmitter (LIT)	A	E to I
Low Level Alarm	Level Switch (LS) or Level Indicating Transmitter (LIT)	B and C	E to I
Rising Level	Level Indicator (LI) or Level Indicating Transmitter (LIT)	A	I
High Level Alarm	Level Switch (LS) or Level Indicating Transmitter (LIT)	B	I
Rising Pressure (Downstream of NRV)	Pressure Indicator (PI) or Pressure Indicating Transmitter (PIT)	B and D	J
High Pressure Alarm (Downstream of NRV)	Pressure Switch (PS) or Pressure Indicating Transmitter (PIT)	B and D	J
Rising Pressure (Upstream of Float Valve)	Pressure Indicator (PI) or Pressure Indicating Transmitter (PIT)	A	G
High Pressure Alarm (Upstream of Float Valve)	Pressure Indicating Transmitter (PIT)	A and B	G
Falling Pressure (Upstream of Float Valve)	Pressure Indicator (PI) or Pressure Indicating Transmitter (PIT)	A	G
Low Pressure Alarm (Upstream of Float Valve)	Pressure Indicating Transmitter (PIT) or Pressure Switch (PS)	A and B	G

Actions

A	Investigate cause, and monitor to ensure values do not breach safe limits
B	Shut down machine to prevent damage or loss of containment
C	Check inline filter
D	Drain and clean circulating loop (see Section 7.2)

Causes

E	Excessive consumption across the inboard seal and/or leakage at outboard seal
F	Pipe work/joint failure
G	Fault with supply to the reservoir
H	Blockage of the inline filter
I	Possible fault with float valve
J	Degradation of inboard seal resulting in reverse pressure

The signal from the pressure switch or pressure transmitter can be used either:

- LOCALLY (with a Klaxon and/or beacon)
- REMOTELY (through the sites Distributed Control System (DCS))

Direct Connect System (GS USP-D)

TABLE 4. Possible Alarm Signals

Effect	Instrument	Action	Cause
Falling Pressure (Upstream of NRV)	Pressure Indicator (PI) or Pressure Indicating Transmitter (PIT)	A	F to H
Low Pressure Alarm (Upstream of NRV)	Pressure Switch (PS) or Pressure Indicating Transmitter (PIT)	B and C	F to H
Falling Pressure (Downstream of NRV)	Pressure Indicator (PI) or Pressure Indicating Transmitter (PIT)	A	F to I
Low Pressure Alarm (Downstream of NRV)	Pressure Switch (PS) or Pressure Indicating Transmitter (PIT)	B to D	F to I
Rising Pressure (Downstream of NRV)	Pressure Indicator (PI) or Pressure Indicating Transmitter (PIT)	B and E	J
High Pressure Alarm (Downstream of NRV)	Pressure Switch (PS) or Pressure Indicating Transmitter (PIT)	B and E	J
Rising Pressure (Upstream of NRV)	Pressure Indicator (PI) or Pressure Indicating Transmitter (PIT)	A	G
High Pressure Alarm (Upstream of NRV)	Pressure Indicating Transmitter (PIT)	A and B	G

Actions

A	Investigate cause, and monitor to ensure values do not breach safe limits
B	Shut down machine to prevent damage or loss of containment
C	Check inline filter
D	Check pressure control valve
E	Drain and clean circulating loop (see Section 7.2)

Causes

F	Pipe work/joint failure
G	Fault with supply to the system
H	Blockage of the inline filter
I	Possible fault with pressure control valve
J	Degradation of inboard seal resulting in reverse pressure

The signal from the pressure switch or pressure transmitter can be used either:

- LOCALLY (with a Klaxon and/or beacon)
- REMOTELY (through the sites Distributed Control System (DCS))

If necessary, for safety of the process, the alarm signals could be used as a trip function.

John Crane must be consulted in the event of any abnormal malfunction of the sealing system. Excessive leakage rate, premature failure, high relative temperatures are all considered examples of abnormal malfunction.

7.5 Instrument maintenance

All instruments require regular calibration, following local processes and regulations. See the supplier's instruction manual for any additional instructions for maintenance of electrical instruments.

Consult the specific instrument manufacturers manual should there be a malfunction.

7.6 Spare parts

Spare parts must conform to the established technical specifications of the manufacturer. This is guaranteed with John Crane spare parts.

You are advised to stock the most important wear parts on site.

The following data is necessary for spare part orders:

- John Crane code/part number
- John Crane order/ref no.
- Part description
- Quantity

7.7 Annual maintenance checks

Disconnection shall be made by plant person in charge of authorization.

Before any maintenance operation on the system, the machine must be stopped and depressurized, then the barrier fluid pressure must be fully discharged, and the equipment allowed to cool to ambient temperature. A suitable container should be available to contain any liquid drained from the barrier system.

All parts requiring maintenance must be thoroughly decontaminated prior to any work commencing.

All flange joints should be checked for tightness and if necessary, the gasket changed using replacements available from John Crane. If necessary, and prior to refilling with fresh barrier fluid, the system should be flushed with a compatible liquid to remove any internal contamination.

7.8 Heat exchanger maintenance

If fitted, heat exchangers in GS USP systems must be regularly checked to ensure that the cooling surface has not degraded or fouled. The cooling water side of a water-cooled heat exchanger should regularly be back-flushed or cleaned at a frequency depending on the rate of scaling or quality of the water used. See local site regulations for guidance.

8. Accompanying Documents

Installation Drawing (job specific) or Typical Drawing and Operational Data Sheet.

A name and data plate is fitted to each GS USP system. It contains references and part numbers which must be quoted in any communication.

North America
United States of America
Tel: 1-847-967-2400

Europe
United Kingdom
Tel: 44-1753-224000

Latin America
Brazil
Tel: 55-11-3371-2500

Middle East & Africa
United Arab Emirates
Tel: 971-481-27800

Asia Pacific
Singapore
Tel: 65-6518-1800