

## BARRIER LIQUID SYSTEMS

### Installation, Operation & Maintenance Instructions

GS 54 system may only be installed, commissioned and maintained by an authorised plant machinery specialist, paying close attention to these instructions and all other relevant regulations. Failure to do this relieves the manufactures from any liability or warranties.

## 1. General

### 1.1 INTRODUCTION

This Instruction Manual is provided to familiarise the user with the GS 54 system arrangement and its use. The instructions must be used in combination with the GA drawing and P&ID and applied whenever work is done on the GS 54 system 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.

### BARRIER LIQUID

A fluid supplied at a pressure above the pump seal chamber pressure. It is introduced between the two seals of a dual pressurised seal configuration to completely isolate the process liquid from the environment.

## 2. Safety & 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 injury or extensive damage.**



**Warning of electric current.**

**ATTENTION** Special instructions and/or information to avoid damage to the seal and/or its surroundings.

**NOTE** Information for easy installation and efficient operation



Environmental note

Please comply with any additional warning signs on the system.

### 2.2 SAFETY INSTRUCTIONS



**ATTENTION**

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.

GS 54 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 liquid, in certain failure modes, may risk being contaminated. 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.

- Dual pressurised mechanical seals should be used for harmful, toxic and lethal products.
- All safety requirements must be strictly followed.
- Every precaution must be taken to ensure personnel safety.
- Full machinery protection is ensured.

Protective clothing must be worn at all times

Particular 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 perfluoro elastomers 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 / 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.

- During venting or draining of the barrier liquid it should be piped to a vent or reservoir where it can be safely contained or disposed. Periodically the barrier liquid should be checked for contamination and replaced. If the contamination level exceeds site acceptability limits or those required under local/International legislation (whichever are the more stringent) on safety and environmental pollution.
- All above according to the local legislation.
- All periodical maintenance checks have to be in accordance with local legislation and rules.

### 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.”



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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.

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

GS 54 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. In this event follow the following instructions.

Seal systems and generally all auxiliary sealing products installed on rotating equipment skids should be packed in suitable crates or cases by the rotating equipment manufacturer to protect them from damage during shipment. All openings to the system are closed and sealed for shipping.

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. All bolts and threaded connections should be checked for signs that they have come loose during transport. If any seals are broken, then the system is assumed to be contaminated and shall be cleaned accordingly. All loose connections or bolts should be correctly tightened to eliminate any loosening which has occurred during transportation or as part of the cleaning process.

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 54 system 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 itemization.
- A weekly visual external inspection of the protection and preservation should be undertaken, and any deficiencies noticed should be corrected without delay.

#### 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 use system parts are to be transported to the manufacturer or a third party they must 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.



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### 4. Description of the system

In all industries where rotating machines (pumps or mixers) work with toxic or flammable fluids dual mechanical seals are used to prevent the process fluid from escaping into the surrounding environment.

#### 4.1. DUAL PRESSURISED SEALS

Two seals are pressurized by a safe clean barrier fluid at a pressure higher than the process pressure in the seal chamber. Dual seals are used when a single seal cannot guarantee satisfactory performance of the machine in which it is installed and if for safety or environmental reasons no product leakage to atmosphere is allowed.

In this case, the following conditions should be satisfied:

- A. The area between the seals should be filled with a clean barrier liquid compatible with the pumped fluid.
- B. The pressure of the barrier liquid should not be allowed to fall below the Minimum Operational Pressure (as quoted on the Operational Data sheet) to ensure that any leak across the inner seal face will be
- C. The barrier liquid must be re-circulated and cooled to remove heat input from the process and seals.

### 5. Function of the Systems

#### 5.1 GS 54 SYSTEM

Barrier liquid is contained in an atmospheric reservoir/tank. An in-tank pump pressurizes and circulates barrier liquid to the mechanical seals and returns it back into the tank.

Heat exchanger removes heat from the barrier fluid generated by the mechanical seals before it is returned to the tank.

As loss of barrier liquid will result in a gradual drop of the reservoir level, a level gauge is provided to view and monitor the barrier fluid level in reservoir. Low level indication gives adequate advance warning that additional barrier liquid is required.

#### 5.2 EQUIPMENT / INSTRUMENT IOM'S

Equipment manufacturers instructions are provided as an addendum to this IOM.

The GS 54 system should ensure the following functions:

#### 5.3 HEAT DISSIPATION

Heat generated by the mechanical seals and/or positive heat soak from the process is transmitted to the barrier liquid. This heat is removed from the barrier liquid by a heat exchanger which is installed in the barrier liquid return line, between the seal and the reservoir.

#### 5.4 BARRIER FLUID PRESSURIZATION

Barrier fluid pressurization is achieved through the in-tank pump. The pressure is controlled by a pressure control valve on the return line from the mechanical seal. This valve is set to relieve at the desired barrier pressure for the operation of the mechanical seal.

### 5.5 TOPPING UP

Filler/Breather (Item 21) is provided for Manual topping up. The estimated barrier fluid consumption shall be reviewed with John Crane based on seal and application.

### 5.6 PRESSURE LOSS

Falling system pressure is an indication of excessive leakage from the mechanical seal, or a joint in the system, if this is not externally visible at pipe connections, it may indicate deterioration of the seal faces. Pressure loss is monitored by pressure gauges and shall be logged periodically.

### 6. Terminations

The GS 54 system is supplied with the following:

- 1/2" NPTF termination (Nozzle A) for barrier fluid supply (to seal)
- 1/2" NPTF termination (Nozzle B) for barrier fluid return (from seal)
- 1/2" NPTF termination (Nozzle C) for reservoir drain
- 3/4" NPTF termination (Nozzle D) for cooling water inlet
- 3/4" NPTF termination (Nozzle E) for cooling water outlet
- Filler /Breather (Nozzle F) for supply of barrier fluid to reservoir

Refer to GA-251134 for further detail.

### 7. Instrumentation

Instrument description	Abbr.
Pressure Gauge (To seal)	PI
Pressure Gauge (From seal)	PI
Pressure Gauge (Filter)	PI
Level Gauge	LI

An optional temperature gauge can be used to monitor changes in barrier liquid.

### 8. Installation

Normally, the barrier fluid is circulated through the GS 54 system during operation by the intank pump.

Before installing the system consider the following general guidelines:

#### 8.1 POSITIONING

The GS 54 system should be installed within 2 meters of the seal chamber. The GS 54 system shall be bolted to the ground using the hold-down bolt holes in the reservoir frame.

Please pay attention to the following points:

- A. Easy access to the equipment for operation and maintenance
- B. Easy access to drain plugs/valves and connections
- C. Sufficient room for removal of the system (see dimensions in the General Arrangement drawing)
- D. Visibility of Instrument transmitters/indicators

For any variations please consult John Crane for approval.



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### 8.2 PIPEWORK AND CONNECTIONS

Refer to the P&ID in the GA drawing for inter-connecting details and comply with the specific instructions.

Avoid sharp bends and elbows in the inter-connecting pipework to minimize frictional resistance which will impede the circulation flow.

Lines should be installed so as to be self-venting with high point vents if necessary, to prevent vapor locks.

Isolating valves should not be fitted in the circulation lines to and from the seals unless they are lockable full-bore type and locked open.

### 8.3 EXTERNAL CONNECTIONS

Refer to appropriate system drawing for termination details and locations.

### 8.4 ELECTRICAL CONNECTIONS

Refer to diagrams included in terminal housing and also to the manufacturer's instruction manual for wiring instructions. Wiring should only be carried out by qualified personnel taking care to observe the appropriate area classification requirements.



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

### 8.5 DRAINING THE CIRCUIT

The system is fitted with a drain connection, however, it may also be preferable to install a drain valve at the lowest point of the interconnecting pipework to facilitate draining the seal chamber and pipework particularly if this is below the system level and or isolation valves are fitted in the interconnecting pipework. The system and pipework must be drained before any maintenance is undertaken.

### 8.6 BARRIER LIQUIDS

The barrier liquid to be used in this system is Water + Glycol (50% each) or Mineral Oil. The fluid must be clean and free from solids. No change in liquid type should be undertaken without prior consultation with John Crane.

The following general guidelines for barrier liquids shall be followed

- Maximum recommended operating temperature +80°C (176°F).
- The barrier liquid must be stable at both environmental and working temperature to avoid vaporization, solidification or foaming.
- The barrier liquid should have good lubricating properties and resistance to ageing.
- The barrier liquid must be compatible with the process fluid.
- Leakage of the barrier liquid into the atmosphere should be safe and acceptable.

## 9. Commissioning Procedure

Refer to Commissioning Procedure given below. If the system has been stored empty for one month or more, this procedure should be followed.

## 10. Start Up

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

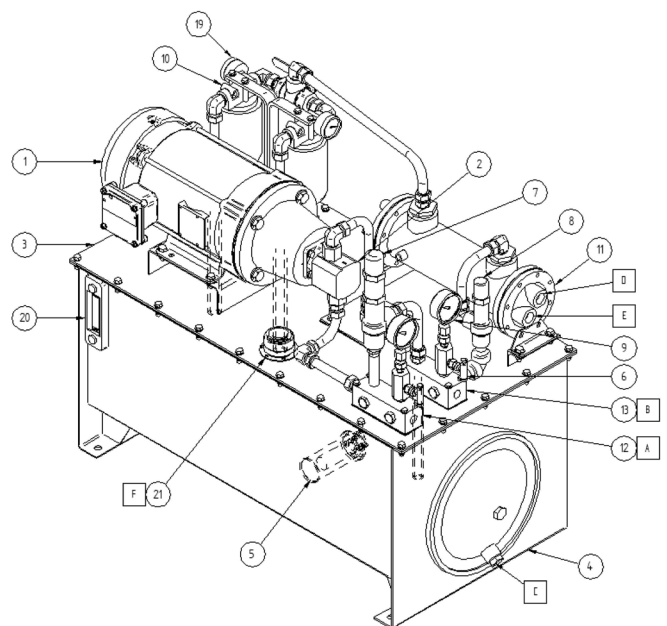
**ATTENTION** Before commencing the start-up procedure, review and become familiar with all the available instructions concerning the equipment, especially the safety warnings

- Fill the reservoir with barrier Fluid through Filler/breather. Maintain the desired level with the help of level gauge.
- Visually check through the Sight Glass (item 20) that the reservoir is full of barrier fluid.
- Start the barrier fluid pump.
- During and after starting up there should be no significant pressure instability in the system. Any significant variations should be corrected immediately.
- Before reading any instruments, vent the pressure instruments to eliminate any residual air in the pressure lines. This can be done through the block & bleed manifold and the bleed port on the top of the filter.
- Check carefully that there is no leakage from any of the joints, if a leak is found tighten the connection nuts and, if necessary, replace the fittings.



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

- Start the main process pump.





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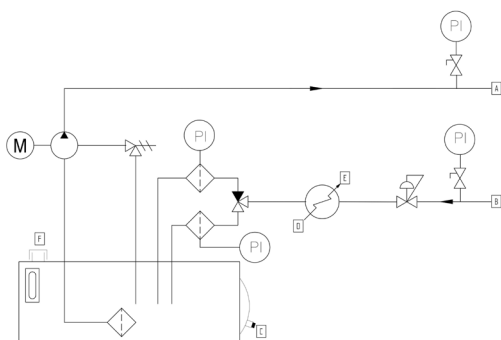
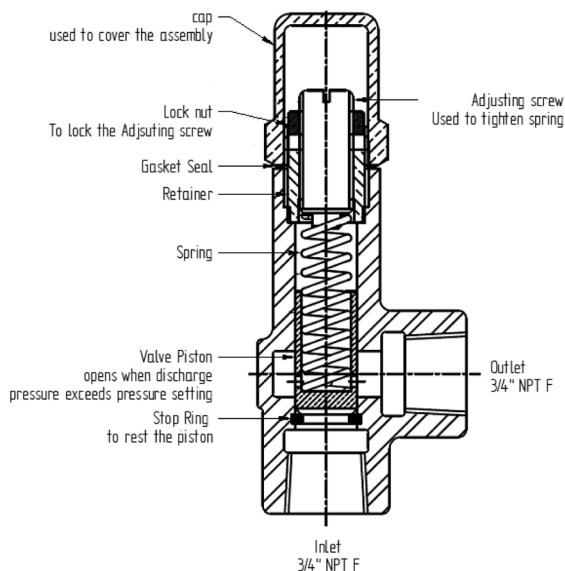
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### 10.1 ADJUSTING PRESSURE CONTROL VALVE SET PRESSURE

The pressure relief valve (item 7) and the pressure control valve (item 8) are pre-set to the pressure specified during manufactured and no adjustment should be necessary. The system may have been provided with fixed valves, or a variable valve. For fixed valves, the valves must be replaced to adjust the pressure setpoints of the system. For a system with variable valves, the procedure to adjust/check the set pressure of the control valve is given below for reference only and should only be carried out while the main process pump is shut down, drained and isolated.

1. Stop the barrier fluid pump.
2. Set the pressure control valve (item 8) to 10 barg /145 psig :
  - A) Loosen the locknut on the adjuster.
  - B) Screw the PCV adjuster fully anti-clockwise (lowest pressure setting).
  - C) Start the barrier fluid pump, the pressure should build to ~5 barg / 73 psig.
  - D) Screw the PCV adjuster clockwise until the pressure reaches the required set point.
  - E) Screw in the locknut on the adjuster.
3. Repeat the above steps for the pressure relief valve (item 7) as necessary.
4. Start the barrier fluid pump.



### 11. Running

#### 11.1 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 authorization 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 dirt.

During normal operation the only attention required is to:

- Monitor system pressure.
- Monitor filter pressure indicator.
- Monitor reservoir level and refill the barrier liquid to ensure continued operation.

Refilling should be carried out as soon as possible after the notice of the low level. Periodic visual checking (at least every 12 hours) of the pressure/level within the system is recommended along with records.

#### 11.2 BARRIER MAINTENANCE

After the first 100 operating hours, and after every subsequent six months:

- Change the barrier liquid.
- Check system and inter-connecting lines are clean and free of corrosion and deposits.

These maintenance intervals may need to be shortened if the operating conditions are extreme.

#### 11.3 SIGNALS AND ALARMS

The standard instrumentation on GS 54 systems has the specific purpose of monitoring loss of barrier liquid through a drop in pressure. **Logging the period between refills will indicate seal condition.** Increasing refill frequency is an indication of seal wear.

Instrument	Effect	Action	Cause
Level Indicator (LI)	Level below Minimum Level Mark	A	F to I
	Rising Level	B	J
Pressure Gauge (PI) to Seal (connection A)	Rising Pressure	B	J to L
	Falling Pressure	B	D to G
Pressure Gauge (PI) from Seal (connection B)	Rising Pressure	B	J to L
	Falling Pressure	B	D to G
Pressure Gauge (PI) at Filter (item 19)	Pressure Gauge needle in red section	C	K

#### Actions

A	Recharge system with fresh barrier liquid (see section 5.5)
B	Shut down equipment to protect seal and prevent loss of containment
C	Renew filter element (see Section 13.3)



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Causes	
D	Degradation of the circulation pump
E	Degradation of the pressure control valve
F	Excessive leakage from the inboard seal (process side) or outboard seal (atmospheric side)
G	Excessive leakage from a flange or joint
H	Normal running leakage from the inboard seal (process side) or outboard seal (atmospheric side)
I	Leakage from a flange or joint
J	Reverse pressure of the seal causing contamination by the process fluid
K	Blocked Filter
L	Seized pressure control valve

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.

### 11.4 NAME AND DATA PLATE

A name and data plate are fitted to each system, giving identification data. Should you need further information or advice please contact your nearest John Crane regional office quoting the system code.

## 12. Decommissioning

**ATTENTION** When the process pump is stopped; the GS 54 system pressure must be maintained until the process pump itself is unpressurised.



**Work on the seal or GS 54 system must only be carried out when the machine is stationary, deenergised and secured against any unforeseen start-up and it is isolated from connections to pressurisation sources.**

Before carrying out any work on the seal or system the barrier liquid must be fully depressurised and drained



**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 gas remaining in the reservoir. Remember fluid is often trapped during draining.**

## 13. Maintenance

Maintenance must be carried out by qualified personnel only, on a no more than annual frequency.

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

### 13.1 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

### 13.2 ANNUAL MAINTENANCE CHECKS

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

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

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 gaskets changed using replacements available from John Crane. If necessary, and prior to refilling with fresh barrier liquid, the system should be flushed with a compatible liquid to remove any internal contamination.

Where required by code or local regulations the walls of pressurized vessels should be internally checked for corrosion damage. Where damage exceeds any corrosion allowance the vessels must be replaced.

### 13.3 FILTER MAINTENANCE

When the needle on the pressure gauge of the active filter (item 59) enters the red area, this indicates that the active filter is becoming choked with debris and the filter element must be replaced.

The GS 54 may use a duplex filter arrangement, consisting of two separate filter housings in parallel (item 8). The system also contains a 3-way valve (item 46) placed between the two filters to divert the flow of liquid to one filter, the running filter, while the other is on standby or being maintained. The valve can be operated while the GS 54 is in operation to allow filter maintenance while providing uninterrupted flow.

As soon as possible, the operator shall change over to the standby filter by operating the 3-way valve. The valve must be operated in a single smooth action to avoid blocking the flow of the pump.

Ensure that the needle of the pressure gauge on the now active filter is in the green section, indicating that this filter contains a clean filter element.

If the GS 54 is using a single filter, the equipment must be shut down in order to change the filter element.



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As soon as possible, replace the filter element in the now offline filter by following these steps:

- Remove the filter housing of the offline filter.
- Remove the filter element.
- Check for any debris remaining in the filter housing.
- Insert a new filter element.
- Check the gasket on the filter housing and replace if damaged.
- Refit the filter housing into the GS 54.

### 13.4 HEAT EXCHANGER MAINTENANCE

Heat exchangers in GS 54 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 be regularly backflushed or cleaned at a frequency depending on the rate of scaling or quality of the water used. See local site regulations for guidance.

### 13.5 BARRIER CONTAMINATION

If there is any evidence a reverse pressure event has occurred, and/or the barrier fluid has been contaminated with process fluid, the GS 54 must be fully stripped down and cleaned to remove all traces of process fluid before re-commissioning.

### 13.6 INSTRUMENT MAINTENANCE

All instruments require regular calibration, following local processes and regulations.



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**Asia Pacific**  
Singapore  
Tel: 65-6518-1800

If the products featured will be used in a potentially dangerous and/or hazardous process, your John Crane representative should be consulted prior to their selection and use. In the interest of continuous development, John Crane Companies reserve the right to alter designs and specifications without prior notice. It is dangerous to smoke while handling products made from PTFE. Old and new PTFE products must not be incinerated. ISO 9001 and ISO14001 Certified, details available on request.