PLAN 52

BUFFER LIQUID SYSTEMS

Installation, Operation & Maintenance Instructions

1. General

1.1 INTRODUCTION

This instruction manual is provided to familiarize the user with the system arrangement and its use. The instructions must be read and applied whenever work is done on the 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.

John Crane reserve the right to change the system and specifications described. The following important terms and definitions are used in this document.

BUFFER LIQUID

A fluid supplied at a pressure lower than the pump seal chamber pressure. It is used as a lubricant and/or to provide a process dilution in the containment chamber of a dual unpressurized seal configuration.

1.2 EUROPEAN AND/OR UK DECLARATION OF INCORPORATION (MACHINERY DIRECTIVE 2006/42/EC, AND UK SI 2008 NO. 1597)

Where appropriate this is attached.

1.3 EUROPEAN AND/OR UK DECLARATION OF CONFORMITY (PRESSURE EQUIPMENT DIRECTIVE 2014/68/EU, AND UK SI 2016 NO. 1105)

In assessing the hazard classification for the European or UK pressure equipment directive/regulations, the most arduous liquid (process or buffer) will determine the classification.

Where appropriate this is attached.

1.4 EUROPEAN AND/OR DECLARATION OF CONFORMITY (ATEX 2014/34/EU, AND EQUIPMENT AND UK SI 2016 NO. 1107)

These instructions are intended for use with the buffer system operating in Equipment Group II, category 2GD and 3GD.

The Declaration covers the complete seal and system and the Maximum Surface temperature is recorded in the Mechanical Seal instruction manual.

Where appropriate this is attached.

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 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.

Plan 52 systems are used with dual seal configurations to reduce the hazard potential from flammable, explosive, toxic or lethal process fluids. The intermediate, protective buffer liquid will be 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.

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. This system is not suitable for running in the event of an uncontrolled fire.

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 buffer fluid.

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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.

2.3.2 RECYCLING

PRODUCT REFURBISHMENT

This product has been designed for long life.

BUFFER LIQUID RECYCLING OR DISPOSAL

Replacement of buffer liquid is required as part of the normal maintenance operation. Recycling of liquid should be considered but if this is impractical because of contamination then an environmentally controlled form of disposal must be arranged.

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.

When seal systems are shipped first to a rotating equipment manufacturer, it is customary for them to be mounted on a skid by the rotating equipment manufacturer.

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.

- Seal systems should be stored in their original packaging and if possible the crate/case should be stored away from direct sunlight, in a wellventilated building with a hard floor.
- Temperature control is not normally necessary, but large temperature fluctuations greater than > 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.
- 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.

Reservoirs which had already been fitted in plants must be transported in a vertical position. Protect the vessels against vibration, which can cause damage.

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.

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

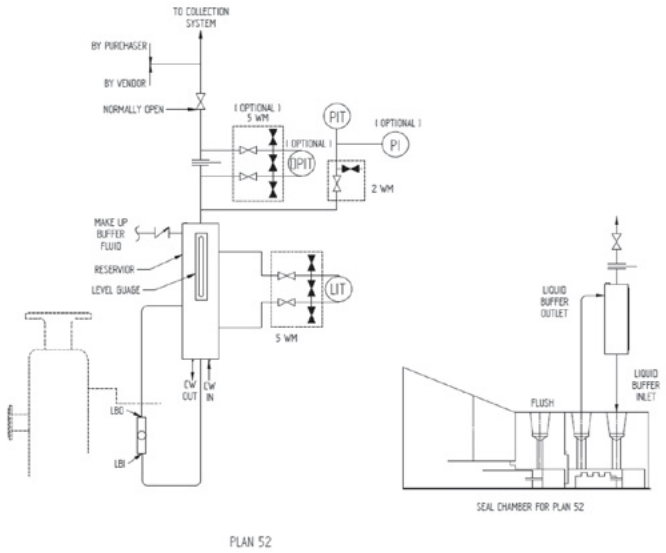
Ensure preservatives and cleaning agents do not affect the elastomers.

4. Description of the system

4.1 FUNCTION OF THE SYSTEM

The system can be used to provide the function of an API Plan 53A seal support system, having a variety of Instrumentation options. The piping plan references used conform to API 682 (4th Edition).

BUFFER LIQUID SYSTEM FOR DUAL UNPRESSURIZED SEALS (PLAN 52)



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This seal configuration comprises an inner seal to retain the process liquid and an outer seal to minimise process leakage to the atmosphere.

Between the two seals a buffer liquid is provided, close to atmospheric pressure, to lubricate, cool and channel process leakage to a safe environment. The system manages the buffer liquid and is ordinarily referred to as piping Plan 52. It provides the following functions:

- A reservoir for the buffer liquid. This provides the working volume for the seals.
- Removes heat from the buffer liquid. This is achieved by one or a combination of alternative methods:
  - Natural convection and radiation from the reservoir and pipework surface.
  - A cooling coil built into the design of the reservoir.
  - A separate air or water cooler installed in the pipework connecting the reservoir and the seals.
- An environment for removal of process leakage
  - These systems are normally used when the major proportion of process leakage is a gas at atmospheric conditions. Gas is channelled from the seal to the reservoir, from which an outlet connection connects it to a process gas management system.
  - These systems may be used when the major proportion of process leakage is a liquid at atmospheric conditions. Liquid leakage will collect in the reservoir and require periodic draining to a process liquid management system.
- Monitors the condition of the inner seal. This can be achieved by constricting the outlet to the gas-management system using an orifice. Pressure can be measured upstream of it with a pressure indicating transmitter and an alarm can be set at a predetermined condition. A further option also exists for a high-level alarm to signal when excessive levels of condensed leakage have contaminated the buffer liquid.
- Monitors the condition of the outer seal. Level in the reservoir is monitored with a visual level gauge and level indicating transmitter. A low-level alarm can be set to signal that the buffer reservoir needs replenishment.

BUFFER LIQUID CIRCULATION

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 thermosyphon mechanism. This is achieved by the temperature difference in the supply and return pipework causing a variation in the specific gravity. Thermosyphon 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. (API 682 4th Edition prohibits reliance on thermosyphon to maintain circulation during normal operation).
- A separate circulation pump installed in the supply line pipework.

BUFFER LIQUID TOP-UP

Periodic topping-up is required to replace buffer liquid used during normal operation. Typical methods of topping-up are:

- Manual filling by means of a funnel.

For operator safety when using this method the equipment should be shut down and depressurized before opening the fill connection.

- Dedicated top-up hand pump and storage reservoir permanently connected to the system reservoir, allowing topping-up without process shut down.
- Mobile top-up trolley which can be used for topping-up multiple systems by use of a hose and quick-connect coupling. This can also be carried out without process shut down.
- Plant-based system supplying an installed buffer liquid manifold.

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Without the intended lubrication the seal face temperature will increase and may provide an ignition source in a potentially explosive atmosphere. Equipment and system operation must ensure seal face lubrication is always available.

4.2 RANGE OF APPLICATION

Buffer systems are designed to service mechanical seals by cooling; they must be operated within their performance limits.

The buffer 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 buffer liquids. It is advised John Crane is contacted for more detailed advice on buffer liquids and a formal approval sought.

Properties of buffer liquids may be the source of flammable or explosive hazards. In Europe and in the UK, Plan 52 buffer 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 buffer 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.

4.3 INSTRUMENTATION AND FITTINGS

The system is usually supplied with the following:

- Flanged or threaded terminations to inter-connecting lines (supply and return)
- Level gauge
- Pressure indicating transmitter
- Level indicating transmitter (measuring differential pressure)
- Pressurization connection
- Water cooling coil

And, upon request with the following options:

- Additional/alternative cooler
- Pressure gauge
- Up to two level switches instead of a level transmitter
- Pressure switch instead of a Pressure indicating transmitter
- Temperature indicator
- Refill hand pump with reservoir
- Differential pressure indicating transmitter (across the orifice)

5. Installation and assembly

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

5.2 PREPARATIONS 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

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5.3 ASSEMBLY

The system should be assembled using the Installation Drawing in Section 8 but considering the following.

- The normal liquid level in the reservoir should be installed 1.0 to 3.0 m/ 3.3 to 9.8 ft above the seal outlet.
- Use the assembly bracket to fasten the reservoir 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.

Tolerated load on interface connections is 0. 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 tank connections.

- Flow-rate 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
  - 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 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
  - 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 buffer temperature and 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. (API 682 4th Edition prohibits reliance on thermosyphon to maintain circulation during normal operation.)

NOTE To assist in the promotion and maintenance of thermosyphonic flow, the warmer pipework leg can be lagged and/or trace heated. (API 682 4th Edition prohibits reliance on thermosyphon to maintain circulation during normal operation.)

- The vent connection from the buffer system reservoir should be connected to a safe recovery or flare system.
- 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. It is also preferable, however, to install a drain valve at the lowest point in the inter-connecting lines to facilitate draining the seal buffer chamber and pipework, particularly if this is below the system level and/or isolation valves are fitted.

5.4 ELECTRICAL CONNECTIONS

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.

When fitted, the circulator pump should operational before the primary equipment pump is started. Use a suitable controller for the start-up sequence

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.

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TABLE 1. Alarm signals

Alarm name	Instrument	Set point	Notes
Refill Alert (Low Level Alarm)	Level Indicating Transmitter (LIT) or Low Level Switch (LLS)	If buffer fluid level drops below the 'LOW LEVEL' line on the level gauge	REQUIRED (when leakage is predominantly gas)
Low Level Shutdown Required Alarm (Low-Low Level Alarm)	Level Indicating Transmitter (LIT)	If buffer fluid level drops below the lowest point on the level gauge	REQUIRED (with LIT)
Drain Alert (High Level Alarm)	Level Indicating Transmitter (LIT) or High Level Switch (HLS)	If buffer fluid level rises above the 'HIGH LEVEL' line on the level gauge	REQUIRED (when leakage is predominantly liquid)
High Shutdown Required Alarm (High-High Level Alarm)	Level Indicating Transmitter (LIT)	If buffer fluid level rises above the highest point on the level gauge	REQUIRED (with LIT)
High Pressure/ Shutdown Required	Pressure Indicating Transmitter (PIT) or Pressure Switch (PS) or Differential Pressure Indicating transmitter (DPIT)	If pressure exceeds the maximum/alarm value on the nameplate	REQUIRED

A. Open the buffer fill connection and the vent valve or vent plug.

B. Using the fill connection, top-up the system with the selected buffer liquid using the top-up system chosen, until the level reaches the 'Normal Liquid Level' (NLL) line on the level gauge. Do not overfill.

NOTE With oil-based liquids it is recommended to fill slowly to avoid aerating the liquid.

C. Carefully check that 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 connector.

D. Completely vent all lines and the chamber between the seals.

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

F. (If fitted) Open the vent connections of each instrument valve to vent the instrument lines.

G. Close fill line. Vent valve remains open.

H. Connect the vent line to the gas management system.

The maximum buffer pressure is specified as the 'High Alarm Pressure' on the nameplate or General Arrangement drawing. See Section 8. A high-pressure alarm must be set to this value using the pressure transmitter to warn operators that there is an excessive ingress of process fluid into the buffer liquid, and the equipment must be shut down.

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

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

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

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

K. Check that the pressure transmitter/switch, and level transmitter/ switches set points are correctly adjusted to suit the duty (Table 1).

NOTE With oil-based liquids it is recommended to fill slowly to avoid aerating the liquid.

L. Start the machine.

M. Check the buffer fluid level and top-up if necessary, following the procedure outlined in Section 7.2.

N. Check suitable flow circulation by measuring the buffer outlet line to confirm there is a suitable temperature rise above the inlet.

O. 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.

P. The buffer settlement temperature when in service should typically be < 80°C (176°F). Some systems sealing hot process liquids may need to operate above this temperature; suitable warnings and protection must then be applied.

6.2 Decommissioning

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

Before carrying out any work on the seal or system, the buffer liquid must be fully depressurized and drained.

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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 buffer system and removal of any dangerous gas remaining in the reservoir. Remember fluid is often trapped during draining.

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

7. Maintenance

7.1 REGULAR MAINTENANCE CHECKS

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

- That the connections are leak-free
- Buffer liquid temperature (when displayed)
- Buffer liquid level. Compare with Low Level and High Level marks on the level gauge
- Buffer pressure. Compare with the alarm pressure on the nameplate
- Cooling water availability to the cooler/cooling coil (if fitted)
- Any abnormal leakage rate from the outer seal
- Condition of alarm signals (see Section 7.5)
- There is no accumulation of dust on any part of the Plan 52. Remove any built up dust as required

Never allow the buffer level to drop below the minimum mark on the vessel, 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.

In the circumstances where a Plan 52 system is used with a toxic or lethal process fluid or contaminant e.g. H2S, the buffer fluid must be periodically checked and replaced when contamination exceeds acceptable levels. Local regulations and legislation must be applied when determining these levels.

7.2 BUFFER TOP-UP

In the case that the process fluid leakage transitions into a gas phase, this process is required to replenish lost buffer volume from the outboard seal. The system is typically sized to allow at least 28 days to pass between top-up intervals. Top-up is carried out by various methods (see Section 4.1).

- Buffer top-up is required when the 'refill alert' is signalled by the level indicating transmitter when the buffer level drops below the 'Low Level' line on the level gauge. The top-up procedure should be carried out before the completion of the following work shift, from when the refill alert is triggered, and before the level falls to the bottom of the level gauge.
- Ensure the replenishment liquid is the correct specification, clean and free from contamination.

If buffer liquid systems need replenishment when in service this should only be done with fill systems that exclude air ingress and/or prevent gas leakage to the atmosphere.

- Using the fill connection, top-up the system with the selected buffer liquid using the top-up system chosen, until the level reaches the 'Normal Liquid Level' (NLL) line on the level gauge.
- Check the pressure in the buffer system. If it has risen above the recommended pressure, crack open the vent valve and reduce the pressure to the required value. Close vent valve.

7.3 BUFFER DRAIN

In the case that the process fluid leakage remains in a liquid phase, this process is required to release excessive buffer volume which has entered the reservoir through leakage form the inboard seal. The system is typically sized to allow at least 28 days to pass between drain intervals. Draining is carried out by various methods (see Section 4.1).

- Buffer draining is required when the 'drain alert' is signalled by the level indicating transmitter when the buffer level rises above the 'High Level' line on the level gauge. The drain procedure should be carried out before the completion of the following work shift, from when the drain alert is triggered, and before the level rises above the top of the level gauge.
- Crack open the drain valve and release the buffer fluid from the system, into a safe container or leakage collection facility, until the level reaches the 'Normal Liquid Level' (NLL) line on the level gauge.

The buffer will be continuously contaminated with process fluid from leakage across the inboard seal. Follow all safety precautions required when handling the process fluid, when handling the buffer fluid.

- Check the buffer fluid to determine if it has been sufficiently contaminated with process fluid to require replacement. See 7.4, buffer maintenance.

7.4 BUFFER MAINTENANCE

After the first 100 operating hours, and after every subsequent 6 months:

- Change the buffer 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.

7.5 INDICATORS AND ALARMS

The instrumentation on the system has the specific purpose of signalling eventual malfunction of the mechanical seals. Possible alarm signals indicating a malfunction are as shown in Table 2.

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TABLE 2. Possible alarm signals indicating a malfunction			
Effect	**Instrument**	**Action**	**Cause**
Rising Pressure	Pressure Gauge (PG) or Pressure Indicating Transmitter (PIT)	—	Excessive E or N
Refill Alert (Low Level Alarm)	Level Indicating Transmitter (LIT) or Low Level Switch (LLS)	A	F/G
Low Shutdown Required Alarm (Low-Low Level Alarm)	Level Indicating Transmitter (LIT)	C	Excessive F/G, or H
Drain Alert (High Level Alarm)	Level Indicating Transmitter (LIT) or High Level Switch (HLS)	B	E
High Shutdown Required Alarm (High-High Level Alarm)	Level Indicating Transmitter (LIT)	C	Excessive E or I/M
High Pressure Alarm	Pressure Indicating Transmitter (PIT) or Pressure Switch (PS) or Differential Pressure Indicating transmitter (DPIT)	C	Excessive E or N
Rising Temperature	Temperature Gauge (TI)	D	J to L

Actions	
A	Recharge system with fresh buffer liquid (see 7.2)
B	Drain system of excess buffer fluid (see 7.3)
C	Shut down equipment to protect seal and prevent loss of containment
D	Investigate cause of increased temperature

Causes	
E	Leakage from the inboard seal (process side)
F	Leakage from the outboard seal (atmospheric side)
G	Leakage from a flange or joint
H	Buffer fluid not topped up within required interval
I	Buffer fluid not drained within required interval
J	Process temperature rise
K	Inadequate cooling or flow of buffer circuit
L	Abnormally high process pressure
M	Buffer fluid topped up above the high level line on the level gauge
N	Back pressure from the flare / vapor collection system

The signal from the pressure transmitter can be used either:

- LOCALLY (with a Klaxon and/or beacon)
- REMOTELY (in the control room)

On critical items the alarm signal could be utilized as a trip function for the plant machinery.

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

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.

7.6 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 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 buffer liquid.

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

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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 buffer 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.

7.8 HEAT EXCHANGER MAINTENANCE

Heat exchangers in Plan 52 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 regular 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.

7.9 INSTRUMENT MAINTENANCE

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

8. Accompanying Documents

Installation Drawing (Job Specific) or

Typical Drawing and Operational Data Sheet

9. Cold Environments

For environments with low ambient temperatures, winterisation features may be added to the Plan 52. These may include:

- Instruments may be supplied mounted in a heated enclosure. The heating element requires electrical connection as part of the installation and assembly procedure (see Section 5.4)
- Heat tracing and/or insulation may be required to maintain the temperature of the fluids in the 52. This heat tracing and/or insulation may be supplied with the Plan 52, or may be applied on site as required.
- Care must be taken during commissioning and operation, that the buffer fluid is brought up to operating temperature before the machine is started, and the correct temperature is maintained throughout operation.

ATTENTION

- **Use dual unpressurized seals with harmful or toxic products.**
- **All safety requirements must be strictly adhered to.**
- **Ensure all precautions are taken to avoid personnel hazards.**
- **Full machinery protection is ensured.**
- **Use protective clothes.**
- **In the event of an operating problem the machinery must be switched off immediately and made safe, promptly.**
- **This seal 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 manufacturer from any liability or warranties.**
- **During normal operation of a dual pressurized or unpressurized seals, working on toxic products like H2S, due to the physical inboard seal leakage towards the outboard seal, the buffer fluid inside the reservoir may be contaminated.**
- **In this case the reservoir must be considered as dangerous and contaminated area by such a product. During the maintenance operation the operators have to be informed about the dangerous area; for safety reasons the operators must be protected wearing gloves and respirators and suitable osmoscope.**
- **Pay attention the reservoir has not to be vented or drained to atmosphere but to a safe area due to the high H2S toxicology, the buffer fluid has to be periodically checked and replaced when contamination exceeds acceptability limits provided by local laws on safety and environment pollution.**

All above according to the local legislation.

For further information and safe operating limits contact John Crane.

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

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