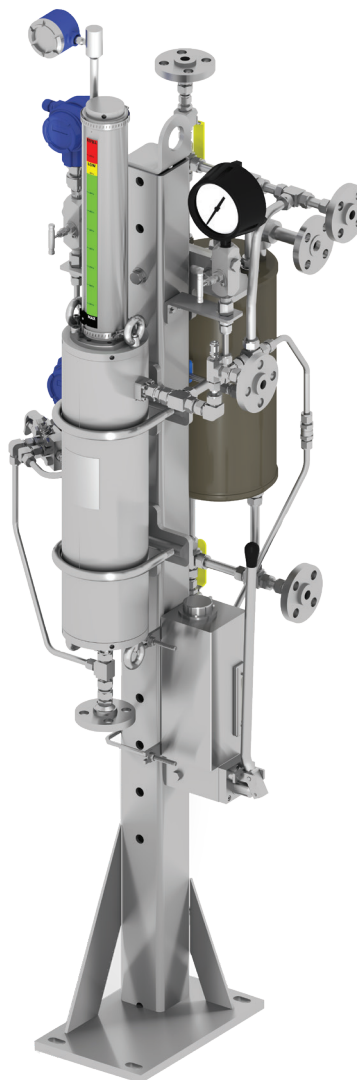


Standard Plan 53C API 682 Plan 53C Piston Accumulator



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1. Introduction

1.1 About this manual

This manual (which is intended for operating, maintenance, and supervisory personnel) provides information on installing, operating, and maintaining the Plan 53C System.

Installation in accordance with the following instructions will contribute to long and trouble-free operation of the assembly.

1.2 How to use this manual

Before using this manual, make sure you have fully read and understood the safety section, which can be found in chapter 2. When being new to the Plan 53C, pay attention to section 4, which describes the system in detail.

Only trained and qualified personnel should operate the Plan 53C. Refer to section 2.3. Inexperienced personnel should work on this system under the supervision of qualified personnel.

When maintaining the 53C, always make sure maintenance procedures are followed. Pay particular attention to the alerts and icons.

The Plan 53C shall be used as described in this manual. Discuss with Flowserve if adjustments beyond its regular use are required.

Changes, modifications, repairs or use under conditions deviating from the design specifications without prior permission of Flowserve can invalidate the product certification, declaration of conformity and / or nameplate.

Note: As hazardous conditions can result from planned as well as unforeseen circumstances, pressurized equipment shall always be operated with caution, per site and local policies.

Before installation, equipment should always be fully inspected including, but not limited to:

- Any possible damage due to transport or storage
- Cleanliness required before operation
- Existence of an affixed nameplate with correct inspection markings and design/test conditions

1.3 Other supplied Documents

Annex II contains the assembly drawing and sub-component manuals.

1.4 Conformity with Standards and Directives

The Plan 53C System conforms to the following standards and directives:

- ASME BPVC Section VIII Div. 1 (U-Stamp)
- Pressure Equipment Directive (PED) 2014/68/EU
- Pressure Equipment (Safety) Regulations (PESR) 2016 (UKCA)
- CSA B51 (CRN)
- ATEX Directive 2014/34/EU
- API 682

1.5 Use of alerts and icons

This manual uses “Notes”, “Cautions”, “Warnings” and “Dangers” to alert you of important information and/or hazardous situations.

Note: “Notes” inform you of important additional information.

CAUTION	
	The equipment, product or surrounding area can be damaged if the “caution” is not obeyed.

WARNING	
	Personnel can be (seriously) injured, or the equipment can be seriously damaged if the “warning” is not obeyed.

DANGER	
	Personnel can be (seriously) injured if the “danger” sign is not obeyed.

DANGER / WARNING	
	Danger or Warning that refers to the use of the system in potentially explosive atmosphere – in accordance with the ATEX Directive 2014/34/EU.

The above icons are the general icons that are used for “Cautions”, “Warnings” and “Dangers”. More specific icons are also used, depending on the type of hazard. See section 2 for an example.

2. Safety

2.1 Types of hazardous exposures

The following hazards can be present in the system:

- High pressure
- Dangerous or Toxic chemicals
- Temperature (hot or cold surfaces)
- Dangerous moving parts (during installation or maintenance)
- Electrical Hazards

If the 53C has any external leaks, the system in which it is used should be stopped and have the leak repaired by qualified personnel. When extreme conditions occur, and the possibility of a failure is imminent, plant and end-user safety regulations shall be followed.

WARNING	
	HIGH PRESSURE: Take caution when de-pressurizing the Plan 53C Piston Accumulator. The Plan 53C Piston Accumulator might have energy stored inside. Make sure that depressurizing happens slowly.

WARNING	
	HOT SURFACES: The Plan 53C Piston Accumulator and surrounding surfaces might be hot. Take care when touching components. Wear the appropriate Personal Protection Equipment (PPE), according to plant regulations.

WARNING	
	HAZARDOUS CHEMICALS: Dangerous chemical might be released during removal of the Plan 53C Piston Accumulator. Wear Personal Protective Equipment (PPE). Follow all safety regulations and Plant regulations.

2.2. General safety

When installing, operating, and maintaining the Plan 53C Piston Accumulator, pay attention to safety:

- Obey all applicable safety laws and regulations
- Obey all plant regulations
- Make sure that only trained and qualified personnel work on it. Refer to section 2.3
- Read and understand each part of this manual
- Follow the installation, operation, and maintenance procedures
- Wear the relevant Personal Protective Equipment (PPE). Refer to section 2.4
- Never work alone (to prevent the possibility of an accident)
- Read the plant requirements for handling hazardous materials
- Check MSDS for relevant information
- Verify safety equipment in and around the work area: first aid kits, safety showers (if applicable), fire extinguishers, escape routes, shut off valves, etc.
- Make sure that personnel are fully trained on how to use the safety equipment and availability of first aid specialist

2.3. Trained and qualified personnel

Qualified personnel are people who have been authorized by those responsible for the safety of the plant to perform the necessary work, and who can recognize and avoid possible dangers.

The following aspects determine the qualification of personnel:

- Appropriate training
- Relevant experience
- Knowledge of relevant standards and specifications
- Knowledge of accident prevention regulations
- Knowledge of plant regulations and operating conditions

2.4. Personal protective equipment (PPE)

The 53C is often used for applications containing high-pressure, high-temperature and/or toxic chemicals. When performing operating or maintenance tasks, make sure you wear the appropriate Personal Protective Equipment (PPE): protective clothing, gloves, safety glasses, et

Always follow local regulations regarding PPE. Wear the safety equipment as defined for the specific work area.



2.5. Actions in extreme conditions

In the unlikely event of emergency operating conditions always follow emergency plant regulations. Immediate evacuation of service personnel shall follow plant regulations.

3. Environmental Considerations

CAUTION	
	You are required by law to dispose waste products and end of life equipment, according to local regulations.

3.1. Disposing of waste products

Make sure waste products are diverted to a safe and suitable location. Always follow local and plant regulations.

Any waste products resulting from the use or maintenance of the Plan 53C Piston Accumulator must be recycled or disposed of according to local environment laws and regulations.

3.2. End of life equipment

WARNING	
	HAZARDOUS CHEMICALS: Dangerous chemical might be released during removal of the Plan 53C Piston Accumulator. Wear Personal Protective Equipment (PPE). Follow all safety regulations and Plant regulations.
WARNING	
	HIGH PRESSURE: Take caution when de-pressurizing the Plan 53C Piston Accumulator. The Plan 53C Piston Accumulator might have energy stored inside. Make sure that de-pressurizing happens slowly.
WARNING	
	HOT SURFACES: The Plan 53C Piston Accumulator and surrounding surfaces might be hot. Take care when touching components. Wear the appropriate Personal Protection Equipment (PPE), according to plant regulations.

When the equipment reaches the end of life, the shutdown procedure (section 7.4) shall be followed. The equipment must then be deinstalled and transported to a safe location. Always pay extra attention to safety!

Note: End of life equipment must be disposed of according to local environment laws and regulations.

4. Description

4.1. Product purpose

- Prevent a dual pressurized seal from leaking process media to atmosphere by circulating a pressurized barrier fluid over the mechanical seal.
- Use a piston accumulator to boost the pressure of a barrier fluid using a reference pressure from the pump to establish a higher pressure in the seal chamber.
- Regulate the temperature of the barrier fluid by using a heat exchanger with water or air.
- Monitor the performance of the mechanical seal by measuring the barrier fluid level, the differential pressure across the piston, and optionally the barrier fluid pressure.
- Lubricate the seal faces.

4.2. Plan 53C Working Principle

Figure 1 shows the dual mechanical seal arrangement with the Plan 53C Piston Accumulator. Notice there are two main flow lines: 1. Reference pressure line (shown in red) and 2. Pressurized line (shown in blue).

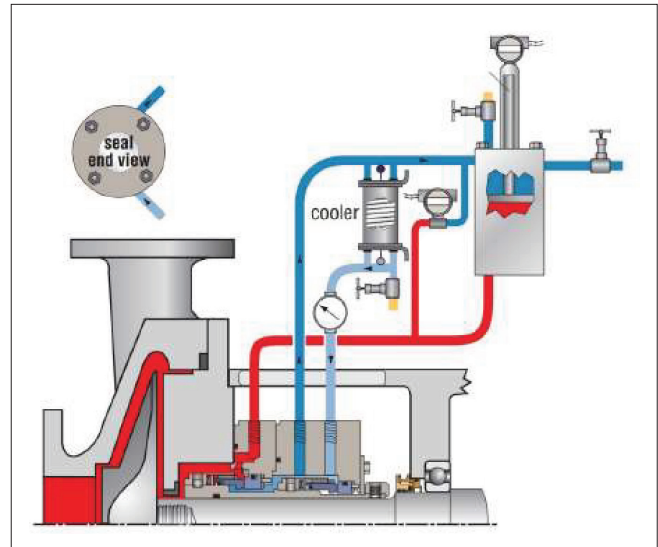


Figure 1: Mechanical Seal with Plan 53C Schematic

In a Piping Plan 53C, there is an external barrier fluid system pressurized by a piston accumulator supplying clean liquid to the barrier fluid seal chamber. The barrier liquid is maintained at a pressure greater than seal chamber pressure. The barrier fluid pressure is typically 1.1 times the reference pressure (this is the pressure boost of the piston accumulator).

Barrier liquid is circulated through the system by means of an internal circulating device. To maximize barrier liquid circulation, the piping losses should be minimized through the proper selection of pipe size, elimination of fittings, use of large radius bends, and reduction in the length of piping runs. Plan 53Cs are used with an Arrangement 3 liquid seal, as shown in figure 2.

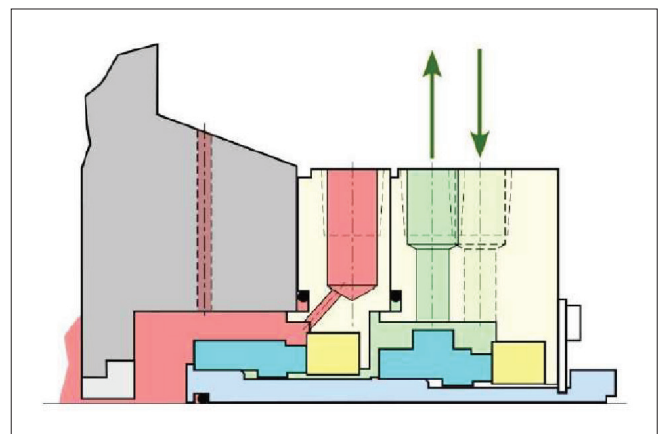


Figure 2: Pump Seal and Pumping Ring Section View

The piston accumulator senses pressure from a reference source (normally a line connected to the seal chamber) and creates a higher pressure through differential areas in the piston. This high pressure creates the required pressure differential necessary for the seal. Since the barrier pressure is generated from the seal chamber pressure, the system is self-energizing and reacts to fluctuations in the seal chamber fluid pressure, as shown in figure 3:

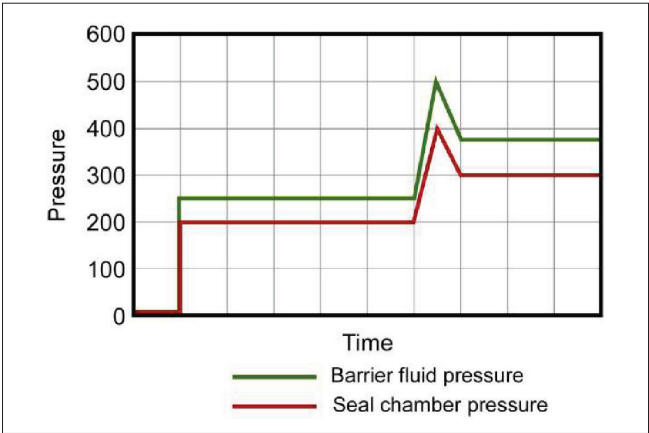


Figure 3 Sample pressure graph showing the barrier fluid (upper chamber) pressure of the piston accumulator tracking the Seal (lower chamber) pressure. In this example, there is no pressure before commissioning, the barrier fluid automatically pressurizes, tracking variations and upsets

To create the reference pressure in the piston transmitter, process fluid is introduced into the lower chamber of the piston, meaning the materials used in the piston transmitter need to be compatible with the process fluid. Process fluids with solids that tend to plate out on metal surfaces or solidify under atmospheric temperatures are not suitable for a Plan 53C.

WARNING	
	HAZARDOUS CHEMICALS: Dangerous chemical might be released during removal of the Plan 53C Piston Accumulator. Wear Personal Protective Equipment (PPE). Follow all safety regulations and Plant regulations.

Effective flow of the Plan 53C system is only achieved with proper exclusion of all gas and air bubbles from the piston accumulator and other components of the 53C. Venting of the system during commissioning is critical to proper operation.

WARNING	
	HIGH PRESSURE: Take caution when de-pressurizing the Plan 53C Piston Accumulator. The Plan 53C Piston Accumulator might have energy stored inside. Make sure that depressurizing happens slowly.

4.3. Plan 53C Description

Figure 4 shows a typical Plan 53C system. The exact system design and components vary depending on the installation requirements. For detailed information on your Plan 53C system, refer to the GA drawing(s) in the appendix.

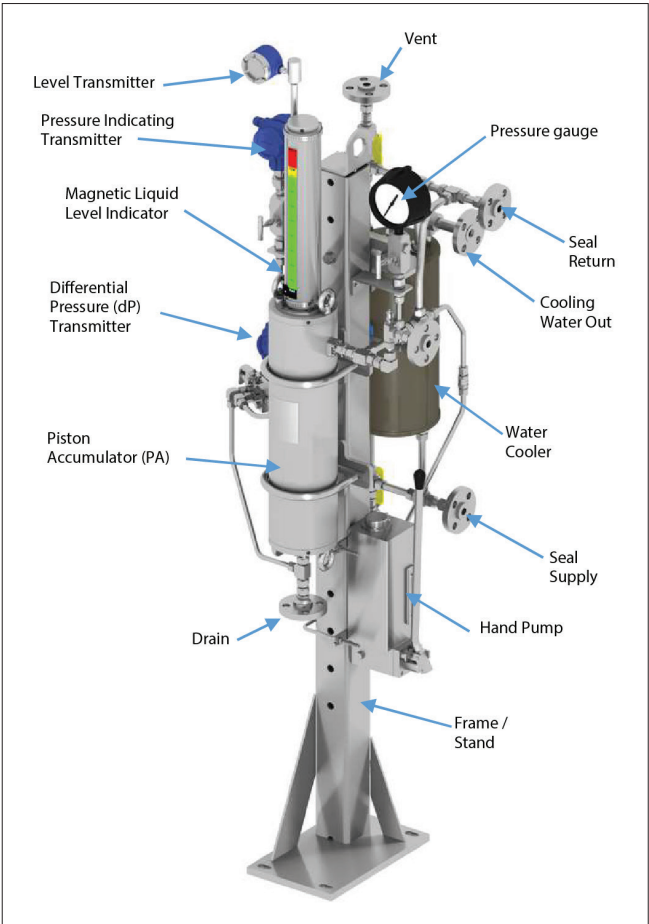


Figure 4: Isometric View of a Typical Plan 53C with a 682H cooler

Note: The images of parts shown in these instructions may differ visually from the actual parts due to manufacturing processes that do not affect the part function or quality. Refer to specific product drawing for connection and dimensional details.

Figure 5 shows a typical Plan 53C system P&ID. The P&ID and the 53C components vary depending on the installation requirements. For detailed information on your specific Plan 53C system, refer to the GA drawing(s) in the appendix.

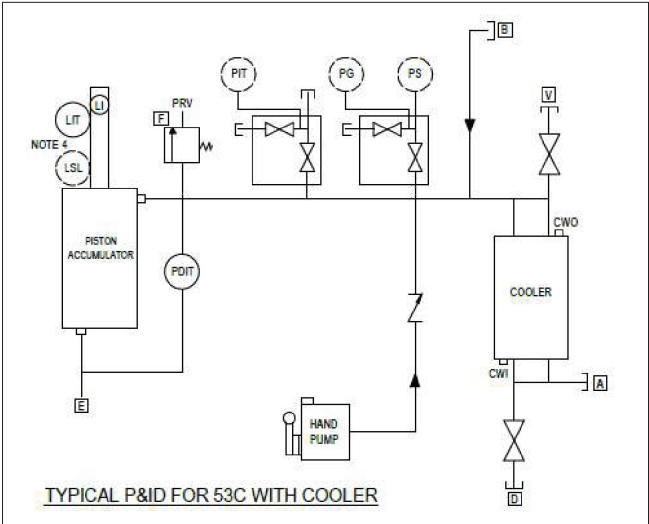


Figure 5: P&ID of a Typical Plan 53C

4.4. Parts

Standard Parts

Acronym	Name	Function
C	Cooler	Used for cooling the working fluid. 3 types are available: water cooler, finned tube/pipe and forced draft air (size depends on the operating conditions).
PA	Piston Accumulator	A pressurized device with a reference chamber and a barrier fluid chamber. A piston is used to boost the pressure of the barrier fluid provided to the dual mechanical seal
LI	Level Indicator	An instrument used to indicate the location of the piston within the housing
LIT	Level Indicating Transmitter	An electrical instrument used to indicate and retransmit the location of the piston within the housing
BBV	Block and Bleed Valve	A flow device used to isolate and drain and/or vent an instrument
BV	Ball / Gate Valve	A device used to allow / prevent flow

Optional Parts

Acronym	Name	Function
HP	Hand Pump	A positive displacement, hand actuated fluid pressurization device used to fill the 53C before use
LSL	Level Switch Low	An electrical instrument used to transmit a signal indicating that the piston is at the lowest acceptable level for proper system operation
PG	Pressure Gauge	An instrument used to monitor the pressure of the barrier fluid
PIT	Pressure Indicating Transmitter	An electrical instrument used to monitor and retransmit the barrier fluid pressure value
PRV	Pressure Relief Valve	A mechanical device used to reduce the pressure of the barrier fluid chamber in case when the set point value is reached
PS	Pressure Switch	An electrical instrument used to transmit a signal indicating that the barrier fluid pressure has reached the lowest acceptable value for proper system operation

The plan 53C is provided with transmitters as standard, as defined by API 682 4th Edition. Switches are available as an option when specified by the customer. The pressure indicating transmitter and pressure gauge, are optional instrumentation, given that these

components are not part of API 682 4th edition, but are frequently requested by customers. Refer to the plan 53C Smart Drawing for a full list of instrumentation available.

4.5. Design Features

The standard plan 53C uses Flowserve's standard 1.5-gallon (5.6 liter) working-volume standard Piston Accumulator. Note this volume is equivalent to the working volume of Flowserve's 682R 5-gallon (19 liters) API 682-compliant reservoir, as described in API 682 section 8.3.6.4.2

Flowserve's Standard Piston Accumulator (PA) is designed to meet and exceed the requirements stated in the Fourth Edition of API Standard 682 for Plan 53C. Its fully machined design allows for quick delivery, ease of operation and maintenance. Refer to figures 6 and 7 for an isometric view and $\frac{3}{4}$ section isometric view of the PA.

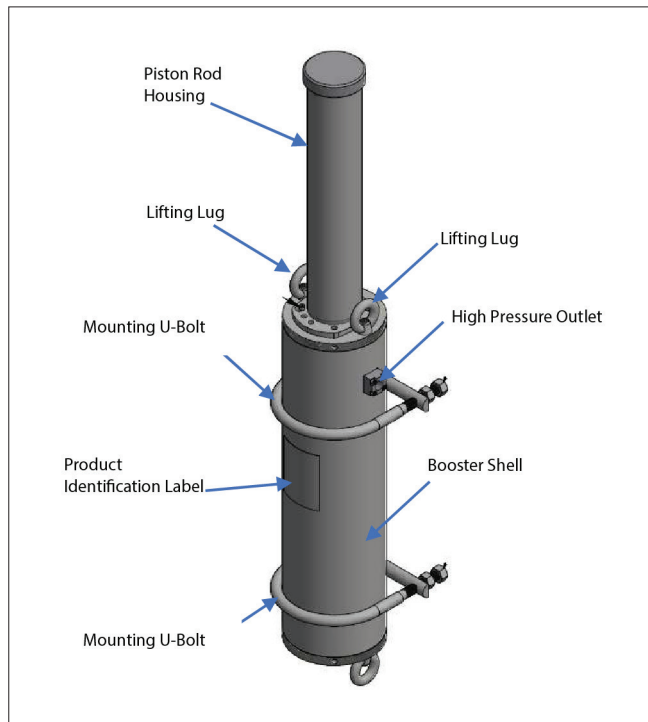


Figure 6: Piston Accumulator Isometric View

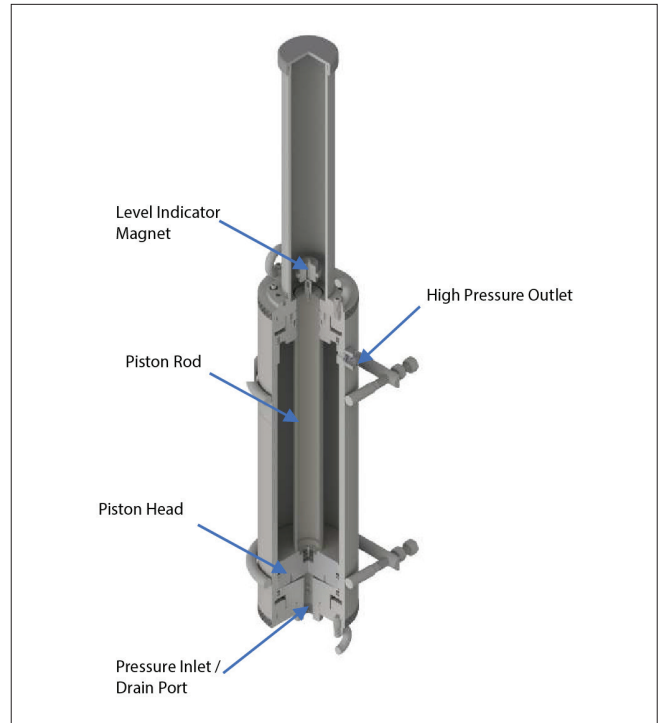


Figure 7: Piston Accumulator $\frac{3}{4}$ Sectional View

The standard 53C is available with 7 optional Flowserve-made coolers, as shown in figure 8. Flowserve Application Engineers can assist you to select the most appropriate cooler for your specific application.

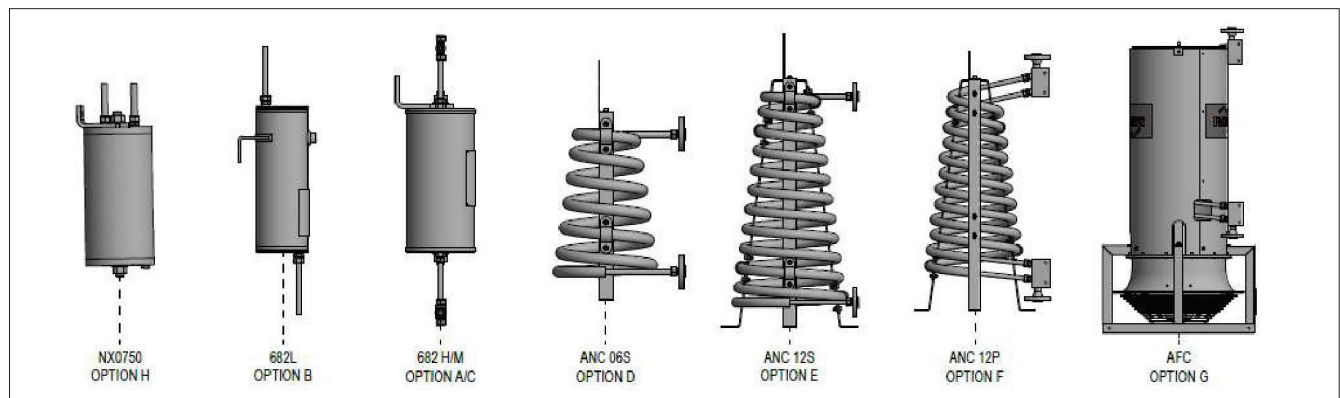


Figure 8: Cooler Options available for Standard Plan 53C

Note: The images of parts shown in these instructions may differ visually from the actual parts due to manufacturing processes that do not affect the part function or quality. Refer to specific product drawing for connection and dimensional details.

The following tables show the design characteristics of the Standard Plan 53C, as a function of the port connection.

Description	NPT	Tubing	Class 600	Class 1500
MAWP	3000 psi @ 400°F (206.8 bar @ 204°C)	3000 psi @ 400°F (206.8 bar @ 204°C)	1240 psi @ 200°F (85.4 bar @ 93.3°C)	300 psi @ 200°F (206.8 bar @ 93.3°C)
MAWT	400°F @ 3000 psi (204°C @ 206.8 bar)	400°F @ 3000 psi (204°C @ 206.8 bar)	400°F @ 1025 psi (204°C @ 70.6 bar)	400°F @ 2570 psi (204°C @ 177.2 bar)
MDMT	-50°F @ 3000 psi (-45.5°C @ 206.8 bar)	-50°F @ 3000 psi (-45.5°C @ 206.8 bar)	-50°F @ 1240 psi (-45.5°C @ 85.4 bar)	-50°F @ 3000 psi (-45.5°C @ 206.8 bar)
Min.Operating (TZ)	-1°F (-18°C)	-1°F (-18°C)	-1°F (-18°C)	-1°F (-18°C)
Min.Operating (AD)	-4°F (-20°C)	-4°F (-20°C)	-4°F (-20°C)	-4°F (-20°C)

Table 1a – Pressure / Temperature rating of the standard plan 53C

Port	Connection	NPT	Tube	Class 600	Class 1500
A	Seal Supply	¾" NPT	¾" Tube OD	¾" RF Class 600	¾" RF Class 1500
B	Seal Return	¾" NPT	¾" Tube OD	¾" RF Class 600	¾" RF Class 1500
D	Drain	¾" NPT	¾" Tube OD	¾" RF Class 600	¾" RF Class 1500
V	Vent	¾" NPT	¾" Tube OD	¾" RF Class 600	¾" RF Class 1500
E	Reference Pressure Port	½" NPT	½" Tube OD	¾" RF Class 600	¾" RF Class 1500
F	PRV Vent	½" NPT	½" Tube OD	¾" RF Class 600	¾" RF Class 1500

Table 1b – Connections table for the standard plan 53C

5. Preservation, Packing, Transport and Storage Requirements

5.1. Mechanical preservation instructions

5.1.1. Preservation

Equipment should not be sealed in a way that it will obstruct inspection. Access for normal inspection and preservation maintenance shall be provided. Internal surfaces of pressure vessels, piping systems and similar equipment shall be dried and cleaned of surface corrosion and foreign material.

The Plan 53C Piston Accumulator shall be thoroughly cleaned and dried after manufacturing and testing, prior to application of preservatives.

For equipment where water is used for cleaning or pressure testing, the water shall have antifreeze medium added unless the water is completely drained off. This also applies if the ambient temperature is below 4°C during any of these operations.

Internal surfaces wholly consisting of corrosion resistant materials shall not be preserved unless stated otherwise.

5.1.2. Packing

For de-preservation the applicable dust caps/plugs need to be removed prior to commissioning. During hook up it is mandatory to keep these caps/plugs in place for as long as possible to prevent contamination.

5.2. Packing

WARNING	
	CRUSH HAZARD: Possible injury and/or trapped limbs. Take care to avoid being trapped or crushed between heavy, moving objects when (un)boxing the cooler.

The Plan 53C Piston Accumulator shall be lifted carefully with proper equipment.

Always make sure that proper lifting devices are used.

To prevent damage during transport all equipment needs to be properly secured inside their package with suitable bolting, straps, or wooden supports.

For unboxing, the equipment must be lifted carefully out of its shipping box.

5.3. Transportation and storage requirements

Note: The following requirements apply to the Plan 53C Piston Accumulator and all related equipment:

Transport and storage criteria	Requirements
Transportation	The system must be transported and stored in the unopened, original shipping box.
Suspect damaged during transportation	Carefully inspect equipment that has been dropped or has been subjected to impacts during transport to confirm that they are operational before installation.
Warehouse requirements	The warehouse must be dry and dust free.
Long-term storage	After a storage period of 2 years, inspect the Plan 53C Piston Accumulator before installation.
Preserving installed Plan 53C Piston Accumulator Series	The preserving medium prevents damage to the installed system or mechanical seal (i.e. preventing fouling or chemical attack). Contact Flowserve if you are unsure which preserving medium to use.

Table 2 - Transport and Storage Criteria

6. Installation

6.1. Introduction

WARNING	
	CRUSH HAZARD: Possible injury and/or trapped limbs. Take care to avoid being trapped or crushed between heavy, moving objects when installing the coolers.

Before installing the Plan 53C Piston Accumulator, make sure you have read and understood the installation requirements in this section. If you have any questions regarding the installation of the Plan 53C Piston Accumulator, contact your local Flowserve representative.

6.2. Safety considerations

WARNING	
	SUFFOCATION HAZARD: Breathing hazardous chemicals in a confined space can result in sudden unconsciousness or death. Take extra care when working in confined areas.

Position the Plan 53C Piston Accumulator as close to your main equipment as possible. Make sure there is sufficient room for:

- Evacuation of the plant in case of an emergency (do not block walkways and emergency exits)
- Safe operation and maintenance of the system

6.3. Installation requirements

Before installation the following shall be checked:

- Any possible damage due to transport or storage
- Cleanliness, required before operation
- Existence of the nameplate with correct inspection markings and design/test conditions

6.4. Product Set-Up

6.4.1. Mounting

The plan 53C does not have specific height requirements when the piston transmitter is connected to a closed cooler loop. For height of the system, refer to the cooler manual in the appendix.

6.4.2. Interconnecting Pipes

The flow of barrier fluid through the system can be generated by:

- A pumping device included in the seal design (such as a pumping ring)
- An external circulating pump
- Thermosyphoning (hot standby)

The interconnecting pipes between the system and the mechanical seal must be fitted correctly to minimize barrier fluid flow restrictions.

As general rule, follow best practices for interconnecting piping:

- Minimize the number of restrictions (for example, by limiting elbows or Tee fittings).
- Use smooth, large radius bends.
- Unless otherwise specified, the pipe size should be ¾" (DN20) and schedule shall be the same as the system piping.
- The pipes must be clean and free of burrs.
- The total pipe length and number of bends shall be kept to a minimum.
- Pipe runs should be sloped continuously up or down to allow for adequate circulation, proper venting and draining.
- Make sure that the loop, including seal flange, does not include vapor traps. When vapor traps cannot be avoided, a proper venting solution shall be added.

- For threaded connections, do not use Teflon tape but an anaerobic thread sealant.
- Leak testing is recommended after assembly. Refer to end user specifications or procedures.

6.5. Installation procedure

Use this procedure to install or reinstall the system.

Procedure

1. Before installing the system, inspect all components for damage. If any of the components are damaged, you should report this to your local Flowserve representative. Refer to section 6.3.
2. Determine the installed position of the system. Refer to the mounting requirements, section 6.4.
3. The 53C system shall not be moved by hand. It is equipped with a lifting lug. Use an appropriate lifting device to position the system as close as possible to the main equipment. Make sure you leave sufficient room for operation and maintenance purposes.

WARNING	
	CRUSH HAZARD: Possible injury and/or trapped limbs. Take care to avoid being trapped or crushed between heavy, moving objects when installing the cooler.

4. Make sure that the 53C system is installed in a rigid support to counteract any vibrations and instability.

WARNING	
	HIGH PRESSURE: Take caution when de-pressurizing the 53C system. The system might have energy stored inside. Make sure that de-pressurizing happens slowly.

5. Connect the 53C reference port to the pump reference line to monitor seal chamber pressure.
6. Connect the seal supply and seal return lines to the corresponding ports in the mechanical seal.
7. Connect the drain to a drain or a safe disposal point
8. Connect the vent port to a safe location.
9. If the 53C is equipped with a water cooler, connect water lines to the cooler. Follow the cooler IOM.
10. Connect wiring to any instruments included with the system including level transmitter, pressure, and level switch/transmitters.
11. If present, connect PRV connection to a safe location.

12. Manufacture the interconnecting piping according to the Installation requirements
13. Make sure the installation is correctly earthed to prevent the potential risk of explosion caused by static electricity.

DANGER	
	EXPLOSION RISK: Static electricity can build up and ignite flammable vapors. The system must be correctly earthed to minimize the risk of explosion caused by static electricity.

Note: Leak testing is recommended after assembly. Refer to end user specifications or procedures.

7. Operation

7.1. Introduction

Use this procedure if:

- the system is being set-up for the first time, or
- the barrier fluid has been completely drained from the system.

A Plan 53C system is not self-venting. Any air trapped in the barrier fluid will have a negative effect on the performance of the seal. During system set-up venting is extremely important.

1. Make sure all instrument block bleed valves are open (as applicable).
2. Make sure the drain block valve is closed.

DANGER	
	EQUIPMENT OR PRODUCT DAMAGE: Dirty or incorrect barrier fluid can damage the equipment or product. Make sure the barrier fluid is correct for the product being processed.

3. Using the level instrumentation, confirm the piston location. Fill the barrier chamber of the booster. The plan 53C shall be filled with clean fluid compatible with the process media.
 - a. Open the vent valve.
 - b. Connect the filling unit (hand pump or external source) to the fill connection of the Plan 53C.
 - c. Fill the barrier chamber with the specified barrier fluid
 - d. Close the vent valve when the booster has filled with fluid and fluid begins to exit thru the vent line.
4. Fill the Reference chamber of the piston accumulator. Open valve to allow fluid to enter and fill the bottom chamber.

5. Review instrument readings
6. Remove all trapped air from both chambers by cycling the piston accumulator:
 - a. Fill the reference chamber until the piston reaches the upper end of the accumulator.
 - b. Fill the upper chamber until the piston reaches the bottom end of the accumulator.
 - c. Repeat steps 6.a and 6.b 3 to 5 times.
7. If the air cannot be removed fully, contact your Flowserve representative for further instructions.
8. Refill the barrier side chamber to the maximum level.
9. Check for leaks at fittings and pipe work, rectify as necessary.

WARNING	
	HIGH PRESSURE: If a PRV is not installed, the high-pressure section of the 53C (barrier fluid) won't be protected against overpressure. Make sure that the MAWP indicated in the 53C drawings is not exceeded during operation.

7.2. Start-Up

1. Make sure the 53C is installed correctly, refer to chapter 6.5.
2. Open the interconnecting valving for the system.
3. Make sure commissioning of the system has been performed properly, following chapter 7.1
4. Start up the pump according end user/plant procedures.

7.3. Product Monitoring

WARNING	
	HIGH PRESSURE: Take caution when de-pressurizing the 53C, as it may have energy stored inside. Make sure that de-pressurizing happens in a controlled manner.

WARNING	
	HOT SURFACES: The 53C and surrounding surfaces might be hot. Take care when touching components. Wear the appropriate Personal Protection Equipment (PPE), according to plant regulations.

WARNING	
	HAZARDOUS CHEMICALS: Hazardous chemicals might be released during removal of the 53C. Wear Personal Protective Equipment (PPE). Follow all safety regulations and Plant regulations.

1. Monitor the 53C for correct operation. Follow periodic maintenance tables per section 8.2. If the 53C does not seem to operate properly, refer to troubleshooting table on chapter 9.
2. Make sure:
 - there are no leaks
 - there is no cavitation in the system (the pressure, temperature and level in the 53C should not fluctuate abruptly)
 - there is no heavy vibration in the system
3. If you notice any problems with the 53C, follow plant regulation for reporting and correcting faulty equipment.
4. 53C performance should be monitored periodically. Follow section 8.2. Baseline temperatures should be collected soon after equipment commissioning.

7.4. System Shut-Down

WARNING	
	HIGH PRESSURE: Take caution when de-pressurizing the 53C, as it may have energy stored inside. Make sure that de-pressurizing happens slowly.

WARNING	
	HOT SURFACES: The 53C and surrounding surfaces might be hot. Take care when touching components. Wear the appropriate Personal Protection Equipment (PPE), according to plant regulations.

WARNING	
	HAZARDOUS CHEMICALS: Hazardous chemicals might be released during removal of the 53C. Wear Personal Protective Equipment (PPE). Follow all safety regulations and Plant regulations.

The 53C may be disconnected only by qualified personnel, in accordance with national, facility and enduser safety regulations and Chapter 2 in this manual.

Check if the 53C can be shut down without negatively affecting the mechanical seal installed in main equipment. System cannot be shut down if any of the following main equipment conditions occur:

- Main equipment/ Pump is on hot stand-by
- Main equipment/ Pump is pressurized
- Main equipment/ Pump is in operation

Note: Always shut down the system according to plant regulations/ end user safety procedures.

Once safe to do so, shut down the 53C by:

1. Shutting down the pump following manufacturer's instructions, end-user and facility regulations
2. Stopping circulation pump (if present)
3. Isolating the 53C system
 - a. Close isolation valves for the cooling water (if present) or turning of cooler fan (if present)
 - b. Close seal interconnecting valves
4. De-pressurizing and drain the 53C system
 - a. Open reference port drain valve
 - b. Open barrier fluid vent valve

For removal and maintenance, the complete system must be de-pressurized (and drained as required)

8. Maintenance

8.1. General guidelines

Periodic maintenance must be done at regular intervals (weekly, monthly, yearly). Refer to the following tables.

All liabilities and warranties to Flowserve for damage incurred using non-original replacement parts and accessories will be rendered null and void.

8.2. Periodic maintenance tables

Use the following tables to plan the periodic maintenance for your system (refer to the table of contents and the Appendix for the relevant information)

Weekly maintenance
Check the seal, 53C, and interconnecting pipe work for leaks. Rectify if necessary.
Confirm that the 53C is not vibrating.
Check the fluid pressure (differential), level and temperature.

Monthly maintenance
Confirm proper operation of the 53C
Check the fluid for impurities.
Vent the 53C interconnecting pipelines if needed

Yearly maintenance
Replace barrier fluid
Confirm proper operation of the 53C, replace Piston Accumulator wear seals if required

Table 3 - Periodic Maintenance Tables

8.3. Inspection Procedure

WARNING	
	HIGH PRESSURE: Take caution when de-pressurizing the 53C, as it may have energy stored inside. Make sure that de-pressurizing happens slowly.

WARNING	
	HOT SURFACES: The 53C and surrounding surfaces might be hot. Take care when touching components. Wear the appropriate Personal Protection Equipment (PPE), according to plant regulations.

WARNING	
	HAZARDOUS CHEMICALS: Hazardous chemicals might be released during removal of the 53C. Wear Personal Protective Equipment (PPE). Follow all safety regulations and Plant regulations.

The product maintenance procedure is as follows:

- Remove the 53C from service. Refer to section 7.3. Shut-Down Product.
- Clean the 53C internally and externally. Follow the assembly drawing. If in doubt, ask a Flowserve representative for clarification.
- Inspect all components for damage or corrosion and replace as needed.
- Re-install the 53C. Refer to section 6.5. Installation Procedure.

9. Troubleshooting

Use the following table to troubleshoot the system. Once you have identified the problem, use the procedures in this manual to resolve the issue. If you are not sure how to troubleshoot or maintain your 53C, please contact your local Flowserve representative.

Note: the recommended response actions always include notify the supervisory authority and respond according to plant regulation.

Parameter	Indication	Possible Cause	Solution
Pressure	Low	- Leakage in connections, gaskets, piping - Mechanical seal failure - Flush/Barrier source supply pressure fails. - Piston Accumulator internal seal leakage	- Check connections for leakage - Check gaskets for leakage - Check piping for leakage - Check mechanical seal - Isolate Piston Accumulator and confirm internal leaking. Contact Flowserve for further instructions
Pressure	High	- Inner mechanical seal failure - Process discharge closed	- Repair mechanical seal - Open discharge line
Flow	Low	- Closed Seal Supply or Seal Return Isolation Valve - Clogged interconnecting piping - Flush/Barrier source supply pressure fails	- Check for blockages, open valves as necessary - Localize blockage and resolve - Review supply source
Temperature	High	Shell and Tube Cooler: - Insufficient cooling fluid supply - Insufficient cooling fluid temperature - Cooling coil is clogged Air Cooler: - Insufficient heat transfer	Shell and Tube Cooler: - Check the temperature and flow rate of the cooling fluid - Check cleanliness of the cooling coil, remove contaminants as required Air Cooler: - Relocate cooler to ensure air draft is available - Review proper operation of air cooler fan

Table 4 - Localization and Elimination of Faults, Damages, and Consequences

ANNEX I

System logbook

Copy and use this logbook to record periodic or corrective maintenance done on your system.

Use the following codes and enter remarks, the date, and your name:

Weekly maintenance (W)	Monthly maintenance (M)	Yearly maintenance (Y)	Adjust (A)	Replace = R
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[illegible]

ANNEX II



Headquarters

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Flowserve Corporation has established industry leadership in the design and manufacture of its products. When properly selected, this Flowserve product is designed to perform its intended function safely during its useful life. However, the purchaser or user of Flowserve products should be aware that Flowserve products might be used in numerous applications under a wide variety of industrial service conditions. Although Flowserve can provide general guidelines, it cannot provide specific data and warnings for all possible applications. The purchaser/user must therefore assume the ultimate responsibility for the proper sizing and selection, installation, operation, and maintenance of Flowserve products. The purchaser/user should read and understand the Installation Instructions included with the product, and train its employees and contractors in the safe use of Flowserve products in connection with the specific application.

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