



## USER INSTRUCTIONS

*Installation*  
*Operation*  
*Maintenance*

# Standard Piston Accumulator



*Experience In Motion*

## 1. Introduction

### 1.1 About this manual

This manual is intended to ensure the safe installation and effective operation of the Standard Piston Accumulator. It is highly recommended that all applicable personnel review and follow the guidance provided by this manual.

**Note:** As hazardous conditions can result from planned as well as unforeseen circumstances, pressurized equipment shall always be operated with caution. Before installation, equipment should always be fully inspected including, but not limited to checking for:

- 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 clearly annotated

### 1.2. How to use this manual

Only trained and qualified personnel should install or operate the equipment. Refer to section 2.3 for safe product operation. Inexperienced personnel should only work on this system under the supervision of a qualified person.

Before using this manual, make sure you have fully read and understand the safety section. Section 5 describes the system in detail.

When system maintenance is performed, ensure that maintenance procedures are followed, paying close attention to the alerts and safety icons.

### 1.3. Other supplied documentation

The assembly drawing is included with the piston accumulator.


### 1.4. Conformity with Standards and Directives


The Standard Piston Accumulator conforms to the following standards and directives:

- ASME BPVC Section VIII Div. 1
- ASME B31.3
- Pressure Equipment Directive (PED) 2014/68/EU
- API Standard 682 (4th Edition)

### 1.5. Use of Alerts and Icons

The manual “Notes”, “Cautions”, and “Warnings” alert you of important information and/or hazardous situations.

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.

More specific icons are also used, depending on the type of hazard.

## 2. Safety


### 2.1. Hazards associated with the Piston Accumulator


The following hazards can be present in the system:

- High pressure
- Dangerous toxic, caustic or corrosive chemicals
- High temperature (hot surfaces and liquids)
- Moving parts

#### Notes:

- The components of a 53C plan (including the piston accumulator) are in contact with the process fluid. Make sure to use protective equipment adequate to the process fluid.

WARNING	
	HIGH PRESSURE: The Piston Accumulator boosts the pressure of the pump process fluid. Review the pressure rating of all components connected to the accumulator to prevent over pressurization. If there is a possibility of pressure exceeding the pipe plan design pressure, a pressure relief valve shall be installed to prevent over pressurization.

WARNING	
	TOXIC, CAUSTIC OR CORROSIVE CHEMICALS: The piston accumulator reference (lower) chamber is filled with process fluid. Ensure proper protective equipment is been worn before working with the accumulator.

### 2.2. General Safety

When installing, operating and maintaining this system, safety of personnel should be a top priority. As such:

- Obey applicable safety laws and regulations
- Read and understand this manual
- Follow the installation, operation, and maintenance procedures
- Wear Personal Protective Equipment (PPE) as required and applicable
- Take proper precautions and follow all plant requirements for handling hazardous materials


### 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 techniques and regulations
- Knowledge of plant regulations and operating conditions

### 2.4. Personal Protective Equipment (PPE)

When operating or maintaining this system, make sure you wear the appropriate Personal Protective Equipment (PPE), including: protective clothing, gloves, safety shoes, safety glasses, hearing protection, etc.

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

WARNING	
	<b>TOXIC, CAUSTIC OR CORROSIVE CHEMICALS:</b> The piston accumulator reference (lower) chamber is filled with process fluid. Ensure proper protective equipment is been worn before working with the accumulator.


## 3. Environmental Considerations


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

### 3.1. Disposing of Waste Products

Any waste products resulting from the use or maintenance of the system must be disposed of according to local environment laws and regulations.

### 3.2. End of Life Equipment)

WARNING	
	<b>DANGER CHEMICALS:</b> Dangerous chemical might be released during removal of the system. Wear PPE. Follow all safety regulations and plant regulations.

WARNING	
	<b>HIGH PRESSURE:</b> High pressure might be stored in the system. Before removing or reinstalling the system, make sure the entire system has been de-pressurized (and drained if required).

Dispose of end of life equipment following local environment laws and regulations.

## 4. Transportation and Storage Requirements

The following requirements apply to the piston accumulator and related equipment:

Transport and storage criteria	Requirements
Transportation	The accumulator must be transported and stored in the unopened, original shipping box.
Suspect damaged during transportation	Inspect components that have been dropped or have 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 1 year, inspect the accumulator before installation.
Preserving installed systems	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.

## 5. Design Overview

### 5.1. Description

Flowserve's Standard Piston Accumulator 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.

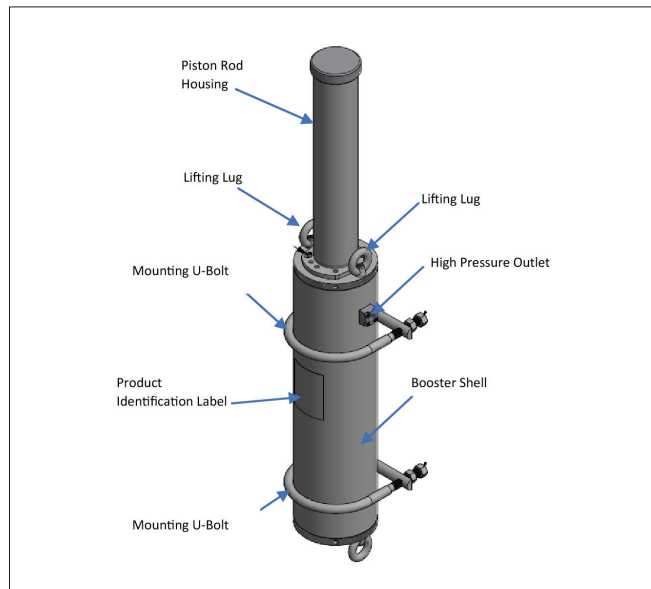


Figure 1: Piston Accumulator Isometric View

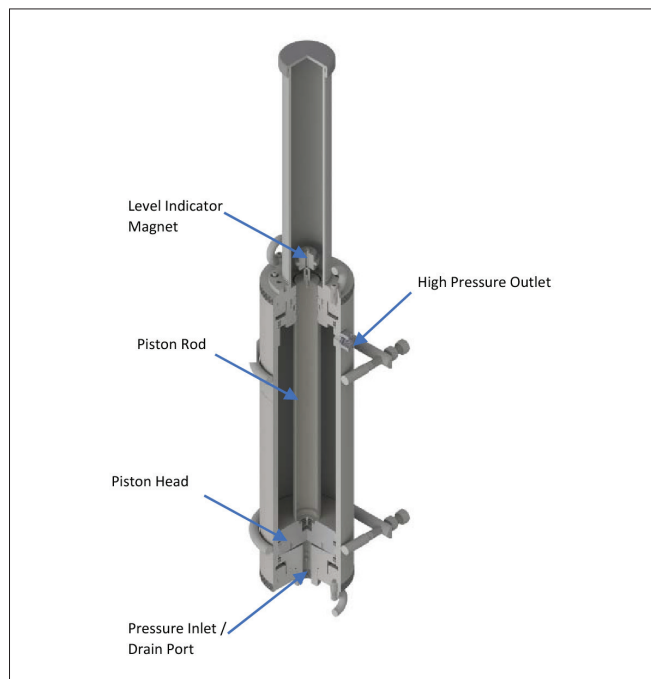



Figure 2: Piston Accumulator 1/4 Sectional View

*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.*

## 6. Installation

Before installing the accumulator, inspect all components for damage. If any of the components are damaged, you should report this to your local Flowserve representative. Install the piston accumulator following the as close to the seal as possible. Make sure there is enough 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.

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

### 6.1. Primary API Plans

#### API Plan 53C

Per API 682 4th edition, a Plan 53C consists of 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 piping and instrumentation diagram (P&ID) is shown in figure 3.

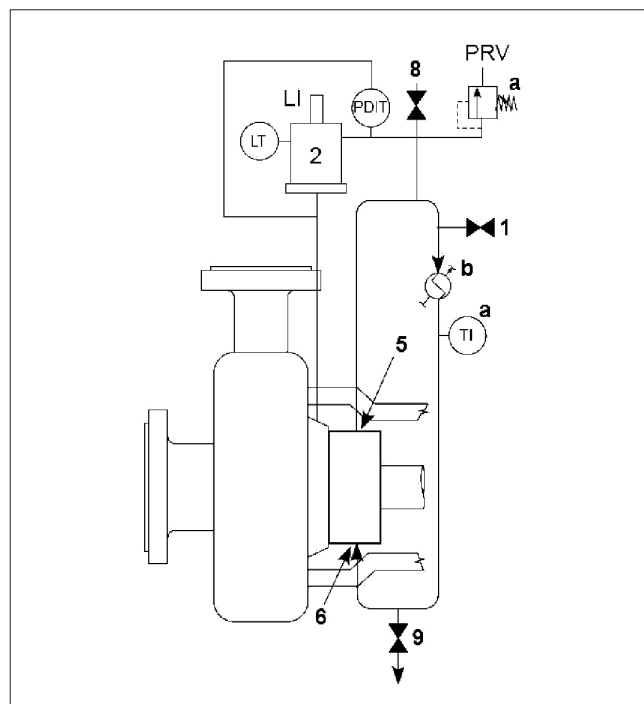


Figure 3: Plan 53C Piping and Instrumentation (P&ID) Schematic. The Piston Accumulator is item 2 (yellow highlighted). Items with key a are optional (if specified).

## Standard Piston Accumulator

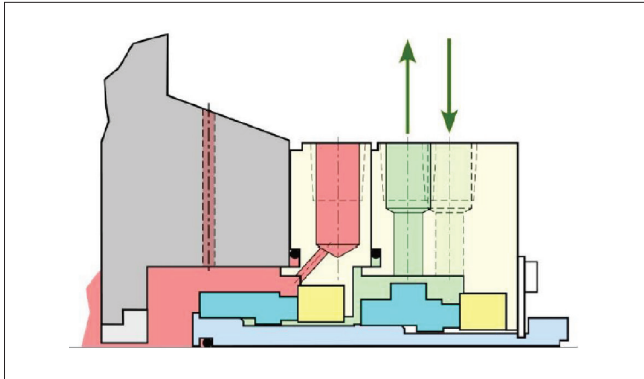


Figure 4. Pump Seal and Pumping Ring Section View

Barrier liquid is distributed 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. 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 an Arrangement 3 seal. Since the barrier pressure is generated from the seal chamber pressure, the system is selfenergizing and reacts to fluctuations in the seal chamber fluid pressure:

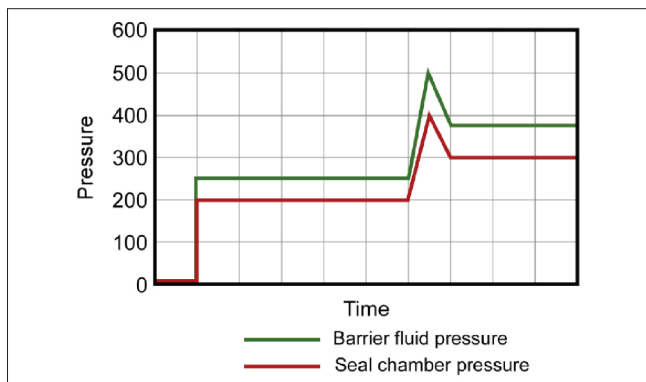


Figure 5. Sample pressure graph showing the barrier fluid (upper chamber) pressure of the piston accumulator tracking the Seal (lower chamber) pressure. In this example, there is no pressure before commissioning, the barrier fluid automatically pressurizes, tracking variations and upsets

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 that contains solids,

tend to plate out on metal surfaces, or solidify under atmospheric temperatures are not suitable for a Plan 53C.

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.

### CAUTION



Venting is critical to ensure proper system operation. If the system is not properly vented, the accumulator may experience erratic (non-uniform) displacement.

## 6.2. Mounting

The accumulator shall be mounted in a vertical orientation, upstream of the cooler following API 682 4th edition guidelines. 2 U-Bolts are provided with the accumulator for mounting, as shown in figures 1 and 2.

Horizontal mounting of the accumulator is not recommended as it reduces the accumulator working volume, and gasses (including air) becoming trapped in the reference and the barrier fluid chambers, resulting in reduced capacity and lower performance. Mounting the accumulator in a vertical position ensures thorough venting and proper operation.

## 7. Operation

- The barrier fluid section of the Piston Accumulator is not protected against overpressure. If there is a possibility of the barrier fluid pressure exceeding the design pressure, a pressure relief device shall be installed in the recirculation loop to prevent over pressurization (see figure 3).
- When installing and before start-up, ensure that the accumulator, cooler, piping, and vent locations allow for complete venting of all circuits. Vents shall be located at the highest point in each circuit.
- Before start-up, ensure that all the gas is vented from both accumulator chambers to ensure system efficiency and prevent a flow restriction and/or vapor lock condition.
- When installing and before start-up, ensure that the accumulator, cooler, piping, and drain locations allow for complete drainage of all circuits. Drain valves shall be located at the lowest point in each circuit.
- Before start-up, ensure that all piping is properly attached to the appropriate connections for both circuits to prevent fluid leaks and achieve expected accumulator performance.



- During commissioning, once the system reaches steady state temperature, the booster accumulator needs to be charged by feeding barrier fluid thru the highpressure port. This causes the piston to move downwards. Review level indicator in the accumulator to verify that the piston reaches its maximum level.
- During operation, the accumulator piston moves up slowly, pressurizing the barrier fluid circuit. Monitor the level indicator in the accumulator to verify accumulator displacement. The expected recharge time is 28 days (or longer).
- Once the piston reaches the upper limit, the accumulator needs to be recharged. Connect the high-pressure port to a hand pump or a high-pressure barrier fluid source and feed barrier fluid until the piston reaches its maximum level, per the level indicator.
- The recommended minimum actuation pressure for the standard piston accumulator is 1.7 bar (25 psi).

## 8. Maintenance Recommendations

The piston accumulator may only be disconnected by qualified personnel, in accordance with local regulations, the safety standards of the user and in accordance with the users operating procedures.

Before disconnecting the equipment, verify that:

- The equipment is at ambient temperature
- The equipment is not pressurized
- The equipment is drained

Process fluid may remain in the internal accumulator chambers. Therefore, site regulations for liquid removal shall be followed.

### WARNING



**DANGER CHEMICALS:** Dangerous chemical might be released during removal of the system. Wear PPE. Follow all safety regulations and plant regulations.

### WARNING



The process fluid may be at hot temperature. Ensure piston accumulator reaches ambient temperature before servicing. Wear the appropriate Personal Protection Equipment (PPE), according to plant regulations

Service the Standard Piston Accumulator following the reference drawing and instructions in this manual. Note accumulator can be assembled with the Cylinder Shell (1) in horizontal or vertical position.

## Piston Accumulator Disassembly and Inspection

- 8.1** Remove the Piston Accumulator from service and relocate to a safe work area
- 8.2** Place Piston Accumulator securely on a work bench. Holding the shell with an external aid, dismount Piston Housing assembly by removing SHCS (17), set components aside in clean area
- 8.3** Inspect the magnet assembly, unthread Stud (20), set aside in clean area.
- 8.4** Remove the bottom Lifting Eye Nuts (9) and SSS (18). Inspect SSS, set aside in clean area
- 8.5** Unthread Bottom Head (2), taking care not to damage O-Ring (8) and Back-Up Ring (7) during disassembly. Inspect Threaded Head (2), Snap Ring (13), Bottom Plug (5), O-Ring (8) and Back-Up Ring (7). Note any issues, set aside in clean area
- 8.6** Using four 1/4-20 UNC fasteners, remove the Piston Assembly (4) from the Cylinder Shell (1). Inspect Piston Assembly components. Note any issues and obtain pictures for reference, set aside in clean area
- 8.7** Unthread Upper Head (2) and Upper Plug (3) taking care not to damage O-Ring (8) and Back-Up Ring (7) during disassembly. Inspect Threaded Head (2), Upper Plug (3), O-Ring (8) and Back-Up Ring (7). Note any issues and obtain pictures for reference, set aside in clean area
- 8.8** Inspect Cylinder Shell (1) ID, note any scratches or imperfections
- 8.9** Inspect and install Guide Band (23), Rod Seal (25) and Wiper (24) onto Upper Plug (3)

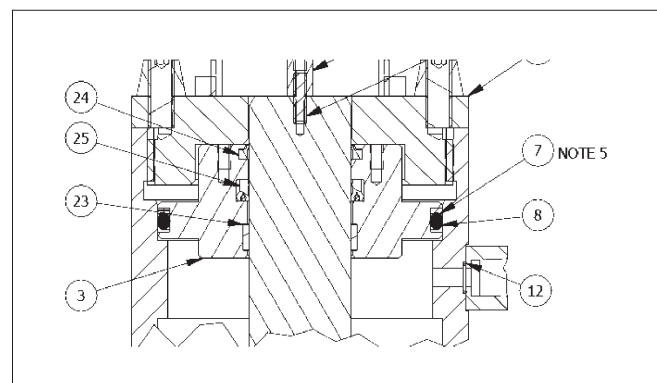


Figure 7: Upper Plug Seals

- 8.10** Inspect and lubricate O-Rings (8). Install O-Ring onto Upper Plug (3), Bottom Plug (5) and Piston (4)
- 8.11** Install Back-Up Rings (7) onto Upper Plug (3) and Bottom Plug (5), observing proper orientation

## Standard Piston Accumulator

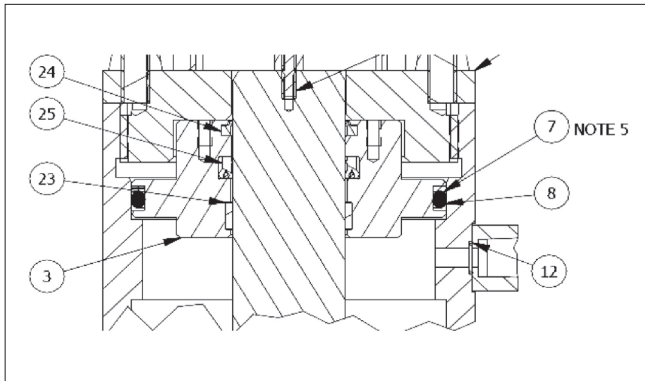


Figure 8: Upper Plug Back-Up Ring must face ambient side of plug for proper operation.

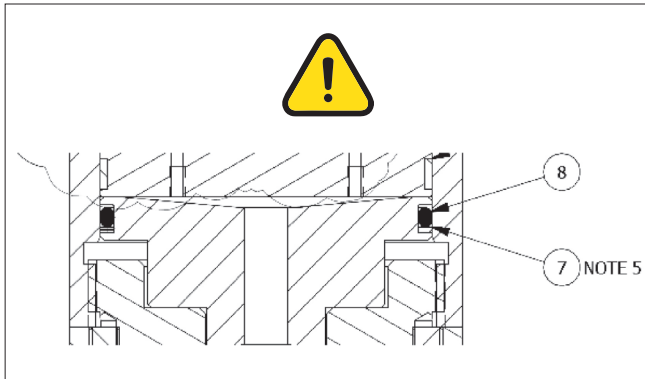


Figure 9: Bottom Plug Back-Up Ring must face ambient side of plug for proper operation.

**8.12** Inspect and install Guide Bands (22) onto Piston (4)

**8.13** Apply a thin coat of a lubricant compatible with the process fluid (such as Molykote) on the first 2" of the

bottom end of the Cylinder wall to facilitate piston assembly. Insert Piston Subassembly (4) onto bottom end of Cylinder Shell (1)

**8.14** Push Piston until Piston Rod (4) is flush with the top end of the Cylinder Shell. Use a press to push the cylinder slowly, if required. Install a temporary cover on the top end of the Cylinder Shell to prevent contamination ingress or damaging inner surface of the Cylinder Shell

**8.15** Insert Bottom Plug (5) onto Cylinder Shell (1), lubricate bottom Head (2) threads with Nickel Anti-Seize and thread onto Cylinder Shell (1), install Snap Ring (13) onto Bottom Plug (5)

**8.16** Stand booster up, remove cover from step 3.2.8 and apply a thin coat of a lubricant compatible with the process fluid (such as Molykote) on the first 2" of the top end of the Cylinder wall. Insert Upper Plug (3) onto Cylinder Shell (1), lubricate Upper Head (2) male threads with Nickel Anti-Seize and thread onto Cylinder Shell (1)

**8.17** Verify there are no gaps between Threaded Heads (2) and Cylinder Shell (1). Apply Loctite 243 to SSS (18, four pieces) and thread two onto each Threaded Head (2) until bottoming. Torque per assembly drawing. Install Lifting Eye Nuts (9) onto SSS (18))

**8.18** Inspect and lubricate O-Ring (12), install O-Ring (12) onto Flange (6). Install Flange (6) onto Cylinder Shell (1) with four SHCS (11), torque per assembly drawing

**8.19** Thread Housing Cap (14) and Housing Mount (16) onto Housing (15). Assembly Housing onto upper Threaded Head (2) using two SHCS (17), torque per assembly drawing

9. APPENDIX A: Standard Piston Accumulator Offerings

PA		15	N	115	N	00	T	
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Working Volume (X10)	
Code	Volume
15	1.5 US Gallons (5.7 Liters)

Reference Pressure Connection	
Code	Description
N	NPT
F	Flange

Boost Ratio (X100)	
Code	Description
115	1.15:1

Seal Pressure Connection	
Code	Description
N	NPT
F	Flange

Special Requirements	
Code	Description
	Flowserve standard (Includes CRN)
-U	ASME BPVC VIII Certification (U-Stamp) Required
-P	Pressure Equipment Directive (PED) 2014/68/ EU CAT.IV Certification Required

O-Rings	
Code	Description
A	AD FFKM
T	TZ FKM

Connection Rating	
Code	Description
00	NPT
06	CL. 600 RFWN
15	CL. 1500 RFWN

Piston Accumulator Part No. and BOM Generator



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#### **Headquarters**

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