Series 111 Accumulator Product Information

MTS®

Model 111.11
Model 111.12

011-553-304 B

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Contents

Introduction

The Series 111 Accumulator stabilize the hydraulic lines in your system. There are two models availlable:

- The Model 111.11B Accumulator is a boss port-mounted accumulator that requires a boss adapter fitting for mounting.
- The Model 111.12C Accumulator is bolt-mounted to a flange and typically has a larger nitrogen gas capacity than the Model 111.11B.

Contents

What you need to know

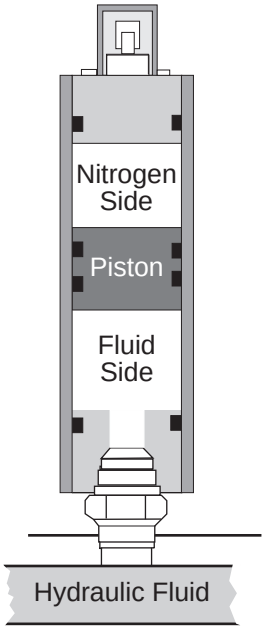
MTS Systems Corporation assumes that you know how to use your controller. See the appropriate manual for information about performing any controller-related step in this manual's procedures. You are expected to know how to perform the following procedures:

- Turning hydraulic pressure on and off
- Selecting a control mode
- Manually adjusting the actuator position

Functional Description

The MTS Series 111 Accumulators can reduce fluctuations hydraulic lines due to sudden changes in hydraulic flow rate. They also act a short term energy source for high-rate tests by providing additional hydraulic flow for short periods to meet irregular peak demands. Like a capacitor, accumulators filter out pulses in the hydraulic fluid to provide steady hydraulic pressure.

Accumulators are like a hydraulic version of a capacitor. They are hydro-pneumatic devices located at strategic points in a hydraulic system. They may be connected to the pressure line and to the return line.



Accumulator

Accumulators are precharged with pressure. Precharge pressure is the pressure of the compressed gas (usually nitrogen) before hydraulic fluid is introduced.

Inserting accumulators into the hydraulic lines permits some fluid to be stored under pressure a short distance from the servovalve and actuator. This has the effect of keeping fluid in the lines in motion and reducing the inertia and line restriction considerations. When the servovalve opens and line pressure begins to drop, the accumulator in the hydraulic service manifold (HSM) immediately supplies part of the fluid volume and maintains the line pressure. Then, when the servovalve closes, the hydraulic power supply (HPS) recharges the accumulator, causing fluid in the lines to remain in motion.

The pattern and frequency of the signal that drives the servovalve will have considerable effect on the HSM accumulator efficiency. Square wave signals, for example, cause a greater demand than sine wave signals or ramp signals.

At some frequencies, fluid flow in the lines may stop completely, and overcoming the fluid inertia may become a more significant operational factor.

An accumulator in the return line damps the pulsing effect caused by “slugs” of fluid being injected into the line as the actuator moves. Movement of hoses and/or hammering of hard lines is also reduced.

Specifications

The tables shown here list the specifications for the Series 111 Accumulators.

Parameter	Specifications	
	Model 111.11B	Model 111.12C
Minimum burst pressure	83 MPa (12,000 psi)	138 MPa (20,000 psi)
Rated fatigue pressure	21 MPa (3000 psi)	22 MPa (3200 psi)
Operating temperature	–40°C to 93.3°C (–40°F to 200°F)	
Hydraulic fluid	Petroleum-based hydraulic fluid. Contact MTS for use with other fluids.	
Charge gas	Dry nitrogen	

Note *Specifications are subject to change without notice. Contact MTS Systems Corporation for verification of specifications critical to your needs.*

Capacity, Dimension, and Weight

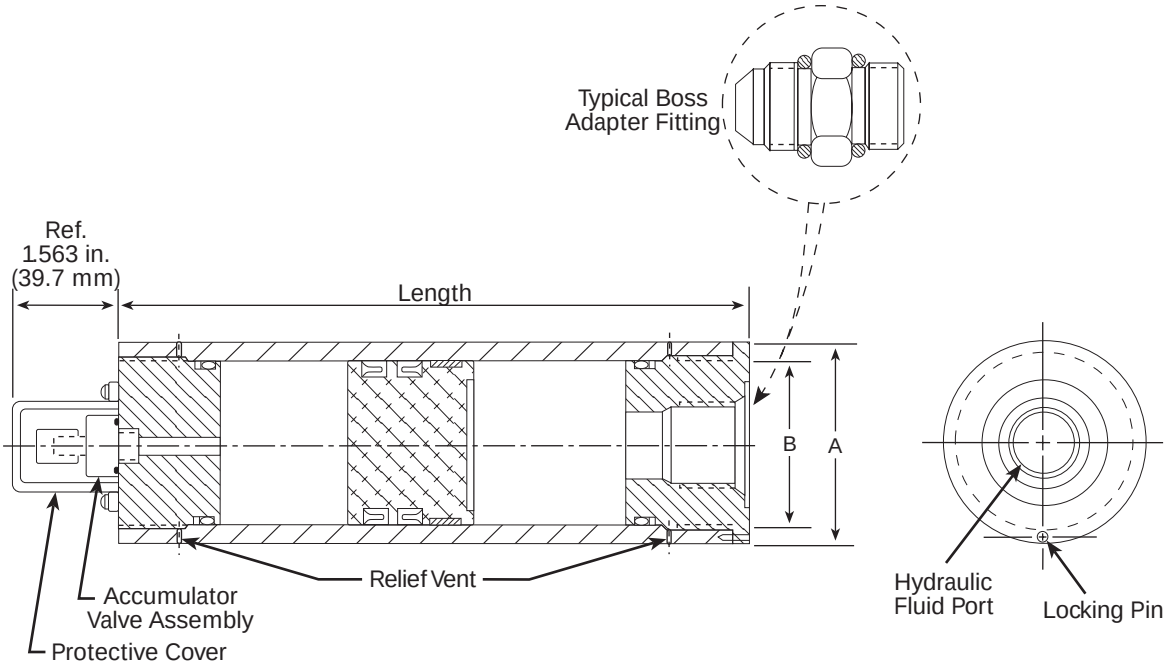
Model*	Nitrogen Gas Capacity		Length†		A†		B†		Hydraulic Fluid Port Connection	Maxp	
			cm	in	cm	in	cm	in		kg	lbs
111.11B-01	82 cm^3	5 $in.^3$	15.54	6.12	7.87	3.1	6.35	2.5	12 SAE (1-1/16-12 UNF-2B)	4.26	9.4
111.11B-02	164 cm^3	10 $in.^3$	18.08	7.12	7.87	3.1	6.35	2.5	12 SAE (1-1/16-12 UNF-2B)	4.63	10.2
111.11B-03	475 cm^3	1 pt	27.94	11.0	7.87	3.1	6.35	2.5	16 SAE (1-5/16-12 UNF-2B)	5.94	13.1
111.11B-04	950 cm^3	1 qt	42.88	16.9	7.87	3.1	6.35	2.5	20 SAE (1-5/8-12 UNF-2B)	7.98	17.6
111.12C-02	950 cm^3	1 qt	29.51	11.6	12.7	5.0	10.16	4.0	1-1/2 SAE 4-bolt flange‡	18.45	40.6
111.12C-03	1.9 l	0.5 gal	39.07	15.4	12.7	5.0	10.16	4.0	1-1/2 SAE 4-bolt flange‡	21.77	48.0
111.12C-04	3.8 l	1 gal	61.93	24.4	12.7	5.0	10.16	4.0	1-1/2 SAE 4-bolt flange‡	29.87	65.8

* The models listed in this table are considered standard models. Other models may be manufactured with different capacities, lengths, or hydraulic fluid port connections than listed here. Contact MTS Systems Corporation for information on nonstandard models.

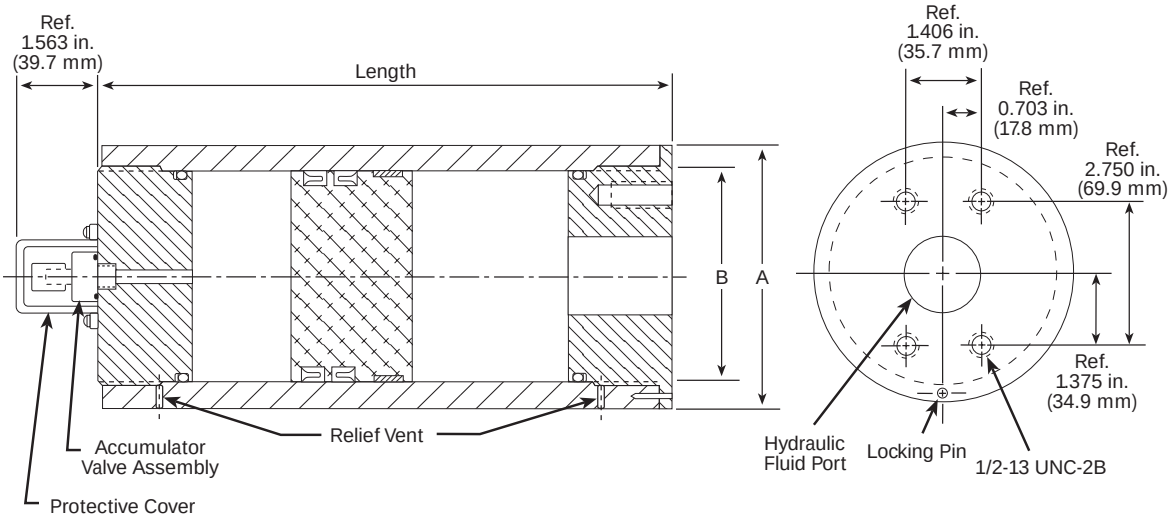
† See the figures on the next page.

‡ Standard pressure series (Code 61).

The cross-section figures shown on this page illustrate the difference between the accumulator models.



Model 111.11B Accumulator Cross-section

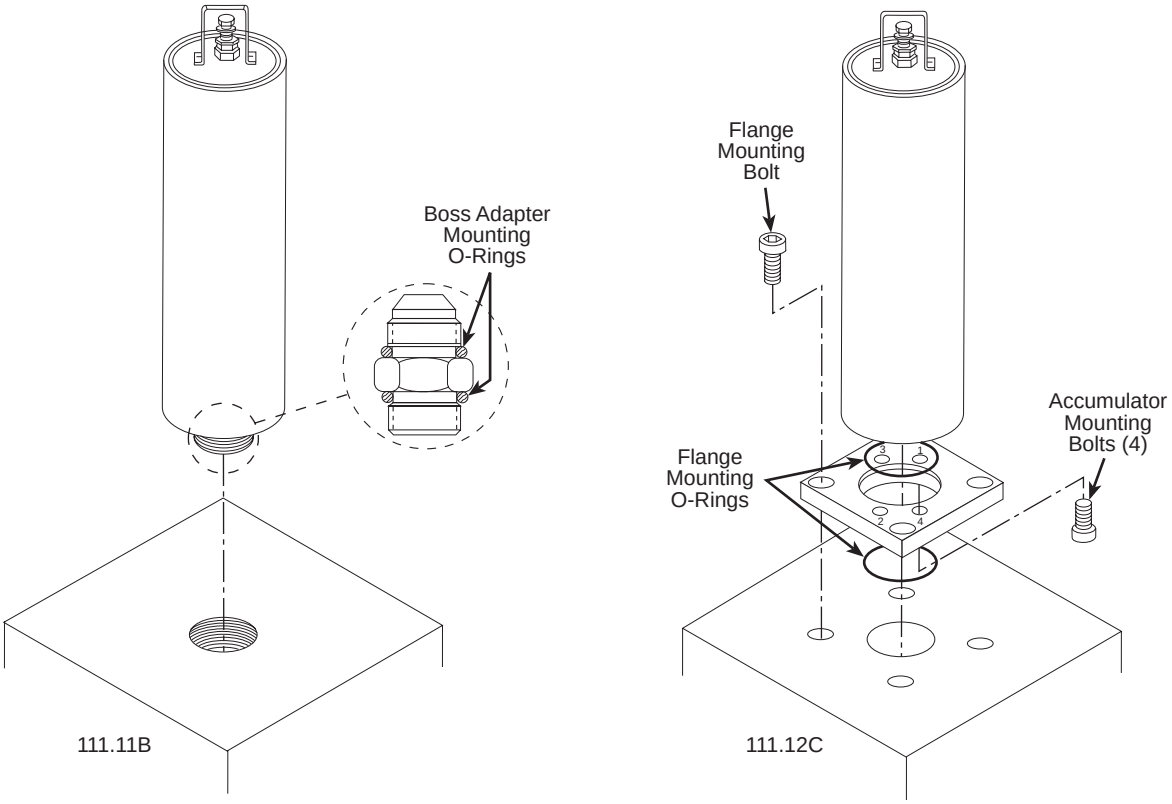


Model 111.12C Accumulator Cross-section

Installation

There are two models of the Series 111 Accumulator. The following figure shows the typical mounting configuration for the Models 111.11B and 111.12C Accumulators.

- The Model 111.11B Accumulator is mounted with a boss adapter fitting and O-ring seals. When the accumulator is ordered as a component, the boss adapter and O-ring seals are not included with the accumulator, they must be purchased separately.
- The Model 111.12C Accumulator is flush mounted with four bolts and O-ring seal(s). When the accumulator is ordered as a component, the four bolts (grade-8) and O-ring seal(s) (max. size 54.28 mm [2.137 in.] outside diameter, 47.22 mm [1.859 in.] inside diameter), are not included with the accumulator and must be purchased separately.



Mounting Configurations

Required equipment

The following equipment is required for accumulator installation:

- Open-end wrench and strap wrench (for the Model 111.11B)
- Hex key set and torque wrench (for the Model 111.12C)

Note *When installing a replacement accumulator into an existing system, the replacement accumulator should be precharged to the same pressure level as the accumulator being removed. Be sure that this precharge level is recorded on the label of the replacement accumulator.*

Procedure

Complete the following steps to mount the accumulator. See the figure on page 9 to complete the following procedure.

1. Mount the accumulator in the system after lubricating the mounting O-ring seal(s). Note the O-ring seal configuration.

   - **For the Model 111.11B Accumulator**

     Thread the unit onto the boss adapter fitting and securely tighten it with a strap wrench.

   - **For the Model 111.12C Accumulator**

     Lubricate and torque the four mounting bolts in increments (according to the pattern shown in the "Mounting Configurations" on page 9 figure) to a final torque of 108 N-m (80 lbf-ft).

2. Check the accumulator precharge pressure as described in "Checking the Accumulator Precharge" on page 13.

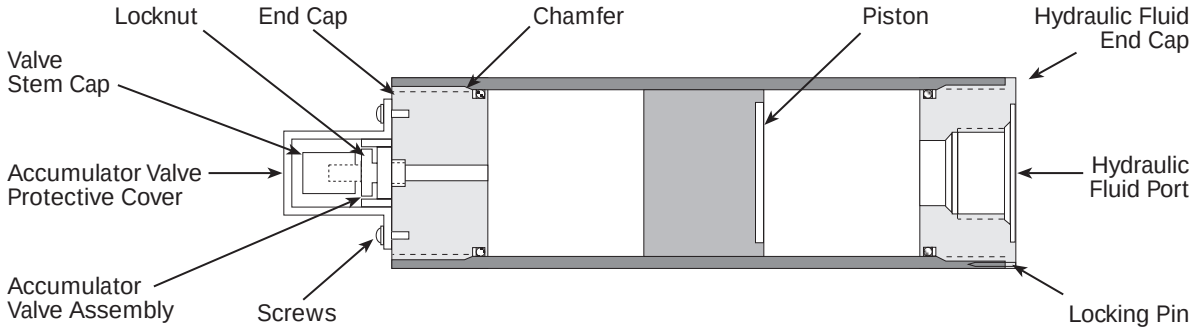
Maintenance

This section describes how to maintain the charge in the accumulator.

Contents

Maintenance guidelines

Maintaining the proper pressure level for your accumulators is essential for optimum system performance and component life. Review the following figure to familiarize yourself with the accumulator components and their locations. Also review the guidelines on the following page before performing any procedure.



Accumulator Components

Use the following guidelines to determine when maintenance is required.

- Check the precharge pressure at periodic intervals. The length of time between checks depends on how the system is used. Some factors to consider when establishing this time interval are operating frequency, displacement, and duration. Start with one month intervals until you determine another interval is more appropriate. See "Checking the Accumulator Precharge" on page 13 for more information.
- Maintain a log book on the condition of the precharge at each check. Use this data to determine if the time between checks should be increased or decreased and if maintenance is required.

- Because the precharge pressure level varies with a temperature change, the level should always be checked at the same temperature. If it is not, use one of the following formulas to determine if the precharge level is acceptable.

Degrees Fahrenheit:

$$\text{current pressure} = \text{original pressure} \times \left(\frac{460 + (\text{current temperatrure})}{460 + (\text{original temperature})} \right)$$

Degrees Celsius:

$$\text{current pressure} = \text{original pressure} \times \left(\frac{273 + (\text{current temperatrure})}{273 + (\text{original temperature})} \right)$$

- If a pressure line accumulator has a pressure level change of ±1.4 MPa (200 psi) between checks, the accumulator requires maintenance or the time interval between checks needs to be shortened.
- If a return line accumulator has a change of ±50% of the original pressure level between checks, the accumulator requires maintenance or the time interval between checks needs to be shortened.
- If the precharge pressure level increases at each check interval, this indicates that fluid is collecting on the gas side (a small amount of fluid leakage is normal). When the precharge pressure level cannot be maintained within the limits, remove the fluid and charge the accumulator. If the levels are again exceeded at the first check interval, replace the piston seals after the initial fluid has been changed.
- If the precharge pressure level decreases at each check interval, this indicates gas leakage to the fluid side. When the precharge pressure level cannot be maintained within the limits stated in the previous guidelines, replace the accumulator piston seals.
- During normal operation, the accumulator piston should be near the center of the accumulator cylinder. To check the approximate piston location, note the warm-to-hot transition point on the accumulator cylinder wall during operation. If the piston is near the charging stem end, the accumulator may need charging. If the piston is at the other end, the accumulator may have an excess charge, or more likely an excessive amount of hydraulic fluid has collected in the gas chamber.

Checking the Accumulator Precharge

Special equipment

The following equipment is for any Series 111 Accumulator:

- Accumulator charging kit (MTS part number 376986-01)

Procedure

To check your accumulator precharge, perform the following:

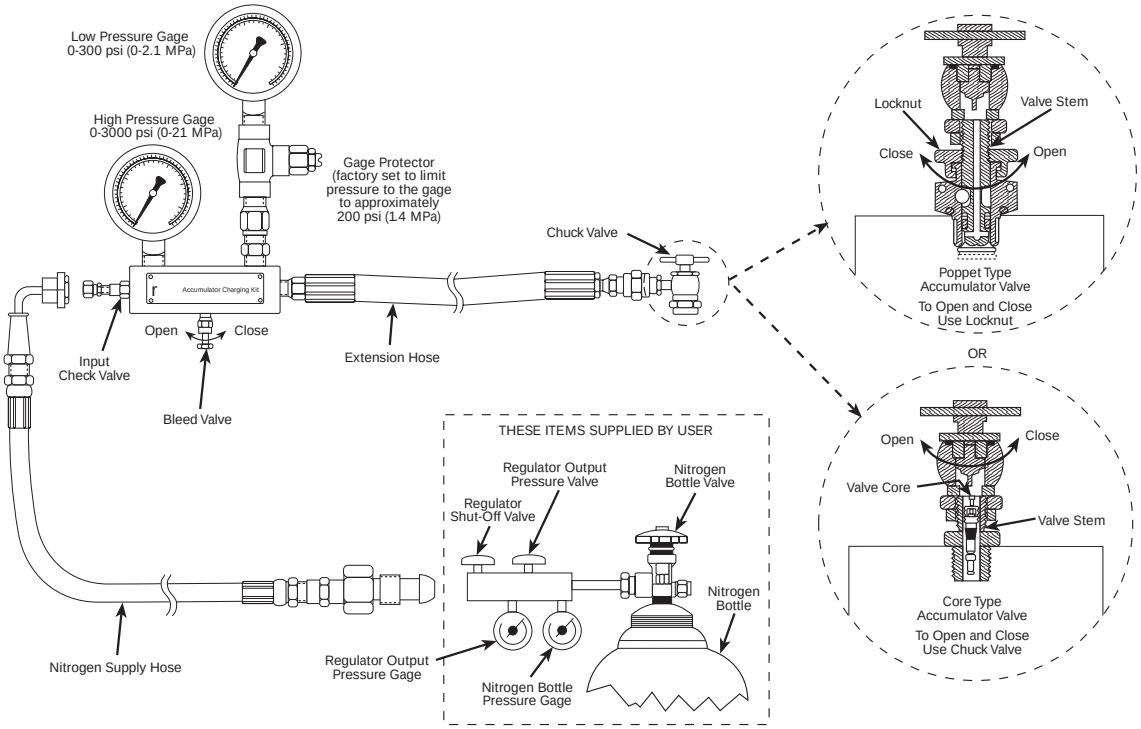
⚠ WARNING

Accumulators are pressurized devices.

Pressurized accumulators and their parts can become lethal projectiles if disassembled and can cause death to persons and/or damage to equipment.

Do not remove an accumulator that is pressurized. Completely remove hydraulic pressure and discharge the accumulator before any parts, except the protective cover and valve stem cap are removed.

1. Ensure that system hydraulic pressure has been reduced to zero before proceeding. To do this, turn off the hydraulic power unit and exercise the actuator until it stops moving.
2. Close the bleed valve on the accumulator charging kit. Remove the protective cover and valve stem cap from the accumulator (see “Accumulator Components” on page 11 and the figure below).
3. Go to the appropriate procedure on the next page.



Checking the Series 111 Accumulator Precharge

The Series 111 Accumulators use the poppet-type valve (as shown on the previous page).

1. Connect the charging kit chuck valve to the accumulator valve stem.
2. With an open-end wrench, turn the locknut counterclockwise on the accumulator valve assembly to open the valve. Read the pressure on either the high or low accumulator charging kit pressure gage.
   - If the pressure reading is other than the required pressure level recorded on the accumulator, go to the procedure "Changing the Precharge Pressure" on page 15.
   - If the pressure level corresponds to the level recorded on the accumulator label, turn the locknut clockwise to close the valve and continue this procedure.
3. Open the bleed valve on the accumulator charging kit and remove the chuck valve from the accumulator. Replace the valve stem cap and protective cover on the accumulator.

Checking a Non-MTS Accumulator Precharge

Non-MTS accumulators typically use either a poppet type valve or a core type valve (as shown on the previous page).

1. Determine which type of gas pressure valve is present on the accumulator and connect the charging kit chuck valve to the accumulator valve stem.
2. Open the locknut (poppet-type) or chuck valve (core-type).

Note *The poppet-type valve opens by turning the locknut counterclockwise and closes by turning the locknut clockwise. To open a core type valve, attach a chuck valve to the valve stem and turn the chuck valve handle clockwise to depress the valve core. Close the valve by turning the handle counterclockwise.*

3. Read the pressure on either the high or low accumulator charging kit pressure gage. The low pressure gage is limited to approximately 1.4 MPa (200 psi) by the gage protector.
   - If the pressure reading is other than the required pressure level recorded on the accumulator, go to the procedure "Changing the Precharge Pressure" on page 15.
   - If the pressure level corresponds to the level recorded on the accumulator label, close the locknut (poppet-type) or close the chuck valve (core-type). Continue to Step 4.
4. Open the bleed valve on the accumulator charging kit and remove the chuck valve from the accumulator. Replace the valve stem cap and protective cover on the accumulator.

Changing the Precharge Pressure

Often the precharge of an accumulator mounted on a hydraulic supply line is increased to enhance system performance and reduce the transient HPS flow demands. Accumulators may be precharged to 10 MPa (1500 psi) or more, although amounts above 14 MPa (2200 psi) will have less and less performance effect in most situations. Be sure that you read the following warning before you charge your accumulator.

⚠ WARNING

Accumulators have specific pressure ratings.

If the precharge pressure is too high, the accumulator can bottom out causing the release of metal particles into the hydraulic fluid. Charging accumulators above their rated level can damage system equipment.

Do not charge accumulators to pressures above their rated level. Charge accumulators below their rated fatigue pressure of 21 MPa (3000 psi) for the Model 111.11B and 22 MPa (3200 psi) for the Model 111.12C. Use a suitable regulator and gage set to an accumulator's charges.

Before you begin

Go to "Checking the Accumulator Precharge" on page 13 to determine if you need to change the precharge pressure.

Decreasing pressure

Complete the following steps to decrease the precharge pressure.

1. Slowly open the bleed valve on the accumulator charging kit until gas begins to escape. When the pressure reading on the appropriate pressure gage drops to the level required, close the bleed valve.
2. Close the locknut (or close the chuck valve if you have a core-type valve). Open the bleed valve on the accumulator charging kit and remove the chuck valve from the accumulator.
3. Install the valve stem cap and protective cover.

Increasing pressure

Complete the following steps to increase the precharge pressure.

1. Close the locknut on the accumulator (or close the chuck valve for a core-type valve).
2. Open the bleed valve two turns.

⚠ WARNING

Mixing gases can produce unpredictable results.

Do not use another gas to precharge an accumulator.

Use only dry nitrogen gas to precharge accumulators.

3. Connect the nitrogen supply hose from the supply bottle pressure regulator output to the input check valve on the charging kit.

4. Open the nitrogen bottle valve. Check the nitrogen bottle pressure gage on the regulator. (The bottle must contain sufficient pressure to provide an adequate gas volume.)
5. Monitor the regulator output pressure gage and adjust the regulator output pressure valve to the required level.

⚠ CAUTION

Avoid rapid and extreme pressure transitions.

Rapid flow rates with pressure differentials of more than 2.1 MPa (300 psi) across the input check valve can damage the valve seal(s).

Do not allow rapid flow rates. Open the regulator shut-off valve only far enough to permit a gradual transfer of gas.

6. Slowly open the regulator shut-off valve until gas is heard escaping from the accumulator charging kit bleed valve. Allow gas to slowly escape for approximately ten seconds, then close the bleed valve. Immediately close the regulator shut-off valve before the pressure reading on either the high or low charging kit pressure gage exceeds the pressure level of the accumulator.
7. Open the locknut (or open the chuck valve for a core-type valve). Slowly open the regulator shut-off valve until the pressure indicator on either the high or low charging kit pressure gage begins to rise. When the pressure is at the required pressure level (recorded on the accumulator), close the regulator shut-off valve.
8. Close the locknut (or close the chuck valve for a core type valve).
9. Open the bleed valve on the accumulator charging kit and remove the chuck valve from the accumulator.
10. Install the valve stem cap and protective cover. Close the valve on the nitrogen bottle.

Purging Fluid from the Gas Chamber

When you should perform this procedure

Piston-type accumulators may collect hydraulic fluid in the gas chamber, which then reduces the gas volume of the accumulator. The fluid should be purged from the gas side if a pressure check procedure shows one or more of the following:

- A consistent trend of pressure being higher than expected.
- Precharging requires smaller volumes of gas than expected to obtain a desired pressure level.
- Fluid is expelled from a gas valve during gas venting.

⚠ CAUTION

Venting pressurized gasses can generate loud noises and freezing temperatures.

Transferring gasses from high to low pressure containers creates freezing temperatures.

Do not work with pressurized gasses without wearing protective clothing. Wear heavy gloves, safety glasses, and ear plugs when working with pressurized gases

Procedure

Complete the following steps to purge the fluid from the gas chamber. See “Accumulator Components” on page 11.

1. If the valve stem of the accumulator is facing down, go directly to step 2.

   If the valve stem of the accumulator is facing up or the accumulator is on its side, remove the accumulator as described in “Removing the Accumulator” on page 18 and turn it so the valve stem is facing down.

2. Remove the accumulator valve protective cover and the valve stem cap. Securely position the accumulator with the gas valve down.

3. Place a suitable container under the valve stem to capture any expelled fluid. Use an open-end wrench and open the locknut on the accumulator valve assembly two or three full turns. Allow gas pressure to reduce to zero and hydraulic fluid to expel.

4. Replace the accumulator as described in “Installation” on page 9. Then precharge the accumulator as described in “Changing the Precharge Pressure” on page 15.

Removing the Accumulator

Perform the following steps to remove the accumulator.

⚠ WARNING

Accumulators are pressurized devices.

Pressurized accumulators and their parts can become lethal projectiles if disassembled and can cause death to persons and/or damage to equipment.

Do not remove an accumulator that is pressurized. Completely remove hydraulic pressure and discharge the accumulator before any parts, except the protective cover and valve stem cap are removed.

1. Ensure that system hydraulic pressure has been reduced to zero before proceeding. To do this, turn off the hydraulic power unit and exercise the actuator until it stops moving.
2. Place a drain pan under the accumulator to be removed.
3. To prevent contamination of the hydraulic fluid, cover any ports that are exposed.
4. If you have the Model 111.12C Accumulator, use a hex key to remove the flange and accumulator mounting bolts (see “Accumulator Components” on page 11).

   If you have the Model 111.11B Accumulator, use an open-end and strap wrench to loosen the accumulator from the boss adapter fitting.
5. Perform any required maintenance (see the other procedures in this section).
6. To reinstall the accumulator, use the procedure in “Installation” on page 9.

Replacing the Accumulator Seal

Special equipment

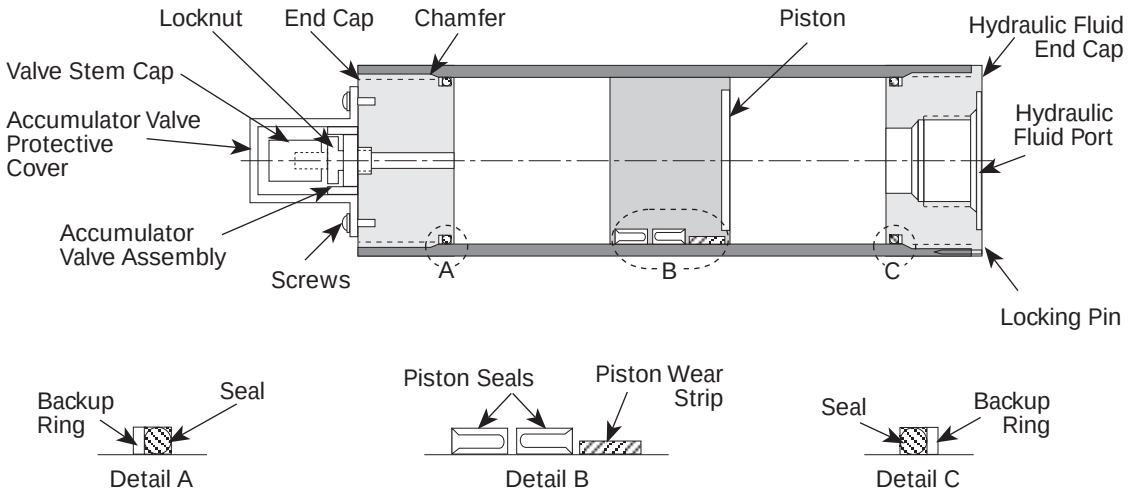
The following equipment is required to replace any Series 111 Accumulator seals:

- A seal kit (MTS part number 041-463-501 for the Model 111.11B or MTS part number 041-463-301 for the Model 111.12C)
- Accumulator charging kit (MTS part number 376986-01)

Procedure

Use the following procedure to replace any Series 111 Accumulator seals:

1. Remove the accumulator as described in "Removing the Accumulator" on page 18.
2. Remove the accumulator valve protective cover and the valve stem cap. Securely position the accumulator with the gas valve down.
3. Place a suitable container under the valve stem to capture any expelled fluid. Use an open-end wrench and open the locknut on the accumulator valve assembly two or three full turns. Allow gas pressure to reduce to zero and any hydraulic fluid to be expelled.
4. Use an open-end wrench and remove the accumulator valve assembly from the end cap. To remove the end cap, hold the accumulator body with a strap wrench, insert the spanner wrench pins into the screw holes in the end cap, and rotate the wrench counterclockwise.
5. Insert an aluminum or wooden rod into the hydraulic fluid port opening (you may have to remove the boss adapter fitting from the hydraulic fluid port of Model 111.11B Accumulators) until it contacts the piston. Push the piston out of the cylinder.



Accumulator Seal Details

6. See “Accumulator Seal Details” on page 19 for details A and B for this step. Remove the end cap backup ring and seal (detail A), and the piston seals and wear strip (detail B). Clean the cylinder with a soft cloth and inspect the piston and inner walls for scratches. If the inner walls of the cylinder are scratched to the extent that the piston seals cannot seal properly, replace the entire accumulator.

7. Install a new piston seals, wear strip, new seal, and backup ring on the end cap.

8. Apply a small amount of clean hydraulic fluid to the piston seals and piston wear strip. Gently insert the piston into the cylinder with the piston wear strip turned toward the hydraulic fluid port end, taking care not to pinch the piston seals against the chamfered surface of the cylinder. Ensure that the piston is aligned within the cylinder. Firmly push the piston 2 to 3 inches (5 to 7 cm) into the cylinder.

9. Apply a small amount of clean hydraulic fluid to the end cap seal and backup ring. Turn the end cap into the cylinder until the threads are engaged.

Note *Do not overtighten the end cap.Tightening the end cap with extreme force does not improve the seal and can damage the cap and/or cylinder threads.Tighten the end cap using the following steps.*

10. Hold the accumulator body with a strap wrench and use a pin spanner wrench to rotate the end cap clockwise until the outer cap surface is almost flush with the end of the cylinder and resistance indicates that the cap and cylinder chamfer surfaces have met.

11. Thread the accumulator valve assembly into the end cap port. Use an open-end wrench and tighten the valve assembly until the underside of the hexagonal flange contacts the outer end cap surface.

12. Check the condition of the mounting O-rings on the boss adapter fitting (Model 111.11B) or the flange mounting O-rings (Model 111.12C). If damaged, replace with new seals from the accumulator seal kit.