MTS FSE MODULAR TRAINING

Hydraulic Service Manifolds

November 4, 2015 Rev A

be certain.

Hydraulic Service Manifold (HSM)

- A hydraulic service manifold is installed between a HPU and an actuator.
- Hydraulic service manifolds are not required on every system.
  - A system with only one actuator or only one load frame and a HPU may not have a HSM
- A HSM can perform the following functions:
  - Pressure control to actuator
  - Additional filtration
  - Additional accumulation
  - Provide pilot pressure and hydrostatic bearing pressure
  - Provide an electrical device to enable first on / last off control
- Not all HSM's have all functions.

HSM Types

» There are two styles of HSM's, floor standing and load frame mounted.

Floor Standing

Load Frame Mounted

HSM Models

» MTS has manufactured several different model HSM's with a variety of oil pressure off/low/high control methods and other options.

HSM Type	Style	Where Used	Control type
284	Floor Standing	Structural Systems	Solenoid
290	Floor Standing	Structural Systems	Solenoid
293	Floor Standing	Structural Systems	Solenoid
294	Load Frame	312 Load Frames	Solenoid
298	Load Frame	318 Load Frames	Proportional
Landmark	Load Frame	Landmark Load Frames	Proportional

* 284 HSM's which were the first standard production HSM's, are obsolete, and will not be included in this module. Landmark HSM's are explained in the Landmark module.

Solenoid and Proportional Valves

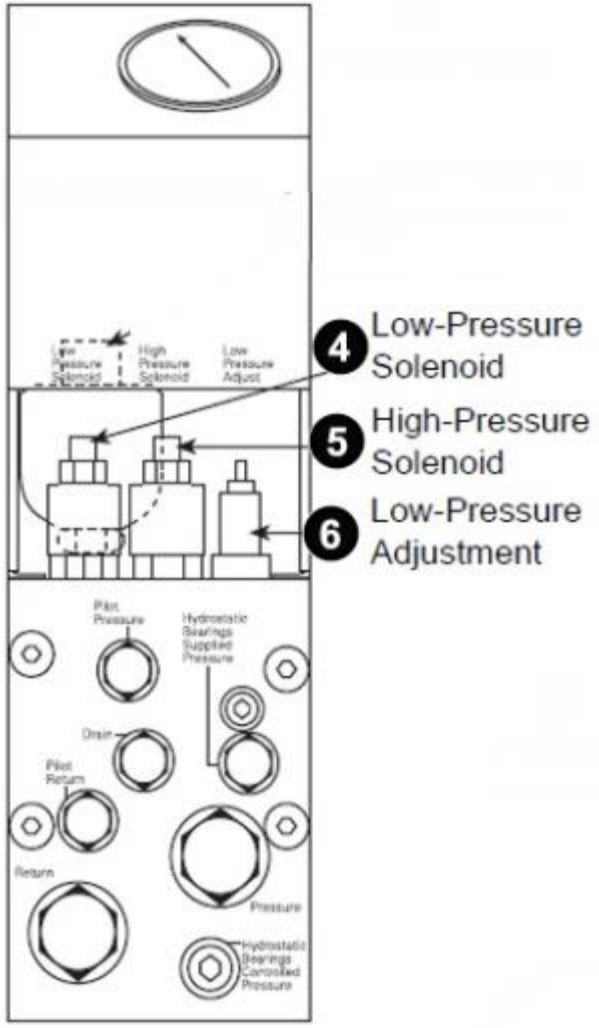
- HSM's use either solenoid valves or a proportional valve to control the oil pressure to the actuator.

- Solenoid valves have two states, off and on.
  - HSM's which only have actuator off / on control have one solenoid valve
  - HSM's which have off / low / high control contain two solenoid valves
    - One solenoid controls the low pressure to the system, and the second valve controls the high pressure to the system.
    - Both are off/on solenoids.

- A proportional valve is a single valve that controls both low and high pressure.

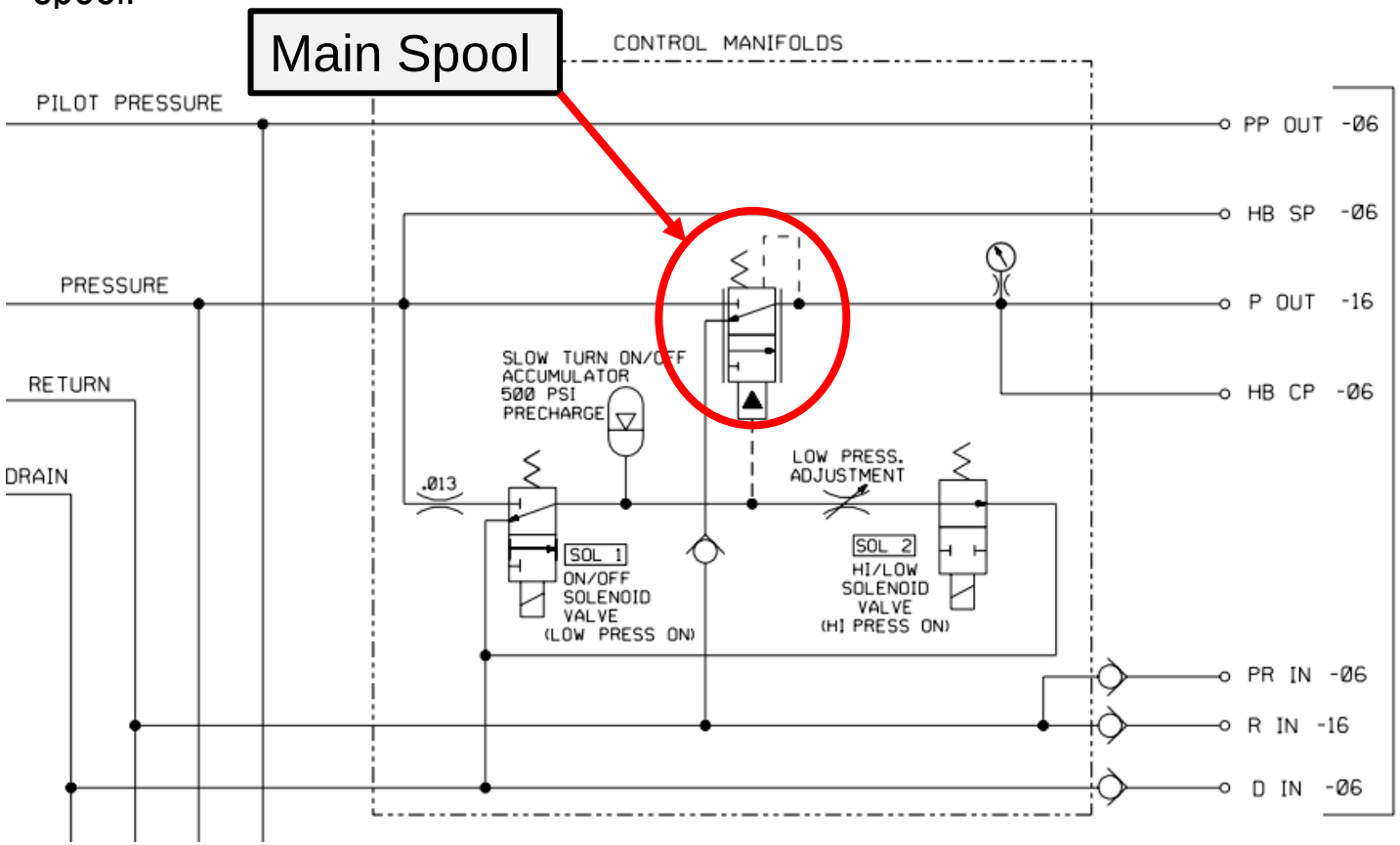
Solenoid Valve Logic

- To turn on the HSM in low pressure, only the low pressure solenoid is energized
- To turn on the HSM in high pressure, both the low and high pressure solenoids are energized
- If only the high solenoid is energized there will be no pressure output of the HSM or at the actuator.



Solenoid Valve Main Spool

- On a HSM such as the 293 the solenoid controls the main spool in the HSM.
  - The oil to the actuator does not flow through the solenoid but rather through the main spool.



Solenoid Low Pressure

- Low pressure is adjusted using a needle valve.
- On solenoid controlled versions with low pressure control when transitioning from low to high pressure the transition time is controlled by the nitrogen charge in the slow turn on accumulator.
- The high to off pressure transition is rapid and is not effected by the charge in the slow turn on accumulator.

Solenoid Valve Cable Connections

- HSM's have been available with solenoid valves in either 110 VAC or 24 VDC configurations.
  - For new systems the only option available is 24 VDC.

- The coils can be changed in the field to match requirements.
  - To change the coil remove the nut from the cartridge valve and slide the coil off the stem of the cartridge valve.

Solenoid Valve Cable Connections

- On early HSM's with round MS style connectors such as the model 284 and 294 the number of pins indicated the coil voltage.
  - 2 Pin connectors are 110 VAC
  - 3 Pin connectors are 24 VDC

110 VAC Coil Connector

24 VDC Coil Connector

Solenoid Valve Cable Connections

- HSMs manufactured in the 80's and early 90's such as the model 290 used a square DIN connector for 110 VAC and a 3 pin round MS connector for 24 VDC

110 VAC Coil Connector

24 VDC Coil Connector

Solenoid Valve Cable Connections

- Current version HSMs such as the model 293 use a square DIN connector for 24 VDC.
  - A 3 pin MS to DIN adapter is available to convert a cable with round MS connectors to a square DIN style coil. The adapter part number is 011-282-226

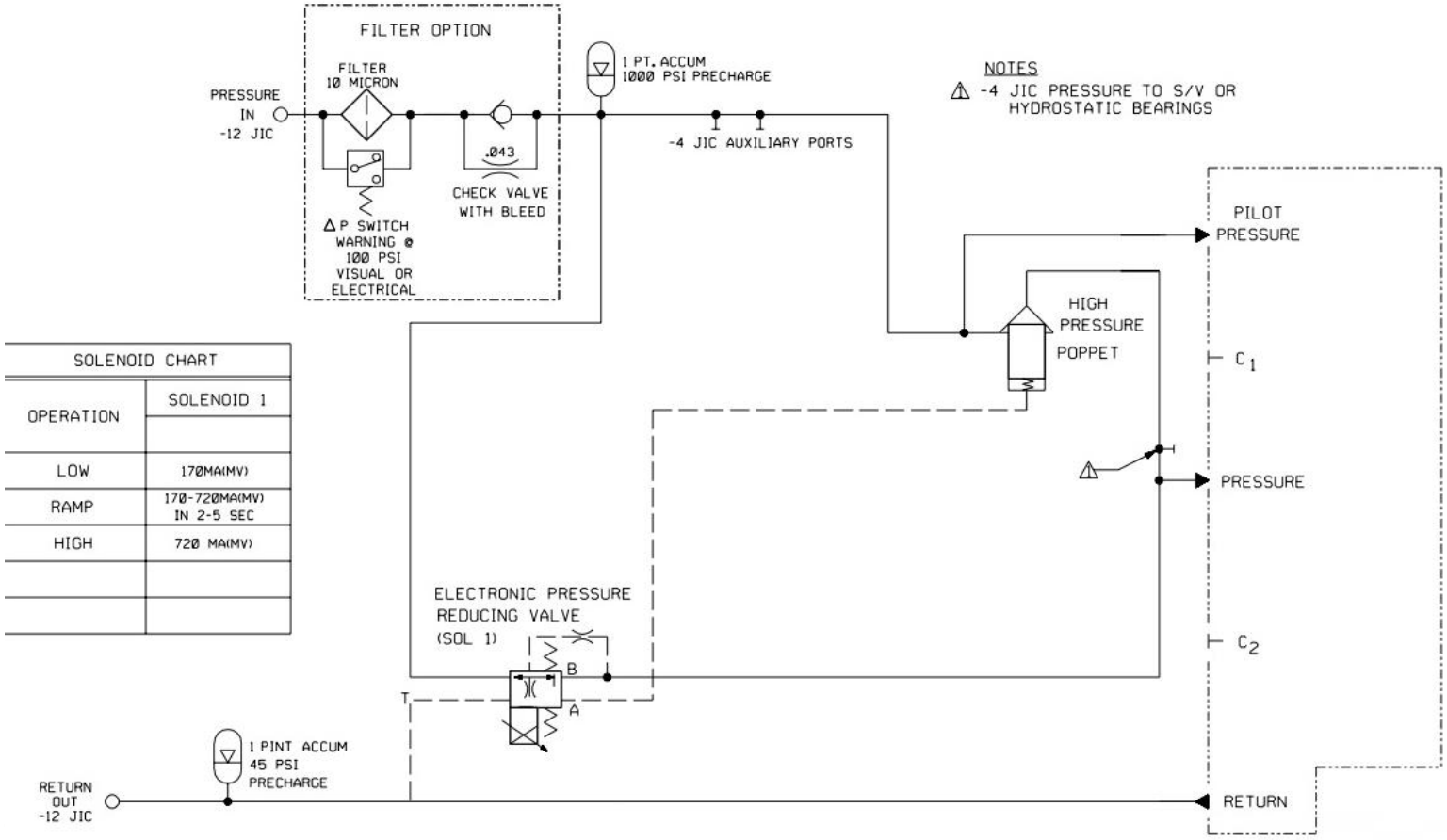
Cable Connector

Coil Connector

Proportional Valve Logic

» A proportional valve varies the system pressure proportional to the current applied to the valve. The proportional valve controls a poppet valve.

- The oil to the actuator flows through the poppet valve.

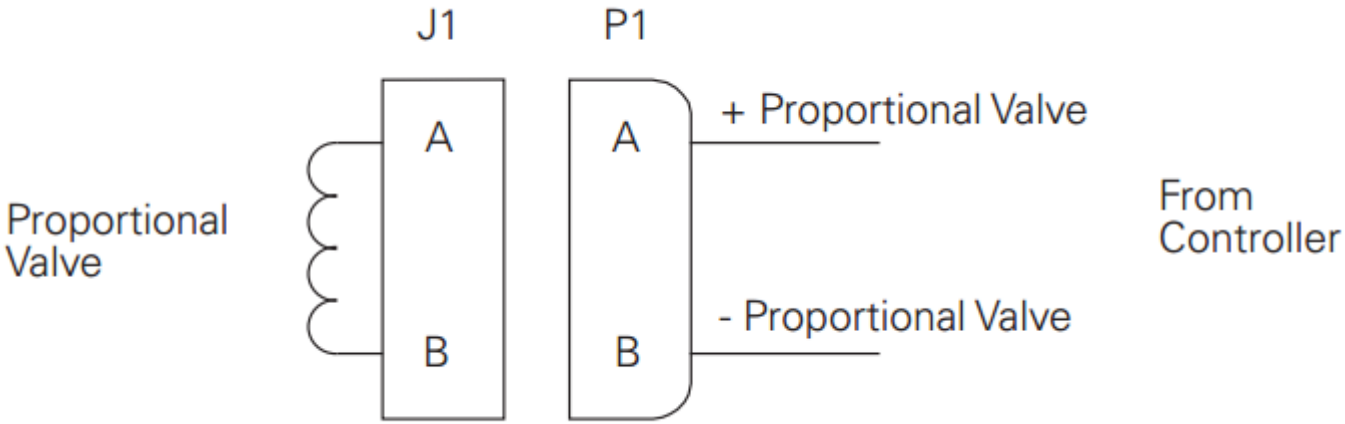


Proportional Valve Logic

- With a proportional valve the low to high transition time is controlled by an electrical ramp rate.
  - In older analog controllers this was performed by hardware
  - The ramp rate was adjusted using a screwdriver adjustment
  - In modern digital controllers the ramp rate is controlled by a setting in the controller
- The transition from high to off is rapid.
- Low pressure is adjusted by changing the current to the valve.
  - This is a screwdriver adjustment on an analog controller or a software setting on a digital controller.

Proportional Valve Cable Connection

- 298 proportional electrical connector
  - 3 pin connector

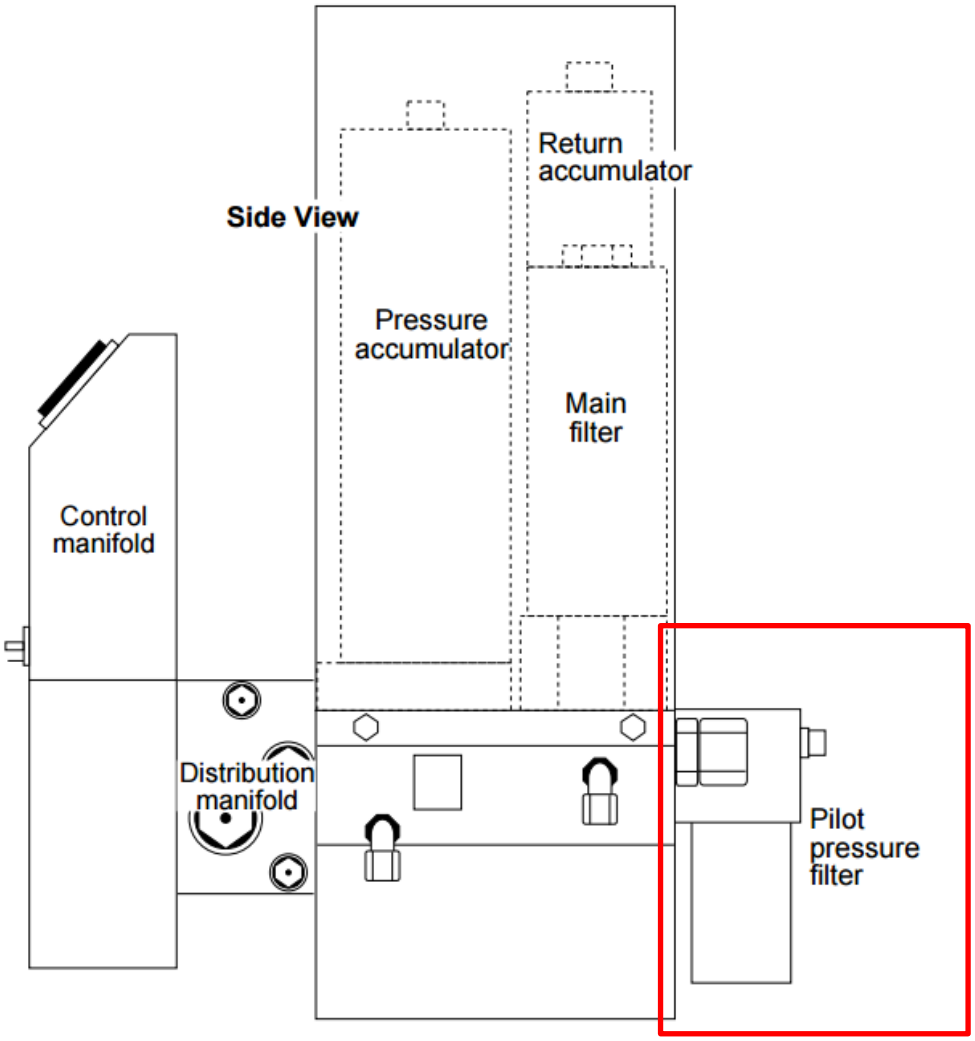


Pilot Pressure

- One of the functions of a HSM is to supply pilot pressure to a system.
  - Pilot pressure is always present when the HPU is on and is not controlled by the solenoids or proportional valve in the HSM.
  - Pilot pressure is full HPU pressure.
  - When disconnecting a pilot pressure hose ensure the HPU is off, stored energy is dissipated, and appropriate lock out / tag out procedures are in use.
- Pilot pressure is required for 3-stage servo valves
- Systems with 5 port 2-stage servo valves use pilot pressure to control the servo valve while transitioning from off to low to high pressure.
- Can be used for actuators with hydrostatic bearings if there is not a dedicated hydrostatic bearing supply port.

Pilot Pressure

» Most HSM's that have the pilot pressure option installed have an additional filter for the pilot pressure circuit located on the HSM.



First On / Last Off

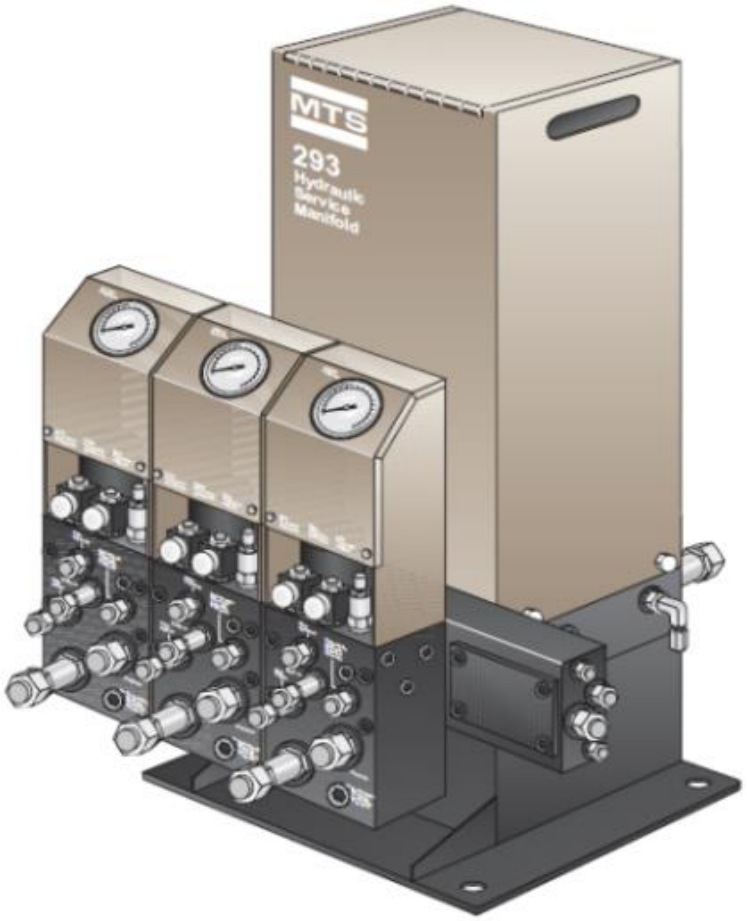
- Having an HSM for each system in a laboratory enables the use of First On / Last Off.

- First on / last off is used in laboratories that have several systems and one HPU. As the name implies, the first controller that turns on, turns on the pump and the HSM connected to that controller. Hydraulic pressure is applied to the input of all the HSM's but will not pass thru the HSM's until they are turned on by their individual controllers.

- The last controller to turn off will also stop the pump.

Stand Alone HSM Installation Location

- To be most effective, the HSM should be placed as close as possible to the actuator(s) it is connected to.
- The further the HSM is from the actuator, the less effective the accumulator's will be.



Series 293.1X Hydraulic Service Manifold

HSM Maintenance

- Maintenance for a HSM includes filter changes and accumulator servicing.

- Change the filters as recommended in the product manual for the HSM.
  - Cold oil can cause the dirty filter indicator to trip and show the need for replacement when it is not actually required. Always reset the indicator when oil is warm and confirm it continues to trip indicating the filter is dirty.

- The typical default accumulator charges are:
  - Pressure 1000 PSI
  - Return 45 PSI
  - Pilot Pressure 1000 PSI

Troubleshooting the HSM

- The solenoid may work electrically but not mechanically.
- A common failure is a solenoid valve that sticks.
  - This can be caused by contaminated hydraulic fluid.
  - When there is no pressure on the output of the HSM and voltage is present on the coil it is most likely a bad solenoid valve.
- Another common failure is a coil which shorts.
  - A shorted coil will normally cause a fuse to blow when the valve is energized.

Troubleshooting the HSM

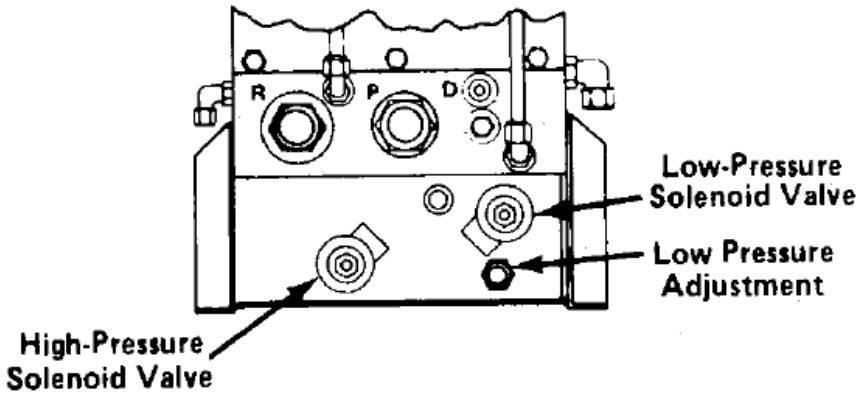
- Servo hydraulic systems have a circuit called dither. Dither is a sine wave signal normally between 500 and 1000 Hz that can be applied to the servo valve to help overcome mechanical friction in the system.
- This dither signal can be heard, but only when hydraulic pressure is present.
- If you suspect that the HSM may not have turned on, simply increase the dither amplitude.
- If you do not hear the dither signal, check the solenoid valves on the HSM.

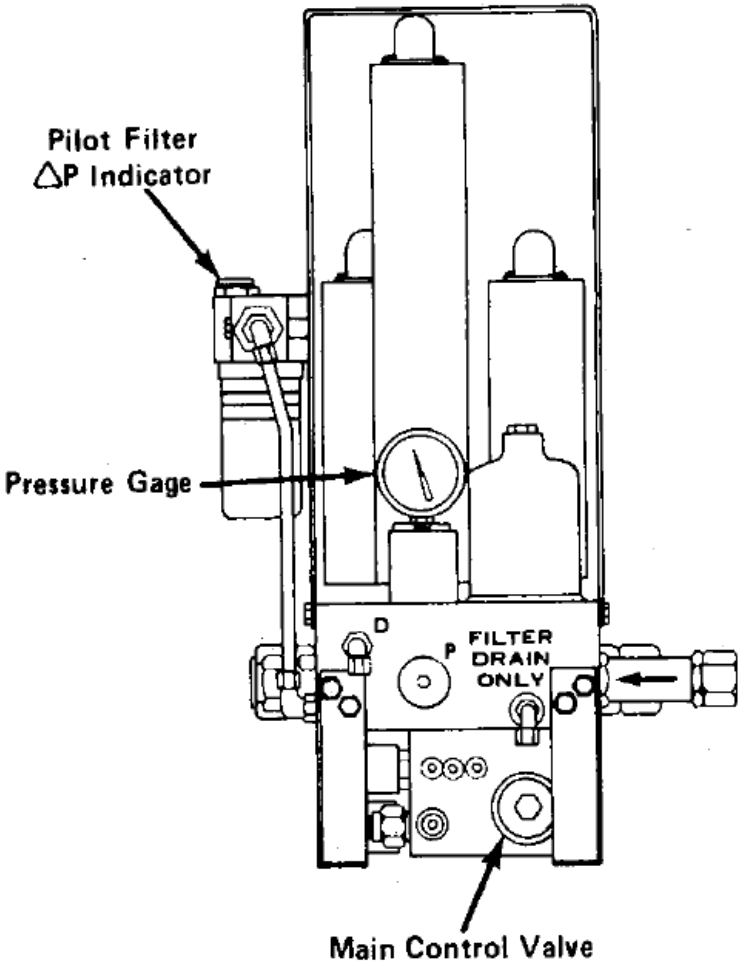
290 Service Manifold

- The 290 hydraulic service manifold is a floor standing HSM.
- This is the predecessor to the model 293
- This was available in multiple flow ratings
  - 190 L/min (50 GPM)
  - 378 L/min (100 GPM)
  - 946 L/min (250 GPM)

290 Service Manifold

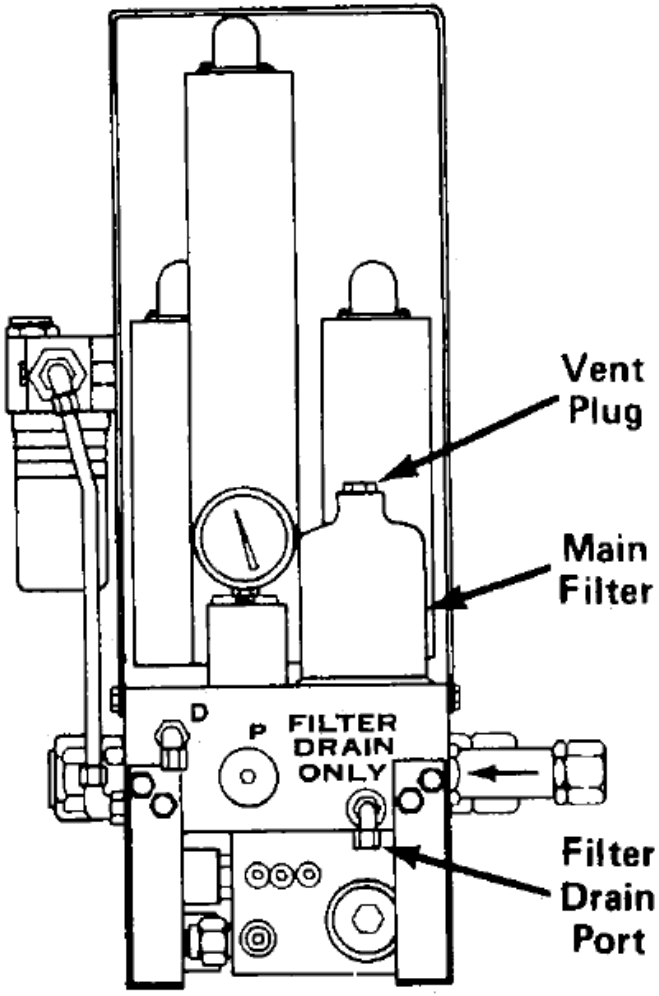
- The 290 service manifold uses the same control logic as a model 293.
- There is a needle valve to adjust the low pressure.





290 Filter change

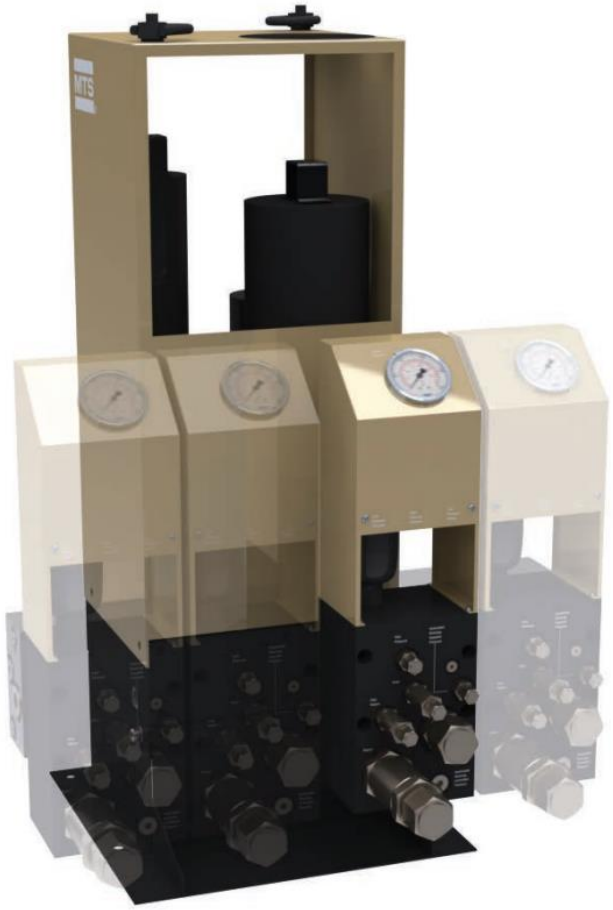
- When changing the filter ensure the HPU is off, stored energy dissipated, and proper lock out / tag out procedures are used.
- When changing the main filter the filter bowl needs to be drained prior to removing the bowl to prevent an oil spill.
- To drain the main filter bowl, place a drain pan under the filter drain port and open the vent plug at the top of the filter bowl.



293 Service Manifold

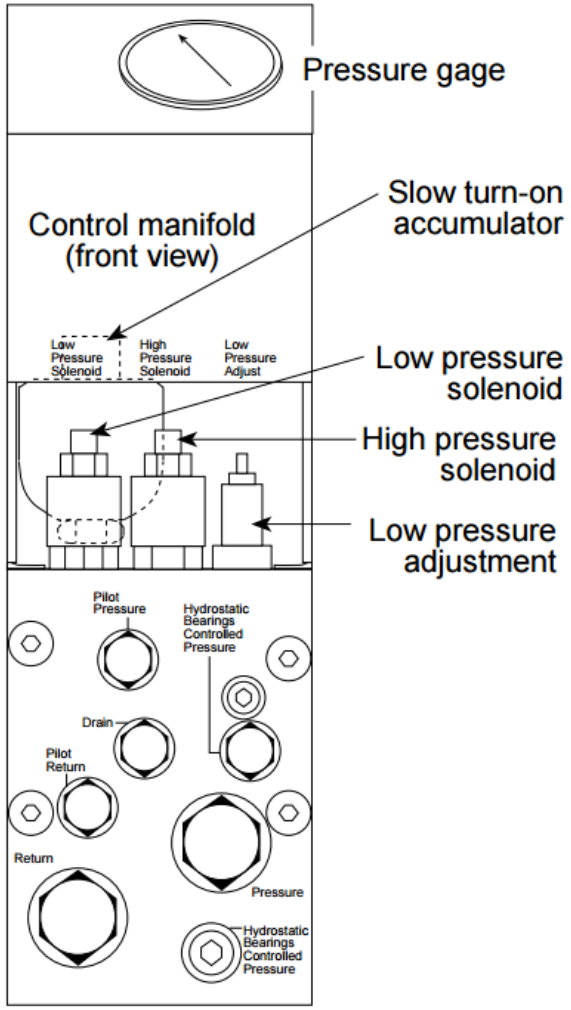
- The 298 manifold is available in multiple flow ratings
  - 190 L/min (50 GPM)
  - 378 L/min (100 GPM)
  - 946 L/min (250 GPM)

- A unique feature of this model HSM is the ability to have multiple HSM stations on a single HSM
  - Options for 1 to 4 stations
  - Can connect several systems to each HSM with individual pressure control
  - Total flow demand from all systems cannot exceed HSM flow rating.



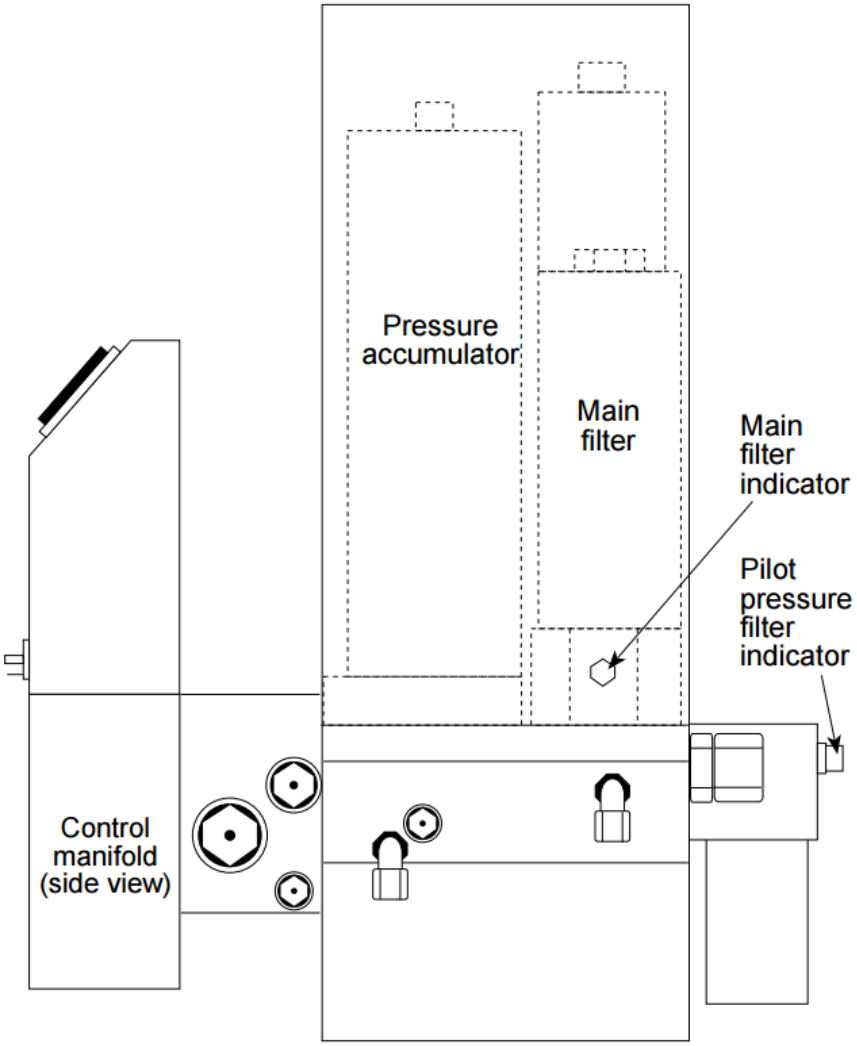
293 HSM Station Manifold

- The manifold for each station contains solenoid valves to control the pressure and a needle valve for low pressure adjust
- The slow turn on accumulator controls the transition time from off to low to high pressure
  - See 293 manual for charge pressure



293 HSM Filters

- When changing the filter ensure the HPU is off, stored energy dissipated, and proper lock out / tag out procedures are used.
- When changing the main filter the filter bowl needs to be drained prior to removing the bowl to prevent an oil spill.
- To drain the main filter bowl, place a drain pan under the filter drain port, remove the cap, drain the bowl prior to removing it.

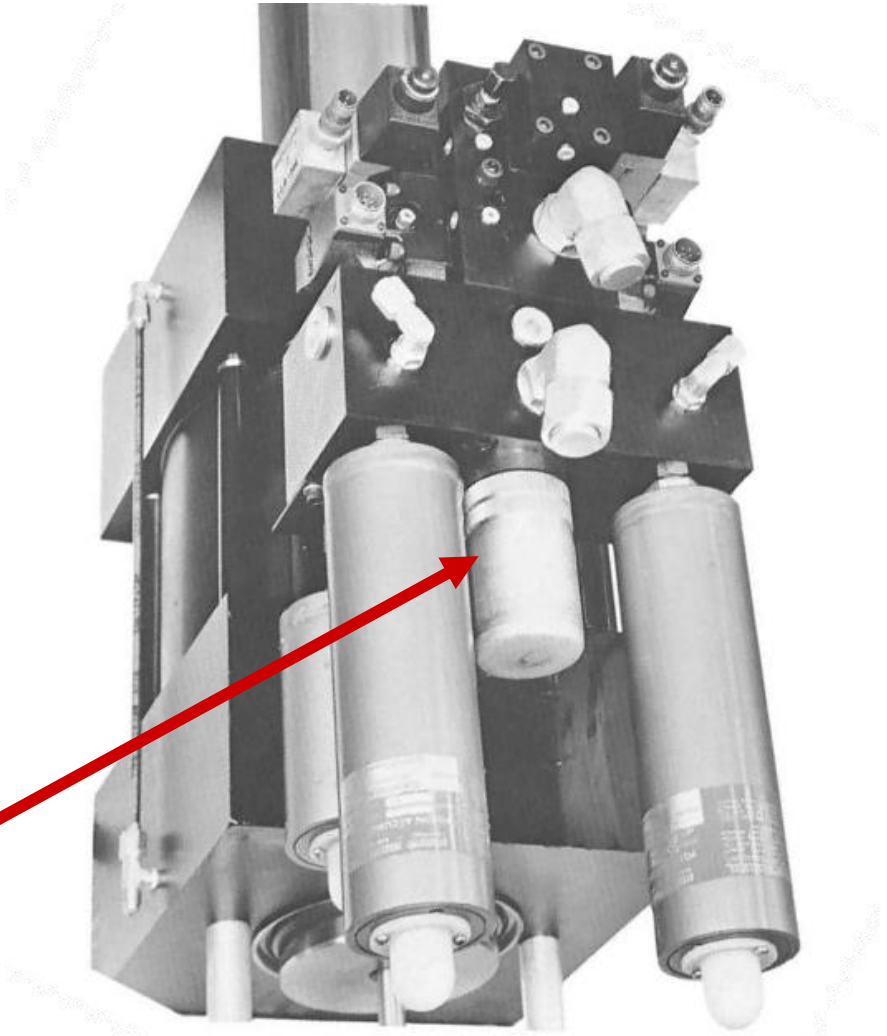


294 Manifold

- The 294 HSM was manufactured in two configurations
- 294.11 - No pressure control
  - No solenoid valves
  - Uses 4 port servo valves only.
- 294.12 – Off/Low/High pressure control
  - Used two solenoid valves (either 110 VAC or 24 VDC).
  - Uses 5 port servo valves only.
- The 294 manifold mounts directly to a 204 actuator.

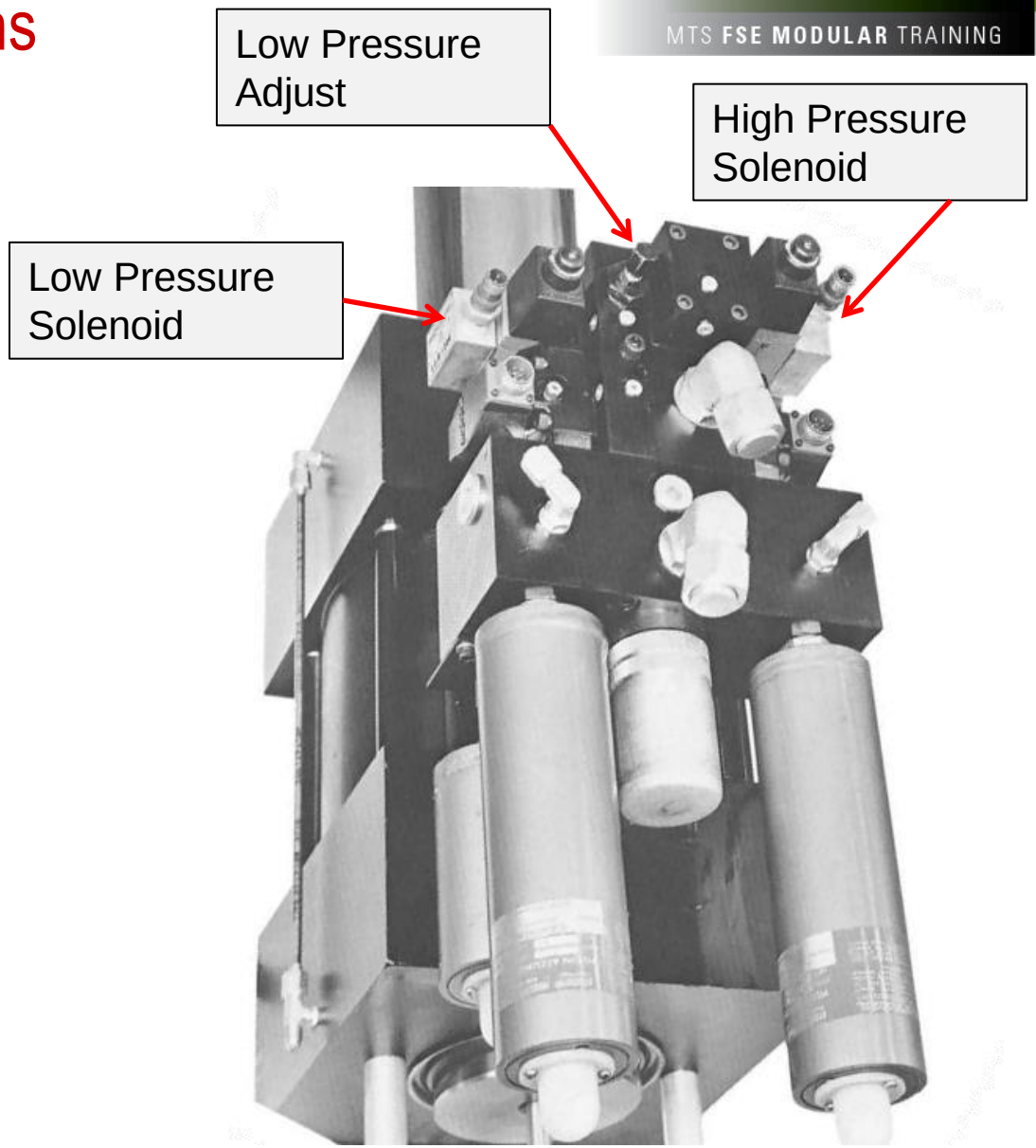
294 Manifold Filter

- The 294 HSM filter does not have a bypass circuit.
  - A dirty filter can restrict oil flow and reduce performance
- This is a screw on filter housing. To change filter:
  - Ensure HPU is off and stored energy is dissipated.
  - Unscrew the filter housing and pull down to remove the filter.
  - Install a new filter on the manifold.
  - Reinstall the filter housing.



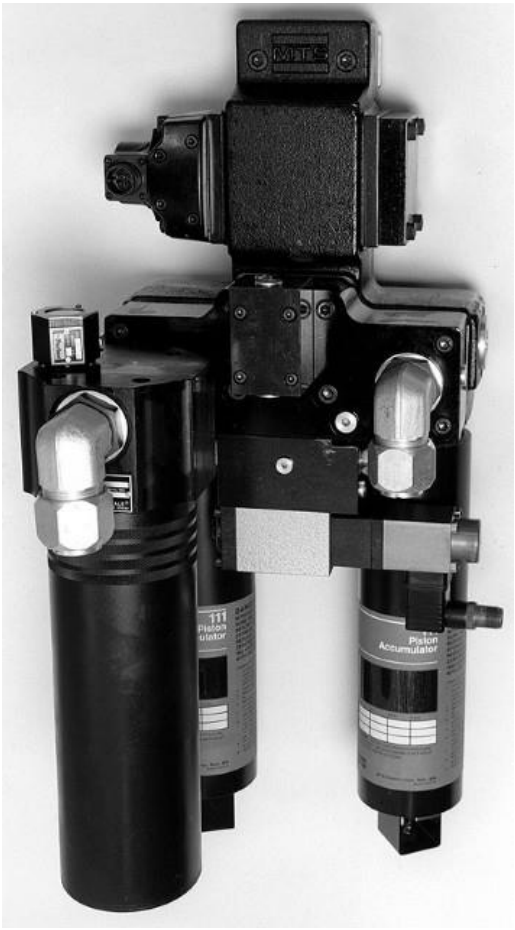
294 Component Locations

- The low pressure solenoid is located on the left side of the manifold.
- The high pressure solenoid is located on the right side of the manifold.
- The low pressure adjust needle valve can be found in the upper left corner of the manifold.



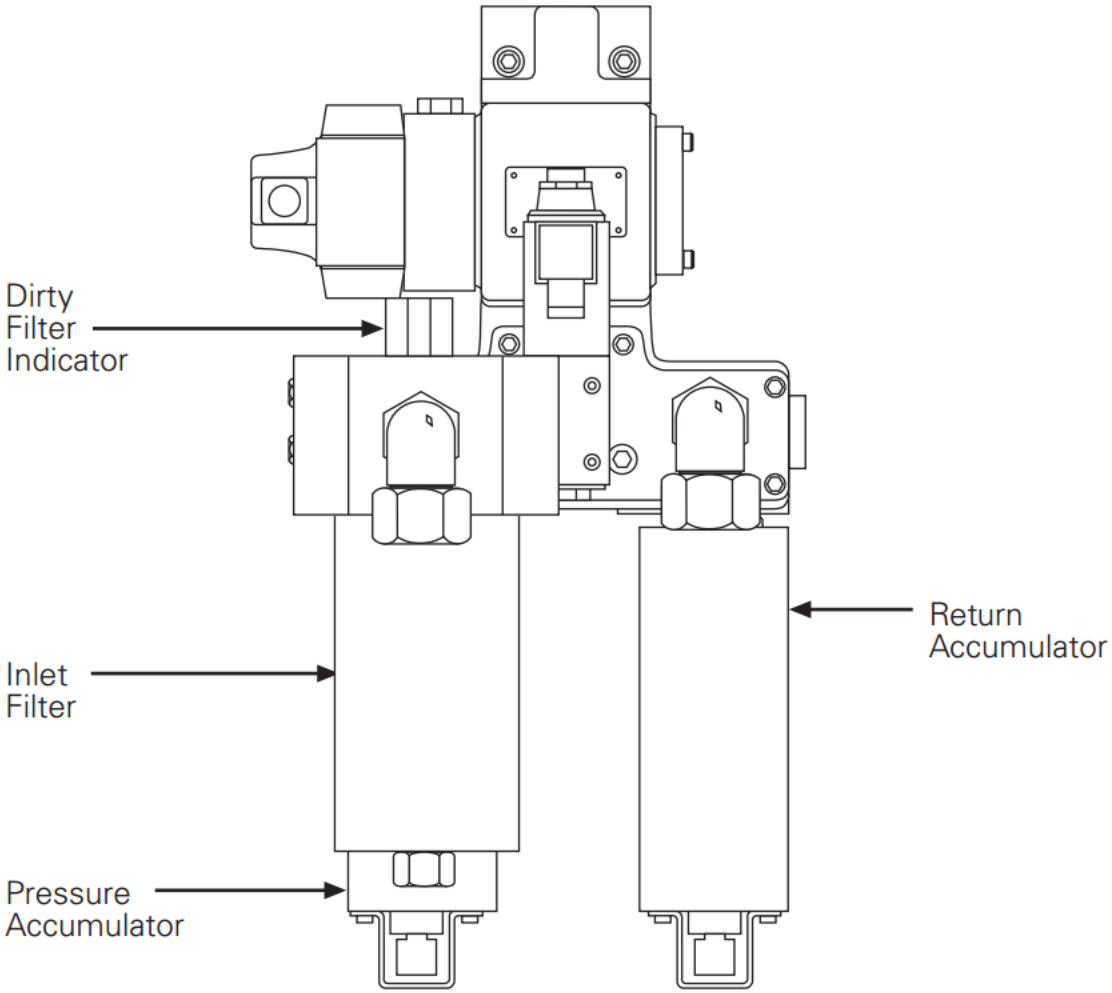
298 Manifold

- The 298 HSM has is available in several different styles.
  - All 298 manifold styles use 5 port servovalves
- 298.10 – No pressure control
- 298.11 – Off / On only. No low pressure control
  - Uses 1 solenoid valve to control a poppet valve.
- 298.12 – Off / Low / High pressure control
  - Uses 1 proportional valve to control a poppet valve.



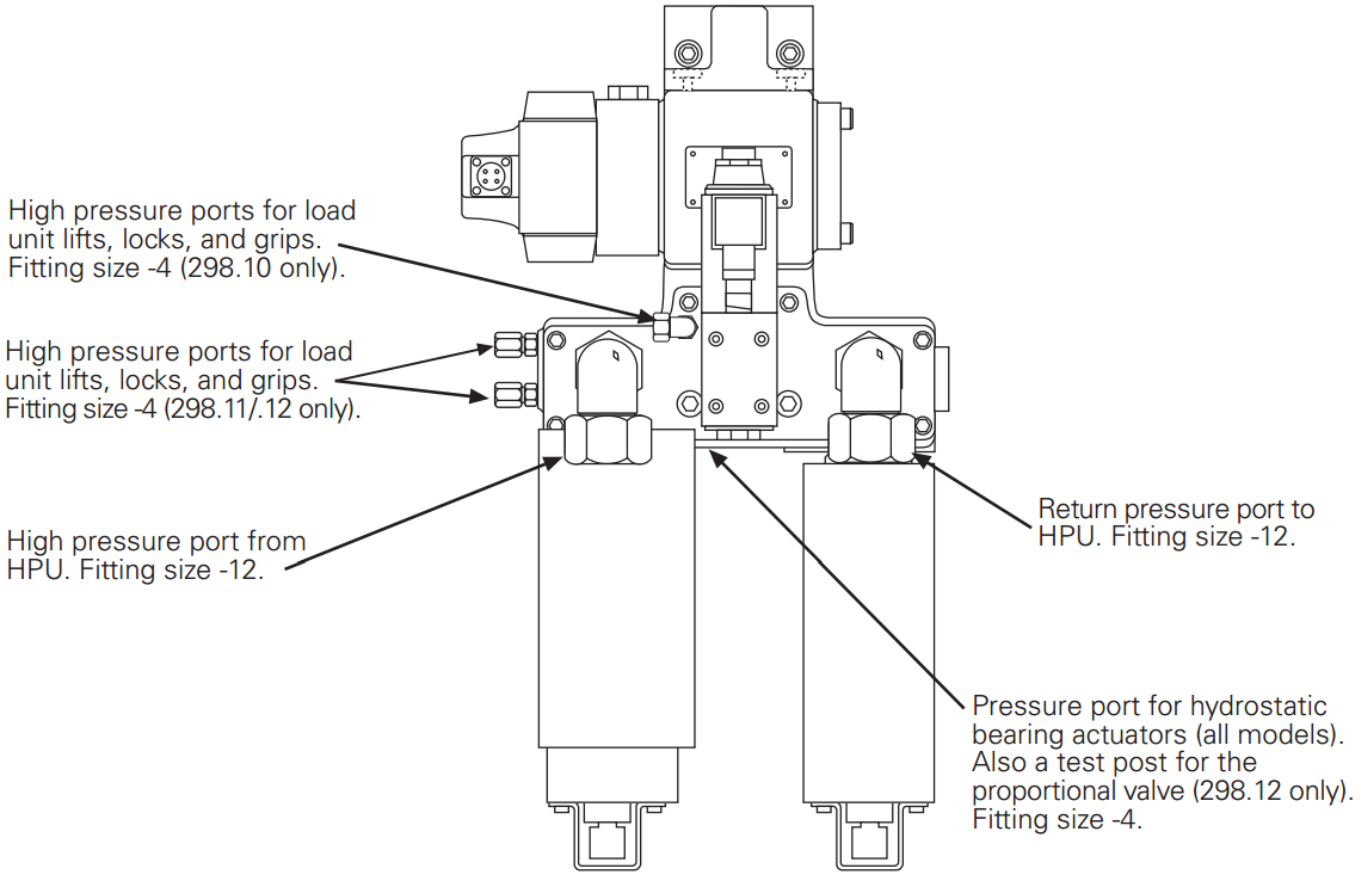
298 Manifold Filter

- The filter on the 298 manifold is external.
- This is optional and not all systems have this filter.
- This is attached at the pressure input fitting



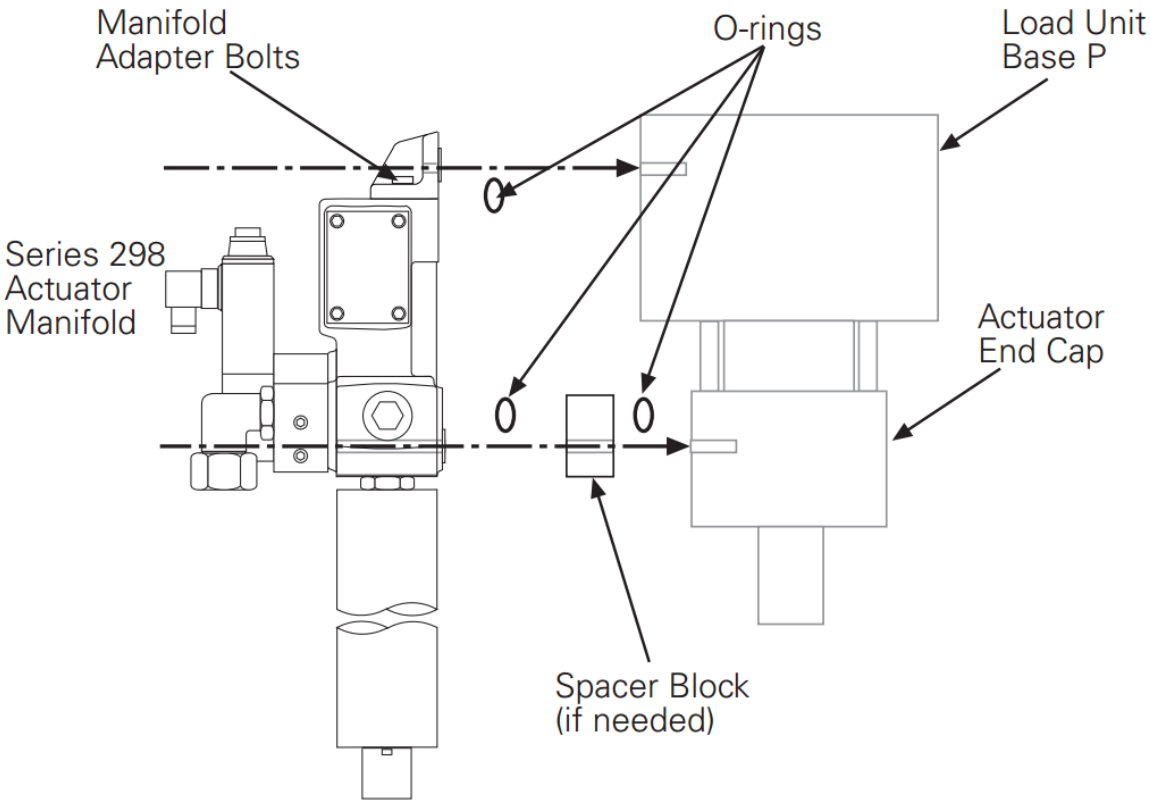
298 Manifold External Connections

» The 298 manifold has ports for load frame lift / lock, grip controls, and hydrostatic bearings.



298 Manifold Mounting

» The 298 manifold mounts directly to a 318 load frame
  - The top of the manifold attaches to the load frame base
  - The bottom of the manifold attaches to the lower actuator end cap



298 Manifold Spacer Block

» The spacer block at the bottom of the manifold is not symmetrical.
- The oil port is off center
- When removing the manifold for service note the orientation of the spacer block.