MTS FSE MODULAR TRAINING

Hydraulic Power Unit

January 12, 2017 rev E

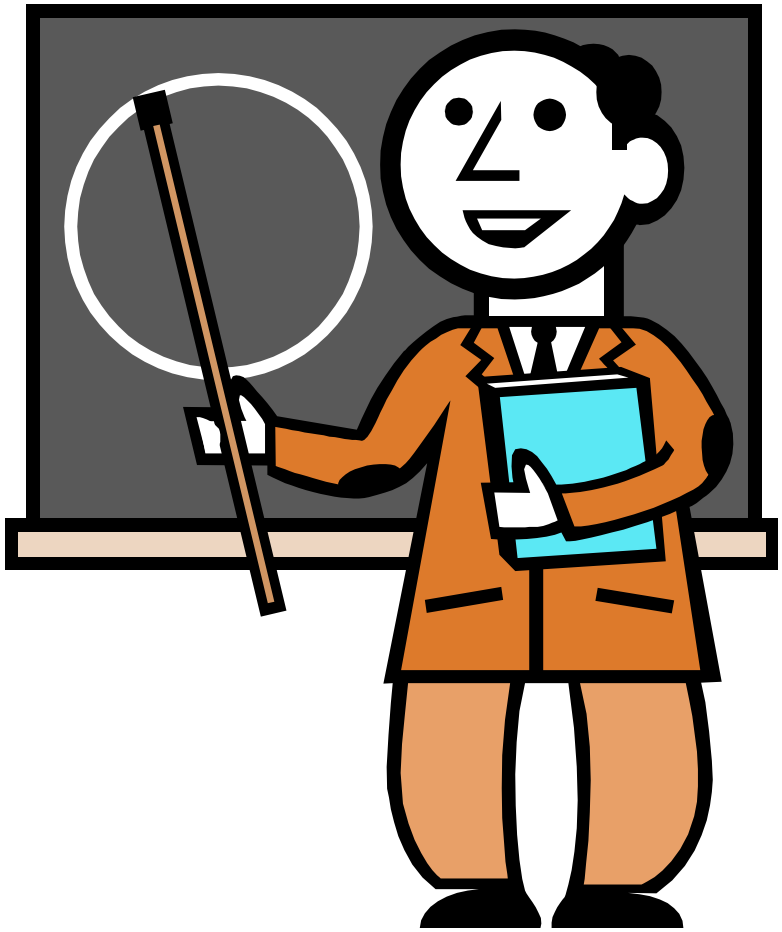
be certain.

Introduction

» This module will cover

- Theory of operation
- Installation
- Operation
- Adjustments
- Maintenance
- Repair
- Reference Information

Theory of Operation



Hydraulic Power Unit

» Before we start talking about hydraulic power supplies, also known as hydraulic pumps or hydraulic power units, lets correct one very common misconception.

Series 505 Hydraulic Power Unit

Hydraulic Pump

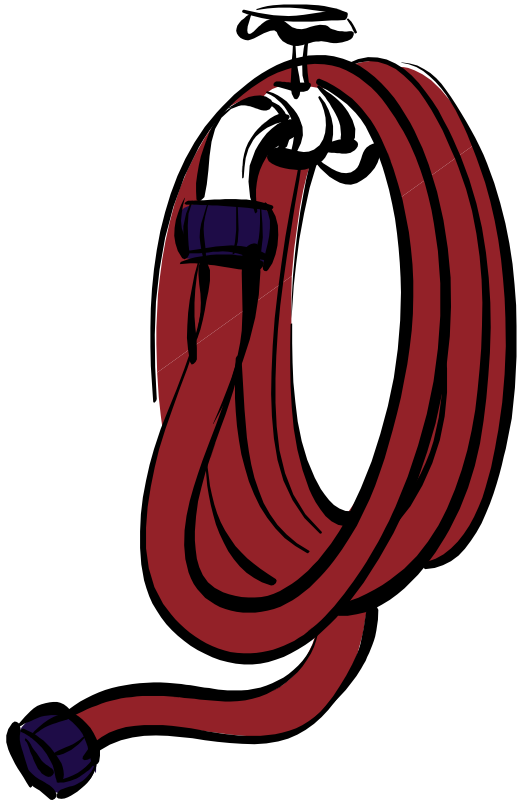
- Here is a question to ponder:
- What does a hydraulic pump do?
- Does it create pressure?
- Does it create flow?

Hydraulic Pump

- Each HPU will contain at least one motor and one pump.
- The motor turns the pump, as the pump turns it creates flow.
- Pumps do not create pressure.
- Pressure is created by applying a restriction to the output of the pump.

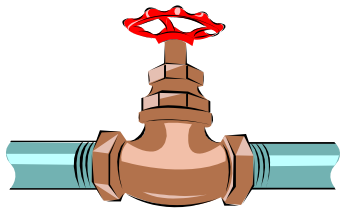
Example

- A good example of this theory is the common garden hose.
- When we turn on the water valve, the water flows out of the end of the hose.
- We can increase the pressure out of the hose simply by placing our thumb over the outlet.
- We increase the restriction thus we increase the pressure, this same logic applies to all pumps.



Solenoid Valve

» In our hydraulic systems we use control valves to create the restriction, instead of the finger over the end of the hose.



Solenoid Valve

- A solenoid valve often replaces the gate valve in a hydraulic system.
- Solenoid valves are either on or off.
- Typically when the solenoid valve is off, it allows the output to flow back to the tank.
- When turned on, the solenoid valve blocks this flow, thus creating pressure.

Solenoid Valves

- Solenoid valves are available in either of these two designs. Both work mechanically and electrically the same.

Hydraulic Power Unit

- Standard MTS HPU's operate at 210 bar (3000 PSI)
  - Optional higher pressure HPU's available
  - Flow capacity Gallons per Minute (gpm) or Liters per Minute (lpm) varies depending on model and input power line frequency
  - 50 Hz models typically provide less flow than same HPU used at 60 Hz

Series 505 Hydraulic Power Unit

HPU Pump Types

- There are two basic types of pumps commonly used in the industry, fixed volume and variable volume.

- Fixed Volume
  - Pumps the same flow regardless of demand
  - Example: 23 gpm rated pump always pump 23 gpm.
  - Excess is recirculated to reservoir.

- Variable Volume
  - Pumps only create the flow to equal demand
  - Example: 30 gpm rated pump might only generate 2 gpm to meet demand.
  - There is no excess flow.

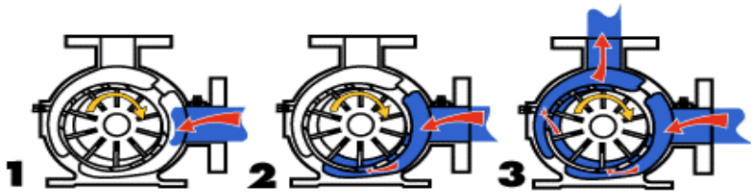
Fixed Volume Pump

- Fixed Volume or Vane type Pumps
  - Used on MTS 21 gpm and smaller HPU's (non 505 Models)
  - Not very efficient
  - Susceptible to internal wear

- Fixed volume pumps always generate maximum rated oil flow when running. Any excess flow that is not required by the equipment in the lab is directly recirculated to the reservoir by the relief valve in the HPU

Fixed Volume Pump

A slotted rotor or impeller is eccentrically supported in a cycloidal cam. The rotor is located close to the wall of the cam so a crescent-shaped cavity is formed. The rotor is sealed into the cam by two sideplates. Vanes or blades fit within the slots of the impeller. As the impeller rotates (*yellow arrow*) and fluid enters the pump, centrifugal force, hydraulic pressure, and/or pushrods push the vanes to the walls of the housing. The tight seal among the vanes, rotor, cam, and sideplate is the key to the good suction characteristics common to the Vane pumping principle.



Fixed Volume Pump

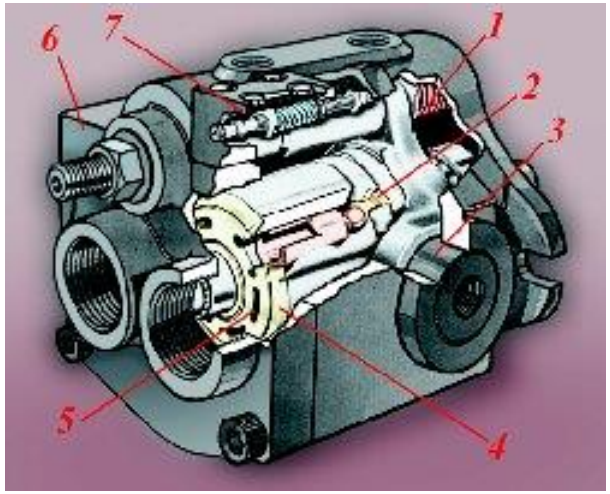
- As the pump turns, the seal between the end of the vanes and the case wears. The amount of flow that is available will decrease as the internal leakage between the vanes and case increase.

- This creates two less obvious issues beyond the reduced system performance.

  - 1. Possible contamination of system
  - 2. Increase current draw on the pump motor

Variable Volume Piston Pump

- Used on the current 505 / 515 series “SilentFlo” pumps.
- Prior to the 505 series, were used primarily on units with greater than 21 gpm / 75 lpm of flow.
- Flow from a variable volume pump automatically adjusts per system requirement.



Variable Volume Piston Pump

- They are more energy efficient then a fixed volume pump.
- Less susceptible to internal wear.
- Flow capacity is always stated as the maximum flow.

Variable Volume Piston Pump

- A typical variable volume pump has many pistons which rotate at motor speed. The amount of flow generated is dependent on the area and stroke of the piston.

- Under each piston is a swash plate, this plate is movable. The amount that the plate moves is controlled by the swash plate compensator. As the demand for flow increases or decreases the compensator moves the swash plate. At zero demand (no actuator movement), the flow output from the pump is at its minimum.

MTS HPU

- Previous generation legacy HPU
  - 510 – 30 gpm and smaller
    - Typically fixed volume (some variable volume styles produced)
  - 506
    - Less than 30 gpm typically fixed volume
    - Greater than 30 gpm typically variable volume pump

- Silent Flo – All capacities use variable volume pump submerged in the oil reservoir
  - 505 G1 – 1st generation
  - 505 G2 – 2nd generation with updated electrical panel
  - 515 – Newest available

Pressure Adjust Circuits

- Primary pressure adjust
  - Variable volume – Compensator adjustment located on pump
  - Fixed volume – Relief valve located on HPU manifold
- Secondary pressure relief
  - If primary pressure adjust is adjusted to high or fails the secondary pressure relief will prevent the HPU from generating pressure beyond the setting
    - 3000 PSI HPU secondary pressure adjust set for 3250 PSI
- Low Pressure
  - Operated by solenoid
  - Current models dump full pump capacity flow directly to reservoir with out restriction

Oil Filtration

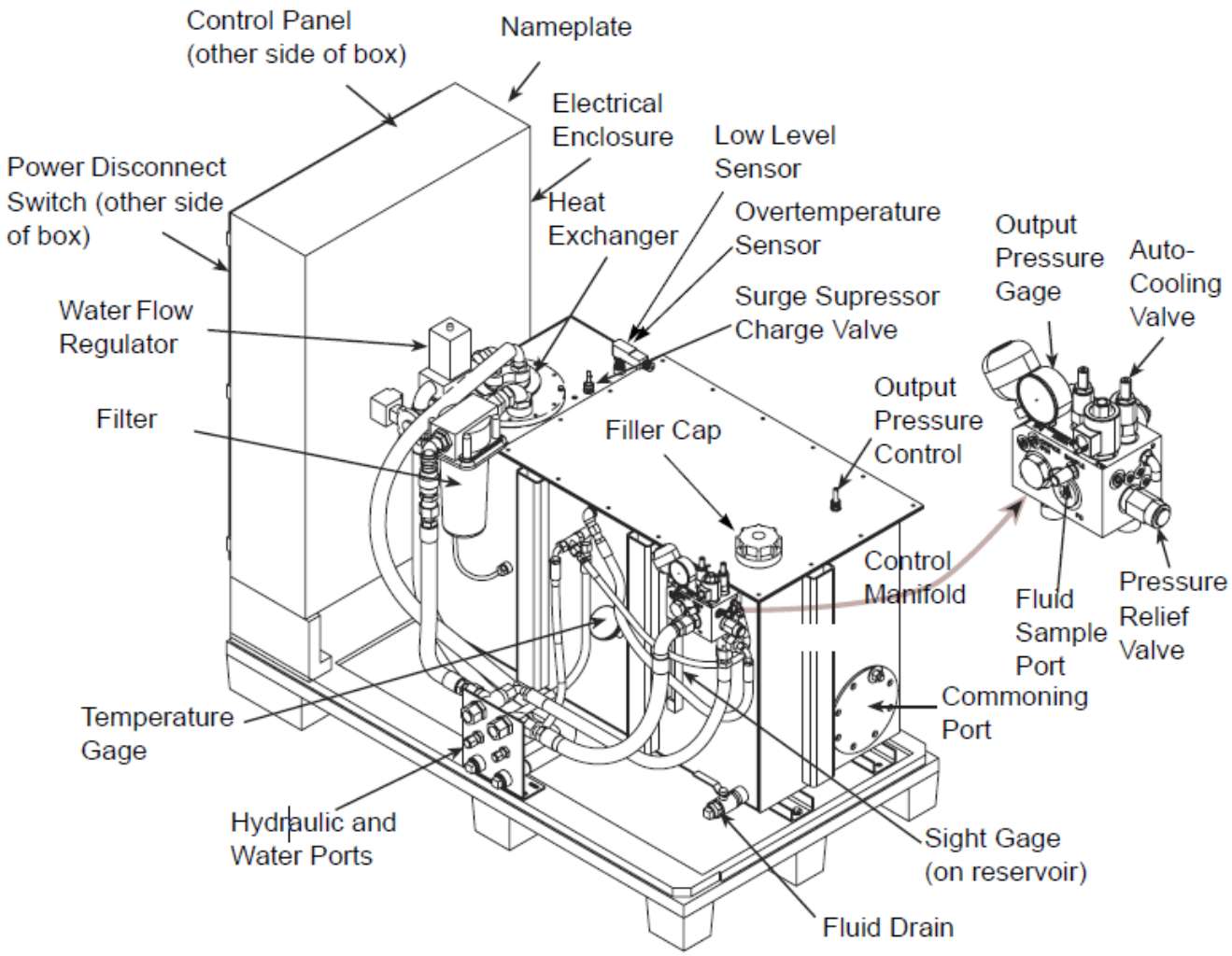
- Clean contamination free oil is required for servo hydraulic systems
  - Accomplished using filters
- MTS HPU's utilize a combination of low pressure, high pressure, and return line filters
  - Oil is filtered to a cleanliness level of 3 micron
  - There is either an electronic or mechanical dirty filter indicator
  - All low pressure and return line filters are 3 micron
  - Some high pressure filters are 10 micron or larger
- Example particle size in Microns:
  - Human Hair 50-300
  - Mold Spores 10-30
  - Red Blood Cells 5-10

Warning Systems

- A temperature sensor will shut down the HPU when the oil reservoir temperature exceeds the limit
  - Normal operating temperature is 43 deg C (110 deg F)
  - On modern HPU's this limit is factory set for 55 deg C (131 deg F)
  - On older HPU's this limit is factory set for 52 deg C (125 deg F)
  - Check appropriate product manual for proper shutdown temperature

- A oil level sensor monitors the reservoir oil level and will shut down the HPU when the oil is below the limit
  - This limit is adjusted as required

Typical Hydraulic Power Unit



Local / Remote Operation

All of the HPU's manufactured by MTS have a connector with a jumper plug mounted on the motor starter box that connects the HPU to the controller for remote operation.

For local operation, the cable is removed and the jumper plug is installed.

Control types

» Relay logic

» PLC Controlled

Relay Logic

- In older HPU's, a series of relays were used to control the functions of the pump. In newer pumps the relays have been replaced with a programmable logic controller or PLC.

- Both function as on/off devices for limits such as the over temperature and low level and controls such as motor start/stop.

Relay Logic

» Typically found on older style pumps and the 505.07 and 505.11 SilentFlo HPU. As name implies it uses relays to control the function of the pump.

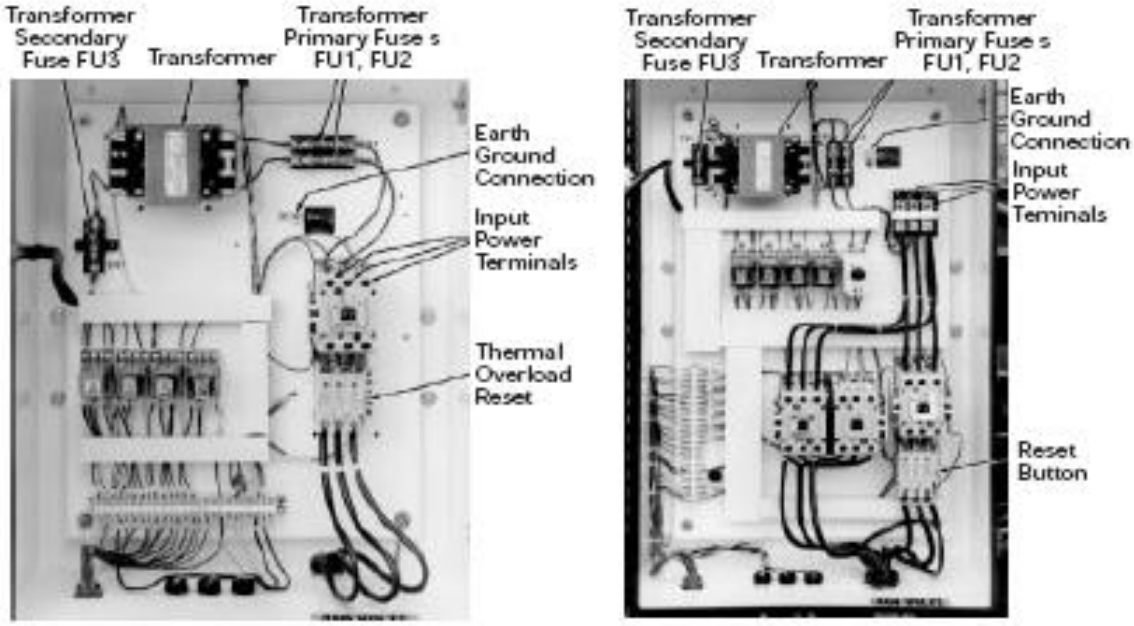
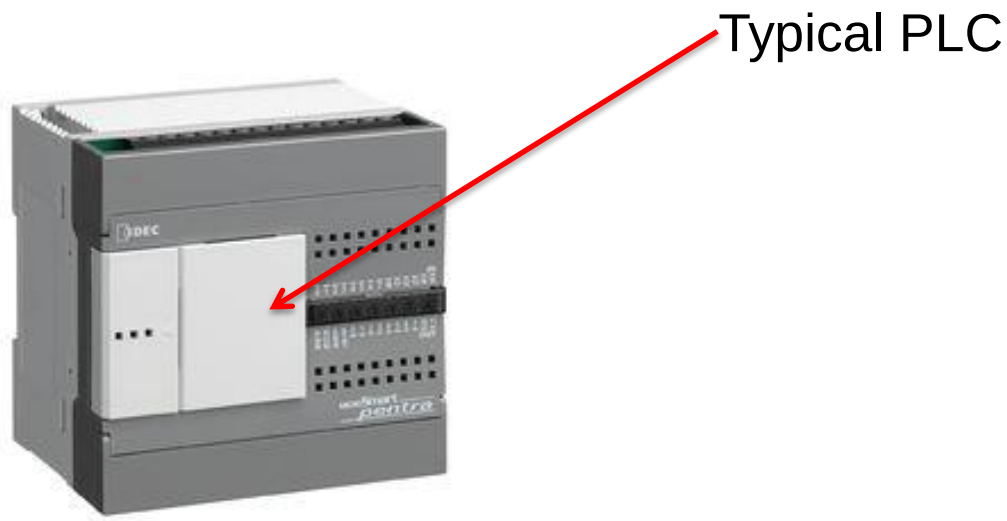


Figure 3-1. Motor Starter Box

PLC Logic

- Newer HPU's have a PLC instead of relays.
- The PLC contains programming logic that controls the pumps function.



Identifying Logic Style

- The best way to identify if the HPU is relay or PLC driven is to check inside the motor starter box for the presence of either relays or a PLC.
- If you have access to MTS Finder, you could also use the assembly number of the HPU, and check the Bill of Materials (BOM), for the presence of the relays or the PLC.
- If the HPU is operated as a stand alone unit, where there is no connection to the system electronics, there is no real concern as to the control logic of the HPU, whether it is relay or PCL.
- However, if you connect the HPU to the controller, the type of HPU controls MUST match the controller type.

Relay Logic Controllers

- Analog controllers, like the 458 shown below, were design to control relay logic.
- When an relay logic pump and analog controller are connected together, a simple cable is used.
- If the 458 is connected to an HPU with a PLC, an interface box may be required.

Relay Logic

» If a digital controller is connected to an HPU with relay logic, an interface box is always required.

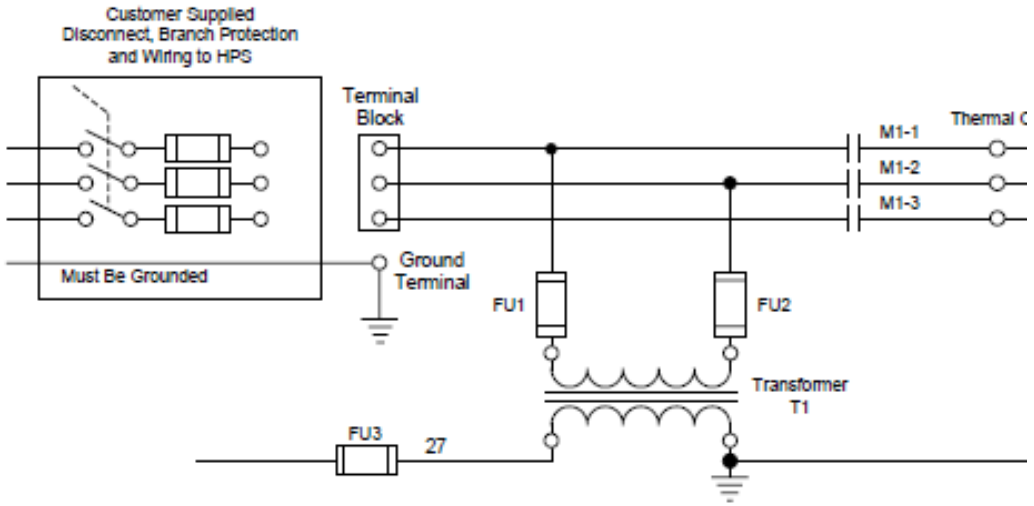
Single 493 Chassis with a non-PLC pump

493.07 Interface Box Usage

HPU Type	Controller Type	Interface Required	Notes
Relay	458 / Analog	No	
Relay	493 / 494	Yes	
PLC	458	No	Must be only 458
PLC	493/494	No	
PLC	458 + 493/494	Yes	Isolate Between 493/494 and HPU

Control Circuit Voltage

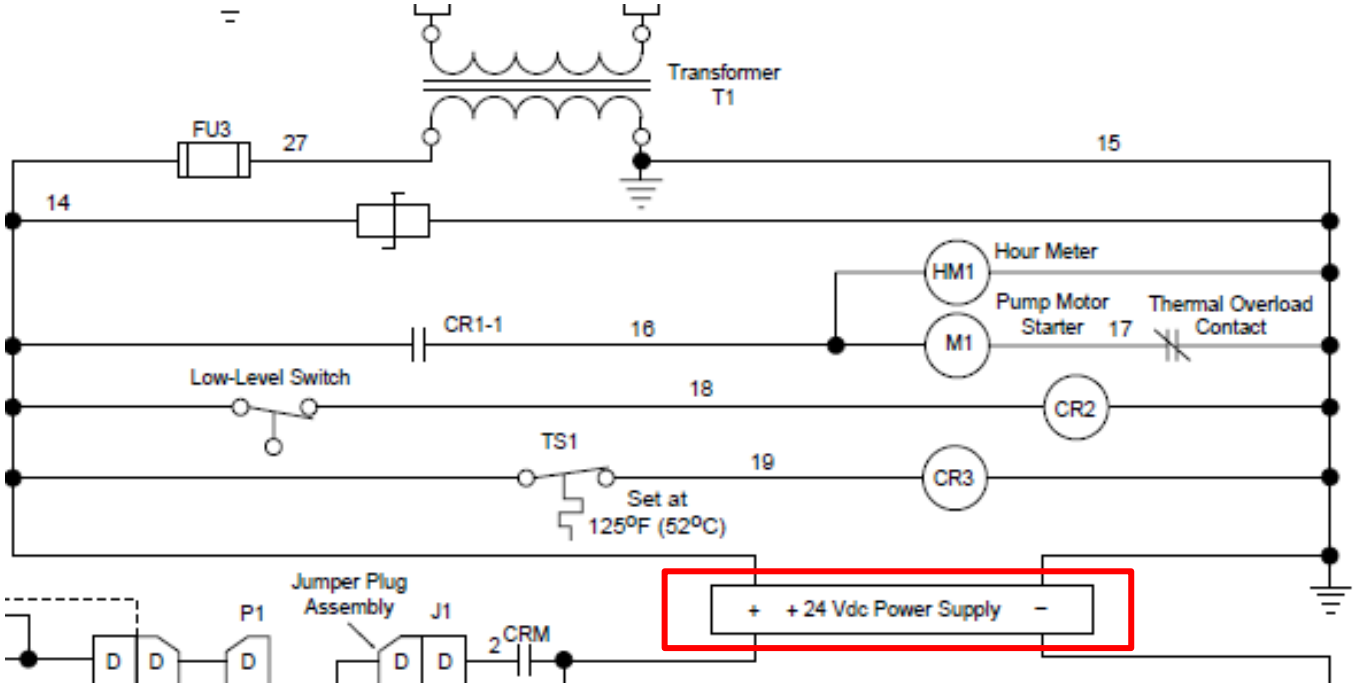
» Nearly all of the HPUs manufactured by MTS Systems use 3 phase AC power for the pump motors. Inside of the motor starter box is a transformer that converts one of these 3 phase power legs to 110 VAC single phase.



Line Voltage Configuration

Control Circuit Voltage

» On pumps manufactured prior to 1980, this single phase 110 VAC was used as the control (foreign) voltage. After this date, MTS added a power supply to the motor starter box that would convert the 110 VAC to 24 VDC. The 24 VDC control voltage is now the standard configuration.



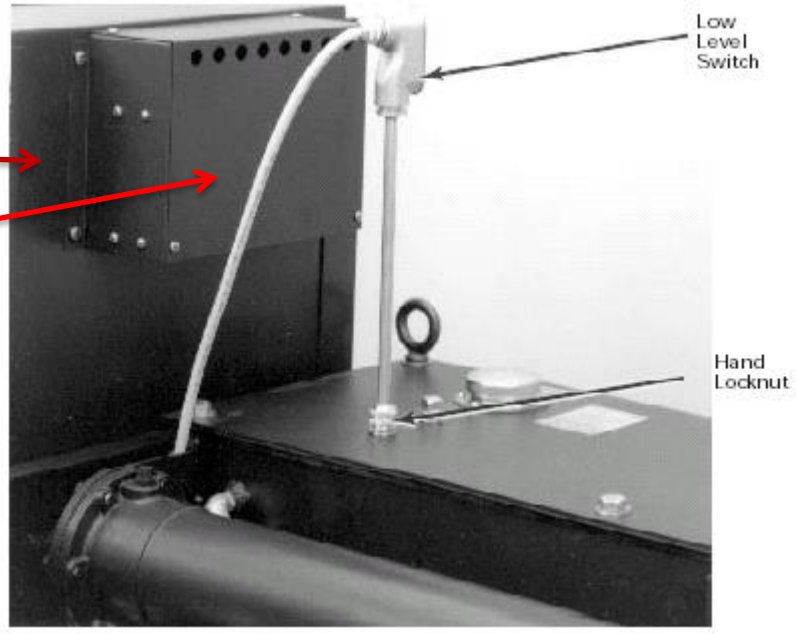
Control Circuit Voltage

- On older HPU's, the easiest way is to check if it is a 24 VDC system or not is to look at the pump itself. If it is 24 VDC, then there will be a 24 VDC power supply mounted on the back of the starter box.

- New generation HPU's are only available with 24 VDC control circuit voltage.
  - The 24 VDC power supply is inside the control cabinet

Motor Starter Box

24 VDC Power Supply



Control Circuit Voltage

- Visual identification of a 24 VDC Pump.
- Open the motor starter box and look at the colors of the wiring.
- If wiring inside the motor starter box is a combination of both red and blue wiring, the pump control voltage is 24 DC.
- Red only wiring with no blue indicates 110 VAC control voltage.
- Black wiring used in the high voltage sections and does not indicate either 110 VAC or 24 VDC control voltage.
- The red and white are the 110 VAC and the AC Ground. The blue and the blue/white are the 24 VDC and the DC Ground.
- Note: Both the AC & the DC grounds are at the same potential!

Control Circuit Voltage

- The control voltage of the pump is sent to the control electronics. On some electronics, the pump control voltage is directly wired to the controller, so the HPU control voltage and the electronics must be the same.

- This control voltage is used to turn on the solenoid valves mounted on the load frames or hydraulic service manifolds. These voltages must match the control voltage of the HPU.

- The control voltage must be determined prior to performing a system upgrade.

Remote Control Connection

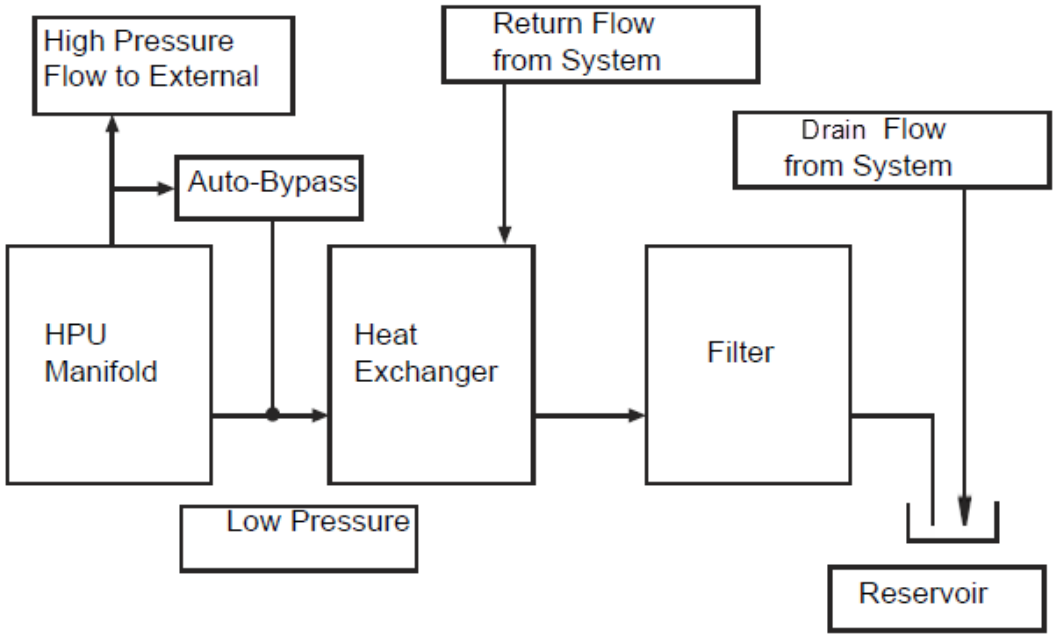
- Prior to the 505 G2 series of HPU, MTS employed a standard 16 pin MS connector on all HPU's.
  - This is used to connect to the controller
- The 505 G2 Series now uses a Turck M27 26 pin high density connector.
  - The mating connector is PN 100-225-005.
- Due to the different electrical connector, an adapter cable PN 100-225-003 is required to connect an older style HPU cable with an MS connector to a newer style 505 G2 HPU with a M27 connector.

Oil Cooling

- As hydraulic oil is forced through the system, it heats up.
- Heat can destroy or shorten the life of hydraulic oil.
- There are two basic ways to cool the oil.
  - Water Cooled
  - Air Cooled

Cooling Circuits – 505 HPU

- Oil flows to the heat exchanger from the following locations
  - When flow to lab is normal all return oil passes through heat exchanger
  - When flow to lab is low the Auto-Bypass sends oil through heat exchanger for cooling
  - When in low pressure all oil passes through heat exchanger
- The drain flow from the lab does not pass through heat exchanger
  - High drain line flow can increase the HPU reservoir temperature



Typical 505 SilentFlo HPU

Auto Cooling Circuits – 505 HPU

- The auto-cooling valve is adjusted such that the shift between valve closed and valve opened occurs just below the output pressure level. Whenever system pressure is above the shift level of the auto-cooling valve (indicating low system demand), the valve opens to port a small amount of hydraulic fluid through the return filter to the heat exchanger. When system pressure drops below the shift level (indicating an increase in system demand), the valve closes and full flow is available to the system.

- The auto cooling valve is adjusted to operate from 14 MPa (2000 psi) to 21 MPa (3000 psi).
  - If the HPU output pressure is adjusted below 14 Mpa (2000 psi) for extended periods of time the autocooling valve will need to be readjusted

Cooling Circuits – Small 506 / 510 HPU

- For Fixed volume pumps used in small 506.XX or 510.XX such as 506.01 or 510.21 all oil is sent to heat exchanger regardless of flow to lab. Fixed volume always produces maximum flow. Excess that is not used for lab testing is sent across relief valve to heat exchanger.

- The oil which does not flow through heat exchanger and can cause the reservoir temperature to rise is
  - Drain line from lab
  - Case drain from pump
  - Secondary pressure relief

Cooling Circuits –Large 506

- For variable volume pumps used in large 506 HPU's such as 506.5X and larger only the required flow for the lab generated. In this case there is no excess oil.

- When a supercharge pump is in use on 506.6X and larger the full rated capacity of the HPU is pumped by the supercharge pump. All of this oil passes through the heat exchanger.
  - If this style HPU overheats it can be cooled by only running the supercharge pump

- The oil which does not flow through heat exchanger and can cause the reservoir temperature to rise is
  - Drain line from lab
  - Case drain from pump
  - Secondary pressure relief

Heat Exchanger

- Heat Exchanger: A Piece of equipment built for efficient heat transfer from one medium to another. MTS uses two methods.
  - Hydraulic Fluid to Water
  - Hydraulic Fluid to Air
- MTS uses 2 types of heat exchanger
  - Shell and Tube
  - Plate design
- Everyday example of a common heat exchanger
  - Radiator in automobile
- For additional information see the Heat Exchanger Care and Water Quality Guide
  - MTS Manual P/N 015-164-000

Heat Exchanger

- The combination of the heat exchanger and the water valve have a total pressure load of 35 PSI/ 2.41 Bar.

- Because of this pressure load, there must be a 35 PSID/2.41 Bar delta (pressure differential) between the inlet and the outlet water of the heat exchanger.

Heat Exchanger

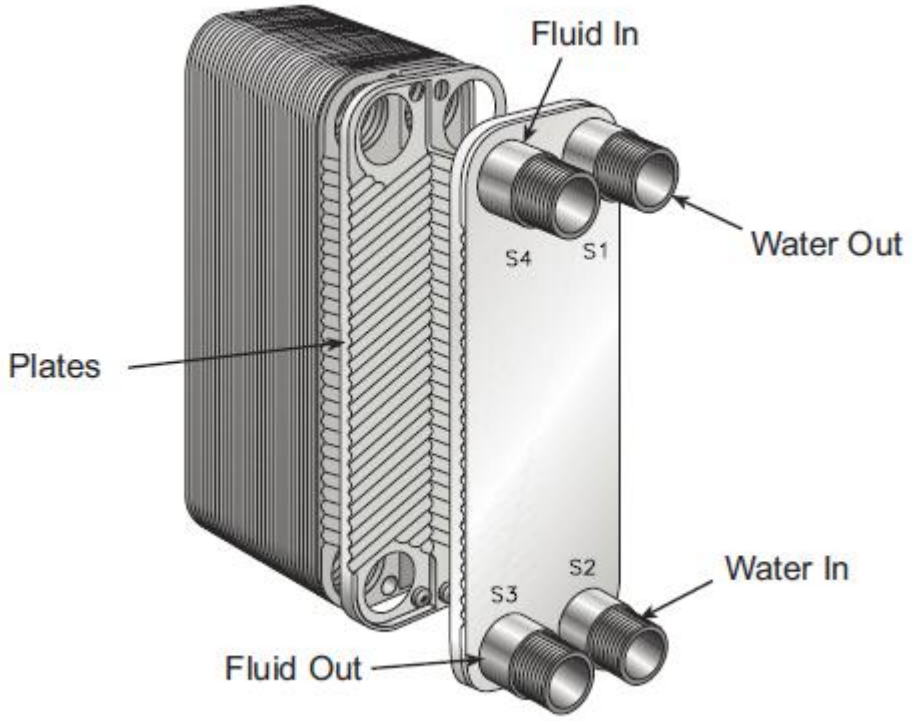
- For example, lets say city water is connected to the Inlet of the heat exchanger and the discharge side is connected to building drain.
- Since the normal building water pressure is 45-50 PSI, the 35 PSID is easily met, however this method wastes several gpm of water, as it is sent down the drain.
- Many customers have elected to use closed looped water systems instead of allowing the water to go down the drain.

Heat Exchanger

- MTS does not sell or manufacture a chilled or closed looped water system.
- Use of a chilled water system can in itself create more problems. Most systems maintain a constant pressure within the system, typically 50 PSI.
- This will not provide the 35 PSID between the inlet and outlet of the heat exchanger.
- A boost pump may need to be installed by the customer to get the inlet pressure to 35 PSI above the chiller constant pressure.

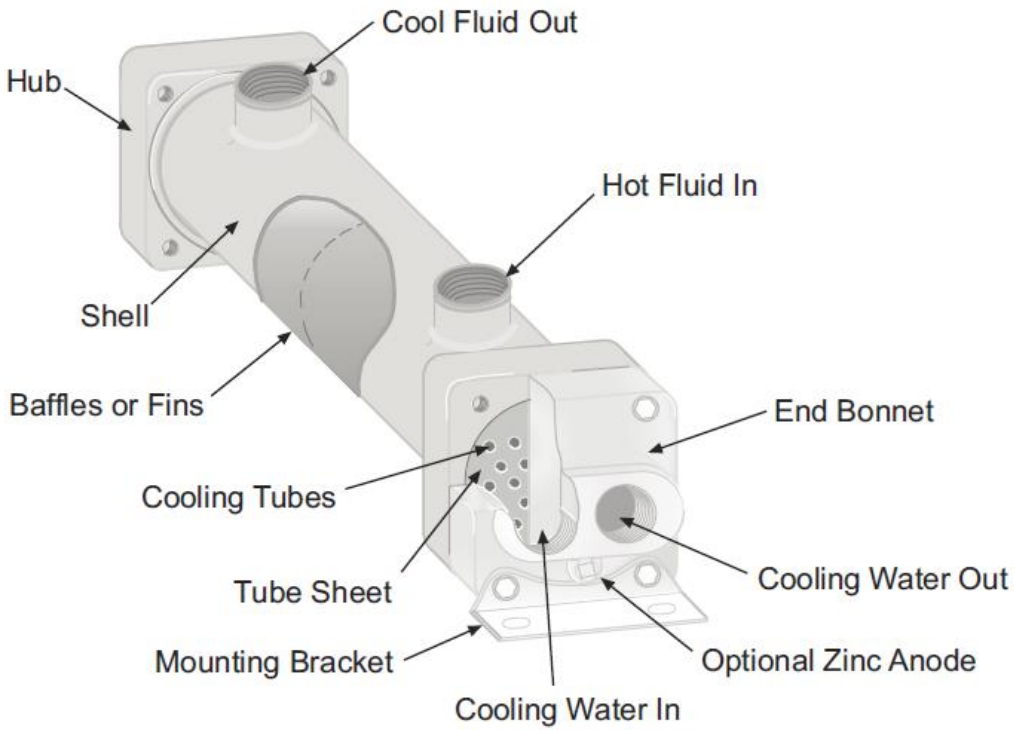
Hydraulic Fluid to Water Heat Exchanger

» Plate Design Heat Exchanger
  - Hot Hydraulic fluid passes between a series of plates.
  - Cooling water passes between alternating plates.



Hydraulic Fluid to Water Heat Exchanger

» Shell and Tube Heat Exchanger
  - Hot Hydraulic fluid circulates through the shell and over the outside surface of a bundle of tubes
  - Cooling water passes though the inside of the tubes



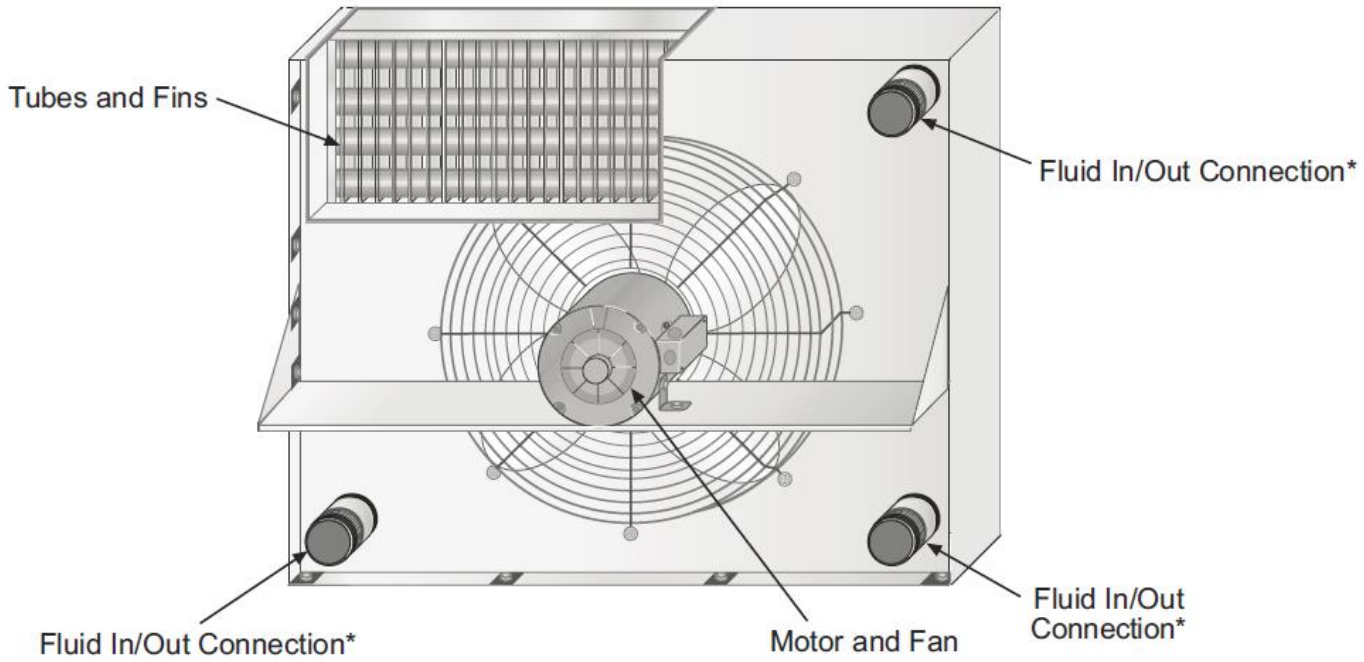
Heat Exchanger Damage

- A common Issue with a shell and tube heat exchanger is it will become clogged with sediment after several years of use reducing the cooling surface area of the heat exchanger
- If enough of the heat exchanger clogs, the HPU will over heat.
- Another concern is that the Inner tubes are copper. Chemicals in the water can have a reaction with the copper and build up contamination. This reaction is corrosive to the copper tubing.
- Best case scenario, the HPU will simply go into an over temperature condition and interlock.
- Worst case is that the tubes become weak enough to start leaking, allowing the cooling water and oil to mix.

Heat Exchanger Damage

- Failed heat exchanger
  - Oil contaminated with water. Oil will have a milky white appearance.
    - Requires oil change and complete flushing of system
    - Monitor until water is eliminated
  - Water drain contaminated with oil.
    - May impact local waste water treatment
    - May have environmental impact

Hydraulic Fluid to Air Heat Exchanger



* Hot Fluid In/Cool Fluid Out connections vary between models

Oil Temperature Regulation

- A flow control valve on the water inlet side of the heat exchanger regulates the reservoir oil temperature
  - The valve contains a probe which is inserted through the side of the reservoir to measure oil temperature
  - Higher oil temperature = more water flow

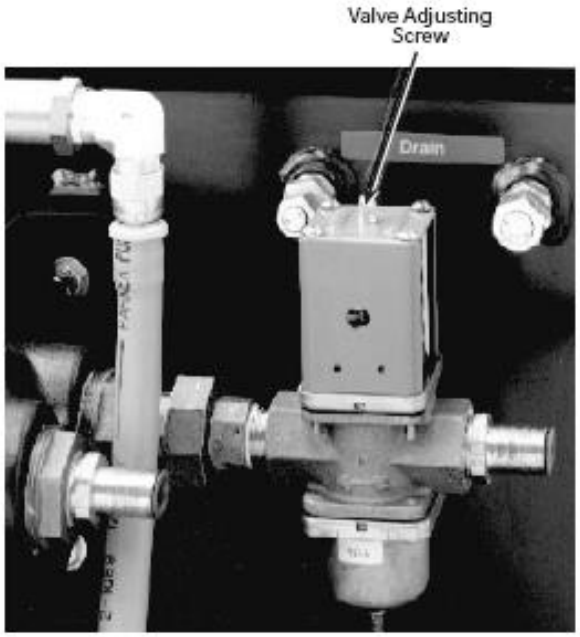


Figure 3-3. Water-Regulating Valve Adjustment

Heat Exchanger

- When an air cooled heat exchanger is used, the water heat exchanger is removed from the HPU. A mixing valve is installed that controls the amount of oil sent to the air cooled heat exchanger based on the temperature of the oil.

- The electronics of the HPU are modified to provide control for the fan motor on the heat exchanger.

HPU Options

- Surge Suppressor
  - Used to smooth oil ripple or pressure pulsations caused by the pump
  - Commonly found on variable volume piston type pumps
  - Requires regularly scheduled maintenance to sustain nitrogen gas charge
- Tuned Hose
  - Alternative to Surge Suppressor
  - Strategically selected length of hose attached to pump pressure output internal to HPU which will dampen pressure pulsations caused by pump
  - No maintenance necessary
- Accumulator
  - Used to provide short duration peak flow in excess of pump capacity

HPU Options - Run on Demand (ROD)

- A typical 505-90 HPU would consist of three 30 gpm pumps. These pumps are all connected together within the HPU.
- Without ROD, the operator would have to select how many of the pumps it is necessary to run. Then at start up, all of the selected pumps would start.
- With the optional ROD installed, a single pump will start while the others will remain in standby until they are required due to demand for flow.
  - When more demand is required the additional pumps are started.
- ROD sequences which pump starts first.
  - 505 G1 - A different pump starts with each start cycle. (not hour balanced)
  - 505 G2 – Pumps are hour balanced to equalize run time

SilentFlo Circuit Breakers

- The circuit breakers and main power disconnect are designed to meet the latest safety directives using color codes to indicate status
  - When switched off or tripped the color is “Green”
  - When switched on the color is “Red”

Emergency Stop Circuits

- Prior to the 505 G2 SilentFlo HPU all systems used a single chain emergency stop
- To meet improved safety requirements the 505 G2 uses a dual chain emergency stop
  - The new HPU contains a Pilz controller in the dual chain circuit.
  - Dual chain allows for redundant circuit monitoring
- All Standard servo hydraulic controllers manufactured to date are a single chain circuit.

Emergency Stop Circuits – Pilz safety relay

- The Pilz safety relay has a rotary switch on it that will determine if the safety chain is single or dual chain.
  - The 11 O'clock setting (In2+ A) is for single chain operation
  - The 1 O'clock setting (In2- A) is for dual chain operation.
- To connect to a MTS controller requires configuring for a single chain (In2+ A)
- The standard setting for a standalone G2 HPU is dual chain (In2- A)

Emergency Stop Circuits – Pilz safety relay

- Standard shipment configuration is stand-alone, so the Pilz is shipped in dual channel mode. The E-stop chain must be configured to match system controller type.

- When using adapter cable part number 100-225-003 which adapts from the Turck connector to the MS connector, E-stop must be configured for single channel mode. This is accomplished by changing the rotary selector switch on the yellow Pilz to the In2 +A position (11 o'clock position).

- If the E-stop circuit is working correctly, all the green led's on the Pilz will be illuminated. If all the led's are not illuminated, then either an E-stop button is pushed or Pilz is not configured correctly.

505 SiletFlo HPU – G2 E-Stop

- Recovery of an emergency stop is different on the G2 series HPU than from legacy systems.
- Conventional systems, the emergency stops switches are simply cleared, and the software reset.
- Due to added safety requirements the reset process on the G2 is a little more involved.

505 SiletFlo HPU – G2 E-Stop

- When the e-stop is pressed on the HPU, the 793 software will display:

- HPU J25 Unexpected HPS ON to OFF transition detected
- HPU J25 Enable interlock active
- Interlock 1—External Hardware

- If the e-stop on the frame is pressed the 793 software will display:

- HPU J25 Load Frame E-Stop Interlock (J29)
- Interlock 1—External Hardware

505 SiletFlo HPU – G2 E-Stop

- Important Difference:

- Regardless of which emergency stop is depressed, and then cleared, the operator MUST physically go to the the HPU and reset the fault before they can restart the HPU.

Installation

HPU Installation Customer Responsibilities

- The customer is responsible for connecting the 3 Phase power to the pump.
- The customer is also responsible for connecting the cooling water.
- Most service engineers are not licensed electricians or plumbers.
  - Connecting either of these may violate local ordinances.
- If MTS has contractual responsibility to install incoming power an Electrician will be used for this

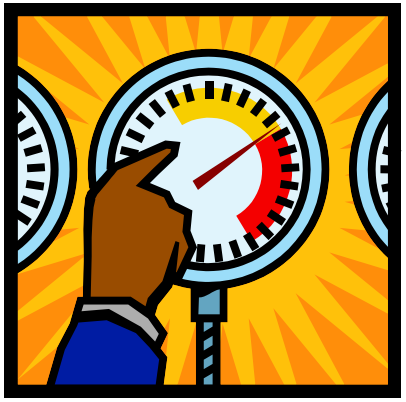
HPU Incoming Power Connection

- It is the customer responsibility to connect facility power to the HPU
  - This should be performed by a licensed electrician
  - The incoming power cable must be properly torqued at HPU power connection
  - If power is energized and HPU electrical cabinet door is open the FSE is required to have proper personal protective equipment (ppe) including Arc Flash protection clothing and properly rated gloves

Heat Exchanger

- When you are installing a new HPU, it is advised that you verify the presence of the required water pressure differential between water inlet pressure and water outlet pressure before you connect and run the new HPU.

- Without the proper water pressure difference the pump will over heat causing an interlock.



Example Cooling Water Flow Requirements

- Refer to the appropriate product manual to ensure you have adequate water flow and differential pressure
  - Example: For a 505.07 HPU the cooling water requirements are as shown below

Water flow rating (input temperature)		
15.5°C (60°F)	4.9 L/m (1.3 gpm)	9.1 L/m (2.4 gpm)
21.1°C (70°F)	6.1 L/m (1.6 gpm)	12.1 L/m (3.2 gpm)
26.7°C (80°F)	8.3 L/m (2.2 gpm)	18.9 L/m (5.0 gpm)
32.2°C (90°F)	15.9 L/m (4.2 gpm)	49.2 L/m (13.0 gpm)
Heat load (maximum)	12.3 kW (42,000 Btu/hr)	20.5 kW (70,000 Btu/hr)

Remove Fill Cap Plug

- The HPU ships with a sealed plug inside the reservoir fill cap which should be removed prior to startup.
  - Remove reservoir fill cap
  - Remove red plug
  - Insert screen if shipped separately
    - Located in electrical enclosure
  - Replace reservoir fill cap

Fill Reservoir with Hydraulic Oil

- Hydraulic Power Units shipped from MTS do not contain hydraulic oil.
- This is a change from previous methods. In the past some HPU's were shipped with oil inside the reservoir.
- Mobil DTE 25 or an approved hydraulic oil will need to be added during installation using a transfer pump.
  - See module 11 Hydraulic oil for current approved oils
- Different brands or types of Hydraulic Oil should NEVER be mixed
- Use of a non-approved oil may invalidate warranty

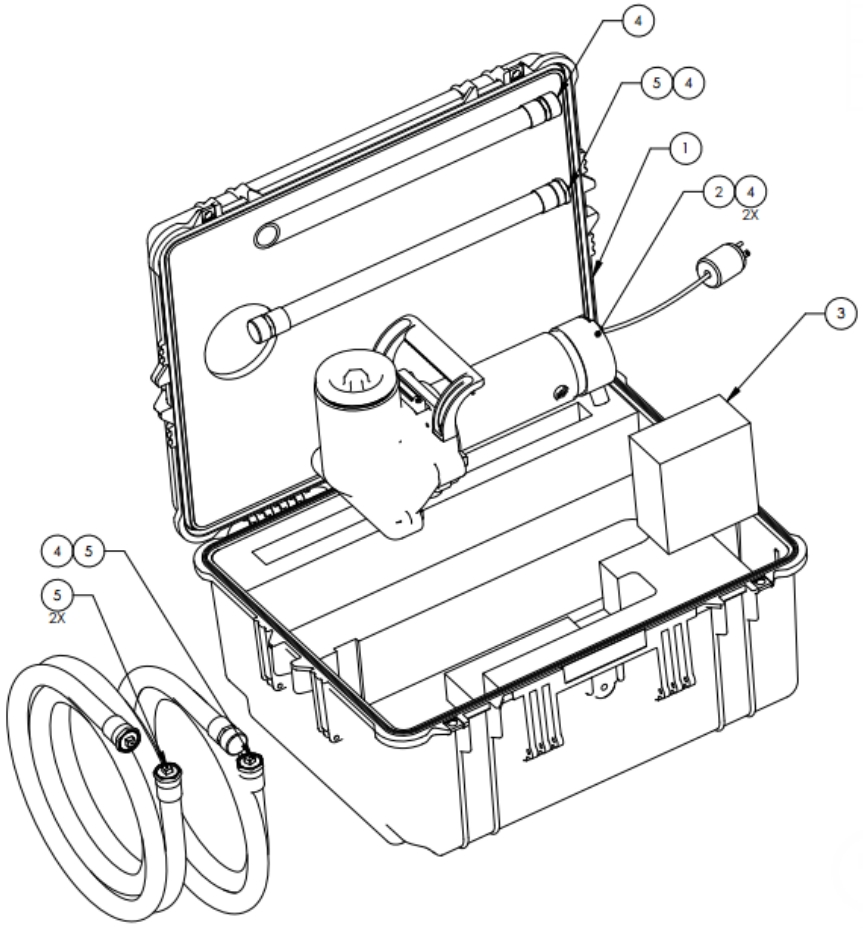
New Oil Cleanliness

- New oil from a barrel, pail or tote does not meet the cleanliness requirement
- Must be filtered prior to being added to the reservoir
  - Use a transfer pump with a 3micron filter. No larger than10 micron filter

Transfer Pump Part Number

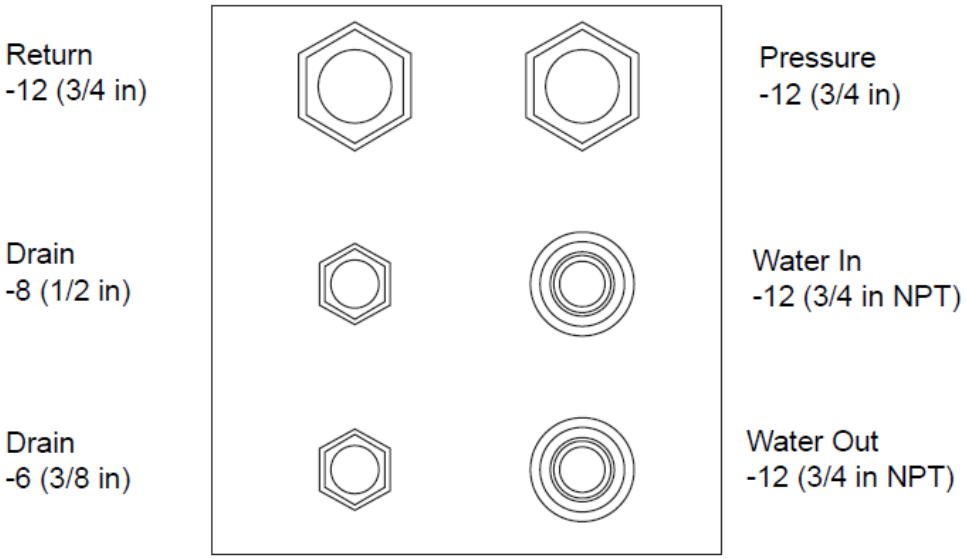
» The MTS part numbers for a transfer pump with a 10 Micron filter are listed below.

Part Number	Cord / Plug
100-320-427	US
100-320-428	Europe
100-320-429	UK
100-320-430	Italy
100-320-431	China
100-320-432	Australia
100-320-433	Brazil
100-320-434	Japan
100-320-435	ZA/India



Connect Hydraulic Hoses

- Connect Pressure, Return, and drain hoses from laboratory to HPU
  - Turn off HPU. Use appropriate Lock out / Tag out procedures
  - Verify pressure is at zero on pressure gage.
  - Clean fitting exterior before removing cap
  - Once cap is removed immediately install hose to minimize contamination
  - Small 505 ORFS fittings standard – Optional Adapters to JIC
  - Refer to appropriate product manual for exact connection locations and type



Typical 505 small HPU Hose connections

Initial HPU Startup

- A good practice is to run the pump locally before you connect the control cables or any of the hydraulic hoses.
  - Install jumper on remote cable connector

- Doing this allows you to determine if the pump is rotating in the correct direction.

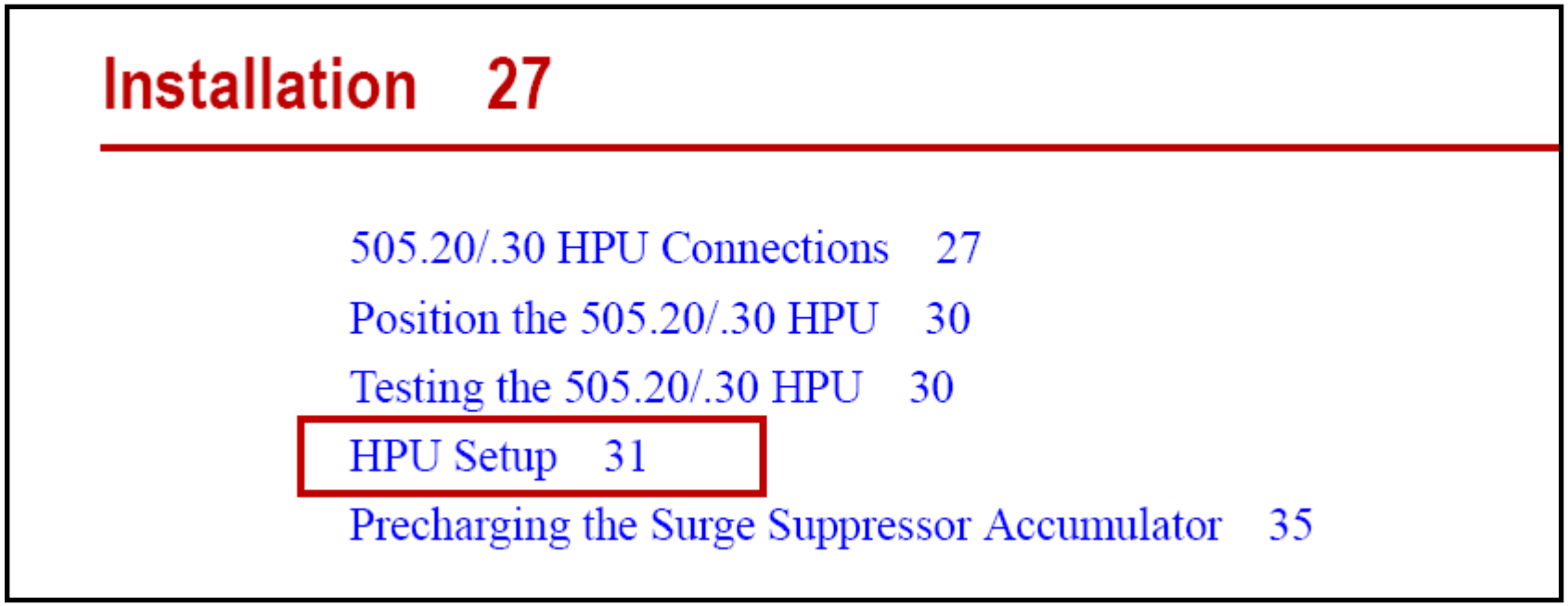
Initial HPU Startup

- Typical startup sequence
  - Install jumper on remote control connector
  - Power on incoming power
  - Pull out stop button
  - Push reset
  - Verify all interlocks cleared
  - Turn pump off – low – high
  - Check for pressure
    - Do not operate longer than 10 seconds if there is no pressure
  - If no pressure have electrician change incoming power phasing
  - If pressure present check for leaks
- Use appropriate product manual for HPU operation details

Initial HPU Setup

» To help understand the sequence to configure the HPU please read the section titled HPU setup on pages 31 through 35 in the 505.20/30 G2 SilentFlo Product manual from the link below.

Link to 505.20/30 G2 SilentFlo Product Manual



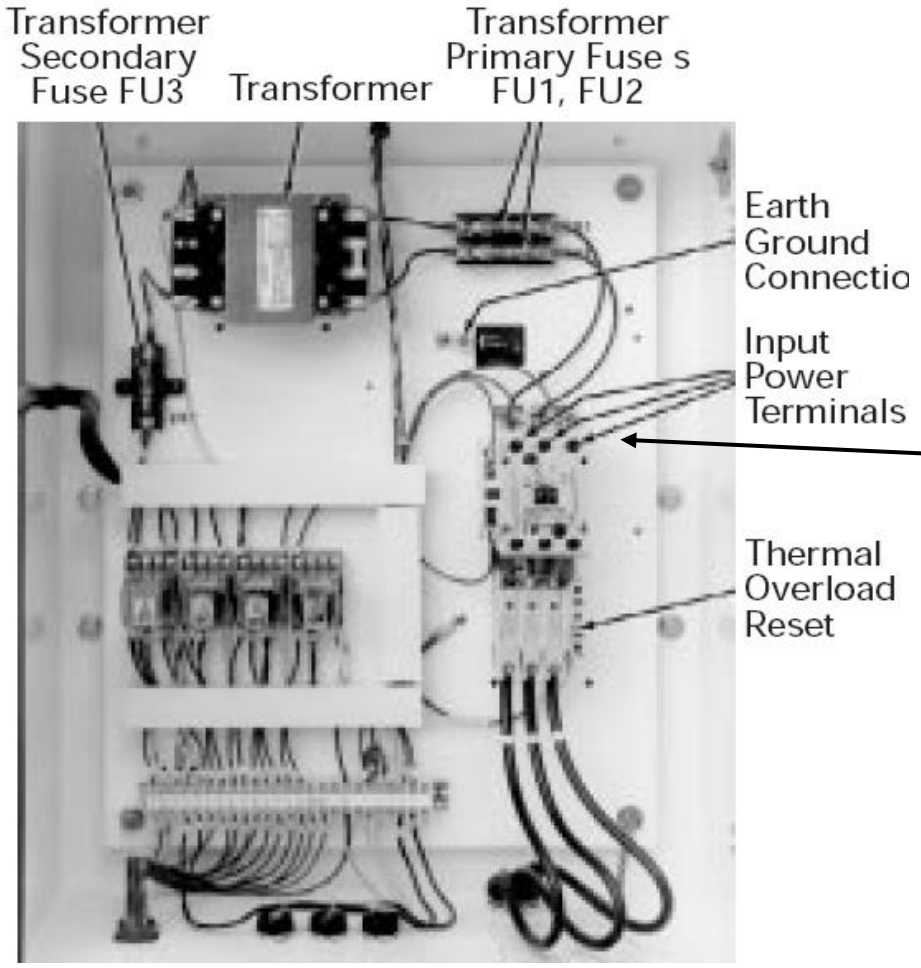
Installation 27

505.20/.30 HPU Connections 27
Position the 505.20/.30 HPU 30
Testing the 505.20/.30 HPU 30
HPU Setup 31
Precharging the Surge Suppressor Accumulator 35

Incoming Power Phasing

- If the 3 phase power is reversed, the pump will rotate backwards.
- To verify the correct phasing on older pumps, simply look at the top of the pump, there should be an arrow on the motor indicating the correct direction.
- On the 505 pumps, since the pump and motor are inside the reservoir, your only option is to see if you can build pressure. If you can not, or you hear a gurgling sound, the pump is turning backwards.
  - Make sure you are in high pressure
  - Do not run more than 10 seconds if not rotating the proper direction

Motor Direction Rotation



To change direction of motor rotation have electrician reverse any two of three power Input wires.

Operation

Operation

- Typical operation sequence for local control

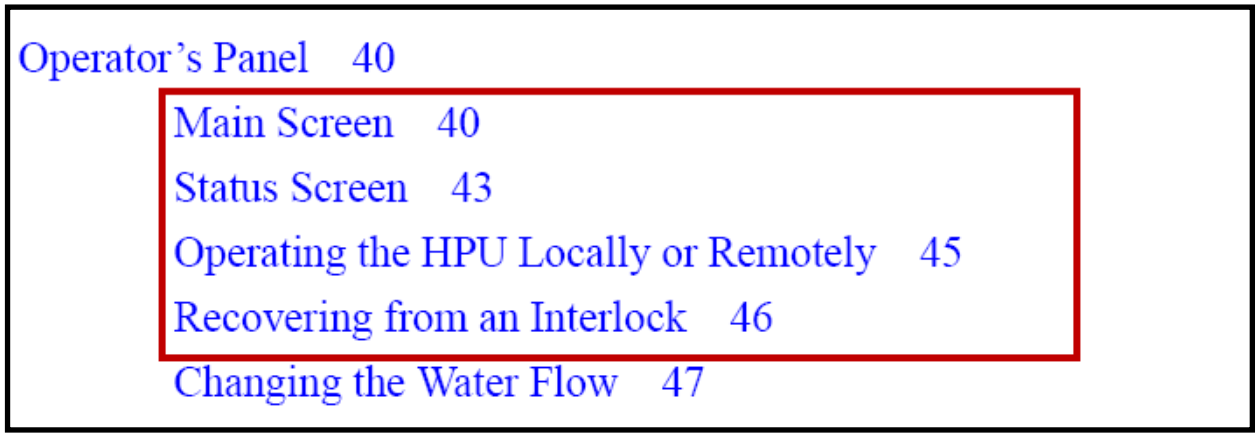
- Turn on main power on electrical enclosure
- Pull out Stop button
- Reset any interlocks
- Verify all interlocks are cleared
- Switch HPU from Off to Low
- Switch HPU from Low to High

Operation

» To help understand the touch screen interface please read the sections on pages 40 through 46 in the 505.20/30 G2 SilentFlo Product manual from the link below.

- Main Screen
- Status Screen
- Operating the HPU Locally or Remotely
- Recovering from an Interlock

Link to 505.20/30 G2 SilentFlo Product Manual



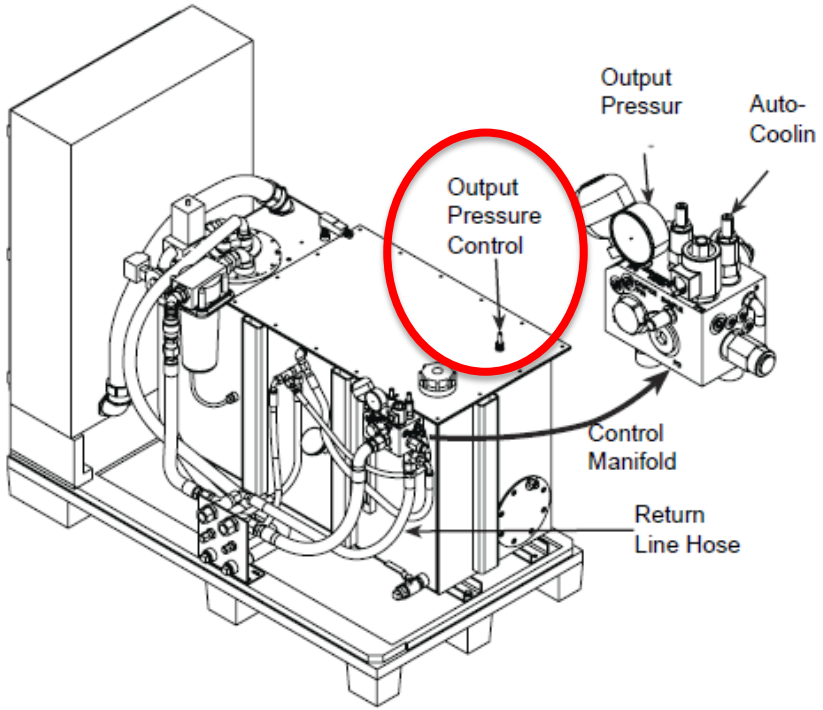
Adjustments

Adjustments

- Pressure adjust
- Secondary pressure relief adjust
- Cooling adjust
- Low level sensor adjust

Pressure Adjustment

- Below is the pressure adjust procedure for a typical MTS HPU. See appropriate product manual for specific requirements
- Turn on high hydraulic pressure. Ensure that there are no flow demands by the system.
- Loosen the nut securing the output pressure control.



Control Locations

Pressure Adjustment

- Monitor the hydraulic pressure gage located on the control manifold. Adjust the output pressure as follows until the desired pressure is displayed.
  - Turn the output pressure control clockwise to increase the pressure.
  - Turn the output pressure control counterclockwise to decrease the pressure.
- Hold the output pressure control to prevent it from moving and tighten the nut to secure it.
- Check the hydraulic pressure gage to ensure that the desired hydraulic pressure is being maintained.

Secondary Pressure Relief Adjustment

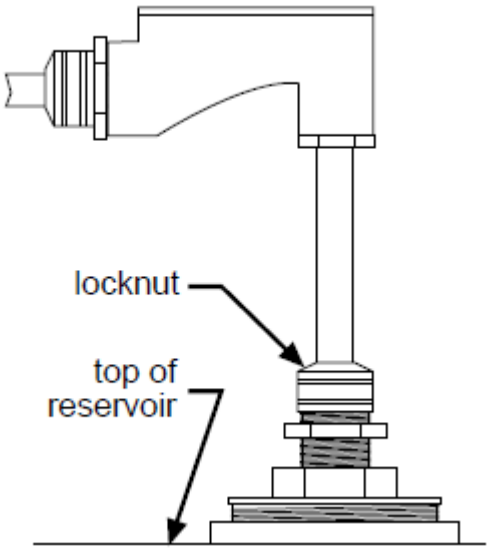
- The Secondary Pressure Relief valve is factory adjusted.
  - Adjusted to 3250 PSI on SilentFlo
- Early model HPU's have an adjustable secondary pressure relief
- On some model HPU's it is not possible to alter this adjustment.
  - See appropriate product manual for specific requirements

Reservoir Temperature Adjustment

- Ensure there is flow from the pump out to the lab and back to the return line
  - The heat exchanger is in the return line and requires oil flow for cooling
  - This can be accomplished by running a long displacement slow sine wave
- Wait for reservoir temperature to stabilize
- The water cooling valve is manufactured by Penn Refrigeration (now Johnson Controls). This valve is known as “the Penn valve” at MTS.
- Turn the Penn valve adjusting screw clockwise to decrease the operating temperature, or counterclockwise to increase the operating temperature, as desired. One turn (360°) of the adjusting screw produces a change in hydraulic fluid temperature of approximately 3°C (5°F).
  - Arrow on the Penn valve is in the direction of warmer oil
- Note the effect after 15 minutes.
- Repeat adjustment until the hydraulic fluid temperature stabilizes
  - SilentFlo reservoir temperature between 43°C and 49°C (110°F and 120°F).

Low Oil Level Sensor Adjustment

- With the HPU turned off, fill the reservoir to the correct fluid level.
- Turn on the HPU and apply high pressure.
- All systems attached to HPU should be turned on to ensure all accumulators are in the oil circuit and have filled. This ensures the maximum amount of oil required from the HPU reservoir is consumed.
- Loosen the hand locknut on the stem of the switch, and slowly raise the switch until the **Low Fluid Level** indicator lights.
- Lower the switch about 1.5 in. (38 mm).
- Tighten the locknut.
- Reset any applicable interlock circuits.



Maintenance

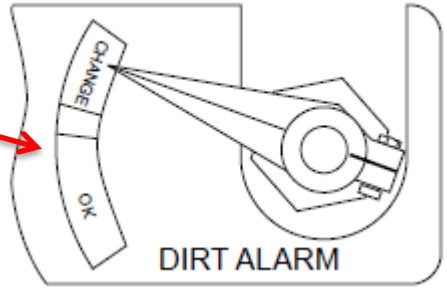
Maintenance

- Filter Change
- Adding Make up oil
- Oil Sampling
- Oil Quality
- Oil Change
- Surge suppressor charging

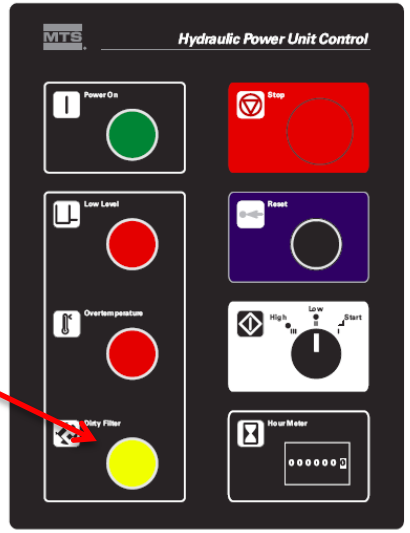
HPU Filter Change

- The HPU filter(s) should be changed
  - When dirty filter is indicated either by panel light or mechanical indicator
    - It is common for the dirty filter indicator lamp to turn on with cold oil.
    - Be sure to reset indicator once oil is warm.
    - If indicator comes back on the filter should be replaced.
    - If indicator remains off it is not necessary to replace the filter.
  - Every 1000 hours or 6 months of operation
  - Every time the oil is changed

Mechanical Dirty Filter Indicator



Dirty Filter Panel Lamp Indicator



Front Panel Controls

HPU Filter Change

- Turn off the HPU.
  - Use appropriate Lock Out / Tag Out procedures
- Check the output pressure gage.
  - Be sure the pressure is at zero before proceeding.
- Unscrew the filter housing and remove it from the HPU.
  - Be careful not to spill any hydraulic fluid.
- Remove the disposable element from the manifold.
  - Remove any connectors or end cap plugs from the filter element.
  - Discard any fluid contained in the filter housing and the filter element.
- Wipe out any remaining sludge in the filter housing with a lint-free cloth.
  - Notify customer if contamination such as metal shavings detected in filter bowl
  - May require further maintenance to locate source of contamination
- Inspect the O-rings in the manifold for any sign of deterioration. If necessary, replace the defective O-ring(s).

HPU Filter Change

- Transfer any couplers or end cap plugs from the old filter element to the new filter element
- Insert a new element onto the filter manifold.
- Reinstall the filter housing.
- Turn on the HPU and switch to high-pressure mode. Inspect the seal between the housing and the manifold for any signs of leakage. If leakage occurs, repeat this procedure (without replacing the filter element).
- If you are changing the filter because the dirty filter indicator tripped, run the HPU for two to four hours to remove contaminants..
- Press the **Reset** button on the HPU control panel to reset any interlocks and turn off the **Dirty Filter** indicator.

HPU Replacement Filter

- Part numbers for replacement filter element and O-rings are not always found on HPU BOM.
  - MTS often purchases filter housing and element as a package so individual parts may not shown on BOM
  - Ensure if you get a replacement element part number from a HPU BOM that it is the element only and not the complete housing with element

- Filter Element Part number can be located in the following places:
  - The service catalog contains MTS part numbers for the filter element and O-ring for most MTS HPU's
  - The HPU manual
  - The HMPG web site

Adding Make up oil

» When adding make up oil

- Only use same oil as what is currently present in system
- Use transfer pump equipped with a 10 micron filter to add oil
- Readjust Low Oil Level sensor after adding oil

Oil Sampling

- The only approved method for a FSE to sample oil is using a FIST tool
  - The FIST tool is not available to be purchased by customers
  - Customer oil sample tool P/N 055-589-601
- For sampling procedure see Fluid Care video manual in the Routine Maintenance – Fluid Care training module
- See Fluid Care procedures located on Fluid Care page of service QMS site
  - FS-OP 4404
  - FS-OP 4405
  - FS-OP 4406

Oil Quality

- There are several visual indicators of oil quality
- If the oil is milky white this is an indicator of water in the oil
  - Immediately stop using the system
  - Oil must be replaced and system must be flushed until water is absent
  - Failure to stop using system will result in additional failures in the system
    - Servo valves
    - HSM control valves
    - End cap nylon delamination
- If oil is dark this does not automatically indicate bad oil
- If oil is dark and has burned or foul odor most likely the oil needs to be replaced.
  - Recommend MTS Fluid Care to determine oil quality

HPU Oil Change

- Press the stop button to turn off the HPU.
  - Use appropriate Lock Out / Tag Out procedures
- Remove the filler cap and screen
- Use a transfer pump to remove the used oil
  - Place transfer pump in filter bypass mode
  - Customer responsible for disposal
- Replace the filter element(s)

HPU Oil Change

- Add new oil to the reservoir
  - Use a transfer pump
  - Filter the oil to 10 micron
- Reinstall filler cap and screen
- Turn on HPU
- Run in high pressure and check for leaks
- Verify that dirty filter indicator extinguishes

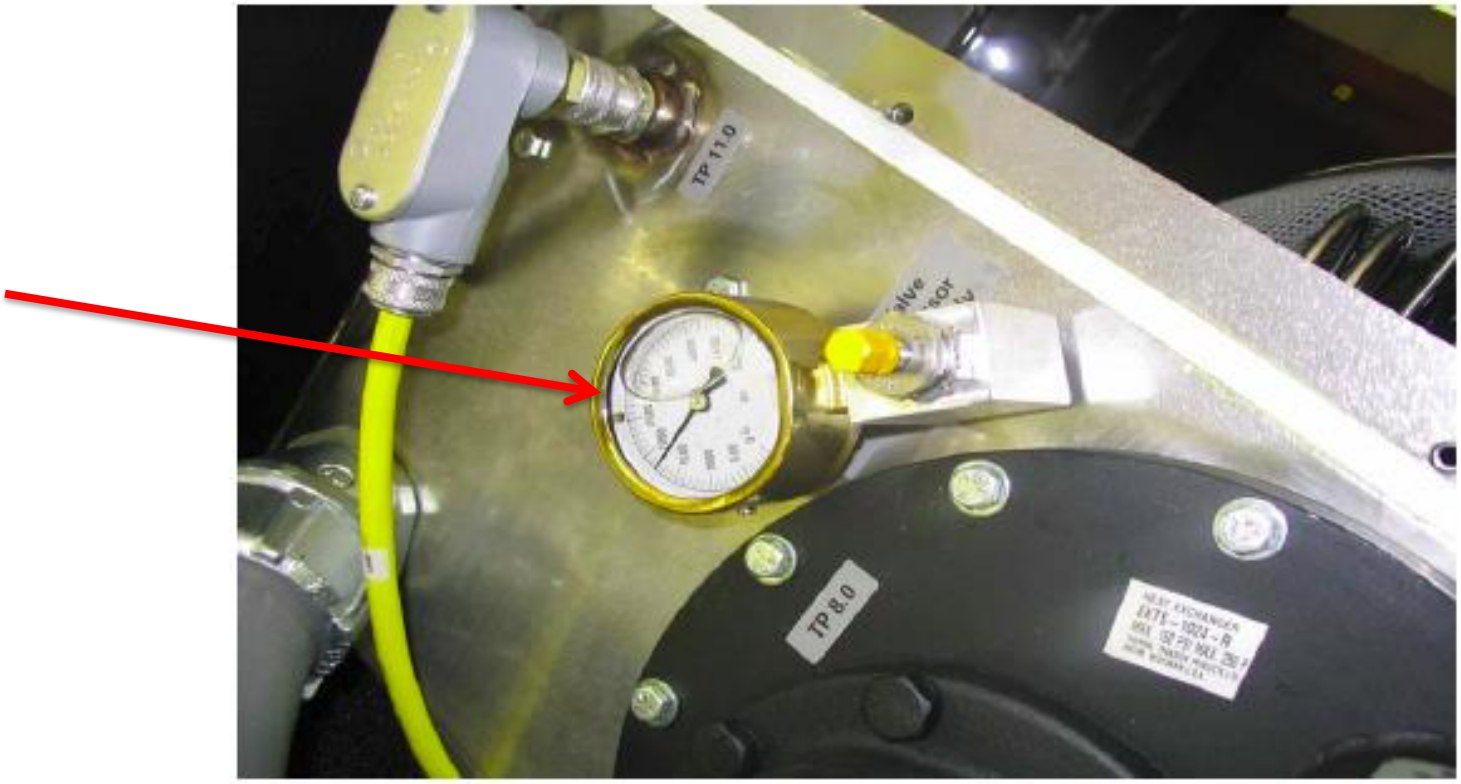
Surge Suppressor Charging

- The surge suppressor is pre-charged to 50%-60% of pump operating pressure
  - For a 3000 PSI HPU this is 1500-1800 PSI

- If pre-charge pressure is not within specification charge per procedure found in product manual
  - **WARNING: Only use dry nitrogen gas to charge surge suppressor. Use of any other gas can be dangerous.**
  - Procedure on following pages

Surge Suppressor Charging

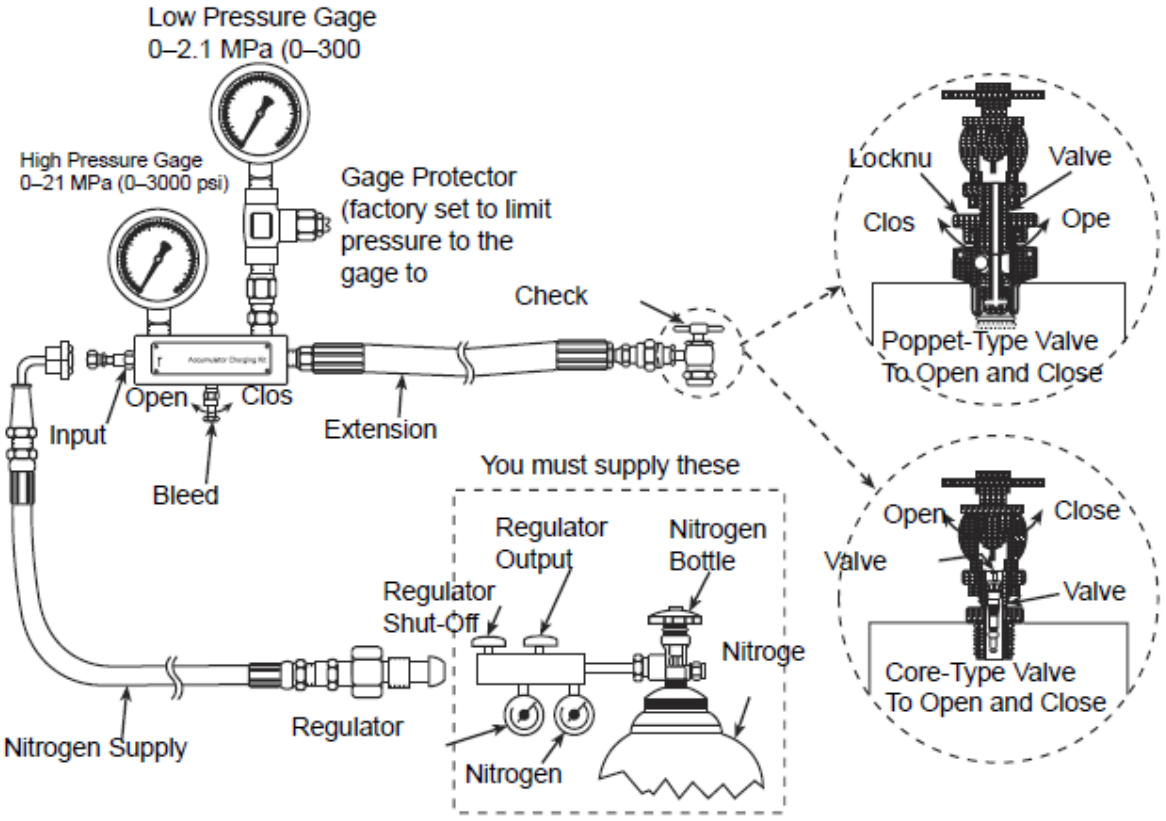
» Use the indicator gage on the HPU or an accumulator charge kit to check surge suppressor pre-charge pressure
  - HPU must be off while checking this



Surge Suppressor Charging

Checking the precharge pressure

The nitrogen precharge should be about 50–60% of the output pressure. Monitor the pressure gage. If the pressure reading is outside the range of 10.3–12.5 MPa (1500–1800 psi), perform the procedure "Changing the precharge pressure."



Charging Kit

Surge Suppressor Charging

Changing the precharge pressure

The nitrogen precharge should be within the range of 10.3–12.5 MPa (1500–1800 psi) which is 50–60% of the output pressure (21 MPa or 3000 psi). Perform one of the following procedures to change the precharge pressure:

Decreasing pressure

To decrease the precharge pressure:

1. Slowly open the bleed valve on the 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. 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

To increase the precharge pressure:

1. Close the locknut on the accumulator.
2. Open the bleed valve two turns.

Surge Suppressor Charging

⚠ WARNING

Precharging with a gas other than dry nitrogen will cause the existing nitrogen within the surge suppressor to be mixed with the new gas.

Mixing gases can produce unpredictable results.

Use only dry nitrogen gas to precharge the surge suppressors.

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.

Surge Suppressor Charging

⚠ CAUTION

Opening the regulator shut-off valve too far can cause a rapid flow rate and an extreme pressure differential.

A rapid flow rate with a high pressure differential across the input check valve can damage the check 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, and 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. 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, close the regulator shut-off valve.
8. Close the locknut.
9. Open the bleed valve on the charging kit and remove the chuck valve from the accumulator.

Install the valve stem cap and protective cover. Close the valve on the nitrogen bottle.

Repairs

PLC

- On the large pumps, 505.60 and up, the PLC battery is replaceable and rated for 10 years.
  - To reload the program use an option specific proprietary USB chip.

- The smaller pumps, 505.30 and down, the PLC battery is not replaceable. The PLC must be changed when the battery dies.

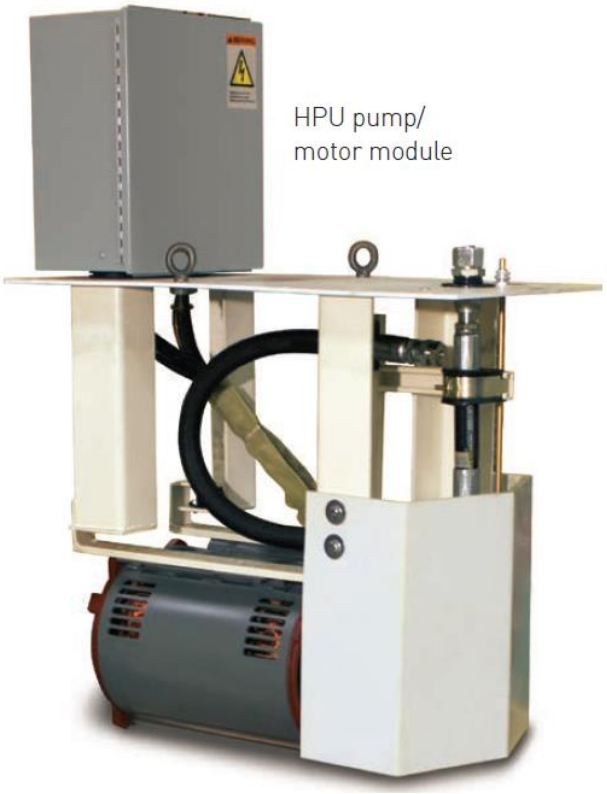
Pump Case Drain

- On systems where the pump is external to the oil the case drain can be used to monitor the health of the pump
- As the pump wears the amount of oil exhausted by the case drain will increase
- Set the pump for the same conditions each time this is checked
  - Typical requirement is full pump flow at HPU design pressure
- Excess case drain flow does not pass through the heat exchanger
  - This oil typically has an elevated temperature and can overheat a HPU that does not have a large amount of oil flowing through the heat exchanger

Pump Module Replacement

» The 505 SilentFlo series of HPU's uses a Field Replacement Unit (FRU) exchange program for motor / pump replacement

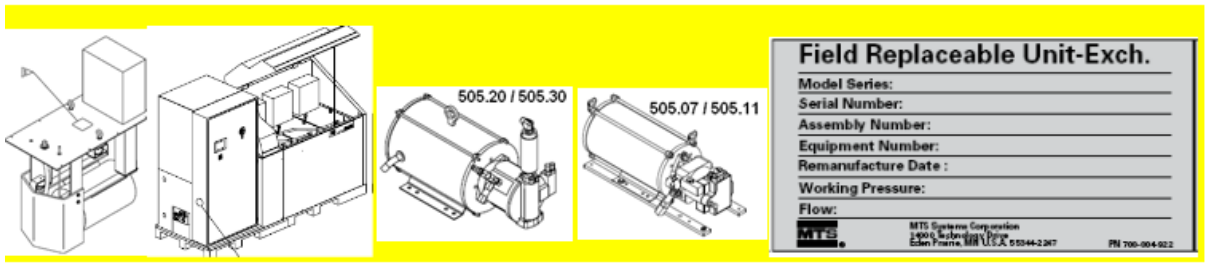
- A complete replacement module arrives in a reusable shipping container
- The module that was removed from the customer system gets returned to MTS in the reusable shipping container
- **Module ships with inlet plug in place to prevent oil loss. It is located on the bottom of the FRU. Remove plug prior to use.**



Pump Module Replacement

- Service Sales will complete the FRU RMA form for the replacement module
  - HPU model, operating voltage, assembly numbers, and other required information
  - This information will determine which part number FRU ships and whether the surge suppressor or tuned hose option is supplied

SilentFlo™ pump/motor module FRU
RMA Input Form - MTS Factory Services



RAN #:		MTS FSE Responsible for Install:	
Customer Name:		Date:	
Site Number:		Original MTS System number:	
HPU Assembly #:		HPU S/N:	
module Assembly #:		Hrs on Module:	Module S/N:

HPU model: ☐ 505.07 ☐ 505.11 ☐ 505.20 ☐ 505.30 ☐ 505.60 ☐ 505.90 ☐ 505.120 ☐ 505.150 ☐ 505.180

HVAC PWR: ☐ 200VAC ☐ 400VAC ☐ 460-480VAC ☐ 575VAC

Reason for exchange: ☐ Functional Module with degraded performance ☐ Non-Functional pump/motor module

Additional Information

- Additional information on current production HPU's can be located on the HMPG website.
  - From the Intranet Home Page go to
    - Groups > HMPG > Power Units
- http://groups.mts.com/HMPG/G1orG2.htm