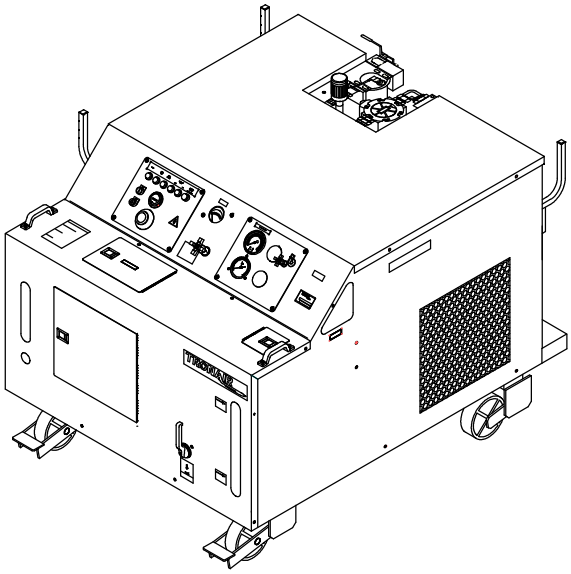
Operation & Service Instructions



Model: 5621
Hydraulic Power Unit

CE

09/2013 – Rev. 02

1740 Eber Rd
Holland, OH 43528-9794
USA

Tronair, Inc.
www.tronair.com
Email: sales@tronair.com

Phone: (419) 866-6301
800-426-6301
Fax: (419) 867-0634

REVISION	DATE	TEXT AFFECTED
01	11/2010	Original Release
02	09/2013	Modified 9.10.1 Electrical Components with 100 ft. Input Cord Option

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This product can not be modified without the written approval of Tronair, Inc. Any modifications done without written approval voids all warranties and releases Tronair, Inc., its suppliers, distributors, employees, or financial institutions from any liability from consequences that may occur. Only Tronair OEM replacement parts shall be used.

1.0 PRODUCT INFORMATION

1.1 DESCRIPTION

Hydraulic Power Unit

Model Number:	**Fluid Type:**
5621	MIL-PRF-83282

1.2 MODEL & SERIAL NUMBER

Reference nameplate on unit.

1.3 MANUFACTURER

TRONAIR, Inc.
1740 Eber Road
Holland, Ohio 43528-9794 USA

Telephone: (419) 866-6301 or 800-426-6301
Fax: (419) 867-0634
E-mail: sales@tronair.com
Website: www.tronair.com

1.4 FUNCTION

The Hydraulic Power Unit (HPU) provides a source of clean, pressurized hydraulic fluid for performing required aircraft maintenance. An electric motor drives a pressure compensated piston pump. Filters are provided on the pressure and return systems. A bypass (dump) valve allows starting and stopping of the unit under a no-load, safe condition. The unit may use either the aircraft or on-board HPU reservoir. Cooling is provided for continuous operation.

1.5 REQUIREMENTS

Adequate electrical power must be provided for proper functioning of the HPU. See the unit nameplate for proper voltage and frequency. See the Technical Manual for proper sizing of electrical supply and protection equipment in the facility.

2.0 SAFETY INFORMATION

2.1 USAGE AND SAFETY INFORMATION

The HPU provides pressurized hydraulic fluid for performing aircraft maintenance.

To insure safe operations please read the following statements and understand their meaning. Also refer to your equipment manufacturer's manual for other important safety information. This manual contains safety precautions which are explained below. Please read carefully.

WARNING! — Warning is used to indicate the presence of a hazard that ***can cause severe personal injury, death, or substantial property damage*** if the warning notice is ignored.
CAUTION! — Caution is used to indicate the presence of a hazard that ***will or can cause minor personal injury or property damage*** if the caution notice is ignored.

2.2 EXPLANATION OF WARNING & DANGER SIGNS

Accidental Starts! Before servicing the HPU or equipment, always disconnect electrical power supply to prevent accidental starting.

Rotating Parts! Keep hands, feet, hair, and clothing away from all moving parts to prevent injury. Never operate the HPU with covers, shrouds, or guards removed.

Electrical Shock! Never touch electrical wires or components while the HPU is attached to the power source. They can be sources of electrical shock. DO NOT operate HPU with cabinet panels removed.

Pressurized Fluid! Before servicing the HPU or equipment, always open the bypass valve to relieve any residual pressure in the hydraulic system.

2.3 COMPONENT SAFETY FEATURES

- Pump/Motor coupling guard
- Sheet metal panels
- Pressure and return system relief valves
- Control circuit fuses
- Motor overload protection

2.0 SAFETY INFORMATION *(continued)*

2.4 FUNCTIONAL SAFETY FEATURES

- Emergency shut off switch
- Floor lock
- Calibration port shut off valve
- Fluid sample shut off valve

2.5 PERSONAL PROTECTION EQUIPMENT

- Safety glasses must be worn when operating the HPU.
- Additional equipment recommended by the fluid manufacturer (gloves, etc.). ***Reference Appendix pertaining to Material Safety Data Sheet pertaining to fluid(s).***

2.6 SAFETY GUIDELINES

- Operator must be properly trained prior to operating the HPU.
- HPU power switch must be in "Off" position when connecting or disconnecting hoses to the aircraft.
- Bypass valve must be in the "Open" position when starting or stopping the HPU.
- Electrical power must be disconnected from the HPU and the bypass valve must be in the "Open" position before servicing the HPU. (Reference Technical Manual for details on servicing the HPU.)

2.7 GENERAL COMMENT

The HPU is intended to be operated by personnel trained in the proper use in conjunction with the aircraft maintenance manual.

The HPU must be used in accordance with the Technical and Operator Manuals and the intended aircraft.

3.0 PREPARATION PRIOR TO FIRST USE

3.1 GENERAL

Prior to operating the HPU, the user should become familiar with this Operator Manual.

3.2 SERVICING RESERVOIR

Fill the reservoir with the correct fluid (see label next to reservoir fill for correct type of fluid) until fluid level is above the minimum fluid level mark but below the maximum fluid level. ***See Figure 5.3.1 Front Panel Controls*** for reservoir fill location.

3.3 CONNECTING ELECTRICAL LEADS

Electrical Shock! Never touch electrical wires or components while electrical power is attached. Only qualified electricians should connect the electrical leads.

Install plug onto the electrical cord. If motor rotation is not correct, change any two of the three leads at the plug. **Reference 11.0 Electrical Power and Protection Requirements** for power requirements and fuse sizes**.** (See ***5.4 Start up Procedures*** before starting HPU.)

WARNING!

Balanced three phase voltage must be available to prevent overheating and damage to the motor.

Voltage unbalanced between phases occurs when the voltages differ from one another.

Some reasons for imbalance are:

1. **Unequal loading of each phase**
2. **Poor connections in the supply**
3. **Single phase condition caused by blown fuses or bad connections**

If these conditions occur in the incoming power system, a protective devise, such as a voltage monitor, should be installed on the machine to prevent motor damage.

4.0 TRAINING

4.1 TRAINING REQUIREMENTS

The employer of the operator is responsible for providing a training program sufficient for the safe operation of the HPU.

4.2 TRAINING PROGRAM

The employer provided operator training program should cover safety procedures concerning use of the HPU in and around the intended aircraft at the intended aircraft servicing location.

4.3 OPERATOR TRAINING

The operator training should provide the required training for safe operation of the HPU.

NOTE: Maintenance and Trouble Shooting are to be performed by a skilled and trained technician.

5.0 OPERATION

5.1 OPERATING PARAMETERS

- The user shall use the HPU in accordance with the aircraft manufacturer's instructions.
- The user shall operate the HPU in accordance with the Technical and Operator Manuals.
- The employer of the operator shall provide all necessary training.

5.2 NUMERICAL VALUES

5.2.1 Model 5621

Fluid Type MIL-PRF-83282

5.2.2 Physical

- Weight (Dry)**:** 3,150 lbs (1,430 kg)
- Dimensions**:** Width 63.75 in (162 cm) *Add 7.5 in (19 cm) for Dual System*
- Height 59 in (149.9 cm)
- Depth 78 in (198 cm)
- Power Cord: 50 ft (15.24 m) long
- Pressure Hoses: 25 ft (7.62 m)..... Standard Length
  50 ft (15.24 m) Optional Length
  -16 (1 in, 25.4 mm) ..... Working Diameter
- Return Hoses: 25 ft (7.62 m)..... Standard Length
  50 ft (15.24 m) Optional Length
  -24 (1½ in, 38.1 mm) Working Diameter
- Hand Pump Hose: 15 ft (4.57 m)..... Standard Length
  -6 (3/8 in, 9.53 mm) Working Diameter

5.2.3 Hydraulic Pump

- A pressure compensated, adjustable maximum volume piston pump.
- Maximum flow at 60 Hz..... 34 gpm (129 lpm)
- Maximum flow at 50 Hz..... 28 gpm (107 lpm)
- Maximum operating pressure at 50 Hz and 60 Hz ..... 3,500 psi (241 bar)
- System pressure relief valve setting..... 3,750 psi (259 bar)
- Performance Curve for 50 Hz and 60 Hz ..... Reference ***Figure 5.2.3***

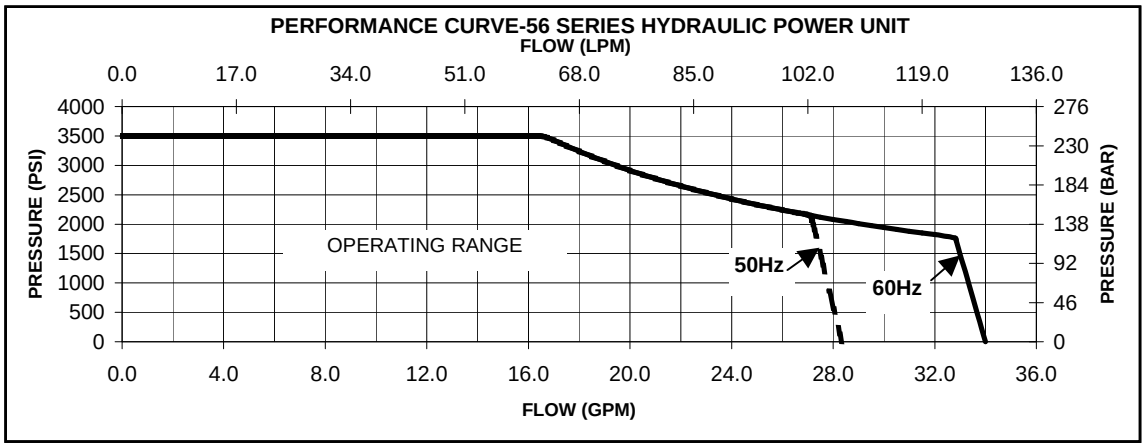


***FIGURE 5.2.3* – Performance Curve (50 Hz and 60 Hz)**

5.2 NUMERICAL VALUES *(continued)*

5.2.4 Electric Motor

A 40 horsepower, TEFC electric motor is the prime mover for the HPU. This is attached to the hydraulic pump using a pump/motor adapter and a spider/coupling rotating interface.

MOTOR POWER REQUIREMENTS			
60 Hz Applications		**50 Hz Applications**	
Voltage	**Full Load Amps**	**Voltage**	**Full Load Amps**
208	117.2	200	120.5
230	106.0	220	103.0
380	57.0	380	62.0
460	53.0	415	60.0
575	42.0	440	56.0

***FIGURE 5.2.4* –Motor Power Requirements**

5.2.5 Filters

- Pressure..... 2 micron rating, non-bypass high collapse microglass type. Non-cleanable element.
- Return ..... 5 micron rating, 25 psi (1.72 bar) bypass microglass type. Non-cleanable element.
- Hand Pump *(Option M)* ..... 2 micron rating, non-bypass microglass type. Non-cleanable element.
- Air/Desiccant..... 3 micron filter, silica gel desiccant type. Non-cleanable element.

5.2.6 Hand Pump *(Option M)*

Two stage hand pump, low pressure stage 0–500 psi (0–34.47 bars) and 500–5,000 psi (34.47–344.74 bars) high pressure stage. Pump automatically changes stage internally based on system pressure.

Low Pressure Stage:	Piston Diameter	1½ in (38.1 mm)
	Working Pressure	0–500 psi (0–34.47 bar)
	Displacement/Stroke	2.1 in^3 (34.4 cm^3)
	Force/100 psi (6.89 bar)	12.0 lbs/100 psi (7.74 N/bar)
High Pressure Stage:	Piston Diameter	5/8 inch (15.88 mm)
	Working Pressure	500–5000 psi (34.47–344.74)
	Displacement/Stroke	0.4 in3 (6.55 cm3)
	Force/100 psi (6.89 bar)	2.2 lbs/100 psi (1.42 N/bar)
Pressure Relief Setting:	5,250 psi (362.0 bar)	

5.0 Operation continued on following page.

5.0 OPERATION *(continued)*

5.3 LOCATION & LAYOUT OF CONTROLS

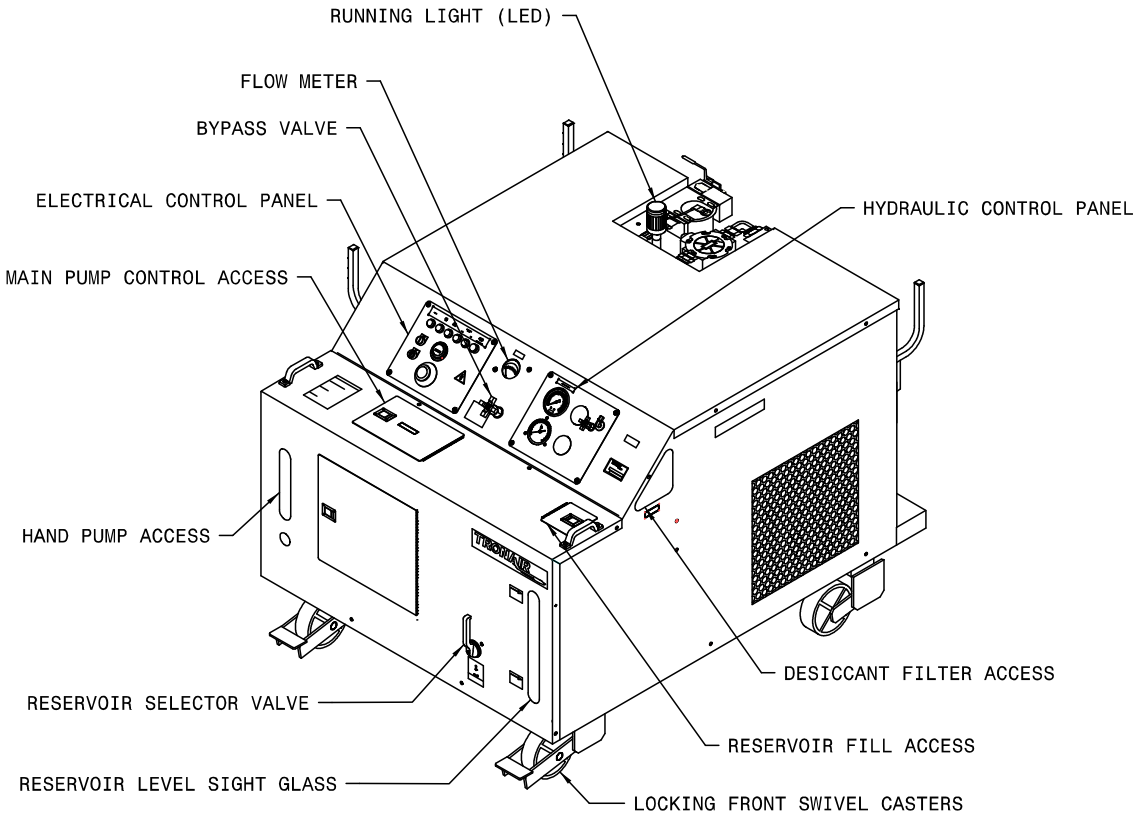


***FIGURE 5.3.1* – Front Panel Controls**

5.3.1 Front Panel Controls

- Electrical Control Panel..... *See Section 5.3.2*
- Hydraulic Control Panel ..... *See Section 5.3.3*
- Bypass Valve ..... For loading and unloading the Hydraulic Pump.
- Flowmeter ..... Displays the flow from the Hydraulic Pump.
- Pump Control Access..... See ***Figure 5.3.5 - Hydraulic Pump Controls***.
- Reservoir Selector..... For selecting between using the aircraft reservoir or the HPU reservoir.
- Sight Gauge ..... Visual indicator displays the fluid level in the reservoir.
- Reservoir Fill Access..... Locking cap for servicing the HPU reservoir.
- Desiccant Filter ..... Access to the reservoir air filter/desiccant filter.
- Hand Pump *(Option M)* ..... Access for hand pump and relief screw, handle stored inside.
- Locking Swivel Caster..... Locking/unlocking, foot actuated and released locking front caster.
- Running Light..... Displays green LED light when unit is running.

5.3 LOCATION & LAYOUT OF CONTROLS *(continued)*

5.3.2 Electrical Control Panel

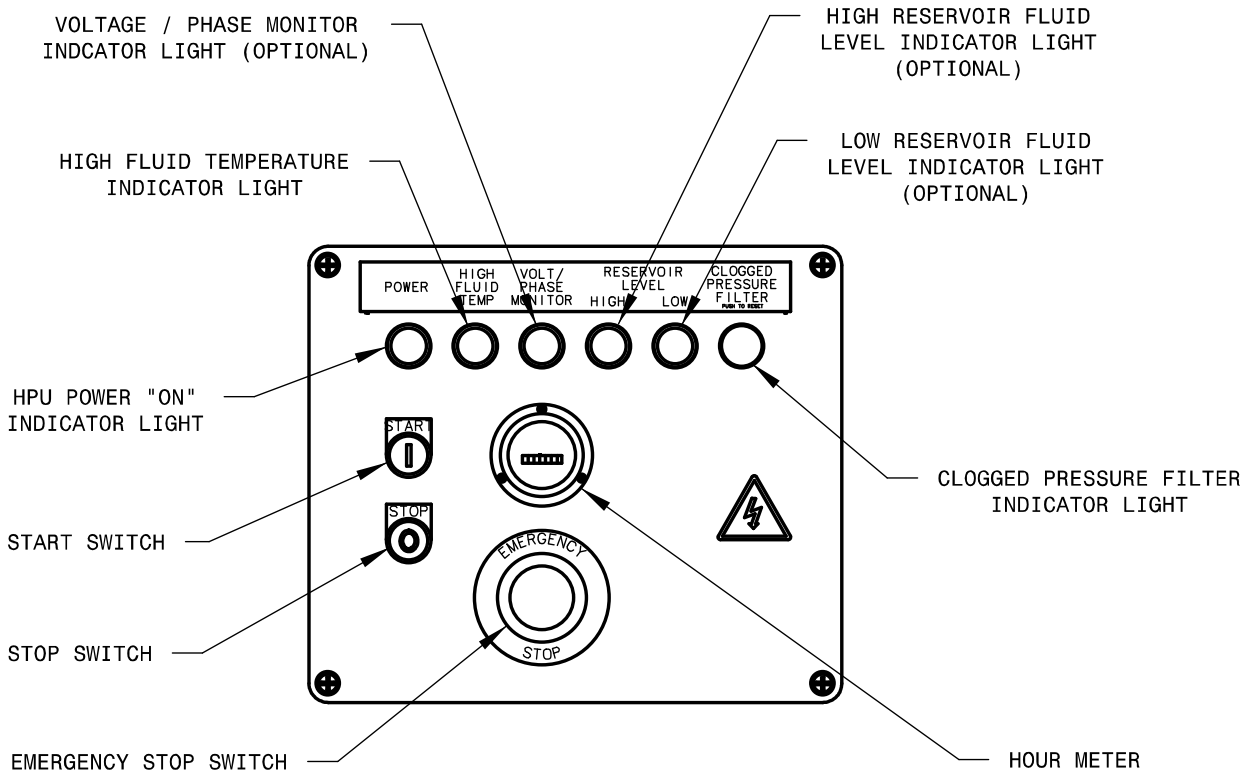


***FIGURE 5.3.2* – Electrical Control Panel**

- Emergency Stop..... Removes power to all electrical devices, must turn to reset.
- Stop Switch..... Turns off the electric motors driving the hydraulic pump and cooling fan.
- Start Switch..... Turns on the electric motors driving the hydraulic pump and cooling fan.
- HPU Power "On" Indicator Light..... Light is illuminated when the electric motors driving the hydraulic pump and cooling fan are on.
- High Fluid Temperature Indicator Light..... Light is illuminated when the return fluid temperature reaches 160° F (71° C) or above. The HPU will shut down when light is illuminated. The HPU can be re-started when the fluid has cooled and the indicator light is off.
- High Reservoir Fluid Level Indicator Light *(Option L)*..... Light is illuminated when the fluid level in the reservoir is above the normal operating range. The HPU will shut down until the fluid level is restored to a normal operating level.
- Low Reservoir Fluid Level Indicator Light *(Option L)*..... Light is illuminated when the fluid level in the reservoir is below the normal operating range. The HPU will shut down until the fluid level is restored to a normal operating level.
- Voltage/Phase Monitor Indicator Light *(Options G – J)*..... Light is illuminated if any of the following conditions occur
  - Voltage imbalance between L1, L2, L3, greater than 5%
  - Loss of voltage from L1, L2, L3
  - Over voltage from L1, L2, L3, greater than 5%
  - Change in phase orientation between L1, L2, L3. The HPU will shut down until the electrical problem is corrected.
- Clogged Pressure Filter Indicator..... Light is illuminated when the pressure filter element requires changing. The HPU will not shut down when illuminated. Pressing the illuminated button will reset the light.

5.3 Location & Layout of Controls continued on following page.

5.3 LOCATION & LAYOUT OF CONTROLS *(continued)*

5.3.3 Hydraulic Control Panel

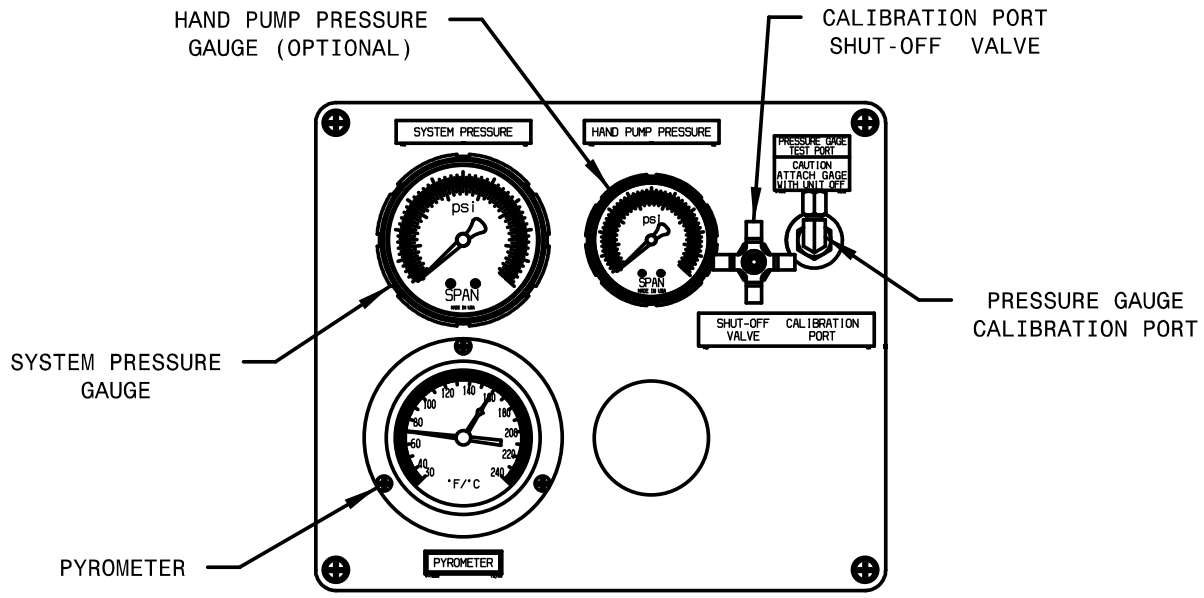


***FIGURE 5.3.3* – Hydraulic Control Panel**

- System Pressure Gauge ..... Displays the system pressure on an analog fluid dampened gauge.
- Pyrometer ..... Displays the fluid temperature in the return system on an analog gauge. A warning indicator preset to 160° F (71° C) warns of high operating temperature.
- Pressure Gauge Calibration Port ..... Allows for calibration of the system pressure gauge up to the operating pressure of HPU. Calibration port shut off valve must be used in conjunction with the calibration port.
- Calibration Port Shut Off Valve ..... Used to shut off pressure to the calibration port. This valve should only be opened when the external standard gage is attached.
- Hand Pump Pressure Gauge ..... Displays the hand pump system pressure on an analog fluid dampened gauge. (Option M)

5.3 LOCATION & LAYOUT OF CONTROLS *(continued)*

5.3.4 Rear Panel Controls

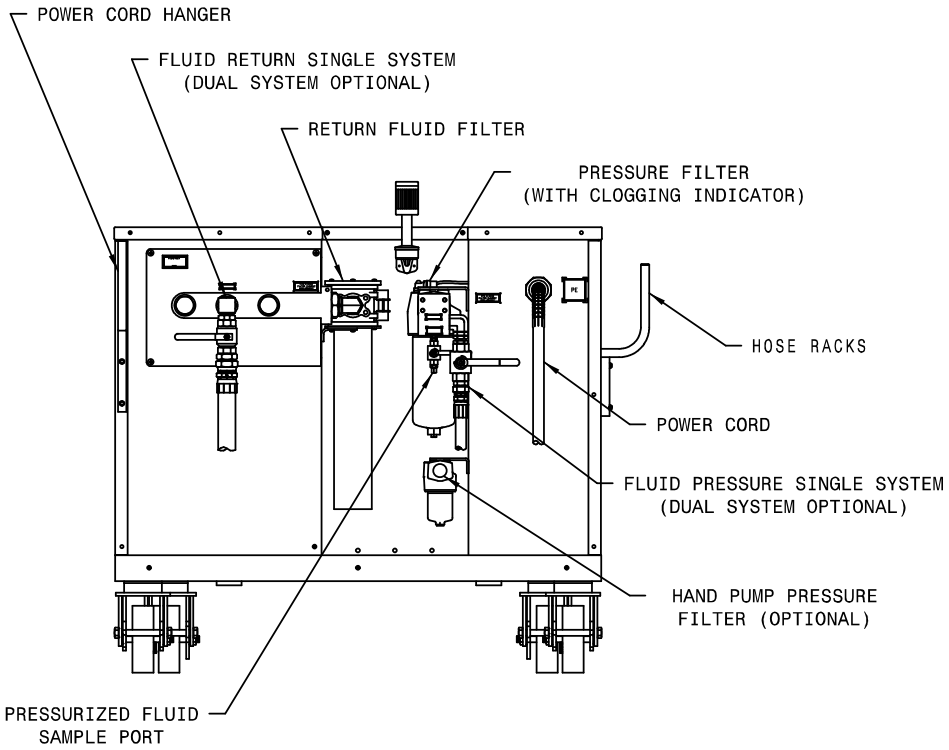


***FIGURE 5.3.4* – Rear Panel Controls**

- * Fluid Pressure System..... The source of pressurized fluid from the HPU that flows to the aircraft pressure system through the pressure hose.
- * Fluid Return System ..... Fluid returning to the HPU from the aircraft that flows through the return hoses.
- Pressure Fluid Filter..... Filters the pressurized fluid before it flows to the aircraft pressure system.
- Return Fluid Filter..... Filters the fluid returning from the aircraft before it enters the HPU.
- Pressurized Fluid Sample Port..... A sample valve is provided to obtain a fluid sample for analysis. In order to obtain a representative sample, it is suggested that ANSI/B93.19M-1972 (R1993) be followed.
- Hand Pump Pressure Filter..... Filters the pressurized fluid before it flows to the aircraft system. *(Option M)*
- Hose Racks..... Location for storing the pressure, return and optional hand pump hoses when not in use.
- Power Cord Hanger ..... Location for storing the power cord when not in use.

∗ ***Dual System (Optional) consists of two (2) each of these items.***

5.3 Location & Layout of Controls continued on following page.

5.3 LOCATION & LAYOUT OF CONTROLS *(continued)*

5.3.5 Hydraulic Pump Controls

The hydraulic pump flow control and pressure control are located through the pump control access door.

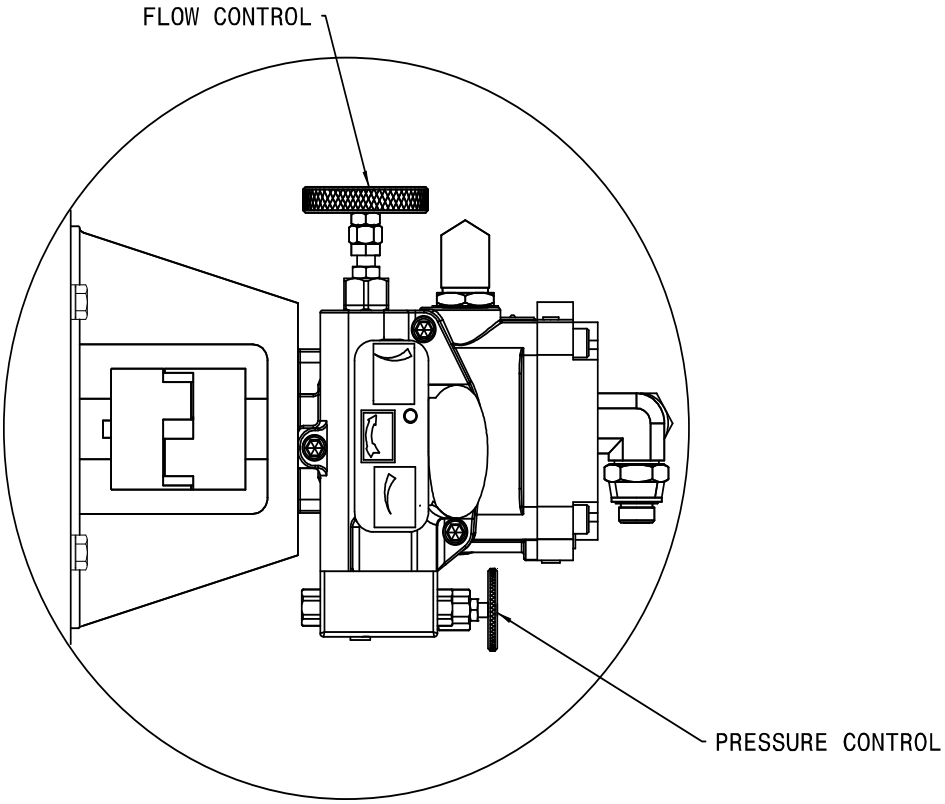


***FIGURE 5.3.5* – Hydraulic Pump Controls**

- Flow Control ..... This control is used to set the maximum flow required from the HPU.
- Pressure Control ..... The pressure control is used to set the system pressure of the HPU during operation.

5.3 LOCATION & LAYOUT OF CONTROLS *(continued)*

5.3.6 Hand Pump Controls *(Option M)*

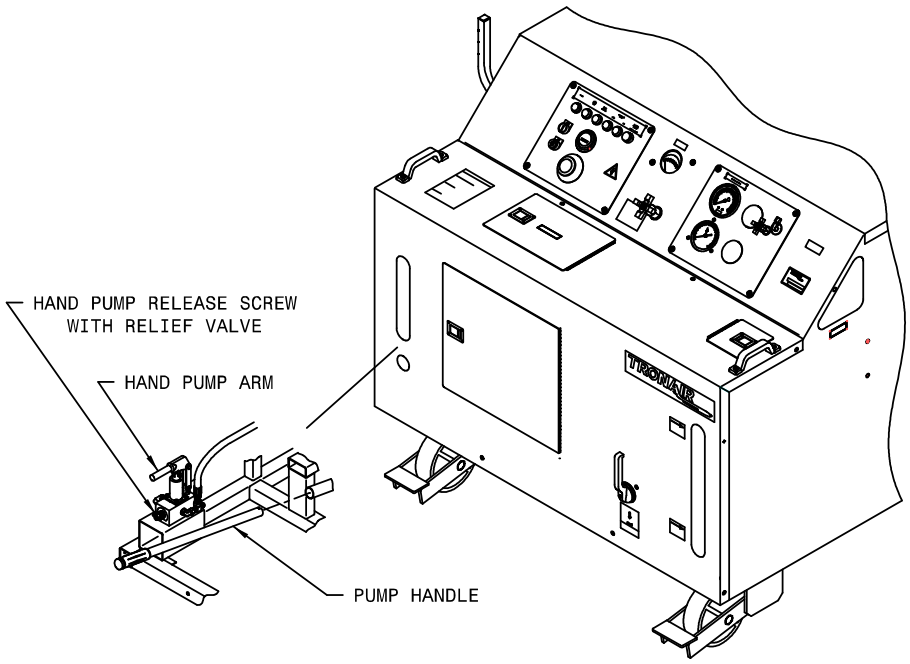


***FIGURE 5.3.6* – Hand Pump Controls**

Reference 5.8 Hand Pump Operation.

- Pump Handle ..... Located inside the front access door is the hand pump handle used for opening and closing the hand pump relief screw and stroking the hand pump arm.
- Hand Pump Relief Screw..... Accessed through the front panel opening, this screw allows opening and closing of the hand pump hydraulic circuit using the hand pump handle.
- Hand Pump Arm..... The handle is used to access the hand pump arm used for up and down motion to produce hydraulic flow and pressure.

5.3 Location & Layout of Controls continued on following page.

5.3 LOCATION & LAYOUT OF CONTROLS *(continued)*

5.3.7 Dual System Controls *(Option C)*

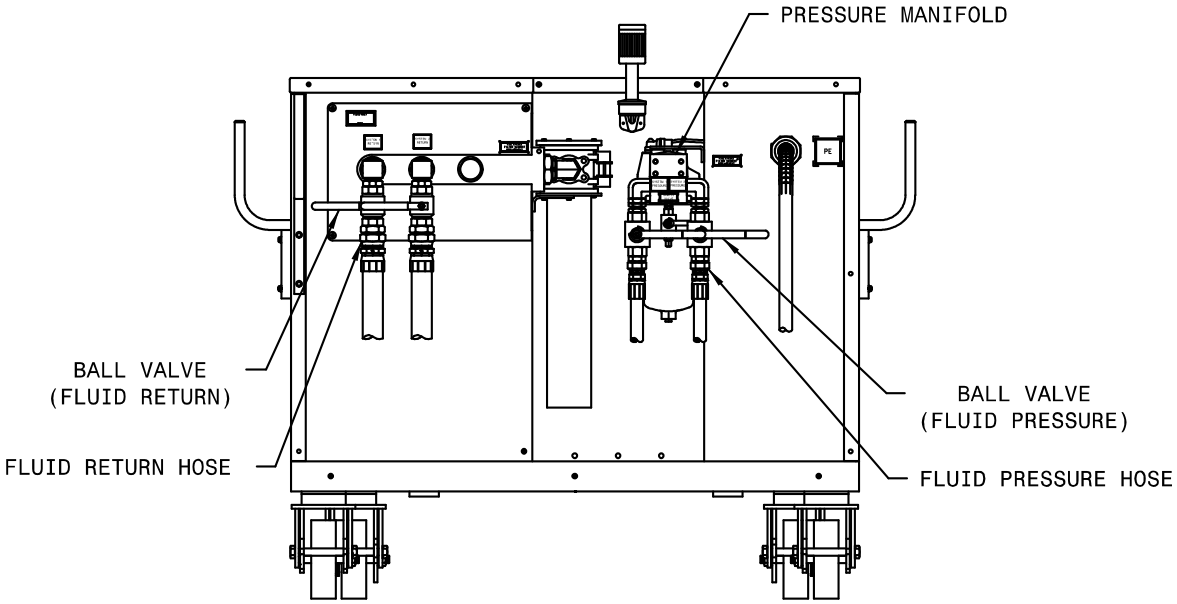


***FIGURE 5.3.7* – Dual System Controls**

Reference 5.7 Dual System Operation.

- Pressure Manifold ..... Houses the pressure valves.
- Fluid Pressure Ball Valve ..... Used to turn on and off the flow to separate aircraft systems. Always use in either fully open or fully closed position; never use in a partially open position.
- Fluid Pressure Hose..... Connects HPU to aircraft pressure systems.
- Fluid Return Hose ..... Connects HPU to aircraft return systems.

WARNING!

NEVER open or close dual system valves without shutting off the Hydraulic Power Unit. Damage to the aircraft system or reservoir may result if either return line valve is closed while the machine is running.

- Fluid Return Ball Valve..... Used to turn on and off the flow from separate aircraft systems. Always use in either fully open or fully closed position; never use in a partially open position.

5.0 OPERATION *(continued)*

5.4 START UP PROCEDURES

5.4.1 Procedure for First Time or Different Electrical Supply ONLY

Phase Monitor (Options G – J Only): Check that the phase monitor light on the instrument panel is not illuminated. If the light is illuminated, change any two of the three input leads at the plug. Once the phase monitor light is not illuminated with power attached, check for proper motor rotation.

a. Remove the pump/motor coupling guard. Reference ***Figure 5.4.1 – Pump/Motor Coupling Access***.

Rotating Parts! Keep hands, feet, hair, and clothing away from all moving parts to prevent injury. Never operate the HPU with covers, shrouds, or guards removed.

Electrical Shock! Never touch electrical wires or components while the HPU is attached to the power source. They can be sources of electrical shock.

Do not operate HPU with cabinet panels removed.

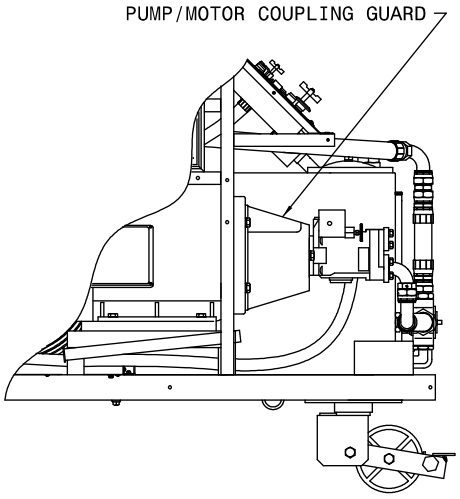


FIGURE 5.4.1
Pump/Motor Coupling Access

b. Verify that the unit has been prepared for use by connecting electrical leads and servicing the reservoir. (Reference section 3.0 Preparation Prior to First Use.)
c. Keeping hands clear of the pump/motor coupling area, momentarily press the start button and immediately press the stop button.
d. Observe direction of rotation of the pump/motor coupling. When the Operator is facing the front panel, the pump/motor coupling should be rotating in a clockwise direction.
e. If the pump/motor coupling is rotating in a counter-clockwise direction, change any two of the three leads at the plug. Observe direction of rotation to verify that pump/motor is rotating in a clockwise direction.
f. Replace the pump/motor coupling guard.

5.4.2 Initial Start Up of the HPU

a. Unit must be prepared per section *3.0 Preparation Prior to First Use* and section *5.4.1 First Time or Different Electrical Supply ONLY* before starting the HPU.
b. Operator must be familiar with this manual and be properly trained prior to starting the HPU.
c. Connect quick disconnects to hose ends or cap the pressure and return hose ends.
d. Place the reservoir selector valve in "HPU Reservoir" position.
e. Place the bypass valve in the "Open" position.
f. Press the start switch and adjust the flow control until approximately 10 gpm (38 lpm) is displayed on the flowmeter. (If no flow displays on the flowmeter after adjusting the flow control, reference *Trouble Shooting 8.2 No Flow*).
g. Close the bypass valve, adjust the pressure control until 3,000 psi (206.84 bars) is displayed on the pressure gauge. (If no pressure displays on the system pressure gauge after adjusting the pressure control, reference *Trouble Shooting 8.4 No Pressure or Reduced Pressure)*.
h. Open the bypass valve; press the stop switch.

NOTE: Maintenance and Trouble Shooting are to be performed by a skilled and trained technician.

5.5 PRELIMINARY ADJUSTMENTS FOR OPERATION

The following are basic to the operation of the HPU and should be thoroughly understood. The pressure and flow controls have lock nuts to prevent rotation of the control shaft during operation. These nuts should be moved away from the pump during adjustment of flow or pressure in order to eliminate binding of the control shafts.

5.5.1 Flow Control Adjustment

a. Open bypass valve.
b. Select "Hydraulic Power Unit" position with reservoir selector valve.
c. Start HPU.
d. Adjust flow control on pump for maximum desired flow. Observing the flowmeter, read flow in gallons (liters) per minute directly from flowmeter. Be sure the control shaft lock nut is loose during adjustment. Tighten after adjustment to maintain setting.

5.5 Preliminary Adjustments for Operation continued on following page.

5.5 PRELIMINARY ADJUSTMENTS FOR OPERATION *(continued)*

5.5.2 Pressure Control Adjustment

a. Open bypass valve.
b. Select "Hydraulic Power Unit" position with reservoir selector valve.
c. Start HPU.
d. Close bypass valve.
e. Adjust pressure control for desired pressure; observing the system pressure gauge, read in psi (bars). Be sure the control shaft lock nut is loose during adjustment. Tighten after adjustment to maintain setting.

NOTE: Once the flow and pressure controls have been adjusted, it is not necessary to change these settings after each operation unless desired.

5.5.3 Reservoir Selector Valve Operation

Operation of the reservoir selector valve allows the operator to select either the aircraft reservoir (closed loop) or the HPU reservoir (open loop).

CAUTION!

The reservoir selector valve should only be operated when the HPU is not running. The operation of the reservoir selector valve should be done prior to starting the HPU.

a. Aircraft Reservoir Position (Closed Loop)

In this position, the HPU is dependent on the aircraft reservoir and system for an adequate supply of fluid. Cavitation, due to an inadequate fluid supply from the aircraft, may be indicated by erratic fluctuation of the system pressure gauge or flowmeter. At times, the aircraft fluid supply will be restricted due to small return oil lines in the aircraft. If this is a problem, decrease the flow control setting until the cavitation is eliminated.

b. HPU Reservoir Position (Open Loop)

In this position, the HPU reservoir supplies fluid to the pump and accepts return fluid from the aircraft. It is desirable to operate the HPU in this mode since it eliminates any possibility of cavitation.

Since the HPU reservoir is vented to atmosphere and the aircraft is at a higher level, it is normal for the aircraft reservoir to drain into the HPU reservoir. It is, therefore, necessary to be sure that sufficient room is available in the HPU reservoir to accommodate the additional fluid.

CAUTION!

The aircraft system reservoir must be serviced after completion of operational testing.

In the "HPU Reservoir" position, faster landing gear swings are usually possible since there is no restriction to flow at the pump inlet.

5.5 PRELIMINARY ADJUSTMENTS FOR OPERATION *(continued*)

5.5.4 Bypass Valve Operation

The bypass valve is used for unloading the pump. The valve should be either in the fully open or fully closed position only. Do not operate the valve in a partially open position.

a. Start Up Operation

The bypass valve must be opened prior to starting the HPU in order to allow the motor to start under a no load condition and not pressurize the aircraft hydraulic system.

b. Shut Down Operation

Prior to shutdown, the bypass valve must be opened to bleed off any residual system pressure.

CAUTION!

Excessive heat, which could damage machine components, will be generated if the bypass valve is partially open or is used for regulating flow or pressure.

- **Use the flow and pressure controls for regulation.**
- **Use the bypass valve for unloading the system only.**

5.6 BLEEDING AIR FROM SYSTEM

Rapid fluctuations of the pressure gage and flow-meter are indications of cavitation or entrapped air in the hydraulic lines and/or components. Air may enter the system when:

- Operating the unit with insufficient oil in the reservoir.
- Changing a component on the aircraft.
- Changing hose connections and/or couplings.

5.6.1 To Easily Purge the Unit of Air

a. Fill reservoir to recommended level.
b. Open bypass valve.
c. Place reservoir selector valve in “Hydraulic Power Unit” position.
d. Start unit and adjust flow control to maximum position.

NOTE: If fluid is not flowing, shut off HPU and reference 8.2 No Flow in Trouble Shooting section of Technical Manual

e. Run unit for five (5) minutes and shut off.
f. If additional bleeding is required, connect the pressure and return hoses together and open all pressure and return ball valves at the rear of the HPU. Start the HPU and slowly close the bypass valve (**system pressure should remain under 200 psi (approximately 14 bar)**. Allow fluid to flow at full flow for five (5) minutes, then shut the HPU off.

WARNING!

Failure to open the return ball valves will cause hose or valve rupture. Property damage and personal injury can result.

5.7 DUAL SYSTEM OPERATION *(Option C)*

The dual system option allows control of fluid flow to aircraft with two hydraulic systems. The systems consist of two sets of hoses and valves located in the pressure and return systems. The valves are mounted on the rear of the hydraulic power unit and are of the 90o ball type. The valves are open when the operating handle is in line with the valve.

Although both systems may be operated simultaneously, usually only one system is required at any one time. If both valve sets are open simultaneously, the pump output will be divided between the two systems. Also, cross flow between aircraft reservoirs may occur if a reservoir level or pressure differential exists. Select valve positions prior to starting machine.

5.7.1 To Operate the Dual System

a. Before starting machine, open pressure and return valves of the same system.

WARNING!

Ensure pressure and return hoses of the same system are paired and used together.

b. After completing tests on one system, shut the machine off before selecting the second system.

WARNING!

NEVER open or close dual system valves without shutting off the Hydraulic Power Unit. Damage to the aircraft system or reservoir may result if either return line valve is closed while the machine is running.

5.0 Operation continued on following page.

5.0 OPERATION *(continued)*

5.8 HAND PUMP OPERATION *(Option M)*

The Hand Pump Option allows for filling the reservoir (low pressure) or static testing of components or system (high pressure). The hand pump circuit is separate from the main hydraulic system; a separate filter and hose are attached to the back panel of the HPU.

5.8.1 To Operate the Hand Pump

a. Remove the pump handle from inside the front access door. (Reference ***Figure 5.3.6 – Hand Pump Controls***)
b. Insert the end of the pump handle through the front panel opening into the hand pump relief screw.
c. Turn the pump handle clockwise to close the relief screw.
d. Insert the pump handle onto the hand pump arm through the front panel slot.
e. Pump the handle using an up and down motion. Observe the hand pump system pressure on the hydraulic control panel (***Figure 5.3.3 Hydraulic Control Panel***). The pump is an automatic two stage pump. 500 psi (34.47 bar) can be produced with high fluid flow and 5,000 psi (344.74 bar) can be produced with low fluid flow.
f. Turning the relief screw in a counter-clockwise direction releases hydraulic pressure in the hand pump system.

Pressurized Fluid! Before disconnecting the hand pump pressure hose, ALWAYS open the relief screw valve to relieve any residual pressure in the hydraulic system.

5.9 SAMPLE VALVE

A sample valve is provided on the rear of the unit to obtain a fluid sample for analysis or inspection.

In order to obtain a representative fluid sample, it is suggested that ANSI/B93.19M-1972 (R1993) be followed. Reference Appendix.

Pressurized Fluid! Before servicing the HPU or equipment, ALWAYS open the bypass valve to relieve any residual pressure in the hydraulic system.

5.10 EMERGENCY SHUT DOWN PROCEDURE

In the event an emergency shut down is necessary, press the emergency stop switch located on the electrical panel. (Reference Figure 5.3.2 – Electrical Control Panel) Open the bypass valve to remove any system pressure.

5.11 DESCRIPTION OF ALARM SYSTEMS

Reference Figure 5.3.2 – Electrical Control Panel.

5.11.1 High Fluid Temperature Indicator

The indicator light for high fluid temperature is an active light which will illuminate when the return fluid temperature is 160° F (71° C) or above. The HPU will shut down if the light is illuminated. The HPU can be re-started when the fluid has cooled sufficiently and the light has shut off.

If the high temperature light is illuminated reference section 8.0 Trouble Shooting.

5.11.2 Voltage/Phase Monitor Indicator *(Options G – J)*

The indicator light for the voltage/phase monitor is an active light which will illuminate if there is a problem with the incoming electrical power source. The HPU will shut down if the light is illuminated.

If the voltage/phase monitor light is illuminated, reference section 8.0 Trouble Shooting.

5.11.3 High and Low Reservoir Level Indicator *(Option L)*

The indicator lights for high and low reservoir level are active lights which will illuminate when the reservoir fluid level is either above the maximum level or below the minimum level. The HPU will shut down if either of the lights are illuminated.

If the light on either of the reservoir level indicator lights, restore the fluid level in the reservoir to a normal operating range.

5.11.4 Clogged Filter Indicator Light

The indicator light for the clogged filter is a passive light which will illuminate if the pressure filter element becomes clogged or is in need of replacement. The HPU will not shut down if the light is illuminated.

If the clogged filter indicator light is illuminated, the pressure filter element requires changing. Reference section 9.13.11 Electric Filter Clogging Indicator (Option R) for maintenance procedure. Pressing the clogging filter indicator light will reset the light and the light will turn off.

NOTE: Maintenance and Trouble Shooting are to be performed by a skilled and trained technician.

6.0 PACKAGING AND STORAGE

6.1 PACKAGING REQUIREMENTS

a. Drain hydraulic fluid until level is below the minimum fluid level indicator.
b. Block up the unit on a pallet so the wheels are not touching the pallet or shipping container.
c. Plug all hose ends.
d. Strap unit to pallet or shipping container using the tie down rings located on the frame bottom.

NOTE: Use at least four (4) straps with a minimum 4,000 lb (1,814 kg) capacity each.

6.2 HANDLING

The unit is designed to be moved by hand using the handles located on the front of the unit. The unit can be lifted by means of a fork truck from the center of the machine. Lifting must be from the motor side of the unit only.

NOTE: Be sure the forks are long enough to reach the frame cross members for stability during lifting. Spread the forks to their maximum width for stability. Reference Figure 7.0 – HPU on Forklift.

6.3 PACKAGING PROTECTION

No special packaging material for cushioning or suspension is required.

6.4 LABELING OF PACKAGING

Packaging should be labeled as follows: **DO NOT DROP**
THIS SIDE UP
DO NOT STACK

6.5 STORAGE COMPATIBILITY

No special considerations for short term storage (less than three months).

6.6 STORAGE ENVIRONMENT

Cover HPU with a suitable, non-abrasive tarp if storing outside. For storage periods greater than three months, drain hydraulic fluid from all hoses and the reservoir. Cover unit to protect outside surface.

If storing outside, protect unit from freezing water, sand, dirt, and direct sunlight. A cover is highly recommended.

6.7 STORAGE SPACE AND HANDLING FACILITIES

- Weight (Dry)**:** 3,150 lbs (1,430 kg)
- Dimensions**:** Width 63 ¾ in (162 cm) *Add 7.5 in (19 cm) for Dual System.*
  Height 59 in (149.9 cm)
  Depth 78 in (198 cm)

7.0 TRANSPORTATION

1. Do not stack Hydraulic Power Units.
2. The unit can be lifted by means of a fork truck from the motor side center of the HPU.

NOTE: Be sure the forks are long enough to reach frame cross members for stability during lifting. Spread the forks to their maximum width for stability. Reference Figure 7.0 – HPU on Forklift.

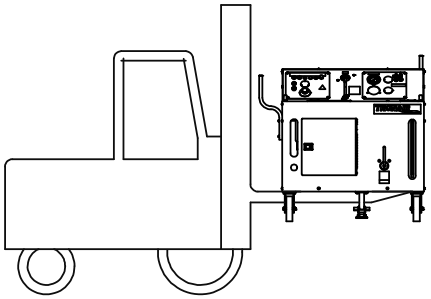


***FIGURE 7.0* – HPU on Forklift**

8.0 TROUBLE SHOOTING

The following is a guide to solutions of common problems associated with the HPU. See related Appendix for Hydraulic and Electrical Schematics.

If the problem is not resolved using the trouble shooting information, call the manufacturer for Technical Assistance (See Section 1.3 Manufacturer).

NOTE: Maintenance and Trouble Shooting are to be performed by a skilled and trained Technician.

8.1 HPU WILL NOT START

Possible Cause	Solution
Supply power off	Check incoming power and restore power. Check across-the-line voltage on all three phase legs.
Supply power fuses are blown/ Circuit breakers tripped	Check and replace. Check across-the-line voltage on all three phase legs.
Control Transformer fuses blown	Check and replace.
Supply power phase or voltage incorrect *(Phase/Voltage Monitor Option G – J only)*	Voltage/Phase Monitor Indicator light will be illuminated. Refer to Section ***3.3 Connecting Electrical Leads***.
Reservoir fluid level is too high or too low *(Electric Reservoir Level Option L only)*	One reservoir level indicator light (Low or High) will be illuminated. Fill the reservoir above the Minimum Fluid Level arrow to extinguish the Low Level light. Drain fluid below the Maximum Fluid Level arrow to extinguish the High Level light.
High return fluid temperature	High Fluid Temperature indicator light will be illuminated. Allow the hydraulic fluid to cool until the light goes out. Refer to *Section 8.5 for Over-heated Causes.*
Motor has tripped thermal overload device	Allow the motor to cool. The thermal overload device (motor starter) will reset automatically after sufficient cooling. The tripped condition is usually caused by loading the motor beyond its rated capacity; however, any condition (such as unbalanced voltage) that causes an increase in amperage can result in a tripped condition.

NOTE: Using the bypass valve to meter flow or pressure will increase the motor load and may cause the thermal overload device to trip. Refer to section 5.5.4 Bypass Valve Operation for proper use of the bypass valve.

8.2 NO FLOW

Possible Cause	Solution
Motor turning in wrong direction	See Section ***3.3 Connecting Electrical Leads.***
Flow control set too low	Increase flow setting.
Fluid level in reservoir too low	Service the HPU reservoir.
Air in pump inlet lines	Disconnect the HPU from the aircraft. Fill the HPU reservoir to a level above the pump inlet port. Set the reservoir selector valve to the HPU Reservoir position. **Fully open the Bypass Valve.** Close the Pressure and Return ball valves at the rear of the unit. Adjust the pump flow to maximum and "bump" the start and stop switches to "jog" the motor. Flow should be indicated at the Flowmeter on first or second "jog".
Motor is turning but pump is not	Check pump and motor couplings to ensure they are tight.
Flow path does not exist	A flow path (such as a moving actuator or an open circuit) must exist for flow to be present. When system pressure exceeds the compensator control setting, or when the system no longer requires flow, the control de-strokes the pump while maintaining the preset pressure.

NOTE: Under some conditions where a large amount of air has entered the system, the pump may not be able to draw an initial prime. If this occurs, loosen the inlet hose near the pump and allow air to escape. Re-tighten the hose when fluid appears.

8.0 TROUBLE SHOOTING *(continued)*

8.3 REDUCED FLOW

Possible Cause	Solution
Flow control is set too low	Increase flow setting.
Pressure adjustment is set too low	Slightly increase pressure setting.
Pressure compensator control is reducing pump output.	When system pressure exceeds the compensator control setting, or when the system no longer requires flow, the control de-strokes the pump while maintaining the preset pressure.
Pump inlet is not receiving enough fluid (cavitation)	Follow the procedure for “Air in pump inlet lines” in Section 8.2.
Motor is “Single Phasing”	Motor is not getting power on all three phase legs. Check across-the-line voltage on all three phase legs.
Supply voltage is 50 Hz	Pumps used on 50 Hz units will flow at only 83% of the pump nameplate rating. An HPU designed to run on 50 Hz will supply flow as stated in the specifications for that unit.

8.4 NO PRESSURE or REDUCED PRESSURE

Possible Cause	Solution
Pressure adjustment is set too low	Increase pressure adjustment.
Motor is “Single Phasing”	Motor is not getting power on all three phase legs. Check across-the-line voltage on all three phase legs.
Pump inlet is not receiving enough fluid (cavitation)	Follow the procedure for “Air in pump inlet lines” in Section 8.2.
Flow path is open	Pressure is resistance to flow. The HPU will reach full pressure as flow paths (such as moving actuators and open valves) are closed.

8.5 FLUID OVERHEATS

Possible Cause	Solution
Fan is not functioning properly	Check the cooler fan output. Forced air should be easily detected at the right hand side of the HPU. Check the fuses for the fan motor (***See Appendix Electrical Schematic INS-1608***).
Bypass valve or rear ball valve is being used in a partially closed position	The bypass valve and all ball valves must be used in a fully open or fully closed position. These valves are not intended for metering flow. All flow adjustments must be made using the pump flow control.

8.6 HAND PUMP (*Option M)* IS NOT PUMPING FLUID

Possible Cause	Solution
Release screw is open	Use the slotted end of the pump handle to close the release screw located at the base of the pump.
Ball valve is closed	Open the ball valve for the pump inlet line located at the bottom of the reservoir.
Pump piston is filled with air	If the pump is not primed after several strokes, remove the bleed screw from the top of the pump piston (see section *9.13.9.a – Pump Diagram*). Slowly stroke the pump until fluid is present at the bleed screw. Replace the bleed screw.

9.0 MAINTENANCE

9.1 GENERAL

Periodically inspect the HPU for loose fasteners, hose fittings, damaged hoses, and worn electrical cables. Make repairs as needed for safe operation.

Reference Sections 9.2 – 9.14 for Parts Lists, Descriptions and Illustrations.

9.2 ELECTRIC MOTOR

The Electric Motor is pre-greased by the manufacturer. Periodic greasing is necessary on a frequently used HPU. ***Reference Appendix – Lincoln Motor Manual*** for details.

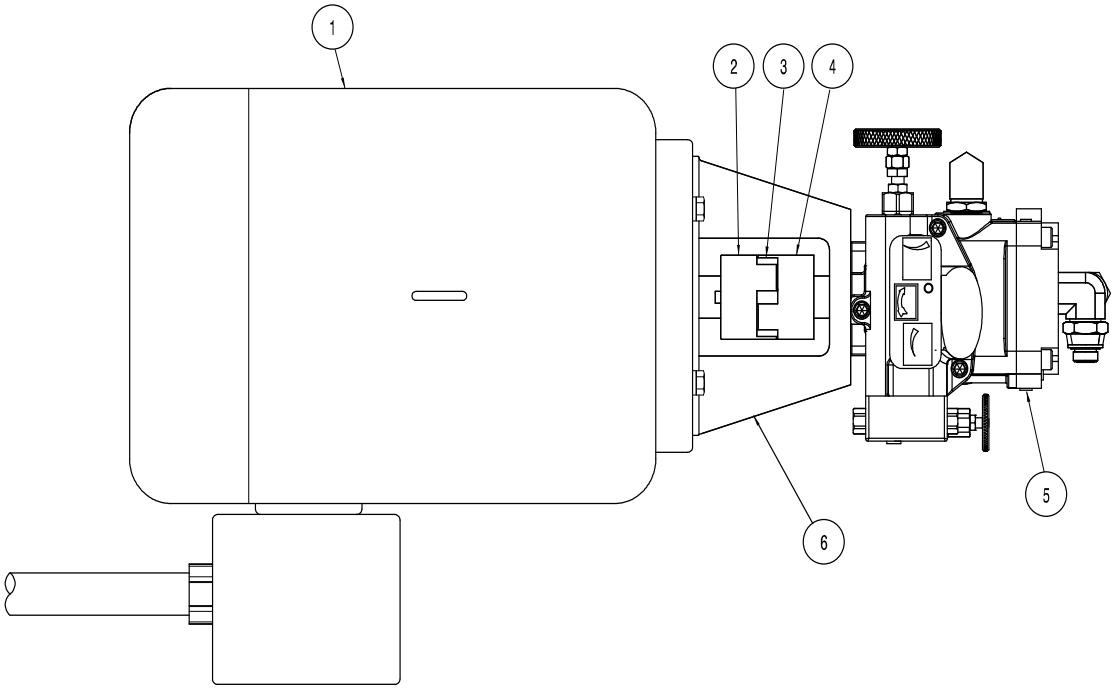


***FIGURE 9.2* – Electric Motor/Hydraulic Pump Assembly**

PARTS LIST

Item	Part Number	Description	Qty
1	*Reference following:*	Electric Motor	1

60 Hz Applications

Voltage	Part Number
208	EC-1224-05
230	EC-1224-05
380	EC-1224-04
460	EC-1224-05
575	EC-1224-06

50 Hz Applications

Voltage	Part Number
200	EC-1555-15
220	EC-1555-14
380	EC-1224-05
415	EC-1224-05
440	EC-1555-13

2	H-2226-03	Coupling (Motor Half)	1
3	H-2229	Spider (Hytrel)	1
4	H-2226-14	Coupling (Pump Half)	1
5	*Reference 9.3 and 9.3.1*	Hydraulic Pump	1
6	HC-1427-02	Pump/Motor Adapter	1

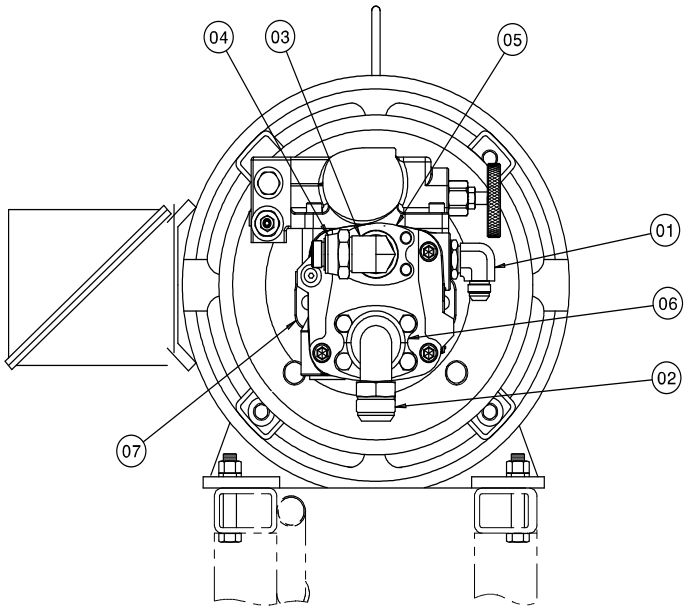
9.0 MAINTENANCE *(continued)*

9.3 HYDRAULIC PUMP

The hydraulic pump does not require regular maintenance. Under normal operating conditions, the pump will perform for thousands of hours of use without rebuilding. See ***Appendix – Oilgear Pump Manual*** for further details.

9.3.1 Hydraulic Pump Replacement Parts

***FIGURE 9.3.1* – Hydraulic Pump**



PARTS LIST

Fluid Type: MIL-PRF-83282

Item	Part Number	Description	Qty
1	N-2001-24-S-B	Elbow, 12-16	1
2	N-2078-11	Flange, 90° Elbow	1
3	N-2679-12	Flange, Elbow	1
4	N-2055-20-S	Reducer, Tube	1
5	N-2664-03-S-B	Kit, Flange	1
6	N-2545-06-S-B	Kit, Flange	1
♦ 7	HC-2494-01	Hydraulic Pump	1

♦ ***Refer to section 9.14 for listing of Replacement Labels.***

9.3.2 Hydraulic Pump Replacement Seal Kits

Fluid Type: MIL-PRF-83282

Part Number	Description
K517105-B13	Kit, Pump Seal
K-517107-004	Kit, Control Seal
L517104-313	Kit, Shaft and Bearing Seal

9.0 Maintenance continued on following page

9.0 MAINTENANCE *(continued)*

9.4 HYDRAULIC FLUID

Any time an unusual color, smell or visual indicator is noticed with the hydraulic fluid, a sample analysis should be performed to determine the condition of the fluid. (See Section ***5.9 – Sample Valve Operation***)

Refer to the manufacturer of the specific fluid for your unit to obtain additional information:

Model Number:	**Fluid Type:**
5621	MIL-PRF-83282

9.5 FILTERS

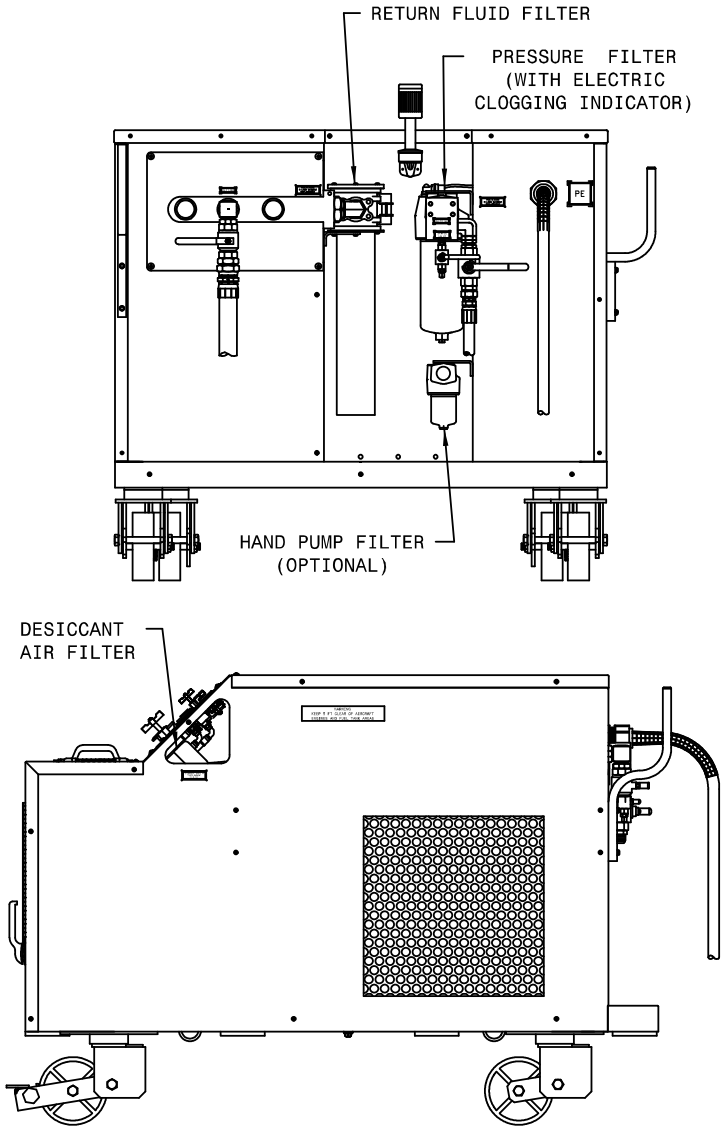


FIGURE 9.5 **– Filter Locations**

9.5 FILTERS *(continued)*

9.5.1 Pressure Filter Element

Replace the filter element any time the clogged filter indicator light is triggered.

Replace the filter element annually to ensure proper cleanliness of the hydraulic system. This is a minimum requirement.

Standard filter changes depend on how frequently the HPU is used and the cleanliness of the fluid, along with the environment to which the HPU is exposed. Periodic fluid analysis is recommended to properly determine the optimum frequency of filter element changes.

PARTS LIST

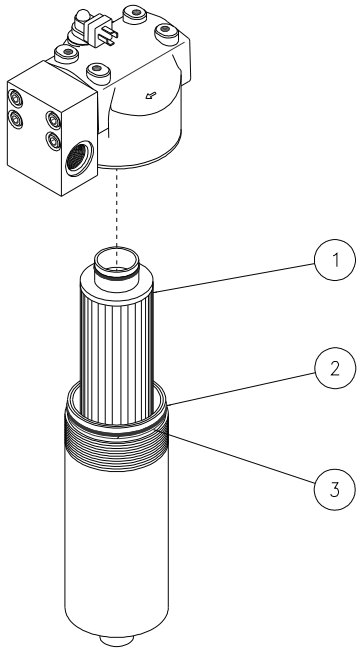


***FIGURE 9.5.1* – Pressure Filter Element Replacement**

Fluid Type: MIL-PRF-83282

Item	Part Number	Description	Qty
1 – 3	K-3613	Kit, Replacement Filter Element	1
2 & 3	K-3798	O-ring and Backup Ring	1

9.5 Filters continued on following page.

9.5 FILTERS *(continued)*

9.5.2 Return Filter Element

Replace the return filter element at the same time the pressure filter element is being replaced.

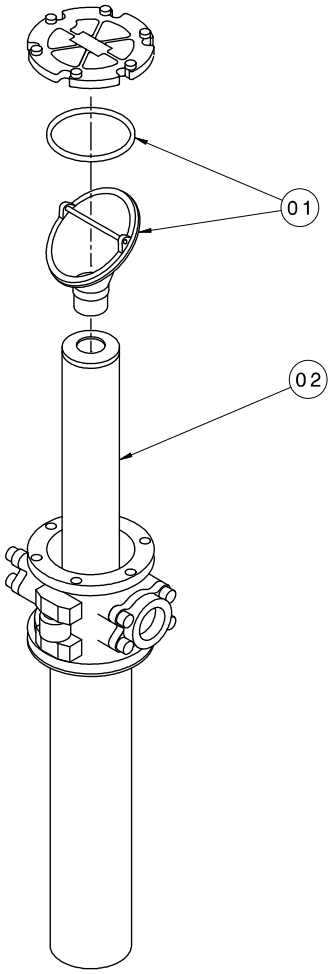


FIGURE 9.5.2 **– Return Filter Element Replacement**

PARTS LIST

Fluid Type: MIL-PRF-83282

Item	Part Number	Description	Qty
1	HC-2000-350	O-ring	2
1 & 2	K-3615	Kit, Replacement Filter Element	1

9.5 FILTERS *(continued)*

9.5.3 Hand Pump *(Option M)* Filter Element

Replacement of the hand pump filter element is dictated by frequency of use and the cleanliness of the fluid, along with the environment to which the HPU is exposed. Changing the hand pump filter element at the same time as the pressure filter element will ensure a regular maintenance schedule.

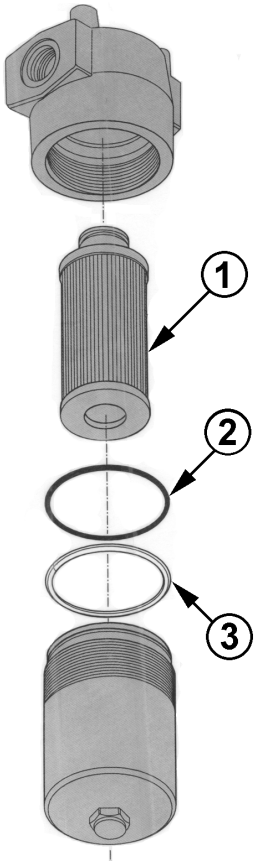


***FIGURE 9.5.3* – Hand Pump (Option M) Filter Element Replacement**

PARTS LIST

Fluid Type: MIL-PRF-83282

Item	Part Number	Description	Qty
1 – 3	K-3751	Kit, Replacement Filter Element	1
2 & 3	K-3796	O-ring and Backup Ring	1

9.5 Filters continued on following page.

9.5 FILTERS *(continued)*

9.5.4 Desiccant Air Filter

Replace the desiccant/air filter whenever the material inside the element is pink or reddish in color (see Element Label for details).

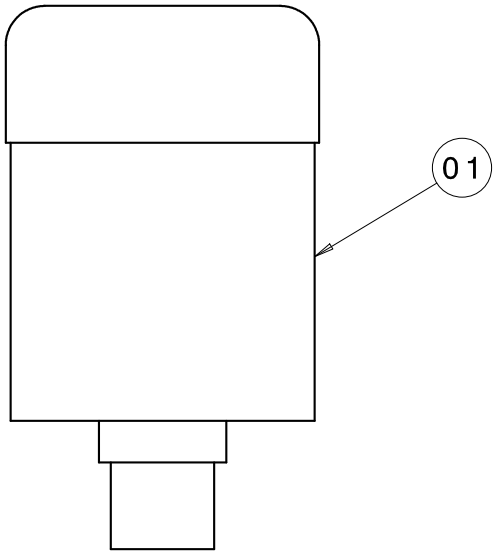


***FIGURE 9.5.4* – Desiccant Air Filter Replacement**

PARTS LIST

Item	Part Number	Description	Qty
1	HC-1763	Filter Element	1

9.5.5 Pressure Filter Assembly with Electric Filter Clogging Indicator

The Electric Filter Clogging Indicator does not require regular general maintenance. The panel light will illuminate when the clogging indicator senses a 98 psi differential pressure across the filter element. Installing a new filter element will eliminate the clogged condition. Pushing the illuminated button will reset the indicator light.

NOTE: Higher flow rates will result in higher differential pressures. (Example: The clogging indicator may sense a 98 psi differential pressure at a flow rate of 34 gpm but not show a clogged condition when the flow rate is reduced to 10 gpm.

9.5.5 Pressure Filter Assembly with Electric Filter Clogging Indicator *(continued)*

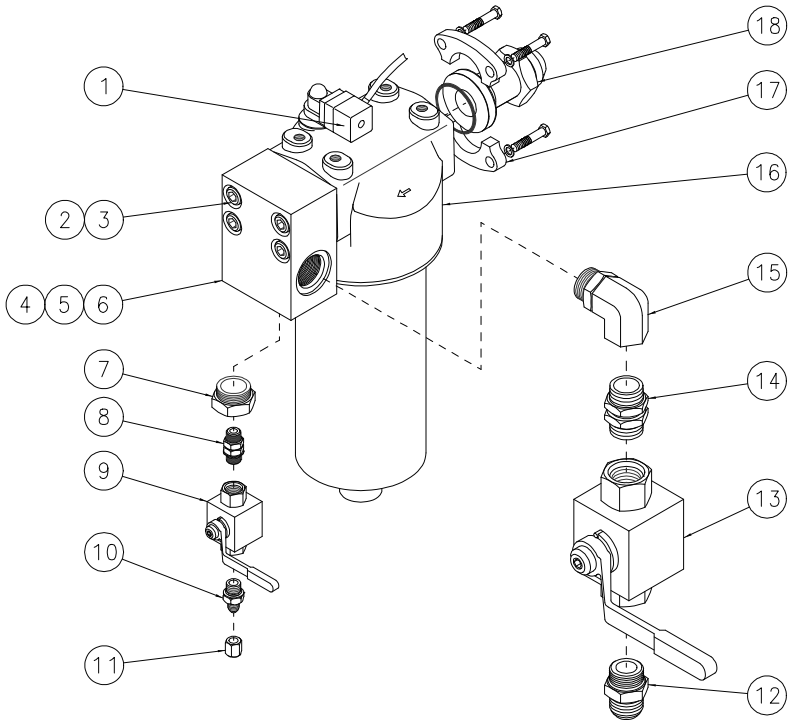


***FIGURE 9.5.5* – Pressure Filter Assembly with Electric Filter Clogged Indicator**

PARTS LIST

Fluid Type: MIL-PRF-83282

Item	Part Number	Description	Qty
1	EC-1778	DIN Connector Cable	1
2	G-1151-109224	Screw, Socket Head Cap, ½-13	1
3	G-1251-1090HC	Lockwasher, high collar	1
4	J-3280	Flange, SAE Adapter	1
5	HC-2000-222	O-ring, Series 2	1
6	N-2053-10-S-B	Plug, Hex Head with O-ring	1
7	N-2463-31-S-B	Fitting, Reducer/Expander	1
8	N-2464-05-S-B	Union, #6 Straight Thread	1
9	HC-1768-02	Valve, Ball	1
10	N-2007-05-S-B	Connector, Straight Thread	1
11	N-2008-03-S	Cap, #4	1
12	N-2007-24-S-B	Connector, Straight Thread	1
13	HC-1768-05	Valve, Ball	1
14	N-2464-10-S-B	Union, #16 Straight Thread	1
15	N-2661-06-S-B	Elbow, Straight Thread	1
16	HC-2044-01	Filter, Pressure	1
17	N-2664-03-S-B	Kit, Flange	1
18	N-2667-05	Adapter, Flange	1

9.5 Filters continued on following page.

9.5 FILTERS *(continued)*

9.5.6 Return Filter Assembly

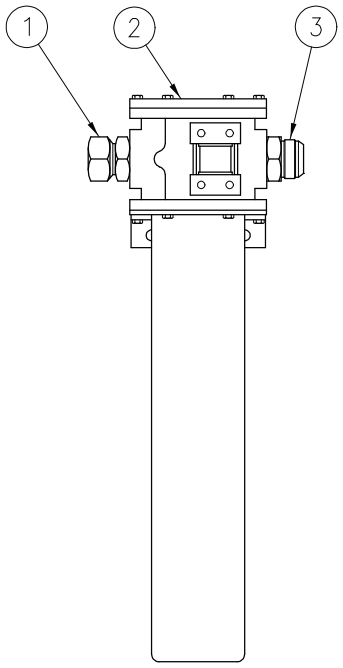


FIGURE 9.5.6 **– Return Filter Assembly**

PARTS LIST

Fluid Type: MIL-PRF-83282

Item	Part Number	Description	Qty
1	N-2036-13-S-B	Fitting, 37° Swivel	1
2	HC-2045-01	Filter, Return	1
3	N-2007-31-S-B	Connector, #24 Straight Thread	1

9.0 MAINTENANCE *(continued)*

9.6 HYDRAULIC HOSES

Hoses used on the HPU must be periodically inspected for damage, blisters, leaks, or hose end problems. Any damaged or defective hose should be replaced as soon as possible.

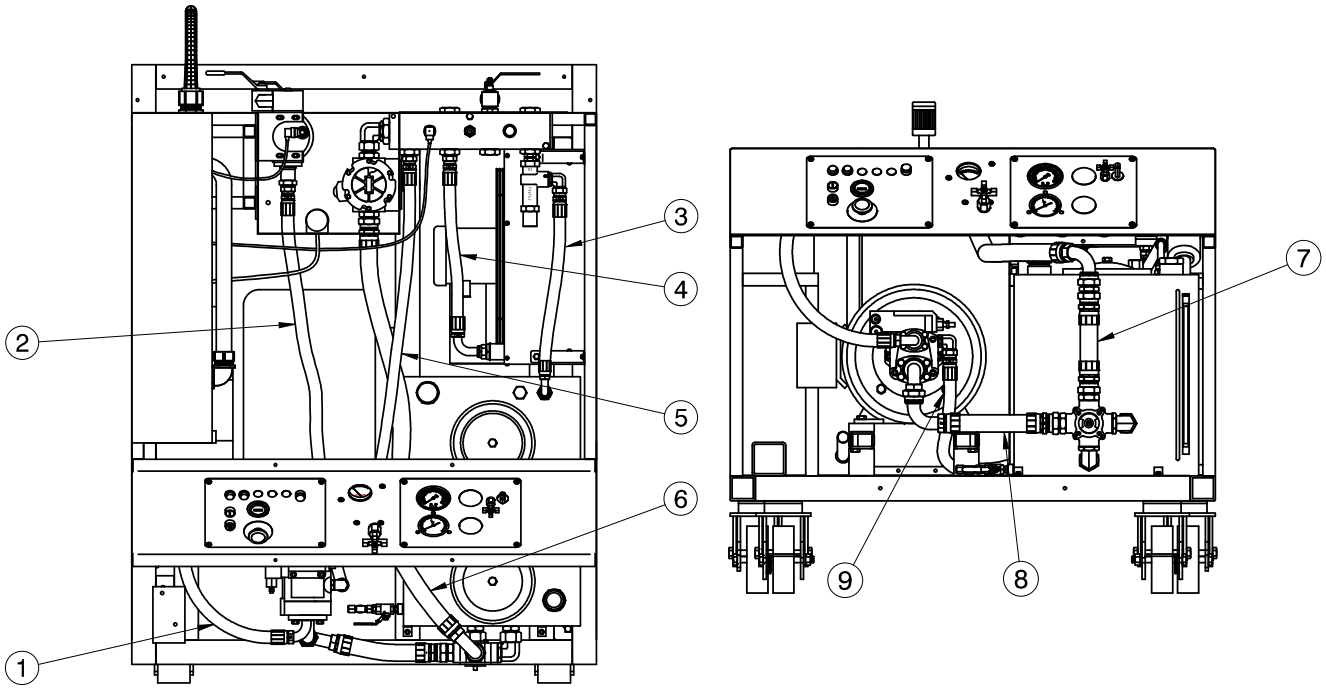


FIGURE 9.6 **– Hydraulic Hoses**

PARTS LIST

Fluid Type: MIL-PRF-83282

Item	Part Number	Description	Qty
1	TF-1038-25*80.5	Assembly, Hose #16	1
2	TF-1038-28*39.0	Assembly, Hose #16	1
3	TF-1038-32*27.0	Assembly, Hose #16	1
4	TF-1038-31*27.0	Assembly, Hose #16	1
5	TF-1037-24*50.5	Assembly, Hose #16	1
6	TF-1039-13*56.5	Assembly, Hose #24	1
7	TF-1039-12*11.5	Assembly, Hose #24	1
8	TF-1039-13*17.3	Assembly, Hose #24	1
9	TF-1037-22*60.0	Assembly, Hose #16	1
Not Shown	TF-1038-28*300	External Pressure Hose	1
Not Shown	TF-1039-12*300	External Return Hose	1

9.0 Maintenance continued on following page

9.0 MAINTENANCE *(continued)*

9.7 INSTRUMENT PANEL

Refer to Section ***9.6 Hydraulic Hoses*** concerning hose inspection for general maintenance on Item 3 Hose Assembly.

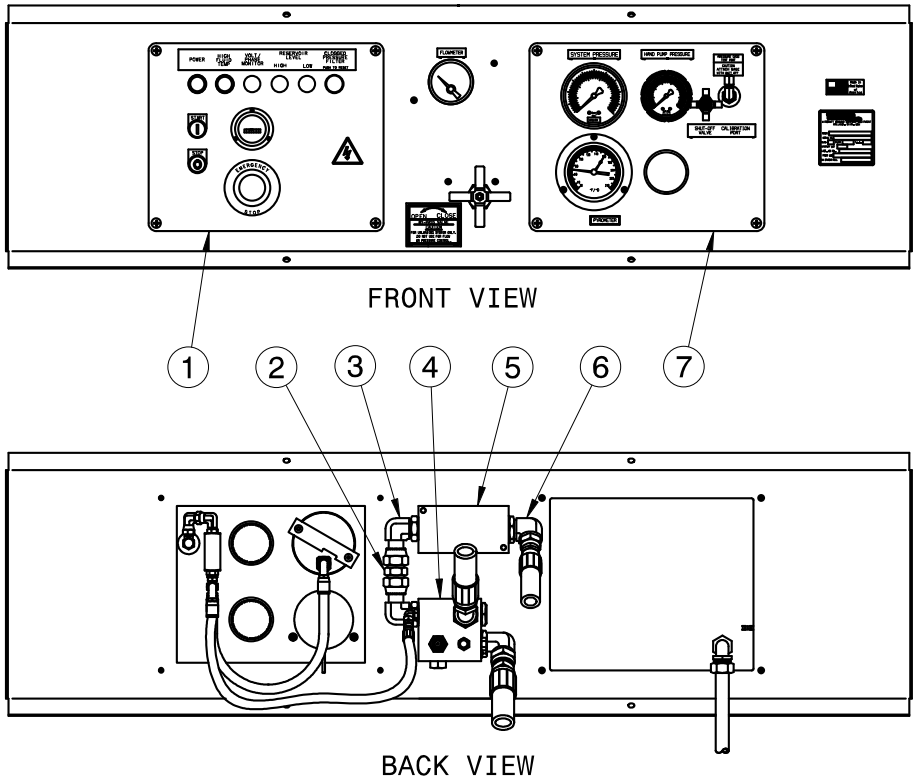


FIGURE 9.7 **– Instrument Panel**

PARTS LIST

Fluid Type: MIL-PRF-83282

Item	Part Number	Description	Qty
1	*See Page 30*	Electric Panel	1
2	N-2665-08-S-B	Fitting, ORFS Tube End	1
3	N-2634-05-S-B	Elbow, 90°	1
4	*See Page 32*	Assembly, Pressure Manifold	1
5	HC-1404	Flowmeter	1
	HC-1404-01	Flowmeter (Calibrated)	1
6	N-2001-25-S-B	Elbow, 90°	1
7	*See Page 31*	Hydraulic Panel	1

9.7 INSTRUMENT PANEL *(continued)*

9.7.1 Electric Panel

The Electric Panel does not require regular general maintenance.

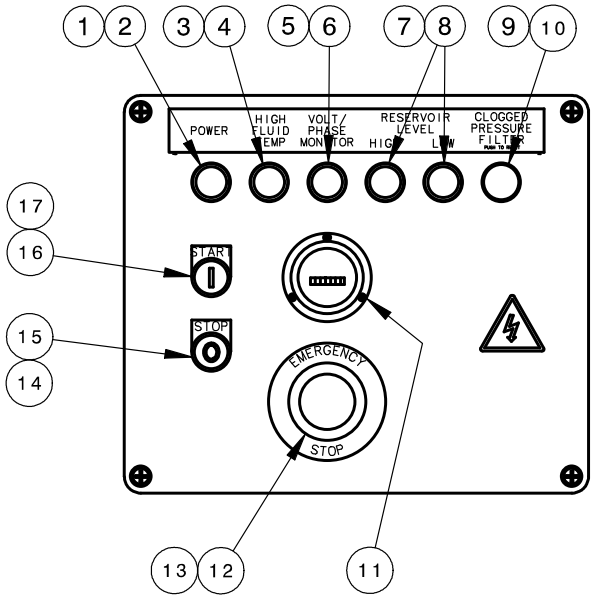


***FIGURE 9.7.1* – Electric Panel**

PARTS LIST

Fluid Type: MIL-PRF-83282

Item	Component	Part Number	Description	Qty
1	Standard	EC-1945-01	Light, Diffused Pilot	1
2	Standard	EC-1951-MN5G	Power, Module w/Latch	1
3	Option	EC-1945-03	Light, Diffused Pilot	1
4	Option	EC-1951-MN5Y	Power, Module w/Latch	1
5	Option	EC-1945-03	Light, Diffused Pilot	1
6	Option	EC-1951-MN5Y	Power, Module w/Latch	1
7	Option	EC-1945-04	Light, Diffused Pilot	2
8	Option	EC-1951-MN5B	Power, Module w/Latch	2
9	Option	EC-1952	Push Button, Illuminated/Flush	1
10	Option	EC-1944	Power, Module w/Contact/Latch	1
11	Option	EC-1577	Hour Meter (50 Hz Operation)	1
11	Option	EC-1578	Hour Meter (60 Hz Operation)	1
12	Standard	EC-1948	Switch, Emergency Stop	1
13	Standard	EC-1946-MX02	Contact Block w/Latch	1
14	Standard	EC-1953-ME205	Push Button, Non-Illuminated	1
15	Standard	EC-1946-MX01	Contact Block w/Latch	1
16	Standard	EC-1953-MF306	Push Button, Non-Illuminated	1
17	Standard	EC-1946-MX10	Contact Block w/Latch	1

9.7 Instrument Panel continued on following page.

9.7 INSTRUMENT PANEL *(continued)*

9.7.2 Hydraulic Panel

Annual calibration of instrumentation is recommended. See Section ***12.0 – Calibration of Instrumentation*** for details of calibration.

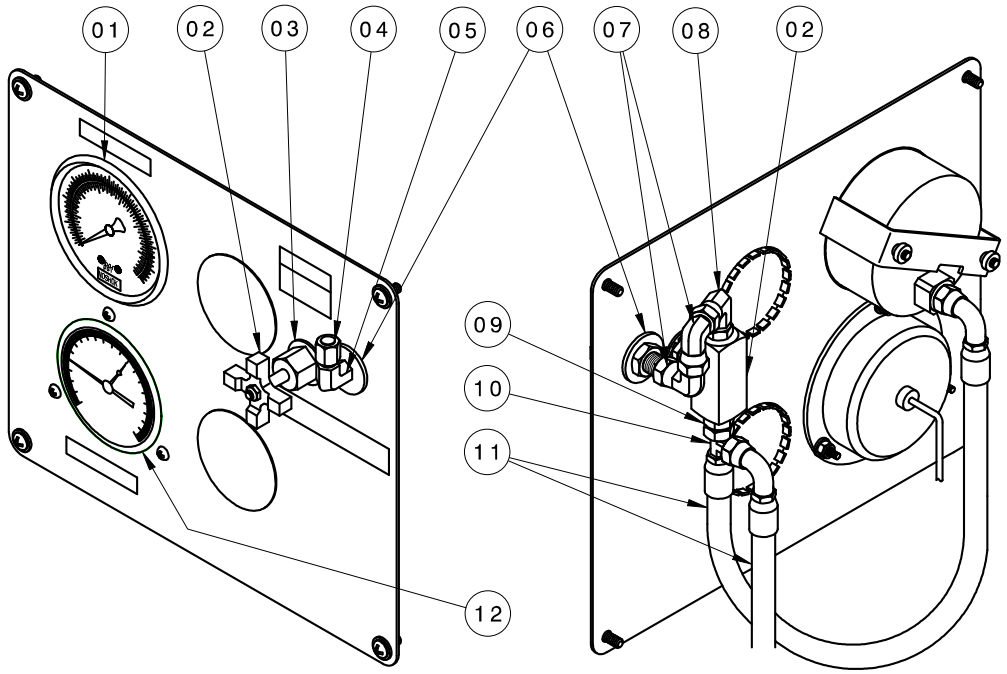


FIGURE 9.7.2 **– Hydraulic Panel**

PARTS LIST

Fluid Type: MIL-PRF-83282

Item	Part Number	Description	Qty
1	HC-2144	Gauge, Pressure	1
2	HC-1900-01	Valve, Needle	1
3	HC-1122	Kit, Panel Mounting	1
4	N-2008-03-S	Cap, ¾ JIC	1
5	N-2022-03-S	Elbow, Bulkhead Union #4	1
6	G-1250-1080W	Flatwasher, 7/16 Wide	1
7	N-2002-03-S	Elbow, 90° Swivel Nut #4	2
8	N-2049-07-S-B	Elbow, 90° Swivel 6-4	1
9	N-2007-03-S-B	Connector, Straight Thread	1
10	N-2016-03-S	Tee, Swivel Nut Run #4	1
11	TF-1038-16*24.0	Assembly, Hose	2
12	HC-2268-01	Gauge, Pyrometer	1

9.7 INSTRUMENT PANEL *(continued)*

9.7.3 Pressure Manifold Assembly

The Pressure Manifold components do not require regular general maintenance.

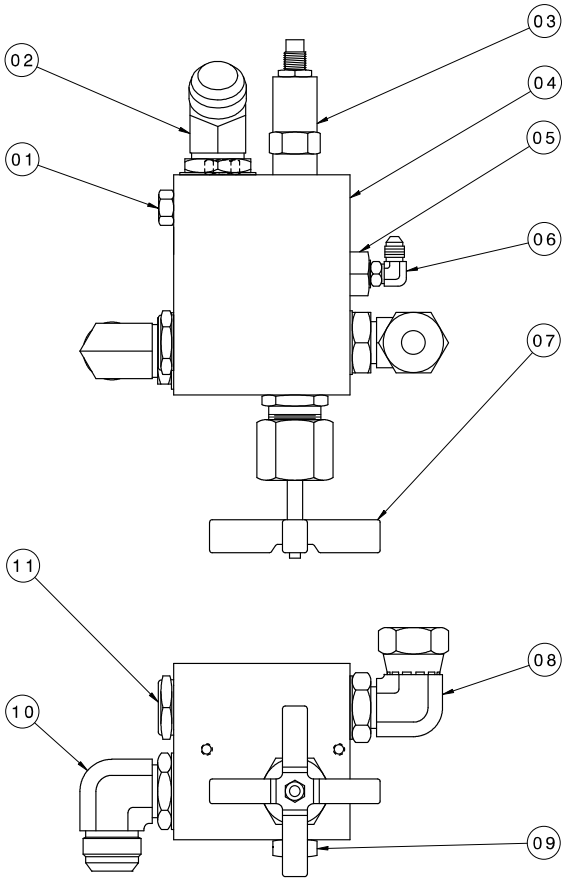


***FIGURE 9.7.3* – Pressure Manifold Assembly**

PARTS LIST

Fluid Type: MIL-PRF-83282

Item	Part Number	Description	Qty
1	N-2053-05-S-B	Plug, O-ring Hex Head	2
2	N-2042-16-S-B	Connector, 45° Straight Thread	1
3	HC-1442	Valve, Pressure Relief	1
4	J-3245	Manifold, Pressure	1
5	N-2463-36-S-B	Fitting, Reducer-Expander	1
6	N-2001-03-S-B	Connector, Straight Thread	1
7	HC-1254-05	Valve, Needle	1
8	N-2634-05-S-B	Elbow, 90° Swivel & O-ring	1
9	N-2053-07-S-B	Plug, O-ring Hex Head	1
10	N-2001-24-S-B	Elbow, Straight Thread 90°	1
11	HC-2158	Valve, Check	1

9.7.3 Pressure Manifold Assembly continued on following page.

9.7.3 Pressure Manifold Assembly *(continued)*

9.7.3.a System Pressure Relief Valve

The System Pressure Relief Valve does not require regular general maintenance. It is possible however, for a contaminant to hold the relief valve in a partially open condition. If service is required, the new or repaired relief valve must be reset to 3,750 psig.

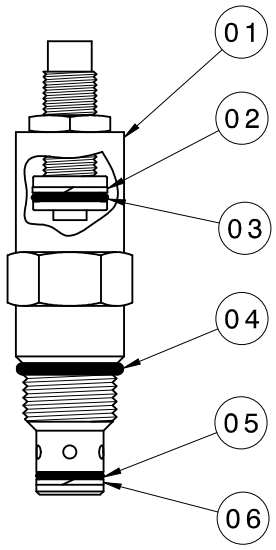


***FIGURE 9.7.3.a* – System Pressure Relief Valve**

PARTS LIST

Fluid Type: MIL-PRF-83282

Item	Part Number	Description	Qty
♦ 1	HC-1442	Pressure Relief Valve *(Not Set)*	1
2	HC-2020-015	Backup Ring, *(Teflon)*	1
3	HC-2000-015	O-ring, Series 2	1
4	HC-2010-910	O-ring, Series 3	1
5	HC-2000-014	O-ring, Series 2	1
6	HC-2020-014	Backup Ring, *(Teflon)*	1

♦ ***Item 1 consists of Items 2 – 6.***

9.7.3 Pressure Manifold Assembly *(continued)*

9.7.3.b Check Valve

The Check Valve does not require regular general maintenance.

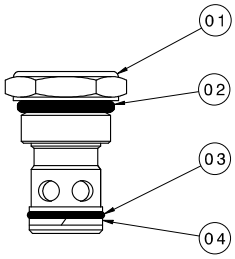


FIGURE 9.7.3.b **– Check Valve**

PARTS LIST

Fluid Type: MIL-PRF-83282

Item	Part Number	Description	Qty
♦ 1	HC-2158	Check Valve	1
2	HC-2010-912	O-ring, Series 3	1
3	HC-2000-115	O-ring, Series 2	1
4	HC-2020-115	Backup Ring	1

♦ ***Item 1 consists of Items 2 – 4.***

9.7.3.c Bypass Valve

The Bypass Valve does not require regular general maintenance.

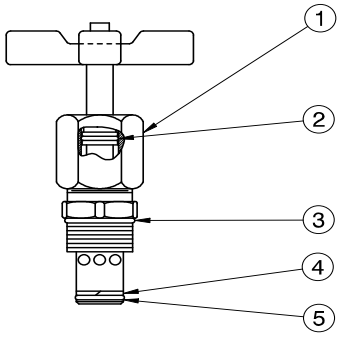


FIGURE 9.7.3.c **– Bypass Valve**

PARTS LIST

Fluid Type: MIL-PRF-83282

Item	Part Number	Description	Qty
♦ 1	HC-1254-05	Needle Valve	1
2	HC-2000-112	O-ring	1
3	HC-2010-916	O-ring	1
4	HC-2020-118	Backup Ring	1
5	HC-2000-118	O-ring	1

♦ ***Item 1 consists of Items 2 – 5.***

9.0 Maintenance continued on following page.

9.0 MAINTENANCE *(continued)*

9.8 RESERVOIR ASSEMBLY

Replace the desiccant air filter whenever the material inside the element is pink or reddish in color (See Element label for details). The Reservoir Assembly does not require regular general maintenance. If periodic inspections for silt are desired, be certain to thoroughly clean the dome cover and surrounding area before removing the dome cover. The Selector Valve (Item 19) is not field serviceable.

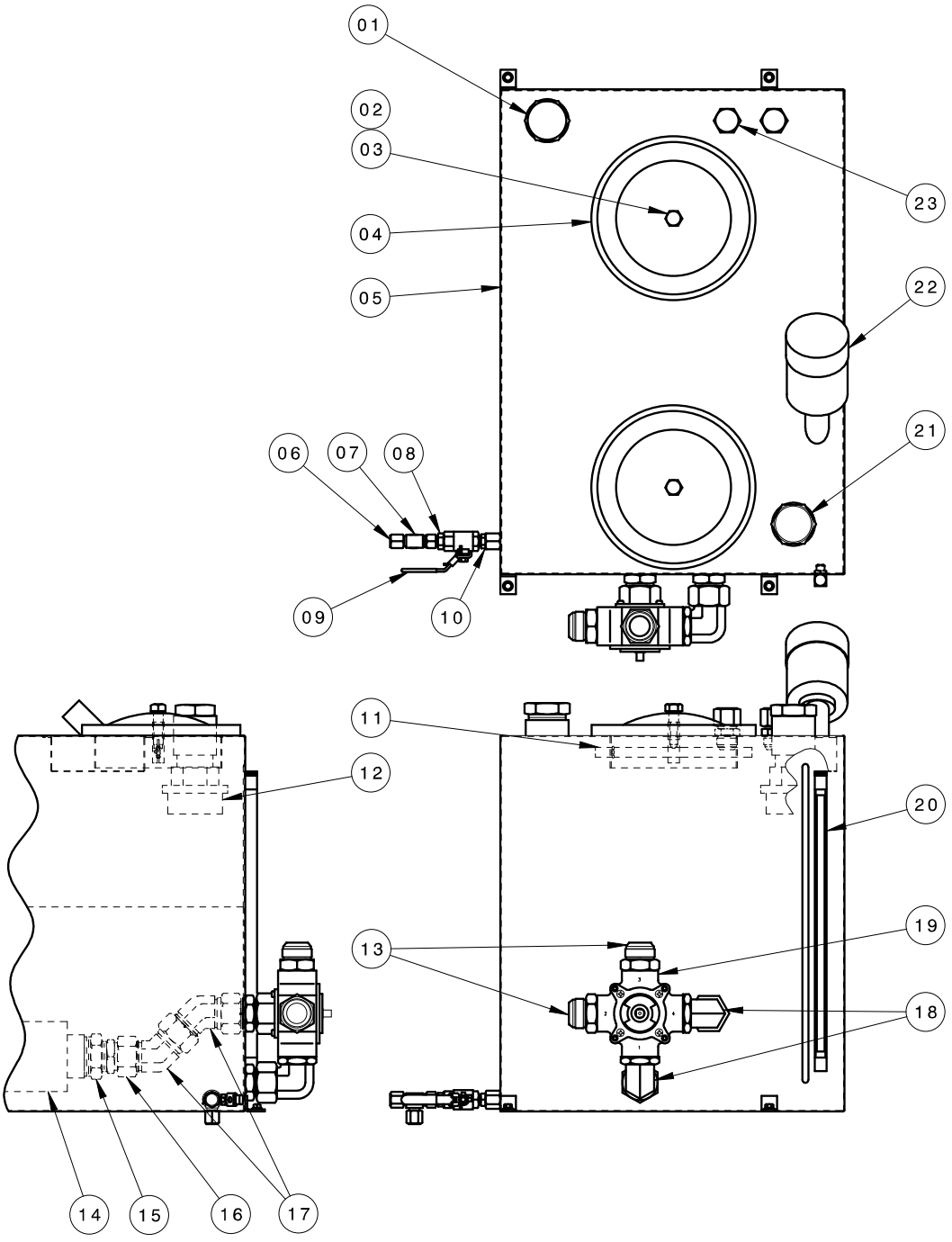


***FIGURE 9.8* – Reservoir Assembly**

9.8 RESERVOIR ASSEMBLY *(continued)*

PARTS LIST

Fluid Type: MIL-PRF-83282

Item	Part Number	Description	Qty
1	N-2206-09-S	Plug, Hex Head, 2" NPT	1
2	G-1100-110016	Bolt, Hex Head, Grade 5, 5/8-11 x 1¾" long	2
3	H-1735-02	Washer, Nylon	2
4	H-1740	Assembly, Cover	2
5	H-2537	Reservoir, 70 gallon (Stainless Steel)	1
6	N-2008-06-S	Cap, #8	2
7	N-2016-06-S	Tee, Swivel Run, #8 JIC	1
8	N-2007-11-S-B	Connector, Straight Thread #8 SAE x #8 JIC	1
9	HC-1761	Valve, Ball SAE #8 Lockable	1
10	HC-2010-908	O-ring, Series 3	1
11	Z-2394-01	Assembly, Clamp	2
12	HC-1542	Strainer, Nipple Style	1
13	N-2007-31-S-B	Connector, Straight Thread #24 SAE x #24 JIC	2
14	HC-1397-05	Diffuser	1
15	N-2210-25-S	Reducer, Pipe Thread	1
16	N-2030-15-S	Fitting, Swivel Nut	1
17	N-2081-10-S	Fitting, 45° Swivel Nut	2
18	HC-2049-24-S-B	Elbow, 90° Swivel, #24	2
19	HC-2042-01	Valve, Selector, #24 SAE	1
20	HC-1382-18	Gauge, Sight, 18"	1
21	N-2206-09-SS	Plug, Hex Head	1
22	HC-1763	Filter, Desiccant	1
23	N-2008-10-S	Cap, #10	2

9.0 Maintenance continued on following page.

9.0 MAINTENANCE *(continued)*

9.9 RETURN MANIFOLD ASSEMBLY

The Return Manifold does not require regular general maintenance.

NOTE: DO NOT attempt to adjust the Return System Pressure Relief Valve. See Section 9.9.1 – Return System Pressure Relief Valve for details.

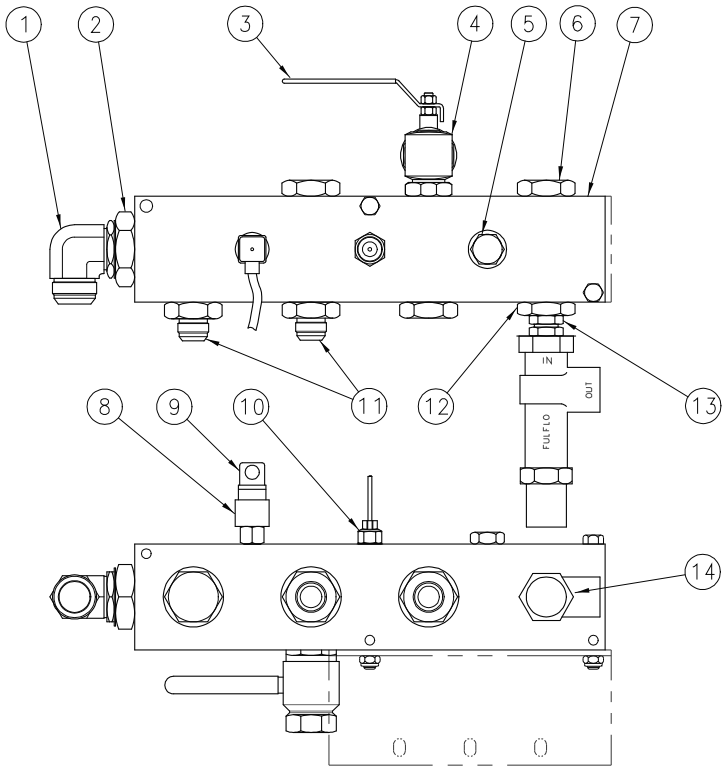


***FIGURE 9.9* – Return Manifold Assembly**

PARTS LIST

Fluid Type: MIL-PRF-83282

Item	Part Number	Description	Qty
1	N-2001-31-S-B	Elbow, Straight Thread, #24 SAE x #24 JIC	1
2	N-2463-28-S-B	Fitting, Reducer/Expander, 24/32 SAE	1
3	HC-2058-02	Valve, Ball	1
4	N-2666-08-S-B	Elbow, Straight Thread, #24 SAE	1
5	N-2053-08-S-B	Plug, Hex Head, #12 O-ring	1
6	N-2053-12-S-B	Plug, Hex Head, #24 O-ring	3
7	HC-2043	Manifold, Return	1
8	EC-1782-01	Switch, Temperature	1
9	EC-1778	Cable, DIN Connector	1
10	HC-2268-01	Gauge, Pyrometer	*Ref.*
11	N-2007-34-S-B	Connector, Straight Thread, #24 SAE x #16 JIC	2
12	N-2463-24-S-B	Fitting, Reducer/Expander, 16/24	1
13	N-2464-10-S-B	Union, Straight Thread #16 SAE	1
14	HC-2201	Valve, Pressure Relief (*Pre-set*)	1

9.9 RETURN MANIFOLD ASSEMBLY *(continued)*

9.9.1 Return System Pressure Relief Valve

The Return System Pressure Relief Valve can be purchased as a preset assembly. If the relief valve is serviced by the end user, the valve must be set to crack at 150+/-7 psig **before** being re-installed on the HPU.

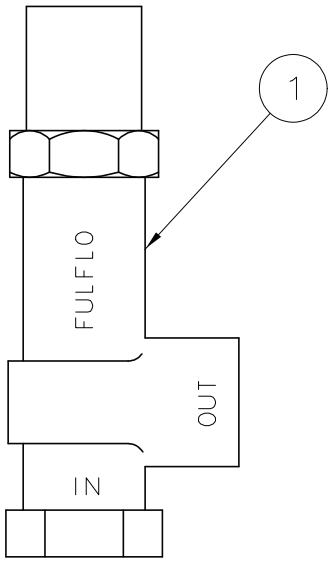


***FIGURE 9.9.1* – Return System Pressure Relief Valve**

PARTS LIST

Fluid Type: MIL-PRF-83282

Item	Part Number	Description	Qty
1	HC-2201	Valve, Pressure Relief (*Pre-set*)	1
Not Shown	♦ HC-2000-220	O-ring, Series 2	1

♦ ***Included with Item 1.***

9.0 Maintenance continued on following page.

9.0 MAINTENANCE *(continued)*

9.10 ELECTRICAL COMPONENTS

Regularly inspect the external power cord for nicks, cuts, abrasion, and fluid damage. Replace power cord if damage is found. See Section 10.0 Provision of Spares for recommended spare fuses.

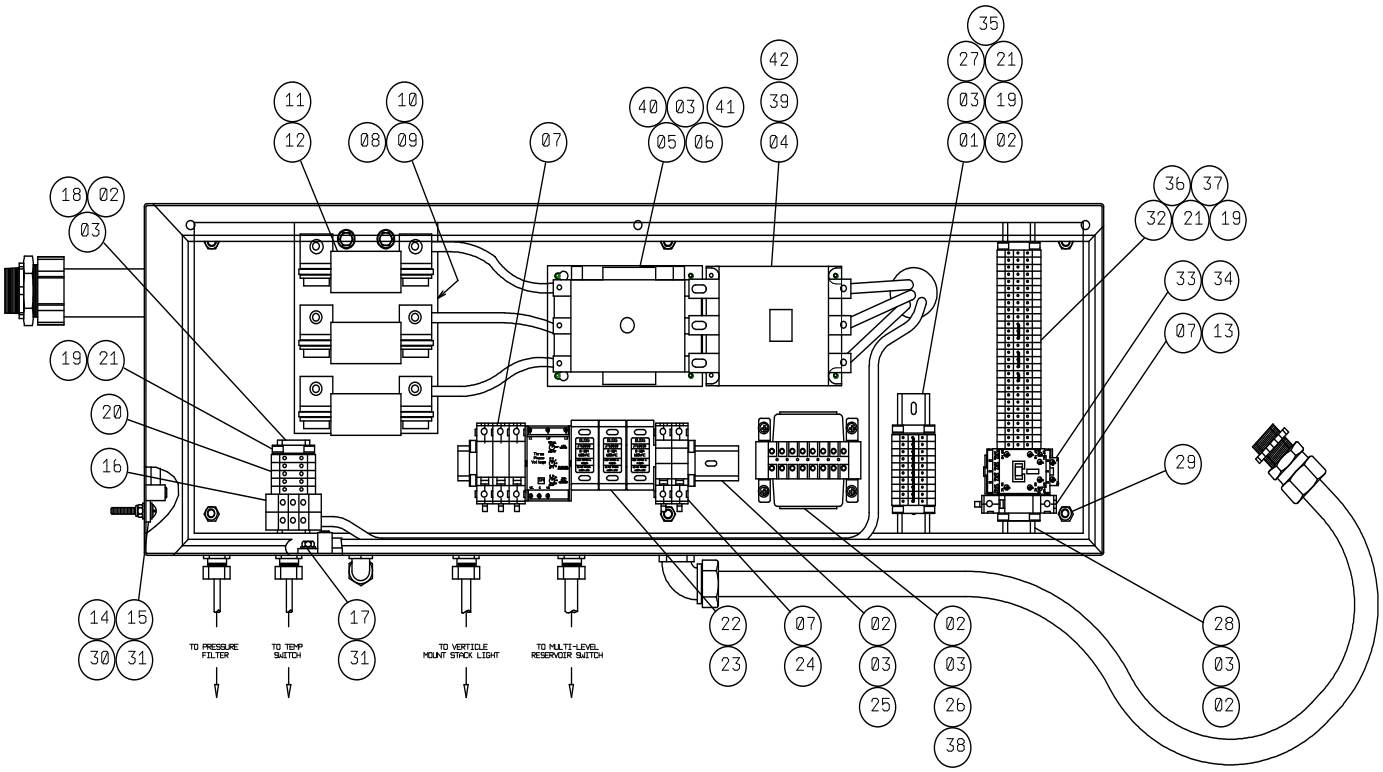


***FIGURE 9.10* – Electrical Components**

Set Item 04 to Automatic Reset position. Wire per Electrical Schematic INS-1608. Reference Wire Diagram INS-1597.

PARTS LIST

Item	Part Number	Description	Qty
1	EC-1598	Rail, Din	1
2	G-1159-103504	Screw, RD HD CRS REC, #10-32 x ½ Long	12
3	G-1250-1030N	Flatwasher, #10 Narrow	16
7	EC-1541-01	Fuse Holder, IEC Class CC	3
8	EC-1563	Fuse Block, Class J	1
9	G-1100-106506	Bolt, HH GR 5, 5/16-24 x ¾ Long	4
10	G-1250-1060N	Flatwasher, 5/16 Narrow	4
13	EC-1542-09	Fuse, LP-CC-Low Peak 1-6/10A	1
14	EC-1432-04	Lug, Ground	1
15	G-1159-105516	Screw, RND HD CRS REC, ¼ - 28 x 1 ¾ Long	1
16	EC-1957	Block, IEC Ground	2
17	EC-1532-02	Lug, Ground	1
18	EC-1600	Rail, Din	1
19	EC-1959	Anchor, IEC End	7
20	EC-1958	Block, IEC Ground	5
21	EC-1960-01	Barrier, End	3
22	EC-1596-01	Fuse Holder, Class J	3
25	EC-1599	Rail, Din	1
27	EC-1956-03	Block, IEC Terminal (Blue)	10
28	EC-1597	Rail, Din	1
29	G-1202-1070	Stopnut, Elastic 3/8 – 16	6
30	G-1202-1055	Stopnut, Elastic ¼ - 28	1
31	G-1250-1050N	Flatwasher, ¼ Narrow	4
32	EC-1956-02	Block, IEC Terminal (Red)	28
33	EC-1591-04	Latch, Mechanical	1
34	EC-1564	Relay, Control	1

9.10 ELECTRICAL COMPONENTS *(continued)*

PARTS LIST

Item	Part Number	Description	Qty
35	EC-1961-04	Jumper, Center	1
36	EC-1961-02	Jumper, Center	2
37	EC-1961-01	Jumper, Center	1
38	EC-1826	Guard, Finger Touchproof	1
40	G-1159-103510	Screw, RD HD CRS REC, #10-32 x 1 ¾ LG	6
42	EC-1965	Shield, Current Adjustment	1

PARTS LIST

Item	60 Hz Applications					Description	Qty
	208	230	380	460	575		
4	EC-1920	EC-1920	EC-1920	EC-1525	EC-1525	Relay, Overload	1
5	EC-1922	EC-1922	EC-1922	EC-1842	EC-1842	Contactor, IEC Motor	1
6	EC-1924-01	EC-1924-01	EC-1924-01	N/A	N/A	Lug Set, Terminal	2
11	J-3492	J-3492	EC-1585-06	EC-1585-06	EC-1585-12	Cover, Sami Fuse	3
12	EC-1556-07	EC-1556-07	EC-1556-01	EC-1556-01	EC-1556-30	Fuse, Class J	3
23	EC-1557-03	EC-1557-03	EC-1557-01	EC-1557-01	EC-1557-01	Fuse, Class J	3
24	EC-1726-15	EC-1726-14	EC-1726-08	EC-1726-07	EC-1726-07	Fuse, Class CC	2
26	EC-1804-03	EC-1147	EC-1804-03	EC-1147	EC-1804-03	Transformer, Control (150 W)	1
39	EC-1924-02	EC-1924-02	EC-1924-02	N/A	N/A	Lug Set, Terminal	1
41	N/A	N/A	N/A	EC-1607	EC-1607	Block, Auxiliary Contact	1

Item	50 Hz Applications					Description	Qty
	200	220	380	415	440		
4	EC-1920	EC-1920	EC-1525	EC-1525	EC-1525	Relay, Overload	1
5	EC-1922	EC-1922	EC-1842	EC-1842	EC-1842	Contactor, IEC Motor	1
6	EC-1924-01	EC-1924-01	N/A	N/A	N/A	Lug Set, Terminal	2
11	J-3492	J-3492	EC-1585-06	EC-1585-06	EC-1585-06	Cover, Sami Fuse	3
12	EC-1556-07	EC-1556-06	EC-1556-01	EC-1556-01	EC-1556-01	Fuse, Class J	3
23	EC-1557-03	EC-1557-03	EC-1557-01	EC-1557-01	EC-1557-01	Fuse, Class J	3
24	EC-1726-16	EC-1726-15	EC-1726-08	EC-1726-08	EC-1726-08	Fuse, Class CC	2
26	EC-1804-03	EC-1147	EC-1804-03	EC-1147	EC-1804-03	Transformer, Control (150 W)	1
39	EC-1924-02	EC-1924-02	N/A	N/A	N/A	Lug Set, Terminal	1
41	N/A	N/A	EC-1607	EC-1607	EC-1607	Block, Auxiliary Contact	1

9.10 Electrical components continued on following page.

9.10 ELECTRICAL COMPONENTS *(continued)*

9.10.1 Electrical Components With 100 ft. Input Cord Option

Regularly inspect the external power cord for nicks, cuts, abrasion, and fluid damage. Replace power cord if damage is found. See Section 10.0 Provision of Spares for recommended spare fuses.

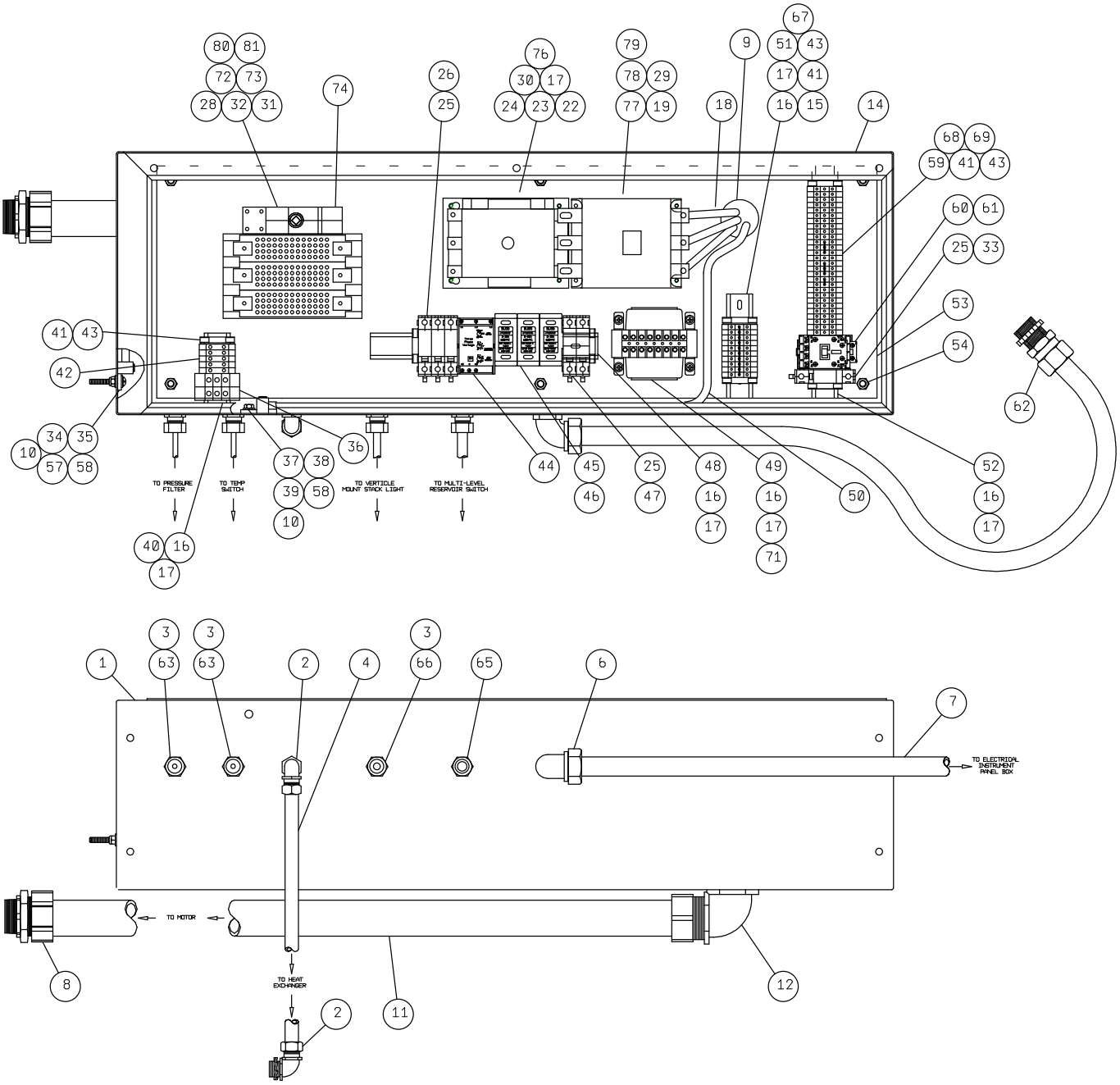


***FIGURE 9.10.1* – Electrical Components**

Set Item 04 to Automatic Reset position. Wire per Electrical Schematic INS-1608. Reference Wire Diagram INS-1597.

9.10.1 Electrical Components With 100 ft. Input Cord Option *(continued)*

PARTS LIST

Item	Part Number	Description	Qty
1	EC-1512-01	Enclosure, Electrical	1
2	EC-1168-01	Elbow, 90º Conduit ⅜”	2
3	EC-1176-02	Locknut, Conduit	3
4	EC-1187-03*60.0	Conduit, Flexible Wiring ⅜”	1
5	H-2432-06	Plug, Sheetmetal Ø⅞	1
6	EC-1168-04	Elbow, 90º Conduit 1”	1
7	EC-1187-06*60.0	Conduit, Flexible Wiring 1”	1
9	H-1901-29	Grommet	1
10	V-1665	Label, Ground	2
11	EC-1187-08*48.0	Conduit, Flexible Wiring	1
15	EC-1598	Rail, Din	1
16	G-1159-103504	Screw, RD HD CRS REC, #10-32 x ½ Long	12
17	G-1250-1030N	Flatwasher, #10 Narrow	16
25	EC-1541-01	Fuse Holder, IEC Class CC	3
30	G-1159-103510	Screw, RD HD CRS REC, #10-32 x 1 ¾ Long	6
33	EC-1542-09	Fuse, LP-CC-Low Peak 1-6/10A	1
34	EC-1432-04	Lug, Ground	1
35	G-1159-105516	Screw, RND HD CRS REC, ¼ - 28 x 1 ¾ Long	1
36	EC-1957	Block, IEC Ground	2
37	EC-1532-02	Lug, Ground	1
40	EC-1600	Rail, Din	1
41	EC-1959	Anchor, IEC End	7
42	EC-1958	Block, IEC Ground	5
43	EC-1960-01	Barrier, End	3
45	EC-1596-01	Fuse Holder, Class J	3
48	EC-1599	Rail, Din	1
49	EC-1804-03	Transformer, Control (150 W)	1
51	EC-1956-03	Block, IEC Terminal (Blue)	10
52	EC-1597	Rail, Din	1
53	S-2027	Panel, Inner	1
54	G-1202-1070	Stopnut, Elastic 3/8 – 16	6
57	G-1202-1055	Stopnut, Elastic ¼ - 28	1
58	G-1250-1050N	Flatwasher, ¼ Narrow	8
59	EC-1956-02	Block, IEC Terminal (Red)	28
60	EC-1591-04	Latch, Mechanical	1
61	EC-1564	Relay, Control	1
62	EC-1167-04	Connector, Conduit 1”	1
63	EC-1175-05-A	Connector, Power Cable	1
64	V-1978	Label, Electrical	1
66	EC-1175-06-A	Connector, Power Cable	1
67	EC-1961-04	Jumper, Center	1
68	EC-1961-03	Jumper, Center	2
69	EC-1961-01	Jumper, Center	1
71	EC-1826	Guard, Finger Touchproof	1
Not Shown	EC-1666	Harness, Wiring	1

9.10.1 Electrical components with 100 ft input cord option continued on following page.

9.10.1 Electrical Components With 100 ft. Input Cord Option *(continued)*

PARTS LIST

Item	60 Hz Applications					Description	Qty
	208	230	380	460	575		
8	EC-1167-07	EC-1167-06	EC-1167-06	EC-1167-06	EC-1167-06	Connector, Conduit	1
12	EC-1168-07	EC-1168-06	EC-1168-06	EC-1168-06	EC-1168-06	Elbow, 90º Conduit	1
18	EC-1284-10*72.0	EC-1263-08*72.0	EC-1263-05*72.0	EC-1263-05*72.0	EC-1263-05*72.0	Wire, Power (2 AWG)	3
19	EC-1920	EC-1920	EC-1920	EC-1525	EC-1525	Relay, Overload	1
22	EC-1922	EC-1922	EC-1922	EC-1587	EC-1587	Contactor, IEC Motor	1
27	EC-1284-10*12.0	EC-1263-08*12.0	EC-1263-05*12.0	EC-1263-05*12.0	EC-1263-05*12.0	Wire, Power (2 AWG)	3
28	EC-2670	EC-2670	EC-2653	EC-2653	EC-2669	Disconnect, Fused	1
29	EC-1924-02	EC-1924-02	EC-1924-02	N/A	N/A	Lug Set, Terminal Output & Input	2
31	EC-1911 Qty 3	EC-1911 Qty 3	N/A	N/A	EC-1909 Qty 1	Cover, Fuse	See Part
32	EC-1556-07	EC-1556-07	EC-1556-02	EC-1556-01	EC-1557-31	Fuse, Class J	3
39	EC-1284-10*12.0	EC-1572-08*12.0	EC-1572-05*12.0	EC-1572-05*12.0	EC-1572-05*12.0	Wire, Chassis Ground (2 AWG)	1
46	EC-1557-03	EC-1557-03	EC-1557-01	EC-1557-01	EC-1557-01	Fuse, Class J (Heat Exchanger)	3
47	EC-1726-15	EC-1726-14	EC-1726-08	EC-1726-07	EC-1726-07	Fuse, Class CC (Primary)	2
50	EC-1284-10*94.0	EC-1572-08*94.0	EC-1572-05*94.0	EC-1572-05*94.0	EC-1572-05*94.0	Wire, Ground (2 AWG)	1
72	EC-2655	EC-2655	EC-2655	EC-2655	N/A	Shaft, Operating	1
73	EC-2654	EC-2654	EC-2654	EC-2654	N/A	Handle, Operating	1
74	G-1100-105510	G-1100-105510	G-1100-105510	G-1100-105510	G-1497-102006	Hardware	4
76	N/A	N/A	N/A	EC-1607	EC-1607	Block, Auxiliary Contact	1
77	N/A	N/A	N/A	EC-1965	EC-1965	Shield, Current Adjustment	1
78	N/A	N/A	N/A	EC-1606	EC-1606	Shield, Contact	1
79	EC-1964-01	EC-1964-01	EC-1964-01	N/A	N/A	Cover, Terminal	3
80	EC-1724	EC-1724	N/A	N/A	N/A	Lug, Terminal	2
81	EC-2143	EC-2143	N/A	N/A	N/A	Shield, Terminal	1

9.10.1 Electrical Components With 100 ft. Input Cord Option *(continued)*

PARTS LIST

Item	50 Hz Applications					Description	Qty
	200	220	380	415	440		
8	EC-1167-07	EC-1167-06	EC-1167-06	EC-1167-06	EC-1167-06	Connector, Conduit	1
12	EC-1168-07	EC-1168-06	EC-1168-06	EC-1168-06	EC-1168-06	Elbow, 90º Conduit	1
18	EC-1284-10*72.0	EC-1263-08*72.0	EC-1263-05*72.0	EC-1263-05*72.0	EC-1263-05*72.0	Wire, Power (2 AWG)	3
19	EC-1920	EC-1920	EC-1525	EC-1525	EC-1525	Relay, Overload	1
22	EC-1922	EC-1922	EC-1587	EC-1587	EC-1587	Contactor, IEC Motor	1
27	EC-1284-10*12.0	EC-1263-08*12.0	EC-1263-05*12.0	EC-1263-05*12.0	EC-1263-05*12.0	Wire, Power (2 AWG)	3
28	EC-2670	EC-2670	EC-2653	EC-2653	EC-2669	Disconnect, Fused	1
29	EC-1924-02	EC-1924-02	N/A	N/A	N/A	Lug Set, Terminal Output & Input	2
31	EC-1911	EC-1911	N/A	N/A	N/A	Cover, Fuse	3
32	EC-1556-08	EC-1556-07	EC-1556-02	EC-1556-02	EC-1557-02	Fuse, Class J	3
39	EC-1284-10*12.0	EC-1572-08*12.0	EC-1572-05*12.0	EC-1572-05*12.0	EC-1572-05*12.0	Wire, Chassis Ground (2 AWG)	1
46	EC-1557-03	EC-1557-03	EC-1557-01	EC-1557-01	EC-1557-01	Fuse, Class J (Heat Exchanger)	3
47	EC-1726-16	EC-1726-15	EC-1726-08	EC-1726-08	EC-1726-08	Fuse, Class CC (Primary)	2
50	EC-1284-10*94.0	EC-1572-08*94.0	EC-1572-05*94.0	EC-1572-05*94.0	EC-1572-05*94.0	Wire, Ground (2 AWG)	1
72	EC-2655	EC-2655	EC-2655	EC-2655	EC-2655	Shaft, Operating	1
73	EC-2654	EC-2654	EC-2654	EC-2654	EC-2654	Handle, Operating	1
74	G-1100-105510	G-1100-105510	G-1100-105510	G-1100-105510	G-1100-105510	Hardware	4
76	N/A	N/A	EC-1607	EC-1607	EC-1607	Block, Auxiliary Contact	1
77	N/A	N/A	EC-1965	EC-1965	EC-1965	Shield, Current Adjustment	1
78	N/A	N/A	EC-1606	EC-1606	EC-1606	Shield, Contact	1
79	EC-1964-01	EC-1964-01	N/A	N/A	N/A	Cover, Terminal	3
80	EC-1724	EC-1724	N/A	N/A	N/A	Lug, Terminal	2
81	EC-2143	EC-2143	N/A	N/A	N/A	Shield, Terminal	1

9.0 Maintenance continued on following page.

9.0 MAINTENANCE *(continued)*

9.11 HEAT EXCHANGER ASSEMBLY

The Heat Exchanger Assembly does not require regular general maintenance.

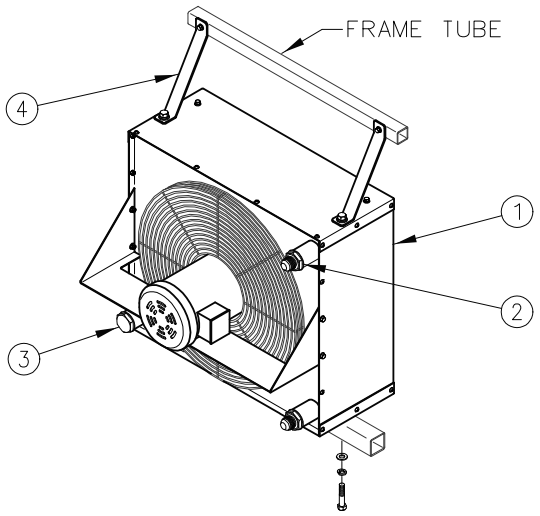


***FIGURE 9.11* – Heat Exchanger Assembly**

PARTS LIST

Fluid Type: MIL-PRF-83282

Item	Part Number	Description	Qty
1	*Reference Table below*	Heat Exchanger	1
2	N-2007-27-S-B	Connector, #20 SAE x #16 JIC	1
3	N-2066-20-S-B	Plug, O-ring #20	1
4	J-3404-01	Strap	2

Voltage	Frequency	Part Number
208v	60 Hz	HC-2137-01
230v	60 Hz	HC-2137-01
380v	60 Hz	HC-2137-01
460v	60 Hz	HC-2137-01
575v	60 Hz	HC-2137-02
200v	50 Hz	HC-2137-01
220v	50 Hz	HC-2137-01
380v	50 Hz	HC-2137-01
415v	50 Hz	HC-2137-01
440v	50 Hz	HC-2137-01

9.0 MAINTENANCE *(continued)*

9.12 EXTERNAL COMPONENTS

Keep HPU clean. Do not allow labels to become damaged; thusly illegible. Regularly inspect casters and floor locks to ensure safe working condition.

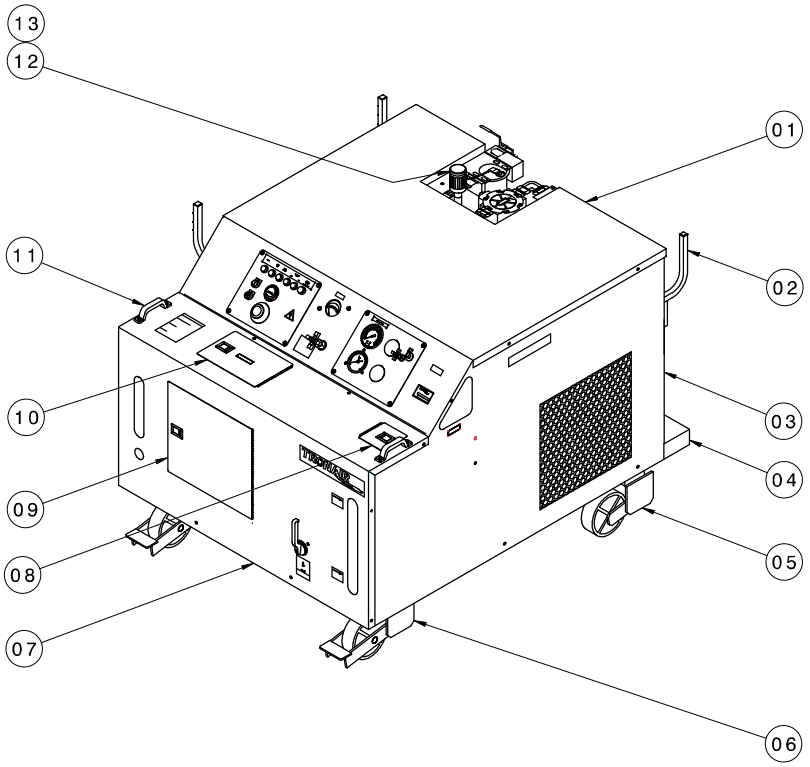


***FIGURE 9.12* – External Components**

PARTS LIST

Item	Part Number	Description	Qty
1	S-1763-01	Top Panel	1
2	Z-5549-01	Hanger	3
3	Z-5362-01	Right Side Panel	1
4	S-1782-01	Panel, End	1
5	U-1099	Rigid Caster	2
6	U-1100	Swivel Caster	2
7	Z-5408-01	Front Panel	1
8	Z-4781	Filler Door	1
9	Z-5576	Front Access Door	1
10	Z-4783	Pump Access Door	1
11	H-1780	Handle	2
12	EC-1794	Box, Vertical Mount Junction	1
13	EC-1791	Light, Pole Mounted Stack	1
Not Shown	Z-5367-01	Left Side Panel	1
Not Shown	Z-5165-01	Frame	1
Not Shown	S-1703-01	Electrical Box Cover	1

9.0 Maintenance continued on following page.

9.0 MAINTENANCE *(continued)*

9.13 ADDITIONAL FEATURES

9.13.1 50 ft (15.2 m) Hoses *(Option B)*

Refer to Section ***9.6 Hydraulic Hoses*** concerning hose inspection.

PARTS LIST

Fluid Type: MIL-PRF-83282

Part Number	Description	Qty
TF-1038-28*300	Pressure Hose, 50 ft/15 m	1 per Option
TF-1039-12*300	Return Hose, 50 ft/15 m	1 per Option
N-2011-10-S	Union, #16	1 per Option
N-2011-12-S	Union, #24	1 per Option

9.13 ADDITIONAL FEATURES *(continued)*

9.13.2 Dual System *(Option C)*

Refer to Section ***9.6 Hydraulic Hoses*** concerning hose inspection.

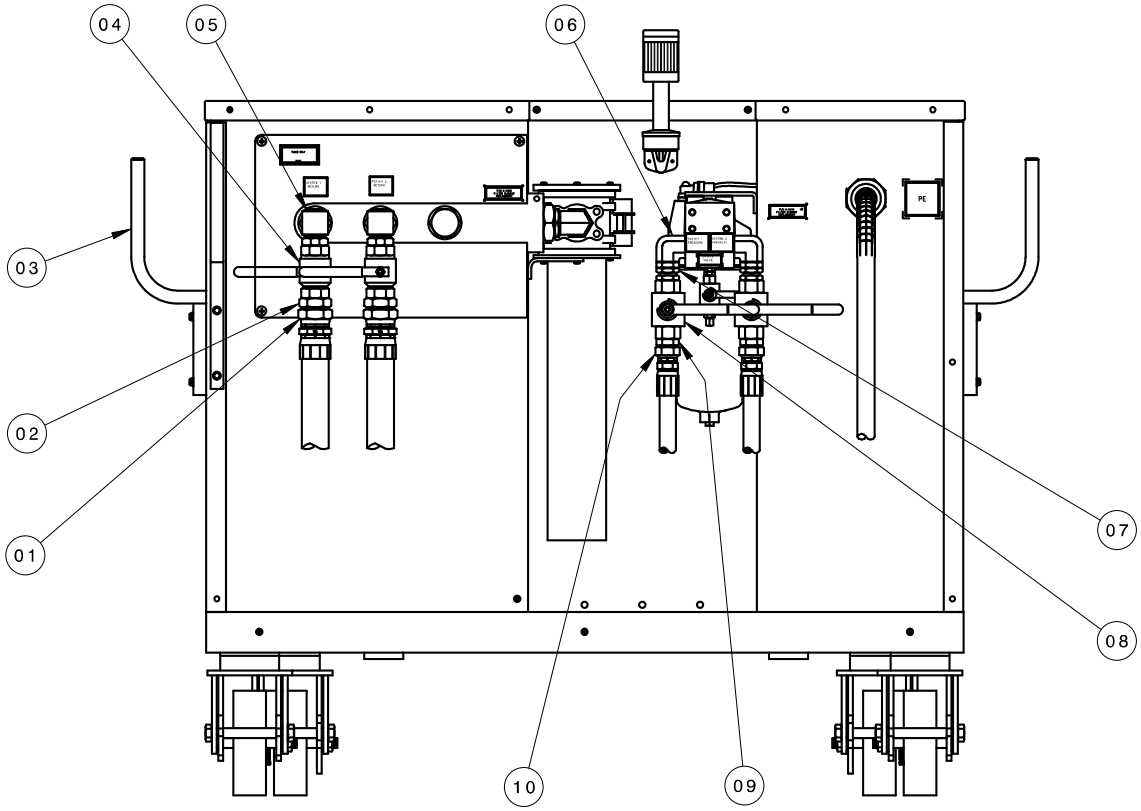


FIGURE 9.13.2 **– Dual System**

PARTS LIST

Fluid Type: MIL-PRF-83282

Item	Part Number	Description	Qty
1	TF-1039-12*300	Assembly, Hose #24	1
2	N-2007-31-S-B	Connector, Straight Thread	1
3	Z-5549-01	Weldment, Hose Hanger	2
4	HC-2058-02	Valve, Ball	1
5	N-2666-08-S-B	Elbow, Straight Thread #24	1
6	N-2661-06-S-B	Elbow, Straight Thread	1
7	N-2464-10-S-B	Union, #16 Straight Thread	1
8	HC-1768-05	Valve, Ball	1
9	N-2007-24-S-B	Connector, Straight Thread	1
10	TF-1038-28*300	Assembly, Hose #16	1

9.13 Additional Features continued on following page.

9.13 ADDITIONAL FEATURES (continued)

9.13.3 Voltage/Phase Monitor *(Options G – J)*

The Voltage/Phase Monitor does not require regular general maintenance. The panel indicator light will illuminate if a tripped condition exists. If the Voltage/Phase Monitor is causing the HPU to shut off, verify the ♦Phase Monitor settings shown. Continued tripping may indicate a serious electrical problem. See Section ***10.0 – Provision of Spares*** for recommended spare fuses.

NOTE: Wire per Electrical Schematic INS-1608. Reference Wiring Diagram INS-1597. Section 9.7.1 Electrical Panel for Panel Light.

PARTS LIST

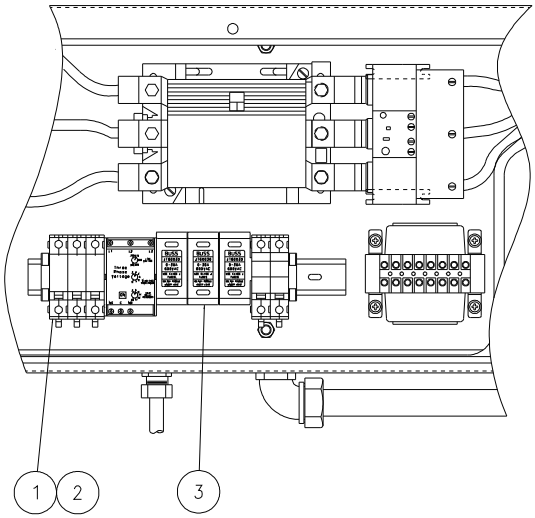


***FIGURE 9.13.3* – Voltage/Phase Monitor**

Item	Part Number	Description	Qty
1	EC-1541-01	Fuse Holder, IEC Class CC	3
2	EC-1675-12	Fuse, KTK-R, 2 amp	3
♦ 3	*See Table below*	Phase Monitor	1

Phase Monitor

Option	Voltage	Frequency	Part Number
G	200 – 230	50/60 Hz	EC-1543-02
H	380	50/60 Hz	EC-1543-03
I	415 – 460	50/60 Hz	EC-1543-04
J	575	60 Hz	EC-1543-05

♦ Setting Instructions for Item 3:

1. Set ***Line Voltage*** to match the voltage rating of the Hydraulic Power Unit.
2. Set ***% Voltage Unbalanced*** to 5% for 60 Hz unit or 6% for 50 Hz unit.
3. Set ***Trip Delay*** to three (3) seconds.

9.13 ADDITIONAL FEATURES *(continued)*

9.13.4 Electric Reservoir Level *(Option L)*

The Electric Reservoir Level switch does not require regular general maintenance. Panel indicator lights will indicate low or high fluid level.

NOTE: Wire per Electrical Schematic INS-1608. Reference Wiring Diagram INS-1597. Reference 9.7.1 Electrical Panel for Panel Light

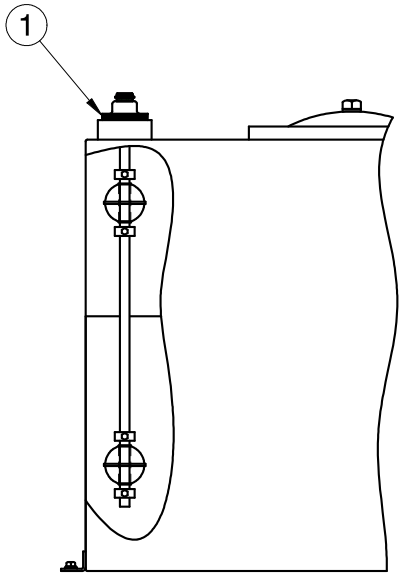


***FIGURE 9.13.4* – Electric Reservoir Level**

PARTS LIST

Item	Part Number	Description	Qty
1	EC-1783	Multi-Level Switch *(includes Plug-in Cable)*	1

9.13 Additional Features continued on following page.

9.13 ADDITIONAL FEATURES *(continued)*

9.13.5 Hand Pump *(Option M)*

Refer to Section ***9.6 Hydraulic Hoses*** concerning hose inspection for general maintenance on Items 4, 5, 7 and 13 hose assemblies. Refer to Section ***9.5.3 – Hand Pump (Optional) Filter*** .

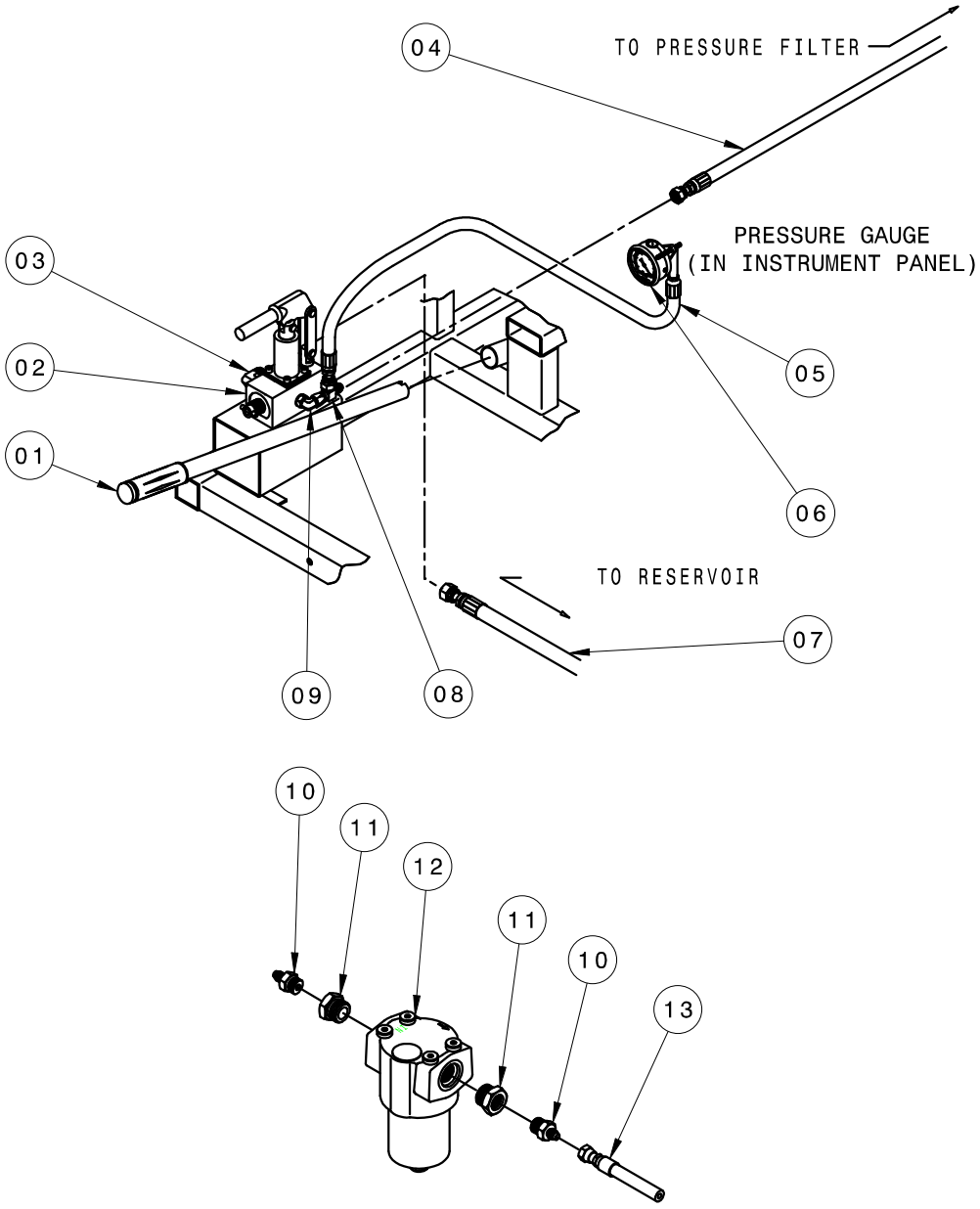


FIGURE 9.13.5 **– Hand Pump**

9.13.5 Hand Pump (Option M) (continued)

PARTS LIST

Fluid Type: MIL-PRF-83282

Item	Part Number	Description	Qty
1	H-1009-01	Pump Handle	1
2	HC-1778	Hand Pump, Two Stage	1
3	N-2001-11-S-B	Elbow, #8 SAE x #8 JIC Flare	1
4	TF-1038-15*56.5	Hose Assembly, #4	1
5	TF-1038-15*56.5	Hose Assembly, #4	1
6	HC-2146	Pressure Gauge	1
7	TF-1037-21*38.0	Hose Assembly, #8	1
8	N-2016-05-S	Tee, Swivel Nut, #6	1
9	N-2001-08-S-B	Elbow, #6 SAE x #6 JIC Flare	1
10	N-2007-06-S-B	Fitting, Male Connector	1
11	N-2463-10-S-B	Reducer Fitting	2
12	HC-1776	Pressure Filter	1
13	TF-1038-14*180	Hose Assembly, #4	1

9.13.5 Hand pump continued on following page

9.13.5 Hand Pump (Option M) (continued)

9.13.5.a Two Stage Pump with Relief

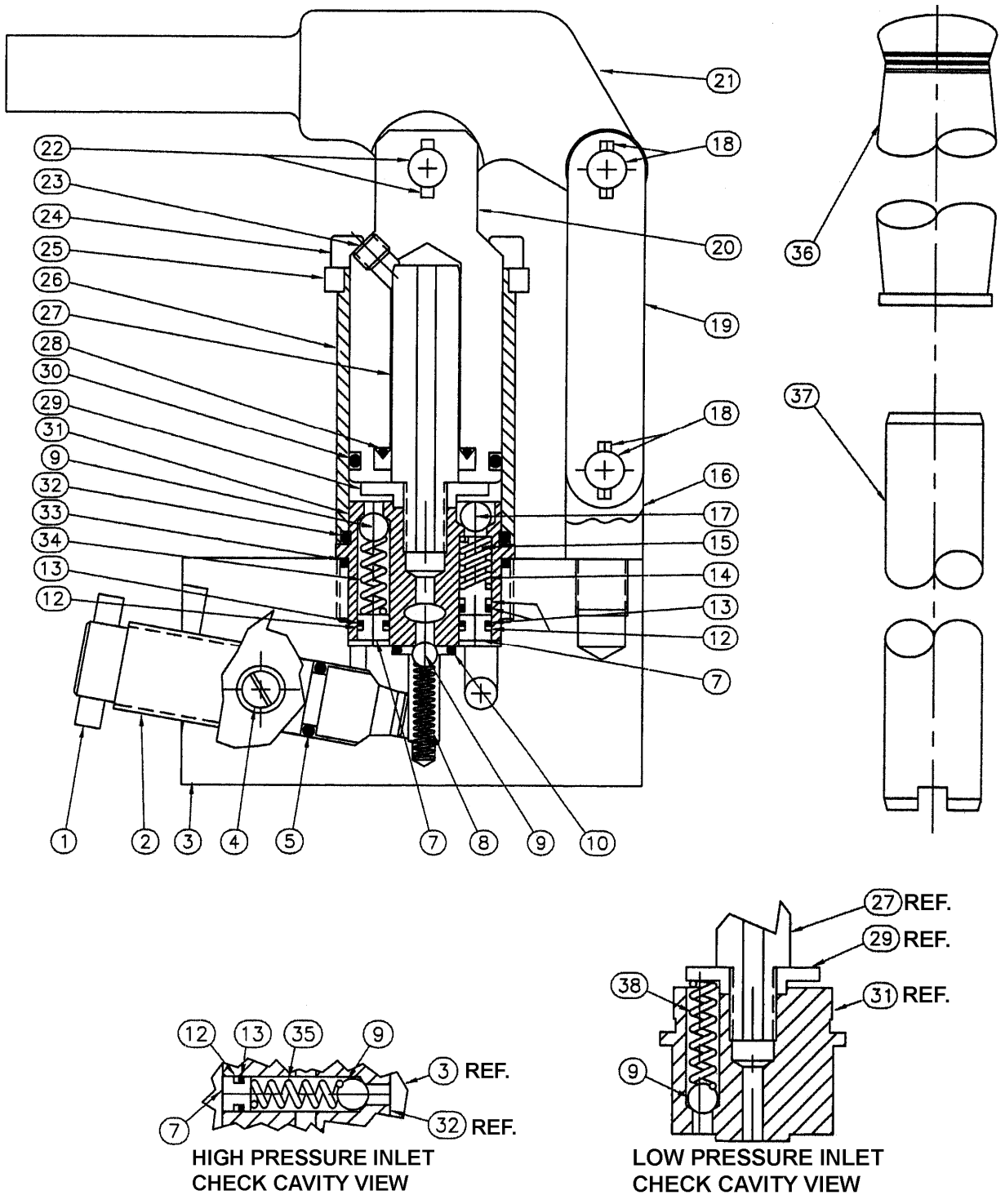


FIGURE 9.13.9.a **– Two Stage Pump with Relief**

9.13.5.a Two Stage Pump with Relief *(continued)*

PARTS LIST

Fluid Type: MIL-PRF-83282

Item	Part Number	Description	Qty
1	519-000	Pin	1
3	CXC-990022-001	Body	1
7	505-001	Plug, Valve Body	3
15	571-121	Piston, Bypass Assembly	1
16	508-000	Pivot	1
20	566-125	Piston L.P	1
23	583-120	Plug	1
24	09-ADDF-04-20 X 56	Tie Rod	4
25	582-125	Flange	1
26	563-121	Tube	1
27	562-125	H.P. Piston	1
29	564-120	Retainer	1
31	560-120	Valve Body	1
36	H-1223	Grip, Handle	1
37	H-1009-01	Handle with Grip	1
	HK-1095	**Kit, Internal Parts**; *consists of*:	
6	*(Not Shown)*	Ball, Release	0
8		Spring, Outlet Check	1
9		Ball, Check	4
14		Spring, Bypass	1
17		Ball, Bypass	1
34		Spring, L.P. Outlet	1
35		Spring, H.P. Outlet	1
38		Spring, Intake L.P.	1
	HK-1029	**Kit, Pump Seal**; *consists of:* 1	
5		O-ring, BUNA	1
10		O-ring, BUNA	1
12		Backup Ring (Teflon)	4
13		O-ring, BUNA	4
28		H.P. Piston Seal	1
30		O-ring, BUNA	1
32		O-ring, BUNA	1
33		O-ring, BUNA	1
	HK-1068	**Kit, Pump Linkage**; *consists of:* 1	
18		Pin Linkage Assembly	2
19		Strap	2
21		Handle Bracket	1
22		Clevis Pin Assembly	1
	HK-3118	**Kit, Release Screw**; *consists of:* 1	
2		Screw, Release/Relief	1
4		Retainer, Release Screw	1

9.13 Additional Features continued on following page.

9.13 ADDITIONAL FEATURES *(continued)*

9.13.6 Towing Trailer (*Option N*)

Capacity ..... 4,000 lbs (1,814 kg)
Front Axle Capacity ..... 2,000 lbs (907 kg)
Rear Axle Capacity ..... 2,000 lbs (907 kg)
Tires ..... 4.80-8NHS x 6 Ply
Rated at 970 lbs (440 kg)
(105 psi at 10 mph/7.24 bar at 16 kph)

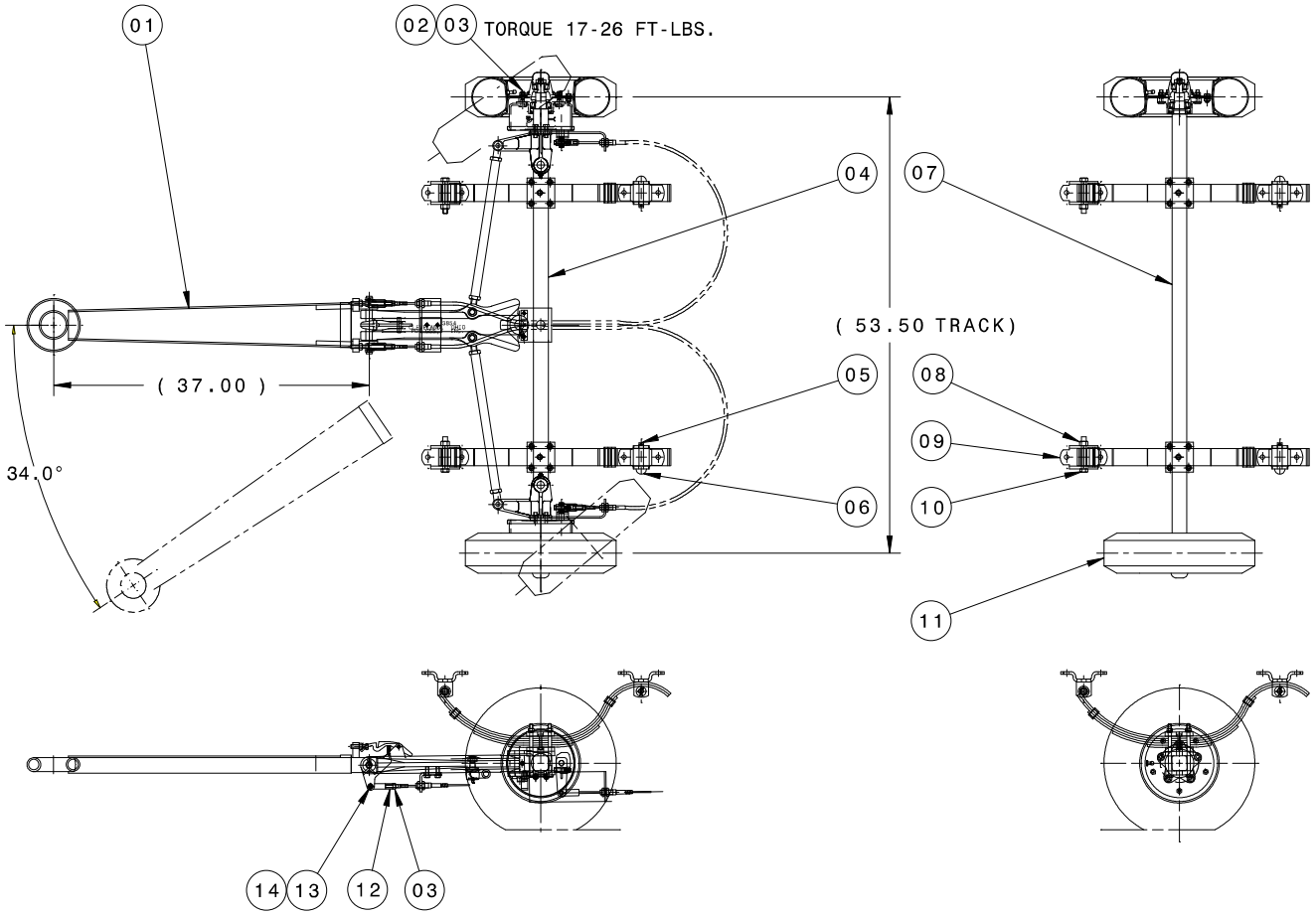


FIGURE 9.13.6 – Towing Trailer

PARTS LIST

Item	Part Number	Description	Qty
1	59-3502	Assembly, Drawbar	1
2	4700-4	Lockwasher (3/8)	20
3	4601-47	Nut, Hex Head (3/8-24)	22
4	6-1395	Assembly, Front Axle	1
5	4800-3	Pin, Cotter	4
6	5403-1	Rivet	4
7	8-1345	Assembly, Rear Axle	1
8	4601-33	Nut, Self-Locking (9/16-12)	4
9	4251	Bracket, Spring	8
10	4901-19	Bolt (9/16-12 x 3¾")	4
11	5-3705	Wheel and Tire Assembly	4
12	5205	Yoke	2
13	5206	Pin, Yoke	2
14	4800-2	Pin, Cotter (3/32 x ¾")	2

9.0 MAINTENANCE *(continued)*

9.14 REPLACEMENT LABELS PARTS LISTS

9.14.1 Base Unit

Part Number	Description	Qty
V-1001	"Made in USA"	1
V-1033-01	"TRONAIR"	1
V-1050	ISO Electrical Shock Symbol	2
V-1365	"SYSTEM PRESSURE"	1
V-1366	"HPU BY-PASS VALVE"	1
V-1374	"ROTATION"	1
V-1470	"CAUTION . . ."	1
V-1882	Control Panel Lights	1
V-1883	"HOUR METER	1
V-1884	"FLOWMETER"	1
V-1886	"PYROMETER"	1
V-1888	"SHUT-OFF/CALIBRATION PORT"	1
V-1893	"SAMPLE VALVE"	1
V-1894	"PRESSURE"	1
V-1895	"RETURN"	1
V-1896	"MAXIMUM OIL LEVEL"	1
V-1897	"MINIMUM OIL LEVEL"	1
V-1898	"PRESSURE and FLOW CONTROLS INSIDE"	1
V-1900	"WARNING KEEP 5 FT CLEAR . . ."	2
V-1914	Reservoir Selector Valve	1
V-1918	"PE"	1
V-1919	"OPERATING INSTRUCTIONS . . ."	1
V-2008	"FLOW INCREASE"	1
V-2009	"PRESSURE INCREASE"	1

9.14.2 Fluid Labels

Fluid Type: MIL-PRF-83282

Part Number	Description	Qty
V-1976	"MIL-PRF-83282"	2

9.14.3 Filter Element Kit Labels

Fluid Type: MIL-PRF-83282

Part Number	Description	Qty
V-1959	"REPLACEMENT FILTER ELEMENT K-3613"	1
V-1961	"REPLACEMENT FILTER ELEMENT K-3615"	1
V-1916	"REPLACEMENT DESICCANT FILTER ELEMENT HC-1763"	1

9.14.4 Dual System *(Option C)*

Part Number	Description	Qty
V-2004	"SYSTEM 1 PRESSURE"	1
V-2005	"SYSTEM 2 PRESSURE"	1
V-2006	"SYSTEM 1 RETURN"	1
V-2007	"SYSTEM 2 RETURN"	1

9.14.5 Hand Pump *(Option M)* Labels

Part Number	Description	Qty
V-1887	"HAND PUMP PRESSURE"	1
V-1915	"HAND PUMP"	1
V-1988	"REPLACEMENT FILTER ELEMENT K-3751"	1

10.0 PROVISION OF SPARES

10.1 SOURCE OF SPARE PARTS

TRONAIR, Inc.
1740 Eber Road
Holland, Ohio 43528-9794 USA

Telephone: (419) 866-6301 or 800-426-6301
Fax: (419) 867-0634
E-mail: sales@tronair.com
Website: www.tronair.com

10.2 RECOMMENDED SPARE PARTS LISTS

It is recommended that the following spare parts be kept on hand and available for immediate use during maintenance.

10.2.1 Spare Electrical Parts

Part Number	Description	Qty
Refer to Section 9.10 Electrical Components Item 20	Fuse, Transformer Primary	2
EC-1542-09	Fuse, Transformer Secondary	1
Refer to Section 9.10 Electrical Components Item 22	Fuse, Heat Exchanger	3
EC-1675-12	Fuse, Phase Monitor *(Optional)*	3
Refer to Section 9.10 Electrical Components Item 2	Fuse, Main Power	3

10.2.2 Spare Parts

Fluid Type: MIL-PRF-83282

Part Number	Description	Qty
HC-1763	Desiccant Filter Element	1
*	Kit, Gaskets and O-rings for Main Pump	1
K-3613	Kit, Pressure Filter Element	1
K-3615	Kit, Return Filter Element	1
*	Kit, Shaft Seal and Retainer for Main Pump	1
K-3751	Kit, Hand Pump Filter Element *(Optional)*	1

* Not available at time of publishing. Call Tronair for Part Number.

11.0 ELECTRICAL POWER REQUIREMENTS

11.1 The electrical power supply for the HPU must include a fused disconnect using Type J or Type R fuses or equivalent magnetic type circuit breakers designed for protecting an electrical motor. This necessary equipment is for protection of the HPU, power cord, and customer-supplied plug and receptacle. *Reference the Table below:*

ELECTRICAL POWER AND PROTECTION REQUIREMENTS

60 Hz Applications					
Voltage	208	230	380	460	575
Full Load Amps	117.2	106	57	53	42
Locked Rotor Amps	642	580	348	290	232
Recommended Fuse Size	150	150	80	70	60
Maximum Fuse Size	175	150	80	80	60

50 Hz Applications					
Voltage	200	220	380	415	440
Full Load Amps	120.5	103	62	60	56
Locked Rotor Amps	642	570	372	360	303
Recommended Fuse Size	150	125	80	80	70
Maximum Fuse Size	175	150	90	90	80

12.0 CALIBRATION OF INSTRUMENTATION

All gauges on the Hydraulic Power Unit can be either returned to Tronair for calibration or certified by the end user if proper calibration equipment is available. Gauges returned to Tronair for calibration will be tested with standards traceable to N.I.S.T. (National Institute of Standards and Technology). Tronair recommends calibration of instrumentation at yearly intervals, but actual calibration dates may be based upon frequency of use and the end users quality system. For information on returning gauges for calibration, Reference ***12.1 – Source of Calibration***.

12.1 SOURCE OF CALIBRATION

TRONAIR, Inc.
1740 Eber Road
Holland, Ohio 43528-9794 USA

Telephone: (419) 866-6301 or 800-426-6301
Fax: (419) 867-0634
E-mail: sales@tronair.com
Website: www.tronair.com

12.2 ANALOG PRESSURE GAUGE – System Pressure

12.2.1 Self Calibration

An accurate pressure calibration gauge is required for calibration of the System Pressure gauge. There are two methods available. Method A can be used if the HPU is equipped with a calibration port *(Option Q)*. Method B must be used if the HPU is **not** equipped with a calibration port. Follow the necessary steps below.

NOTE: Method A can only test the gauge up to the rated operating pressure of the HPU (3,500 psi).

Method A: Shut off HPU and disconnect from aircraft. Close the calibration port **Shut-off Valve** on the instrument panel of the HPU. Attach the "Master" calibration gauge to the **Calibration Port** on the instrument panel.

Set up the HPU as follows:

Reservoir Selector Valve.....Set to HPU Reservoir
Bypass Valve .....Open
Pressure Ball Valves (at rear of unit).....Closed
Return Ball Valves (at rear of unit) .....Closed

Start the HPU. Open the calibration port Shut-off Valve. Close the Bypass valve to build system pressure. Record gauge values at the designated increments.

Open the Bypass valve.

Shut off the HPU and close the calibration port Shut-off Valve before disconnecting the "Master" calibration gauge.

Method B: Shut off the HPU and disconnect it from the power source. Remove the **Hydraulic Panel** from the front instrument panel (four screws). Disconnect the hose from the System Pressure gauge (remove gauge from panel if necessary). Attach calibration test equipment to the gauge and record gauge values at the designated increments.

SYSTEM PRESSURE GAUGE (HC-2144)

Applied Pressure (System Pressure Gauge) (psig)	Minimum Acceptable (psig)	Maximum Acceptable (psig)	Gauge Movement (Direction)	Indicated Pressure (Calibration Gauge) (psig)
1000	910	1090	Increasing	
2000	1910	2090	Increasing	
3000	2910	3090	Increasing	
4000	3910	4090	Increasing	
5000	4910	5090	Increasing	
6000	5910	6090	Increasing	
5000	4910	5090	Decreasing	
4000	3910	4090	Decreasing	
3000	2910	3090	Decreasing	
2000	1910	2090	Decreasing	
1000	910	1090	Decreasing	
Allowable operating tolerance: +/- 1.5% of full scale (90 psig) at room temperature (70° F).				

12.0 Calibration of instrumentation continued on following page

12.0 CALIBRATION OF INSTRUMENTATION *(continued)*

12.3 ANALOG PRESSURE GAUGE (Hand Pump Pressure- *Option M Only*)

12.3.1 Self Calibration

An accurate pressure calibration gauge is required for calibration of the Hand Pump Pressure gauge. Follow the necessary steps below.

Shut off the HPU and disconnect it from the power source. Remove the **Hydraulic Panel** from the front instrument panel (four screws). Disconnect the hose from the Hand Pump Pressure gauge (remove gauge from panel if necessary). Attach calibration test equipment to the gauge and record gauge values at the designated increments.

HAND PUMP PRESSURE GAUGE (HC-2146)

Applied Pressure (Hand Pump Pressure Gauge) (psig)	**Minimum Acceptable (psig)**	**Maximum Acceptable (psig)**	**Gauge Movement (Direction)**	**Indicated Pressure (Calibration Gauge) (psig)**
1000	700	1300	Increasing	
2000	1700	2300	Increasing	
5000	4800	5200	Increasing	
8000	7700	8300	Increasing	
10,000	9700	10,300	Increasing	
8000	5940	8300	Decreasing	
5000	4800	5200	Decreasing	
2000	1700	2300	Decreasing	
1000	700	1300	Decreasing	
Allowable operating tolerance:	+/- 3% of full scale (300 psig) at room temperature (70° F).			
	+/- 2% of full scale for middle third of scale (200 psig) at room temperature (70° F).			

12.4 ANALOG TEMPERATURE GAUGE *(Pyrometer)*

12.4.1 Self Calibration

An accurate temperature calibration gauge is required for calibration of the Pyrometer. The pyrometer bulb is located in the return manifold (rear of unit) and can be accessed by removal of the HPU top panel. See Section ***9.7.2 – Pyrometer*** for location. Follow the necessary steps below.

1. Remove the pyrometer bulb from the return manifold by removing the slotted brass nut that retains the bulb in the well.
2. Connect the temperature calibration gauge to the bulb of the pyrometer.

The Temperature Value Must Be:

Pyrometer Temperature Display (° F)	**Minimum Acceptable (° F)**	**Maximum Acceptable (° F)**	**Temperature Calibration gauge (° F)**
160	158	162	

13.0 IN SERVICE SUPPORT

Contact Tronair, Inc. for technical services and information. See Section ***1.3 – Manufacturer***.

14.0 GUARANTEES/LIMITATION OF LIABILITY

Tronair products are warranted to be free of manufacturing or material defects for a period of one year after shipment to the original customer. This is solely limited to the repair or replacement of defective components. This warranty does not cover the following items:

a) Parts required for normal maintenance
b) Parts covered by a component manufacturers warranty
c) Replacement parts have a 90-day warranty from date of shipment

If you have a problem that may require service, contact Tronair immediately. Do not attempt to repair or disassemble a product without first contacting Tronair, any action may affect warranty coverage. When you contact Tronair be prepared to provide the following information:

a) Product Model Number
b) Product Serial Number
c) Description of the problem

If warranty coverage is approved, either replacement parts will be sent or the product will have to be returned to Tronair for repairs. If the product is to be returned, a Return Material Authorization (RMA) number will be issued for reference purposes on any shipping documents. Failure to obtain a RMA in advance of returning an item will result in a service fee. A decision on the extent of warranty coverage on returned products is reserved pending inspection at Tronair. Any shipments to Tronair must be shipped freight prepaid. Freight costs on shipments to customers will be paid by Tronair on any warranty claims only. Any unauthorized modification of the Tronair products or use of the Tronair products in violation of cautions and warnings in any manual (including updates) or safety bulletins published or delivered by Tronair will immediately void any warranty, express or implied.

The obligations of Tronair expressly stated herein are in lieu of all other warranties or conditions expressed or implied. **Any unauthorized modification of the Tronair products or use of the Tronair products in violations of cautions and warnings in any manual (including updates) or safety bulletins published or delivered by Tronair will immediately *void any warranty, express or implied* and Tronair *disclaims any and all liability for injury (WITHOUT LIMITATION and including DEATH), loss or damage arising from or relating to such misuse*.**

15.0 APPENDICES

APPENDIX I	Declaration of Conformity
APPENDIX II	Hydraulic Schematic (INS-1660)
APPENDIX III	Electrical Schematic (INS-1608 and INS-2016)
APPENDIX IV	Wiring Diagram (INS-1597 and INS-2046)
APPENDIX V	Lincoln Motor Manual
APPENDIX VI	Oilgear Pump Manual
APPENDIX VII	Material Safety Data Sheet (MSDS) pertaining to MIL-PRF-83282 Fluid
APPENDIX VIII	ANSI/B93.19M-1972 (R1993-Excerpt)
APPENDIX IX	Instrument Certification Notice

TRONAIR

APPENDIX I

Declaration
Of
Conformity

Declaration of Conformity

The design, development and manufacture is in accordance with European Community guidelines

Mobile Hydraulic Power Unit
(Electric Motor Driven)

Relevant draft complied with by the machinery:
prEN 1915-1:1995

Relevant standards complied with by the machinery:
prEN 982:1996
prEN 60204-1:1997
HFPA/JIC T2.24.1-1990
ISO 4021:1997
ARP 1247B
NFPA 70/NEC 1999

Identification of person empowered to sign on behalf of the Manufacturer:

David L. Kidd

Quality Assurance representative

1740 Eber Rd
Holland, OH 43528-9794
USA

Tronair, Inc.
www.tronair.com
Email: sales@tronair.com

Phone: (419) 866-6301
800-426-6301
Fax: (419) 867-0634

TRONAIR

APPENDIX II

Hydraulic Schematic
(INS-1660)

TRONAIR

APPENDIX III

Electrical Schematic
(INS-1608 and INS-2016)

TRONAIR

APPENDIX IV

Wiring Diagram
(INS-1597 and INS-2046)

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APPENDIX V

Lincoln Motor Manual

Carefully read and fully understand this Owner's Manual prior to installation, operation and maintenance of your motor.

1. SAFETY DEPENDS ON YOU

Lincoln motors are designed and manufactured with safety in mind. However, your overall safety can be increased by properly installing, operating and maintaining the motor. Read and observe all instructions, warnings and specific safety precautions included in this manual and THINK BEFORE YOU ACT!

2. RECEIVING AND INSPECTION

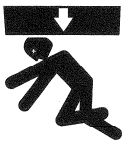
Check packing list and inspect motor to make certain no damage has occurred in shipment. Claims for any damage done in shipment must be made by the purchaser against the transportation company.

Turn the motor shaft by hand to be certain that it rotates freely. Be careful not to cut yourself on the shaft keyway; it is razor sharp!

Check the nameplate for conformance with power supply and control equipment requirements.

3. HANDLING

⚠ WARNING



FALLING EQUIPMENT can injure.

- **Lift only with equipment of adequate lifting capacity.**
- **If so equipped, use lift ring(s) on the motor to lift ONLY the motor and accessories mounted by Lincoln.**

In case of assemblies on a common base, the motor lift ring(s) CANNOT be used to lift the assembly and base but, rather, the assembly should be lifted by a sling around the base or by other lifting means provided on the base. In all cases, care should be taken to assure lifting in the direction intended in the design of the lifting means. Likewise, precautions should be taken to prevent hazardous overloads due to deceleration, acceleration or shock forces.

4. STORAGE

Motor stock areas should be clean, dry, vibration free and have a relatively constant ambient temperature. For added bearing protection while the motor is in storage, turn the motor shaft every six months.

A motor stored on equipment and component equipment prior to installation should be kept dry and protected from the weather. If the equipment is exposed to the atmosphere, cover the motor with a waterproof cover. Motors should be stored in the horizontal position with drains operable and positioned in the lowest point. CAUTION: Do not completely surround the motor with the protective covering. The bottom area should be open at all times.

Windings should be checked with a megohm-meter (Megger) at the time equipment is put in storage. Upon removal from storage, the resistance reading must not have dropped more than 50% from the initial reading. Any drop below this point necessitates electrical or mechanical drying. Note the sensitivity of properly connected megohm-meters can deliver erroneous values. Be sure to carefully follow the megohm-meter's operating instructions when making measurements.

All external motor parts subject to corrosion, such as the shaft and other machined surfaces, must be protected by applying a corrosion-resistant coating.

5. INSTALLATION

For maximum motor life, locate the motor in a clean, dry, well ventilated place easily accessible for inspecting, cleaning and lubricating. The temperature of the surrounding air should not exceed 104°F (40°C) except for motors with nameplates indicating a higher allowable maximum ambient temperature.

⚠ WARNING

MOVING PARTS can injure.

- **BEFORE starting motor, be sure shaft key is captive.**
- **Consider application and provide guarding to protect personnel.**

5.1 INSTALLATION – MECHANICAL

Base

Mount the motor on a firm foundation or base sufficiently rigid to prevent excessive vibration. On foot-mounted motors, use appropriately sized bolts through all four mounting holes. For frames which have six or eight mounting holes, use the two closest the drive shaft and two on the end opposite the drive shaft (one on each side of the frame). If necessary, properly shim the motor to prevent undue stress on the motor frame and to precision align the unit.

Position

Standard motors may be mounted in any position. The radial and thrust load capacity of the motor's bearing system provides for this feature.

Drains

All motors have drain holes located in the end brackets. As standard, drains are in place for the horizontal with feet down mounting position. Other positions may require either rotation of the end brackets or drilling additional holes to attain proper drainage. Be sure existing drain or vent holes do not permit contaminant entry when motor is mounted in the other positions.

Additional drain holes exist near the bearing cartridge in both end brackets of 284T thru 449T steel frame motors. The drain holes are closed with a plastic plug. When the motor is vertically mounted, the plug located in the lower end bracket must be removed. To access the plug on blower end, simply remove the shroud; on some models, it is also necessary to take off the blower.

Drive – Power Transmission

The pulley, sprocket, or gear used in the drive should be located on the shaft as close to the shaft shoulder as possible. Do not drive the unit on the shaft as this will damage the bearings. Coat the shaft lightly with heavy oil before installing pulley.

Belt Drive: Align the pulleys so that the belt(s) will run true. Consult the belt manufacturer's catalog for recommended tension. Properly tension the belt; excessive tension will cause premature bearing failure. If possible, the lower side of the belt should be the driving side. On multiple belt installations be sure all belts are matched for length.

Chain Drive: Mount the sprocket on the shaft as close to the shaft shoulder as possible. Align the sprockets so that the chain will run true. Avoid excessive chain tension.

Gear Drive and Direct Connection: Accurate alignment is essential. Secure the motor and driven unit rigidly to the base. Shims may be needed to achieve proper alignment.

Excessive motor vibration may result if the full length of the motor shaft key is not completely engaged by the coupling or sheave. For these situations, adjustment of the key length is required.

5.2 INSTALLATION – ELECTRICAL

⚠ WARNING

ELECTRIC SHOCK can kill.

- **Disconnect input power supply before installing or servicing motor.**
- **Motor lead connections can short and cause damage or injury if not well secured and insulated.**
- **Use washers, lock washers and the largest bolt size which will pass through the motor lead terminals in making connections.**
- **Insulate the connection, equal to or better than the insulation on the supply conductors.**
- **Properly ground the motor — see GROUNDING.**

Check power supply to make certain that voltage, frequency and current carrying capacity are in accordance with the motor nameplate.

Proper branch circuit supply to a motor should include a disconnect switch, short circuit current fuse or breaker protection, motor starter (controller) and correctly sized thermal elements or overload relay protection.

Short circuit current fuses or breakers are for the protection of the branch circuit. Starter or motor controller overload relays are for the protection of the motor.

Each of these should be properly sized and installed per the National Electrical Code and local codes.

Properly ground the motor – See GROUNDING.

Terminal Box

Remove the appropriate knockout. For terminal boxes without a knockout, either a threaded power-conduit entry hole is provided or the installer is responsible for supplying a correctly sized hole.

The majority of terminal boxes can be rotated in place to allow power lead entry from the 3, 6, 9 or 12 o'clock direction.

Motor Connection

All single speed and two-speed Lincoln motors are capable of across-the-line or autotransformer starting. Reference the lead connection diagram located on the nameplate or inside of the terminal box cover.

Single speed motors have reduced voltage start capability per the following chart.

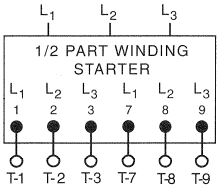
Number of Motor Leads	Number of Rated Voltages	Lead Numbers	YDS	PWS
3	Single	1-3	No	No
6	Single	1-3, 7-9	No	Yes
	Single	1-6	Yes	No
	Dual	1-6	Yes(1)	No
9	Dual	1-9	No	No
12	Single	1-12	Yes	Yes
	Dual	1-12	Yes	No(2)

(1) YDS capability on lower voltage only.
(2) PWS capability on lower voltage only, 1200 RPM, 324T-365T steel frame motors with Model Number efficiency letters of "S" or "H".

Contact Customer Service at 1-800-668-6748 (phone),
1-888-536-6867 (fax) or mailbox@lincolnmotors.com (e-mail) for a copy of across-the-line and other reduced voltage start connection diagrams.

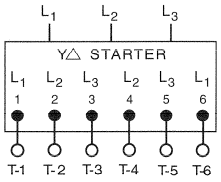
Connection Diagram 1

Single Voltage, 6 Leads
Part Winding Start Connection



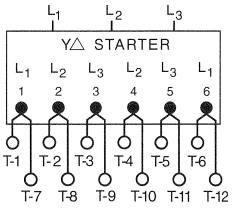
Connection Diagram 2

Single Voltage, 6 Leads
Y△ Start Connection



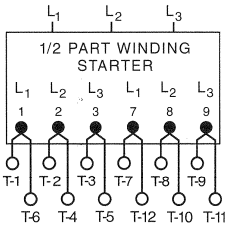
Connection Diagram 3

Single Voltage, 12 Leads
Y△ Start Connection



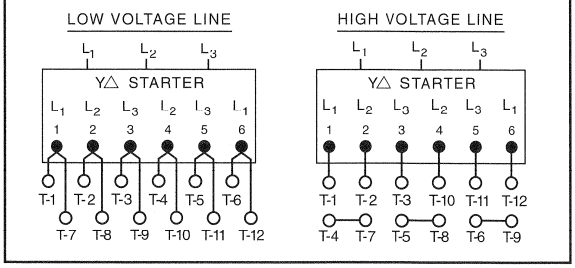
Connection Diagram 4

Single Voltage, 12 Leads
Part Winding Start Connection



Connection Diagram 5

Dual Voltage, 12 Leads
Y△ Start Connection



Space Heater (option)

Leads for space heaters are identified as H1 and H2. Heater voltage and watts are marked on the motor nameplate and should be checked prior to connection to power source.

Thermostat (option)

Leads for thermostats (normally closed, automatic reset contacts) are identified as P1 and P2. Connect these to a relay or signaling device. Motor line current cannot be handled by the thermostat.

Table 1 — Thermostat Contact Ratings

Voltage (60 Hz)	110V	220V
Max. Cont. Current (amps)	3.0	1.5
Min. Cont. Current (amps)	0.2	0.1

Thermistor (option)

Leads for thermistors are identified as P3 and P4. Thermistors require connection to Texas Instruments® Control Module Model 32AA or its equivalent for proper operation. This item may be purchased from Lincoln - see LC100 catalog.

Brake (option)

Carefully read and fully understand the instructions supplied by the brake manufacturer (see inside of brake housing or separately enclosed sheet). Contact the brake manufacturer for additional information.

GROUNDING

⚠ WARNING

ELECTRIC SHOCK can kill.

- **Connect the motor frame to a good earth ground per the National Electrical Code and local codes to limit the potential to ground in the event of contact between live electrical parts and the metal exterior.**

Lincoln motors may be electrically connected to earth ground using a terminal box mounting screw or a separate grounding screw when provided. Both are accessible inside the mounted terminal box. When a bronze mounting screw is supplied, always use it as the grounding point. In making the ground connection, the installer should make certain that there is a good electrical connection between the grounding lead and the motor.

6. OPERATION

Three phase squirrel cage induction motors will operate successfully, but not necessarily in accordance with nameplate ratings, at voltages 10 percent above or below nameplated value at the design frequency.

⚠ WARNING

MOVING PARTS can injure.

- **Before starting the motor, remove all unused shaft keys and loose rotating parts to prevent them from flying off and causing bodily injury.**
- **Keep away from moving parts.**

ELECTRIC SHOCK can kill.

- **Do not operate with covers removed.**
- **Do not touch electrically live parts.**

After checking that the shaft key is secure, operate the motor free of load and check the direction of rotation. If the motor rotates in the wrong direction, interchange any two supply leads.

Couple the motor to its load and operate it for a minimum of one hour. During this period, check for any unusual noise or thermal conditions. Check the actual operating current to be sure that the nameplate current times service factor is not exceeded for steady continuous loads.

7. MAINTENANCE

⚠ WARNING

ELECTRIC SHOCK can kill.

- **Internal parts of the motor may be at line potential even when it is not rotating.**
- **Disconnect all input power to the drive and motor before performing any maintenance.**

Lincoln motors have been designed and manufactured with long motor life expectancy and trouble-free operation in mind.

Periodically inspect the motor for excessive dirt, friction or vibration. Dust may be blown from an inaccessible location using compressed air. Keep the ventilation openings clear to allow free passage of air. Make sure the drain holes in the motors are kept open and the shaft slinger is positioned against the end bracket. Grease or oil can be wiped by using a petroleum solvent.

Overheating of the bearings caused by excessive friction is usually caused by one of the following factors:

1. Bent shaft.
2. Excessive belt tension.
3. Excessive end or side thrust from the gearing, flexible coupling, etc.
4. Poor alignment.

Damaging vibrations can be caused by loose motor mountings, motor misalignment resulting from the settling or distortion of the foundation, or it may be transmitted from the driven machine. Vibration may also be caused by excessive belt or chain tension.

BEARING SYSTEM

Lincoln motors have a high quality, premium design bearing system. Bearing sizes and enclosures are identified on most motor nameplates. The majority are double-shielded, deep-groove ball bearings. Double-sealed ball bearings are used on some motors in frames 56 and 143T thru 145T. A drive-end cylindrical roller bearing is standard on Crusher Duty motors, frames 405T and larger.

Lubrication instructions and/or grease specifications provided on the motor supersede the following information.

In general, the motor's bearing system has sufficient grease to last indefinitely under normal service conditions. For severe or extreme service conditions, it is advisable to add one-quarter ounce of grease to each bearing per the schedule listed in Table 2. Use a good quality, moisture-resistant, polyurea-based grease such as Chevron SRI #2. Lithium based greases are not compatible with polyurea-based greases; mixing the two types may result in the loss of lubrication.

Motors designed for low ambient applications have bearings with special low temperature grease. Use Beacon 325 lithium based grease or equivalent per the appropriate interval in Table 2.

Motors designed for high ambient applications have bearings with special high temperature grease. Use Dow Corning DC44 silicone grease or equivalent per the interval in Table 2 under "Extreme".

Severe Service: Operating horizontally, 24 hours per day, vibration, dirty, dusty, high humidity, weather exposure, or ambient temperatures from 104-130°F (40-55°C).

Extreme Service: Operating vertically, heavy vibration or shock, heavy duty cycle, very dirty or ambient temperatures from 130-150°F (55-65°C).

Table 2 : Bearing Lubrication Intervals

Motor Syn Speed	Motor Horsepower	Service Conditions	
		Severe	Extreme
BALL BEARINGS			
1800 RPM and slower	1/4 to 7-1/2 HP	2 years	6 months
	10 to 40 HP	1 year	3 months
	50 HP and up	6 months	3 months
above 1800 RPM	all sizes	3 months	3 months
ROLLER BEARINGS			
all speeds	all sizes	3 months	3 months

When adding lubricant, keep all dirt out of the area. Wipe the fitting completely clean and use clean grease dispensing equipment. More bearing failures are caused by dirt introduced during greasing than from insufficient grease.

If the motor is equipped with a relief port or tube, make certain it is open and free of caked or hardened grease. Before replacing relief plugs, allow excess grease or pressure to vent by running the motor for several minutes after lubrication.

⚠ CAUTION

- **LUBRICANT SHOULD BE ADDED AT A STEADY MODERATE PRESSURE. IF ADDED UNDER HEAVY PRESSURE BEARING SHIELD(S) MAY COLLAPSE.**
- **DO NOT OVER GREASE.**

PARTS

All parts should be ordered from Authorized Motor Warranty Stations. Call your Lincoln Motors Sales Office for location and phone number. A "Service Directory" listing all Authorized Motor Warranty Stations by geographic location is available; request Bulletin SD-6. These shops stock GENUINE Lincoln replacement parts and have factory trained personnel to service your motor.

8. WHO TO CALL

For the location and phone number of the Lincoln Motors District Sales Office nearest you, check your local Yellow Pages or call 1-800-MOTOR-4-U (1-800-668-6748) or visit our web site at
www.lincolnmotors.com.

9. WARRANTY

Lincoln Motors, the Seller, warrants all new *standard* motors and accessories thereof against defects in workmanship and material provided the equipment has been properly cared for and operated under normal conditions. All warranty periods begin on the date of shipment to the original purchaser. Warranty periods for ***low voltage (< 600 V)*** motors are defined in the following chart. The warranty period for ***medium voltage (> 600 V)*** motors is one year on sine-wave power. Contact Lincoln for warranty period on PWM power.

Model Number Prefix	Efficiency Code(s)	Frame Sizes	Warranty Period	
			Sine-Wave Power	PWM Power
AA, AF, AN	S, P, B	143T-286T	5 Yrs	2 Yrs*
CF, SD	M	143T-215T	2 Yrs	1 Yr
CF, CN, CS, CP	E, H, P, B	143T-449T	5 Yrs	2 Yrs*
		182U-449U	5 Yrs	2 Yrs*
C5, C6	H, P	M504-689	3 Yrs	Contact Lincoln #
MD, SE	S	284T-445T	5 Yrs	1 Yr
RC, RJ, SC	H	56-145T	5 Yrs	2 Yrs*
RD, RF	S	56-56H	5 Yrs	2 Yrs*
REW, SEW	S	56-256T	1 Yr	1 Yr
SD, SF	S, H, P, B	143T-449T	5 Yrs	2 Yrs*
Field Kits and Accessories			5 Yrs	

* Applies to motors with a service factor of 1.15 or higher. Motors with a 1.0 service factor have a 1 year warranty on PWM power.

If the Buyer gives the Seller written notice of any defects in equipment within any period of the warranty and the Seller's inspection confirms the existence of such defects, then the Seller shall correct the defect or defects at its option, either by repair or replacement F.O.B. its own factory or other place as designated by the Seller. The remedy provided the Buyer herein for breach of Seller's warranty shall be exclusive.

No expense, liability or responsibility will be assumed by the Seller for repairs made outside of the Seller's factory without written authority from the Seller.

The Seller shall not be liable for any consequential damages in case of any failure to meet the conditions of any warranty. The liability of the Seller arising out of the supplying of said equipment or its use by the Buyer, whether on warranties or otherwise, shall not in any case exceed the cost of correcting defects in the equipment in accordance with the above guarantee. Upon the expiration of any period of warranty, all such liability shall terminate.

The foregoing guarantees and remedies are exclusive and except as above set forth there are no guarantees or warranties with respect to accessories or equipment, either expressed or arising by option of law or trade usage or otherwise implied, including with limitation the warranty of merchantability, all such warranties being waived by the Buyer.

- indicates change since last printing.

Lincoln™ MOTORS

LINCOLN MOTORS
Cleveland OH 44117-2525 USA

Tel: 1-800-MOTOR-4-U (668-6748)
Fax: 1-888-536-6867
Web: www.lincolnmotors.com
E-Mail: mailbox@lincolnmotors.com

IM566-A December 1999

TRONAIR

APPENDIX V

Oilgear Pump Manual

SERVICE INSTRUCTIONS

OILGEAR TYPE "PVWH", "PVWW" AND "PVW" OPEN LOOP VARIABLE DISPLACEMENT PUMPS

PURPOSE OF INSTRUCTIONS

These instructions are written to simplify your work when installing, operating and maintaining these Oilgear pumps. Your acquaintance with the construction, principle of operation and characteristics of these units will help you attain satisfactory performance, reduce down-time and increase the units life. Some units have been modified from those described in this bulletin and other changes may be made without notice.

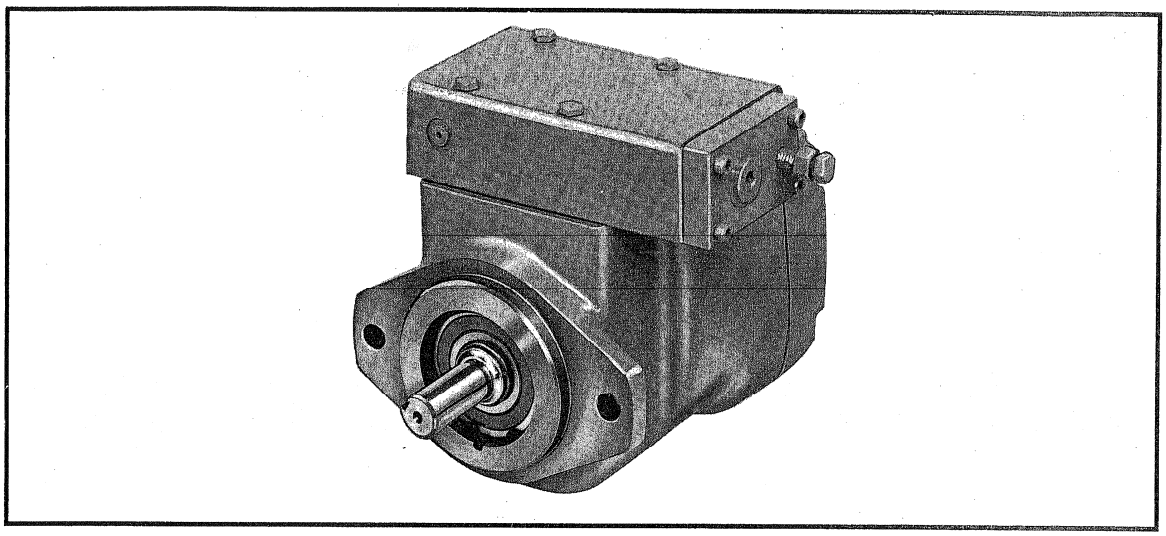


Figure 1. Typical Oilgear "PVWH" Open Loop Pump (55503R).

REFERENCE MATERIAL

Specifications, "PVWW" Pumps	Bulletin	47013
Specifications, "PVW" Pumps	Bulletin	47014
Specifications, "PVWH" Pumps	Bulletin	47015
Fluid Recommendations	Bulletin	90000
Contamination Evaluation Guide	Bulletin	90004
Filtration Recommendations	Bulletin	90007
Piping Information	Bulletin	90011
Pump Control Instructions		
Pressure Compensating Controls		
"CN & CL" Single Pressure	Bulletin	947515
"C2 & C3" Multiple Pressure	Bulletin	947518
"CU" Soft Start Pressure	Bulletin	947517
"CH" High-Low Pressure	Bulletin	947514
"HP" Horsepower Limiter	Bulletin	947513
Volume/Pressure Sensing Controls		
"CF" Single Pressure/Load Sense	Bulletin	947516
"2F" Dual Pressure/Load Sense	Bulletin	947512
"HF" Horsepower Limit/Load Sense	Bulletin	947511
Volume Controls		
"HN" Handwheel	Bulletin	947115
"MN & MS" Lever	Bulletin	947116
"RU" Solenoid, Two Volume	Bulletin	947815
"RS & RY" Solenoid Two Volume & Neutral	Bulletin	947816
Electronic		
"VU" Solenoid Operated Servo	Bulletin	947715
"VV" Servo Valve	Bulletin	947716

I. PREPARATION AND INSTALLATION

A. MOUNTING

PUMP WITHOUT RESERVOIR. The pump may be mounted in any position. But, for convenience the recommended mounting position is with the driveshaft axis on a horizontal plane and with case drain "Port 1" to the top side. Secure the unit to a rigid mounting surface. See section "B" on "Piping & Fittings".

THE OILGEAR COMPANY
2300 So. 51st. Street
Milwaukee, WI 53219

Re-Issued November, 1995

PUMP WITH RESERVOIR. These units are usually fully piped and equipped, although it may be necessary to connect to supercharge circuit when used. Mount reservoir on level foundation with reservoir bottom at least six (6) inches above floor level to facilitate fluid changes.

B. PIPING AND FITTINGS

See reference "Piping Information" bulletin and individual circuit diagram before connecting pump to system.

For "PVWH" and "PVW" Pumps using 150-300 SSU VISCOSITY FLUIDS, an inlet strainer is not required. Inlet should be unrestricted and have a minimum of fittings. See reference "Specification Bulletin" for minimum inlet "psia" requirements at selected input rpm. If suction line is used, it should reach within 1 to 2 times its diameter from the bottom of reservoir - do not "bottom-out" tubes in reservoir.

For "PVWW" Pumps using 27-30 SSU VISCOSITY FLUIDS, pumps should have a flooded inlet and an inlet filter should **not** be used. Inlet should not be restricted and have a minimum of fittings. Inlet velocity should not exceed 5 fps. (1,5 m/s).

Arrange case drain line so case remains full of fluid (non-siphoning) at less than 25 psi (1,7 bar) and case pressure must **not be 10 psi** (0,7 bar) **greater than inlet pressure.** Each drain line must be separate, unrestricted, full sized and connected directly to the reservoir below the lowest fluid level. Drain tubing should NOT incorporate a "suction break". Provisions for opening this line without draining (siphoning) reservoir should be made.

WARNING:

Running pump in "Neutral" position (zero delivery) for long periods of time without supercharge (or a case bleed thru circuit) can damage the pump.

System and pump must be protected against over-loads by separate high pressure relief valves. Install bleed valve(s) at highest point(s) in system. Consult The Oilgear Company for other recommendations.

C. POWER

Power is required in proportion to volume and pressure used. Motor size recommendations for specific applications can be obtained from The Oilgear Company. Standard low starting torque motors are suitable for most applications.

CAUTION:

Never start or stop unit under load unless system is approved by The Oilgear Company. It may be necessary to provide delivery bypass in some circuits.

D. DRIVE

See rotation direction plate on units' housing. Units are available for left hand (CCW) or right hand (CW) rotation but are **not** reversible. Use direct drive. Size and install coupling per manufacturer's instructions.

CAUTION:

Do not drive coupling onto pump driveshaft. If fit is too tight, it may be necessary to heat coupling (see manufacturer's instructions).

Misalignment of pump shaft to driveshaft should **not** exceed 0.005" (0,13 mm) Total Indicator Readout (TIR) in any plane.

E. FILTRATION

To assure long life from your hydraulic system, keep fluid clean at all times. See reference bulletins on "Filtration Recommendations" and "Contamination Evaluation". Oilgear recommends the use of a filter in an auxiliary (pilot) pump circuit. Replace filter element(s) when filter condition indicator reaches "change" area at normal fluid temperature. Drain and thoroughly clean filter case.

FOR 150-300 SSU VISCOSITY FLUID, use of ten micron filtration (Beta 10 of four or better) in pressure or return line is recommended.

FOR 27-30 SSU VISCOSITY FLUID, use of ten micron filtration (Beta 10 of fifteen or better) in pressure or return line is recommended. **Continuous filtration is required.**

F. FLUID COOLING

When pump is operating continuously at rated pressure or frequently at peak load, auxiliary cooling of fluid may be necessary. Fluid temperature should not exceed limits specified in referenced bulletin on "Fluid Recommendations".

G. AIR BREATHER

On most installations, an oil bath type air breather is mounted on top of fluid reservoir. It is important for the breather to be of adequate size to allow air flow in and out of reservoir as fluid level changes. Keep breather case filled to the "fluid level" mark. About once every six months, remove cover, wash screens in solvent, clean and refill case to "fluid level" mark and install dry screen. See manufactures' recommendations.

H. FLUID, FILLING AND STARTING RECOMMENDATIONS

"PVWH" and "PVW" Pumps use 150-300 SSU VISCOSITY FLUIDS, meeting or exceeding lubricating specifications of SAE 10W AP1 Engine Service Classifications - SC, CC or SE (or ISOVG32 thru 68) is recommended, viscosity range 150-300 SSU at 100°F (37,7°C). **For fire resistant fluids,** phosphate ester hydraulic fluids can be used in accordance with manufacturer's recommendations.

"PVWW" Pumps may use 27-30 SSU VISCOSITY FLUIDS, it is suggested you confirm your selection with your Oilgear representative before you specify the type of hydraulic fluid. High Water Content Fluids (HWCF) 95-5, water glycol and oil emulsion fluids can be used in accordance with fluid manufacturer's recommendations.

Refer to instruction plate on unit, reservoir, machine and/or referenced "Fluid Recommendations" bulletin. Pump all fluid into reservoir thorough a clean (see Section E for Beta ratings) filter. Fill reservoir to, but not above, "high level" mark on sight gage with hydraulic fluid. **Remove case drain line at the pump and fill pump case with hydraulic fluid.**

Turn driveshaft a few times by hand with a spanner wrench to be sure parts are free.

Table 1. TORQUE TO TURN SHAFT

SIZE UNIT	Approx. Torque to Turn Shaft	
	foot pounds	Nm
04, 06, 10	1.7 - 2.1	2,3 - 2,8
11, 15, 20	2.9 - 3.3	4,0 - 4,5
25, 34, 45, 60	7.9 - 8.3	10,8 - 11,3

With pump under "no load", or with pump control at "neutral" turn drive unit on and off several times before allowing pump to attain full speed. The system can usually be filled by running the pump and operating the control. Watch the fluid level in the reservoir and stop pump if the level reaches "low level" mark. Add fluid and start again. With differential (cylinder) systems, fluid must not be above "high level" when ram is retracted or below "low level" when extended. Bleed air from the system by opening air bleed petcocks at highest point in the system. Close connections or petcocks tightly when solid stream of fluid appears.

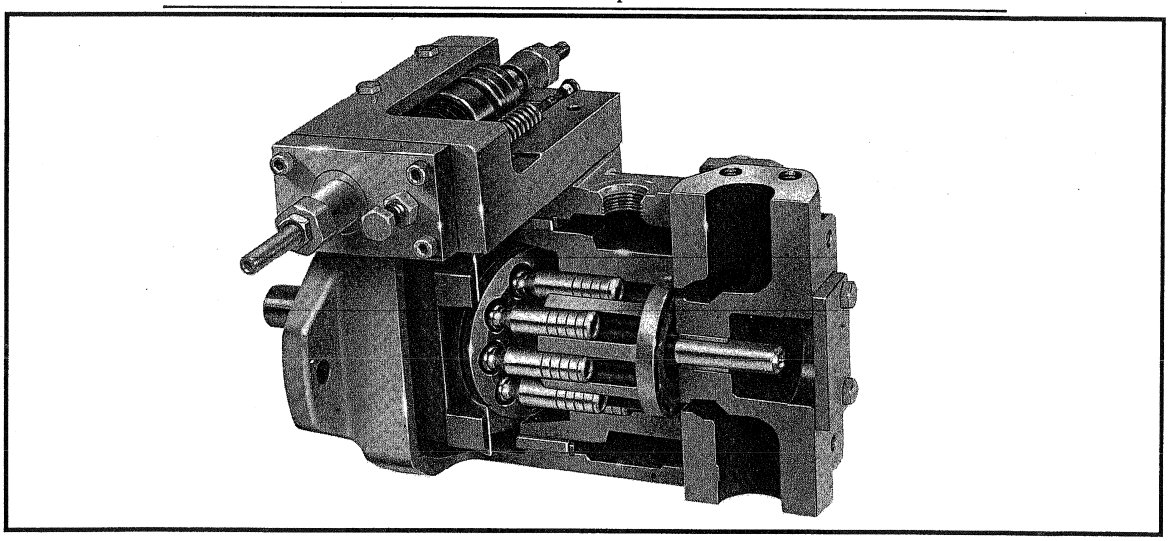


Figure 2. Cut-a-Way (cross section) of Typical "PVWH" Pump from the right side. (88050R)

II. CONSTRUCTION

Refer to Figures 2, 10 and 11. A driveshaft (1) runs through the centerline of pump housing (5), saddle block (8) and valve plate (22). Pump cylinder barrel (18) is splined to driveshaft. A bearing (3) supports the outboard end of the driveshaft and a bushing integral with the valve plate supports the inboard end. The pump cylinder barrel is carried in a journal type hydrodynamic cylinder bearing (12). The valve plate (22) has two crescent shaped ports. Pumping piston/shoe assemblies (15) in the cylinder barrel are held against a swashblock (11) by a shoe retainer (14). The shoe retainer is held in position by a fulcrum ball (16) which is forced outward by shoe retainer spring (17). The spring acts against the pump cylinder barrel forcing it against the valve plate while also forcing the piston shoe against the swashblock (11). The semi-cylinder shaped swashblock limits the piston stroke and can be swivelled in arc shaped saddle bearings (10A and 10B) which are pinned (9) into the saddle (8). The swashblock is swivelled by a control (covered in referenced material).

For **"PVWH"** Pumps **(only)**, the ("pressure" side) saddle bearing is force lubricated. A small hole in the face of the swashblock (11) provides "porting" for the hydrostatic balance fluid [of the piston/shoe assembly (15)] through the swashblock to a rectangular shaped groove milled in one of the two arc shaped swashblock faces, to lubricate the face of the mating saddle bearing. **"PVW" and "PVWW" Pumps are not provided with this feature.**

SEE PAGES 4 and 5 "III. PRINCIPLE OF OPERATION" and "IV. SPECIFICATIONS"

V. MALFUNCTIONS AND CAUSES

A. UNRESPONSIVE OR SLUGGISH CONTROL

1. See reference control instruction material.
2. Low control input (pilot) pressure for "R" and "V" volume type controls only.
3. Swashblock saddle bearings (10A & 10B) worn or damaged.

B. INSUFFICIENT PUMP VOLUME

1. Delivery limited by faulty control (see appropriate control instruction material).
2. Obstructed suction circuit or insufficient supercharge volume.
3. Insufficient drive motor speed.
4. Worn or grooved cylinder barrel (18) and/or valve plate (22) matching surfaces.
5. Worn piston/shoe assemblies (15) or piston bores in cylinder (18).
6. Worn or damaged piston shoe or swashblock (11).

C. IRREGULAR OR UNSTEADY OPERATION

1. Faulty control.
2. Fluid level in reservoir is low or supercharge is insufficient.
3. Air entering hydraulic system.
4. Worn axial piston pump.
5. Faculty output circuit components (cylinder, motors, valves, etc.).

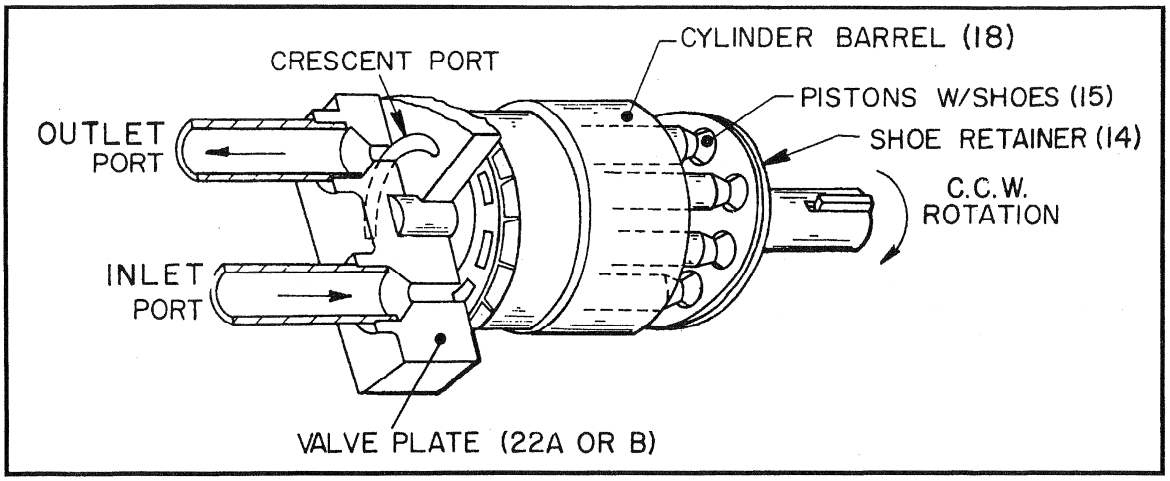


Figure 3. Type "PVWH" Pumping Mechanism (511783).

III. PRINCIPLE OF OPERATION

A ONE-WAY PUMP DRIVEN COUNTERCLOCKWISE (LEFT HAND), IS DESCRIBED.

See Figure 3. Turning the driveshaft rotates the splined cylinder barrel (18) which contains pumping pistons with swivel shoes (15). A shoe retainer (14), backed up by a spring (17) loaded fulcrum ball (16), holds piston shoes against a swashblock (11).

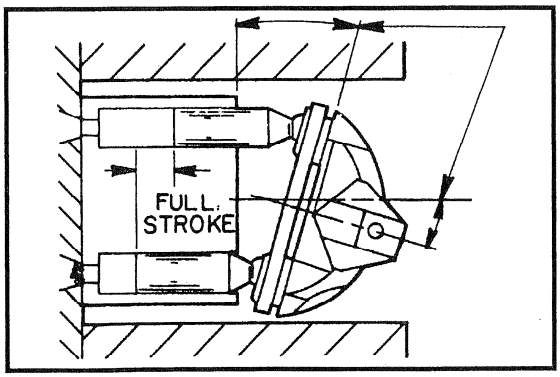


Figure 4. POSITION A Plan (Top) View, Swashblock Positioned for Full Delivery Port A. (511783)

SEE FIGURE 4. POSITION A. When the control positions the swashblock for full delivery from Port A, the swashblock face is at maximum angle (to the cylinder face). When cylinder is rotated, the piston move in and out of their bores as the shoes "ride" against the angled swashblock.

As the cylinder rotates, the individual piston bores are connected alternately to the lower (Port B) and upper (Port A) crescent shaped ports in the valve plate. While connected to the lower (suction) Port B, each piston moves outward, drawing fluid from Port B into the piston bore until it's outermost stroke is reached. At that point, the piston bore passes from the lower crescent port to the upper crescent port.

While rotating across the upper crescent, each piston moves across the angled swashblock face. Thus, each piston is forced inward. Each piston displaces fluid thru the upper crescent port to Port A until it's innermost stroke is reached. At that point, the piston bore passes from the upper to the lower crescent again and the operating cycle is repeated.

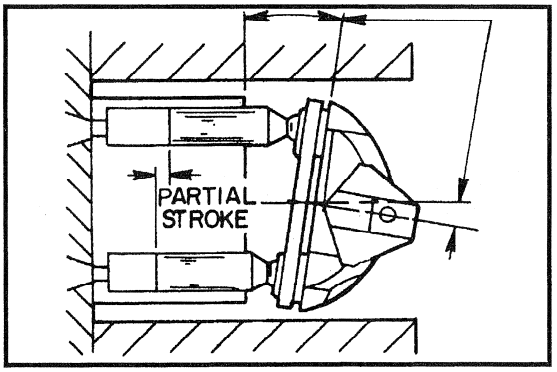


Figure 5. POSITION A/2 Plan (Top) View, Swashblock Positioned for Partial Delivery from Port A (511783).

SEE FIGURE 5. POSITION A/2. A study of the diagram will show that the degree of swashblock angle determines the length of the piston stroke (difference between outermost and innermost position) thereby determining the amount of delivery from the pump.

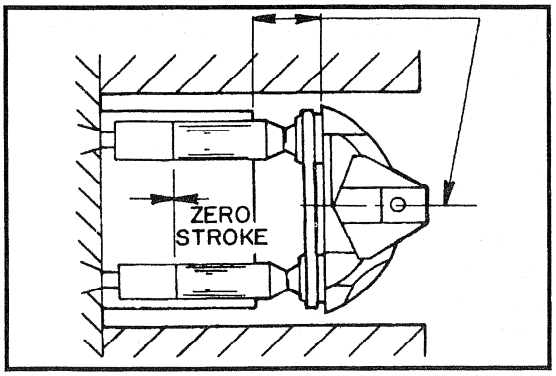


Figure 6 POSITION N, Plan (Top) View, Swashblock Positioned for "Neutral" (no stroke, no delivery) (511783).

SEE FIGURE 6. POSITION N. Neutral position results when the control centers the swashblock. The swashblock angle is now zero and swashblock face is now parallel to cylinder face. Therefore, no inward or outward motion of the pump piston exist as piston shoes rotate around the swashblock face. The lack of inward and outward motion results in no fluid being displaced from the piston bores to the crescents in the valve plate and consequently no delivery from pump ports.

IV. SPECIFICATIONS

See referenced material, pump control material and individual application circuits for exceptions.

Tables 2. NOMINAL PERFORMANCE DATA

"PVWH" AND "PVW" PUMPS with 150-300 SSU VISCOSITY FLUID

FRAME SIZE	UNIT SIZE	THEORETICAL MAXIMUM DISPLACEMENT		RATED CONTINUOUS PRESSURE		MAXIMUM PRESSURE		FLOW RATE at 1800 rpm, rated continuous pressure & 14.7 psia (1 bar_{abs}) inlet condition		MINIMUM INLET PRESSURE* psia (bar_{abs})			MAXIMUM SPEED†	POWER INPUT at rated continuous pressure and 1800 rpm	
		in^3/rev	ml/rev	psi	bar	psi	bar	gpm	l/min	1200 rpm	1500 rpm	1800 rpm	rpm	hp	kw
A	04	0.66	10,8	5000	344,8	5800	400,0	4.2	15,9	5.4 (,37)	5.7 (,39)	6.1 (,42)	3000	16.3	12,2
	06	0.86	14,1	4000	275,9	4500	310,3	5.9	22,4	5.5 (,38)	5.9 (,41)	6.4 (,44)	3000	17.7	13,2
	10	1.35	22,1	3000	206,9	3500	241,4	9.5	36,0	5.5 (,38)	6.0 (,41)	7.0 (,48)	3000	20.2	15,1
B	11	1.55	25,4	5000	344,8	5800	400,0	10.9	41,3	7.0 (,48)	7.3 (,50)	8.2 (,57)	3000	36.5	27,2
	15	2.06	33,8	3500	241,4	4000	275,9	14.7	55,7	7.0 (,48)	7.6 (,52)	8.4 (,58)	3000	35.5	26,5
	20	2.83	46,4	2500	172,4	3000	206,9	20.6	78,1	7.2 (,50)	7.9 (,54)	9.0 (,62)	2400	35.0	26,1
C	25	3.88	63,6	5000	344,8	5800	400,0	27.4	103,8	7.6 (,52)	8.5 (,59)	9.5 (,66)	2400	95.1	70,9
	34	4.67	76,5	3500	241,4	4000	275,9	33.7	127,7	8.0 (,55)	8.6 (,59)	9.6 (,66)	2400	80.4	60,0
	45	6.00	98,3	2500	172,4	3000	206,9	43.3	164,1	7.6 (,52)	8.6 (,59)	9.8 (,68)	2400	74.1	55,3
	60	7.94	130,2	1500	103,4	2000	137,9	58.2	220,3	8.0 (,55)	9.3 (,64)	14.5 (1,00)	1800	64,0	47,8

* For higher speeds see suction curves.

Higher speeds available - consult factory Note: Minimum speed 600 rpm

"PVWW" Pumps with 27-30 SSU VISCOSITY FLUID

FRAME SIZE	UNIT SIZE	THEORETICAL MAXIMUM DISPLACEMENT		RATED CONTINUOUS PRESSURE		MAXIMUM PRESSURE *		FLOW RATE at 1800 rpm, rated continuous pressure & 14,7 psia (1 bar_{abs}) inlet condition		MAXIMUM SPEED at 1800 rpm and 14.7 psia inlet condition	POWER INPUT at rated continuous pressure and 1800 rpm	
		in^3/rev	ml/rev	psi	bar	psi	bar	gpm	l/min	rpm	hp	kw
A	06	0.86	14,1	3000	206,9	3500	241,4	5.5	20,8	1800	12.9	9,6
	10	1.35	22,1	2000	137,9	2500	172,5	9.0	34,1	1800	13.3	9,9
B	15	2.06	33,8	3000	206,9	3500	241,4	12.7	48,1	1800	30.4	22,7
	20	2.83	46,4	2000	137,9	2500	172,5	20.3	76,9	1800	27.8	20,7
C	34	4.67	76,5	3000	206,9	3500	241,4	32.6	123,6	1800	68.4	51,0
	45	6.00	98,3	2000	137,9	2500	172,5	42.8	162,2	1800	59.7	44,5
	60	7.94	130,2	1200	82,7	1500	103,4	56.6	214,2	1800	47.0	35,1

* Higher pressure available— consult factory.

Note: Minimum speed 600 rpm

Table 3. NOMINAL DIMENSIONS and WEIGHTS without controls.

UNIT SIZE	LENGTH		WIDTH		HEIGHT		WEIGHT	
	in.	mm.	in.	mm.	in.	mm.	lbs.	kg.
04, 06 & 10	7.20	182,9	4.32	109,7	4.50	114,3	32	14,5
11, 15 & 20	8.50	215,9	4.80	147,3	6.11	155,2	68	30,9
25, 34, 45 & 60	10.44	265,2	6.76	171,7	7.18	182,4	103	46,8

See Page 3 for "V". Malfunctions and Causes"

D. LOSS OF PRESSURE

1. Worn piston pump.
2. Worn or grooved cylinder barrel (18) and/or valve plate (22) matching surfaces.
3. Worn piston/shoe assemblies (15) or piston bores in cylinder.
4. Faulty output circuit components.
5. Faulty control.

E. EXCESSIVE OR HIGH PEAK PRESSURE

1. Faulty output circuit components (pay particular atten tion to relief valves). **The use of a "spike" relief valve (fast acting) is recommended.**

F. EXCESSIVE NOISE

1. Pump incorrectly being stopped or started under load.
2. Low fluid level in reservoir or insufficient supercharge resulting in cavitation.
3. Air entering hydraulic system.
4. Fluid too cold or viscosity to high.
5. Suction line problem i.e.; obstruction in line, line too long, line diameter too small, too many bends and/or loops in line.
6. Broken or worn piston/shoe assembly (15).
7. Pump rotating in wrong direction.

G. EXCESSIVE HEATING

1. Operating pump above rated or peak pressure.
2. Low fluid level in reservoir or insufficient supercharge.
3. Air entering hydraulic system.
4. Worn piston pump.
5. Worn or grooved cylinder barrel (18) and/or valve plate (22) matching surfaces.
6. Faulty output circuit components (continuous blowing relief valve or "slip" through valves, cylinder, etc).
7. Insufficient cooling provision or clogged coolers.

VI. TESTING AND ADJUSTING

WARNING - Shut pump off and release pressure from the system before disassembling components. Failure to comply with these instructions could result in personal injury or death. **Blocking pressure line before (up-stream from) pump relief valve or system high pressure relief valve will result in damage and could result in serious personal injury.**

A. PISTON PUMP

To check for worn piston pump, measurement of the leakage can be made from the case drain while the pump is under pressure, but pressure control (when used) is not "unloading". After the unit is warm, either install a flow meter in the drain line or have the flow from the drain line directed into a large container or reservoir. The pump case must remain full of fluid during this test.

CAUTION:

Do not run a pump on stroke against a blocked output unless it is protected by a high pressure relief valve and then run no longer than necessary to check slip. Limit discharge to prevent dropping reservoir fluid below "low" level.

With an accurate high pressure gage in the pressure line, start pump, put it on stroke and stall (or block) output device to raise system pressure to maximum (as set by system relief valve). Read the flow meter, or time the case drain flow to fill a known size container and calculate the flow rate in terms of cubic inches per minute (cipm). The leakage should conform with Table 4 or 5. Additional leakage indicates wear, but does not become critical until it impairs performance.

B. CONTROL

Refer to applicable (referenced) pump control instructions material.

Table 4. **"PVWH" Pump** NOMINAL CASE SLIP vs. High Pressure at 1800 rpm (viscosities of 160 SSU).

PUMP	1500 psi		2500 psi		3000 psi		3500 psi		4000 psi		5000 psi	
	cipm	lpm	cipm	lpm	cipm	lpm	cipm	lpm	cipm	lpm	cipm	lpm
04											200	3,3
06									200	3,3	NA	NA
10					200	3,3	NA	NA	NA	NA	NA	NA
11											300	4,9
15							300	4,9	NA	NA	NA	NA
20			300	4,9	NA	NA	NA	NA	NA	NA	NA	NA
25											460	7,6
34							460	7,6	NA	NA	NA	NA
45			460	7,6	NA	NA	NA	NA	NA	NA	NA	NA
60	530	8,7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 5. **"PVWW & PVW" Pump** NOMINAL CASE SLIP vs. High Pressure at 1800 rpm (viscosity of 160 SSU).

PUMP SIZE	Case Slip at Full Stroke and Indicated Pressure									
	1500 psi/PVW 1200 psi/PVWW		2500 psi		3000 psi		3500 psi		4000 psi	
	cipm	lpm	cipm	lpm	cipm	lpm	cipm	lpm	cipm	lpm
06									150	2,5
10					150	2,5	NA	NA	NA	NA
15							230	3,8	NA	NA
20			230	3,8	NA	NA	NA	NA	NA	NA
34							350	5,7	NA	NA
45			350	5,7	NA	NA	NA	NA	NA	NA
60	390	6,4	NA	NA	NA	NA	NA	NA	NA	NA

VII. DISASSEMBLY

A. GENERAL

Refer to Figures 10 and 11. It will be advantageous to tag similar parts (particularly screws, plugs and o'rings) during disassembly to be certain they don't become confused with similar parts and to assure they will be returned to original location. Do not remove (locator) roll pins unless they are deformed or otherwise in need of replacement.

B. PREPARATION

For disassembly and assembly, a crane and/or sling capable of handling 200 lb. loads will be useful.

When disassembling or assembling unit, we recommend choosing an area where no traces of dust, sand or other abrasive particles, which could damage the unit, are in the air. We also recommend not working near welding, sand blasting, grinding benches and the like. Place all parts on a CLEAN surface. To clean parts which have been disassembled, it is important to use CLEAN solvents. All tools and gages should be CLEAN prior to working with these units and new CLEAN lint free rags used to handle and dry parts.

WARNING: NEVER attempt to remove or install any components or assemblies while unit and system is running. Always stop the pump, shut-off power and release pressure from the system before servicing or testing. Be sure provisions have been made so case drain line can be disconnected from unit without causing the line to drain (siphon) the reservoir.

Disconnect pump from drive motor and piping. Usually, it is necessary to remove the pump from it's mounting before the case can be drained.

After removing pump from mounting, but before disassembly, cap or plug all ports and clean the outside thoroughly to prevent entry of dust into the system.

Refer to Figure 10 and 11. Depending upon what part or parts are to be inspected, it may not be necessary to completely take apart all assemblies.

C. CONTROL GROUP

See reference material for applicable information on the control your unit is equipped with. Remove four hex. head cap screws and lift the control group assembly, with control pin, straight up from the top of the pump assembly. Control pin may or may not remain in the swashblock (11). Remove control gasket and o'rings from pump housing.

D. VALVE PLATE GROUP

If another unit is coupled to thru shaft units, it will be necessary to remove coupling (half) (180 or 190) before removing valve plate (22). Block unit on bench with driveshaft facing down. Remove valve plate (22) by alternately removing four hex head screws (25) and lifting straight up. Remove valve plate gasket (21) and o'ring (28).

E. ROTATING GROUP

WARNING: Extreme care must be taken not to damage cylinder wear surface (that matches against the valve plate), bearing diameters or piston shoes. The use of a sling, and/or assistance from others and use of proper lifting techniques are strongly recommended to prevent personal injury.

Place the pump in a horizontal position and remove the rotating group by turning shaft (1) slowly while pulling the cylinder barrel (18) from the housing.

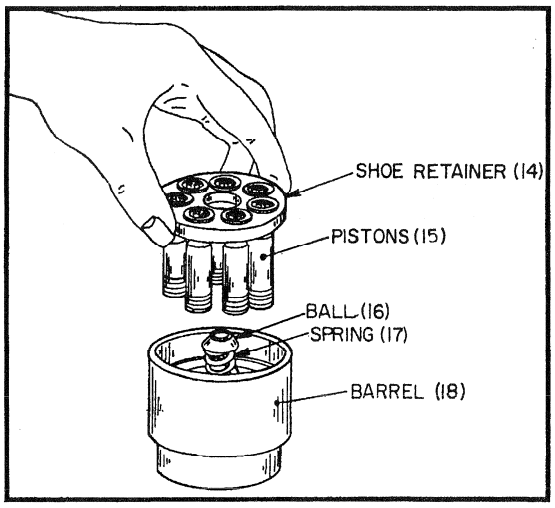


Figure 7. Rotating Group Disassembly (511783).

See Figure 7. Lift out shoe retainer (14) with piston/shoe assemblies (15) and remove fulcrum ball (16) and shoe retainer spring (17).

Remove retaining ring (13) and pull hydrodynamic cylinder bearing (12) from pump housing.

F. DRIVESHAFT GROUP

Remove drive key (2) if used and driveshaft bearing retainer ring (29). Grasp outboard end of driveshaft (1) and pull out from pump housing. Remove shaft retainer ring (4) and front driveshaft bearing (3). Remove seal retainer (6) and shaft seal (7) from housing only if necessary.

G. SWASHBLOCK GROUP

Reach inside the case and remove swashblock (11). **Note which saddle bearing is in the upper (10A) position and which is in the lower (10B) position.** Remove saddle bearings (10A and 10B) from the saddle (8) if necessary. If necessary, the saddle itself can be pulled out. On most units, the saddle is located by pin (20) and can be pulled from the housing. On early units, the saddle is located in the case by two dowel pins (not shown) and the saddle is secured to the case by two nylock socket head cap screws (not shown) which will have to be removed before the saddle can be withdrawn from the housing.

VIII. INSPECTION

Clean all parts thoroughly. Inspect all seals, and o'rings for hardening, cracking or deterioration and replace if necessary. Check all locating pins for damage and spring for cracking or signs of fatigue.

WARNING: Always wear safety goggles when using solvents or compressed air. Failure to wear safety goggles could result in serious personal injury.

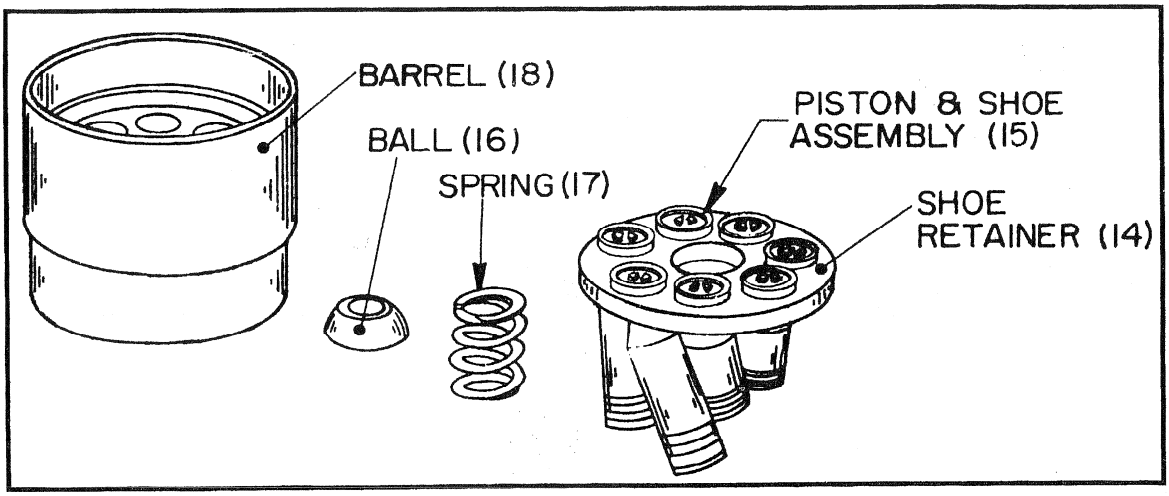


Figure 8. Rotating Group Inspection (511783)

A. CONTROL GROUP

See applicable reference material on pump controls. Be sure to carefully check control pin for cracks and/or signs of fatigue. Check fit of control pin in swashblock. It should be a slip fit without "side-play".

B. VALVE PLATE GROUP

Inspect the valve plate (22) surface that mates with the cylinder barrel (18) for excessive wear or scoring. Remove minor defects by lightly stoning the surface with a hard stone that is flat to within 0.001" (0,03mm). Be sure to stone lightly. Any excessive stoning will remove the hardened surface. If wear or damage is extensive, replace the valve plate (as part of Valve Plate Assembly Kit No. 79L or 79R) and cylinder barrel (18).

C. ROTATING GROUP

Inspect cylinder barrel (18) piston bores and the face that mates with valve plate for wear or scoring. Remove minor defects by lightly stoning the surface with a hard stone that is flat to within 0.001" (0,03 mm). Be sure to stone lightly. Any excessive stoning will remove the hardened surface. If defects can not be removed by this method, replace the cylinder barrel as part of Rotating Group Kit No. 73. Inspect hydrodynamic cylinder bearing (12) and matching cylinder barrel surface for galling, pitting, roughness, damage and replace if necessary.

Check all piston/shoe assemblies (15) to be sure they ride properly on the swashblock.

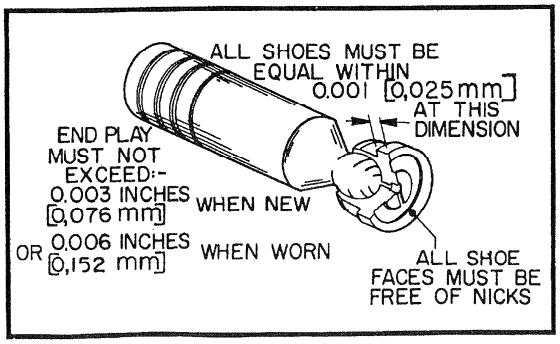


Figure 9. Piston and Shoe Inspection (511783).

See Figure 9. Piston shoes must pivot smoothly, but end play should not exceed 0.006" (0.152 mm). Check end play as follows: Place square end of piston on bench and hold down firmly. Pull on end of shoe with other hand and note end play. The shoe must rotate and pivot on the piston ball. Inspect each shoe face for nicks and scratches. Measure shoe thickness [the part held between shoe retainer (14) and swashblock (11)]. All shoes must be equal within 0.001" (0,025 mm). If a single piston/shoe assembly needs to be replaced, all piston/shoe assemblies must be replaced. Replace as part of Piston/Shoe Kit No. 87 . When installing a new rotating group kit, make sure pistons are free in their bores.

D. SWASHBLOCK GROUP

Inspect the swashblock (11) for wear or scoring. In the case of size 60 units, inspect the swashblock wearplate (11A). If damage is extensive, replace the swashblock and/or wearplate as part of Swashblock Kit No. 82.

"**PVWH**" Pumps **(only)**, check the very small holes in the face of the swashblock. This hole provides "porting" for the hydrostatic balance fluid (of the piston/shoe assembly) to be channelled through the swashblock to the face of the saddle bearing (providing pressure lubrication).

Compare saddle bearing (10A and 10B) thickness in worn area to thickness in an unworn area. Replace saddle bearings if difference is greater than 0.008 in (0,2mm). Check mating surface of swashblock for cracks or excessive wear. Swashblock movement in saddle bearings must be smooth. Replace as part of Saddle Bearing Kit No. 85.

E. DRIVESHAFT GROUP

Check shaft seal (7) for deterioration or cracks. Replace if necessary. Examine the sealing area of the shaft (1) for scoring or wear. Inspect shaft bearing (3) for roughness, galling, pitting or binding. Check shaft and splines for wear. If driveshaft is bent, scored or worn excessively or if bearing is bad, replace as part of Shaft and Bearing Kit No. 74K or 74S. Inspect bushing in valve plate (22). If replacement is necessary, the bushing is not available as a loose item, it is included when ordering Valve Plate Assembly Kit No. 79L or 79R.

IX. ASSEMBLY

Refer to Figures 10 and 11. The procedure for assembling the pump is basically the reverse order of disassembly. During assembly, install new gaskets seals and o'rings (Kit No. 77). Apply a thin film of CLEAN grease or hydraulic fluid to sealing components to ease assembly. If a new rotating group (Kit No. 73) is used, lubricate thoroughly with CLEAN hydraulic fluid. Apply fluid generously to all wear surfaces.

A. SWASHBLOCK GROUP

If removed, press shaft seal (7) into front of pump housing (5) and then place housing on bench with mounting flange side down. Place saddle block (8) into housing - center properly [a locating hole in the saddle and a pin (20) in the housing must match]. On early units, two dowel pins (not shown) locate the saddle and saddle is secured to housing by two nylock socket head cap screws.

The saddle bearings (10A and 10B) and swashblock (11) can now be installed. Check the swashblock faces that mate with the saddle bearings (10A and 10B). One of these faces has a rectangular groove cut into it. The groove should be on the control (upper) side of the swashblock for left hand driven pumps and on the (lower) side for right hand driven pumps.

For size **04, 06, 10 and 25 "PVWH"** Pumps **only**, the plastic backed saddle bearing should be positioned on pin (9) to mate with the rectangular groove milled in arc shaped swashblock (11). Place steel backed saddle bearing on pin (9) in other location.

For size **11, 15, 20, 34, 45 and 60 "PVWH"** Pumps **only**, both saddle bearings are steel backed. It is recommended they be put back in their original locations. If replacement saddle bearings are used - it makes no difference which is placed in which location.

For **all size "PVWW" and "PVW"** Pumps **only**, both bearings are the same. It is recommended they be put back in their original locations. If replacement saddle bearings are used - it makes no difference which is placed in which location.

NOTE: - Install saddle bearings on size 04 thru 20 with notched corners toward shaft and bearing. Does not apply to 25 thru 60 size.

Place the swashblock into the case and be sure the swashblock swivels in the saddle bearings. With new bearings, swivelling may be stiff (not always smooth).

Position the hydrodynamic bearing (12) into the case so the pin (in the bearing) will fit (per Table 6) a corresponding slot in the housing. The bearing should fit into place with little difficulty and be square to the axis of the pump. Tap bearing into place if necessary, using extreme care not to damage the bearing. Insert retaining ring (13) to hold bearing in place.

Table 6. HYDRODYNAMIC BEARING LOCATION PIN POSITION

Left Hand (CCW) Pumps = Pin at 8:00 o'clock position between saddle protrusion and pump housing.
Right Hand (CW) Pumps = Pin at 4:00 o'clock position between saddle protrusion and pump housing.

B. DRIVESHAFT GROUP

Place housing on its side with axis horizontal and then install seal retainer (6). Place front driveshaft bearing (3) onto driveshaft (1) and lock in place with shaft retaining ring (4). Lubricate shaft seal (7) and shaft, then insert driveshaft and bearing assembly into pump housing (5) and lock in place with driveshaft bearing retainer ring (29).

C. ROTATING GROUP

See Figure 7. Place the cylinder barrel (18), wear surface down, on a clean cloth. Place the shoe retainer spring (17) in the center of the barrel with the fulcrum ball (16) on top of it. Insert the pistons/shoe assemblies (15) into the shoe retainer (14). As a unit, fit the pistons into their bores in the cylinder barrel. **DO NOT FORCE.** If aligned properly, the pistons will fit smoothly.

WARNING: Assistance from others and proper lifting technique is strongly recommended to prevent personal injury while assembling larger sized pump rotating groups into the pump. The rotating group can now be carefully installed over the tail of the driveshaft (1) and into the pump housing (5). When installing the rotating group, support the weight of the cylinder barrel (18), as cylinder spline is passed over the tailshaft, to avoid scratching or damage. Push cylinder forward until the cylinder spline reaches the driveshaft spline and rotate the cylinder slightly to engage shaft splines. Continue to slide cylinder forward until it encounters the hydrodynamic cylinder bearing (12). Lifting the tailshaft slightly helps cylinder barrel (18) and cylinder bearing (12) engagement. Continue pushing cylinder forward until the piston shoes contact the swashblock. At this point, the back of the cylinder should be located slightly outside the back of the pump housing.

D. VALVE PLATE GROUP

Place pump housing on bench with open end facing up. Install new o'ring (28) and gasket (21) on housing. Make sure the tail end of shaft engages bushing while positioning the valve plate (22) on pins (19) and housing. Finger tighten hex head cap screw (25) closest to o'ring (28) first and then alternately tighten other cap screws per Table 7. On thru shaft units connected to another pump or device, install coupling half.

Table 7. TORQUES

SIZE UNIT	VALVE PLATE		CONTROL	
	Ft. Lbs.	N.m.	Ft. Lbs.	N.m.
04, 06, 10	15	20,4	8.3	11,3
11, 15, 20	37	50,3	8.3	11,3
25, 34, 45, 60	56	76,2	16.6	22,6

E. CONTROL GROUP

See reference material for applicable information on the control your unit is equipped with. See appropriate control reference for control group mounting. See Table 8 for Torques to secure control group to pump housing.

SEE SECTION "I. PREPARATION and INSTALLATION".

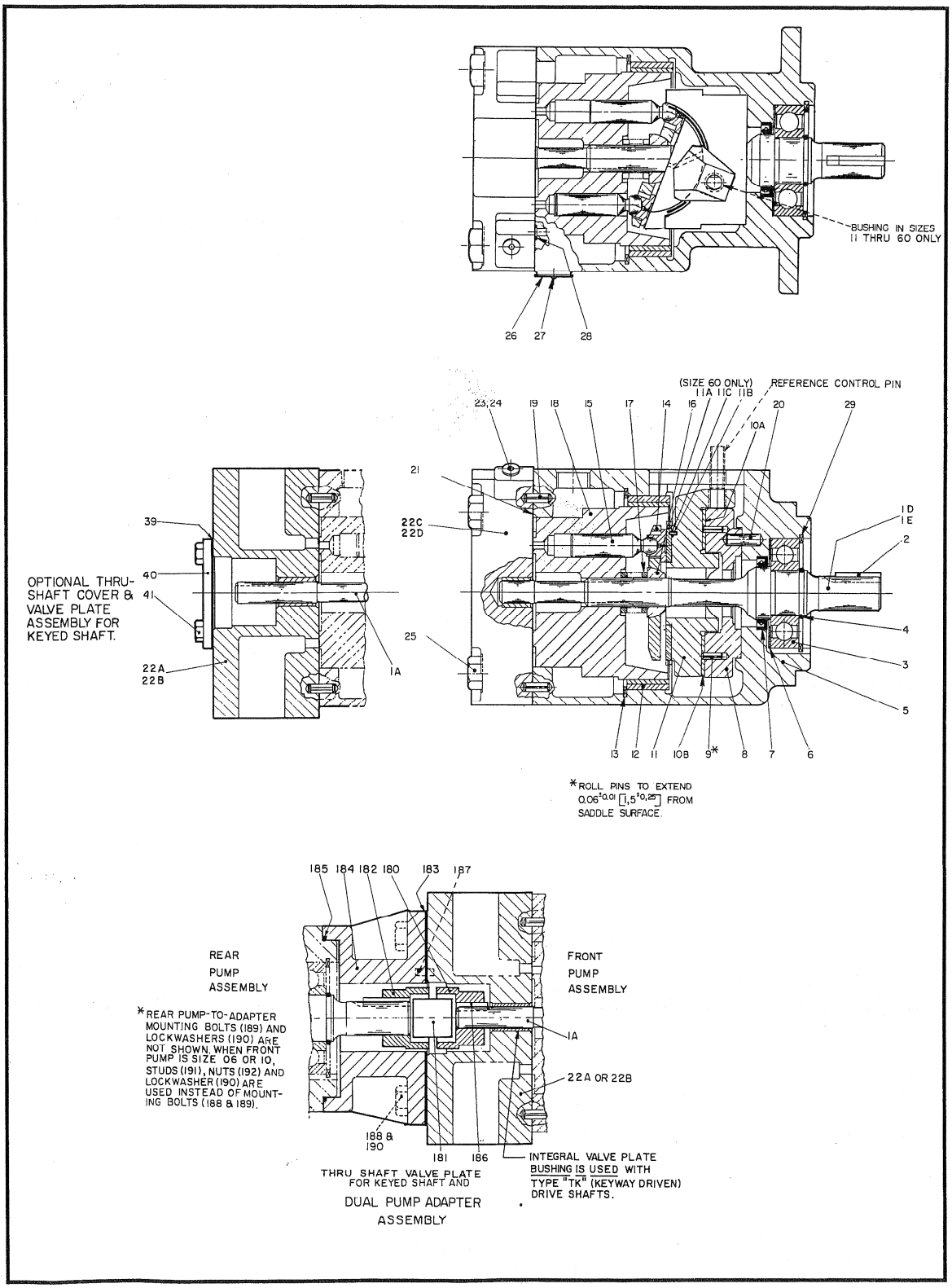


Figure 10. Parts Drawing, Basic "PVWH", "PVWW" and "PVW" Pumps without Controls. DS-SW-8A (511783)

X. PARTS LISTS

Parts used in this assembly are per Oilgear Specifications. Use Oilgear parts to ensure compatibility with assembly requirements. When ordering replacement parts, be sure to include pump type and serial number. To assure seal and packing compatibility, specify type of hydraulic fluid used.

ITEM NO.	DESCRIPTION
1A	Driveshaft w/Keyway (side port)
1B	Driveshaft w/SAE Spline (side port)
1D	Driveshaft w/Keyway (rear port)
1E	Driveshaft w/SAE Spline (rear port)
2	Key, Driveshaft
3	Bearing, Front Driveshaft
4	Ring, Shaft Retainer
5	Housing, Pump
6	Retainer, Seal
7	Seal, Shaft
8	Block, Saddle (items 8 & 9 sold as an assembly)
9	Pin, Roll (items 8 & 9 sold as an assembly)
10A	Bearing, Upper Saddle
10B	Bearing, Lower Saddle
11	Swashblock
11A	Wearplate, Swashblock (size 60 only)
11B	Pin, Roll (size 60 "PVWH" only)
11C	Seal, O'ring (size 60 "PVWH" only)
12	Bearing, Cylinder Hydrodynamic
13	Ring, Retainer
14	Retainer, Shoe
15	Assembly, Piston/Shoe

ITEM NO.	DESCRIPTION
16	Ball, Fulcrum
17	Spring, Shoe Retainer
18	Barrel, Cylinder
19	Pin, Roll
20	Pin, Saddle Locating
21	Gasket, Valve Plate
22A	Valve Plate, Side Port/rear shaft, LH
22B	Valve Plate, Side Port/rear shaft, RH
22C	Valve Plate, Rear Port, LH
22D	Valve Plate, Rear Port, RH
23	Seal, O'ring
24	Plug, SAE Hollow Hex
25	Screw, Hex. Hd.
26	Nameplate, Identification
27	Screw, Drive
28	Seal, O'ring
29	Ring, Driveshaft Bearing Retainer
39	Gasket
40	Cover
41	Screw, Hex. Hd. Cap

DUAL PUMP ADAPTER AND COUPLING KITS

SIZE 04, 06 & 10

ITEM NO.	DESCRIPTION
*185	Seal, O'ring
*190	Lockwasher
*191	Stud
*192	Nut

*Used when 04, 06 or 10 is front pump in dual arrangement instead of bolts (188 and 189).

SIZE 11 THRU 60

ITEM NO.	DESCRIPTION
180	Coupling, Front
181	Key, Coupling
182	Coupling, Rear
183	Gasket, Adapter
184	Adapter
185	Seal, O'ring
186	Key, Coupling
187	Pin, Roll
188	Screw, Hex. Hd. Cap
189	Screw, Hex. Hd. Cap (not shown)
190	Lockwasher (not shown)
191	Coupling, Spline
192	Pin, Roll

O'RING SIZES

ARP 568 Uniform Size Number with Durometer

ITEM NO.	PUMP SIZE		
	04, 06, 10	11, 15, 20	25, 34, 45, 60
11C			"PVWH" 60 Only 006 - 70
23	902 - 90	902 - 90	902 - 90
28	010 - 90	010 - 90	*010 - 90 012 - 90
185	**	**	**

* Used on early units.
** Consult factory.

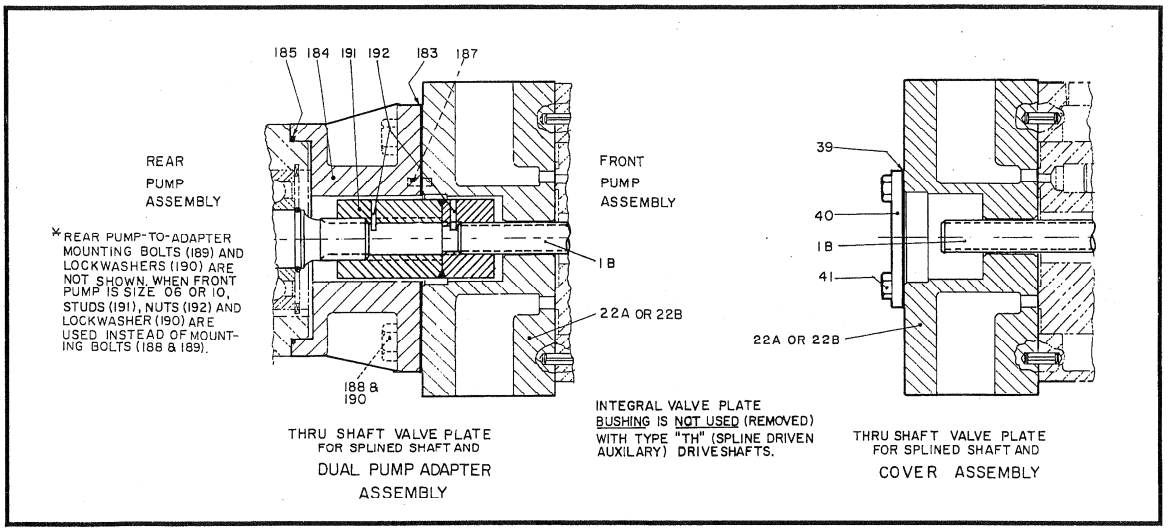


Figure 11. Parts drawing Showing Driveshaft w/SAE Spline Shaft (Side Ports) DS-SW-8A. (511783)

IT IS RECOMMENDED THAT SPARE OR REPLACEMENT PARTS BE ORDERED AS PART OF THE FOLLOWING KITS.

HOUSING & PINS
KIT No. 72

ITEM	DESCRIPTION
5	Housing, Pump
7	Seal, Shaft
19	Pin, Roll
20	Pin, Saddle Locating

ROTATING GROUP
Kit No. 73

14	Retainer, Shoe
15	Assembly, Piston/Shoe
16	Ball, Fulcrum
17	Spring, Shoe Retainer
18	Barrel, Cylinder

SHAFT & BEARING
Kit No. 74

1	Driveshaft
2	Key, Driveshaft
3	Bearing, Front Driveshaft
4	Ring, Front Driveshaft
6	Retainer, Seal
29	Ring, Driveshaft Bearing Retainer

GASKET & SEAL
Kit No. 77

7	Seal, Shaft
21	Gasket, Valve Plate
23	Seal, O'ring
28	Seal, O'ring

VALVE PLATE
Kit No. 79

21	Gasket, Valve Plate
22	Valve, Plate
23	Seal, O'ring
24	Plug, Hollow Hex
25	Screw, Hex. Hd.
28	Seal, O'ring

SCREWS, KEY & TAG
Kit No. 80

ITEM	DESCRIPTION
2	Key, Driveshaft
25	Screw, Hex. Hd.
26	Nameplate, Identification
27	Screw, Drive

ROTATING GROUP BEARING
Kit No. 81

12	Bearing, Cylinder Hydrodynamic
13	Ring, Retainer

SWASHBLOCK
Kit No. 82

11	Swashblock

SADDLE
Kit No. 84

8	Block, Saddle
9	Pin, Roll
10A	Bearing, Upper Saddle
10B	Bearing, Lower Saddle

SADDLE BEARING
Kit No. 85

10A	Bearing, Upper Saddle
10B	Bearing, Lower Saddle

NOTES:

SERVICE INSTRUCTIONS

Bulletin 947515

HYDURA TYPE "CN" AND "CL" PRESSURE COMPENSATOR CONTROLS FOR "PVW" PUMPS

PURPOSE OF INSTRUCTIONS:

These instructions have been prepared to simplify and minimize your work of operating HYDURA type "CN" and "CL" controlled units. This material will inform you as to basic construction, principle of operation and service part listings. Some controls may be modified for specific applications from those described in this bulletin and other changes may be made without notice.

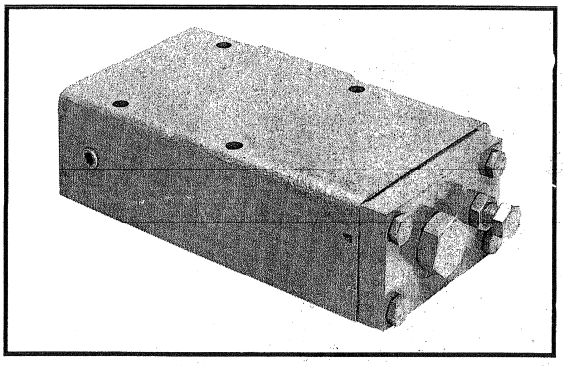
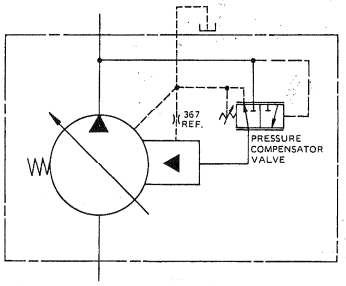


Figure 1. Typical "CN/CL" type control for HYDURA "PVW" pumps (55160).



ASA diagram for "CN/CL" control shown with typical pump.

I. PRINCIPLE OF OPERATION

Refer to figure 3. The pressure compensator control ensures maximum pump flow until the system reaches the controls preset pressure setting. The control then regulates the pump output flow to match the flow requirements of the system while maintaining the preset output pressure. When the system pressure exceeds the compensator control setting, or the system no longer requires flow, the control destrokes the pump while maintaining the preset pressure. "CN" controls can be adjusted from 750 psi (51,7 bar) working pressure up to the maximum pressure rating of the applicable pump, "CL" controls can be adjusted from 250 psi (17,2 bar) working pressure up to a maximum of 1500 psi (103,4 bar). Remote pressure compensating control option can be accomplished by using an adjustable sequence type valve (separate) remote from control.

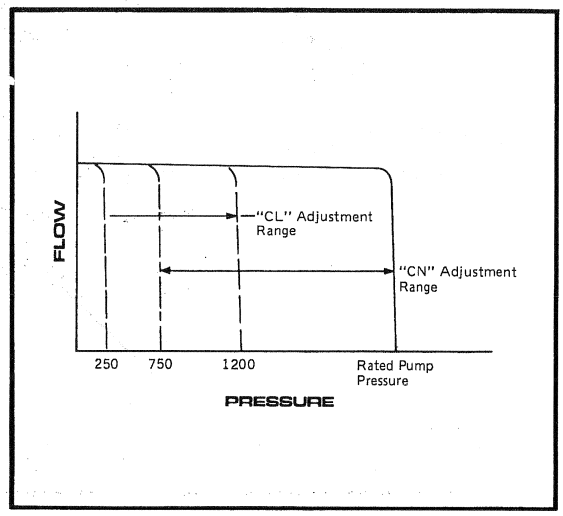


Figure 2. Curve indicating flow vs pressure for "CN/CL" type controls.

REFERENCE MATERIAL

DESCRIPTION	BULLETIN
Fluid Recommendations	90000
Filtration Recommendations	90007
"PVW" and "PVWH" Variable Delivery Pumps	947015

THE OILGEAR COMPANY
2300 So. 51st. Street
Milwaukee, Wisconsin 53219

Reissued: March, 1991

PARTS USED IN THIS ASSEMBLY ARE PER HYDURA SPECIFICATIONS. USE HYDURA PARTS TO INSURE COMPATIBILITY WITH ASSEMBLY REQUIREMENTS. WHEN ORDERING REPLACEMENT PARTS, INCLUDE TYPE DESIGNATION, SERIAL NUMBER STAMPED ON NAMEPLATE, ITEM NUMBER AND BULLETIN NUMBER. WHEN ORDERING O-RINGS AND SEALS, SPECIFY TYPE OF HYDRAULIC FLUID USED.

PARTS LIST

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
303	Screw, HHC Mounting	370	Spring, Control Piston
355	O-ring	371	Plug, Control
356	O-ring	372	Cover, Control Housing
357	Nut, Jam	373	Pin, Control Piston
358	Screw, Pressure Adjusting	374	Screw, SHC
359	Plug, SAE	375	O-ring
360	Plug, SAE	376	Assembly, Pressure Compensator Adjusting
361	Plug, SAE	380	O-ring
362	Piston, Control	381	Stop, Control Piston (Sizes 15-60 Only)
363	Spool, Pressure Compensator	382	Sleeve, Control Piston Stop (Sizes 34-60 Only)
364	Seat, Spring	390	Nut, Jam
365	Gasket, Cover	391	Stem, Minimum Volume Stop
366	Spring, Pressure Compensator	392	Adapter, Minimum And Maximum Volume Stem
367	Orifice, Control Piston (.040)	393	Stem, Maximum Volume Stop
368	Housing, Control	394	O-ring
369	Gasket, Control Housing		

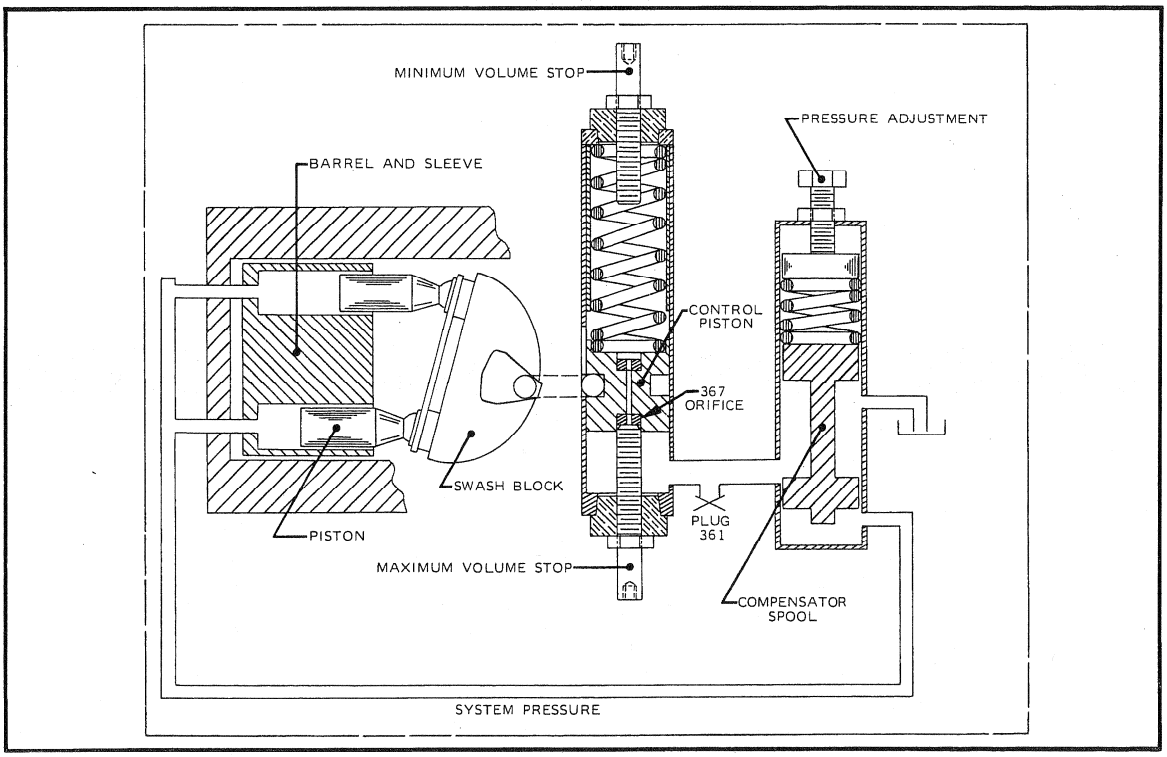


Figure 3. Diagram illustrating swashblock at full delivery and type "CN/CL" control at maximum volume stop.

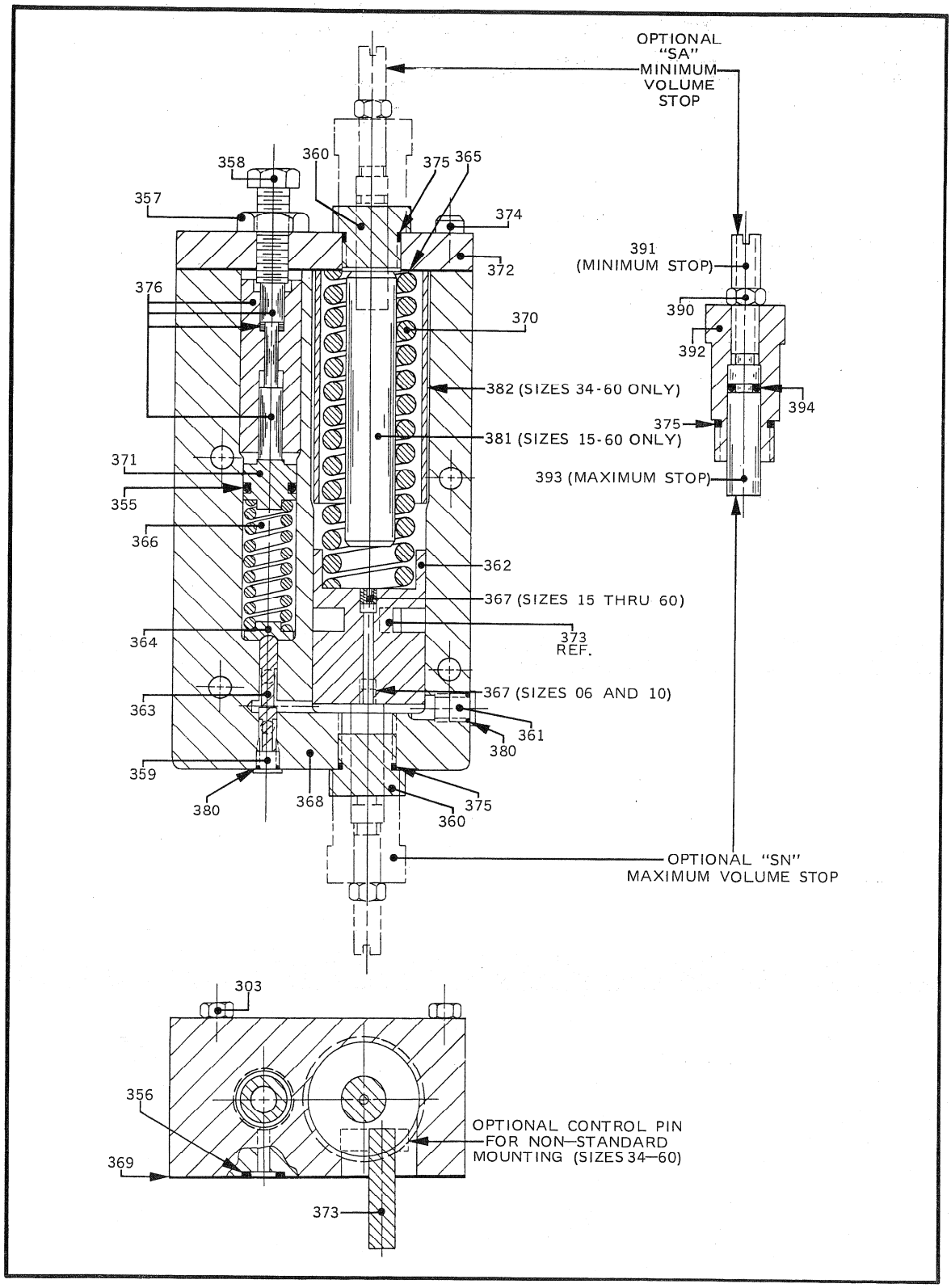


Figure 4. Parts drawing, HYDURA type "CN/CL" control (509820-B).

LINE MOUNTED REMOTE PRESSURE CONTROL FOR TYPE "CN/CL" PUMP CONTROLS

Refer to figure 5. Remote operation of "CN/CL" controls can be assomplished by installing a HYDURA remote compensator valve (Number LM-HSS-801-35) at the locations shown in the control circuit.

REMOTE PRESSURE CONTROL OPERATION:

When system pressure reaches the setting of the remote pressure compensating valve, the valve opens and ports fluid into the control piston chamber via the maximum volume stop hole. When a maximum volume stop is used, a plug (number 361 on "CN/CL" controls) must be removed to allow fluid to be ported to the control piston chamber. This fluid flow causes the pump to destroke and maintain system pressure.

MINOR CHANGES TO PUMP CONTROL:

The compensator setting on the pump control must be set at least 200 psi (13,8 bar) higher than the required maximum system pressure setting of the remote compensator valve. Doing this will prevent the pump compensator control from interacting with the remote adjustable compensator (sequence) valve.

NOTE:

Maximum volume stop adjusts from zero stroke to full stroke as follows:

SIZE	NUMBER OF TURNS
06/10	11 TURNS
15/20	14.5 TURNS
34/45/60	18 TURNS

REMOTE COMPENSATOR / MINIMIZING CASE LEAKAGE:

Refer to figure 6. To minimize case leakage and power loss, plug the drain port of the compensating spool (located on the underside of the control body) with a number 10-24 setscrew. This will result in maintaining the standard "CN" or "CL" control case leakage although response time will decrease slightly by a few milliseconds. Standard response time, if needed, can be obtained by installing a .040" orifice in the compensating spool drain instead of plugging it.

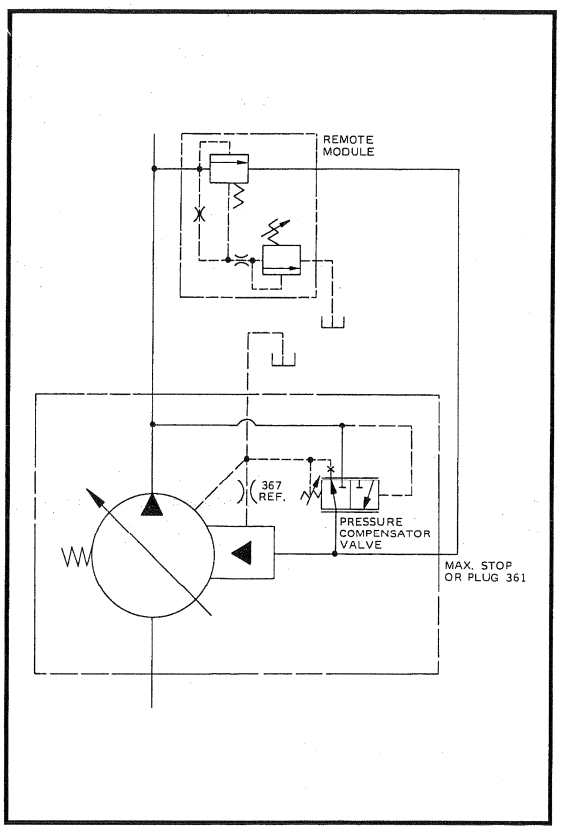


Figure 5. "CN/CL" control circuit with remote pressure control.

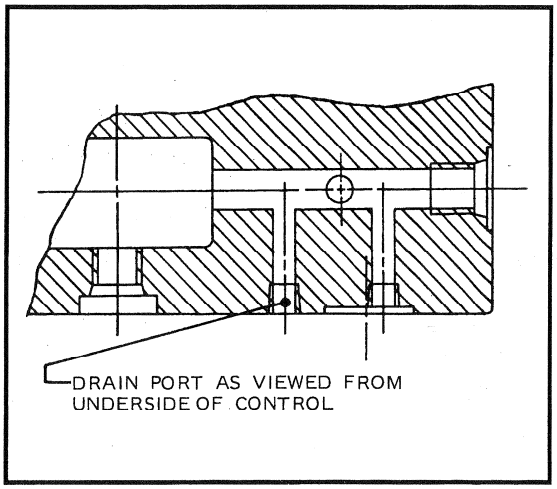


Figure 6. "CN/CL" control drain port location.

THE OILGEAR COMPANY
2300 So. 51st. Street
Milwaukee, Wisconsin 53219

Bulletin 947515

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TRONAIR

APPENDIX VI

Material Safety Data Sheet (MSDS) Hydraulic Fluid

Material Safety Data Sheet

Section 1. Chemical Product and Company Identification

Common Name	**BRAYCO MICRONIC 882**	Code	27009-AW
Supplier	CASTROL INDUSTRIAL NORTH AMERICA INC. 1001 WEST 31ST STREET DOWNERS GROVE, IL 60515-1280 Product Information: 630 241-4000	Validation Date	10/11/2002
		Print Date	10/11/2002
Synonym	Brayco Micronic 882 (Red)		
Trade name	Not available.	Responsible Name	Product Stewardship
Material Uses	Industrial applications	In Case of Emergency	CHEMTREC (800) 424-9300
Manufacturer	CASTROL INDUSTRIAL NORTH AMERICA INC 1001 WEST 31ST STREET DOWNERS GROVE, IL 60515-1280		

Section 2. Composition, Information on Ingredients

Name	CAS #	% by Weight	Exposure Limits
Hazardous Ingredients - None Known			

Section 3. Hazards Identification

Physical state / Appearance

Liquid.

Mild. Petroleum Odor (Slight.)

Red. Liquid.

Emergency Overview

CAUTION!

MAY CAUSE EYE AND SKIN IRRITATION.
MIST: MAY CAUSE RESPIRATORY TRACT IRRITATION.

Avoid contact with skin and eyes. Wash thoroughly after handling. Do not ingest. However, in light of good industrial hygiene, exposure to any chemical should be kept to a minimum.

Routes of Entry

Skin Contact. Eye contact. Inhalation. Ingestion.

Potential Acute Health Effects

Eyes May cause eye irritation.

Skin May cause skin irritation.

Inhalation Vapor: Solution may cause irritation of mouth, throat, and esophagus. High vapor concentrations can cause headaches, dizziness, drowsiness, and nausea, and may lead to unconsciousness. Vapor: Prolonged repeated exposure may cause chemical pneumonitis.

Ingestion Oral LD50: Not established. Ingestion may cause gastrointestinal irritation and diarrhea.

No additional remark.

Potential Chronic Health Effects

Prolonged or repeated contact can defat the skin and lead to irritation and/or dermatitis.
CARCINOGENIC EFFECTS:No component of this product at levels greater than 0.1% is identified as a carcinogen by ACGIH or the International Agency for Research on Cancer (IARC). No component of this product present at levels greater than 0.1% is identified as a carcinogen by the U.S. National Toxicology Program (NTP) or the U.S. Occupational Safety and Health Act (OSHA).
MUTAGENIC EFFECTS:No component of this product at levels greater than 0.1% is classified by established regulatory criteria as a mutagen.
TERATOGENIC EFFECTS:No component of this product at levels greater than 0.1% is classified by established regulatory criteria as teratogenic or embryotoxic.

Continued on Next Page

Medical Conditions Aggravated by Overexposure:	Repeated or prolonged exposure is not known to aggravate medical condition.
Overexposure /Signs/Symptoms	Not available.

See Toxicological Information (section 11)

Section 4. First Aid Measures

Eye Contact	Flush with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical attention.
Skin Contact	Wash contaminated skin with soap and water. Get medical attention if irritation develops. Wash clothing before reuse.
Inhalation	Breathing difficulty or Respiratory tract irritation: Remove to fresh air. If the victim is not breathing, perform mouth-to-mouth resuscitation. If breathing is difficult, give oxygen. Get medical attention immediately.
Ingestion	If affected person is conscious, give plenty of water to drink. NEVER give an unconscious person anything to ingest. Do not induce vomiting. ASPIRATION HAZARD. If vomiting occurs, keep head lower than hips to help prevent aspiration. Get medical attention immediately.
Notes to Physician	Not available.

Section 5. Fire Fighting Measures

Flammability of the Product	May be combustible at high temperature.
Autoignition temperature	Not available.
Flash Point	OPEN CUP: 245°C (473°F) (Cleveland.).
Flammable Limits	Not available.
Products of Combustion	These products are carbon oxides (CO, CO2).
Fire Hazards in Presence of Various Substances	Slightly flammable to flammable in presence of open flames, sparks and static discharge, of shocks, of heat, of oxidizing materials.
Explosion Hazards in Presence of Various Substances	This material is not explosive as defined by established regulatory criteria.
Fire Fighting Media and Instructions	SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Cool closed containers exposed to fire with water. Hot containers may explode. Use water spray to keep fire exposed containers cool. Do not use water jet.
Protective Clothing (Fire)	Fire fighters should wear positive pressure self-contained breathing apparatus (SCBA) and full turnout gear.
Special Remarks on Fire Hazards	None identified.
Special Remarks on Explosion Hazards	None identified.

Continued on Next Page

Section 6. Accidental Release Measures

Small Spill and Leak	Absorb with an inert material and put the spilled material in an appropriate waste disposal. Do not allow any potentially contaminated water including rain water, runoff from fire fighting or spills to enter any waterway, sewer or drain.
Large Spill and Leak	Absorb with an inert material and put the spilled material in an appropriate waste disposal. Do not allow any potentially contaminated water including rain water, runoff from fire fighting or spills to enter any waterway, sewer or drain.

Section 7. Handling and Storage

Mist/Aerosol.: Over-exposure by inhalation may cause respiratory irritation. However, in light of good industrial hygiene, exposure to any chemical should be kept to a minimum. Do not ingest. Avoid contact with eyes, skin and clothing. Wash thoroughly after handling.

Keep container tightly closed. Keep container in a cool, well-ventilated area. Empty containers may contain harmful, flammable/combustible or explosive residue or vapors. Do not cut, grind, drill, weld, reuse or dispose of containers unless adequate precautions are taken against these hazards.

Section 8. Exposure Controls and Personal Protection

Engineering Controls	Mist/Aerosol.: Over-exposure by inhalation may cause respiratory irritation. Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective occupational exposure limits. However, in light of good industrial hygiene, exposure to any chemical should be kept to a minimum.

Personal Protection

Eyes	Safety glasses with side shields. OR Chemical splash goggles.
Body	Avoid prolonged or repeated contact with skin. Wear clothing and footwear that cannot be penetrated by chemicals or oil.
Respiratory	A respirator is not needed under normal and intended conditions of product use. Wear appropriate respirator when ventilation is inadequate.
Hands	Impervious gloves.
Feet	Not applicable.

Protective Clothing (Pictograms)

Personal Protection in Case of a Large Spill: Splash goggles. Full suit. Boots. Gloves. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Product Name	Exposure Limits
No hazardous ingredients.	

Consult local authorities for acceptable exposure limits.

Continued on Next Page

Section 9. Physical and Chemical Properties

Physical state / Appearance	Liquid.
Boiling/Condensation Point	Not available.
Melting/Freezing Point	Not available.
pH (Concentration)	Not available.
pH Dilution % and Value	Not available.
Critical Temperature	Not available.
Specific Gravity	0.84 (Water = 1)
Vapor Pressure	Not available.
Vapor Density	Not available.
Volatility	Not available.
Odor Threshold	Not available.
Evaporation Rate	Not available.
VOC	Not available. VOC Method Not available.
Viscosity	14.0 minimun cSt @ 40C
Solubility	Very slightly soluble in cold water, hot water.
Physical Chemical Comments	Not available.

Odor	Mild, Petroleum Odor (Slight.)
Taste	Not available.
Color	Red, Liquid.

Section 10. Stability and Reactivity

Stability and Reactivity	The product is stable.
Conditions of Instability	Avoid excessive heat.
Incompatibility with Various Substances	Reactive with oxidizing agents, acids, alkalis.
Hazardous Decomposition Products	carbon oxides (CO, CO2), sulfur oxides (SO2, SO3...), nitrogen oxides (NO, NO2...)
Hazardous Polymerization	Will not occur.

Section 11. Toxicological Information

Toxicity to Animals	LD50: Not available. LC50: Not available.
Chronic Effects on Humans	Prolonged or repeated contact can defat the skin and lead to irritation and/or dermatitis. CARCINOGENIC EFFECTS:No component of this product at levels greater than 0.1% is identified as a carcinogen by ACGIH or the International Agency for Research on Cancer (IARC). No component of this product present at levels greater than 0.1% is identified as a carcinogen by the U.S. National Toxicology Program (NTP) or the U.S. Occupational Safety and Health Act (OSHA). MUTAGENIC EFFECTS:No component of this product at levels greater than 0.1% is classified by established regulatory criteria as a mutagen. TERATOGENIC EFFECTS:No component of this product at levels greater than 0.1% is classified by established regulatory criteria as teratogenic or embryotoxic.

Continued on Next Page

	REPRODUCTIVE EFFECTS: No component of this product at levels greater than 0.1% is classified by established regulatory criteria as a reproductive toxin.
Other Toxic Effects on Humans	No specific information is available in our database regarding the other toxic effects of this material for humans.
Special Remarks on Toxicity to Animals	No additional remark.
Special Remarks on Chronic Effects on Humans	No additional remark.
Special Remarks on Other Toxic Effects on Humans	No additional remark.

Section 12. Ecological Information

Ecotoxicity	Not determined.
BOD and COD	Not determined.
Biodegradable/OECD	Not determined.
Mobility	Not determined.
Products of Degradation	carbon oxides (CO, CO2), sulfur oxides (SO2, SO3...), nitrogen oxides (NO, NO2...)
Toxicity of the Products of Biodegradation	Not determined.
Special Remarks on the Products of Biodegradation	No additional remark.

Section 13. Disposal Considerations

Waste Information	Waste must be disposed of in accordance with federal, state and local environmental control regulations. Keep out of waterways. Disposal of this material to the land may be banned by federal law (40 CFR 268).
RCRA Waste Code(s)	USED OIL
Waste Stream	Not determined.

Consult your local or regional authorities.

Section 14. Transport Information

DOT Classification	Not a DOT controlled material (United States).
Marine Pollutant	Not available.
Special Provisions for Transport	NOT REGULATED
ADR/RID Classification	Not determined.
IMO/IMDG Classification	Not determined.
ICAO/IATA Classification	Not determined.

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Section 15. Regulatory Information

U.S. Federal Regulations

TSCA 8(d) H and S data reporting: PHENOL, 4-(1,1-DIMETHYLETHYL)-, PHOSPHATE (3:1): 1982; PHOSPHORIC ACID, (1,1-DIMETHYLETHYL)PHENYL DIPHENYL ESTER: 1982; TRIPHENYL PHOSPHATE: 1982; ETHYL BENZENE: 1987; TOLUENE: 1982; O-TOLUIDINE: 1986; ANILINE: 1982

SARA 302/304 emergency planning and notification: No products were found.

SARA 311/312 MSDS distribution - chemical inventory - hazard identification: Not listed.

SARA 313 toxic chemical notification and release reporting: No products were found.

Clean Water Act (CWA) 307: ETHYL BENZENE; TOLUENE; BENZENE
Clean Water Act (CWA) 311: No products were found.
Clean air act (CAA) 112 accidental release prevention: No products were found.
Clean air act (CAA) 112 regulated toxic substances: No products were found.
Clean air act (CAA) 112 regulated flammable substances: No products were found.

State Regulations

No products were found.

California Prop 65: WARNING! This product contains trace amounts of the following chemicals which the State of California has found to cause cancer, birth defects or other reproductive harm.: TOLUENE; O-TOLUIDINE; ANILINE; BENZENE

Inventory Lists

TSCA 8(b) inventory: In compliance.

CEPA DSL: In compliance.

Australia (NICNAS): In compliance.

Korea (TCCL): Not determined.

Philippines (RA6969): Not determined.

MITI: In compliance.

EINECS: In compliance.

Section 16. Other Information

Label Requirements

MAY CAUSE EYE AND SKIN IRRITATION.
MIST: MAY CAUSE RESPIRATORY TRACT IRRITATION.

Hazardous Material Information System (U.S.A.)

Health	1
Flammability	1
Reactivity	0
Personal Protection	b

National Fire Protection Association (U.S.A.)

References Not available.

Other Special Considerations No additional remark.

Validated by Product Stewardship on 10/11/2002. | Printed 10/11/2002.

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CHEMTREC (800) 424-9300

Notice to Reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above named supplier nor any of its subsidiaries assumes any liability whatsoever for the accuracy or completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

TRONAIR

APPENDIX VII

ANSI/B93.19M-1972
(R1993-Excerpt)

AMERICAN NATIONAL STANDARD

ANSI/B93.19M-1972 (R1993)
First edition
6 December 1972

AMERICAN NATIONAL STANDARDS INSTITUTE • A NATIONAL STANDARD FOR FLUID POWER

Hydraulic fluid power — Particulate contamination analysis — Extraction of fluid samples from lines of an operating system

(Technically identical to ISO 4021:1977)
(NFPA/T2.9.1-1972)
(Metric only)

SPONSOR

National
FLUID POWER
Association

Descriptors: hydraulic fluid power, liquids, chemical analysis, sampling, contamination.

Hydraulic fluid power — Particulate contamination analysis — Extraction of fluid samples from lines of an operating system

0 Introduction

In hydraulic fluid power systems, power is transmitted and controlled through a fluid under pressure within an enclosed circuit. The fluid is both a lubricant and a power-transmitting medium

Reliable system performance requires control of the fluid medium. Qualitative and quantitative determination of particulate contamination in the fluid medium requires precision in obtaining the sample and determining the nature and extent of contamination.

The most representative sample is obtained from a system while the fluid is following in a turbulent manner. This standard gives the procedure for obtaining that sample, known as a dynamic sample.

1 Scope

This standard specifies a method of extracting dynamic fluid samples from a line of an operating hydraulic fluid power system.

The hydraulic fluid samples must be representative of the particulate contaminant in the fluid flowing at the point of sampling. (The samples are used for particulate contamination analysis.)

2 References

ISO 1219, *Fluid power systems and components — Graphic symbols.*

ISO 5598, *Fluid power — Vocabulary.*

3 Definitions

3.1 fluid sampling, dynamic: The extraction of a sample of fluid from a turbulent section of a flow stream.

3.2 fluid sampling, static: The extraction of a sample of fluid from a fluid at rest.

3.3 sampler, turbulent: A device for creating turbulence in the main stream while extracting a fluid sample.

3.4 For definitions of other terms used, see ISO 5598.

4 Graphic symbols

Graphic symbols used are in accordance with ISO 1219.

5 Rules

5.1 Use a dynamic fluid sampling method (see clause 7).

5.2 Control the rate of sample extraction only by means of a capillary restriction.

5.3 Attach the sampling device permanently, or by a quick disconnect coupling.

6 Sampling device

Note — Take normal precautions to safeguard personnel and equipment.

6.1 Use a typical sampling device as shown in the figure if turbulent flow conditions exist in the main stream.

6.1.1 Permanently attach the ball valve or the valved portion of the quick disconnect coupling to the port through which the sample is to be taken.

6.1.2 Provide a dust cap for the item in 6.1.1.

6.1.3 Use the remaining equipment only for sampling.

6.1.4 Select capillary tubing having an inside diameter and length consistent with the sampling rate desired.

6.1.4.1 Do not use capillary tubing having an inside diameter smaller than 1,25 mm. Other cross-sections (such as rectangular) may be used provided that the smallest inside dimension is not less than 1 mm.

6.1.4.2 Sharpen and deburr the ends of the capillary tube to facilitate subsequent piercing of the film covering the sampling bottle mouth.

6.2 If turbulence in the flow stream cannot be ensured, use a means of creating turbulence such as a turbulent flow sampler.

7 Sampling procedure

7.1 Where a sampling device incorporating a quick disconnect coupling is used, attach the separable portions of the sampling device to the permanently attached portion.

7.2 Open the ball valve.

7.3 Pass a minimum of 200 cm^3 of fluid through the sampling device before collecting the fluid.

7.4 Without disturbing the ball valve, place the sampling bottle in position to collect the fluid.

7.4.1 Use the sharp end of the capillary tubing to pierce the plastic film covering the bottle mouth.

7.4.2 Take a sample of not more than 75 % and not less than 50 % of the sampling bottle volume.

7.5 When a sufficient sample has been collected, remove the sampling bottle before turning off the flow with the ball valve.

7.6 Recap the sample bottle immediately after withdrawing the capillary tubing.

7.7 Where a sampling device incorporating a quick disconnect coupling is used, disconnect the separable portions of the sampling device and remove any residual fluid films by flushing with a suitable solvent.

7.8 Immediately upon disconnection, replace the dust cap on the permanently mounted section of the quick disconnect coupling.

8 Identification statement

Use the following statement in test reports, catalogs and sales literature when electing to comply with this standard:

"Method of extracting fluid samples conforms to ANSI/B93.19M-1972, *Hydraulic fluid power — Particulate contamination analysis — Extraction of fluid samples from lines of an operating system.*"

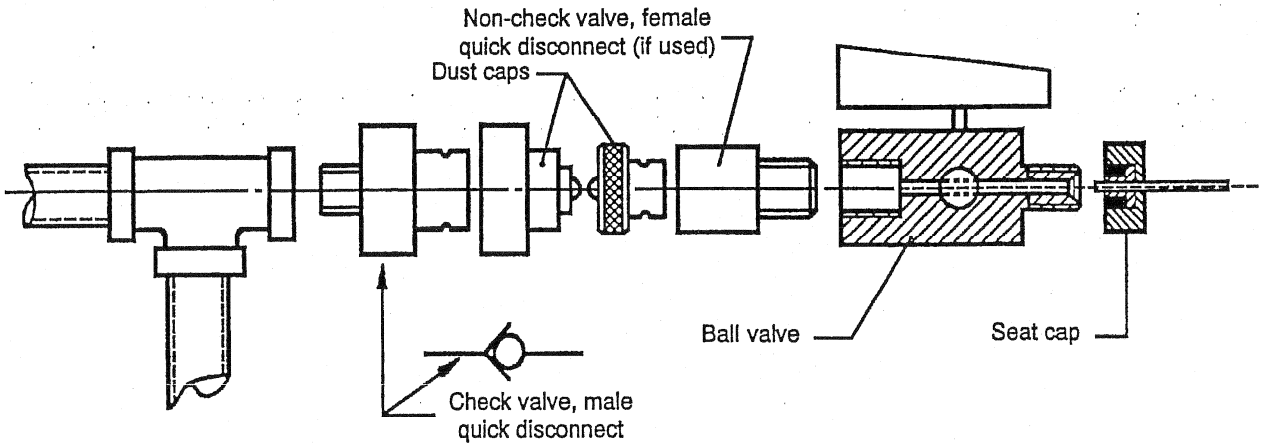

Figure 1 — Typical field type sampling device

APPENDIX VIII

Instrument Certification Notice

Instrument Certification Notice

The gauge Certificates of Calibration supplied for the gauge(s) on this unit contain the calibration data for the actual instrument calibrated, along with the calibration date of the **STANDARD** used to perform the calibration check.

The due date for re-calibration of the instrument should be based upon the date the instrument was placed in service in your facility. Re-calibration should be done on a periodic basis as dictated by the end user's quality system or other overriding requirements.

Note that Tronair, Inc. does not supply certificates of calibration on flow meters or pyrometers unless requested at the time of placed order. These instruments are considered reference indicators only and are not critical to the test(s) being performed on the aircraft.

1740 Eber Rd
Holland, OH 43528-9794
USA

Tronair, Inc.
www.tronair.com
Email: sales@tronair.com

Phone: (419) 866-6301
800-426-6301
Fax: (419) 867-0634