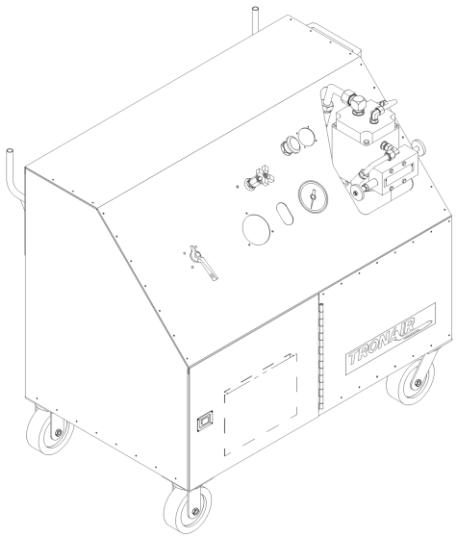
OPERATION & SERVICE MANUAL



51X0 Series
5110, 5120, 5130, 5140
Hydraulic Power Units

08/2021 – Rev. 02

For Spare Parts, Operations & Service Manuals or Service Needs
Scan the QR code or visit Tronair.com/aftermarket

Tronair, Inc.
1 Air Cargo Pkwy East
Swanton, OH 43558

Phone: (419) 866-6301 | 800-426-6301
Web: www.tronair.com
Email: sales@tronair.com

REVISION	DATE	TEXT CHANGED
01	11/2017	Original release
07	08/2021	Added section 5.6 Infrequent HPU Use and updated 8.0 Maintenance

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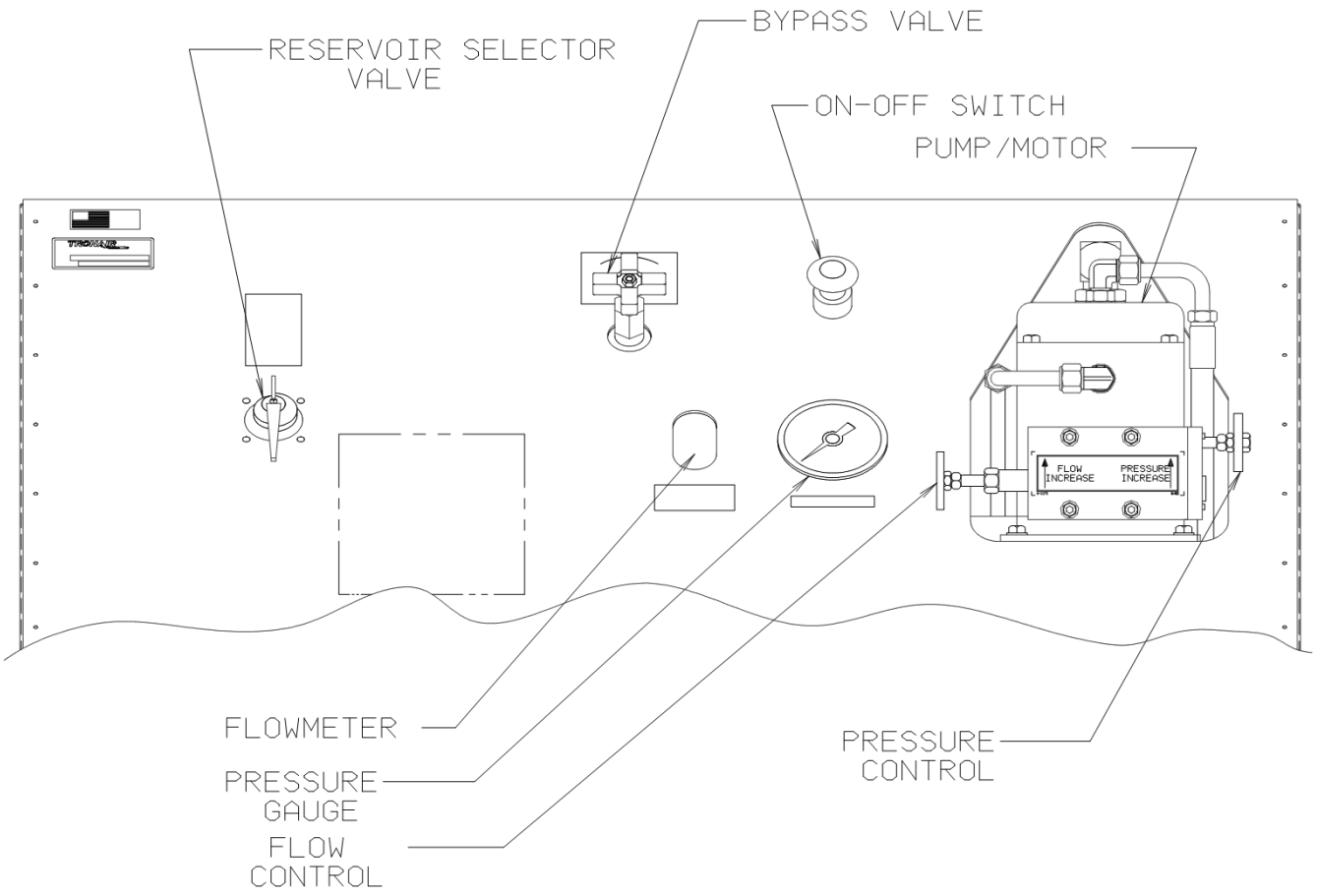
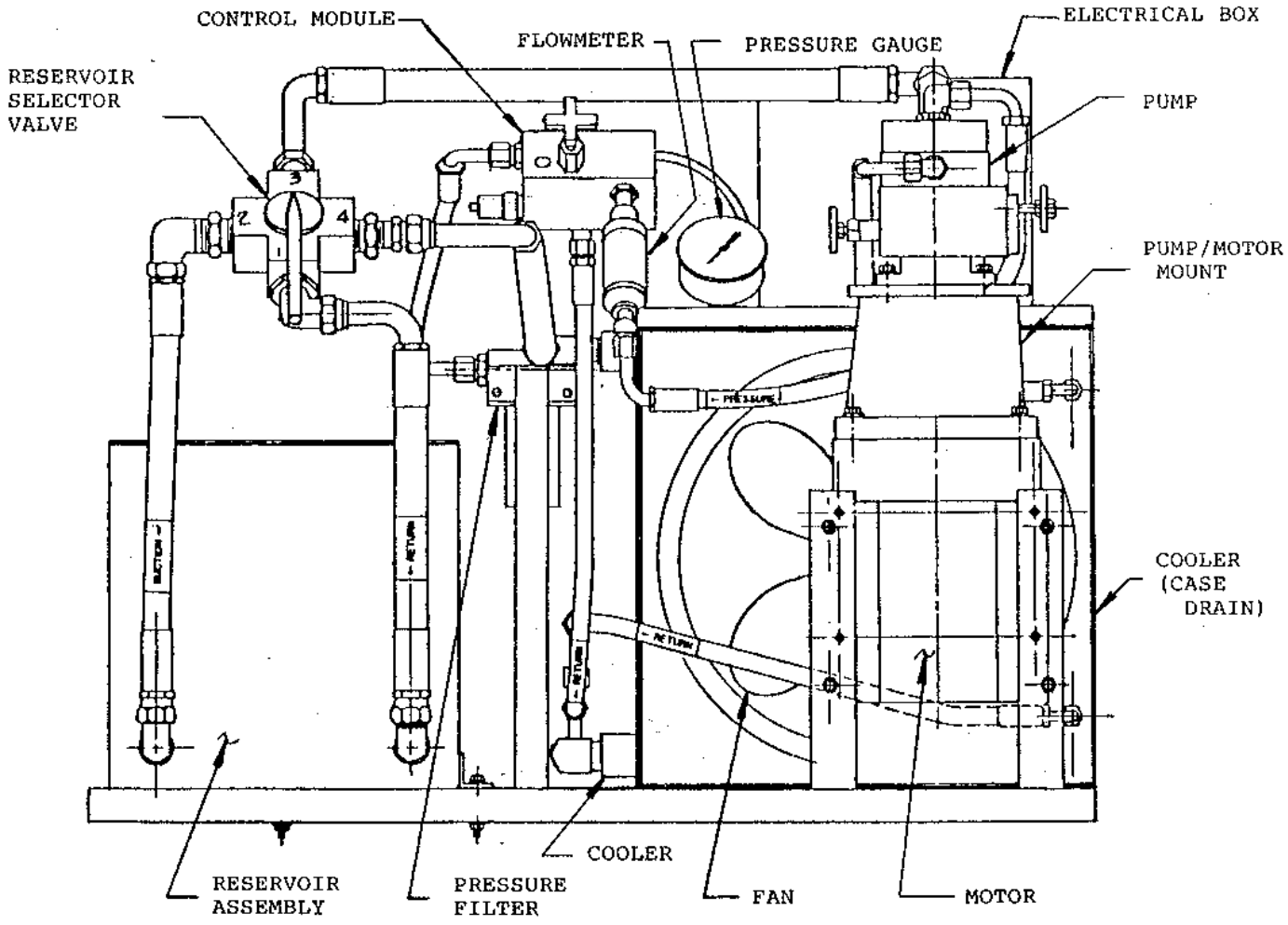
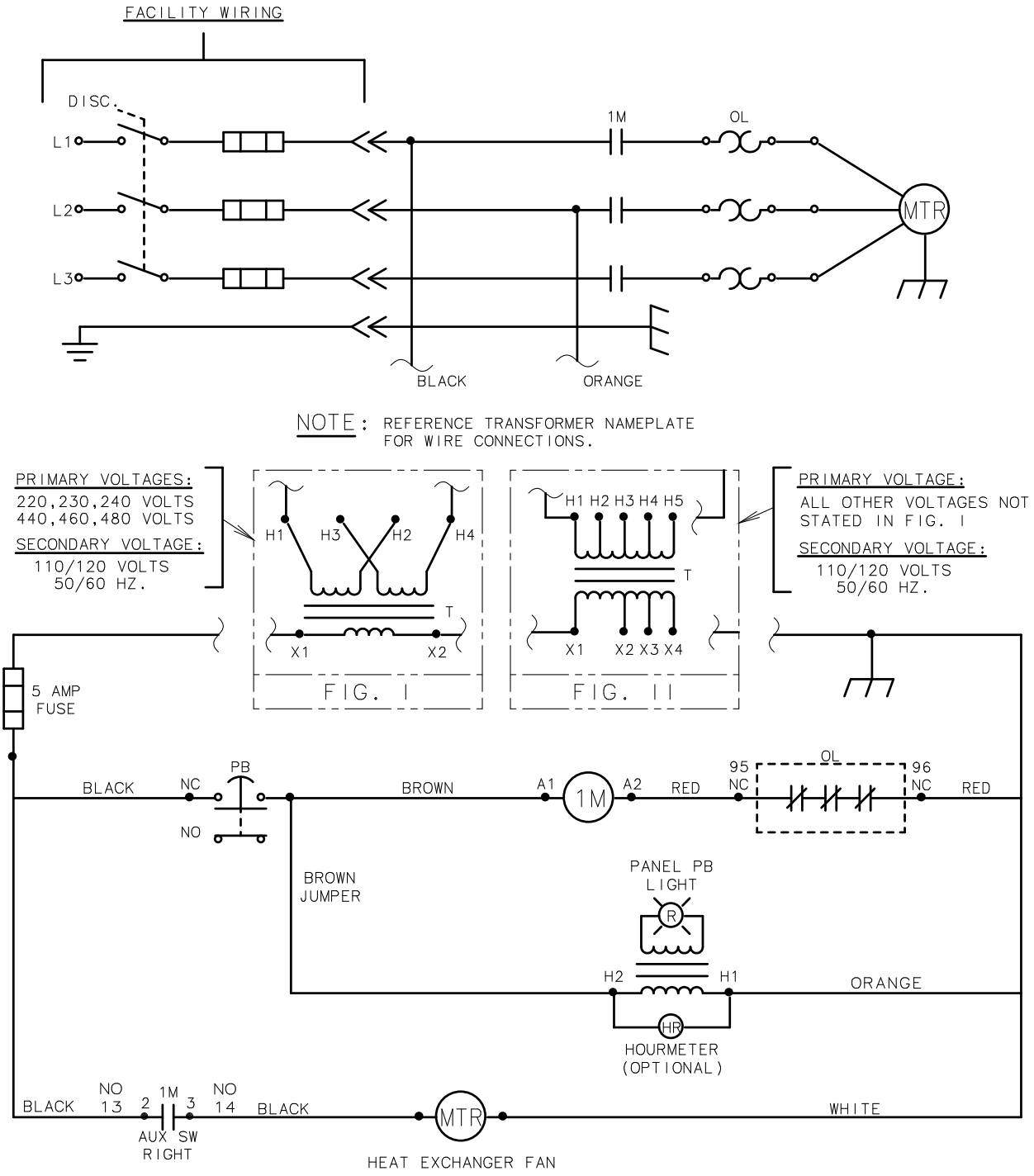
Front Panel Controls



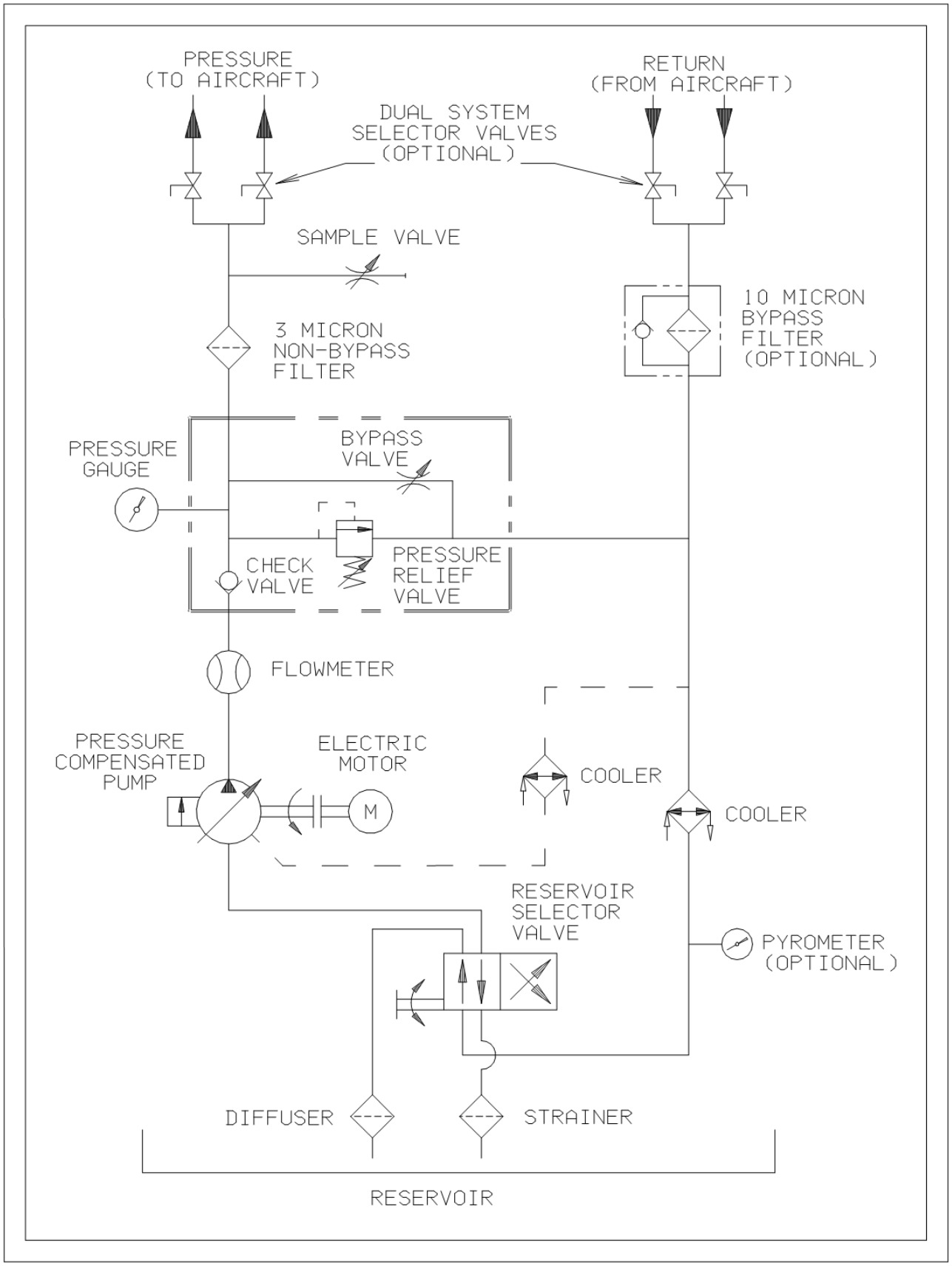
Internal Components



Electrical Schematic



Hydraulic Schematic



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., it 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

The Tronair Hydraulic Power Unit (HPU) provides a source of clean, pressurized hydraulic fluid for performing required aircraft maintenance.

Hydraulic Power Unit

Model Number	**Fluid Type**
5110	MIL-PRF-5606
5120	MIL-PRF-83282
5130	Aviation Phosphate Ester, Type IV and V
5140	MIL-PRF-87257

Some important features are:

- Pressure compensated pump with integral pressure and flow controls
- 10 gallon (37.8 liters) reservoir w/selector valve
- Bypass valve
- Case drain cooler
- Manual starter with overload protection
- Non bypass filter with 2 micron filter element

1.2 MODEL & SERIAL NUMBER

Reference nameplate on unit

1.3 MANUFACTURER

TRONAIR, Inc.
1 Air Cargo Pkwy East
Swanton, Ohio 43558 USA

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

1.4 TECHNICAL SPECIFICATIONS

1.4.1 HYDRAULIC

Fluid	MIL-PRF-5606
Pressure Range	250 – 3000 psi (17.2 –207 bar)
Flow Range	0-6 gpm (22.7 l)
Filtration	2 Micron Absolute
Reservoir Capacity	13 gal (49.2 l)

1.4.2 ELECTRICAL

Power Requirements..... 3 Phase

60 Hz	**50 Hz**
15 amps @ 208 VAC	15.0 amps @ 220 VAC
13.6 amps @ 230 VAC	7.48 amps @ 380, 415, 440 VAC
6.8 amps @ 460 VAC	
5.4 amps @ 575 VAC	

1.4.3 MECHANICAL

Length	45 in (114.3 cm)
Width	33 in (83.8 cm)
Height	44 in (111.8 cm)
Weight	525 lbs (238.1 kg)

2.0 SAFETY INFORMATION

2.1 USAGE AND SAFETY INFORMATION

The HPU provides pressurized hydraulic fluid for performing aircraft maintenance.

To ensure 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.

3.0 PREPARATION FOR USE

The HPU is shipped completely assembled and only the following steps are required to make the unit operational.

3.1 SERVICING RESERVOIR

Fill the reservoir with the correct fluid until fluid level is slightly above the minimum oil level mark.

3.2 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 and check for proper motor rotation by "bumping" the on-off switch. Correct motor rotation is indicated by an arrow on pump motor adapter. If rotation is not correct, change any two of the three input leads at the plug or inside the electrical component box.

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

Due to the complexity, differences, and ongoing changes in aircraft hydraulic systems, no attempt has been made to relate to any specific aircraft operation. It is suggested that this manual and the HPU be studied thoroughly in order to obtain optimum benefit of the various features. By combining an understanding of the HPU and the aircraft hydraulic system, many services not mentioned in this manual may be performed. Refer to the hydraulic schematic, front panel controls, and internal components pages for clarification while reading this manual.

5.1 GENERAL COMMENTS

Most questions or problems concerning hydraulic power units are usually caused by improper training or understanding of hydraulics. The following comments are given to aid in obtaining maximum benefits from the hydraulic power unit.

5.1.1 Training

Be sure that all personnel who will use the machine read the operating manual and receive training. We encourage customers to call Tronair to discuss any operating or testing requirements.

5.1.2 Use of the HPU Reservoir

It is suggested that the integral reservoir be used whenever possible. Use of this reservoir eliminates any possibility of cavitation of the pump. Most complaints of pump noises are due to fluid restrictions in the aircraft systems when using the aircraft reservoir. Also, if the integral reservoir is used, the HPU will run considerably cooler. This occurs because the pump case drain oil is directed to the reservoir instead of the pump return. The only compromise in using the HPU reservoir is that the aircraft system reservoir must be serviced after testing, which is standard procedure.

5.2 PRELIMINARY ADJUSTMENTS AND OPERATIONS

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 shafts during operation. These nuts should be moved away from the pump during adjustments of flow or pressure in order to eliminate binding of the control shafts.

5.2.1 Flow Control Adjustment

1. Open bypass valve.
2. Select "Hydraulic Power Unit" position with reservoir selector valve.
3. Start HPU.
4. Adjust flow control for maximum desired flow. Observing the flowmeter, read flow (gallons per minute) directly from flowmeter scale. Be sure the control shaft locknut is loose during adjustment. Tighten after adjustment to maintain setting.

5.2.2 Pressure Control Adjustment

1. Open bypass valve.
2. Select "Hydraulic Power Unit" position with reservoir selector valve.
3. Start HPU.
4. Close bypass valve.
5. Adjust pressure control for desired pressure. Be sure the control shaft locknut 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.

5.2.3 Reservoir Selector Valve Operation

Operation of the reservoir selector valve allows the operator to select either the aircraft reservoir (Closed Loop) of 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.

5.2.3.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 indication of the system pressure gauge or flowmeter. Usually, the aircraft fluid supply will be restricted due to small return oil lines in the aircraft. Sometimes this problem can be minimized or eliminated by pressurizing the aircraft reservoir with air.

CAUTION!

If the aircraft reservoir is pressurized, DO NOT EXCEED the aircraft manufacturer's recommendations.

If the aircraft reservoir cannot be pressurized or the cavitation persists, decrease the flow control setting until the cavitation is eliminated.

5.2.3.b HPU Reservoir Position (Open Loop)

In this position, the HPU reservoir supplies oil to the pump and accepts return oil 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 are no restrictions to flow at the pump inlet.

On most aircraft, the aircraft reservoir may usually be serviced by disconnecting the return hose. Normally servo leakage or operation of a hydraulic component will allow some flow to the aircraft reservoir. Caution should be observed if this method is used.

WARNINGS!

- **When using the HPU reservoir, it may be possible to overfill the aircraft reservoir if several landing gear swings are done in a short time period.**
- **Always wait approximately 15 seconds between gear swings to allow the aircraft reservoir to drain into the HPU.**
- **Do not change the reservoir selector valve position while the machine is running.**

5.2.4 Bypass Valve Operation

The bypass valve is used for unloading the pump flow in conjunction with the flowmeter.

Start Up Operation
The bypass valve should be opened prior to starting the HPU in order to allow the motor to start under a no load condition.

Shut down Operation
Prior to shutdown, the bypass valve may 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 opened or is used for regulating flow or pressure.

- Use the **flow and pressure controls for regulation.**
- **Use the by**pass valve for unloading the system.

5.3 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 American National Standard number B93.19-1972 be followed.

5.4 BLEEDING AIR FROM SYSTEM

Rapid fluctuations of the pressure gauge and flowmeter 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 the hose connections and/or couplings.

To Easily Purge the Unit of Air:

1. Fill reservoir to recommended level.
2. Open bypass valve.
3. Place reservoir selector valve in "Hydraulic Power Unit" position.
4. Start unit and adjust flow control to maximum position.
5. Run unit for five (5) minutes and shut off.
6. If additional bleeding is required, proceed with the following steps:
    a. Connect the pressure and return hoses together. (Kits containing the necessary fitting(s) are available from Tronair)
    b. If the unit is equipped with pressure and return ball valves, open the ball valves prior to starting the unit.

WARNING!

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

    c. Place the reservoir selector valve in the “Hydraulic Power Unit” position.
    d. Open the bypass valve on the instrument panel
    e. Start unit and adjust flow control to maximum position.
    f. Close the bypass valve and allow the unit to run for 5 minutes.

Under some conditions where a large amount of air has entered the system, the pump may not be able to draw an initial prime and will not pump. If this occurs, it may be necessary to fill the pump inlet line with fluid.

5.5 ABBREVIATED OPERATING INSTRUCTIONS

These instructions may be used for fast reference after a thorough understanding of the HPU operation has been achieved.

5.5.1 Initial Adjustments

1. Set flow control (Section 5.2.1).
2. Set pressure control (Section 5.2.2).

5.5.2 Prior to Starting

1. Select reservoir valve position (Section 5.2.3).
2. Open bypass valve (Section 5.2.4).

5.5.3 Operation

1. Start HPU.
2. Close bypass valve.

5.5.4 Shut Off

1. Open bypass valve.
2. Stop HPU.

5.6 INFREQUENT HPU USE

If the unit is not used frequently Tronair recommends operating the unit monthly. Operating regularly assures that the seals are kept lubricated, eliminates air pockets in the system, reduces moisture in the fluid and helps extend the hose life.

5.6.1 Infrequent HPU Use Start Up Procedure

1. Assure that the HPU reservoir is filled between the minimum and maximum level
2. Connect the unit to a proper electrical power source
3. If unit is equipped with a run around kit, connect the pressure and return hoses together
4. Place the reservoir selector valve in “HPU Reservoir” position
5. Open the return ball valves on the back of the unit
6. Pressure ball valves
   a. If unit **IS** equipped with a runaround kit **ensure the hoses are connected to each other**, open the pressure ball valves on the back of the unit
   b. If the hoses **are not connected to each other**, close the pressure ball valves on the back of the unit
7. Verify the return ball valves on the back of the unit are open
8. Fully open the bypass valve
9. Adjust the pressure control to the minimum setting (CCW)
10. Start the unit and verify the flow is above “0” on the flowmeter
    a. If flow is present: adjust the flow control to increase flow (CW)
    b. If no flow is immediately present: turn unit off, verify the motor rotation (see 3.3 Connecting Electrical Leads), correct rotation if necessary
11. Set flow to ½ the maximum flow capacity of the unit. You may need to increase the pressure adjustment to achieve flow.
12. Bypass valve
    a. If unit **IS** equipped with a runaround kit **ensure the hoses are connected to each other**, fully close the bypass valve
    b. If the hoses **are not connected to each other**, leave the bypass valve fully open
13. Operate the unit for 15-30 minutes in this condition. Fluid temperature should reach 100º-130º F (37.8º-54.4º C)
14. At the completion of the 15-30 minute circulation run, open the bypass valve and shut off the unit
15. Remove the electric power
16. Place the selector valve in the Aircraft Reservoir position
17. Close the pressure and return ball valves on the back of the unit

5.7 OPTIONS

The following options are available. Refer to the appropriate option description for operation information.

5.7.1 Split System (Option C) Operation

The Split 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 the reservoirs may occur if a reservoir level or pressure differential exists. Select valve positions prior to starting machine.

To Operate the Split System:

1. 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.

2. After completing tests on one system, shut the machine **OFF** before selecting the second system.

WARNING!

Never open or close split 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.

3. If equipped with the ***Split System Crossover Check (Option D)***, separate pressure gauges are located after each system pressure shut off valve. This allows bleed down pressures to be read when the pressure valves are closed. Follow aircraft manufacturer's instructions.

5.7.2 Hourmeter (Option F – 60 Hz)

The Hourmeter records operating hours of the HPU. The main use of the Hourmeter is to schedule filter changes.

5.7.3 Pyrometer (Option K)

The Pyrometer indicates fluid temperature in the return system. It is normal for this temperature to increase when the aircraft is not demanding any flow and the HPU is holding pressure.

CAUTION!

If this temperature rises to 150o F:

1. **Operate from HPU reservoir or,**
3. **Open the bypass valve or,**
4. **Cycle the landing gear a few times or,**
5. **Shut off the HPU.**

5.7.4 Hand Pump (Option M)

This pump is used primarily for filling aircraft reservoirs after testing, bleeding brakes, etc.

6.0 PACKAGING AND STORAGE

6.1 PACKAGING REQUIREMENTS

In the event that the HPU will not be used for 12 months or longer, the reservoir may be drained. The unit should then be appropriately covered in order to maintain cleanliness.

6.2 PACKAGING PROTECTION

No special packaging material for cushioning or suspension is required.

6.3 LABELING OF PACKAGING

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

6.4 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.

7.0 TROUBLE SHOOTING

7.1 NO FLOW OR PRESSURE

Possible Cause	Solution
Flow control set too low	Increase flow setting
Motor running in wrong direction	See Section 3.0 Preparation for Use
Insufficient oil in reservoir	See Section 3.0 Preparation for Use
Air in hydraulic lines	See Section 5.4 Bleeding Air From System
Faulty pump	Repair or replace pump

7.2 FLUCTUATING PRESSURE OR FLOW

Possible Cause	Solution
Pump cavitation	See Section 5.2.3.a Aircraft Reservoir Position
Air in hydraulic lines	See Section 5.4 Bleeding Air From System

7.3 UNIT OVERHEATS

Possible Cause	Solution
Running unit for long time periods without operating aircraft components	Cycle landing gear or other components periodically or allow unit to cool
Bypass valve partially open	See Section 5.2.4 Bypass Valve Operation

NOTES:
1. ***Running time under deadhead condition can be increased substantially by selecting the "Hydraulic Power Unit" position; reservoir selector valve.***
2. ***When a pressure compensated pump is required to hold pressure without any flow delivery (dead headed condition) it is normal for the pump case drain flow and temperature to increase. By selecting the "Hydraulic Power Unit" position of the selector valve, all of the oil in the reservoir is utilized for cooling.***

8.0 MAINTENANCE

If the unit is not used frequently Tronair recommends operating the unit monthly. Operating regularly assures that the seals are kept lubricated, eliminates air pockets in the system, reduces moisture in the fluid and helps extend the hose life. If the unit is not used frequently see 5.6 Infrequent Use Procedure.

8.1 GENERAL MAINTENANCE

- The hydraulic power unit should be maintained in a safe and clean condition at all times.
- Locate and correct the source of any and all leaks.
- Inspect hoses and electrical cord periodically for damage and wear. Replace as required.

8.2 FILTER MAINTENANCE

Replace the filter element annually to ensure proper cleanliness of the hydraulic system. This is a minimum requirement. Replace the return filter element at the same time the pressure filter element is being replaced.

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.

8.3 LUBRICATION

The swivel casters are equipped with grease fittings which should be lubricated annually.

8.4 STORAGE

In the event that the HPU will not be used for 12 months or longer, the reservoir may be drained. The unit should then be appropriately covered in order to maintain cleanliness.

9.0 PROVISION OF SPARES

9.1 SOURCE OF SPARE PARTS

Spare parts may be obtained from the manufacturer:

TRONAIR, Inc.
1 Air Cargo Pkwy East
Swanton, Ohio 43558 USA

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

For Spare Parts, Operations & Service Manuals or Service Needs:
Scan the QR code or visit Tronair.com/aftermarket

9.2 RECOMMENDED SPARE PARTS LISTS

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

9.2.1 Spare Parts

Model 5110 & 5120 Parts List

Fluid Type: MIL-PRF-5606 & MIL-PRF-83282

Part Number	Description	Qty
HC-1763	DESICCANT FILTER ELEMENT	1
K-1414	KIT,REPL.FILTER ELEMENT	1
K-3096	KIT, FILTER ELEMENT	1
K-3098	KIT, FILTER ELEMENT if equipped with handpump	1
K-4002	KIT, TEST FLUID	1
HC-1399	GAUGE, PRESSURE 0-5000 PSI	1
TF-1037-01*180	ASSEMBLY, HOSE (#8 MB)	1
TF-1039-01*180	ASSEMBLY, HOSE (#12 MB)	1
TF-1043-01*180	ASSEMBLY, HOSE (#4 MB) if equipped with handpump	1

Model 5130 Parts List

Fluid Type: Aviation Phosphate Ester, Type IV & V

Part Number	Description	Qty
HC-1763	DESICCANT FILTER ELEMENT	1
K-1415	KIT,REPL.FILTER ELEMENT	1
K-3097	KIT, FILTER ELEMENT	1
K-3099	KIT, FILTER ELEMENT if equipped with handpump	1
K-4061	KIT, TEST FLUID	1
HC-1399	GAUGE, PRESSURE 0-5000 PSI	1
TF-1041-09*180	ASSEMBLY, HOSE (#8 MB)	1
TF-1043-01*180	ASSEMBLY, HOSE (#12 MB)	1
TF-1041-01*180	ASSEMBLY, HOSE (#4 MB) if equipped with handpump	1

Model 5140 Parts List

Fluid Type: Aviation Phosphate Ester, Type IV & V

Part Number	Description	Qty
HC-1763	DESICCANT FILTER ELEMENT	1
K-4273	KIT,REPL.FILTER ELEMENT	1
K-4271	KIT, FILTER ELEMENT	1
K-3099	KIT, FILTER ELEMENT if equipped with handpump	1
K-4008	KIT, TEST FLUID	1
HC-1399	GAUGE, PRESSURE 0-5000 PSI	1
TF-1038-23*180	ASSEMBLY, HOSE (#8 MB)	1
TF-1039-21*180	ASSEMBLY, HOSE (#12 MB)	1
TF-1038-01*180	ASSEMBLY, HOSE (#12 MB) if equipped with handpump	1

10.0 IN SERVICE SUPPORT

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

11.0 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*.**

12.0 APPENDICES

APPENDIX I	Instrument Certification Notice
APPENDIX II	Oilgear Type PVWJ Pump Manuals
APPENDIX III	Lincoln Motor Manual
APPENDIX IV	Model: 5110, SDS Hydraulic Fluid – MIL-FRF-5626
APPENDIX V	Model: 5120, SDS Hydraulic Fluid – MIL-PRF-83282
APPENDIX VI	Model: 5130, SDS Hydraulic Fluid – Phosphate Ester
APPENDIX VII	Model: 5140, SDS Hydraulic Fluid – MIL-PRF-87257

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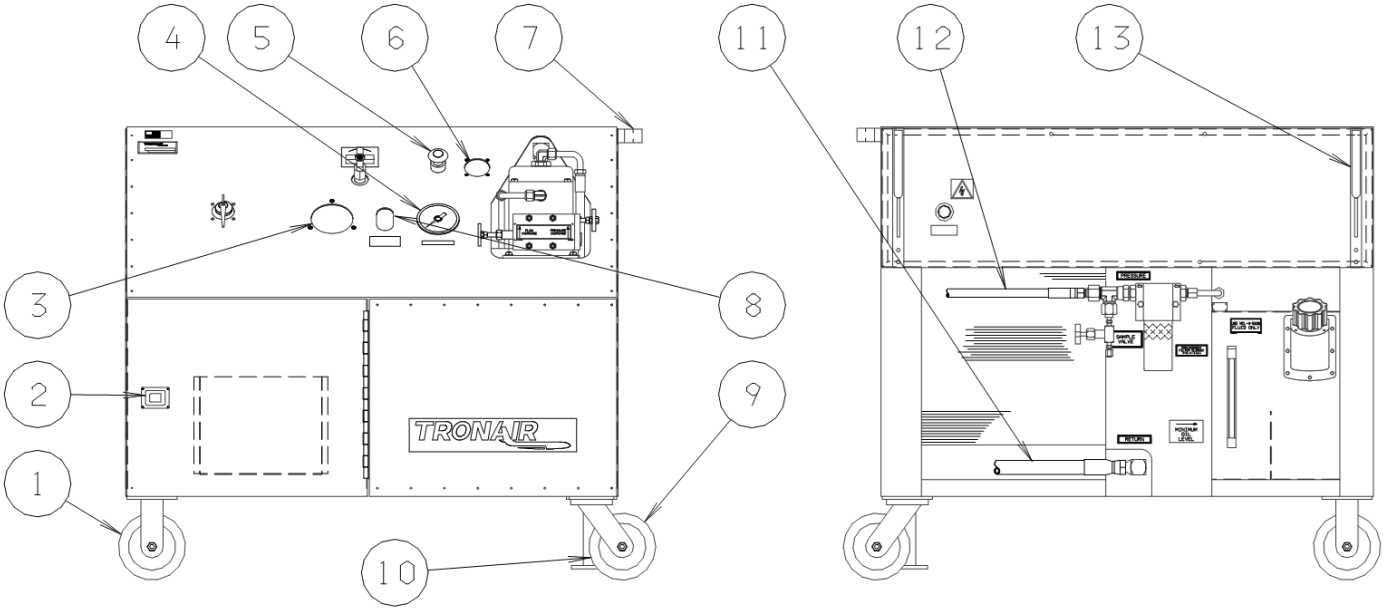
External Components

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



All Units

Item	Part Number	Description	Qty
1	U-1013	Caster (Rigid)	2
2	H-1207	Latch	1
3	HC-2267	Pyrometer (Option K)	1
4	HC-1399	Gauge, Pressure	1
5	EC-1058	Switch, On/Off	1
	EC-1073	Lamp, Replacement	1
6	EC-1060	Hourmeter (Option F)	1
7	H-1584	Handle	1
9	U-1014	Caster (Swivel)	2
10	H-1175	Lock, Floor	1
13	Z-1296-01	Hanger, Hose	2

The remaining parts are fluid specific.

External Components

Model 5110 & 5120 Parts List

Fluid Type: MIL-PRF-5606 & MIL-PRF-83282

Item	Part Number	Description	Qty
8	HC-2150	Flowmeter	1
	HC-2150-A1	Flowmeter (Calibrated)	1
11	TF-1039-01*180	Hose, Return	1
	TF-1039-01*300	Hose, Return (Option A)	1
12	TF-1037-01*180	Hose, Pressure	1
	TF-1037-01*300	Hose, Pressure (Option A)	1

Model 5130 Parts List

Fluid Type: Aviation Phosphate Ester, Type IV & V

Item	Part Number	Description	Qty
8	HC-2153	Flowmeter	1
	HC-2153-A1	Flowmeter (Calibrated)	1
11	TF-1041-01*180	Hose, Return	1
	TF-1041-01*300	Hose, Return (Option A)	1
12	TF-1041-09*180	Hose, Pressure	1
	TF-1041-09*300	Hose, Pressure (Option A)	1

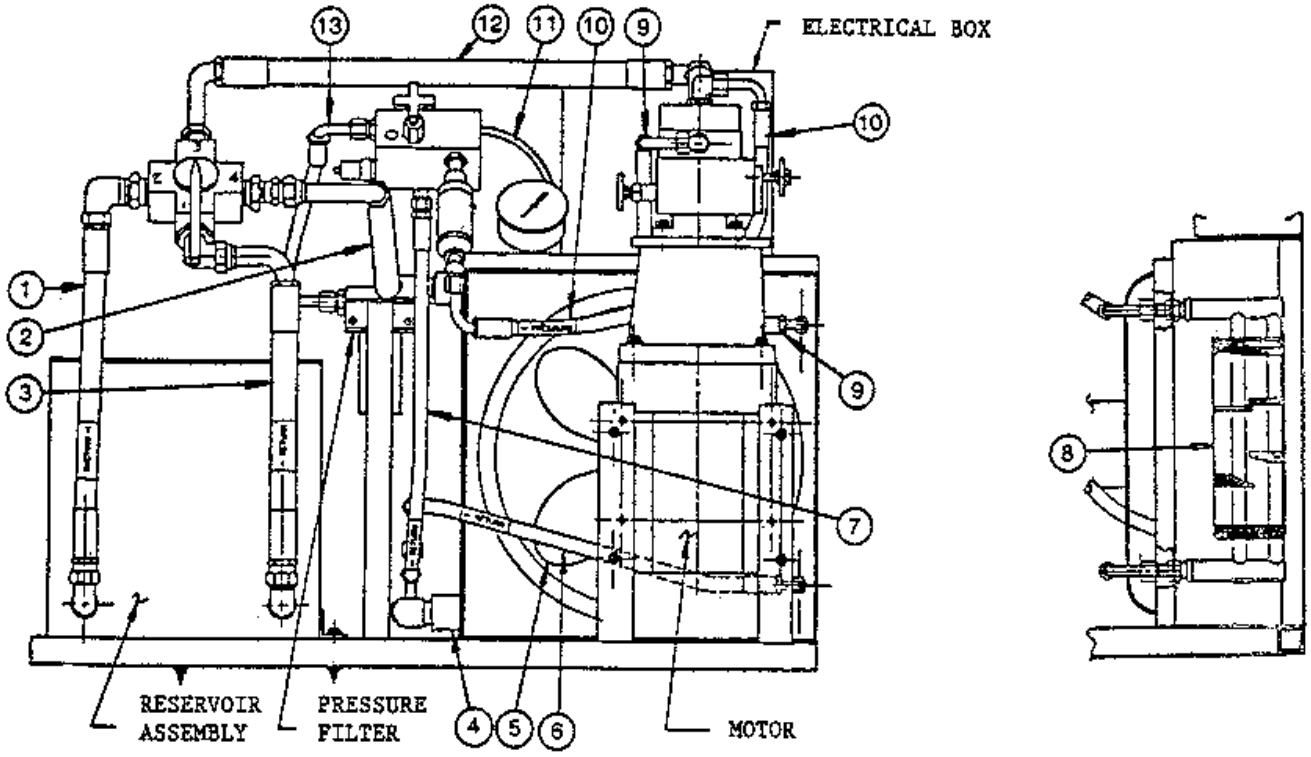
Model 5140 Parts List

Fluid Type: MIL-PRF-87257

Item	Part Number	Description	Qty
8	HC-2150	Flowmeter	1
	HC-2150-A1	Flowmeter (Calibrated)	1
11	TF-1039-21*180	Hose, Return	1
	TF-1039-21*300	Hose, Return (Option A)	1
12	TF-1038-23*180	Hose, Pressure	1
	TF-1038-23*300	Hose, Pressure (Option A)	1

Internal Components

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Model 5110 & 5120 Parts List

Fluid Type: MIL-PRF-5606 & MIL-PRF-83282

Item	Part Number	Description	Qty
1	TF-1039-02*20.8	Assembly, Hose	1
2	TF-1039-05*16.2	Assembly, Hose	1
3	TF-1039-05*17.3	Assembly, Hose	1
4	HC-1214	Cooler	1
5	EC-1229	Fan	1
6	TF-1037-05*32.0	Assembly, Hose	1
7	TF-1037-01*28.0	Assembly, Hose	1
8	HC-1388-1	Cooler (Case Drain)	1
9	TF-1037-08*22.5	Assembly, Hose	1
10	TF-1037-07*30.0	Assembly, Hose	1
11	TF-1037-03*16.0	Assembly, Hose	1
12	TF-1039-06*29.0	Assembly, Hose	1
13	TF-1037-04*22.0	Assembly, Hose	1

Model 5130 Parts List

Fluid Type: Aviation Phosphate Ester, Type IV & V

Item	Part Number	Description	Qty
1	TF-1041-01*20.8	Assembly, Hose	1
2	TF-1041-07*16.2	Assembly, Hose	1
3	TF-1041-07*17.3	Assembly, Hose	1
4	HC-1214	Cooler	1
5	EC-1229	Fan	1
6	TF-1041-10*32.0	Assembly, Hose	1
7	TF-1041-09*28.0	Assembly, Hose	1
8	HC-1388-01	Cooler (Case Drain)	1
9	TF-1041-08*22.5	Assembly, Hose	1
10	TF-1041-40*30.0	Assembly, Hose	1
11	TF-1041-05*16.0	Assembly, Hose	1
12	TF-1041-06*29.0	Assembly, Hose	1
13	TF-1041-42*22.0	Assembly, Hose	1

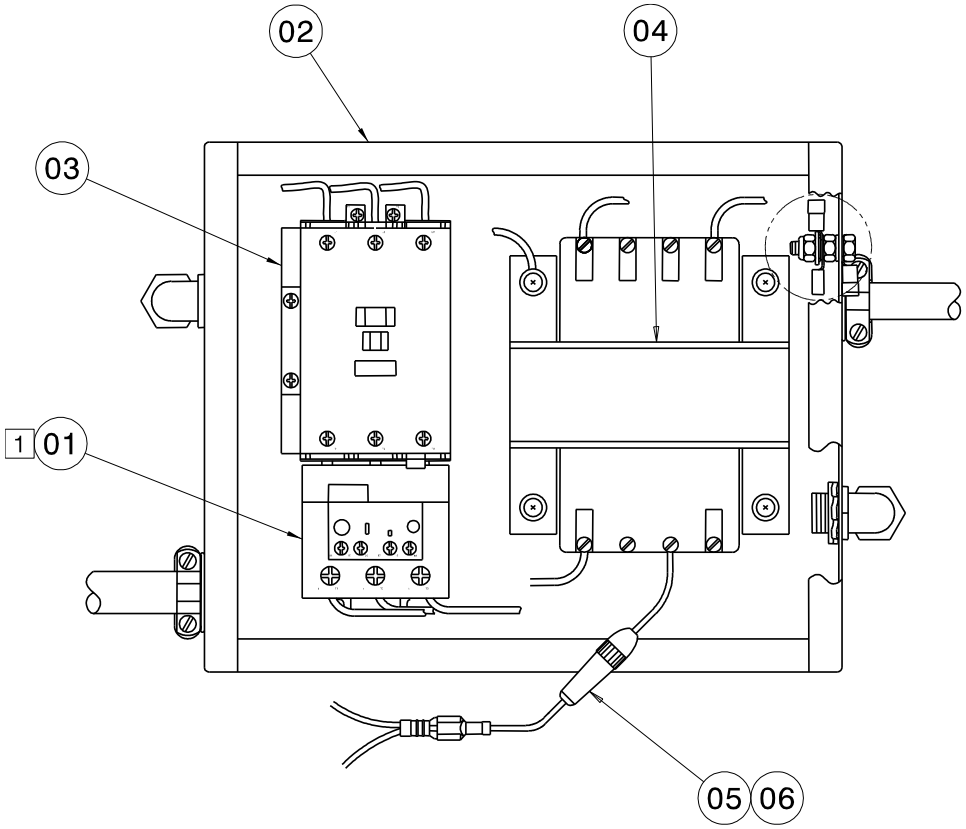
Model 5140 Parts List

Fluid Type: MIL-PRF-87257

Item	Part Number	Description	Qty
1	TF-1039-22*20.8	Assembly, Hose	1
2	TF-1039-24*16.2	Assembly, Hose	1
3	TF-1039-24*17.3	Assembly, Hose	1
4	HC-1214	Cooler	1
5	EC-1229	Fan	1
6	TF-1037-31*32.0	Assembly, Hose	1
7	TF-1038-23*28.0	Assembly, Hose	1
8	HC-1388-01	Cooler (Case Drain)	1
9	TF-1037-33*22.5	Assembly, Hose	1
10	TF-1037-32*30.0	Assembly, Hose	1
11	TF-1038-14*16.0	Assembly, Hose	1
12	TF-1039-25*29.0	Assembly, Hose	1
13	TF-1037-30*22.0	Assembly, Hose	1

Electrical Components

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



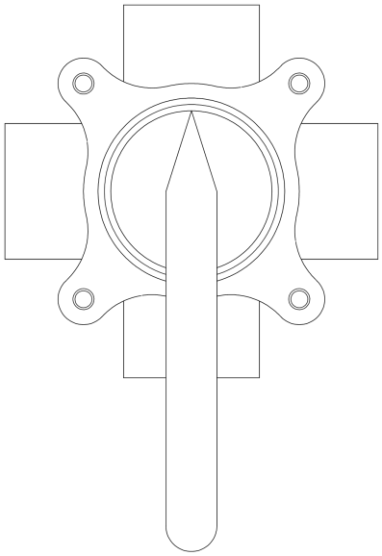
Set Item 01 to "Manual" and set "A2" to its corresponding full load amps.

Item	Part Number	Description	Qty
1	EC-1834	Relay, IEC Overload	1
2	EC-1067	Box, Electrical	1
3	*See Table*	Contactor, IEC Motor	1
4	*See Table*	Transformer	1
5	EC-1328	Holder, Fuse	1
6	EC-1210-08	Fuse	1

ITEM	60 HZ Applications						
	208	230	380	460	575	Description	Qty.
3	EC-1838	EC-1838	EC-1838	EC-1836	EC-1836	Contactor, IEC Motor	1
4	EC-1804-04	EC-1074	EC-1804-04	EC-1074	EC-1804-04	Transformer	1

ITEM	50 HZ Applications						
	200	220	380	415	440	Description	Qty.
3	EC-1838	EC-1838	EC-1836	EC-1836	EC-1836	Contactor, IEC Motor	1
4	EC-1804-04	EC-1074	EC-1804-04	EC-1804-04	EC-1074	Transformer	1

Reservoir Selector Valve



Note: This valve is not field serviceable. Contact Tronair for service information.

Model 5110 & 5120 Parts List

Fluid Type: MIL-PRF-5606 & MIL-PRF-83282

Item	Part Number	Description	Qty
1	K-2139	Kit, Replacement Selector Valve	1

Model 5130 Parts List

Fluid Type: Aviation Phosphate Ester, Type IV & V

Item	Part Number	Description	Qty
1	K-2140	Kit, Replacement Selector Valve	1

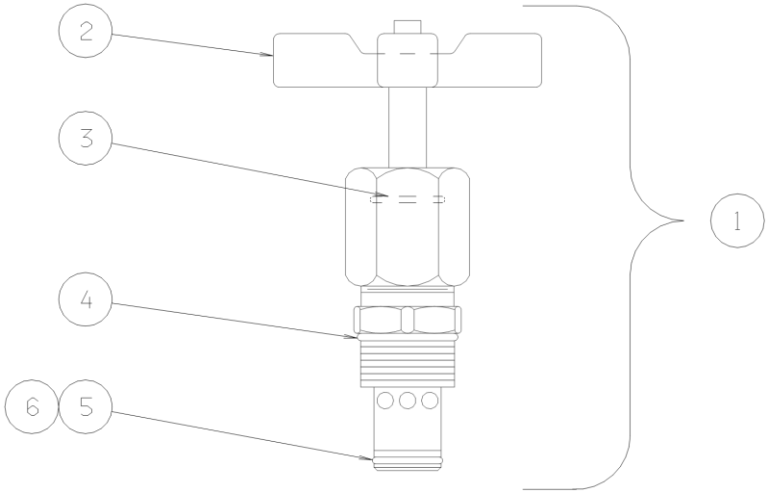
Model 5140 Parts List

Fluid Type: MIL-PRF-87257

Item	Part Number	Description	Qty
1	K-2438	Kit, Replacement Selector Valve	1

Bypass Valve

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Model 5110 & 5120 Parts List

Fluid Type: MIL-PRF-5606 & MIL-PRF-83282

Item	Part Number	Description	Qty
1	HC-1254	Assembly, Bypass Valve	1
2	HC-1130	Handle, Valve	1
3	HC-2000-012	O-ring	1
4	HC-2010-910	O-ring	1
5	HC-2000-014	O-ring	1
6	HC-2020-014	Ring, Backup	1

Model 5130 Parts List

Fluid Type: Aviation Phosphate Ester, Type IV & V

Item	Part Number	Description	Qty
1	Z-1711	Assembly, Bypass Valve	1
2	HC-1130	Handle, Valve	1
3	HC-2006-012	O-ring	1
4	HC-2013-910	O-ring	1
5	HC-2006-014	O-ring	1
6	HC-2020-014	Ring, Backup	1

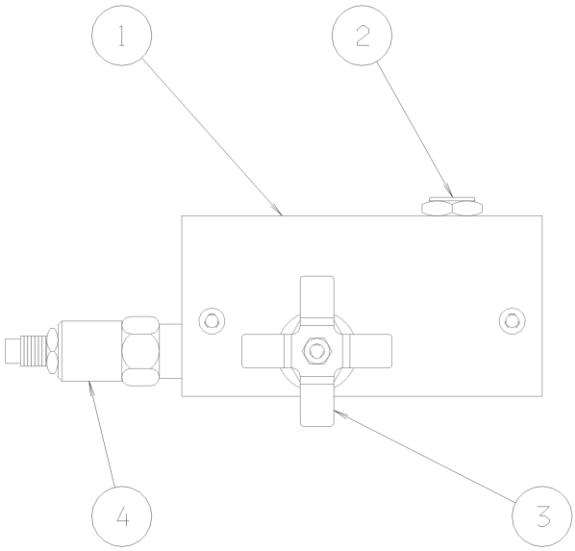
Model 5140 Parts List

Fluid Type: MIL-PRF-87257

Item	Part Number	Description	Qty
1	HC-1700	Assembly, Bypass Valve	1
2	HC-1130	Handle, Valve	1
3	HC-2007-012	O-ring	1
4	HC-2014-910	O-ring	1
5	HC-2007-014	O-ring	1
6	HC-2020-014	Ring, Backup	1

Control Module

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Model 5110 & 5120 Parts List

Fluid Type: MIL-PRF-5606 & MIL-PRF-83282

Item	Part Number	Description	Qty
1	J-1476	Body, Valve	1
2	HC-1262	Valve, Check	1
3	HC-1254	Valve, Bypass	1
4	HC-1264-01	Valve, Pressure Relief	1

Model 5130 Parts List

Fluid Type: Aviation Phosphate Ester, Type IV & V

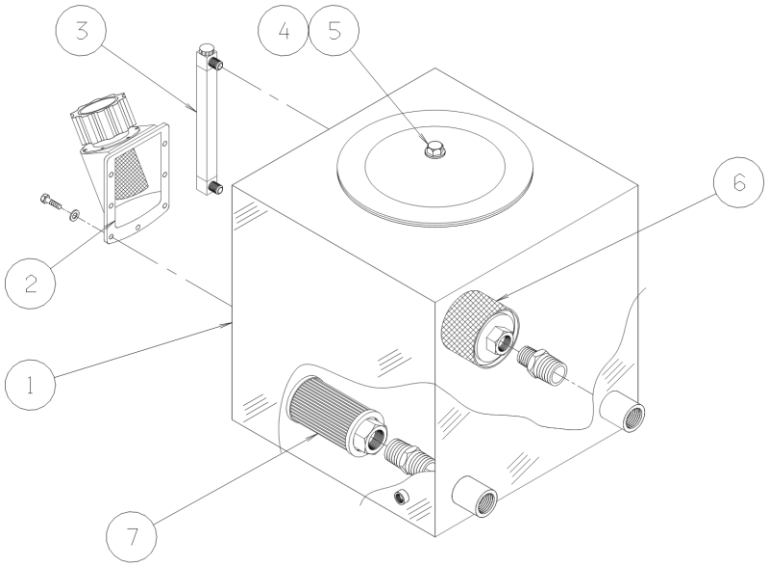
Item	Part Number	Description	Qty
1	J-1476	Body, Valve	1
2	Z-1712	Valve, Check	1
3	Z-1711	Valve, Bypass	1
4	Z-1713	Valve, Pressure Relief	1

Model 5140 Parts List

Fluid Type: MIL-PRF-87257

Item	Part Number	Description	Qty
1	J-1476	Body, Valve	1
2	HC-2208	Valve, Check	1
3	HC-1700	Valve, Bypass	1
4	HC-2443	Valve, Pressure Relief	1

Reservoir Assembly



Model 5110 & 5120 Parts List

Fluid Type: MIL-PRF-5606 & MIL-PRF-83282

Item	Part Number	Description	Qty
1	H-1164	Reservoir	1
2	HC-1106	Filler, Breather	1
4	H-1733-01	Gasket, Cover	1
5	H-1735-02	Washer, Nylon	1
6	HC-1029	Diffuser	1
7	HC-1107	Strainer	1

The remaining part is fluid specific.

Model 5110 & 5120 Parts List

Fluid Type: MIL-PRF-5606 & MIL-PRF-83282

Item	Part Number	Description	Qty
3	HC-1382-08	Gauge, Sight	1

Model 5130 Parts List

Fluid Type: Aviation Phosphate Ester, Type IV & V

Item	Part Number	Description	Qty
3	HC-1383-08	Gauge, Sight	1

Model 5140 Parts List

Fluid Type: MIL-PRF-87257

Item	Part Number	Description	Qty
3	HC-2212-08	Gauge, Sight	1

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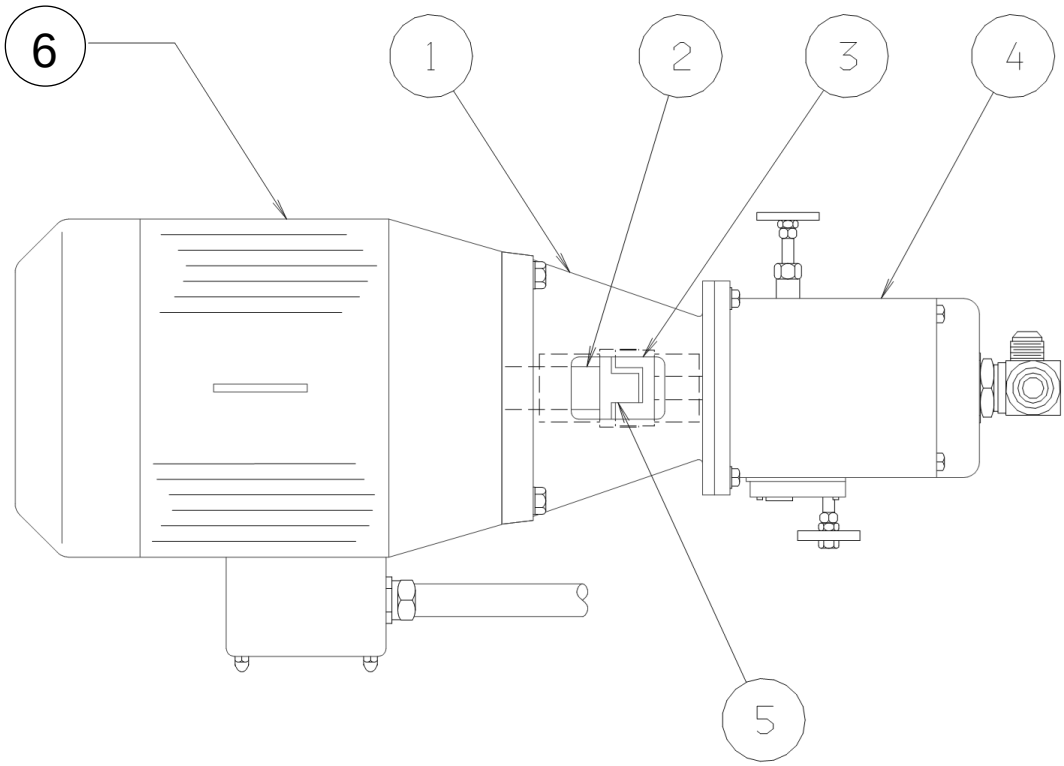
Pump/Motor Assembly

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



NOTE: All bolts are Grade 5.

- ***See Appendix II – Pump manufacturer's service booklet for additional information of Hydraulic Pump and additional repair kits.***

All Models

Item	Part Number	Description	Qty
1	HC-1393-11	Mount, Pump/Motor	1
2	H-2224-03	Coupling, Body (Motor)	1
3	H-2224-01	Coupling, Body (Pump)	1
5	H-2227	Coupling—Spider	1
6	EC-1186-05	Motor	1

The remaining parts are fluid specific.

Pump/Motor Assembly

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

Model 5110 & 5120 Parts List

Fluid Type: MIL-PRF-5606 & MIL-PRF-83282

Item	Part Number	Description	Qty
4	K-4268	Kit, Hydraulic Pump with Hardware	1
Not Shown	TBD	Shaft Seal	1
	TBD	Kit, Gaskets & O-rings	1

Model 5130 Parts List

Fluid Type: MIL-PRF-5606 & MIL-PRF-83282

Item	Part Number	Description	Qty
4	K-4269	Kit, Hydraulic Pump with Hardware	1
Not Shown	TBD	Shaft Seal	1
	TBD	Kit, Gaskets & O-rings	1

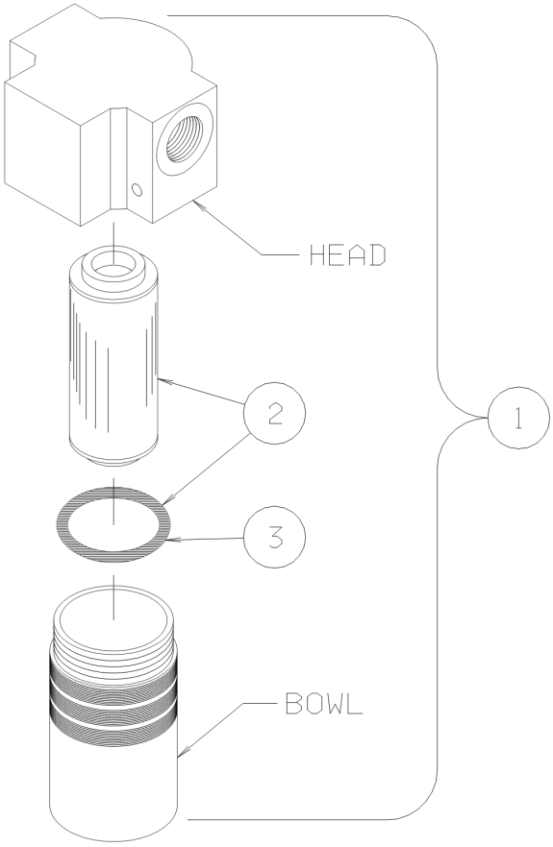
Model 5140 Parts List

Fluid Type: MIL-PRF-87257

Item	Part Number	Description	Qty
4	Z-4221	Kit, Hydraulic Pump with Hardware	1
Not Shown	TBD	Shaft Seal	1
	TBD	Kit, Gaskets & O-rings	1

Filter Assembly

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



NOTE: Item 3 is included in Item 2.

Model 5110 & 5120 Parts List

Fluid Type: MIL-PRF-5606 & MIL-PRF-83282

Item	Part Number	Description	Qty
1	HC-1083	Assembly, Filter	1
2	K-1414	Kit, Filter Element	1
3	HC-2000-138	O-ring, Bowl	1

Model 5130 Parts List

Fluid Type: Aviation Phosphate Ester, Type IV & V

Item	Part Number	Description	Qty
1	HC-1084	Assembly, Filter	1
2	K-1415	Kit, Filter Element	1
3	HC-2006-138	O-ring, Bowl	1

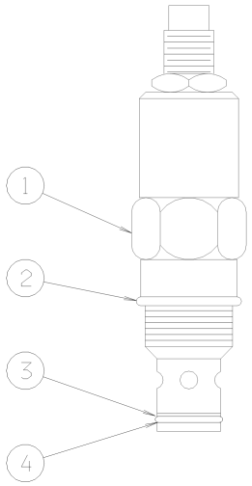
Model 5140 Parts List

Fluid Type: MIL-PRF-87257

Item	Part Number	Description	Qty
1	Z-5885	Assembly, Filter	1
2	K-4273	Kit, Filter Element	1
3	HC-2007-138	O-ring, Bowl	1

Pressure Relief Valve

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Model 5110 & 5120 Parts List

Fluid Type: MIL-PRF-5606 & MIL-PRF-83282

Item	Part Number	Description	Qty
1	HC-1264-01	Valve, Pressure Relief	1
2	HC-2010-910	O-ring	1
3	HC-2000-014	O-ring	1
4	HC-2020-014	Ring, Backup	1

Model 5130 Parts List

Fluid Type: Aviation Phosphate Ester, Type IV & V

Item	Part Number	Description	Qty
1	HC-1353-02	Valve, Pressure Relief	1
2	HC-2013-910	O-ring	1
3	HC-2006-014	O-ring	1
4	HC-2020-014	Ring, Backup	1

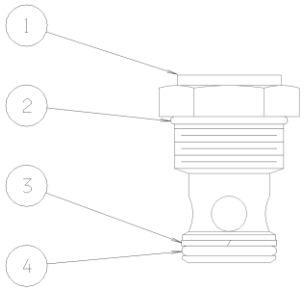
Model 5140 Parts List

Fluid Type: MIL-PRF-87257

Item	Part Number	Description	Qty
1	HC-1451	Valve, Pressure Relief	1
2	HC-2014-910	O-ring	1
3	HC-2007-014	O-ring	1
4	HC-2020-014	Ring, Backup	1

Check Valve

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Model 5110 & 5120 Parts List

Fluid Type: MIL-PRF-5606 & MIL-PRF-83282

Item	Part Number	Description	Qty
1	HC-1262	Valve, Check	1
2	HC-2010-910	O-ring	1
3	HC-2000-014	O-ring	1
4	HC-2020-014	Ring, Backup	1

Model 5130 Parts List

Fluid Type: Aviation Phosphate Ester, Type IV & V

Item	Part Number	Description	Qty
1	Z-1712	Valve, Check	1
2	HC-2013-910	O-ring	1
3	HC-2006-014	O-ring	1
4	HC-2020-014	Ring, Backup	1

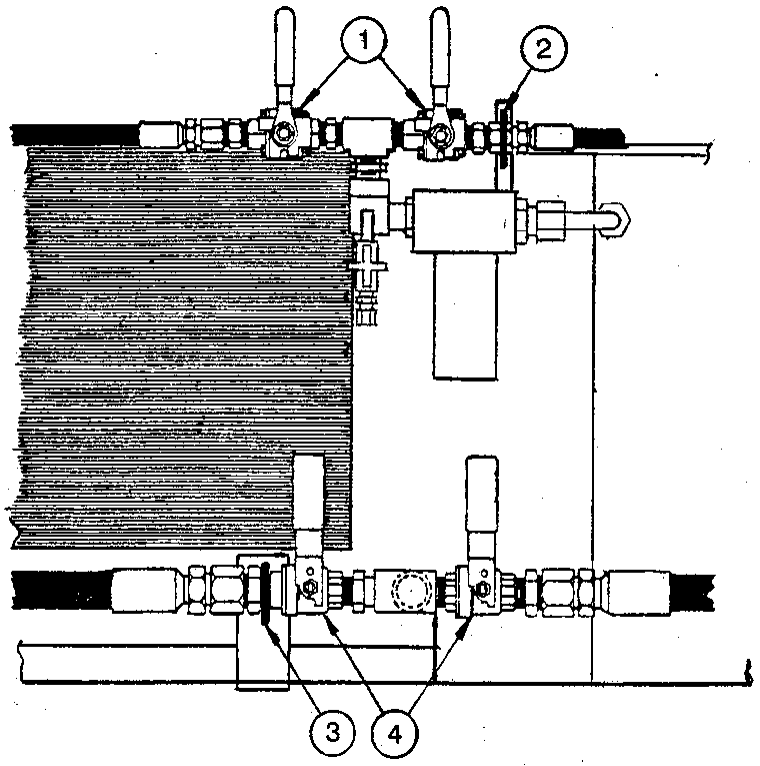
Model 5140 Parts List

Fluid Type: MIL-PRF-87257

Item	Part Number	Description	Qty
1	HC-2208	Valve, Check	1
2	HC-2014-910	O-ring	1
3	HC-2007-014	O-ring	1
4	HC-2007-014	Ring, Backup	1

Split System (Option C)

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



All Models

Item	Part Number	Description	Qty
2	G-1009-09	U-Bolt	1
3	G-1009-18	U-Bolt	1
4	HC-1111	Valve, Ball (Return)	2

The remaining part is fluid specific.

Model 5110 & 5120 Parts List

Fluid Type: MIL-PRF-5606 & MIL-PRF-83282

Item	Part Number	Description	Qty
1	HC-1139	Valve, Ball (Pressure)	2

Model 5130 Parts List

Fluid Type: Aviation Phosphate Ester, Type IV & V

Item	Part Number	Description	Qty
1	HC-1654-04	Valve, Ball (Pressure)	1

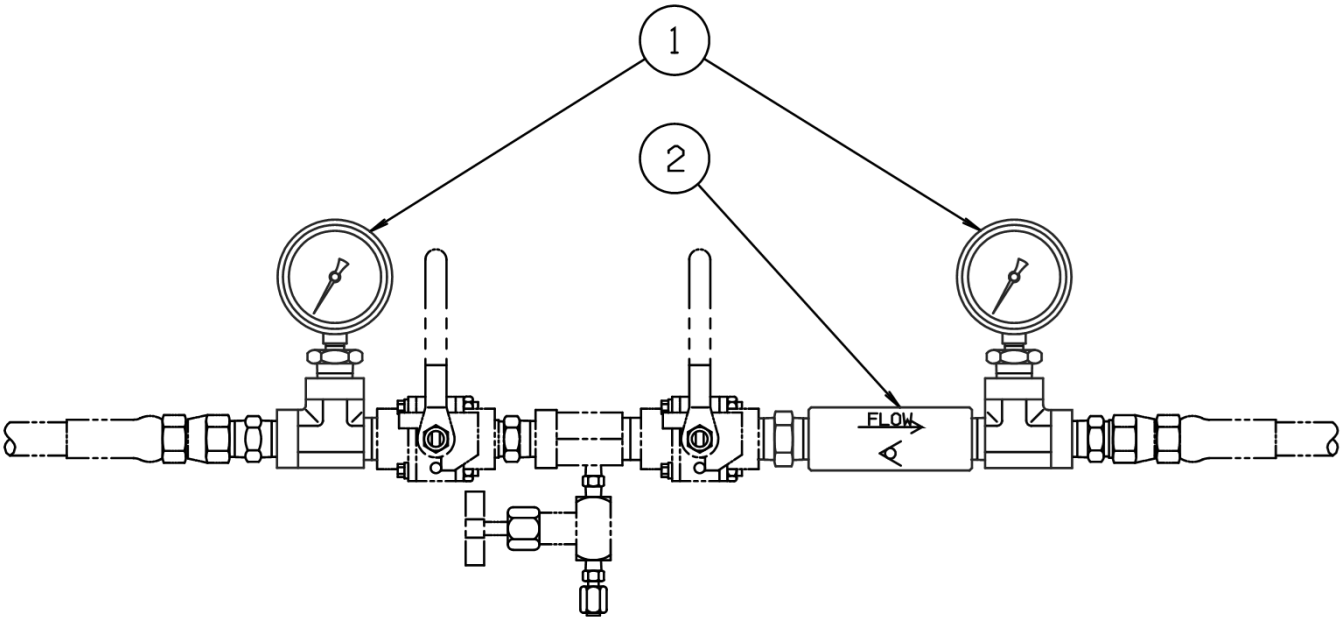
Model 5140 Parts List

Fluid Type: MIL-PRF-87257

Item	Part Number	Description	Qty
1	HC-2437	Valve, Ball (Pressure)	1

Split System Crossover Check (Option D)

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



All Models

Item	Part Number	Description	Qty
1	HC-1042	Gauge, Pressure	2
2	HC-1059	Valve, Check	1

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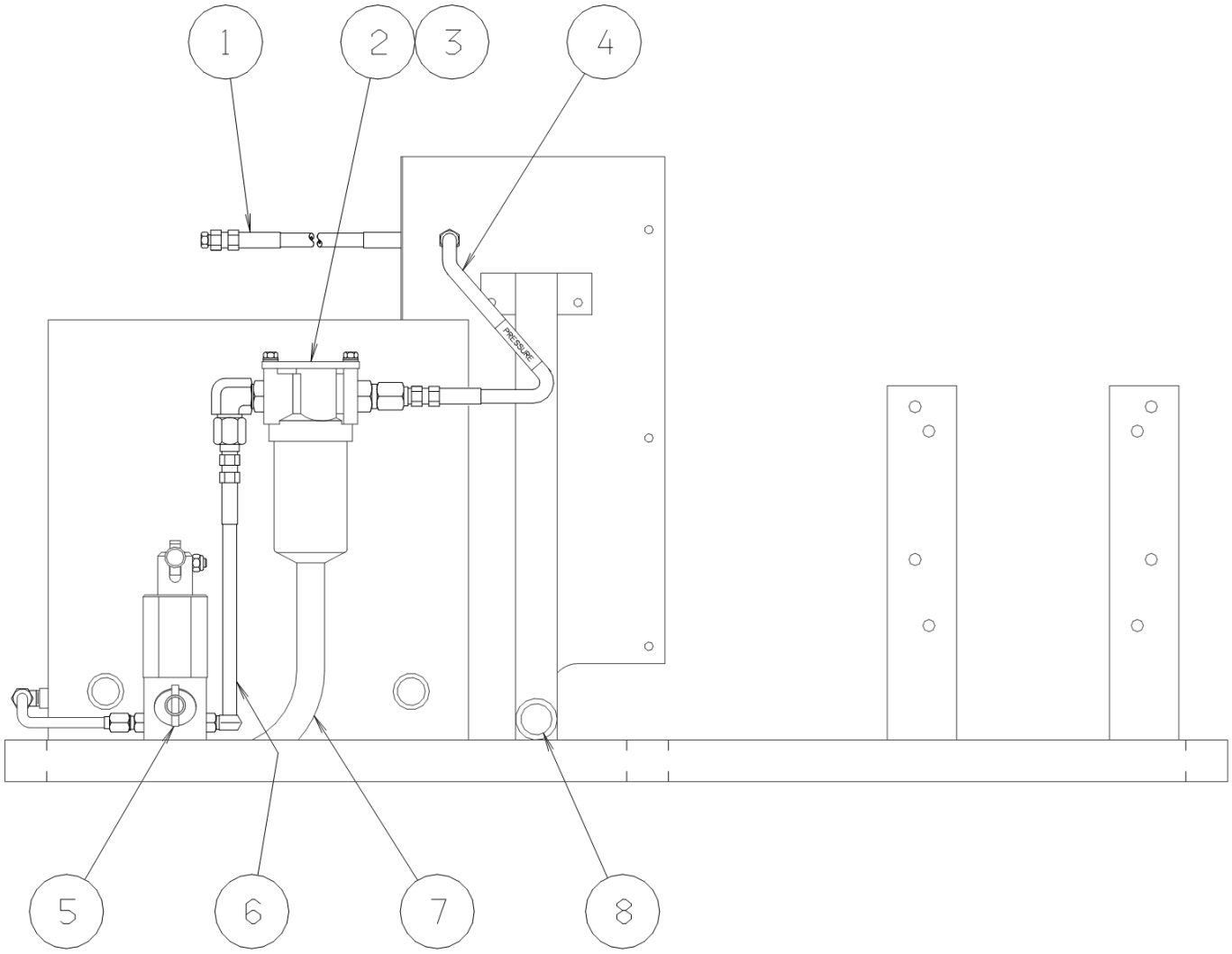
Reservoir Fill Hand Pump (Option M)

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



♦ ***Reference Pages 36 & 37 for Hand Pump exploded view and additional Replacement Parts and Kits***

Reservoir Fill Hand Pump (Option M)

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

Model 5110 & 5120 Parts List

Fluid Type: MIL-PRF-5606 & MIL-PRF-83282

Item	Part Number	Description	Qty
1	TF-1043-01*180	Hose	1
2	HC-1481	Assembly, Filter	1
3	K-3098	Kit, Replacement Filter Element	1
4	TF-1043-01*27.0	Hose	1
♦ 5	HC-2161	Hand Pump 500 psi	1
	HK-3699	Kit, Hand Pump Seal	1
6	TF-1043-01*09.9	Hose	1
7	Z-2881-01	Weldment, Filter Bracket	1
8	H-1009-01	Handle, Pump	1

Model 5130 Parts List

Fluid Type: Aviation Phosphate Ester, Type IV & V

Item	Part Number	Description	Qty
1	TF-1041-01*180	Hose	1
2	HC-1480	Assembly, Filter	1
3	K-3099	Kit, Replacement Filter Element	1
4	TF-1041-05*27.0	Hose	1
♦ 5	HC-2162	Hand Pump 500 psi	1
	HK-3700	Kit, Hand Pump Seal	1
6	TF-1041-05*09.9	Hose	1
7	Z-2881-01	Weldment, Filter Bracket	1
8	H-1009-01	Handle, Pump	1

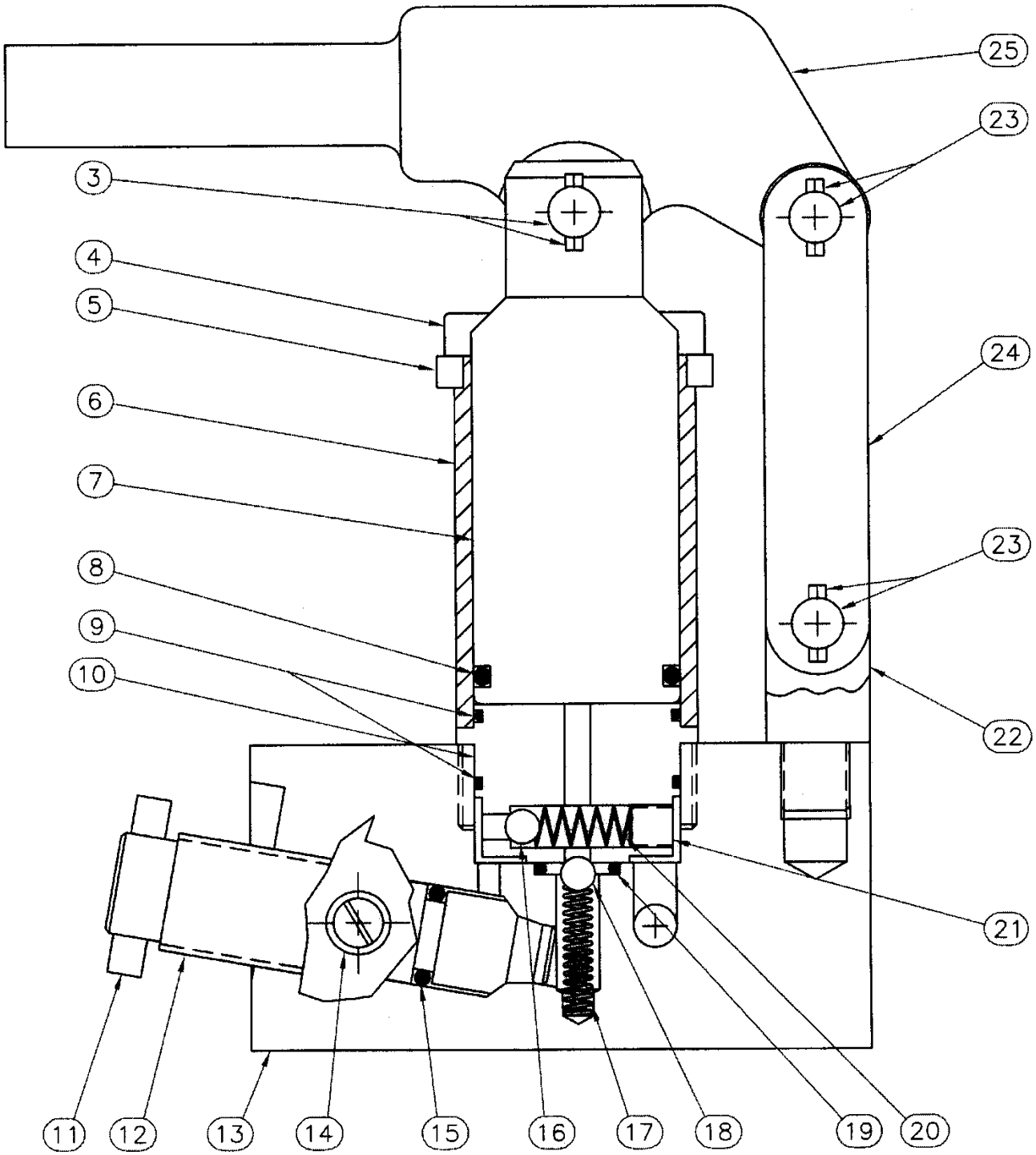
Model 5140 Parts List

Fluid Type: MIL-PRF-87257

Item	Part Number	Description	Qty
1	TF-1038-14*180	Hose	1
2	HC-1481	Assembly, Filter	1
3	TBD	Kit, Replacement Filter Element	1
4	TF-1038-14*27.0	Hose	1
♦ 5	HC-2439	Hand Pump 500 psi	1
	TBD	Kit, Hand Pump Seal	1
6	TF-1038-14*09.9	Hose	1
7	Z-4302-01	Weldment, Filter Bracket	1
8	H-1009-01	Handle, Pump	1

Hand Pump (Option M)

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Hand Pump (Option M)

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

All Models

Item	Part Number	Description	Qty
3	531-000	Clevis Pin Assembly	1
4	568-120	Tie Rods	4
5	582-125	Retaining Flange	1
6	504-120	Tube	1
7	507-121	Piston	1
10	503-120	Valve Block	1
11	*Reference Only*	*Available only in Assembly*	1
13	CXD-020023-001	Body	1
14	530-000T	Retainer	1
12	5M2-B01-0500T	Screw Release	1
21	540-000	Plug	1
22	508-000	Pivot	1
	SRK-PHR-120	**Kit, Check Ball/Spring**; *consists of:*	
16		Intake Check Ball	1
17		Outlet Check Spring	1
18		Outlet Check Ball	1
20		Intake Check Spring	1
	SRK-PL-000T	**Kit, Bracket**; *consists of:*	
23		Linkage Pin Assembly	2
24		Strap	2
25		Bracket Handle	1
	511-240T	**Kit, Handle**; *consists of:*	
Not Shown		Handle Grip	1
		Handle	1

The remaining parts are fluid specific.

Model 5110, 5120 & 5130 Parts List

Fluid Type: MIL-PRF-5606 & MIL-PRF-83282

Item	Part Number	Description	Qty
	SRK-PSB-120	**Kit, O-ring;** *consists of:*	
8		O-ring, BUNA	1
9		O-ring, BUNA	2
15		O-ring, BUNA	1
19		O-ring, BUNA	1

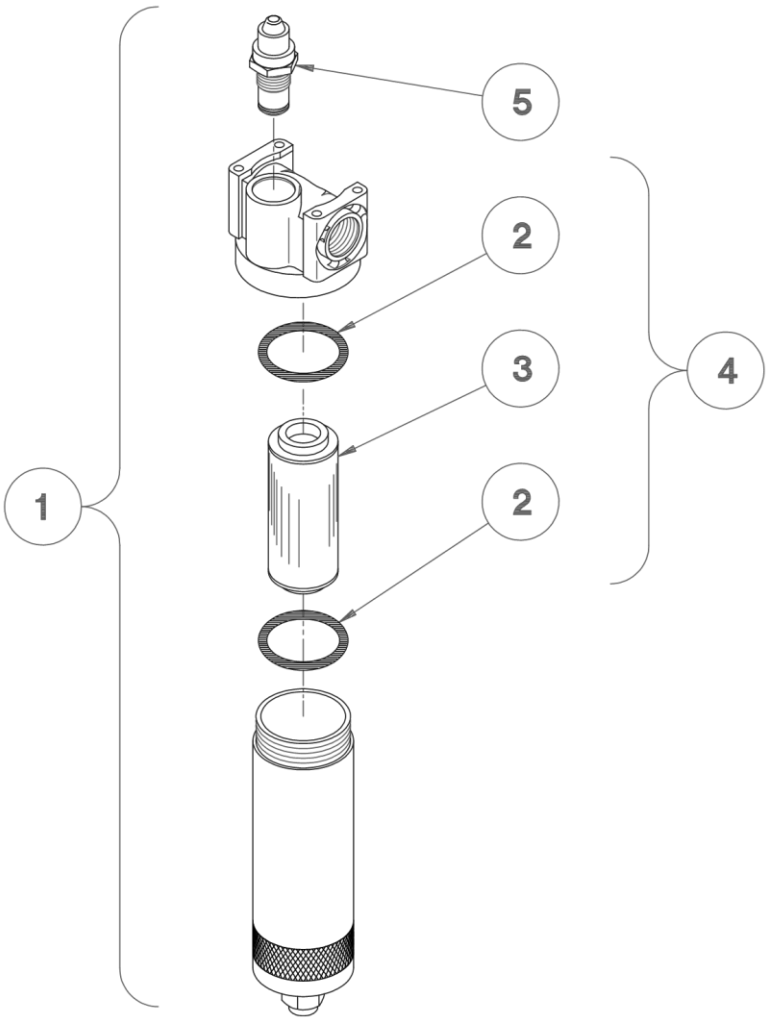
Model 5140 Parts List

Fluid Type: Aviation Phosphate Ester, Type IV & V

Item	Part Number	Description	Qty
	TBD	**Kit, O-ring;** *consists of:*	
8		O-ring, BUNA	1
9		O-ring, BUNA	2
15		O-ring, BUNA	1
19		O-ring, BUNA	1

Return Filter Assembly (Option W)

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



NOTE: Item 4 is included with Item 3.

Return Filter Assembly (Option W)

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

Model 5110 & 5120 Parts List

Fluid Type: MIL-PRF-5606 & MIL-PRF-83282

Item	Part Number	Description	Qty
1	HC-1453	Assembly, Filter	1
2	HC-2000-142	O-ring	2
3	HC-1454	Element, Filter	1
4	K-3096	Kit, Filter Element	1
5	HC-1849	Indicator, Clogging	1

Model 5130 Parts List

Fluid Type: Aviation Phosphate Ester, Type IV & V

Item	Part Number	Description	Qty
1	HC-1447	Assembly, Filter	1
2	HC-2006-142	O-ring	2
3	HC-1476	Element, Filter	1
4	K-3097	Kit, Filter Element	1
5	HC-1851	Indicator, Clogging	1

Model 5140 Parts List

Fluid Type: MIL-PRF-87257

Item	Part Number	Description	Qty
1	HC-2441	Assembly, Filter	1
2	HC-2007-142	O-ring	2
3	HC-1454	Element, Filter	1
4	K-4271	Kit, Filter Element	1
5	HC-1849	Indicator, Clogging	1

APPENDIX I

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.

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TRONAIR®

APPENDIX II

Oilgear
Type PVWJ Pump Manual

OILGEAR TYPE "PVWJ" PUMPS - PVWJ-011/-014/-022/-025/-034/-046/-064/ -076/-098/-130 SERVICE INSTRUCTIONS

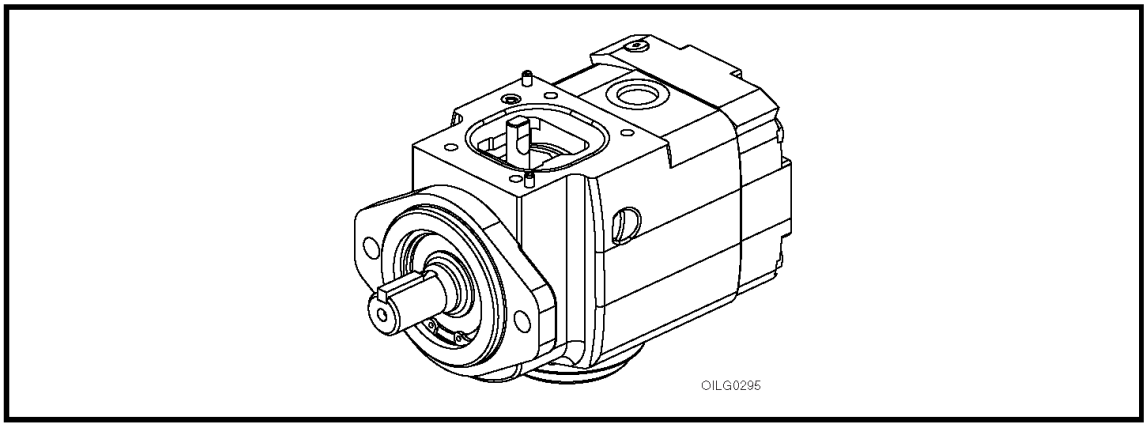

Figure 1. Typical Oilgear "PVWJ" Open Loop Pump

PURPOSE OF INSTRUCTIONS

These instructions will simplify the installation, operation, maintenance and troubleshooting of Oilgear type "PVWJ" pumps.

Become familiar with the construction, principle of operation and characteristics of your pump to help you attain satisfactory performance, reduce shut-down and increase the pump's service life. Some pumps have been modified from those described in this bulletin and other changes may be made without notice.

REFERENCE MATERIAL

Fluid Recommendations .....Bulletin 90000
Contamination Evaluation Guide.....Bulletin 90004
Filtration Recommendations .....Bulletin 90007
Piping Information .....Bulletin 90011
Proper Installation of Vertical Pumps .....Bulletin 90014
Alternate Remote Compensating of Single/Multiple Load Sense Pumps DS-47974-A
PVWJ Open Loop Pumps, Application Guidelines.....Bulletin 847085
PVWJ Open Loop Pumps, Sales .....Bulletin 47085

(continued)

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THE OILGEAR COMPANY
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PVWJ BASIC PUMP INSTALLATIONS

PVWJ PUMP CONTROL INSTRUCTIONS

PVWJ PUMP CONTROL INSTALLATIONS

Read and understand this entire instruction sheet before repairing, or adjusting your Oilgear product.

Those who use and maintain this equipment must be thoroughly trained and familiar with the product. If incorrectly used or maintained, this product and its equipment can cause severe injury.

SAFETY SYMBOLS

The following signal words are used in this instruction sheet to identify areas of concern where your safety may be involved. Carefully read the text and observe any instructions provided to ensure your safety.

⚠ DANGER ⚠

THIS SIGNAL WORD INDICATES AN IMMINENTLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, WILL RESULT IN DEATH OR SERIOUS INJURY.

⚠ WARNING

This signal word indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

This signal word indicates that a potentially hazardous situation exists which, if not avoided, may result in damage to equipment or minor personal injury.

NOTE *While not directly relevant to the topic being discussed, the NOTE is used to emphasize information provided, or provide additional information which may be of benefit.*

⚠ WARNING

This service information is designed for the maintenance of your Oilgear product. It contains the information on the correct procedures determined by Oilgear for the safe manner of servicing. Always keep this instruction sheet in a location where it is readily available for the persons who use and maintain the product. Additional copies of this instruction sheet are available through the Oilgear Company. Contact us at 414-327-1700 or visit our website: www.oilgear.com. Please contact us if you have any questions regarding the information in this instruction bulletin.

NOTE *The cleanliness of working on this pump or the hydraulic system is extremely important to the safety and reliability of the pump and the system. Always make sure the fittings are clean on the outside before removing them from their connections, are capped and plugged when removed and placed in a clean rag or container until they are reinstalled.*

⚠ WARNING

Some service operations may require special tools or equipment. If you require information on these items, please contact Oilgear before attempting these repairs and service operations.

⚠ WARNING

Read, understand, and follow the safety guidelines, dangers, and warnings contained in this instruction sheet to promote reliable operation and prevent serious personal injury.

⚠ WARNING

DO NOT attempt to service this machinery in an environment where safety regulations are not established and in place.

⚠ WARNING

DO NOT operate the hydraulic system if a leak is present. Serious injury may result.

⚠ WARNING

Hydraulic systems operate under very high-pressure. Hydraulic fluid escaping from a pressurized system can penetrate unprotected body tissue. DO NOT inspect for hydraulic leaks with bare hands or other exposed body parts. As a minimum, wear leather gloves prior to inspecting for leaks and use cardboard or wood. If leaks are present, relieve pressure and allow system to cool prior to servicing. If injured by escaping hydraulic oil, contact a physician immediately. Serious complications may arise if not treated immediately. If you have questions regarding inspecting for hydraulic leaks, please contact Oilgear prior to servicing.

⚠ WARNING

Hydraulic hoses and tubing must be inspected on a daily basis for leaks, cuts, abrasions, damage and improper clearance along any mounting frame for hidden damage before the unit is put into service. Replace damaged hoses or hoses you suspect are damaged before the system is returned to service! Hoses must be replaced every two years. Failure to properly inspect and maintain the system may result in serious injury.

⚠ WARNING

Hydraulic systems are hot. DO NOT TOUCH! Serious personal injury may result from hot oil. When you have completed working on the hydraulic system, thoroughly clean any spilled oil from the equipment. Do not spill any hydraulic fluids on the ground. Clean any hydraulic fluids from your skin as soon as you have completed maintenance and repairs. Dispose of used oil and system filters as required by law.

⚠ WARNING

Use correct hoses, fittings, and adapters with the correct SAE rating when replacing hoses to prevent possible serious injury. Always replace hoses, fittings, and adapters with replacements that have a proper, suitable, working pressure rating. Replacement hoses must be of the correct length and must comply with the hose manufacturer's and Oilgear's installation guidelines and recommendations.

⚠ WARNING

Hydraulic hoses have the SAE ratings marked on the hose to assist you in selecting the correct hose. The same manufacturer must supply any replacement hydraulic hoses and fitting assemblies. As an example: Brand "X" hose and brand "Y" fitting will not normally be compatible. No "Twist" is allowed in the hydraulic hoses. "Twist" may result in premature hose failure. This can cause serious injury. Please contact Oilgear for assistance when required.

⚠ WARNING

Hydraulic cylinders can be holding a function in a certain position when thepump is OFF. An example of this is a function being held in the lift or partial lift position by the cylinders. If a hydraulic line is removed or the hydraulic circuits or controls are being worked on, gravity may allow the function being held in position to drop. All workers and personnel must remain clear of these areas when working on or operating the hydraulic system. Block and secure all devices and functions which apply before beginning work or operation. Failure to comply with this can result in serious injury or death.

⚠ WARNING

Any hydraulic pipe which is replaced must conform to SAE J1065 specifications. If incorrect hydraulic pipe is installed, the hydraulic system may fail, causing serious injury. Damaged or leaking fittings, pipes or hoses must be replaced before the system is returned to service.

⚠ WARNING

DO NOT heat hydraulic pipe. The carbon content of this steel tube is such that if heated for bending, and either water or air quenched, the pipe may lose its ductility and thereby be subject to failure under high-pressure conditions. Serious injury can result. Damaged or leaking pipes must be replaced before the system is returned to service. Please contact Oilgear if you require assistance or have questions.

⚠ WARNING

All hydraulic pressure must be relieved from the hydraulic system prior to removing any components from the system. To relieve the hydraulic pressure from the hydraulic system, turn off the motor and operate the control panel with the key in the ON position. Failure to comply can result in serious injury. If you have any questions concerning relieving the hydraulic pressure from the system, please contact Oilgear.

⚠ WARNING

Hydraulic components can be heavy. Use caution while lifting these components. Serious personal injury can be avoided with proper handling of the components.

⚠ WARNING

Please contact Oilgear if you require assistance, when performing hydraulic test procedures, use the proper hydraulic gauges. Installing an incorrect test gauge could result in serious injury if the gauge fails. Use properly rated hydraulic hoses to allow the test gauge to be read away from moving parts and functions.

⚠ WARNING

Increasing hydraulic pressure beyond the recommendations may result in serious damage to the pump and system or serious personal injury and may void the Oilgear Warranty. If you have questions concerning hydraulic pressures or testing procedures, please contact Oilgear before attempting the test procedures or making adjustments.

⚠ WARNING

An Oilgear pump or pump control must not be modified in any way without authorization from Oilgear. Modifications may not comply with safety standards, including ANSI safety standards, and may result in serious personal injury. Please contact Oilgear if you require assistance.

⚠ WARNING

DO NOT enter under hydraulic supported equipment unless they are fully supported or blocked. Failure to follow this procedure can result in serious injury or death.

⚠ WARNING

Any Oilgear pump safety decals must be replaced anytime they are damaged, missing, or cannot be read clearly. Failure to have proper decals in place can result in serious injury or death. (If you require safety decals, please contact Oilgear for replacement safety decals, at no charge.)

⚠ WARNING

Be sure everyone is clear of the area around the hydraulic system before operating after servicing. Remain attentive at all times when operating to check your work until you are completely sure it is safe to return to service. Failure to heed this warning may result in serious personal injury or death.

⚠ WARNING

Wear the proper protective clothing when operating, servicing or maintaining the hydraulic system or the Oilgear pump. Wear the correct protective gear, safety glasses, gloves, and safety shoes. Serious injury can result without proper protective gear.

⚠ WARNING

Make sure to keep hands and feet and other parts of your body clear of revolving or moving parts. Failure to comply can cause serious injury.

⚠ WARNING

DO NOT wear watches, rings, or jewelry while working with electrical and mechanical equipment. These items can be hazardous and can cause serious and painful injuries if they come into contact with electrical wires, moving parts, or hydraulic equipment.

PREPARATION AND INSTALLATION

MOUNTING

Pump Without Reservoir - The pump can be mounted in any position. But, the recommended mounting position is with the drive shaft on a horizontal plane and the case drain port 1 on the top side. Secure the pump to a rigid mounting surface. Refer to the referenced Oilgear Piping Information Bulletin 90011.

Pump With Reservoir - These pumps are usually fully piped and equipped. It may be necessary to connect to a super-charge circuit when used. Mount reservoir on level foundation with the reservoir bottom at least 6 inches (152 mm) above floor level to facilitate fluid changes.

PIPING AND FITTINGS

Refer to the referenced Oilgear Piping Information Bulletin 90011 and individual circuit diagram before connecting the pump to the system. Inlet velocity must not exceed 5 fps (1,5 mps). Inlet should be unrestricted and have a minimum of fittings.

NOTE *DO NOT use an inlet strainer.*

Arrange line from "case drain" so the case remains full of fluid (non-siphoning). Case pressure must be less than 25 psi (1,7 bar). For higher case pressures and the special shaft seals required, contact our Customer Service. Each drain line must be a separate line, unrestricted, full sized and connected directly to the reservoir below the lowest fluid level. Make provisions for opening this line without draining (siphoning) reservoir.

⚠ WARNING

Running the pump in NEUTRAL position (zero delivery) for extended periods without a supercharge circuit can damage the pump. The system and pump must be protected against overloads by separate high-pressure relief valves. Install bleed valve(s) at the highest point(s) in system.

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

DO NOT start or stop unit under load unless system is approved by Oilgear. It may be necessary to provide delivery bypass in some circuits.

DRIVE

Verify rotation direction plate on the pump's housing. Clockwise pumps must be driven clockwise and counterclockwise pumps must be driven counterclockwise. Use direct drive coupling. Size and install coupling per manufacturer's instructions.

CAUTION

DO NOT drive the coupling onto the pump drive shaft. If it is too tight, it may be necessary to heat coupling for installation. Refer to manufacturer's instructions.

Misalignment of pump shaft to driver's shaft should not exceed 0.005 inches (0,13 mm) Total Indicator Readout (TIR) in any plane.

FILTRATION

Keep the fluid clean at all times to ensure long life from your hydraulic system. Refer to the referenced Oilgear Filtration Recommendations bulletin 90007 and Oilgear Contamination Evaluation Guide Bulletin 90004. Oilgear recommends use of a filter in the pressure or return line. Replace filter element(s) when the filter condition indicator reaches change area at normal fluid temperature. Drain and thoroughly clean filter case. Use replacement element(s) of same beta 10 ratio (normally a ratio of 4 with hydraulic oils).

FLUID COOLING

When the pump is operated continuously at the rated pressure or frequently at peak load, auxiliary cooling of the fluid may be necessary. Fluid temperature should not exceed limits specified in the referenced Oilgear Fluid Recommendations Bulletin 90000.

AIR BREATHER

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

FLUID, FILLING AND STARTING RECOMMENDATIONS

Refer to instruction plate on the unit, reservoir, machine and/or reference, fluid recommendations bulletin. Fire resistant fluids and phosphate ester fluids can be used in accordance with fluid manufacturer's recommendations.

1. Pump all fluid into reservoir through a clean (beta 10 ratio of 4 or more) filter. Fill reservoir to, but not above, "high level" mark on the sight gauge.
2. **Remove case drain line and fill pump case with hydraulic fluid.**
3. Turn drive shaft a few times by hand with a spanner wrench to make sure parts rotate.

Unit	Approximate torque to turn drive shaft
-011/-014/-022	1.7-2.1 ft·lbs (2,3-2,8 N·m)
-025/-034/-046	2.9-3.3 ft·lbs (4,0-4,5 N·m)
-064/-076/-098/-130	7.9-8.3 ft·lbs (18,8-11,3 N·m)

Table 1. Torque to Turn Shaft

With pump under "no load" or with pump control at NEUTRAL:

4. Turn drive unit ON and OFF several times before allowing pump to reach full speed. The system can usually be filled by running the pump and operating the control.
5. The fluid level in the reservoir should decrease. Stop the pump. **DO NOT** allow the fluid level to go beyond the "low level." If the level reaches the "low level" mark, add fluid and repeat step.

NOTE *With differential (cylinder) systems, the fluid must not be above "high level" when the ram is retracted or below "low level" when extended. Bleed air from the system by loosening connections or opening petcocks at the highest point in the system. Close connections or petcocks tightly when solid stream of fluid appears.*

SPECIFICATIONS

NOTE *Refer to reference material, pump control material and individual application circuit for exceptions.*

FRAME	UNIT	THEORETICAL MAXIMUM DISPLACEMENT		RATED CONTINUOUS PRESSURE		MAXIMUM PRESSURE		FLOW RATE at 1800 rpm, rated continuous pressure and 14,7 psia (1.0 bar) inlet condition		MAXIMUM INLET PRESSURE* psia (bar)			MAXIMUM SPEED**	POWER INPUT at rated continuous pressure & 1800 rpm	
		in^3/rev	ml/rev	psi	bar	psi	bar	gpm	l/mi	1200 rpm	1500 rpm	1800 rpm	rpm	hp	kw
A	011	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
	014	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
	022	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	025	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
	034	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
	046	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	064	3.88	63,6	5000	344,8	5800	400,0	27.4	103,8	7.6 (,59)	8.5 (,59)	9.5 (,66)	2400	95.1	70,9
	076	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
	098	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
	130	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.
** Minimum speed 600 rpm

Case pressure should be less than 25 psi (1,7 bar). For higher pressure, consult factory.
Higher speeds available - consult factory.

Table 2. Nominal Performance Data with 150-300 SSU viscosity fluids.

Frame	Unit	Length		Width		Height		Weight	
		inches	mm	inches	mm	inches	mm	lbs.	kg
A	011/-014/-022	7.20	182,9	4.32	109,7	4.50	114,3	32	14,5
B	025/-034/-046	8.50	215,9	5.80	147,3	6.11	155,2	68	30,9
C	064/-076/-098/-130	10.44	265,2	6.76	171,7	7.18	182,4	103	46,8

All dimensions (without controls) are for rear ported units. For dimensions of other configurations, contact your Oilgear Representative or see the appropriate Data Sheet.

Table 3. Nominal Dimensions and Weights without controls.

Refer to installation drawings for more detailed dimensions and port configurations.

TROUBLESHOOTING

PROBLEM	CAUSES	REMEDY
Unresponsive or Unstable Control	Swashblock (201) bearing surface and/or saddle bearings (204) worn or damaged.	Inspect and replace if necessary.
	Control pin (721) and/or hole in swashblock (201) worn significantly.	
	Saddle bearing locating pins (207) broken.	
	Fluid is contaminated.	Inspect and clean if necessary. See bulletin 90007.
	Control piston orifice plugged.	See appropriate control service bulletin.
	Contamination trapped between control piston and piston bore is not allowing piston to move smoothly.	
	Contamination trapped between control spool and spool bore is not allowing spool to move smoothly.	
	Faulty remote pressure compensator circuit components.	Inspect and replace if necessary.
	Hydraulic line between remote pressure compensator components and RP port of control is too long.	Shorten line length.
	Insufficient control flow.	Increase size of control piston orifice (732).
Insufficient Outlet Volume	Swashblock (201) not stroking to desired displacement.	Inspect for obstruction and remove. Replace worn or damaged parts.
	Low input drive speed.	Refer to appropriate pump performance specifications.
	Worn or grooved cylinder barrel (101) and/or valve plate (401) mating surfaces.	Inspect and replace if necessary.
	Failed drive shaft (301).	
	Worn or damaged piston shoes (102) or swashblock (201).	
	Worn pistons and/or piston bores.	
	Excessive wear or inadequately supported hydrodynamic bearing (202).	
	Maximum volume stop adjusted incorrectly.	Adjust maximum volume stop CCW to increase outlet flow.
	Control piston stuck off stroke.	See appropriate control service bulletin.
	Pressure compensator is set too close to operating pressure.	
De-strokes at Low Pressure	Pressure compensator adjustment not set correctly.	See appropriate control service bulletin.
	Control piston orifice (732) plugged.	
	Damaged or fractured control spring.	
	Severely worn control spool and/or spool bore.	
	Damaged or fractured control piston spring.	
	Faulty remote pressure compensator circuit components.	
Excessive Peak Pressure	Pressure compensator is set too high.	See appropriate control service bulletin.
	Minimum volume stop is set too high.	
	Fluid is contaminated.	Inspect and clean if necessary. See bulletin 90007.
	Swashblock (201) bearing surface and/or saddle bearings (204) worn or damaged.	Inspect and replace if necessary.
	Contamination trapped between control piston and piston bore is not allowing piston to move smoothly.	See appropriate control service bulletin.
	Contamination trapped between control spool and spool bore is not allowing spool to move smoothly.	
	Hydraulic line between remote pressure compensator components and RP port of control is too long.	Shorten line length.
	Faulty remote pressure compensator circuit components.	Inspect and replace if necessary.
	Restriction in drilled passages between pump outlet port and control spool.	Inspect and clean if necessary.

Excessive Heating	Operating pump above rated or peak pressure.	Consult appropriate pump specification for pressure limitations.
	Low fluid level in reservoir.	Verify fluid level is above reservoir suction line.
	Insufficient pump inlet pressure.	Eliminate any obstructions or other pressure drops in pump inlet plumbing. Consult appropriate pump specification for inlet pressure requirements.
	Air entering pump inlet plumbing.	Eliminate leaks that would allow air to enter the fluid stream.
	Worn pistons (102) or cylinder barrel (101).	Inspect and replace if necessary.
	Worn or damaged cylinder barrel (101) and/or valve plate (401) mating surfaces.	
	Faulty circuit components (continuously blowing relief valve or a high-pressure leak).	Eliminate leak or replace faulty components.
	Insufficient cooling provisions.	Inspect heat exchanger for obstructions and remove.
	Reservoir is too small.	Consult Bulletin 90050-B, Reservoir Design.
Excessive Noise	Pump stopped or started incorrectly under load.	Verify operator procedure.
	Low fluid level in reservoir.	Verify fluid level is above reservoir suction line.
	Air entering pump inlet plumbing.	Eliminate leaks that would allow air to enter the fluid stream.
	Broken shoe/piston assembly (102).	Inspect and replace if necessary.
	Worn or damaged cylinder barrel (101) and/or hydrodynamic bearing (202) running surface.	
	Faulty circuit components (continuously blowing relief valve or a high-pressure leak).	Eliminate leak or replace faulty components.
	Insufficient pump inlet pressure.	Consult appropriate pump specification for inlet pressure requirements.
	Excessive fluid viscosity.	Consult Application Guidelines (Bulletin 847085) for maximum viscosity limitations.
	Insufficient pump inlet pressure.	Eliminate any obstructions or other pressure drops in pump inlet plumbing. Consult appropriate pump specification for inlet pressure requirements.
	Pump input shaft rotating in wrong direction.	Inspect and correct drive rotation.

PRINCIPLE OF OPERATION

The illustrations show the pump driven clockwise (right hand) from the top (plan) view.

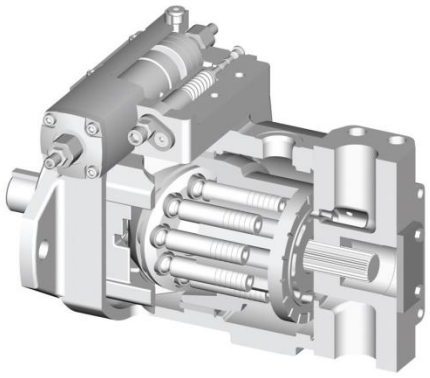

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Figure 2. Cut-a-way of a Typical "PVWJ" Pump with Typical Control

Position B, Pump During Full Delivery FROM PORT B - Figure 3

Rotating the drive shaft **(301)** clockwise turns the splined cylinder, which contains the pumping pistons **(102)**. When the cylinder rotates, the pistons move in and out within their bores as the shoes ride against the angled **(C)** swashblock **(201)**.

As the cylinder rotates, the individual piston bores are connected, alternately, to the crescent shaped upper (port **A**) and lower (port **B**) in the valve plate. While connected to the upper side (suction) port **A**, each piston moves outward **OUT**, drawing fluid from port **A** into the piston bore until its outermost stroke **(D)** is reached. At this point, the piston bore passes from the upper crescent port **A** to the lower crescent port **B**.

While rotating across the lower crescent, each piston moves across the angled swashblock face and then each piston is forced inward **IN**. Each piston then displaces fluid through the lower crescent to port **B** until its innermost stroke **(D)** is reached. At this point, the piston bore passes from the lower to the upper crescent again and the cycle is repeated.

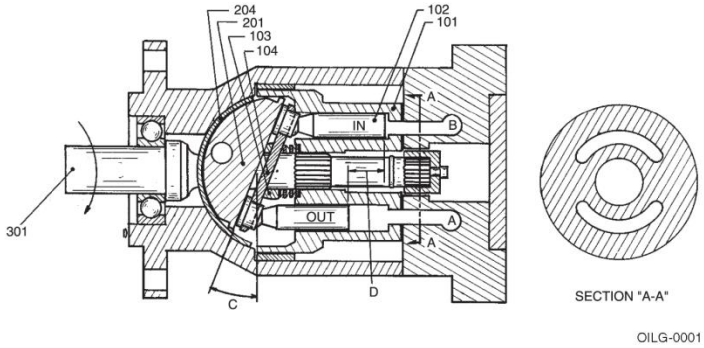

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Figure 3. Position B, Pump During Full Delivery From Port B

Position B/2, Pump During One Half Delivery FROM PORT B - Figure 4

This illustration shows that the angle **(E)** of the swashblock determines the length of the piston stroke **(F)**, (the difference between outermost and innermost position) which determines the amount of delivery from the pump. In this case, the stroke angle **(E)** is one-half of the stroke, which means the piston stroke is one-half and the pump delivery is one-half.

Position N, Pump In Neutral, No Stroke, No Delivery - Figure 5

Neutral position results when the control centers the swashblock. The swashblock angle **(G)** is now zero and swashblock face is parallel to the cylinder face. There is no inward or outward motion of the pump pistons as piston shoes rotate around the swashblock face. With no inward and outward motion or no stroke **(H)**, **NEUTRAL** no fluid is being displaced from the piston bores to the crescents in the valve plate and there is no delivery from pump ports.

NOTE *Illustration reference numbers match the part item number in the parts list.*

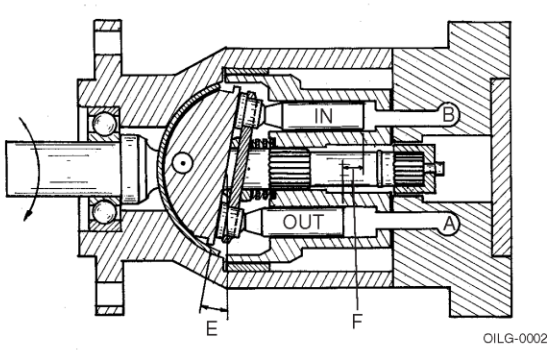

Figure 4. Position B/2, Pump During One Half Delivery From Port B

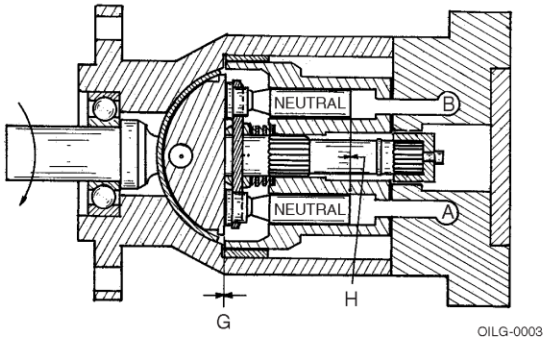

Figure 5. Position N, Pump In Neutral, No Stroke, No Delivery

TESTING AND ADJUSTING

PISTON PUMP

To check for a worn piston pump, make a leak measurement test from the case drain while the pump is under pressure. 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.

⚠ WARNING

Shut the 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 the pressure line between the pump and the system (or pump) high-pressure relief valve will result in damage and could result in serious personal injury.

With an accurate high-pressure gauge in the pressure line, start the pump and stall (or block) output device to raise system pressure to maximum (as set by system relief valve). Read the measurement on the flow meter or time and measure the case drain flow used to fill a known size container and calculate the flow rate in terms of cubic inches per minute (cipm). The leakage should conform to **Table 4**.

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.

NOTE *Increasing shaft speed or a decrease in fluid viscosity will increase leakage. Manually or mechanically de-stroking the pump has a negligible effect on leakage.*

NOTE *Additional leakage indicates wear, but does not become critical until it impairs performance.*

NOTE *If testing a unit with a pressure compensator control, make sure the compensator setting is at least 500 psi above the pump outlet pressure to assure the pump is at full stroke.*

Unit	Full Stroke Leakage @ Pump Outlet Pressure (psi)											
	1500 psi		2500 psi		3000 psi		3500 psi		4000 psi		5000 psi	
	cipm	lpm	cipm	lpm	cipm	lpm	cipm	lpm	cipm	lpm	cipm	lpm
011	50	2.08	70	1.1	80	1.3	100	1.6	120	2.0	200	3.3
014	90	1.5	120	2.0	140	2.3	165	2.7	200	3.3	-	-
022	120	2.0	170	2.8	200	3.3	-	-	-	-	-	-
025	105	1.7	135	2.2	150	2.4	175	2.9	210	3.4	300	4.9
034	150	2.4	210	3.4	250	4.1	300	4.9	-	-	-	-
046	230	3.8	300	4.9	-	-	-	-	-	-	-	-
064	150	2.4	205	3.4	240	3.9	275	4.5	320	5.2	460	7.6
076	200	3.3	305	5.0	375	6.1	460	7.6	-	-	-	-
098	270	4.4	460	7.6	-	-	-	-	-	-	-	-
130	530	8.7	-	-	-	-	-	-	-	-	-	-

Table 4. Nominal Case Slip at full stroke and 1800 RPM, fluid viscosity 160 SSU.

DISASSEMBLY

NOTE *The cleanliness of working on this pump or the hydraulic system is extremely important to the safety and reliability of the pump and the system.*

When disassembling or assembling the pump, choose a clean, dry, dust and sand-free area where no traces of abrasive particles are in the air which can damage the pump and system. DO NOT work near welding, sandblasting, grinding benches or similar conditions.

Always make sure the fittings are clean on the outside before removing them from their connections. Make sure they are capped and plugged when removed. Place them on a clean surface and in a clean rag or container until they are reinstalled. When cleaning parts which have been disassembled, it is important to use CLEAN cleaning solvents and allow parts to dry. All tools and gauges should be clean prior to working with the system and use new, CLEAN, lint-free rags to handle and dry parts.

⚠ WARNING

DO NOT attempt to remove or install any components or assembly while the pump and system is running. Always stop the pump, shut OFF the power and release pressure from the system before servicing or testing. Be sure provisions have been made so the case drain line can be disconnected from the unit without causing the line to drain (siphon) the reservoir.

1. Disconnect case drain line from port **1** or **1A**.
2. Drain pump case through the remaining (port **1** or **1A**) on the bottom of case. If plugs are inaccessible, it may be necessary to remove the pump from the mounting and drive motor before draining it.
3. After removing the pump from the mounting and before disassembly, cap or plug all ports and clean the outside of unit thoroughly to prevent dust from entering the system. See **Figures 10** and **18**.

NOTE *Depending on what part or parts are to be inspected, it may not be necessary to completely take apart all assemblies.*

CONTROL GROUP

Refer to the reference material for the information which applies to the control your pump is equipped with. Some force is required to remove the control housing.

1. Remove socket head cap screws.
2. Lift the control group assembly, with control pin, straight up from the top of the pump assembly. The control pin may or may not remain in the swashblock **(201)**.
3. Remove control gasket and O-rings from the pump housing.

VALVE PLATE GROUP

If another pump is coupled to thru-shaft pumps, remove coupling half before removing valve plate.

1. Block the pump on a bench with the drive shaft facing down.
2. If applicable, remove relief valve block from valve plate.
3. Remove the valve plate **(401)** by removing four hex head cap screws **(403)** and lifting it straight up.
4. Remove O-rings.

ROTATING GROUP

⚠ WARNING

The rotating group may be heavy. Be careful not to damage cylinder wear surface which mates against the valve plate, bearing diameters or piston shoes. Use proper lifting techniques and assistance from others to prevent personal injury.

1. Place the pump in a horizontal position.
2. Remove the rotating group by turning shaft **(301)** slowly, while pulling the cylinder barrel **(101)** from the housing.
3. Identify (number) each pump piston shoe assembly **(102)** and its respective bore in the cylinder barrel **(101)** and shoe retainer **(104)** for easy reassembly.
4. See **Figure 6**. Lift out shoe retainer **(104)** with pistons **(102)** and remove the fulcrum ball **(103)** and shoe retainer spring **(105)**.

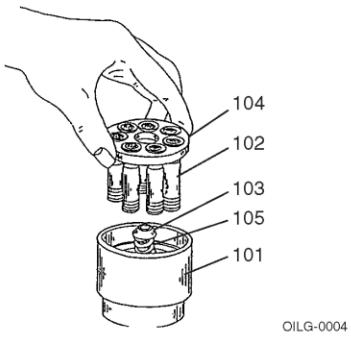

Figure 6. Rotating Group Disassembly.

5. Remove retaining ring **(208)** and pull the hydrodynamic bearing **(202)** and roll pins, if necessary, **(205)** from the housing. Note the position of roll pin **(205)** inside of case.

DRIVE SHAFT GROUP

1. Remove the drive key **(303)**, if used and the drive shaft bearing retainer ring **(305)**.
2. Grasp outboard end of drive shaft **(301)** and pull it out of the pump housing.
3. Remove the shaft seal retainer **(302)** and shaft seal **(007)** from the housing only if necessary.

SWASHBLOCK GROUP

1. Reach inside the housing and remove the swashblock **(201)** and saddle bearings **(204)**.
2. If applicable, remove the saddle block **(216)** from the housing.

INSPECTION

Clean all parts thoroughly and allow them to dry. Inspect all seals and O-rings for hardening, cracking or deterioration. Replace if necessary or if you suspect damage. Check all locating pins for damage and springs for cracking or signs of cracking or signs of wear.

⚠ WARNING

Wear proper protective gear when using solvents or compressed air, servicing or maintaining the hydraulic system or the Oilgear pump. Wear correct protective gear, safety glasses, gloves and safety shoes. Serious injury can result without proper protective gear.

CONTROL GROUP

Refer to the reference material on pump controls. Be sure to carefully check the control pin for cracks and/or signs of fatigue. Check fit of the pin in the swashblock. It should be a slip-fit without side-play. Replace if necessary or if you suspect damage.

VALVE PLATE GROUP

Inspect the valve plate **(401)** surface which mates with the cylinder barrel **(101)** for excessive wear or scoring. Remove minor defects by lightly stoning the surface with a hard stone which is flat to within 0.001 inches (0,025 mm).

NOTE *Be sure to stone lightly. Any excessive stoning will remove the hardened surface. If wear or damage is extensive, replace the valve plate.*

ROTATING GROUP

Inspect cylinder barrel **(101)** piston bores and the face which mate with the valve plate for wear and scoring. Remove minor defects on the face by lightly stoning or lapping the surface.

Inspect the cylinder bearing **(202)** for damage and replace if necessary. Check all piston and shoe assemblies **(102)** to be sure they ride properly on the swashblock.

NOTE *Be sure to stone lightly. Any excessive stoning will remove the hardened surface. If wear or damage is extensive and defects cannot be removed, replace the cylinder barrel.*

See **Figure 7**. Check each shoe face for nicks and scratches, and the shoe for smooth pivot action on the piston.

NOTE *If one or more piston/shoe assembly needs to be replaced, replace all the piston/shoe assemblies. When installing new piston/ shoe assemblies or the rotating group, make sure the pistons move freely in their respective bores.*

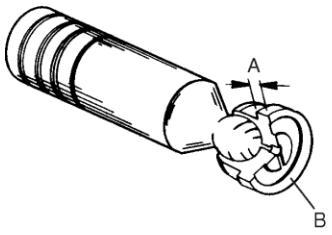

Figure 7. Piston and Shoe Inspection

(A) All shoes must be equal within 0.001 inches (0,025 mm) at this dimension.
(B) All shoe faces must be free of nicks.

NOTE *End play should not to exceed 0.003 inches (0,076 mm) when new or 0.006 inches (0,152 mm) when worn.*

SWASHBLOCK GROUP

Inspect the swashblock **(201)** for wear and scoring. If defects are minor, stone the swashblock lightly. If damage is extensive, replace the swashblock.

Check the small hole in the face of the swashblock. The hole provides “porting” for the hydrostatic balance fluid of the piston/shoe assembly to be channeled through the swashblock to the face of the saddle bearing, providing pressure lubrication.

Compare the saddle bearing **(204)** thickness in a worn area to thickness in an unworn area. Replace saddle bearings if the difference is greater than 0.015 inches (0,4 mm).

Check the mating surface of swashblock for cracks or excessive wear. The swashblock movement in the saddle bearings must be smooth. Replace if necessary.

NOTE *Be sure to stone lightly. Any excessive stoning will remove the hardened surface. If wear or damage is extensive and defects cannot be removed, replace if necessary or if you suspect them of being bad.*

DRIVE SHAFT GROUP

Check:

- the shaft seal **(007)** for deterioration or cracks. Replace if necessary (push-out).
- the shaft bearing **(306)** for galling, pitting, binding or roughness.
- the rear shaft bushing in valve plate.
- the shaft and its splines for wear. Replace any parts necessary.
- for grooving of the shaft where the shaft seal contacts it.

ASSEMBLY

See **Figures 8, 9 and 10**. Follow the disassembly procedures in reverse for re-assembling the pump.

During assembly, install new seals and O-rings. Apply a thin film of CLEAN grease or hydraulic fluid to sealing components to ease assembly. If a new rotating group is used, lubricate thoroughly with CLEAN hydraulic fluid. Apply fluid generously to all wear surfaces.

SWASHBLOCK GROUP

If removed,

1. Press shaft seal **(007)** into front of pump housing.
2. Place housing on a bench with the mounting flange side down.
3. If applicable, install the saddle block **(216)** into the housing. Make sure the anti-rotating pin **(217)** aligns the saddle block correctly.
4. Grease the back side of each saddle bearing **(204)** and place on the pin to locate the bearings in the pump case. Make sure the pins do not protrude.
5. Insert swashblock **(201)** into the pump housing. Once in place, be sure the swashblock swivels in the saddle bearings. With new bearings, swiveling may be stiff and not always smooth.
6. Make sure the roll pin **(205)** is inserted into the cylinder bearing **(202)**. Position the cylinder bearing so the pin is located at the same location as it was when the pump was disassembled. The bearing should fit into place with a little difficulty and be square to the axis of the pump.
7. Tap bearing into place if necessary using extreme care not to damage the bearing.
8. Insert retaining ring **(208)** to hold bearing in place.

NOTE *Refer to **Figure 8** and **Figure 9** for the correct orientation of the pins for the appropriate frame size.*

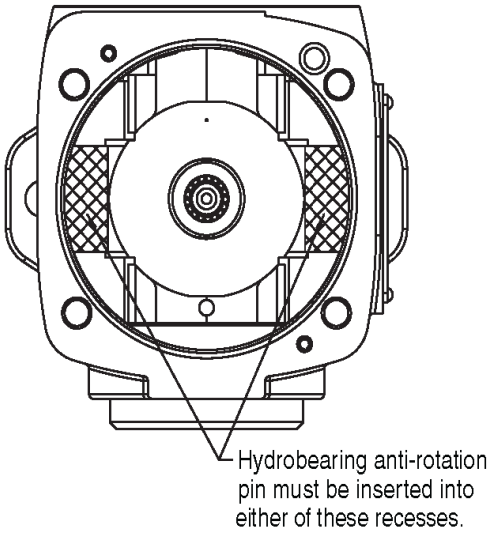

Figure 8. A-Frame Orientation of Pins

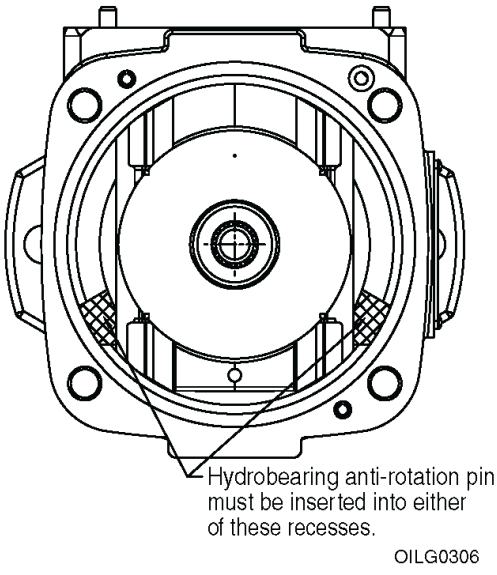

Figure 9. B-Frame and C-Frame Orientation of Pins

DRIVE SHAFT GROUP

1. Place the housing on its side with the axis horizontal.
2. Install the seal retainer **(302)**.
3. Lubricate the shaft seal **(007)** and shaft.
4. Insert the drive shaft **(301)** and bearing assembly into the housing.
5. Lock in place with the drive shaft bearing retainer ring **(305)**.

ROTATING GROUP

See **Figure 6.**

1. Place the cylinder barrel **(101)**, wear surface down, on a clean cloth.
2. Place the shoe retainer spring **(105)** in the center of the barrel with the fulcrum ball **(103)** on top of it.
3. Insert the identified pistons **(102)** into their corresponding identified holes of the shoe retainer **(104)**. As a unit, fit the pistons into their corresponding, identified bores in the cylinder barrel. **DO NOT FORCE.** If everything is aligned properly, the pistons will fit smoothly.

⚠ WARNING

The rotating group weight may be heavy. Be careful not to damage cylinder wear surface which mates against the valve plate, bearing diameters or piston shoes. Use proper lifting techniques and assistance from others to prevent personal injury.

The rotating group can now be carefully installed over the tail of the drive shaft **(301)** and into the pump housing **(001)**.

NOTE *When installing the rotating group, support the weight of the cylinder barrel **(101)**, as cylinder spline is passed over the tailshaft, to avoid scratching or damage.*

4. Push cylinder forward until the cylinder spline reaches the drive shaft spline and rotate slightly to engage shaft splines. Continue to slide cylinder forward until it encounters the cylinder bearing **(202)**. Lifting the tailshaft slightly helps the cylinder **(101)** and the cylinder bearing **(202)** engagement. Continue pushing the cylinder forward until the piston shoes contact the swashblock. The back of the cylinder should slightly protrude outside the back of the pump housing.
5. Install and torque the four control screws to the appropriate value shown in **Table 5**.

RELIEF VALVE BLOCK

1. Install new O-rings on the relief block.
2. Position the relief valve block over the outlet port of the valve plate.
3. Install and torque the four screws to the appropriate value shown in **Table 5**.

VALVE PLATE GROUP

1. Place the partially assembled pump housing on a bench with the open end facing up.
2. Install new O-rings on the housing.
3. Position the valve plate **(401)** over the tailshaft and on pins **(005)** and housing.
4. Install and torque the four valve plate screws to the appropriate value shown in **Table 5**.
5. If any plugs were removed, reinstall and torque them to the appropriate value shown in **Table 5**.

CONTROL GROUP

1. Place the assembled pump on its side with the axis horizontal.
2. Install new O-rings on the housing.
3. Install the control pin into the swashblock.
4. Position the control assembly so the control pin fits into the annular slot of the control piston.
5. Assemble the control assembly to the pump assembly, making sure that both alignment pins **(006)** are correctly inserted into their respective holes of the control body.

NOTE *It may be necessary to mechanically position the control piston to correctly align the control on the pump.*

PVWJ PUMP TORQUES

	Item Number	Description	Head Type & Size	Tightening Torque
A-Frame PVWJ-011 PVWJ-014 PVWJ-022	002	Housing Plug	3/4" Internal Hex	100 ft-lbs (136 N·m)
	403	Valve Plate Screws	3/8" Internal Hex or 9/16" External Hex	15 ft-lbs (20 N·m)
	507	Tandem Cover Screws	1/2" Internal Hex	325 in.-lbs (5 N·m)
	601	SAE #2 Plug	1/8" Internal Hex	45 in.-lbs (5 N·m)
	626	SAE #10 Plug	1" External Hex	90 ft-lbs (122 N·m)
B-Frame PVWJ-025 PVWJ-034 PVWJ-046	403	Valve Plate Screws	3/4" External Hex	37 in.-lbs (50 N·m)
	405	SAE #2 Plug	1/8" Internal Hex	45 in.-lbs (5 N·m)
	503	SAE A Tandem Mounting Screws	9/16" External Hex	28 ft-lbs (38 N·m)
		SAE B Tandem Mounting Screws	3/4" External Hex	37 ft-lbs (50 N·m)
	507	Cover Plate or Adapter Screws	1/2" External Hex	325 in.-lbs (37 N·m)
	902	Relief Valve Block Screws	3/8" Internal Hex	44 ft-lbs (60 N·m)
C-Frame PVWJ-064 PVWJ-076 PVWJ-098 PVWJ-130	403	Valve Plate Screws	14 mm Internal Hex	56 ft-lbs (76 N·m)
	503	SAE A Tandem Mounting Screws	9/16" External Hex	28 ft-lbs (38 N·m)
		SAE B Tandem Mounting Screws	3/4" External Hex	37 ft-lbs (50 N·m)
		SAE C Tandem Mounting Screws	15/16" External Hex	74 ft-lbs (100 N·m)
	507	Cover Plate Screws	1/2" External Hex	325 in.-lbs (37 N·m)
		Adapter Screws	9/16" External Hex	28 ft-lbs (38 N·m)
	601	SAE #2 Plug	1/8" Internal Hex	45 in.-lbs (5 N·m)
	902	Relief Valve Block Screws (PVWH-076/-098/-130)	3/8" Internal Hex	68 ft-lbs (92 N·m)
		Relief Valve Block Screws (PVWH-064)	1/2" Internal Hex	138 ft-lbs (187 N·m)

Table 5. PVWJ Pump Assembly Torques

CONTROL O-RING SEALS

Item Number	ARP 568 Uniform Size Number	Shore A Durometer
1008	008	70
1010	010	90
1012	012	90
1042	042	70
1138	138	70
1145	145	70
1155	155	70
1159	159	70
1219	219	90
1222	222	90
1225	225	90
1228	228	90
1237	237	70
1242	242	70
1252	252	70
1257	257	70
1500	See note 1	80
1902	902	90
1910	910	90

Note 1. 94 mm OD x 2.5 mm

Table 6. PVWJ Pump O-Ring Seals

NOTES

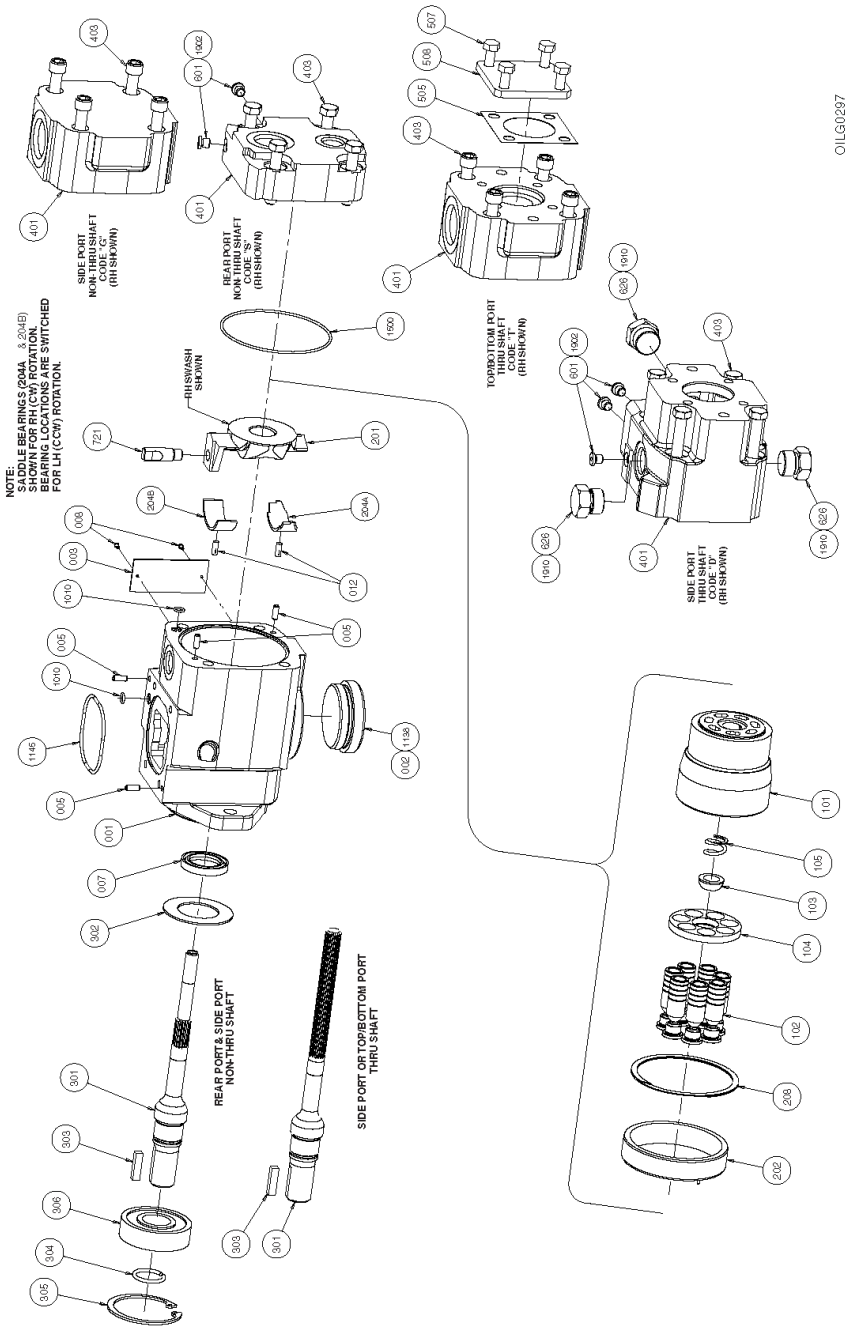

Figure 10. Exploded parts drawing, PVWJ-011/-014/-022 A-Frame (520024-101 sheet 2 of 4).

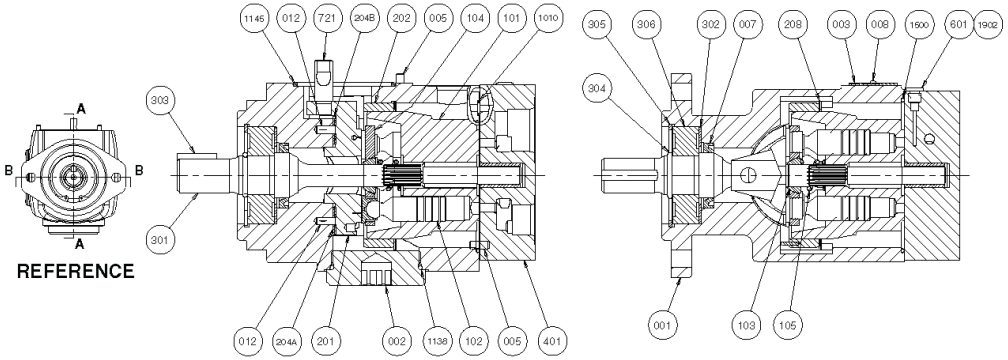

Figure 11. Cross section and plan view parts drawing, PVWJ-011/-014/-022 A-Frame (520024-101 sheet 1 of 4).

PVWJ-011/-014/-022 A-FRAME PUMP PARTS LIST

Parts used in these assemblies are per Oilgear specifications. Use only Oilgear parts to ensure compatibility with assembly requirements. When ordering replacement parts, be sure to include pump type and serial number, bulletin number and item number. Specify type of hydraulic fluid to ensure seal and packing compatibility.

NOTE Parts drawings may not be identical to Oilgear drawings referenced.

Item	Qty.	Description
HOUSING ASSEMBLY GROUP		
001	1	Pump Housing
002	1	Plug
003	1	Name Tag
005	4	Roll Pin
007	1	Shaft Seal
008	2	Drive Screws
012	2	Saddle Bearing Locating Pin
1010	2	O-Ring
1138	1	O-Ring
1145	1	O-Ring
1500	1	O-Ring
ROTARY ASSEMBLY GROUP		
101	1	Barrel
102	7	Piston & Shoe Assembly
103	1	Fulcrum Ball
104	1	Shoe Retainer
105	1	Shoe Retainer Spring
SWASHBLOCK ASSEMBLY GROUP		
201	1	Swashblock
202	1	Hydrodynamic Bearing
204A	1	Saddle Bearing (pressure side)
204B	1	Saddle Bearing (suction side)
208	1	Retaining Ring
721	1	Control Pin
DRIVE SHAFT ASSEMBLY GROUP		
301	1	Drive Shaft
302	1	Seal Retainer
303	1	Key
304	1	Shaft Retainer Ring
305	1	Shaft Bearing Retainer Ring
306	1	Front Drive Shaft Bearing
VALVE PLATE ASSEMBLY GROUP		
401	1	Valve Plate
403	4	Screw
601	Note 1	Plug
626	Note 1	Plug
1902	Note 1	O-Ring
1910	Note 1	O-Ring
COVER PLATE PARTS		
505	1	Gasket
507	4	Screw
508	1	Cover Plate

Note 1. Qty is 0, 1, 2 or 3 dependent on Valve Plate type.

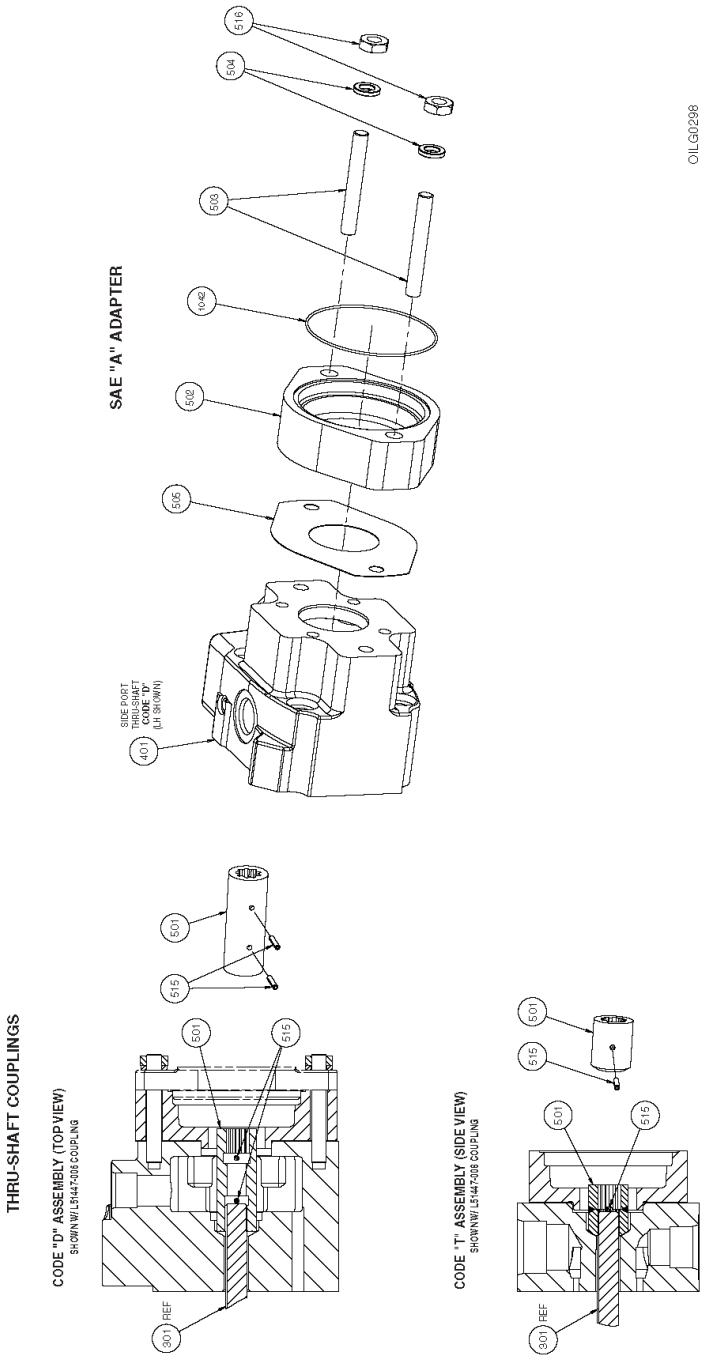

Figure 12. Exploded parts drawing, PVWJ-011/-014/-022 A-Frame,Thru-Shaft Couplings and SAE "A" Adapter (520024-101 sheet 3 of 4).

Item	Qty.	Description
DRIVE SHAFT ASSEMBLY GROUP		
301	1	Drive Shaft
VALVE PLATE ASSEMBLY GROUP		
401	1	Valve Plate

DUAL PUMP ADAPTER PARTS		
501	1	Coupling
502	1	Adapter
503	2	Stud
504	2	Washer
505	1	Gasket
515	1	Roll Pin
516	2	Hex Nut
1042	1	O-Ring

SERVICE KITS

Reference 520024-101
SERVICE KIT Drawings figures 10-12

Document Number: 520024-SK1
Revision: New

PVWJ A-Frame Units (PVWJ-011/-014/-022)

Description	Kit No.	Design Series	Items Included (quantity is 1 unless noted)
Housing Kits			
All Models	L51116-30	A1	001, 005(4), 007, 012, 1010(2), 1145, 1500
Rotating Group Bearing Kit			
All Models	L51203-1	A1	202, 208
Shaft & Bearing Kits			
Kits for Non Thru-Shaft Models			
3/4" Dia. Keyed (Code "Y")	L51128-11	A1	301, 302, 303, 304, 305, 306
7/8" Dia. Keyed (Code "B")	L51128-15	A1	301, 302, 303, 304, 305, 306
5/8" 9T SAE Spline (Code "S")	L51128-13	A1	301, 302, 304, 305, 306
7/8" 13T Industrial Spline (Code "C")	L51128-17	A1	301, 302, 304, 305, 306
Kits for Thru-Shaft Models with Code "DA" Valve Plates			
3/4" Dia. Keyed (Code "Y")	L51518-11A	A1	301, 302, 303, 304, 305, 306
7/8" Dia. Keyed (Code "B")	L51518-11	A1	301, 302, 303, 304, 305, 306
5/8" 9T SAE Spline (Code "S")	L51518-10	A1	301, 302, 304, 305, 306
5/8" 9T Industrial Spline (Code "D")	L51518-12Z	A1	301, 302, 304, 305, 306
7/8" 13T Industrial Spline (Code "C")	L51518-12	A1	301, 302, 304, 305, 306
Kits for Thru-Shaft Models with Code "TA" Valve Plates			
3/4" Dia. Keyed (Code "Y")	L51518-33A	A1	301, 302, 303, 304, 305, 306
7/8" Dia. Keyed (Code "B")	L51518-39A	A1	301, 302, 303, 304, 305, 306
5/8" 9T SAE Spline (Code "S")	L51518-35A	A1	301, 302, 304, 305, 306
5/8" 9T Industrial Spline (Code "D")	L51518-37A	A1	301, 302, 304, 305, 306
7/8" 13T Industrial Spline (Code "C")	L51518-57	A1	301, 302, 304, 305, 306
Swashblock Kits			
LH (CCW) Models	L50488-3	A1	201, 721
RH (CW) Models	L50488-5	A1	201, 721
Rotating Group Kits			
PVWJ-011	L50052-8	A1	101, 102(7), 103, 104, 105
PVWJ-014	L50052-7	A1	101, 102(7), 103, 104, 105
PVWJ-022	L50053-7	A1	101, 102(7), 103, 104, 105
Saddle Bearing Kit			
All Models	L51053-4	A1	204A, 204B

Valve Plate Kits			
PVWJ-011			
LH Rear Port (Code "SA")	K51101-500	A1	401, 403(4), 601(2), 1010, 1500, 1902(2)
RH Rear Port (Code "SA")	K51101-501	A1	401, 403(4), 601(2), 1010, 1500, 1902(2)
LH Side Port, Non Thru-Shaft (Code "GA")	K51101-502	A1	401, 403(4), 650(2), 1010, 1500
RH Side Port, Non Thru-Shaft (Code "GA")	K51101-503	A1	401, 403(4), 650(2), 1010, 1500
LH Side Port, Thru-Shaft (Code "DA")	K51101-504	A1	401, 403(4), 601(2), 626(3), 1010, 1500, 1902(2), 1910(3)
RH Side Port, Thru-Shaft (Code "DA")	K51101-505	A1	401, 403(4), 601(2), 626(3), 1010, 1500, 1902(2), 1910(3)
LH Top/Bottom Port, Thru-Shaft (Code "TA")	K51101-506	A1	401, 403(4), 650(2), 1010, 1500
LH Top/Bottom Port, Thru-Shaft (Code "TA")	K51101-507	A1	401, 403(4), 650(2), 1010, 1500
PVWJ-014			
LH Rear Port (Code "SA")	K51101-508	A1	401, 403(4), 601(2), 1010, 1500, 1902(2)
RH Rear Port (Code "SA")	K51101-509	A1	401, 403(4), 601(2), 1010, 1500, 1902(2)
LH Side Port, Non Thru-Shaft (Code "GA")	K51101-510	A1	401, 403(4), 650(2), 1010, 1500
RH Side Port, Non Thru-Shaft (Code "GA")	K51101-511	A1	401, 403(4), 650(2), 1010, 1500
LH Side Port, Thru-Shaft (Code "DA")	K51101-512	A1	401, 403(4), 601(2), 626(3), 1010, 1500, 1902(2), 1910(3)
RH Side Port, Thru-Shaft (Code "DA")	K51101-513	A1	401, 403(4), 601(2), 626(3), 1010, 1500, 1902(3), 1910(3)
LH Top/Bottom Port, Thru-Shaft (Code "TA")	K51101-514	A1	401, 403(4), 650(2), 1010, 1500
LH Top/Bottom Port, Thru-Shaft (Code "TA")	K51101-515	A1	401, 403(4), 650(2), 1010, 1500
PVWJ-022			
LH Rear Port (Code "SA")	K51101-516	A1	401, 403(4), 601(2), 1010, 1500, 1902(2)
RH Rear Port (Code "SA")	K51101-517	A1	401, 403(4), 601(2), 1010, 1500, 1902(2)
LH Side Port, Non Thru-Shaft (Code "GA")	K51101-518	A1	401, 403(4), 650(2), 1010, 1500
RH Side Port, Non Thru-Shaft (Code "GA")	K51101-519	A1	401, 403(4), 650(2), 1010, 1500
LH Side Port, Thru-Shaft (Code "DA")	K51101-520	A1	401, 403(4), 601(2), 626(3), 1010, 1500, 1902(2), 1910(2)
RH Side Port, Thru-Shaft (Code "DA")	K51101-521	A1	401, 403(4), 601(3), 626(3), 1010, 1500, 1902(2), 1910(3)
LH Top/Bottom Port, Thru-Shaft (Code "TA")	K51101-522	A1	401, 403(4), 650(2), 1010, 1500
LH Top/Bottom Port, Thru-Shaft(Code "TA")	K51101-523	A1	401, 403(4), 650(2), 1010, 1500
Pump Seal Kit			
All models	L50824-24	A1	007, 1010(2), 1138, 1145, 1500, 1902(3), 1910(3)
Piston & Shoe Kits			
PVWJ-011	L51363-900	A1	102(7)
PVWJ-014	L50021-900	A1	102(7)
PVWJ-022	L50021-901	A1	102(7)
Shoe Retainer & Holddown Ball Kit			
All models	L50019	A1	103, 104
Tag Kit			
All models	L50921	A1	003, 008(2)

Control Pin			
All models	50623-5	A1	721
Cover Plate Kit			
All models	L50671	A1	505, 507(4), 508
Coupling & Adapter Kits			
All models using code "DA" Valve Plate	L51081-48	A1	501, 502, 503(2), 504(2), 505, 506, 515(2), 516(2)
All models using code "TA" Valve Plate	L51081-113	A1	501, 502, 503(2), 504(2), 505, 506, 515, 516(2)

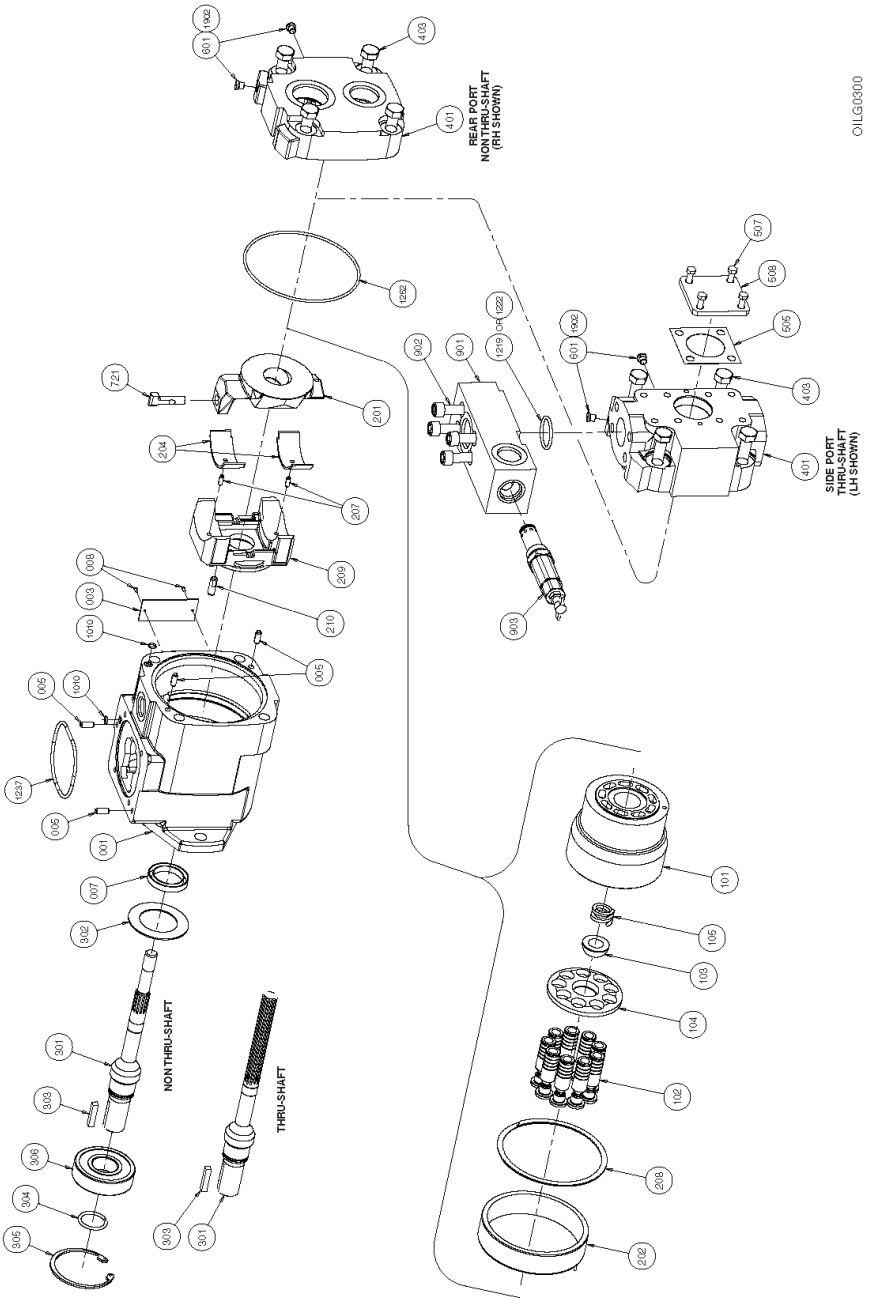

Figure 13. Exploded parts drawing, PVWJ-025/-034/-046 B-Frame (520024-201 sheet 2 of 4).

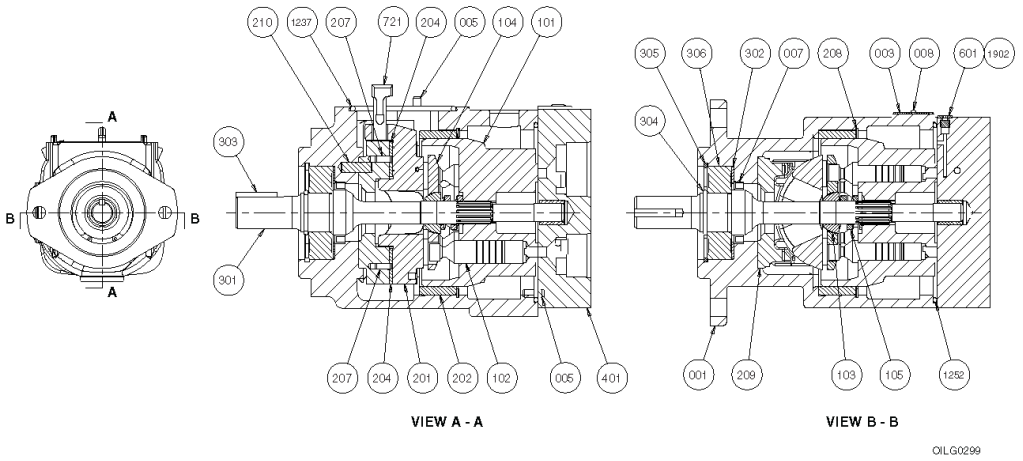

Figure 14. Cross section and plan view parts drawing, PVWJ-025/-034/-046 B-Frame (520024-201 sheet 1 of 4).

PVWJ-025/-034/-046 B-FRAME PUMP PARTS LIST

Item	Qty.	Description
HOUSING ASSEMBLY GROUP		
001	1	Pump Housing
003	1	Name Tag
005	4	Roll Pin
007	1	Shaft Seal
008	2	Drive Screws
1010	2	O-Ring
1237	1	O-Ring
1252	1	O-Ring
ROTARY ASSEMBLY GROUP		
101	1	Barrel
102	9	Piston & Shoe Assembly
103	1	Fulcrum Ball
104	1	Shoe Retainer
105	1	Shoe Retainer Spring

SWASHBLOCK ASSEMBLY GROUP		
201	1	Swashblock
202	1	Hydrodynamic Bearing
204	2	Saddle Bearing
207	2	Saddle Bearing Locating Pin
208	1	Retaining Ring
209	1	Saddle Block
210	1	Saddle Block Locating Ring
721	1	Control Pin
DRIVE SHAFT ASSEMBLY GROUP		
301	1	Drive Shaft
302	1	Seal Retainer
303	1	Key
304	1	Shaft Retainer Ring
305	1	Shaft Bearing Retainer Ring
306	1	Front Drive Shaft Bearing
VALVE PLATE ASSEMBLY GROUP		
401	1	Valve Plate
403	4	Screw
601	2	Plug
1902	2	O-Ring

COVER PLATE PARTS		
505	1	Gasket
507	4	Screw
508	1	Cover Plate
RELIEF VALVE ASSEMBLY GROUP-OPTIONAL		
901	1	Block
902	1	Screw
903	1	Relief Valve Cartridge
1219	1	O-Ring (PVWJ-025)
1222	1	O-Ring (PVWJ-034/-046)

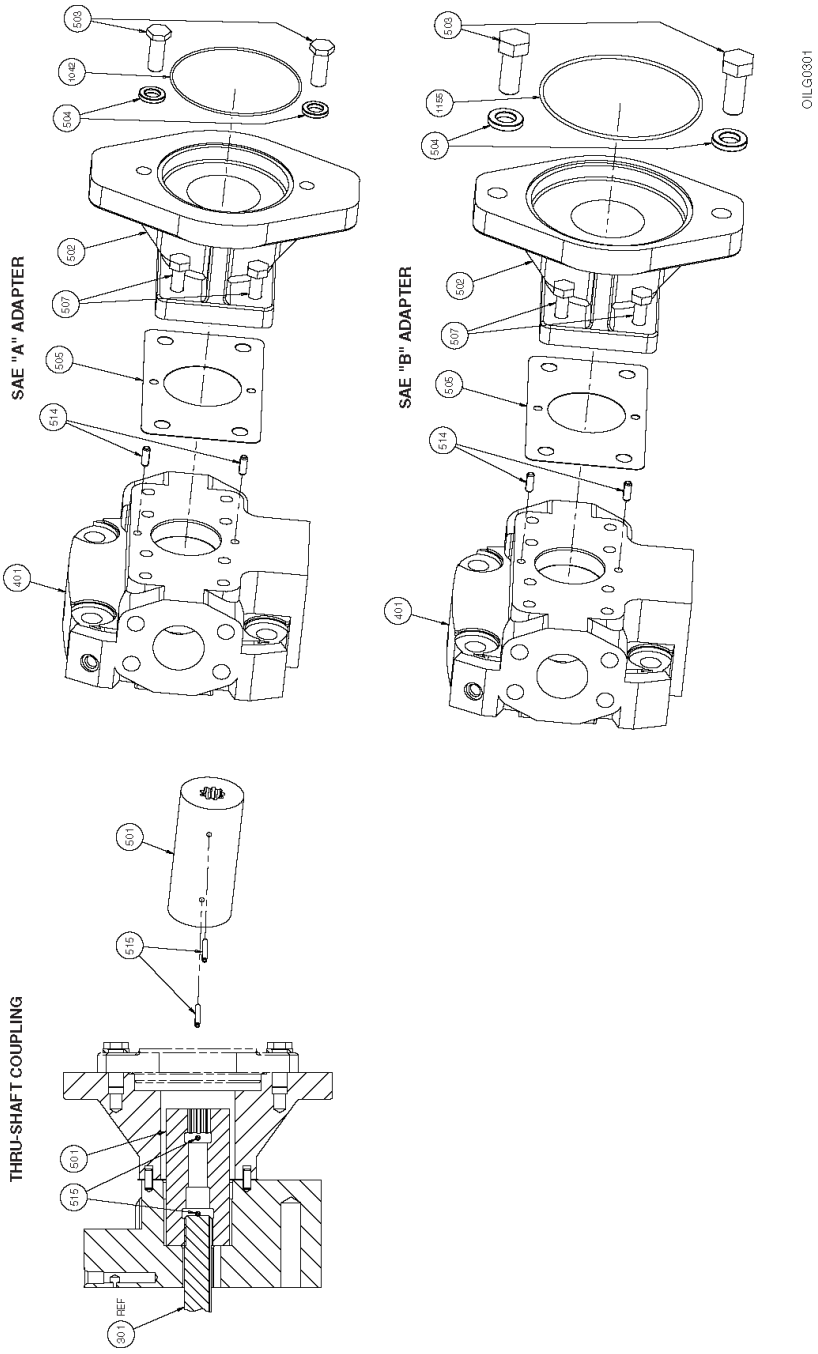

Figure 15. Exploded parts drawing, PVWJ-025/-034/-046 B-Frame,Thru-Shaft Coupling, SAE "A" and SAE "B" Adapter (520024-201 sheet 3 of 4).

Item	Qty.	Description
DRIVE SHAFT ASSEMBLY GROUP		
301	1	Drive Shaft
VALVE PLATE ASSEMBLY GROUP		
401	1	Valve Plate

DUAL PUMP ADAPTER PARTS		
501	1	Coupling
502	1	Adapter
503	2	Screw
504	2	Washer
505	1	Gasket
507	4	Screw
514	1	Roll Pin
515	1	Roll Pin
1042	1	O-Ring
1155	1	O-Ring

SERVICE KITS

Reference 520024-201
SERVICE KIT Drawings figures 13-15

Document Number: 520024-SK2
Revision: New

PVWJ B-Frame Units (PVWJ-025/-034/-046)

Description	Kit No.	Design Series	Items Included (quantity is 1 unless noted)
Housing Kits			
All Models	K51121-101	A1	001, 005(4), 007, 1010(2), 1237, 1252
Rotating Group Bearing Kit			
All Models	L51065-1	A1	202, 208
Shaft & Bearing Kits			
PVWJ-025/-034/-046			
7/8" Dia. Keyed (Code Y)	L51129-11	A1	301, 302, 303, 304, 305, 306
1" Dia. Keyed (Code B)	L51129-15	A1	301, 302, 303, 304, 305, 306
7/8" 13T Spline (Code S)	L51129-13	A1	301, 302, 304, 305, 306
1" 15T Spline (Code C)	L51129-17	A1	301, 302, 304, 305, 306
7/8" 13T Spline (Code D) (Industrial)	L51129-39Z	A1	301, 302, 304, 305, 306
7/8" Dia. Keyed (Code Y)	L51519-11A	A1	301, 302, 303, 304, 305, 306
1" Dia. Keyed (Code B)	L51519-11	A1	301, 302, 303, 304, 305, 306
7/8" 13T Spline (Code S)(SAE)	L51519-10	A1	301, 302, 304, 305, 306
7/8" 13T Spline (Code D) (Industrial)	L51519-12Z	A1	301, 302, 304, 305, 306
Swashblock Kits			
LH (CCW) Models	L50480-1	A1	201, 721
RH (CW) Models	L50480-2	A1	201, 721
Saddle Bearing Kit			
All models	L51053-5	A1	204(2)
Rotating Group Kits			
PVWJ-025	L50167-10	A1	101, 102(9), 103, 104, 105
PVWJ-034	L50167-7	A1	101, 102(9), 103, 104, 105
PVWJ-046	L50168-7	A1	101, 102(9), 103, 104, 105

Saddle Kit			
All models	L51052-7	A1	204(2), 207(2), 209
Valve Plate Kits			
PVWJ-025			
LH Rear Port (Code "SA")	K51102-201	A1	401, 403(4), 601(2), 1010, 1252, 1902(2)
RH Rear Port (Code "SA")	K51102-202	A1	401, 403(4), 601(2), 1010, 1252, 1902(2)
LH Side Port, Thru-Shaft (Code "DF" & "DR")	K51102-203	A1	401, 403(4), 601(2), 1010, 1252, 1902(2)
RH Side Port, Thru-Shaft (Code "DF" & "DR")	K51102-204	A1	401, 403(4), 601(2), 1010, 1252, 1902(2)
PVWJ-034			
LH Rear Port (Code "SA"	K51102-205	A1	401, 403(4), 601(2), 1010, 1252, 1902(2)
RH Rear Port (Code "SA")	K51102-206	A1	401, 403(4), 601(2), 1010, 1252, 1902(2)
LH Side Port, Thru-Shaft (Code "DF" & "DR")	K51102-207	A1	401, 403(4), 601(2), 1010, 1252, 1902(2)
RH Side Port, Thru-Shaft (Code "DF" & "DR")	K51102-208	A1	401, 403(4), 601(2), 1010, 1252, 1902(2)
PVWJ-046			
LH Rear Port (Code "SA")	K51102-209	A1	401, 403(4), 601(2), 1010, 1252, 1902(2)
RH Rear Port (Code "SA")	K51102-210	A1	401, 403(4), 601(2), 1010, 1252, 1902(2)
LH Side Port, Thru-Shaft (Code "DF" & "DR")	K51102-211	A1	401, 403(4), 601(2), 1010, 1252, 1902(2)
RH Side Port, Thru-Shaft (Code "DF" & "DR")	K51102-212	A1	401, 403(4), 601(2), 1010, 1252, 1902(2)
Pump Seal Kit			
All models	K50825-200	A1	007, 1010(2), 1237, 1252, 1902(2)
Piston & Shoe Kits			
PVWJ-025	L51349-900	A1	102(9)
PVWJ-034	L50146-900	A1	102(9)
PVWJ-046	L50175-900	A1	102(9)
Shoe Retainer & Holddown Ball Kit			
All models	L50132	A1	103, 104
Tag Kit			
All models	L50921	A1	003, 008(2)
Control Pin			
All models	51339-5	A1	721
Cover Plate Kit			
All models	L50671	A1	505, 507(4), 508
Coupling & Adapter Kits			
SAE A Adapter	L51081-53	A1	501, 502, 503(2), 504(2), 505, 507(4), 514(2), 515(2), 1042
SAE B Adapter	L51081-43	A1	501, 502, 503(2), 504(2), 505, 507(4), 514(2), 515(2), 1155

NOTES

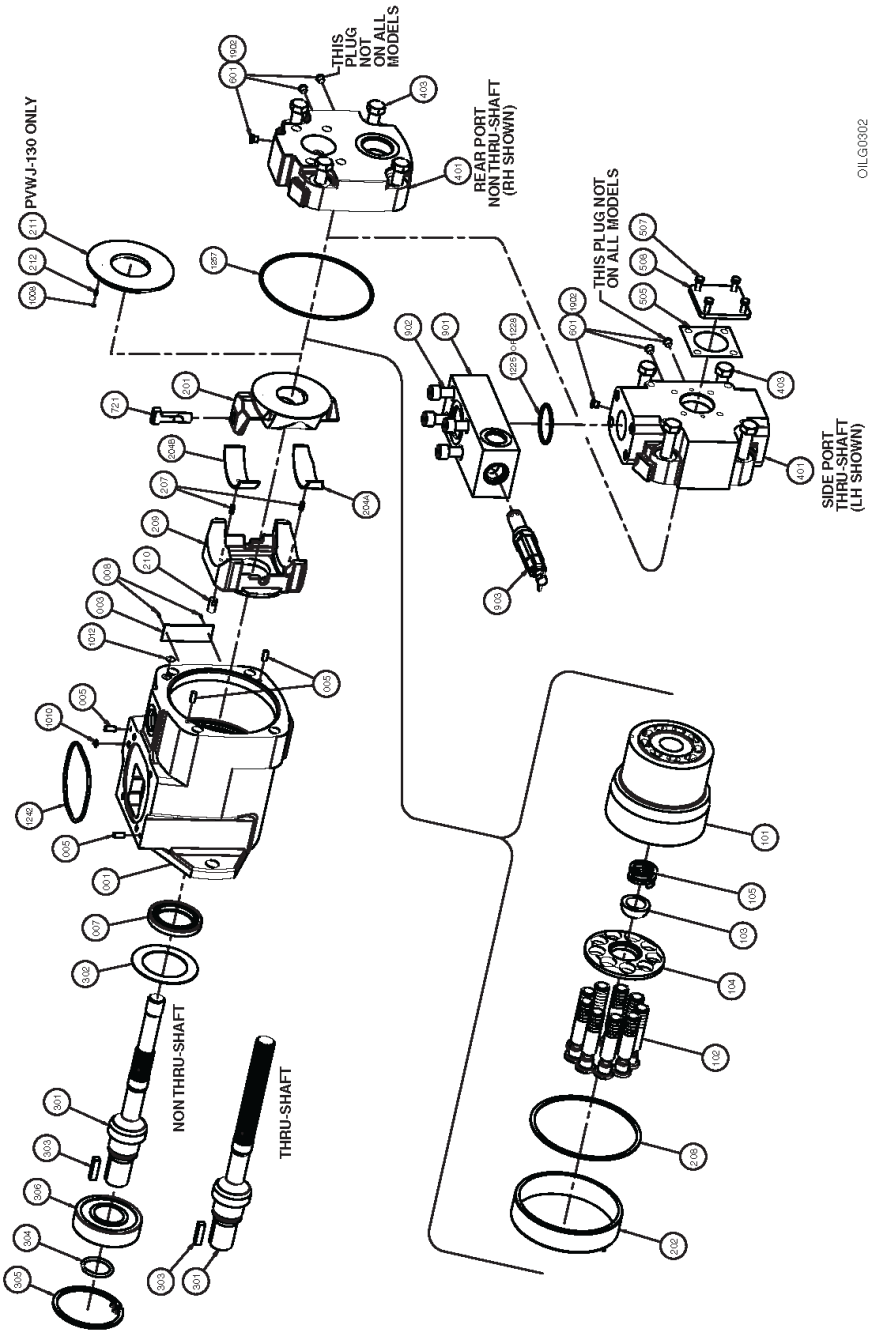

Figure 16. Exploded parts drawing, PVWJ-064/-076/-098/-130 C-Frame (520024-301 sheet 2 of 4).

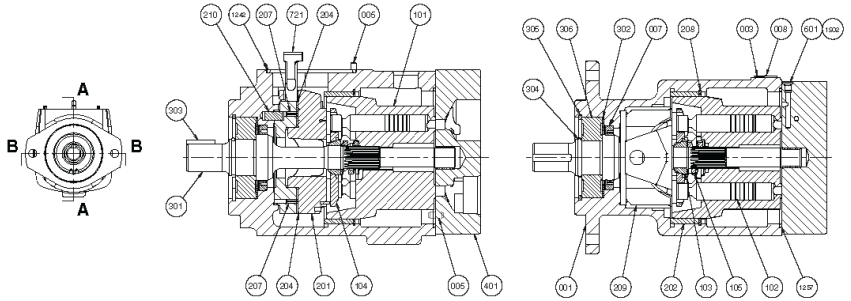

Figure 17. Cross section and plan view parts drawing, -064/-076/-098/-130 C-Frame (520024-301 sheet 1 of 4).

PVWJ-064-076/-098/-130 C-FRAME PUMP PARTS LIST

Item	Qty.	Description
HOUSING ASSEMBLY GROUP		
001	1	Pump Housing
003	1	Name Tag
005	4	Roll Pin
007	1	Shaft Seal
008	2	Drive Screws
1010	1	O-Ring
1012	1	O-Ring
1242	1	O-Ring
1257	1	O-Ring
ROTARY ASSEMBLY GROUP		
101	1	Barrel
102	9	Piston & Shoe Assembly
103	1	Fulcrum Ball
104	1	Shoe Retainer
105	1	Shoe Retainer Spring

SWASHBLOCK ASSEMBLY GROUP		
201	1	Swashblock
202	1	Hydrodynamic Bearing
204A	1	Saddle Bearing (PVWJ-064)
204B	1 or 2	Saddle Bearing (PVWJ-064/-076/-098)
204C	2	Saddle Bearing (PVWJ-130)
207	2	Saddle Bearing Locating Pin
208	1	Retaining Ring
209	1	Saddle Block
210	1	Saddle Block Locating Ring
211	1	Wear Plate (PVWJ-130 only)
212	1	Wear Plate Locating Pin (PVWJ-130 only)
721	1	Control Pin
1008	1	O-Ring (PVWJ-130 only)
DRIVE SHAFT ASSEMBLY GROUP		
301	1	Drive Shaft
302	1	Seal Retainer
303	1	Key
304	1	Shaft Retainer Ring
305	1	Shaft Bearing Retainer Ring
306	1	Front Drive Shaft Bearing

VALVE PLATE ASSEMBLY GROUP		
401	1	Valve Plate
403	4	Screw
601	2 or 3	Plug
1902	2 or 3	O-Ring
COVER PLATE PARTS		
505	1	Gasket
507	4	Screw
508	1	Cover Plate
RELIEF VALVE ASSEMBLY GROUP-OPTIONAL		
901	1	Block
902	1	Screw
903	1	Relief Valve Cartridge
1225	1	O-Ring (PVWJ-064)
1228	1	O-Ring (PVWJ-076/-098/-130)

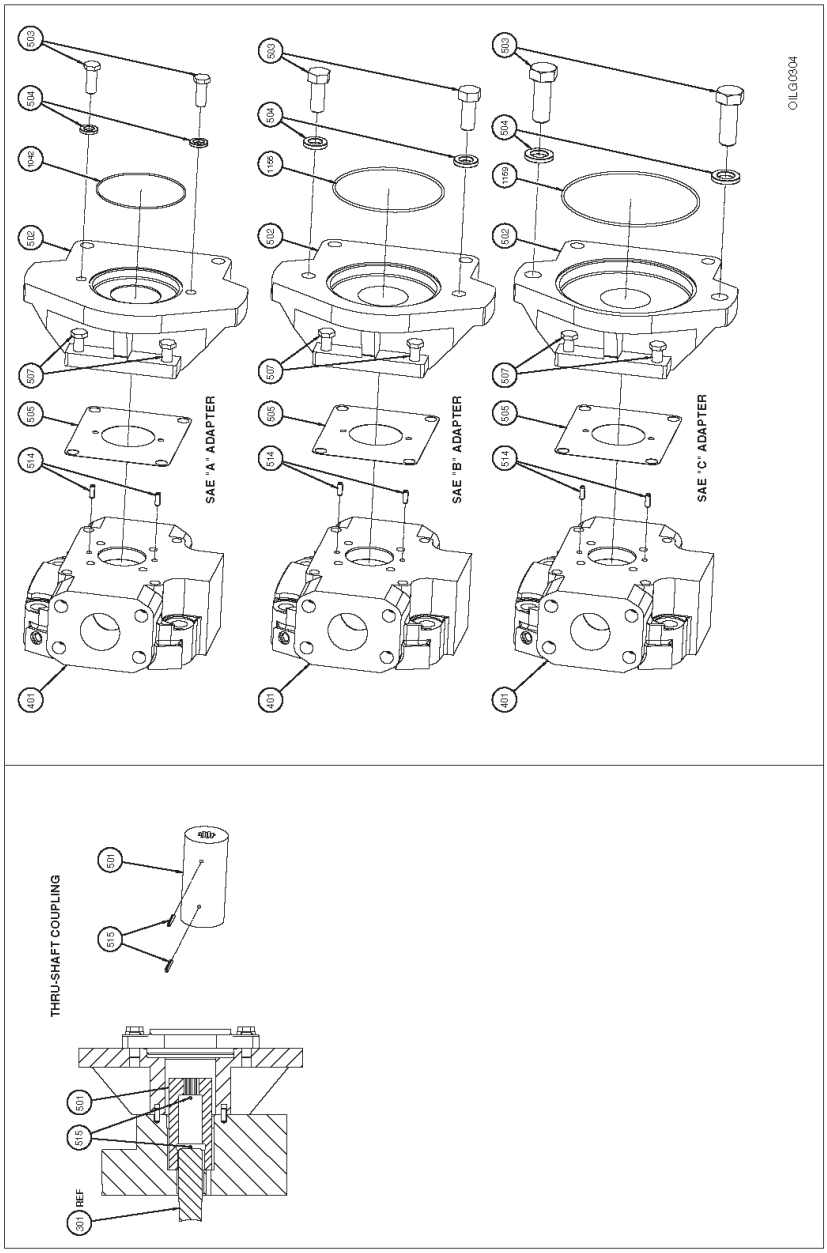

Figure 18. Exploded parts drawing, PVWJ-064/-076/-098/-130 C-Frame, Thru-Shaft Coupling, SAE "A", SAE "B" and SAE "C" Adapter (520024-301 sheet 3 of 4).

Item	Qty.	Description
DRIVE SHAFT ASSEMBLY GROUP		
301	1	Drive Shaft
VALVE PLATE ASSEMBLY GROUP		
401	1	Valve Plate

DUAL PUMP ADAPTER		
501	1	Coupling
502	1	Adapter
503	2	Screw
504	2	Washer
505	1	Gasket
507	4	Screw
514	2	Roll Pin
515	2	Roll Pin
1042	1	O-Ring
1155	1	O-Ring
1159	1	O-Ring

SERVICE KITS

PVWJ C-Frame Units
(PVWJ-064/-076/-098/-130)

Reference 520024-301
SERVICE KIT Drawings figures 16-18

Document Number: 520024-SK3
Revision: New

Description	Kit No.	Design Series	Items Included (quantity is 1 unless noted)
Housing Kits			
All Models	K51114-101	A1	001, 005(4), 007, 1010(2), 1242, 1257
Rotating Group Bearing Kit			
All Models	L51066-1	A1	202, 208
Shaft & Bearing Kits			
1 1/4" Dia. Keyed (Code Y) Standard	L51130-11	A1	301, 302, 303, 304, 305, 306
1 1/4" 14T Spline (Code S) Standard (SAE)	L51130-13	A1	301, 302, 304, 305, 306
1 1/4" 14T Spline (Code D) Standard (Industrial)	L51130-13Z	A1	301, 302, 304, 305, 306
1 1/4" Dia. Keyed (Code Y) T-S	L51520-11	A1	301, 302, 303, 304, 305, 306
1 1/4" 14T Spline (Code S) T-S (SAE)	L51520-10	A1	301, 302, 304, 305, 306
1 1/4" 14T Spline (Code D) T-S (Industrial)	L51520-12Z	A1	301, 302, 304, 305, 306
Swashblock Kits			
PVWJ-064/-076/-098 LH (CCW) Models	L50481-3	A1	201, 721
PVWJ-064/-076/-098 RH (CW) Models	L50481-5	A1	201, 721
PVWJ-130 LH (CCW) Models	L50481-4	A1	201, 211, 212, 213, 721
PVWJ-130 RH (CW) Models	L50481-6	A1	201, 211, 212, 213, 721
Saddle Bearing Kits			
PVWJ-064	L51053-8	A1	204A, 204B
PVWJ-076 & -098	L51053-6	A1	204B(2)
PVWJ-130	L51053-7	A1	204C(2)
Rotating Group Kits			
PVWJ-064	L50108-11	A1	101, 102(9), 103, 104, 105
PVWJ-076	L50087-7	A1	101, 102(9), 103, 104, 105
PVWJ-098	L50108-7	A1	101, 102(9), 103, 104, 105
PVWJ-130	L50108-8	A1	101, 102(9), 103, 104, 105
Saddle Kits			
PVWJ-064	L51052-13	A1	204A, 204B, 207(2), 209
PVWJ-076 & -098	L51052-8	A1	204B(2), 207(2), 209
PVWJ-130	L51052-9	A1	204C(2), 207(2), 209

Valve Plate Kits			
PVWJ-064			
LH Rear Port (Code "SA")	K51103-213	A1	401, 403(4), 405(2), 408(2), 1012, 1257
RH Rear Port (Code "SA")	K51103-214	A1	401, 403(4), 405(3), 408(3), 1012, 1257
LH Side Port, Thru Shaft (Code "DF" & "DR")	K51103-215	A1	401, 403(4), 405(2), 408(2), 1012, 1257
RH Side Port, Thru Shaft (Code "DF" & "DR")	K51103-216	A1	401, 403(4), 405(3), 408(3), 1012, 1257
PVWJ-076			
LH Rear Port (Code "SA"	K51103-201	A1	401, 403(4), 405(2), 408(2), 1012, 1257
RH Rear Port (Code "SA")	K51103-202	A1	401, 403(4), 405(3), 408(3), 1012, 1257
LH Side Port, Thru Shaft (Code "DF" & "DR")	K51103-207	A1	401, 403(4), 405(2), 408(2), 1012, 1257
RH Side Port, Thru Shaft (Code "DF" & "DR")	K51103-208	A1	401, 403(4), 405(3), 408(3), 1012, 1257
PVWJ-098			
LH Rear Port (Code "SA")	K51103-203	A1	401, 403(4), 405(2), 408(2), 1012, 1257
RH Rear Port (Code "SA")	K51103-204	A1	401, 403(4), 405(3), 408(3), 1012, 1257
LH Side Port, Thru Shaft (Code "DF" & "DR")	K51103-209	A1	401, 403(4), 405(2), 408(2), 1012, 1257
RH Side Port, Thru Shaft (Code "DF" & "DR")	K51103-210	A1	401, 403(4), 405(3), 408(3), 1012, 1257
PVWJ-130			
LH Rear Port (Code "SA")	K51103-205	A1	401, 403(4), 405(2), 408(2), 1012, 1257
RH Rear Port (Code "SA")	K51103-206	A1	401, 403(4), 405(3), 408(3), 1012, 1257
LH Side Port, Thru Shaft (Code "DF" & "DR")	K51103-211	A1	401, 403(4), 405(2), 408(2), 1012, 1257
RH Side Port, Thru Shaft (Code "DF" & "DR")	K51103-212	A1	401, 403(4), 405(3), 408(3), 1012, 1257
Pump Seal Kit			
All models	K50826-200	A1	007, 1008, 1010, 1012, 1242, 1257, 1902(3)
Piston & Shoe Kits			
PVWJ-064	L51109-900	A1	102(9)
PVWJ-076	L51107-900	A1	102(9)
PVWJ-098	L51109-901	A1	102(9)
PVWJ-130	L51303-900	A1	102(9)
Shoe Retainer & Holddown Ball Kits			
PVWJ-064/-076/-098	L50071	A1	103, 104
PVWJ-130	L51305-2	A1	103, 104
Tag Kit			
All models	L50921	A1	003, 008(2)
Control Pin			
All models	51339-2	A1	721

Cover Plate Kit			
All models	L50671	A1	505, 507(4), 508
Coupling & Adapter Kits			
SAE A Adapter	L51081-52	A1	501, 502, 503(2), 504(2), 505, 507(4), 514(2), 515(2), 1042
SAE B Adapter	L51081-51	A1	501, 502, 503(2), 504(2), 505, 507(4), 514(2), 515(2), 1155
SAE C Adapter	L51081-49	A1	501, 502, 503(2), 504(2), 505, 507(4), 514(2), 1159

AFTER SALES SERVICES

At Oilgear we build products to last. It is the nature of this type of machinery to require proper maintenance regardless of the care we put into manufacturing. Oilgear has several service programs in place to help you.

STAY-ON-STREAM SERVICE

By signing up for Oilgear's Stay-On-Stream program, you can prepare for problems before they happen. Certain field tests such as fluid testing, slip testing and electronic profile recording comparisons can be performed by our field service people or your own factory trained personnel. These tests can indicate problems before they become "down-time" difficulties.

SERVICE SCHOOLS

Oilgear conducts training to train your maintenance personnel. "General" hydraulic or electronic training is conducted at our Milwaukee, Wisconsin plant on a regular basis. "Custom" training, specifically addressing your particular hydraulic and electro-hydraulic equipment, can be conducted at your facilities.

SPARE PARTS AVAILABILITY

Prepare for your future needs by stocking Oilgear original factory parts. Having the correct parts and necessary skills "in-plant" enables you to minimize "down-time." Oilgear has developed parts kits to cover likely future needs. Oilgear Field Service Technicians are also ready to assist you and your maintenance people in trouble-shooting and repairing equipment.

THE OILGEAR COMPANY
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Milwaukee, Wisconsin 53219
phone: 414/327-1700 fax: 414/327-0532
www.oilgear.com

Issued: August 2006

Bulletin 947085

SERVICE INSTRUCTIONS "PVWJ" A-FRAME PUMPS -011/-014/-022 FOR TYPE "P-1NN" AND "P-LNN" PRESSURE COMPENSATING CONTROLS

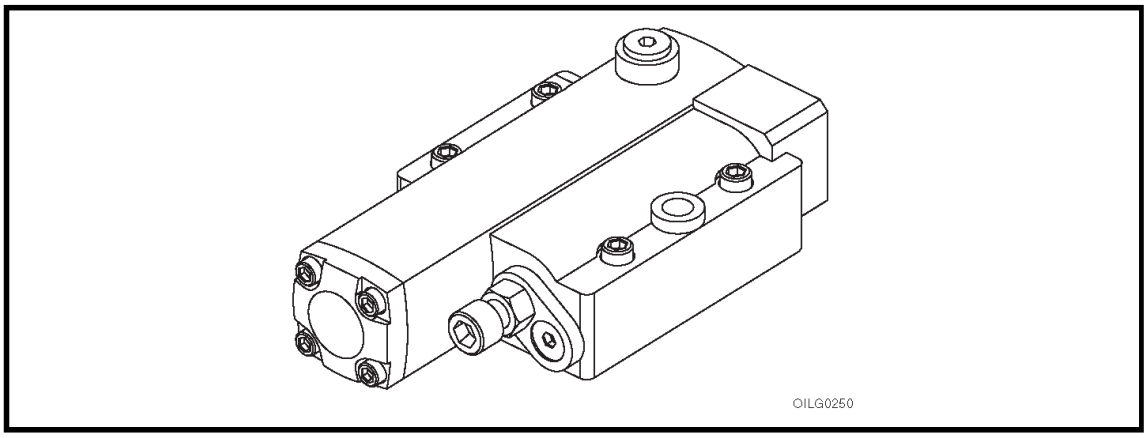

Figure 1. Typical Oilgear Type "P-1NN" and "P-LNN" Pressure Compensator Controls for "PVWJ" A-Frame Pump

PURPOSE OF INSTRUCTIONS

These instructions will simplify the installation, operation and maintenance of Oilgear type "P-1NN" and "P-LNN" controlled units.

This material will inform you about the basic construction, principle of operation and service parts listings. Some controls may be modified for specific applications from those described in this bulletin and other changes may be made without notice.

GENERAL REFERENCE MATERIAL

Fluid Recommendations ..... Bulletin 90000
Contamination Evaluation Guide ..... Bulletin 90004
Filtration Recommendations ..... Bulletin 90007
Piping Information ..... Bulletin 90011
Proper Installation of Vertical Pumps ..... Bulletin 90014
PVWJ Open Loop Pumps, Application Guidelines ..... Bulletin 847085
PVWJ Open Loop Pumps (All Frame Sizes) Service Instructions ..... Bulletin 947085
PVWJ Open Loop Pumps, Sales ..... Bulletin 47085

PVWJ PUMP INSTALLATIONS

PVWJ A Frame (PVWJ-011/-014/-022) w/ Rear Ports DS-47480
PVWJ A Frame (PVWJ-011/-014/-022) w/ Side Ports DS-47481
PVWJ A Frame (PVWJ-011/-014/-022) w/ Side Ports & Thru Shaft DS-47482

PVWJ PUMP CONTROL INSTALLATIONS

"P-1NN" and "P-LNN" Pressure Compensator for PVWJ-011/-014/-022 ..... DS-47984

THE OILGEAR COMPANY
2300 South 51st Street
Milwaukee, Wisconsin 53219
www.oilgear.com

Issued: August 2006

Read and understand this entire instruction sheet before repairing, or adjusting your Oilgear product.

Those who use and maintain this equipment must be thoroughly trained and familiar with the product. If incorrectly used or maintained, this product and its equipment can cause severe injury.

SAFETY SYMBOLS

The following signal words are used in this instruction sheet to identify areas of concern where your safety may be involved. Carefully read the text and observe any instructions provided to ensure your safety.

⚠ DANGER ⚠

THIS SIGNAL WORD INDICATES AN IMMINENTLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, WILL RESULT IN DEATH OR SERIOUS INJURY.

⚠ WARNING

This signal word indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

This signal word indicates that a potentially hazardous situation exists which, if not avoided, may result in damage to equipment or minor personal injury.

NOTE *While not directly relevant to the topic being discussed, the NOTE is used to emphasize information provided, or provide additional information which may be of benefit.*

⚠ WARNING

This service information is designed for the maintenance of your Oilgear product. It contains the information on the correct procedures determined by Oilgear for the safe manner of servicing. Always keep this instruction sheet in a location where it is readily available for the persons who use and maintain the product. Additional copies of this instruction sheet are available through the Oilgear Company. Contact us at 414-327-1700 or visit our website: www.oilgear.com. Please contact us if you have any questions regarding the information in this instruction bulletin.

NOTE *The cleanliness of working on this pump control or the hydraulic system is extremely important to the safety and reliability of the pump and the system. Always make sure the fittings are clean on the outside before removing them from their connections, are capped and plugged when removed and placed in a clean rag or container until they are reinstalled.*

⚠ WARNING

Some service operations may require special tools or equipment. If you require information on these items, please contact Oilgear before attempting these repairs and service operations.

⚠ WARNING

Read, understand and follow the safety guidelines, dangers and warnings contained in this instruction sheet to promote reliable operation and prevent serious personal injury.

⚠ WARNING

DO NOT attempt to service this machinery in an environment where safety regulations are not established and in place.

⚠ WARNING

DO NOT operate the hydraulic system if a leak is present. Serious injury may result.

⚠ WARNING

Hydraulic systems operate under very high pressure. Hydraulic fluid escaping from a pressurized system can penetrate unprotected body tissue. DO NOT inspect for hydraulic leaks with bare hands or other exposed body parts. As a minimum, wear leather gloves prior to inspecting for leaks and use cardboard or wood. If leaks are present, relieve pressure and allow system to cool prior to servicing. If injured by escaping hydraulic oil, contact a physician immediately. Serious complications may arise if not treated immediately. If you have questions regarding inspecting for hydraulic leaks, please contact Oilgear prior to servicing.

⚠ WARNING

Hydraulic hoses and tubing must be inspected on a daily basis for leaks, cuts, abrasions, damage and improper clearance along any mounting frame for hidden damage before the unit is put into service. Replace damaged hoses or hoses you suspect are damaged before the system is returned to service! Hoses must be replaced every two years. Failure to properly inspect and maintain the system may result in serious injury.

⚠ WARNING

Hydraulic systems are hot. DO NOT TOUCH! Serious personal injury may result from hot oil. When you have completed working on the hydraulic system, thoroughly clean any spilled oil from the equipment. Do not spill any hydraulic fluids on the ground. Clean any hydraulic fluids from your skin as soon as you have completed maintenance and repairs. Dispose of used oil and system filters as required by law.

⚠ WARNING

Use correct hoses, fittings, and adapters with the correct SAE rating when replacing hoses to prevent possible serious injury. Always replace hoses, fittings and adapters with replacements that have a proper, suitable, working pressure rating. Replacement hoses must be of the correct length and must comply with the hose manufacturer's and Oilgear's installation guidelines and recommendations.

⚠ WARNING

Hydraulic hoses have the SAE ratings marked on the hose to assist you in selecting the correct hose. The same manufacturer must supply any replacement hydraulic hoses and fitting assemblies. As an example: Brand "X" hose and brand "Y" fitting will not normally be compatible. No "Twist" is allowed in the hydraulic hoses. "Twist" may result in premature hose failure. This can cause serious injury. Please contact Oilgear for assistance when required.

⚠ WARNING

Hydraulic cylinders can be holding a function in a certain position when the pump is OFF. An example of this is a function being held in the lift or partial lift position by the cylinders. If a hydraulic line is removed or the hydraulic circuits or controls are being worked on, gravity may allow the function being held in position to drop. All workers and personnel must remain clear of these areas when working on or operating the hydraulic system. Block and secure all devices and functions which apply before beginning work or operation. Failure to comply with this can result in serious injury or death.

⚠ WARNING

Any hydraulic pipe which is replaced must conform to SAE J1065 specifications. If incorrect hydraulic pipe is installed, the hydraulic system may fail, causing serious injury. Damaged or leaking fittings, pipes or hoses must be replaced before the system is returned to service.

⚠ WARNING

DO NOT heat hydraulic pipe. The carbon content of this steel tube is such that if heated for bending, and either water or air quenched, the pipe may lose its ductility and thereby be subject to failure under high pressure conditions. Serious injury can result. Damaged or leaking pipes must be replaced before the system is returned to service. Please contact Oilgear if you require assistance or have questions.

⚠ WARNING

All hydraulic pressure must be relieved from the hydraulic system prior to removing any components from the system. To relieve the hydraulic pressure from the hydraulic system, turn off the motor and operate the control panel with the key in the ON position. Failure to comply can result in serious injury. If you have any questions concerning relieving the hydraulic pressure from the system, please contact Oilgear.

⚠ WARNING

Hydraulic components can be heavy. Use caution while lifting these components. Serious personal injury can be avoided with proper handling of the components.

⚠ WARNING

Please contact Oilgear if you require assistance. When performing hydraulic test procedures, use the proper hydraulic gauges. Installing an incorrect test gauge could result in serious injury if the gauge fails. Use properly rated hydraulic hoses to allow the test gauge to be read away from moving parts and functions.

⚠ WARNING

Increasing hydraulic pressure beyond the recommendations may result in serious damage to the pump and system or serious personal injury and may void the Oilgear Warranty. If you have questions concerning hydraulic pressures or testing procedures, please contact Oilgear before attempting the test procedures or making adjustments.

⚠ WARNING

An Oilgear pump or pump control must not be modified in any way without authorization from Oilgear. Modifications may not comply with safety standards, including ANSI safety standards, and may result in serious personal injury. Please contact Oilgear if you require assistance.

⚠ WARNING

DO NOT enter under hydraulic supported equipment unless they are fully supported or blocked. Failure to follow this procedure can result in serious injury or death.

⚠ WARNING

Any Oilgear pump safety decals must be replaced anytime they are damaged, missing or cannot be read clearly. Failure to have proper decals in place can result in serious injury or death. (If you require safety decals, please contact Oilgear for replacement safety decals, at no charge.)

⚠ WARNING

Be sure everyone is clear of the area around the hydraulic system before operating after servicing. Remain attentive at all times when operating to check your work until you are completely sure it is safe to return to service. Failure to heed this warning may result in serious personal injury or death.

⚠ WARNING

Wear the proper protective clothing when operating, servicing or maintaining the hydraulic system or the Oilgear pump. Wear the correct protective gear, safety glasses, gloves and safety shoes. Serious injury can result without proper protective gear.

⚠ WARNING

Make sure to keep hands, feet and other parts of your body clear of revolving or moving parts. Failure to comply can cause serious injury.

⚠ WARNING

DO NOT wear watches, rings or jewelry while working with electrical and mechanical equipment. These items can be hazardous and can cause serious and painful injuries if they come into contact with electrical wires, moving parts or hydraulic equipment.

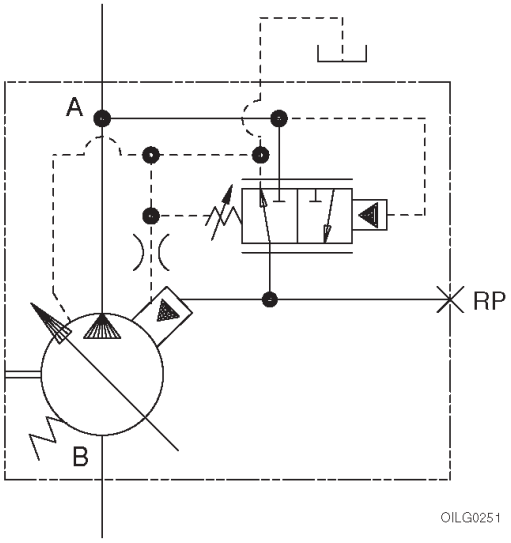

Figure 2. ASA Diagram for "P-1NN" or "P-LNN" Controls Shown with Typical Pump

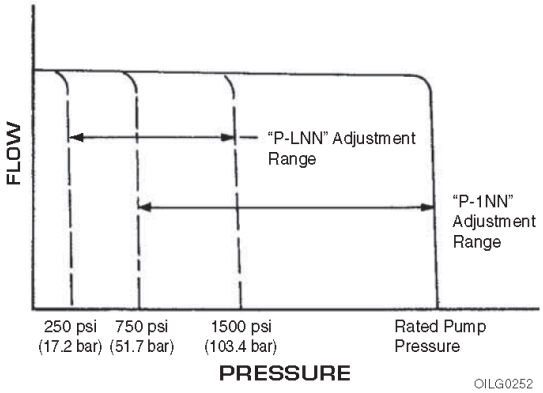

Figure 3. Curve Indicating Flow Versus Pressure for "P-1NN" or "P-LNN" Type Controls

TROUBLESHOOTING

PROBLEM	CAUSES	REMEDY
Unresponsive or Unstable Control	Swashblock bearing surface and/or Saddle Bearings worn or damaged.	See appropriate pump service bulletin.
	Control Pin and/or hole in Swashblock worn significantly.	
	Saddle Bearing Locating Pins broken.	
	Fluid is contaminated.	Inspect and clean if necessary. See bulletin 90007.
	Control Piston orifice (732) plugged.	Inspect and clean if necessary.
	Contamination trapped between control piston (702) and piston bore is not allowing piston to move smoothly.	Inspect and clean if necessary. Replace scored or damaged parts.
	Contamination trapped between control spool (706) and spool bore is not allowing spool to move smoothly.	
	Faulty remote pressure compensator circuit components.	Inspect and replace if necessary.
	Hydraulic line between remote pressure compensator components and RP port of control is too long.	Shorten line length.
	Insufficient control flow.	Increase size of control piston orifice (732).
Insufficient Outlet Volume	Swashblock not stroking to desired displacement.	See appropriate pump service bulletin.
	Low input drive speed.	
	Worn or grooved Cylinder Barrel and/or Valve Plate mating surfaces.	
	Failed Driveshaft.	
	Worn or damaged Piston Shoes or Swashblock.	
	Worn Pistons and/or piston bores.	
	Control Piston stuck off stroke.	Inspect and replace if necessary.
	Maximum Volume Stop adjusted incorrectly.	Adjust Maximum Volume Stop CCW to increase outlet flow.
	Pressure Compensator is set too close to operating pressure.	Adjust Pressure Compensator setting CW to increase setting.
Destrokes at low pressure	Pressure compensator adjustment not set correctly.	Adjust Pressure Compensator setting CW to increase setting and retorque jam nut (715).
	Control Piston orifice (732) plugged.	Inspect and clean if necessary.
	Damaged or fractured control spring (items 708 and/or 709).	Inspect and replace if necessary.
	Severely worn control spool (706) and/or spool bore.	
	Damaged or fractured control piston spring (item 703).	
	Faulty remote pressure compensator circuit components.	
Excessive peak pressure	Pressure Compensator is set too high.	Adjust Pressure Compensator setting CCW to decrease setting.
	Minimum Volume Stop is set too high.	Adjust Minimum Volume Stop CCW to decrease outlet flow.
	Fluid is contaminated.	Inspect and clean if necessary. See bulletin 90007.
	Swashblock bearing surface and/or Saddle Bearings worn or damaged.	See appropriate pump service bulletin.
	Contamination trapped between control piston (702) and piston bore is not allowing piston to move smoothly.	Inspect and clean if necessary. Replace scored or damaged parts.
	Contamination trapped between control spool (706) and spool bore is not allowing spool to move smoothly.	
	Hydraulic line between remote pressure compensator components and RP port of control is too long.	Shorten line length.
	Faulty remote pressure compensator circuit components.	Inspect and replace if necessary.
	Restriction in drilled passages between pump outlet port and control spool.	Inspect and clean if necessary.

PRINCIPLE OF OPERATION

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 de-strokes the pump while maintaining the preset pressure.

"P-1NN" controls can be adjusted from 750 psi (51,7 bar) working pressure up to the maximum pressure rating of the applicable pump. "P-LNN" controls can be adjusted from 250 psi (17,2 bar) up to a maximum of 1500 psi (103,4 bar).

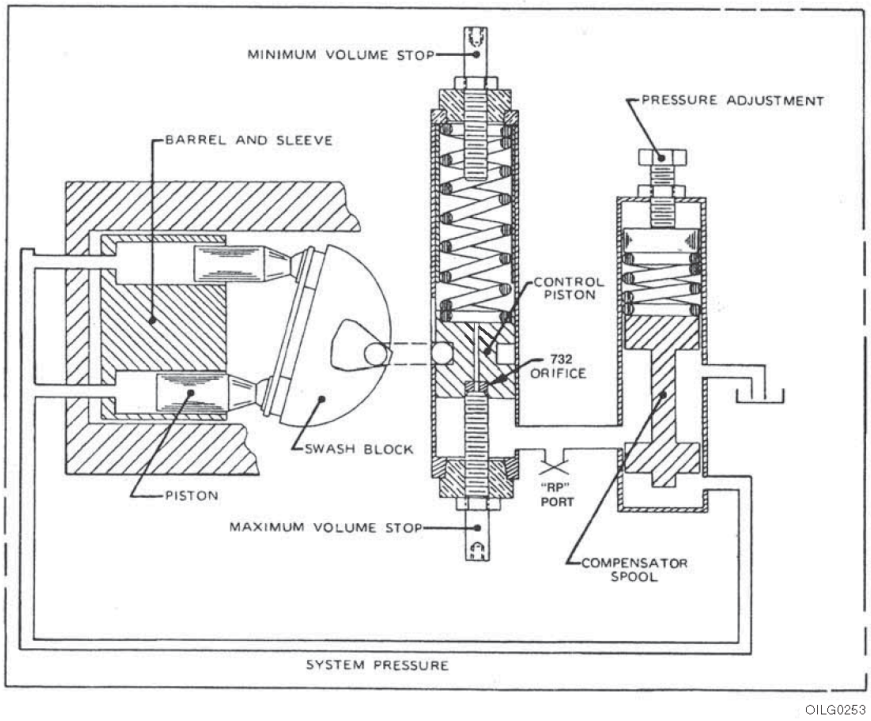

Figure 4. Swashblock at Full Delivery and "P-1NN" or "P-LNN" Controls at Maximum Volume Stop

LINE MOUNTED REMOTE PRESSURE CONTROL FOR TYPE "P-1NN" AND "P-LNN" PUMP CONTROLS - VSR (REMOTE SEQUENCE VALVE)

Remote operation of "P-1NN" and "P-LNN" controls can be accomplished by installing an Oilgear VSR Module at the location shown in the control circuit. Use module L51542 for units rated continuously for 4000 psi (275,8 bar) or less. Use L51542-1 for units rated above 4000 psi (275,8 bar).

NOTE *To minimize case leakage and power loss, plug the control drain port with a #10-24 UNC setscrew to maintain the standard "P-1NN" or "P-LNN" control case leakage. The plug will increase response time. Standard response time can be obtained by installing a .040 inch (1,0 mm) orifice instead of plugging it.*

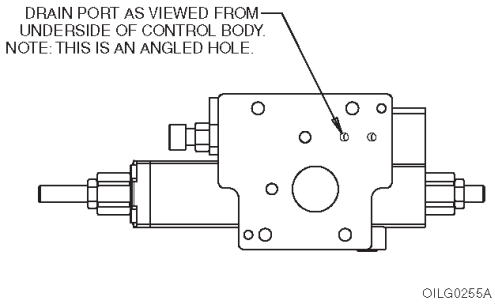

Figure 7. "P-1NN" and "P-LNN" Control Drain Port Location

NOTE *The compensator setting on the pump control must be set at least 200 psi (13,8 bar) higher than the required pressure setting of the remote compensator module to prevent the pump compensator control from interacting with the remote compensator module.*

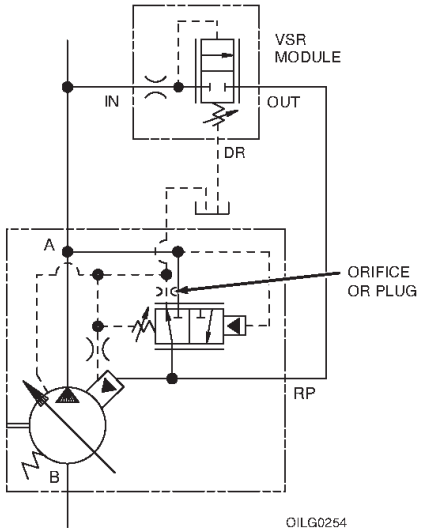

Figure 5. "P-1NN" and "P-LNN" Control Circuit with Remote Pressure Control

SCREW AND PLUG TORQUES FOR CONTROLS

Item Number	Description	Head Type & Size	Tightening Torque
601	SAE #2 Plug	1/8" Internal Hex	45 in.-lbs (5 N·m)
603	SAE #4 Plug	3/16" Internal Hex	120 in.-lbs (14 N·m)
606	SAE #8 Plug	5/16" Internal Hex	45 ft-lbs (61 N·m)
711	PC Adjuster Screw LHCS	3/32" Internal Hex	57 in.-lbs (6 N·m)
714	Adjuster Plate Screw	5/32" Internal Hex	80 in.-lbs (9 N·m)
720	Max. or Min. Volume Stop Housing	7/8" External Hex	50 ft-lbs (68 N·m)
722	End Cap Screws	5/32" Internal Hex	80 in.-lbs (9 N·m)
723	Control Body Screws	3/16" Internal Hex	120 in.-lbs (14 N·m)
732	Control Piston Orifice	3/32" Internal Hex	20 in.-lbs (2.3 N·m)

CONTROL O-RING SEALS

Item Number	ARP 568 Uniform Size Number	Shore A Durometer
1010	-010	90
1011	-011	90
1020	-020	90
1113	-113	90
1145	-145	70
1902	-902	90
1904	-904	90
1908	-908	90

PARTS LIST

Parts used in these assemblies are per Oilgear specifications. Use only Oilgear parts to ensure compatibility with assembly requirements. When ordering replacement parts, be sure to include pump type and serial number, bulletin number and item number. Specify type of hydraulic fluid to ensure seal and packing compatibility.

NOTE *Parts drawings may not be identical to Oilgear drawings referenced.*

PVWJ A-FRAME -011/-014/-022 PRESSURE COMPENSATOR CONTROLS ("P-1NN" STANDARD & "P-LNN" LOW PRESSURE CONTROLS)

Item	Description
	COMMON PARTS GROUP
601	SAE#2 Plug
603	SAE#4 Plug
606	SAE#8 Plug
701	Control Block
702	Control Piston
703	Control Piston Spring
705	End Cap
706	Pressure Compensator Control Spool
707	Spring Seat
708	Pressure Compensator Spring (Outer)
709*	Pressure Compensator Spring (Inner)
710	Control Plug
711	Screw
712	Shims
713	Adjuster Plate
714	Screw
715	Jam Nut
716	Pressure Compensator Adjustment Screw
717	Min. Volume Stop Stem
718	Max. Volume Stop Stem
719	Jam Nut
720	Volume Stop Housing
721	Control Pin
722	Screw, End Cap
723	Screw, Control Body
732	Orifice
1010	O-Ring
1011	O-Ring
1020	O-Ring
1113	O-Ring
1145	O-Ring
1902	O-Ring
1904	O-Ring
1908	O-Ring

*Only used in P-1 Control.

SERVICE KITS

Document Number: 519975-SK1
Revision: New

PVWJ Service Kits

Reference 519975-101
SERVICE KIT, Figures 8 & 9

Description	Kit No.	Design Series	Items Included (quantity is 1 unless noted)
Main Control Body Kits			
PVWJ-011	K50460-100	A1	701, 706
PVWJ-014/-022	K50460-200	A1	701, 706
Control Piston Kits			
All Models	K50521	A1	702, 732
Pressure Compensator Spools			
PVWJ-011	50015-100	A1	706
PVWJ-014/-022	50015-200	A1	706
Control Spring Kits			
P-LNN (All Models)	K50036-103	A1	703, 708
PVWJ-011 P-1NN	K50036-106	A1	703, 708
PVWJ-014/-022 P-1NN	K50036-109	A1	703, 708, 709
Control Pins			
All Models	50623-5	A1	721
Volume Stop Kits			
Maximum Volume Stop (All Models)	K50590	A1	718, 719, 720, 1011, 1908
Minimum Volume Stop (All Models)	K50590-100	A1	705, 717, 719, 720, 1011, 1020, 1908
Pressure Compensator Adjuster Kits			
All Models	K50660-100	A1	710, 711, 712, 713, 715, 716, 1113
Control Seal Kit			
All Models	K50824-100	A1	1010, 1011, 1020, 1113, 1145, 1902, 1904, 1908

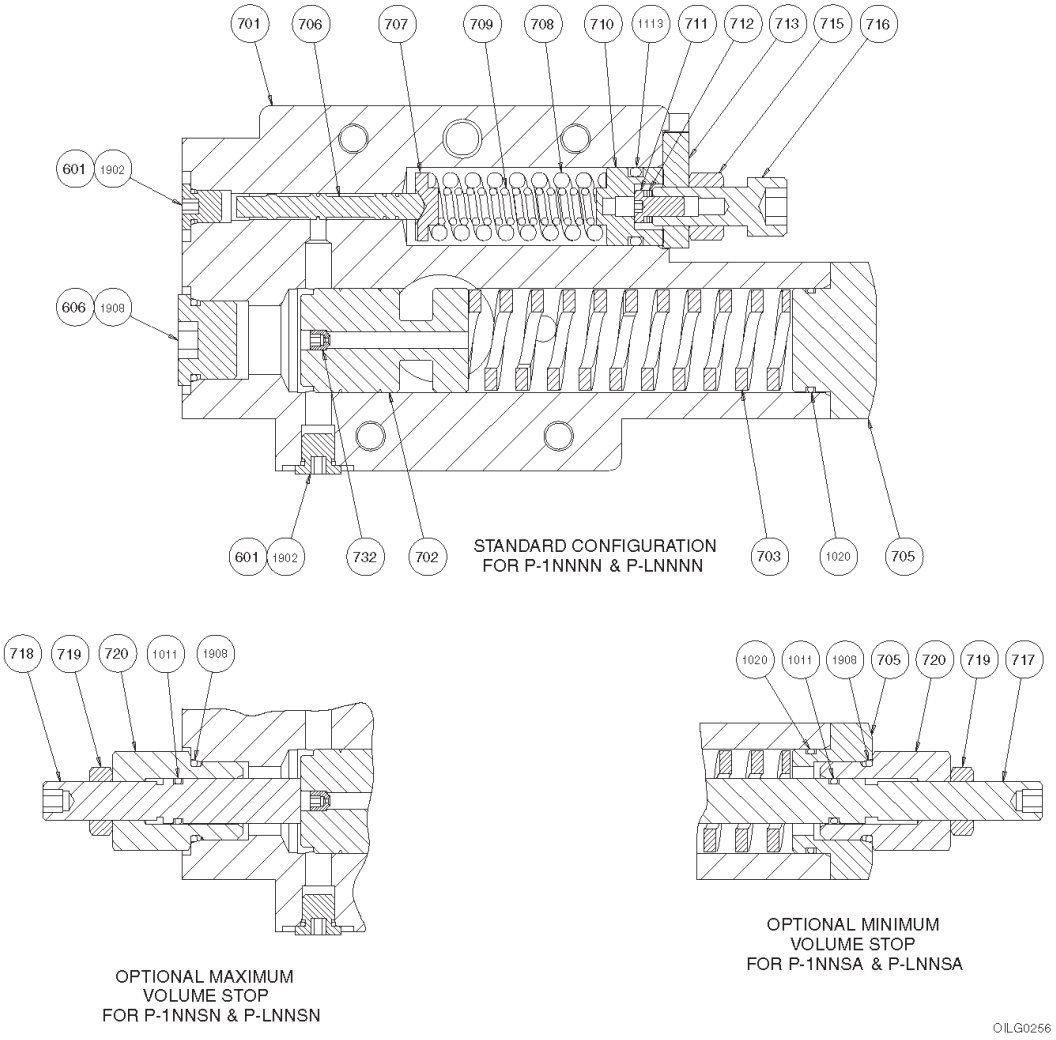

Figure 8. Parts Drawing for “P-1NN” and “P-LNN” Control (519975-101 sheet 1)

MAXIMUM AND MINIMUM VOLUME STOP

The maximum volume stop can be adjusted to attain a maximum volume from full to 25% of full flow. The pump can be de-stroked from full to 25% flow with eight half-turns of the volume stop. One turn clockwise will decrease maximum pump outlet flow 9%.

The minimum volume stop can be adjusted to attain a minimum volume from zero to full flow. One turn clockwise will increase minimum pump outlet flow 9%.

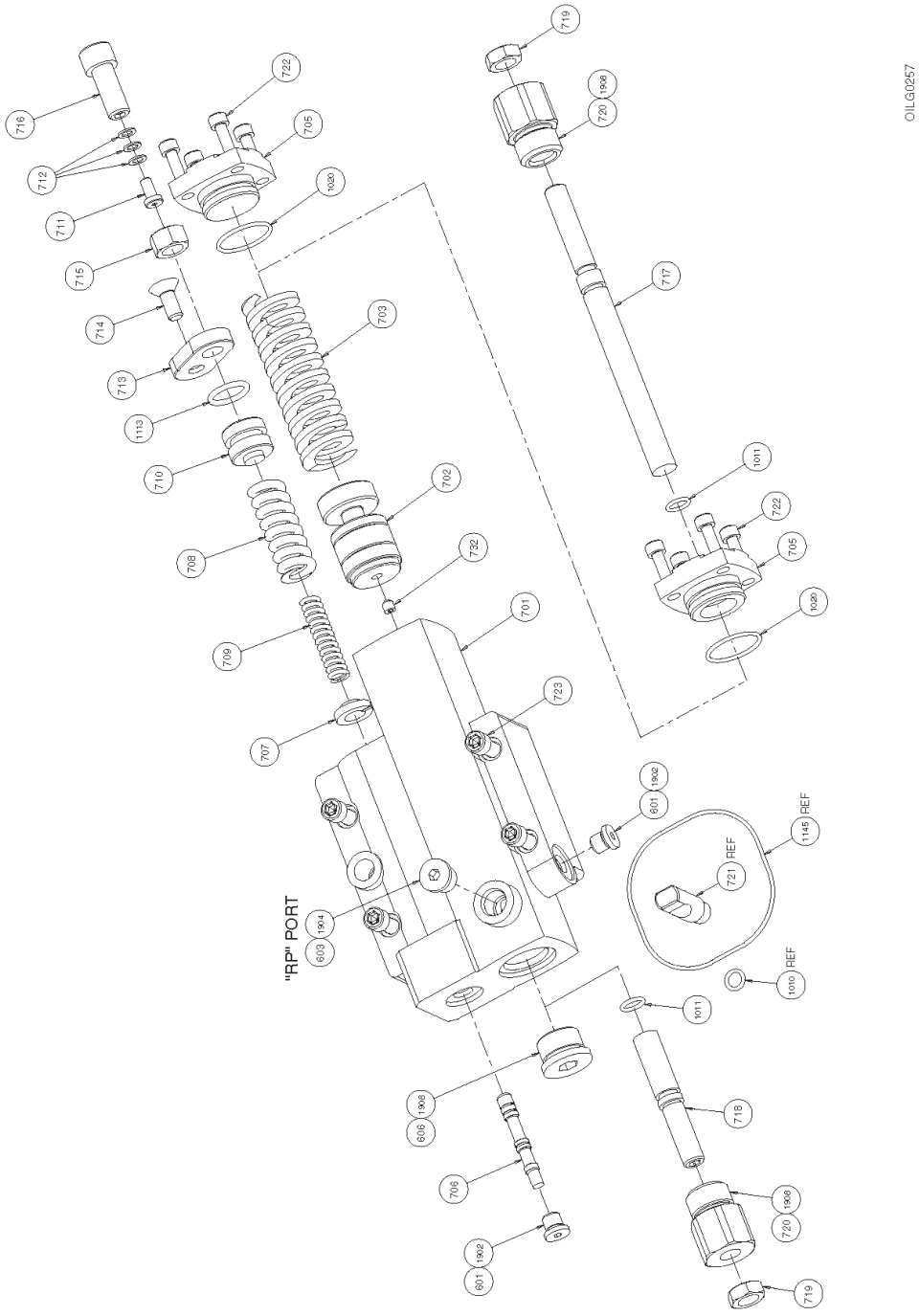

Figure 9. Exploded Parts Drawing for “P-1NN” and “P-LNN” Control (519975-101 sheet 2)

NOTES

NOTES

AFTER SALES SERVICES

At Oilgear we build products to last. It is the nature of this type of machinery to require proper maintenance regardless of the care we put into manufacturing. Oilgear has several service programs in place to help you.

STAY-ON-STREAM SERVICE

By signing up for Oilgear's Stay-On-Stream program, you can prepare for problems before they happen. Certain field tests such as fluid testing, slip testing and electronic profile recording comparisons can be performed by our field service people or your own factory trained personnel. These tests can indicate problems before they become "down-time" difficulties.

SERVICE SCHOOLS

Oilgear conducts training to train your maintenance personnel. "General" hydraulic or electronic training is conducted at our Milwaukee, Wisconsin plant on a regular basis. "Custom" training, specifically addressing your particular hydraulic and electro-hydraulic equipment, can be conducted at your facilities.

SPARE PARTS AVAILABILITY

Prepare for your future needs by stocking Oilgear original factory parts. Having the correct parts and necessary skills "in-plant" enables you to minimize "down-time." Oilgear has developed parts kits to cover likely future needs. Oilgear Field Service Technicians are also ready to assist you and your maintenance people in troubleshooting and repairing equipment.

Issued: August 2006

THE OILGEAR COMPANY
2300 South 51st Street
Milwaukee, Wisconsin 53219
www.oilgear.com

Bulletin 947633

SERVICE INSTRUCTIONS "PVWJ" B-FRAME PUMPS -025/-034/-046 FOR TYPE "P-1NN" AND "P-LNN" PRESSURE COMPENSATING CONTROLS

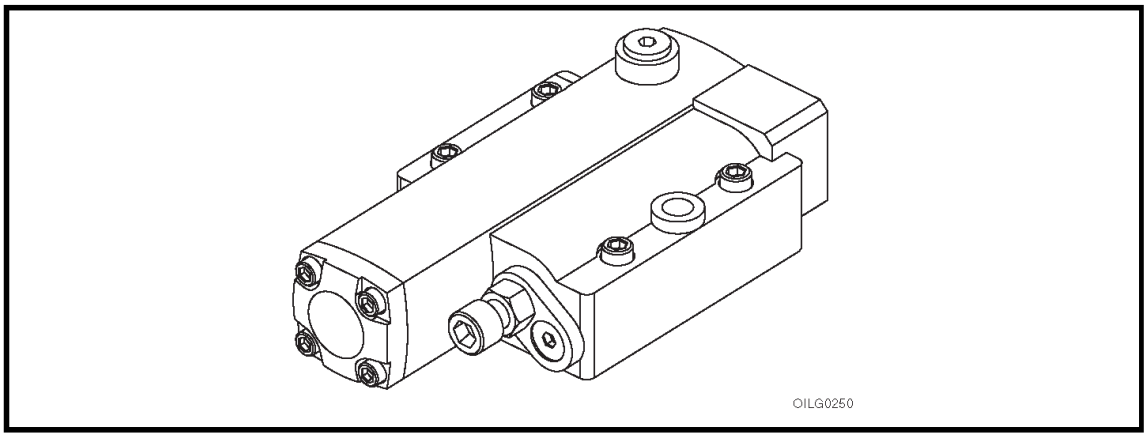

Figure 1. Typical Oilgear Type "P-1NN" and "P-LNN" Pressure Compensator Controls for "PVWJ" B-Frame Pump

PURPOSE OF INSTRUCTIONS

These instructions will simplify the installation, operation and maintenance of Oilgear type "P-1NN" and "P-LNN" controlled units.

This material will inform you about the basic construction, principle of operation and service parts listings. Some controls may be modified for specific applications from those described in this bulletin and other changes may be made without notice.

REFERENCE MATERIAL

Fluid Recommendations ..... Bulletin 90000
Contamination Evaluation Guide ..... Bulletin 90004
Filtration Recommendations ..... Bulletin 90007
Piping Information ..... Bulletin 90011
Proper Installation of Vertical Pumps ..... Bulletin 90014
PVWJ Open Loop Pumps, Application Guidelines ..... Bulletin 847085
PVWJ Open Loop Pumps (All Frame Sizes) Service Instructions ..... Bulletin 947085
PVWJ Open Loop Pumps, Sales ..... Bulletin 47085

PVWJ PUMP INSTALLATIONS

PVWJ B Frame (PVWJ-025/-034/-046) w/ Rear Ports DS-47483
PVWJ B Frame (PVWJ-025/-034/-046) w/ Side Ports DS-47484
PVWJ B Frame (PVWJ-025/-034/-046) w/ Side Ports & Thru Shaft DS-47485

PVWJ PUMP CONTROL INSTALLATIONS

"P-1NN" and "P-LNN" Pressure Compensator for PVWJ-025/-034/-046 ..... DS-47985

THE OILGEAR COMPANY
2300 South 51st Street
Milwaukee, Wisconsin 53219
www.oilgear.com

Issued: August 2006

Safety First

Read and understand this entire instruction sheet before repairing, or adjusting your Oilgear product.

Those who use and maintain this equipment must be thoroughly trained and familiar with the product. If incorrectly used or maintained, this product and its equipment can cause severe injury.

SAFETY SYMBOLS

The following signal words are used in this instruction sheet to identify areas of concern where your safety may be involved. Carefully read the text and observe any instructions provided to ensure your safety.

⚠ DANGER ⚠

THIS SIGNAL WORD INDICATES AN IMMINENTLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, WILL RESULT IN DEATH OR SERIOUS INJURY.

⚠ WARNING

This signal word indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

This signal word indicates that a potentially hazardous situation exists which, if not avoided, may result in damage to equipment or minor personal injury.

NOTE *While not directly relevant to the topic being discussed, the NOTE is used to emphasize information provided, or provide additional information which may be of benefit.*

⚠ WARNING

This service information is designed for the maintenance of your Oilgear product. It contains the information on the correct procedures determined by Oilgear for the safe manner of servicing. Always keep this instruction sheet in a location where it is readily available for the persons who use and maintain the product. Additional copies of this instruction sheet are available through the Oilgear Company. Contact us at 414-327-1700 or visit our website: www.oilgear.com. Please contact us if you have any questions regarding the information in this instruction bulletin.

NOTE *The cleanliness of working on this pump control or the hydraulic system is extremely important to the safety and reliability of the pump and the system. Always make sure the fittings are clean on the outside before removing them from their connections, are capped and plugged when removed and placed in a clean rag or container until they are reinstalled.*

⚠ WARNING

Some service operations may require special tools or equipment. If you require information on these items, please contact Oilgear before attempting these repairs and service operations.

⚠ WARNING

Read, understand and follow the safety guidelines, dangers and warnings contained in this instruction sheet to promote reliable operation and prevent serious personal injury.

⚠ WARNING

DO NOT attempt to service this machinery in an environment where safety regulations are not established and in place.

⚠ WARNING

DO NOT operate the hydraulic system if a leak is present. Serious injury may result.

⚠ WARNING

Hydraulic systems operate under very high pressure. Hydraulic fluid escaping from a pressurized system can penetrate unprotected body tissue. DO NOT inspect for hydraulic leaks with bare hands or other exposed body parts. As a minimum, wear leather gloves prior to inspecting for leaks and use cardboard or wood. If leaks are present, relieve pressure and allow system to cool prior to servicing. If injured by escaping hydraulic oil, contact a physician immediately. Serious complications may arise if not treated immediately. If you have questions regarding inspecting for hydraulic leaks, please contact Oilgear prior to servicing.

⚠ WARNING

Hydraulic hoses and tubing must be inspected on a daily basis for leaks, cuts, abrasions, damage and improper clearance along any mounting frame for hidden damage before the unit is put into service. Replace damaged hoses or hoses you suspect are damaged before the system is returned to service! Hoses must be replaced every two years. Failure to properly inspect and maintain the system may result in serious injury.

⚠ WARNING

Hydraulic systems are hot. DO NOT TOUCH! Serious personal injury may result from hot oil. When you have completed working on the hydraulic system, thoroughly clean any spilled oil from the equipment. Do not spill any hydraulic fluids on the ground. Clean any hydraulic fluids from your skin as soon as you have completed maintenance and repairs. Dispose of used oil and system filters as required by law.

⚠ WARNING

Use correct hoses, fittings, and adapters with the correct SAE rating when replacing hoses to prevent possible serious injury. Always replace hoses, fittings and adapters with replacements that have a proper, suitable, working pressure rating. Replacement hoses must be of the correct length and must comply with the hose manufacturer's and Oilgear's installation guidelines and recommendations.

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Hydraulic hoses have the SAE ratings marked on the hose to assist you in selecting the correct hose. The same manufacturer must supply any replacement hydraulic hoses and fitting assemblies. As an example: Brand "X" hose and brand "Y" fitting will not normally be compatible. No "Twist" is allowed in the hydraulic hoses. "Twist" may result in premature hose failure. This can cause serious injury. Please contact Oilgear for assistance when required.

⚠ WARNING

Hydraulic cylinders can be holding a function in a certain position when the pump is OFF. An example of this is a function being held in the lift or partial lift position by the cylinders. If a hydraulic line is removed or the hydraulic circuits or controls are being worked on, gravity may allow the function being held in position to drop. All workers and personnel must remain clear of these areas when working on or operating the hydraulic system. Block and secure all devices and functions which apply before beginning work or operation. Failure to comply with this can result in serious injury or death.

⚠ WARNING

Any hydraulic pipe which is replaced must conform to SAE J1065 specifications. If incorrect hydraulic pipe is installed, the hydraulic system may fail, causing serious injury. Damaged or leaking fittings, pipes or hoses must be replaced before the system is returned to service.

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All hydraulic pressure must be relieved from the hydraulic system prior to removing any components from the system. To relieve the hydraulic pressure from the hydraulic system, turn off the motor and operate the control panel with the key in the ON position. Failure to comply can result in serious injury. If you have any questions concerning relieving the hydraulic pressure from the system, please contact Oilgear.

⚠ WARNING

Hydraulic components can be heavy. Use caution while lifting these components. Serious personal injury can be avoided with proper handling of the components.

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Please contact Oilgear if you require assistance. When performing hydraulic test procedures, use the proper hydraulic gauges. Installing an incorrect test gauge could result in serious injury if the gauge fails. Use properly rated hydraulic hoses to allow the test gauge to be read away from moving parts and functions.

⚠ WARNING

Increasing hydraulic pressure beyond the recommendations may result in serious damage to the pump and system or serious personal injury and may void the Oilgear Warranty. If you have questions concerning hydraulic pressures or testing procedures, please contact Oilgear before attempting the test procedures or making adjustments.

⚠ WARNING

An Oilgear pump or pump control must not be modified in any way without authorization from Oilgear. Modifications may not comply with safety standards, including ANSI safety standards, and may result in serious personal injury. Please contact Oilgear if you require assistance.

⚠ WARNING

DO NOT enter under hydraulic supported equipment unless they are fully supported or blocked. Failure to follow this procedure can result in serious injury or death.

⚠ WARNING

Any Oilgear pump safety decals must be replaced anytime they are damaged, missing or cannot be read clearly. Failure to have proper decals in place can result in serious injury or death. (If you require safety decals, please contact Oilgear for replacement safety decals, at no charge.)

⚠ WARNING

Be sure everyone is clear of the area around the hydraulic system before operating after servicing. Remain attentive at all times when operating to check your work until you are completely sure it is safe to return to service. Failure to heed this warning may result in serious personal injury or death.

⚠ WARNING

Wear the proper protective clothing when operating, servicing or maintaining the hydraulic system or the Oilgear pump. Wear the correct protective gear, safety glasses, gloves and safety shoes. Serious injury can result without proper protective gear.

⚠ WARNING

Make sure to keep hands, feet and other parts of your body clear of revolving or moving parts. Failure to comply can cause serious injury.

⚠ WARNING

DO NOT wear watches, rings or jewelry while working with electrical and mechanical equipment. These items can be hazardous and can cause serious and painful injuries if they come into contact with electrical wires, moving parts or hydraulic equipment.

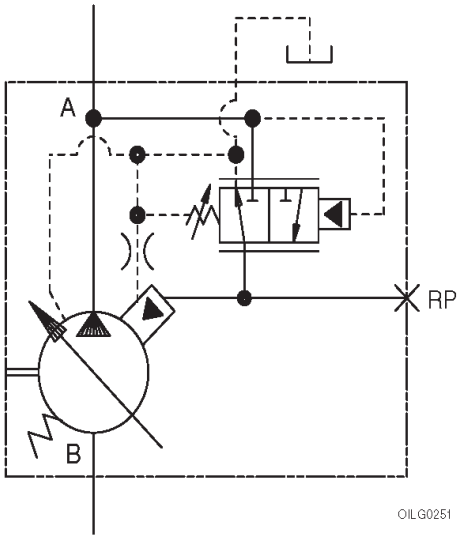


Figure 2. ASA Diagram for "P-1NN" or "P-LNN" Controls Shown with Typical Pump

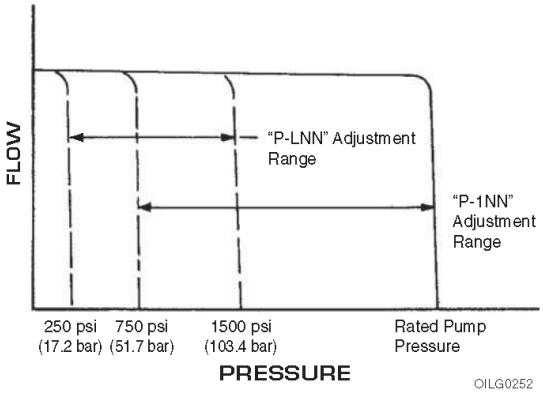


Figure 3. Curve Indicating Flow Versus Pressure for "P-1NN" or "P-LNN" Type Controls

TROUBLESHOOTING

PROBLEM	CAUSES	REMEDY
Unresponsive or Unstable Control	Swashblock bearing surface and/or Saddle Bearings worn or damaged.	See appropriate pump service bulletin.
	Control Pin and/or hole in Swashblock worn significantly.	
	Saddle Bearing Locating Pins broken.	
	Fluid is contaminated.	Inspect and clean if necessary. See bulletin 90007.
	Control Piston orifice (732) plugged.	Inspect and clean if necessary.
	Contamination trapped between control piston (702) and piston bore is not allowing piston to move smoothly.	Inspect and clean if necessary. Replace scored or damaged parts.
	Contamination trapped between control spool (706) and spool bore is not allowing spool to move smoothly.	
	Faulty remote pressure compensator circuit components.	Inspect and replace if necessary.
	Hydraulic line between remote pressure compensator components and RP port of control is too long.	Shorten line length.
	Insufficient control flow.	Increase size of control piston orifice (732).
Insufficient Outlet Volume	Swashblock not stroking to desired displacement.	See appropriate pump service bulletin.
	Low input drive speed.	
	Worn or grooved Cylinder Barrel and/or Valve Plate mating surfaces.	
	Failed Driveshaft.	
	Worn or damaged Piston Shoes or Swashblock.	
	Worn Pistons and/or piston bores.	
	Control Piston stuck off stroke.	Inspect and replace if necessary.
	Maximum Volume Stop adjusted incorrectly.	Adjust Maximum Volume Stop CCW to increase outlet flow.
	Pressure Compensator is set too close to operating pressure.	Adjust Pressure Compensator setting CW to increase setting.
Destrokes at low pressure	Pressure compensator adjustment not set correctly.	Adjust Pressure Compensator setting CW to increase setting and retorque jam nut (715).
	Control Piston orifice (732) plugged.	Inspect and clean if necessary.
	Damaged or fractured control spring (items 708 and/or 709).	Inspect and replace if necessary.
	Severely worn control spool (706) and/or spool bore.	
	Damaged or fractured control piston spring (item 703).	
	Faulty remote pressure compensator circuit components.	
Excessive peak pressure	Pressure Compensator is set too high.	Adjust Pressure Compensator setting CCW to decrease setting.
	Minimum Volume Stop is set too high.	Adjust Minimum Volume Stop CCW to decrease outlet flow.
	Fluid is contaminated.	Inspect and clean if necessary. See bulletin 90007.
	Swashblock bearing surface and/or Saddle Bearings worn or damaged.	See appropriate pump service bulletin.
	Contamination trapped between control piston (702) and piston bore is not allowing piston to move smoothly.	Inspect and clean if necessary. Replace scored or damaged parts.
	Contamination trapped between control spool (706) and spool bore is not allowing spool to move smoothly.	
	Hydraulic line between remote pressure compensator components and RP port of control is too long.	Shorten line length.
	Faulty remote pressure compensator circuit components.	Inspect and replace if necessary.
	Restriction in drilled passages between pump outlet port and control spool.	Inspect and clean if necessary.

PRINCIPLE OF OPERATION

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 de-strokes the pump while maintaining the preset pressure.

"P-1NN" controls can be adjusted from 750 psi (51,7 bar) working pressure up to the maximum pressure rating of the applicable pump. "P-LNN" controls can be adjusted from 250 psi (17,2 bar) up to a maximum of 1500 psi (103,4 bar).

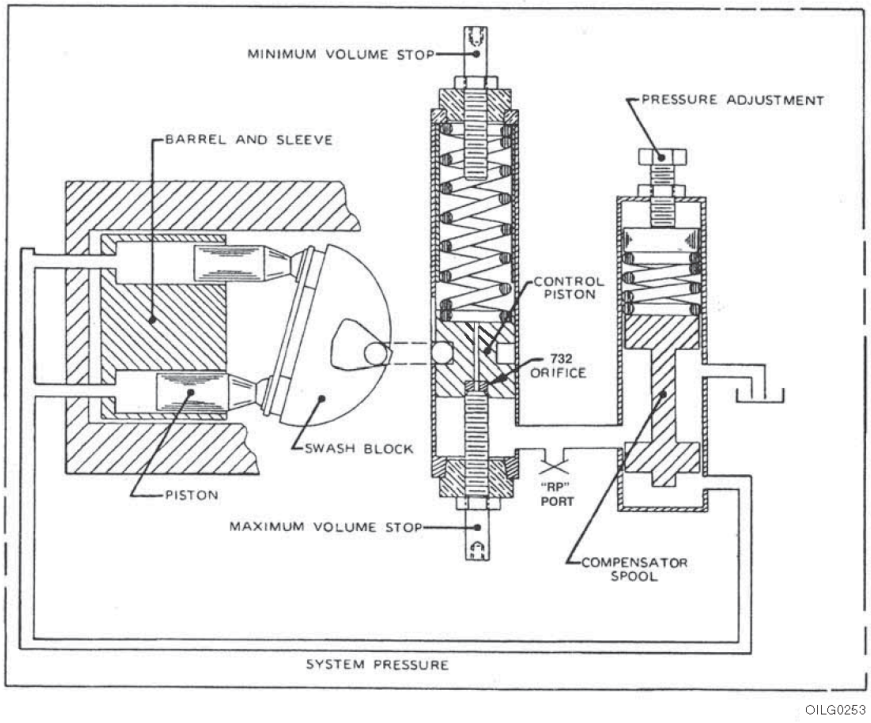


Figure 4. Swashblock at Full Delivery and "P-1NN" or "P-LNN" Controls at Maximum Volume Stop

LINE MOUNTED REMOTE PRESSURE CONTROL FOR TYPE "P-1NN" AND "P-LNN" PUMP CONTROLS - VSR (REMOTE SEQUENCE VALVE)

Remote operation of "P-1NN" and "P-LNN" controls can be accomplished by installing an Oilgear VSR Module at the location shown in the control circuit. Use module L51542 for units rated continuously for 4000 psi (275,8 bar) or less. Use L51542-1 for units rated above 4000 psi (275,8 bar).

NOTE *To minimize case leakage and power loss, plug the control drain port with a #10-24 UNC setscrew to maintain the standard "P-1NN" or "P-LNN" control case leakage. The plug will increase response time. Standard response time can be obtained by installing a .040 inch (1,0 mm) orifice instead of plugging it.*

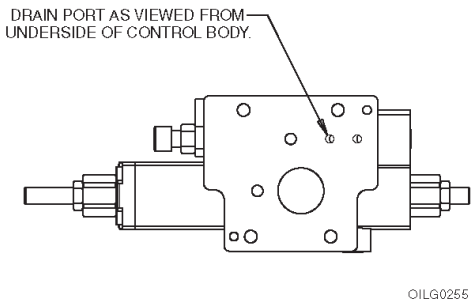


Figure 7. "P-1NN" and "P-LNN" Control Drain Port Location

NOTE *The compensator setting on the pump control must be set at least 200 psi (13,8 bar) higher than the required pressure setting of the remote compensator module to prevent the pump compensator control from interacting with the remote compensator module.*

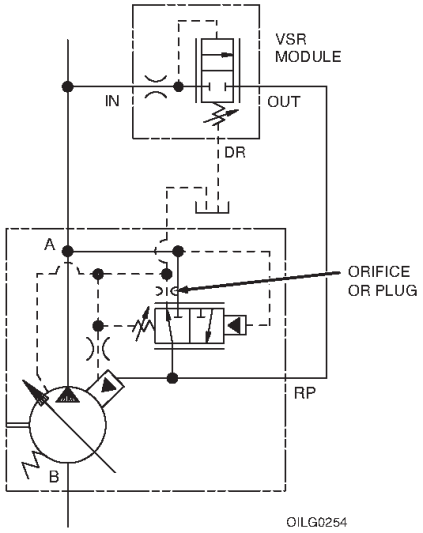


Figure 5. "P-1NN" and "P-LNN" Control Circuit with Remote Pressure Control

SCREW AND PLUG TORQUES FOR CONTROLS

Item Number	Description	Head Type & Size	Tightening Torque
601	SAE #2 Plug	1/8" Internal Hex	45 in.-lbs (5 N·m)
603	SAE #4 Plug	3/16" Internal Hex	120 in.-lbs (14 N·m)
606	SAE #8 Plug	5/16" Internal Hex	45 ft-lbs (61 N·m)
711	PC Adjuster Screw LHCS	3/32" Internal Hex	57 in.-lbs (6 N·m)
714	Adjuster Plate Screw	5/32" Internal Hex	80 in.-lbs (9 N·m)
720	Max. or Min. Volume Stop Housing	7/8" External Hex	50 ft-lbs (68 N·m)
722	End Cap Screws	3/16" Internal Hex	120 in.-lbs (14 N·m)
723	Control Body Screws	3/16" Internal Hex	120 in.-lbs (14 N·m)
732	Control Piston Orifice	3/32" Internal Hex	20 in.-lbs (2.3 N·m)

CONTROL O-RING SEALS

Item Number	ARP 568 Uniform Size Number	Shore A Durometer
1010	-010	90
1011	-011	90
1113	-113	90
1125	-125	90
1237	-237	70
1902	-902	90
1904	-904	90
1908	-908	90

PARTS LIST

Parts used in these assemblies are per Oilgear specifications. Use only Oilgear parts to ensure compatibility with assembly requirements. When ordering replacement parts, be sure to include pump type and serial number, bulletin number and item number. Specify type of hydraulic fluid to ensure seal and packing compatibility.

NOTE *Parts drawings may not be identical to Oilgear drawings referenced.*

PVWJ-025/-034/-046 PRESSURE COMPENSATOR CONTROLS (“P-1NN” STANDARD & “P-LNN” LOW PRESSURE CONTROLS)

Item	Description
	COMMON PARTS GROUP
601	SAE#2 Plug
603	SAE#4 Plug
606	SAE#8 Plug
701	Control Block
702	Control Piston
703	Control Piston Spring
704	Piston Stop
705	End Cap
706	Pressure Compensator Control Spool
707	Spring Seat
708	Pressure Compensator Spring (Outer)
709*	Pressure Compensator Spring (Inner)
710	Control Plug
711	Screw
712	Shims
713	Adjuster Plate
714	Screw
715	Jam Nut
716	Pressure Compensator Adjustment Screw
717	Min. Volume Stop Stem
718	Max. Volume Stop Stem
719	Jam Nut
720	Volume Stop Housing
721	Control Pin
722	Screw, End Cap
723	Screw, Control Body
732	Orifice
1010	O-Ring
1011	O-Ring
1113	O-Ring
1125	O-Ring
1237	O-Ring
1902	O-Ring
1904	O-Ring
1908	O-Ring

*Only used in P-1 Control.

SERVICE KITS

Document Number: 519975-SK2
Revision: New

PVWJ Service Kits

Reference 519975-201
SERVICE KIT, Figures 8 & 9

Description	Kit No.	Design Series	Items Included (quantity is 1 unless noted)
Main Control Body Kits			
PVWJ-025	K50432-100	A1	701, 706
PVWJ-034/-046	K50432-200	A1	701, 706
Control Piston Kits			
All Models	K50484	A1	702, 732
Pressure Compensator Spools			
PVWJ-025	50015-100	A1	706
PVWJ-034/-046	50015-200	A1	706
Control Spring Kits			
P-LNN (All Models)	K50036-104	A1	703, 708
PVWJ-025 P-1NN	K50036-107	A1	703, 708
PVWJ-034/-046 P-1NN	K50036-110	A1	703, 708, 709
Control Pins			
All Models	51339-5	A1	721
Volume Stop Kits			
Maximum Volume Stop (All Models)	K50590	A1	718, 719, 720, 1011, 1908
Minimum Volume Stop (All Models)	K50590-200	A1	705, 717, 719, 720, 1011, 1020, 1908
Pressure Compensator Adjuster Kits			
All Models	K50660-200	A1	710, 711, 712, 713, 715, 716, 1113
Control Seal Kit			
All Models	K50824-200	A1	1010, 1011, 1113, 1125, 1237, 1902, 1904, 1908

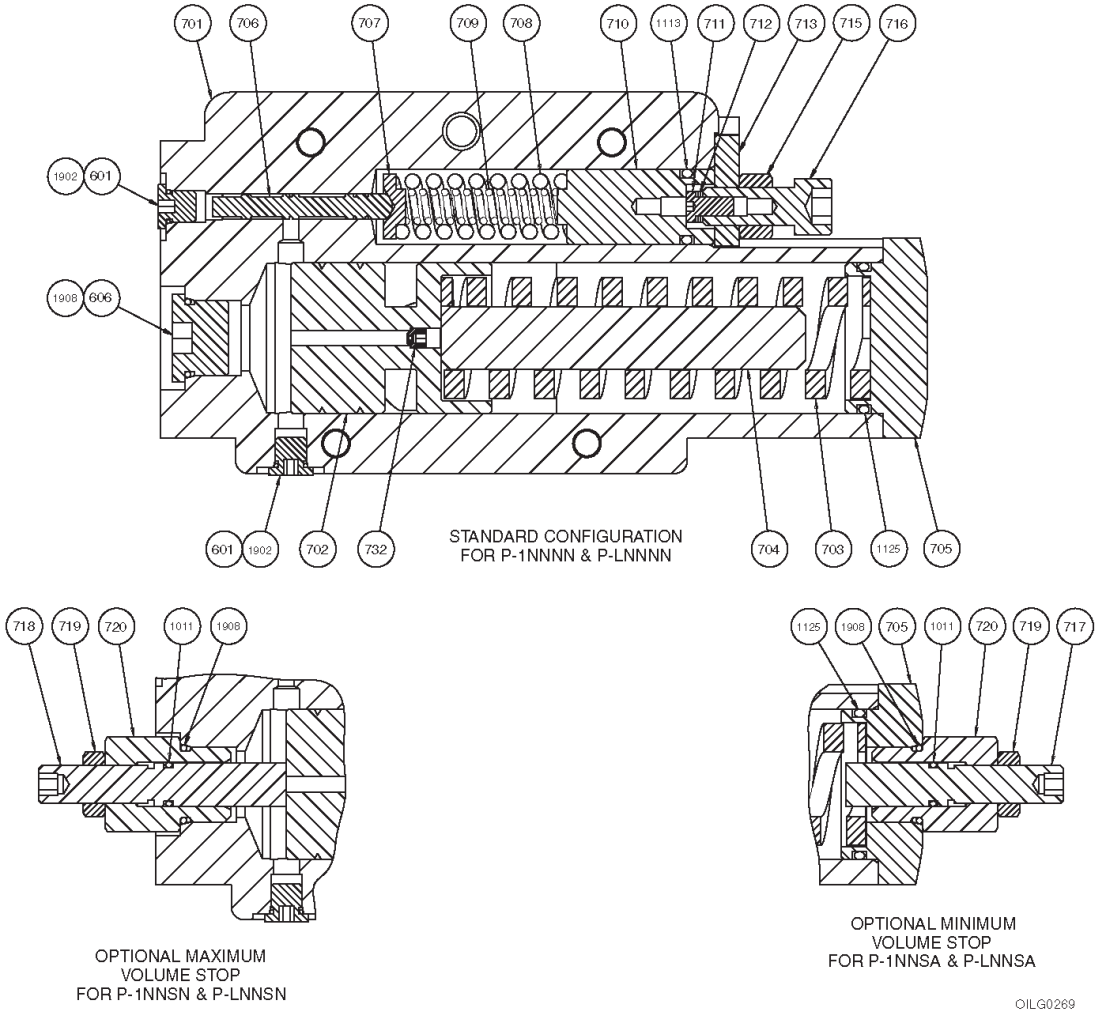


Figure 8. Parts Drawing for “P-1NN” and “P-LNN” Control (519975-201 sheet 1)

MAXIMUM AND MINIMUM VOLUME STOP

The maximum volume stop can be adjusted to attain a maximum volume from full to 25% of full flow. The pump can be de-stroked from full to 25% flow with 11 turns of the volume stop. One turn clockwise will decrease maximum pump outlet flow 7%.

The minimum volume stop can be adjusted to attain a minimum volume from zero to full flow. The adjustment requires 14 turns to go from zero to full flow. One turn clockwise will increase minimum pump outlet flow 9%.

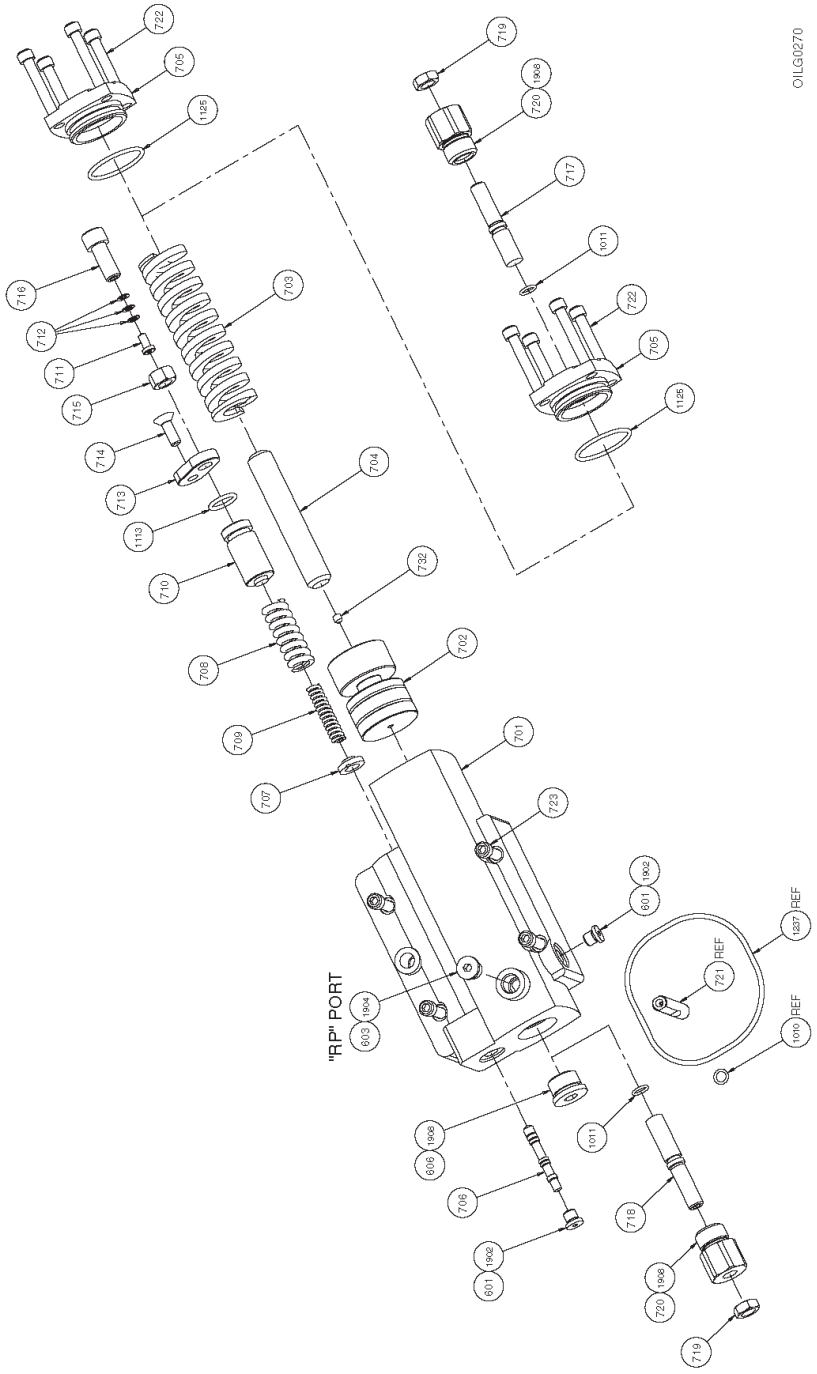


Figure 9. Exploded Parts Drawing for “P-1NN” and “P-LNN” Control (519975-201 sheet 2)

NOTES

NOTES

AFTER SALES SERVICES

At Oilgear we build products to last. It is the nature of this type of machinery to require proper maintenance regardless of the care we put into manufacturing. Oilgear has several service programs in place to help you.

STAY-ON-STREAM SERVICE

By signing up for Oilgear's Stay-On-Stream program, you can prepare for problems before they happen. Certain field tests such as fluid testing, slip testing and electronic profile recording comparisons can be performed by our field service people or your own factory trained personnel. These tests can indicate problems before they become "down-time" difficulties.

SERVICE SCHOOLS

Oilgear conducts training to train your maintenance personnel. "General" hydraulic or electronic training is conducted at our Milwaukee, Wisconsin plant on a regular basis. "Custom" training, specifically addressing your particular hydraulic and electro-hydraulic equipment, can be conducted at your facilities.

SPARE PARTS AVAILABILITY

Prepare for your future needs by stocking Oilgear original factory parts. Having the correct parts and necessary skills "in-plant" enables you to minimize "down-time." Oilgear has developed parts kits to cover likely future needs. Oilgear Field Service Technicians are also ready to assist you and your maintenance people in troubleshooting and repairing equipment.

Issued: August 2006

THE OILGEAR COMPANY
2300 South 51st Street
Milwaukee, Wisconsin 53219
www.oilgear.com

Bulletin 947634

APPENDIX III

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.

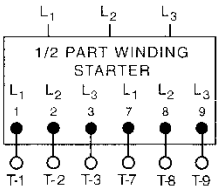
Number of Motor Leads	Number of Rated Voltages	Lead Numbers	YDS	PWS
3	Single	1-3	No	No
6	Single	1-3, 7-9	No	Yes
	Single	1-6	Yes	No
	Dual	1-6	Yes(1)	No
9	Dual	1-9	No	No
12	Single	1-12	Yes	Yes
	Dual	1-12	Yes	No(2)

(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.

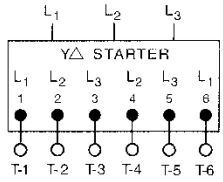
Connection Diagram 1

Single Voltage, 6 Leads
Part Winding Start Connection



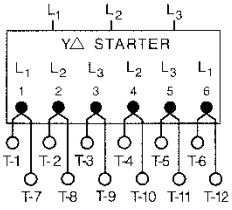
Connection Diagram 2

Single Voltage, 6 Leads
Y△ Start Connection



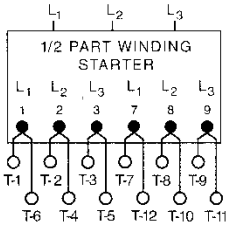
Connection Diagram 3

Single Voltage, 12 Leads
Y△ Start Connection



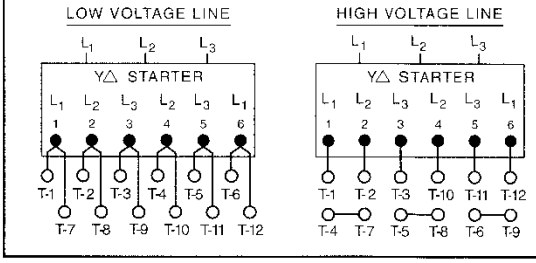
Connection Diagram 4

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.

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

- indicates change since last printing.

APPENDIX IV

Models: 5110
Safety Data Sheet (SDS)
MIL-PRF-5606 Hydraulic Fluid

SAFETY DATA SHEET

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

PRODUCT

Product Name: **MOBIL AERO HFA**
Product Description: Base Oil and Additives
Product Code: 201550401020, 490110-00, 970584
Intended Use: Aviation hydraulic oil

COMPANY IDENTIFICATION

Supplier: **EXXON MOBIL CORPORATION**
22777 Springwoods Village Parkway
Spring, TX. 77253 USA

24 Hour Health Emergency	609-737-4411
Transportation Emergency Phone	800-424-9300 or 703-527-3887 CHEMTREC
Product Technical Information	800-662-4525
MSDS Internet Address	http://www.exxon.com, http://www.mobil.com

SECTION 2 HAZARDS IDENTIFICATION

This material is hazardous according to regulatory guidelines (see (M)SDS Section 15).

CLASSIFICATION:

Flammable liquid: Category 4.
Aspiration toxicant: Category 1.

LABEL:
Pictogram:

Signal Word: Danger

Hazard Statements:
H227: Combustible liquid. H304: May be fatal if swallowed and enters airways.

Precautionary Statements:
P210: Keep away from flames and hot surfaces. -- No smoking. P273: Avoid release to the environment. P280: Wear protective gloves and eye / face protection.P301 + P310: IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician. P331: Do NOT induce vomiting. P370 + P378: In case of fire: Use water fog, foam, dry chemical or carbon dioxide (CO2) to extinguish.P403 + P235: Store in a well-ventilated place. Keep cool. P405: Store locked up.P501: Dispose of contents and container in accordance with local regulations.

Other hazard information:

HAZARD NOT OTHERWISE CLASSIFIED (HNOC): None as defined under 29 CFR 1910.1200.

PHYSICAL / CHEMICAL HAZARDS

Material can accumulate static charges which may cause an ignition. Material can release vapors that readily form flammable mixtures. Vapor accumulation could flash and/or explode if ignited. Combustible.

HEALTH HAZARDS

High-pressure injection under skin may cause serious damage. Excessive exposure may result in eye, skin, or respiratory irritation.

ENVIRONMENTAL HAZARDS

No significant hazards.

NFPA Hazard ID:	Health:	1	Flammability:	2	Reactivity:	0
HMIS Hazard ID:	Health:	1*	Flammability:	2	Reactivity:	0

NOTE: This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

SECTION 3 COMPOSITION / INFORMATION ON INGREDIENTS

This material is defined as a mixture.

Hazardous Substance(s) or Complex Substance(s) required for disclosure

Name	CAS#	Concentration*	GHS Hazard Codes
2,6-DI-TERT-BUTYL-P-CRESOL	128-37-0	0.1 - < 1%	H400(M factor 1), H410(M factor 1)
DISTILLATES (PETROLEUM), HYDROTREATED LIGHT	64742-47-8	5 - < 10%	H304
HYDROTREATED LIGHT NAPHTHENIC DISTILLATE (PETROLEUM)	64742-53-6	50 - < 70%	H227, H304
HYDROTREATED MIDDLE DISTILLATE (PETROLEUM)	64742-46-7	20 - < 30%	H304
TRIPHENYL PHOSPHATE	115-86-6	0.1 - < 0.25%	H400(M factor 1), H410(M factor 1)

* All concentrations are percent by weight unless material is a gas. Gas concentrations are in percent by volume.

As per paragraph (i) of 29 CFR 1910.1200, formulation is considered a trade secret and specific chemical identity and exact percentage (concentration) of composition may have been withheld. Specific chemical identity and exact percentage composition will be provided to health professionals, employees, or designated representatives in accordance with applicable provisions of paragraph (i).

SECTION 4 FIRST AID MEASURES

INHALATION

Remove from further exposure. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation.

SKIN CONTACT

Wash contact areas with soap and water. Remove contaminated clothing. Launder contaminated clothing before reuse. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

EYE CONTACT

Flush thoroughly with water. If irritation occurs, get medical assistance.

INGESTION

Seek immediate medical attention. Do not induce vomiting.

NOTE TO PHYSICIAN

If ingested, material may be aspirated into the lungs and cause chemical pneumonitis. Treat appropriately.

SECTION 5 FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA

Appropriate Extinguishing Media: Use water fog, foam, dry chemical or carbon dioxide (CO2) to extinguish flames.

Inappropriate Extinguishing Media: Straight Streams of Water

FIRE FIGHTING

Fire Fighting Instructions: Evacuate area. Prevent runoff from fire control or dilution from entering streams, sewers, or drinking water supply. Firefighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces and to protect personnel.

Unusual Fire Hazards: Combustible. Pressurized mists may form a flammable mixture.

Hazardous Combustion Products: Aldehydes, Incomplete combustion products, Oxides of carbon, Phosphorus oxides, Smoke, Fume, Sulfur oxides

FLAMMABILITY PROPERTIES

Flash Point [Method]: >82°C (180°F) [ASTM D-93]
Flammable Limits (Approximate volume % in air): LEL: 0.7 UEL: 7.0 [Estimated]
Autoignition Temperature: >225°C (437°F)

SECTION 6 ACCIDENTAL RELEASE MEASURES

NOTIFICATION PROCEDURES

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable

regulations. US regulations require reporting releases of this material to the environment which exceed the applicable reportable quantity or oil spills which could reach any waterway including intermittent dry creeks. The National Response Center can be reached at (800)424-8802.

PROTECTIVE MEASURES

Avoid contact with spilled material. Warn or evacuate occupants in surrounding and downwind areas if required due to toxicity or flammability of the material. See Section 5 for fire fighting information. See the Hazard Identification Section for Significant Hazards. See Section 4 for First Aid Advice. See Section 8 for advice on the minimum requirements for personal protective equipment. Additional protective measures may be necessary, depending on the specific circumstances and/or the expert judgment of the emergency responders.

For emergency responders: Respiratory protection: respiratory protection will be necessary only in special cases, e.g., formation of mists. Half-face or full-face respirator with filter(s) for dust/organic vapor or Self Contained Breathing Apparatus (SCBA) can be used depending on the size of spill and potential level of exposure. If the exposure cannot be completely characterized or an oxygen deficient atmosphere is possible or anticipated, SCBA is recommended. Work gloves that are resistant to hydrocarbons are recommended. Gloves made of polyvinyl acetate (PVA) are not water-resistant and are not suitable for emergency use. Chemical goggles are recommended if splashes or contact with eyes is possible. Small spills: normal antistatic work clothes are usually adequate. Large spills: full body suit of chemical resistant, antistatic material is recommended.

SPILL MANAGEMENT

Land Spill: Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Stop leak if you can do it without risk. All equipment used when handling the product must be grounded. Do not touch or walk through spilled material. Prevent entry into waterways, sewer, basements or confined areas. A vapor suppressing foam may be used to reduce vapors. Use clean non-sparking tools to collect absorbed material. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Large Spills: Water spray may reduce vapor; but may not prevent ignition in closed spaces. Recover by pumping or with suitable absorbent.

Water Spill: Stop leak if you can do it without risk. Confine the spill immediately with booms. Warn other shipping. Remove from the surface by skimming or with suitable absorbents. Seek the advice of a specialist before using dispersants.

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

ENVIRONMENTAL PRECAUTIONS

Large Spills: Dike far ahead of liquid spill for later recovery and disposal. Prevent entry into waterways, sewers, basements or confined areas.

SECTION 7 HANDLING AND STORAGE

HANDLING

Avoid contact with skin. Avoid prolonged breathing of mists and heated vapor. Prevent small spills and leakage to avoid slip hazard. Material can accumulate static charges which may cause an electrical spark (ignition source). When the material is handled in bulk, an electrical spark could ignite any flammable vapors from liquids or residues that may be present (e.g., during switch-loading operations). Use proper bonding and/or ground procedures. However, bonding and grounds may not eliminate the hazard from static

accumulation. Consult local applicable standards for guidance. Additional references include American Petroleum Institute 2003 (Protection Against Ignitions Arising out of Static, Lightning and Stray Currents) or National Fire Protection Agency 77 (Recommended Practice on Static Electricity) or CENELEC CLC/TR 50404 (Electrostatics - Code of practice for the avoidance of hazards due to static electricity).

Static Accumulator: This material is a static accumulator.

STORAGE

The container choice, for example storage vessel, may effect static accumulation and dissipation. Keep container closed. Handle containers with care. Open slowly in order to control possible pressure release. Store in a cool, well-ventilated area. Storage containers should be grounded and bonded. Fixed storage containers, transfer containers and associated equipment should be grounded and bonded to prevent accumulation of static charge.

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE LIMIT VALUES

Exposure limits/standards (Note: Exposure limits are not additive)

Substance Name	Form	Limit / Standard			NOTE	Source
2,6-DI-TERT-BUTYL-P-CRESOL	Inhalable fraction and vapor	TWA	2 mg/m3		N/A	ACGIH
DISTILLATES (PETROLEUM), HYDROTREATED LIGHT [total hydrocarbon vapor]	Non-Aerosol	TWA	200 mg/m3		Skin	ACGIH
HYDROTREATED LIGHT NAPHTHENIC DISTILLATE (PETROLEUM)	Mist.	TWA	5 mg/m3		N/A	OSHA Z1
HYDROTREATED LIGHT NAPHTHENIC DISTILLATE (PETROLEUM)	Inhalable fraction.	TWA	5 mg/m3		N/A	ACGIH
HYDROTREATED LIGHT NAPHTHENIC DISTILLATE (PETROLEUM)	Mist.	TWA	5 mg/m3		N/A	ACGIH
HYDROTREATED MIDDLE DISTILLATE (PETROLEUM)	Mist.	TWA	5 mg/m3		N/A	OSHA Z1
HYDROTREATED MIDDLE DISTILLATE (PETROLEUM)	Inhalable fraction.	TWA	5 mg/m3		N/A	ACGIH
TRIPHENYL PHOSPHATE		TWA	3 mg/m3		N/A	OSHA Z1
TRIPHENYL PHOSPHATE		TWA	3 mg/m3		N/A	ACGIH

Exposure limits/standards for materials that can be formed when handling this product: When mists/aerosols can occur the following are recommended: 5 mg/m³ - ACGIH TLV (inhalable fraction), 5 mg/m³ - OSHA PEL.

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

No biological limits allocated.

ENGINEERING CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions.

Control measures to consider:
Use explosion-proof ventilation equipment to stay below exposure limits.

PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

Respiratory Protection: If engineering controls do not maintain airborne contaminant concentrations at a level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:
No special requirements under ordinary conditions of use and with adequate ventilation.

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapor warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

Hand Protection: Any specific glove information provided is based on published literature and glove manufacturer data. Glove suitability and breakthrough time will differ depending on the specific use conditions. Contact the glove manufacturer for specific advice on glove selection and breakthrough times for your use conditions. Inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:
If prolonged or repeated contact is likely, chemical resistant gloves are recommended. If contact with forearms is likely, wear gauntlet style gloves.

Eye Protection: If contact is likely, safety glasses with side shields are recommended.

Skin and Body Protection: Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:
If prolonged or repeated contact is likely, chemical, and oil resistant clothing is recommended.

Specific Hygiene Measures: Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practice good housekeeping.

ENVIRONMENTAL CONTROLS
Comply with applicable environmental regulations limiting discharge to air, water and soil. Protect the environment by applying appropriate control measures to prevent or limit emissions.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Note: Physical and chemical properties are provided for safety, health and environmental considerations only and may not fully represent product specifications. Contact the Supplier for additional information.

GENERAL INFORMATION
Physical State: Liquid
Color: Red

Odor: Characteristic
Odor Threshold: N/D

IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION

Relative Density (at 15 °C): 0.88
Flammability (Solid, Gas): N/A
Flash Point [Method]: >82°C (180°F) [ASTM D-93]
Flammable Limits (Approximate volume % in air): LEL: 0.7 UEL: 7.0 [Estimated]
Autoignition Temperature: >225°C (437°F)
Boiling Point / Range: N/D
Decomposition Temperature: N/D
Vapor Density (Air = 1): N/D
Vapor Pressure: [N/D at 20 °C]
Evaporation Rate (n-butyl acetate = 1): N/D
pH: N/A
Log Pow (n-Octanol/Water Partition Coefficient): N/D
Solubility in Water: Negligible
Viscosity: 13.8 cSt (13.8 mm2/sec) at 40 °C | 5.1 cSt (5.1 mm2/sec) at 100°C [ASTM D 445]
Oxidizing Properties: See Hazards Identification Section.

OTHER INFORMATION

Freezing Point: N/D
Melting Point: N/A
Pour Point: -60°C (-76°F) [ASTM D97]
DMSO Extract (mineral oil only), IP-346: < 3 %wt

SECTION 10 STABILITY AND REACTIVITY

REACTIVITY: See sub-sections below.

STABILITY: Material is stable under normal conditions.

CONDITIONS TO AVOID: Open flames and high energy ignition sources.

MATERIALS TO AVOID: Strong oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS: Material does not decompose at ambient temperatures.

POSSIBILITY OF HAZARDOUS REACTIONS: Hazardous polymerization will not occur.

SECTION 11 TOXICOLOGICAL INFORMATION

INFORMATION ON TOXICOLOGICAL EFFECTS

Hazard Class	Conclusion / Remarks
Inhalation	
Acute Toxicity: No end point data for material.	Minimally Toxic. Based on assessment of the components.
Irritation: No end point data for material.	Elevated temperatures or mechanical action may form vapors, mist, or fumes which may be irritating to the eyes, nose, throat, or lungs.

Ingestion	
Acute Toxicity: No end point data for material.	Minimally Toxic. Based on assessment of the components.
Skin	
Acute Toxicity: No end point data for material.	Minimally Toxic. Based on assessment of the components.
Skin Corrosion/Irritation: No end point data for material.	May dry the skin leading to discomfort and dermatitis. Based on assessment of the components.
Eye	
Serious Eye Damage/Irritation: No end point data for material.	May cause mild, short-lasting discomfort to eyes. Based on assessment of the components.
Sensitization	
Respiratory Sensitization: No end point data for material.	Not expected to be a respiratory sensitizer.
Skin Sensitization: No end point data for material.	Not expected to be a skin sensitizer. Based on assessment of the components.
Aspiration: Data available.	May be fatal if swallowed and enters airways. Based on physico-chemical properties of the material.
Germ Cell Mutagenicity: No end point data for material.	Not expected to be a germ cell mutagen. Based on assessment of the components.
Carcinogenicity: No end point data for material.	Not expected to cause cancer. Based on assessment of the components.
Reproductive Toxicity: No end point data for material.	Not expected to be a reproductive toxicant. Based on assessment of the components.
Lactation: No end point data for material.	Not expected to cause harm to breast-fed children.
Specific Target Organ Toxicity (STOT)	
Single Exposure: No end point data for material.	Not expected to cause organ damage from a single exposure.
Repeated Exposure: No end point data for material.	Not expected to cause organ damage from prolonged or repeated exposure. Based on assessment of the components.

TOXICITY FOR SUBSTANCES

NAME	ACUTE TOXICITY
2,6-DI-TERT-BUTYL-P-CRESOL	Oral Lethality: LD50 0.89 g/kg (Rat)

OTHER INFORMATION

For the product itself:

Repeated and/or prolonged exposure may cause irritation to the skin, eyes, or respiratory tract. Small amounts of liquid aspirated into the lungs during ingestion or from vomiting may cause chemical pneumonitis or pulmonary edema.

Contains:

Base oil severely refined: Not carcinogenic in animal studies. Representative material passes IP-346, Modified Ames test, and/or other screening tests. Dermal and inhalation studies showed minimal effects; lung non-specific infiltration of immune cells, oil deposition and minimal granuloma formation. Not sensitizing in test animals.

The following ingredients are cited on the lists below: None.

--REGULATORY LISTS SEARCHED--

1 = NTP CARC	3 = IARC 1	5 = IARC 2B
2 = NTP SUS	4 = IARC 2A	6 = OSHA CARC

SECTION 12 ECOLOGICAL INFORMATION

The information given is based on data available for the material, the components of the material, and similar materials.

ECOTOXICITY

Material -- Not expected to be harmful to aquatic organisms.

MOBILITY

More volatile component -- Highly volatile, will partition rapidly to air. Not expected to partition to sediment and wastewater solids.

Less volatile component -- Low solubility and floats and is expected to migrate from water to the land. Expected to partition to sediment and wastewater solids.

PERSISTENCE AND DEGRADABILITY

Biodegradation:

Components -- Expected to be inherently biodegradable

BIOACCUMULATION POTENTIAL

Majority of components -- Has the potential to bioaccumulate, however metabolism or physical properties may reduce the bioconcentration or limit bioavailability.

SECTION 13 DISPOSAL CONSIDERATIONS

Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

DISPOSAL RECOMMENDATIONS

Product is suitable for burning in an enclosed controlled burner for fuel value or disposal by supervised incineration at very high temperatures to prevent formation of undesirable combustion products. Protect the environment. Dispose of used oil at designated sites. Minimize skin contact. Do not mix used oils with solvents, brake fluids or coolants.

REGULATORY DISPOSAL INFORMATION

RCRA Information: The unused product, in our opinion, is not specifically listed by the EPA as a hazardous waste (40 CFR, Part 261D), nor is it formulated to contain materials which are listed as hazardous wastes. It does not exhibit the hazardous characteristics of ignitability, corrosivity or reactivity and is not formulated with contaminants as determined by the Toxicity Characteristic Leaching Procedure (TCLP). However, used product may be regulated.

Empty Container Warning Empty Container Warning (where applicable): Empty containers may contain residue and can be dangerous. Do not attempt to refill or clean containers without proper instructions. Empty drums should be

completely drained and safely stored until appropriately reconditioned or disposed. Empty containers should be taken for recycling, recovery, or disposal through suitably qualified or licensed contractor and in accordance with governmental regulations. DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION. THEY MAY EXPLODE AND CAUSE INJURY OR DEATH.

SECTION 14 TRANSPORT INFORMATION

LAND (DOT)

Proper Shipping Name: COMBUSTIBLE LIQUID, N.O.S. (Distillates (Petroleum), Hydrotreated Light)
Hazard Class & Division: COMBUSTIBLE LIQUID
ID Number: NA1993
Packing Group: III
ERG Number: 128
Label(s): NONE
Transport Document Name: NA1993, COMBUSTIBLE LIQUID, N.O.S. (Distillates (Petroleum), Hydrotreated Light), COMBUSTIBLE LIQUID, PG III

Footnote: This material is not regulated under 49 CFR in a container of 119 gallon capacity or less when transported solely by land, as long as the material is not a hazardous waste, a marine pollutant, or specifically listed as a hazardous substance.

LAND (TDG): Not Regulated for Land Transport

SEA (IMDG): Not Regulated for Sea Transport according to IMDG-Code

Marine Pollutant: No

AIR (IATA): Not Regulated for Air Transport

SECTION 15 REGULATORY INFORMATION

OSHA HAZARD COMMUNICATION STANDARD: This material is considered hazardous in accordance with OSHA HazCom 2012, 29 CFR 1910.1200.

Listed or exempt from listing/notification on the following chemical inventories: AICS, DSL, ENCS, IECSC, KECI, PICCS, TCSI, TSCA

EPCRA SECTION 302: This material contains no extremely hazardous substances.

SARA (311/312) REPORTABLE HAZARD CATEGORIES: Fire. Immediate Health. Delayed Health.

SARA (313) TOXIC RELEASE INVENTORY: This material contains no chemicals subject to the supplier notification requirements of the SARA 313 Toxic Release Program.

The following ingredients are cited on the lists below:

Chemical Name	CAS Number	List Citations
DISTILLATES (PETROLEUM), HYDROTREATED LIGHT	64742-47-8	1, 17, 18
HYDROTREATED LIGHT NAPHTHENIC DISTILLATE (PETROLEUM)	64742-53-6	1, 4, 13, 17, 18
HYDROTREATED MIDDLE DISTILLATE (PETROLEUM)	64742-46-7	1, 4, 17, 18

--REGULATORY LISTS SEARCHED--

1 = ACGIH ALL	6 = TSCA 5a2	11 = CA P65 REPRO	16 = MN RTK
2 = ACGIH A1	7 = TSCA 5e	12 = CA RTK	17 = NJ RTK
3 = ACGIH A2	8 = TSCA 6	13 = IL RTK	18 = PA RTK
4 = OSHA Z	9 = TSCA 12b	14 = LA RTK	19 = RI RTK
5 = TSCA 4	10 = CA P65 CARC	15 = MI 293	

Code key: CARC=Carcinogen; REPRO=Reproductive

SECTION 16 OTHER INFORMATION

N/D = Not determined, N/A = Not applicable

KEY TO THE H-CODES CONTAINED IN SECTION 3 OF THIS DOCUMENT (for information only):
H227: Combustible liquid; Flammable Liquid, Cat 4
H304: May be fatal if swallowed and enters airways; Aspiration, Cat 1
H400: Very toxic to aquatic life; Acute Env Tox, Cat 1
H410: Very toxic to aquatic life with long lasting effects; Chronic Env Tox, Cat 1

THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:
Revision Changes:
Section 01: Company Mailing Address information was modified.
Section 05: Hazardous Combustion Products information was modified.
Section 15: List Citations Table information was modified.
Section 15: National Chemical Inventory Listing information was modified.
Section 14: Marine Pollutant information was modified.
Composition: Component Table information was modified.
Section 08: Exposure Limits Table information was modified.
Section 16: Revision Information - Implementation of GHS requirements phrase. information was deleted.

Internal Use Only

MHC: 2A, 0, 0, 0, 1, 1 PPEC: C

DGN: 2005454XUS (552975)

APPENDIX V

Model: 5120
SDS Hydraulic Fluid
MIL-PRF-83282

SAFETY DATA SHEET

Section 1. Identification

Product name Brayco Micronic 882

SDS # 451700

Historic SDS #: 27009

Code 451700-US03

Relevant identified uses of the substance or mixture and uses advised against

Product use Hydraulic fluid
For specific application advice see appropriate Technical Data Sheet or consult our company representative.

Supplier

Castrol Industrial North America, Inc.
150 W. Warrenville Road
Naperville, IL 60563
Product Information: +1-877-641-1600

BP Lubricants USA Inc.
1500 Valley Road
Wayne, NJ 07470
Telephone: (973) 633-2200

EMERGENCY SPILL INFORMATION: 1 (800) 424-9300 CHEMTREC (USA)

Section 2. Hazards identification

OSHA/HCS status This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture ASPIRATION HAZARD - Category 1

GHS label elements

Hazard pictograms

Signal word Danger

Hazard statements May be fatal if swallowed and enters airways.

Precautionary statements

Prevention Not applicable.

Response IF SWALLOWED: Immediately call a POISON CENTER or physician. Do NOT induce vomiting.

Storage Store locked up.

Disposal Dispose of contents and container in accordance with all local, regional, national and international regulations.

Hazards not otherwise classified Defatting to the skin.
Note: High Pressure Applications
Injections through the skin resulting from contact with the product at high pressure constitute a major medical emergency.
See 'Notes to physician' under First-Aid Measures, Section 4 of this Safety Data Sheet.

Section 3. Composition/information on ingredients

Substance/mixture Mixture

Synthetic lubricant and additives.

Ingredient name	CAS number	%
1-Decene, homopolymer, hydrogenated	68037-01-4	≥50 - ≤75

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Check for and remove any contact lenses. Get medical attention.

Skin contact Wash skin thoroughly with soap and water or use recognized skin cleanser. Remove contaminated clothing and shoes. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention if symptoms occur.

Inhalation If inhaled, remove to fresh air. Get medical attention if symptoms occur.

Ingestion Do not induce vomiting. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Aspiration hazard if swallowed. Can enter lungs and cause damage. Get medical attention immediately.

Protection of first-aiders No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

Most important symptoms/effects, acute and delayed

See Section 11 for more detailed information on health effects and symptoms.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician Treatment should in general be symptomatic and directed to relieving any effects. Product can be aspirated on swallowing or following regurgitation of stomach contents, and can cause severe and potentially fatal chemical pneumonitis, which will require urgent treatment. Because of the risk of aspiration, induction of vomiting and gastric lavage should be avoided. Gastric lavage should be undertaken only after endotracheal intubation. Monitor for cardiac dysrhythmias.

Note: High Pressure Applications
Injections through the skin resulting from contact with the product at high pressure constitute a major medical emergency. Injuries may not appear serious at first but within a few hours tissue becomes swollen, discolored and extremely painful with extensive subcutaneous necrosis.
Surgical exploration should be undertaken without delay. Thorough and extensive debridement of the wound and underlying tissue is necessary to minimize tissue loss and prevent or limit permanent damage. Note that high pressure may force the product considerable distances along tissue planes.

Specific treatments No specific treatment.

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media In case of fire, use foam, dry chemical or carbon dioxide extinguisher or spray.

Unsuitable extinguishing media Do not use water jet.

Section 5. Fire-fighting measures

Specific hazards arising from the chemical

In a fire or if heated, a pressure increase will occur and the container may burst.

Hazardous combustion products

Combustion products may include the following:
carbon dioxide
carbon monoxide

Special protective actions for fire-fighters

Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Special protective equipment for fire-fighters

Fire-fighters should wear positive pressure self-contained breathing apparatus (SCBA) and full turnout gear.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel

No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Avoid breathing vapor or mist. Provide adequate ventilation. Put on appropriate personal protective equipment. Floors may be slippery; use care to avoid falling. Contact emergency personnel.

For emergency responders

Entry into a confined space or poorly ventilated area contaminated with vapor, mist or fume is extremely hazardous without the correct respiratory protective equipment and a safe system of work. Wear self-contained breathing apparatus. Wear a suitable chemical protective suit. Chemical resistant boots. See also the information in "For non-emergency personnel".

Environmental precautions

Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill

Stop leak if without risk. Move containers from spill area. Absorb with an inert material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Large spill

Stop leak if without risk. Move containers from spill area. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations. Contaminated absorbent material may pose the same hazard as the spilled product. Dispose of via a licensed waste disposal contractor.

Section 7. Handling and storage

Precautions for safe handling

Protective measures

Put on appropriate personal protective equipment (see Section 8). Avoid breathing vapor or mist. Avoid contact with eyes, skin and clothing. Empty containers retain product residue and can be hazardous. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Do not reuse container. Do not swallow. Aspiration hazard if swallowed. Can enter lungs and cause damage. Never siphon by mouth.

Advice on general occupational hygiene

Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Wash thoroughly after handling. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Section 7. Handling and storage

Conditions for safe storage, including any incompatibilities

Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Store locked up. Keep container tightly closed and sealed until ready for use. Store and use only in equipment/containers designed for use with this product. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

1-Decene, homopolymer, hydrogenated	None.

Appropriate engineering controls

All activities involving chemicals should be assessed for their risks to health, to ensure exposures are adequately controlled. Personal protective equipment should only be considered after other forms of control measures (e.g. engineering controls) have been suitably evaluated. Personal protective equipment should conform to appropriate standards, be suitable for use, be kept in good condition and properly maintained. Your supplier of personal protective equipment should be consulted for advice on selection and appropriate standards. For further information contact your national organisation for standards.
Provide exhaust ventilation or other engineering controls to keep the relevant airborne concentrations below their respective occupational exposure limits.
The final choice of protective equipment will depend upon a risk assessment. It is important to ensure that all items of personal protective equipment are compatible.

Environmental exposure controls

Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures

Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection

Safety glasses with side shields.

Skin protection

Hand protection

Wear protective gloves if prolonged or repeated contact is likely. Wear chemical resistant gloves. Recommended: Nitrile gloves. The correct choice of protective gloves depends upon the chemicals being handled, the conditions of work and use, and the condition of the gloves (even the best chemically resistant glove will break down after repeated chemical exposures). Most gloves provide only a short time of protection before they must be discarded and replaced. Because specific work environments and material handling practices vary, safety procedures should be developed for each intended application. Gloves should therefore be chosen in consultation with the supplier/ manufacturer and with a full assessment of the working conditions.

Body protection

Use of protective clothing is good industrial practice.
Cotton or polyester/cotton overalls will only provide protection against light superficial contamination that will not soak through to the skin. Overalls should be laundered on a regular basis. When the risk of skin exposure is high (e.g. when cleaning up spillages or if there is a risk of splashing) then chemical resistant aprons and/or impervious chemical suits and boots will be required.
Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Other skin protection

Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Section 8. Exposure controls/personal protection

Respiratory protection

In case of insufficient ventilation, wear suitable respiratory equipment.
The correct choice of respiratory protection depends upon the chemicals being handled, the conditions of work and use, and the condition of the respiratory equipment. Safety procedures should be developed for each intended application. Respiratory protection equipment should therefore be chosen in consultation with the supplier/manufacturer and with a full assessment of the working conditions.

Section 9. Physical and chemical properties

Appearance

Physical state	Liquid.
Color	Red. [Dark]
Odor	Mild.
Odor threshold	Not available.
pH	Not available.
Melting point	Not available.
Boiling point	Not available.
Flash point	Open cup: 205°C (401°F) [Cleveland.]
Pour point	-55 °C
Evaporation rate	Not available.
Flammability (solid, gas)	Not applicable. Based on - Physical state
Lower and upper explosive (flammable) limits	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Density	<1000 kg/m^3 (<1 g/cm^3) at 15°C
Solubility	insoluble in water.
Partition coefficient: n-octanol/water	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Kinematic: 14 mm^2/s (14 cSt) at 40°C

Section 10. Stability and reactivity

Reactivity	No specific test data available for this product. Refer to Conditions to avoid and Incompatible materials for additional information.
Chemical stability	The product is stable.
Possibility of hazardous reactions	Under normal conditions of storage and use, hazardous reactions will not occur. Under normal conditions of storage and use, hazardous polymerization will not occur.
Conditions to avoid	No specific data.
Incompatible materials	Reactive or incompatible with the following materials: oxidizing materials.
Hazardous decomposition products	Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Section 11. Toxicological information

Information on toxicological effects

Aspiration hazard

Name	Result
1-Decene, homopolymer, hydrogenated	ASPIRATION HAZARD - Category 1

Information on the likely routes of exposure Routes of entry anticipated: Dermal, Inhalation.

Potential acute health effects

Eye contact No known significant effects or critical hazards.

Skin contact No known significant effects or critical hazards.

Inhalation Vapor inhalation under ambient conditions is not normally a problem due to low vapor pressure.

Ingestion Aspiration hazard if swallowed -- harmful or fatal if liquid is aspirated into lungs.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact No specific data.

Skin contact Adverse symptoms may include the following:
irritation
dryness
cracking

Inhalation No specific data.

Ingestion Adverse symptoms may include the following:
nausea or vomiting

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects Not available.

Potential delayed effects Not available.

Long term exposure

Potential immediate effects Not available.

Potential delayed effects Not available.

Potential chronic health effects

General No known significant effects or critical hazards.

Carcinogenicity No known significant effects or critical hazards.

Mutagenicity No known significant effects or critical hazards.

Teratogenicity No known significant effects or critical hazards.

Developmental effects No known significant effects or critical hazards.

Fertility effects No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

No testing has been performed by the manufacturer.

Persistence and degradability

Not expected to be rapidly degradable.

Bioaccumulative potential

Not available.

Mobility in soil

Soil/water partition coefficient (K_{OC})	Not available.
Mobility	Non-volatile.Liquid.insoluble in water.

Other adverse effects No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods The generation of waste should be avoided or minimized wherever possible. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Section 14. Transport information

	DOT Classification	TDG Classification	IMDG	IATA
UN number	Not regulated.	Not regulated.	Not regulated.	Not regulated.
UN proper shipping name	-	-	-	-
Transport hazard class(es)	-	-	-	-
Packing group	-	-	-	-
Environmental hazards	No.	No.	No.	No.
Additional information	-	-	-	-

Special precautions for user Not available.

Transport in bulk according to Annex II of MARPOL and the IBC Code Not available.

Section 15. Regulatory information

U.S. Federal regulations

United States inventory (TSCA 8b) All components are listed or exempted.

TSCA 12(b) one-time export: 2,2',6,6'-tetra-tert-butyl-4,4'-methylenediphenol

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 311/312

Classification Not applicable.

SARA 313

Form R - Reporting requirements This product does not contain any hazardous ingredients at or above regulated thresholds.

Supplier notification This product does not contain any hazardous ingredients at or above regulated thresholds.

State regulations

Massachusetts None of the components are listed.

New Jersey None of the components are listed.

Pennsylvania None of the components are listed.

California Prop. 65 No products were found.

Other regulations

Australia inventory (AICS) All components are listed or exempted.

Canada inventory All components are listed or exempted.

China inventory (IECSC) All components are listed or exempted.

Japan inventory (ENCS) All components are listed or exempted.

Korea inventory (KECI) All components are listed or exempted.

Philippines inventory (PICCS) All components are listed or exempted.

Taiwan Chemical Substances Inventory (TCSI) Not determined.

REACH Status The company, as identified in Section 1, sells this product in the EU in compliance with the current requirements of REACH.

Section 16. Other information

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

History

Date of issue/Date of revision 03/27/2017.

Date of previous issue 11/22/2016.

Prepared by Product Stewardship

Key to abbreviations

ACGIH = American Conference of Industrial Hygienists
ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
CAS Number = Chemical Abstracts Service Registry Number
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container

Section 16. Other information

IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
OEL = Occupational Exposure Limit
SDS = Safety Data Sheet
STEL = Short term exposure limit
TWA = Time weighted average
UN = United Nations
UN Number = United Nations Number, a four digit number assigned by the United Nations Committee of Experts on the Transport of Dangerous Goods.
Varies = may contain one or more of the following 101316-69-2, 101316-70-5, 101316-71-6, 101316-72-7, 64741-88-4, 64741-89-5, 64741-95-3, 64741-96-4, 64741-97-5, 64742-01-4, 64742-44-5, 64742-45-6, 64742-52-5, 64742-53-6, 64742-54-7, 64742-55-8, 64742-56-9, 64742-57-0, 64742-58-1, 64742-62-7, 64742-63-8, 64742-64-9, 64742-65-0, 64742-70-7, 72623-85-9, 72623-86-0, 72623-87-1, 74869-22-0, 90669-74-2

Indicates information that has changed from previously issued version.

Notice to reader

All reasonably practicable steps have been taken to ensure this data sheet and the health, safety and environmental information contained in it is accurate as of the date specified below. No warranty or representation, express or implied is made as to the accuracy or completeness of the data and information in this data sheet.

The data and advice given apply when the product is sold for the stated application or applications. You should not use the product other than for the stated application or applications without seeking advice from BP Group.

It is the user's obligation to evaluate and use this product safely and to comply with all applicable laws and regulations. The BP Group shall not be responsible for any damage or injury resulting from use, other than the stated product use of the material, from any failure to adhere to recommendations, or from any hazards inherent in the nature of the material. Purchasers of the product for supply to a third party for use at work, have a duty to take all necessary steps to ensure that any person handling or using the product is provided with the information in this sheet. Employers have a duty to tell employees and others who may be affected of any hazards described in this sheet and of any precautions that should be taken. You can contact the BP Group to ensure that this document is the most current available. Alteration of this document is strictly prohibited.

APPENDIX VI

Model: 5130
SDS Hydraulic Fluid
Phosphate Ester

Skydrol® LD4 Fire Resistant Hydraulic Fluid

Version	Revision Date:	SDS Number:	Date of last issue: 06/02/2015
2.2	08/09/2016	150000093409	Date of first issue: 10/24/2013

SDSUS / PRD / 0001

SECTION 1. IDENTIFICATION

Product name : Skydrol® LD4 Fire Resistant Hydraulic Fluid

Product code : P3410201

Manufacturer or supplier's details

Company name of supplier : Eastman Chemical Company

Address : 200 South Wilcox Drive
Kingsport TN 37660-5280

Telephone : (423) 229-2000

Emergency telephone number : CHEMTREC: +1-800-424-9300, +1-703-527-3887 CCN7321
For emergency transportation information, in the United States: call CHEMTREC at 800-424-9300 or call 423-229-2000.

Recommended use of the chemical and restrictions on use

Recommended use : Hydraulic fluids

Restrictions on use : None known.

SECTION 2. HAZARDS IDENTIFICATION

GHS Classification

Skin irritation : Category 2

Carcinogenicity : Category 2

GHS label elements

Hazard pictograms :

Signal word : Warning

Hazard statements : H315 Causes skin irritation.
H351 Suspected of causing cancer.

Precautionary statements : **Prevention:**
P201 Obtain special instructions before use.
P202 Do not handle until all safety precautions have been read and understood.
P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/ protective clothing/ eye protection/ face protection.

Response:
P302 + P352 IF ON SKIN: Wash with plenty of soap and water.
P308 + P313 IF exposed or concerned: Get medical advice/ attention.
P332 + P313 If skin irritation occurs: Get medical advice/ attention.
P362 Take off contaminated clothing and wash before reuse.
Storage:
P405 Store locked up.
Disposal:
P501 Dispose of contents/ container to an approved waste disposal plant.

Other hazards

None known.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Components

Chemical name	CAS-No.	Concentration (% w/w)
Tributyl phosphate	126-73-8	55 - 65
Dibutylphenylphosphate	2528-36-1	20 - 30
Butyl diphenyl phosphate	2752-95-6	5 - 10
7-Oxabicyclo[4.1.0]heptane-3-carboxylic acid, 2-ethylhexyl ester	62256-00-2	< 10
butylated hydroxytoluene	128-37-0	1

SECTION 4. FIRST AID MEASURES

If inhaled : Move to fresh air.
If breathing is difficult, give oxygen.
Consult a physician if necessary.

In case of skin contact : Wash off immediately with plenty of water for at least 15 minutes.
Get medical attention if symptoms occur.
Wash contaminated clothing before reuse.

In case of eye contact : In case of contact, immediately flush eyes with plenty of water for at least 15 minutes.
Get medical attention if symptoms occur.

If swallowed : Call a physician or poison control centre immediately.
Do not induce vomiting without medical advice.
Rinse mouth.
Never give anything by mouth to an unconscious person.

Most important symptoms and effects, both acute and delayed : Causes skin irritation.
Suspected of causing cancer.

Notes to physician	:	Treat symptomatically.

SECTION 5. FIREFIGHTING MEASURES

Suitable extinguishing media	:	Water spray Carbon dioxide (CO2) Dry chemical Foam
Unsuitable extinguishing media	:	Do not use a solid water stream as it may scatter and spread fire.
Hazardous combustion products	:	carbon dioxide, carbon monoxide oxides of phosphorus
Further information	:	Use a water spray to cool fully closed containers. Do not allow run-off from fire fighting to enter drains or water courses.
Special protective equipment for firefighters	:	Wear an approved positive pressure self-contained breathing apparatus in addition to standard fire fighting gear.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures	:	Ventilate the area. Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray. Avoid contact with skin and eyes. Material can create slippery conditions. Wear appropriate personal protective equipment. Local authorities should be advised if significant spillages cannot be contained.
Environmental precautions	:	Clear up spills immediately and dispose of waste safely. Avoid release to the environment. Collect spillage.
Methods and materials for containment and cleaning up	:	Contain spillage, soak up with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and transfer to a container for disposal according to local / national regulations (see section 13).

SECTION 7. HANDLING AND STORAGE

Advice on safe handling	:	Do not breathe vapours or spray mist. Handle product only in closed system or provide appropriate exhaust ventilation at machinery. In case of insufficient ventilation, wear suitable respiratory equipment. Wear appropriate personal protective equipment. Avoid contact with skin, eyes and clothing.

Wash thoroughly after handling.
Wash contaminated clothing before reuse.
Drain or remove substance from equipment prior to break-in or maintenance.
Handle in accordance with good industrial hygiene and safety practice.

Conditions for safe storage : Store locked up.
Keep container tightly closed in a dry and well-ventilated place.
Keep in a cool place away from oxidizing agents.

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

Components	CAS-No.	Value type (Form of exposure)	Control parameters / Permissible concentration	Basis
Tributyl phosphate	126-73-8	TWA (Inhalable fraction and vapor)	5 mg/m3	ACGIH
		TWA	0.2 ppm 2.5 mg/m3	NIOSH REL
		TWA	5 mg/m3	OSHA Z-1
		TWA	0.2 ppm 2.5 mg/m3	OSHA P0
Dibutylphenylphosphate	2528-36-1	TWA	0.3 ppm	ACGIH
butylated hydroxytoluene	128-37-0	TWA (Inhalable fraction and vapor)	2 mg/m3	ACGIH
		TWA	10 mg/m3	NIOSH REL
		TWA	10 mg/m3	OSHA P0

Hazardous components without workplace control parameters

Components	CAS-No.
7-Oxabicyclo[4.1.0]heptane-3-carboxylic acid, 2-ethylhexyl ester	62256-00-2

Engineering measures : Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level.

Personal protective equipment

Respiratory protection : Use a properly fitted, particulate filter respirator complying with an approved standard if a risk assessment indicates this is necessary.

Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable.
If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn.

Hand protection

Remarks : Wear suitable gloves. Please observe the instructions regarding permeability and breakthrough time which are provided by the supplier of the gloves. Also take into consideration the specific local conditions under which the product is used, such as the danger of cuts, abrasion, and the contact time. After contamination with product change the gloves immediately and dispose of them according to relevant national and local regulations.

Eye protection : Wear safety glasses with side shields (or goggles).

Skin and body protection : Wear suitable protective clothing.

Protective measures : Ensure that eye flushing systems and safety showers are located close to the working place.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	oily
Colour	:	purple
Odour	:	odourless
pH	:	No data available
Melting point/range	:	< -62 °C
Flash point	:	160 °C Method: Cleveland open cup
Vapour pressure	:	0.27 hPa (25 °C)
Relative density	:	1.004 - 1.014 (25 °C)
Viscosity		
Viscosity, kinematic	:	< 2000 mm2/s (-54 °C)
		11.15 mm2/s (38 °C)
		3.83 mm2/s (99 °C)

SECTION 10. STABILITY AND REACTIVITY

Reactivity	:	None reasonably foreseeable.
Chemical stability	:	Stable under normal conditions.
Possibility of hazardous reactions	:	None known.
Conditions to avoid	:	None known.
Incompatible materials	:	Strong oxidizing agents
Hazardous decomposition products	:	Emits acrid smoke and fumes when heated to decomposition.

SECTION 11. TOXICOLOGICAL INFORMATION

Acute toxicity

Not classified based on available information.

Product:

Acute oral toxicity	:	LD50 (Rat, Male and Female): 2,100 mg/kg
Acute inhalation toxicity	:	LC50 (Rat, male): > 5.8 mg/l Exposure time: 4 h Test atmosphere: dust/mist Assessment: The substance or mixture has no acute inhalation toxicity Remarks: (highest concentration tested)
Acute dermal toxicity	:	LD50 Dermal (Rabbit, Male and Female): > 3,160 mg/kg Assessment: The substance or mixture has no acute dermal toxicity

Components:

Tributyl phosphate:

Acute oral toxicity	:	LD50 Oral (Rat, Male and Female): 1,553 mg/kg Method: Acute Oral Toxicity Assessment: Harmful if swallowed.
Acute inhalation toxicity	:	LC50 (Rat, Male and Female): > 4.242 mg/l Exposure time: 4 h Test atmosphere: dust/mist Assessment: The substance or mixture has no acute inhalation toxicity
Acute dermal toxicity	:	LD50 Dermal (Rabbit, Male and Female): > 3,100 mg/kg Assessment: The substance or mixture has no acute dermal toxicity

Dibutylphenylphosphate:

Acute oral toxicity : Acute toxicity estimate (Rat, Male and Female): 2,400 - 3,000 mg/kg
Assessment: Not classified

Acute inhalation toxicity : LCLo (Rat, Male and Female): > 5 mg/l
Exposure time: 4 h
Test atmosphere: dust/mist

LC50 (Rat, Male and Female): > 5 mg/l
Exposure time: 4 h
Test atmosphere: dust/mist
Assessment: Not classified

Acute dermal toxicity : LD50 Dermal (Rabbit, Male and Female): > 5,000 mg/kg
Assessment: Not classified

7-Oxabicyclo[4.1.0]heptane-3-carboxylic acid, 2-ethylhexyl ester:
Acute oral toxicity : LD50 Oral (Rat, Male and Female): 4,470 mg/kg

Acute dermal toxicity : LD50 Dermal (Rabbit, Male and Female): > 7,940 mg/kg

butylated hydroxytoluene:
Acute oral toxicity : LD50 Oral (Rat): > 6,000 mg/kg

Acute dermal toxicity : LD50 Dermal (Guinea pig): > 20,000 mg/kg

Skin corrosion/irritation

Causes skin irritation.

Product:

Species: Rabbit
Exposure time: 24 h
Assessment: irritating
Result: moderate irritation

Components:

Tributyl phosphate:
Species: Rabbit
Exposure time: 4 h
Assessment: Causes skin irritation.
Method: Acute Dermal Irritation / Corrosion
Result: irritating

Dibutylphenylphosphate:
Species: Rabbit
Assessment: Not classified

Species: Humans
Exposure time: 24 h
Assessment: Not classified

7-Oxabicyclo[4.1.0]heptane-3-carboxylic acid, 2-ethylhexyl ester:
Species: Rabbit

Exposure time: 24 h
Assessment: Not classified as hazardous.
Result: slight to moderate irritation

butylated hydroxytoluene:
Species: Rabbit
Exposure time: 24 h
Result: very slight

Serious eye damage/eye irritation

Not classified based on available information.

Product:

Species: Rabbit
Result: slight
Exposure time: 24 h
Assessment: Not classified

Components:

Tributyl phosphate:
Species: Rabbit
Result: slight irritation
Exposure time: 24 h
Assessment: Not classified
Method: Acute Eye Irritation / Corrosion

Dibutylphenylphosphate:
Species: Rabbit
Result: slight
Assessment: Not classified

7-Oxabicyclo[4.1.0]heptane-3-carboxylic acid, 2-ethylhexyl ester:
Species: Rabbit
Result: slight irritation
Exposure time: 24 h
Assessment: Not classified

butylated hydroxytoluene:
Species: Rabbit
Result: none

Respiratory or skin sensitisation

Skin sensitisation: Not classified based on available information.
Respiratory sensitisation: Not classified based on available information.

Product:

Test Type: Human experience
Assessment: Not classified
Method: Human Repeat Insult Patch Test
Result: Does not cause skin sensitisation.

Components:

Tributyl phosphate:
Test Type: Skin Sensitization
Species: Guinea pig
Assessment: Not classified
Result: Does not cause skin sensitisation.

Test Type: Skin Sensitization
Species: Humans
Assessment: Not classified
Result: Does not cause skin sensitisation.

Dibutylphenylphosphate:
Test Type: Human experience
Species: Humans
Assessment: Not classified
Result: non-sensitizing

7-Oxabicyclo[4.1.0]heptane-3-carboxylic acid, 2-ethylhexyl ester:
Test Type: Skin Sensitization
Species: Guinea pig
Result: May cause sensitisation by skin contact.

butylated hydroxytoluene:
Test Type: Skin sensitisation
Species: Guinea pig
Result: non-sensitizing

Germ cell mutagenicity

Not classified based on available information.

Product:

Genotoxicity in vitro	:	Test Type: Salmonella typhimurium assay (Ames test) Metabolic activation: +/- activation Result: negative
	:	Test Type: Mutagenicity - Mammalian Metabolic activation: +/- activation Method: In vitro Mammalian Chromosome Aberration Test Result: negative

Components:

Tributyl phosphate:

Genotoxicity in vitro	:	Test Type: Mutagenicity - Bacterial Metabolic activation: +/- activation Method: Bacterial Reverse Mutation Assay Result: negative
	:	Test Type: Mutagenicity - Mammalian Metabolic activation: +/- activation Method: In vitro Mammalian Chromosome Aberration Test Result: equivocal
Genotoxicity in vivo	:	Species: Rat (Male and Female)

Application Route: oral: gavage
Method: Mammalian Bone Marrow Chromosome Aberration Test
Result: negative

Dibutylphenylphosphate:

Genotoxicity in vitro : Test Type: Salmonella typhimurium assay (Ames test)
Metabolic activation: +/- activation
Method: Bacterial Reverse Mutation Assay
Result: negative

: Test Type: Mutagenicity - Mammalian
Metabolic activation: +/- activation
Method: In vitro Mammalian Cell Gene Mutation Test
Result: negative

: Test Type: Chromosome aberration test in vitro
Metabolic activation: +/- activation
Method: In vitro Mammalian Chromosome Aberration Test
Result: negative

: Test Type: Mutagenicity - Mammalian
Metabolic activation: - activation
Method: Genetic Toxicology: DNA Damage and Repair, Unscheduled DNA Synthesis in Mammalian Cells In Vitro
Result: negative

Genotoxicity in vivo : Species: Rat (Male and Female)
Application Route: intraperitoneal injection
Result: negative

7-Oxabicyclo[4.1.0]heptane-3-carboxylic acid, 2-ethylhexyl ester:

Genotoxicity in vitro : Test Type: Salmonella typhimurium assay (Ames test)
Metabolic activation: +/- activation
Method: Bacterial Reverse Mutation Assay
Result: negative

: Test Type: Mutagenicity - Mammalian
Metabolic activation: +/- activation
Method: In vitro Mammalian Chromosome Aberration Test
Result: equivocal

: Test Type: Mutagenicity - Mammalian
Metabolic activation: +/- activation
Method: In vitro Mammalian Cell Gene Mutation Test
Result: negative

Genotoxicity in vivo : Species: Rat (Male and Female)
Application Route: intraperitoneal injection
Method: Mammalian Bone Marrow Chromosome Aberration Test
Result: equivocal

Carcinogenicity

Suspected of causing cancer.

Components:

Tributyl phosphate:
Species: Rat, (Male and Female)
Application Route: Ingestion
Method: EPA OTS 798.3300
Remarks: Limited evidence of a carcinogenic effect.
May cause cancer.

IARC	No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
OSHA	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.
NTP	No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

Reproductive toxicity

Not classified based on available information.

Components:

Tributyl phosphate:

Effects on fertility	:	Test Type: Two Generation Reproductive Toxicity Study Species: Rat Sex: Male and Female Application Route: Ingestion NOAEL: 225 mg/kg, Method: EPA OTS 798.4900
Effects on foetal development	:	Species: Rat Application Route: Oral 750 mg/kg Method: EPA OTS 798.4900

Dibutylphenylphosphate:

Effects on fertility	:	Species: Rat Sex: Male and Female Application Route: Ingestion NOAEL: 5 mg/l, F1: Lowest observed adverse effect level 50 mg/kg, F2: Lowest observed adverse effect level 50 mg/kg, Method: EPA OTS 798.4900
Effects on foetal development	:	Species: Rat Application Route: oral (gavage)

300 mg/kg
3 mg/kg

STOT - single exposure

Not classified based on available information.

Components:

Tributyl phosphate:
Assessment: Based on available data, the classification criteria are not met.

Dibutylphenylphosphate:
Assessment: Not classified

STOT - repeated exposure

Not classified based on available information.

Components:

Tributyl phosphate:
Assessment: Based on available data, the classification criteria are not met.

Dibutylphenylphosphate:
Exposure routes: inhalation (dust/mist/fume)
Target Organs: Respiratory system
Assessment: Not classified

Repeated dose toxicity

Product:

Species: Rat, Male and Female
NOAEL: 40 mg/m3
Application Route: Inhalation
Exposure time: 28 days
Target Organs: Blood, Respiratory system
Remarks: Irritating to eyes and respiratory system.

Components:

Tributyl phosphate:
Species: Mouse, Male and Female
NOEL: 75 mg/kg
Application Route: in feed
Exposure time: 90 days

Dibutylphenylphosphate:
Species: Rat, Male and Female
NOAEL: 5 mg/kg
LOAEL: 50 mg/kg
Application Route: oral (feed)
Exposure time: 90 days

Species: Rat, Male and Female
NOAEC: 5 mg/m3
Application Route: Inhalation

Exposure time: 90 days

Species: Rabbit, Male and Female
No observed adverse effect level: 100 mg/kg bw/day
Application Route: Dermal Study
Exposure time: 21 d

Aspiration toxicity

Not classified based on available information.

Product:

Not applicable

Components:

7-Oxabicyclo[4.1.0]heptane-3-carboxylic acid, 2-ethylhexyl ester:
Not applicable

Experience with human exposure

Product:

Inhalation	:	Remarks: None known.
Skin contact	:	Remarks: Causes skin irritation.
Eye contact	:	Remarks: Contact with the eyes may be very painful but does not cause damage.
Ingestion	:	Remarks: None known.

SECTION 12. ECOLOGICAL INFORMATION

Ecotoxicity

Product:

Toxicity to fish	:	LC50 (Oncorhynchus mykiss (rainbow trout)): 5.2 mg/l Exposure time: 96 h
Toxicity to daphnia and other aquatic invertebrates	:	LC50 (Daphnia magna (Water flea)): 5.8 mg/l Exposure time: 48 h
Toxicity to algae	:	EC50 (Selenastrum capricornutum (green algae)): 8.2 mg/l Exposure time: 96 h

Components:

Tributyl phosphate:

Toxicity to fish	:	LC50 (Oncorhynchus mykiss (rainbow trout)): 4.2 mg/l Exposure time: 96 h
Toxicity to daphnia and other	:	EC50 (Daphnia magna (Water flea)): 1.8 mg/l

aquatic invertebrates		Exposure time: 48 h
Toxicity to algae	:	EC50 (Desmodesmus subspicatus (Scenedesmus subspicatus)): 1.1 mg/l Exposure time: 72 h
Toxicity to fish (Chronic toxicity)	:	NOEC (Oncorhynchus mykiss (rainbow trout)): 0.82 mg/l Exposure time: 95 d 1.7 mg/l
Toxicity to daphnia and other aquatic invertebrates (Chronic toxicity)	:	NOEC (Daphnia magna (Water flea)): 1.3 mg/l Exposure time: 21 d

Dibutylphenylphosphate:

Toxicity to fish	:	LL50 (Cyprinus carpio (Carp)): 1.8 mg/l Exposure time: 96 h
Toxicity to daphnia and other aquatic invertebrates	:	EC50 (Daphnia magna (Water flea)): 1.4 mg/l Exposure time: 48 h
Toxicity to algae	:	EL50 (Selenastrum capricornutum (green algae)): 9.6 mg/l Exposure time: 72 h Method: EL50 method of the water accommodated fraction (W.A.F.) NOELR (Selenastrum capricornutum (green algae)): 3.5 mg/l Exposure time: 72 h Method: EL50 method of the water accommodated fraction (W.A.F.)
Toxicity to fish (Chronic toxicity)	:	NOEC (Oncorhynchus mykiss (rainbow trout)): > 0.11 mg/l Exposure time: 60 d
Toxicity to daphnia and other aquatic invertebrates (Chronic toxicity)	:	NOEC (Daphnia magna (Water flea)): 0.106 mg/l Exposure time: 21 d

butylated hydroxytoluene:

Toxicity to fish	:	LC50 (Fish): 0.199 mg/l Exposure time: 96 h
Toxicity to daphnia and other aquatic invertebrates	:	EC50 (Daphnia (water flea)): 0.48 mg/l Exposure time: 48 h
Toxicity to algae	:	EC50 (Chlorella pyrenoidosa (aglae)): 0.758 mg/l Exposure time: 96 h

Persistence and degradability

Product:

Biochemical Oxygen Demand (BOD)	:	Remarks: not determined

Chemical Oxygen Demand (COD) : Remarks: not determined

Components:

Tributyl phosphate:

Biodegradability : Result: Readily biodegradable

Dibutylphenylphosphate:

Biodegradability : Method: Ready Biodegradability: Manometric Respirometry Test
Remarks: Readily biodegradable

Method: Ready Biodegradability: Modified MITI Test (I)
Remarks: Not readily biodegradable.

7-Oxabicyclo[4.1.0]heptane-3-carboxylic acid, 2-ethylhexyl ester:

Biodegradability : Concentration: 100 mg/l
Method: Ready Biodegradability: Modified MITI Test (I)
Remarks: Readily biodegradable

Bioaccumulative potential

Components:

Tributyl phosphate:

Bioaccumulation : Species: Cyprinus carpio (Carp)
Bioconcentration factor (BCF): 20
Exposure time: 56 d
Method: OECD Test Guideline 305

Bioconcentration factor (BCF): 35
Exposure time: 38 d

Partition coefficient: n-octanol/water : Pow: 10,100

Dibutylphenylphosphate:

Bioaccumulation : Species: Cyprinus carpio (Carp)
Bioconcentration factor (BCF): 35
Method: OECD Test Guideline 305

Mobility in soil

No data available

Other adverse effects

Product:

Ozone-Depletion Potential :

Regulation: 40 CFR Protection of Environment; Part 82 Protection of Stratospheric Ozone - CAA Section 602 Class I Substances

Remarks: This product neither contains, nor was manufactured with a Class I or Class II ODS as defined by the U.S. Clean Air Act Section 602 (40 CFR 82, Subpt. A, App.A + B).

SECTION 13. DISPOSAL CONSIDERATIONS

Disposal methods

Waste from residues : This product meets the criteria for a synthetic used oil under the U.S. EPA Standards for the Management of Used Oil (40 CFR 279). Those standards govern recycling and disposal in lieu of 40 CFR 260 -272 of the Federal hazardous waste program in states that have adopted these used oil regulations. Consult your attorney or appropriate regulatory official to be sure these standards have been adopted in your state. Recycle or burn in accordance with the applicable standards. Dispose of in accordance with local regulations.

SECTION 14. TRANSPORT INFORMATION

International Regulation

IATA-DGR
Not regulated as a dangerous good

IMDG-Code
Not regulated as a dangerous good

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code
Not applicable for product as supplied.

National Regulations

49 CFR
Not regulated as a dangerous good

SECTION 15. REGULATORY INFORMATION

EPCRA - Emergency Planning and Community Right-to-Know Act

SARA 311/312 Hazards : Acute Health Hazard
Chronic Health Hazard

SARA 302 : No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 : This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

Clean Air Act

This product neither contains, nor was manufactured with a Class I or Class II ODS as defined by the U.S. Clean Air Act Section 602 (40 CFR 82, Subpt. A, App.A + B).
This product does not contain any hazardous air pollutants (HAP), as defined by the U.S. Clean Air Act Section 112 (40 CFR 61).
This product does not contain any chemicals listed under the U.S. Clean Air Act Section 112(r) for Accidental Release Prevention (40 CFR 68.130, Subpart F).
This product does not contain any chemicals listed under the U.S. Clean Air Act Section 111 SOCMI Intermediate or Final VOC's (40 CFR 60.489).

Clean Water Act

This product does not contain any Hazardous Substances listed under the U.S. CleanWater Act, Section 311, Table 116.4A.
This product does not contain any Hazardous Chemicals listed under the U.S. CleanWater Act, Section 311, Table 117.3.
This product does not contain any toxic pollutants listed under the U.S. Clean Water Act Section 307

The components of this product are reported in the following inventories:

DSL	:	All components of this product are on the Canadian DSL
AICS	:	On the inventory, or in compliance with the inventory
ENCS	:	On the inventory, or in compliance with the inventory
KECI	:	Not listed
PICCS	:	Not listed
IECSC	:	On the inventory, or in compliance with the inventory
TSCA	:	On TSCA Inventory

TSCA list

No substances are subject to a Significant New Use Rule.

No substances are subject to TSCA 12(b) export notification requirements.

SECTION 16. OTHER INFORMATION

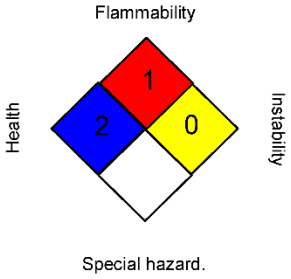
Full text of other abbreviations

AICS - Australian Inventory of Chemical Substances; ASTM - American Society for the Testing of Materials; bw - Body weight; CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act; CMR - Carcinogen, Mutagen or Reproductive Toxicant; DIN - Standard of the German Institute for Standardisation; DOT - Department of Transportation; DSL - Domestic Substances List (Canada); ECx - Concentration associated with x% response; EHS - Extremely Hazardous Substance; ELx - Loading rate associated with x% response; EmS - Emergency Schedule; ENCS - Existing and New Chemical Substances (Japan); ErCx - Concentration associated with x% growth rate response; ERG - Emergency Response Guide; GHS - Globally Harmonized System; GLP - Good Laboratory Practice; HMIS - Hazardous Materials Identification System; IARC - International Agency for Research on Cancer; IATA - International Air Transport

Association; IBC - International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk; IC50 - Half maximal inhibitory concentration; ICAO - International Civil Aviation Organization; IECSC - Inventory of Existing Chemical Substances in China; IMDG - International Maritime Dangerous Goods; IMO - International Maritime Organization; ISHL - Industrial Safety and Health Law (Japan); ISO - International Organisation for Standardization; KECI - Korea Existing Chemicals Inventory; LC50 - Lethal Concentration to 50 % of a test population; LD50 - Lethal Dose to 50% of a test population (Median Lethal Dose); MARPOL - International Convention for the Prevention of Pollution from Ships; MSHA - Mine Safety and Health Administration; n.o.s. - Not Otherwise Specified; NFPA - National Fire Protection Association; NO(A)EC - No Observed (Adverse) Effect Concentration; NO(A)EL - No Observed (Adverse) Effect Level; NOELR - No Observable Effect Loading Rate; NTP - National Toxicology Program; NZIoC - New Zealand Inventory of Chemicals; OECD - Organization for Economic Co-operation and Development; OPPTS - Office of Chemical Safety and Pollution Prevention; PBT - Persistent, Bioaccumulative and Toxic substance; PICCS - Philippines Inventory of Chemicals and Chemical Substances; (Q)SAR - (Quantitative) Structure Activity Relationship; RCRA - Resource Conservation and Recovery Act; REACH - Regulation (EC) No 1907/2006 of the European Parliament and of the Council concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals; RQ - Reportable Quantity; SADT - Self-Accelerating Decomposition Temperature; SARA - Superfund Amendments and Reauthorization Act; SDS - Safety Data Sheet; TCSI - Taiwan Chemical Substance Inventory; TSCA - Toxic Substances Control Act (United States); UN - United Nations; UNRTDG - United Nations Recommendations on the Transport of Dangerous Goods; vPvB - Very Persistent and Very Bioaccumulative

Further information

NFPA:



HMIS III:

HEALTH	2*
FLAMMABILITY	1
PHYSICAL HAZARD	0

0 = not significant, 1 =Slight,
2 = Moderate, 3 = High
4 = Extreme, * = Chronic

Sources of key data used to compile the Safety Data Sheet	:	www.EastmanAviationSolutions.com
Revision Date	:	08/09/2016

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

US / EN

APPENDIX VII

Model: 5140
SDS Hydraulic Fluid
MIL-PRF-87257

SAFETY DATA SHEET

Section 1. Identification

Product name Brayco Micronic 881

SDS # 459667

Historic SDS #: 27020

Code 459667-US03

Relevant identified uses of the substance or mixture and uses advised against

Product use Hydraulic fluid
For specific application advice see appropriate Technical Data Sheet or consult our company representative.

Supplier

Castrol Industrial North America, Inc.
150 W. Warrenville Road
Naperville, IL 60563
Product Information: +1-877-641-1600

BP Lubricants USA Inc.
1500 Valley Road
Wayne, NJ 07470
Telephone: (973) 633-2200

EMERGENCY SPILL INFORMATION: 1 (800) 424-9300 CHEMTREC (USA)

Section 2. Hazards identification

OSHA/HCS status This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture ASPIRATION HAZARD - Category 1

GHS label elements

Hazard pictograms

Signal word Danger

Hazard statements May be fatal if swallowed and enters airways.

Precautionary statements

Prevention Not applicable.

Response IF SWALLOWED: Immediately call a POISON CENTER or physician. Do NOT induce vomiting.

Storage Store locked up.

Disposal Dispose of contents and container in accordance with all local, regional, national and international regulations.

Hazards not otherwise classified Defatting to the skin.
Note: High Pressure Applications
Injections through the skin resulting from contact with the product at high pressure constitute a major medical emergency.
See 'Notes to physician' under First-Aid Measures, Section 4 of this Safety Data Sheet.

Section 3. Composition/information on ingredients

Substance/mixture Mixture

Synthetic base stock. Proprietary performance additives.

Ingredient name	CAS number	%
Dec-1-ene, dimers, hydrogenated	68649-11-6	≥25 - ≤50
1-Decene, homopolymer, hydrogenated	68037-01-4	≥10 - ≤25

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Check for and remove any contact lenses. Get medical attention.

Skin contact Wash skin thoroughly with soap and water or use recognized skin cleanser. Remove contaminated clothing and shoes. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention if symptoms occur.

Inhalation If inhaled, remove to fresh air. Get medical attention if symptoms occur.

Ingestion Do not induce vomiting. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Aspiration hazard if swallowed. Can enter lungs and cause damage. Get medical attention immediately.

Protection of first-aiders No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

Most important symptoms/effects, acute and delayed

See Section 11 for more detailed information on health effects and symptoms.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician Treatment should in general be symptomatic and directed to relieving any effects. Product can be aspirated on swallowing or following regurgitation of stomach contents, and can cause severe and potentially fatal chemical pneumonitis, which will require urgent treatment. Because of the risk of aspiration, induction of vomiting and gastric lavage should be avoided. Gastric lavage should be undertaken only after endotracheal intubation. Monitor for cardiac dysrhythmias.

Note: High Pressure Applications
Injections through the skin resulting from contact with the product at high pressure constitute a major medical emergency. Injuries may not appear serious at first but within a few hours tissue becomes swollen, discolored and extremely painful with extensive subcutaneous necrosis.
Surgical exploration should be undertaken without delay. Thorough and extensive debridement of the wound and underlying tissue is necessary to minimize tissue loss and prevent or limit permanent damage. Note that high pressure may force the product considerable distances along tissue planes.

Specific treatments No specific treatment.

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media
In case of fire, use foam, dry chemical or carbon dioxide extinguisher or spray.

Unsuitable extinguishing media
Do not use water jet.

Specific hazards arising from the chemical
In a fire or if heated, a pressure increase will occur and the container may burst.

Hazardous combustion products
Combustion products may include the following:
carbon dioxide
carbon monoxide

Special protective actions for fire-fighters
Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Special protective equipment for fire-fighters
Fire-fighters should wear positive pressure self-contained breathing apparatus (SCBA) and full turnout gear.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel
No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Avoid breathing vapor or mist. Provide adequate ventilation. Put on appropriate personal protective equipment. Floors may be slippery; use care to avoid falling. Contact emergency personnel.

For emergency responders
Entry into a confined space or poorly ventilated area contaminated with vapor, mist or fume is extremely hazardous without the correct respiratory protective equipment and a safe system of work. Wear self-contained breathing apparatus. Wear a suitable chemical protective suit. Chemical resistant boots. See also the information in "For non-emergency personnel".

Environmental precautions
Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill
Stop leak if without risk. Move containers from spill area. Absorb with an inert material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Large spill
Stop leak if without risk. Move containers from spill area. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations. Contaminated absorbent material may pose the same hazard as the spilled product. Dispose of via a licensed waste disposal contractor.

Section 7. Handling and storage

Precautions for safe handling

Protective measures
Put on appropriate personal protective equipment (see Section 8). Avoid breathing vapor or mist. Avoid contact with eyes, skin and clothing. Empty containers retain product residue and can be hazardous. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Do not reuse container. Do not swallow. Aspiration hazard if swallowed. Can enter lungs and cause damage. Never siphon by mouth.

Section 7. Handling and storage

Advice on general occupational hygiene

Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Wash thoroughly after handling. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities

Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Store locked up. Keep container tightly closed and sealed until ready for use. Store and use only in equipment/containers designed for use with this product. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Dec-1-ene, dimers, hydrogenated	None.
1-Decene, homopolymer, hydrogenated	None.

Appropriate engineering controls

All activities involving chemicals should be assessed for their risks to health, to ensure exposures are adequately controlled. Personal protective equipment should only be considered after other forms of control measures (e.g. engineering controls) have been suitably evaluated. Personal protective equipment should conform to appropriate standards, be suitable for use, be kept in good condition and properly maintained.
Your supplier of personal protective equipment should be consulted for advice on selection and appropriate standards. For further information contact your national organisation for standards.
Provide exhaust ventilation or other engineering controls to keep the relevant airborne concentrations below their respective occupational exposure limits.
The final choice of protective equipment will depend upon a risk assessment. It is important to ensure that all items of personal protective equipment are compatible.

Environmental exposure controls

Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures

Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period.
Appropriate techniques should be used to remove potentially contaminated clothing.
Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection

Safety glasses with side shields.

Skin protection

Hand protection

Wear protective gloves if prolonged or repeated contact is likely. Wear chemical resistant gloves. Recommended: Nitrile gloves. The correct choice of protective gloves depends upon the chemicals being handled, the conditions of work and use, and the condition of the gloves (even the best chemically resistant glove will break down after repeated chemical exposures). Most gloves provide only a short time of protection before they must be discarded and replaced. Because specific work environments and material handling practices vary, safety procedures should be developed for each intended application. Gloves should therefore be chosen in consultation with the supplier/ manufacturer and with a full assessment of the working conditions.

Section 8. Exposure controls/personal protection

Body protection
Use of protective clothing is good industrial practice.
Cotton or polyester/cotton overalls will only provide protection against light superficial contamination that will not soak through to the skin. Overalls should be laundered on a regular basis. When the risk of skin exposure is high (e.g. when cleaning up spillages or if there is a risk of splashing) then chemical resistant aprons and/or impervious chemical suits and boots will be required.
Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Other skin protection
Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection
In case of insufficient ventilation, wear suitable respiratory equipment.
The correct choice of respiratory protection depends upon the chemicals being handled, the conditions of work and use, and the condition of the respiratory equipment. Safety procedures should be developed for each intended application. Respiratory protection equipment should therefore be chosen in consultation with the supplier/manufacturer and with a full assessment of the working conditions.

Section 9. Physical and chemical properties

Appearance

Physical state Liquid.

Color Red. [Dark]

Odor Mild.

Odor threshold Not available.

pH Not available.

Melting point Not available.

Boiling point Not available.

Flash point Open cup: 172°C (341.6°F) [Cleveland.]

Pour point -66 °C

Evaporation rate Not available.

Flammability (solid, gas) Not applicable. Based on - Physical state

Lower and upper explosive (flammable) limits Not available.

Vapor pressure Not available.

Vapor density Not available.

Density <1000 kg/m^3 (<1 g/cm^3) at 15.6°C

Solubility insoluble in water.

Partition coefficient: n-octanol/water Not available.

Auto-ignition temperature Not available.

Decomposition temperature Not available.

Viscosity Kinematic: 7 mm^2/s (7 cSt) at 40°C

Section 10. Stability and reactivity

Reactivity
No specific test data available for this product. Refer to Conditions to avoid and Incompatible materials for additional information.

Chemical stability
The product is stable.

Possibility of hazardous reactions
Under normal conditions of storage and use, hazardous reactions will not occur.
Under normal conditions of storage and use, hazardous polymerization will not occur.

Conditions to avoid
No specific data.

Section 10. Stability and reactivity

Incompatible materials Reactive or incompatible with the following materials: oxidizing materials.

Hazardous decomposition products Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Section 11. Toxicological information

Information on toxicological effects

Aspiration hazard

Name	Result
Dec-1-ene, dimers, hydrogenated	ASPIRATION HAZARD - Category 1
1-Decene, homopolymer, hydrogenated	ASPIRATION HAZARD - Category 1

Information on the likely routes of exposure Routes of entry anticipated: Dermal, Inhalation.

Potential acute health effects

Eye contact No known significant effects or critical hazards.

Skin contact No known significant effects or critical hazards.

Inhalation Vapor inhalation under ambient conditions is not normally a problem due to low vapor pressure.

Ingestion Aspiration hazard if swallowed -- harmful or fatal if liquid is aspirated into lungs.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact No specific data.

Skin contact Adverse symptoms may include the following:
irritation
dryness
cracking

Inhalation No specific data.

Ingestion Adverse symptoms may include the following:
nausea or vomiting

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects Not available.

Potential delayed effects Not available.

Long term exposure

Potential immediate effects Not available.

Potential delayed effects Not available.

Potential chronic health effects

General No known significant effects or critical hazards.

Carcinogenicity No known significant effects or critical hazards.

Mutagenicity No known significant effects or critical hazards.

Teratogenicity No known significant effects or critical hazards.

Developmental effects No known significant effects or critical hazards.

Fertility effects No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Section 11. Toxicological information

Route	ATE value
Inhalation (vapors)	22.48 mg/l

Section 12. Ecological information

Toxicity

No testing has been performed by the manufacturer.

Persistence and degradability

Not expected to be rapidly degradable.

Bioaccumulative potential

Not available.

Mobility in soil

Soil/water partition coefficient (K_{OC}) Not available.

Mobility Non-volatile. Liquid. insoluble in water.

Other adverse effects No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods The generation of waste should be avoided or minimized wherever possible. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Section 14. Transport information

	DOT Classification	TDG Classification	IMDG	IATA
UN number	Not regulated.	Not regulated.	Not regulated.	Not regulated.
UN proper shipping name	-	-	-	-
Transport hazard class(es)	-	-	-	-
Packing group	-	-	-	-
Environmental hazards	No.	No.	No.	No.

Section 14. Transport information

Additional information	-	-	-	-

Special precautions for user Not available.

Transport in bulk according to Annex II of MARPOL and the IBC Code Not available.

Section 15. Regulatory information

U.S. Federal regulations

United States inventory (TSCA 8b) All components are listed or exempted.

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 311/312

Classification Not applicable.

SARA 313

Form R - Reporting requirements This product does not contain any hazardous ingredients at or above regulated thresholds.

Supplier notification This product does not contain any hazardous ingredients at or above regulated thresholds.

State regulations

Massachusetts None of the components are listed.

New Jersey None of the components are listed.

Pennsylvania None of the components are listed.

California Prop. 65 No products were found.

Other regulations

Australia inventory (AICS) All components are listed or exempted.

Canada inventory All components are listed or exempted.

China inventory (IECSC) All components are listed or exempted.

Japan inventory (ENCS) All components are listed or exempted.

Korea inventory (KECI) All components are listed or exempted.

Philippines inventory (PICCS) All components are listed or exempted.

Taiwan Chemical Substances Inventory (TCSI) Not determined.

REACH Status The company, as identified in Section 1, sells this product in the EU in compliance with the current requirements of REACH.

Section 16. Other information

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

History

06/22/2017.

Section 16. Other information

Date of issue/Date of revision	
Date of previous issue	02/02/2017.
Prepared by	Product Stewardship
Key to abbreviations	ACGIH = American Conference of Industrial Hygienists ATE = Acute Toxicity Estimate BCF = Bioconcentration Factor CAS Number = Chemical Abstracts Service Registry Number GHS = Globally Harmonized System of Classification and Labelling of Chemicals IATA = International Air Transport Association IBC = Intermediate Bulk Container IMDG = International Maritime Dangerous Goods LogPow = logarithm of the octanol/water partition coefficient MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution) OEL = Occupational Exposure Limit SDS = Safety Data Sheet STEL = Short term exposure limit TWA = Time weighted average UN = United Nations UN Number = United Nations Number, a four digit number assigned by the United Nations Committee of Experts on the Transport of Dangerous Goods. Varies = may contain one or more of the following 101316-69-2, 101316-70-5, 101316-71-6, 101316-72-7, 64741-88-4, 64741-89-5, 64741-95-3, 64741-96-4, 64741-97-5, 64742-01-4, 64742-44-5, 64742-45-6, 64742-52-5, 64742-53-6, 64742-54-7, 64742-55-8, 64742-56-9, 64742-57-0, 64742-58-1, 64742-62-7, 64742-63-8, 64742-64-9, 64742-65-0, 64742-70-7, 72623-85-9, 72623-86-0, 72623-87-1, 74869-22-0, 90669-74-2

Indicates information that has changed from previously issued version.

Notice to reader

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