ALAMO INDUSTRIAL

MAVERICK

BOOM ARM MOWER

Published 12/04

Part No. 02982288

SERVICE MANUAL

ATTENCIÓN!

LEA EL INSTRUCTIVO

Si No Lee Ingles, Pida Ayuda a Alguien Que Si Lo Lea Para Que le Traduzca las Medidas de Seguridad.

An Operator's Manual was shipped with the equipment in the Manual Canister. This Operator's Manual is an integral part of the safe operation of this machine and must be maintained with the unit at all times. READ, UNDERSTAND, and FOLLOW the Safety and Operation Instructions contained in this manual before operating the equipment. If the Operator's Manual is not with the equipment, contact your dealer or Alamo Industrial (830-379-1480) to obtain a Free copy before operating the equipment.

ALAMO INDUSTRIAL

1502 E. Walnut
Seguin, Texas 78155
830-379-1480

MEMBER OF THE ALAMO GROUP
ALWAYS ON THE CUTTING EDGE

TO THE OWNER/OPERATOR/DEALER

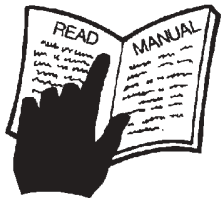
All implements with moving parts are potentially hazardous. There is no substitute for a cautious, safe-minded operator who recognizes the potential hazards and follows reasonable safety practices. The manufacturer has designed this implement to be used with all its safety equipment properly attached to minimize the chance of accidents.

BEFORE YOU START!! Read the safety messages on the implement and shown in your manual. Observe the rules of safety and common sense!

DANGER

FAILING TO FOLLOW SAFETY MESSAGES AND OPERATING INSTURCTIONS CAN CAUSE SERIOUS BODILY INJURY OR EVEN DEATH TO OPERATOR AND OTHERS IN THE AREA.

1.



2. NO RIDERS, NO CHILDREN OPERATORS

3. USE SAFETY SHOES, HARD HAT, SAFETY GLASSES, SEAT BELTS, & ROPS

4. BLOCK UP SECURELY BEFORE WORKING UNDER.

1. Study and understand Operator's Manuals, Safety Signs, and Instructional Decals for tractor & flail mower to prevent misuse, abuse, & accidents. Practice before operating mower in a confined area or near passersby.

- Learn how to stop engine suddenly in an emergency. Be alert for passersby and especially children.

2. Allow no children on or near implement or tractor. Allow no riders on tractor or implement. Falling off can cause serious injury or death from being runover by tractor or mower or contact with Flail Mower Blades.

3. Operate only with tractor having Roll-Over Protective Structure (ROPS) and with seatbelt fastened securely and snugly to prevent injury and possible death from falling off or tractor overturn. Personal Protective Equipment such as Hard Hat, Safety Glasses, Safety Shoes, and Ear Plugs are recommended.

4. Block up or support raised machine and all lifted components securely before putting hands or feet under or working underneath any lifted component to prevent crushing injury or death from sudden dropping or inadvertent operation of controls. Make certain that area is clear before lowering or folding.

5. Before transporting, put Lift Lever in detent or full-lift position. Install Transport Safety Devices securely on folding implements. Slow down when turning and on hillsides.

- Install **Restrictor in folding circuit to slow down lowering and unfolding if action is faster than is desirable.

6. Make certain that SMV sign, Warning Lights, and Reflectors are clearly visible. Follow local traffic codes.

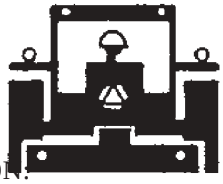
7. Never operate with Flail Mower or Folding Section raised if passersby, bystanders or traffic are in the area to reduce possibility of injury or death form objects thrown by Blades under Shields or implement structure.

8. Before dismounting, secure flail mower in transport position or lower to ground.

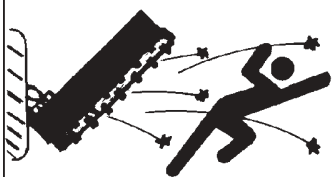
- Put tractor in park or set brake, disengage PTO, stop engine, remove key, and wait until noise of rotation has ceased to prevent entanglement in rotating parts which may cause injury or death.
- Never mount or dismount a moving vehicle. Crushing from runover may cause injury or death.

5. TRANSPORT SAFELY, LOCK UP.

6. USE SMV, LIGHTS, & REFLECTORS.



7. DO NOT OPERATE WITH MOWER OR WING RAISED.



8. DO NOT MOUNT OR DISMOUNT WHILE MOVING.

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WARRANTY INFORMATION:

Read and understand the complete Warranty Statement found in this Manual. Fill out the Warranty Registration Form in full and return it within 30 Days. Make certain the Serial Number of the Machine is recorded on the Warranty Card and on the Warranty Form that you retain. The use of "will-fit" parts will void your warranty and can cause catastrophic failure with possible injury or death.

INTRODUCTION

ABOUT THIS MANUAL:

The intent of this publications to provide the competent technician with the information necessary to perform the CORRECT repairs to the Alamo Industrial Product. This will, in turn provide for complete customer satisfaction

It is hoped that the information contained in this and other Manuals will provide enough detail to eliminate the need for contact of the Alamo Industrial Technical Service Dept. However, it should be understood that many instances may arrive wherein correspondence with the Manufacturer is necessary.

CONTACTING MANUFACTURER: (Please help us Help You! Before You Call!)

Alamo Industrial Service Staff Members are dedicated to helping you solve yours or your customer's service problem as quickly and efficiently as possible. Unfortunately, we receive entirely to many calls with only a minimum amount of information. In some cases, the correspondent has never gone out to look at the equipment and merely calls inquiring of the problems described to him by the operator or customer.

PART NUMBERS: Part numbers listed in this manual are subject to change without notice as designs are made to adapter to the tractor or for a design improvement. Before ordering parts ALWAYS Measure old part to make certain that is the one you will need. This manual is designed to be used along with the Parts and Operators Manual.

Most calls received by Alamo Industrial Service can be classified into approx. 6 general categories.

1. Hydraulic or Mechanical Trouble Shooting.
2. Request for Technical Information or Specifications.
3. Mounting or Fitting Problem.
4. Special Service Problem.
5. Equipment Application Problems.
6. Tractor Problem Inquiries.

HOW YOU CAN HELP:

Make sure the call is necessary! Most of the calls received may not be necessary if the Dealer Service Technician would do the following.

1. Check the Service Information at your Dealership provided by Alamo Industrial, This would include, Service Bulletins, Information Bulletins, Parts Manuals, Operators Manuals or Service Manuals, many of these are available via the Alamo Industrial Internet site (Alamo - Industrial. Com). Attempt to diagnose or repair problem before calling.

2. If a call to Alamo Industrial is needed, Certain Information should be available and ready for the Alamo Industrial Service Staff. Such information as, Machine Model, Serial Number, Your Dealer Name, Your Account Number and Any other information that will be useful. This information is vital for the development of a prompt and correct solution to the problem. This will also help to develop a database of problems and related solutions, which will expedite a solution to future problems of a similar nature.

3. The technician may be asked to provide detailed information about the problem including the results of any required trouble shooting techniques. If the information is not available, The technician may be asked to get the information and call back. Most recommendations for repairs will be based on the procedures listed in the Service Manual / Trouble Shooting Guide.

CONTACT ALAMO INDUSTRIAL:

Alamo Industrial, 1502 E. Walnut St. Seguin TX. 78155,
Technical Service Dept. PH: 830-379-1480

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Section 1

Model Specifications Maverick Boom 24' & 30'

READ THIS BEFORE BEGINNING ASSEMBLY, REPAIRS OR TESTING:

The Maverick has computerized electronics. The electronic components can be damaged if care is not taken when performing repairs, testing and/or during assembly.

DO NOT

1. **DO NOT** short any wires across or allow them to be shorted out.

2. **DO NOT** attempt to jump across any wires or supply them with alternate power source.

3. **DO NOT** install higher rated fuses than are recommended by manufacturer.

4. **DO NOT** do any welding on unit unless the computer modules are unplugged first, this is to prevent a power surge going into modules (THIS IS VERY IMPORTANT). This could also apply to the tractor components. Check Tractors repair guide for specific instruction about tractor model and type.

5. **DO NOT** attempt to repair or adjust a component that is not intended to be repaired, example sealed components as there are no serviceable components inside.

6. **DO NOT** let anyone attempt any testing or repairs unless they are an experienced and qualified technician. Technicians must have proper tools, gauges, meters etc. to perform proper diagnosis and/or repairs.

7. **DO NOT** perform any repairs with dirty tools or in dirty area. When working on hydraulic components keeping system clean and free of contamination is important.

8. **DO NOT** start or engage system if the oil level is not at the proper level or condition. Never start or run unit low or out of oil.

9. **DO NOT** install / add any oil unless you know it is the correct type and the container is clean. Make certain the oil is not contaminated with dirt or any liquid.

SPECIFICATIONS - MAVERICK

1. CUTTING CIRCUIT SPECIFICATIONS

Hyd. Pump Speed (Front Aux Pump)	1950 RPM
Hyd. Motor Speed	1220 RPM
Hyd. Motor Rated HP	199 HP
Hyd. Motor Rotation (as viewed f/ Top of the Deck)	CW (Clockwise)
Relief Valve Setting At Motor	4000 PSI
Relief Valve Setting At Pump	4500 PSI
Hyd. Pump Flow (Front Pump @ 1950 RPM)	25.3 GPM
Hyd. Oil Operating Temperature @ 100° F Ambient	155 - 165 ° F.
Hyd. Oil Filtration, (Discharge f/ Charge Pump)	10 Micron
Hyd. Tank Capacity	17-1/2 Gal.
Hyd. Motor Start Stop Time (Approximate)	6 Seconds
Cutting Diameter, (Rotary Head)	58 Inch
Spindle	4.5 " by 9" Heat Treated Alloy
Blade Bar Type	Stacked 3 Leaf
Blade Bar Size	1-1/4" Thick X 5" Wide (Ea. Leaf)
Blade Bar Material.... Bottom Leaf	T1 Steel
Middle & Top Leaf	HRFB Steel
Blade Swing	360 Deg Swing
Blade Material	High Carbon Alloy Steel
Cutter Weight. (Approximate w/ Rotary Head)	950 lbs.
Cutter Deck Opening & Closing	Hyd. Operated Door
Recommended Hydraulic Oil	ISO AW 100 Hyd. Oil
Fluid Cleanliness level	ISO 16/14/11

2. BOOM SPECIFICATIONS

Boom Reach 24 Foot Boom	Out 24'
Boom Reach 30 Foot Boom	Out 30'
Frame	Manufactured Box Sections
Pins	Chrome Plated Alloy
Bushings	Greasable
Weight, 24' Boom	1250 lbs.
Weight, 30' Boom	1450 lbs
Boom Rest	Tractor Axle Mounted
Boom Mounting	ROPS or CAB Tractor Optional

3. FILTRATION

Control Valve Functions: Control functions include All Hydraulic Cylinders used to manipulate the Maverick Boom. The boom and frame cylinders are powered by a self contained hydraulic system. The pump is loctated on the front of the tractor. There is an in-line pressure filter (P/N 02981371) between the closed center load sense pump and cylinder control valve. There is a return filter (P/N 02981391) mounted to the tank that filters the fluid returning from the control valve to the tank. Filter change recommended for every 200 to 250 hours. An electronic monitoring system monitors element back pressure for indication of clogged filter prior to element change.

Mower Head Functions: Mower Head Functions are operated by Pump, which is mounted to the front of the Tractor Engine. This will have an in-line Filter installed into hydraulic circuit, This filter should be changed on a regular maintenance schedule. Filter are rated by Micron size (10 Micron), Filters should be replaced with original Alamo Industrial Replacement Filters to make certain the correct rated filter element is installed at all times. (Pressure Filter is P/N 02968922 and Return Filter Replacement Element is P/N 02968923)

4. HYDROSTATIC PUMP SPEC'S

Cutter Head Pump Circuit Spec's:

Pump Type..... Piston Type
Pump Speed (Front Engine Mounted).....Run Engine to 540 PTO Speed
Relief Setting at the Pump.....4500 PSI
Pump Flow (Front Engine Operating Speed).....25.3 GPM

Boom Cylinder Pump Circuit Spe'c's:

Pump Type..... Piston Type
Pump Speed..... 1800 RPM
Pump Flow (Front Engine Operating Speed).....15.6 GPM
Low Pressure Standby.....250 PSI
High Pressure Comp.....3000 PSI
Horse Power at 1850 RPM (Engine Speed)..... 28.5 HP

5. HYDRAULIC HOSE CODES

Hydraulic Hose Band Mark Color Codes:

Hose's and/or fittings are marked with a Color Coded Plastic Band around it. Some Bands are a solid Color and some have a Colored with a Stripe. The purpose of the colored bands are to provide a quick reference for hose and port connection. A metal band is also attachted to the hose, on that band is an Alamo Industrial Part Number for reference if needing a replacement hose. **Always Check Hose Size, Color Code & Part Number**

Boom Cylinder Circuit Hoses:

Color Tie	(Code)	Hose Size	Hyd. Function
Green	G	SAE # 6	Swing, Back (Rod End)
Green / White	G/W	SAE # 6	Swing, Forward (Base End)
Orange	OR	SAE # 6	Lift, Down (Rod End)
Orange / White	OR/W	SAE # 6	Lift, Up (Base End)
Blue	B	SAE # 6	Dipper, In (Rod End)
Blue / White	B/W	SAE # 6	Dipper, Out (Base End)
Yellow	Y	SAE # 6	Telescope, In (Rod End)
Yellow / White	Y/W	SAE # 6	Telescope, Out (Base End)
Red	R	SAE # 6	Head Tilt, Up (Rod End)
Red / White	R/W	SAE # 6	Head Tilt, Down (Base End)
Green	G	SAE # 4	Swivel, CW (Rod End)
Green / White	G/W	SAE # 4	Swivel, CCW (Base End)
Yellow	Y	SAE # 4	Door, Open (Rod End)
Yellow / White	Y/W	SAE # 4	Door, Closed (Base End)

Motor Circuit Hoses:

Color Tie	(Code)	Hose Size	Hyd. Function
Red	R	SAE # 16	Pressure Flow to Motor
Orange	OR	SAE # 16	Return Flow From Motor
Blue	B	SAE # 8	Case Flow From Motor to Boom
Blue	B	SAE # 12	Case Flow at Boom to Tank

6. HYDRAULIC CYLINDER PRESSURE RATES:

Cylinder Type..... Welded Cylinders
Cylinder Working Pressure..... 3000 PSI

Hydraulic Cylnder Repair Specs:

Cylinder Part No.	Cylinder Function	Piston Nut Torque ft. lbs.	Gland Torque ft. lbs.	Seal Kit Part No.
02981275	Swing	400-500	80-120 (Head)	02982066
02981278	Lift (30 ft.)	400-500	80-120 (Head)	02982069
02981279	Lift (24 ft.)	400-500	80-120 (Head)	02982070
02981277	Dipper	400-500	80-120 (Head)	02982068
02981280	Tilt	400-500	80-120 (Head)	02982071
02961480A	Door (Rotary)	150-250	80-120 (Head)	02975528
02970710A	Door (Flail Axe)	40-60	80-120 (Head)	02975532
02971423	Slide (Timber Cat)	400-500	50-60 (Tie Rod)	02973505
02811000A	Door (Ditcher)	150-250	80-120 (Head)	02975528
02981316	Stabilizer	40-60	80-120 (Head)	02982073
02981315	Swivel (Rotary)	300-400	80-120 (Head)	02982072
02981276	Extension	300-400	80-120 (Head)	02982067

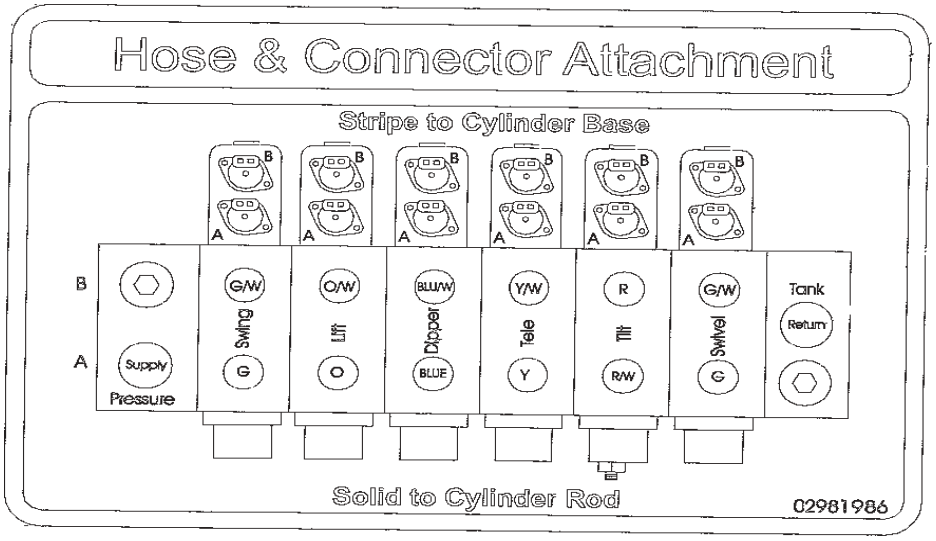
7. VALVE SPECIFICATIONS

Valve Type: Multi-Section, Load Sense, Pressure Compensated, Directional control Valve. Features electro-hydraulic spool actuators for proportional characteristics.

Valve Construction: Multi-Section, Individual Spool, with electro-hydraulic solenoids. Tie rod bolt together type.

Valve Controller: Mechanical over Electric. 3-axis, multi-function, lever-type joystick.

Valve Porting and Hose Connections: Hoses connect to valve as shown by color code. See Decal P/N 02981986 below, Electrical connections connect as shown, Reference label on connector and corresponding solenoid.



8. Valve Spool Functions & Spec's (Boom Feature):

Main Relief at Inlet 3335 psi

Valve Spool Functions & Specs:

Band Color	Spool No.	Cyl. Function	Travel Direction	Port	Work Port Relief	Pressure Rating
G/W	1	Swing	Forward	B	3045 psi.	2.0
G	1	Swing	Back	A	3045 psi.	2.0
OR	2	Lift	Down	B	1160 psi.	7.92
OR/W	2	Lift	Up	A	Plug	7.92
B/W	3	Dipper	Out	B	Plug	3.17
B	3	Dipper	In	A	1160 psi.	3.17
Y/W	4	Telescope	Out	B	2030 psi	3.17
Y	4	Telescope	In	A	Plug	3.17
R/W	5	Tilt	Up	A	Plug	3.17
R	5	Tilt	Down	B	2030 psi	3.17
G	6	Swivel	CW (top)	A	2755 psi	6.60
G/W	6	Swivel	CCW (top)	B	2755 psi	6.60

Valve Spool Functions & Specs:

The Cylinder Cycle has adjustable settings, slow, medium and fast, Time Cylinder cycle of unit, Time indicates the time for the Cylinder to travel the full amount of its extension or retraction. The lift times up and down are taken with the dipper fully extended and begin with the Deck flat on the ground. All Cycle times are measured at the rated Tractor RPM. Test Times should vary as according to the setting being used.

Valve Leakage:

Maximum internal Valve Leakage from the Cylinder. Ports to Tank at any Valve Segment, Oil Pressure at 1450 PSI and Oil Viscosity at 102 SSU = 1.25 Cubic Inch / Minute

Standby (Pilot) Pressure:

Standby (Pilot) Pressure = 200 to 250 PSI.

9. HOSE END FITTING TORQUE SPECS:

Hose End Type: 37 Degree Angle End Steel Hose End Fittings*

Dash Size	Nominal Cyl. Size (in.)	Torque in. lbs.	Torque ft .lbs.
-4	1/4"	140	12
-6	3/8"	230	19
-8	1/2"	450	38
-10	5/8"	650	54
-12	3/4"	900	75
-16	1"	1200	100
-20	1-1/4"	1600	133
-24	1-1/2"	2000	167
-32	2"	2800	233

* Straight Threads do not always seal better when higher torques are used. Too much torque causes distortion and may lead to leakage. DO NOT over torque fittings and DO NOT allow any contaminants to enter system through fittings when installing them.

10. Special Torque Specifications (Rotary Heads)

Motor to Spindle Housing..... 100 ft. lbs.
Spindle to Deck..... 425 ft. lbs.
Spindle to Adjusting Nut (Bearing Preload).....25 in. lbs. Rolling Torque
Blade Bar Leaf Bolts (1-1/4" Bolts)..... 2000 ft. lbs.
Blade Bar to Spindle Bolts..... 400 ft. lbs.
Blade Bolts..... 400 ft. lbs.
Motor Plate..... See Set Up Instructions

11. TORQUE VALUES - BOLTS: Recommended Torque, Ft. lbs. & (Nm)

IMPORTANT! Listed below IS BOLT TORQUE and NOT APPLICATION TORQUE, Component Application Torque will vary depending on what is bolted down and the type material (Metal) that is being bolted together. Thread condition and lubrication will vary Torque settings.

Inch Sizes

Bolt Dia. inch	2 (B) Plain Head	5 (D) 3 Dashes	8 (F) 6 Dashes
1/4	Not Used	10 (14)	14 (19)
5/16	Not Used	20 (27)	30 (41)
3/8	Not Used	35 (47)	50 (68)
7/16	35 (47)	55 (75)	80 (108)
1/2	55 (75)	85 (115)	120 (163)
9/16	75 (102)	130 (176)	175 (230)
5/8	105 (142)	170 (230)	240 (325)
3/4	185 (251)	300 (407)	425 (576)
7/8	160 (217)	445 (603)	685 (929)
1	250 (339)	670 (908)	1030 (1396)
1-1/8	330 (447)	910 (1234)	1460 (1979)
1-1/4	480 (651)	1250 (1695)	2060 (2793)

ALWAYS CHECK MARKINGS ON TOP OF BOLT HEAD OR OTHER BOLT DESCRIP-TIONS

Metric Sizes

Bolt Dia. mm	4.8	8.8	10.9
6	5	7	12
8	11	20	25
10	20	40	58
12	37	70	105
14	60	100	140
16	92	155	200
18	118	216	280
20	160	270	355
22	215	330	430
24	285	500	700
27	450	875	1000
30	600	1200	1700
33	800	1600	2300
36	900	2100	3000

NOTES

Section 2

VALVE OPERATION & HOSE ROUTING 24' & 30' BOOM

CONTROL VALVE - BOOM & MOTOR CONTROL

Maverick Boom and Motor Control Circuits:

It is advised that this section be read before proceeding with any repairs or test, with the display and electronics used in this application the system will test many components for you. This is done by following the prompts on the display screen.

Visually check all hose connections to make sure valve and cylinders are connected correctly. This section will deal with the control valve and hose routing, valve function and operation. As this is a Elctro-Hydraulic unit there are two section to deal with the controls. Electric section and the valve section. These two sections are closely linked together making it necessary to check both section together. See section 2 & 3 for these test,

DO NOT pressure wash this system, while the components are sealed the soaps, acid and high water pressure used in the pressure washer can damage these seals and cause moisture to enter system causing damage.

DO NOT do any welding around these electronic components, If welding is required in a repair the electronic components MUST be disconnected (unplugged). Un plug all components, Joystick, Modules, Displays and any other electronic component. If not unplugged the current from the welded can cause serious damage to electronic components.

Additional repair and diagnostic procedures for the electrical system is available on the internet web site of the manufacture of this system at: **REFERENCE PRODUCT MANUAL FOR MDM DISPLAY. THIS MANUAL IS AVAILABLE FROM THE MANUFACTURER ON THE INTERNET AT www.iqan.com viewable and printable with ADOBE ACROBAT READER. If you do not have Adobe Acrobat Reader it can be obtained at www.adobe.com.** Make certain that the instructions you refer to is for the MDM system, the manufacturer has more than one system.

The boom and motor control is electronic over hydraulics. If these functions are not properly set or working properly the mower can not be operated. Also make certain that all fluid levels are OK and with in operating limits.

The first thing that should be checked is the main (electrical) power supply to the system, this can be checked on the display unit when power is on (See Electronic Control Section).

The set-up portion as shown in the next pages should be checked to make certain the joystick and motor functions are set correctly. Check all the connections if not operating properly. If the settings are not correct the system will not function properly.

Check the emergency stop (E-Stop) switch if it is in the off position the system will not operate and the system cannot be set properly.

Never short across any of these components as the type electronics used can be seriously damaged. Always use a volt / ohm meter to test any circuits.

GENERAL INFORMATION: Load Sensing Valve

Load Sensing Principles

The “Load sensing” (Closed Centered) principle is just that, a hydraulic relationship between components that sense the power required to overcome or sustain a load. It is commonly used with a variable displacement pump. The load sensing feature will control the fluid delivery from the pump to the valve.

The goal of the system is to reduce wasted energy, wear, and tear from continuously pumping fluid under pressure when there is no demand on the system.

How It works

A communication line between the pump and the valve transmits a pressure reading between the pump and cylinder control valve. When the operator demands boom movement the corresponding valve-spool is shifted, there is then a fluctuation in pressure of that corresponding cylinder line.

If a pressure increase is seen (lifting load) in a cylinder work port (at the valve) that pressure increase (flow demand) is communicated to the pump. If the pressure raises above the low pressure stand by of the pump (200-250 PSI) the pump will supply flow to the valve to overcome the high pressure, low flow situation.

That flow is then delivered to the valve via the pump, and sent to the cylinder work ports and into the cylinder that is requiring flow thus moving the cylinder and lifting the load. As the lifting load reaches it’s designated stopping point, the operator demand is released and the valve-spool centered back in neutral. The work port pressure is no longer transmitted through the valve & pump communication line so the pump decreases the flow, and rests back at low-pressure stand by until further flow demand is required.

The Maverick hydraulic system is identical to this principle, the following sections will outline each of the three main components, and their responsibility to the control system as a whole.

DIRECTIONAL CONTROL VALVE

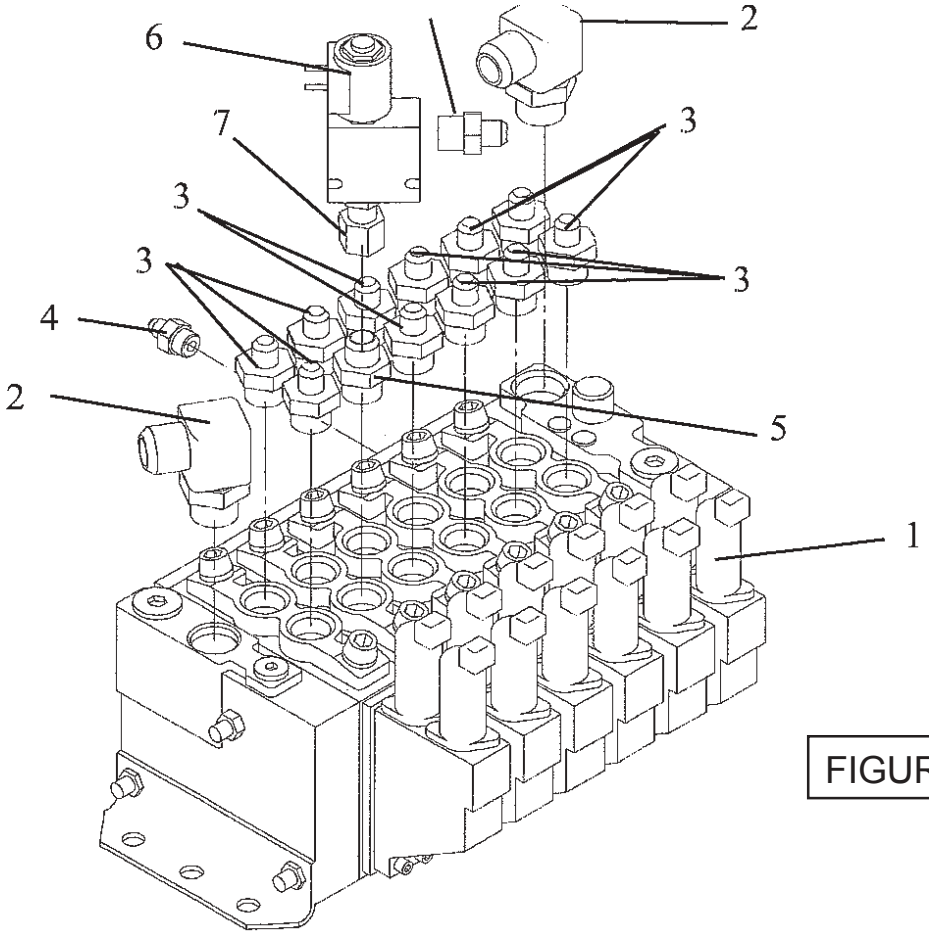
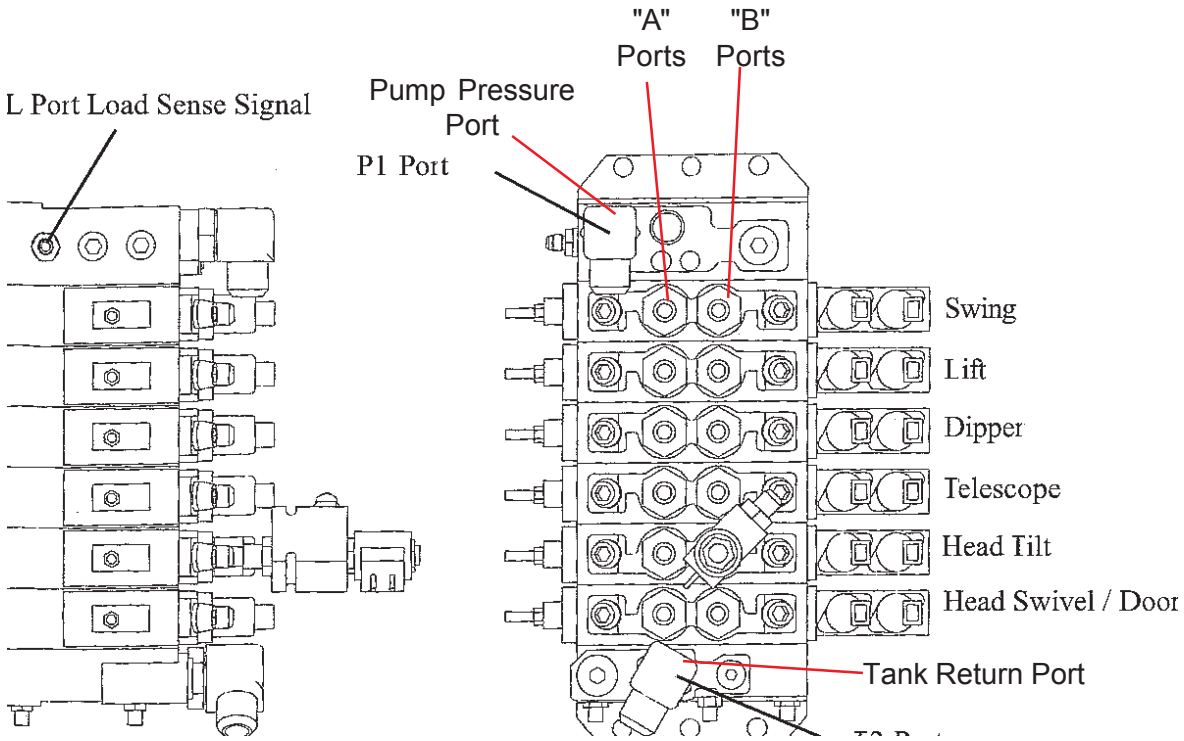


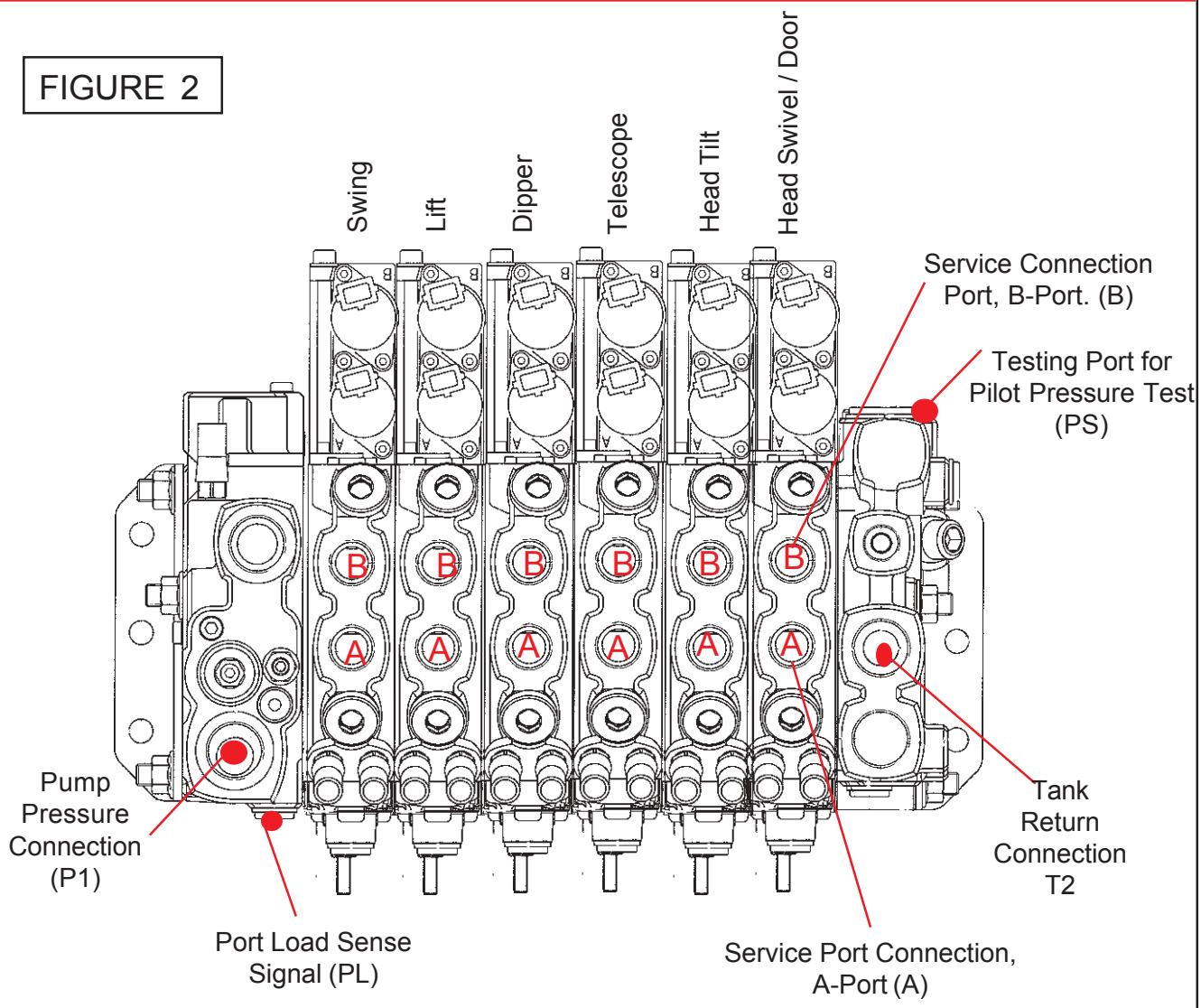
FIGURE 1



DIRECTIONAL CONTROL VALVE

Item	Part No.	Qty	Description
	02981888	**--**	**Valve & Fittings Asy, 6 Spool**
1	02981370	1	Valve Asy w/o Fittings
2	02090800	2	Adapter Hyd, Elbow 12MB - 12MJ 90°
3	02972177	11	Adapter Hyd, Straight 10MB - 6MJ
4	03200284	1	Adapter Hyd, Straight 6MB - 4MJ
5	02981889	1	Adapter Hyd, Straight 10MB - 6MJ
6	02972208	1	Valve Solenoid Asy
7	02975438	1	Adapter Hyd, Straight 8MB - 8FJX
8	02981890	1	Adapter Hyd, Straight 8MB - 6MJ

FIGURE 2



HYDRAULIC FUNCTIONS:

The Hydraulic Functions of the Machete Boom Mower are controlled by a Pilot operated Electrically Actuated Control Valve.

GENERAL OPERATION:

This Section addresses the method of operation of the electrical part of controls. The function of the Hydraulic Valve itself will be covered in another Section. Four Functions, The Lift, The Dipper, Swing and Telescope are "Proportional" meaning that the Speed of operation can be slowed down or Sped up according to the position of the Joystick Control. The Door, Tilt and Swivel Functions are "On" or "Off" only, Meaning that their speed of operation is dependent upon the volume of Oil Flowing through the Circuit and cannot be controlled by the Joystick position. In Our application the Oil Volume varies with the Tractor Engine Speed.

SPECIFIC OPERATION: (Figure 3)

The Electrical Power to operate the Circuits is obtained from a Switched and Fused Tractor Voltage Source. This means that the Electrical Power Wire to the Harness should only be connected to a Wire that has Voltage when the ignition is in the "On" Position. If Connection of the Harness is to a constant current source it will cause power drain on Battery and eventually Battery Failure. Furthermore the Master Switch on the Display Console must be in the "On" position to allow for the operation of any of the Control Functions. To achieve Electrical Proportional Actuation, The main Spool Position is adjusted so that it corresponds to an Electrical signal sent from the Joystick Controller. The Position of the Joystick is Electrically sensed by a Potentiometer located in the Joystick Assembly which sends the positioning information to the electric controller. The Signal from the Joystick is converted by the electronic Controller into Hydraulic Pressure by activating a series of Hydraulic Valves. These Valves direct the Standby or Pilot Pressure Oil to the proper end of the Spool to cause it to move. This Signal is registered by the electronic controller which will activate the series of valves as needed to move the spool in either direction until the spool is positioned in accordance with the location of the Joystick. An equilibrium between the Joystick and feedback signal is the end result.

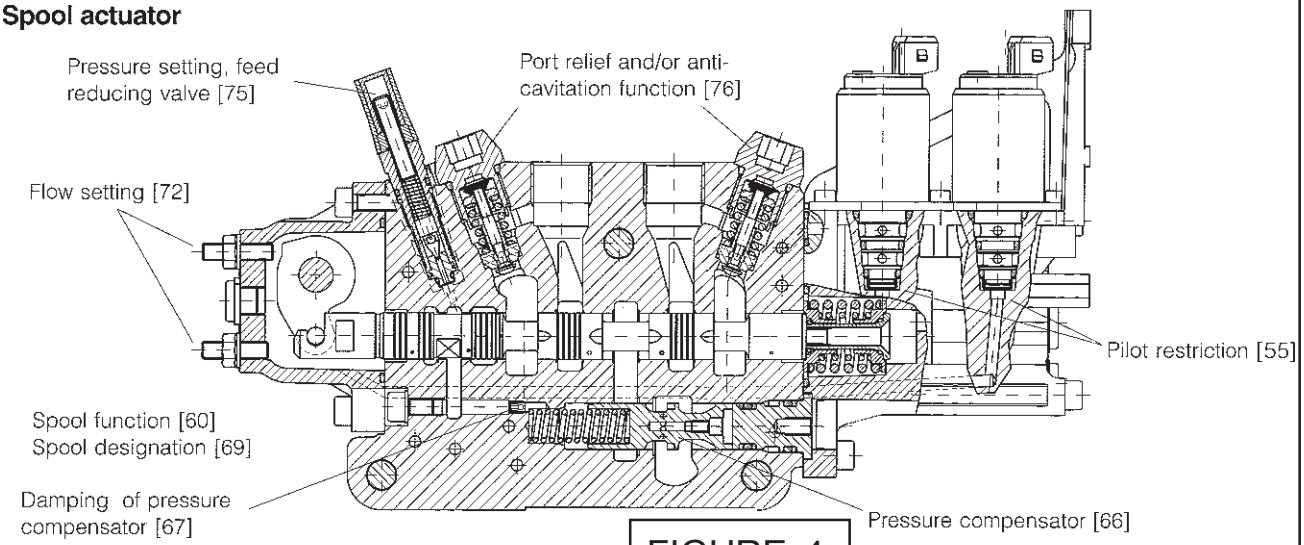


FIGURE 4

CONTROL VALVE COMPONENTS: Valve Section Components

Each of the Valve Sections contains the following Components.

1. Segment Compensating Spool
2. Anti-Cavitation Check / Work Port Relief Valve
3. Manual Over Ride Control
4. Mechanical Flow Limiters
5. Main Flow Control Spool
6. Shuttle valve

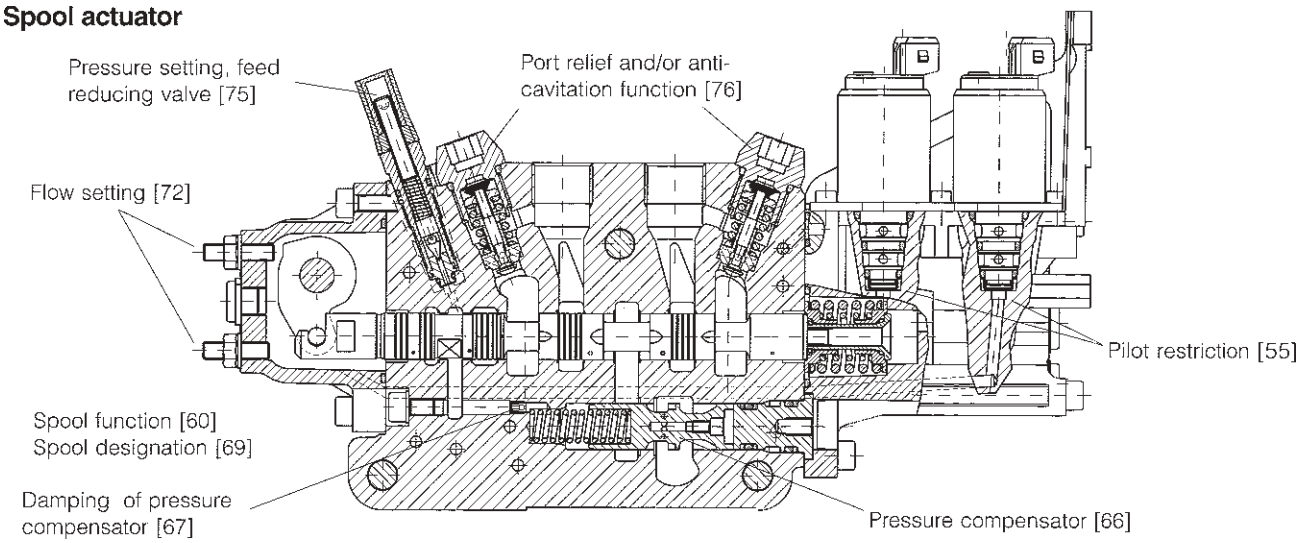


FIGURE 7

SEGMENT COMPENSATING SPOOL, Pressurized Oil must pass by the segment Pressure Compensating Spool before it is used by the Cylinders. The Compensating Spool uses Load Sense and Spring Pressure to maintain constant pressure drop across the Main spool, Both when the Load changes and when a Segment with a higher load pressure is activated.

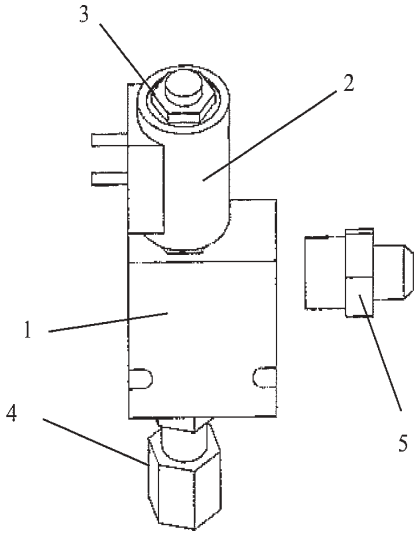
Anti-Cavitation Check / Work Port Relief Valves, Work Port Relief Valves are installed in the Swing, Lift and Dipper Circuits to limit the max pressure in those particular circuits to a lower pressure than the Main System Relief. The Anti-Cavitation Check Valve allows Oil to be taken from the return (Tank "T" Port) galley of the Valve when needed to prevent Cavitation of Cylinder. The Tilt and Door Valve Sections do not contain these valves.

Main Flow Control Spools, The Flow Control Spools work in conjunction with the Valve Body to direct the flow of Oil to the Cylinders. The spool is actuated by Pilot Oil Pressure, which is controlled by the Proportional Control System. It can also be Mechanically operated with the use of an external Lever or Wrench. Spools cannot be interchanged in the Valve Section due to the special individual designs of Spools. Maximum Stroke Adjusters are pre-set at the factory and will not need Adjusting.

Load Sense Shuttle Valve, The Load Sense Shuttle Valve located in each Section insures that the Load Sense Signal from the Valve Section with the highest Pressure is sent through the Load sense Line.

HYDRAULIC LOCK VALVE: (Head Tilt Function)

An Electric Solenoid Operated Hydraulic Lock Valve (Figure 5) is incorporated in the Head Tilt Function to prevent excessive (Head Lift Cylinder) leak down during storage or transportation. The Solenoid which operates this valve is normally in the Locked position until Head Lowering function is actuated at Joystick. When Joystick is actuated to lower Head an electric signal is sent to solenoid to open Lock valve. When the function to raise the Head is activated there is no electric signal from Joystick. The pressure against the valve when head is being raised will force Valve open like a relief Valve allowing Oil to pass through it. If this valve will not open it could stop head from lifting or dropping. The valve is plumbed into the Hydraulic Circuitry of the Head Tilt Function and is located near the Control Valve.



Hydraulic Lock Valve

Item	Part No.	Qty.	Description
	02972208	--	Solenoid Valve Asy
1	02971425	1	Seal Kit, f/ solenoid Valve
2	02975198	1	Coil, 12V- DC w/Dual 8-32NF Studs
3	02975199	1	Cartridge, Solenoid Valve
4	02975438	1	Adapter Hyd, Straight 8MB-6FJX
5	02981890	1	Adapter Hyd, Straight 5MB - 6MJ

FIGURE 5

ELECTRIC SIGNALS:

Electrical Signals are sent to the Controllers etc. through a Wiring Harness, The Harness is supplied with a one way connectors at the Joystick (So it can not be installed Wrong). Connectors are supplied for each electric valve controller connection. The Plug will only fit together one way and should always have right connections. BUT if the terminals within this Plug are moved around or the connections at the valve end are changed then the Plug would still be connected the same way and be Wrong. If any connections are removed they MUST be placed back in the same order they came out of. See Wireing schematic on the following pages S for Plug Connection (Letter Code) & Terminal locations,

See Figure Schematic for actual Wire locations.

DO NOT CHANGE LOCATIONS OF PINS AND/OR WIRES IN PLUGS, THEY MUST BE CONNECTEDTHE SAME WHEN REPLACED OR THE SYSTEM WILL MALFUNCTION AND THIS COULD ALSO DAMAGE JOYSTICK CONTROLLER COMPONENTS.

DOOR / SWING CYL DIVERTER VALVE - P/N 02977622

Diverter Valve.:

The Diverter valve is a electrical operated valve that allows the hydraulic pressure to be shared to operate two (or more if valves are stacked) funtions with a single pressure supply. This valve is strictly a diverter valve and is designed to direct the pressure, not regulate the flow or pressure.

The Port openings on this diverter valve are marked with letter number codes which show wich port is connected to which hose and where that hose connect on other end (See Figure 18)

Port	Function & Connection
P1	Hose Hydraulic Pressure from Door / Swivel (B) Port on Control Valve
P2	Hose Hydraulic Return to Door / Swivel (A) Port on Control Valve
C1	Hose to Head Swivel Cylinder Base End
C2	Hose to Door Cylinder Base End
C3	Hose to Door Cylinder Rod End
C4	Hose to Head Swivel Cylinder Rod End

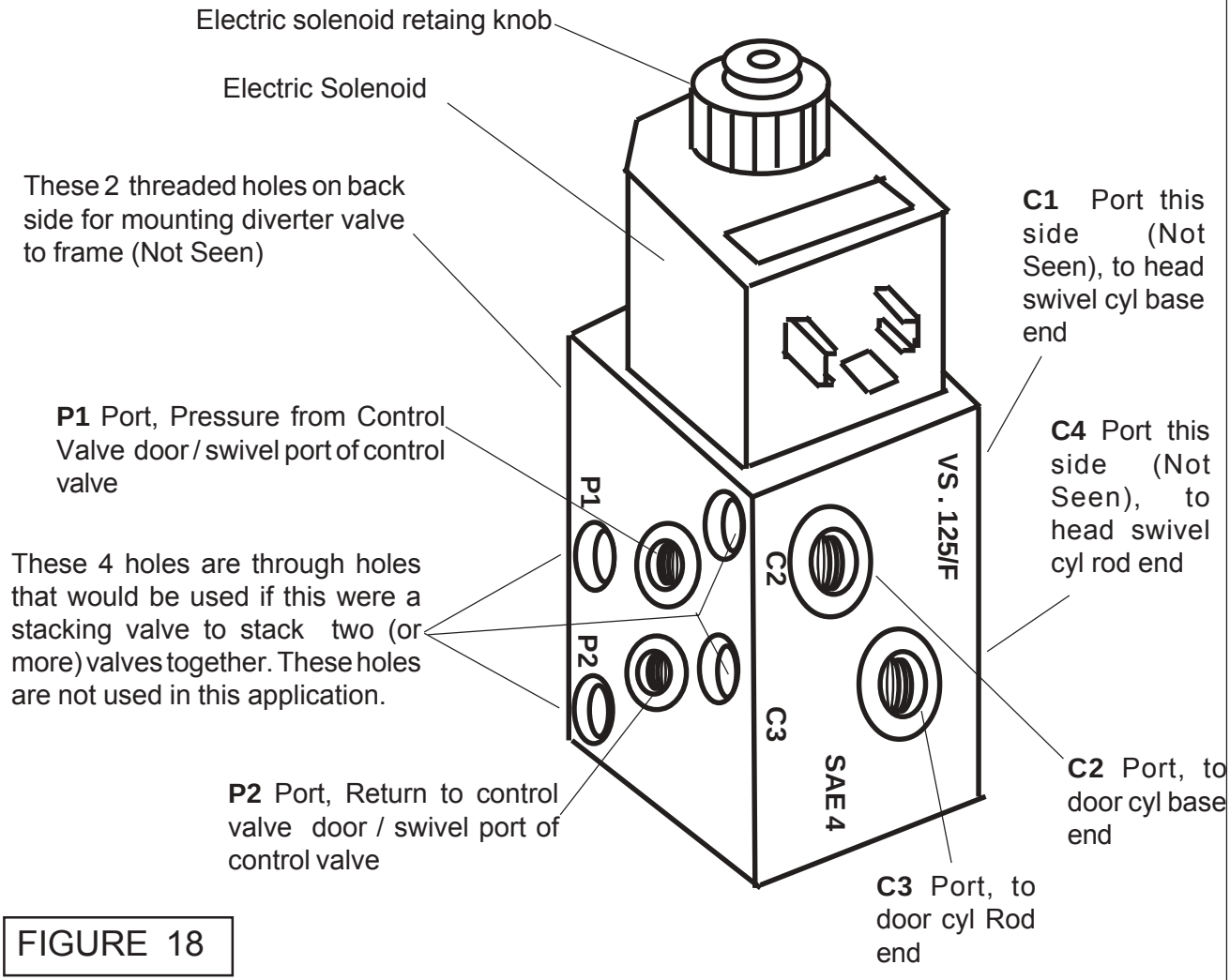


FIGURE 18

Control Valve Technical Information (See Figure 1 & 2)

Pressures:

Pump Inlet..... Max. 4600 psi (320 bar*)
Service Ports..... Max. 5000 psi (350 bar*)
Tank Connection..... Max. 290 psi (20 bar)

Flow Rates Recommended:

Pump Connection..... Max. 40 US gpm (150 l/min)
Service Port with
Pressure Compensator..... Max. 24 US gpm (90** l/min)
Service Port without
Pressure Compensator..... Max. 33 US gpm (125** l/min)
Return From Service Port..... Max. 40 US gpm (150 l/min)

* Stated pressures are absolute shock pressures at 10 bar tank pressure
** Depending on Spool Varient

Feed Reducing valves:

Setting Range..... 725 - 4800 psi (50 - 300 bar)

Internal Pilot Pressure:

Fixed Setting..... 320 or 508 psi (22 or 35 bar)

Temperature:

Oil Temperature, Function Range..... Max. 225° F
Oil Temperature, Working Range..... Max. 225° F

Filtration:

Filtration must be arranged so that contamination class 18/14 according to ISO 4406 is not exceeded. For the Pilot circuit, target contamination class 16/13 according to ISO 4406 is recommended.

Hydraulic Fluids:

Oil Type Recommended..... ISO 100 AW Hydraulic Oil

Valve Connection Information

Connection	Location	G-Version	UN-Version
P1	Inlet Section	G 3/4	1-1/16-12 UN-2B
T2	End Section	G 3/4	1-1/16-12 UN-2B
A,B	Spool Section	G 1/2	7/8-14 UNF-2B
PL	Inlet Section	G 1/4	9/16-18 UNF-2B
PS	End Section	G 1/4	9/16-18 UNF-2B

Valve Weights

Section:	Weight
Inlet Section	12.1 lbs. (5.5 kg)
End Section	9.3 lbs. (4.2 kg)
Spool Section w/ Spool Actuater:	
ECH	11.9 lbs. (5.4 kg)

NOTES

Hydraulic Circuit Diagram Showing Basic Functions

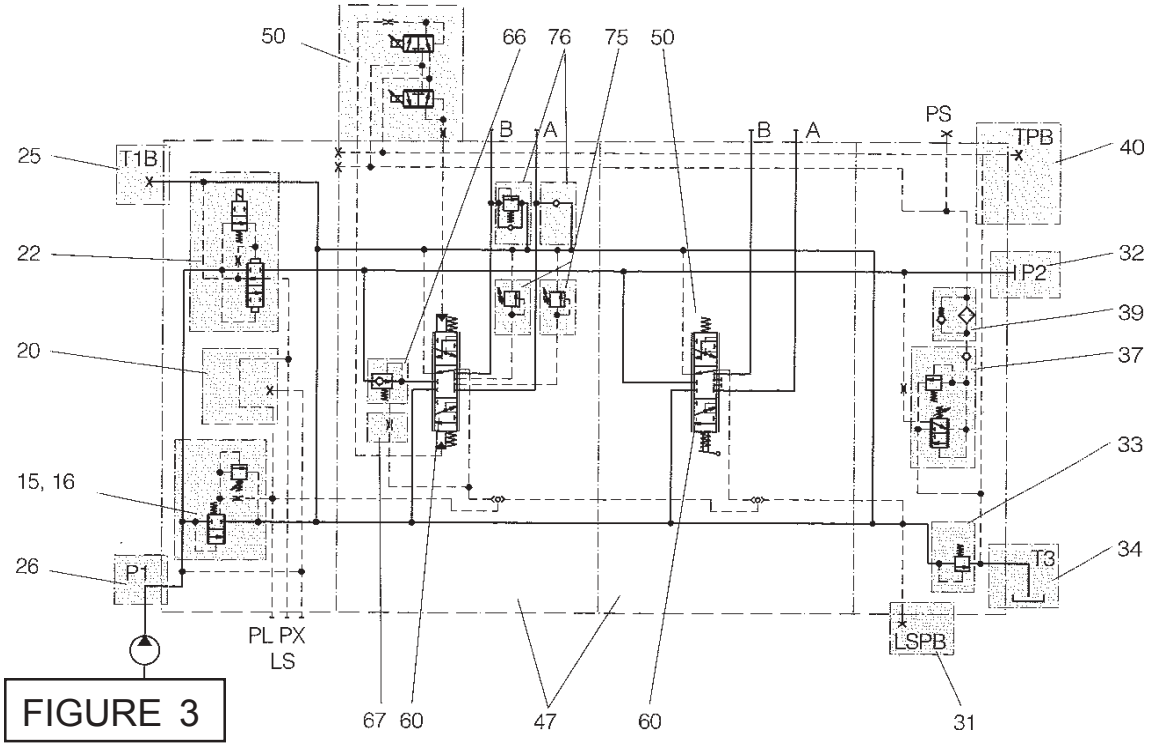


FIGURE 3

The item numbers in the hydraulic circuit diagram and table below refer to the valve function areas for which different options are available. The valve in the example above is equipped according to the description below. For other equipment alternatives see under respective valve function area (item number) in catalog

Item	Code	Description
15	CFC	Inlet w/ bypass for systems w/ fixed pump
16	PS	Pilot-Operated main pressure relief valve
20	KB	Prepared for load-signal copying
22	BEN	Electrically activated pump-unloading function that blocks the pump and unloads the signal.
25	T1B	Tank Connection in inlet plugged.
26	P1	Pump connection in inlet open.
31	LSPB	Load-signal connection for parallel-connected valve plugged.
32	P2	Pump Connection.
33	MF	Counter pressure valve with fixed setting.
34	T3	Tank Connection open.
37	R	Pressure reducing valve with separate safety valve for internal pilot pressure supply.
39	S	Internal coarse filter for pilot circuit.

(Continued Next Page)

(Continued From Previous Page)

Item	Code	Description
40	TPB	Prepared for separate tank connection from pilot circuit.
47	TTT	Section 1 equipped with pressure compensator separate feed reducers for A- and 8-ports, and prepared for port relief valves in both service ports.
	000	Section 2 without pressure compensator, feed reducer or port relief valve.
50	EC	Section 1 equipped with proportional electrohydraulic remote control.
	CH	Section 2 equipped for direct with spring centering.
60	D	Sections 1 and 2 equipped with spool for double acting function, with service ports blocked in neutral position.
66	K	Pressure compensator with built-in check valve function.
67	0.8	Restriction of load signal to pressure compensator.
75		Pressure setting for feed reducers in A- and B- ports.
76A	N2	Anti-cavitation valve in A-Port.
76B		Pressure setting for combined port-relief and anti cavitation valve in B-port.

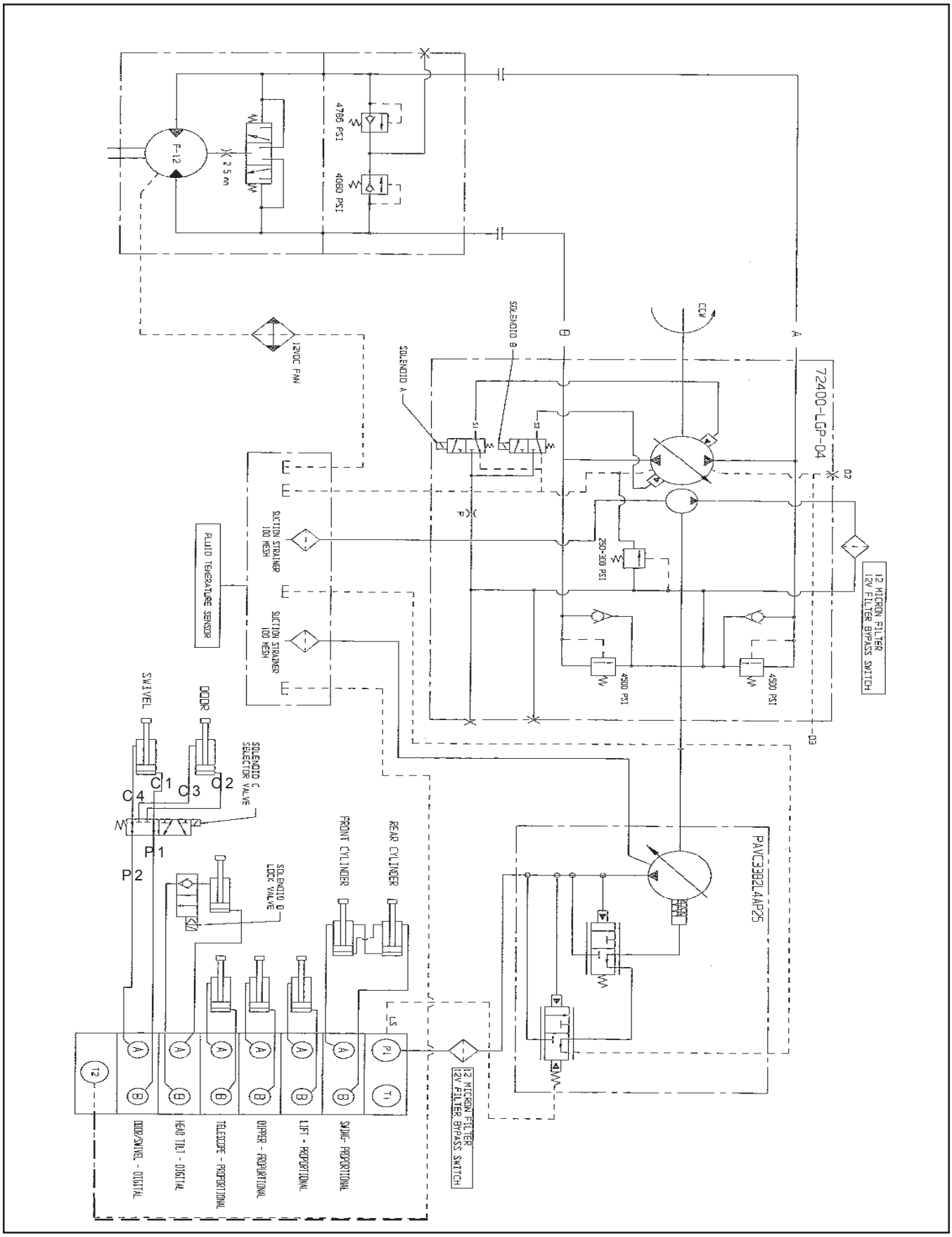
Valve Spool Functions & Spec's (Boom Feature):

Main Relief at Inlet 3335 psi

Valve Spool Functions & Specs:

Band Color	Spool No.	Cyl. Function	Travel Direction	Port	Work Port Relief	Pressure Rating
G/W	1	Swing	Forward	B	3045 psi.	2.0
G	1	Swing	Back	A	3045 psi.	2.0
OR	2	Lift	Down	B	1160 psi.	7.92
OR/W	2	Lift	Up	A	Plug	7.92
B/W	3	Dipper	Out	B	Plug	3.17
B	3	Dipper	In	A	1160 psi.	3.17
Y/W	4	Telescope	Out	B	2030 psi	3.17
Y	4	Telescope	In	A	Plug	3.17
R/W	5	Tilt	Up	A	Plug	3.17
R	5	Tilt	Down	B	2030 psi	3.17
G	6	Swivel	CW (top)	A	2755 psi	6.60
G/W	6	Swivel	CCW (top)	B	2755 psi	6.60

Hydraulic Schematic P/N 02981897



HYDRAULIC HOSE CODES

Hydraulic Hose Band Mark Color Codes: Hose's and/or fittings are marked with a Color Coded Plastic Band around it. Some Bands are a solid Color and some have a Colored with a Stripe. The purpose of the colored bands are to provide a quick reference for hose and port connection. A metal band is also attachted to the hose, on that band is an Alamo Industrial Part Number for reference if needing a replacement hose. **Always Check Hose Size, Color Code & Part Number**

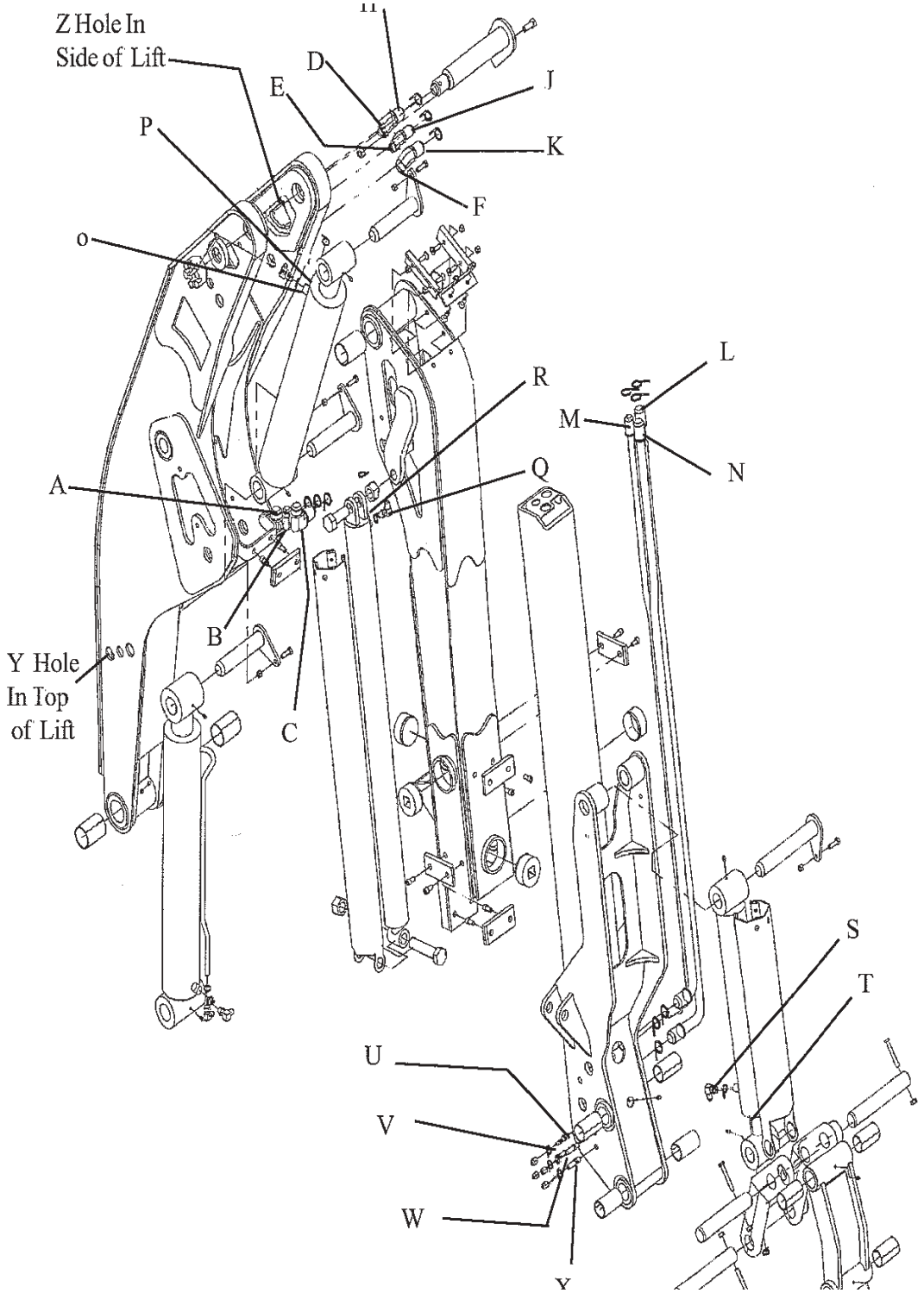
Boom Cylinder Circuit Hoses:

Color Tie	(Code)	Hose Size	Port	Hyd. Function
Green	G	SAE # 6	A	Swing, Back (Rod End)
Green / White	G/W	SAE # 6	B	Swing, Forward (Base End)
Orange	OR	SAE # 6	B	Lift, Down (Rod End)
Orange / White	OR/W	SAE # 6	A	Lift, Up (Base End)
Blue	B	SAE # 6	A	Dipper, In (Rod End)
Blue / White	B/W	SAE # 6	B	Dipper, Out (Base End)
Yellow	Y	SAE # 6	B	Telescope, In (Rod End)
Yellow / White	Y/W	SAE # 6	A	Telescope, Out (Base End)
Red	R	SAE # 6	A	Head Tilt, Up (Rod End)
Red / White	R/W	SAE # 6	B	Head Tilt, Down (Base End)
Green	G	SAE # 4	A	Swivel, CW (Rod End)
Green / White	G/W	SAE # 4	B	Swivel, CCW (Base End)
Yellow	Y	SAE # 4	A	Door, Open (Rod End)
Yellow / White	Y/W	SAE # 4	B	Door, Closed (Base End)

Motor Circuit Hoses:

Color Tie	(Code)	Hose Size		Hyd. Function
Red	R	SAE # 16	--	Pressure Flow to Motor
Orange	OR	SAE # 16	--	Return Flow From Motor
Blue	B	SAE # 8	--	Case Flow From Motor to Boom
Blue	B	SAE # 12	--	Case Flow at Boom to Tank

HYDRAULIC HOSE CONNECTIONS 24 FT BOOM



HYDRAULIC HOSE CONNECTIONS 24 FT BOOM

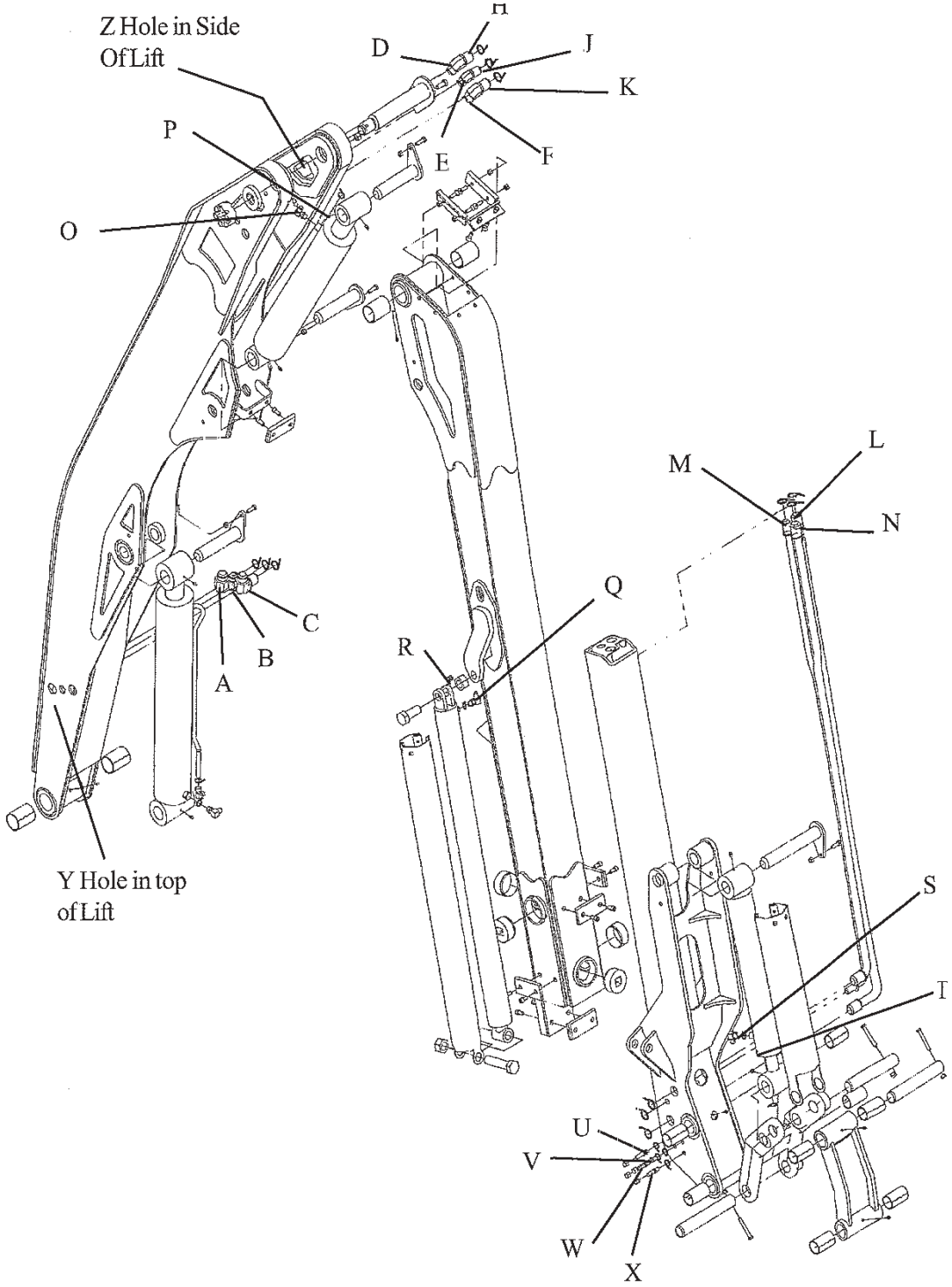
Part No.	Qty.	End-1	End-2	Description
02981823	1	Y(MJ)	Z(FJX)	Hose, #4 - 4MJ - 4FJX - 76" Lg. - Yel Tie - Door (Lift Sect'n)
02981824	1	Y(MJ)	Z(FJX)	Hose, #4 - 4MJ - 4FJX - 76" Lg. - Yel/Wht Tie - Door (Lift Sect'n)
02981828	1	Y(MJ)	Z(FJX)	Hose, #4 - 4MJ - 4FJX - 76" Lg. - Grn Tie - Swivel (Lift Sect'n)
02981829	1	Y(MJ)	Z(FJX)	Hose, #4 - 4MJ - 4FJX - 76" Lg. - Grn/Wht Tie - Swivel (Lift Sect'n)
02981830	1	Y(MJ)	Z(FJX)	Hose, #6 - 6MJ - 6FJX - 76" Lg. - Yel Tie - Ext'n (Lift Sect'n)
02981831	1	Y(MJ)	Z(FJX)	Hose, #6 - 6MJ - 6FJX - 76" Lg. - Yel/Wht Tie - Ext'n (Lift Sect'n)
02981832	1	Y(MJ)	Z(FJX)	Hose, #6 - 6MJ - 6FJX - 76" Lg. - Red Tie - Tilt (Lift Sect'n)
02981833	1	Y(MJ)	Z(FJX)	Hose, #6 - 6MJ - 6FJX - 76" Lg. - Red/Wht Tie - Tilt (Lift Sect'n)
02981834	1	Y(MJ)	O(FJX)	Hose, #6 - 6MJ - 6FJX - 96" Lg. - Blu Tie - Dipper (Dipper Sect'n)
02981835	1	Y(MJ)	P(FJX)	Hose, #6 - 6MJ - 6FJX - 96" Lg. - Blu/Wht Tie - Dipper (Dipper Sect'n)
02981836	1	Z(MJ)	R(FJX)	Hose, #6 - 6MJ - 6FJX - 88" Lg. - Yel Tie - Ext'n (Dipper Sect'n)
02981837	1	Z(MJ)	Q(FJX)	Hose, #6 - 6MJ - 6FJX - 88" Lg. - Yel/Wht Tie - Ext'n (Dipper Sect'n)
02981838	1	Z(MJ)	V(FJX)	Hose, #4 - 4MJ - 4FJX - 176" Lg. - Yel Tie - Door (Dipper Sect'n)
02981839	1	Z(MJ)	U(FJX)	Hose, #4 - 4MJ - 4FJX - 176" Lg. - Yel/Wht Tie - Door (Dipper Sect'n)
02981840	1	Z(MJ)	X(FJX)	Hose, #4 - 4MJ - 4FJX - 176" Lg. - Grn Tie - Swivel (Dipper Sect'n)
02981841	1	Z(MJ)	W(FJX)	Hose, #4 - 4MJ - 4FJX - 176" Lg. - Grn/Wht Tie - Swivel (Dipper Sect'n)
02981842	1	Z(MJ)	T(FJX)	Hose, #6 - 6MJ - 6FJX - 176" Lg. - Red Tie - Tilt (Dipper Sect'n)
02981843	1	Z(MJ)	S(FJX)	Hose, #6 - 6MJ - 6FJX - 176" Lg. - Red/Wht Tie - Tilt (Dipper Sect'n)
02981846	1	C(FJX)	F(FJX)	Hose, #16-16FJX-16FJX90°-102" Lg.-Red Tie-Motor-P (Lift Sect'n)
02981847	1	A(FJX)	D(FJX)	Hose, #16-16FJX-16FJX90°-102" Lg.-Org Tie-Motor-R (Lift Sect'n)
02981848	1	K(FJX)	L(FJX)	Hose, #16-16FJX-16FJX-54" Lg.-Red Tie-Motor-P (Dipper Sect'n)
02981849	1	H(FJX)	N(FJX)	Hose, #16-16FJX-16FJX-58" Lg.-Org Tie-Motor-R (Dipper Sect'n)
02981850	1	B(FJX)	E(FJX)	Hose, #12-12FJX-12FJX90°-102"Lg.-Blu Tie-Case Drain (Lift Sect'n)
02981851	1	J(FJX)	M(FJX)	Hose, #12-12FJX-12FJX-56" Lg.-Blu Tie-Case Drain (Dipper Sect'n)

NOTE 1: Hose End-1 & End-2, these are where the ends of that hose connect, the letter shows location of that end and ( ) show type hose fitting at that end.

NOTE 2: The hoses have plastic ties on the to show which hose is which. The colors are abreviated to YEL = Yellow, YEL/W = Yellow with White/stripe, GRN = Green, GRN/W = Green with White Stripe, RED = Red, RED/W = Red with White Stripe, BLU - Blue, BLU/W = Blue with White Stripe, ORG = Orange, ORG/W = Orange with White Stripe.

NOTE 3: (Sect'n) = Location where hose is located on boom

HYDRAULIC HOSE CONNECTIONS 30 FT BOOM



HYDRAULIC HOSE CONNECTIONS 30 FT BOOM

Part No.	Qty.	End-1	End-2	Description
02981879	1	Y(MJ)	Z(FJX)	Hose, #4 - 4MJ - 4FJX - 115" Lg. - Yel Tie - Door (Lift Sect'n)
02981880	1	Y(MJ)	Z(FJX)	Hose, #4 - 4MJ - 4FJX - 115" Lg. - Yel/Wht Tie - Door (Lift Sect'n)
02981855	1	Y(MJ)	Z(FJX)	Hose, #4 - 4MJ - 4FJX - 115" Lg. - Grn Tie - Swivel (Lift Sect'n)
02981856	1	Y(MJ)	Z(FJX)	Hose, #4 - 4MJ - 4FJX - 115" Lg. - Grn/Wht Tie - Swivel (Lift Sect'n)
02981857	1	Y(MJ)	Z(FJX)	Hose, #6 - 6MJ - 6FJX - 115" Lg. - Yel Tie - Ext'n (Lift Sect'n)
02981858	1	Y(MJ)	Z(FJX)	Hose, #6 - 6MJ - 6FJX - 115" Lg. - Yel/Wht Tie - Ext'n (Lift Sect'n)
02981859	1	Y(MJ)	Z(FJX)	Hose, #6 - 6MJ - 6FJX - 115" Lg. - Red Tie - Tilt (Lift Sect'n)
02981860	1	Y(MJ)	Z(FJX)	Hose, #6 - 6MJ - 6FJX - 115" Lg. - Red/Wht Tie - Tilt (Lift Sect'n)
02981861	1	Y(MJ)	O(FJX)	Hose, #6 - 6MJ - 6FJX - 135" Lg. - Blu Tie - Dipper (Dipper Sect'n)
02981862	1	Y(MJ)	P(FJX)	Hose, #6 - 6MJ - 6FJX - 135" Lg. - Blu/Wht Tie - Dipper (Dipper Sect'n)
02981863	1	Z(MJ)	R(FJX)	Hose, #6 - 6MJ - 6FJX - 125" Lg. - Yel Tie - Ext'n (Dipper Sect'n)
02981864	1	Z(MJ)	Q(FJX)	Hose, #6 - 6MJ - 6FJX - 125" Lg. - Yel/Wht Tie - Ext'n (Dipper Sect'n)
02981865	1	Z(MJ)	V(FJX)	Hose, #4 - 4MJ - 4FJX - 214" Lg. - Yel Tie - Door (Dipper Sect'n)
02981866	1	Z(MJ)	U(FJX)	Hose, #4 - 4MJ - 4FJX - 214" Lg. - Yel/Wht Tie - Door (Dipper Sect'n)
02981867	1	Z(MJ)	X(FJX)	Hose, #4 - 4MJ - 4FJX - 214" Lg. - Grn Tie - Swivel (Dipper Sect'n)
02981868	1	Z(MJ)	W(FJX)	Hose, #4 - 4MJ - 4FJX - 214" Lg. - Grn/Wht Tie - Swivel (Dipper Sect'n)
02981869	1	Z(MJ)	T(FJX)	Hose, #6 - 6MJ - 6FJX - 214" Lg. - Red Tie - Tilt (Dipper Sect'n)
02981870	1	Z(MJ)	S(FJX)	Hose, #6 - 6MJ - 6FJX - 214" Lg. - Red/Wht Tie - Tilt (Dipper Sect'n)
02981873	1	C(FJX)	F(FJX)	Hose, #16-16FJX-16FJX90°-140" Lg.-Red Tie-Motor-P (Lift Sect'n)
02981874	1	A(FJX)	D(FJX)	Hose, #16-16FJX-16FJX90°-140" Lg.-Org Tie-Motor-R (Lift Sect'n)
02981875	1	K(FJX)	L(FJX)	Hose, #16-16FJX-16FJX-94" Lg.-Red Tie-Motor-P (Dipper Sect'n)
02981876	1	H(FJX)	N(FJX)	Hose, #16-16FJX-16FJX-98" Lg.-Org Tie-Motor-R (Dipper Sect'n)
02981877	1	B(FJX)	E(FJX)	Hose, #12-12FJX-12FJX90°-140"Lg.-Blu Tie-Case Drain (Lift Sect'n)
02981878	1	J(FJX)	M(FJX)	Hose, #12-12FJX-12FJX-96" Lg.-Blu Tie-Case Drain (Dipper Sect'n)

NOTE 1: Hose End-1 & End-2, these are where the ends of that hose connect, the letter shows location of that end and ( ) show type hose fitting at that end.

NOTE 2: The hoses have plastic ties on the to show which hose is which. The colors are abreviated to YEL = Yellow, YEL/W = Yellow with White/stripe, GRN = Green, GRN/W = Green with White Stripe, RED = Red, RED/W = Red with White Stripe, BLU - Blue, BLU/W = Blue with White Stripe, ORG = Orange, ORG/W = Orange with White Stripe.

NOTE 3: (Sect'n) = Location where hose is located on boom

MAVERICK CONTROL VALVE

HYDRAULIC SYSTEM - POSITIONING - TEST PROCEDURES

NOTE: The Maverick is equipped with manual override controls for the Control Valve. In case of Emergency Electrical failure or for testing purposes, The positioning Hydraulics can be operated manually. Refer to Isolation Test 2 for instructions or review Control Valve Section.

IMPORTANT NOTE:

1. Repairing a failed Component is not always repairing the Cause of a failure, When making repairs always check all associated components because one component can be the cause of another component failure.

INFORMATION COLLECTION: Any information on Unit from operator will be helpful.

1. What is Model Unit, Size, Type Head, Type Tractor it is mounted on etc?
2. What is not working correctly? In as much detail as possible.
3. Has this malfunction existed for some time, just start suddenly, continuos malfunction or off and on, when does malfunctions occur.
4. Did this malfunction result from an earlier malfunction? What if any repairs, adjustment, modifications or any changes to any components have been made to unit recently. (Repairs - Maintenance - Accidents - Operator Change)
5. Have all the obvious items been checked, Oil Levels (Tractor & Unit Reservoirs), Electrical Supply (Dead Battery, Loose connections, etc.)
6. Does the malfunction affect all circuits, one, two or more?
7. Does malfunction affect both sides of the same function or just one (Example Lift & Lower, in or out, etc)
8. Does malfunction happen when Cold or Hot, only Cold or only Hot, more when Cold than Hot, more when Hot than Cold etc.
9. What Conditions? What is Unit doing when malfunction occurs, running at low? RPM, High RPM, heavy Cutting, light Cutting, Level Ground, Slope Angle etc.
10. Any information that will help determine what may be causing the Malfunction or to pin point the location of the malfunction.

VISUAL TEST:

1. Do Not Start Tractor till all visual inspections are done. Check All Fluid Levels (Fluid Levels should be checked with oil warm and with all components filled with Oil from operation), Remove any bolt on / Slip on Cover that prevent visual inspection of general condition of components. Look for any Broken Components, Missing Components, Loose Components, Oil Leaks, Damaged Components. Look for any thing that is obvious to cause a problem.
2. Replace any missing / broken components, tighten any loose components, repair any Oil Leaks before beginning any further test.

OPERATIONAL TEST:

1. Visual Test should have been done already, If not go back one page and perform visual test now. Pump and/or Valve covers should be removed.
2. Start Tractor Engine, When starting Machete Boom functions always listen to sound of Engine, Sound should change when Boom Hydraulics are in the working position.
3. With Tractor Engine running operate each Circuit, Paying close attention to every thing the unit does or does not do.
4. The Engine speed should drop (the Sound Change) when the Valve spool moves and the Pump comes under a load, If the Engine sound does not change when the Circuit is activated (on a Load Sense System) it is an indication that there is a possible malfunction in the Load Sense Circuit.
5. Observe each function of the Joystick control throughout its complete range of movement. Check the Cylinder speeds, Look for “Jerky” operation (the Cylinder should respond smoothly to the movement of the Joystick). Look for time delay between movement of Joystick and movement of Cylinders.
6. After checking each function, attempt to duplicate the malfunction described by Operator, Using the information gathered in the Operator Interview. If you are not able to get machine to malfunction, see if operator can get the machine to malfunction.
7. When the Malfunction occurs, take note of all conditions that exist during the time of the malfunction, Some things to take note of are,
    - **A.** Engine Speed or Sound.
    - **B.** Position of Articulating Members.
    - **C.** Operating Temperature
    - **D.** Length of time Unit has been running
    - **E.** Position of Joystick before and during malfunction.
    - **F.** Position and Condition of Tractor
    - **G.** Any other condition you might notice.
8. Duplicate the conditions that existed when the malfunction occurred to determine if the malfunction will occur every time that the same conditions exist. Try different combinations of conditions to determine which conditions actually affect the malfunction and which ones just happened to be there when the malfunction occurred.

NOTES

Section 3

JOYSTICK OPERATION ELECTRONIC CONTROLS 24' & 30' BOOM

CONTROL VALVE - BOOM & MOTOR CONTROL

Maverick Boom and Motor Control Circuits:

It is advised that this section be read before proceeding with any repairs or test, with the display and electronics used in this application the system will test many components for you. This is done by following the prompts on the display screen.

DO NOT pressure wash this system, while the components are sealed the soaps, acid and high water pressure used in the pressure washer can damage these seals and cause moisture to enter system causing damage.

DO NOT do any welding around these electronic components, If welding is required in a repair the electronic components MUST be disconnected (unplugged). Un plug all components, Joystick, Modules, Displays and any other electronic component. If not unplugged the current from the welded can cause serious damage to electronic components.

Additional repair and diagnostic procedures for the electrical system is available on the internet web site of the manufacture of this system at: **REFERENCE PRODUCT MANUAL FOR MDM DISPLAY. THIS MANUAL IS AVAILABLE FROM THE MANUFACTURER ON THE INTERNET AT www.iqan.com viewable and printable with ADOBE ACROBAT READER. If you do not have Adobe Acrobat Reader it can be obtained at www.adobe.com.** Make certain that the instructions you refer to is for the MDM system, the manufacturer has more than one system.

The boom and motor control is electronic over hydraulics. If these functions are not properly set or working properly the mower can not be operated. Also make certain that all fluid levels are OK and with in operating limits.

The first thing that should be checked is the main (electrical) power supply to the system, this can be checked on the display unit when power is on.

The set-up portion as shown in the next pages should be checked to make certain the joystick and motor functions are set correctly. Check all the connections if not operating properly. If the settings are not correct the system will not function properly.

Check the emergency stop (E-Stop) switch if it is in the off position the system will not operate and the system cannot be set properly.

Never short across any of these components as the type electronics used can be seriously damaged. Always use a volt / ohm meter to test any circuits.

CONTROL VALVE - BOOM CONTROL

Maverick Boom Control System:

1. Operating the Boom Control functions is done so by means of a load sensing electronic over hydraulic system. There are three main areas of that system, the electronic network, instrumentation and hydraulic components.

2. System components are, The hydraulic System, The electronic network, The instrumentation and Operator Interface.

3. The Hydraulic System, The hydraulic components are responsible for transferring mechanical power into hydraulic power. There are two separate hydraulic circuits, the boom circuit and the mower head circuit.

4. How the boom is controlled, The system progression starts with operator input at the joystick (Figure 7-A) or other instrumentation. Input is received at the CAN module (Figure 7-B) and joins the network. That information is transferred via the network to the valve solenoid (Figure 7-C) which activates and moves the spool sending hydraulic fluid pressure to the cylinder (Figure 7-D) and moves the load.

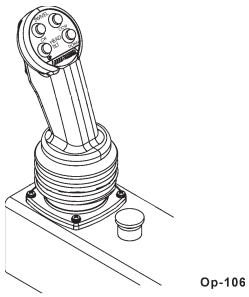


FIGURE 7-A

FIGURE 7-B

FIGURE 7-C

FIGURE 7-D

FIGURE 7

Maverick Mower Head Circuit:

1. The Motor Circuit. The motor circuit for the cutting head operation is operated through display (Figure 8-A). By selecting the activation parameter the coil will shift the servo-piston at the hydrostatic pump (Figure 8-B), stroking the pump into the "On" position. Flow will then be supplied to the hydraulic motor at the cutter head (Figure 8-C). Activate the motor circuit while the engine RPM is at idle. Once activated, the engine RPM can be raised to the 540 PTO required speed, if the 540 PTO engine speed is not noted on the tractors RPM gauge consult tractor owners manual to find what the required speed is. At any time the Emergency stop switch (Figure 8-D) located on the joystick will deactivate the cutter motor circuit. The blade will stop within 6 second when the emergency switch is shut "Off"

Maverick Mower Head Circuit: (continued from Previous page)

FIGURE 8-A

FIGURE 8-B

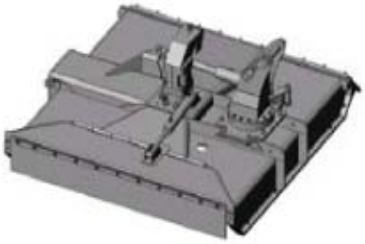


FIGURE 8-C

FIGURE 8-D

FIGURE 8

Maverick Electronic Network: (Figure 9)

Electronic Network. The electronic network is the control and communication network that receives and transmits data to certain components in the boom control system. Its purpose, is to manage the incoming and outgoing information.

There are five main components. The MDM is an operator Display that is located in the cab. The purpose of the display is to house the programming software for the system control and provide an interface between the operator and the Maverick Boom.

The interface is utilized through a multi-screen function that allows the operator to set individual parameters for customized control functions.

The display also provides tools such as an on board measurement device, useful for determining short circuits, component loss, and/or power supply issues. **REFERENCE PRODUCT MANUAL FOR MDM DISPLAY. THIS MANUAL IS AVAILABLE FROM THE MANUFACTURER ON THE INTERNET AT www.iqan.com viewable and printable with ADOBE ACROBAT READER. If you do not have Adobe Acrobat Reader it can be obtained at www.adobe.com.**

Make certain to view the MDM section as this is the type used on the maverick boom, there are listings at the web site that will not apply to the maverick boom.

FIGURE 9

Maverick Electronic Network:

(continued)

The XP2 The XP2 is a controller module that is mounted at the front of the tractor next to the maverick control valve. The function of this component is to provide a gateway for incoming and outgoing information. Information is sent via the network to this module in order to provide control of the solenoids for valve operation (See Figure 10) **REFERENCE PRODUCT MANUAL FOR MDM DISPLAY. THIS MANUAL IS AVAILABLE FROM THE MANUFACTURER ON THE INTERNET AT www.iqan.com viewable and printable with ADOBE ACROBAT READER. If you do not have Adobe Acrobat Reader it can be obtained at www.adobe.com.**

XP2 (Expansion, Power)

Analog Inputs	4	Prop. Output	4x2
Digital Inputs	(4)	Digital Outputs	4
Freq. Inputs	(2)	E-Gas	-

Op-110

FIGURE 10

The XT2. The XT2 is also a controller module that is mounted at the front of the tractor on the side of the tank, The function of this component is to provide a gateway for incoming and outgoing information. This module receives input from instrumentation, then provides that information to the network for further utilization. **(See Figure 11) REFERENCE PRODUCT MANUAL FOR MDM DISPLAY. THIS MANUAL IS AVAILABLE FROM THE MANUFACTURER ON THE INTERNET AT www.iqan.com viewable and printable with ADOBE ACROBAT READER. If you do not have Adobe Acrobat Reader it can be obtained at www.adobe.com.**

XT2(Expansion, Transmission)

Analog Inputs	10	Prop. Outputs	2x2
J1909 CAN hub	1	Digital Outputs	6
Freq. Inputs	(3)	E-Gas	1

Op-111

FIGURE 11

The XS The XS is expansion module that provides extra input and output capabilities in order to gain more flexibility on the network. The XS is responsible for receiving the signals from the joystick and other in cab inputs and making them available on the network. **REFERENCE PRODUCT MANUAL FOR MDM DISPLAY. THIS MANUAL IS AVAILABLE FROM THE MANUFACTURER ON THE INTERNET AT www.iqan.com viewable and printable with ADOBE ACROBAT READER. If you do not have Adobe Acrobat Reader it can be obtained at www.adobe.com.**

XS (expansion, signal)

Op-105

FIGURE 12

Maverick Instrumentation:

Instrumentation The Maverick Boom utilizes instrumentation for certain decision making activities. Listed below are the sensors included on this unit. Tank Temperature Sensor, Charge Pressure Filter Switch, Valve Pressure Filter Switch and Return Filter Switch.

Tank Temperature Sensor. The tank temperature sensor monitors the fluid temperature in the area of the pump suction screens. the temperature is real time and is used on the network to accomplish certain objectives. The first, is to display on the interface while the cutter circuit is operating. The second, is to be used to control the electric fan on the hydraulic cooler. At any time the fluid level reaches 150° F. the fan is activated and remains activated until fluid temperature drops to or below the desired temperature (See Figure 13).

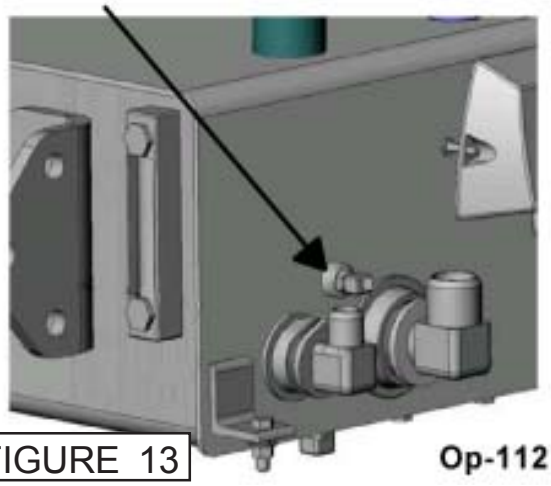


FIGURE 13

The Charge Pressure Filter Switch The charge pressure filter switch is located at the filter in the charge loop on the hydrostatic pump (See Figure 14). The sensor monitors the back pressure created by the filter element when in use. When the back pressure reaches a setting of 50 psi the switch will trigger and prompt the operator for a filter element change of filter element.

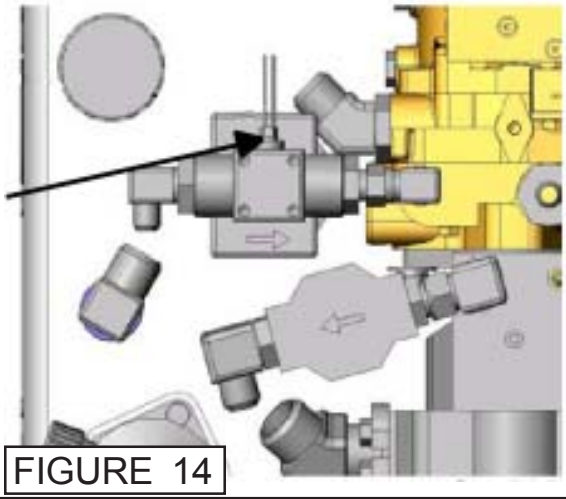


FIGURE 14

The Valve Pressure Filter Switch The Valve pressure filter switch is located at the pressure filter in the valve pressure circuit, between the closed center load sense pump and the control valve (See Figure 15). The sensor monitors the back pressure created by the filter element when in use. When the back pressure reaches a setting of 50 psi the switch will trigger and prompt the operator for a filter element change.

WARNING! This filter does not have a bypass. The element must be changed at the appropriate time to avoid element danmage and system contamination.

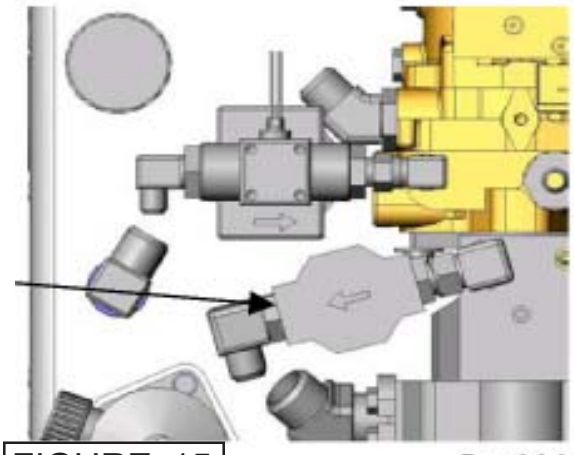


FIGURE 15

Maverick Instrumentation:
(continued)

The Return Filter Switch. The return filter switch is located at the return filter mounted on to the tank top. The fluid returning from the cylinder control valve is filtered before returning to tank at this location (See Figure 16). The sensor monitors back pressure created by the filter assembly while cylinder circuit is in operation. When the back pressure reaches 25 psi the switch will trigger and prompt the operator for a filter element change.

WARNING! This filter does not have a by-pass. The element must be changed at the appropriate time to avoid element damage and system contamination.

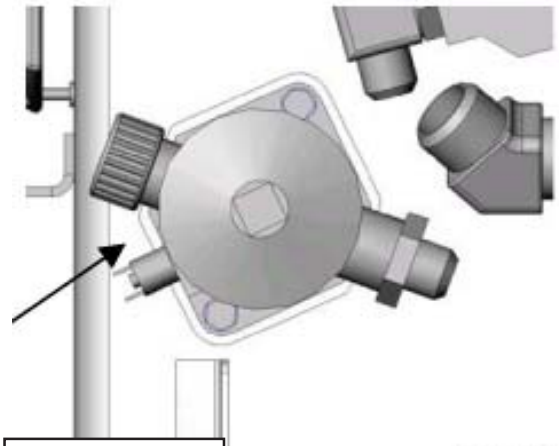


FIGURE 16 Op-115

Maverick Operator Interface :

The Operator Interface The operator selects parameters provided by a menu system in the MDM display. The parameters are used to establish how the boom unit functions. The menu system is comprised of two sections. The first section is setup, the second section powers up the boom control circuit and cutter head circuit. The following steps outline how to successfully page through the menu system to execute operation.

Executing Set-Up The following representations will outline the steps necessary to execute set-up.

* Key Escape or back at anytime to revert to the previous screen or restart the set-up menu at any time.

Alamo Industrial Boom Menu

Key F1 For Setup

SETUP

* Key F-1 to access the set-up menu.

Select Boom Operating Speed

LOW MED HIGH

* Key the corresponding F-key to establish the desired boom speed. This parameter is provided for customizable operation.

Maverick Operator Interface : (continued)

Choose Cutterhead for Set-Up
F1 All Others
F2 Timbercat Sicklebar

OTHERS | TIMBERCAT | BACK

* Key the corresponding F-key for the head attachment that will be used, This is an important step because this parameter chooses which direction the fluid will enter the motor. The Timbercat Sicklebar mower is the only head attachment that currently requires the operator to send reverse flow, for all others chose F-1 key for standard directional flow.

Set-Up Complete

F1 to Enable Joystick

ON | | MAIN MENU

* Key F-1 to activate Joystick, the Boom will not move until the joystick is activated. The Boom function Set-up is now complete, the boom speed, the head attachment has been chosen and the joystick has been activated.

Motor Power Condition

F1 to Enable Cutterhead

ON | | BACK

* Key F-1 to power motor. This is best done when the engine RPM is at idle speed. Doing this a t high RPM will cause the system pressure to surge sending fluid over the relief and causing excess heat to be introduced into the system.

* At any time the Cutter Head Motor E-Stop (emergency stop) can be pushed to disable the motor circuit. If this is done the Switch must be raised in the run position before the motor circuit can be reactivated.

Maverick Operator Interface : (continued)

Cutterhead is On

Oil Temp. 45.0 F

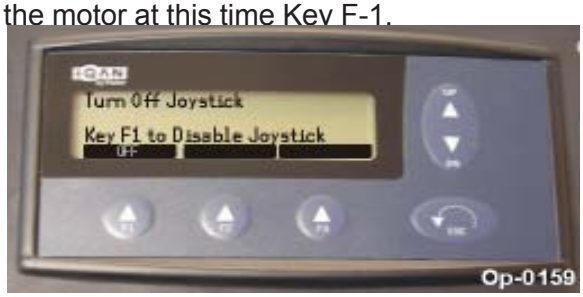
OFF

* At this time the motor circuit is powered and the mower head motor is active. This screen also shows the tank temperature in degrees Fahrenheit. To turn off the motor at this time Key F-1.

Turn Off Joystick

Key F1 to Disable Joystick

OFF



* The Joystick Master control switch must be off to prevent accidental movement of boom and cutting head when ever mower is not being operated, such as when in transport.

Cylinder Supply Pump Pressure Adjust (If Needed):

Special Note: If after setting the display controls, check to make certain that functions operate correctly. If the Boom will not lift. The Pump for the Cylinder supply may have to be adjusted. This is a simple process that will require a 7/16" wrench for this adjustment and a 1/2" wrench for the locking nut. Looking on the LH side of the pump there are two adjustments, one has a 7/16" hex head and the other a ridged round head, Only adjust the one with the hex head. DO NOT adjust or change the round ridged adjustment as it is set from the factory. Adjust the 7/16" hex one by turning it in till it seats completely (Do not force adjustment after is seats). Then back it back out 1/2 turn, this will give you the 2800 psi required to oprtate the boom. (See Figure A & B). Hold the adjusting nut while turning the locking nut so the adjustment nut does not turn with it changing the setting.

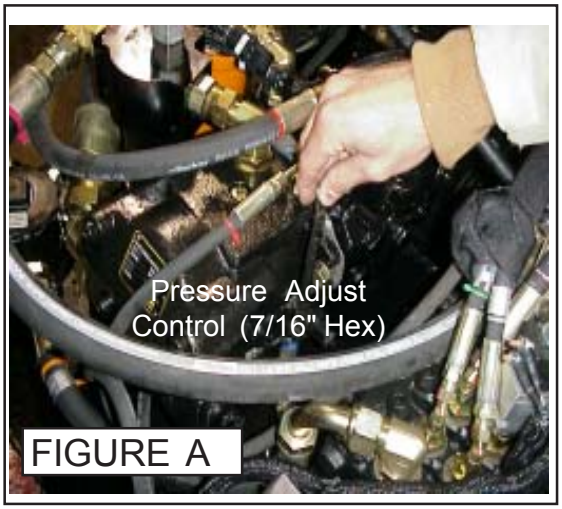
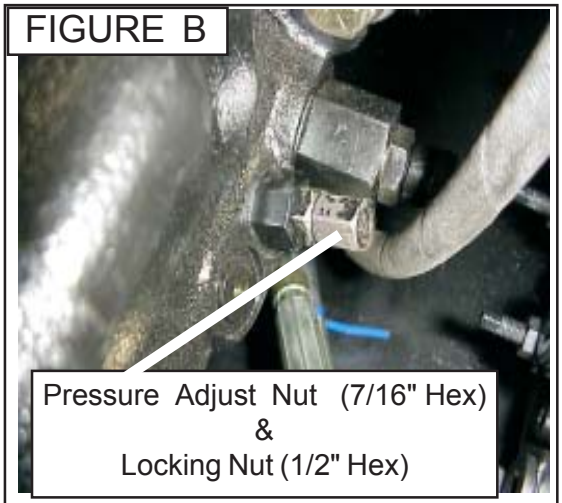


FIGURE A

FIGURE B

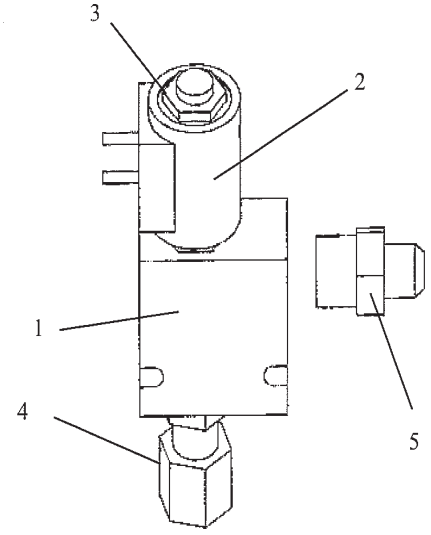


Pressure Adjust Nut (7/16" Hex)
&
Locking Nut (1/2" Hex)

HYDRAULIC LOCK VALVE: (Head Tilt Function)

An Electric Solenoid Operated Hydraulic Lock Valve (Figure 17) is incorporated in the Head Tilt

Function to prevent excessive (Head Lift Cylinder) leak down during storage or transportation. The Solenoid which operates this valve is normally in the Locked position until Head Lowering function is actuated at Joystick. When Joystick is actuated to lower Head an electric signal is sent to solenoid to open Lock valve. When the function to raise the Head is activated there is no electric signal from Joystick. The pressure against the valve when head is being raised will force Valve open like a relief Valve allowing Oil to pass through it. If this valve will not open it could stop head from lifting or dropping. The valve is plumbed into the Hydraulic Circuitry of the Head Tilt Function and is located near the Control Valve.



Hydraulic Lock Valve

Item	Part No.	Qty.	Description
	02972208	--	Solenoid Valve Asy
1	02971425	1	Seal Kit, f/ solenoid Valve
2	02975198	1	Coil, 12V- DC w/Dual 8-32NF Studs
3	02975199	1	Cartridge, Solenoid Valve
4	02975438	1	Adapter Hyd, Straight 8MB-6FJX
5	02981890	1	Adapter Hyd, Straight 5MB - 6MJ

FIGURE 17

ELECTRIC SIGNALS:

Electrical Signals are sent to the Controllers etc. through a Wiring Harness, The Harness is supplied with a one way connectors at the Joystick (So it can not be installed Wrong). Connectors are supplied for each electric valve controller connection. The Plug will only fit together one way and should always have right connections. BUT if the terminals within this Plug are moved around or the connections at the valve end are changed then the Plug would still be connected the same way and be Wrong. If any connections are removed they MUST be placed back in the same order they came out of. See Wireing schematic on the following pages S for Plug Connection (Letter Code) & Terminal locations,

See Figure Schematic for actual Wire locations.

DO NOT CHANGE LOCATIONS OF PINS AND/OR WIRES IN PLUGS, THEY MUST BE CONNECTEDTHE SAME WHEN REPLACED OR THE SYSTEM WILL MALFUNCTION AND THIS COULD ALSO DAMAGE JOYSTICK CONTROLLER COMPONENTS.

DOOR / SWING CYL DIVERTER VALVE - P/N 02977622

Diverter Valve.:

The diverter valve is a electrical operated valve that allows the hydraulic pressure to be shared to operate two (or more if valves are stacked) funtions with a single pressure supply. This valve is strictly a diverter valve and is designed to direct the pressure, not regulate the flow or pressure.

The Port openings on this diverter valve are marked with letter number codes which show wich port is connected to which hose and where that hose connect on other end (See Figure 18)

Port	Function & Connection
P1	Hose Hydraulic Pressure from Door / Swivel (B) Port on Control Valve
P2	Hose Hydraulic Return to Door / Swivel (A) Port on Control Valve
C1	Hose to Head Swivel Cylinder Base End
C2	Hose to Door Cylinder Base End
C3	Hose to Door Cylinder Rod End
C4	Hose to Head Swivel Cylinder Rod End

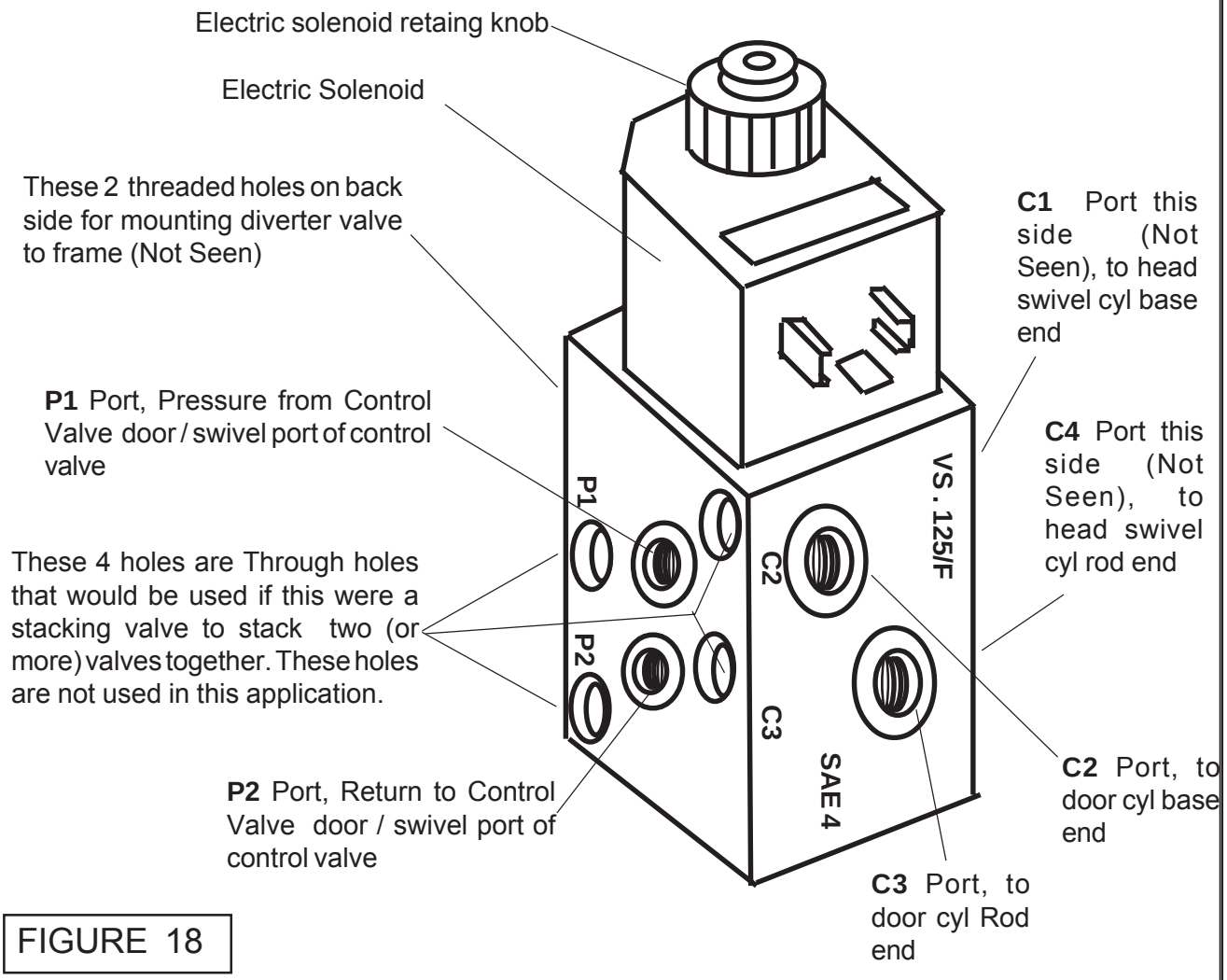


FIGURE 18

JOYSTICK FUNCTIONS: (Figure 19)

To operate a function the following series of events must work.

1. The Joystick Controller is moved in the correct direction the required distance, During its movement an electrical signal is sent to the electric Controller in the proper Valve Section of the Control Valve.
2. The Electric Controller sends an electrical signal, which causes the Proportional Control Valves to actuate the proper amount based on the signal from the Controller. EXAMPLE: Valves 1 & 3 allow Pilot Pressure Oil to flow to the corresponding end of the Spool, Thus causing it to move. Valves 2 & 4 allow the Oil from the opposite end of the Spool to return to the Tank. (NOTE: Lift, Swing and Dipper functions are Proportional, Door and Tilt functions are "ON" or "Off" Only, See later section for explanation of Proportional).
3. The Spool position Transducer sends an electrical signal to the Electronic Controller which indicates the position of the Spool.
4. The Electronic Controller will continue to adjust the Valves (1 - 4) in order to maintain an equilibrium between the Joystick signal and the feedback signal.
5. Reaction time from the time the Joystick is moved until the Spool moves is approximately 300 milliseconds.

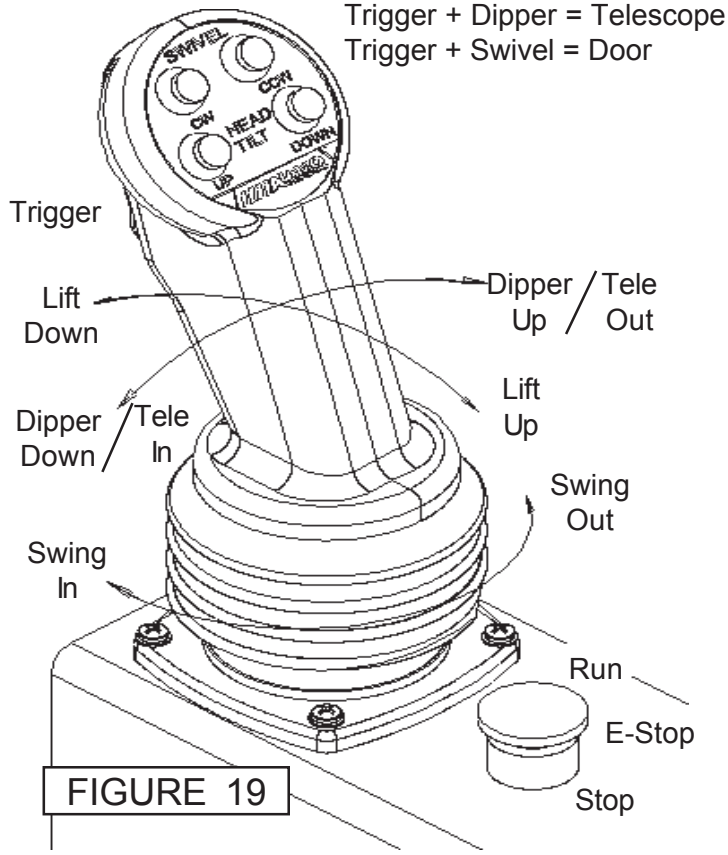


FIGURE 19

Joystick Functions

Push Buttons Only

Top Left	=	Swivel CW
Top Right	=	Swivel CCW
Bottom Left	=	Tilt Up
Botom Right	=	Tilt Down

Push Button & Trigger Switch

Top Left	=	Door Open
Top Right	=	Door Close

Handle Movement

Push Front	=	Lift Down
Pull Back	=	Lift Up
Push Right	=	Dipper Up
Push Left	=	Dipper Down
Rotate Right	=	Swing Back
Rotate Left	=	Swing Forward

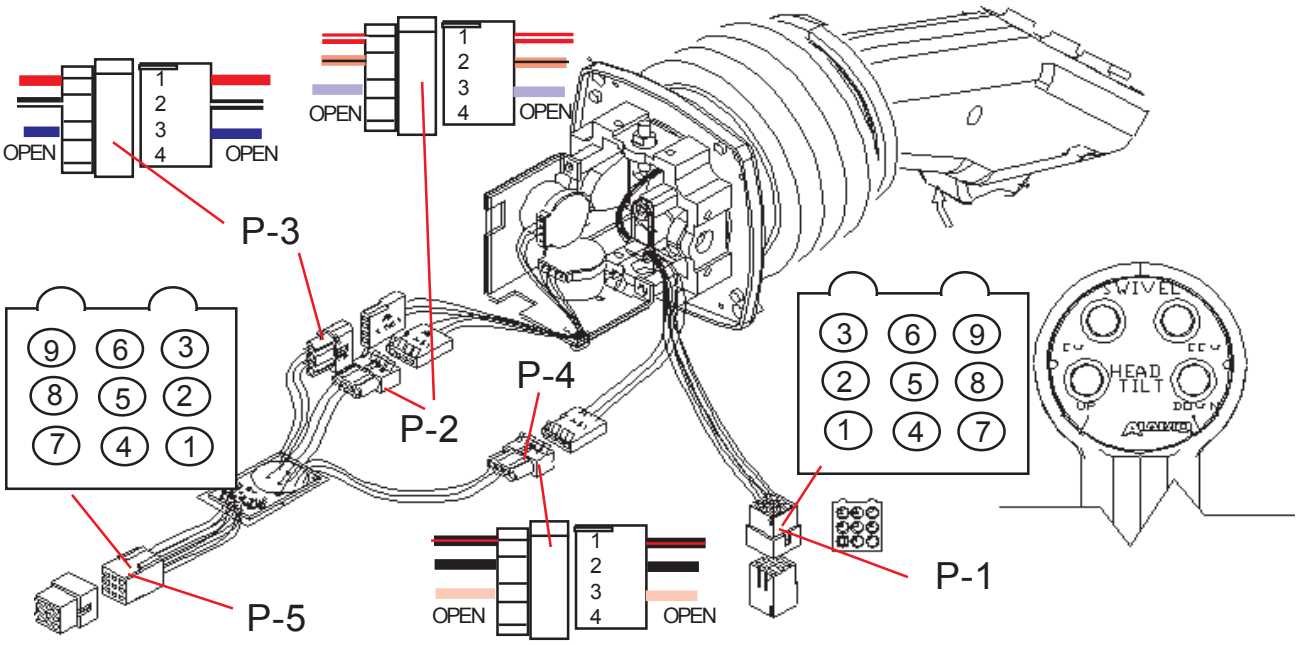
Trigger & Handle Movement

Push Right	=	Telescope Out
Push Left	=	Telescope In

JOYSTICK Schematic: (next page)

The Joystick Schematic shown on next page shows the plugs at the joystick. The Joystick is P/N 02981374. These plugs are mark with numbers on them and the pin location numbers are cast into the plastic plug. The wires are solid color or a color with a stripe. If testing any of these wires it is best to use a voltmeter.

CONTROL VALVE - JOYSTICK SCHEMATIC 02981374



Plugs are marked with numbers on them to identify the pins in that plug, these numbers are made onto the plug as shown in illustration above

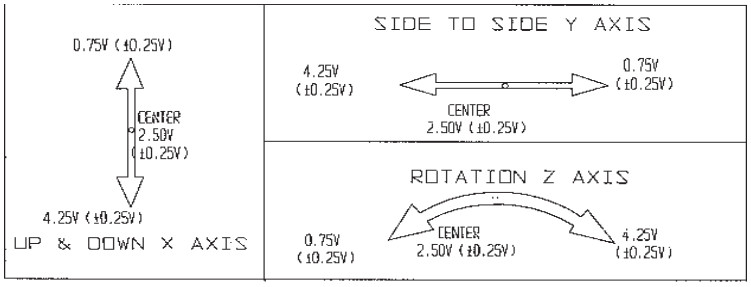
Plug ID	Pin No.	Wire Color	Function
P-1	1	Wht/Red	Power (+5V)
P-1	2	Wht/Grn	Up
P-1	3	Wht /Yel	CW
P-1	4	Wht/Blk	CCW
P-1	5	Wht/Blu	Down
P-1	6	Wht	Trigger
P-1	7	Open	Open (no wire)
P-1	8	Open	Open (no wire)
P-1	9	Open	Open (no wire)

Plug ID	Pin No.	Wire Color
P-2	1	Red/Wht
P-2	2	Brn/Blk
P-2	3	Vio
P-2	4	Open (no wire)

Plug ID	Pin No.	Wire Color
P-3	1	Red
P-3	2	Blk/Wht
P-3	3	Blu
P-3	4	Open (no wire)

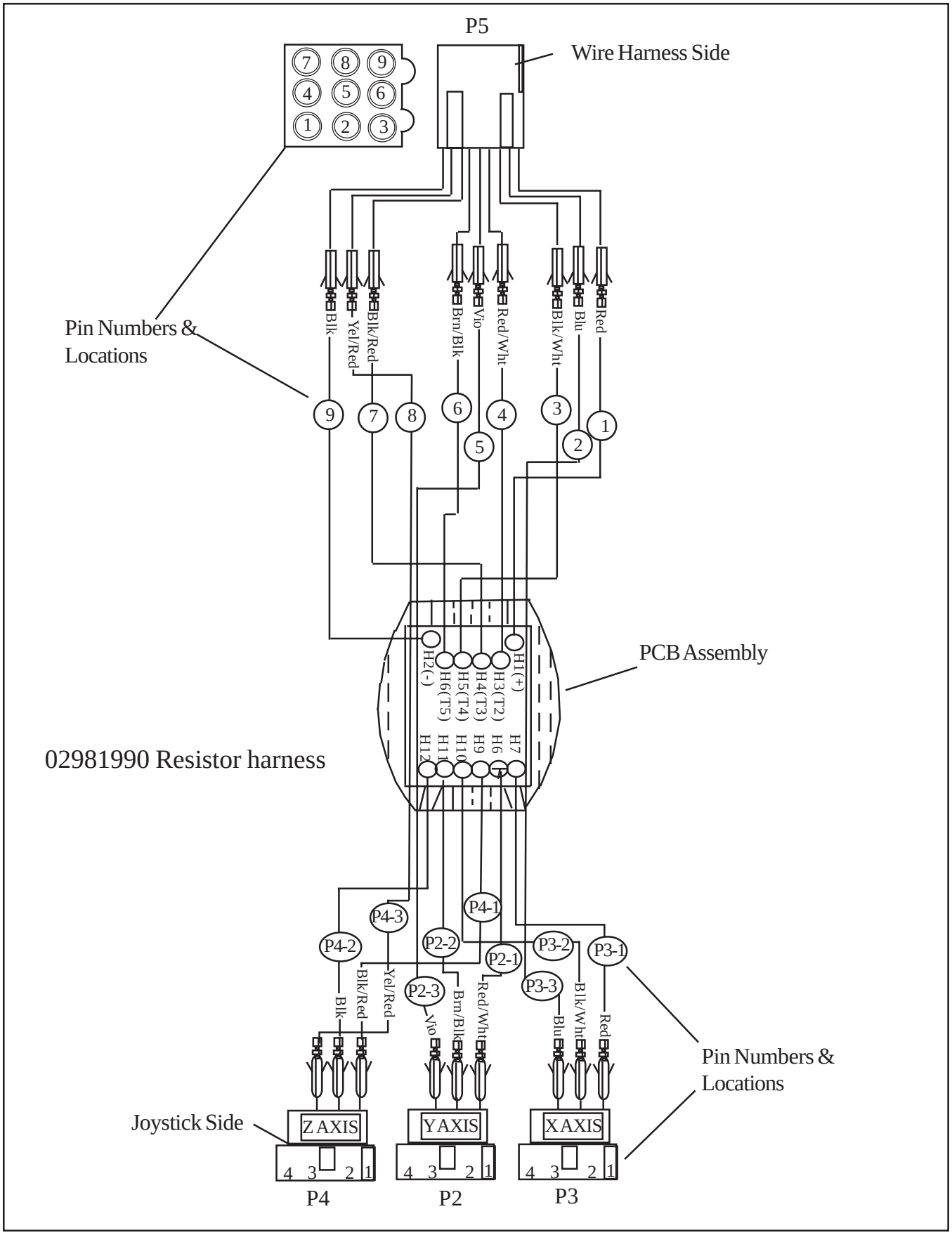
Plug ID	Pin No.	Wire Color
P-4	1	Red
P-4	2	Blk/Wht
P-4	3	Blu
P-4	4	Open (no wire)

Plug ID	Pin No.	Wire Color	Axis	Function
P-5	1	Red	X	Power
P-5	2	Blu	X	Output (0.5 to 4.5 V)
P-5	3	Blk/Wht	X	Neg. (-)
P-5	4	Red/Wht	Y	Power (+5V)
P-5	5	Vio	Y	Output (0.5 to 4.5 V)
P-5	6	Brn/Blk	Y	Neg (-)
P-5	7	Blk/Red	Z	Power (+5V)
P-5	8	Yel/Red	Z	Output (0.5 to 4.5 V)
P-5	9	Blk	Z	Neg (-)



Plug P-5 pin function Axis as show above

RESISTER WIRE HARNESS - P/N 02981990



RESISTER WIRE HARNESS - P/N 02981990

Item	Pin Location.	Qty.	Description
1	Pin 1 (P-5)	1	Red Wire
2	Pin 2 (P-5)	1	Blue Wire
3	Pin 3 (P-5)	1	Black & White Stripe Wire
4	Pin 4 (P-5)	1	Red & White Stripe Wire
5	Pin 5 (P-5)	1	Violet Wire
6	Pin 6 (P-5)	1	Brown & Black Stripe Wire
7	Pin 7 (P-5)	1	Black & Red Stripe Wire
8	Pin 8 (P-5)	1	Yellow & Red Stripe Wire
9	Pin 9 (P-5)	1	Black Wire
10	Pin 1 (P-2)	1	Red & White Stripe Wire
11	Pin 2 (P-2)	1	Brown & Black Stripe Wire
12	Pin 3 (P-2)	1	Violet Wire
---	Pin 4 (P-2)	0	Open (No Wire)
13	Pin 1 (P-3)	1	Red Wire
14	Pin 2 (P-3)	1	Black & White Stripe
15	Pin 3 (P-3)	1	Blue Wire
---	Pin 4 (P-3)	0	Open (No Wire)
16	Pin 1 (P-4)	1	Black & Red Stripe Wire
17	Pin 2 (P-4)	1	Black Wire
18	Pin 3 (P-4)	1	Yellow & Red Stripe Wire
---	Pin 4 (P-4)	0	Open (No Wire)

NOTE: Listed above is the resister wire harness P/N 02981990, this harness connects to the joystick and interior wire harness. The wire colors indicate which pin is which wire. The plugs will have numbers on them to indicate pin location.

Emergency Stop Switch P/N 02964028A

Emergency Stop (E-Stop) Switch:

The emergency stop switch, also referred to as the E-Stop Switch is to stop the head motor from turning. It is designed to stop the blades from rotating in 6 second from time switch is activated. The E-Stop switch will not allow the head to start when activated the Switch is engaged, if you are unable to get head to start always check this first.

Some parts may not be available as replacement parts for this switch, available as an assembly only.

The emergency stop switch is mounted in the arm rest, if it is not mounted in arm rest it must be mounted where operator can have access to it immediately if needed.

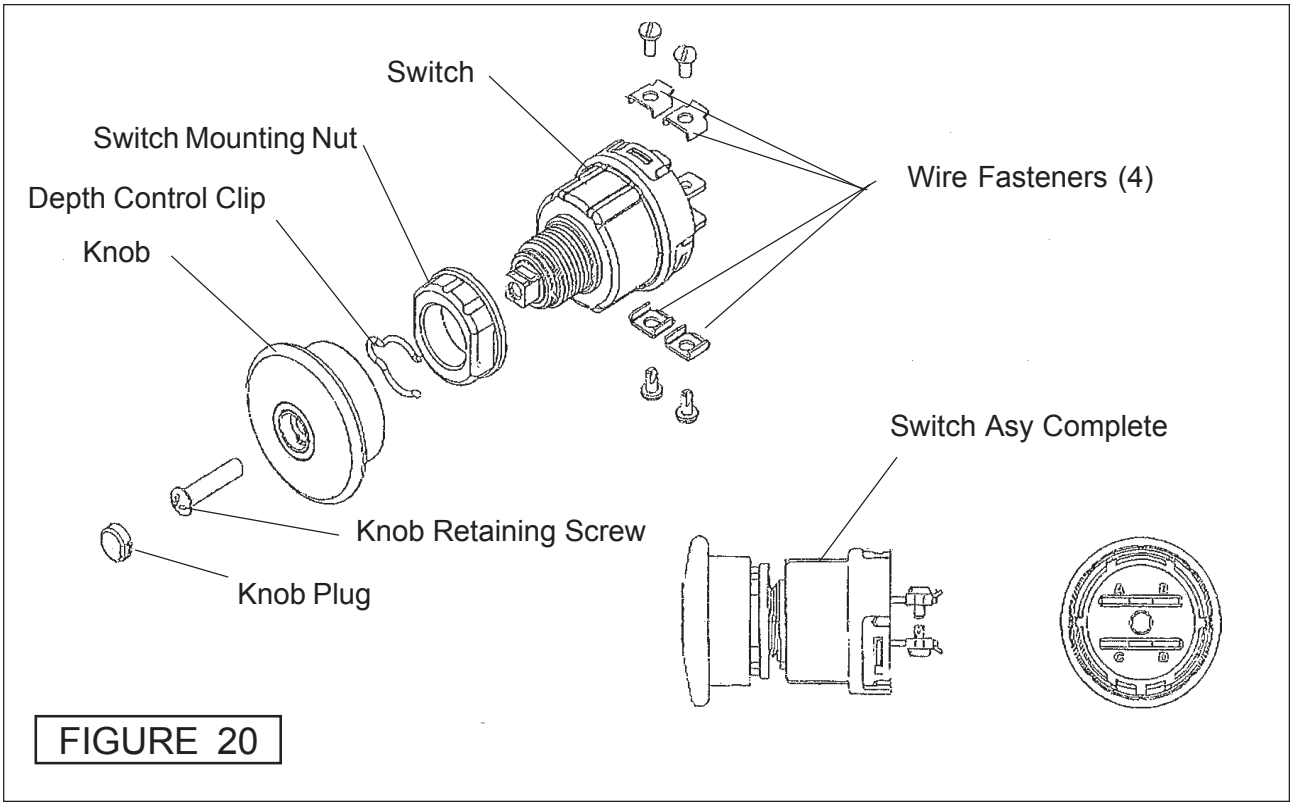
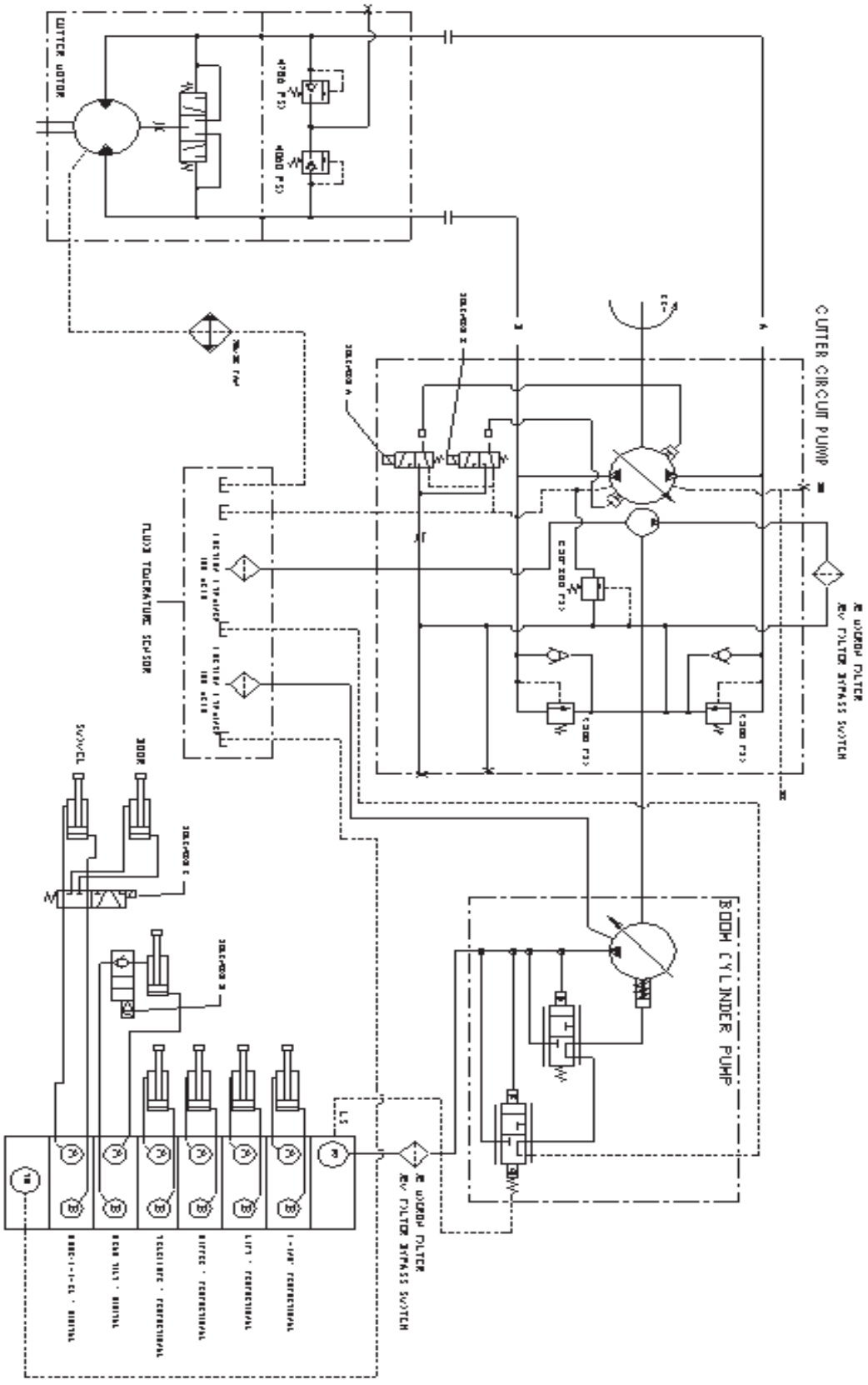
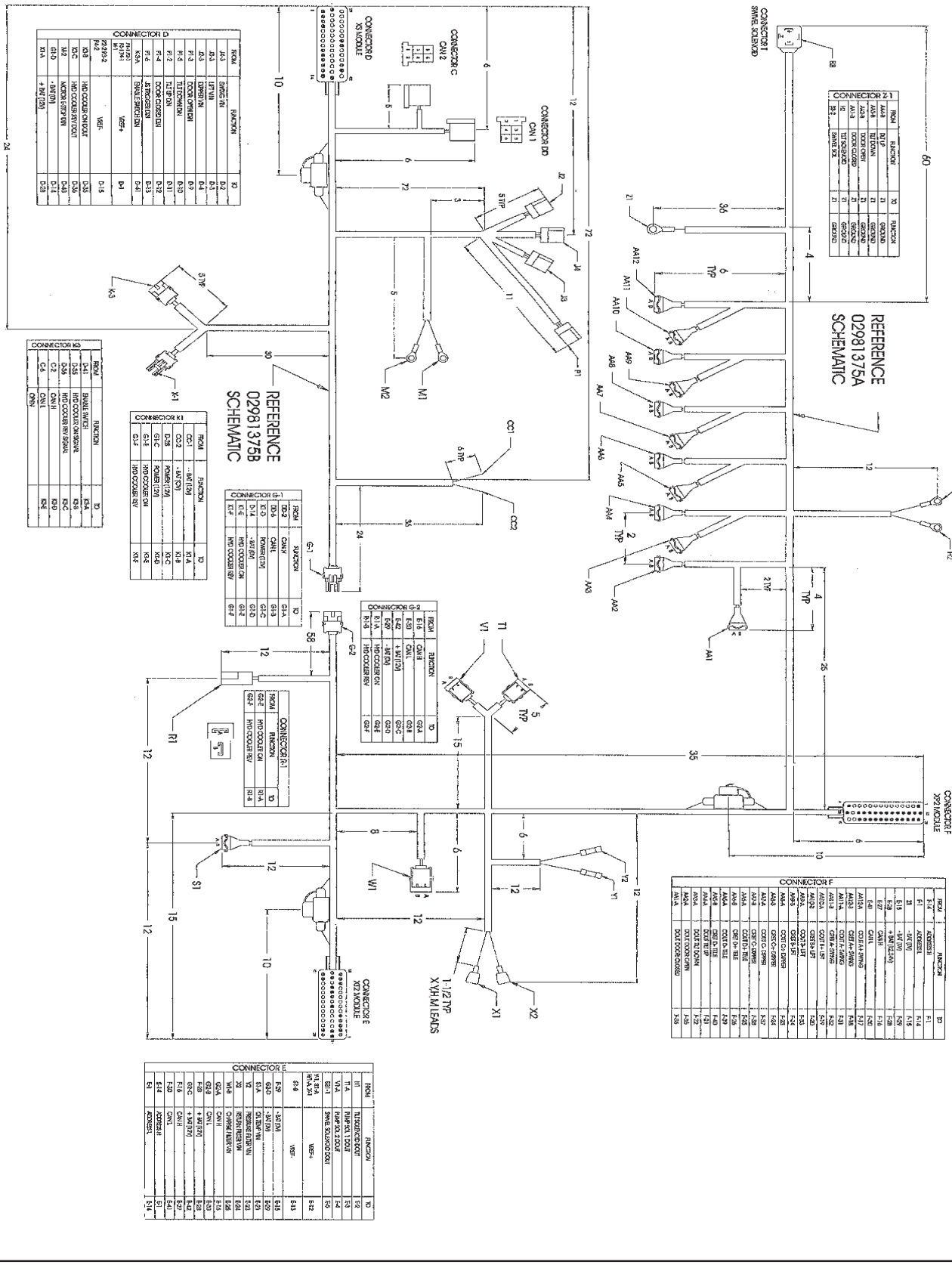


FIGURE 20

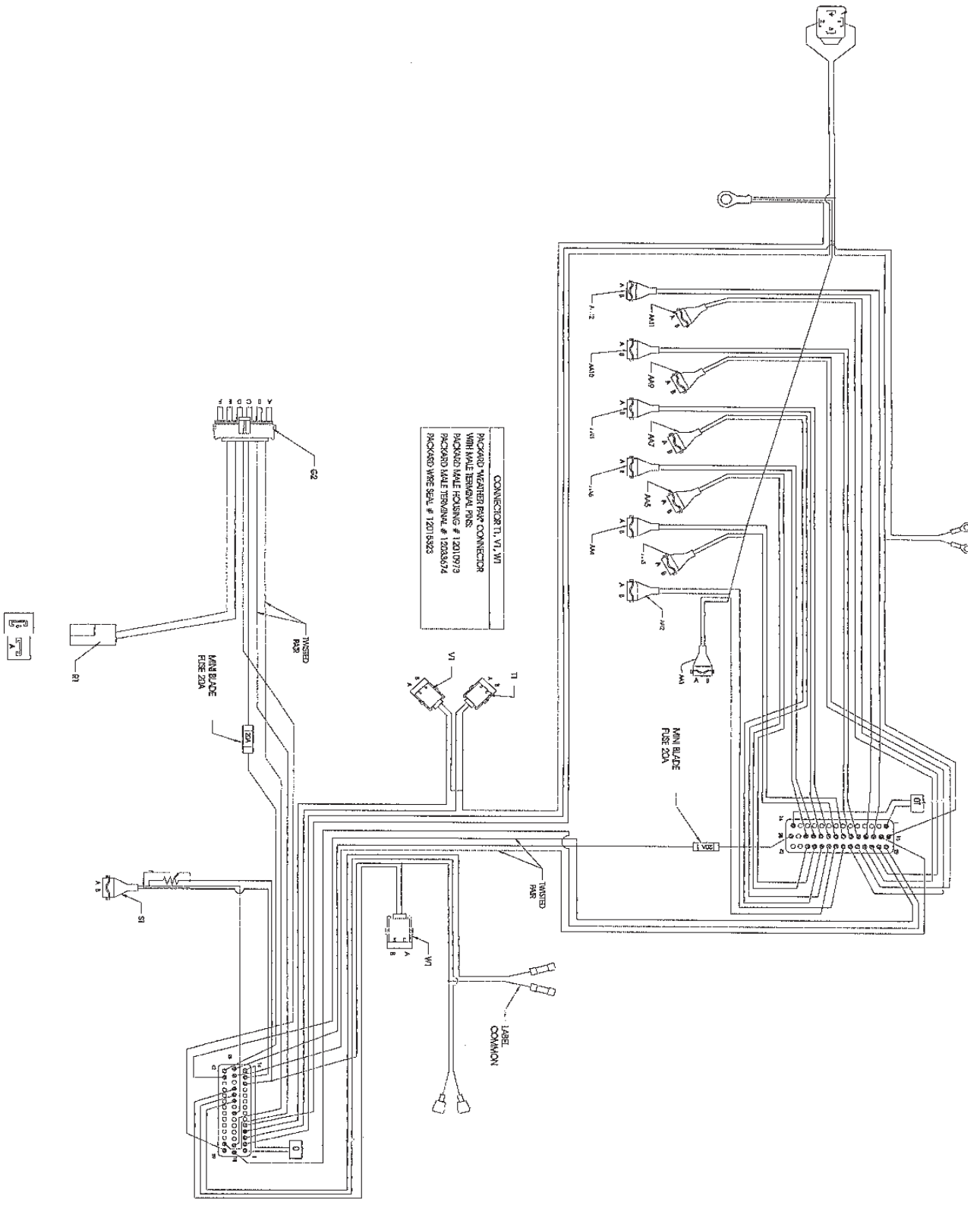
Hydraulic Schematic P/N 02981897



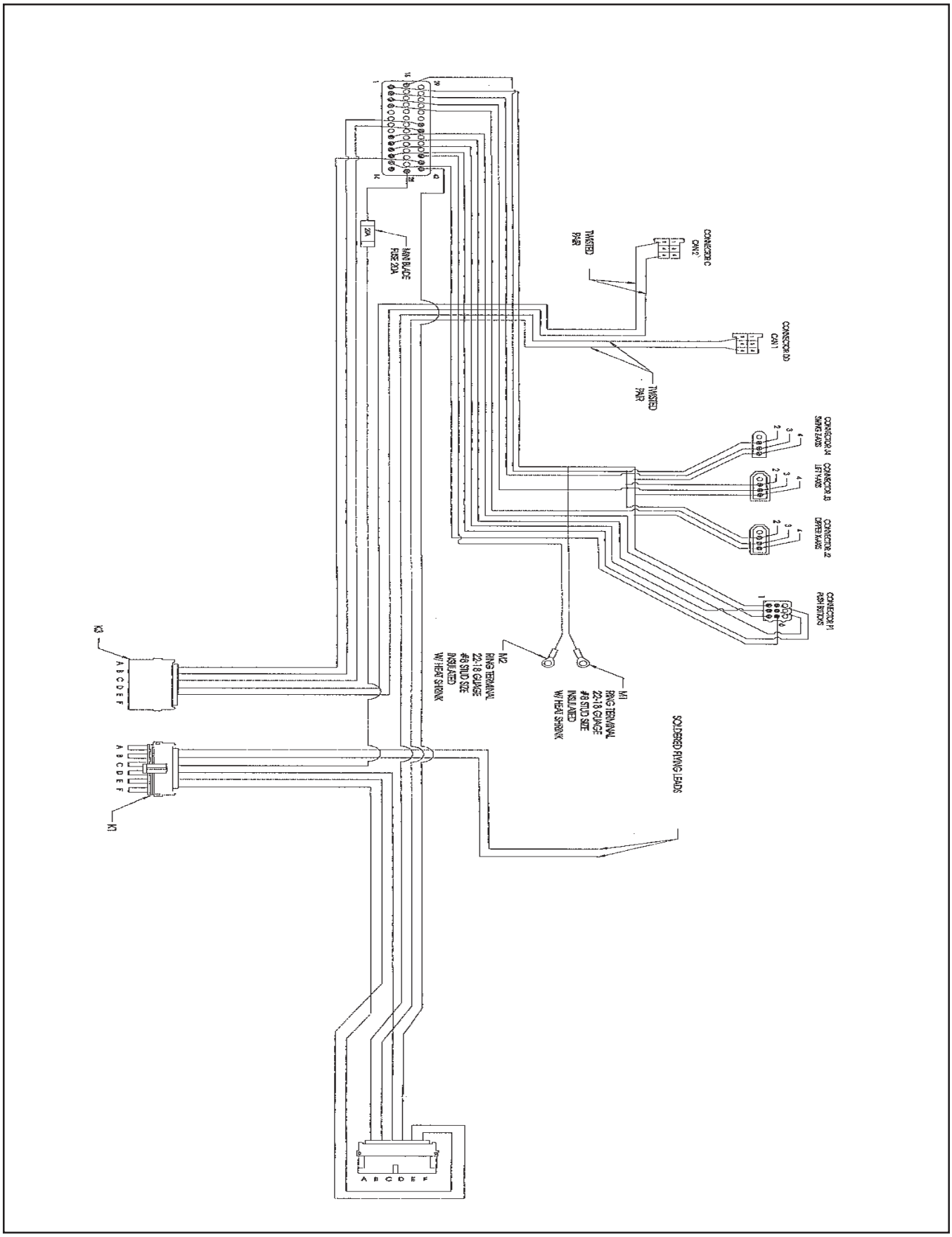
Wire Harness Schematic, Exterior P/N 02981375



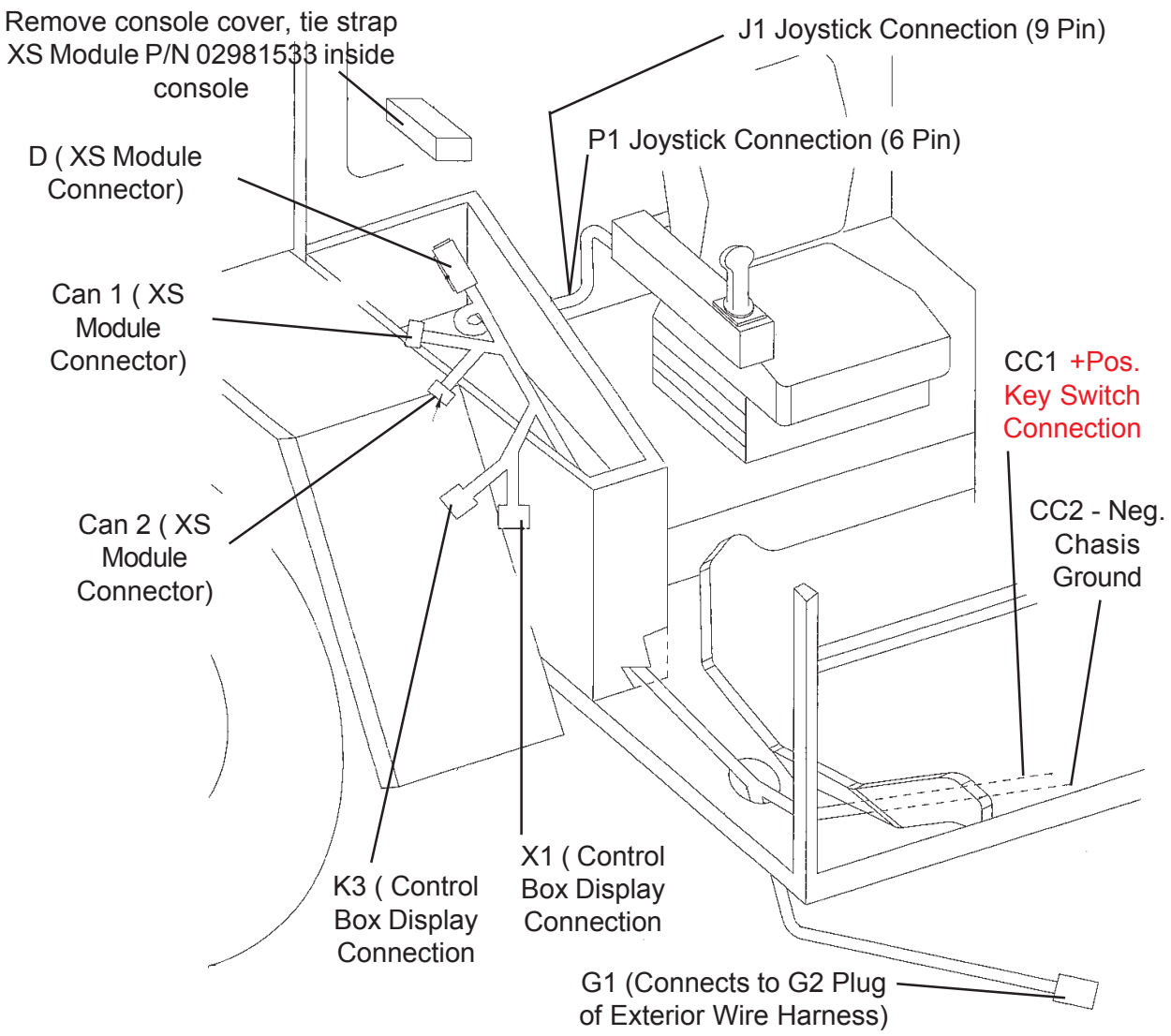
Wire Harness Schematic, Exterior P/N 02981375A



Wire Harness Schematic, Interior P/N 02981375B



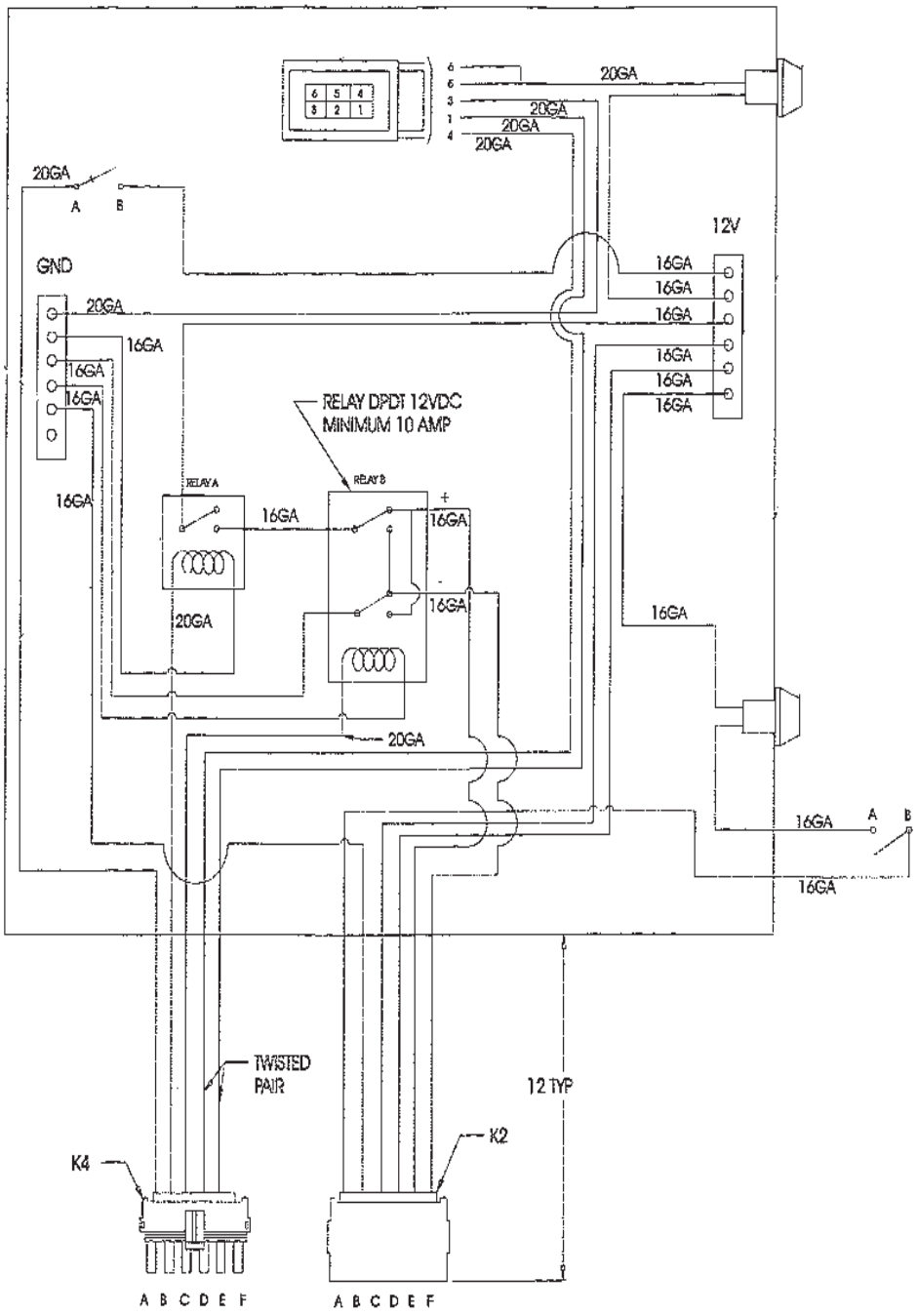
Wire Harness Schematic, Interior P/N 02981375B



Code	Connection
Can 1	XS Module Can1 Connection (2 of 3 Connections)
Can 2	XS Module Can 2 Connection (3 of 3 Connections)
CC1	+ Positive Key Switch Connection **(MUST Connect to key switch wire)**
CC2	- Negative Chasis Ground
D	XS Moudule C1 Connection (1 of 3 Connections)
G1	Exterior Harness G2 Plug (coonnects Interior & exterior Harness)
J1	Joystick Resister Harness (9 Pin Plug)
K3	Control Box Display Connection (1 of 2 Connections)
M1	E-Stop Switch (use A or B of Switch)
M2	E-Stop Switch (use A or B of Switch)
X1	Control Box Display Connection (2 of 2 Connections

Above wire harness is the same as the one on the previous page, except that it is overlayed over a tractor drawing to illustrate how the wiring is layed out when installed into the tractor

Control Box Wire Schematic, Interior P/N 02981376



JOYSTICK TROUBLE SHOOTING:

The Joystick Wiring Harness has 2 wire connections to link Joystick to Tractor Power Supply (12 Volt DC). One red colored wire (for Positive Connection) and 1 Black colored wire (for Ground Connection). These wires will provide power to start the Front Auxilary Pump that runs the Cutting Head Motor Circuit and power to operate the 5 spool Valve Electrical Circuits. The Hydraulics to operate Spool valve is furnished by the secondary pump system mounted to the front pump.

With the Switch (Keyed Switch) of tractor in the "On" position and the Rocker Master Switch on Display Console in the "On" position a Light (on Master Switch) should be on. This light indicates that electrical power is available to the control circuits. To Check this Current at Switch (Master or Motor Stop Start Switch) it can be done with a test light or Voltmeter.

VALVE CONTROLS CONNECTION TROUBLE SHOOTING:

1. **Proportional Controlled Functions,** Only the Swing, Lift, Dipper and Telescopic Functions are Proportional Controlled, Therefore only these three functions will show progressive readings. The Tilt, Door and Swivel Functions are "On" or "Off, when checking keep track of which connection is being checked, as it will make a difference in reading on voltmeter

2. **All Connections are marked on plug** where they plug onto Valve (See Figure 5)

3. Make sure Tractor Engine is off and cannot be started while you are working on it.

4. **Relieve Any Hydraulic Pressure,** Make sure any Hydraulic Pressure in any Lines or Cylinders has been relieved and Mower / Boom are resting on the Ground completely. This should be done by working the Manual Overrides on Valve to be sure pressures are relieved.

5. **Turn on Ignition** Switch of Tractor to the "On" position (But DO NOT Start Engine)

6. **Activate J's through Display.**

7. **Remove the "Din" connector** from the control Valve Section being tested to check voltage.

8. **The Spade type Pins** will be on the Section of the Valve and the plug will have slots where it plugs on, Each of these connectors have numbers at the slot to ID which connections (see Figure 5) connect where, these plugs cannot be reversed, will only plug on one way.

9. **Tilt Function,** The Tilt Section incorporates a 'Lock Out Solenoid" on the down function side that operates on 12 Volts, See previous page (Figure 3) for this Lock Out Solenoid Valve

JOYSTICK TROUBLE SHOOTING:

VALVE CONTROLS CONNECTION TROUBLE SHOOTING: (Continued)

10. **Emergency Field Test,** Can be performed without a Voltage Meter, But it is always best to use a Voltmeter for electrical testing. NEVER use an extra 12 Volt hot wire to supply current to connections for testing Valve or Joystick connections or components as it would damage components.
Emergency Field Test, if in a remote location and you do not have a Volt Meter, You can test the Joystick and Harness by temporally relocating (swapping) the plugs on the Valve to make another action performs a different function. This will tell if the problem is in Joystick or connections. Also in an emergency situation this method could be performed to get unit in transport position or use method in next step. Note: be sure to move any swapped connection back to their original location when diagnosing a problem.

11. **Mechanical Valve Test, This** test will tell if problem is in Valve or electrical Circuit. This can also be used to put unit in a transport position or to move unit in emergency situations. There is a manual override on the valve that will allow you to move the Components (Boom, Head & Etc.) Manually. **Follow the following steps.**

A. Use extreme caution while performing this operation, Know where every one around you is at all the times! DO NOT do this if you are not experienced with the functions of unit, Go back and learn Functions.

B. With Tractor Engine On and pump engaged.

C. Turn “On” Master Switch on Joystick Console, This will engage pump and all electric functions.

D. Make sure no one is near Tractor, Boom or Head.

E. Locate Control Valve, It will be mounted in Front at Front Pump.

F. Remove all covers required to gain access to Valve.

G. With Tractor Engine running, it is necessary to have pump pressure for this activity.

H. Go to valve and look for activator solenoids, unplug the wire harness connection for the function you want to manually activate. In the center of the solenoid you will see a pin, depress (push) this pin inwards, the movement of this pin should correspond to the required cylinder and direction. USE CAUTION, movement may be quick and jerky, so as not to damage anything press pin slowly and watch the reaction to get familiar with movement speed.

Section 4

TANDEM PUMP SECTION

Motor & Cylinder Supply Pumps

24' & 30' BOOM

PUMP - MOTOR & BOOM CIRCUIT

INTRODUCTION:

The information in this Section of Book is re-printed with Permission of the Eaton Corp. This Section of Book provides service information for the Servo Controlled Piston Pump P/N 02967192. Step by Step instructions for the complete dis-assembly and re-assembly of the Pump are given. In Most diagrams there are no Component Part Numbers Listed, Only Item numbers and Descriptions, This is because most parts shown as break-down in drawings are for location & identification only and are not available as replacement parts. NO Dirt at all should be around Parts during repairs.

BEFORE STARTING REPAIRS: Service Rules (READ THIS)

1. Remove Front Cover. Clean Pump and surrounding area completely before removing any connections or Lines. NO DIRT OR DEBRIS CAN BE ALLOWED ON OR NEAR HYDRAULIC SYTEM IF IT IS BEING WORKED ON, ANY DIRT OR CONTAMINANTS IN SYSTEM NO MATTER HOW SMALL WILL DAMAGE SYSTEM!
2. After cleaning around all connections thoroughly, Dis-connect all connections, Lines, Hoses, Wiring and Remove the Pump Completely from the Tractor. Plug all hoses and Lines on Tractor and on Pump, DO NOT leave any open Lines. NO Contamination Should be allowed into system at all.
3. Clean Area, Clean all Tools, Pans etc. The cleaning of Area and Tools MUST be done before moving (Cleaned) Pump there. Drain Oil from Pump, Recheck outside of Pump to Make Sure it is Clean
4. After dis-assembly of Pump wash all metal components in clean solvent.
5. Use compressed Air to dry parts after washing (Compressed air must be filtered and moisture free). DO NOT wipe them dry with Paper Towels or Cloth as these will leave lint and/or dust contamination. DO NOT USE Compressed Air to spin any component (Such as Bearings or Plates) as this will damage them and could be dangerous.
6. Always use new Seals when re-assembling Hydraulic Pumps, Lubricate the new rubber Seals with a Petroleum Jelly, (Vaseline) before installing them.
7. DO NOT reinstall worn or damaged Parts back in Pump, DO NOT Use a worn or damaged Pump Housing.
8. Torque all Bolts over Gasketed Joints. Then repeat the Torque sequence to make sure Bolts are tight, some times Gaskets can give a Torque reading that is OK but is not, so always re-check Torque.
9. Verifying the accuracy of Pump Repairs on an authorized test stand is essential.

REQUIRED TOOLS:

1. Hex Allen Wrench (Qty 5) (9/16", 5/32", 5/16", 3/32", 5/64"
2. Retaining Ring Pliers (Qty 3), 1 each of Internal (Straight .070 tip) internal (Straight .090 tip) & 1 each External (Straight 0.90 tip)
3. Retaining E-Ring Applicator (Qty 2), 1 each 9/32" & 1 each 1/2".
4. O-Ring Pick (Qty 1)
5. End Wrench (Qty 4), 1 each of 7/16", 9/16", 3/4", 1"
6. Torque Wrench (Qty 1), 0 to 100 ft. lbs. (135.6 nm) capacity
7. Hammer, Soft Face (Qty 1)
8. Seal Driver Set (Qty 1)
9. Arbor Press (Qty 1)
10. Sockets (Qty 3) 7/16", 9/16", 3/4" (Drive Size should match Torque Wrench Drive)
11. Light Petroleum Jelly (Vaseline)
12 Locktite, # 222 and #277 or equivalent (Qty 1 tube each)

PUMP - MOTOR & BOOM CIRCUIT

RECOMMENDED GAUGES FOR DIAGNOSTICS:

1. Inlet Vacuum: 30 PSI to 30 in Mercury (207 bar to 0 bar)
2. System Pressure Gauge: 6,000 PSI (700 bar)
3. Charge Pressure Gauge: 0 to 500 PSI (0 to 25 bar)

SYSTEM / CHARGE RELIEF PRESSURE SETTINGS:

Inlet Vacuum:	6 in Mercury (.203 bar)
Case Pressure:	25 PSI (1.7 bar)
Charge Pressure:	250 to 300 PSI (17.24 to 20.68 bar)
System Pressure:	4500 PSI Max / 3000 PSI Continuos (306 bar Max 207 bar Continuos)
Motor Relief:	4000 PSI (272 bar)

The High Pressure relief Valves are all Factory Pre-Set and Cannot be re-adjusted.

The Pressure Setting is stamped on each valve with a three digit Code number. To identify, Multiply this stamped number by 10 to get the Valves pressure settings, Example 500 stamped in valve is 10 X 500 = 5000 PSI (345 bar).

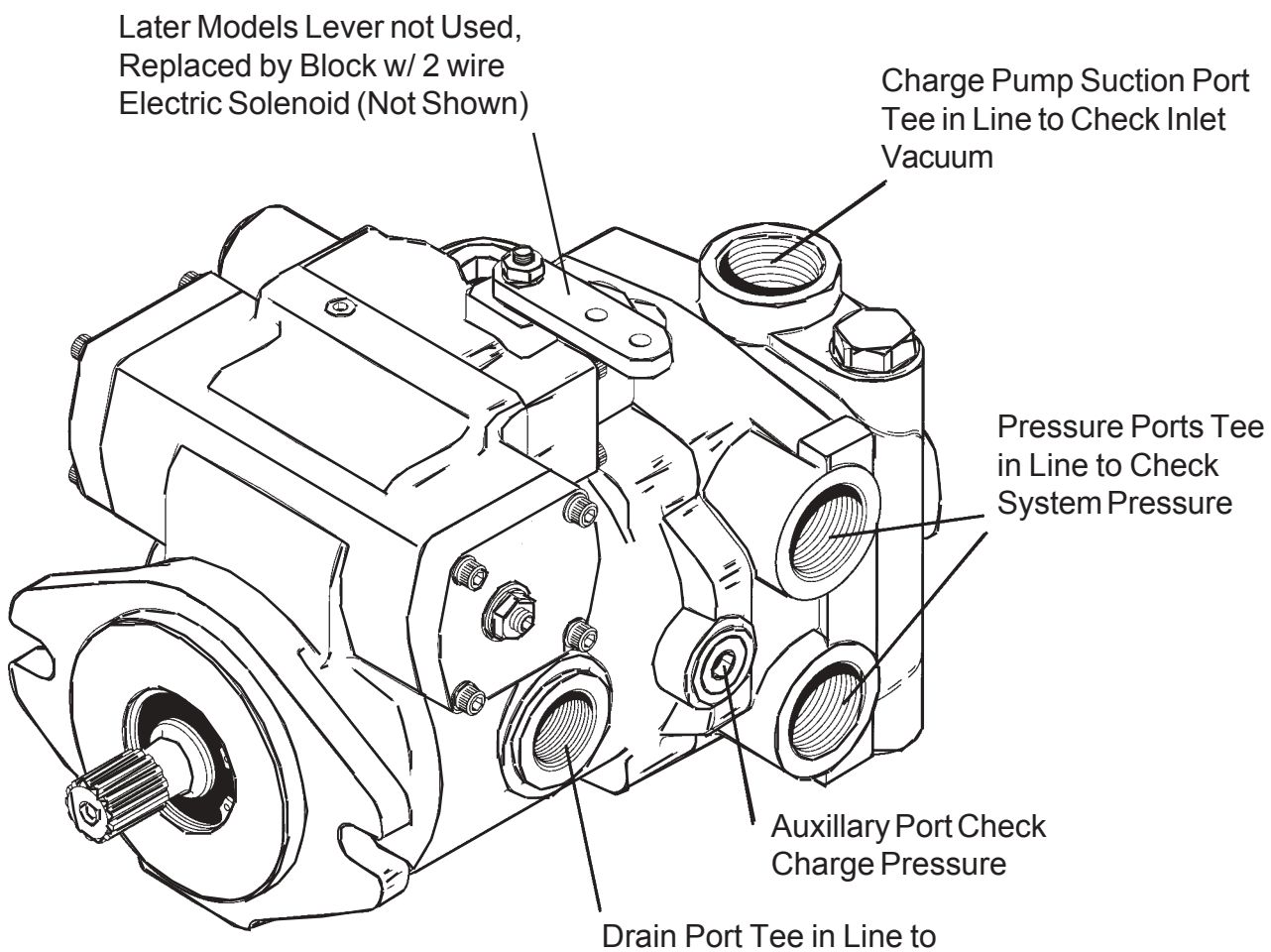


FIGURE 20

IMPORTANT! Pump MUST be PRIMED with Hydraulic Oil prior to operation for the first time, this is very important.

Prime Hydraulic Pump:

1. **<u>The Hydraulic Pump MUST be Primed.</u>** The hydraulic pump is primed by putting oil directly in to the pump. Looking at the pump, out near the end of the pump there is a Allen plug (See Figure 21A). Remove this plug and install only approved hydraulic oil (See Step 1 through 3 of hydraulic tank filling). Fill the cavity completely full up to plug threads. IMPORTANT! This must be done before the unit is ever started. Make certain that the O-Ring Seal is on plug and reinstall it after cavity is full of oil, now the pump is primed. The Unit still will not operate until the step of setting the electronics to operate the system are done.

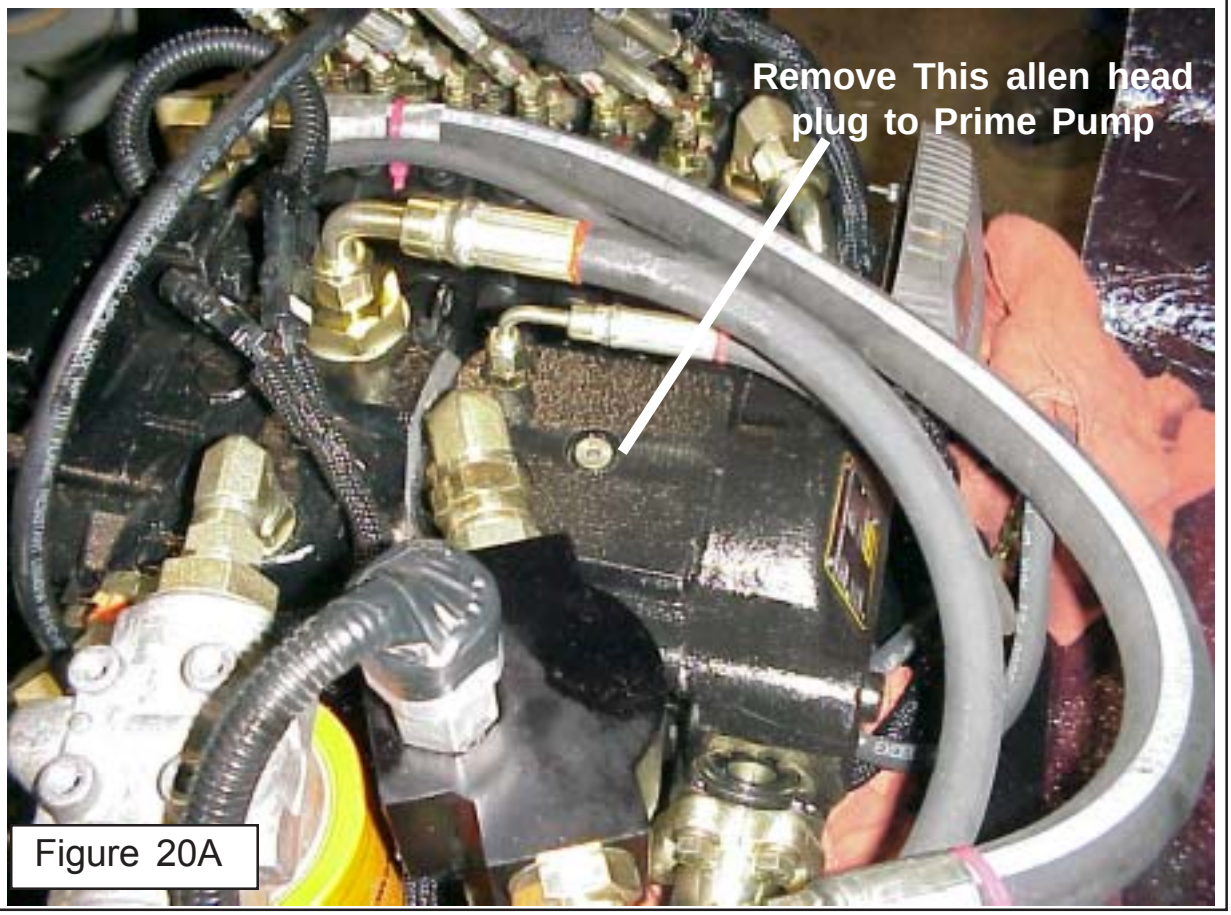


Figure 20A

MOTOR CIRCUIT - PUMP ENGAGE

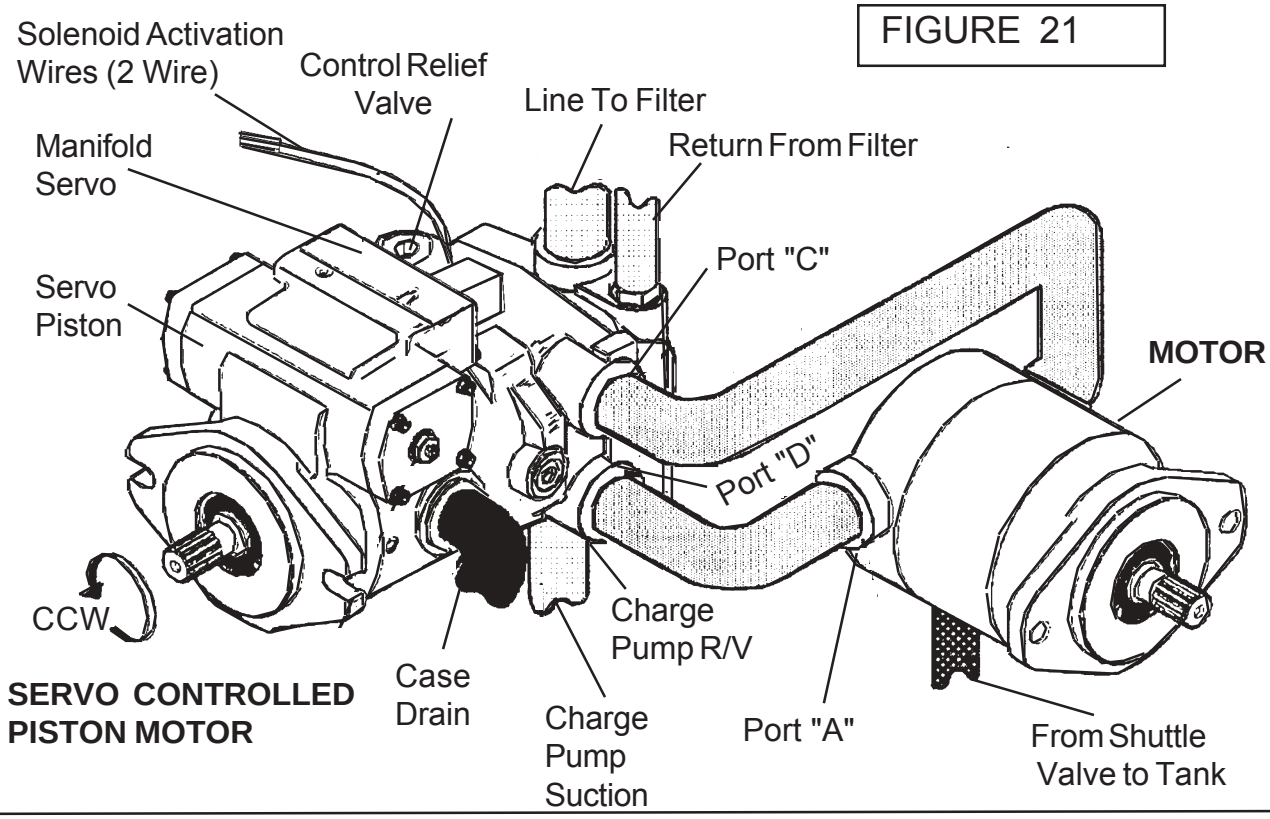
Note: The Servo Control Valve, Lever and Solenoid have been replaced by a manifold and Solenoid valve Cartridge, Please make note on all diagrams and text.

The Method used on the Machete to transmit Engine Power to the Mowing Head is called a “Closed Loop” or “ Hydrostatic” System (Figure 21). Engine Power is converted to Hydraulic Power by the Variable Displacement Hydraulic Piston Pump. Oil is sent to the Fixed Displacement Motor through the Hoses that run down the Boom. Oil passing through the Motor converts the Hydraulic Power Back into Mechanical Power to Rotate the Blades.

The Shuttle Valve in the Motor returns 8 GPM back to the Tank for Cooling. The remainder of the return oil remains in the Closed Loop. Some of the advantages of using a Closed Loop System for the Motor Circuit are, 1. A Smaller quantity of Oil is required, 2. System acts as its own “Brake” slowing down the Blades and 3. Less Fuel consumed due to “No Load” condition when Motor Circuit is disengaged.

Another feature of the Alamo System is that the Oil is filtered after it leaves the Charge Pump and before it enters the High Pressure Loop.

FIGURE 21



The Motor Circuit is engaged by two Manually Operated Switches (See Figures 36, 37, & 38 in Motor Repair Section for Types Used). These Switches have varied from “On - Off” to “Momentary’, But all have served the same purpose. Closing the Switches completes a Circuit through the Solenoid. The Purpose of a “Solenoid” is to actuate a Pump Control, which actuates a Valve to turn on the Pump; this has varied some over the years. This movement causes the Camplate in the Pump to move. Movement of the Camplate when the Pump is turning causes the length of Piston Stroke to Change, Causing Oil to too be moved. The Greater the Angle, the longer the stroke, The longer the stroke the more Oil is Pumped, and the more oil pumped means the motor turns faster.

MOTOR CIRCUIT - PUMP ENGAGE

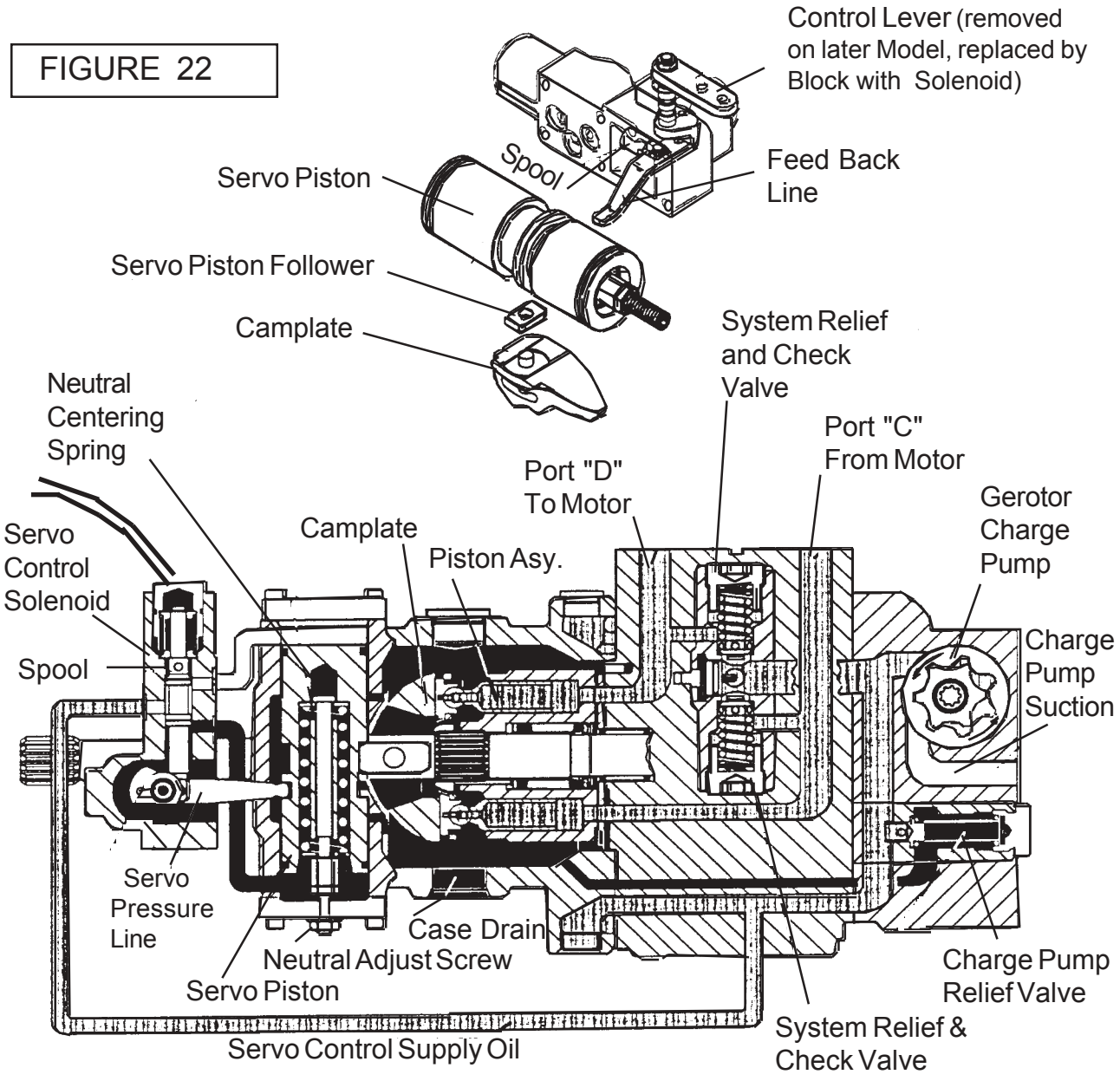
Note: The Servo Control System, (Changed see "Note" on Previous Page)

Movement of the Variable Displacement Pump Control Lever (Figure 22) starts pump Output. As Lever is rotated, it moves the Spring centered Servo Control Spool first. Movement of the Spool allows Charge Pump Oil past the Spool to one side of the Servo Piston (Figure 22). The Pressurized Servo Piston pushed against the Camplate (figure 22) causes the Camplate to rotate to a Pre-Set Angle. Oil from the opposite end of the Servo Piston is exhausted to the Pump Housing through the Control Valve Spool.

When the Control Lever (Solenoid & Block on Current Models) is returned to the Neutral position, The Spool centers itself, allowing the Pressure on both ends of the Servo Piston to equalize. The Piston and. Camplate return to a Neutral position and Oil flow from the Piston Pump ceases.

Orifices between the Control Valve and the Servo Piston control speed of the Camplate movement. Neutral Adjustment Screw is to set Servo in Neutral position to prevent flow to motor, a Buzz Bar Head will have a screw on both sides. Rotary head shown below.

FIGURE 22



MOTOR CIRCUIT - PUMP DIS-ENGAGE

Motor Circuit Disengage (w/ Engine Running)

The Alamo Closed Loop Motor Circuit ic considered to be Neutral when there is no output being generated by the Variable Displacement Pump, as the Shaft, Internal components and Charge Pump are being driven by Tractor Engine. The Camplate is in the centered position and the length of Stroke of the Pistons is equal, therefore there is no flow being generated by the pump

At this point the Charge Pump is drawing Oil through a Suction Screen from the Tank to provide flow to perform the following functions.

1. Keep the Circuit Primed and make up internal leakage.
2. Maintain Back Pressure on Pump asnd Motor Pistons
3. Operate Control Funtions to Start Pump.
4. Maintain Temperature Control, to prevent Oil Heating in Pump.

Oil from the Charge Pump is directed to two dual purpose system Relief and Check Valves (Figure 23). Since the Charge Pressure is greater than the pressure in either side of the Closed Loop , The Check Valves open and charged Oil (at Charge Pressure) is available to both sides of the closed Loop. When the System is primed, any excess Oil is relieved through the Charge Pump relief Valve, which maintains a pressure of 250 to 300 PSI.

The Piston Pump remains in Neutral as long as the Camplate remains in the centered position, this is controlled by the Servo Control System, If Pump does not stay in neutral check the Neutral Adjusting screw. This is usually noticed by Motor wanting to run.

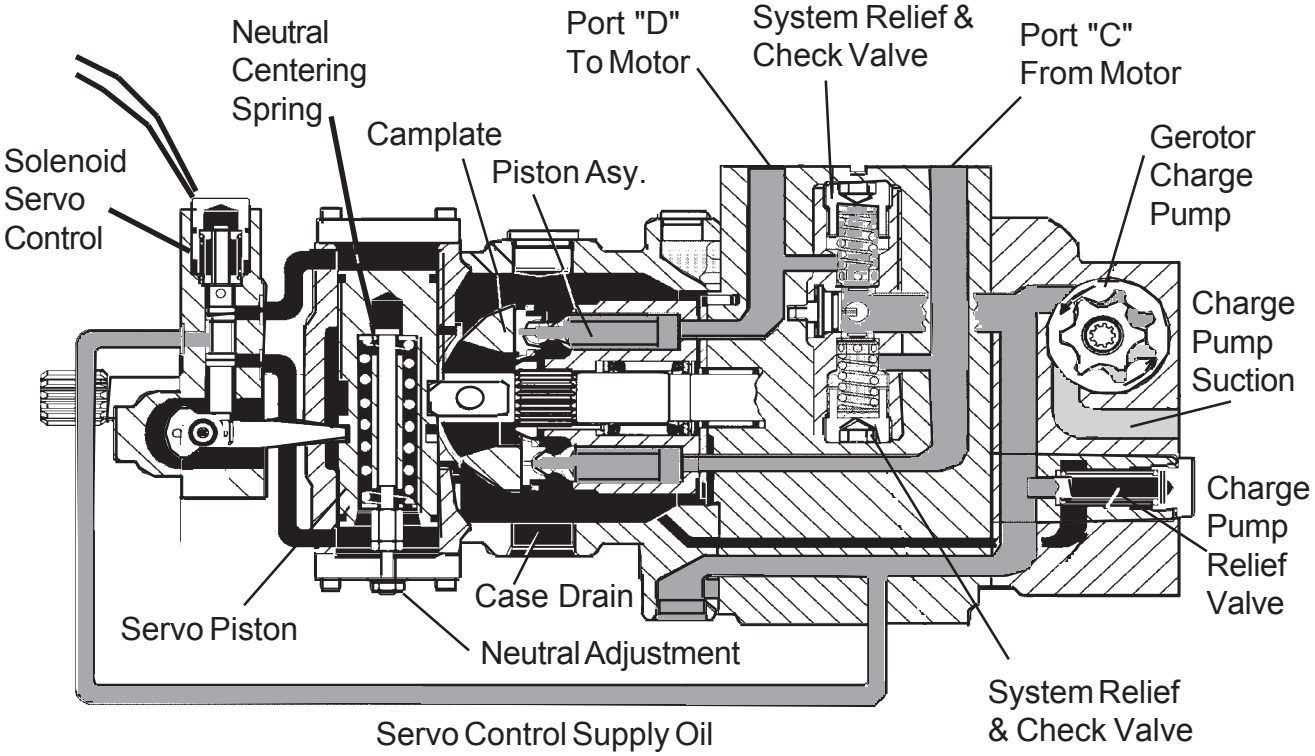


FIGURE 23

MOTOR CIRCUIT - PUMP ENGAGE

Motor Circuit Engaged (w/ Engine Running)

When the Switch and Solenoid are activated, The Servo control System moves the Camplate to its Maximum Angle. As the Piston Block rotates, The Angle of the Camplate causes the Pistons to move in and out of thier Bores as they follow the Camplate, This results in Oil being drawn into the Piston Bore as the Piston is pulled outward, and Oil being expelled into the other side of the Loop as the Piston is forced back into its bore, This creates the flow of Oil necessary to power the Motor. Movement of the Camplate angle from the neutral to maximum is set at approximatly 6 seconds and is controlled by the size of the Orfice between the Control Valve & Pump Case.

Oil under charge pressure is available at the Check Seats of the combination System Relief & Check Valves. As the Piston is drawn outwards in its bore, The combination of lower pressure in the Piston Bore and charge pressure in Port "C" causes the Check Valve for Port "C" to come off its seat, Allowing Oil At Charge pressure to fill the Piston Bore. As the Piston Block rotates the Oil is trapped in its bore by the Valve Plate. As the Piston Block rotates more, the piston is forced back into its bore expelling the Oil into Port "D" through an opening in the Valve Plate. The Higher pressure in Port "D" seats the Check Valve for Port "D", Seperating Oil in Port "C" from Oil in Port "D". Oil is forced to go through the Motor causing Motor Rotation.

Any Leakage from the Piston Block Valve Plate, Pistons, or excess Oil from the Charge Pump Relief Valve is vented to the case and is returned to Tank through the case Drain Port.

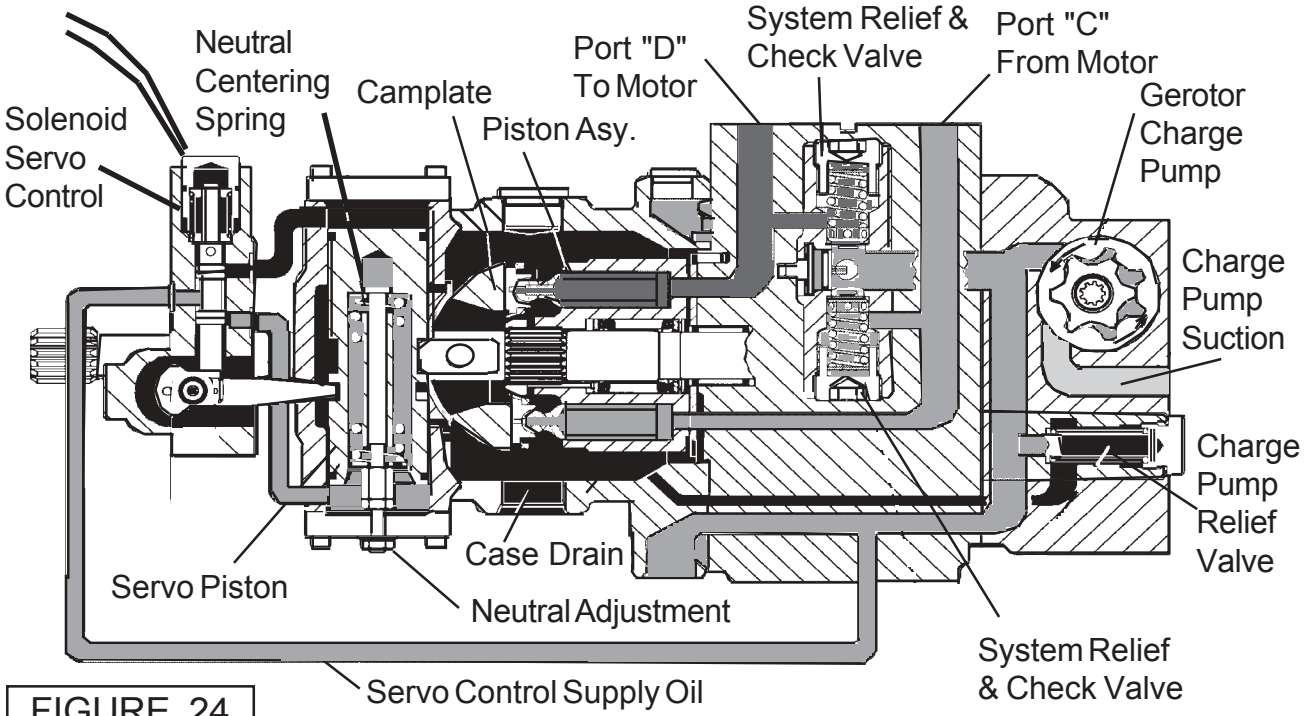


FIGURE 24

Relief Valve Operation:

When the pressure in Port "D" exceeds the setting of the Relief Valve (4500 PSI), the large Spring in the Relief Valve is compressed, Opening an Orfice allowing excess Oil to relieve into the Charge Circuit, Since the Check Valve for Port "C" is open, The Oil is available to the intake side of Pump

There is also a relief Valve in the High Pressure side of the Loop at the Motor. This Valve is set to relieve at 4000 PSI and is in the circuit to absorb pike pressure encountered during severe operation.

MOTOR CIRCUIT PUMP - PARTS LOCATION

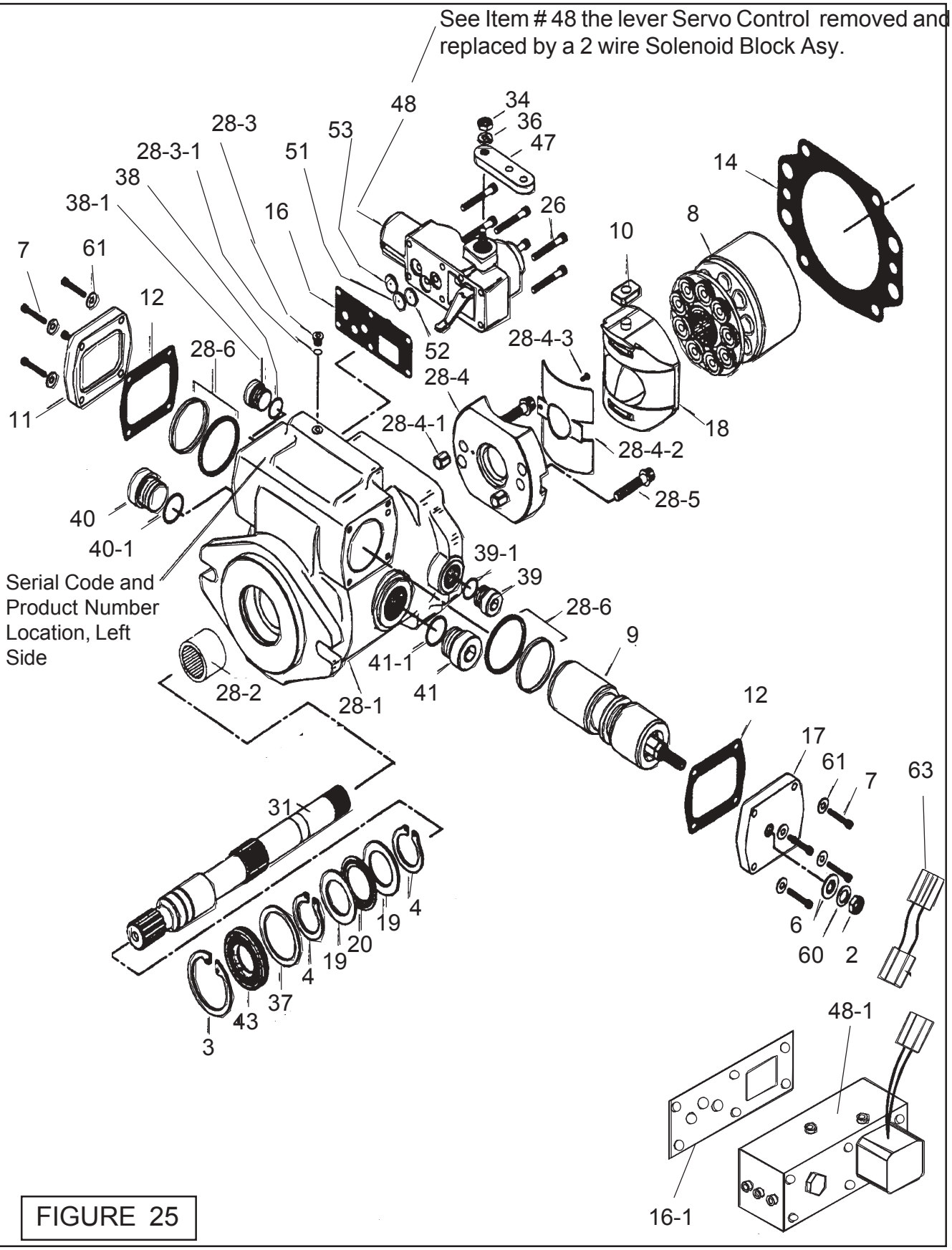


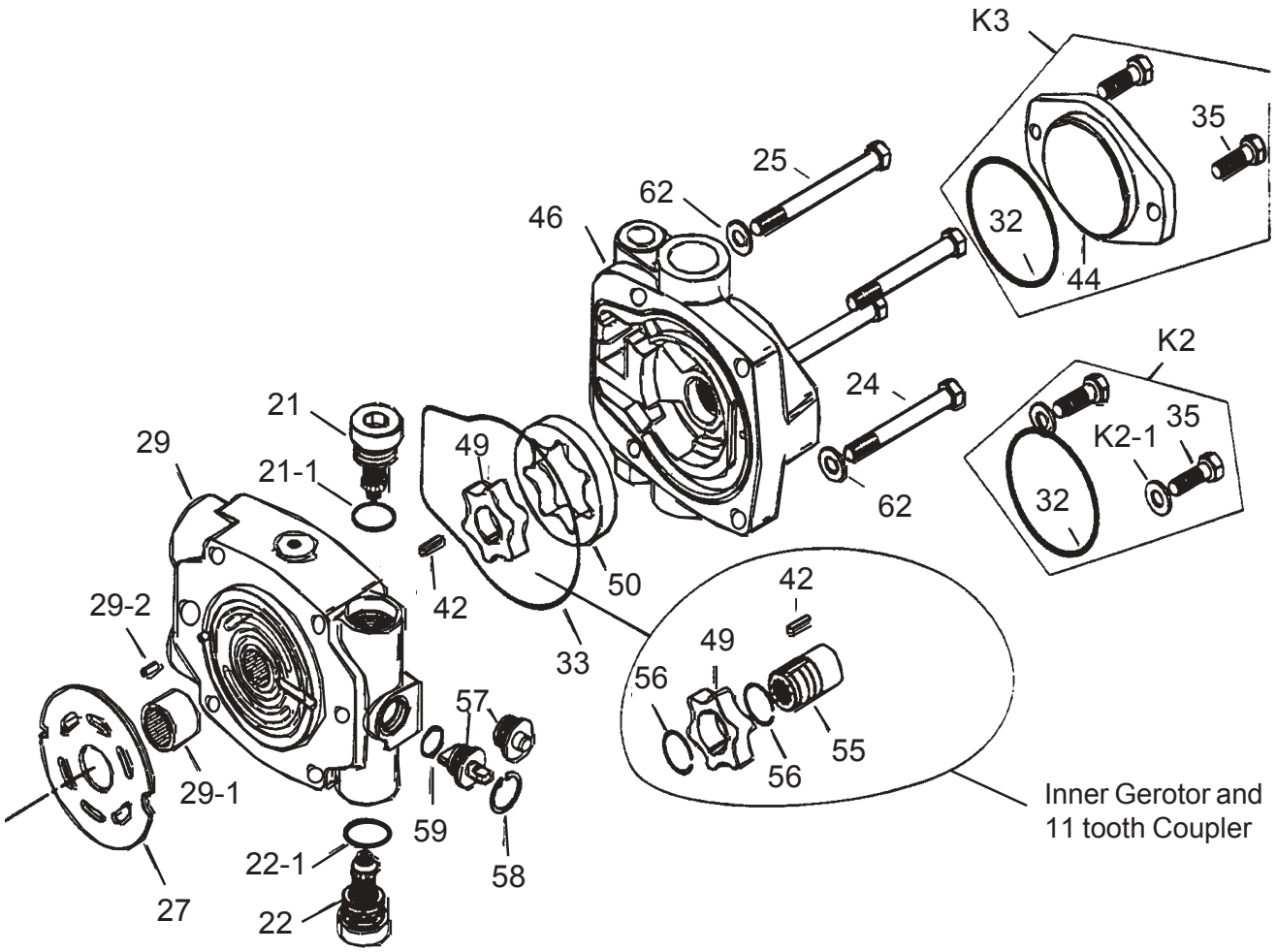
FIGURE 25

MOTOR CIRCUIT PUMP - PARTS LOCATION

Item	Qty	Description
2	1	Jam Nut
3	1	Retaining Ring
4	2	Retaining Ring
6	1	Seal Washer
7	8	Bolt, #10-24 X 1" (25.4 mm) Long
8	1	Rotating Kit Asy.
9	1	Servo Piston Asy.
10	1	Servo Piston Follower
11	1	Cover Plate
12	2	Gasket, Cover Plate
14	1	Gasket, Housing
16	1	Gasket, Control Housing (Used 1997 & Down)
16-1	1	Gasket, Solenoid Servo Asy, (Used 1998 & Up)
17	1	Cover Plate
18	1	Camplate
19	2	Thrust Race
20	1	Thrust Bearing
21	1	Relief Valve, For Port "C"
21-1	1	O-Ring, .097" Dia. X .755" ID, (2.46 mm Dia. X 19.18 mm ID)
22	1	Relief Valve, For Port "D"
22-1	1	O-Ring, .097" Dia. X .755" ID, (2.46 mm Dia. X 19.18 mm ID)
23	4	Bolt, 3/8"-16 X 2-1/4" (57.2 mm Long)
24	2	Bolt, 3/8"-16 X 3-1/5" (88.9 mm Long)
25	2	Bolt, 3/8"-16 X 4" (101.6 mm Long)
26	6	Bolt
27	1	Valve Plate
28	1	Housing Asy (Includes Following Items)
28-1	1	Housing Only
28-2	1	Bearing, Press Fit
28-3	1	Plug, Sub-Asy.
28-3-1	1	O-Ring, .064" Dia X .239" ID (1.63 mm Dia X 6.1 mm ID)
28-4	1	Cradle Sub-Asy
28-4-1	2	Dowel Bushing
28-4-2	1	Bushing
28-4-3	1	Bolt, Button Head
28-5	2	Bolt
28-6	2	Seal, Sub-Asy.
29	1	Back Plate Asy.
29-1	1	Bearing, Press fit
29-2	1	Roll Pin

Note: If replaced with a new Pump it will be the Electric Solenoid Servo Control Type, Reference to Insert Sheet # 02970224 for Electric Servo Control Manifold Asy.

MOTOR CIRCUIT PUMP - PARTS LOCATION



VALVE PLATE
IDENTIFICATION

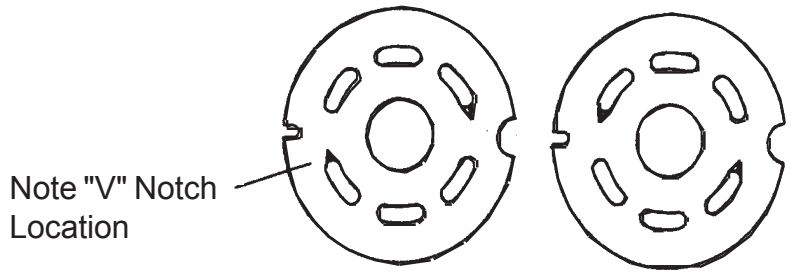


FIGURE 26

MOTOR CIRCUIT PUMP - PARTS LOCATION

Item	Qty	Description
31	1	Drive Shaft
32	1	O-Ring, .0625" Dia X 3.25" ID (1.59 mm Dia. X 82.55 mm ID)
33	1	O-Ring, Molded
34	1	Nut (Used 1997 & Down)
35	2	Bolt, 3/8"-16 X 1" (25.4 mm Long)
36	1	Lockwasher
37	1	Washer
38	1	Plug
38-1	1	O-Ring, .087" Dia. X .644" ID (2.21 mm Dia. X 16.36 mm ID)
39	1	Plug
39-1	1	O-Ring, .087" Dia. X .644" ID (2.21 mm Dia. X 16.36 mm ID)
40	1	Plug
40-1	1	O-Ring, .116" Dia. X .924" ID (2.95 mm Dia. X 23.47 mm ID)
41	1	Plug
41-1	1	O-Ring, .116" Dia. X .924" ID (2.95 mm Dia. X 23.47 mm ID)
42	1	Key
43	1	Cover Plate
44	1	Shaft Seal
46	1	Charge Pump Adapter Asy.
47	1	Control Arm (Used 1997 & Down)
48	1	Manual Servo Control Asy.(used 1997 & down)
48-1	1	Solenoid Servo Control Manifold Asy, (Used 1998 & Up) Not Shown
49	1	Inner Ring Gerotor
50	1	Outer Ring Gerotor
51	1	Supply Orfice
52	1	Control Valve Orfice
53	1	Control Arm Orfice
57	1	Dump Valve Actuator of Plug
58	1	Retaining Ring
59	1	Quad Ring .062" Dia. X .625" ID (1.59 mm Dia. X 15.9 mm ID)
60	1	Washer
61	8	Washer
62	3	Washer
63	1	Adapter Wire Harness, 3 wire to 2 wire (P/N 02970201) used only when converting pre-1997 units to later Pumps. See Insert Sheet # 02970224 for instructions.

MOTOR CIRCUIT PUMP - DIS-ASSEMBLY

PUMP DIS-ASSEMBLY:

The following instructions apply to a single Servo Controlled Piston Pump with or without Gerotor Charge Pump. A Tandem Pump Assembly should be separated into individual Pumps before dis-assembly

1. Position the Pump into a protected Jaw Vise (make sure Vise is Clean), Clamping onto the outer portion of the flange (DO NOT OVER TIGHTEN IN VISE), with the Bolts up, Mark the relationship of the working Ports (for re-assembly identification) to the Servo Control Assembly with a Scribe (Make a Line). Remove the four bolts retaining the Back Plate. (If no Gerotor Charge Pump Skip to Step 6).
2. Lift the Charge Pump Adapter Assembly straight up off Back Plate, Shaft and Gerotor. Gerotor may stay in adapter or on Back Plate.
3. Remove O-Ring from Charge Pump Adapter.
4. **Remove Outer Gerotor Ring** from either the Charge Pump Adapter of the Inner Gerotor Ring.
5. **Remove the Inner Gerotor Ring** and Key from the Drive Shaft or Inner Gerotor Ring and Coupler Assembly from Shaft.
6. Lift Back Plate straight up off Shaft and Housing. Remove Valve Plate from Back Plate or from rotating Kit Assembly, Still in Housing.
7. From Back Plate, remove Dump Valve Retaining Ring, Dump Valve or Plug, and Relief Valve Assemblies. NOTE: Mark the Relief Valve in relationship to the Cavity it was removed from, for Re-Assembly purposes.
8. **Back Plate inspection** (See Figure 27).
   Check the Bearing (Press Fit) in Back Plate, If Needles remain in cage, Move freely and settings is at the Dimension shown in Figure 27, removal of Bearings is not required. Check Roll Pin in Back Plate, If tight and set to dimensions shown in Figure 27 , removal is not required.

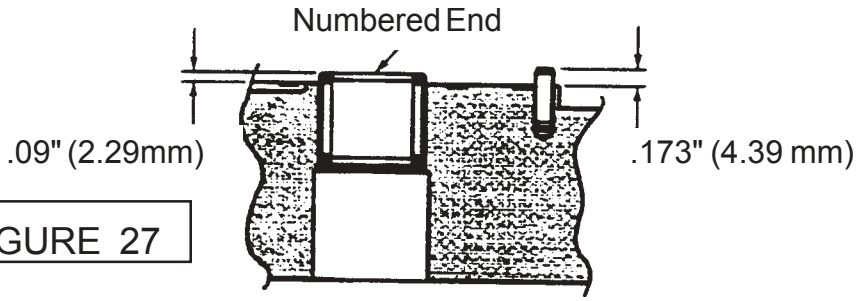


FIGURE 27

9. Remove Housing Gasket from Housing of Back Plate.
10. With Pump Still in Vise, remove the six Bolts retaining the Manual Servo Control Assembly (or Solenoid Servo Assembly 1998 & Up). Remove the Control Assembly and Control Housing Gasket from the Housing, remove the Orifice Plates noticing the Location for Re-Assembly. Remove Nut and Lock Washer from control Arm, Note position of Control Arm for Re-Assembly on Manual Servo Assembly (1997 & Down). (Refer to Appendix B for Dis-Assembly and Inspection of Control Assembly)
11. **To remove Rotating Kit Assembly** from housing first remove Pump from Vise holding the Rotating Kit assembly in position. Lower Pump so that the Shaft end (Flange End) is up. Set the rear of Housing onto table with Housing flat and Rotating Kit Assembly at rest on table. (Hole in table for protruding Shaft is required). Lift and remove the Housing and Shaft from Rotating Kit Assembly and Camplate.

12. **Remove Camplate** from rotating kit Assembly and Servo Piston follower from Camplate. (Refer to Appendix C for dis-assembly and inspection of Rotating Kit).
13. **Camplate Inspection**, The Finish on the Piston Shoe Surfaces of the Camplate should show no signs of scoring at all. Inspect Camplate Bushing surface for wear and surface for coating transfer from Bushing.
14. **To remove Servo Piston Assembly** from Housing start with the four bolts and washers retaining each cover plate.
15. In removing the Cover Plate from the Servo Piston Bolt. Remove Jam Nut, Washer and Seal Washer. Hold the Servo Piston Plate with Hex Key and unscrew Cover Plate off Bolt.
16. **Remove Servo Piston Assembly** and Seal Sub-Assemblies (Two Sets) from Housing. Note: Dis-Assembly of Servo Assembly is not required.
17. Remove retaining Ring from the Cover of the Housing. Press the Shaft, Shaft Seal or Spacer and Washer from Housing, Remove Retaining Ring Thrust Washer, Thrust Bearing, Second Thrust Washer and second Retaining Ring from Shaft.
18. **Housing Inspection** (See Figure 28), Check the Bearing (Press Fit) in Housing. If needles remain in cage, move freely and set at the dimension shown in Figure 28, Removal of Bearing will not be required.

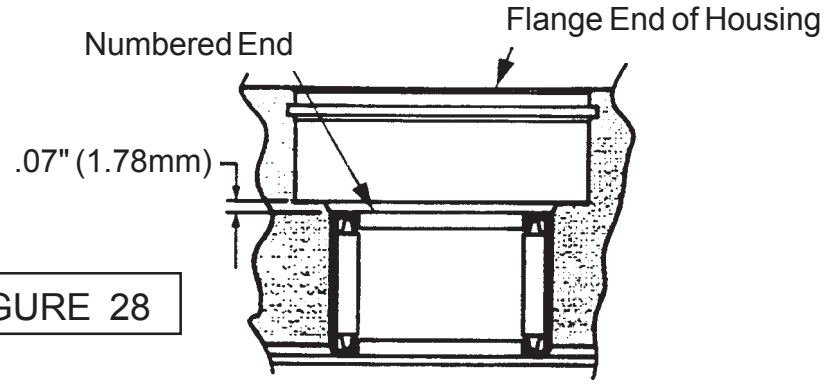


FIGURE 28

19. **To remove Cradle Sub-Assembly** remove the two Bolts retaining Cradle inside Housing. Move the Cradle Sub-Assembly back-an-forth to release Dowel Bushing and removing Cradle Sub-Assemblies from Housing.
20. Remove Button Head Bolts to remove Bushing from cradle.
21. **Bushing Inspection,** Inspect bushing for contamination embodiment within Coating of Bushing surface coming in contact with Camplate.
22. **Remove All Plugs from Housing,** This for inspection to make sure contamination is not caught under plugs or in passages.
23. **Discard Parts**, This will include, The Shaft Seal and all O-Rings from all assemblies, Replace with new ones; **NEVER** use old Seals to assemble Pump.

MOTOR CIRCUIT PUMP - RE-ASSEMBLY

PUMP RE-ASSEMBLY:

The following instructions apply to a single Servo Controlled Piston Pump with or without Gerotor Charge Pump. A Tandem Pump Assembly should be separated into individual Pumps before dis-assembly and assembled back the same way.

1. All Parts should have been cleaned and critical moving parts lubricated as described in Steps below Before Starting Re-Assembly. (Also Listed in Previous Introduction Page)

- **A.** After dis-assembly of Pump wash all metal components in clean solvent.
- **B.** Use compressed Air to dry parts after washing (Compressed air must be filtered and moisture free). DO NOT wipe them dry with Paper Towels or Cloth as these will leave lint and/or dust contamination. DO NOT USE Compressed Air to Spin any component (such as Bearings or Plates) as this will damage or Blow them apart. Secure any part before using compressed Air to dry it.
- **C.** Always use new Seals when re-assembling Hydraulic Pumps, Lubricate the new rubber Seals with a Petroleum Jelly, (Vaseline) before installing them.
- **D.** DO NOT reinstall worn or damaged Parts back in Pump, DO NOT use a worn or damaged Pump Housing.

2. If Bearings are being replaced in Housing Press them in now, See Figure 28 for dimension on how far to press them in, This is a critical dimension and make sure the numbered end of Bearing is pointing outward.

3. Install the two new Seal Sub-Assemblies into the Servo Piston cavity of Housing

4. **Screw the Cover Plate onto the Servo Piston Assembly**, Install new Cover Plate Gasket in place on Housing. Install Servo Piston Assembly and Cover Plate into Servo Piston bore in right side of housing (as shown in Figure 29). Retain Cover Plate with four each Washers and Bolts, Torque these Bolts to 40 to 48 in. lbs. (4.5 to 5.4 nm).

5. **Servo Piston Neutral Adjustment,** Centering the Servo Piston Assembly is required. Measure in from the left side and set Servo Piston .5" (12.7 mm) from the surface of Housing Servo Bore as shown in Figure 29. (Final adjustment may be require after Pump is installed and operating to obtain Neutral). Special Note: if Unit is equipped with Buzz Bar Head it will have a Neutral (Centering) Adjustment on one side of Servo Piston and piston travel limiting Screw on the other side.

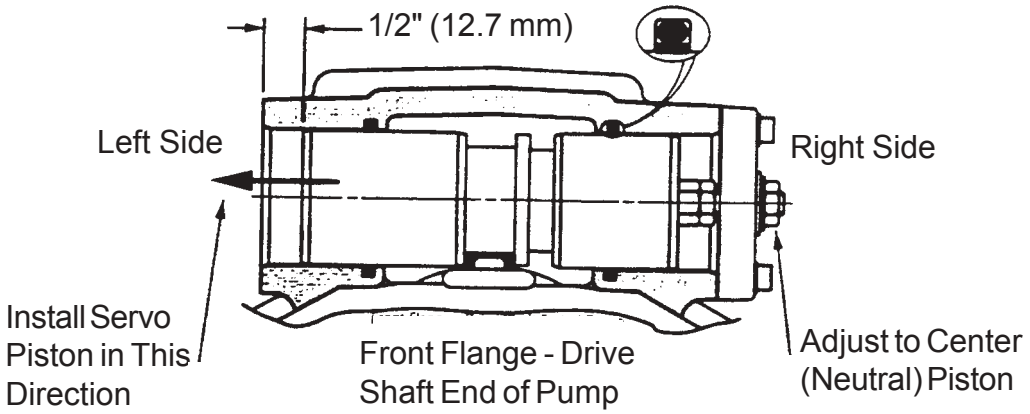


FIGURE 29

6. **Install New Seal Washer**, Washer and Jam Nut to Servo Piston Bolt (Only do this after Centering of Servo Piston has been done). Holding Servo Piston Bolt with Hex Key Wrench Torque Jam Nut to 150 to 160 in. lbs. (17 to 18 nm). Recheck Servo Piston Measurements (See Figure 29) If Measurement is OK install Cover Plate and Cover Plate Gasket on Left Side of Servo Piston, Retain cover with 4 each of # 10-24 Bolts, Torque these Bolts to 40 to 48 in. lbs. (4.5 to 5.4 nm). Note: If on Buzz Bar Head units there is Flow Limiter Bolt and Nut added in LH side cover plate, this looks like the Adjusting Centering Bolt on RH Side. This adjusting bolt on the LH side cover is only to limit the Flow to the Buss Bar Head. The Left Hand side cover is added as Servo Piston Travel Limiting Adjusting Bolt.
7. **To Assemble Cradle Sub-Assembly**, Press Dowel Bushing into Cradle and install Bushing into Cradle retaining with Button Bolt. Torque Button Bolt to 14 to 16 in. lbs. (1.6 to 1.8 nm).
8. **Place Cradle Sub-Assembly into Housing making** sure Dowel Bushings and Cradle is completely seated into Housing. Retain Cradle Sub-Assembly with two Bolts that have Locktite # 277 (or equivalent) applied to the end of the threads. Torque these Bolts to 25 to 28 in. lbs. (34 to 38 nm)
9. **To Install Shaft Components,** Place Exterior Retaining Ring, Thrust Race, Thrust Bearing, Second Thrust Race and second Retaining Ring onto Shaft. Position Washer and Shaft Seal or Spacer onto Shaft.
10. **Install Servo Piston Follower onto Camplate Dowel Pin**, Install Camplate carefully onto Bushing (Coat Bushing Surface with Hydraulic Oil), Aligning Servo Piston Follower with Slot in Servo Piston Assembly. (Refer to Appendix C for Re-Assembly of Rotating Kit Assembly).
11. **To Install Rotation Kit Assembly**, Leave Housing and Shaft in the Horizontal position. Holding Camplate into position with Screw Driver through Controller Linkage passage-way at the top of the Housing, Place Rotating Kit Assembly over shaft and into Housing until Pistons are in against Camplate. Make sure all parts are in Housing completely and properly positioned. Return the Pump to the Vise with open end of Housing up. Clamping Housing on the outer portion of the flange.
12. **Install Gasket on Housing**, Install New Gasket on Housing now.
13. **If necessary, Press New Bearing and Roll Pin in to Back Plate** to dimension shown in Figure 34. Bearing MUST be installed with the numbered end of Bearing Outward. Roll Pin must be installed with split in Roll Pin away from Bearing.
14. **Install Relief Valve**, Always Install New O-Rings on Relief Valves, Install Relief Valves in its original cavity in Back Plate that it was taken out of is recommended, but if they are switched it should not affect anything as they are both the same setting. Torque Relief Valves (Tighten) to 100 to 110 ft. lbs. (136 to 149 nm).
15. **Install New Quad Ring on Dump Valve or Plug**, Install Dump Valve or Plug and retain with Retaining Ring into Back Plate. Note: Make sure paddle of Dump Valve is perpendicular to relief valve axis prior to installing or damage could occur.
16. **Apply a small amount of Petroleum Jelly to the Steel Side of Valve Plate** to hold it in place for installation. Aligning the Index Pin, Place the Valve Plate in position onto the Back Plate with the Steel side against Back Plate.
17. **Install Back Plate Assembly into Housing Assembly**; Make sure Ports are positioned correctly, Valve Plate and Gasket stay in place. If No Gerotor Charge Pump Skip to step 22

MOTOR CIRCUIT PUMP - RE-ASSEMBLY

18. **Install Key and Inner Ring Gerotor** onto Shaft or Coupler Assembly, Lubricate Inner Ring Gerotor before Assembly. (Refer to appendix A for Re-Assembly of Charge Relief Valve in Adapter Plate).
19. **Install O-Ring and Outer Ring Gerotor** onto Adapter Plate, Lubricate both O-Ring and outer ring to hold in position during assembly of adapter plate, Install adapter plate onto Back Plate. Make sure O-Ring and Gerotor Ring stay in place.
20. **Retain Back Plate and Adapter Plate** (when used) with four Bolts, Torque these Bolts to 27 to 31 ft. lbs. (37 to 42 nm). (refer to Appendix B for Re-Assembly of Manual Servo Control Assembly).
21. **Install Control Housing Gasket onto Housing**, Install Orifices into Control Assembly and retain in position with Petroleum Jelly (Vaseline). Install Manual Servo Control Assembly onto housing making sure feed back link entered small groove in Servo Piston Assembly (Manual Servo Control on units 1997 & Down). Units 1998 & Up have Solenoid Servo Manifold Assembly to install here.
22. **Retain Servo Control Assembly with six Bolts**. Torque these Bolts to 40 to 48 in. lbs. (4.5 to 5.4 nm)
23. **Install Control Arm.** Only applies to units 1997 & Down with Manual Servo Control. Install Control Arm onto Control Assembly input Arm, Retain with Lock Washer and Nut, Torque from 4 to 6 ft. lbs. (5 to 8 nm).
24. **Install Plugs:** Install new O-Ring on all Plugs into Housing, Torque 3/4" Plugs from 21 to 24 ft. lbs. (28 to 32 nm) and torque 1-1/4" Plugs from 40 to 45 ft. lbs. (54 to 61 nm).
25. **Check all Assembly Steps** before Testing and Re-Installing Pump back on Tractor, Follow Start-Up procedures as outlined in Operators Manual. Pump MUST be Pre-Lubed prior to starting up or Pump will be damaged. This is done by putting recommended Hydraulic Oil into pump, See Specification chart for type Oil recommended. On Models (Machete) where the tank is higher than the pump the suction line will have positive Oil flow and usually Pre-Lube itself.

NOTES

CHARGE PUMP ADAPTER DIS-ASSEMBLY:

1. **The following instructions apply to Charge Pump Adapter Dis-Assembly** (See Figure 30 & 31)
2. **Clean,** Make Sure that every thing, Pump, Connections, Tools, Work Bench, Vise and all general conditions are very clean before beginning any work.
3. **Remove** Plug, Shims, Springs, and Poppet from Adapter Assembly
4. **Inspect Charge Pump Relief Valve Seat** inside the Charge Pump Adapter. Check to insure that seat is smooth and free of Burrs or other defects or damage.
5. **Inspect the Charge Pump Relief Valve Spring**, Make sure it is not bent or broken.
6. **Inspect the Bearing or Bushing inside the Charge Pump Adapter**. The Bearing Needles must remain in the bearing Cage at dimensions shown in Figure 36. The Bushing (if used) must have no excessive scoring.

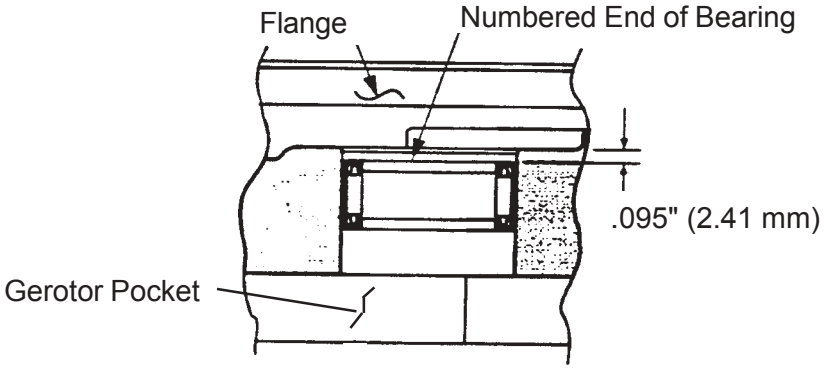
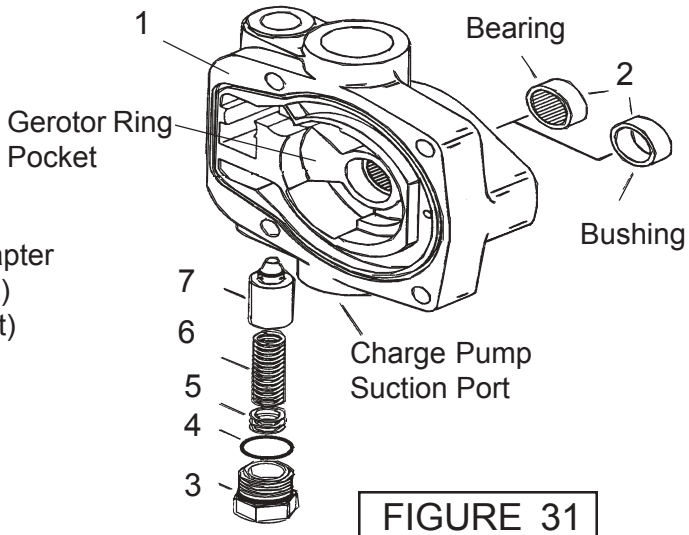


FIGURE 30

CHARGE PUMP ADAPTER RE-ASSEMBLY:

1. **New Bearing or Bushing in Adapter Assembly,** If necessary Press New Bearing or Bushing into Adapter Assembly. The Bearing must be installed to dimensions as listed in Figure 30. The Numbered end MUST be installed Outward toward Flange as Shown in Figure 30
2. **The Bushing,** if used must be pressed flush to .010" (.254 mm) recessed
3. **Install Poppet,** Spring, Shims, and New O-Ring on Plug. Screw Plug into Adapter Assembly (See Figure 37). Torque Plug to 27 to 30 ft. lbs. (36.6 to 40.7 nm)



Item	Qty	Description
1	1	Chrage Pump Adapter
2	1	Bearing (Press Fit)
	1	Bushing (Press Fit)
3	1	Plug
4	1	O-Ring
5	a/r	Shims
6	1	Spring
7	1	Poppet

FIGURE 31

MANUAL SERVO CONTROL DIS-ASSEMBLY:

1. **The following instructions apply to Manual Servo Control Dis-Assembly** (See Figure 32)
2. **Clean,** Make Sure that everything, Pump, Connections, Tools, Work Bench, Vise and all general conditions are very clean before beginning any work.
3. **Input Shaft Removal,** Remove Wiper Seal (item 16) with Screwdriver. Remove Set Screw (item 13) retaining Input Shaft (item 14) and remove it from Control Housing.
4. **Valve Spool Plug,** Remove Set Screw (item 8) from Plug (item 2) retaining Valve Spool (item 7) and remove Plug. Remove O-Ring (item 3) if it did not come out with plug or remove after Valve Spool is removed.
5. **Feedback Link and Bell Crank,** Remove E-Ring (item 11) from Pin (item 10) retaining Feedback Link (item 9). Remove Feedback Link and Bell Crank from Control Housing, Head Pin (item 17) is a press fit into Bell Crank, Removal of Head Pin is not required as part of repair unless it is damaged.
6. **Valve Spool,** Remove Valve Spool (item 7) from Housing after Step 5 is done, Compress Spring (item 6) on Spool and remove E-Ring (item 4), This allows Spring Retainer (item 5), Spring (item 6) and other Spring Retainer (item 5) to slide off of Valve Spool.
7. **O-Rings and Cleaning Parts,** Make sure all O-Rings are removed from Housing, (Throw away all old O-Rings). Inspect and clean all parts, clean all Parts with Clean Solvent and Dry with Compressed Air Only (See introduction section for more cleaning information). Lubricate all parts in preparations for re-assembly.

MANUAL SERVO CONTROL RE-ASSEMBLY:

1. **The following instructions apply to Manual Servo Control Re-Assembly** (See Figure 32)
2. **Clean,** Make Sure that every thing, Parts, Tools, Work Bench, Vise and all general conditions are very clean before beginning any work. Make sure all parts are lubricated.
3. **Valve Spool Spring,** Install Spring Retainer (item 5), Spring (item 6) and second Spring Retainer (item 5) onto Valve Spool (item 7). Compress Spring by pushing on outer Spring Retainer and install E-Ring (item 4) onto Valve Spool.
4. **Valve Spool,** Install Valve Spool assembled into Control Housing (item 1) making sure that the metering notches (See Figure 32) are facing outward and can be seen through the Metering Ports, Check the notches at this time, if the notches cannot be seen it will not work.
5. **Feedback Link and Bell Crank,** Bell Crank (item 12) should have Head Pin (item 17) already installed. Position Bell Crank in Housing, Slide Feedback Link (item 9) into position between Clevis on Valve Spool aligning holes, install Retaining Dowel Pin (item 10) and E-Ring (item 11).
6. **Input Shaft,** Install New O-Ring (item 15) onto Input Shaft (item 14), Hold Bell Crank in position with Feedback Link Slot and align Splined Hole of Bell Crank with Input Shaft Cavity. Install Input Shaft into Control Housing and Bell Crank. Apply Locktite # 242 or equivalent to Set Screw (item 13) and install it to retain Input Shaft. Tighten Set Screw till it bottoms out against Input Shaft and then back it out 1/4 turn.
7. **Wiper Seal,** Install Wiper Seal (item 16) on Input Shaft and seat into Control Housing.
8. **Valve Spool Plug,** Install New O-Ring (item 3) onto Valve Spool Plug (item 2) and install Plug, Tighten Plug till there is no play in Valve Spool with Input Shaft held stationary. Lock in place with Set Screw (item 8), Torque Set Screw to 17 to 25 in. lbs. (2 to 3 nm)

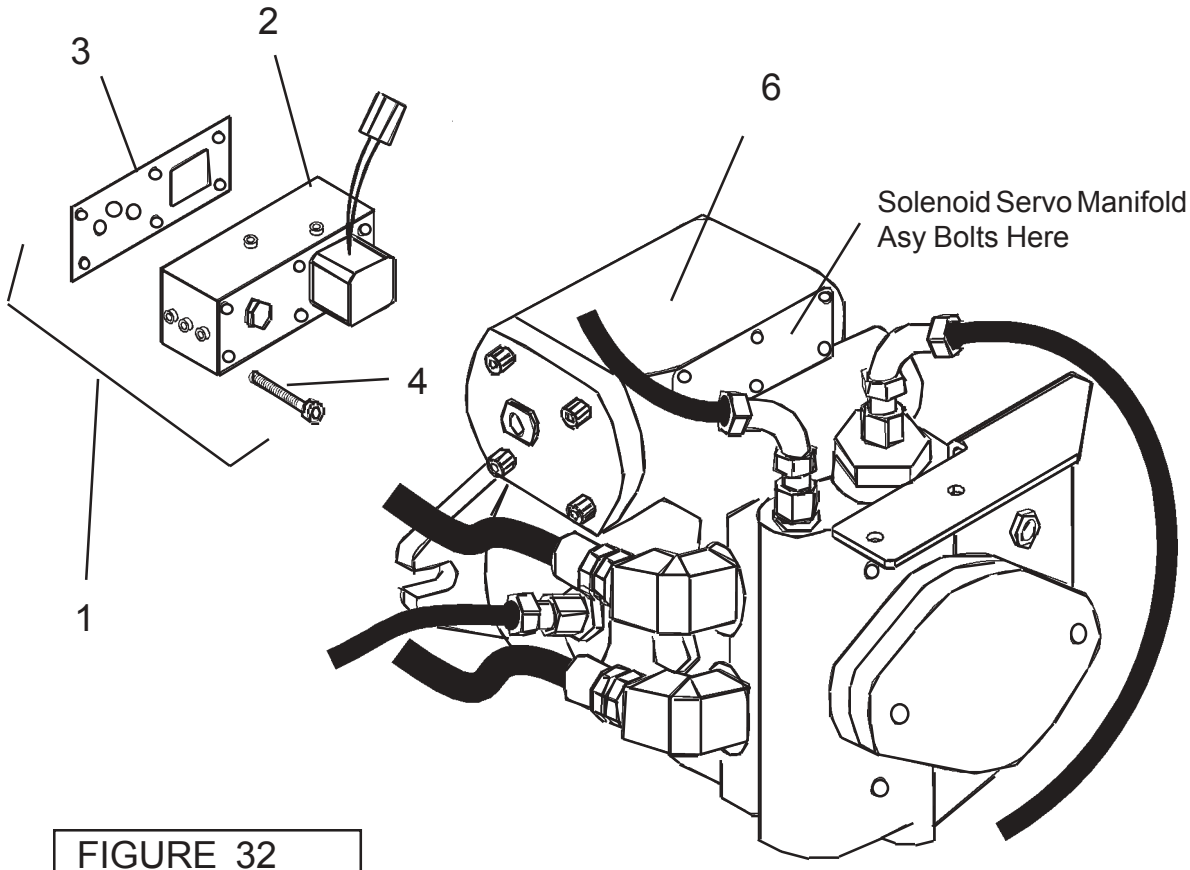


FIGURE 32

Solenoid Servo Control Manifold Assembly

Item	Part No.	Qty	Description
1	----------	1	Solenoid Servo Control Manifold Kit (items 2 through 7)
2	02970207	1	Solenoid Manifold Assembly w/ Solenoid
3	02970209	1	Gasket
4	02970208	6	Bolt
5	02970201	1	Decal Instructions (Not Shown)
6	02969527	1	Pump Assembly w/ Item # 1 (New Pump)
	02969527RB	ref	Pump Assembly w/ Item # 1 (Re-Built Pump)

NOTE: Listed above (Item 1) Kit as reference only, Also listed as reference is Pump Assembly Complete.

ROTATING KIT DIS-ASSEMBLY: (See Figure 33)

1. **The following instructions apply to Rotating Kit Assembly Dis-Assembly**
   Dis-Assembly of Rotating Assembly is required for inspection Only, There are no repairable Parts that can be replaced. (See Figure 33)
2. **Clean,** Make Sure that every thing, Tools, Work Bench, Vise and all general conditions are very clean before beginning any work.
3. **Inspection,** Examine the outside diameter of the Pistons for finish condition. They should not show wear or deep scratches, Inspect the shoes for a snug fit on the ball end of the Pistons and a flat smooth surface that comes in contact with the Camplate. DO NOT LAP the Piston Shoes. (Do Not Lap means do not sand, file or try to smooth machined surface).
4. **Piston Shoes,** If Piston Shoes are rough DO NOT LAP them.
5. **Spider,** Examine Spider for wear in the Pivot area, Examine Pivot to insure smoothness and no signs of wear.
6. **Piston Block,** Inspect the Piston Block surface that makes contact with Valve Plate. This surface should be smooth and free of deep scratches, DO NOT LAP Piston Block
7. **Pistons,** The Pistons should move freely in Piston Block Bore. If they are sticky in the Bore, Examine the Bore for scoring or contamination.
8. **Pins and Spring,** To inspect Pins and Spring CAUTION should be taken in removing Spring, The Spring is highly compressed and the retaining Ring should not be removed without compressing the Spring safely.
9. **Piston Block Dis-Assembly,** The following Tools will be needed to dis-assemble Piston Block.
   A. Flat Washers, 2 ea. 3/8" ID X 1-1/8 OD
   B. Bolt, 1 ea. 3/8" X 3-1/4" NC
   C. Nut, 3/8" NC
10. **To remove Spring**, Place one of the Flat Washers over the 3/8" X 3-1/4" NC Bolt, Put Bolt through the center of the Piston Block and apply the second Flat Washer. Let the Washer rest on the three Pins and retain with Nut. Turning Nut and compressing Spring inside Block. Use a pair of Retaining Ring Pliers and remove the Internal Retaining Ring. Remove the Nut, Bolt and two Flat Washers from Block, removing the Washer, Spring, Second Washer, Three Pins and Pin Keeper at the same time.

ROTATING KIT RE-ASSEMBLY: (See Figure 33)

1. **The following instructions apply to Rotating Kit Assembly Re-Assembly**
   Re-Assembly of Rotating Assembly. (See Figure 34)
2. **Clean,** Make Sure that every thing, Tools, Work Bench, Vise and all general conditions are very clean before beginning any work. Make sure all parts are lubricated with Hydraulic Oil prior to re-assembly.
3. **To reassemble the rotating Kit Assembly** complete the following, Compress the Pin Keeper and install in Spline of the Piston Block. Install the three Pins with the Head end to the inside of the Block and position in Special grooves of the Piston Block Spline.
4. Install the Washer, Spring and second Washer into the Piston Block, Use the two 3/8" ID Flat Washers, the 38" Nut and the 3/8" x 3-1/4" Bolt to compress Spring and retain with Retaining Ring. Remove the Nut, Bolt and two washers.
5. Install Pivot onto the three Pins, Spider on the Pivot and Piston Assemblies through the Spider and into Piston Block, resting on Spider.

MOTOR CIRCUIT PUMP - ROTATING KIT ASY

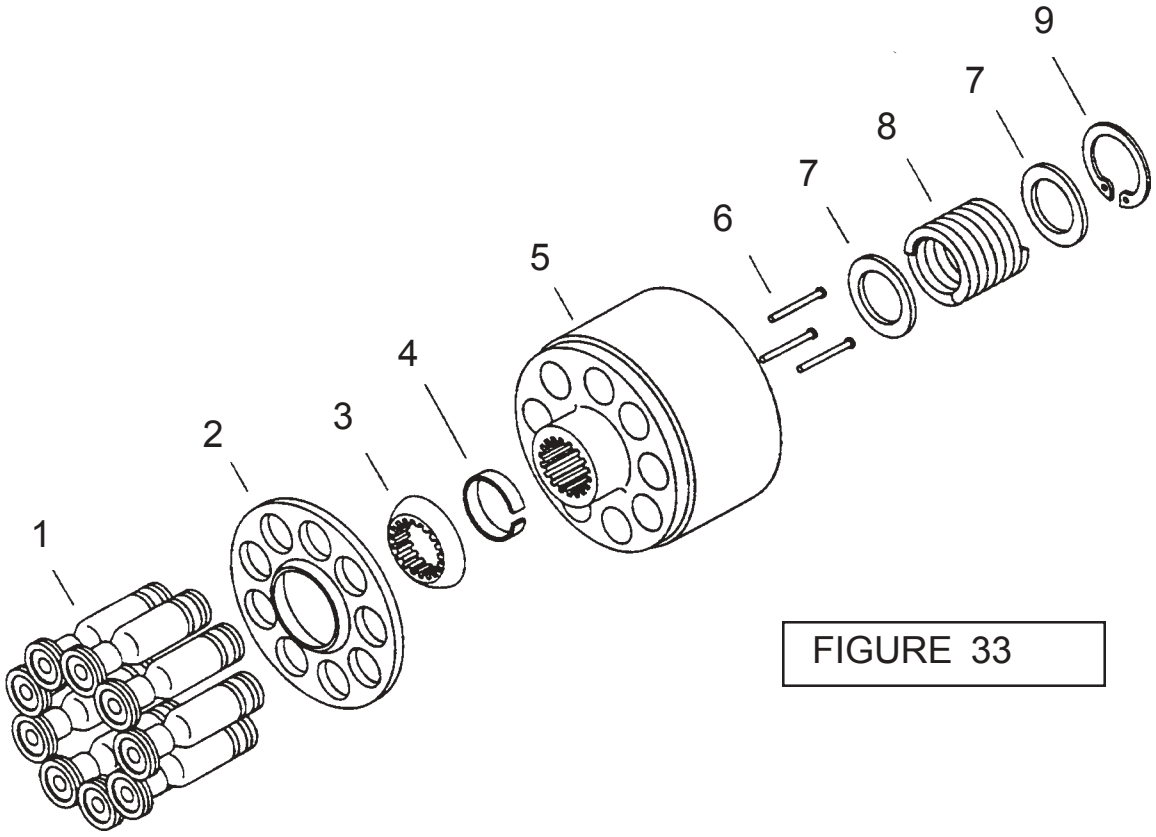


FIGURE 33

Rotating Kit Assembly

Item	Qty	Description
1	9	Piston Assembly
2	1	Spider
3	1	Spider Pivot
4	1	Retainer
5	1	Piston Block
6	3	Pins
7	2	Wsher
8	1	Spring
9	1	Retaining Ring

PUMP - BOOM CIRCUIT

Variable Volume Piston Pump:
Piggy Back Pump Boom Circuit Supply Pump

The Boom Supply pump is the piggy back pump bolted to the front pump, shown below is the pump with the end plate (shown on different pump) this is for illustration only and not a true drawing of pump.

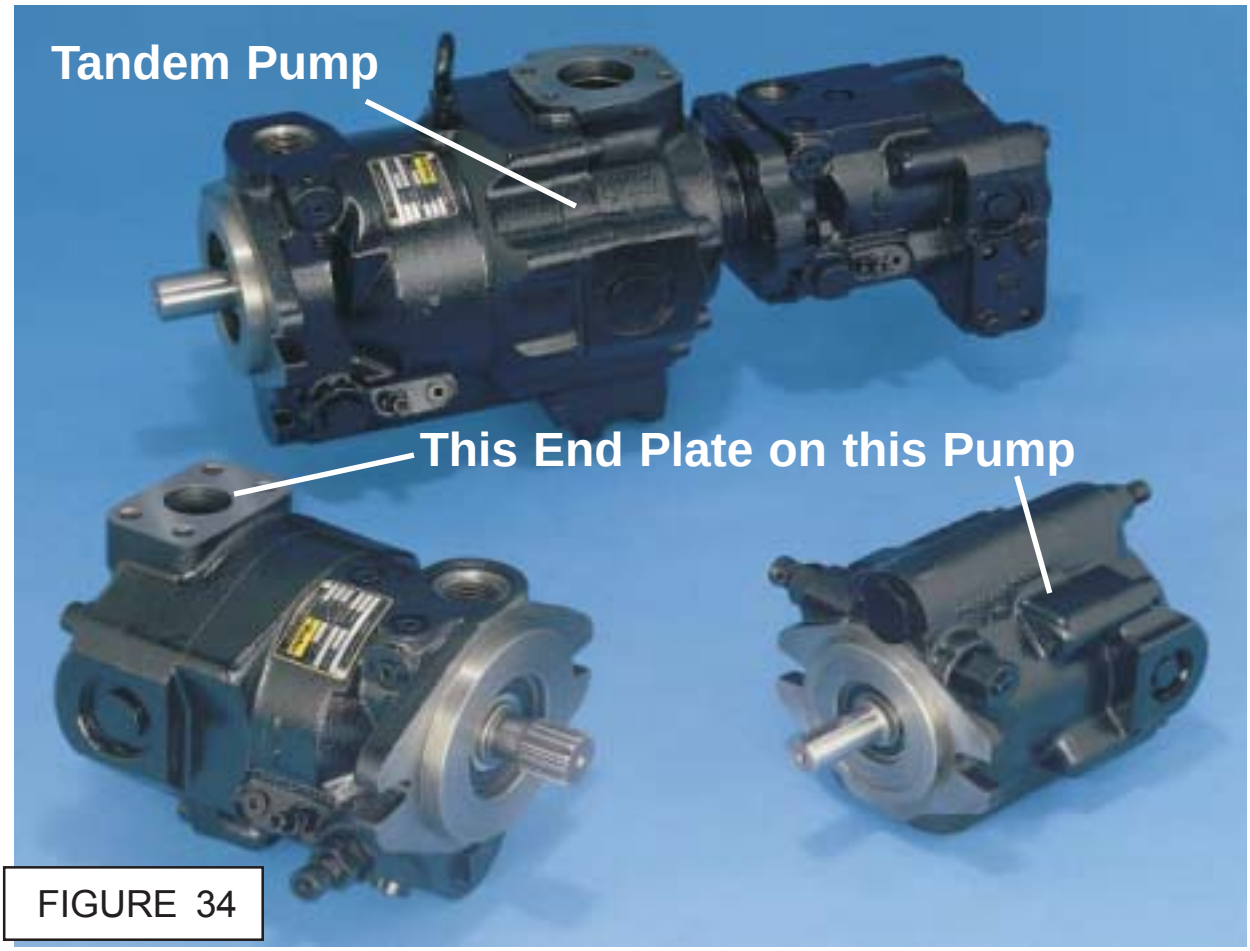


FIGURE 34

Pump Specification:

Pump Delivery @ 3000 psi @ 1800 RPM is = 15.6 GPM @ Max continous Pressure 3000 psi. (207bar)

Cylinder Supply Pump Pressure Adjust (If Needed):

Special Note: If after setting the display controls, check to make certain that functions operate correctly. If the Boom will not lift. The Pump for the Cylinder supply may have to be adjusted. This is a simple process that will require a 7/16" wrench for this adjustment and a 1/2" wrench for the locking nut. Looking on the LH side of the pump there are two adjustments, one has a 7/16" hex head and the other a ridged round head, Only adjust the one with the hex head. DO NOT adjust or change the round ridged adjustment as it is set from the factory. Adjust the 7/16" hex one by turning it in till it seats completely (Do not force adjustment after is seats). Then back it back out 1/2 turn, this will give you the 2800 psi required to oprtate the boom. (See Figure 34A & 34B). Hold the adjusting nut while turning the locking nut so the adjustment nut does not turn with it changing the setting.

FIGURE 34A

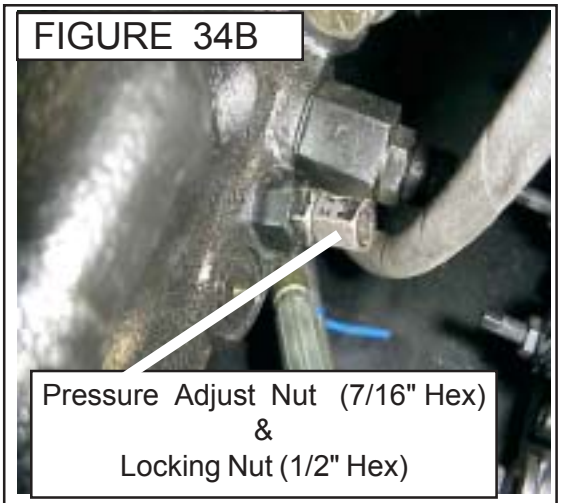


FIGURE 34B

PUMP - BOOM CIRCUIT

Introduction: Variable Piston Pump

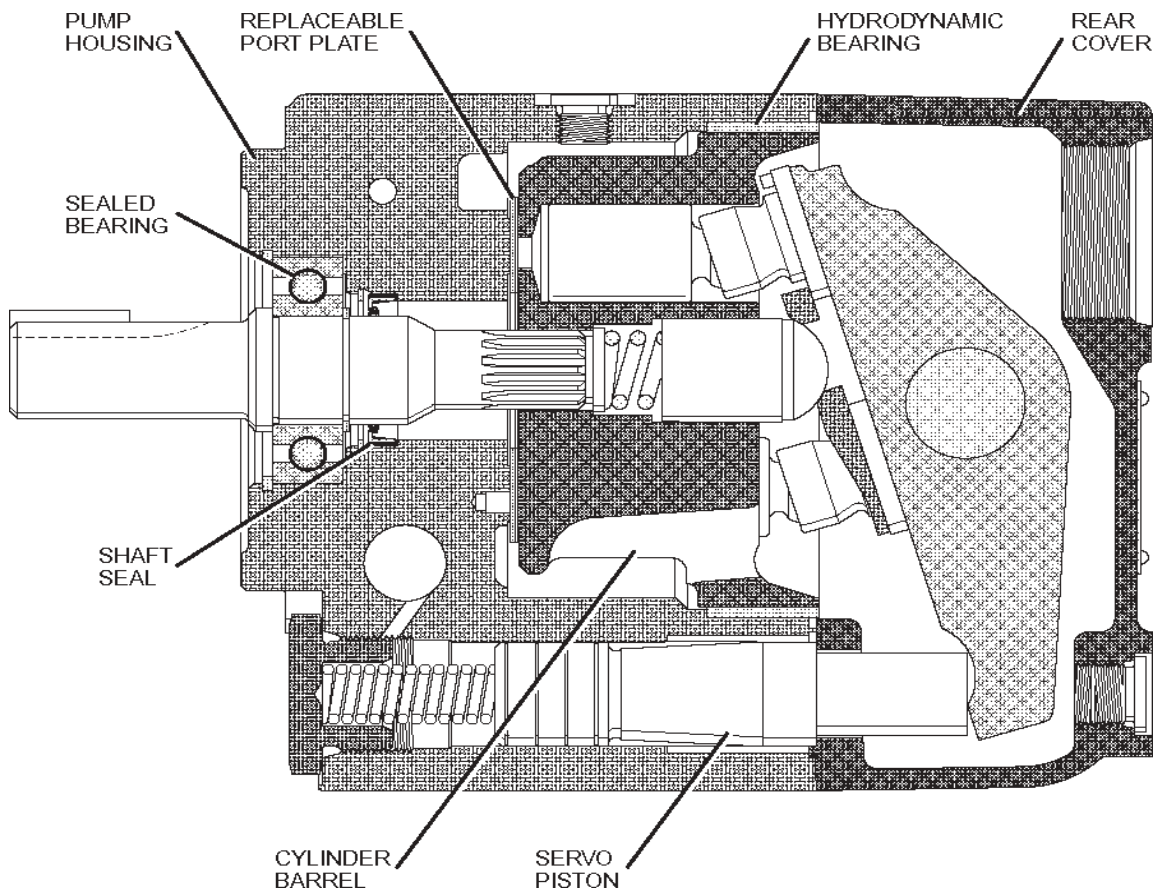


FIGURE 35

Features

* High Strength Cast Iron Housing
* Built-in Supercharger
* High Speed capacity - 3000 RPM
* Sealed Shaft Bearing
* Two Piece design for ease of service
* Cartridge Type Controls - Field Changeable
* Replaceable Bronze Clad Port Plate
* Airbleed Standard for Quick Priming
* Hydrodynamic Barrel Bearing
* Full Pressure Rating on Water Glycol Fluids
* Pump Case & Shaft Sea - See Inlet Pressure Only

Controls

* Pressure Compensation
* Load Sensing
* Horsepower (Torque) Limiting
* Horsepower & Load Sensing
* Remote Pressure Compensation
* Adjustable Maximum Volume Stop
* Electrohydraulic Pressure
* Electrohydraulic Flow & Pressure (Servo Controled)
* Low Pressure Standby
* Filter and/or Cool Drain Line (100 psi Max.)

General Description: Variable Piston Pump

All control is achieved by proper positioning of the swash plate. This is achieved by the servo piston acting on one end of the swash plate working against the combined effect of the offsetting forces of the pistons and centering spring on other end. The control spool acts as a metering valve which varies the pressure behind the servo piston.

As shown in Figure 36 Detail "A", the amount of flow produced by the Piston Pump is dependent upon the length of the stroke of the pumping pistons. This length of stroke in turn is determined by the position of the swash plate. Maximum flow is achieved at an angle of 17°.

The rotating piston barrel, driven by the prime mover, moves the pistons in a circular path and the piston slippers are supported hydrostatically against the face of the swash plate. When the swash plate is in a vertical position, perpendicular to the center line of the piston barrel, there is no piston stroke and consequently no fluid displacement. When the swash plate is positioned at an angle, the pistons are forced in and out of the barrel and fluid displacement takes place. The greater the angle of the swash plate, the greater the piston stroke.

The center line of the pumping piston assembly is offset from the center line of the swash plate. Therefore, as shown in Figure 36 Detail "B", the pistons effective summation force tends to destroke the swash plate to a vertical (neutral) position. This destroking force is balanced as the swash plate is angled by the force of the servo piston.

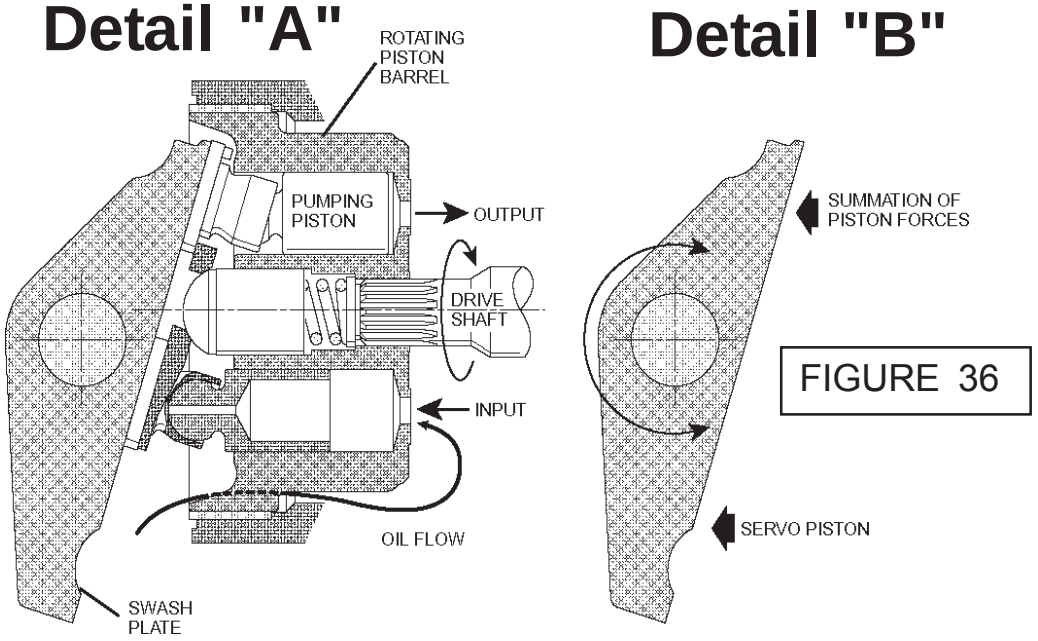


FIGURE 36

Pressure Compensated Control: Variable Piston Pump

Swash Plate angle controls the output flow of the pump. Swash plate angle is controlled by the force generated against the swash plate by the pumping pistons and the force of the servo piston. The force of the servo piston is greater than the force of the pumping pistons when both are at the same pressure (See Figure 37)

Pressure Compensated Control: (continued)

By means of internal porting, pressure is connected from the output port to the servo piston via orifice (E), and to the control spool via passage (D). Also pressure is applied to the control spool chamber through orifice (F). As long as the pressures at both ends of the control spool remain equal, the spool will remain offset upward, due to the added force of the spring (See Figure 37)

When pressure reaches the setting of the compensator control, the dart leaves its seat causing the pressure in the spool chamber to be reduced. The spool now moves downward causing pressure in the servo piston cavity to vent via port "A" (control drain) . The reduced pressure at the servo piston allows the servo piston allows the servo piston to move to the right. This movement reduces the angle of the swash plate and thereby reduces the pumps output flow (See Figure 37)

As pump pressure on the control spool drops below pressure and spring force in the spool chamber, the control spool moves upward to maintain an equilibrium on both sides of the spool. If pump pressure falls below compensator control setting, the control spool moves up, bringing the pump to maximum displacement (See Figure 37)

Adjustment of Pumps Procedure: Standard Pressure Compensated Pumps

Pumps are shipped from factory with a differential pressure of approximately 150 psi (10 bar) at 50% of maximum swash angle. Differential pressure will not normally change through the life of the pump. If this control has been tampered with, a close **approximation** of the correct setting can be made as follows.

Dead head the pump (no flow) with 0-3000 psi (0-207 bar) gauge in the **OUTLET** port **(Not the low signal "B" port)**, back the pressure compensator adjustment out (full counterclockwise).

The gauge should read between 325-375 psi (22-26 bar). If the gauge reads different than this, turn the differential adjustment knob (differential option 4) or add/remove shims (omit option) until correct psi figure is reached (See Figure 37).

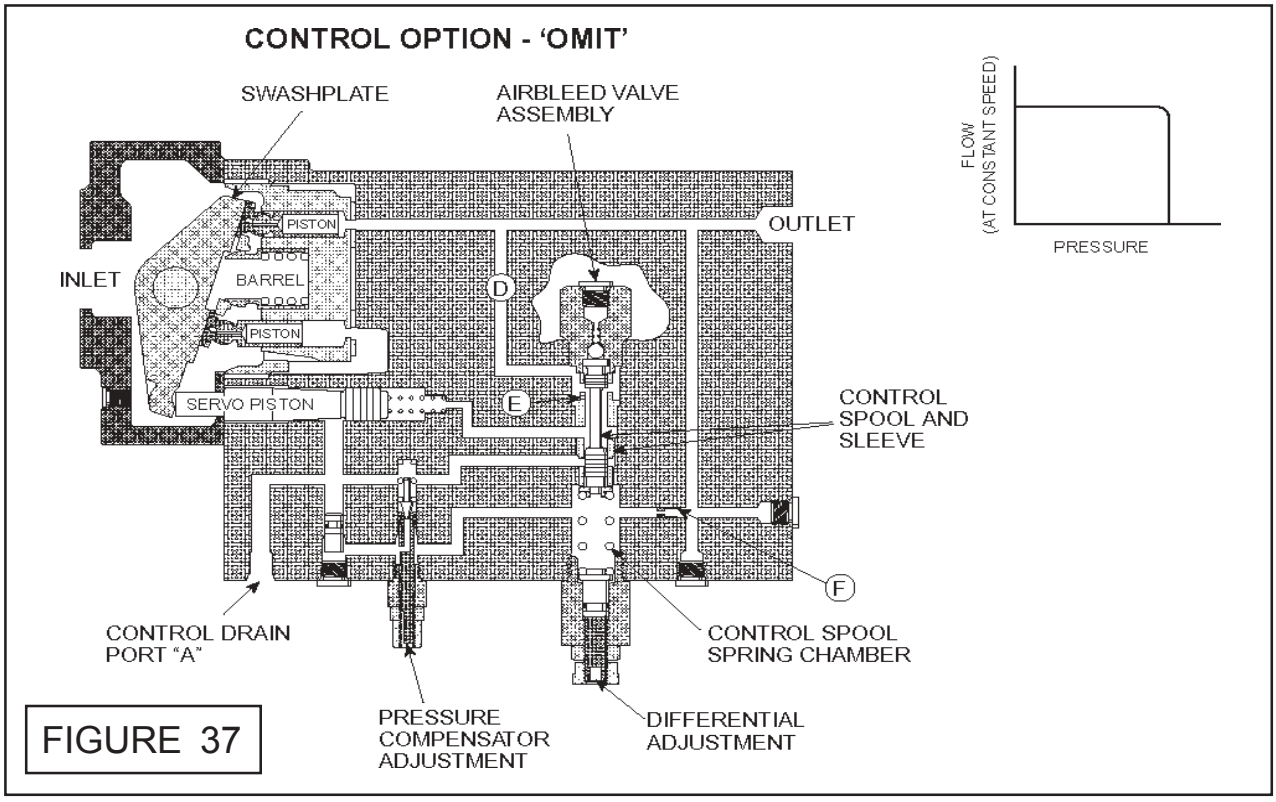


FIGURE 37

PUMP - BOOM CIRCUIT

Remote Pressure Control: Control Type (M)

Remote control of the output pressure can be achieved by controlling the pressure in the low signal "B" port when the pump is set up for control type (M). A Manual, hydraulically piloted, pressure control device is installed in the line from the low signal "B" port to tank. The pump will then maintain pressure approximately equal to the pressure in the "B" port plus the pump differential setting.

Low Pressure Standby:

This option can be used as an alternative to the load sensing option (A) to achieve low pressure standby. Minimum standby pressure is somewhat higher than that achieved using option (A). In the compensating mode there is approximately 3 GPM (1.14 LPM) flow from the low signal "B" port in addition to 9 GPM (3.4LPM) flow from the control drain port "A".

Multiple Pressure Standby:

If the pressure in the low signal "B" port is limited by a relief valve, as the desired pump outlet pressure is reached, the relief valve in the "B" port will allow the pump to standby at a preset pressure. Adding to this concept, multiple, remotely piloted relief valves plumbed in parallel in the "B" port line can yield multiple, sequential pressure settings.

Electrohydraulic Pressure & Flow Control:

A proportional pressure control valve can be used in place of relief valves to give variable pressure control proportional to an electrical input signal to the valve. By combining this arrangement with the swash plate position sensing device, amplifier, and logic circuit, servo control of pressure and/or flow is achieved.

Note: In most systems, a load equivalent to the minimum operating pressure of the pump cannot be guaranteed. Because of this, a sequence valve is required in the discharge line to maintain servo flow control. Please refer to ordering information in parts/operators manual for servo components.

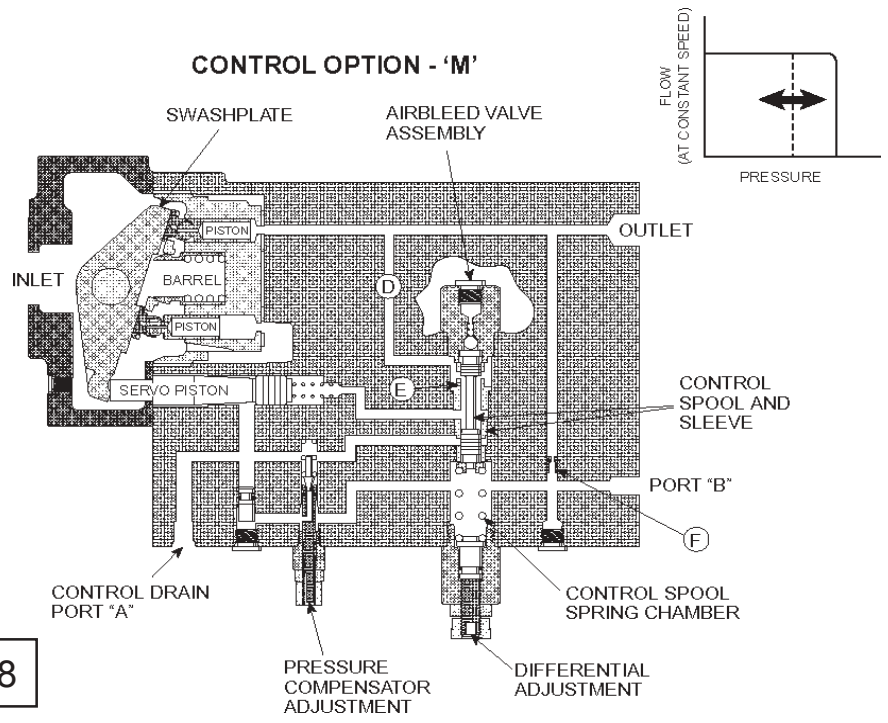


FIGURE 38

PUMP - BOOM CIRCUIT

Pressure & Flow Control (Load Sensing) : Control Type (A)

Flow control is achieved by placing an orifice (fixed or adjustable) in the pump outlet port. The pressure drop (Δ A) across this flow control is the governing signal that controls the pump's output, as explained below.

Whenever the pressure drop at the flow control increases (indicating an increase in output flow), the pump attempts to compensate by decreasing the output flow. It does this by sensing the lower on the downstream side of the flow control via line (C), which is balanced against the pump pressure via passage (D), on the control spool. The control spool is forced down against the control spool spring by differential pressure. This vents the servo piston cavity, destroking the pump to a point where the set pressure drop across the orifice is maintained and the flow is obtained.

The converse of this is also true whenever the pressure drop decreases (indicating a decrease in output flow). In this case, the control spool is forced up. This increases pump displacement in an attempt to maintain the predetermined pressure drop or constant flow.

It should be noted that the pump is still pressure compensated and destrokes at the selected pressure setting. The pressure compensator control will override the flow control whenever the pressure compensator control setting is reached.

Low Pressure Standby:

This arrangement can also be used to provide low pressure standby by venting the "B" port through a simple on/off valve suitable for flows of 1-2 GPM (3.8-7.6 LPM). When flow or pressure is required, this valve is closed allowing system pressure to build behind the control spool and bringing the pump on-stroke.

Load Sensing:

If instead of measuring the pressure drop across the orifice in the pump outlet port, it is measured downstream of a directional control valve, a constant pressure drop will be maintained across the valve spool. This results in a constant flow for any given opening of the directional control valve regardless of the work load downstream or the operating speed of the pump.

The pump "senses" the amount of pressure necessary to move the load and adjust output flow to match the valve opening selected and pressure to overcome the load plus the Preset (Δ P) across the valve spool.

The benefits of this arrangement are that excellent , repeatable flow characteristics are achieved, and considerable energy savings are realized while metering compared to using a straight pressure compensated system.

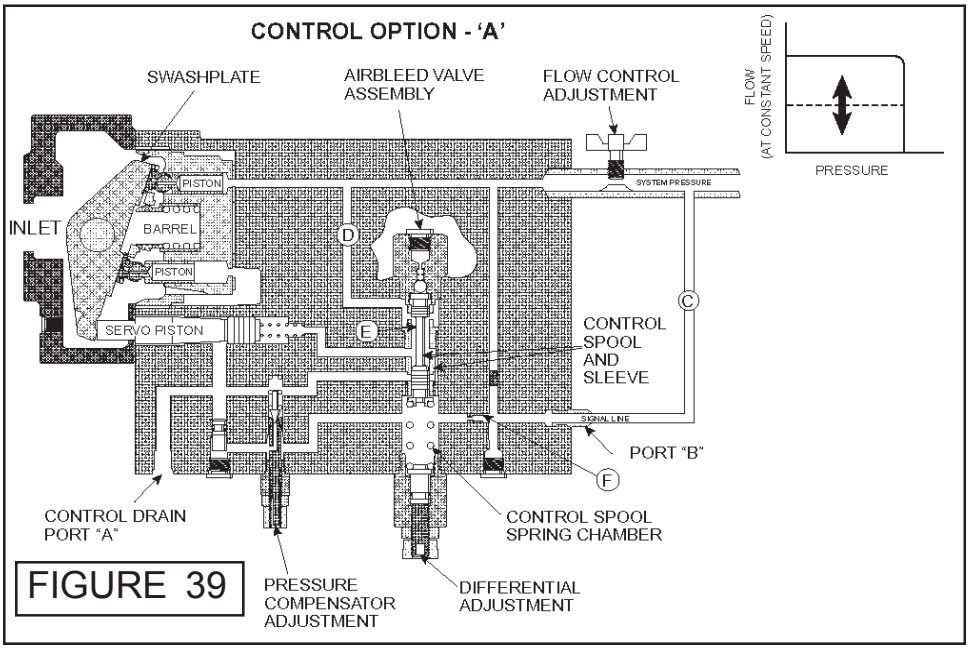


FIGURE 39

Pressure & Horsepower Control: Control Type (H)

The horsepower is sensitive to the position of the servo piston. When the servo piston is to the right, the swash plate causes low flow and the power control piston develops maximum spring pressure on its companion poppet (mechanical feedback). When the servo piston is left and the flow is high, the power control piston reduces spring pressure on the poppet. This allows it to open under less pressure in the control spool chamber. As with the operation of the pressure compensator control, this allows the control spool to move downward, venting the servo piston cavity and causing the servo piston to move to the right. This reduces output flow and thereby power.

As indicated in drawing (See Figure 40) pressure in the control spool chamber is affected by both the pressure compensator control and the power control. The resultant pressure in this chamber is a function of the set points of these two controls. Both set points are adjustable.

Pressure, Horsepower & Flow Control: Control Type (C)

In addition to the three control configurations just discussed, it is possible to combine all three control devices in one pump. In this mode, the position of the control spool is a function of the actions of the pressure compensator adjustment, horse power adjustment and flow control. (See Figure 41)

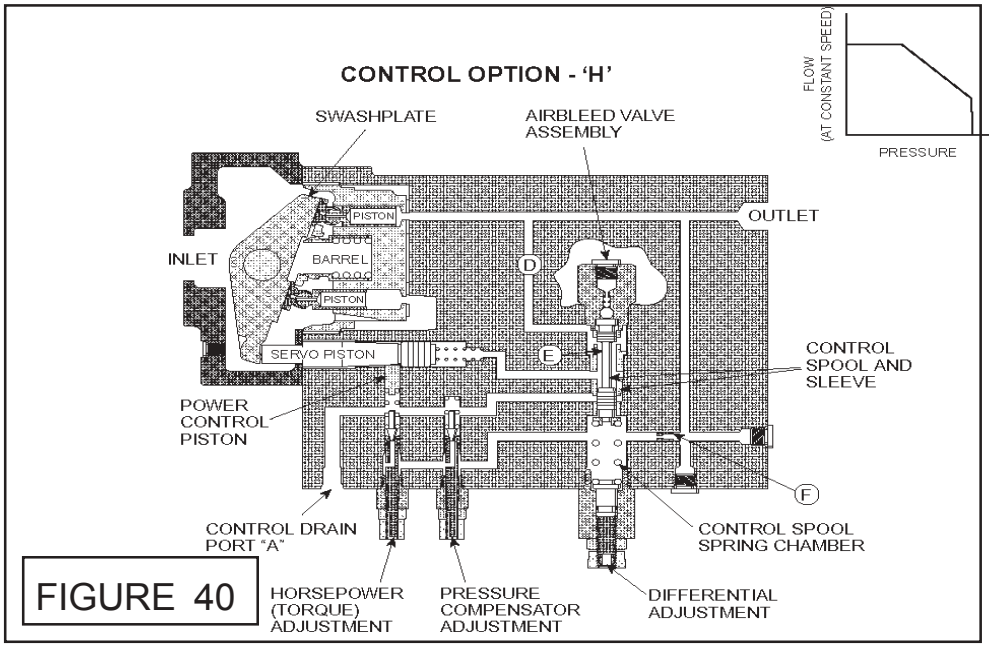


FIGURE 40

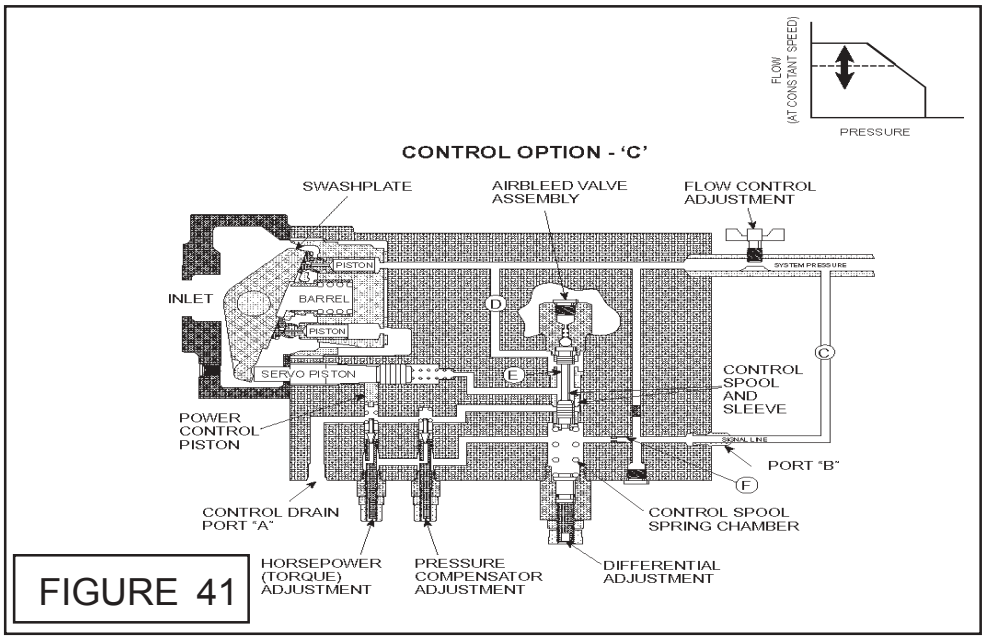


FIGURE 41

PUMP - BOOM CIRCUIT

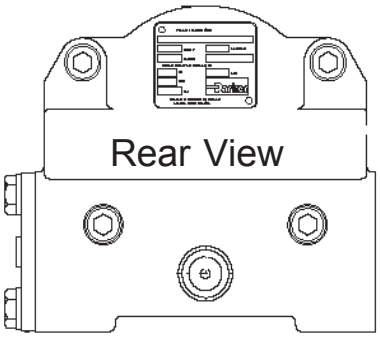
Port Sizes

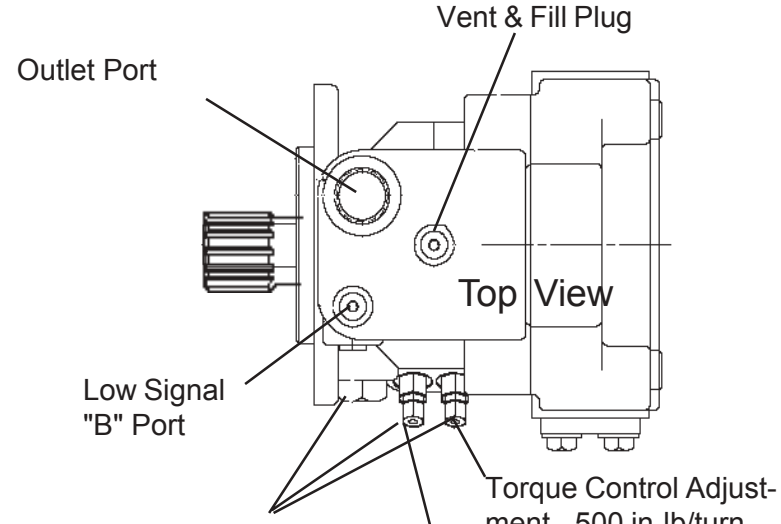
Port Location				
Option	Outlet Port	Inlet Port	Control Drain	Signal Port
2	SAE-12 Straight Thread (1-1/16-12UNC)	1-1/4 SAE 4-Bolt Flange 7/16-14 Threads Standard Pressure Series (Code 61)	SAE-4 Straight Thread (7/16-20UNC)	SAE-4 Straight Thread (7/16-20UNC)
8	ISO 6149-12 Straight Thread (M27 x 2)	1-1/4 SAE 4-Bolt Flange M10 x 1.5 Threads Standard Pressure Series (Code 61)	ISO 6149-4 Straight Thread (M12 x 1.5)	ISO 6149-4 Straight Thread (M12 x 1.5)

Dimensions — Side Port

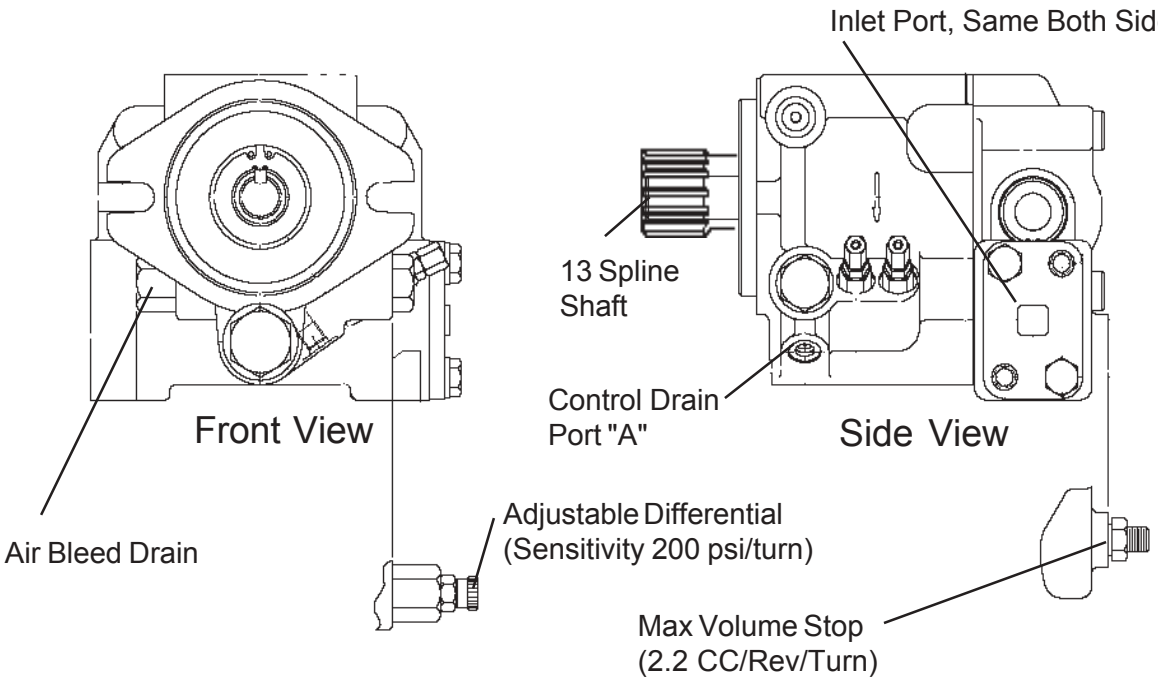
Millimeter equivalents for inch dimensions are shown in (**).

Note:
Shown & dimensioned is a clockwise pump, ports "A'" & "B", delivery port & pump controls will be on the opposite side for the counter clockwise pump used on Maverick Boom



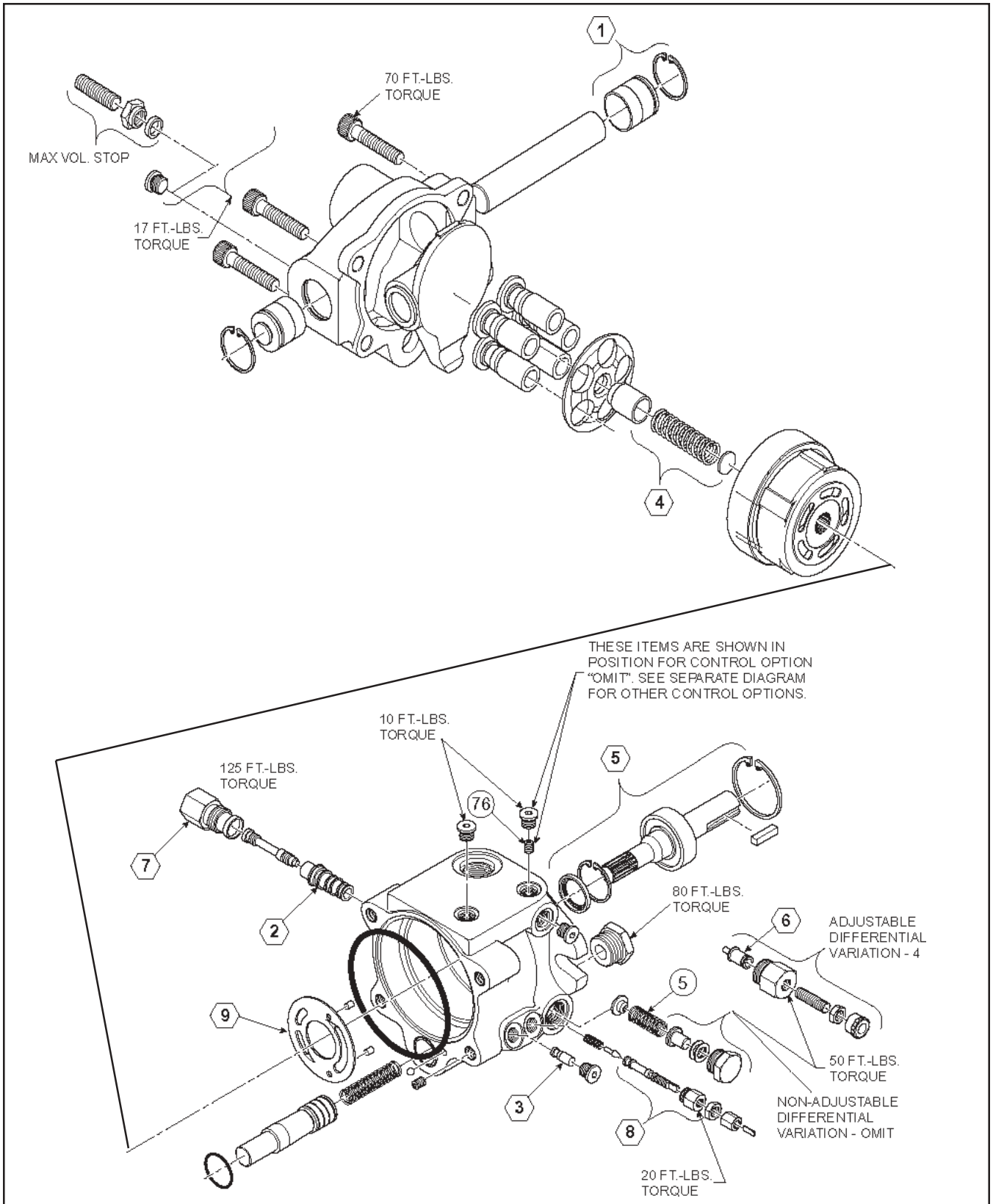


This Plug & Adjustments are opposite side of pump than is shown, CW pump shown CCW pump Used



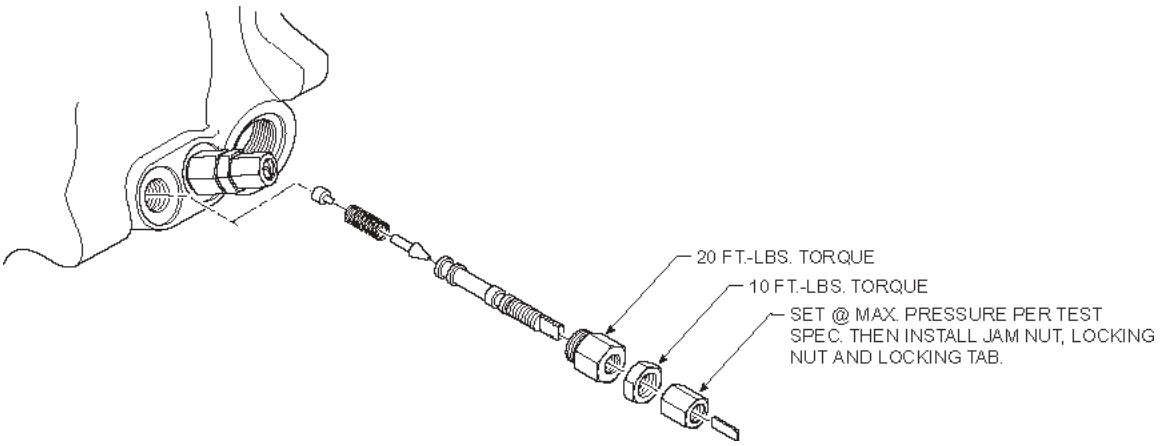
Clockwise Pump Shown, Actual Pump Is Counter Clockwise Which will have ports and adjustment on the opposite side as shown in drawing

PUMP - BOOM CIRCUIT

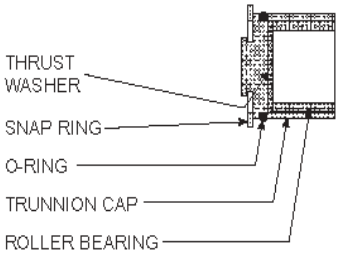


PUMP - BOOM CIRCUIT

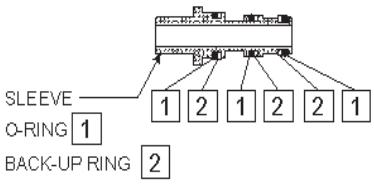
10 Pressure, Power & Flow Compensator



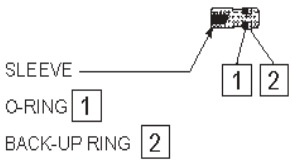
1 TRUNNION CAP ASSEMBLY



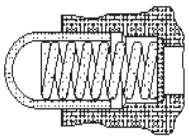
2 SLEEVE ASSEMBLY



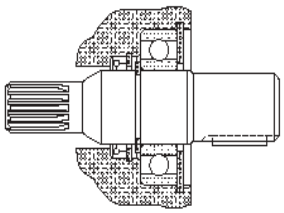
3 PLUG ASSEMBLY



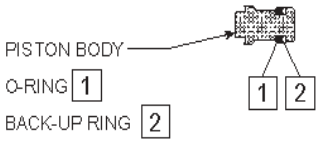
4 RETAINER DETAIL



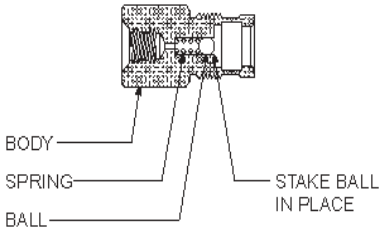
5 BEARING SHAFT ASSEMBLY



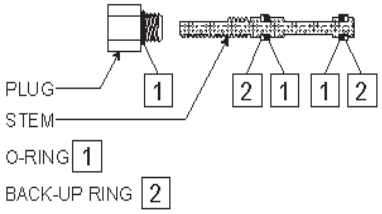
6 PISTON - DIFFERENTIAL CONTROL



7 AIR BLEED ASSEMBLY



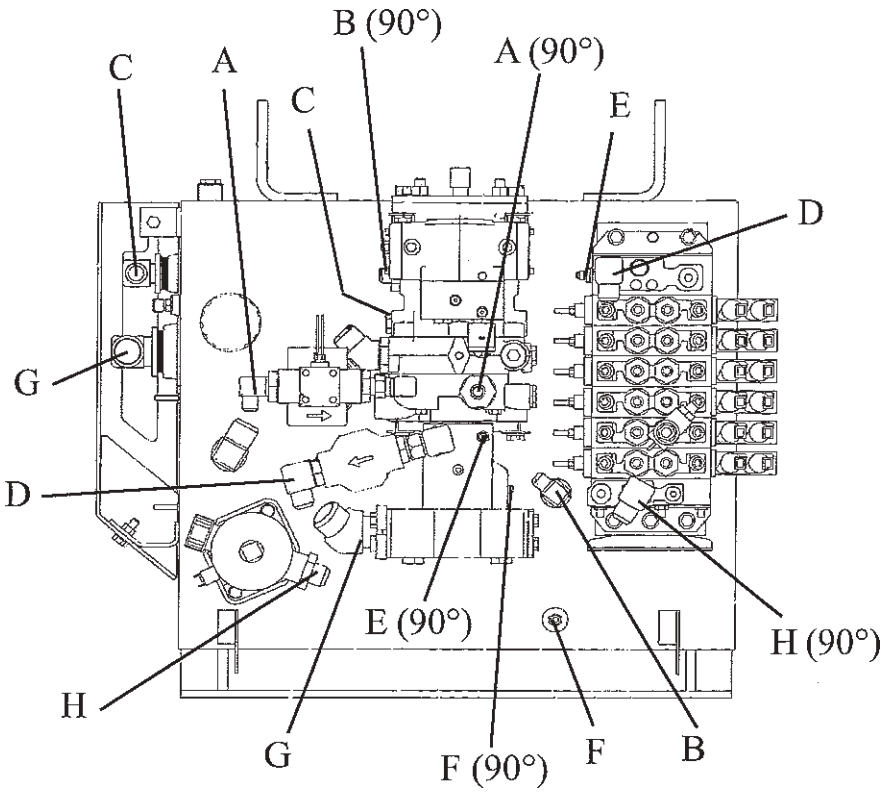
8 ADJUSTING STEM ASSEMBLY



9 PORT PLATE

LEFT HAND (CCW) PORT PLATE SHOWN IN ASSEMBLY (ABOVE).
RIGHT HAND (CW) PORT PLATE SHOWN BELOW.

MOTOR & BOOM PUMP - HOSE ROUTING



Item	Part No.	Qty.	Description
A	02981427	1	Hose, 8FJX - 8FJX 90° - 24" Lg. w/Red Tie (Charge Filter to Pump)
B	02981428	1	Hose, 8FJX - 8FJX 90° - 21" Lg. w/ Blu Tie (Case Drain to Tank)
C	02981429	1	Hose, 12FJX - 12FJX - 23" Lg. (Pump to Suction Filter) hose under pump and cannot be seen in drawing.
D	02981430	1	Hose, 12FJX - 12FJX - 31" Lg. w/ Red Tie (Pressure Filter to Supply)
E	02981431	1	Hose, 4FJX - 4FJX 90° - 35" Lg. w/ Red Tie (Pump Load Sense to Valve (PX)
F	02981432	1	Hose, 4FJX - 4FJX 90° - 20" Lg. w/ Blu Tie (Pump Regulator to Tank)
G	02981433	1	Hose, 20FJX - 12FJX - 24" Lg. (Pump to Suction Filter)
H	02981462	1	Hose, 12FJX - 12FJX 90° - 20" Lg. w/ Org Tie (Valve Return to Tank)

NOTE: Hoses are not shown in drawing above, this is for clarity. The hose routing is for the hoses which connect from one point to the other. Use the instructions and hose description listed to follow hose routing. Example: Hose - A connects to one end marked A and the other end of hose connects to the other item marked A. This is done with the other letters as well, the hose must connect to the same letter markings on each end as in drawing. Some hose will be marked with a colored plastic tie.
Some hose will have a straight fitting or a 90° fitting. This is to allow hoses to be routed to where they clear other items, when connecting hose put the end on that has the correct fitting as noted in drawing with (90°) or the straight fitting if note marked hose routing that is to make hoses clear other items. Do Not connect hose to different letter items, all hose end must connect to the same letter on both ends.
TO ID HOSES: Always check Size, Length, Fittings and Color Plastic Tie to identify the hoses. Some hoses will have the same color tie but the size, length or fittings will be different.

Section 5

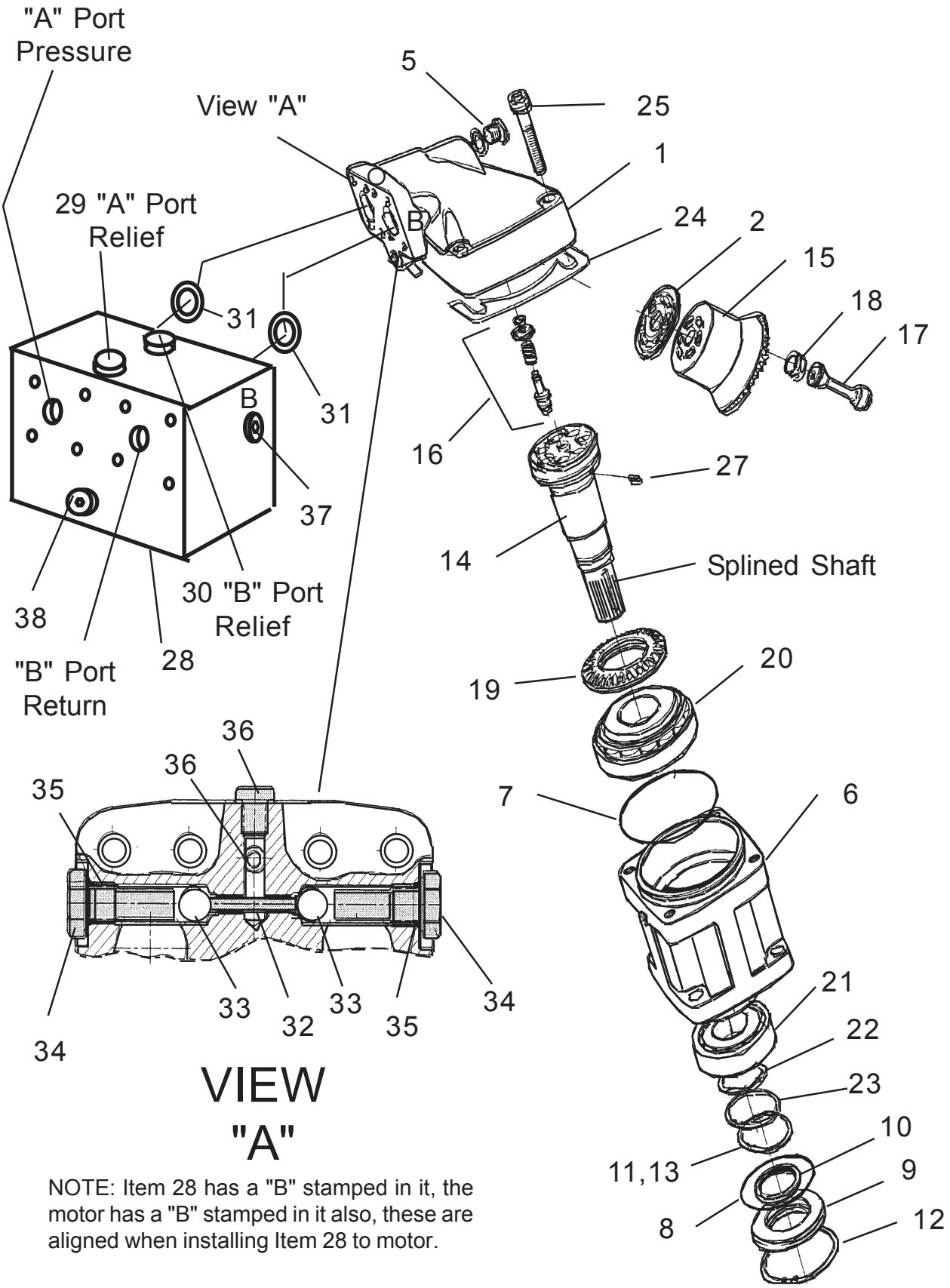
MOTOR CIRCUIT 24' & 30' BOOM

MOTOR P/N 02979881

Parts Location & Service Instructions

This Section is for Motor Asy P/N 02979881

MOTOR P/N 02979881 - PARTS LOCATION



NOTE: Item 28 has a "B" stamped in it, the motor has a "B" stamped in it also, these are aligned when installing Item 28 to motor.

MOTOR P/N 02979881 - PARTS LOCATION

Rotary Head

Item	Part No.	Qty	Description
	02979881	-	Motor Asy
1.	02980529	1	Barrel Housing Asy.
2.	02980530	1	Vlalve Plate (*)
4.	02980536	1	Nozzle
5.	02980537	1	Plug Asy. Hexagon
6.	02980538	1	Bearing Housing
7.	02980539	1	O-Ring (*) (**)
8.	02980540	1	O-Ring(*) (**)
9.	02980541	1	Seal Carrier
10.	02980542	1	Shaft Seal (*) (**)
11.	02980543	1	Spacer Washer
12.	02980544	1	Retaining Ring
13.	02980545	1	Retaining Ring
14.	02980546	1	Shaft Asy
15.	02980548	1	Cylinder Barrel (*)
16.	02980549	1	Barrel Support
17.	02980550	7	Piston Asy. (*)
18.	02980551	21	Piston Ring
19.	02980552	1	Ring Gear
20.	02980553	1	Bearing, Roller
21.	02980554	1	Bearing, Roller
22.	02980555	a/r	Spacer Washer
23.	02980556	1	Retaining Ring
24.	02980557	a/r	Shim 0.5
	02980558	a/r	Shim 0.2
	02980559	a/r	Shim 0.4
	02980560	a/r	Shim 0.6
	02980561	a/r	Shim 0.8
	02980562	a/r	Shim 1.0
	02980563	a/r	Shim 0.7
25.	02980564	4	Bolt, Socket Head
26.	02980565	1	Safety Valve
27.	02980547	1	Guide Pin
28.	02980571	1	Relief Manifold
	02980570	a/r	Relief Valve Seal Kit
29.	02960568	1	Relief Valve, 280 Bar (A-Port)
30.	02980569	1	Relief Valve, 330 Bar (B-Port)
31.	02980237	2	O-Ring
33.	02980532	2	Ball
34.	02980533	2	Plug, Hexagon
35.	02980534	2	O-Ring
36.	02980535	2	Plug, Asy.
37.	02980572	2	Plug Asy.
38.	02980573	1	Plug Asy.
39.	02980566	1	Rebuild Kit (*)
40.	02980567	1	Seal Kit (**)

(**) These parts are included in Seal Kit

(*) These parts are included in Rebuild Kit

MOTOR P/N 02979881 - SPECIFICATIONS

Motor P/N 02979881 Specifications [3]

		European Standards		United States Standards
Displacement.....		80.4 (Cm / Rev)	or	4.9 (Cu. In. / Rev
Motor Operating Speed.	Max Intermittent...	5,200 rpm	or	5,200 rp
	Max Continous....	4,000 rpm	or	4,000 rp
	Min Continous.....	50 rpm	or	50 rpm
Motor Torque (Theor.).....		128 NM (at 100 Bar)	or	94 ft.lbs. (at 1450 psi)
		614 NM (at 480 Bar)	or	453 ft. lbs (at 6960 psi)
Motor Input Flow.....	Max Intermittent....	418 L/min	or	110 gpm
	Max Continous....	322 L/min	or	85 gpm
Operating Pressure.....	Max Intermittent....	480 Bar	or	6960 psi
	Max Continous.....	420 Bar	or	6100 psi
Maximum Case Pressure.....		10 bar (at 1500 rpm)	or	145 psi (at 1500 rpm)
Fluid Contamination Level.....		18/13 (ISO Code 4406)	or	18/13 (ISO Code 4406)
Motor Shipping Weight.....		26 kg	or	57 lbs.

Specifications Subject To Change Without Notification

MOTOR P/N 02979881 - PARTS LOCATION

General Information:

The Motor P/N 02979881 is Sperical Piston design. This motor is used on the Rotary Head. This is a high Torque Motor, with heavy duty roller bearings. See Figure 1 below for component location.

1. Barrel Housing
2. Valve Plate
3. Cylinder Barrel
4. Piston with Piston Ring
5. Timing Gear
6. Tapered Roller Bearing
7. Bearing Housing
8. Shaft Seal
9. Output / Input Shaft

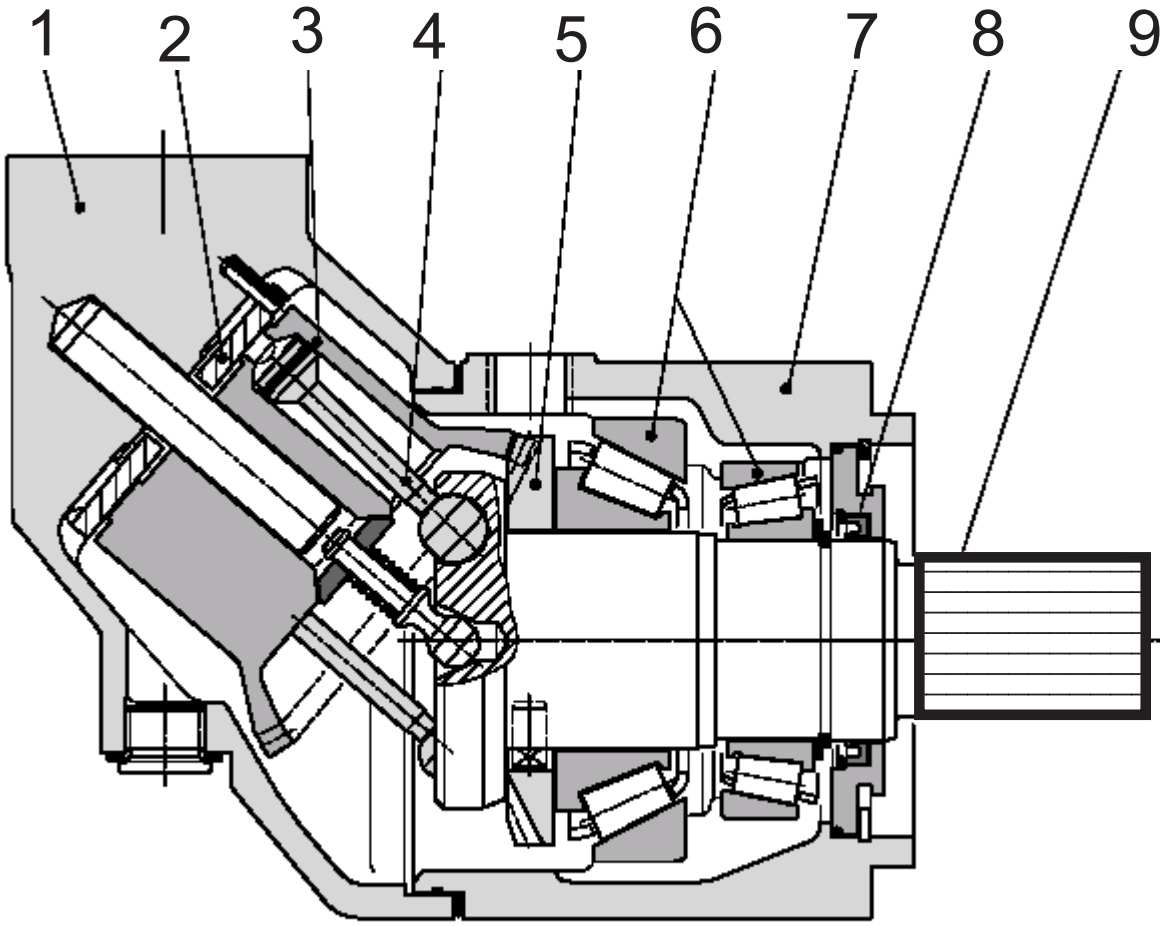


Figure 1 Motor Assembly

MOTOR P/N 02979881 - DISASSEMBLY

Motor Disassembly:

1. Clean Outer Surface Motor , hose and deck surfaces Before removing any components. Motor and hoses must be completely clean, dry the exterior of the motor and hoses. Make certain that you have proper containers to catch any oil that will drain out. Plug all hoses that are removed and plug all opening of motor fittings. Make certain the work area and all tools are clean. No contamination can be allowed to get into system. Refer to the previous parts page for part location in disassembly instructions, It works well to print a copy and have it laying to one side as you read these instructions. Instructions should be read all the way through prior to beginning disassembly

2. Remove Barrel Housing. Clamp Motor in a vise as shown in figure 1. There are 4 bolts (item 25) located on top of the Barrel Housing Assembly (item 1). Remove these four bolts. Lift Barrel Housing (item 1) as shown in Figure 2. Use caution to make certain the valve plate (Item 2) doesn't fall out when lifting the Barrel Housing off. By lifting straight up you should be able to use your finger to make certain the valve plate (item 2) does not fall out and get damaged. Make a note of which side of Valve plate is up and which side is down, this will be important during reassembly.

3. Remove Cylinder Barrel. Remove the Shim (item 24) and set it aside. Lift the Cylinder Barrel up and out (See Figure 4), This will leave the barrel support components (item 16) sticking up out of the shaft. Support components (item 16) are an assembly of four parts. The pistons (item 17) will also be sticking up. Make certain all the removed components are laid in a clean area.

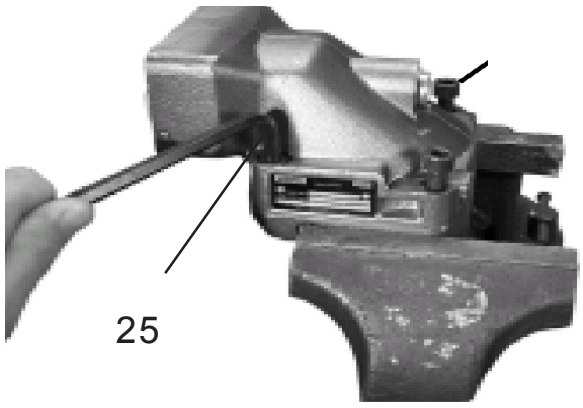


Figure 2

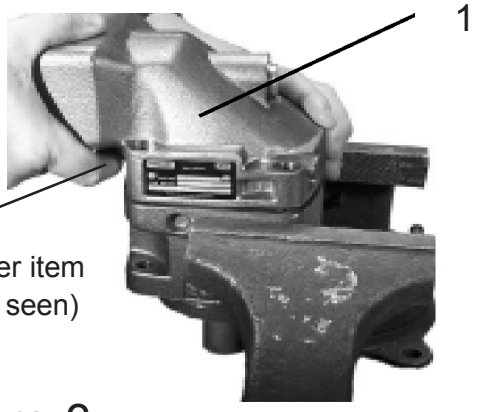


Figure 3

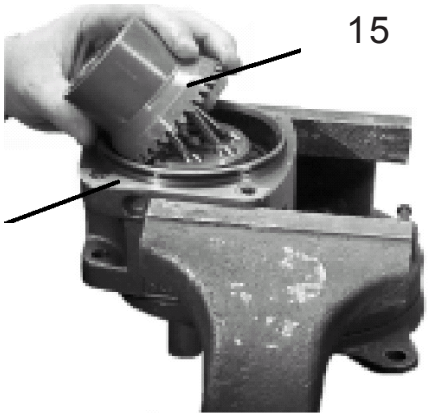


Figure 4

MOTOR P/N 02979881 - DISASSEMBLY

Motor Disassembly: Continued

4. Lift Out Barrel Support . Lift the barrel support out (item 16), make certain that all the parts in barrel support are accounted for. (See Figure 5)

5. Remove the Pistons (item 17), there are 7 pistons and 21 piston rings (item 18) that will be removed. There are 3 piston rings per piston. (See Figure 6)

6. Remove Bearing Housing Sealing O-Ring. There is an O-Ring (item 7) that is used to seal barrel housing assembly (item 1) to bearing housing (item 6). Remove this O-ring (See Figure 7) This will leave Shaft Assembly (item 14) still in Bearing housing (item 6)

7. Remove Retaining Snap Ring. Remove the Bearing Housing Assembly from vise and turn it over so the shaft end is pointing upward and re-clamp it into vise as shown in figure 8. Using internal Snap Ring pliers to remove the snap ring that retains the seal carrier (item 9). Note: Smooth Shaft shown, actual shaft is splined in this motor.

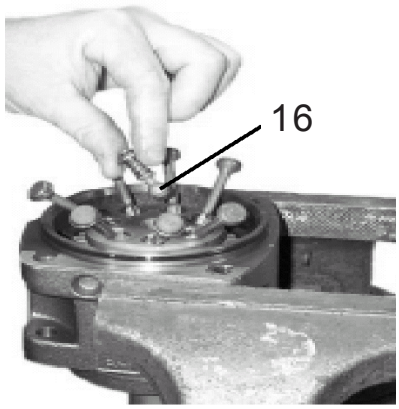


Figure 5

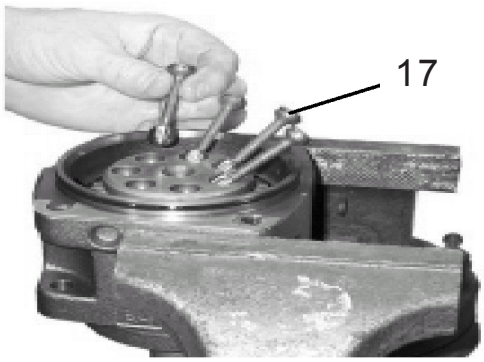


Figure 6

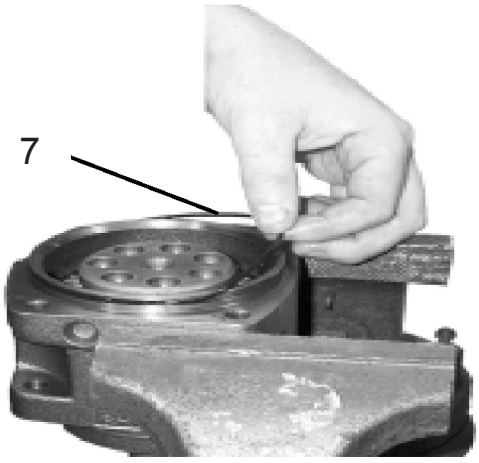


Figure 7

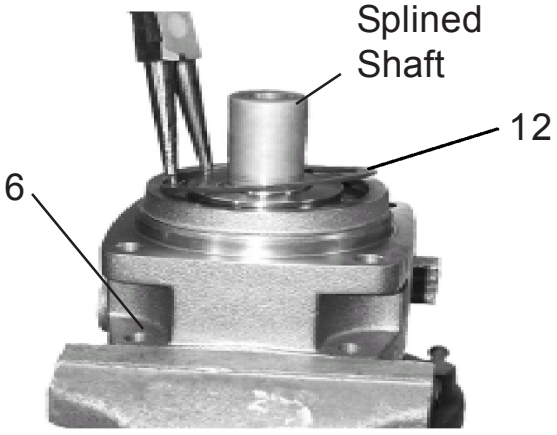


Figure 8

MOTOR P/N 02979881 - DISASSEMBLY

Motor Disassembly: Continued

8. Remove Seal Carrier . Using small pry tool lift seal carrier (item 9) up and slide it off of shaft as shown in Figure 9.

9. Remove sealing O-Ring. There is an O-Ring (item 8) under seal carrier that you can reach and pull out. (See Figure 10)

10. Remove External Snap Ring From Shaft,. Looking down on the shaft as shown in Figure 11, there are spacer washers (items 11, 13 & 22) and external snap ring. Make certain to make a note of where they are located and how many there are. Use snap ring pliers to remove retaining ring, do not pry it off of shaft as this would scratch the shaft.

11. Remove Spacer Washer. Under the Snap Ring. Remove any spacer washer under the snap ring, noting their quantity and location. (See Figure 12). Make certain to keep all Spacers in the same order they came off.

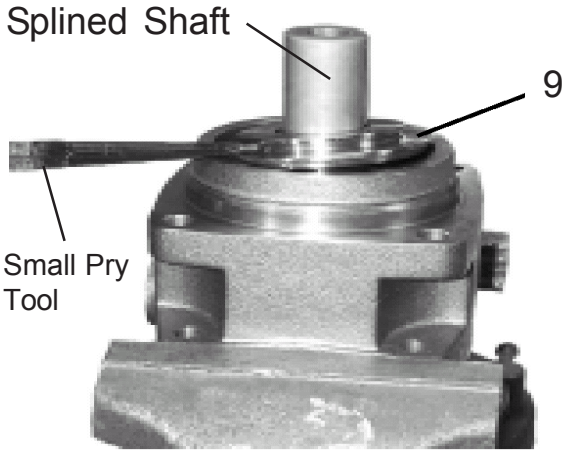


Figure 9

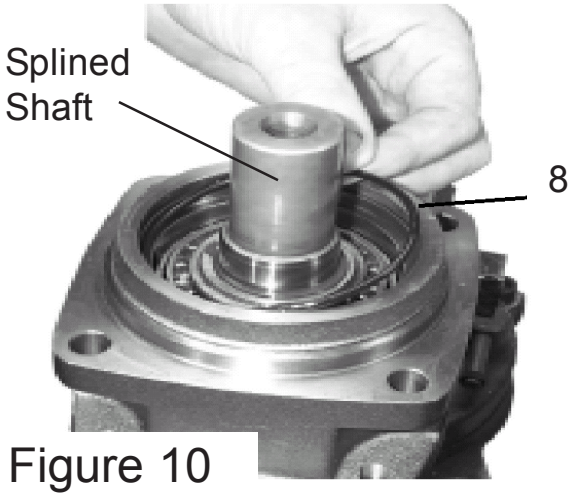


Figure 10

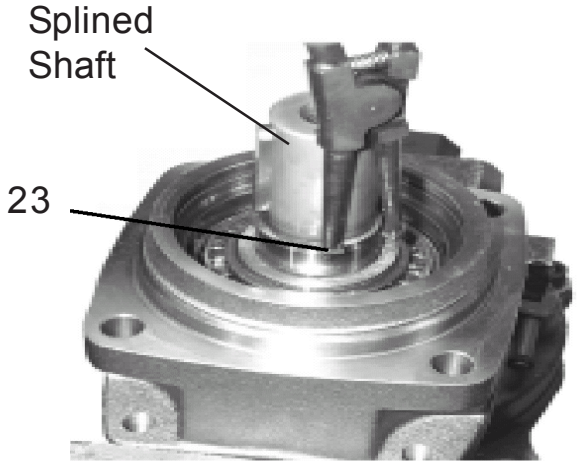


Figure 11

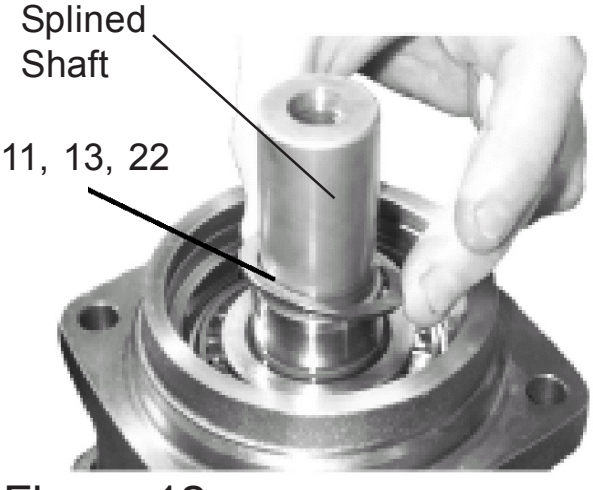


Figure 12

MOTOR P/N 02979881 - DISASSEMBLY

Motor Disassembly: Continued

12. Remove Shaft. Remove Bearing housing from Vise and move to a press. Set the Housing in press where the bottom is open as the shaft will come out the bottom,. (See Figure 13) Make certain you support the shaft in a way that will not allow it to fall out when pressed and hit the floor. It will not take a lot of pressure to remove shaft so you should be able to catch it with your hand.

13. Remove Small Lower Bearing Cone. The lower bearing cone (item 21) will lift out of the housing once the shaft is removed. (See Figure 14)

14. Remove the Bearing Cups from Bearing Housing (item 6). This will only need to be done if they are being replace. Using a hammer and a mandre, tap the small bearing ring off. (See Figure 15 & 16) The Bearing Cups will drive out from the opposite side of each other. The lower bearing cup is tapped from the top and the upper Bearing cup will be tapped from the bottom side of the housing.

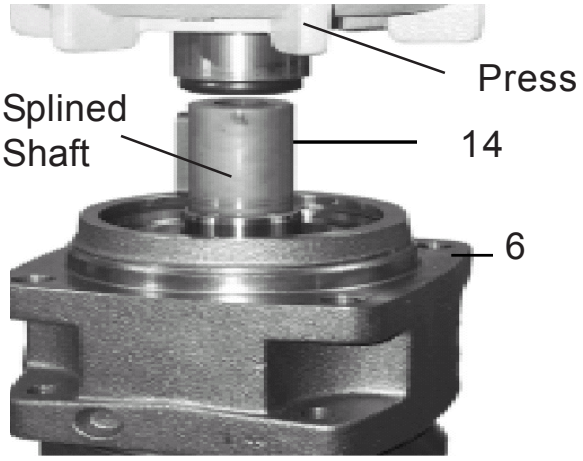


Figure 13

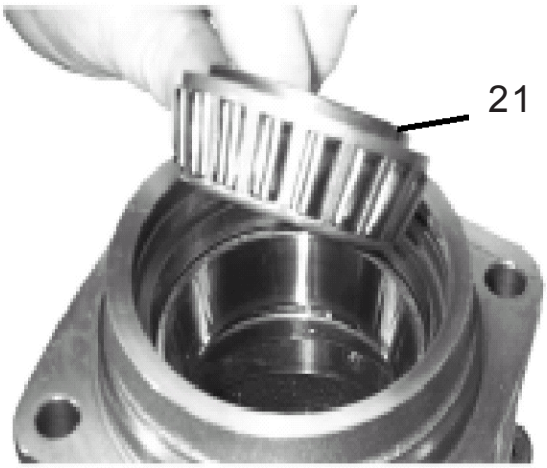


Figure 14


Figure 15


Figure 16

Motor Disassembly: Continued

15. Remove Gear and Upper Bearing Remove upper bearing cone and gear at the same time. Sit Shaft down over a tube that will support the gear (item 19). Using press on Shaft (item 14) , Shaft will slide down through the gear and bearing at the same time. Make certain to support Shaft in such a way it will not fall through and hit the floor. (See Figure 17) Figure 16

16. Inspect all parts. The Motor is now disassembled. Inspect all of the disassembled part for wear and damage. Replace worn and/or damaged parts. After cleaning and washing parts keep them in clean area. If the motor is to remain disassembled for any period of time, lightly coat the surfaces of the parts with hydraulic oil and store them in a closed container to prevent the parts from rusting or becoming contaminated.

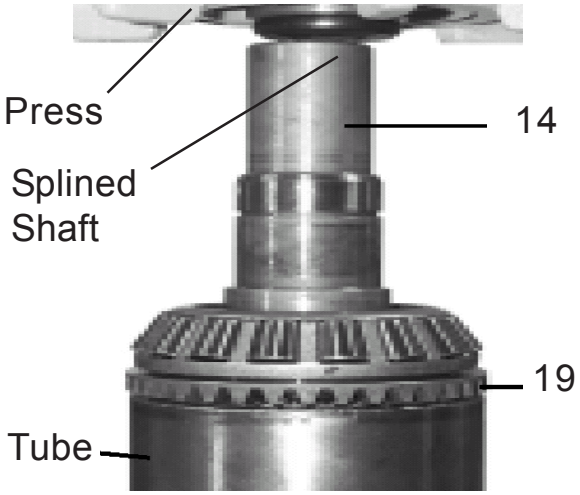


Figure 17

MOTOR P/N 02979881 - ASSEMBLY

Motor Assembly:

1. Install Gear & Bearing Cone on Shaft. Install Gear (item 19) down over shaft (item 14), make certain Gear is on in correct direction and the guide pin (item 27) is installed. Slide Bearing Cone (item 20) down onto Shaft with small part of Bearing Cone up as shown in Figure 18. Using a tube sleeve (tool shown in last figure of this section) press Bearing cone and Gear down onto shaft with a press. The tube must only contact the inner edge of the bearing. See Figure 40 at the end of this section for tool dimensions.

2. Install Bearing Cups into Bearing Housing. This will need to be done if the bearing cups were removed. Install bearing cups (1/2 of item 20) into Bearing housing using a press and tube that is close to the size of the bearing cup. Make certain the Bearing cups are completly seated. (See Figure 19)

3. Install Shaft Assembly into Bearing Housing. Install the Shaft Assembly (Shaft, Gear and Bearing) into the Bearing housing. Slide the Lower Bearing cone down over Shaft. You will need to support shaft while pressing Bearing Cone onto shaft, make certain to support it with something that will not damage it or get contamination on it. Using a tube and a press to push bearing down until it is seated in Bearing cup, Press Bearing Cone on until the proper Bearing preload is achieved. Proper Bearing Preload is the removal of the slack in the bearing, remove end play.

4. Remove Bearing Housing with Shaft From Press. Remove assembly from press and reinstall it into the vise as was done during disassembly process. Install it with the spline end of the shaft pointing up.

5. Install The Lower Bearing and Spacer Washers. Press lower bearing onto shaft until Zero End play is achieved. Install Lower bearing spacer washer (item 22) Quantity will vary as these shim type spacer washer are used to maintain zero bearing end play. Start with the same quantity that was removed and check. Adjust quantity as required to achieve proper bearing load. (See Figure 21)

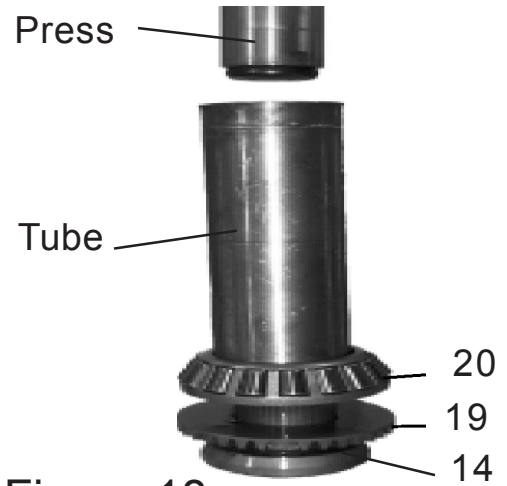


Figure 18

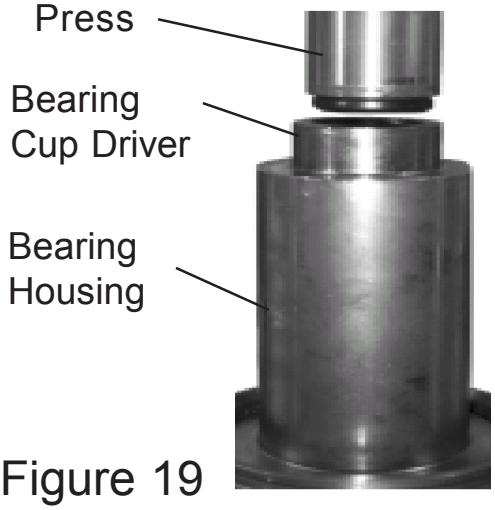


Figure 19

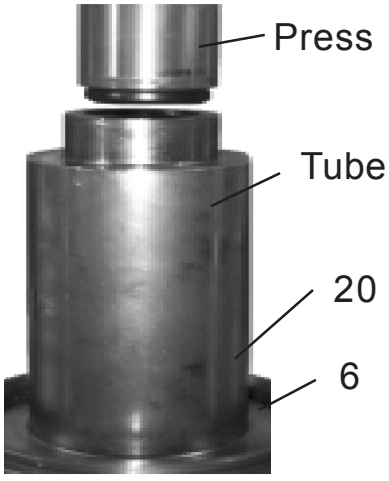


Figure 20

Motor Assembly: Continued

6. Install Bearing Retaining Ring. This is an external snap ring (item 23). Use snap ring pliers to slide snap ring down over shaft. (See Figure 22). Check Bearing load after snap ring is installed to make certain shaft has zero end play with bearings, If end play is not correct, the snap ring will need to be removed and the quantity of spacer washers will have to be changed.

7. Install O-Ring Seal. Install the O-Ring seal (item 8) into Bearing housing making certain it is straight and seated into housing. (See Figure 23)

8. Install Seal into Seal Carrier. Drive the old Seal out of Seal Carrier (See Figure 24) Install new seal (item 10) using a seal driver. Coat the ID of seal with a light coat of oil. (See Figure 25)

9. Install Seal and Seal Carrier. The Seal Carrier (item 9) has a shaft seal (item 10) that is installed into it. This needs to be installed before Seal carrier is installed into Bearing housing. (See Figure 26)

10. Install Seal Carrier Retaining Ring. Using Internal Snap Ring Pliers Install the retaining ring (item 12) into bearing housing. This will complete the lower end assembly. (See Figure 27) Remove the bearing housing from the vise and turn it over. Reinstall it into the vise with the gear end up. (See Figure 28)

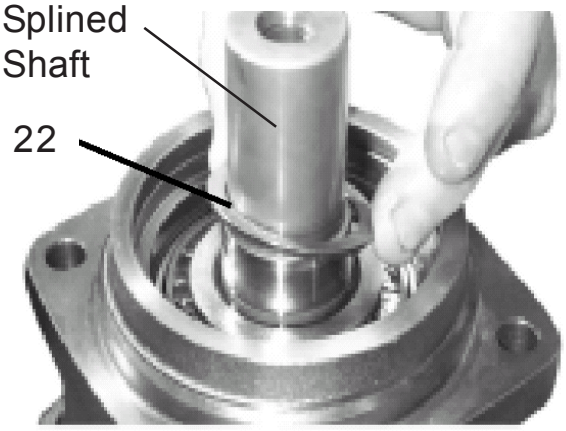


Figure 21

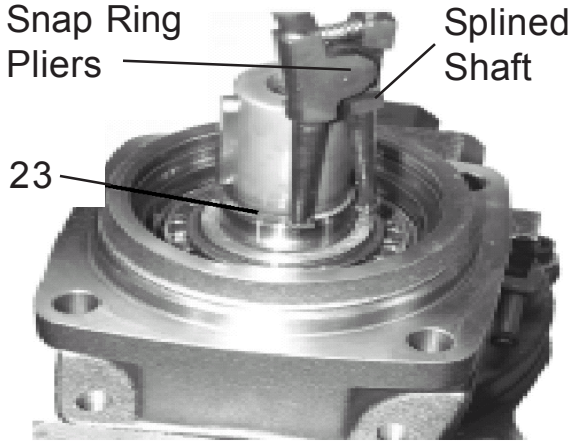


Figure 22

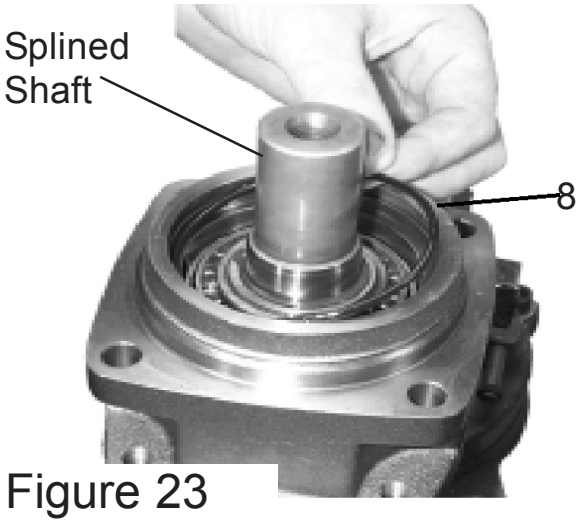


Figure 23

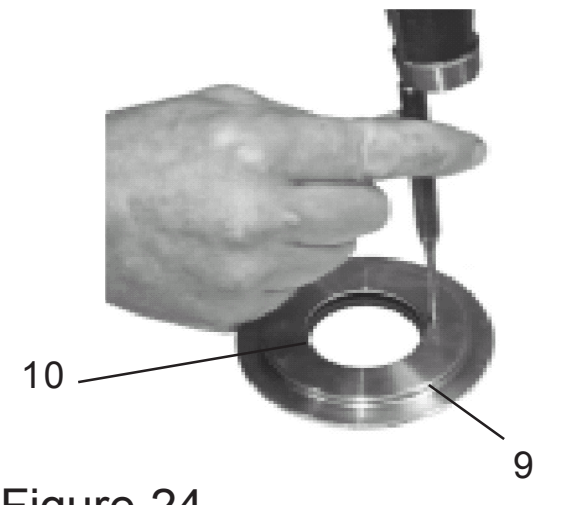


Figure 24

Motor Assembly: Continued

11. Install O-Ring Seal. Install the O-Ring Seal (item 7) into bearing housing (See Figure 28).

12. Install Pistons & Piston Rings. Coat the pistons (item 17) with hydraulic oil, make certain all 7 pistons have 3 rings (item 18) each on them. (See Figure 29). Piston will lay over to the side as shown in figure 29 but will slip down into the holes as shown in Figure 30.

13. Install Barrel Support. The Barrel Support (item 16) is a 4 piece assembly that installs in the center of the shaft, make certain all components of the barrel support is installed. (See Figure 30)

14. Install Shims. Install the bearing housing shims (item 24) onto bearing housing (See Figure 31), These shims are various thickness and the quantity required will vary, start with the same amount and thickness that was removed.

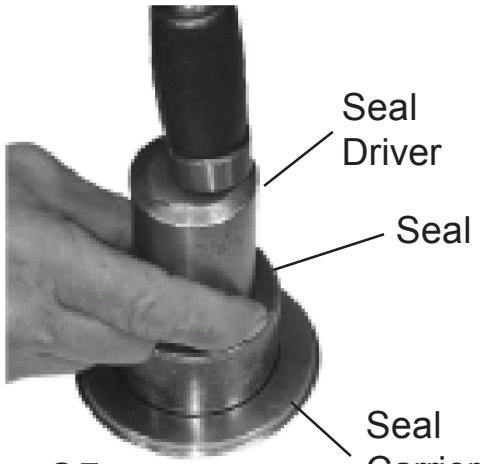


Figure 25

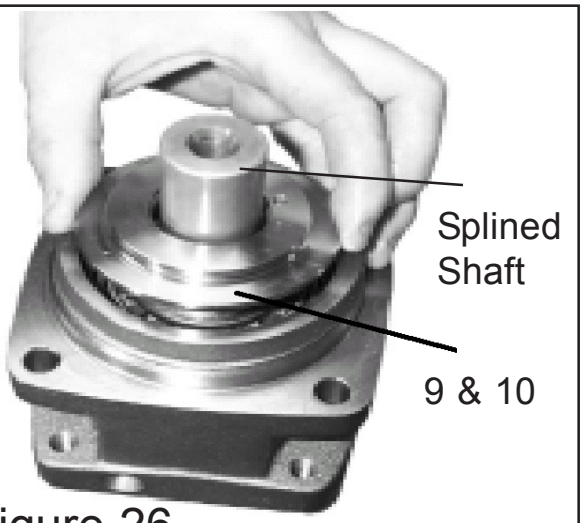


Figure 26

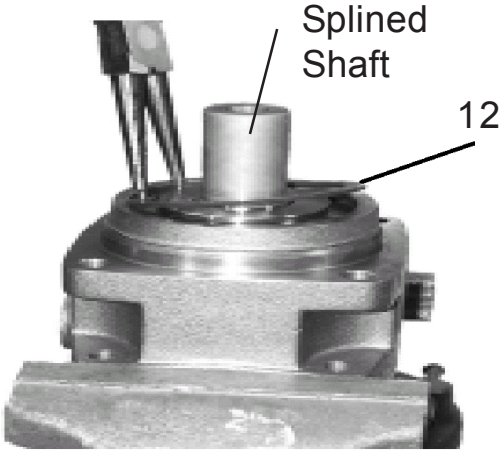


Figure 27

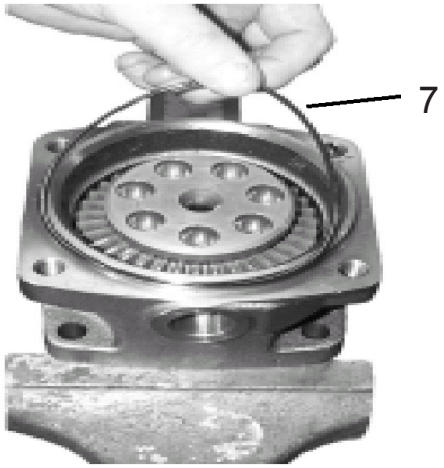
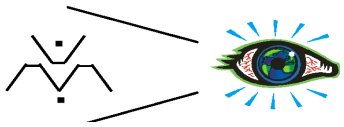


Figure 28

Motor Assembly: Continued

15 Install Cylinder Barrel. When installing the **cylinder barrel (item 15), it must be timed.** There are punch marks on the Shaft Gear and the gear of cylinder barrel, these marks must be aligned as shown below. (See Figure 32) Set this assembly aside for now.



16. Install Valve Plate, Coat Valve plate (item 2) with a coat of grease (See Figure 33) will be to hold valve plate in housing during assembly. With the Barrel Hosing assembly in vise install the valve plate into it. This plate must be installed with the correct side down and the correct side up. (See Figure 34). Note the location of the notch in OD of valve plate.

17. Install Barrel Housing. Clamp Bearing housing and Shaft assembly back into the vice. With the barrel housing assembly turned up as shown in figure 35. Make certain the Valve plate (item 2) is installed inside the barrel housing and facing the correct direction. Make certain the Shims (item 24) are still installed on the Bearing housing. Sit the barrel housing (item 1) down over the bearing housing (item 6). Install the four bolts (item 25), and Torque these four bolts using an alternating pattern to 75 ft. lbs. +/- 7 ft lbs (See Figure 36)

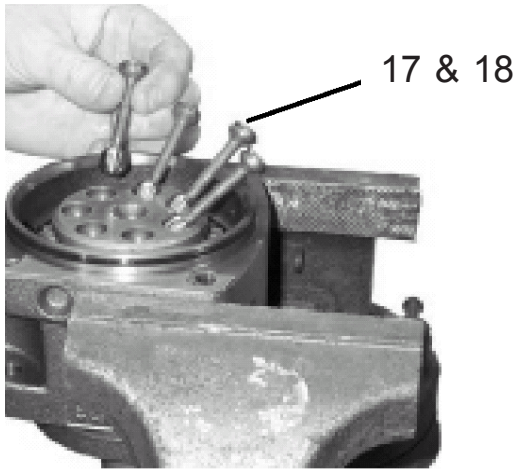


Figure 29

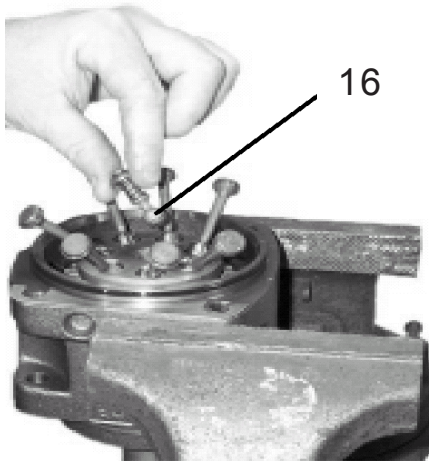


Figure 30

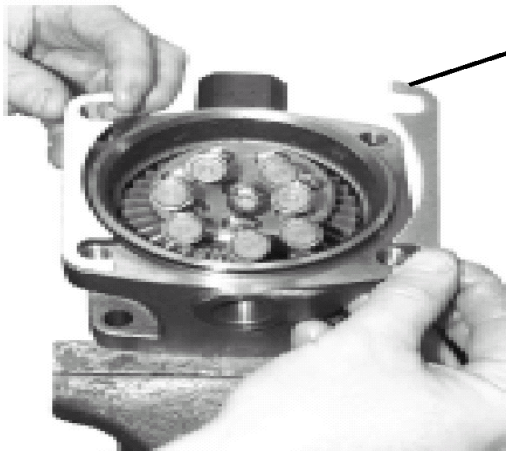


Figure 31

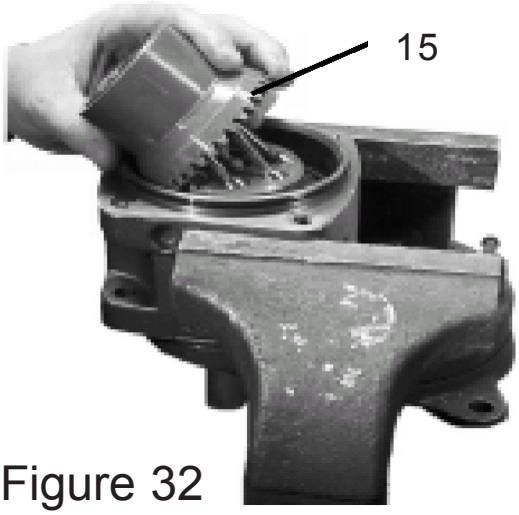


Figure 32

Motor Assembly: Continued

18. Install Relief Manifold. It would not have been required to remove the Relief Manifold (item 28) to disassemble the motor, it could have been left attached to the Barrel Housing Assembly (item 1) . If it was removed, inspect the O-Rings (item 31) and replace if nessacary. The reliefs (item 29 & 30) would not have had to be removed, but if they were make certain to replace them the same way they were removed, there is a Relief Valve Seal Kit (See item 28) available as repair parts. (See Figure 37)

19. Inspect all assembly steps done and make certain every thing is clean, all opening should be plugged and remain plug until hoseconnections are attached.

20 If only replacing Seal as a repair See Figure 8 & 9 in disassembly section and Figures 24, 25, 26 & 27 in the assembly section.

It will be required to remove Seal Carrier Retaining Ring, Pull Seal Carrier out of pump Bearing Housing and remove seal from seal carrier. Make certain to check the O-Ring Seal under seal carrier, it should be replaced when seal carrier is removed and reinstalled. Reverse procedure to reinstall seal carrier. (See Figure 38 & 39)

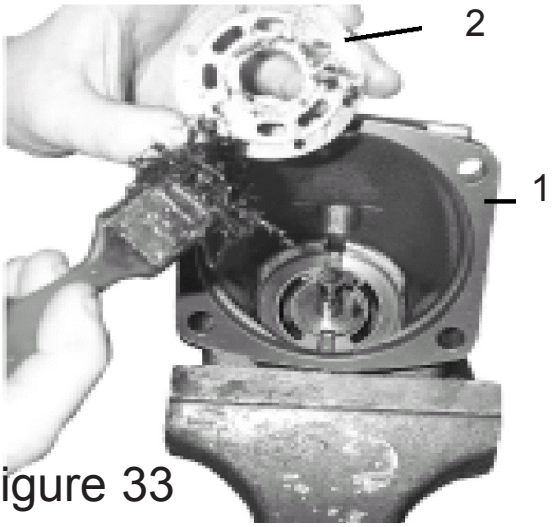


Figure 33

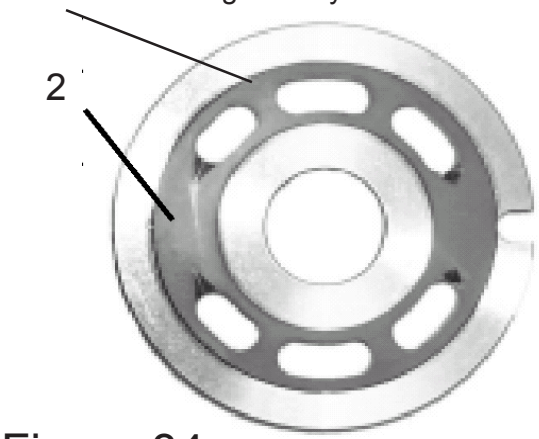


Figure 34

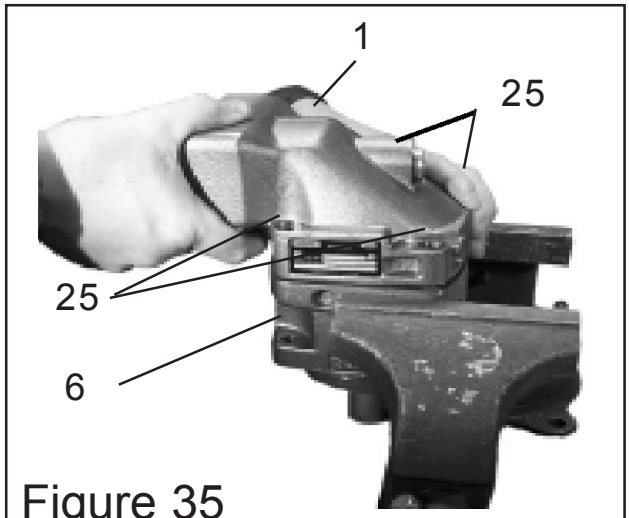


Figure 35

Figure 36

MOTOR P/N 02979881 - ASSEMBLY

Motor Assembly: Continued

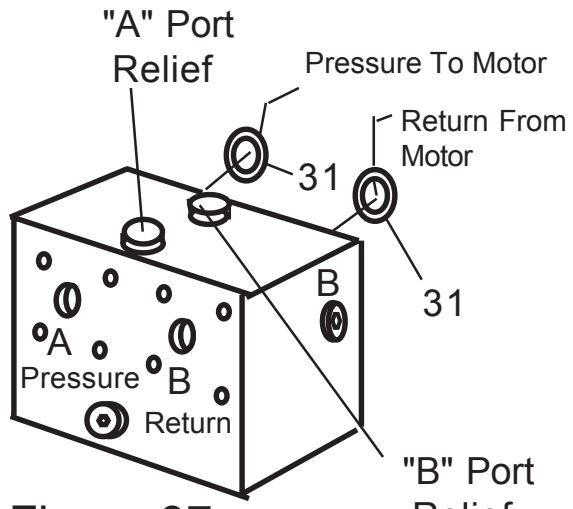


Figure 37

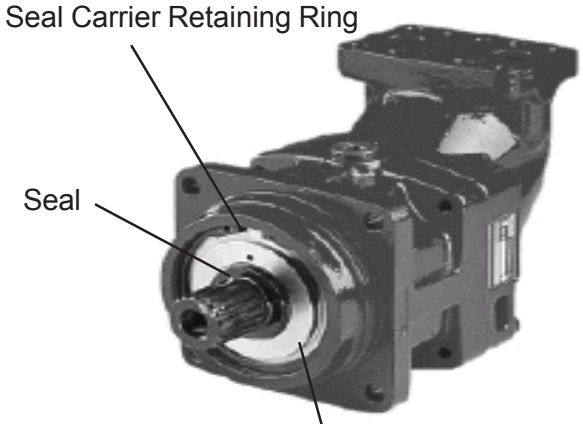


Figure 38

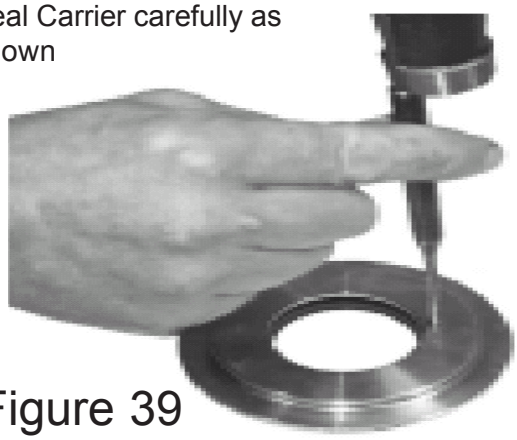
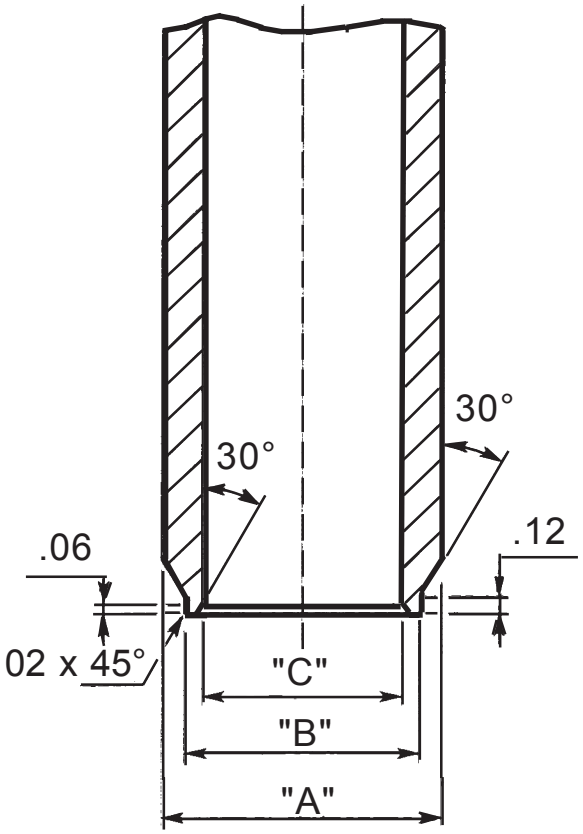


Figure 39

This tool can be machined from tubing to create a bearing driver to install bearings on motor shaft.



Diminsions

"A"	=	2.91" + 0 / -.04
"B"	=	2.75"
"C"	=	2.441" + .008 / - 0

Figure 40

NOTES

Section 6

SPINDLE REPAIR F/ ROTARY MOWER 24' & 30' BOOM

Procedures: Remove Blade Bar

1. Clean all components of Boom and Head, Remove all Dirt and any other material that may contaminate components as being dis-assembled or after it has been disassembled.
2. Move Tractor to Level and Firm Ground, Concrete Floor is Best.
3. Swing the Boom to the Side of the Tractor; Extend Boom out till fully extended. Stand Head Up so Blade Bar is facing out away from Tractor in the folded up position.
4. Fully apply the Park Brake on Tractor.
5. Place all Gears in Tractor in the Neutral Position.
6. Shut Off Tractor, remove Key and disable Tractor so it cannot be started till you are ready to have it started.
7. This procedure can be done with head connected to Boom or with it removed, But if removed you will have to lift Head to remove Blade Carrier Assembly.
8. Remove Blade Bar Assembly, Use Caution the Blade Bar is very heavy Do Not remove the retaining bolts till it is secure to where it will not fall. An easy way to support Blade Bar when removing it is to only remove 2 of the 4 retaining bolts. Get 2 long bolts with same size and threads but longer than what was removed, cut the heads off of these 2 longer bolts and screw them in where you removed the 2 retaining bolts. This will support Blade carrier while you remove the other 2 bolts, this allows the Blade carrier to slide off. The four Blade Bar Retaining Bolts are Torqued to 400 ft. lbs. and are tight. It may be required to hold Blade Bar when removing them, This can be done by connecting a Chain to Blade Bar and securing it to Deck. Make Note of the length of the four Blade Bar Retaining Bolts in center Blade Bar (See Figure 85), Never put Bolts back in that are longer or Shorter they will damage Spindle Shaft.
9. It will not be required to dis-assemble Blade Bar Carrier Assembly once it has been removed from Spindle. But if you do dis-assemble it the 4 Blade Bar Assembly Bolts, 2 long and 2 short, are torqued to 2000 ft. lbs., Blade Bolts Torque to 400 ft. lbs. These Torque Values are based on Clean, Lubricated and undamaged threads. These Components must be torqued back to these setting when re-assembled.

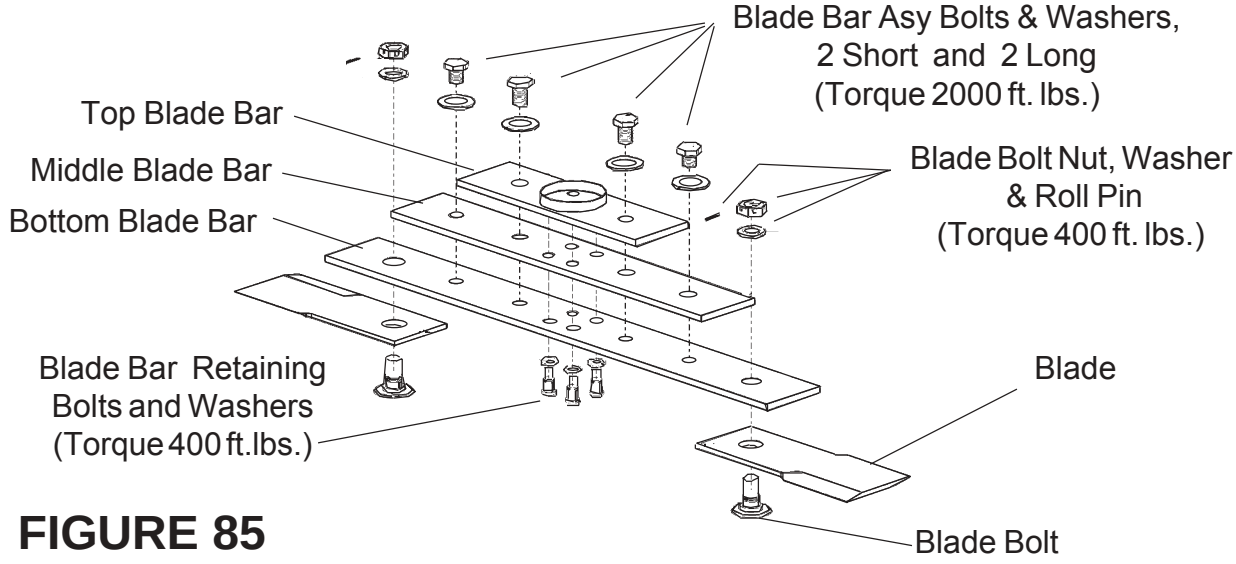


FIGURE 85

SPINDLE - REPAIR

Procedures: Remove Motor and Spindle

1. Remove the four Bolts that Retain Motor to Spindle, Working Motor side to side lift it away from Spindle. If the Head is standing up on side Oil may run out of Spindle when seal of Gasket is broken, be ready to catch it in a container. It will not be necessary to remove Hoses or connections to motor, you will be able to set motor aside with Hoses connected. Do not let weight of motor hang on hoses.
2. Remove Spindle from deck, There are six bolts that hold Spindle down to Deck, remove these Bolts and Nuts to remove Spindle from Deck. You will need someone on bottom side of Deck to hold the Bolts as you take the Nuts off. Spindle will lift off deck from top of Deck.
3. Move Spindle to work Bench; Older Models used a 000 Grease (Thick Oil) that will Drain Slowly, the later models use a Grease that will not drain at all. It is Best to remove grease when Spindle has been dis-assembled.

Procedures: Dis-Assemble Spindle

1. Spindle Dis-Assembly, (See Figure 87) The Spindle Shaft is held in with 2 notched round Nuts and a Tabbed Locking Washer, first use small Blunt Chisel to bend tab out away from Notch on Round Nut, Using Tabbed Socket (consult your local Tool supplier) un-screw outer Locking Nut, Lift tabbed Washer off Shaft, un-screw lower Bearing Adjusting Nut. It is best to replace Tabbed Washer with new one.
2. Remove Spindle Shaft, Because of fit of Upper Bearing Cone it will be required to Press Shaft out through bottom of Housing, This should not take a great deal of effort but some. Put a soft Metal Pin (Brass) into top hole of Shaft, (Do Not put one in that will be too big and get stuck). Using Press; push Pin and Shaft Down, It will come out through bottom of Housing.
3. Remove Bearing Cones, Upper Bearing Cone will have stayed in Housing, reach in from to top to remove it, Lower Bearing Cone should have come out and still be on Spindle, For Cleaning and inspecting this Bearing Cone should be removed. You may need a Bearing Puller to remove Lower Bearing Cone from Shaft.
4. Remove Lower Seal from Housing, Discard Old Seal Do Not re-use it only install new Seals.
5. Remove Bearing Cups, Bearing Cups will need to be driven out of Housing with a driver or Pressed out, But they do Need to come out straight, DO NOT DRIVE them out from one side only, keep equal force all the way around them when taking them out or Housing could be damaged.
6. Cleaning Housing, Clean the Housing completely, No Oil or Grease left in it, Completely inspect all areas of Housing, Bearing Cup Bore, Seal Bore, Flanges, Inner and Out surface of Housing for scratches, cracks, Burrs (especially Seal Area for Burrs), Always Dry Parts after Cleaning, Make sure there is no Solvent residue on them that will pollute lubricant, After Cleaning if Parts are not to be assembled right a way put a coat of Oil over ID of Housing and over Gasket area at the top to prevent rust, Un-painted Clean steel will rust very rapidly if left dry of Oil. Keep it covered to keep dust and dirt from collecting on oiled surface.

Procedures: Re-Assemble Spindle

1. Spindle Re-Assembly, (See Figure 88) Make sure Housing is Clean and in Good Shape.
2. Install Bearing Cups, Using a Driver or Press install Upper and Lower Bearing Cups, Make sure they are seated completely into Housing.
3. Install Lower Seal, Inspect Lower Seal area one more time, Make sure there are no burrs around surface, Install lower Seal Using a Driver (consult your local Tool supplier), After installed coat ID of Seal with light coat of Grease.

Contnued Next Page

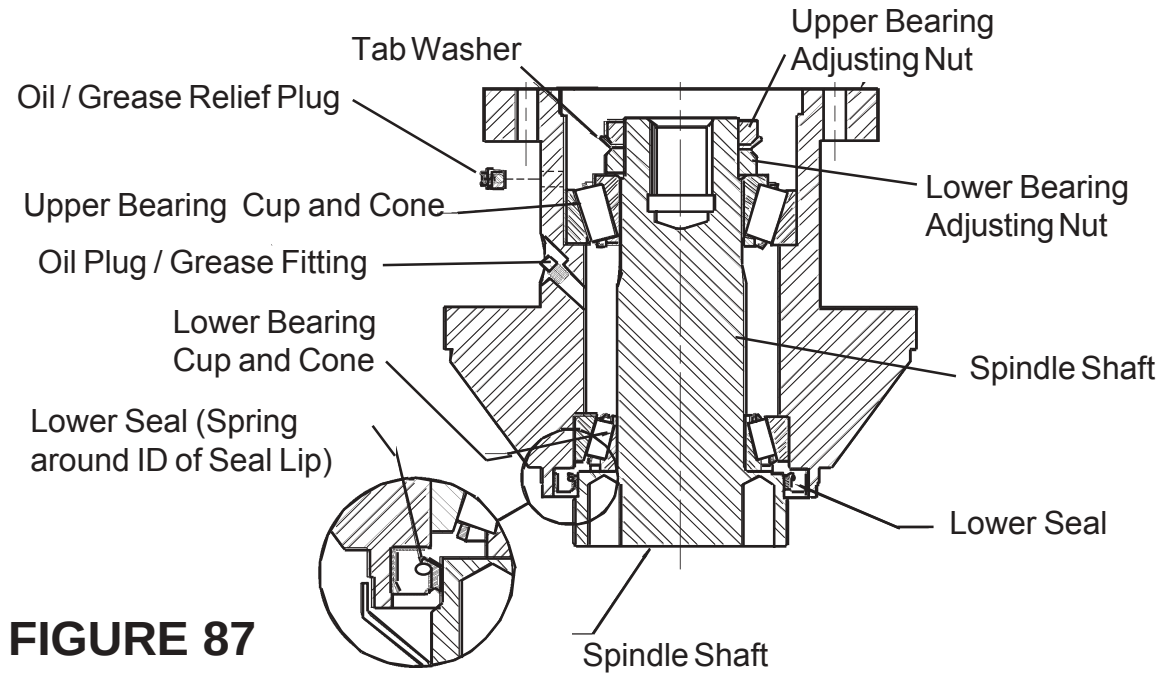


FIGURE 87

Procedures: Re-Assemble Spindle (continued)

4. Install Lower Bearing Cone, Inspect Spindle Shaft Condition. Lower Bearing Cone is installed on Spindle Shaft and pressed down till seated on bottom lip on Shaft. Be careful pressing Bearing on, do not damage Bearing. Coat lower Bearing with light coat of Grease.

5. Install Spindle Shaft, Put light coat of Grease on Seal area of Shaft, this will help Shaft go into Seal. Insert Spindle Shaft with lower Bearing Cone installed on it into Spindle Housing from the Bottom, Use Caution when lower part of Shaft reaches lower Seal. work shaft into seal carefully.

6. Install Upper Bearing Cone, Support Spindle Shaft from Bottom and Press (New type is press on and Older type pushed on) Upper Bearing Cone on to Spindle Shaft, Don't press on Bearing Rollers or Cage as this will damage Bearing. It is installed till it is seated into Bearing Cup, Remember to keep Spindle Shaft supported at bottom.

7. Install lower Bearing Adjusting Nut with chamfer up, Tighten Nut till it contacts Bearing Cone, But do not torque at this time. Clamp Spindle to Bench (or Vise) so that Spindle Shaft can rotate. Tighten till it takes 25 in. lbs. to rotate Spindle Shaft, Tap Shaft with a Hammer to make sure Bearings seat straight and recheck Rolling Torque (must be 25 in. lbs. of rolling Torque).

8. Install Tabbed Washer on to Spindle, Inner tab in slot and Outer tabs facing up.

9. Before Installing Top Nut with chamfer on Nut facing down, Make sure Shaft is locked (Clamped) so it will not Turn in Spindle Housing, Torque this top Nut to 100 ft lbs. Bend the Tab of the Locking Washer to fit into one of the Grooves on top nut. Recheck Rolling Torque of Shaft, it should be 25 in lbs. Rolling Torque.

10. Install Grease Plug in bottom hole and Grease Relief Plug in the upper hole. Note: When grease is cold it could force bottom Seal out of Housing. Let grease warm before filling begins. Excessive Pressure of Air Grease Gun could force Seal out, Use low Pressure.

SPINDLE - REPAIR

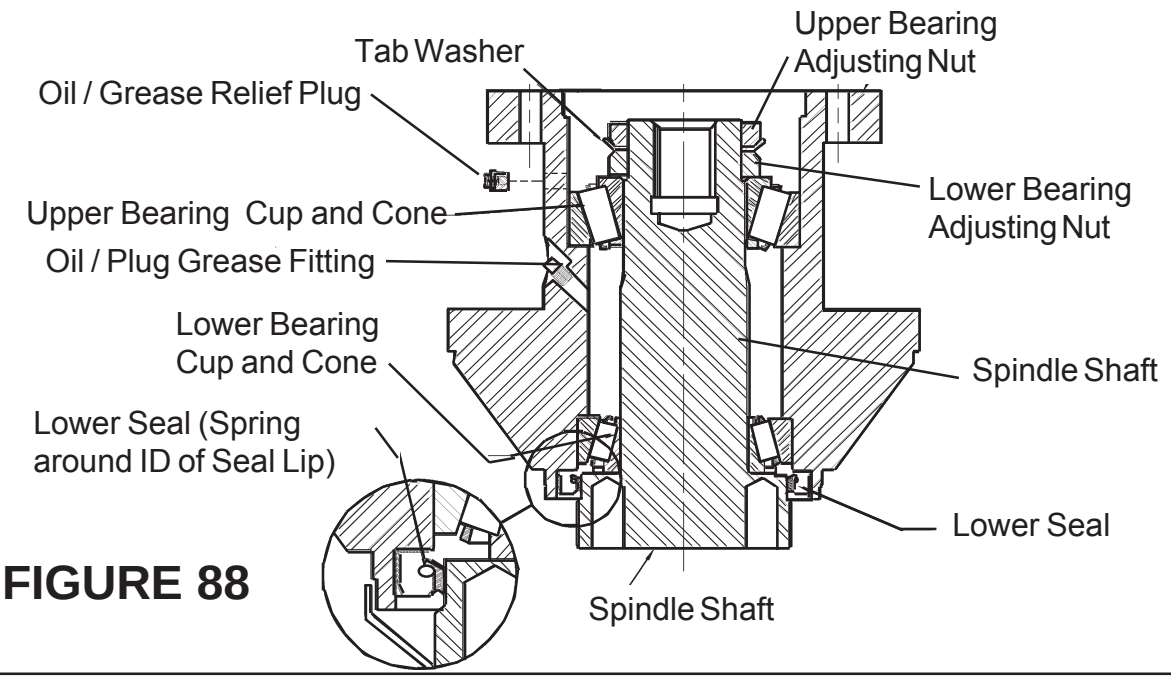


FIGURE 88

Procedures: Install Spindle, Motor and Blade Carrier

1. Install Spindle on Deck, Slide Spindle into Deck from Top Side, Install Hardened Washers on Bolts then Insert eight 3/4" Retaining Bolts up from Bottom of Deck, Install the eight Locknuts on Bolts. Torque these Bolts in an alternating Pattern to 300 to 320 ft. lbs. DO NOT leave off hardened Flat Washers, Use Lock Nuts only, do not use Lock Washers,
2. Install Spindle Housing Gasket, Install Spindle Gasket on top of Spindle. Make sure old Gasket was removed and not stuck to Bottom of Motor.
3. Install Motor onto Spindle Housing, Set Motor down onto Spindle making sure Motor sets down flat and is fully seated against Spindle Housing. Make sure Motor is installed correctly. This is important that Motor be installed correctly so Case drain comes out in right place. The Valve body bolts torque 25 to 30 ft lbs. in an alternating pattern. Insert the four 1/2" retaining Bolts that holds Motor to Spindle, Tighten these four Bolts until Motor seats against Spindle Housing, If Motor will not sit Flat against Housing DO NOT force it, Something is wrong, Check everything or you could break Flange off of Motor. torque the four 1/2" bolts 100 to 110 ft. lbs.
4. Fill Spindle with Grease, Make Sure that Spindle Grease Relief Plug is installed, Fill Spindle with Grease Fill with grease until it comes out the Relief Plug. When grease is cold, removing Grease relief Plug will help to prevent Seal from blowing out during filling, replace plug after filled with grease. Wipe away excess Grease.
5. Install Blade Bar Carrier, As Bar Blade Carrier was only removed and not dis-asembled it should only be a matter of bolting the Assembly on and Torqueing it down? If Bar Blade Carrier was Dis-Assembled it will have to be assembled and components Torqued as specified, See Figure 85 on previous Pages. Blade Bar leaf Assembly Bolts MUST be torqued to 2000 ft. lbs., There are four of these Bolts, 2 long and 2 short, They MUST be torqued BEFORE Blade Bar is bolted to Spindle. The Blade Bolts must be torqued to 400 ft. lbs. and Roll Pin Installed. The Blade Bar Retaining Bolts (Socket Head Bolts that attaches blade bar to spindle) and lock washer must be installed, These will torque to 400 ft. lbs.
6. After Assembly is completed check all steps to be sure they are completed, Test run Head then Stop and recheck all components including Grease Level in Spindle. Spindle temperature can reach 200 F. after running, so do not check the Temperature by touching it.

NOTES

Section 7

Frame & Boom With Hose Routing

24' & 30' BOOM

Under Mount frame Asy:

1. Before beginning any repairs on this section make certain the boom is extended outward to full extend and laying on the floor. Before removing the Boom Pivot Pin support the boom with an overhead hoist so as when Pie is removed boom can be lifted out of the way. NEVER REMOVE ANY PINS OR BOLTS unless boom is supported at pivot end and head end is resting on the floor.

2. The under mount frame asy is made up of the Turret, Center Section Frame Weldment, Boom Mount, Swing Cylinders, Swing Cylinder Trunnion Mount, Turret Cylinder Link and Counter Weight.

3. The Turret Asy will be shipped assembled to the Boom mount with the hoses and cylinders plus attaching hardware assembled to it.

4. The Swing Cylinders have replaceable mounting bushing which can be replaced by removing the bottom cover and trunnion mount weldment. The Cylinders can be dropped down enough to replace the bushing. The replace the Trunnion Mount weldment. Also by removing the cylinders the Turret Cylinder link can be removed.

5. The Turret assembly has a large bearing assembly bolted to it and then bolted to the Boom Mount. This Bearing CANNOT be removed (or replaced) unless the Boom is disconnected from it first. When disconnecting boom make certain the boom is supported as not to fall (See Step 1). The Bolts retaining the turret to the bearing and the bolts connecting bearing to the Boom Mount MUST be torqued to the required specification, This is very critical. See the Bolt Torque Chart in the beginning of this manual.

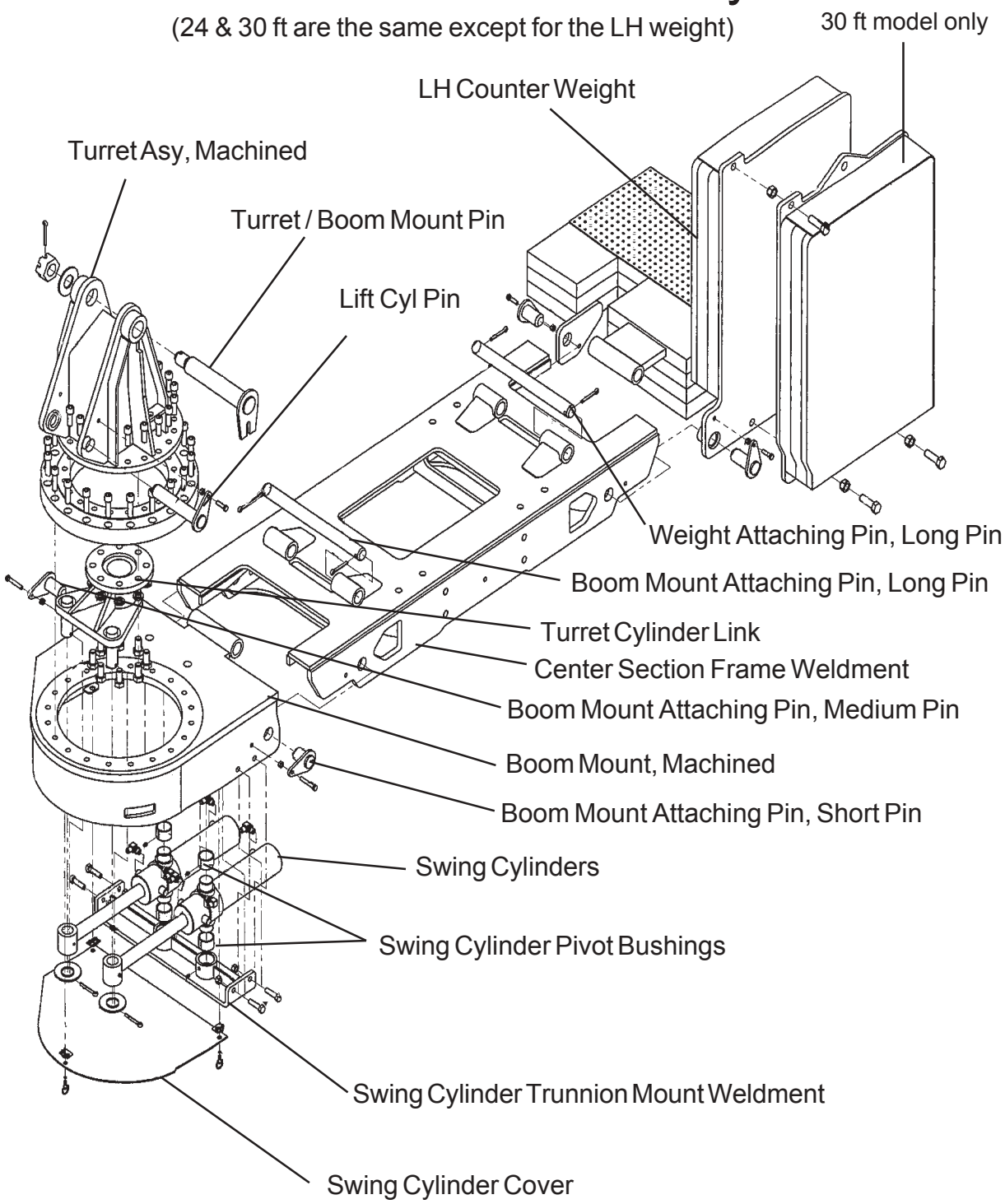
6. DO NOT remove any mount pins and/or bolts unless the components are supported properly to prevent them from falling

7. The Turret Bearing Assembly has 3 grease fittings, each 120° apart. All three of these grease fittings must be greased because of the diameter of the bearing this to ensure an even distribution of grease though out the diameter of the bearing assembly.

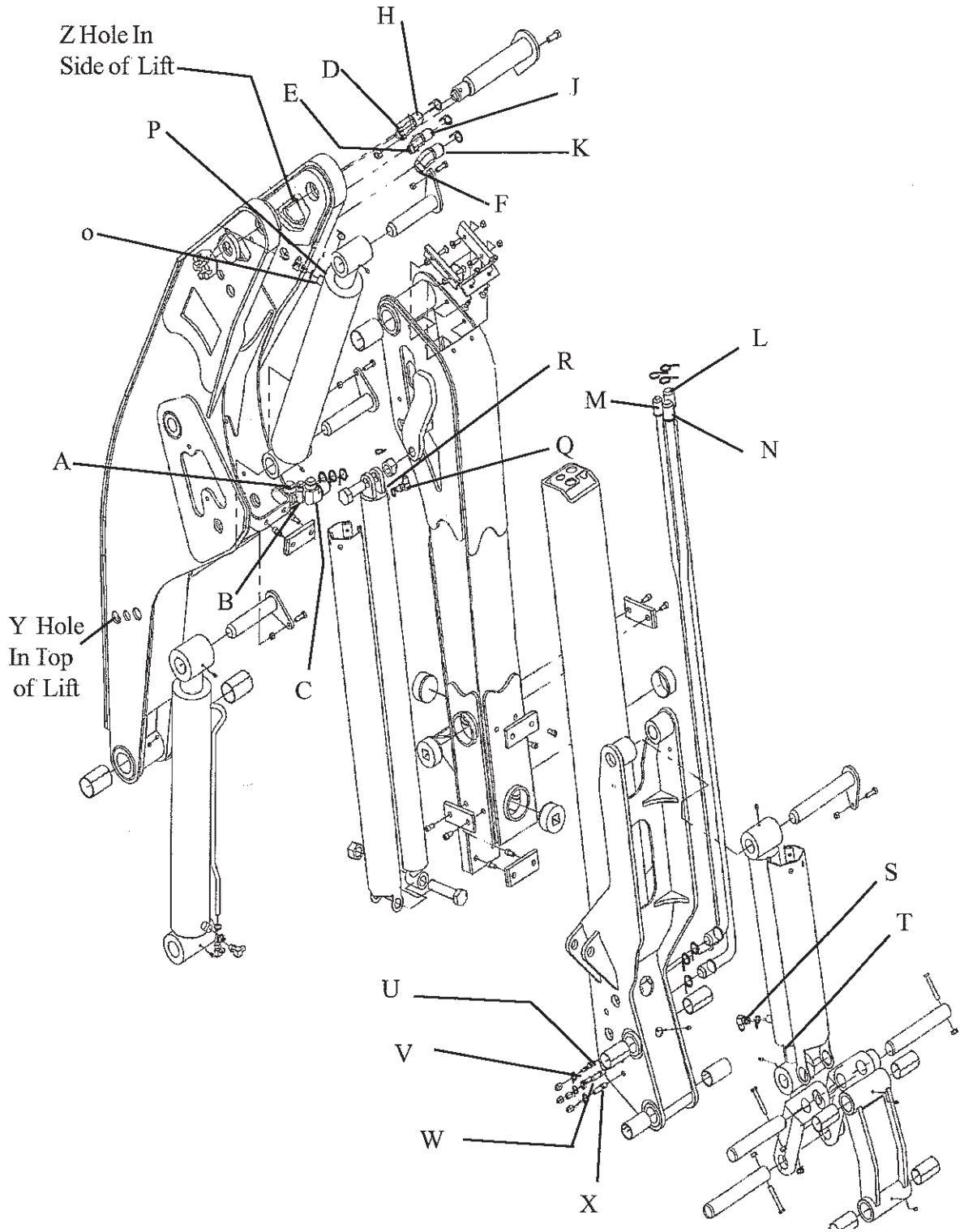
8. If the hoses for the swing cylinders are disconnected or replaced make certain that they are reconnected correctly as shown in this section (Swing Cylinder Hose Routing). If the hoses are not connected correctly the swing will not function correctly.

Under Mount Frame Asy

(24 & 30 ft are the same except for the LH weight)



24 FOOT BOOM HOSE & ROUTING



24 FOOT BOOM HOSE & ROUTING

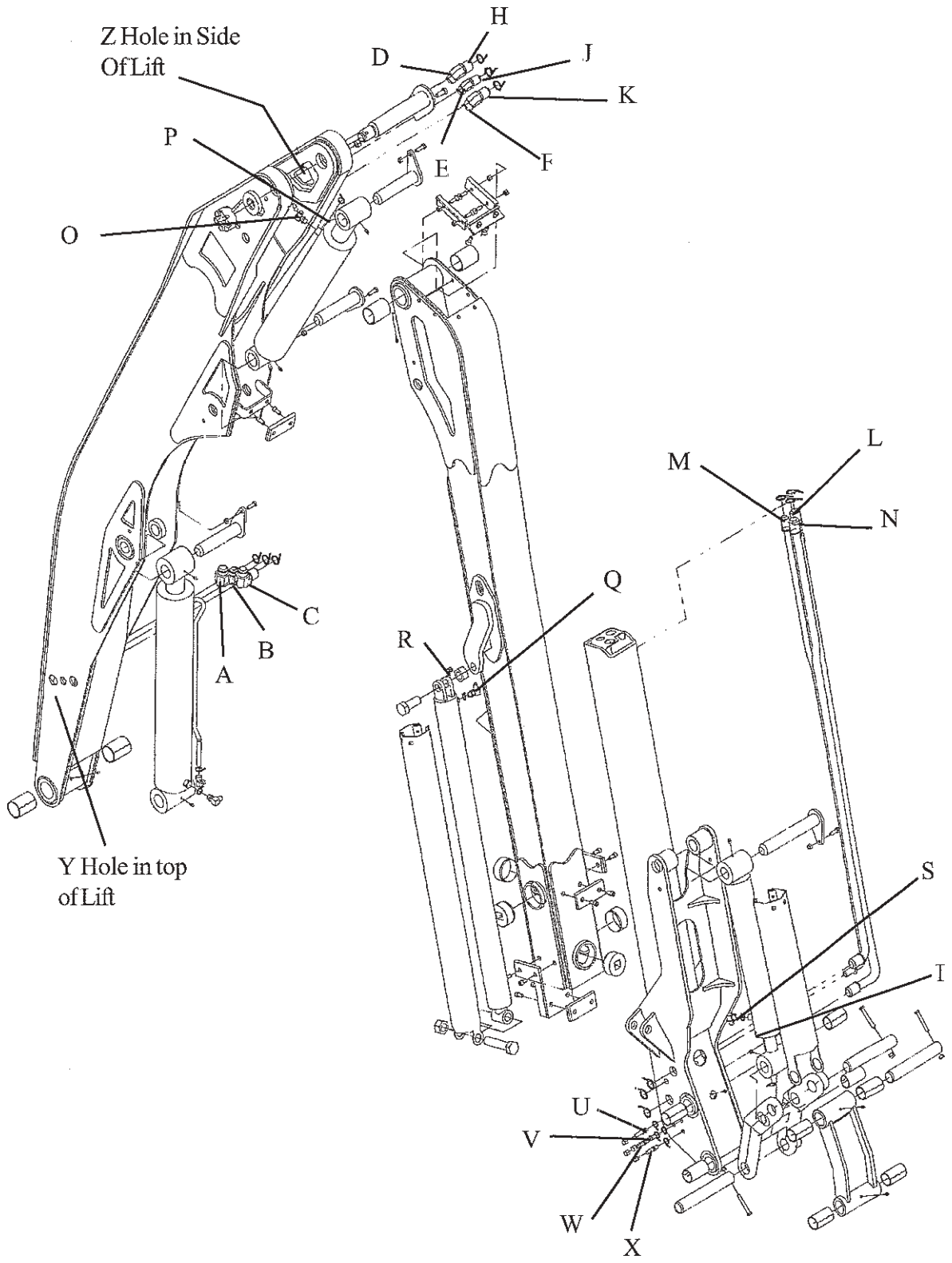
Item	Part No.	Qty	End-1	End-2	Description
1	02981823	1	Y(MJ)	Z(FJX)	Hose, #4-4MJ-4FJX-76"Lg-Yellow Tie - Door (Lift Section)
2	02981824	1	Y(MJ)	Z(FJX)	Hose, #4-4MJ-4FJX-76"Lg-Yellow/White Tie - Door (Lift Section)
3	02981828	1	Y(MJ)	Z(FJX)	Hose, #4-4MJ-4FJX-76"Lg-Green Tie - Swivel (Lift Section)
4	02981829	1	Y(MJ)	Z(FJX)	Hose, #4-4MJ-4FJX-76"Lg-Green/White Tie - Swivel (Lift Section)
5	02981830	1	Y(MJ)	Z(FJX)	Hose, #6-6MJ-6FJX-76"Lg-Yel Tie - Ext'n (Lift Section)
6	02981831	1	Y(MJ)	Z(FJX)	Hose, #6-6MJ-6FJX-76"Lg-Yellow/White Tie - Ext'n (Lift Section)
7	02981832	1	Y(MJ)	Z(FJX)	Hose, #6-6MJ-6FJX-76"Lg-Red Tie - Tilt (Lift Section)
8	02981833	1	Y(MJ)	Z(FJX)	Hose, #6-6MJ-6FJX-76"Lg-Red/White Tie - Tilt (Lift Section)
9	02981834	1	Y(MJ)	O(FJX)	Hose, #6-6MJ-6FJX-96"Lg-Blue Tie - Dipper (Lift Section)
10	02981835	1	Y(MJ)	P(FJX)	Hose, #6-6MJ-6FJX-96"Lg-Blue/White Tie - Dipper (Lift Section)
11	02981836	1	Y(MJ)	R(FJX)	Hose, #6-6MJ-6FJX-88"Lg-Yellow Tie - Ext'n (Dipper Section)
12	02981837	1	Z(MJ)	Q(FJX)	Hose, #6-6MJ-6FJX-88"Lg-Yellow/White Tie - Ext'n (Dipper Section)
13	02981838	1	Z(MJ)	V(FJX)	Hose, #4-4MJ-4FJX-176"Lg-Yellow Tie - Door (Dipper Section)
14	02981839	1	Z(MJ)	U(FJX)	Hose, #4-4MJ-4FJX-176"Lg-Yellow/White Tie - Door (Dipper Section)
15	02981840	1	Z(MJ)	X(FJX)	Hose, #4-4MJ-4FJX-176"Lg-Green Tie - Swivel (Dipper Section)
16	02981841	1	Z(MJ)	W(FJX)	Hose, #4-4MJ-4FJX-176"Lg-Green/White Tie - Swivel (Dipper Section)
17	02981842	1	Z(MJ)	T(FJX)	Hose, #6-6MJ-6FJX-176"Lg-Red Tie - Tilt (Dipper Section)
18	02981843	1	Z(MJ)	S(FJX)	Hose, #6-6MJ-6FJX-176"Lg-Red/White Tie - Tilt (Dipper Section)
19	02981846	1	C(FJX)	F(FJX)	Hose, #16-16FJX-16FJX90-102"Lg-Red Tie - Mtr Prs'r (Lift Section)
20	02981847	1	A(FJX)	D(FJX)	Hose, #16-16FJX-16FJX90-102"Lg-Orange Tie - Mtr Rtrn (Lift Section)
21	02981848	1	K(FJX)	L(FJX)	Hose, #16-16FJX-16FJX-54"Lg-Red Tie - Mtr Prs'r (Dipper Section)
22	02981849	1	H(FJX)	N(FJX)	Hose, #16-16FJX-16FJX-58"Lg-Orange Tie - Mtr Rtrn (Dipper Section)
23	02981850	1	B(FJX)	E(FJX)	Hose, #12-12FJX-12FJX-102"Lg-Blue Tie - Case Drain (Lift Section)
24	02981851	1	J(FJX)	M(FJX)	Hose, #12-12FJX-12FJX-56"Lg-Blue Tie - Case Drain (Dipper Section)

NOTE:

Hose end-1 & hose end-2, These are where the ends of the hose connects, the letter shows location of that end and ( ) shows type hose fitting on that end of hose.

The Hoses have plastic ties on then to help show which hose is which, the ties are a solid color or they will have a white stripe on them. The same color tie may be used twice but should not be used twice on the same size of hose. Example a yellow tie may be used on a #4 hose and again on a #6 or larger hose, always check the color coded ties and the size of the hose identify the hose and its location.

30 FOOT BOOM HOSE ROUTING



30 FOOT BOOM HOSE & ROUTING

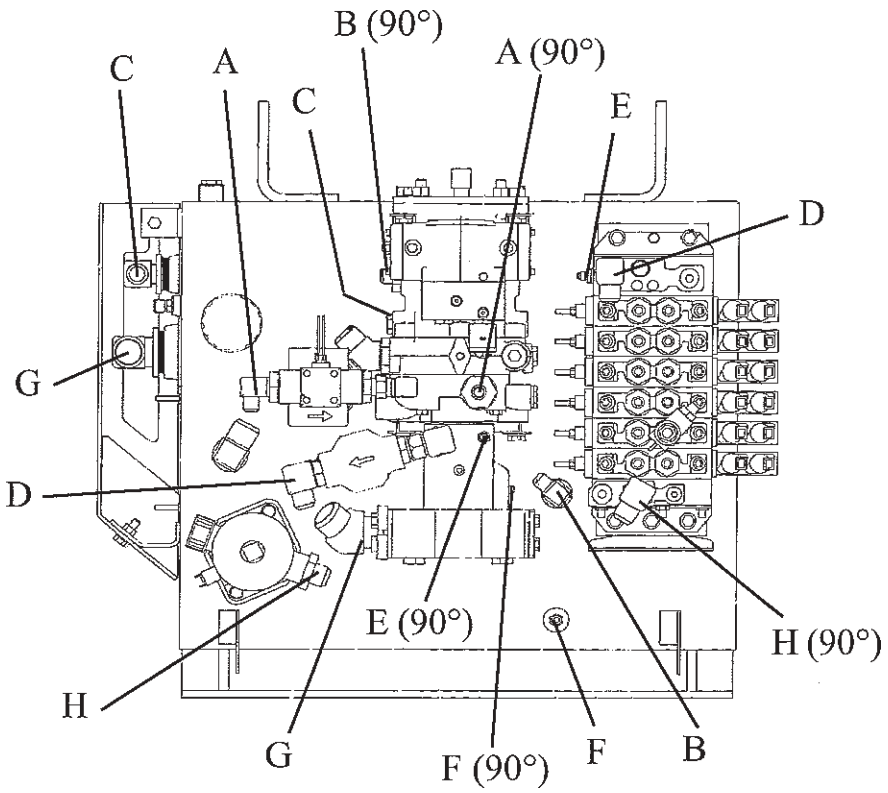
Item	Part No.	Qty	End-1	End-2	Description
1	02981879	1	Y(MJ)	Z(FJX)	Hose, #4-4MJ-4FJX-115"Lg-Yellow Tie - Door (Lift Section)
2	02981880	1	Y(MJ)	Z(FJX)	Hose, #4-4MJ-4FJX-115"Lg-Yellow/White Tie - Door (Lift Section)
3	02981855	1	Y(MJ)	Z(FJX)	Hose, #4-4MJ-4FJX-115"Lg-Green Tie - Swivel (Lift Section)
4	02981856	1	Y(MJ)	Z(FJX)	Hose, #4-4MJ-4FJX-115"Lg-Green/White Tie - Swivel (Lift Section)
5	02981857	1	Y(MJ)	Z(FJX)	Hose, #6-6MJ-6FJX-115"Lg-Yel Tie - Ext'n (Lift Section)
6	02981858	1	Y(MJ)	Z(FJX)	Hose, #6-6MJ-6FJX-115"Lg-Yellow/White Tie - Ext'n (Lift Section)
7	02981859	1	Y(MJ)	Z(FJX)	Hose, #6-6MJ-6FJX-115"Lg-Red Tie - Tilt (Lift Section)
8	02981860	1	Y(MJ)	Z(FJX)	Hose, #6-6MJ-6FJX-115"Lg-Red/White Tie - Tilt (Lift Section)
9	02981861	1	Y(MJ)	O(FJX)	Hose, #6-6MJ-6FJX-135"Lg-Blue Tie - Dipper (Lift Section)
10	02981862	1	Y(MJ)	P(FJX)	Hose, #6-6MJ-6FJX-135"Lg-Blue/White Tie - Dipper (Lift Section)
11	02981863	1	Y(MJ)	R(FJX)	Hose, #6-6MJ-6FJX-125"Lg-Yellow Tie - Ext'n (Dipper Section)
12	02981864	1	Z(MJ)	Q(FJX)	Hose, #6-6MJ-6FJX-125"Lg-Yellow/White Tie - Ext'n (Dipper Section)
13	02981865	1	Z(MJ)	V(FJX)	Hose, #4-4MJ-4FJX-214"Lg-Yellow Tie - Door (Dipper Section)
14	02981866	1	Z(MJ)	U(FJX)	Hose, #4-4MJ-4FJX-214"Lg-Yellow/White Tie - Door (Dipper Section)
15	02981867	1	Z(MJ)	X(FJX)	Hose, #4-4MJ-4FJX-214"Lg-Green Tie - Swivel (Dipper Section)
16	02981868	1	Z(MJ)	W(FJX)	Hose, #4-4MJ-4FJX-214"Lg-Green/White Tie - Swivel (Dipper Section)
17	02981869	1	Z(MJ)	T(FJX)	Hose, #6-6MJ-6FJX-214"Lg-Red Tie - Tilt (Dipper Section)
18	02981870	1	Z(MJ)	S(FJX)	Hose, #6-6MJ-6FJX-214"Lg-Red/White Tie - Tilt (Dipper Section)
19	02981873	1	C(FJX)	F(FJX)	Hose, #16-16FJX-16FJX90-140"Lg-Red Tie - Mtr Prs'r (Lift Section)
20	02981874	1	A(FJX)	D(FJX)	Hose, #16-16FJX-16FJX90-140"Lg-Orange Tie - Mtr Rtrn (Lift Section)
21	02981875	1	K(FJX)	L(FJX)	Hose, #16-16FJX-16FJX-94"Lg-Red Tie - Mtr Prs'r (Dipper Section)
22	02981876	1	H(FJX)	N(FJX)	Hose, #16-16FJX-16FJX-98"Lg-Orange Tie - Mtr Rtrn (Dipper Section)
23	02981877	1	B(FJX)	E(FJX)	Hose, #12-12FJX-12FJX-140"Lg-Blue Tie - Case Drain (Lift Section)
24	02981878	1	J(FJX)	M(FJX)	Hose, #12-12FJX-12FJX-96"Lg-Blue Tie - Case Drain (Dipper Section)

NOTE:

Hose end-1 & hose end-2, These are where the ends of the hose connects, the letter shows location of that end and ( ) shows type hose fitting on that end of hose.

The Hoses have plastic ties on then to help show which hose is which, the ties are a solid color or they will have a white stripe on them. The same color tie may be used twice but should not be used twice on the same size of hose. Example a yellow tie may be used on a #4 hose and again on a #6 or larger hose, always check the color coded ties and the size of the hose identify the hose and its location.

HYDRAULIC KIT HOSE ROUTING



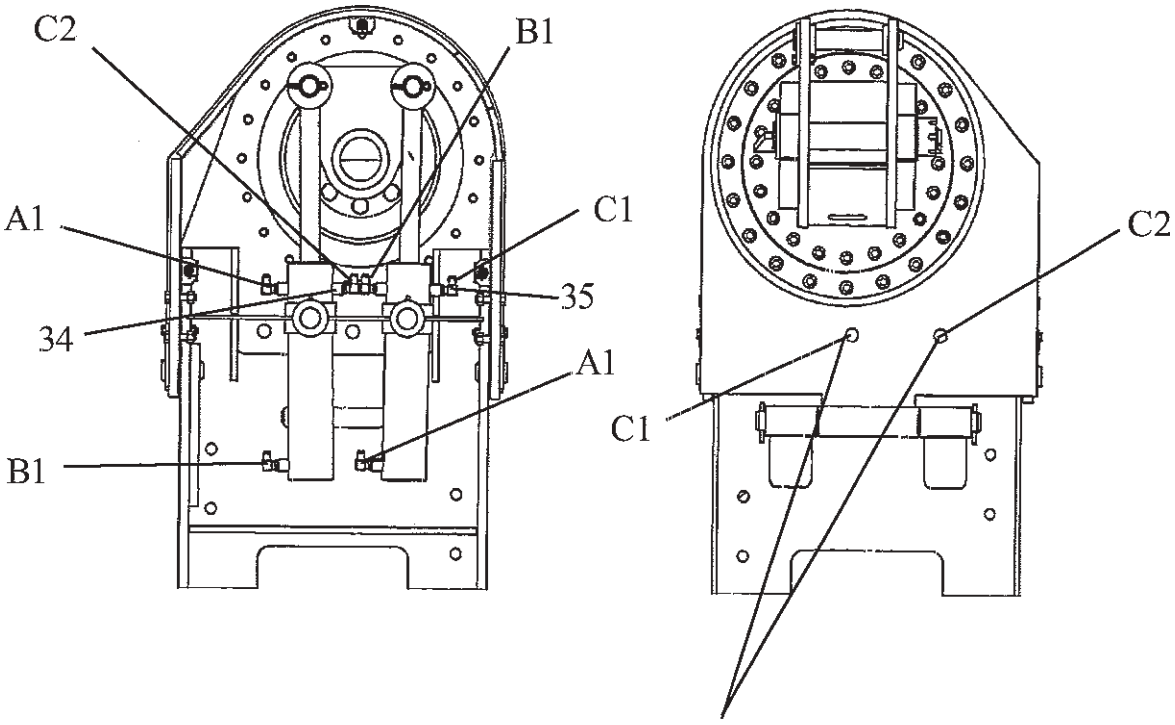
Item	Part No.	Qty	Description
A	02981427	1	Hose, #8-8FJX-8FJX90-24"Lg-Red Tie - (Charge Filter to Pump)
B	02981428	1	Hose, #8-8FJX-8FJX90-21"Lg-Blue Tie - (Case Drain to Tank)
C	02981429	1	Hose, #12-12FJX-12FJX-23"Lg- (Pump to Suction Filter) Under Pump Connection Not Shown in Drawing.
D	02981430	1	Hose, #12-12FJX-12FJX-31"Lg-Red Tie (Pressure Filter to Supply)
E	02981431	1	Hose, #4-4FJX-4FJX90-35"Lg-Red Tie (Pump Load Sense to Valve PX)
F	02981432	1	Hose, #4-4FJX-4FJX90-20"Lg-Blue Tie (Pump Regulator to Tank)
G	02981433	1	Hose, #20-20FJX-20FJX-24"Lg-(Pump to Suction Filter)
H	02981462	1	Hose, #12-12FJX-12FJX90-20"Lg-Orange Tie (Valve Return to Filter)

NOTE:

Hoses are not shown in drawing above, this is for clarity. The Hose routing is for the hoses which connect from one point to the other. Use the instructions and hose descriptions listed to follow hose routing.

Example: Hose - A connects to one end marked A and the other end connects to the other connection marked A. This is done with the other letter as well, the hose must connect to the same letter mark on each end. Some hose have a plastic colored tie on it to ID hose and location. Some hoses will have a elbow on one end, these are marked in drawing above with (90°), this meads the hose end with the elbow connects to this end. To ID hoses always check hose size, length and colored plastic tie.

SWING CYLINDER HOSE ROUTING (24/30 FT BOOM)



Item	Part No.	Qty	Description
A1	02981825	1	Hose, #6-6FJX-6FJX-28"Lg
B1	02981825	1	Hose, #6-6FJX-6FJX-28"Lg
C1	02981826	1	Hose, #6-6FJX-6MJ-16"Lg- Geen Tie
C2	02981827	1	Hose, #6-6FJX-6MJ-16"Lg- Green / White Tie
34	02968832	1	Plastic Tie, Green
35	02968833	1	Plastic Tie, Green / White

NOTE:

Hose are not shown in drawing, this is for clarity. The hose routing is for hoses which connect from one point to the other. Use the instructions and hose descriptions listed to follow hose routing.

Example: Hose - A1 connects to one end marked A1 and the other end connects to the other connection marked A1. This is done with the other letters as well, the hose must connect to the same letter mark on each end. Some hose have a plastic colored tie on it to ID hose and location.To ID hoses always check hose size, length and colored plastic tie.

NOTES

Section 8

POSSIBLE FAILURE CAUSE & SOLUTIONS

24' & 30' BOOM

Possible Failure Cause and Solution Section

NOTE;

This Section is written to give a POSSIBLE CAUSE of a problem and the POSSIBLE SOLUTION of a problem, it is also to aid in finding problems and to correct problems. There may be more than one cause to a problem as there may be more than one solution. Inspection and testing by you at the Unit site can diagnose these problems, This section cannot be used as absolute diagnose of a problem as well as not to give the absolute solution. It can only suggest where to check and what to repair.

General:

Cracks in mowing Decks or Booms can be generally attributed to Severe Usage and/or Vibration caused by an imbalance in the rotating parts. It should be remembered that vibrations occur as a result of operation when cutting Heavy Material or hitting stationary object that cause a component to bend, break or lose pieces etc. In some cases it may be the result of a design or application, this is something that will have to be determined through investigation of circumstance.

Simply welding up a Crack will not usually yield a satisfactory repair; simply welding may cause another weak spot during welding process. The condition that caused crack may still be present. It is usually advisable to grind down the weld and add a plate over the weld to span the site of the original crack.

Adding a reinforcing piece (or Extra Brace) may not be as good as it sounds a number of reasons this is not advisable. Because you could be making an area that needs to flex some to relieve stress is being eliminated; the added weight may change the balance of unit or component.

A good suggestion for future reference is to take photos of cracks (Failures) before the repairs are made; this will aid you in future failures to see what happened in the past ones. This is a good idea because the failed area may not always cause the failure, it may be caused by something else and it is sometimes hard to explain what the failure looked like before it was repaired.

Always repaint any area that has been re-welded to prevent rust as well as cosmetic appearances.

POSSIBLE FAILURE / CAUSE & SOLUTION

Boom Breaks Back Too Easily: **Boom is designed to break back if to much resistance is meet for safety reason.**

CAUSE: **Work Port Relief for Swing Cylinder Malfunction?**
SOLUTION: Test for Pressure required to Break Back the Boom. If Pressure is lower or higer than Specified, Adjust or Replace Work Port Relief Valve.

CAUSE: **Cutting Head Positioned Too Close To The Ground?**
SOLUTION: This is an Operational Problem, The Operator will be required to adjust the way the unit is being run and raise the Head Up.

CAUSE: **Operator Running Into Too Heavy Material or Traveling Too Fast?**
SOLUTION: This is an Operational Problem, The Operator will be required to adjust the way the unit is being run and Adjust Operating procedures to eliminate this.

CAUSE: **Inadequate Bracing?**
SOLUTION: This is a difficult subject, It is recommended that you consult with the factory before making modifications of this type, Adding additional pieces may change many components functions, the weight that would be added changes the balance weight ratio. The Hydraulics ability to lift and even lower could be affected. Adding weight is not recommended.

Boom Drops When Two Functions Actuated:

CAUSE: **Low Oil Level in Tractor Hydraulic System?**
SOLUTION: Fill and Bleed all Cylinders (Run All Cylinders through thier Cycle), Then fill Tractor Hydraulic Oil to Proper Level, Run Cylinders through thier Cycle again and recheck Hydraulic Sump Oil Level again. If the Cylinders are not Filled then Oil Level brought to Specs the Oil Level could be low during operation causing damage to Tractor Hydraulic System.

CAUSE: **Too Rapid Drop Of Boom?** (Too Rapid Drop in Cylinder)
SOLUTION: Restrictors damaged or removed, Check restrictors if they have them, Make sure correct size Hoses are installed to cylinders. Repair or Replace as needed.

CAUSE: **Defective or Damaged Joy Stick Controller?**
SOLUTION: There are very few replaceable Parts in Joy Stick Controller, See the Repair Section for Testing and repairing the Joystick. DO NOT Replace Joystick till all Test have been performed to pin down the problem area. There are a number of tests to locate problem area that can be used, these are listed through out sections of the repair Manual as well as some listed in the Operators Manual.

Cylinder Boom Positioning:

Cyl. Continue to move after Joy Stick released.

Boom Moves on its Own (Electronic Joystick).
Joystick does Not return to Neutral.

CAUSE: **Defective or Damaged Joy Stick Controller?**
SOLUTION: There are very few replaceable Parts in Joy Stick Controller, See the Repair Section for Testing and repairing the Joystick. DO NOT Replace Joystick till all Test have been performed to pin down the problem area. There are a number of test to locate problem area that can be used, these are listed through out sections of the repair Manual as well as some listed in the Operators Manual.

CAUSE: **Oil Contaminated?**
SOLUTION: If the Filters are Not Maintained properly on the Tractor Hydraulic System, Fine contaminates can get into the Solenoid valves, this prevents them from seating Properly. This can result in Boom Circuits moving without input from the Joystick Controller. When Filters get full, It causes the Bypass valve on the Filter to Open and allow unfiltered Oil to go throughout the System. Once this is allowed to happen even though the Filters are later changed, it is no guarantee that the malfunction will not re-occur because the contamination could be any where in the system waiting to break free and travel on through the system. Later Models (Machete) had an add on filter added which has a lower Micron Rating than Tractor Filter, This was added to keep Contamination from Tractor System from going through the Boom System, Both Tractor and add on Boom Filter will have to be changed an a regular maintance schedule, See Operators manual.

Control Valve Spool or Spools Sticking

CAUSE: **Control Valve Bolted to Mounting Plate Incorrectly?**
SOLUTION: Loosen bolts and re-tighten 1 turn at a time using a criss-cross pattern. The Valve Body can be placed in a bind if the mounting bolts are tightened un-evenly. This can cause the Spool to stick in the bore or cause the Valve to leak internaly.

CAUSE: **Contamination in Valve Spool?**
SOLUTION: Find Contamination source and correct it, Clean Valve, Change Filters, Replace Oil (if required to remove contamination), Re-Assemble and Test.

CAUSE: **Faulty Valve Spool or Section?**
SOLUTION: Replace Valve Section, If the valve Section is defective, The Malfunction will most likely occur immediately after being placed in service. If the Unit has been operating for sometime, the problem is most likely to be a failure not a defective part there fore more checking maybe needed to determine why the Valve Spool failed.

Cylinder Excessive Drift:

NOTE: All Cylinder Hydraulic Systems have some amount of drift or leakage in the system. All parts have tolerances and all parts Must have clearance in order to function. Clearance necessary to allow the part to function also results in some internal leakage. Cylinder Drift can also be refered to as "Leak Down" or "Settling", In most cases, the cause of Cylinder Drift will be found in the Cylinder, Valve (s) or Lines. Components have a different leakage rate. Reducing the amount of drift also has its drawbacks. "Tight" components are very sensitive to contamination, Seizure due to high operating temperatures, Seizure due to contamination. Valves have a tight clearance, restrictors have small openings. Leaking External Lines cause Cylinder Drift but this is the easiest problem to correct as it is the easiest type to find. There fore most causes listed below will deal with Internal Leakage. See "Cylinder Drift Rate Chart" in Specification Section of Product Repair Manual to determine if drift rate is excessive. See Cylinders Leak Section for Cylinder leak Problems.

CAUSE: **Cylinder Pistons Seals Bypassing?** Dual Function Cylinders have 2 lines and have pressure both ends, Single Function Cylinders have 1 line and pressure on one end and Vent Plug on other, Piston bypass in Single Action Cylinders it will not require this test, If they leak the Oil will leak out of Vent Plug.

SOLUTION: Raise load and support it safely. Drain Pressure off Line after Load is supported and before removing any lines. Drain Pressure can be done with Tractor "Off" and open valve to lower Load. Remove and solidly plug lines to the Cylinder. Remove Load Support (Hoist will be reqiured), Document the time it takes for the load to drift down. (See Cylinder Drift Chart) If the Piston Seal is cause of excessive Drift down this will tell you. Reseal or Repair Cylinders as required. Note Piston Seal bypass can be caused by damaged Seals, oversized or worn Cylinder Bores. Some Cylinders don't function through out the intire length of their stroke, So the oversize wear could only be in part of the bore, When checking Bore size it is recommended to check entire length of Bore if the length of stroke is not known.

CAUSE: **Work Port Relief Valves Not Seating Properly?**

SOLUTION: Test Cylinders for Bypassing as above. If OK, Leakage must be occurring in the Control Valve Spool or Work Port Reliefs (if Equipped). Suspend the Load with the Cylinders and place Valve Lever in "Hold" (Neutral / Centered) position. Use a "Stethoscope" Tool (or equivelant), Listen to the Valve Body next to the Work Port that is suspect. The Oil will be making a shrill whistling sound as it leaks past the Work Port Poppet. If Leakage is evident, Lower the Load and inspect to Work Port Relief Valve, replace if needed.

Cylinder Excessive Drift: (Continued)

CAUSE: **Leakage Past Control Valve Spool?**

SOLUTION: If excessive Cylinder Drift is confirmed and the Cylinder and Work Port Relief Valves have been eliminated, The possibility is the Control Valve Spool itself. If clearance between the Control valve Spool and Body are causing the drift, the Only Solution is to replace the Valve Section. Keep in mind that the cause for excess clearance must be found and corrected. Frequently the cause is pre-mature wear from abrasive material (Contamination) in the Oil. If this is not corrected failure will re-occur.

CAUSE: **Abrasive Contamination In Oil?**

SOLUTION: Abrasive Contaminants (Dirt, Iron Particles, Clutch Disc Material etc.) in the Oil Sump / System is a major contributor to all of the above internal leakage problems. It is especially likely if the Positioning Hydraulics are using Oil from the Tractor Hydraulic System. If the Tractor Hydraulic System is not properly maintained, Materials from Gears, Clutch Disc and Etc. can enter the Control Valve and Cylinders causing excessive Pre-mature Wear. If Abrasive material Wear is found the complete system Should be flushed and cleaned. On Some Later Models an additional Filter System has been added as additional Filtering of Tractor Hydraulic Oil. But even this add on Filter, if not maintained, will run through the Filter Bypass and contaminate System. KEEP FILTERS CLEAN and/or Replace on a good Maintenance Schedule.

CAUSE: **Electrical Short Circuit?**

SOLUTION: Electrical short causing controls to emit electrical current even though controller is in neutral position. Check all wire connections and try to determine where electrical short is, Repair or replace as needed. Usually this type of problem will allow drift to be rapid unless Short is through Joystick controller, There should be no electrical current when Valve and Joystick are in centered (neutral) position

Cylinder Leaks At Fittings:

CAUSE: **Loose or Wrong Fittings?**

SOLUTION: Make sure correct Fittings are installed and are torqued to correct specification. Boss

Fittings may have damaged O-Ring, Check and repair as required.

CAUSE: **Port Cracked at Fitting?**

SOLUTION: Repair or Replace Cylinder and/or Fitting. This type failure is more common on Cylinders with Pipe Fittings than the ones with O-Ring Boss Fittings. The reason is because the Pipe Thread is tapered and can be over tightened and the tapered thread acts as a wedge. Don't over tighten any fittings, Don't use Teflon tape at all, if using a Semi Liquid Pipe Thread Sealer Don't put excessive amount on fitting and Never put sealer into ID of Port, It will get into system and contaminate it.

CAUSE: **Deformed or Damaged Fitting?** (JIC)

SOLUTION: Replace damaged Fittings and/or Hose, Over tightening of JIC Fittings can deform the Flares on the Fitting and create leaks. See Torque Specification for proper Torque Values.

Cylinder Leaks Around Rod:

CAUSE: **Faulty Seals On Cylinder Gland?**
SOLUTION: Dis-Assemble and Re-Seal Gland. Seals can be damaged by foreign objects, or worn by abrasive material such as Dirt getting into Seal and/or Rod. Seals can also be damaged during Assembly and this type of damage will almost always show up shortly after being put in service.

CAUSE: **Damage To Cylinder Rod?**
SOLUTION: Determine the cause of the Damage, Dent, Scratch, Rust and/or something stuck to Rod. The Damage and cause should always be identified and corrected before any repairs are made, Repairing the failure and leaving the cause will result in more failure. In Some cases a Cylinder Rod can be cleaned up with CROCUS CLOTH (a very fine abrasive material), DO NOT USE anything more abrasive than crocus cloth. A major problem for cylinders is storage when unit is not being used for a while, The Rods are a chrome alloy but if subjected to moisture long enough they will rust, This is not a problem when being operated as they are to be cleaned with every in and out stroke. If Unit is going to be stored for an extended time you can coat Rods (Exposed Part) with Oil or Grease to protect them, But If you do this it must be cleaned off before running to remove the Dust that will have collected on rod from Oil and grease.

CAUSE: **Cylinder Rod Bent?**
SOLUTION: Determine and correct cause of bent Rod, Replace Rod and Re-Seal Cylinder.

Cylinder Moves On Its Own: (Under Power)

CAUSE: **Control Valve Spool Stuck?**
SOLUTION: Locate stuck Spool, repair or replace Spool, Determine why Spool is stuck, Debris, Foreign Objects, Contamination, Broken Spool Components and etc. If just the Spool is replaced and the reason it failed is not corrected, it will fail again.

CAUSE: **Return Spring Broken in Control Valve?**
SOLUTION: Repair or Replace Spring, Determine why it broke.

CAUSE: **Binding of Control Cables or Linkage?** (Remote Cable Control Models)
SOLUTION: Determine cause of Cable Binding or Sticking, repair or replace as required. Sometimes it may be the Linkage sticking or binding and not the Cable, It may be required to disconnect Cables from Linkage to determine which is sticking, If it is the Linkage repair as needed. Cables may stick because of internal abrasion inside calve Housing, Some times this damage is not visible.

Cylinder Moves On Its Own: Under power (Continued)

CAUSE: **Controller Not Returning to Center?** (Electronic Joystick Control Models)
SOLUTION: Test Joy Stick Controller as shown in Repair Manual, Repair or Replace as needed. Note: Do Not replace Joystick till Test have been performed to eleminate other possible failures, Other Malfunctions can appear like Joystick Failures.

CAUSE: **2 Way Radio RF Interference?** (Models will Electronic Controllers)
SOLUTION: Radio Frequency interference is a common problem with all electronic controllers in all equipment and vehicles. Normally keying the microphone of the radio will result in some unwanted or unexpected operation. In the case of a boom mower on of the boom functions may slowly begin to move.
The resolution of this problem requires that power to the controller be disconnected when operating the radio. To accomplish this, simply switch off the power switch on the controller box prior to using the radio.
This may affect Tractors that are equipped with two way radios and when using radio to send, When Radio Receives there should be no interference.

Cylinder Moves Wrong Way:

(Opposite of direction it should per Control Movement)

CAUSE: **Hoses Routed incorrectly?** (On New or Repaired Units)
SOLUTION: Route hoses per Hose Diagram in Parts Manual.

CAUSE: **Incorrect Valve Operation Plate?** (On New or Repaired Units)
SOLUTION: Replace with correct Plate.

CAUSE: **Wire Harness improperly connected?** (On New or Repaired Units with Joystick)
SOLUTION: Change connectors to other solenoid valve on Same Circuit and test. Applies to Old Apitech valve Models (Ten Connector Wiring harness 5 on each side of Valve,)

CAUSE: **Confusion On Direction Travel of Joystick or Switch Application ?**
SOLUTION: The Function of Joystick is specific to type or combinations of movement that is made to perform that function, If the system was not connected correctly when first assembled the the movements may not match what is expected. See Operators Manual, Parts Manual or Repair Manuaul for what action or combination of actions should operate what function.

Cylinder Moves Intermittent: (All Functions)

CAUSE: **Obvious Causes Check First?** (Check These First)
SOLUTION: Perform all Operational checks, Tank Oil Level , Pump Operation, Control Valve Circuit (Electrical Supply & Hyd Supply), All Circuits affected or only some Circuits. If All Circuits will not work the Problem is most likely up-stream of the control Valve or an electrical Problem (Models with Joystick Controller). The Following Causes are based on Only some circuits being affected, Not all Circuits.

CAUSE: **Load Sense Signal Not Reaching The Tractor Pump Control?**
SOLUTION: Remove, Inspect and clean Signal Lines from Control Valve to Priority Valve. Check all orfices to make sure they are clear. Note: it is not unusual for the debris to drain out of system with the Oil when the pressure is released or the lines are removed. Everything can appear clear then be pushed back in when pressure is applied or it may never return, this can be a difficult malfunction to find as well as correct. This means even though it was checked once it does not mean the problem is not there.

CAUSE: **Low Oil Level In Tractor ?**
SOLUTION: Fill to Proper Level with recommended Oil. See Specification Chart for recommended Oil type.

CAUSE: **No Voltage to Joystick Controller?**
SOLUTION: Check for Voltage to Controller. repair or replace as required, Wiring, Fuses, Switches, etc.

CAUSE: **Faulty Joystick Controller ?**
SOLUTION: Check for Voltage output from Controller. With power to Controller and Joystick function actuated, Check for Voltage at Harness end of Solenoid Valve Connector for that function that is actuated. If there is no Output Voltage from Controller, check Controller End of Harness, If still no Voltage Repair or Replace Controller as needed. If Voltage at Controller then check Harness and Repair or Replace as needed. (see pages 56 and 57 trouble Shooting / Testing)

CAUSE: **Faulty Tractor Hydraulic System ?**
SOLUTION: Perform Hydraulic ? Electrical isolation Test. If Tractor System is at Fault, Trouble Shoot and Repair Tractor per Tractor Manufactures Guidelines.

CAUSE: **No or Low Pilot Pressure?**
SOLUTION: Check Pilot Pressure. Test, Adjust or Replace Pilot Pressure Valve as required

Cylinder Moves Spongy or Jerky:

CAUSE: **Air in Oil?**

SOLUTION: Run the System for a few minutes. Check for Air in the Oil in the Tank. Air entrained Oil will have a foamy appearance. If Air is present, find the Air Leak and correct it. Air Leak can be in the Suction Line and Oil may not leak out because there may only be Oil in that location when the Pump is sucking it in. With the Tractor Engine "Off" you can find a leak by pressurizing the Tank, This will not take but a few pounds of pressure (3 to 5 PSI or less). Look for leakage in the Suction Lines, Because the Oil Pick-Up is lower than the Oil Level this will force Oil out the leak. Leaks in Hoses and at Fittings can draw Air into System as Oil Flows Past. Systems that have had severe or prolonged Air Entry Problems may have Experienced Pump Damage.

CAUSE: **Air in the Cylinders?**

SOLUTION: Remove Air from Cylinders by Bleeding the System. Operate Cylinders and Hold at maximum stroke for several seconds. Repeat several times to purge Air from Cylinder. Repeat for other Cylinders till condition no longer exist.

CAUSE: **Wrong Type of Oil?**

SOLUTION: Fill to Proper Level with recommended Oil. See Specification Chart for recommended Oil type. If changing Oil in Old type Unit always use most recent recommended Oil Type but do not mix types of Oil.

CAUSE: **Cold Oil?**

SOLUTION: Run Unit at low Speed until Oil warms up. If Oil is to cold and flows slowly it can cause Cavitation, this will damage Pump. DO NOT Operate if Oil is so thick that you have this problem, wait till it warms up or move unit To a Building where Oil can warm up before operating.

CAUSE: **Faulty Pump Drive?**

SOLUTION: Inspect Pump Drive Components for wear and damage, or other reason pump May not run smoothly. If Pump is not smooth then Pressure will not be steady causing surges in pressure.

CAUSE: **Work Port Relief Set Too Low for Application?**

SOLUTION: Install proper work Port Relief. If the Pressure needed to operate the function Can exceed the setting of the valve in certain positions, it will cause the Oil to bypass, causing jerky movement of the function.

Cylinder Moves, Some Functions Work, But Not All:

CAUSE: **Faulty Joystick Controller?**

SOLUTION: Check Output voltage at the harness end connector for the affected Function, (Switch ON, Engine OFF, Joystick Function Actuated). If No Voltage is present, Check Harness, If Harness is OK, Repair or Replace Controller as needed. (See Page 56 and 57)

Cylinder Moves, Some Functions Work, But Not All:

(Continued)

CAUSE: **Obvious Causes Check First?** (Check These First)

SOLUTION: You may have enough Oil to operate one function but not all because Some Cylinders will require more volume than others will. Perform all Operational checks, Tank Oil Level, Pump Operation, Control Valves Circuit (Electrical Supply and Hydraulic Oil Supply), All Circuits affected or only some Circuits. If All Circuits will not work the Problem is most likely up-stream of the control Valve or an electrical Problem? (Models with Joystick Controller). The Following Causes are based on Only some circuits being affected, Not all Circuits.

CAUSE: **Faulty Solenoid Valve?**

SOLUTION: If Pilot Pressure is present with engine running, Voltage is delivered to the Coil and/or Module, the function operates manually but not Electrically, it is likely that the valve is the Problem. Repair or replace as needed.

CAUSE: **Control Valve Bolted to Mount Plate Incorrectly?**

SOLUTION: Loosen Bolts and retighten 1 turn at a time using a criss cross pattern. The Valve Body can be placed in a bind if the mounting bolts are tightened incorrectly. This can cause the Spool to stick in the Bore or results in Internal Valve Leakage.

CAUSE: **Contamination in the Valve Spool?**

SOLUTION: Clean Valve, Check complete System for contamination, Flush and Clean as required. Reassemble and Test.

CAUSE: **Faulty Valve Spool or Section?**

SOLUTION: Determine what caused Valve Spool to be Faulty, is it a failure or a defect, A Defect usually shows up soon, Failure can be any time. If Defect Repair or Replace as needed, If Failure determine cause of Failure, Repair Failure cause and Repair or replace Spool Section.

CAUSE: **Faulty Control Module?** (electric over hydraulic new style (5 wire) valve only.

SOLUTION: Valve control modules may develop one of two modes of failure:

1. Water damage: In this case condensation will develop in the circuit board cavity of the controller and result in a short. With this mode, the controller will stop working in one or both directions and will very seldom regain function.

2. Thermal Fatigue: This failure will be identified as a module which performs adequately when cold but will stop working in one or both directions as the unit warms up. This is caused by fatigue of the wire strip located inside the module. Identify the signal wire from the joystick attached to the faulty segment of the valve (swing, lift, dipper, etc). Use a phillips screw driver to remove the wire. Remove the wire attached to the module next to the faulty segment and swap the two wires. If the problem moves to the new location, the problem is in the Joystick or harness. If the problem continues in the affected valve segment, replace the module.

Cylinder Won't Move At All: (No Power)

CAUSE: **Obvious Causes Check First?** (Check These First)
SOLUTION: Perform all Operational checks, Tank Oil Level, Pump Operation, Control Valve Circuit (Electrical Supply & Hydraulic Supply), All Circuits affected or only some Circuits. If All Circuits will not work the Problem is most likely up-stream of the control Valve or an electrical Problem (Models with Joystick Controller). The Following Causes are based on only some circuits being affected, Not all circuits.

CAUSE: **Incorrect Hose Routing?** (Unit has never worked or been repaired)
SOLUTION: Check Hose Routing with Parts Manual and Assembly Guide to make sure Hoses are routed correctly. Move and reconnect Hoses as required.

CAUSE: **Work Port Relief Installed Improperly?** (Unit has never worked or been repaired)
SOLUTION: Determine correct positioning of Work Port Relief's. If relief's are incorrectly installed, Install correctly and Test.

CAUSE: **Work Port Relief Malfunction?**
SOLUTION: Determine if one or both sides are affected. Make sure Work Port Relief's are in proper position, Swap Hoses with another circuit or swap Work Port relief's with another circuit to determine where problem lies. Repair or replace faulty Parts as required.

CAUSE: **Control valve or Remote Control Malfunction?**
SOLUTION: Observe actuation of Valve Spool in relation to Control Lever. Repair any faults.

CAUSE: **Restrictions in System?**
SOLUTION: Look for Kinked, Plugged, Pinched Hoses or Lines. Observe as Cutting Head is moved throughout its range of movement. Do not forget the possibility of foreign objects being lodged in Restrictors, Hoses, Tubes, Fittings and/or Lines

CAUSE: **Piston has come off of Rod?**
SOLUTION: This can be difficult to diagnose, if the Piston comes completely off of Rod it can be pushed to bottom of Barrel below Port, Then Oil just circulates around through Piston with little or no resistance, This makes it appear there is no Pressure or valve is not working. The best way to check would be with a Flowmeter in Cylinder Line. Check, Repair or Replace as required.

CAUSE: **Vent Plug Block or Not Installed?** (Power One Way Cylinders)
SOLUTION: This applies to Cylinders that only Stroke in or Out under pressure, The return Stroke under gravity. Remove Plug, Clean or Replace as needed. If No Vent Plug is there determine if one is needed and install as required. (See Parts / Operators Manual for Vent Plug requirements).

Cylinder Won't Move Under Load: (Moves Slowly)

CAUSE: **Obvious Causes Check First?** (Check These First)
SOLUTION: Perform all Operational checks, Tank Oil Level, Pump Operation, Control Valve Circuit (Electrical Supply & Hydraulic Supply), All Circuits affected or only some Circuits. If All Circuits will not work the Problem is most likely up-stream of the control Valve or an electrical Problem (Models with Joystick Controller). The Following Causes are based on only some circuits being affected, Not all Circuits.

CAUSE: **Incorrect Hose Routing?** (Unit has never worked or been repaired)
SOLUTION: Check Hose Routing with Parts Manual and Assembly Guide to make sure Hoses Are routed correctly. Move and reconnect Hoses as required.

CAUSE: **Work Port Relief Installed Improperly?** (Unit has never worked or has been repaired or worked on)
SOLUTION: Determine correct positioning of Work Port Relief's. If reliefs are incorrectly installed, Install correctly and Test.

CAUSE: **Work Port Relief Malfunction?**
SOLUTION: Determine if one or both sides are affected. Make sure Work Port Relief's are in proper position, Swap Hoses with another circuit or swap Work Port relief's with another circuit to determine where problem lies. Repair or replace faulty Parts as required.

CAUSE: **Control valve or Remote Control Malfunction?**
SOLUTION: Observe actuation of Valve Spool in relation to Control Lever. Repair any faults.

CAUSE: **Restrictions in System?**
SOLUTION: Check Hoses and Lines for Kinks / Obstructions. Hoses have an inner lining that can turn loose and block a hose. If Assembly or Repair work has been performed, recheck all connections for correct location. Some may not be visible without some dis-assembly. Unplanned restrictions cause increased backpressure, loss of usable power, excess Heating of Oil and failure of Shaft Seals.
Restrictions can sometimes be found by measuring the temperature of the Oil (or fittings) at various points in circuit as heat will usually be higher at the restriction. The restriction should be located at or upstream of the increased temperature point.
Restrictions are sometimes caused by foreign objects that get into the system, This can happen during servicing, maintenance or repairs. It is not uncommon to find bolts, nuts, plastic plugs, paper or rags stuck into system when it was being repaired or assembled then forgotten about.
Restrictions sometimes can be a piece off of a failed component up stream or a Component such as a Hose built wrong.

Cylinder Won't Move Under Load: (Continued)

CAUSE: **Piston has come off of Rod?**
SOLUTION: This can be difficult to find, If the Piston comes completely off of Rod it can be pushed to bottom of Barrel below Port, Then Oil just circulates through Cylinder with little or no resistance, This makes it appear there is no Pressure or valve isn't working. The best way to check would be with a Flowmeter in Cylinder Line. Check, Repair or Replace as required.

CAUSE: **Restrictor Valve Installed in Wrong Line, Backwards or Plugged?**
SOLUTION: Determine the correct location of installation for Restrictor and make sure it is in correct location. Inspect for being Plugged, Clean or Replace as needed.

CAUSE: **Excessive Internal Leakage in Pump / Motor?**
SOLUTION: Perform Flow and Pressure Test. If results aren't within Specifications, determine the cause of the internal leakage, correct the cause. Replace worn or damaged parts. It is good to replace the Filter any time the Pump and/or Motor are repaired or replaced. Pump and/or Motor wear usually occurs over a long period and are gradual loses of power and excess heating of Oil. This may go un-noticed until it is severe making the operator think it just started, this can make this type of failure hard to determine. Pre-Mature Pump and/or Motor Failure wear occurs quickly, The problem for these failures must be found and repaired or the failure will be repetitive. The Most common cause of Pre-Mature Failure is Cavitation, Oil Contamination, Oil Aeration and/or Defects in Pump and/or Motor. MACHETE SPECIFIC, When performing the Flow Test on the Machete, The flow going to Motor and either the return from the Motor or the Case drain must be determined. These figures will indicate internal leakage in the Motor.

CAUSE: **Air in Oil?**
SOLUTION: Run the System for a few minutes. Check for Air in the Oil in the Tank. Air entrained Oil will have a foamy appearance. If Air is present, find the Air Leak and correct it. Air Leak can be in the Suction Line and Oil may not leak out because there may only be Oil in that location when the Pump is sucking it in. With the Tractor Engine "Off" you can find a leak by pressurizing the Tank; This will not take but a few pounds of pressure (3 to 5 PSI or Less) look for leakage in the Suction Lines, Because the Oil Pick-Up is lower than the Oil Level this will force Oil out the leak. Leaks in Hoses and at Fittings can draw Air into System as Oil Flows Past. Systems that have had severe or prolonged Air Entry Problems may have Experienced Pump Damage.

CAUSE: **Engine RPM Too Slow?**
SOLUTION: Run Tractor Engine at required Speed to achieve GPM through Pump, See Specification Section in Repair Manual.

CAUSE: **Vent Plug Block or Not Installed?** (Power One Way Cylinders)
SOLUTION: This applies to Cylinders that only Stroke in or Out under pressure, The return Stroke under gravity. Remove Plug, Clean or Replace as needed. If No Vent Plug is there determine if one is needed and install as required. (See Parts / Operators Manual for Vent Plug requirements).

Cylinder Rod Bent:

CAUSE: **Excessive Load Applied to Cylinder?**
SOLUTION: This is an Operational Problem or Operational Accident. The Mode of failure would be that an excessive load was applied while the Control Valve Spool was in “Hold” and there was no Work Port Relief in circuit (or it was malfunctioning). Corrective action is to counsel the operator to avoid conditions that resulted in bending. repair or replace Cylinder and any other damaged component. A good example would be using Tractor Wheel Power to put pressure against boom and Valve closed so Cylinder can not give (Exceeding Break-A-Way).

CAUSE: **Misalignment of Cylinder Lugs?**
SOLUTION: make sure something has not been bent, Frame, Lugs and etc. Align Cylinder Lugs (may require cutting and Welding) or replace faulty Parts as needed. Mis-Alignment of Lugs place a side load on Rods that can cause them to bend. Usually this alignment is noticeable.

CAUSE: **Work Port Relief Malfunction?**
SOLUTION: Check relief Pressure of Valves that are in the affected circuit. Adjust or replace them as needed to bring them to specification (See Repair Manual). Do not operate with Relief Setting incorrect, this will cause damage. Also check to make sure that Port Relief’s are installed correctly and in the proper places.

CAUSE: **Interference with Another Part of Component?**
SOLUTION: Repair or Replace the damaged cylinder. Slowly actuate the Implement throughout its full range of motion, utilizing all possible Cylinders. Observe for interference with any other Part. Correct cause of interference as needed.

Cylinder Rod Came Out of Cylinder:

CAUSE: **Piston Nut Backed Off of Rod?**
SOLUTION: Replace damaged Parts and Assemble. Make sure Piston Nut is Correct and Properly Torqued. This problem is usually caused by improper assembly (Nut Not Torqued) but can also be caused by a faulty Nut and/or Rod threads, This failure would show Rod Threads that are damaged most likely. Some times Threads will show damage from Piston working on Rod because it has been operated while Nut was loose.

CAUSE: **Wrong Nut On Rod?**
SOLUTION: Replace with correct Piston Nut, Check Piston Nut that it is not too Thin, Wrong Threads or Insufficient Thread engagement on Rod.

Cylinder Rod Came Out of Cylinder: (Continued)

CAUSE: **Relief Valve Setting Too High?**

SOLUTION: After Replacing the damaged Parts, test the Settings of the Relief Valve, Test this by slowly pressurizing the Cylinder to determine the Relief Pressure, a Pressure Gauge installed inline for testing will show this Relief Pressure. If Pressure exceeds what Relief Should be stop. Repair or replace Relief Valve and retest. IF RELIEF IS TO HIGH DO NOT CONTINUE WITH PRESSURE UNTILL RELIEF IS REPAIRED OR DAMAGE WILL RESULT. Note: Usually Rods that have Nuts pulled off due to Pressure to high will have Threads pulled off of Rod.

Deck Cracks:

CAUSE: **Severe Usage?**

SOLUTION: Prepare and Repair, Weld, Grind Down, Add Scab Plate and Re-Paint Repaired Area.

CAUSE: **Vibration?**

SOLUTION: Locate and correct cause of Vibration problem. Prepare and Repair, Weld, Grind Down, Add Scab Plate and Re-Paint Repair Area.

CAUSE: **Poor or Missing Welds, Missing Bracing?**

SOLUTION: Prepare and Repair, Weld, Grind Down, Add Scab Plate and Re-Paint Repaired Area. As this will usually be found rather quickly from delivery date it should be covered under warranty, always take photos of this before any repairs as they may be requested by factory.

CAUSE: **Inadequate Bracing?**

SOLUTION: This is a difficult subject, It is recommended that you consult with the factory before making modifications of this type, Adding additional pieces may change many components functions, the weight added could affect balance weight ratio and the Hydraulic Functions ability to lift.

Deck Worn on Underside:

CAUSE: **Mowing Over Sand or Other Abrasive Material?** Under side of deck has Sand Blasted appearance. This Sand Blasted appearance will also be visible on Blades and Carrier, most severe on Fan Blades (Up-Lift Blades).

SOLUTION: 1. Run Mower with as low a Tractor RPM as Possible (Decreased PTO Speed) and still get a satisfactory Mowing job done. Use Flat non Up Lift Blades is available. Try to do the mowing at a time when the ground is still damp (earlier in day).

2. Check to make sure mower is operating at correct RPM (540 or 1000 as required by mower components). If a 540 RPM mower was connected to a 1000 RPM Tractor the Blade Tip Speed would be way to high and this would create severe amount of Sand and Dust under deck.

Deck Worn on Underside: (Continued)

CAUSE: **Deck being Worn and Ripped away by Heavy Debris?**
SOLUTION: Make sure material being cut is not to heavy, large or thick for unit being used, This type wear will be accompanied by dents and large scratches. The best solution for this is to make sure that Unit is suited for job. Make sure job is not over tasking Unit.

CAUSE: **Deck Worn from Continuous Use?**
SOLUTION: The Deck will wear over time, If Deck had severe wear by sand or other debris at one time causing excess (premature) wear, then this will make it wear that much faster and the only solution would be to replace Deck.

Hydraulic System Noise: (Squeal)

CAUSE: **Restrictions in System?** A Squeal may be normal in some Valves when the lowering function is actuated as Oil is going over restrictors.
SOLUTION: Check Hoses and Lines for Kinks / Obstructions. Hoses have an inner lining that can turn loose and block a hose. If Assembly or Repair work has been performed, recheck all connections for correct location. Some may not be visible without some disassembly. Unplanned restrictions cause increased backpressure, loss of usable power and excess heating of Oil. Restrictions can sometimes be found by measuring the temperature of the Oil (or fittings) at various points in circuit as heat will usually be higher at the restriction. The restriction should be located at or upstream of the increased temperature point. Foreign objects that get into the system sometimes cause restrictions, This can happen during servicing, maintenance or repairs. It is not uncommon to find bolts, nuts, plastic plugs, paper or rags stuck into system when it was being repaired or assembled then forgotten about. Restrictions sometimes can be a piece off of a failed component up stream or a Component such as a Hose built wrong

CAUSE: **Relief Valve Malfunction?**
SOLUTION: Perform Flow Pressure Test. If Flow is correct and Pressure is Low, remove Relief Valve and inspect for damaged Seals, Contamination or other abnormalities. Re-Seal, Adjust or replace the Valve as needed. Leakage through the Valve (from Low Pressure setting) or leakage around the Valve from damaged Seals will cause heating of the Oil and Low Power complaints. NOTE: There may be situations when Pump Flow is insufficient to reach Relief Pressure. Therefore it is important to test for proper Flow before condemning the Relief Valve.

Hydraulic System Noise: (Continued)

CAUSE: **Cavitation?** Cavitation is caused by inadequate amount of fluid reaching the Pump, Cavitation will damage Pump, so do not run with a Cavitation problem any more than necessary to check system. If Suction side is pulling Air in the Oil will usually cause Oil to Foam after running some.

SOLUTION: Cavitation is usually caused by a restriction of some sort in the suction lines, but can also be caused by an un-vented tank which creates a vacuum when the pump has a demand for Oil. Other problems such as plugged Suction Screens or very thick Oil can cause cavitation. The cause must be found and corrected before a new Pump is installed as cavitation will damage a Pump. Repair or Replace components a required.

CAUSE: **Wrong Oil?** (Oil to Thick or Viscous)

SOLUTION: Make sure correct Oil is used, Recommended Hydraulic Oil only should be used. Do not mix grades and types of Oil, if wrong oil has been used it must be completely remove before adding different types Oil. See Specification Chart for recommended Oil type

Hydraulic System Overheating:

Note:

1. Overheating of the Hydraulic System can have many individual causes. Before going too far into trouble shooting an overheating complaint it would be well to understand exactly the difference between HOT and TO HOT.

2. Heat is produced anytime a Hydraulic System is working. Heat is generated when the Oil moves from an area of High Pressure to an area of Low Pressure. These “Pressure drops” occur when work is performed by the System and normally occurs in Pumps, Motors, Hoses and Valves. They are expected and allowed for in the design of the System.

3. Alamo Industrial’s Systems are designed to operate at approximately 100 Degrees F. above ambient temperature (Ambient Temperature measured close to Tank) with the proper Oil Level in tank and System. Small variances can be expected due to normal wear in the System and other environmental conditions. A System is not considered to be overheating unless it significantly exceeds 100 degree F. over ambient temperature. This is not to be measured by touching, use a temperature measuring device to measure temperature to avoid being burnt.

4. When Discussing the Problem with a Customer, it is important to determine the condition under which the Symptoms occur. For example, Ask if the Symptom has existed for the life of the machine, has been gradually getting worse, or if it has occurred suddenly. A sudden occurrence might indicate that foreign material entered the system when work was being performed. Gradual worsening would indicate internal leakage (Wear or Breakage). Symptoms that occur with specific operators would indicate a possible operational problem. Symptoms that have been present for some time could be any of the above problems.

Hydraulic System Overheating: (Continued)

CAUSE: **Restrictions?** Just as indicated, an unintentional obstruction to normal Oil Flow through the circuit.

SOLUTION: Check for an unwanted increase in pressure, The obstruction would be down stream from the Pressure increase, so you would want to check pressure going back toward pressure inlet. As Oil passes through the obstruction it causes Heat increase, a check of temperatures will generally be near restriction, a heat sensing gun works well for this. Some Examples of Restrictions are:

- Kinked, Mashed or Internally Broken Hoses.
- Obstruction by foreign materials in lines.
- Plugged Filter or Wrong Filters installed
- Open (Stuck) By Pass Valve
- Wrong Size Hoses or fittings installed.
- Repair work done and parts assembled wrong.

The number of possibilities is numerous, Do not forget when checking especially for kinks in hoses it may be required to run the cylinders through their complete range of movement to check them. Know what repair work or modifications were performed.

CAUSE: **Wrong Type Valve being Used For Tractor?** (Tractor Hydraulics Only)

SOLUTION: Determine type of Control Valve for Tractor, Is tractor a Fixed Displacement (Open Center) System or a Load Sense (Closed Center) System. Make Sure the Valve that is installed is the correct one for the Type Tractor Hydraulics be used. If the Wrong System is Used it will cause a Heating problem.

CAUSE: **Spool Valve Stuck In Open or Partially Open Position?**

SOLUTION: Repair or Replace Valve components as needed.

CAUSE: **Relief Valve Set to Low?** (Load Sense / Closed Center Only)

SOLUTION: Relief Valve for Mower Positioning Control Valve must be set higher than Tractor Relief Valve, Otherwise the Oil will bypass continuously and overheat rapidly.

CAUSE: **Leakage?**

SOLUTION: This type Leakage is Internal, an External Leak will not cause Heating unless it causes enough Oil loss to effect the Oils cooling. Another type leakage would be Air entering the system on the suction side, This may not leak externally when system is engaged because it would be a suction. Some internal leakage is always present because of tolerance in the components, Valve, Pump, Motor and other components. But usually this is compensated for in the design of the system and components. Internal leakage will normally increase with wear and age on the system components. Heating from normal internal leakage is usually not severe or noticeable until it reaches advanced stages. It usually occurs gradually and is accompanied by a gradual loss of power. Test System for leakage by running Pressure and flow Test, Rebuild or Replace as required.

Hydraulic System Overheating: (Continued)

CAUSE: **Excessive Pump or Motor Wear?** These will be accompanied by a Power Loss when Mower Head is Cutting. Rapid Pump and/or Motor wear can be from damage caused by Cavitation (restricted Oil Supply), Contamination, Aeration, or defects in the Pump and Motor. Air Leaks (Air being sucked into system) causes Air Bubbles to be entrained into the Oil. These Air Bubbles will reduce the lubricating ability of the Oil causing adhesive wear to the Pump and Motor and a rapid increase in internal leakage, Air entrained Oil will have a foamy look after the system has run for a while.

SOLUTION: Test System for excessive Pump and Motor Wear or Cavitaion by running Pressure and flow Test, Repair or Replace as required.

CAUSE: **Engine RPM Too High?**

SOLUTION: Run Tractor Engine at required Speed to achieve GPM through Pump, See Specification Section in Repair Manual.

CAUSE: **Malfunctioning Valves?** (Main Relief, Priority Valves and Logic Valves)

SOLUTION: Test the above Valves, they are on the High Pressure Side of the system, these act on a pressure differential and are spring loaded. The Typical failure is a Leaking Seal between the Valve Cartridge and the Valve Block. An improper Low setting of Relief Valve to Low a Pressure can cause rapid Heating as the Oil passes from the High Pressure to the Low-Pressure area. The same is true for the other Spring Type Valves such as the Priority Valve (Governors).

CAUSE: **Operational Problems?** (Cutting Excessively Heavy Material, Traveling to Fast for Conditions, Improper Cutting Height)

SOLUTION: Make sure Cutting Height is not so low Blades are hitting Ground. Make sure that Travel Speed while cutting does not exceed cutting capacity of Model Design. Make sure something too heavy for this model is not being cut. Make Sure the Tractor Engine is running at the correct RPM to run Hydraulics at the correct Speed. All of these can cause Over Heating by forcing the system pressure over relief (causing Relief Valves to Open and heating the Oil as it passes across the Valve). If the system pressure is going over relief too frequently or for too long at a time, The Oil capacity will not be sufficient to maintain the desired operating temperature. Travel Speed is always dependent on the material being cut.

Motor Flange Breaking:

CAUSE: **Insufficient Support on Upper End of Motor?**

SOLUTION: 1. Make sure that the Motor Plate is installed on top of Motor and that it is installed correctly, These Plates must be installed with clearance dimensions and Torque settings, See the Spindle repair instruction in the Operators / Product Service Manual.
2. Some Units built prior to 1996 did not have this Motor Plate on it, There was a kit made to add to these early units. Kit P/N 02970754 can be used to add Motor Plate to Units made prior to 1996.

CAUSE: **Motor to Spindle retaining Bolts not Tight?**

SOLUTION: Check and Tighten Motor to Spindle Mounting Bolts.

Motor Inoperative: (Won't Run)

CAUSE: **Low Oil Level or No Oil?**
SOLUTION: Check and Correct Oil Level, If oil level was extremely Low or Empty, Pump Damage most likely has occurred, This will also have to be checked. Repair any cause of Oil loss before continuing.

CAUSE: **No Oil Flow to Motor?** Front Pump Inoperative, No Pump Pressure reaching Motor.
SOLUTION: Oil Level is correct but no Oil Flow to Motor. Check Pump connection to Tractor, Shafts, Couplers and Adapters, make sure they are not stripped or broken. Check to make sure Pump is "ON" if equipped with Pump "Shut Off". Check to make sure Motor is "ON" when equipped with "Shut Off". Check for any malfunctions in Drive System and Shut Off Components.

CAUSE: **No Voltage to Solenoid Valve?** (If Equipped)
SOLUTION: Check Fuse (if used), replace if required and try again. With Tractor Ignition Switch "ON", and Mower Switch "ON" Test for voltage at the Solenoid Valve. A quick test is to turn switches on (With Tractor Engine "Off") and see if a small metal object such as a paper clip or washer will stick to the end of the Valve when the mower is turned "ON". If it does not, The Coil is not magnetizing the Valve. Test for Voltage at the Wire using a test Light or Voltmeter. If no Voltage is present, trace the circuit back through the wiring, the Mower Switch, The Fuse and the Tractor Wiring to locate the faulty part. If Current is available to the Solenoid but Solenoid won't turn on motor replace Solenoid.

CAUSE: **Spindle Locked Up?**
SOLUTION: The Spindle can be locked up causing Motor not to Start, This can usually be felt or seen in the System trying to run but having to bypass. Sometimes the Spindle is not seized but only tight, this can prevent motor from starting right away from a dead Stop or slowly start, The tightness is not enough to prevent motor from running once it is started, See the Spindle Section for more information.

Motor Over Heating: (Motor Over Heating is considered when the Operating temperature exceeds 100 degrees F. over ambient Temperature).

CAUSE: **Oil Level Too Low?**
SOLUTION: Make sure it is filled to proper level with recommended Oil. Determine reason for low Oil Level (leaks, etc.) and correct problem, Run Mower and check temperature, it should not exceed 100 degree F. above ambient Temperature.

CAUSE: **Incorrect Oil Used?**
SOLUTION: Use recommended Hydraulic Oil, DO NOT mix Oils that are not compatible, in some cases it may be required to drain and replace all the oil. See Specification Chart for recommended Oil Type. When repairing unit it is recommended that Oil be update to recommended Oil.

Motor Over Heating: (Continued)

CAUSE: **Air in Oil?**

SOLUTION: Run the System for a few minutes. Check for Air in the Oil in the Tank. Air entrained Oil will have a foamy appearance. If Air is present, find the Air Leak and correct it. Air Leak can be in the Suction Line and Oil may not leak out because there may only be Oil in that location when the Pump is sucking it in. With the Tractor Engine Off you can find a leak by pressurizing the Tank, This will not take but a few pounds of pressure (10 PSI or Less) look for leakage in the Suction Lines, Because the Oil Pick-Up is lower than the Oil Level this will force Oil out the leak. Leaks in Hoses and at Fittings can draw Air into System as Oil Flows Past. Systems that have had severe or prolonged Air Entry Problems may have Experienced Pump Damage.

CAUSE: **Engine RPM Too High?**

SOLUTION: Run Tractor Engine at required Speed to achieve GPM through Pump, See Specification Section in Repair Manual.

CAUSE: **Excessive Ground Speed for Mowing Conditions?** (Operational Problem)

SOLUTION: This will usually also have a Heating Problem if continuing to mow. Observe (or Ask Operator) mowing conditions, Material being Cut etc. Correct Ground Speed is always relative to Material and conditions of mowing. One indication of Excessive Ground Speed is considerable wear on tips of blades but this is not exclusive of Excessive Ground Speed as the Wear can be caused by other factors. So Blade Wear alone is not definite Travel Speed problem. The Cut is Choppy and uneven, the material is coming from under deck in Lumps instead of being distributed across width of Deck. These conditions can force the Oil to go over relief because of excessive Load on Motor. A Change of Ground Speed and/or material being cut by unit will cure this problem.

CAUSE: **Excessive Ground Contact with Blades?** (Operational Problem)

SOLUTION: Inspect Blades, Blade Carrier and Blade Bolts for wear, Excessive wear could indicate frequent contact with the ground, Check cutting Height of Blades above Skid Shoes, Check for proper Blades and Skid Shoe condition, Repair or Replace as required.

CAUSE: **Incorrect Oil Installed?**

SOLUTION: Incorrect Oil installed may produce internal wear, which will overheat the motor. Use only the recommended Oil for the model being used. See Specification Chart for correct Oil type. Do not mix Oil Types as the may not be compatible, if types of Oil are being changed over, completely change the Oil, Drain and flush the system before installing the new Oil.

Motor Over Heating: (Continued)

CAUSE: **Excessive Internal Leakage in Pump / Motor?**

SOLUTION: Perform Flow and Pressure Test. If results are not within Specifications, determine the cause of the internal leakage, correct the cause. Replace worn or damaged parts. It is good to replace the Filter any time the Pump and/or Motor are repaired or replaced. Pump and/or Motor wear usually occurs over a long period and are gradual loss of power and excess heating of Oil. This may go un-noticed until it is severe, making the operator think it just started, this can make this type of failure hard to determine. Pre-Mature Pump and/or Motor Failure wear occurs quickly, The problem for these failures must be found and repaired or the failure will be repetitive. The Most common cause of Pre-Mature Failure is Cavitation, Oil Contamination, Oil Aeration and/or Defects in Pump and/or Motor. MACHETE SPECIFIC, When performing the Flow Test on the Machete, The flow going to the Motor and either the return from the Motor or the Case drain must be determined. These figures will indicate internal leakage in the Motor.

CAUSE: **Relief Valve Malfunction?**

SOLUTION: Perform Flow Pressure Test. If Flow is correct and Pressure is Low, remove Relief Valve and inspect for damaged Seals, Contamination or other abnormalities. Re-Seal, Adjust or replace the Valve as needed. Leakage through the Valve (from Low Pressure setting) or leakage around the Valve from damaged Seals will cause heating of the Oil and Low Power complaints.
NOTE: There may be situations when Pump Flow is insufficient to reach Relief Pressure. Therefore it is important the proper Flow be present before condemning the Relief Valve.

CAUSE: **Restrictions in System?**

SOLUTION: Check Hoses / Lines for Kinks/Obstructions. Hoses have inner linings that can turn loose to block it. If assembly or Repair work has been performed, recheck all connections for correct location. Some may not be visible without some disassembly. Unplanned restrictions cause increased backpressure, loss of usable power and excess Heating of Oil. Restrictions can sometimes be found by measuring the temp of the Oil (or fittings) at various points in circuit for higher heat. The restriction should be located at or upstream of the increased temp. point. Foreign objects sometimes cause restrictions in the system,
This can happen during servicing, maintenance or repairs. It is not uncommon to find bolts, nuts, plastic plugs, paper or rags stuck into system when it was used as being repaired or assembled then forgotten about. Restrictions sometimes can be a piece off of a failed component up stream, a Component such as a Hose built wrong.

CAUSE: **Insufficient Flow From Charge Pump?** (MACHETE SPECIFIC)

SOLUTION: Measure Flow from charge Pump (Install Flowmeter in series upstream of Charge Filter). If Flow is significantly less than 6 GPM at rated RPM. Replace the Pump Assembly and retest for proper Flow.

Motor Shaft Seal Leaking:

CAUSE: **Excessive Back Pressure on return side of Motor?** (Constant or Intermittent)
SOLUTION: Check for restrictions on the return side of Motor (See Overheating in General). Check all return Plumbing for kinked hoses or hoses that can Kink in various positions of the Cutting Head or Boom. Look for plugged Lines or a Plugged Filter. Check also for other Valves or add-on components downstream of the motor that can stop or restrict the Flow of Oil. Do not just replace the Seal without curing the problem, if you do it will likely happen again.

CAUSE: **Incorrect Oil Used?**
SOLUTION: Use recommended Hydraulic Oil, DO NOT mix Oils that are not compatible, in some cases it may be required to drain and replace all the oil. See Specification Chart for recommended Oil Type. When repairing unit it is recommended that Oil is updated to recommended Oil.

CAUSE: **Shaft Seal Worn?**
SOLUTION: This is usually visible damage. Replace Seal if Shaft is NOT also worn, If Shaft is worn (Groove or scratches in Shaft) it is advisable to replace the Motor. Seal and Shaft wear are normally caused by abrasive material (dirt) getting around the Seal, Damage can also occur from damaged Spindle Assembly. What ever the cause it must be corrected before new Motor is installed.

CAUSE: **Shaft Seal Coming Out of Bore?**
SOLUTION: Check Seal retainer if equipped to make sure that retainer is of proper size and installed properly. Install New Seal and proper retainer, But always try to find the cause of Seal blowing out to correct the problem.

CAUSE: **Faulty Motor?**
SOLUTION: Motors can leak at the Shaft Seal due to internal wear, Damaged Internal Seals or Improper Assembly. Repair or Replace as required.

Motor Runs Too Slow: (Or Slows Down under Load)

Note: The Motor on the Cutting Head running too slow can be a result of many causes and not all caused by the Motor itself. It needs to be determined whether the Symptom occurs by itself or if it is accompanied by other symptoms such as overheating, unusual noise, etc. The question should be asked whether the symptom occurs when the mower is freewheeling or only when the Mower is cutting under a load (light or heavy grass). If the Motor only slows when under a load see Motor Stop Section. If Mower Loads and not under a Load see the following Section Motor runs to Slow.

Motor Runs Too Slow: (Continued)

CAUSE: **Engine RPM Too Slow?**
SOLUTION: Run Tractor Engine at required Speed to achieve GPM through Pump, See Specification Section in Repair Manual.

CAUSE: **Pump Drive Damaged?**
SOLUTION: Inspect Pump Drive components for wear or damage, If Pump is not being driven properly, repair or replaced parts as required.

CAUSE: **Faulty Logic Valve in Motor Control Circuit?** (If Equipped)
SOLUTION: Remove and inspect Logic Cartridge for damaged seals or contamination, Repair, Reseal or Replace as needed. If the Seals on the Logic Valve repeatedly fail, it will likely be required to replace the Valve Block due to damage or erosion in the Valve Bore.

CAUSE: **Air in Oil?**
SOLUTION: Run the System for a few minutes. Check for Air in the Oil in the Tank. Air entrained Oil will have a foamy appearance. If Air is present, find the Air Leak and correct it. Air Leak can be in the Suction Line and Oil may not leak out because there may only be Oil in that location when the Pump is sucking it in. With the Tractor Engine Off you can find a leak by pressurizing the Tank, This will not take but a few pounds of pressure (10 PSI or less) look for leakage in the Suction Lines, Because the Oil Pick-Up is lower than the Oil Level this will force Oil out the leak. Leaks in Hoses and at Fittings can draw Air into System as Oil Flows Past. Systems that have had severe or prolonged Air Entry Problems may have Experienced Pump Damage.

CAUSE: **Restrictions in System?**
SOLUTION: Check Hoses / Lines for Kinks/Obstructions. Hoses have inner linings that can turn loose to block it. If Assembly or Repair work has been performed, recheck all connections for correct location. Some may not be visible without some dis-assembly. Unplanned restrictions cause increased backpressure, loss of usable power and excess Heating of Oil. Restrictions can sometimes be found by measuring the temperature of the Oil (or fittings) at various points in circuit for higher heat. The restriction should be located at or upstream of the increased temperature point. Foreign objects sometimes cause restrictions in the system, This can happen during servicing, maintenance or repairs. It is not uncommon to find bolts, nuts, plastic plugs, paper or rags stuck into system when it was used as being repaired or assembled then forgotten about. Restrictions sometimes can be a piece off of a failed component up stream, Component such as a Hose built wrong.

CAUSE: **Damaged O-Ring on Solenoid Valve?** (If Equipped)
SOLUTION: Remove Valve and inspect Seals, replace if damaged.

CAUSE: **Insufficient Flow From Charge Pump?** (MACHETE SPECIFIC)
SOLUTION: Measure Flow from charge Pump (Install Flowmeter in series upstream of Charge Filter). If Flow is significantly less than 6 GPM at rated RPM. Replace the Pump Assembly and retest for proper Flow.

Motor Runs Too Slow: Continued

CAUSE: **Excessive Internal Leakage in Pump / Motor?**
SOLUTION: Perform Flow and Pressure Test. If results are not within Specifications, determine the cause of the internal leakage, correct the cause. Replace worn or damaged parts. It is good to replace the Filter any time the Pump and/or Motor are repaired or replaced. Pump and/or Motor wear usually occurs over a long period and are gradual loss of power and excess heating of Oil. This may go unnoticed till it is severe making the operator think it just started, this can make this type of failure hard to determine. Pre-Mature Pump and/or Motor Failure wear occurs quickly, The problem for these failures must be found and repair or the failure will be repetitive. The Most common cause of Pre-Mature Failure is Cavitation, Oil Contamination, Oil Aeration and/or Defects in Pump and/or Motor.

Motor Stops: (Mower Quits Under Load)

CAUSE: **Incorrect Oil Used?**
SOLUTION: Use recommended Hydraulic Oil, DO NOT mix Oils that are not compatible, in some cases it may be required to drain and replace all the oil. See Specification Chart for recommended Oil Type. When repairing unit it is recommended that Oil is updated to recommended Oil.

CAUSE: **Air In Oil?**
SOLUTION: Run the System for a few minutes. Check for Air in the Oil in the Tank. Air entrained Oil will have a foamy appearance. If Air is present, find the Air Leak and correct it. Air Leak can be in the Suction Line and Oil may not leak out because there may only be Oil in that location when the Pump is sucking it in. With the Tractor Engine Off you can find a leak by pressurizing the Tank, This will not take but a few pounds of pressure (10 PSI or Less) look for leakage in the Suction Lines, Because the Oil Pick-Up is lower than the Oil Level this will force Oil out the leak. Leaks in Hoses and at Fittings can draw Air into System as Oil Flows Past. Systems that have had severe or prolonged Air Entry Problems may have Experienced Pump Damage.

CAUSE: **Engine RPM Too Slow?**
SOLUTION: Run Tractor Engine at required Speed to achieve GPM through Pump, See Specification Section in Repair Manual.

Motor Stops: (Mower Quits Under Load) (Continued)

CAUSE: **Excessive Ground Speed For Mowing Conditions?** (Operational Problem)

SOLUTION: This will usually also have a Heating Problem if continuing to mow. Observe (or Ask Operator) mowing conditions, Material being Cut etc. Correct Ground Speed is always relative to Material and conditions of mowing. One indication of Excessive Ground Speed is considerable wear on tips of blades but this is not exclusive of Excessive Ground Speed as the Wear can be caused by other factors. So Blade Wear alone is not definite Travel Speed problem. The Cut is Choppy and uneven, the material is coming from under deck in Lumps instead of distributed across width of Deck. These conditions can force the Oil to go over relief because of excessive Load on Motor. A Change of Ground Speed and/or application will cure this problem.

CAUSE: **Excessive Internal Leakage in Pump / Motor?**

SOLUTION: Perform Flow / Pressure Test. If results are not within Specifications, determine cause of the internal leakage, correct the cause. Replace worn / damaged parts. It is good to replace the Filter anytime the Pump and/or Motor are repaired or replaced. Pump and/or Motor wear usually occurs over a long period and are gradual loss of power and excess heating of Oil. This may go unnoticed till it is severe making the operator think it just started, this can make this type of failure hard to determine. Pre-Mature Pump and/or Motor Failure wear occurs quickly, The problem for these failures must be found and repaired or the failure will be repetitive. The Most common cause of Pre-Mature Failure is Cavitation, Oil Contamination, Oil Aeration and/or Defects in Pump and/or Motor.

CAUSE: **Low Relief Valve Setting?**

SOLUTION: Best Tested with Pressure / Flowmeter, Some Relief Valve can be Repaired, Some Only Replaced, See Assembly set up instruction on Relief Valves, See Specification Section on Relief valve Settings. DON'T exceed recommended Relief Settings. Before condemning Relief Valve do a Flow and Pressure Test, The Pump under some conditions can't build enough pressure to make the relief open and this would appear Relief Valve is stuck, A Flowmeter will show when Pressure Relief opens.

CAUSE: **Restrictions in System?**

SOLUTION: Check Hoses / lines for Kinks / Obstructions. May not be visible without disassembly. Unplanned restrictions cause increased back pressure, loss of usable power and excessive heating of Oil (Usually at the restriction). Restrictions can sometimes be found by checking different locations for the temperature, The restriction will generally be upstream of heated spot. There are a number of things that can cause this heating problem, Most common Problem, Contamination, Kinked or Damaged Hose,

Pump Seizure: (Pump Locking Up)

CAUSE: **Lack of Oil?** (Lubrication)

SOLUTION: This is normally caused by failure to Pre-Lube the Pump before starting or cavitation (Air or Lack of Oil) during operation. A Lack of Pre-Lube failure will occur soon after start up if Pre-Lube is not done when unit is assembled. Obstruction or damage to Intake (Suction) Side of Pump or Lines can cause this problem. The solution would be to determine what is damaged and why was Oil Low, Repair or Replace as required

CAUSE: **Improper Assembly?**

SOLUTION: Damage can be caused by over torquing the Pump components, incorrect alignment or location of components. Improper Torquing or Assembly will normally show up very soon after start up. The solution would be to determine what is damaged and why, Repair or Replace as required

CAUSE: **Faulty - Defective Pump?**

SOLUTION: Sometimes Oil passages are not open inside the Pump during Manufacturing. These problems will show up as early Bearing failures or Pump not working when installed and very seldom occur after being run for awhile unless there is debris or other contamination blocking something. The solution would be to determine damage, why, and Repair or Replace as required

CAUSE: **Foreign Material?** (Contamination)

SOLUTION: Objects left in Tank or fall in during service. This can include, Dirt, Pieces of Hose, Plugs, Rags or any other object can be left or get into system. Keep everything clean and account for every thing used when serviced. The solution is to determine what is damaged and why, Repair/ Replace as required.

Pump Wear: (Rapid Excessive Wear)

CAUSE: **Contamination In System?**

SOLUTION: Locate and correct source of contaminants, This could include the complete system, Pump, Motor, Valves, Hoses, Tank, Oil, Filter System or any other component including your source of replacement Oil Supply. The Contaminants must be found and completely removed and stopped. The Solution is to repair or replace worn parts, Completely Flush and Clean all Hydraulic Components, Install New Clean Recommended Oil.

CAUSE: **Cavitation?**

SOLUTION: Cavitation is caused by inadequate amount of Fluid (Hydraulic Oil) reaching Pump, Usually a restriction of some sort in the suction lines but can also be caused by an unvented Tank. This will cause a vacuum when the Pump starts demanding Oil, The Pump cannot pull Oil out of this vacuum. Other Problems such as plugged Suction Screens or very Thick Oil can cause cavitation. This must be found and corrected before repairing old Pump or installing new one.

CAUSE: **Air In The Oil?**

SOLUTION: Run System for a few minutes. Check for Air in the Oil in the Tank. Air entrained Oil has a foamy appearance. If Air is present, find the Air Leak and correct it. Air Leak can be in the Suction Line and Oil may not leak out because there may only be Oil in that location when the Pump is sucking it in. With the Tractor Engine Off you can find a leak by pressurizing the Tank, This will not take but a few pounds of pressure (10 PSI or Less) look for leakage in the Suction Lines, Because the Oil Pick-Up is lower than the Oil Level this will force Oil out the leak. Leaks in Hoses and at Fittings can draw Air into System as Oil Flows Past. Systems that have severe or prolonged Air Entry Problems may have Experienced Pump Damage.

CAUSE: **Pump Not Pre-Lubed before Starting?**

SOLUTION: Repair or Replace Pump, Fill Pump with Oil during Assembly and or before Starting, This can be done by pouring Oil into the Suction Hose and letting it run into Pump as you are connecting Suction Hose, The Pump should have been Assembled using lubricant as it was assembled. The Machete and Brahma this is not required as the Pump is lower than the tank. This will make the suction line full of Oil to Pump

CAUSE: **Incorrect Oil Used?**

SOLUTION: Use recommended Hydraulic Oil, DO NOT mix Oils that are not compatible, in some cases it may be required to drain and replace all the oil. See Specification Chart for recommended Oil Type. When repairing unit it is recommended that Oil is updated to recommended Oil.

CAUSE: **Water In Oil?**

SOLUTION: Moisture in Oil adversely affects the lubricating ability of the Oil. The Source of the Moisture entry must be found and corrected, The System cleaned and flushed, All damaged components replaced. DO NOT operate system with moisture in it because the moisture will turn to Steam when heated, Steam will pit and damage components of Pump, Valves and Motors. As well as the Lubricating ability of the Oil will be diminished.

Spindle Leaking at Motor:

CAUSE: **Filling Spindle with Hydraulic Oil?** Motor Seal Leaks.
SOLUTION: Determine and correct cause of Motor Shaft Seal Leaking, Re-Seal Motor, Clean Repack or rebuild Spindle as required. Note: Be sure to determine what caused Seal to Blow out and repair that problem before considering the repair to be done. If you just put in New Motor Seal you have not cured the cause of the Problem. See Motor Seal Leaking for possible cause of Seal problems.

CAUSE: **Motor Loose or Bolts Missing?**
SOLUTION: Tighten Motor to Spindle retaining bolts, If they will not tighten? check and repair threads. Notice this problem will let Spindle Oil Leak but will not let Hydraulic Oil from Motor Leak.

CAUSE: **Gasket Torn or Damaged?**
SOLUTION: Remove Motor, Check surface of Spindle Housing and surface of Motor, Clean Surfaces of both, Check for Burrs or deep Scratches. Burrs can be removed by carefully filing surface, If you file surface caution must be taken to keep filings out of Spindle. If Scratches they can be filled with a sealer. Make Sure Sealer is Oil compatible?

CAUSE: **Pressure in Spindle Housing? Excess Backpressure.**
SOLUTION: Make sure Relief Plug installed or Relief Plug is not clogged, Check Spindle Oil level so it is not overfull, Notice this will be Spindle Oil leaking out not Hydraulic Oil.

Spindle Leaking around Bottom Seal:

CAUSE: **Seal Damaged?** Could be damaged by foreign material.
SOLUTION: It will be required to replace Seal and refill Spindle with Lubricant. Before replacing Seal always check to make sure Shaft Bearings have not lost Pre-load (Shaft will be loose in Housing) as this will make Seal Leak and will damage Seal. If Shaft is Loose see next cause / Solution. Always Check condition of Shaft surface at Seal Area that it is not damaged, Always coat ID of Seal with light coat of grease before installing.

CAUSE: **Bearings Loose?**
SOLUTION: If Bearings are Loose the Bearing Pre-Load is lost and Bearings are most likely damaged, Remove Motor, Dis-assemble Spindle, clean and Inspect, Rebuild and Fill with Lubricant. (See Spindle Repair / Product Service manual).

Spindle Leaking at Relief Plug:

CAUSE: **Relief Fitting Installed in Wrong Hole?**

SOLUTION: 1. First Determine what is leaking, Spindle Oil or Hydraulic Oil, If it is Spindle Oil continue, If it is Hydraulic Oil See Motor Seal Leaking.
2. Sometimes the Fill Plug (Grease Fitting on Spindles that are filled with Grease) and the Relief Fitting are installed in the wrong Holes. The relief Fitting should be in the Upper Hole (Hole closest to the Motor) if there are 2 holes. Note: There were changes made to Spindle in 1996 to add another Hole near the top of the Housing (above Oil Level) for the Relief Fitting to be installed, a Plug was installed into the lower hole where the relief/fill plug was installed as the early spindle only had the one hole. Spindle should always be installed with Pressure and Fill Plugs pointing away from Tractor.

CAUSE: **Spindle Overfilled?**

SOLUTION: Continue running (Only continue to Run if sure Leak is because Spindle is Over Filled) and clean up the mess until the leakage stops or remove some of the lubricant with possibly a suction gun,

Spindle Over Heating:

Spindle will operate up to 200 F. which is considered within tolerance range and is not considered over heating, DON'T Check for over heating with the touch of your Hand, The Temperature is to high and will burn you.

CAUSE: **Low Oil Level in Spindle?**

SOLUTION: Find causes of Low Oil Level and correct it. If Spindle was run Low Lubricant it is likely to be Bearing Damage from lack of Lubricant. The Spindle should be dis-assembled, Inspected and reassembled replacing any damaged parts. Always use New Seals.

CAUSE: **Excessive Bearing Pre-load?** (Bearings to Tight)

SOLUTION: Bearing need to be removed and inspected for damage from running too tight. Rebuild Spindle replacing Parts as required, Always replace with new Seal. Set Bearing Pre-Load and Lock Adjusting and Locking Nut down as instructed in Spindle repair section to correct Specifications, always double check to make sure Nuts are Locked in place.

CAUSE: **Bolts Holding Blade Bar to Spindle replaced and New Bolts to Long?**

SOLUTION: Check that Blade Bar Retaining Bolts are not to Long to cause them to bottom out and jam through Spindle damaging Shaft. Always make sure same Length Bolts are installed that came Out. If to long of Bolts have been installed in Spindle, it will have to be rebuilt.

Spindle Shaft Loose or Falls Out:

Note: When Spindles are properly assembled and lubricated, The Shaft should not loosen up in service. Shaft loosening up is an indication of a serious internal problem. Merely tightening up the adjusting Nut will not correct the cause of the problem.

CAUSE: **Bearing Adjusting Nut Backed Off?** (Not Properly Locked)
SOLUTION: Dis-Assemble Spindle and inspect Parts for damage, All components have a possibility of being damaged if ran with Bearings Loose. Install required replacement parts and re-assemble. See Spindle repair section for assembly and settings.

CAUSE: **Bearing Cups or Bearing Cones Not Seated Properly?**
SOLUTION: 1. IF MOWER HAS NOT BEEN RUN since Spindle was assembled, Find out why Bearings are not seated and correct problem, readjust Bearing Pre-load and make sure Bearings are seated properly, Fill with Lubricant and Test.
2. IF MOWER HAS BEEN RUN since Spindle was assembled. Dis-Assemble Spindle and inspect Parts for damage, All components have a possibility of being damaged if ran with Bearings Loose. Install required replacement parts and re-assemble. See Spindle repair section for assembly instructions and settings.

CAUSE: **Shaft Falls Out of Spindle Housing?** (Lost Bearing Pre-Load))
SOLUTION: Remove Motor from Spindle Housing and Remove Spindle from Deck. Clean and inspect all Parts, try to determine what part failed and why. Replace Parts as required and re-assemble spindle assembly. Note: Pay close attention to the threads on top of the Shaft where Bearing Adjusting Nuts screw on if using old shaft, make sure that Shaft and Nut Threads are in good shape and compatible. DO NOT use old parts if the fit of them is not correct.

Spindle Locks Up: (Seizes and will not turn)

CAUSE: **Low Oil Level in Spindle?** (Causing it to Over Heat)
SOLUTION: This will damage almost all parts in Spindle Assembly, the only way to find out is to completely dis-assemble the spindle. Repair and / or Replace as required.

CAUSE: **Excessive Bearing Pre-load?** (Bearings to Tight)
SOLUTION: Bearing needs to be removed and inspected for damage from running too tight. Rebuild Spindle replacing Parts as required, Always replace with new Seal. Set Bearing Pre-Load and Lock Adjusting and Locking Nut down as instructed in Spindle repair section to correct Specifications, always double check to make sure Nuts are locked in place.

CAUSE: **Bolts Holding Blade Bar to Spindle replaced and New Bolts to Long?**
SOLUTION: Check that Blade Bar Retaining Bolts are not too long to cause them to bottom out and jam through Spindle damaging Shaft. Always make sure same Length Bolts are installed that came out. If to long of Bolts have been installed in Spindle, it will have to be rebuilt.

CAUSE: **Seal Protector Damaged?** (Component Bent), The Seal Protector, there has been two types, Old Type was a Cup type that slid up on to bottom of Shaft. This type usually would not stop the Spindle from spinning while running if it got bent, but it could prevent the spindle from starting. The New Type is a Steel Wing that is welded to Blade Bar, it is thicker than old type but it can get bent.
SOLUTION: Check Seal protector type and if damaged repair or replace as required Seal protector can be straighten if damage will allow, as long as it does not hit Housing and protect Seal it will be OK.

Starter on Tractor Will Not Crank:

Note: Most of the problems that will cause the Tractor not to fail to crank will be found in the Tractor, However there are some causes that involve the Mower. Only those problems that are caused by the Mower are covered here, and only mower models that have electrical systems that are tied in with Tractor Electrical system could affect Tractor Starting Circuit.

CAUSE: **Mower "ON" / "OFF" Switch Engaged?**
SOLUTION: Move Mower Switch to the "Off" Position and retry Tractor Starter System. Tractor is not supposed to start when Mower Switch is on, This is a safety feature and is not to be bypassed. When Mower Switch is "Off" the System is internally bypassed to allow the Tractor to Start. Therefore if Switch is "Off" and Starter circuit is not complete through switch, Check Wiring and Switch. Repair or Replace as needed.

Starter on Tractor Will Not Crank: (Continued)

CAUSE: **Mower "ON" / "OFF" Switch or Wiring Malfunction?**

SOLUTION: CAUTION, MAKE SURE TRACTOR IS IN NEUTRAL WITH PARKING BRAKE SET! MAKE SURE ENGINE IS DISABLED TO SO THAT IT WILL NOT SUDDENLY START SHOULD IT START CRANKING, ALSO MAKE SURE EVERYONE AROUND YOU KNOWS THAT THE TRACTOR ENGINE MAY SUDDENLY START CRANKING! THIS BECAUSE WHEN DEALING WITH A SHORT OR LOOSE CONNECTION YOU MAY MOVE IT AND MAKE IT START TO OPERATE!

Check for Voltage at Starter Solenoid when Starter Switch is engaged. If Voltage is not present make Sure Mower Switch is "Off" and recheck for Voltage at Starter Solenoid. If still no Voltage check through circuit till voltage is found (checking must be done with Starter Switch engaged). The faulty component is most likely immediately down stream of the point of voltage. Repair or Replace as needed and retest system. DO NOT BYPASS MOWER SWITCH SAFETY FEATURE!

Tractor Battery Dead or Low:

Note: Most of the problems that will cause the Tractor Battery to fail drain power will be found in the Tractor, However there is a cause that involves the Mower. Only the problem that could be caused by the Mower is covered here, and only mower models that have electrical systems that are tied in with Tractor Electrical system could affect Tractor Battery Circuit.

CAUSE: **"ON" / "OFF" Switch or Joystick Wired Incorrectly?**

SOLUTION: Power Wire from Tractor to Mower control system must be wired through the Tractor Ignition (Key) Switch to where it only has current when Tractor (Key) Ignition Switch is "ON". If the Mower Power Source is connected where it has Power (Constant Power) when Tractor Ignition (Key) Switch is "OFF" it will put a constant Drain on Battery. This is the only one problem that should be able to affect Tractor Battery from Mower Electrical System. Check where Wiring is connected, Correct as required, See Operators, Parts or Repair Manuals for Wiring Schematics.

NOTES

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