



SERVICE & MAINTENANCE

Model 26MRT

3120892

April 11, 2000



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SECTION A. INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

A.A GENERAL

This section contains the general safety precautions which must be observed during maintenance of the aerial platform. It is of utmost importance that maintenance personnel pay strict attention to these warnings and precautions to avoid possible injury to themselves or others, or damage to the equipment. A maintenance program must be followed to ensure that the machine is safe to operate.

⚠ WARNING

MODIFICATION OF THE MACHINE WITHOUT CERTIFICATION BY A RESPONSIBLE AUTHORITY THAT THE MACHINE IS AT LEAST AS SAFE AS ORIGINALLY MANUFACTURED, IS A SAFETY VIOLATION.

The specific precautions to be observed during maintenance are inserted at the appropriate point in the manual. These precautions are, for the most part, those that apply when servicing hydraulic and larger machine component parts.

Your safety, and that of others, is the first consideration when engaging in the maintenance of equipment. Always be conscious of weight. Never attempt to move heavy parts without the aid of a mechanical device. Do not allow heavy objects to rest in an unstable position. When raising a portion of the equipment, ensure that adequate support is provided.

⚠ WARNING

SINCE THE MACHINE MANUFACTURER HAS NO DIRECT CONTROL OVER THE FIELD INSPECTION AND MAINTENANCE, SAFETY IN THIS AREA RESPONSIBILITY OF THE OWNER/OPERATOR.

A.B HYDRAULIC SYSTEM SAFETY

It should be noted that the machines hydraulic systems operate at extremely high potentially dangerous pressures. Every effort should be made to relieve any system pressure prior to disconnecting or removing any portion of the system.

Relieve system pressure by cycling the applicable control several times with the engine stopped and ignition on, to direct any line pressure back into the reservoir. Pressure feed lines to system components can then be disconnected with minimal fluid loss.

A.C MAINTENANCE

⚠ WARNING

FAILURE TO COMPLY WITH SAFETY PRECAUTIONS LISTED IN THIS SECTION MAY RESULT IN MACHINE DAMAGE, PERSONNEL INJURY OR DEATH AND IS A SAFETY VIOLATION.

- NO SMOKING IS MANDATORY. NEVER REFUEL DURING ELECTRICAL STORMS. ENSURE THAT FUEL CAP IS CLOSED AND SECURE AT ALL OTHER TIMES.
- REMOVE ALL RINGS, WATCHES AND JEWELRY WHEN PERFORMING ANY MAINTENANCE.
- DO NOT WEAR LONG HAIR UNRESTRAINED, OR LOOSE-FITTING CLOTHING AND NECKTIES WHICH ARE APT TO BECOME CAUGHT ON OR ENTANGLED IN EQUIPMENT.
- OBSERVE AND OBEY ALL WARNINGS AND CAUTIONS ON MACHINE AND IN SERVICE MANUAL.
- KEEP OIL, GREASE, WATER, ETC. WIPED FROM STANDING SURFACES AND HAND HOLDS.
- USE CAUTION WHEN CHECKING A HOT, PRESSURIZED COOLANT SYSTEM.
- NEVER WORK UNDER AN ELEVATED BOOM UNTIL BOOM HAS BEEN SAFELY RESTRAINED FROM ANY MOVEMENT BY BLOCKING OR OVERHEAD SLING, OR BOOM SAFETY PROP HAS BEEN ENGAGED.
- BEFORE MAKING ADJUSTMENTS, LUBRICATING OR PERFORMING ANY OTHER MAINTENANCE, SHUT OFF ALL POWER CONTROLS.
- BATTERY SHOULD ALWAYS BE DISCONNECTED DURING REPLACEMENT OF ELECTRICAL COMPONENTS.
- KEEP ALL SUPPORT EQUIPMENT AND ATTACHMENTS STOWED IN THEIR PROPER PLACE.
- USE ONLY APPROVED, NONFLAMMABLE CLEANING SOLVENTS.

REVISION LOG

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SECTION 1. SPECIFICATIONS

1.1 CAPACITIES

Hydraulic Oil Tank

56.8 liters (15.0 gallons)

Hydraulic System (Including Tank)

Approximately 68.1 liters (18.0 gallons)

Fuel Tank

29.5 liters (7.8 gallons)

Drive Axle

6.4 liters (3 pints)

1.2 COMPONENT DATA

Engine

Daihatsu Gasoline/LP

3 cylinder, liquid-cooled

21 horsepower @ 3,000 rpm

Idle - 1,500 rpm

Mid Engine - 2,000 rpm

High Engine - 3,000 rpm

Alternator - 14 Amp

Cooling System Capacity

Engine - 1.8 liters (1.9 quarts)

Crankcase Capacity - 3.0 liters (3.2 quarts)

Yanmar Diesel

3 cylinder, liquid-cooled

22 horsepower @ 3,000 rpm

Idle - 1,200 rpm

Mid Engine - 2,000 rpm

High Engine - 3,000 rpm

Alternator - 40 Amp

Cooling System Capacity

0.9 liters (1.0 quarts) - engine

Crankcase Capacity - 2.4 liters (2.5 quarts)

Drive Pump

Closed loop piston type

Output - 56.8 lpm (15 gpm) @ 3,000 rpm

Displacement - 19.0 cm³/rev. (1.16 in.³/rev.)

Lift/Steer Pump

Gear type

Output - 11.7 lpm (3.1 gpm) @ 3,000 rpm.

Displacement - 4.0 cm³/rev. (0.24 in.³/rev.).

Steer/Drive System

Steer (Front) Tires - Dico Multi-Trac C/S 26 x 12.00 - 12 NHS; 6 ply; inflate to 2.8 bar (40 psi).

Toe-In - Adjust to 6.4 mm (.25 in) overall.

Drive (Rear) Tires - Dico Tru-Power TL 26 x 12.00 - 12 NHS; 6 ply; inflate to 2.8 bar (40 psi).

Drive Brake - Mico hydraulic multi-disc.

Drive Motor - Eaton 2000 Series; 131 cm³/rev. (8.0 in.³/rev.).

Drive Axle - Dana Model 44 rigid semi-float, no spin axle assembly; 5.89 ratio; oil capacity - 1.4 liters (3 pints).

Hydraulic Filter - Inline

Return - Bypass Type

10 Microns Nominal

Platform Size

Standard - 1.4 m x 2.2 m (54 in. x 88 in.)

1.3 PERFORMANCE DATA

Travel Speed

Maximum Speed - 7.2 kmh (4.5 mph)

Elevated Speed - 1.1 kmh (0.7 mph)

Gradeability

35%

Turning Radius

Inside - 2.5 m (8 ft. 1 in.)

Outside - 4.7 m (15 ft. 4 in.)

SECTION 1 - SPECIFICATIONS

Lift

Up - 34-42 seconds

Down - 31-39 seconds

Platform Capacity

Standard - 455 kg (1,000 lb.)

Manual Platform Extension Capacity

115 kg (250 lb.)

Machine Weight

Approximately 2359 kg (5,200 lb.)

Wheelbase

2.0 m (78.0 in.)

Machine Height (Platform Fully Elevated)

7.9 m (26 ft.)

Machine Height (Platform Lowered)

2.3 m (89.0 in.)

Platform Railing Height

1.0 m (39.5 in.)

Machine Length

2.7 m (105.0 in.)

Machine Width

1.8 m (69.0 in.)

Ground Clearance

14.0 cm (5.5 in.)

Maximum Tire Load

921 kg (2,030 lb.) @ 1.3 bar (19 psi)

1.5 LUBRICATION

Hydraulic Oil

Table 1-1. Hydraulic Oil

HYDRAULIC SYSTEM OPERATING TEMPERATURE RANGE	SAE VISCOSITY GRADE
0 to +23 degrees F (-18 to -5 degrees C)	10W
0 to +210 degrees F (-18 to +100 degrees C)	10W-20, 10W-30
+50 to +210 degrees F (+10 to +100 degrees C)	20W-20

NOTE: Hydraulic oils must have anti-wear qualities at least to API Service Classification GL-3, and sufficient chemical stability for mobile hydraulic system service. JLG Industries recommends Mobilfluid 424 hydraulic oil, which has an SAE viscosity of 10W-30 and a viscosity index of 152.

Aside from JLG recommendations, it is not advisable to mix oils of different brands or types, as they may not contain the same required additives or be of comparable viscosities. If use of hydraulic oil other than Mobilfluid 424 is desired, contact JLG Industries for proper recommendations.

1.4 TORQUE REQUIREMENTS

All wheel lug nuts should be torqued to 122 Nm (90 ft lb) every 150 hours.

NOTE: When maintenance becomes necessary or a fastener has loosened, refer to the Torque Chart in this section to determine proper torque value.

Lubrication Specifications

1.6 CYLINDER SPECIFICATIONS

Table 1-2. Lubrication Specifications

KEY	SPECIFICATIONS
MPG	Multipurpose Grease having a minimum dripping point of 350 degrees F. Excellent water resistance and adhesive qualities, and being of extreme pressure type. (Timken OK 40 pounds minimum.)
EPGL	Extreme Pressure Gear Lube (oil) meeting API service classification GL-5 or MIL-Spec MIL-L-2105.
EO	Engine (crankcase) Oil. Gas - API SF/SG class, MIL-L-2104. Diesel - API CC/CD class, MIL-L-2104B/MIL-L-2104C.
HO	Hydraulic Oil. API service classification GL-3, e.g. Mobil 424.

NOTE: All dimensions are given in inches (in), with the metric equivalent, centimeters (cm), given in parentheses.

Table 1-3. Cylinder Specifications

Description	Bore	Stroke	Rod Dia.
Lift Cylinder	4.00 (10.2)	39.75 (101.0)	2.50 (6.4)
Steer Cylinder (DoubleRod)	2.00 (5.1)	2.69 (6.83)	1.25 (3.18)

1.7 PRESSURE SETTINGS

Main Relief - 145 bar (2100 psi)

Steer Relief - 103 bar (1500 psi)

Lift Up Relief - 145 bar (2100 psi)

Lift Down Relief - 62 bar (900 psi)

1.8 SERIAL NUMBER LOCATIONS

For machine identification, a serial number plate is affixed to the machine. The plate is located on the rear center of the machine frame, just below the middle step of the ladder. In addition, if the serial number plate is damaged or missing, the machine serial number is stamped on the right front frame rail, adjacent to the sizzor arms.

1.9 LIMIT SWITCHES

The machine is equipped with the following limit switches:

Tilt Alarm (Optional) - 5° - Illuminates a light on the platform and sounds an alarm when the machine is 5° out of level in any direction.

High Drive Cut-Out - High drive speed is cut out when the platform is raised above the stowed position.

1.10 MAJOR COMPONENT WEIGHTS

Table 1-4. Major Component Weights

Component	lb	kg
Platform	382	173
Manual Platform Extension	221	100
Arm Assembly (Includes Lift Cylinder)	1618	734
Chassis - w/Standard Tires	2979	1351

1.11 CRITICAL STABILITY WEIGHTS

⚠ WARNING

DO NOT REPLACE ITEMS CRITICAL TO STABILITY, SUCH AS ENGINES, AXLES OR TIRES, WITH ITEMS OF DIFFERENT WEIGHT OR SPECIFICATION. DO NOT MODIFY UNIT IN ANY WAY TO AFFECT STABILITY.

Table 1-5. Critical Stability Weights

Component	lb	kg
Tire and Wheel Assembly - Std (each)	50	23
Daihatsu Gasoline/LP Engine	132	60
Yanmar Diesel Engine	183	81
Dana Drive Axle	130	59

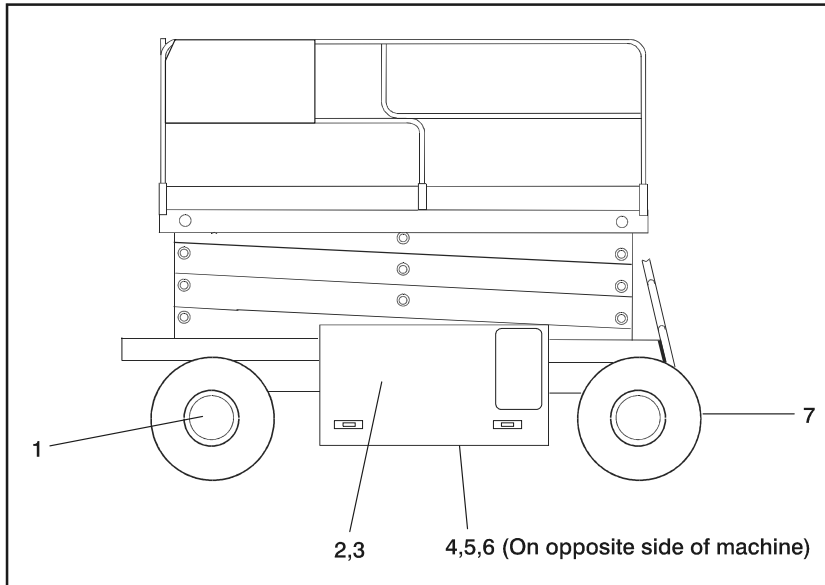


Figure 1-1. Lubrication Diagram

Table 1-6. Lubrication Chart

INDEX NO	COMPONENT	NUMBER/TYPE LUBE POINTS	LUBE METHODS	INTERVAL HOURS
1	Wheel Bearings	2- Front Wheels	MPG - repack	1200
2	Hydraulic Oil	Fill Cap/Drain Plug	HO - Check HO Level HO - Change HO	Daily/1200
3	Hydraulic Return Filter	N/A	N/A	50/300
4	Charge Pump Filter	N/A	N/A	50/300
5	Crankcase - Vanguard Gasoline/LP Engine	FillCap/Drain Plug	EO - Check EO Level EO - Change EO	Daily/50/300
6	Crankcase - Yanmar Diesel Engine	FillCap/Drain Plug	EO - Check EO Level EO - Change EO	Daily/50/300
7	Rear Axle	FillCap/Drain Plug	EPGL - Check EPGL Level EPGL - Change EPGL	150/1200

KEY TO LUBRICANTS:

EO - Engine Oil

EPGL - Extreme Pressure Gear Lubricant

HO - Hydraulic Oil - Mobilfluid 424

MPG - Multi-purpose Grease

WARNING

TO AVOID PERSONAL INJURY, USE SAFETY PROP FOR ALL MAINTENANCE REQUIREING PLATFORM TO BE ELEVATED.

NOTE:

1. Be sure to lubricate like items on each side.
2. Recommended lubricating intervals are based on machine operations under normal conditions. For machines used in multi-shift operations and/or exposed to hostile environments or conditions, lubrication frequencies must be increased accordingly.
3. Operate hydraulic functions through one complete cycle before checking hydraulic oil level in tank. Oil should be visible in ADD sight window on hydraulic tank. If oil is not visible, add oil until oil is visible in both ADD and FULL sight windows on tank. Do not overfill tank.

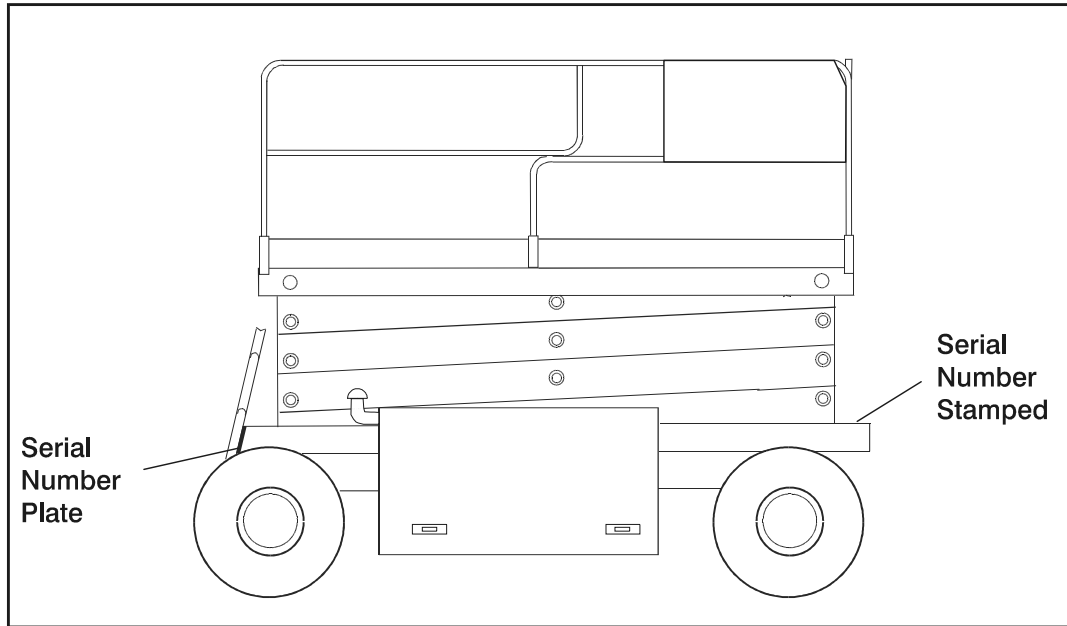


Figure 1-2. Serial Number Locations

SECTION 1 - SPECIFICATIONS

SIZE	THD	BOLT DIA. (CM)	THREAD STRESS AREA (SQ. CM)	VALUES FOR ZINC PLATED BOLTS ONLY										UNPLATED CAP SCREWS	
				SAE GRADE 5 BOLTS & GRADE 2 NUTS					SAE GRADE 8 BOLTS & GRADE 8 NUTS					UNBRANO 1960 SERIES SOCKET HEAD CAP SCREW WITH LOC-WEL PATCH	
				CLAMP LOAD (KG)	(DRY OR LOC. 263) NM	(LUB.) NM	(LOCTITE 262) NM	(LOCTITE 242 OR 271) NM	CLAMP LOAD (KG)	(DRY OR LOC. 263) NM	(LUB.) NM	(LOCTITE 262) NM	(LOCTITE 242 OR 271) NM	CLAMP LOAD (KG)	TORQUE (as received) NM
4	40	0.2845	0.0153	172	1	1	1	1	1	1	245	2	1	—	—
48	48	0.2845	0.0168	191	1	1	1	1	1	1	272	2	1	—	—
6	32	0.3505	0.0232	263	2	2	2	2	2	2	372	3	2	—	—
6	40	0.3505	0.0258	277	2	2	2	2	2	2	417	3	2	—	—
8	32	0.4166	0.0356	408	4	3	3	3	3	3	572	5	4	—	—
8	36	0.4166	0.0374	426	4	3	3	3	3	3	599	5	4	—	—
10	24	0.4826	0.0445	508	5	4	4	4	4	4	717	7	5	—	—
10	32	0.4826	0.0508	583	6	4	4	4	4	4	817	8	6	—	—
1/4	20	0.6350	0.0808	916	11	9	9	9	9	9	1297	16	12	18	1442
1/4	28	0.6350	0.0925	1052	14	10	10	10	10	10	1488	19	14	21	1651
5/16	18	0.7938	0.1331	1515	23	18	22	26	29	26	2141	34	25	30	41
5/16	24	0.7938	0.1473	1678	26	19	23	29	29	26	2821	34	27	34	41
3/8	16	0.9525	0.1969	2241	41	31	38	48	48	48	3175	61	48	54	68
3/8	24	0.9525	0.2230	2540	48	34	43	54	54	54	3583	68	48	61	75
7/16	14	1.1112	0.2700	3085	68	48	61	75	75	75	4332	95	75	85	109
7/16	20	1.1112	0.3015	3425	75	68	68	81	81	81	4854	109	81	95	122
1/2	13	1.2700	0.3604	4105	102	75	92	115	115	115	5783	149	109	130	163
1/2	20	1.2700	0.4061	4854	122	88	108	136	136	136	6532	163	122	146	183
9/16	12	1.4288	0.4623	5262	149	109	133	163	163	163	7539	204	149	188	224
9/16	18	1.4288	0.5156	5874	163	122	148	183	183	183	8278	231	176	209	258
5/8	11	1.5875	0.5740	6532	204	149	183	224	224	224	9231	298	231	244	326
5/8	18	1.5875	0.6502	7394	231	176	207	258	258	258	10433	326	244	277	359
3/4	10	1.9050	0.8484	9662	353	271	325	387	387	387	13663	515	380	408	570
3/4	16	1.9050	0.9474	10796	407	298	363	448	448	448	15241	570	434	456	631
7/8	9	2.2225	1.1735	13336	583	434	523	644	644	644	18870	814	624	658	895
7/8	14	2.2225	1.2929	14697	637	475	576	705	705	705	20775	895	678	724	983
1	8	2.5400	1.5392	17509	868	651	785	915	915	915	23360	1220	922	931	1342
1	12	2.5400	1.6840	19142	949	719	858	997	997	997	27080	1356	1003	1079	1492
1-1/8	7	2.8575	1.9380	19187	1085	814	968	1139	1139	1139	31162	1736	1302	1396	1898
1-1/8	12	2.8575	2.1742	21546	1193	895	1087	1254	1254	1254	34927	1953	1464	1566	2136
1-1/4	7	3.1750	2.4613	24404	1519	1139	1368	1593	1593	1593	38554	2468	1844	1970	2712
1-1/4	12	3.1750	2.7254	27035	1681	1247	1516	1762	1762	1762	43818	2712	2034	2183	2983
1-1/2	6	3.4925	2.9337	29076	1980	1492	1792	2068	2068	2068	47174	3227	2413	2586	3559
1-1/2	12	3.4925	3.3401	33113	2278	1708	2042	2373	2373	2373	53570	3688	2766	2935	4068
1-1/2	6	3.8100	3.5687	35381	2630	1980	2379	2746	2746	2746	57380	4284	3200	3430	4712
1-1/2	12	3.8100	4.0132	39781	2983	2224	2676	3118	3118	3118	142200	4827	3607	3856	5322
															71669
															4433

Note: These torque values do not apply to cadmium plated fasteners.



SAE GRADE 5



SAE GRADE 8

Figure 1-3. Torque Chart

SECTION 2. PROCEDURES

2.1 GENERAL

This section provides information necessary to perform maintenance on the scissor lift. Descriptions, techniques and specific procedures are designed to provide the safest and most efficient maintenance for use by personnel responsible for ensuring the correct installation and operation of machine components and systems.

⚠ CAUTION

WHEN AN ABNORMAL CONDITION IS NOTED AND PROCEDURES CONTAINED HEREIN DO NOT SPECIFICALLY RELATE TO THE NOTED IRREGULARITY, WORK SHOULD BE STOPPED AND TECHNICALLY QUALIFIED GUIDANCE OBTAINED BEFORE WORK IS RESUMED.

The maintenance procedures included consist of servicing and component removal and installation, disassembly and assembly, inspection, lubrication and cleaning. Information on any special tools or test equipment is also provided where applicable.

2.2 SERVICING AND MAINTENANCE GUIDELINES

General

The following information is provided to assist you in the use and application of servicing and maintenance procedures contained in this chapter.

Safety and Workmanship

Your safety, and that of others, is the first consideration when engaging in the maintenance of equipment. Always be conscious of weight. Never attempt to move heavy parts without the aid of a mechanical device. Do not allow heavy objects to rest in an unstable position. When raising a portion of the equipment, ensure that adequate support is provided.

Cleanliness

1. The most important single item in preserving the long service life of a machine is to keep dirt and foreign materials out of the vital components. Precautions have been taken to safeguard against this. Shields, covers, seals, and filters are provided to keep air, fuel, and oil supplies clean; however, these items must be maintained on a scheduled basis in order to function properly.
2. At any time when air, fuel, or oil lines are disconnected, clear adjacent areas as well as the openings

and fittings themselves. As soon as a line or component is disconnected, cap or cover all openings to prevent entry of foreign matter.

3. Clean and inspect all parts during servicing or maintenance, and assure that all passages and openings are unobstructed. Cover all parts to keep them clean. Be sure all parts are clean before they are installed. New parts should remain in their containers until they are ready to be used.

Components Removal and Installation

4. Use adjustable lifting devices, whenever possible, if mechanical assistance is required. All slings (chains, cables, etc.) should be parallel to each other and as near perpendicular as possible to top of part being lifted.
5. Should it be necessary to remove a component on an angle, keep in mind that the capacity of an eyebolt or similar bracket lessens, as the angle between the supporting structure and the component becomes less than 90°.
6. If a part resists removal, check to see whether all nuts, bolts, cables, brackets, wiring, etc., have been removed and that no adjacent parts are interfering.

Component Disassembly and Reassembly

When disassembling or reassembling a component, complete the procedural steps in sequence. Do not partially disassemble or assemble one part, then start on another. Always recheck your work to assure that nothing has been overlooked. Do not make any adjustments, other than those recommended, without obtaining proper approval.

Pressure-Fit Parts

When assembling pressure-fit parts, use an "anti-seize" or molybdenum disulfide base compound to lubricate the mating surface.

Bearings

1. When a bearing is removed, cover it to keep out dirt and abrasives. Clean bearings in nonflammable cleaning solvent and allow to drip dry. Compressed air can be used but do not spin the bearing.
2. Discard bearings if the races and balls (or rollers) are pitted, scored, or burned.
3. If a bearing is found to be serviceable, apply a light coat of oil and wrap it in clean (waxed) paper. Do not unwrap reusable or new bearings until they are ready to install.

4. Lubricate new or used serviceable bearings before installation. When pressing a bearing into a retainer or bore, apply pressure to the outer race. If the bearing is to be installed on a shaft, apply pressure to the inner race.

Gaskets

Check that holes in gaskets align with openings in the mating parts. If it becomes necessary to hand-fabricate a gasket, use gasket material or stock of equivalent material and thickness. Be sure to cut holes in the right location, as blank gaskets can cause serious system damage.

Bolt Usage and Torque Application

1. Use bolts of proper length. A bolt which is too long will bottom before the head is tight against its related part. If a bolt is too short, there will not be enough thread area to engage and hold the part properly. When replacing bolts, use only those having the same specifications of the original, or one which is equivalent.
2. Unless specific torque requirements are given within the text, standard torque values should be used on heat-treated bolts, studs, and steel nuts, in accordance with recommended shop practices.

Hydraulic Lines and Electrical Wiring

Clearly mark or tag hydraulic lines and electrical wiring, as well as their receptacles, when disconnecting or removing them from the unit. This will assure that they are correctly reinstalled.

Hydraulic System

1. Keep the system clean. If evidence of metal or rubber particles is found in the hydraulic system, drain and flush the entire system.
2. Disassemble and reassemble parts on clean work surface. Clean all metal parts with non-flammable cleaning solvent. Lubricate components, as required, to aid assembly.

Lubrication

Service applicable components with the amount, type, and grade of lubricant recommended in this manual, at the specified intervals. When recommended lubricants are not available, consult your local supplier for an equivalent that meets or exceeds the specifications listed.

Batteries

Clean batteries, using a non-metallic brush and a solution of baking soda and water. Rinse with clean water. After cleaning, thoroughly dry batteries and coat terminals with an anti-corrosion compound.

Lubrication and Servicing

Components and assemblies requiring lubrication and servicing are shown in Section 1.

2.3 LUBRICATION INFORMATION

Hydraulic System

1. The primary enemy of a hydraulic system is contamination. Contaminants enter the system by various means, e.g., using inadequate hydraulic oil, allowing moisture, grease, filings, sealing components, sand, etc., to enter when performing maintenance, or by permitting the pump to cavitate due to insufficient system warm-up or leaks in the pump supply (suction) lines.
2. The design and manufacturing tolerances of the component working parts are very close, therefore, even the smallest amount of dirt or foreign matter entering a system can cause wear or damage to the components and generally results in faulty operation. Every precaution must be taken to keep hydraulic oil clean, including reserve oil in storage. Hydraulic system filters should be checked, cleaned, and/or replaced as necessary, at the specified intervals required in the Lubrication Chart in Section 1 and the Preventive Maintenance and Inspection Chart in this section. Always examine filters for evidence of metal particles.
3. Cloudy oils indicate a high moisture content which permits organic growth, resulting in oxidation or corrosion. If this condition occurs, the system must be drained, flushed, and refilled with clean oil.
4. It is not advisable to mix oils of different brands or types, except as recommended, as they may not contain the same required additives or be of comparable viscosities. Good grade mineral oils, with viscosities suited to the ambient temperatures in which the machine is operating, are recommended for use.

NOTE: *Metal particles may appear in the oil or filters of new machines due to the wear-in of meshing components.*

Hydraulic Oil

1. Refer to Section 1 for recommendations for viscosity ranges.
2. JLG recommends Mobilfluid 424, which has an SAE viscosity of 10W-30 and a viscosity index of 152.

NOTE: Start-up of hydraulic system with oil temperatures below -26°C (-15°F) is not recommended. If it is necessary to start the system in a sub-zero environment, it will be necessary to heat the oil with a low density, 100VAC heater to a minimum temperature of -26°C (-15°F).

3. The only exception to the above is to drain and fill the system with Mobil DTE 11 oil or its equivalent. This will allow start up at temperatures down to -29°C (-20°F). However, use of this oil will give poor performance at temperatures above 49°C (120°F). Systems using DTE 11 oil should not be operated at temperatures above 94°C (200°F) under any condition.

Changing Hydraulic Oil

1. Use of any of the recommended crankcase or hydraulic oils eliminates the need for changing the oil on a regular basis. However, filter elements must be changed after the first 50 hours of operation and every 300 hours thereafter. If it is necessary to change the oil, use only those oils meeting or exceeding the specifications appearing in this manual. If unable to obtain the same type of oil supplied with the machine, consult local supplier for assistance in selecting the proper equivalent. Avoid mixing petroleum and synthetic base oils. JLG Industries recommends changing the hydraulic oil every two years.
2. Use every precaution to keep the hydraulic oil clean. If the oil must be poured from the original container into another, be sure to clean all possible contaminants from the service container. Always clean the mesh element of the filter and replace the cartridge any time the system oil is changed.
3. While the unit is shut down, a good preventive maintenance measure is to make a thorough inspection of all hydraulic components, lines, fittings, etc., as well as a functional check of each system, before placing the machine back in service.

Lubrication Specifications

Specified lubricants, as recommended by the component manufacturers, are always the best choice, however, multi-purpose greases usually have the qualities which meet a variety of single purpose grease requirements. Should any question arise regarding the use of greases in maintenance stock, consult your local supplier for evaluation.

2.4 CYLINDERS - THEORY OF OPERATION

Cylinders are of the double acting type. The Lift and Steer systems incorporate double acting cylinders. A double

acting cylinder is one that requires oil flow to operate the cylinder rod in both directions. Directing oil (by actuating the corresponding control valve to the piston side of the cylinder) forces the piston to travel toward the rod end of the barrel, extending the cylinder rod (piston attached to rod). When the oil flow is stopped, movement of the rod will stop. By directing oil to the rod side of the cylinder, the piston will be forced in the opposite direction and the cylinder rod will retract.

A holding valve is used in the Lift circuit to prevent retraction of the cylinder rod should a hydraulic line rupture or a leak develop between the cylinder and its related control valve.

2.5 VALVES - THEORY OF OPERATION

Solenoid Control Valves (Bang-Bang)

Control valves used are four-way three-position solenoid valves of the sliding spool design. When a circuit is activated and the control valve solenoid energizes, the spool is shifted and the corresponding work port opens to permit oil flow to the component in the selected circuit, with the opposite work port opening to reservoir. Once the circuit is deactivated (control returned to neutral), the valve spool returns to neutral (center) and oil flow is then directed through the valve body and returns to reservoir. A typical control valve consists of the valve body, sliding spool, and two solenoid assemblies. The spool is machine fitted in the bore of the valve body. Lands on the spool divide the bore into various chambers, which, when the spool is shifted, align with corresponding ports in the valve body open to common flow. At the same time other ports would be blocked to flow. The spool is spring-loaded to center position, therefore when the control is released, the spool automatically returns to neutral, prohibiting any flow through the circuit.

Proportional Control Valves

The proportional control valves provide a power output matching that required by the load. A small line connected to a load sensing port feeds load pressure back to a sequence valve. The sequence valve senses the difference between the load and pump outlet pressure, and varies the pump displacement to keep the difference constant. This differential pressure is applied across the valve's meter-in spool, with the effect that pump flow is determined by the degree of spool opening, independent of load pressure. Return lines are connected together, simplifying routing of return flow and to help reduce cavitation. Load sensing lines connect through shuttle valves to feed the highest load signal back to the sequence valve. Integral actuator port relief valves, anti-cavitation check valves, and load check valves are standard.

Relief Valves

Main relief valves are installed at various points within the hydraulic system to protect associated systems and components against excessive pressure. Excessive pressure can be developed when a cylinder reaches its limit of travel and the flow of pressurized fluid continues from the system control. The relief valve provides an alternate path for the continuing flow from the pump, thus preventing rupture of the cylinder, hydraulic line or fitting. Complete failure of the system pump is also avoided by relieving circuit pressure. The relief valve is installed in the circuit between the pump outlet (pressure line) and the cylinder of the circuit, generally as an integral part of the system valve bank. Relief pressures are set slightly higher than the load requirement, with the valve diverting excess pump delivery back to the reservoir when operating pressure of the component is reached.

Crossover Relief Valves

Crossover relief valves are used in circuits where the actuator requires an operating pressure lower than that supplied to the system. When the circuit is activated and the required pressure at the actuator is developed, the crossover relief diverts excess pump flow to the reservoir. Individual, integral reliefs are provided for each side of the circuit.

2.6 COMPONENT FUNCTIONAL DESCRIPTION

Hydraulic Pump

The machine is equipped with two hydraulic pumps, a function pump and a drive pump. The function pump is a single-section gear pump that controls the lift and steer functions and provides an output of 11.7 lpm (3.1 gpm). The drive pump is a single-section piston pump that controls the drive function and provides an output of 56.8 lpm (15 gpm).

Lift Cylinder Counterbalance/Manual Descent Valve

The lift cylinder counterbalance/manual descent valve is located on top of the lift cylinder. The counterbalance valve is used to hold the platform in place when raised. A cable is connected to the valve which, when pulled, manually opens the lift down port and allows the platform to be lowered in the event hydraulic power is lost.

2.7 WEAR PADS

Sliding Pads

The original thickness of the sliding pads is 51 mm (2 in). Replace sliding pads when worn to 48 mm (1.875 in).

2.8 CYLINDER CHECKING PROCEDURES

NOTE: *Cylinder checks must be performed any time a cylinder component is replaced or when improper system operation is suspected.*

Cylinder w/o Counterbalance Valves - Steer Cylinder

IMPORTANT

OPERATE FUNCTIONS FROM GROUND CONTROL STATION ONLY.

DO NOT FULLY EXTEND CYLINDER TO END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

1. Using all applicable safety precautions, activate motor and fully extend cylinder to be checked. Shut down motor.
2. Carefully disconnect hydraulic hose from retract port of cylinder. There will be initial weeping of hydraulic fluid which can be caught in a suitable container. After the initial discharge, there should be no further leakage from the retract port.
3. Activate motor and activate cylinder extend function. Check retract port for leakage.
4. If cylinder leakage is 6-8 drops per minute or more, piston seals are defective and must be replaced. If cylinder retract port leakage is less than 6-8 drops per minute, carefully reconnect hose to retract port and retract cylinder.
5. With cylinder fully retracted, shut down motor and carefully disconnect hydraulic hose from cylinder extend port.
6. Activate motor and activate cylinder retract function. Check extend port for leakage.
7. If cylinder leakage is 6-8 drops per minute or more, piston seals are defective and must be replaced. If extend port leakage is less than 6-8 drops per minute, carefully reconnect hose to extend port, then activate cylinder through one complete cycle and check for leaks.

Cylinders w/Single Counterbalance Valves - Lift Cylinder

⚠ IMPORTANT

OPERATE ALL FUNCTIONS FROM GROUND CONTROL STATION ONLY.

1. Using all applicable safety precautions, activate hydraulic system.

⚠ WARNING

WHEN WORKING ON THE LIFT CYLINDER, RAISE THE PLATFORM COMPLETELY AND SUPPORT THE PLATFORM USING A SUITABLE OVERHEAD LIFTING DEVICE.

DO NOT FULLY EXTEND LIFT CYLINDER TO END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Raise platform completely then retract cylinder slightly to avoid trapping pressure. Place a suitable overhead lifting device approximately 1 inch (2.5 cm) below the platform.
3. Shut down hydraulic system and allow machine to sit for 10-15 minutes. Carefully remove hydraulic hoses from cylinder port block.
4. There will be initial weeping of hydraulic fluid, which can be caught in a suitable container. After the initial discharge, there should not be any further leakage from the ports. If leakage continues at a rate of 6-8 drops per minute or more, the counterbalance valve is defective and must be replaced.
5. If no repairs are necessary or when repairs have been made, carefully reconnect hydraulic hoses to the appropriate ports.
6. Remove lifting device from platform, activate hydraulic system and run cylinder through one complete cycle to check for leaks.

2.9 LIFT CYLINDER REMOVAL AND INSTALLATION

Removal

1. Place the machine on a flat and level surface. Start the motor and raise the platform. Shut down the engine and attach a suitable lifting device to the platform.
2. Remove the bolt and locknut securing the cylinder rod attach pin to the upper inner arm assembly. Using a suitable brass drift, drive out the rod end attach pin from the arm assembly.

3. Retract the lift cylinder rod completely.
4. Tag and disconnect the hydraulic lines, then cap the lift cylinder hydraulic lines and ports.
5. Remove the bolt and locknut securing the barrel end attach pin to the lower arm assembly. Using a suitable brass drift, drive out the barrel end attach pin from the arm assembly.
6. Carefully remove the cylinder from the scissor lift and place in a suitable work area.

Installation

1. Install lift cylinder in place using suitable slings, aligning barrel end attach pin mounting holes on lower arm assembly.
2. Using a suitable drift, drive the barrel end attach pin through the mounting holes in the lift cylinder and the lower arm assembly. Secure in place with the bolt and locknut.
3. Remove cylinder port plugs and hydraulic line caps and correctly attach lines to cylinder ports.
4. Extend the cylinder rod until the attach pin hole aligns with those in the upper arm assembly. Using a suitable drift, drive the cylinder rod attach pin through the aligned holes, taking care to align the pin retaining hole with the hole in arm assembly. Secure the pin in place with the bolt and locknut.
5. Lower platform to stowed position and shut down motor. Check hydraulic fluid level and adjust accordingly.

2.10 LIFT CYLINDER REPAIR

Disassembly

⚠ IMPORTANT

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Connect a suitable auxiliary hydraulic power source to the cylinder port block fitting.

⚠ IMPORTANT

DO NOT FULLY EXTEND CYLINDER TO END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if necessary.

SECTION 2 - PROCEDURES

3. If applicable, remove the cartridge-type holding valve and fittings from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

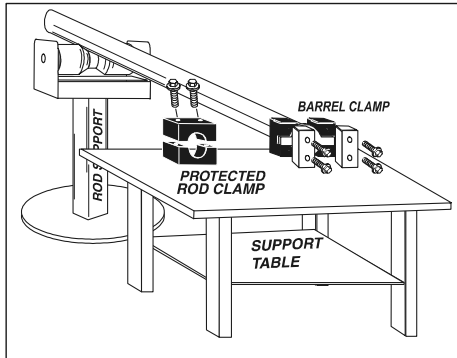


Figure 2-1. Barrel Support

5. To aid in realignment, mark cylinder head and barrel with a center punch. Using an allen wrench, loosen the eight (8) cylinder head retainer cap screws and remove cap screws from cylinder barrel.

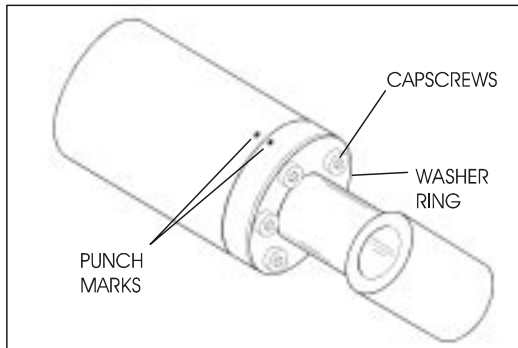


Figure 2-2. Cap Screw Removal

6. If applicable, using a suitable spanner wrench, loosen the spanner nut retainer and remove the spanner nut from the cylinder barrel.
7. Attach a suitable pulling device to the cylinder rod port block or cylinder rod end, as applicable.

⚠ IMPORTANT

EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

8. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

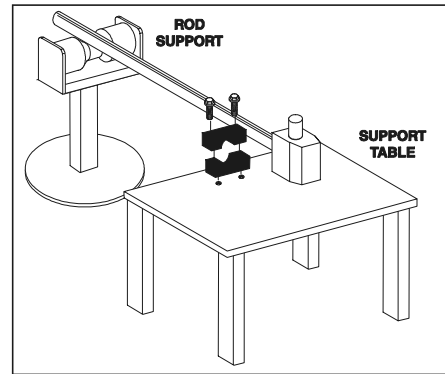


Figure 2-3. Rod Support

9. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
10. If applicable, loosen and remove the nut which attaches the piston to the rod, then remove the piston from the rod.
11. If applicable, loosen and remove the cap screw(s) securing the tapered bushing to the piston.
12. Insert the cap screw(s) in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the cap screw(s) until the bushing is loose on the piston, then remove the bushing from the piston.

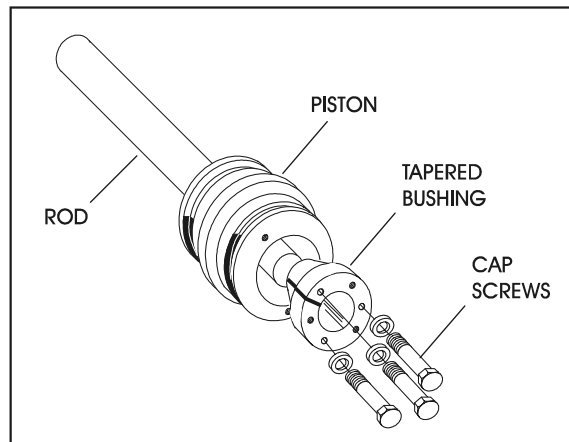


Figure 2-4. Tapered Bushing Removal

13. Screw the piston counter-clockwise, by hand, and remove the piston from the cylinder rod.
14. Remove and discard the piston o-rings, back-up rings, guidelock rings and hydrolock seals.

15. If applicable, remove the piston spacer from the rod.
16. Remove the rod from the holding fixture. Remove the cylinder head and retainer plate from the rod.

Cleaning and Inspection

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
13. If applicable, inspect rod and barrel bearings for signs of correct lubrication and excessive wear. If necessary, replace bearings as follows:
 - a. Thoroughly clean steel bushing hole of burrs, dirt, etc. to facilitate bearing installation.
 - b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod or barrel (as applicable) must be replaced.
 - c. Lubricate inside of steel bushing with WD-40 prior to bearing installation.
 - d. Using arbor of the correct size, carefully press the bearing into the steel bushing.

NOTE: Install the cylinder pin into the Gar-Max bearing dry. Lubrication is not required with chrome pins and bearings.

14. Inspect travel limiting collar or spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
15. If applicable, inspect port block fittings and holding valve. Replace as necessary.
16. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
17. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

Assembly

NOTE: Prior to cylinder assembly, ensure that the proper cylinder seal kit is used.

Apply a light film of hydraulic oil to all components prior to assembly.

1. Using a special tool, pictured in the following illustration, install a new rod seal into the applicable cylinder head gland groove. Refer to the following illustration for the proper tool size.

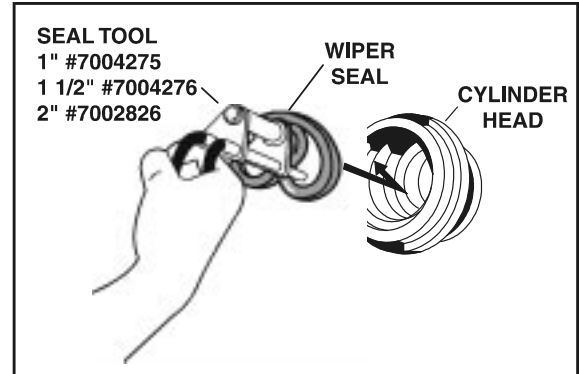


Figure 2-5. Rod Seal Installation

⚠ WARNING

WHEN INSTALLING NEW "POLY-PAK" TYPE PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO FIGURE 2-9., PISTON SEAL KIT FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

SECTION 2 - PROCEDURES

- Using a soft mallet, tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable head gland groove.

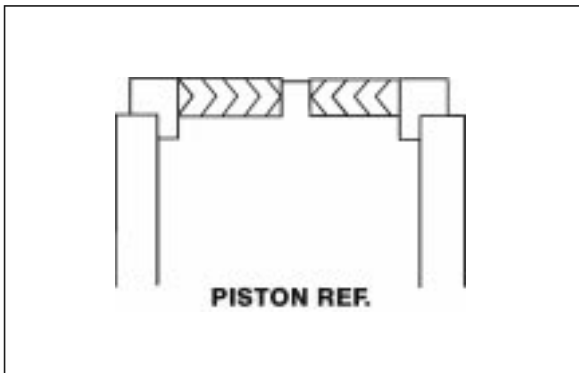


Figure 2-6. Poly-Pak Seal Installation

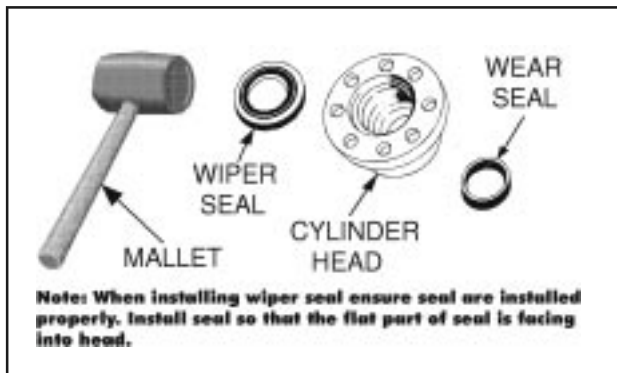


Figure 2-7. Wiper Seal Installation

- Place a new o-ring and back-up seal in the applicable outside diameter groove of the cylinder head as shown in the following illustration.

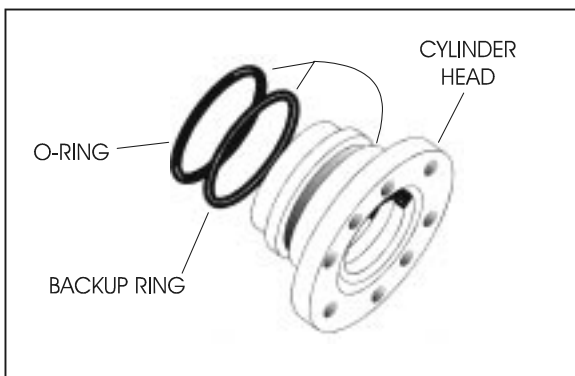


Figure 2-8. Head Seal Kit Installation

- Install a washer ring onto the rod, then carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged.

Push the head along the rod to the rod end, as applicable.

- Carefully slide the piston spacer onto the rod.
- If applicable, correctly place a new o-ring and back-up rings in the inner piston diameter groove.
- Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
- Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and back-up rings are not damaged or dislodged.
- Thread the piston onto the rod until it abuts the spacer end and install the tapered bushing.

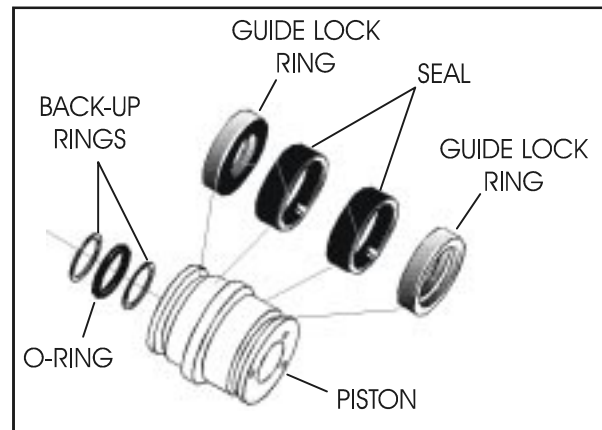


Figure 2-9. Piston Seal Kit

NOTE: When installing the tapered bushing, the piston and mating end of the rod must be free of oil.

CAUTION

WHEN REBUILDING THE LIFT CYLINDER, APPLY LOCTITE #242 TO TAPERED BUSHING BOLTS, THEN TIGHTEN BOLTS SECURELY. REFER TO TABLE 2-1, CYLINDER COMPONENT TORQUE SPECIFICATIONS FOR PROPER BOLT TORQUE VALUES.

10. Install the bolts into the bushing using Loctite #242. Refer to Table 2-1, Cylinder Component Torque Specifications for proper bolt torque values.

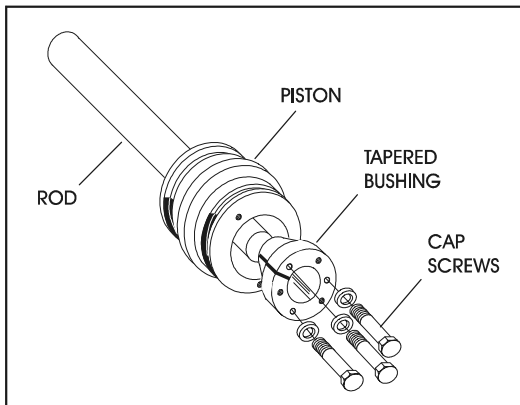


Figure 2-10. Tapered Bushing Installation

11. Remove the cylinder rod from the holding fixture.
12. Place new guidelocks and hydrolock seals in the applicable outside diameter grooves of both the piston and the cylinder head. Refer to Piston Seal Kit Installation illustration.
13. Position the cylinder barrel in a suitable holding fixture.

! IMPORTANT

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

14. With the barrel clamped securely, and while adequately supporting the rod, insert the piston end into the cylinder barrel. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
15. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the cylinder barrel.

16. Secure the cylinder head gland using the washer ring and socket head bolts.

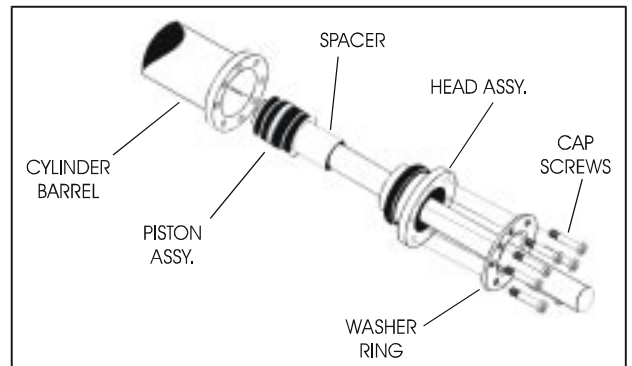


Figure 2-11. Rod Assembly Installation

17. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.
18. If applicable, install the cartridge-type holding valve and fittings in the port block using new o-rings as
19. applicable.

Table 2-1. Cylinder Component Torque Specifications

Componente	Torque Value (w/Loctite)
Tapered Bushing Retaining Screws - Lift Cylinder	80 ft lb (108 Nm)
Head Retaining Screws - Lift Cylinder	9 ft lb (12 Nm)

Table 2-2. Holding Valve Torque Specifications

Description	Torque Value	
Sun - 7/8 hex M20 x 1.5 thds	30 - 35 ft lb	41 - 48 Nm
Sun - 1-1/8 hex 1 - 14 UNS thds	45 - 50 ft lb	61 - 68 Nm
Sun - 1-1/4 hex M36 x 2 thds	150 - 153 ft lb	204 - 207 Nm
Racine - 1-1/8 hex 1-1/16 - 12 thds	50 - 55 ft lb	68 - 75 Nm
Racine - 1-3/8 hex 1-3/16 - 12 thds	75 - 80 ft lb	102 - 109 Nm
Racine - 1-7/8 hex 1-5/8 - 12 thds	100 - 110 ft lb	136 - 149 Nm

2.11 STEER CYLINDER REPAIR

Removal

Before beginning this procedure, ensure that the parking brake is engaged and the rear wheels are chocked.

1. Tag and disconnect the hydraulic lines to the steer cylinder, then cap the steer cylinder hydraulic lines and ports.
2. At each steer spindle, remove the bolt and lock nut securing the steer cylinder to the spindle.
3. When the steer cylinder is disconnected from the steer spindles, turn each wheel by hand to give clearance to remove the steer cylinder from the front axle.

4. Carefully lift the steer cylinder until the cylinder mounting block clears the mounting slot in the bottom of the axle, then slowly remove the cylinder from the axle and place it in a suitable work area.

Disassembly

⚠ IMPORTANT

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Place the cylinder barrel into a suitable holding fixture.
2. Using a suitable chain wrench, carefully remove the cylinder head retainer from one end of the cylinder barrel.
3. Attach a suitable pulling device to one end of the cylinder rod.

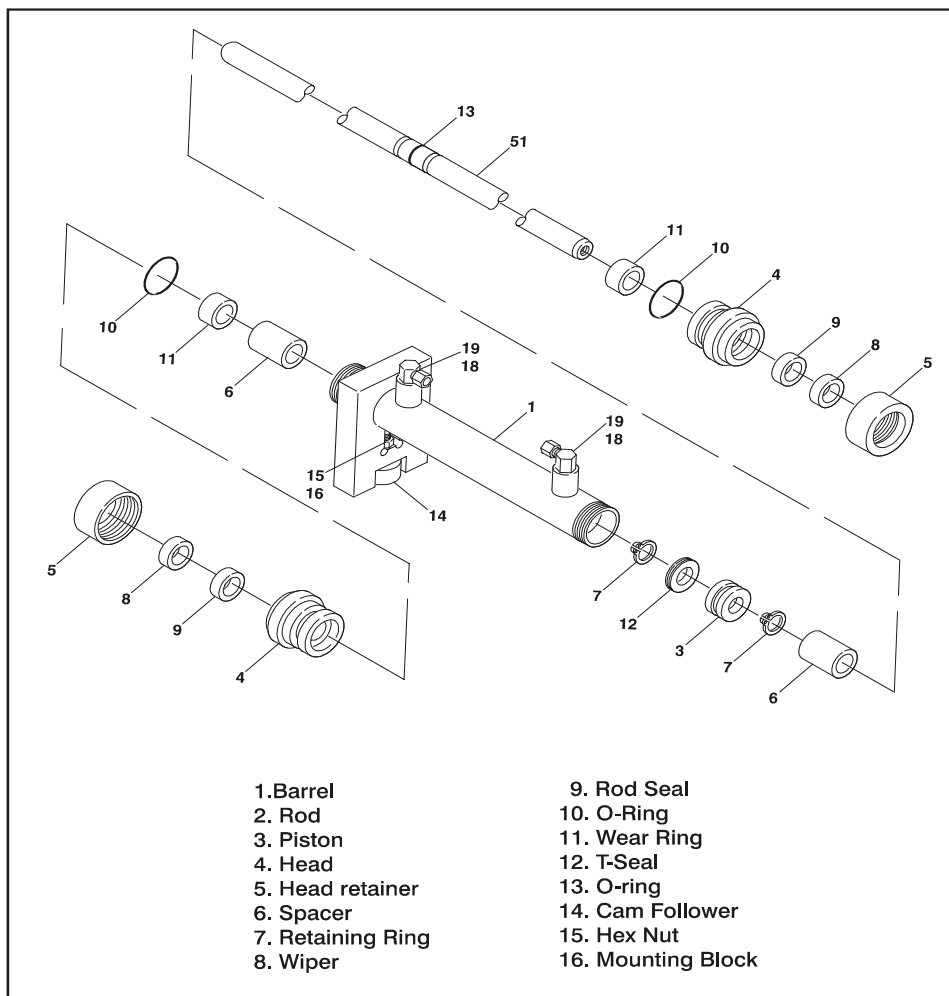


Figure 2-12. Steer Cylinder Assembly

⚠ IMPORTANT

EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, SPACER, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

4. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.
5. Using a suitable chain wrench, carefully remove the remaining cylinder head retainer from the opposite end of the cylinder barrel. Remove the head and remove and discard the wiper, rod seal, O-ring and wear ring.
6. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture.
7. Carefully remove the head from the cylinder rod and remove and discard the wiper, rod seal, o-ring and wear ring.
8. Carefully remove the spacers from the cylinder rod, then remove the retaining rings securing the piston in place on the cylinder rod. Discard the retaining rings.
9. Carefully remove the piston from the cylinder rod. Remove and discard the T-seal and o-ring.
10. Remove the cylinder rod from the holding fixture.

Cleaning and Inspection

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress the rod with Scotch Brite or equivalent. Replace the rod if necessary.
3. Inspect the threaded portion of the rod for excessive damage. Dress the threads as necessary.
4. Inspect the inner surface of the cylinder barrel tube for scoring or other damage. Check the inside diameter for tapering or ovality. Replace the barrel if necessary.
5. Inspect the piston surface for damage, scoring and distortion. Dress the piston surface or replace the piston as necessary.
6. Inspect the seal and o-ring grooves in the piston for burrs and sharp edges. Dress applicable surfaces as necessary.
7. Inspect the inside diameter of the spacers and heads for scoring or other damage and for ovality and tapering. Replace as necessary.

8. Inspect the seal and o-ring grooves in the heads for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect the outside diameter of the spacers and heads for scoring or other damage and ovality and tapering. Replace as necessary.
10. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
11. Inspect the cam follower for wear or damage. Replace as necessary.

Assembly

NOTE: Prior to cylinder assembly, ensure that the proper cylinder seal kit is used.

Apply a light film of hydraulic oil to all components prior to assembly.

1. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture.
2. Place a new o-ring into the cylinder rod piston groove.
3. Place a new T-seal on the piston, then carefully install the piston the cylinder rod, ensuring that the o-ring in the rod groove is not damaged or dislodged. Secure the piston in place with two new retaining rings.
4. Carefully slide the spacers onto the cylinder rod.
5. Place a new wiper, rod seal, o-ring and wear ring on each of the two cylinder heads. Set the heads aside for later installation on the cylinder rod.
6. Remove the cylinder rod assembly from the holding fixture.
7. Position the cylinder barrel in a suitable holding fixture.

⚠ IMPORTANT

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, PISTON AND HEADS. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

8. With the barrel clamped securely, and while adequately supporting the cylinder rod assembly, insert the cylinder rod assembly into the cylinder barrel. Ensure that the piston T-seal and o-ring are not damaged or dislodged.
9. Continue pushing the rod assembly into the cylinder barrel until the cylinder rod is approximately centered in the barrel.

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10. Carefully install one of the cylinder heads on one end of the cylinder rod and push the head onto the rod until it is snug against the end of the cylinder barrel.
11. Install one of the cylinder head retainers on the end of the cylinder barrel and tighten with a suitable chain wrench.
12. Carefully install the remaining cylinder head on the opposite end of the cylinder rod and push the head onto the rod until it is snug against the end of the cylinder barrel.
13. Install the remaining cylinder head retainer on the end of the cylinder barrel and tighten with a suitable chain wrench.

Installation

1. Carefully install the steer cylinder assembly into the front axle. Align the cylinder mounting block on the barrel with the mounting slot in the bottom of the axle and lower the steer cylinder until the mounting block rests in the slot.
2. Turn the steer wheels to line up the mounting holes in the steer spindles and the steer cylinder ends. Secure each end of the steer cylinder with a bolt and lock nut.
3. Reconnect the hydraulic hoses to the applicable cylinder ports.

2.12 TILT ALARM SWITCH ADJUSTMENT (IF EQUIPPED)

NOTE: The machine may be equipped with a tilt alarm switch (sensor), factory set to activate when the machine is out of level in any direction at 5° and will cut out 2 speed drive. Consult factory for tilt sensor adjustment. The only field adjustment necessary is leveling the switch on the spring loaded studs. There are two methods of adjustment, a manual adjustment and an adjustment using a voltmeter.

CAUTION

PERFORM TILT ALARM SWITCH LEVELING PROCEDURE A MINIMUM OF EVERY SIX MONTHS TO ENSURE PROPER OPERATION AND ADJUSTMENT OF SWITCH.

Manual Adjustment

1. Park the machine on a flat, level surface and ensure the machine is level.

NOTE: Ensure switch mounting bracket is level and securely attached.

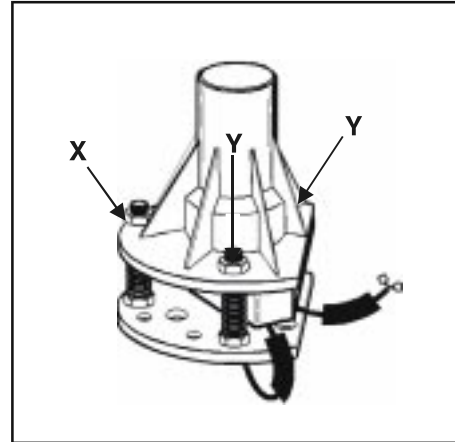


Figure 2-13. Tilt Switch Leveling - Manual Adjustment

2. Level the base of the indicator by tightening the three flange nuts. Tighten each nut through approximately one half of its spring's travel. **DO NOT ADJUST THE "X" NUT DURING THE REMAINDER OF THE PROCEDURE.**
3. With the electrical connections complete, slowly tighten one of the "Y" nuts until the circuit is closed (the light on the Platform Control Console illuminates, the tilt alarm sounds).
4. Slowly back off the nut, counting the number of turns, until the circuit is closed again.
5. Divide the number of turns determined in step 4 in half. Tighten the nut this many turns. The line determined by this nut and the "X" nut is now parallel to the ground.
6. Repeat steps 3 through 5 for the remaining "Y" nut. The switch is now level.
7. Individually push down on one corner at a time; there should be enough travel to cause the switch to trip. If the switch does not trip in all three tests, the flange nuts have been tightened too far. Loosen the "X" nut and repeat steps 3 through 7.

Voltmeter Adjustment

1. Park the machine on a flat, level surface and ensure the machine is level.
2. If the motor is not running, turn the ignition switch to ON

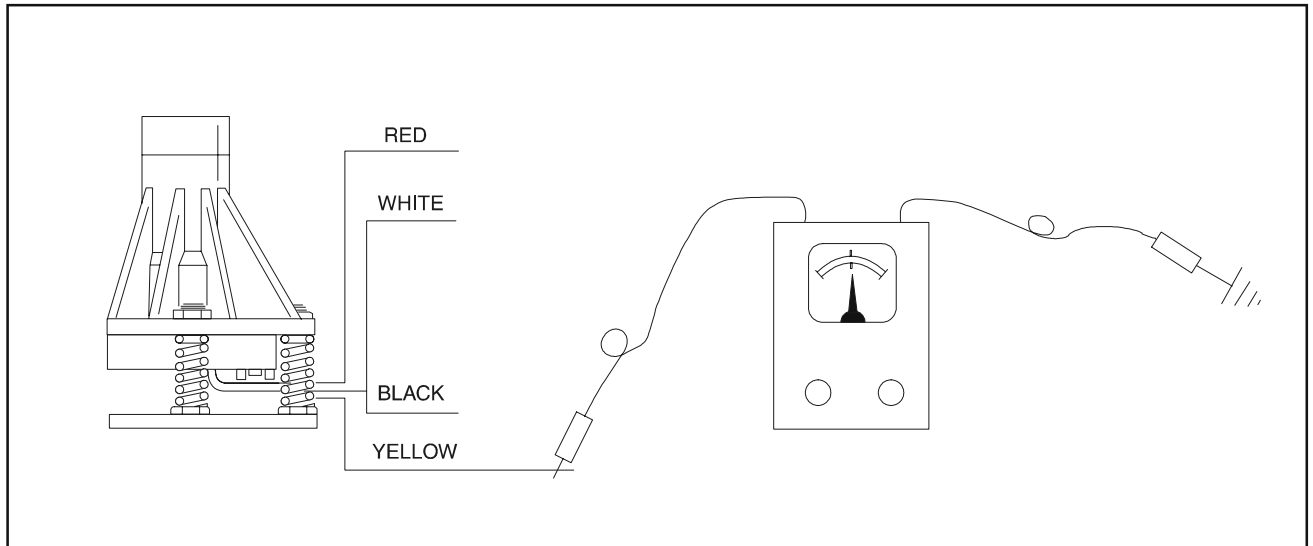


Figure 2-14. Tilt Switch Leveling - Voltmeter Adjustment

3. Connect the black lead of the voltmeter to ground and the red lead to the yellow wire protruding from the pot on the bottom of the sensor.
4. Adjust the leveling nuts to obtain the highest possible voltage reading.
5. Check the voltage at the trip point in all four directions. If the voltage reading is not symmetrical, repeat step 4 above.

2.13 LIMIT SWITCH ADJUSTMENT

Platform Limit Switch

The platform limit switch is located on the left side of the frame of the machine. When activated, the switch cuts out the High Drive function. Adjust the switch to activate when the platform is raised above the stowed position.

2.14 PRESSURE SETTING PROCEDURES

NOTE: Make all pressure adjustments with the engine operating and the hydraulic oil at normal operating temperature. In addition, all functions must be operated from the platform control station in order to achieve full pump speed. It may be necessary to use an assistant to adjust the pressure settings while operating the functions from the platform control station.

Lift Relief Adjustments

1. Install a pressure gauge at gauge port MP, located on the lower right side of the valve body. The port is identified by a stamping on the valve body.
2. From the platform control station, activate the Lift Up function by pressing the ENABLE button and activating the LIFT control switch to the Up position.
3. Bottom out the Lift Up function and adjust the Lift Up relief to 145 bar (2100 psi).
4. From the platform control station, activate the Lift Down function by pressing the ENABLE button and activating the LIFT control switch and activating the controller to the Down position.
5. Bottom out the Lift Down function and adjust the Lift Down relief to 62 bar (900 psi).
6. Remove the pressure gauge from gauge port MP.

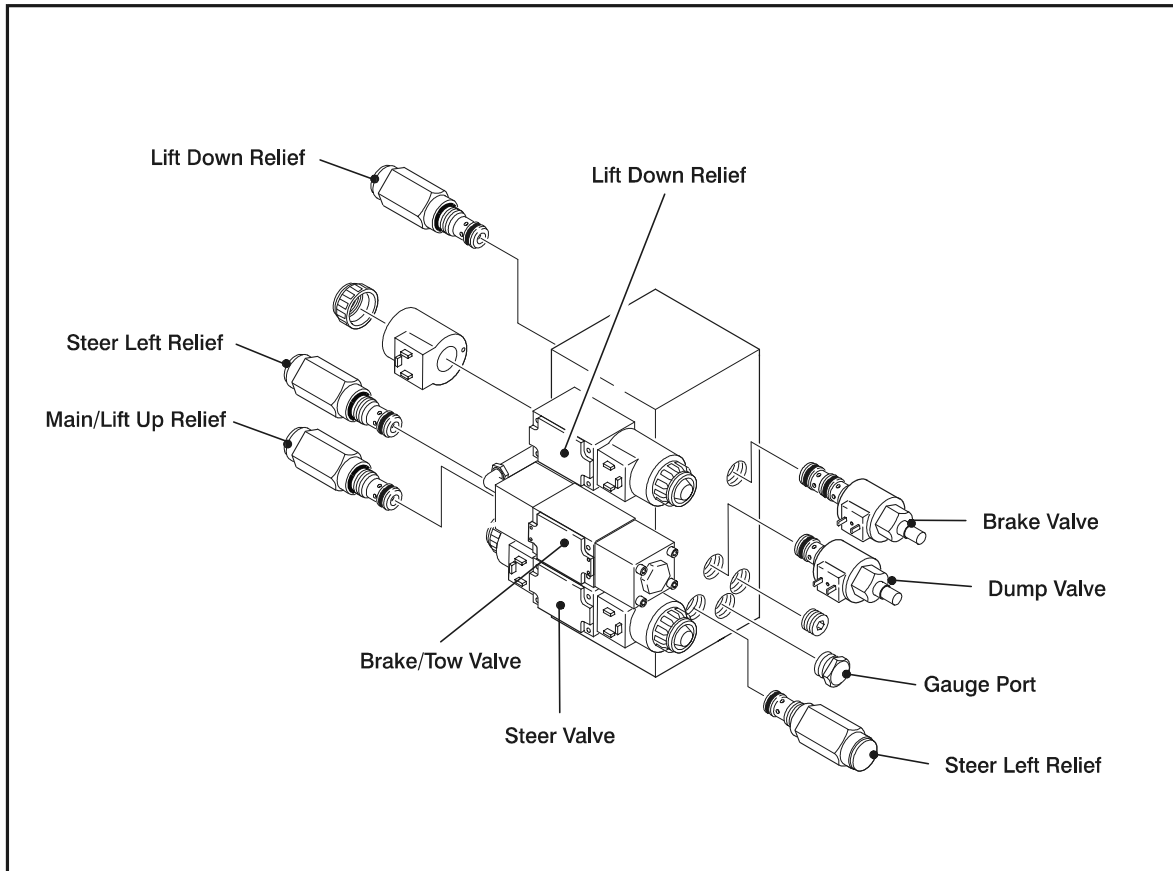


Figure 2-15. Valve Components

Steer Relief Adjustment

1. Install a pressure gauge at gauge port MP, located on the lower right side of the valve body. The port is identified by a stamping on the valve body.
2. Activate the Steer Right function and check Steer pressure. If necessary, adjust Steer pressure to 103 bar (1500 psi).
3. Activate the Steer Left function and check Steer pressure. If necessary, adjust Steer pressure to 103 bar (1500 psi).
4. Remove the pressure gauge from gauge port MP.

2.15 DRIVE AXLE REPAIR

Axle Removal

1. Chock the front wheels of the machine securely.
2. Using a suitable jack or other lifting equipment, raise the rear end of the machine. Support the machine on suitable jack stands or other appropriate supporting equipment.
3. Carefully remove the five wheel nuts securing each wheel and tire assembly to the drive axle and remove the rear wheel and tire assemblies.
4. With the axle properly supported, remove the eight locknuts and washers securing the u-bolts to the frame, then carefully remove the four u-bolts. Remove the supports and remove the drive axle from the machine.

Axle Installation

1. Move the drive axle to its proper position beneath the machine frame, then properly support the axle. Install the four u-bolts and secure them in place with the eight locknuts and washers. When drive axle is properly secured, remove the axle supports.
2. Install the wheel and tire assemblies on the axle and secure each assembly in place with five wheel nuts.
3. Remove the supports from the rear of the machine and remove the chocks from the front wheels.

Wheel Bearings

NOTE: *The drive axle contains two separate axle shafts. The procedures in the following paragraphs pertain to one axle shaft only. The procedures must be repeated for the remaining axle shaft.*

Removal

4. With the axle assembly secured in a suitable holding fixture, remove the bolts and nuts securing the axle shaft retainer to the axle housing.
5. Remove the axle shaft from the housing by pulling on the shaft. It may be necessary to free the axle by prying it loose with two screwdrivers or pry bars.
6. The bearing cup will normally stay in place in the housing. Use a suitable puller (Dana part no. D-131) to remove the bearing cup.
7. Using a suitable puller as in step 3, remove the inner axle shaft seal. Discard the seal and replace it with a new one at assembly.

NOTE: *Avoid contacting seals with cleaning solvent during the cleaning operation.*

8. If the wheel bearings are to be re-used, proceed to Cleaning and Inspection. If the wheel bearings are to be replaced, proceed to step 6.
9. Place the axle shaft in a vise. Drill a 1/4 inch (6.4 mm) hole in the outside of the bearing retaining ring to a depth approximately three-quarters of the thickness of the ring. Do not drill all the way through the ring; the drill could damage the axle shaft.

10. After drilling the ring, use a chisel positioned across the hole and strike sharply to break the ring. Discard the ring and replace it with a new one at the time of assembly.
11. Push the axle shaft retainer and outer axle seal toward the flange of the axle shaft.
12. Attach the flange plate (Dana part no. SP-5443-A) to the axle shaft flange. Install bolts (Dana part no. SP-5026) into the flange plate. Slide the adapter ring (Dana part no. SP-5017) over the axle shaft. Install removing adapters (Dana part no. SP-5442-D) so that they seat under the cup rib ring.
13. Gradually tighten the bolts until they locate in the dimples on the backside of the adapter ring. Tighten the bolts alternately until the bearing cone is removed from the axle shaft. Be careful not to mar the machined surfaces of the axle shaft.

IMPORTANT

DO NOT HEAT OR CUT THE BEARING CONE ASSEMBLY WITH A TORCH TO REMOVE IT. DAMAGE TO THE AXLE SHAFT WILL RESULT.

14. Remove and discard the outer shaft seal; replace it with a new seal at the time of assembly.
15. Remove the axle retainer plate and inspect it for possible distortion. If any portion of the retainer plate is damaged, it should be replaced.

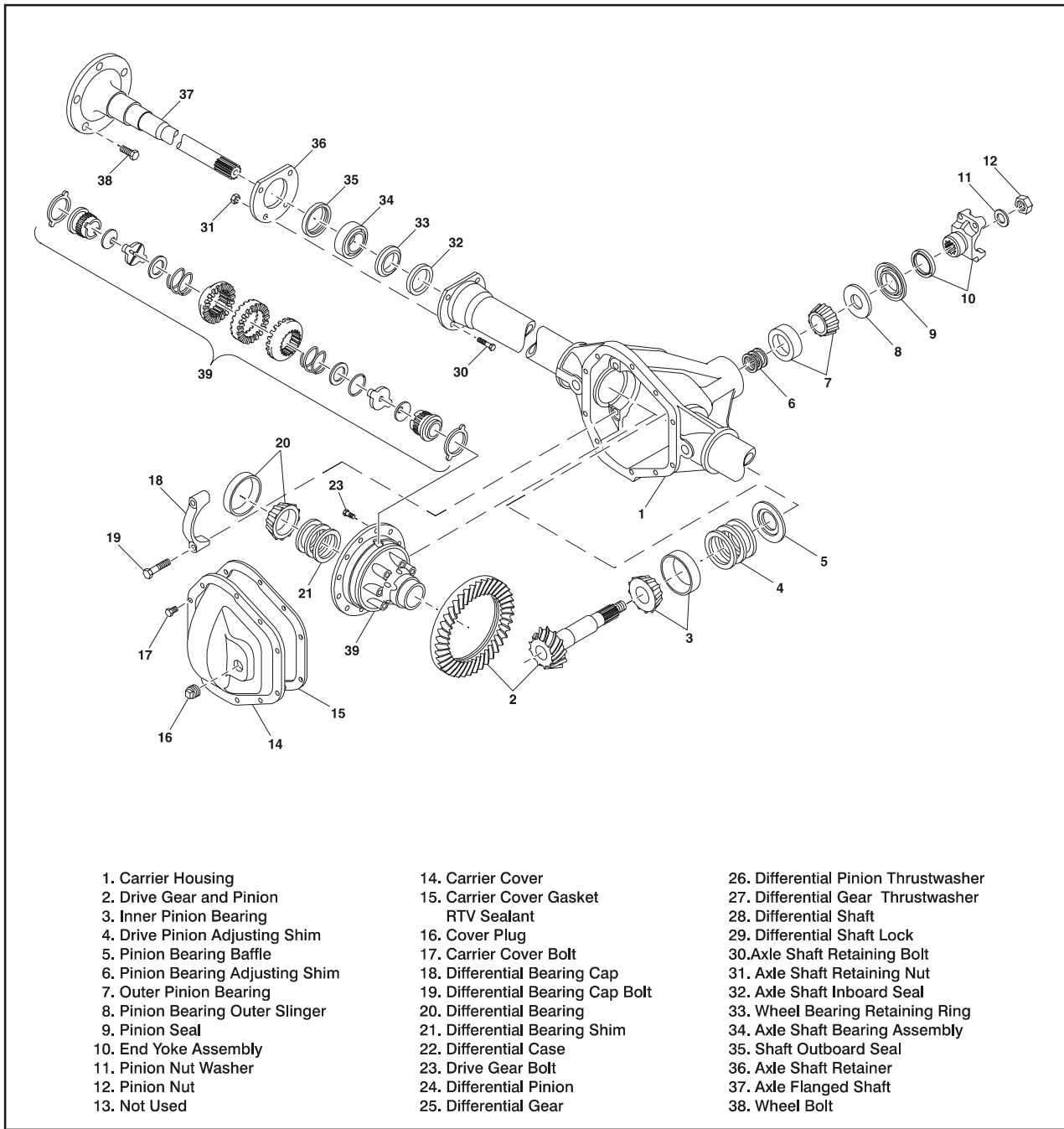


Figure 2-16. Drive Axle Assembly

Cleaning and Inspection

1. Use a standard metal cleaning solvent to clean out the bearing bore in the housing. Wipe this area clean, making sure it is free from dirt or any other contamination that might be present.
2. Inspect the machined surfaces of the axle shaft, such as the seal and bearing diameters. Clean the axle shaft and remove all nicks or burrs.
3. If the wheel bearing is to be replaced, proceed to Installation. If the bearing is to be re-used, clean the bearing cup with any of the standard metal cleaning solvents. Inspect the cup for any possible wear, nicks, etc.
4. The cone assembly can be cleaned in place on the axle shaft. Use any standard metal cleaning solvent and a stiff bristle brush to remove any dirt or any other contamination that might be present, then use compressed air. Air should be directed at the cone assembly so that it goes through the bearing from one end to the other. It is important not to "spin dry" the bearing with compressed air. Spinning the dry bearing may score the raceways and rollers due to the lack of lubricant. Proceed to Installation, step 7, to lubricate the bearing.

Installation

NOTE: *The wheel bearing retainer ring area of the axle shaft is 35.03 mm (1.38 in) minimum in diameter, and the wheel bearing retaining ring is 34.90mm (1.374 inches) maximum. Therefore, it should require some 2,722 kg (6,000 lb.) minimum press to seat the ring against the wheel bearing.*

1. When replacing the wheel bearing, if the flange plate and adapter ring are still attached to the axle shaft flange, remove the bolts from the flange plate and adapter ring, then remove the flange plate and adapter ring from the axle shaft.
 2. Install the axle shaft retainer plate and a new outer shaft seal on the axle shaft. The rubber portion of the oil seal, which extends beyond the casing, has numbers bonded in the rubber. These numbers are to face toward the flange of the axle shaft.
 3. Install a new wheel bearing on the axle shaft. Slide an installing ring (Dana part no. SP-5439) on the axle shaft. Be sure to locate the wheel bearing on the inside of the installing ring. Slide the adapter ring (Dana part no. SP-5017) on the axle shaft and locate on the installing ring. Install bolts and washers (Dana part nos. SP-5026 and SP3020) through the holes in the adapter and into the flange plate.
 4. Tighten the bolts alternately and evenly, making sure that the bearing is not cocked on the axle shaft. Continue until the wheel bearing is seated. To make sure the bearing is seated, use a 0.0381 mm (0.0015 in) feeler gauge between the bearing seat and the bearing. If the gauge enters, force the bearing further onto the axle shaft, until the gauge does not enter.
 5. Loosen and remove the bolts and washers on the adapter ring and remove the adapter ring and the installing ring from the axle shaft. Install the wheel bearing retainer ring on the axle shaft. Slide the installing ring onto the axle shaft, then slide the adapter ring onto the axle shaft and locate on the installing ring. Install bolts and washers through the holes in the adapter ring and into the flange plate.
 6. Tighten the bolts alternately and evenly, making sure the wheel bearing is not cocked on the axle shaft. Continue until the retainer ring is seated. Use a 0.0831 mm (0.0015 in) feeler gauge between the wheel bearing and the retainer ring to be sure that the retainer ring is seated. At least one point should exist, where the gauge will not enter between the retainer ring and the wheel bearing. If the gauge enters completely around the diameter, the retainer ring must be forced further onto the axle shaft.
 7. After the used bearing has been inspected and approved for continued service, or after the new bearing has been installed on the axle shaft, it must be lubricated prior to axle shaft installation.
 8. On the axle shaft, push the seal and retainer away from the bearing to allow a cavity between the seal and bearing.
 9. Fill the cavity between the seal and bearing with the recommended lubricant, a good quality number 2 E.P. (extreme pressure), lithium soap, wheel bearing grease.
 10. After the cavity is full of lubricant, wrap tape completely around the rib ring and seal to enclose the cavity.
 11. With tape still wrapped around the ring, push the seal up until it contacts the rib ring. This will force the lubricant up through the rollers.
- NOTE:** *If lubricant is not apparent on the small end of the bearing rollers, repeat steps 8 thru 11 until lubricant appears.*
12. Remove the tape and wipe excess lubricant on the roller bodies.
 13. Install a new inner axle seal into the axle housing using a seal installer and handle (Dana part nos. D-157 and C-4171). Lubricate the lip of the seal.

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14. Assemble the bearing cup into the bearing bore of the axle housing. Ensure the cup backface is seated firmly against the bearing seat of the housing.
15. Install the axle shaft into the axle housing, taking care not to damage the seal lip and bearing rollers.
16. Line up the holes of the axle shaft retainer with the mounting holes in the end of the axle housing, then push the axle shaft into the housing as far as it will go.
17. Install the bolts and nuts in the mounting holes of the axle shaft retainer plate and tighten by hand. Using a suitable speed wrench, tighten the nuts to approximately 20 Nm (15 ft. lb.).
18. Using a suitable torque wrench (Dana part no. C-524-A), tighten the nuts to a final torque of 34-47 Nm (25-35 ft. lb.).

Carrier Section

NOTE: *If it becomes necessary to disassemble any parts inside the carrier, it is suggested that the entire axle be removed from the scissor lift and held tight in a stand or rack.*

Carrier Disassembly

1. Remove the drain plug and drain the lubricant from the carrier housing.
2. Remove the cover plate screws, cover plate, and cover plate gasket. Discard the old gasket. Tip the carrier housing to allow lubricant to drain completely. Clean the cover face of the carrier, making sure that it is free from any nicks and any particles left by the old gasket.
3. Remove the screws securing the bearing caps to the carrier housing. Note the mating letters stamped on the caps and the carrier. At the time of assembly, the caps are to be assembled exactly as removed. Letters or numbers are in horizontal and vertical positions.

⚠ CAUTION

BEFORE REMOVING THE DIFFERENTIAL CASE AND RING GEAR, ENSURE THE AXLE SHAFTS ARE PULLED OUT FAR ENOUGH FOR CLEARANCE TO REMOVE THE DIFFERENTIAL.

4. Mount a suitable spreader (Dana part no. D-113) and a dial indicator (Dana part no. D-128) to the carrier housing. While monitoring the dial indicator, spread the housing slightly to facilitate removal of the differential case.

⚠ CAUTION

DO NOT SPREAD THE HOUSING MORE THAN 0.508 MM (0.020 IN).

5. Pry the differential case from the carrier housing with two pry bars. Remove the spreader after the differential case has been removed. Use caution to avoid damage to the ring and pinion. Mark on a tag which side the bearing cups came from.
6. Remove the differential bearing cones using a suitable puller (Dana part no. DD-914-9P). Wire the shims, bearing cup and bearing cone together. Identify which side they were removed from (ring gear side or opposite side). If the shims are mutilated, replace them with new shims at the time of assembly. Reposition the case in the puller and remove the remaining bearing cone.

NOTE: *Bearings should be replaced whenever they are removed.*

7. Place a few shop towels over the vise to prevent the ring gear teeth from being nicked after it is free from the differential case. Place the differential case in the vise. Remove the ring gear screws. Tap the ring gear with a rawhide hammer to free it from the case. Remove the case and ring gear from the vise.

NOTE: *Ring gear screws should be replaced whenever they are removed.*

8. Replace the case in the vise and, using a small drift, drive out the lock pin which secures the pinion mate shaft. Remove the shaft.
9. Inspect all parts, including all the machined surfaces of the case itself. If excessive wear is visible on all parts, it is suggested that the complete differential assembly be replaced. If any one of the gears are to be replaced, they are to be replaced as a set.
10. Turn the nose of the carrier housing in a horizontal position to remove the pinion nut. Hold the end yoke with a holding wrench (Dana part no. C-3281) and remove the pinion nut and washer.
11. Remove the end yoke using Dana tool no. C-452. If the yoke shows wear in the area of the seal contact, it should be replaced.
12. Remove the pinion by tapping it with a rawhide hammer. Catch the pinion with your hand to prevent it from falling to the ground and being damaged.

NOTE: On the spline end of the pinion, there are bearing preload shims. These shims may stick to the bearing - pinion - or even fall out. The shims are to be collected and kept together since they will be used later in assembly. Try not to damage the shims. If the shims are mutilated, replace them with new ones.

13. Pull out the pinion seal using a slide hammer (Dana part no. D-131) and discard the seal. Install a new seal at the time of assembly. Remove the bearing cone and outer pinion oil slinger.
14. Turn the nose of the carrier down. Remove the outer pinion bearing cup. Locate the driver on the back edge of the cup and, using a remover and handle (Dana part nos. D-147 and C-4171), drive the cup out of the carrier housing.

NOTE: The axle carrier section may vary in pinion bore depth due to the possible need for either a baffle or a slinger or both.

The baffle serves the purpose of assisting the lubricant to flow up through the oil channels to lubricate the pinion bearings. If used, they are part of the pinion setting adjustment.

15. Remove the inner bearing cup using a remover and handle (Dana part nos. D-148 and C-4171).

NOTE: Shims are located between the bearing cup and the carrier bore, and may also include an oil baffle. If the shims and baffle are bent or nicked, they should be replaced at the time of assembly. Wire the stacks together and measure each. If the stack has to be replaced, replace it with the same thickness.

16. Remove the inner pinion bearing cone using a press, adapter ring, and adapter set (Dana part nos. DD-914-P, DD-914-9, and C-293-39).

NOTE: Both the baffle and slinger are part of the pinion adjustment shims and are to be kept intact for assembly.

Carrier Assembly

1. Assemble the inner axle shaft seals and guides into the carrier housing using a screw and adapter (Dana part nos. D-112 and D-112-1). When assembling the seals, ensure that they are positioned straight and do not get cocked. Turn the forcing screw until it stops; the seal will then be seated.
2. Inspect the flange face of the differential case to be sure it is free of nicks and burrs. Align the holes of the gear with the holes in the case and attach the ring gear to the case using new ring gear screws. Tighten the screws alternately and evenly. Using a suitable torque wrench (Dana part no. C-524-A or

equivalent), torque the screws to 61-81 Nm (45-60 ft. lbs.).

3. Inspect the differential case hubs and remove all nicks, burrs, dirt, etc. from hubs to allow master bearings to rotate freely. Install new master differential bearings (Dana part no. D-135 or equivalent) onto the differential case.
4. Install the differential case (less the pinion). Mount a dial indicator (Dana part no. D-128 or equivalent) with a magnetic base. Locate the tip of the indicator on the flat surface of one of the gear screws. Mark the screw with a piece of chalk.
5. Force the differential assembly as far as possible in the direction towards the indicator. With force still applied, set the indicator to zero (0).

NOTE: The indicator should have a minimum of 5.1 mm (0.200 in) travel.

6. Force the differential assembly as far as it will go in the opposite direction.
7. Repeat steps 5 and 6 until the same indicator reading is obtained in each direction. Record the reading of the indicator. This will be the total amount of shims required (less preload) and will be calculated later during assembly.
8. After making sure the readings are correct, remove the indicator and differential assembly from the housing.

IMPORTANT

DO NOT REMOVE THE MASTER BEARINGS FROM THE DIFFERENTIAL CASE AT THIS TIME.

9. If a new ring gear and pinion are to be used, the following information applies:

Ring gears and pinion gears are supplied in matched sets only. Matching numbers on both the pinion and ring gear are etched for verification. If a new gear set is being used, verify the numbers of each pinion and ring before proceeding with assembly.

The distance from the centerline of the ring gear to the button end of the pinion is 67 mm (2.625 in).

On the button of each pinion there is etched a plus (+) number, a minus (-) number, or a zero (0) number, which indicates the best running position for each particular gear set. This dimension is controlled by the shimming behind the inner bearing cup. For example, if a pinion is etched +3, this pinion would require 0.076 mm (0.003 in) less shims than a pinion etched "0". This means by removing shims, the mounting distance of the pinion is increased to 57.607 mm (2.268 in), which is just what +3 indicates. Or, if a pinion is etched -3, it would require that 0.076 mm

SECTION 2 - PROCEDURES

(0.003 in) more shims be added than if the pinion were etched "0". By adding 0.076 mm (0.003 in) shims, the mounting distance of the pinion was decreased to 66.599 mm (2.622 in), which is just what a -3 etching indicated.

10. If the old ring and pinion set are to be reused, measure the old shim pack and build a new shim pack to the same dimension. If a baffle is in the axle assembly, it is considered as part of the shim pack. To change the pinion adjustment, shims are available in thicknesses of 0.076 mm (0.003 in), 0.127 mm (0.005 in), and 0.254 mm (0.010 in).

NOTE: *If a baffle or slinger is bent or mutilated, it should be replaced.*

11. Measure each shim separately with a micrometer and add together to get total shim pack thickness from original build up.
12. If a new gear set is being used, notice the (+) or (-) etching on both the old and new pinion and adjust the thickness of the new shim pack to compensate for the difference of these two figures.

For example: If the old pinion reads (+) 2 and the new pinion is (-) 2, add 0.102 mm (0.004 in) shims to the original shim pack.

NOTE: *Use large diameter master bearing discs for this axle.*

Be sure that all carrier bores are free from all nicks, dirt, or any other contamination.

13. Place the master pinion block (Dana part no. D-139 or equivalent) into the pinion bore of the carrier.
14. Place arbor discs (Dana part no. D-115-4 or equivalent) and arbor (Dana part no. D-115-3 or equivalent) into the cross bores of the carrier.
15. Place a pinion height block (Dana part no. D-115-1 or equivalent) on top of the master pinion block, and against the arbor block.
16. Place a scooter gage (Dana part no. D-115) on the small step of the pinion height block. Apply finger pressure, making sure the gage is flat on the pinion height block. While pressure is applied, set indicator to zero (0).
17. Slide the scooter gage over the arbor. As the gage slides over top the arbor, it will travel in a clockwise direction. When the indicator is on the center of the arbor (on top), it will stop traveling in a clockwise direction. If the indicator starts to travel in a counter-clockwise direction, this means that the center (top) of the arbor has been passed. Record only the reading when the indicator is at the highest point. This reading indicates the amount of shims necessary to obtain the correct shim pack, plus (+) or minus (-)

the etching on the bottom end of the pinion. If the etching is zero (0), the shim pack will remain unchanged.

For example: If a pinion is etched "+3", this pinion would require 0.076 mm (0.003 in) less shims than a pinion etched zero (0). If a pinion is etched "-3", it will be necessary 0.076 mm (0.003 in) more shims than would be required if the pinion were etched zero (0).

18. Measure each shim separately with a micrometer and add together to get the total shim pack thickness. If a baffle is required, it is to be included in the shim pack. If a slinger is used between the inner bearing cone and the thrust face of the pinion, the slinger is also to be measured and included as a part of the total shim pack.
19. Place the required amount of shims (and baffle if used) in the inner bearing bore; drive the inner bearing cup into the carrier using a cup installer and handle (Dana part nos. D-145 and C-4171, respectively, or equivalent).
20. Assemble the outer pinion bearing cup into the carrier using a cup installer and handle as in step 23.
21. Assemble the inner bearing cone (and slinger if used) on the pinion, then place the bearing installer (Dana part no. W-262 or equivalent) over the pinion shaft. Drive the bearing on the shaft until it is completely seated.
22. Assemble preload shims (which were removed during disassembly) onto pinion. Assemble bearing cone and slinger.
23. Apply a light coat of hypoid lubricant to the lip of the pinion seal and assemble into the housing using a seal installer and handle (Dana part nos. W-147D and C-4171, respectively, or equivalent).
24. Using a suitable yoke holder (Dana part no. C-3281 or equivalent), assemble end yoke, washer and pinion nut. Torque pinion nut to 271-298 Nm (200-220 ft. lb.) using a suitable torque wrench (Dana part no. C-4053 or equivalent).
25. Using a torque wrench calibrated in inch lb., rotate the pinion. Pinion torque should be 2.3-4.5 Nm (20-40 in. lb.). To increase preload, remove shims; to decrease preload, add shims.

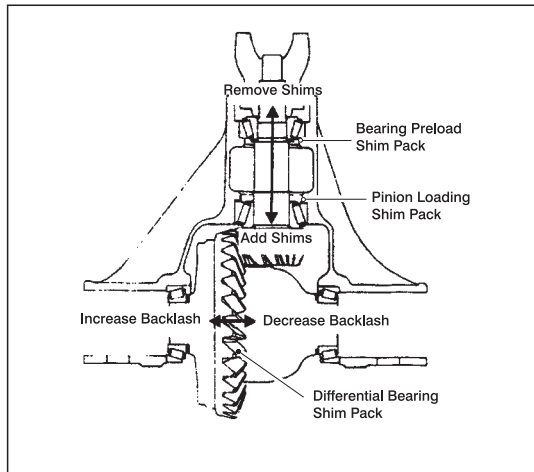


Figure 2-17. Carrier Section

NOTE: Figure 2-17 shows the arrow in the pinion pointing in two directions. The direction of the arrow pointing towards the end yoke indicates that by removing pinion locating shims, the distance from the center line of the axle to the pinion button is increased, giving a plus reading. The preload shim pack does not affect the pinion depth setting. Arrows on the ring gear illustrate the method to increase or decrease backlash and differential bearing preload.

Differential Assembly

1. Place the differential assembly (with the pinion assembled) into the carrier housing. The differential master bearings should still be installed to the differential case.
 2. Set up a dial indicator (Dana part no. D-128). Be sure to locate the dial indicator on the same ring gear screw. Force the ring gear to mesh with the pinion gear. Rock the ring gear to allow the teeth of the gears to mesh. With force still applied to the differential case, set the indicator to zero (0).
 3. Force the differential assembly (ring gear) away from the pinion gear to obtain an indicator reading. Repeat until the same reading is obtained each time. This reading will be the necessary amount of shims between the differential case and the differential bearing on the ring gear side. Remove the indicator and differential case from the carrier. Remove the master bearings from the differential case.
 4. Assemble the required amount of shims onto the differential case hub (ring gear side) as determined in step 3. Place the bearing cone on the hub. Use a bearing installer and handle (Dana part nos. D-156 and S-417) to seat the bearing cone.
 5. Assemble the remaining shims of the total shim pack to the opposite side of the differential case. Add an additional 0.381 mm (0.015 in) of shims on this side to compensate for the differential bearing preload. Assemble the differential bearing using the same tools used in step 4.
 6. Install a spreader and indicator and carefully spread the carrier housing, but DO NOT spread the carrier over 0.381 mm (0.015 in). Remove the indicator.
 7. Assemble the differential bearing cups to the differential bearing cones. Install the differential assembly into the carrier housing.
 8. Install the differential assembly into the carrier housing. Use a rawhide hammer to seat the differential assembly into the cross bore of the carrier housing. Care should be taken to avoid nicking the teeth of the ring gear and pinion during assembly.
 9. Install the bearing caps and secure with screws. Make sure the letters stamped on the caps correspond with those on the carrier housing. Using a suitable torque wrench (Dana part no. C-524-A), torque the bearing cap screws to 95-122 Nm (70-90 ft. lb.).
 10. Check the ring gear and pinion backlash in three equally spaced points. Backlash tolerance is 0.127 to 0.203 mm (0.005 to 0.008 in) and cannot vary more than 0.051 mm (0.002 in) between points checked.
 - High backlash is corrected by moving the ring gear closer to the pinion.
 - Low backlash is corrected by moving the ring gear away from the pinion.
 - These corrections are made by switching shims from one side of the differential case to the other.
- If the backlash is to specification, check the ring gear and pinion as outlined in the following paragraph, then adjust as necessary.
11. When all adjustments have been completed, install a new cover gasket and install the cover plate, securing it with carrier cover bolts. Using a suitable torque wrench (Dana part no. C-524-A), torque bolts to 41-54 Nm (30-40 ft. lb.).

Ring Gear and Pinion Tooth Pattern Interpretation

The TOE of the gear tooth is the portion of the tooth surface at the end towards the center. The HEEL of the gear tooth is the surface of the top of the tooth. Every gear has a characteristic pattern. The illustrations in Figure 2-18 show typical patterns only, and explain how patterns shift as gear location is changed. When making pinion position changes, shims should be changed in the range of 0.051 mm (0.002 in) to 0.102 mm (0.004 in) until the correct pattern has been obtained.

When a change in backlash is required, backlash shims should be changed in the range of 1-1/2 times the amount of backlash required to bring the gears into specification. For example, if the backlash needs to be changed by 0.102 mm (0.004 in), the shim pack should be changed by 0.152 mm (0.006 in) as a starting point. The actual amount of backlash change obtained will vary depending upon the ratio and gear size.

High backlash is corrected by moving the ring gear closer to the pinion. Low backlash is corrected by moving the ring gear away from the pinion. These corrections are made by switching shims from one side of the differential case to the other.

NOTE: When making changes, note that two variables are involved. Example: If you have the backlash set correctly to specifications and you change the pinion position shim, you may have to readjust the backlash to correct specification before checking the pattern.

⚠ CAUTION

GEAR TEETH MAY HAVE SHARP EDGES. WHEN HANDLING GEARS, USE CAUTION TO AVOID PERSONAL INJURY.

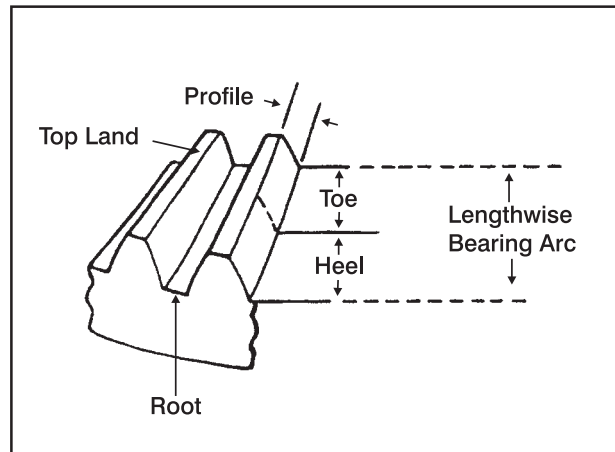


Figure 2-18. Ring Gear and Pinion Tooth Contact Pattern

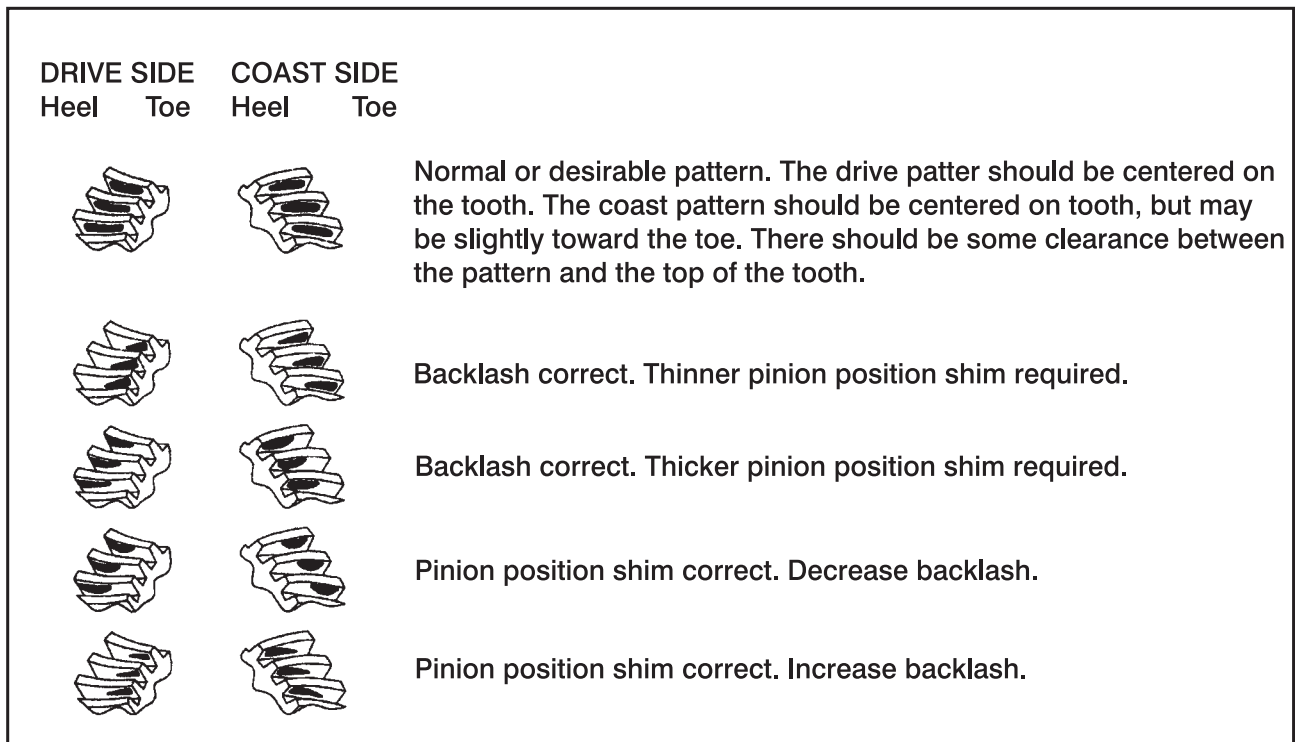


Figure 2-19. Ring Gear Pattern Interpretation

Check the ring gear and pinion tooth pattern as follows:

- Paint the ring gear teeth with a marking compound to both the drive and coast side.
- Rotate the ring gear one complete revolution in both directions while a load is being applied with a large screwdriver or similar tool between the carrier housing and the differential case flange.
- Inspect the ring gear for wear patterns as outlined in Figure 2-19., Ring Gear Pattern Interpretation. Make any necessary adjustments with the following information in mind.
- Decreasing backlash moves the ring gear closer to the pinion.

Drive pattern (convex side of gear) moves slightly lower and toward the toe.

Coast pattern (concave side of gear) moves lower and toward the toe.

- Increasing backlash moves the ring gear away from the pinion.

Drive pattern moves slightly higher and toward the heel.

Coast pattern moves higher and toward the heel.

- Thicker pinion position shim with the backlash constant moves the pinion closer to the ring gear.

Drive pattern moves deeper on the tooth (flank contact) and slightly toward the toe.

Coast pattern moves deeper on the tooth and toward the heel.

- Thinner pinion position shim with the backlash constant moves the pinion further from the ring gear.

Drive pattern moves toward the top of the tooth (face contact) and toward the heel.

Coast pattern moves toward the top of the tooth and slightly toward the toe.

2.16 BRAKE REPAIR

Disassembly

1. With the brake mounted in a suitable holding fixture, remove the two socket head assembly bolts.

SECTION 2 - PROCEDURES

2. Tap the female end of the spline shaft assembly and spring plate with a soft mallet to separate the cover from the spring plate. If the sections will not separate, carefully pry the sections apart with a screwdriver.
3. Remove the retaining ring from the spline shaft assembly.
4. Remove the spline shaft assembly from the cover by tapping the male end of the spline shaft assembly with a soft mallet.
5. If necessary, remove the retaining ring from the spline shaft assembly and remove the outer spline from the shaft.
6. Remove the retaining ring from the cover and press out the oil seal and bearing, if necessary.
7. Remove the four socket head shoulder bolts.
3. Install the retaining ring into the cover.
4. If disassembled, install the outer spline onto the shaft and secure in place with the retaining ring.
5. Press the spline shaft assembly into the bearing until the shaft bottoms on the shaft shoulder. The bearing inner race must be supported during this operation.
6. Install the retaining ring on the shaft.
7. Install the back-up rings on the piston toward the spring pockets.
8. Install the o-rings on the piston. Ensure the o-rings and flat and all twists are removed. Take care not to scratch or mar the piston.
9. Lubricate the piston with clean system hydraulic fluid. Carefully press the piston into the pressure plate. Ensure the piston is oriented such that the threaded holes in the piston are in alignment with the thru holes in the spring plate when installed.

IMPORTANT

DO NOT REMOVE THE SHOULDER BOLTS WITHOUT PRESSURIZING THE BRAKE APPROXIMATELY 300 PSI (21 BAR), OR DAMAGE TO THE BRAKE MAY RESULT.

8. Before removing the primary disc, rotor discs, and stator discs, note the pattern for reassembly purposes.
9. Release the pressure to the brake before removing the four socket head cap screws.
10. Remove the spring plate.
11. Remove the case gasket from the spring plate.
12. Before removing the springs (21-red or 25-blue), note the pattern and color for reassembly purposes.
13. Remove the piston by carefully exerting hydraulic pressure through the brake release port on the pressure plate.
14. Remove the o-rings and back-up rings from the piston. Take care not to scratch or mar the piston.
15. Remove the case gasket from the pressure plate.

Assembly

NOTE: Prior to assembly, clean all parts thoroughly and lubricate all rubber components with clean system hydraulic fluid.

1. Press the oil seal into the cover bore until it is flush with the bearing shoulder. Ensure the oil seal is installed with the open side facing the pilot end of the cover.
2. Press the bearing into position until it bottoms out on the oil seal borestep.

10. Install the springs (21-red or 25-blue) according to the pattern and color noted during disassembly. Different color springs must be alternated.
11. Affix case gaskets to the pressure plate and the spring plate.

NOTE: Bolts should have one or two drops of Loctite #242 applied to the threads prior to assembly.

12. Place the unit on a press. Using the press, depress and install four socket head bolts. Torque the bolts to 48-54 Nm (35-40 ft. lb.). A suitable holding fixture is useful to hold the brake in position.
13. Install the stator discs and rotor discs in the same sequence as noted during disassembly.
14. Install the primary disc.

NOTE: Bolts should have one or two drops of Loctite #242 applied to the threads prior to assembly.

15. Align the discs and partially screw in the four socket head shoulder bolts. Inspect for free movement of stack. Pressurize the brake release approximately 21 bar (300 psi) to release the discs. Torque the shoulder bolts to 20-24 Nm (15-18 ft. lb.) and release the pressure. A suitable holding fixture is useful to hold the brake in position.

NOTE: Bolts should have one or two drops of Loctite #242 applied to the threads prior to assembly.

16. Install the cover using socket head assembly bolts. Torque bolts to 12-15 Nm (9-11 ft. lb.).

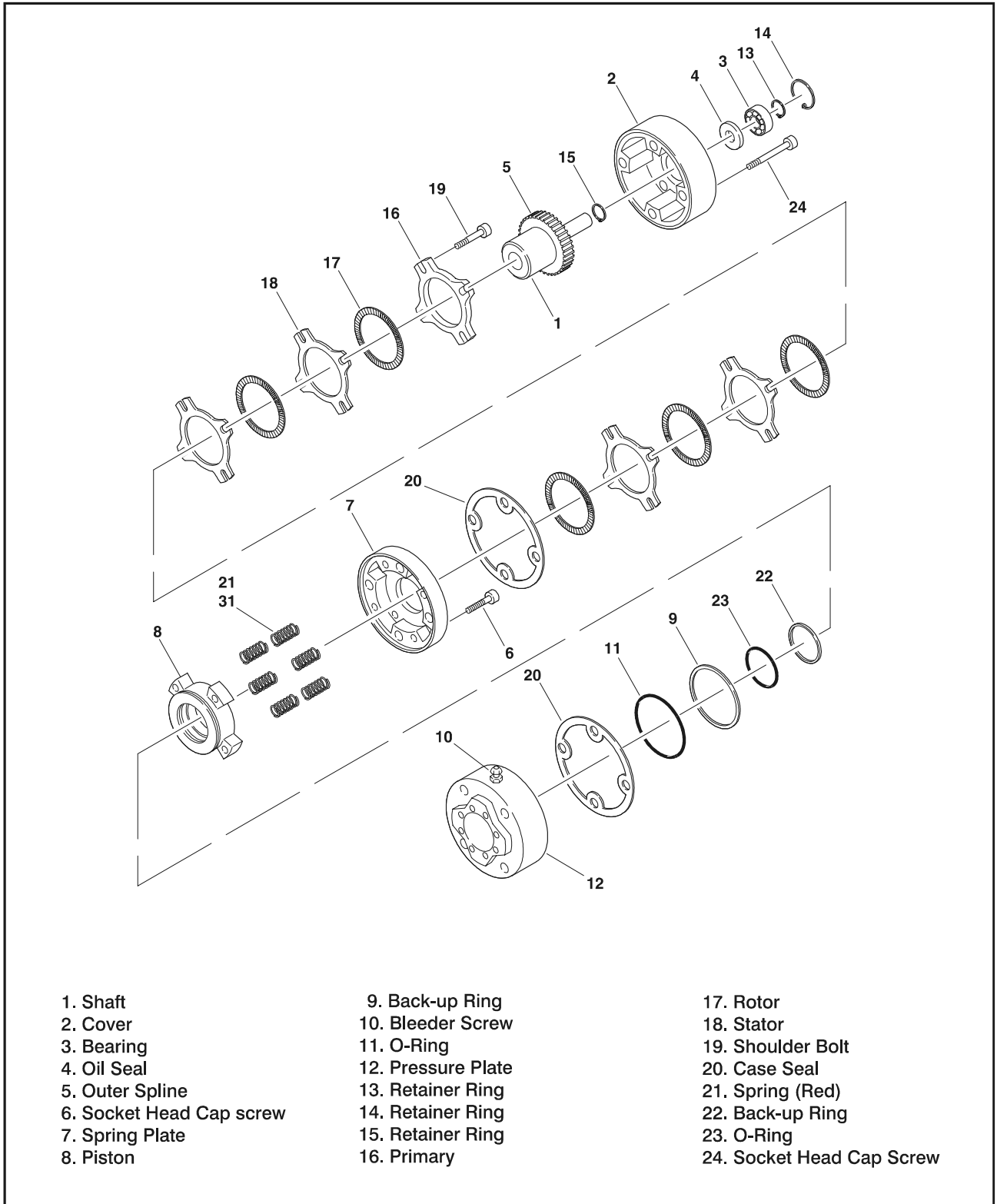


Figure 2-20. Brake Assembly

⚠ CAUTION

IF HYDROSTATIC BENCH TESTING IS PERFORMED ON THE BRAKE ASSEMBLY, RELEASE PRESSURE SHOULD NOT EXCEED 69 BAR (1,000 PSI) UNLESS FOUR ADDITIONAL BOLTS ARE USED FOR SUPPLEMENTAL CLAMPING.

2.17 THROTTLE CHECKS AND ADJUSTMENTS

Gasoline Engine

1. Open the engine hood to gain access to the RPM adjustments.
2. Disconnect the wire harness from the ADDCO throttle and install JLG wire harness #4921850 to the ADDCO and the engine harness, See Figure 2-21., ADDCO Adjustments (Gasoline/Dual Fuel Engine). Start the engine and allow it to come up to operating temperature. Adjust the IDLE #1 engine pot on the ADDCO CW to retract the actuator (lower) or CCW to extend the actuator (higher) until IDLE engine runs at 1500 RPM.
3. Position toggle switch to MID engine. Adjust the MID #2 engine pot on the ADDCO CW to retract the actuator (lower) or CCW to extend the actuator (higher) until MID engine runs at 2000 RPM.
4. Position toggle switch to HIGH engine. Adjust the HIGH #3 engine pot on the ADDCO CW to retract the actuator (lower) or CCW to extend the actuator (higher) until HIGH engine runs at 3000 RPM.

NOTE: *Actuator cable travel must stop slightly before the lever makes contact with the throttle lever stop. Failure to do so will burn out the actuator.*

5. Remove the adjustment harness from the ADDCO and the engine harness and re-connect the engine harness to the ADDCO.

Diesel Engine

NOTE: *Never run the fuel tank dry. Diesel engines cannot be restarted after running out of fuel until the fuel system has been air-vented or 'bled' of air. See the Yanmar Instruction Manual for the proper procedure.*

1. Open the engine hood to gain access to the RPM adjustments.
2. Disconnect the wire harness from the ADDCO throttle and install JLG wire harness #4921850 to the ADDCO and the engine harness, See Figure 2-22., ADDCO Adjustments (Diesel Engine). Start the engine and allow it to come up to operating temper-

ature. Adjust the IDLE screw CW (higher) or CCW (lower) until IDLE speed is 1200 RPM.

3. Position toggle switch to MID engine. Adjust the MID #1 engine pot on the ADDCO CW to retract the actuator (lower) or CCW to extend the actuator (higher) until MID engine runs at 2000 RPM.
4. Position toggle switch to HIGH engine. Adjust the HIGH #2 engine pot on the ADDCO CW to retract the actuator (lower) or CCW to extend the actuator (higher) until HIGH engine runs at 3000 RPM.

NOTE: *Actuator cable travel must stop slightly before the lever makes contact with the throttle lever stop. Failure to do so will burn out the actuator.*

5. Remove the adjustment harness from the ADDCO and the engine harness and re-connect the engine harness to the ADDCO.

2.18 CONTROL CARD SETUP AND TEST PROCEDURES

Valve Driver Card Setup

Before starting this procedure, all hydraulic relief pressure settings and engine RPM settings should be set, and the engine warmed to operating temperature. Refer to Figure 2-23., Valve Driver Card

The following tools will be required to perform the setup procedure: a small straight screwdriver, a voltmeter, and an ammeter with at least a 2 amp capacity.

The valve driver card LED indications are as follows:

LED1 - RANGE*

LED2 - RANGE*

LED3 - OUTPUT ON

LED4 - POWER GOOD

* RANGE Indications

LED1 ON, LED2 ON - 100%

LED1 OFF, LED2 ON - 67%

LED1 ON, LED2 OFF - 45%

LED1 OFF, LED2 OFF - OFF

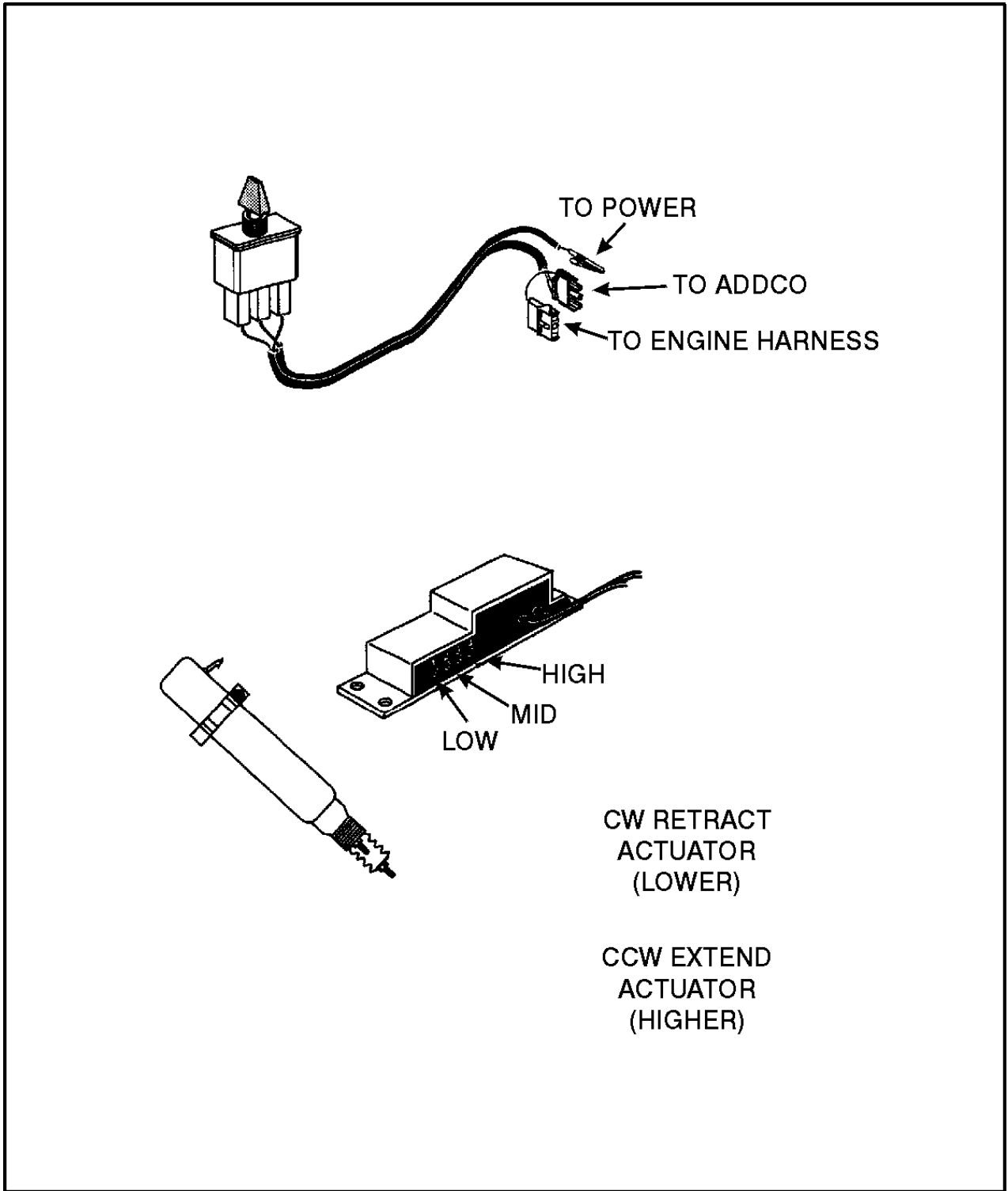


Figure 2-21. ADDCO Adjustments (Gasoline/Dual Fuel Engine)

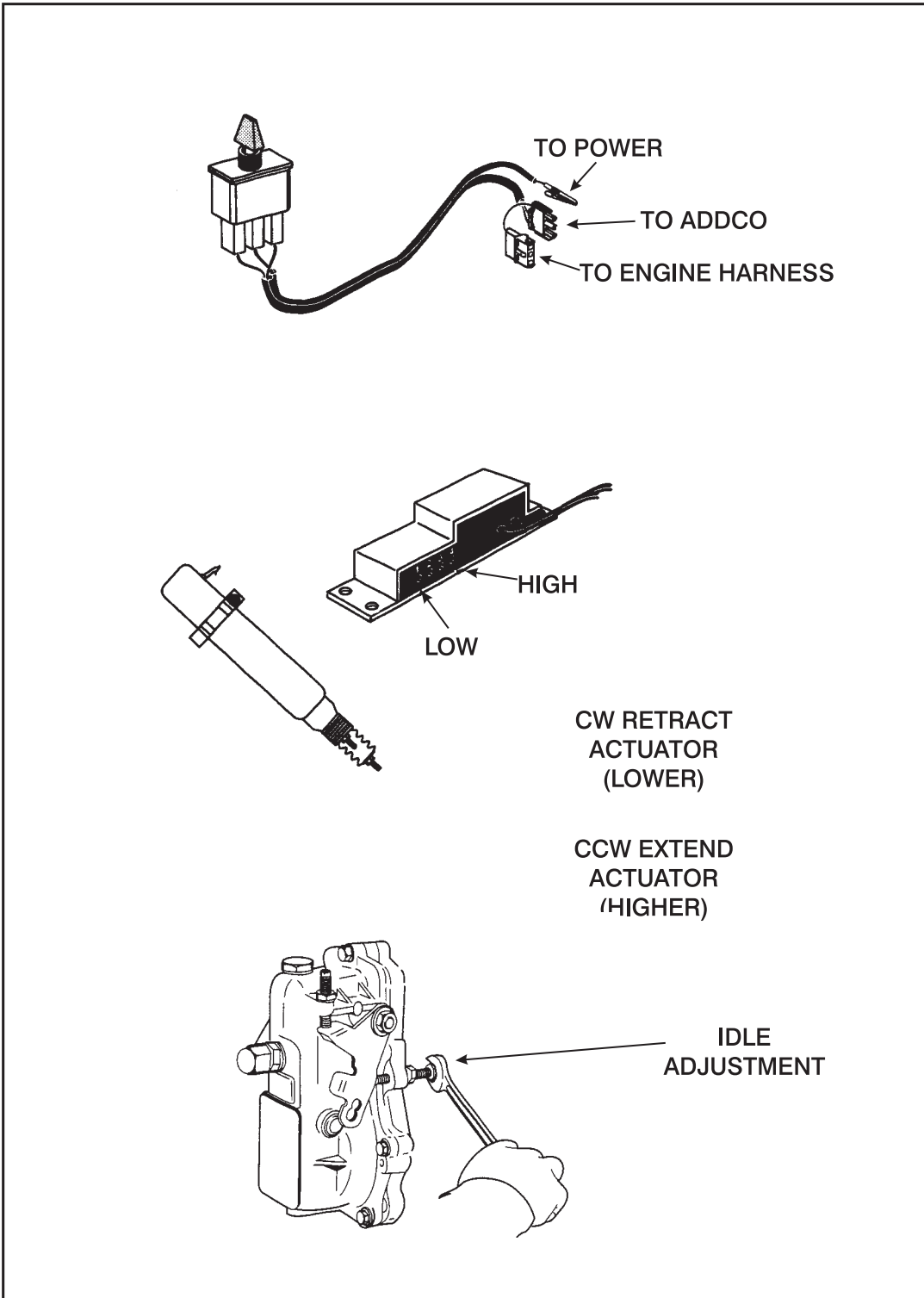


Figure 2-22. ADDCO Adjustments (Diesel Engine)

The valve driver card potentiometer adjustments are as follows:

- P1 - DRIVE FWD ACCEL (A RAMP UP)
- P2 - DRIVE FWD DECEL (A RAMP DOWN)
- P3 - DRIVE FWD HIGH (A MAXIMUM)
- P4 - DRIVE FWD LOW (A MINIMUM)
- P5 - DRIVE REV ACCEL (B RAMP UP)
- P6 - DRIVE REV DECEL (B RAMP DOWN)
- P7 - DRIVE REV HIGH (B MAXIMUM)
- P8 - DRIVE REV LOW (B MINIMUM)

2.19 VALVE DRIVER CARD SETUP PROCEDURE

1. Elevate the drive wheels and support them securely.
2. Turn all eight potentiometers fully counter-clockwise. Turn until the potentiometer clicks at the end of its travel.
3. Start the engine from the platform.

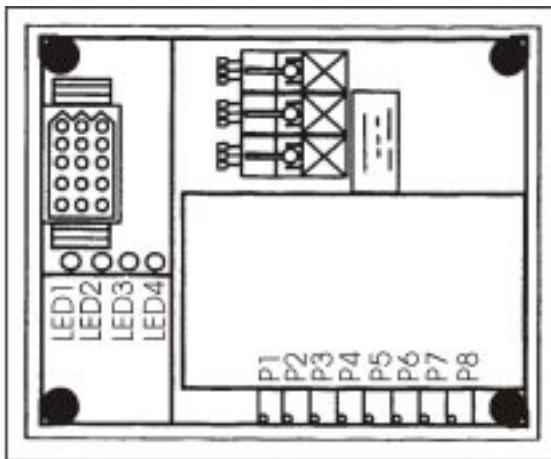


Figure 2-23. Valve Driver Card

4. Verify that the horsepower card (HP) card is operating properly as follows:
 - a. Connect a voltmeter to the HP card with the red lead connected to "L" and the black lead to "MO." These are the only two test points available on the HP card.
 - b. With the engine at idle, and enable depressed, the voltage should read approximately -3.8 volts dc. With the engine running at high engine, the voltage should read at least +2 volts dc. The reading will probably be slightly higher.

NOTE: If the horsepower card's voltage does not change, then the card is not receiving the RPM signal, the engine speed is not correct, or the card is bad. Replace the horsepower card if necessary. DO NOT ATTEMPT TO ADJUST THE HORSEPOWER CARD.

5. Disconnect the control box wiring harness from the valve driver card, then connect test harness 4922012 between the valve driver card and the control box wiring harness. To adjust the "A Driver" forward direction, connect the ammeter to the "A Driver" forward output wire on the test harness to adjust trimpots P1 through P4.
6. Energize drive forward and hold the joystick at "FULL ON." Make sure the speed switch is set to high speed.
7. Turn P4, drive forward low, clockwise until the wheels just start to move. The ammeter should read about 0.4 Amps or 400 mA. This value is approximate, the reading will be slightly different from one machine to another.

NOTE: Adjusting the low setting affects the high. Adjusting the high setting does not affect the low. If you have to re-adjust the low after the high is set, you must re-check the high, the decel, and the accel settings.

8. with drive forward still full on, set P3, drive forward high. Turn P3 clockwise until the ammeter reads 1.1 Amps or 1100 mA. DO NOT TURN ANY HIGHER! The valve will draw more current but no additional speed will be gained and the acceleration and deceleration will not work properly.
9. Next, set P2, drive forward deceleration. Turning P2 clockwise increases the time. Turn the pot approximately 15 turns and test by energizing drive forward, stroking the joystick to full on, then letting go. It should take about 3 seconds for the drive wheels to stop. Adjust P2 to obtain 3 seconds.
10. Next, set P1, drive forward acceleration. Turning P1 clockwise increases the acceleration. Turn the pot approximately 15 turns and test by going from no drive to full on drive forward, then timing how long it takes until the meter reads 1.1 A or 1100 mA. It should take about 5 seconds. Adjust P1 to obtain 5 seconds.
11. To adjust the "B Driver" reverse direction, connect the ammeter to the "B Driver" reverse output wire on the test harness to adjust trimpots P5 through P8.
12. Energize drive joystick and hold the joystick at "FULL ON." Make sure the speed switch is set to high speed.

13. Turn P8, drive reverse low, clockwise until the wheels just start to move. The ammeter should read about 0.4 Amps or 400 mA. This value is approximate, the reading will be slightly different from one machine to another.

NOTE: *Adjusting the low setting affects the high. Adjusting the high setting does not affect the low. If you have to re-adjust the low after the high is set, you must re-check the high, the decel, and the accel settings.*

14. With drive reverse still full on, set P7, drive reverse high. Turn P7 clockwise until the ammeter reads 1.1 Amps or 1100 mA. DO NOT TURN ANY HIGHER! The valve will draw more current but no additional speed will be gained and the acceleration and deceleration will not work properly.
15. Next, set P6, drive reverse deceleration. Turning P6 clockwise increases the time. Turn the pot approximately 15 turns and test by energizing drive reverse, stroking the joystick to full on, then letting go. It should take about 3 seconds for the drive wheels to stop. Adjust P6 to obtain 3 seconds.
16. Next, set P5, drive reverse acceleration. Turning P5 clockwise increases the acceleration. Turn the pot approximately 15 turns and test by going from no drive to full on drive reverse, then timing how long it takes until the meter reads 1.1 A or 1100 mA. It should take about 5 seconds. Adjust P5 to obtain 5 seconds.

Horsepower Card Test

Before starting this procedure, all hydraulic relief pressure settings and engine RPM settings should be set, and the engine warmed to operating temperature. Refer to Figure 2-23., Valve Driver Card.

A voltmeter will be required to perform the test.

1. Elevate the drive wheels and support them securely.
2. Start the engine from the ground control station.
3. Activate high engine. High engine speed must be greater than 3100 rpm.
4. Measure the voltage from 'L' to 'MO' by putting the voltmeter's red lead on "L" and the black lead on "MO." These are the only two test points available on the horsepower card.
5. If the voltmeter displays 1.98 volts dc or greater, the horsepower card is operational and the test is complete.
6. If the voltage is between 1.90 volts dc and 1.97 volts dc and the engine is above 3100 rpm, manually increase the engine rpms and monitor the voltage.

If the voltage does not increase above 1.98 volts dc, the horsepower card is operational and the test is complete.

If the voltage does increase above 1.98 volts dc, replace the horsepower card.

7. If the voltage is below 1.90 volts dc but greater than -1.0 volts dc, replace the horsepower card.
8. If the voltage is below -1.0 volts dc, verify the wiring between the engine and the horsepower card is properly terminated. If the wiring is okay, replace the horsepower card.

2.20 PREVENTIVE MAINTENANCE AND INSPECTION SCHEDULE

The preventive maintenance and inspection checks are listed and defined in the following table. This table is divided into two basic parts, the "AREA" to be inspected and the "INTERVAL" at which the inspection is to take place. Under the "AREA" portion of the table, the various systems along with the components that make up that system are listed. The "INTERVAL" portion of the table is divided into five columns representing the various inspection time periods. The numbers listed within the interval column represent the applicable inspection code for which that component is to be checked.

The checks and services listed in this schedule are not intended to replace any local or regional regulations that may pertain to this type of equipment nor should the lists be considered as all inclusive. Variances in interval times may occur due to climate and/or conditions and depending on the location and use of the machine.

JLG Industries requires that a complete annual inspection be performed in accordance with the "Annual Machine Inspection Report" form. Forms are supplied with each new machine and are also available from JLG Customer Service. Form must be completed and returned to JLG Industries.

IMPORTANT

JLG INDUSTRIES REQUIRES THAT A COMPLETE ANNUAL INSPECTION BE PERFORMED IN ACCORDANCE WITH THE "ANNUAL MACHINE INSPECTION REPORT" FORM.

NOTE: *This machine requires periodic safety and maintenance inspections be a JLG Dealer.*

The inspection and maintenance code numbers are as follows:

1. Check for proper and secure installation.
2. Check for visible damage and legibility.
3. Check for proper fluid level.
4. Check for any structural damage; cracked or broken welds; bent or warped surfaces.
5. Check for leakage.
6. Check for presence of excessive dirt or foreign material.
7. Check for proper operation and freedom of movement.
8. Check for excessive wear or damage.
9. Check for proper tightness and adjustment.
10. Drain, clean and refill.
11. Check for proper operation while pump/motor is running.
12. Check for proper lubrication.
13. Check for evidence of scratches, nicks or rust and for straightness of rod.
14. Check for condition of element; replace as necessary.
15. Check for proper inflation.
16. Check Inspection Decal for current inspection stamp.

SECTION 2 - PROCEDURES

Table 2-3. Preventive Maintenance and Safety Inspection

AREA	INTERVAL				
	10Hours (Daily)	50 Hours (Weekly)	200 Hours (Monthly)	500 Hours (3 Month)	1000 Hours (6 Month)
PLATFORM					
1. Controller	1,11				
2. Switches	1,11				
3. Placards and Decals	1,2				
4. Control Tags	1,2				
5. Hoses and Cables		4,8			
6. Wear Pads			8		
7. Handrails and Chains	1,4				
CHASSIS					
1. Engine Oil	3	5			
2. Battery	3	5			
3. Air Cleaner	1	14			
4. Exhaust System	1		1,5		
5. Engine Mounts			1		
6. Hydraulic Pump	1	5			
7. Valves	1	5			
8. Hydraulic Filter (See Lubrication Chart)		5,14	14		
9. Hydraulic Hoses and Tubing	1	5			
10. Hydraulic Oil Tank*	3	5	4		
11. Hydraulic Tank Breather		6,14			
12. Fuel Tank	3,5		4		
13. Lift Cylinder	1,12	5,6,13	4		
14. Limit Switch	1,7				
15. Tilt Alarm Switch					1,7
16. Placards and Decals	1,2				
17. Wheel and Tire Assemblies	1	8,9			
18. Drive Motors		1,5,6			
19. Drive Brakes		1,6	8		
20. Drive Torque Hubs		1,3,5,6			
21. Steer Cylinder	1	5,6,13	4		
22. Steer Components	1	4,6	8		
23. Wheel Bearings (2 Wheel Drive)			8	12	
24. Sizzor Arms	1,4				
25. Safety Props	1,4				
26. Sliding Wear Pads			8		
27. Pivot Pins/Bolts	1,4		7,8		
28. Switches, Ground Control	1,11				
29. Control Tags	1,2				

* Inspection and Maintenance code 10 to be performed annually

SECTION 3. TROUBLESHOOTING

3.1 GENERAL

This section contains troubleshooting information to be used for locating and correcting most of the operating problems which may develop in the aerial platform. If a problem should develop which is not presented in this section or which is not corrected by listed corrective actions, technically qualified guidance should be obtained before proceeding with any maintenance.

3.2 TROUBLESHOOTING INFORMATION

The troubleshooting procedures applicable to the aerial platform are listed and defined in following troubleshooting tables.

Each malfunction within an individual group or system is followed by a listing of probable causes which will enable determination of the applicable remedial action. The probable causes and the remedial action should, where possible, be checked in the order listed in the tables.

It should be noted that there is no substitute for a thorough knowledge of the equipment and related systems.

It should be recognized that the majority of the problems arising in the machine will be centered in the hydraulic and electrical systems. For this reason, every effort has been made to ensure that all likely problems in these areas are given the fullest possible treatment. In the remaining machine groups, only those problems which are symptomatic of greater problems which have more than one probable cause and remedy are included. This means that problems for which the probable cause and remedy may be immediately obvious are not listed in this section.

The first rule for troubleshooting any circuit that is hydraulically operated and electrically controlled is to determine if the circuit is lacking hydraulic oil and electrical control power. This can be ascertained by overriding the bypass valve (mechanically or electrically) so that oil is available to the function valve, then overriding the function valve mechanically. If the function performs satisfactorily, the problem exists with the control circuit.

3.3 HYDRAULIC CIRCUIT CHECKS

The first reference for improper function of a hydraulic system, where the cause is not immediately apparent, should be the Troubleshooting Chart. The best place to begin the problem analysis is at the power source (pump). Once it is determined that the pump is serviceable, then a systematic check of the circuit components, beginning with the control, would follow. For aid in troubleshooting, refer to the Illustrated Parts Manual for hydraulic diagrams of the various circuits

SECTION 3 - TROUBLESHOOTING

Table 3-1. Elevation System Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Platform Elevation System		
No Response to Lift Control		
	Enable switch not activated.	Activate enable switch.
	Lift control switch not activated within three seconds after enable switch is activated.	Activate enable switch, then activate lift control switch within three seconds.
	Enable circuit not functioning properly.	Replace enable circuit card.
	Lift control switch inoperative.	Repair or replace control switch.
	Hydraulic system oil low.	Replenish oil as necessary.
	Restricted or broken supply line on valve bank or pump.	Clean, repair or replace line.
	Control valve not functioning properly.	Repair or replace valve.
	Lift cylinder not functioning properly.	Repair or replace cylinder.
	Hydraulic pump not functioning properly.	Repair or replace pump.
Platform will not raise.		
	Enable switch not activated.	Activate enable switch.
	Lift control switch not activated within three seconds after enable switch is activated.	Activate enable switch, then activate lift control switch within three seconds.
	Enable circuit not functioning properly.	Replace enable circuit card.
	Load capacity exceeded. (Personnel and/or equipment on platform).	Reduce load. (Refer to capacity placard).
	Hydraulic system oil low.	Replenish oil as necessary.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Control valve not functioning properly.	Repair or replace valve.
	Lift cylinder not functioning properly.	Repair or replace lift cylinder.
	Engine does not respond when lift control switch is moved to up position.	Refer to Electrical System Troubleshooting - No response to control switch.
	No electrical signal being sent to lift up control valve cartridge.	Refer to Electrical System Troubleshooting - No response to control switch.
Platform will not lower		
	Enable switch not activated.	Activate enable switch.
	Lift switch not activated within three sec. after enable switch is activated.	Depress lift switch, then activate controller within three seconds.
	Enable circuit not functioning properly.	Replace enable circuit card.
	No electrical signal sent to lift down control valve cartridge.	Refer to Electrical System Troubleshooting - No response to control switch.
	Lift down control valve cartridge not functioning properly.	Repair or replace lift down control valve cartridge.
	Lift cylinder not functioning properly.	Repair or replace lift cylinder.
	Engine does not respond when lift switch is moved to down position.	Refer to Electrical System Troubleshooting - No response to control switch.
	No electrical signal being sent to lift down control valve.	Refer to Electrical System Troubleshooting - No response to control switch.

Table 3-1. Elevation System Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Platform raises and lowers erratically		
	Hydraulic system oil low.	Replenish oil as necessary.
	Restricted or broken hydraulic line or fitting.	Clean, repair or replace line.
	Counterbalance valve on lift cyl. improperly adjusted or not functioning properly.	Replace valve.
	Control valve not functioning properly.	Repair or replace valve.
	Worn seals in lift cylinder.	Replace seals.
	Lift cylinder not functioning properly.	Repair or replace lift cylinder.
Platform drifts down		
	Manual lowering valve not functioning properly.	Repair or replace valve.
	Worn seals in lift cylinder.	Replace seals.
	Holding valve on lift cylinder not functioning properly.	Repair or replace valve.
High Drive does not operate below horizontal		
	Damaged wiring on limit switch.	Repair or replace wiring.
	Damaged limit switch.	Replace limit switch

SECTION 3 - TROUBLESHOOTING

Table 3-2. Chassis Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Drive System		
No response to drive controller		
	Enable switch not activated. .	Activate enable switch
	Controller not activated within three seconds after enable switch is activated.	Activate enable switch, then activate drive controller within three seconds.
	Enable circuit not functioning properly.	Replace enable circuit card.
	Hydraulic system oil low.	Replenish oil as necessary.
	Hydraulic pump not functioning properly.	Repair or replace pump.
	Restricted or broken pump supply line.	Clean, repair or replace line.
	Drive motor not functioning properly.	Repair or replace motor.
	Damaged wiring on drive controller.	Repair or replace wiring.
	Drive controller not functioning properly.	Repair or replace controller.
	Drive brake not releasing.	Determine cause and repair or replace brake.
Machine drives erratically		
	Microcircuit on controller improperly adjusted.	Adjust microswitch on controller for proper operation.
Machine will not travel forward		
	Enable switch not activated.	Activate enable switch.
	Drive controller not activated within three seconds after enable switch is activated.	Activate enable switch, then activate drive controller within three seconds.
	Enable circuit not functioning properly.	Replace enable circuit card.
	Hydraulic system oil low.	Replenish oil as necessary.
	Restricted or broken hydraulic line or fitting.	Clean, repair or replace line or fitting.
	Control valve not functioning properly.	Repair or replace valve.
	Drive motor not functioning properly.	Repair or replace motor.
	Brake not functioning properly.	Repair or replace brake.
	Engine will not respond when enable switch is activated and drive controller is activated .	Refer to Electrical System Troubleshooting - No response to control switch.
	No electrical signal being sent to the drive valve cartridge.	Refer to Electrical System Troubleshooting - No response to control switch.
Machine will not travel in reverse		
	See: Machine will not travel forward.	

Table 3-2. Chassis Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
High-Speed Drive function does not operate		
	Loose or damaged wiring between drive controller and High Speed switch.	Ensure proper connection of wires. Using suitable test meter, perform continuity test on wiring between switches. Repair or replace wires as necessary.
	Defective high speed control switch.	Replace high speed control switch.
	Loose or damaged wiring in control box wire harness.	Ensure proper connection of wires at the control switch. Using suitable test meter, perform continuity test on wires. Repair or replace harness as necessary.
	Loose or damaged wiring between platform and high speed solenoid.	Ensure proper connection of wires at the platform and at the high speed solenoid. Using suitable test meter, perform continuity test on wires. Repair or replace wires as necessary.
	High speed solenoid not functioning properly.	Replace solenoid.
	Loose or damaged wiring between high speed relay and high speed limit switch.	Ensure proper connection of wires between high speed relay and high speed limit switch. Using suitable test meter, perform continuity test on wires. Repair or replace wires as necessary.
	High speed limit switch not functioning properly.	Repair or replace limit switch.
	Loose or damaged wiring in valve wiring harness.	Ensure proper connection of wires at terminal strip. Using suitable test meter, perform continuity test on wires. Repair or replace wires as necessary.
Steering System		
No response to steer control switch on controller		
	Steer switch on controller not functioning properly.	Repair or replace switch.
	Hydraulic system oil low.	Replenish oil as necessary.
	Hydraulic system pressure too low.	Adjust pressure.
	Loose or damaged wiring on control switch or solenoid valve.	Ensure proper connection of wires at control switch or solenoid valve. Using suitable test meter, perform continuity test on wires. Repair or replace wires as necessary.
	Restricted or broken hydraulic line on valve bank or hydraulic pump.	Clean, repair or replace line.
	Control valve not functioning properly.	Repair or replace valve.
	Steer cylinder not functioning properly.	Repair or replace cylinder.
Machine hard to steer or steering is erratic		
	Hydraulic system oil low.	Replenish oil as necessary.
	Restricted or broken hydraulic line or fitting.	Clean, repair or replace line or fitting.

SECTION 3 - TROUBLESHOOTING

Table 3-2. Chassis Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Machine hard to steer or steering is erratic (cont.)		
	Lack of lubrication on steer components.	Lubricate steer components in accordance with Lubrication Chart.
	Restricted crossover relief valve.	Clean or replace valve.
	Steer system pressure low.	Adjust pressure.
	Bent steering linkage.	Repair or replace linkage as required.
	Hydraulic pump not functioning properly.	Repair or replace valve.
	Steer cylinder not functioning properly.	Repair or replace cylinder.
Steering inoperative		
	Steer switch on controller not functioning properly.	Repair or replace switch.
	Hydraulic system pressure too low.	Adjust pressure.
	Loose or damaged wiring on control switch or solenoid valve.	Ensure proper connection of wires at control switch or solenoid valve. Using suitable test meter, perform continuity test on wires. Repair or replace wires as necessary.
	Solenoid valve not functioning properly.	Repair or replace valve.
	Restricted or broken hydraulic line on valve bank or hydraulic pump.	Clean, repair or replace line.
	Relief valve improperly set or not functioning properly.	Reset, repair or replace valve as necessary.
	Steer cylinder not functioning properly.	Repair or replace cylinder.
Machine will not steer left or right		
	Steer switch on controller not functioning properly.	Replace controller.
	Wiring on steer control switch is damaged.	Repair or replace wiring.
	Wiring on solenoid valve damaged.	Repair or replace wiring.
	Coil in solenoid damaged.	Replace coil.
	Bent cylinder rod.	Repair or replace cylinder.
	Damaged steer linkage.	Repair or replace steer linkage.
Machine wanders; steering not firm		
	Crossover relief valve set too low or not functioning properly.	Reset, repair or replace valve as necessary.
	Steer linkage loose.	Tighten linkage.
	Spindle bushings badly worn.	Replace bushings.

Table 3-3. Hydraulic System Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Hydraulic System - General		
Hydraulic Pump Noisy		
	Air bubbles in oil. (Reservoir too low.)	Replenish oil as necessary.
	Oil filter dirty.	Clean and/or replace filter as necessary.
Pump cavitating. (Vacuum in pump due to oil starvation)		
	Oil in reservoir low .	Replenish oil as necessary.
	Restricted reservoir air vent.	Clean vent.
	Oil viscosity too high.	Drain system and replace with recommended oil. Refer to Hydraulic Oil.
System overheating		
	Oil viscosity too high.	Drain system and replace with recommended oil. Refer to Hydraulic Oil.
	Main relief valve set too high.	Adjust relief valve to proper pressure.
	Hydraulic system oil low.	Replenish oil as necessary.
Pump not delivering oil		
	Defective pump.	Repair or replace pump.
System pressure too low		
	Main relief valve set too low. .	Reset valve as required
	Hydraulic pump not functioning properly.	Repair or replace pump.
	Leak in component, line or fitting.	Repair or replace component, line or fitting.
	Scored valve spool; scored cylinder.	Replace valve; replace cylinder.
System(s) operate erratically		
	Sticking or binding valve cartridge, piston rod, etc..	Clean, repair or replace components as necessary
	Hydraulic oil not at operating temperature.	Allow oil sufficient time to warm up.

SECTION 3 - TROUBLESHOOTING

Table 3-4. Electrical System Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Hand Controller		
Valve will not function when handle is moved in either direction.		
	Enable switch not activated.	Activate enable switch.
	Controller not activated within three seconds after enable switch is activated.	Activate enable switch, then activate controller within three seconds.
	Enable circuit not functioning properly.	Replace enable circuit card.
	No electrical power to handle.	Check electrical input to hand controller (12 Volts).
	No electrical power to valve.	Check electrical output of printed circuit board and electrical signal at the valve.
	Improper ground.	Check for proper grounding of handle.
Control Switches		
No response to a function control switch		
	Enable switch not activated.	Activate enable switch.
	Control switch not activated within three seconds after enable switch is activated.	Activate enable switch, then activate control switch within three seconds.
	Enable circuit not functioning properly.	Replace enable circuit card.
	Applicable emergency stop switch not positioned properly.	Place applicable emergency stop switch to on
	Power selector switch on ground control box not positioned properly. .	Place power selector switch to platform or ground, as required.
	Circuit breaker open.	Determine and correct cause. Reset circuit breaker.
	No voltage present at emergency stop switch.	Check battery cable from battery to emergency stop switch for proper connection or damage. Repair or replace cable as necessary.
	EMERGENCY STOP switch not functioning properly.	Replace switch.
	No voltage supplied to engine start relay from emergency stop switch.	Check battery cable from emergency stop switch to start relay for proper connection or damage. Repair or replace cable as necessary.
	No voltage input at terminal strip.	Check wire from battery to terminal strip for proper connection or damage. Repair or replace wire as necessary.
	No voltage present at circuit breaker.	Check wire from terminal strip to circuit breaker for proper connection or damage. Repair or replace wire as necessary.
	Defective circuit breaker.	Replace circuit breaker.
	No voltage present at function control switch..	Check wiring from emergency stop switch to function control switch for proper connection or damage. Repair or replace wiring as necessary.
	Defective function control switch.	Replace function control switch.

Table 3-4. Electrical System Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
No response to a function control switch (cont.)		
	No voltage present at applicable control valve coil.	Check applicable wire for proper connection at terminal strip, valve harness plug pin, valve harness receptacle pin and engine start relay. Using suitable test meter, perform continuity test on wire. Repair or replace wire or harness as necessary.
	No voltage supplied from terminal strip to engine start relay.	Check applicable wire for proper connection at terminal strip, valve harness plug pin, valve harness receptacle pin and engine start relay. Using suitable test meter, perform continuity test on wire. Repair or replace wire or harness as necessary.
	Defective engine start relay.	Replace engine start relay.
	No voltage supplied to engine from start relay.	Check battery cable from relay to engine for proper connection or damage. Repair or replace cable as necessary.
	No voltage present at applicable control valve coil.	Check applicable wire for proper connection at terminal strip, valve harness plug pin, valve harness receptacle pin and valve coil. Using suitable test meter, perform continuity check on wires. Repair or replace harness as necessary.
	NO TERMINAL STRIPS!!!!!!! No voltage supplied from terminal strip to electric motor start relay.	Check applicable wire for proper connection at terminal strip, valve harness plug pin, valve harness receptacle pin and electric motor start relay. Using suitable test meter, perform continuity test on wire. Repair or replace wire as necessary.
	Defective electric motor start relay.	Replace electric motor start relay.
	No voltage supplied to motor from start relay.	Check battery cable from relay to motor for proper connection or damage. Repair or replace wire as necessary.
	Defective motor/pump assembly.	Replace motor/pump assembly.

SECTION 3 - TROUBLESHOOTING

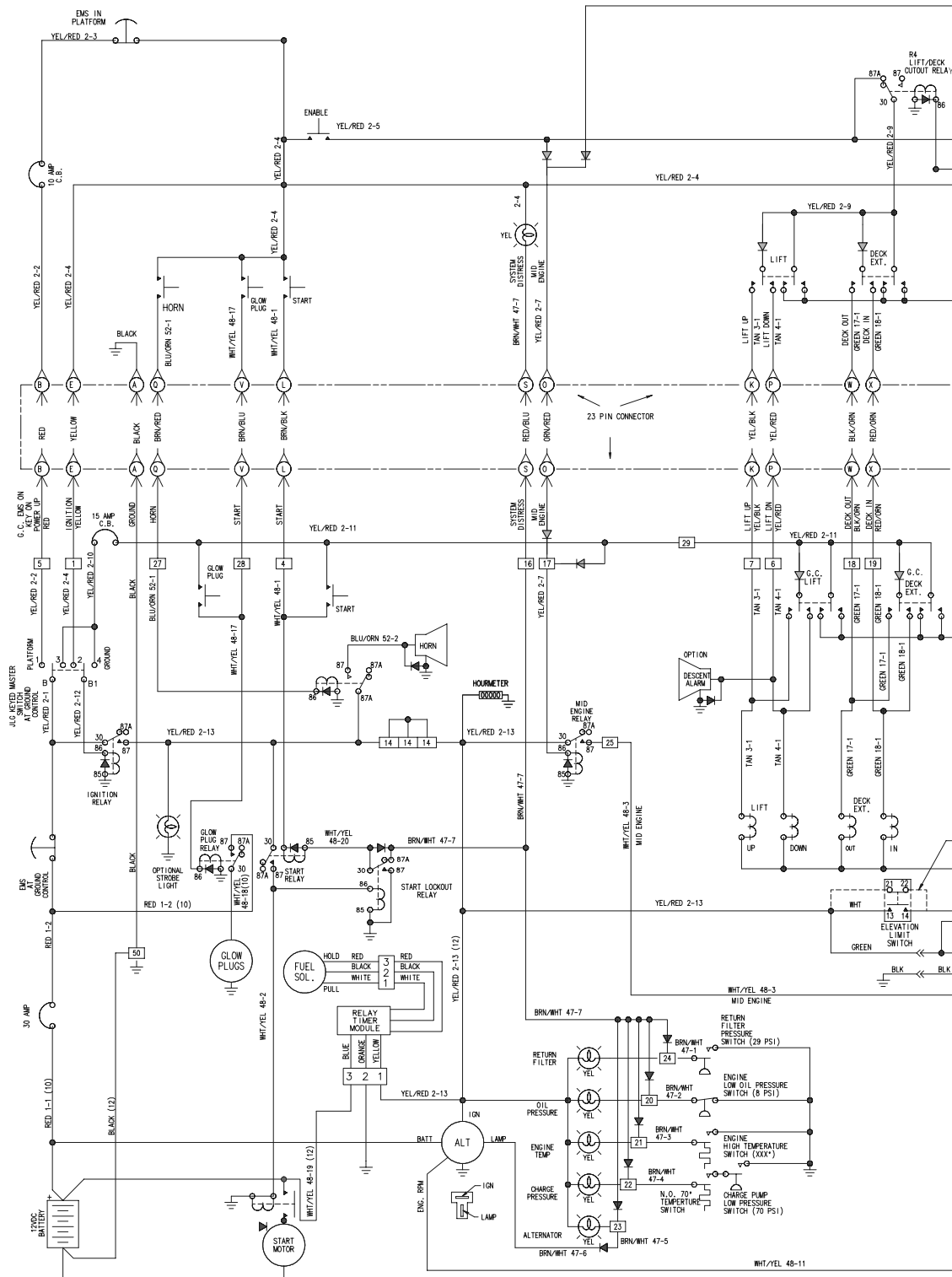


Figure 3-1. Electrical Schematic - Yanmar (Sheet of 1 of 2)

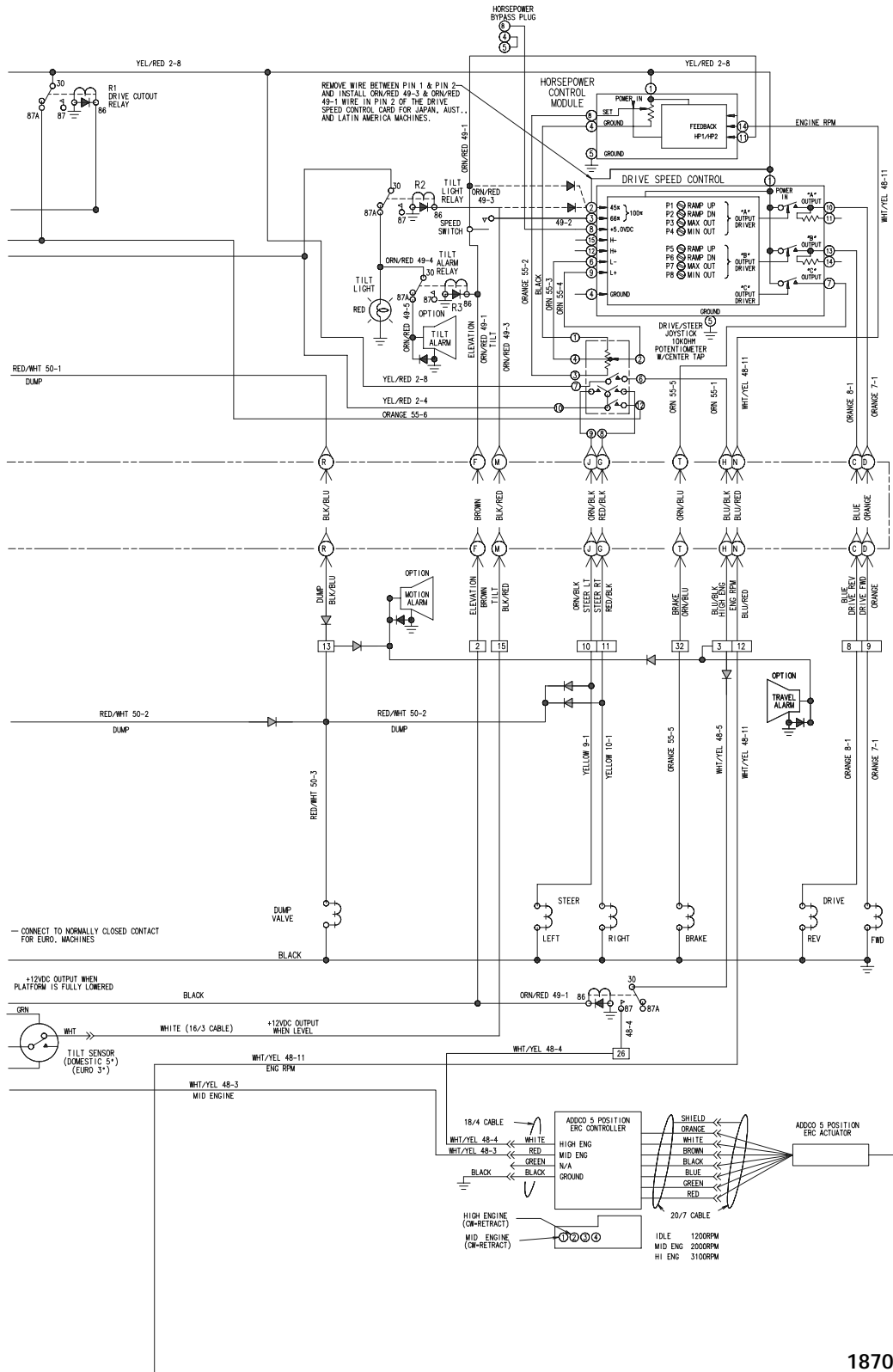


Figure 3-2. Electrical Schematic - Yanmar (Sheet of 2 of 2)

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SECTION 3 - TROUBLESHOOTING

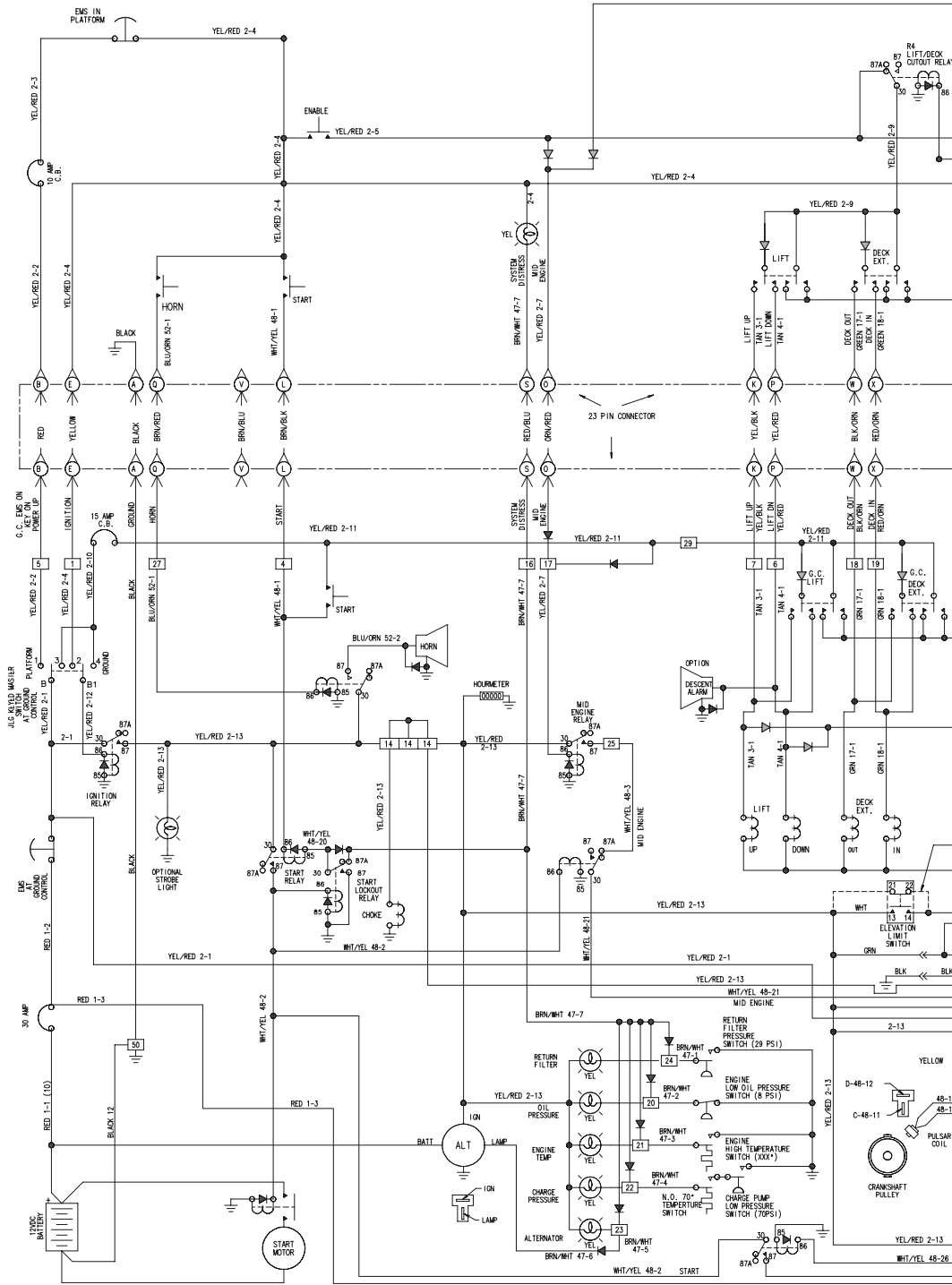
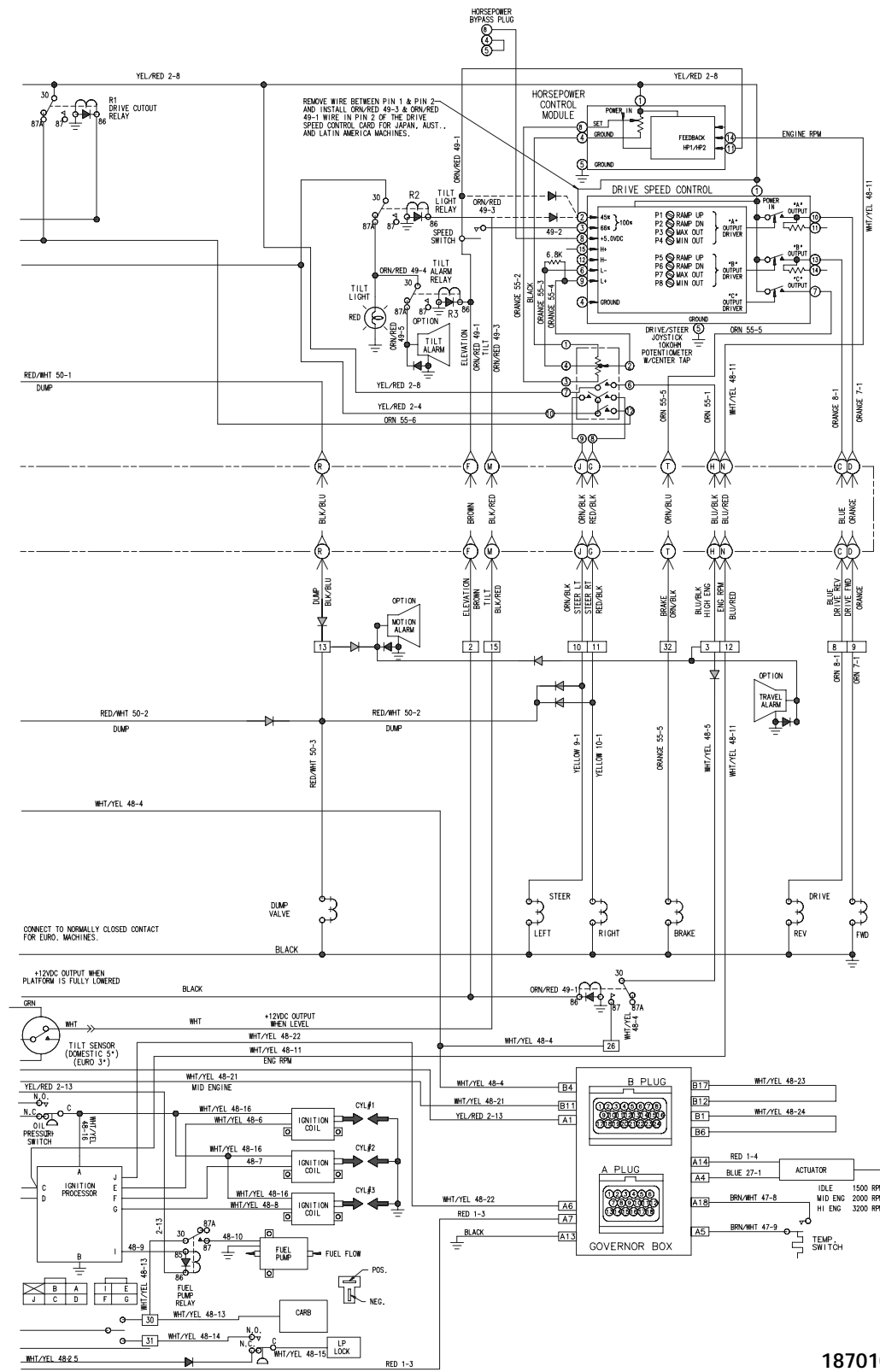


Figure 3-3. Electrical Schematic - Daihatsu (Sheet 1 of 2)



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Figure 3-4. Electrical Schematic - Daihatsu (Sheet 2 of 2)

SECTION 3 - TROUBLESHOOTING

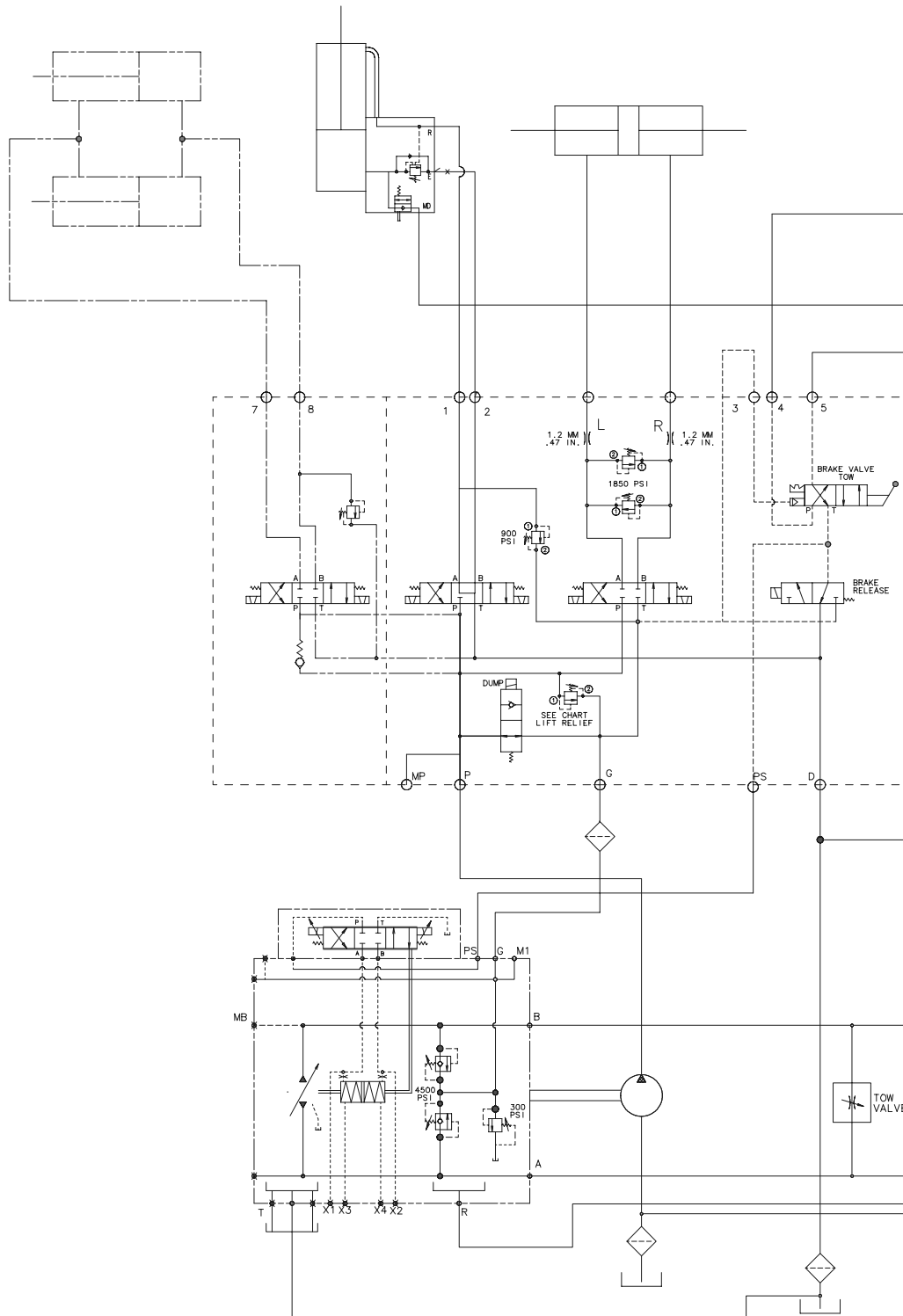


Figure 3-5. Hydraulic Schematic (Sheet 1 of 2)

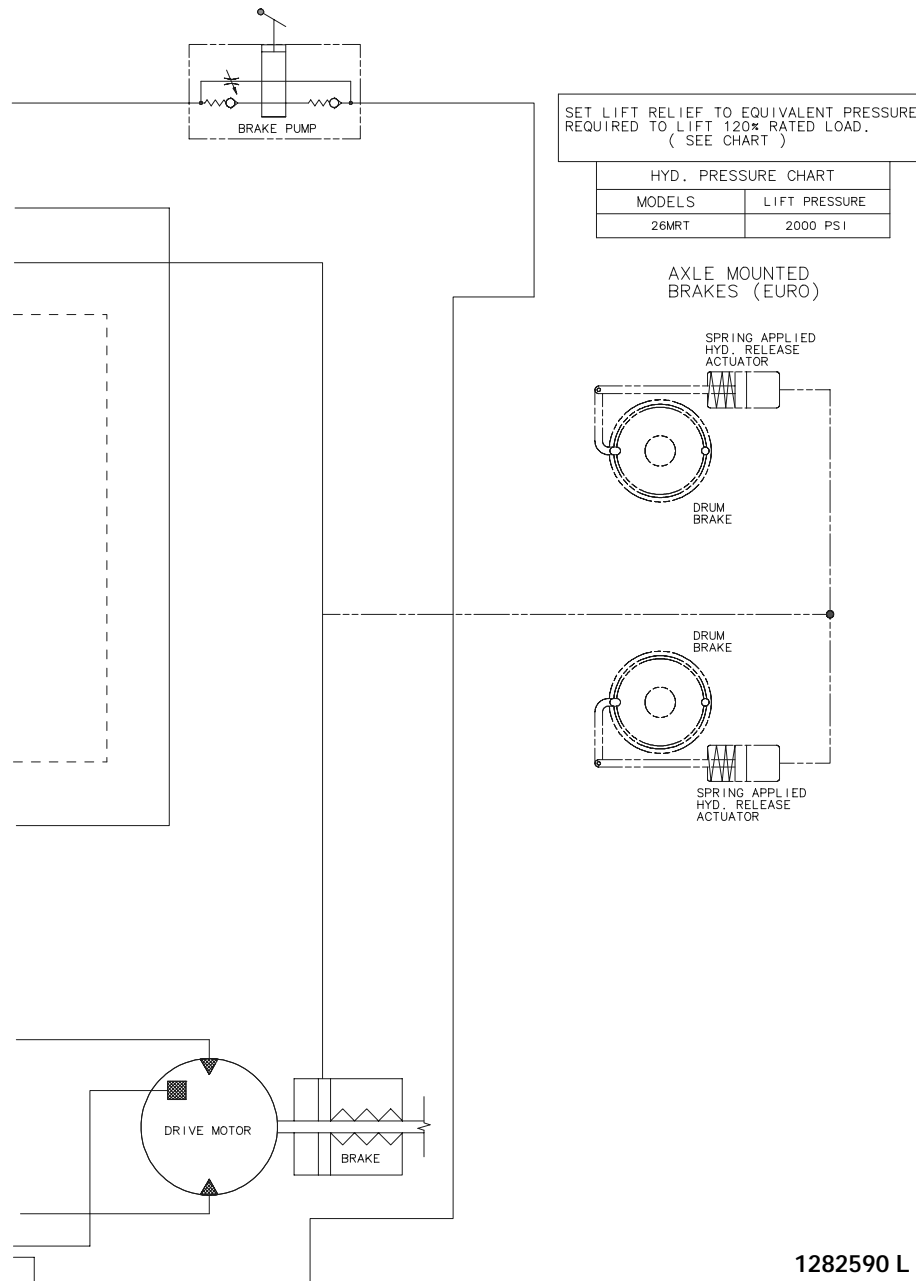


Figure 3-6. Hydraulic Schematic (Sheet 2 of 2)

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