THIS MANUAL CONTAINS INSTRUCTIONS FOR THE SERVICE, ADJUSTMENTS AND MAINTENANCE OF THE MP SERIES SIMON AERIAL BOOM LIFT.

IT IS INTENDED TO BE USED IN CONJUNCTION WITH AND AS A SUPPLEMENT TO THE OPERATORS, PARTS AND COMPONENT REPAIR MANUALS WHICH ARE PROVIDED SEPARATELY.

THE MP SERIES MOBILE PLATFORM HAS BEEN DESIGNED AND BUILT TO PROVIDE THE CUSTOMER WITH MANY YEARS OF DEPENDABLE SERVICE. THE FULL BENEFITS PROVIDED BY THIS MACHINE CAN BE DERIVED ONLY BY FOLLOWING THE PROPER OPERATING AND MAINTENANCE PROCEDURES. ONLY TRAINED AND AUTHORIZED PERSONNEL SHOULD OPERATE AND SERVICE THIS EQUIPMENT. OPERATORS AND SERVICE PERSONNEL SHOULD STUDY THESE MANUALS TO ASSURE THAT THEY HAVE A THOROUGH UNDERSTANDING OF THE CONTENTS WHICH PERTAIN TO THEIR PARTICULAR RESPONSIBILITIES.

OPERATORS MUST ALSO UNDERSTAND ALL WARNINGS AND INSTRUCTIONS ON THE BODY OF THE MACHINE AND CONTROL CONSOLES.

MODIFICATIONS FROM THE ORIGINAL DESIGN OF THIS EQUIPMENT ARE STRICTLY FORBIDDEN WITHOUT WRITTEN PERMISSION FROM SIMON AERIALS, INC.

SIMON AERIALS, INC. RESERVES THE RIGHT TO IMPROVE AND EXPAND PRODUCT FEATURES ON ITS EQUIPMENT. THEREFORE, SPECIFICATIONS AND/OR EQUIPMENT IS SUBJECT TO CHANGE WITHOUT PRIOR NOTICE. THESE MANUALS ARE PERIODICALLY UPDATED TO REFLECT ANY CHANGES THAT OCCURRED BETWEEN PRINTINGS. IT IS THEREFORE RECOMMENDED THAT USERS CONTACT SIMON AERIALS, INC. FOR LATEST INFORMATION REGARDING THIS EQUIPMENT.
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<td>HYDRAULIC SCHEMATIC</td>
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<td></td>
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</tbody>
</table>
ADJUSTMENTS

Two Speed Drive Limit Switches - are located at the front end of the base boom. Adjust the limit switch lever arms for proper operation. Refer to the Drive System section for specifications.

Unit Speed - is adjusted by two adjustable flow control valves located at the directional control valve. By loosening the lock nut, speeds can be increased or decreased as needed by turning the knurled knob.

Brakes - are set at the factory for shipment of the unit only! They should be reset for ground operation upon receipt of the unit. Proper ground operation setting should be approx. 1½ turns from the closed position.

Solenoid Actuators - MUST be bottomed out for full throw of the linkage. When bottomed out, the rod activates a hold coil relieving the high amperage pull coil. If the pull coil does not disengage, the solenoid will burn out.

Boom Extend Chain Adjustment - should be as follows: one inch of droop or chain sag for every ten feet of the unit. Example: 6" = 60' Adjustment is accomplished by tightening or loosening the chain anchor adjusting bolts located on the mid boom section.

IMPORTANT!!! MAINTAIN EQUAL TENSION ON BOTH CHAINS WHEN ADJUSTING.
Swing Gear & Pinion Shaft Backlash - should be set with ZERO BACKLASH! Also note, NO PRE-LOAD of the pinion shaft to the swing bearing is allowed! To adjust, loosen the gear box side lock bolts and adjust the front lock bolts until the proper backlash is attained. After proper adjustment has been made, retighten the side lock bolts and retorque the foot mount plate bolts.

Vertical Swing Reducer Adjustment -

When adjusting the vertical swing reducer assembly, the eccentric bushing located under the reducer must be turned. To accomplish this, remove the locking "T" plate which locks the eccentric bushing in place. This is located on the superstructure in front of the swing reducer. Loosen the foot mount plate bolts and turn the eccentric bushing by means of a screwdriver or any flat object. NOTE: NO BACKLASH OR PINION PRE-LOAD IS ALLOWED IN ADJUSTMENTS!!!!!! After adjustment has been completed, replace the locking "T" plate and retorque the foot plate bolts.

Main Pump Adjustment: John Deere Pump -

To adjust the system pressure, locate the adjusting screw on the side of the main pump adapter plate. Loosen the lock nut and while viewing the pressure gauge, set system pressure to setting specified on the unit serial number tag. After system pressure has been attained, lock the adjustment screw in place. Again re-stroke the pump and check setting on the pressure gauge.

Emergency Pump System Pressure Adjustment -

System pressure is adjusted on the emergency pump by removing the cap over the adjustment screw and turning the screw in or out to increase or decrease pressure accordingly. NOTE: SYSTEM PRESSURE MUST NOT BE ADJUSTED WITHOUT THE USE OF A PRESSURE GAUGE!!!!!!!!
Low Speed Drive - is adjusted by means of a potentiometer wired thru the H-1 circuit to the Drive Circuit Board. When raised and telescopied, adjust pot. to designated speed on Speeds Chart. This chart is located in the Service Manual. Low speed drive should be approximately .5 MPH while high speed drive is approx. 3 MPH.

Engine RPM's

Wisconsin V465 65HP 2500 RPM
VH4D 30HP 2500 RPM
W4-1770 35HP 2600 RPM

Duetz Diesel Idle 1800 RPM

Ford Idle RPM
2.3 Litre 4 Cylinder & High 2750 RPM
4.9 Litre 6 Cylinder
### Bolt Torque Specification For Current Production Models

<table>
<thead>
<tr>
<th>Model</th>
<th>Upper Bearing &amp; Lower Bearing</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPN 30</td>
<td>9/16-12 Grade 8 bolt w/hardened flatwasher torque to 120 ft/lbs.</td>
</tr>
<tr>
<td>MPN 40</td>
<td>5/8-11 Grade 8 bolts w/hardened flatwasher</td>
</tr>
<tr>
<td>MP 50</td>
<td>Torque to 170 ft/lbs</td>
</tr>
<tr>
<td>MPN 55</td>
<td></td>
</tr>
<tr>
<td>MP 60</td>
<td>3/4-16 Grade 8 bolts w/hardened flatwasher</td>
</tr>
<tr>
<td>MPH 60</td>
<td>Torque to 340 ft/lbs</td>
</tr>
<tr>
<td>MP 70</td>
<td></td>
</tr>
<tr>
<td>MP 80</td>
<td></td>
</tr>
<tr>
<td>MP 80N</td>
<td></td>
</tr>
</tbody>
</table>

#### Wheel Torque

<table>
<thead>
<tr>
<th>Model</th>
<th>Front Wheel</th>
<th>Rear Wheel</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPN 30</td>
<td>9/16-18 Grade 5 stud w/lug nut and flatwasher. Torque to 95 ft/lbs</td>
<td>1/2-13 Grade 8 bolt w/lockwasher, torque to 85 ft/lbs.</td>
</tr>
<tr>
<td>MPN 40</td>
<td>9/16-18 Grade 5 stud w/lug nut &amp; flatwasher</td>
<td>1/2-20 Grade 5 stud w/lug nut and flatwasher</td>
</tr>
<tr>
<td>MP 50</td>
<td>Torque to 95 ft/lbs</td>
<td>Torque to 70 ft/lbs</td>
</tr>
<tr>
<td>MPN 55</td>
<td>3/4-16 Grade 5 stud w/lug nut. Torque to 200 ft/lbs.</td>
<td>3/4-16 Grade 5 stud w/lug nut. Torque to 200 ft/lbs.</td>
</tr>
<tr>
<td>MP 60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPL 60</td>
<td></td>
<td></td>
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<tr>
<td>MP 70</td>
<td></td>
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</tr>
<tr>
<td>MP 80</td>
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</tr>
</tbody>
</table>

**NOTE:** ALL BOLT TORQUES ARE CALCULATED USING A LUBRICATED TORQUE SPEC. LUBRICATE ALL BOLTS BEFORE INSTALLATION.
<table>
<thead>
<tr>
<th>Model</th>
<th>Drive Hub Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPN 30</td>
<td>5/8-11 Grade 5 bolts w/lockwasher torque to 120 ft/lbs</td>
</tr>
<tr>
<td>MPN 40</td>
<td>1/2-13 Grade 8 bolts w/lockwasher torque to 85 ft/lbs</td>
</tr>
<tr>
<td>MP 40</td>
<td></td>
</tr>
<tr>
<td>MP 50</td>
<td></td>
</tr>
<tr>
<td>MPN 55</td>
<td>5/8-11 Grade 5 bolts w/lockwasher torque to 120 ft/lbs</td>
</tr>
<tr>
<td>MP 60</td>
<td></td>
</tr>
<tr>
<td>MPL 60</td>
<td></td>
</tr>
<tr>
<td>MP 70</td>
<td></td>
</tr>
<tr>
<td>MP 80</td>
<td></td>
</tr>
<tr>
<td>MP 80N</td>
<td></td>
</tr>
</tbody>
</table>
### Recommended Torque Specifications

**TORQUE IN (LBS.-FT.)**

**BOLTS, CAPSCREWS, STUDS AND NUTS**

**Grade 5 Identification, 3 Radial Dashes 120° Apart on Head of Bolt**

**Grade 8 Identification, 6 Radial Dashes 60° Apart on Head of Bolt**

#### Grade 5

<table>
<thead>
<tr>
<th>Threads</th>
<th>Dry</th>
<th>Lubricated or Plated</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 - 16</td>
<td>31 - 34</td>
<td>23 - 25</td>
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<tr>
<td>20 - 14</td>
<td>49 - 54</td>
<td>37 - 41</td>
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<tr>
<td>18 - 13</td>
<td>75 - 83</td>
<td>57 - 63</td>
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<tr>
<td>16 - 12</td>
<td>109 - 120</td>
<td>82 - 90</td>
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<tr>
<td>14 - 11</td>
<td>150 - 165</td>
<td>113 - 124</td>
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<tr>
<td>10 - 10</td>
<td>266 - 293</td>
<td>200 - 220</td>
</tr>
<tr>
<td>9 - 9</td>
<td>374 - 433</td>
<td>296 - 326</td>
</tr>
<tr>
<td>8 - 8</td>
<td>591 - 649</td>
<td>443 - 489</td>
</tr>
<tr>
<td>7 - 7</td>
<td>794 - 873</td>
<td>596 - 656</td>
</tr>
<tr>
<td>7 - 7</td>
<td>1120 - 1232</td>
<td>840 - 924</td>
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</table>

#### Grade 3

<table>
<thead>
<tr>
<th>Threads</th>
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</thead>
<tbody>
<tr>
<td>24 - 16</td>
<td>31 - 34</td>
<td>23 - 25</td>
</tr>
<tr>
<td>20 - 14</td>
<td>49 - 54</td>
<td>37 - 41</td>
</tr>
<tr>
<td>18 - 13</td>
<td>75 - 83</td>
<td>57 - 63</td>
</tr>
<tr>
<td>16 - 12</td>
<td>109 - 120</td>
<td>82 - 90</td>
</tr>
<tr>
<td>14 - 11</td>
<td>150 - 165</td>
<td>113 - 124</td>
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<tr>
<td>10 - 10</td>
<td>266 - 293</td>
<td>200 - 220</td>
</tr>
<tr>
<td>9 - 9</td>
<td>374 - 433</td>
<td>296 - 326</td>
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<tr>
<td>8 - 8</td>
<td>591 - 649</td>
<td>443 - 489</td>
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<tr>
<td>7 - 7</td>
<td>794 - 873</td>
<td>596 - 656</td>
</tr>
<tr>
<td>7 - 7</td>
<td>1120 - 1232</td>
<td>840 - 924</td>
</tr>
</tbody>
</table>

**APPROVED BY AXLE ENGINEERING**

**REVISED JANUARY 8TH, 1962**
<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>MP40</th>
<th>MN40</th>
<th>MP60</th>
<th>MPL60</th>
<th>MP80</th>
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</thead>
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<tr>
<td>High speed Drive-5 Revolutions</td>
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<td>10-13</td>
<td>12-15</td>
<td>18-21</td>
<td>12-15</td>
</tr>
<tr>
<td>Low speed Drive-5 Revolutions</td>
<td>60-75</td>
<td>60-75</td>
<td>75-100</td>
<td>90-110</td>
<td>75-100</td>
</tr>
<tr>
<td>Boom Up Function</td>
<td>36-40</td>
<td>36-40</td>
<td>75-80</td>
<td>65-70</td>
<td>90-95</td>
</tr>
<tr>
<td>Boom Down Function</td>
<td>47-53</td>
<td>47-53</td>
<td>82-89</td>
<td>72-82</td>
<td>105-110</td>
</tr>
<tr>
<td>Boom Extend</td>
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<td>32-35</td>
<td>45-50</td>
<td>38-47</td>
<td>60-65</td>
</tr>
<tr>
<td>Boom Retract</td>
<td>53-57</td>
<td>53-57</td>
<td>45-50</td>
<td>56-72</td>
<td>60-65</td>
</tr>
<tr>
<td>Swing - 90 Degrees Right &amp; Left Within 6%</td>
<td>30-33</td>
<td>30-33</td>
<td>40-45</td>
<td>40-45</td>
<td>60-65</td>
</tr>
</tbody>
</table>

Note: These speeds may vary per unit due to special construction applications. The speeds listed above are for current standard production models manufactured from current Simon specification data sheets.
<table>
<thead>
<tr>
<th>Nomenclature</th>
<th>Specification and Level Fill</th>
<th>Interval</th>
<th>Fig. Item</th>
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<tr>
<td>Drive Wheel Power Hubs</td>
<td>SAE 90</td>
<td>Initial 100 HRS. then yearly or 1000 HRS, whichever comes first</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>SAE 85-140</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>½ Full</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine Oil</td>
<td>Summer SAE 10W40</td>
<td>Initial 50 HRS. then every 100 HRS. or sooner if the oil is dirty</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Winter SAE 10W30</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>To Full mark on Dip Stick</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydraulic Fluid</td>
<td>To Full mark on gauge with boom down and retracted Mobil DTE-13 Petro Prod. DTE-13 after Aug.1983</td>
<td>Analysis for serviceability 6 months, change every year</td>
<td>11</td>
</tr>
<tr>
<td>Boom Wear Pads</td>
<td>Spray Silicone</td>
<td>Every 6 months</td>
<td>16</td>
</tr>
<tr>
<td>Turntable Swing Bearing</td>
<td>Til new grease comes out at 45° intervals EP N.L.G.i. #2</td>
<td>Monthly or 100 HRS. whichever comes first</td>
<td>3</td>
</tr>
<tr>
<td>Cylinder Pins</td>
<td>Til new grease comes out EP N.L.G.i.#2</td>
<td>Monthly or 100 HRS. whichever comes first</td>
<td>6</td>
</tr>
<tr>
<td>Gasoline</td>
<td>Regular</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Diesel Fuel</td>
<td>Type II</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Steering Spindles</td>
<td>Til new grease comes out EP N.L.G.i. #2</td>
<td>Monthly or 100 HRS. whichever comes first</td>
<td>4</td>
</tr>
<tr>
<td>Wheel Bearings</td>
<td>Clean and repack EP N.L.G.i. #2</td>
<td>Yearly or 1000 HRS. whichever comes first</td>
<td>7</td>
</tr>
<tr>
<td>NOMENCLATURE</td>
<td>SPECIFICATION &amp; FILL LEVEL</td>
<td>INTERVAL</td>
<td></td>
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<tr>
<td>---------------------------------------</td>
<td>-----------------------------</td>
<td>-------------------------------</td>
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<tr>
<td>SWING REDUCER (SWING DRIVE)</td>
<td>OIL SAE 85-140</td>
<td>INITIAL 100 HRS. THEN EVERY YEAR OR 2000 HRS. WHICHEVER COMES FIRST</td>
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<tr>
<td></td>
<td>SAE 90W OR GREASE</td>
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<tr>
<td></td>
<td>EP N.L.G.I. #1 WINTER</td>
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<td>EP N.G.L.I. #0</td>
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<tr>
<td>BOOM CHAIN SPROCKETS OF SHEAVES</td>
<td>EP N.G.L.I. #2 UNTILL NEW GREASE COMES OUT</td>
<td>MONTHLY OR 100 HRS. WHICHEVER COMES FIRST</td>
<td></td>
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<tr>
<td>BOOM CHAIN</td>
<td>WD 40 OR PENETRATING OIL</td>
<td>MONTHLY OR 100 HRS. WHICHEVER COMES FIRST</td>
<td></td>
</tr>
<tr>
<td>PLATFORM ROTATE MECHANISM</td>
<td>MULTI PURPOSE N.G.L.I. #2 UNTILL NEW GREASE COMES OUT</td>
<td>MONTHLY OR 100 HRS. WHICHEVER COMES FIRST</td>
<td></td>
</tr>
<tr>
<td>PLATFORM ROTATE TRU NION (EARLY MODEL MACHINES)</td>
<td>MULTI PURPOSE N.G.L.I. #2 UNTILL NEW GREASE COMES OUT</td>
<td>MONTHLY OR 100 HRS. WHICHEVER COMES FIRST</td>
<td></td>
</tr>
<tr>
<td>STEERING TIE ROD ENDS</td>
<td>EP N.G.L.I. #2 UNTILL NEW GREASE COMES OUT</td>
<td>MONTHLY OR 100 HRS. WHICHEVER COMES FIRST</td>
<td></td>
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</table>
LUBRICATION DIAGRAM
Mobil D.T.E.® 10
Series
PREMIUM HYDRAULIC OILS

The Mobil D.T.E. 10 Series of hydraulic oils was developed specifically to meet the requirements of modern hydraulic systems that must operate at low ambient temperatures or under widely varying ambient temperature conditions. In the marine trade, hydraulically operated deck and cargo handling equipment may be required to operate under tropic conditions at one port and under arctic conditions at the next port within a short period of time. These conditions require that the fluid has sufficiently low viscosity to permit start up of the equipment at the subzero ambient temperatures encountered, yet has sufficiently high viscosity to maintain system efficiency and minimize internal leakage when the system is fully warmed up or high ambient temperatures are encountered. These requirements can be met only by fluids with viscosity indices considerably higher than those of normal petroleum oils, and the fluids must be formulated so that mechanical shearing in the pumps and hydraulic elements does not cause excessive loss of VI and viscosity in service. In addition, these fluids must have the antiwear characteristics required for modern, high pressure hydraulic systems, give long service life, prevent rusting, separate readily from water, and resist foaming in service.

PRODUCT DESCRIPTION

The Mobil D.T.E. 10 Series are very high VI oils with carefully controlled low temperature flow properties. They are manufactured from highly refined base oils combined with selected VI improvers. Antiwear agents, rust and oxidation inhibitors, and a defoamant are also included. All components are selected and balanced to maintain, as nearly as possible, the good air release and water separation properties of the base oils.

In the development of the Mobil D.T.E. 10 Series particular attention was paid to the requirements of systems that must operate under widely varying ambient temperature conditions. A survey was conducted with major builders of marine hydraulic equipment and, based on their requirements, the viscosities of the series were selected. The survey uncovered a requirement for fluids with low, controlled viscosities at subzero temperatures, and viscosities high enough at the maximum anticipated operating temperatures to maintain system efficiency and minimize internal leakage. These desired viscosity-temperature characteristics are obtained in the Mobil D.T.E. 10 Series by selection of base oils with excellent low temperature flow properties and high VI and by the addition of a shearstable VI improver to the base blends. The VI improver used is selected for high resistance to shearing and viscosity loss under the conditions encountered in hydraulic systems. This shear resistance is illustrated by the results of a severe Diesel Injector Shear Test in which no member of the series exceeded 10 to 15 percent loss in viscosity at 100 °F (38 °C) after 10 passes through the injector.

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</thead>
<tbody>
<tr>
<td>API Gravity</td>
<td>31.9</td>
<td>29.2</td>
<td>28.6</td>
<td>27.4</td>
<td>27.5</td>
<td>27.1</td>
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<tr>
<td>Specific Gravity</td>
<td>0.866</td>
<td>0.861</td>
<td>0.884</td>
<td>0.883</td>
<td>0.890</td>
<td>0.892</td>
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<tr>
<td>Flash Point, °C/F</td>
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<td>165</td>
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<td>Pour Point, max. °C/F</td>
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<tr>
<td>Viscosity</td>
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</tr>
<tr>
<td>cSt 40°C</td>
<td>15.0/16.5</td>
<td>32/34</td>
<td>48/49</td>
<td>68/72</td>
<td>100/104</td>
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<td>100°C</td>
<td>4.12</td>
<td>8.37</td>
<td>8.26</td>
<td>10.57</td>
<td>12.87</td>
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<tr>
<td>cSt 100°F (37.8°C)</td>
<td>17.41</td>
<td>36.05</td>
<td>52.42</td>
<td>76.91</td>
<td>113.02</td>
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<td>210°F (98.9°C)</td>
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<td>@ 0°F, max</td>
<td>500</td>
<td>1250</td>
<td>2500</td>
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<td>4.7</td>
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Contamination Checks:

A. Comply with a contamination analysis using the following as a guide in determining the requirement. By utilizing a hydraulic system check, the life of the Simon Aerial's lift will be enhanced.

1. Change the hydraulic fluid any time the engine driven pump is changed.

2. If fluid discoloration is evident in the reservoir sight glass, change hydraulic fluid and flush complete hydraulic system.

3. After the first 50 hours of operation the high pressure filter element indicates a plugged condition (Schroeder filter only). Remove and replace the element to again filter full fluid flow.

4. Change the hydraulic oil whenever the high pressure filter indicates a high metal content.

5. Change hydraulic oil if the valves in the main valve bank assembly have a continuous problem with the spools sticking. Note: Valve stack hold down bolts should be torqued to 15 ft/lbs.

6. Hydraulic fluid should be changed once a year under normal conditions.

7. Hydraulic fluid should be changed every 6 months under dirty or dusty conditions.

B. If the above schedule is followed, it will prevent premature system component wear to include cylinder seals, drive motors and early failure of the pump. It will also decrease unit down time.
C. A contamination analysis should be accomplished by a qualified laboratory with the following information to insure a proper analysis and recommendations.

1. Type of oil (the type of oil at initial fill is Mobil DTE-13)
2. Serial number of the unit having the analysis and the type of unit, ie: mobile aerial platform.
3. Purpose of the analysis, ie: pump failure, discolored oil, etc.
4. Type of analysis, ie: complete to show additive breakdown, acid build-up, viscosity, type and percent of contaminants, etc. There should also be a comparison to new oil data specs plus analysis recommendations.

D. If flushing and replacement of hydraulic fluid is recommended, refer to flushing procedures.
A. Drain, flush and refill the main hydraulic tank

If the hydraulic system is severely contaminated, several system flushings may be needed.

B. Remove the system return hose from the hydraulic oil tank. Cap the hydraulic tank fitting and put the open system return hose in an empty container to catch the contaminated system fluid.

NOTE: it is recommended to use a filter cart and external pumping in the following procedures. The main engine driven pump may be used but CAUTION should be used to insure that the pump does not cavitate. In either case, during flushing, the system pressure should be between 600 and 1000 PSI during flushing except for boom lift which you may need to increase to move the boom. The engine RPM's should also be set at 1650 RPM to reduce the GPM.

C. Remove the brake return hoses at the drive motors and allow 1 quart of fluid to drain from each hose with a fresh supply coming from the reservoir. Reinstall brake return hoses.

NOTE: If a pumping unit is being used, connect the output to the engine pump pressure hose. Start the pump being used and run until gallons of fluid are drained.

CAUTION - MAKE SURE THAT THE MAIN HYDRAULIC PUMP KEEPS A PRIME!!!

D. While standing at the ground controls, activate the destroke toggle switch (main pump / aux. pump). This will bring the pump on line causing fluid flow.

NOTE: During the following steps, hydraulic fluid will be exiting from the open system return hose which MUST be in a suitable containing reservoir. If this hose is not contained, hydraulic fluid will drain on the ground. Continuous monitoring of the reservoir fluid level or fresh hydraulic oil supply MUST be maintained to prevent cavitation. Also, when servicing the hydraulic system from an external drum, keep the pickup tube at least one (1) inch above the bottom of the drum to keep from picking up drum contaminants.

ALL CYLINDERS MUST BE IN THEIR STOWED POSITIONS BEFORE STARTING THIS PROCEDURE.
E. Raise the boom 3 feet then lower it completely 3 times
   Raise the boom to full extension
   Lower the boom 3 feet then raise it back to the fully raised position twice.

F. Extend the boom for 5 seconds then retract it completely 2 times.
   Extend boom fully.
   Retract the boom for 5 seconds then extend it to the full out position twice.

G. Reconnect the system return hose to the pump, retract and lower the boom.

CAUTION: MONITOR THE RESERVOIR FLUID LEVEL WHEN LOWERING AND RETRACTING THE BOOM TO PREVENT THE RESERVOIR FROM OVER FILLING AS MORE HYDRAULIC FLUID ENTERS THE RESERVOIR THAN WHAT IS LEAVING.

H. Disconnect the system return hose as in step. B

I. Extend the boom until high speed drive disengages and raise the drive tires from the ground. Operate the drive until 5 gallons of oil pass through the return hose. Then reverse the drive for 5 more gallons to pass in the reverse mode of operation. Lower the unit to the ground.

J. Cycle the steer cylinder to the full stroke position in both directions twice.

K. Cycle any remaining cylinders twice except platform rotate and platform level.

L. Reconnect all removed hoses to their respective positions.

M. Disconnect the return hose at the free flow end of the check valve under the platform control panel. Plug this line. Install another hose on the check valve and put the loose end in an empty container.

N. Cycle platform rotate two full times then cycle platform level for two more full cycles.
O. Disconnect the master leveling cylinder hoses at the master cylinder and operate the manual leveling valve in both directions until at least 1½ gallons of oil have passed through each disconnected hose. Reconnect the rod end hose and bleed air from the hose before tightening the hose fitting.

P. Raise the boom to its full up position catching the fluid passing out of the blind end port of the master leveling cylinder.

Q. Reconnect the blind end hose to the master leveling cylinder bleeding the air from the hose before tightening the hose fitting.

R. While lowering the boom, use the manual selector for platform leveling through 2 complete cycles of operation.

S. Restore unit to full operating capacity by reconnecting all hoses and resetting system pressure. Fill the hydraulic reservoir to the full mark on the sight gauge.

T. Operate all functions to their extreme positions and insure that the platform levels properly when booming up and down.

U. Check to make certain that reservoir pressurization is operating by pressing the red button on the hydraulic reservoir cap. Escaping air should be heard when the button is depressed.

V. If all the systems are operating properly, check for leaks and repair as needed.
1. **Power trac cross braces breaking** -
   
   A. Check for hose skiving in the power trac. If skiving is noted, proceed to step B.
   
   B. If system pressure is too high, it will cause the hoses to shrink more than normal. If pressure is normal, proceed to step C.
   
   C. If the hydraulic system pressure is normal, the hoses are run to tight in the trac. To achieve proper hose tension, it may be necessary to adjust the hoses 3 or 4 times. NOTE: hoses too loose may be pinched under the power trac.

2. **Power trac sagging** -
   
   A. The lowest portion of a sagging power trac has the pin holes stretched usually caused by a damaged "I" beam support. If the unit is equipped with an over head guard, the trac could also get caught on a damaged guard which could also tear off the moving anchor.
   
   B. Lack of lubrication and/or cleaning.

3. **Boom extent and retract rough in operation-(3 piece boom)**
   
   A. Check boom chain tension, extend boom fully then retract approx. 6 inches. Check the lowest point of the chain to the bottom of the mid boom. The chain should sag 1 inch for every 10 feet of unit model. Example: MP-60 = 6", MP-80 = 8". If too loose, the chain may be stretched and need to be replaced.
   
   B. Excessive sand and/or grit inside boom.
   
   C. Grease on boom collecting grit. The booms are dry running and should require NO GREASING! If lubrication is needed, use only silicone spray.
   
   D. The inside chain anchor block is worn and has sharp edges grabbing the lower base boom when retracting.
   
   E. The lower extend holding valve is out of adjustment. The flow control valves could be out of adjustment.
   
   F. The inner or outer chain has frozen or has stiff links. Clean and lubricate with a penetrating oil, it may be necessary to soak the chain overnight to remove the kinks and/or stiff links.
4. Platforms equipped with rack and pinion rotate actuator. If there is play in rotator, check -
   A. Check for loose mounting bolts for platform to pinion flange.
   B. Check for trapped air in hydraulic lines.
   C. Check for excessive play in mounting pins and hardware.

5. Boom drifts down when raised and telescopcd out.
   A. Check holding valve cartridge to be seating properly
   B. Check that piston seals are good in cylinder. If not, repair as soon as possible.

6. Boom will not retract from the fully extended position.
   A. Hydraulic pressure filter dirty not allowing full system flow.
   B. System pressure set too low. Check system pressure.
   C. Excessive grit on boom sections. Check and lubricate if necessary.

7. Unit will not go into high speed drive when boom is retracted and lowered.
   High pressure filter clogged. Remove and replace filter element.

8. Unit will not drive utilizing the emergency pump.
   The low speed drive valve is inoperative. Check and repair if necessary.

9. Unit function is erratic operating the platform controller.
   A. Micro-switch in controller handle out of adjustment
   B. Possibility of potentiometer failure. Check wiper
   C. Possibility of controller body has wear in the handle stop trac area. If this is the problem, a new body must be installed to prevent over travel of the controller handle.
10. Valve operation(s) sticking in valve bank.
   A. Too much valve body torque on valve stack. Retorque nuts to 15 Ft/Lbs each. (Lower stack only!!)
   B. Valve body facings not milled square causing uneven valve stack pressures resulting in a distorted valve body.
   C. Improper hydraulic oil in unit. Added hydraulic oils may not mix properly causing different additives to breakdown distributing varnishes on moving and non-moving parts. This will eventually lead to component failure.
   D. Contaminated hydraulic fluid will also cause this problem. Samples should be taken on a yearly schedule (maximum) and measured against original specifications.
   E. On older model units, a flow control valve was used that incorporated a spring operated check ball. This spring can become dislodged from its proper location and travel into the valve causing the valve spool to jam.

11. Low speed drive valve inoperative in low speed drive only
   A. Valve spool sticking
   B. A low resistance in one of the high speed drive valve coils. Each coil should have a resistance of 4 ohms. If a high speed drive coil has less than 4 ohms, excessive voltage will feed across the coil to the opposite coil of the low speed drive valve which is being activated. (Lower stack only!!!!)

12. One tire leaves ground surface when the boom is extended over the corner of the unit.
   A. The unit is not on level ground.
   B. The units capacity has been exceeded. Remove excess weight-------IMMEDIATELY!!!!
   C. Tires are under-serviced with calcium chloride. This condition could also rust out the tire rims internally as the normal liquid level is over the top of the rim to reduce oxygen concentration.
WHEEL DRIVE MOTOR FAILURE

CAUSE OF FAILURE
A) Contamination - If one motor failed, the internal loose pieces will eventually flow into the opposite motor causing that motor to fail.

B) Improper installation of needle bearings.

C) Excessive bearing loads caused by high speed braking with brakes set for full application.

D) Useful bearing life exceeded caused by braking loads.

E) System not flushed or protected properly after components failure within the drive circuit.

F) Use of poor quality oils or worn-out oil will decrease the life of any component.

G) Towing machine with hubs engaged.

H) Cavitation - Motor running faster than input is available causing ratcheting.

I) Motor stopping unit, i.e. brake adjustment closed too far, low speed flow valve has a malfunctioning check valve.

SWING GEAR PINION SHAFT, TOOTH AND/OR RING BEARING FAILURE

CAUSE OF FAILURE
Shock = excessive side loading of boom. Unit throttling not being used, causing instant on and off of the swing motion i.e. foot pedal being blocked to the on position, the foot pedal being operated before the controller or the hydra-port control not being maintained for throttle control. Lack of gear lube causing gears to bind. Pinion gear too tight (no backlash to ring gear). Gear box loose causing the load to be at the ends of the gears instead of being evenly distributed over the teeth of the pinion which will also cause ring gear teeth wear due to slippage. Foreign objects caught between the teeth forcing the pinion away from the ring gear.

HYDRAULIC PUMP COUPLING FAILURE

A. Hayes Coupling: Splined coupling not locked to splined shaft, causing coupling to move away from insert resulting in insert destruction and ensuing coupling failure.

B. Browning Coupling: The splined half will move on the spline, eventually working into the back of the pump and destroying the spline. A stop should be welded into the coupling to prevent it from moving into the pump.
EXCESSIVE HEAT  Excessive heat will cause excessive wear on seals and metal parts due to lowered viscosity.

Symptoms = Pump case turns brown, darkens or hydraulic oil darkens. Premature pump failure.

Causes:  1. Excessive water content in the oil.
         2. Improper oil viscosity.
         3. Pump cam bearing failure.
         4. Lack of lubrication, worn out oil, improper oil.
         5. Stroke flow valve opened.
         6. Foot pedal blocked closed.

Corrective Action:  1. Drain and flush system, rebuild pump as required.
                  2. Close pump stroke valve.

WATER IN FLUID

Symptoms = Pitting and etching of pump pistons with eventual pump piston cam wear causing heat build up and premature pump failure.

Corrective Action: Drain and flush system. Replace worn pump components. Check reservoir pressurization.

THE MOST COMMON CAUSES OF HYDRAULIC SYSTEM MALFUNCTIONS IN ORDER

1. Incompatible hydraulic oils mixed, destroying the additives and causing varnish build up resulting in the valves to stick.

2. Water in the oil due to a damp climate and reservoir pressurization inoperative.

3. Improper oil used; viscosity too high cold climates, viscosity too low warm climates. Note: Mobil DTE-13 is a multiple viscosity oil that is light enough for cold climates and resists thinning in warm climates.

4. Fuel in the oil, lowers the viscosity and lubricity of the oil.
VARNISH  Varnish is the dark brownish residue left from oxidation of hydraulic fluids.

Symptoms = This residue will cause pistons and spools to stick and will hang up moving parts with close tolerances.

Causes: 1. Mixing incompatible oils or use of poor quality oils.
         2. Excessive heating of the oil.

Corrective Action:  Drain and flush system.

CAVITATION  Cavitation is a gaseous condition within the fluid stream where the pressure is reduced to the vapor pressure of the fluid. The higher the system pressure the more violent the reaction will be.

Symptoms = Pitting and etching of pump pistons.

Causes: 1. Low reservoir fluid level.
         2. Air leaks in suction line.
         3. Oil viscosity too high, improper oil used.
         5. Pump speed too high.
         6. Vaporization of water.

Corrective Action: 1. Warm up system before using full system pressure or adjust system as required.
                   2. Have fluid analyzed regularly and use proper hydraulic fluid.
                   3. Repair any suction hose leaks.
                   4. Insure reservoir pressurization is operating properly.

POOR LUBRICATION  Parts break through lubricant causing metal to metal contact.

Symptoms = Heads of pump pistons worn to shape of cam. Excessive heat build up.

Causes: 1. Fluid viscosity too low.
         2. Lack of anti wear additives in the oil.
         3. Fluid contaminated with water or other low viscosity liquid.
         4. Improper or poor grade oil used.

Corrective Action: Drain and flush system, install recommended hydraulic oil.
DEUTZ ENGINE

1. Starter stays engaged
   A. Start button sticking
   B. Relay sticking

2. Engine quits after seconds.
   A. Oil pressure switch stuck closed or no oil pressure.
   B. Wire # 20 is grounded energizing the second safety relay.
   C. Start button or plug-in relay sticking closed.

3. The rack (fuel shut off) will not shut the engine off.
   A. Injector fuel shut off shaft is clogged with dirt.
   B. Fuel shut off arm spring broken.
   C. The bolt holding the rack solenoid bell crank is too tight and/or needs cleaning.
   D. The rack solenoid is adjusted improperly, causing the shaft to bind, or adjusted to not allow the linkage to go to the off position.

   A. See items A - C and D above.
   B. If the solenoid is not adjusted to be bottomed out with the rack linkage in the full open position, the holding coil will not engage and the pulling coil will not disengage (The pulling coil will not take a continuous amp load without destruction of the coil very quickly). Also, if you allow the linkage to bottom out completely, when engaged, destruction of the linkage could occur.

5. Excessive engine vibration at idle.
   A. All Deutz engines have a high quivering (vibration) point, that usually occurs between 700 rpm and 1300 rpm. By setting the idle rpm above this point, excessive destructive vibration will be eliminated.

V 465 WISCONSIN ENGINE

1. Engine floods when starting unit.
   A. Choke operator piston sticking.
   B. Choke set too rich.
   C. Starting engine on high throttle, (engine should be started on low rpm or vacuum loss will not allow choke piston to operate).
   D. Throttle linkage binding or out of adjustment, not allowing carburetor to go into idle, or idle rpm set too high causing an intake vacuum loss.
   E. An electric solenoid operated choke is available to eliminate this condition.
Platform Ratchets or Does Not Level Properly
Platform does not stay level while booming up or down.

1. Check for platform drifting
2. Check for damaged parts such as bent pins or elongated pin holes

Oil is escaping from the loop ------ Master cylinder piston is by-passing ---- Disconnect rod line to end port

| Releif valves are by-passing plat. leveling valve is by-passing Boom up thru slight angle
| Remove valve to Remove pressure and tank line tank lines to valve
|-----------------------------

Activate boom thru slight angle

If oil should come out of a valve open port

Repair or replace valve

If oil should come out cyl. port (platform load may be required)

Repair piston seals or replace cylinder
Platform Drifting

With engine off, platform does not stay level

Oil is escaping from the slave cylinder ---- Internal leak ---- Disconnect lines to cylinder (place load in platform if needed to create drifting)

| |

External Leak

| |

Tighten or replace part

| |

No oil leakage. Platform only drifts a short distance.

| |

Repair piston seals or replace cylinder

| |

Oil comes out retract port

| |

Tighten, repair or replace holding valve.

| |

Oil comes out extend port

| |

Repair piston seals or replace cylinder. Also, repair and/or replace holding valve.
This pump has 8 inlet and 8 discharge valves. It also has 8 pistons and 8 piston springs, a cam, crankcase control valve, crankcase pressure control orifice as well as a pressure compensator. It is obvious that as the shaft turns, the pistons move upward and downward.

On the downward piston stroke, fluid is drawn into the piston chamber from the reservoir through the inlet valve. On the upward stroke the fluid is exhausted through the outlet valve and into the unit's hydraulic system.

On this pump, the displacement is varied by reducing the piston travel. The pump pistons are forced down toward the input shaft or cam by the piston springs. Crankcase pressure holds these pistons off the cam while the pump is in a null state. Hydraulic pump flow is controlled by increasing or decreasing the crankcase pressure thus allowing the pistons to move downward to follow the cam. This will then increase fluid volume in the piston chambers.

Crankcase pressure is increased or decreased by the pressure compensator. A hollow poppet type valve, with a spring holding the poppet on its seat has system pressure exerted on it. The poppet is preloaded against its seat by a spring. The poppet will only move away from the seat when system pressure is greater than the spring force. As the poppet moves away from the seat area, a flow path is opened to the crankcase from the discharge side of the pump. The fluid that is exiting the crankcase is restricted by a crankcase orifice resulting in an increase in crankcase pressure as the fluid passes from the crankcase orifice and back to the pump inlet.

Throttle control is maintained through this passage and its flow of oil. A sequence valve is used in conjunction with the destroke solenoid which controls the flow needed to maintain function speed. The sequence valve allows a load sensing pressure to be transmitted through itself at a 200 PSI pressure setting. This load sensing pressure is then channeled to the HPI directional control valve manifold and is split to each individual control valve to sense load. This is called an ISO circuit. As the pilot spool is shifted, the internal pilot or load sensing pressure shifts the main control spool thus changing the load sensing pressure and the related crankcase pressure in the pump. Since the crankcase pressure is decreasing, the pump output is increased to try and maintain the differential flow change. After the pump matches the differential change, crankcase pressure again maintains a null state causing the pump to maintain its required flow rate.
MODEL 505-02,-03,-05 VALVE DRIVE BOARD

I  DESCRIPTION

The Model 505 Valve Drive Boards are an electronic interface between a command source and an electrically modulated valve or transmission stroker. The boards provide a "ramp" function or accel/decel causing a smoothed output to the valve regardless of abrupt command source.

The Models 505-02 and -03 have outputs to drive dual or "grounded" coil valves. Output is provided either to the "A" or "B" coil, depending on the command signal. The Model 505-03 also has auxiliary outputs (Aux A, Aux B) which supply up to 1.0 amp output at supply voltage simultaneously with output of "A" or "B". If only one auxiliary output common to both directions is required, the "Aux A" and "Aux B" can be paralleled.

The Model 505-05 has output to drive single or "floating" coil valves. Output current is provided with "A" terminal positive and "B" terminal ground for "A" command signal, and with "B" terminal positive and "A" terminal ground for "B" command signal.

The command source can be a potentiometer, switch, or inductively coupled joystick control.

The output is pulse width modulated at a frequency compatible with the specific valve for which it has been ordered. If the output of the valve or transmission "pulses", the frequency may need to be increased. Should the output of the driven function exhibit excessive hysteresis, the frequency may need to be decreased. Contact P-Q for instructions and assistance.

II  GENERAL SPECIFICATIONS

Supply Voltage: 10VDC to 30VDC
Load Impedance: 4 Ohms to 60 Ohms
Max Output Current: 2.0 Amps at 12VDC

Accel/Decel Ramp Length:
Standard: 5 Seconds from Off to Hi and
5 Seconds from Hi to Off

Other ramp durations are available upon request.

Note: Ramp Length is adjustable from Zero to Full Ramp.
Proportional Controls - (Cont.)

Model 505 - XX - XX - XX - XX

Special Features:
00 None
01 Unidirectional Command Interface
02 Bidirectional Command Interface
10 Independent "HiA" & "HiB" Adjustment

Max Ramp Duration X.X Seconds:
00 No Ramp Capability
05 5 Seconds (Standard)
10 10 Seconds

Valve Code: Consult P-Q for Valve Code

Type of Output:
-02 Grounded Coil (Dual Coil)
-03 Grounded Coil with Auxiliary Switched Output
-05 Floating Coil (Single Coil)

Note: Be sure to specify the valve or stroker being used and the system voltage.

IV CALIBRATION PROCEDURE

As received, the board should be calibrated for the valve you are using. If the output does not suit your requirements, or the adjustments have been altered and need to be reset, the following procedure should be followed:

A. Turn the following pots counterclockwise twenty (20) turns, or until a "click" is heard: Hi, HiA, Lo, Ramp.

B. Connect supply voltage (+10 to 30VDC) to "Vs" terminal and ground to "GND" terminal.

C. Connect a command source to (+), Sig and (-) terminals as shown in one of the diagrams which follow:

1. Bidirectional Potentiometer Command Connection

   ![Bidirectional Potentiometer Diagram]

   Note: A 10K pot is recommended. A 500 ohm to 10K ohm pot is permissible; limiting resistors must be 2X the pot value.

2. Unidirectional Potentiometer Command Connection

   ![Unidirectional Potentiometer Diagram]

   Note: A 5K pot is recommended. A 250 ohm to 5K ohm pot is permissible; limiting resistors must be 4X and 5X the pot value respectively.
IV Calibration Procedure (continued)

3. Joystick Command Connection

(-) [Diagram]

Sig [Diagram]

(+) [Diagram]

Note: With joystick, wiper does not traverse full range of pot. If another style is used where it does, limiting resistors must be used as in Figure 1.

4. Switch Command Connection

(-) [20K]

Sig [B 10K A]

(+)[20K]

In cases where the length of the leads from the command source to the board is long (over 10 feet), or where the leads are run parallel to the valve coil leads or AC leads, the leads should be shielded. The shielding should be grounded to the "GND" terminal on the board as shown below:

(-) [Diagram]

Sig [Diagram]

(+)[Diagram]

GND [Diagram]

Note: Command wires should be 22 gauge or larger.

D. Connect the valve coil(s) to the board as shown below:

1. Grounded Coil Connection to Model 505-02 or 505-03

[Diagram]
V TROUBLESHOOTING PROCEDURE

1. Equipment Required:
   a. 10-30VDC Supply Source, 2 amps
   b. Volt/Ohmmeter with 0-10VDC range (minimum)
   c. Trim pot adjusting screwdriver
   d. Command source (or 10K potentiometer with two 20K resistors)

2. Power Up Board:
   Connect supply source to \( V_b \) and GND terminals, observing polarity (+ to \( V_b \), - to GND).

3. Check V Reg:
   Measure voltage from (+) to (-) terminals. The regulated supply here should be 6 volts ±.4VDC.

4. Check Signal Swing:
   a. Measure voltage from (-) to Sig. It should read one-half the difference from (+) to (-), or 3 volts ±.2VDC.
   b. Connect command source. With command source in neutral, Sig voltage reading should not change.
   c. If you do not have a command source, use a potentiometer with resistance of .5 to 10K with a fixed value resistor connected from each end of the pot to the (+) and (-) signals. Fixed resistor value should be 2X pct resistance. Connect Sig to pot wiper. With pot one-half way through swing of pot, Sig voltage should be one-half differential from (+) to (-) as in "a." above.
   d. Swing command source in the (+) direction. The voltage at Sig should increase from 3.0VDC to 3.6VDC.
   e. Swing command source in the (-) direction. The voltage at Sig should decrease from 3.0VDC to 2.4VDC.

EXAMPLE of TEST CONNECTIONS
IV  CALIBRATION PROCEDURE (continued)

2. Floating Coil Connection to Model 505-05

![Diagram of floating coil connection]

We strongly recommend a single point grounding scheme be used in the wiring. Power and Ground should be brought directly to the board from the battery or power supply. The valve coils should be grounded to a single wire that is brought back to the Ground of the board. After that connection, the system can be grounded between the power supply and board to the common ground frame if required.

E. Apply command hard on "B" direction and adjust Lo trim pot clockwise to the desired level for the valve you are driving.

F. Continue to apply command hard on "B" and adjust Hi trim pot clockwise to desired max output.

G. Return command to "just on" (10% of travel) and adjust "Lo" to the desired value as required.

H. Recheck "Hi" setting and adjust as required; follow by rechecking "Lo", since one adjustment may affect the other.

I. Apply hard "A" command and adjust "HiA" to desired output (clockwise to increase) through "A" valve coil.

J. Adjust "DEL" pot to the desired delay. Clockwise increases the ramp length for accel and decel. Counterclockwise decreases ramp length or delay. The normally supplied range of ramp is 0-5 seconds.

Note: Since the circuitry has delay for both accelerating and decelerating a load, it is important to note that the only means for stopping the output quickly will be with a power switch which interrupts power to the circuit.

Should an emergency-off condition be necessary, an emergency-off switch should be put in series with the power supply to the board.
V TROUBLESHOOTING PROCEDURE (continued)

5. Check Coil Continuity:
   a. Disconnect wires from terminals A and B on board; check continuity of coil(s) and wiring by connecting an ohmmeter between Coil A and Ground & Coil B and Ground for grounded coil valves. Connect between the two coil wires for floating coil valves. The resistance should be no greater than the load itself.
   b. Reconnect valve coil(s) to the board as shown in calibration procedure, Paragraph "D." If you don't have a valve coil to connect to the board, a resistor of value close to that of the valve coil can be used as a test load.

6. Check Range of Output:
   a. With command source connected and voltmeter reading from terminal B to GND, swing command source toward B (decreasing signal voltage) until meter at B just shows "turn-on."
   b. If output voltage is too low, turn Lo adjustment clockwise. To decrease voltage, turn counterclockwise.
   c. Increase command to max, approximately 2.4 volts at signal with respect to (-). If voltage drop across load is too low, turn Hi clockwise to increase. If it does not increase, turn counterclockwise until meter just starts to drop; this is the max output you will get with this supply voltage and load with a Model 505.
   d. If satisfied with setting obtained in "c." above, return command source to Lo and check Lo setting, as the Hi and Lo trim pots may interact with each other. Readjust and recheck Hi if necessary.
   e. Check max A output by moving command source to cause a 3.6VDC signal at Sig. Adjust A as required for more or less output. LoA will be the product of HIA, Hi and LoB. If HIA equals Hi, LoA will equal LoB. If HIA is 50% higher than Hi, LoA will be 50% higher than LoB.

VI REPAIRS

Field repairs are limited to replacement of defective trim pots. If the outputs do not respond to trim pot adjustment and the signal swings check out properly, the trim pot may be removed and replaced with an equivalent model. If difficulties continue, the board should be returned to P-Q for evaluation and repair.
The electro-proportional MP Series units utilize a series of four (4) individually mounted directional control valves. Each individual valve operates a single function, both in one direction then the other. These valves are mounted on a single manifold block which incorporates a series of load sensing shuttle valves and compensators. This allows for each individual function to be operated proportionally while being devoid of any interaction from another function. This unique system allows for exceptionally smooth operation. The proportional directional control valves are mounted to control Swing, Hoist (Lift), Extend and Drive in that order.

A single proportional valve is made up of two (2) individual valve spool blocks. The top is the pilot spool, which when activated, controls hydraulically the movements of the lower spool which is the main directional spool. The main directional spool is the spool that controls the main work ports of the valve assembly. In a "Null" state, a hydraulic pilot pressure of approximately 200 to 300 PSI is exerted equally on both sides of the pilot spool.
When a control is energized, a signal is generated by the control circuitry and sent to the respective pilot valve. As this coil is energized, it mechanically shifts the pilot spool in the desired direction causing an inverse effect hydraulically. As this pressure changes and is no longer equal, the pressure in the end caps at the main directional control spool shifts the spool.

NOTE: THE DIRECTIONAL CONTROL SPOOL Shifts IN THE OPPOSITE DIRECTION OF THE PILOT SPOOL IN OPERATION.

When the main directional spool is shifted, work will begin on the desired function.

Along with the proportional valve bank, a stack of solenoid operated control valves is also mounted. These solenoid operated directional control valves operate the secondary functions of Steer, Platform Level and Platform Rotate. These valves are fed hydraulically by a 4 GPM flow control valve located on the proportional manifold. This flow control valve is fed hydraulically by a normally closed cartridge valve that, when activated, opens to allow a designated flow of 4 GPM to pass through the flow control valve to the solenoid operated control valves. This oil flow then is shifted to the work ports for the desired function.
1. **Directional Control Valve** -

This valve is a proportional electro-hydraulic control valve which is controlled by a pilot valve. This valve also may utilize a manual hand lever which is directly attached to the main valve spool. This is used for ground control functions only. When electrically activated, the pilot spool shifts allowing internal hydraulic pressures to shift the main valve spool. Hydraulic flow then travels to the work ports. This directional control valve selects the lift function both up and down.

2. **Holding Valve** -

This valve prevents unintentional boom down movement. It allows free fluid flow into the blind side of the lift cylinder. It will not let fluid out of the blind end of the cylinder until pressure in the rod end overcomes a pilot spring force opening a pilot spool thus letting the cylinder retract and lowering the boom.

3. **Lift Cylinder** -

A double acting cylinder powers the boom up and down movements plus supporting the boom.

4. **Flow Control Valve** -

This valve controls the boom down speed and prevents the holding valve from bouncing and squealing.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>TROUBLE SHOOTING</th>
<th>ADJUSTMENTS</th>
<th>REPAIR</th>
<th>MISC.</th>
<th>PARTS</th>
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<td>1 Selector Valve</td>
<td>M6.2 M6.2 M6</td>
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<td>D13</td>
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<td>2 Holding Valve</td>
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<td>M1.3</td>
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<td>4 Flow Control Valve</td>
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Ref #

1. **Directional Control Valve** -

   This valve is a proportional electro-hydraulic control valve which is controlled by a pilot valve. This valve may also utilize a manual hand lever which is directly attached to the main valve spool. This is used for ground control functions only. When electrically activated, the pilot spool shifts allowing internal hydraulic pressures to shift the main valve spool. Hydraulic flow then travels to the work ports. This directional control valve selects boom extension and retract.

2. **Holding Valve** -

   Two load holding valves are utilized in the extend/retract circuits. This is done to prevent unintentional boom movement.

3. **Pressure Reducing Valve** -

   The pressure reducing valve is used on all new style models. This valve allows only a predetermined pressure to the extend side of the telescope cylinder. This pressure is stamped on the valve body and can only be checked by placing a pressure gauge downstream of the reducing valve.

4. **Extend Cylinder** -

   A double acting cylinder powers the boom through the telescope cylinder function. Oil is passed through the telescope cylinder rod which is through drilled. This type of cylinder has NO external transfer tube on trunion mountings. With regards to normal cylinder mountings, a transfer tube is utilized.
Mechanical Extend Function -

On three piece booms, the third section is chain or cable driven depending on model.

The second section of the boom is cylinder driven as the cylinder is connected between the first and second boom sections. This is called a trunion mounted cylinder application.

The first boom section is the base boom. This section holds the second and third sections and allows them to extend and retract.

NOTE: ALL BOOM TUBE SECTIONS SLIDE ON NYLON PADS.

The chains are in two sections. Both sections connect together at the anchor blocks allowing a continuous loop around the second section of boom tube. The chains are anchored first at the inside end of the tip section and secondly at the end of the base boom near the anchor adjustment bolts.

On all Simon Aerial three section booms, there are two (2) extend chains or cables while there is only one (1) retract chain. All the weight placed in the platform is suspended by the two (2) extend chains or cables.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>TROUBLE SHOOTING</th>
<th>ADJUSTMENTS</th>
<th>REPAIR</th>
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<td>D13</td>
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<tr>
<td>3 Reducing Valve</td>
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<td>4 Extend Cylinder</td>
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<td>D19</td>
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</tbody>
</table>
Wire Rope Replacement (for MPH-80, MP-95, or MP-110 with Three-Piece or Four-Piece CABLE Operated Boom)

Disassembly Procedure

NOTE: BOOM SECTIONS MUST BE FULLY RETRACTED BEFORE PERFORMING THE FOLLOWING PROCEDURE.

Remove mid and tip booms (as one unit) from the base boom assembly. This will require disconnecting:

- the hoses to the rod end of the telescope (extend) cylinder,
- the telescope cylinder rod end pin,
- the EXTEND ropes to the front (lower) end of the BASE BOOM section,
- the bottom boom slide (wear) pad and tapped block from the front (lower) end of the MID BOOM section (or sections, for models with 4-piece boom),
- all wear pads from the upper (rear) end of the BASE BOOM section, and
- the bolted block anchoring the RETRACT ropes to the top of the BASE BOOM section upper (rear) end.

Remove the bolted bracket anchoring the ends of the retract and extend ropes on the lower (front) end of the TIP BOOM section. Remove the split half trunnion brackets which attach the telescope cylinder housing (case) to the MID BOOM section (LOWER MID BOOM section on models with 4-piece booms). Lift and slide the telescope cylinder out the lower end of the MID BOOM section.

Remove all of the rope guides on the boom sections, and on the housing of the telescope cylinder, to allow the removal of the extend and retract wire ropes from the boom.
**Disassembly Procedure (Continued)**

Stretch out the new replacement ropes, and measure the free length of each rope (see chart and illustration below).

![Diagram showing how to measure free length of ropes](image)

<table>
<thead>
<tr>
<th>MODEL</th>
<th>EXTEND ROPE</th>
<th>RETRACT ROPE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DIA.</td>
<td>LENGTH</td>
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<td>MPH-80 (MP80-1)</td>
<td>5/8&quot; (16mm)</td>
<td>585.00&quot; (14.859 M)</td>
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<tr>
<td>MP-95</td>
<td>5/8&quot; (16mm)</td>
<td>705.00&quot; (17.907 M)</td>
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<td>MP-110 Tip Boom</td>
<td>1/2&quot; (12.7mm)</td>
<td>385.63&quot; (9.795 M)</td>
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<td>Upper (Rear)</td>
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<tr>
<td>Mid Boom</td>
<td>1/2&quot; (12.7mm)</td>
<td>378.63&quot; (9.617 M)</td>
</tr>
</tbody>
</table>

**Re-assembly Procedure**

Re-assemble the boom by reversing the procedures outlined in the previous steps. **TAKE CARE TO PREVENT CROSSING THE WIRE ROPES AS THEY ARE RE-INSTALLED IN THE BOOM.**
Wire Rope Adjustment

Attach the extend and retract ropes to the BASE BOOM, and tighten the adjusting nuts to remove all visible slack from the ropes. With the telescope cylinder fully retracted, the boom sections should be positioned relative to each other as shown below.

Place Wedge or Wooden Block Here

4.12" ± .5"

11.5" to base boom (lower mid boom for models with four-piece boom) (REF.)

Note: Boom shown with telescope cylinder fully retracted.

The position of the tip boom section RELATIVE TO THE MID BOOM is dependent on the adjustment of the extend and retract ropes. To extend the tip boom, tighten the extend ropes. To retract the tip boom, tighten the retract ropes.

NOTE: DO NOT ALLOW THE ENDS OF THE WIRE ROPES TO TWIST WHILE MAKING THESE INITIAL ADJUSTMENTS.

Extend the tip boom approximately 2" (50mm), which will cause increased slack in the retract ropes. Using a wedge or block of wood as shown in the above illustration, lock the tip boom in this slightly extended position. Tighten the retract ropes EQUALLY to remove any slack in the ropes.

With the tip boom section still blocked, try to retract the boom. This will cause increased slack in the extend ropes. Re-tighten the extend ropes EQUALLY to remove any slack in the ropes.

Remove the wedge or wood block, and retract the boom. The tip boom section should be positioned relative to the mid boom section as shown in the illustration above. If not, repeat the above wire rope adjustment procedure.

Fully extend the boom, then retract about 2" (50mm) and stop. Look inside the boom to determine the amount of slack in the EXTEND ropes. With the boom in this position, the extend ropes should be tight enough so they do not lay loosely on the bottom inside surface of the boom. If the extend ropes have too much slack, tighten the adjusting nuts as necessary to insure both extend ropes are tensioned EQUALLY.
1. **Directional Control Valve** -
   
   This valve is a proportional electro-hydraulic control valve which is controlled by a pilot valve. This valve also may utilize a manual hand lever which is directly attached to the main valve spool. This is used for ground control functions only. When electrically activated, the pilot spool shifts allowing internal hydraulic pressures to shift the main valve spool. Hydraulic flow then travels to the work ports. This directional control valve selects the swing function both clockwise and counterclockwise.

   Since an integral brake is installed in the swing reducer assembly, a motoring spool is used to allow hydraulic flow to relief to tank thus releasing pressure to the brake.

2. **Shuttle Valve** - (used with brake equipped units only)

   This valve selects either clockwise or counterclockwise pressure to be routed to the integral brake assembly.

3. **Swing Motor** -

   This motor is rotor driven which is keyed to a shaft. This in turn powers the gear reducer assembly.

4. **Swing Brake** -

   The brake is a multiple disc type which is part of the swing reducer. This brake prevents the pinion shaft from taking the full load during quick stops by allowing the pinion to slip during overloads.
Swing Circuit (Cont.)

Diagram

Schematic
Ref #

1 Motion Control Valve -

The motion control valve found in the drive system has a two fold purpose. It shuttles hydraulic oil flow to the integral brake assemblies plus it produces a back pressure in the drive system so that unit run a way is impossible. This is accomplished by two (2) counter balance valves located in the motion control valve. Proper brake valve adjustment - open 1 1/2 turn

2 Flow Divider Combiner -

The flow divider combiner provides a differential action for the drive motors. In a turning situation, hydraulic fluid will force the internal spools to channel fluid to the driving wheel. It also has a great impact on driving characteristics when one wheel becomes lite.

3 Globe Valve -

The Globe valve has one function. It allows hydraulic fluid to pass from one drive wheel to the other when unit is in a turn situation. It can be adjusted as to the amount of oil requested to pass but the correct setting should be approximately one and one half turn open from the closed position. In this position, the engine will load slightly and allow a metered amount of hydraulic fluid to pass to the driving wheel.

4 Drive Motors and Brake Assembly -

The brake assembly used on the Simon boom lift is a rool seal type brake. It is a wetted disc which is spring applied with hydraulic release. The drive motor rotor is keyed to a shaft which in turn is splined on both ends. One end of the splined shaft is used for the roll seal brake while the other is inserted into the gear reducer assembly.

Note: Motor internal leakage passed through the brake disc's and back to the main hydraulic reservoir thereby cooling the brake and preventing excessive brake disc wear.

There is also two (2) case drain lines which return directly to the main hydraulic reservoir to reduce motor back pressure.
Ref #

5 Selector Valve - (Series / Parallel)

The selector valve used in the Simon drive system allows for a pilot pressure to shift the directional control spool changing the drive system flow from series flow to parallel flow.

6 Relief Valve -

The relief valve utilized in this drive system is set at 3,000 P.S.I. and adds assurance that the drive system will see only this pressure during the drive mode.
Ref #

1. **Directional Control Valve** -
   
   This valve is a 3 position, 4 port valve. It is normally closed and equipped with a manual override for manual operation. This valve selects hydraulic fluid pressure to the steering circuit.

2. **Hydraulic Swivel** -

   The swivel allows passage of pressure and return fluid between the upper and lower assemblies of the unit. This also allows for 360 degrees of continuous rotation.

3. **Steer Cylinder** -

   The cylinder is double acting and is directly connected to the steering linkage assembly. This cylinder powers all steering movements.

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<td>3 Steer Cylinder</td>
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</table>
Ref #

1. **Flow Valve** -
   
   This adjustable control valve varies the volume of hydraulic fluid entering the rotate and platform leveling circuits. By decreasing the flow to these circuits, this prevents the destruction of the rotating hardware.

2. **Leveling Selector Valve** -
   
   This is a 3 position, 4 port electrically operated solenoid valve. It is normally closed and selects fluid flow to rotate the platform.

3. **Slave Leveling Cylinder** -
   
   The cylinder is a 2 port double acting cylinder connected between the tip boom and the platform. This cylinder controls the position of the platform relative to the tip boom.

4. **Master Leveling Cylinder** -
   
   This cylinder is also a 2 port double acting cylinder with the same displacement as the slave cylinder. This cylinder is located between the upper frame and the boom or boom lift cylinder. Whenever the boom is raised or lowered, the master cylinder is forced to move. The fluid displacement from the master cylinder is in turn sent up the boom to the slave cylinder. This forces the slave cylinder to move the same distance as the master cylinder.

5. **Leveling System Holding Valves** -
   
   These are pilot adjustable and prevent platform movement. In the event of hose failure, the holding valve does not allow fluid to leave the slave cylinder unless input pressure allows the pilot valve to open.
Ref #

6 Relief Valve

This valve is adjustable and prevents high pressure spikes in the leveling circuit that could result in component damage. The pressure spikes occur when the slave cylinder is serviced manually by the selector valve and is not leveled which will cause the cylinder to bottom out before the master cylinder stops moving as the boom is lowered.

<table>
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<th>PARTS</th>
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<tr>
<td>Master Cylinder</td>
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<td>Relief Valves</td>
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<td>M1.1</td>
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</tr>
</tbody>
</table>
Ref #

1. **Flow Valve** -

   This adjustable control valve varies the volume of hydraulic fluid entering the platform rotate and leveling circuits. By decreasing the flow to these circuits, this prevents the destruction of the rotating hardware.

2. **Rotating Selector Valve** -

   This is a 3 position, 4 port electrically operated solenoid valve. It is normally closed and selects fluid flow to rotate the platform.

3. **Rotary Actuator** -

   The rotary actuator utilized in the Simon boom lift is of the rack and pinion type. Hydraulic fluid enters the actuator from either side, depending on the desired rotation, and powers the rack in the opposite direction causing the pinion shaft to rotate.

4. **Double Pilot Operated Check Valve** -

   The double pilot operated check valve used with the rotary actuator is mounted as an integral part of the actuator. Its purpose is to act as the locking component so the actuator does not rotate while not in use. When the rotate circuit is powered by hydraulic fluid, partial fluid flow is piloted over to the return side to unseat the check ball.
1 Main Hydraulic Pump -

The main pump is engine driven and is of a radial piston type. This pump delivers hydraulic fluid, under pressure, through the high pressure filter to the main hydraulic distribution manifold. This manifold is located in the center of the main valve bank.

2 High Pressure Filter -

The high pressure filter, filters the hydraulic fluid before it reaches the main hydraulic distribution manifold. The high pressure filter utilized on current production models is a non by-passing type. The filter element used is rated at 10 microns. This type of hydraulic filter does incorporate a differential pressure shut off valve that will stop fluid flow when the filter becomes dirty. However; this valve allows enough fluid to pass as not to crush the element from back pressure.

Note: Older type Simon booms utilized a high pressure filter with a by-pass circuit. This type of filter is identified by a metal 2 micron filter element located internally in the filter body. This filter housing also has a red indicator pin which, when the element is dirty, pops out of the filter head indicating a by-passing situation.

3 Emergency Pump -

The emergency pump is driven by an electric DC motor. This pump delivers hydraulic fluid, under pressure, to the main hydraulic distribution manifold. This pump should only be used in emergency situations! The electric motor is of a non-continuous type and will fail if used excessively.
The emergency descent package incorporates three (3) manually operated control valves.

During normal operation, these valves allow hydraulic fluid to pass to various function cylinders as directed. In normal operation, the #1 control valve is in the "OPEN" mode while #2 and #3 control valves are to be in the "Closed" mode. This will allow hydraulic fluid to pass through the #1 control valve to the extend cylinder while hydraulic flow is stopped from entering the lift cylinder and the main hydraulic reservoir through the #2 and #3 control valves.

However, if the main hydraulic power source becomes inoperative and/or the auxiliary power source also fails, the emergency descent package can be used. This can be accomplished by "CLOSING" the #1 control valve while "OPENING" the #2 control valve. This will allow hydraulic fluid, under pressure from the raised boom, to flow freely thru the #2 control valve to the extend cylinder causing the extend cylinder to retract.

After the boom has stopped lowering and retracting under its own weight, to continue to lower the boom "OPEN" #3 control valve. This will allow excess hydraulic fluid to pass freely to the main hydraulic reservoir.

NOTE: #3 control valve should only be "OPENED" AFTER the extend cylinder has fully retracted or the boom no longer descends under its own weight.

The emergency retract application for the extend cylinder will only operate when the boom is above horizontal.
Emergency Descent Circuit (Optional)

Extend Cylinder

Lift Cylinder

Extend Directional Valve

Manual Descent Package - Normal Operation
<table>
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<tr>
<th>No.</th>
<th>Document Number</th>
<th>Description</th>
<th>Size</th>
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