PURPOSE

To provide information necessary for understanding the tester, its capabilities & limitations, how to operate, maintain, and calibrate it.

SCOPE

This document applies to the Dynamic Hoist Load Tester, Model DHLT2.

CONTENTS

1. SYSTEM DESCRIPTION

1.1. General

The DHLT is a machine designed to apply a dynamic load test to Electric Hoists. A dynamic load is one that is maintained constant even as the hoist is operated up and down thereby simulating the lifting and lowering of an actual freely suspended load. The intent of the DHLT is to impose such a load equal to 125% of the hoist's WLL to satisfy requirements for load testing of hoists.

To conduct a dynamic load test on an electric hoist, the electric hoist is installed in the DHLT, and the appropriate power supply is connected to the hoist. The DHLT is adjusted to impose the appropriate load on the hoist. The hoist is then operated in the up and down directions. During this operation, the DHLT maintains the load on the hoist.

The DHLT consists of two sub-systems: Mechanical System and Electro-Hydraulic System.

The Mechanical System is comprised of the base and pivoting beam assembly. Primary assembly is a pivoting beams assembly comprised of a lower beam, a column, and an upper beam. The Electric Hoist is attached between the two pivoting beams of this assembly for the dynamic load test.

The Electro-Hydraulic System uses a Hydraulic Cylinder to apply a force to the Pivoting Beams Assembly. This force is transferred by the Pivoting Beams Assembly to the hoist to resist the action of the hoist so the hoist endures dynamic loading. The Hydraulic Cylinder is controlled so the force applied to the Pivoting Beams and the hoist is maintained at a constant level even as the hoist operates and the Pivoting Beams pivot. The Electro-Hydraulic System is comprised of a motor/pump/reservoir, an accumulator, a system pressure gauge, a hydraulic cylinder, a cylinder pressure gauge, a pressure switch, a pressure control valve, an accumulator discharge valve, a filter, a control panel, a pendant, a power supply cord, a hoist connection cord, and a limit switch.

1.2. Components

1.2.1. Motor/Pump/Reservoir – The electric motor is 2 Hp, 1725 rpm, 115/208-230 Volts, 60 Hz, single phase induction motor with a continuous duty rating. The pump is a hydraulic positive displacement gear-type pump with 3,000 psi capacity, 0.138 cubic inch displacement, and a 1 GPM flowrate. The reservoir is a 2.2 gallon tank equipped with a 100 micron inlet strainer, a direct-acting relief valve internally drained to the reservoir (factory set to actuate between 2500 and 3000 psi), and a reservoir vent cap that is foam-filled to prevent entry of airborne particulates. The reservoir is the only part of the hydraulic system that is non-pressurized. The motor drives the pump which is the prime mover of the system. The pump generates the hydraulic system pressure necessary for the operation of the Electro-Hydraulic System.

1.2.2. Accumulator – The accumulator is a gas-filled bladder type with a capacity of 2.5 gallon and a maximum allowable working pressure of 3000 psi. It is pre-charged at the factory with 850 psi of nitrogen gas. The accumulator acts to store energy in the form of pressurized hydraulic fluid.

1.2.3. System Pressure Gauge – 2.5 inch diameter, 0 to 3,000 psi pressure gauge. Glycerin-filled to reduce influence of vibration and shock. Measures the pressure of the hydraulic system.

1.2.4. Hydraulic Cylinder – 5 inch diameter cylinder actuator with 5 inch stroke. Its cap-end is vented to atmosphere. Converts hydraulic pressure into force. Applies force to the pivoting beams assembly necessary to resist the operation of the hoist.

1.2.5. Cylinder Pressure Gauge – 4 inch diameter, 0 to 2,000 psi pressure gauge. Glycerin-filled to reduce influence of vibration and shock. Measures the pressure applied to the hydraulic cylinder.

1.2.6. Pressure Switch – Measures system pressure and actuates two switches to control the operation of the pump motor. One switch turns the pump motor on when system pressure reaches the low setting, the other switch turns the pump motor off when the system pressure reaches the high setting. The factory settings for these switches are 1750 (±50) psi and 2400 (±50) psi.

1.2.7. Pressure Control Valve – Controls the hydraulic pressure applied to the hydraulic cylinder. The control knob is used to set the pressure applied to the hydraulic cylinder. If the pressure in the hydraulic cylinder increases above the control knob setting, the valve diverts hydraulic fluid to the reservoir. If the pressure in the hydraulic cylinder decreases below the control knob setting, the valve admits more pressurized hydraulic fluid from the hydraulic system to the cylinder.

1.2.8. Accumulator Discharge Valve – This normally-closed ball valve is between the accumulator and the reservoir. It is used to relieve system pressure by diverting hydraulic fluid from the pressurized portion of the hydraulic system to the reservoir. This valve is used only for servicing – CAUTION should be used when opening this valve, open slowly and only partially to avoid high flow rates of hydraulic fluid that could result in pressure perturbations and consequential damage to the Pressure Control Valve and/or overflow of the reservoir and/or damage to the filter.

1.2.9. Filter – 10 micron filter element located between the accumulator discharge valve and the reservoir. The filter head has a pressure bypass, which diverts hydraulic fluid around the filter element when the pressure across the filter element exceeds 35 psi. The filter element is rated for 200 psi.

1.2.10. Control Panel – Contains terminal strip, on/off switch & light, fuses, contactor, and plug for connection to the hoist.

1.2.11. Pendant – Connects to the control panel. Has up/down control buttons for controlling the hoist operation.

1.2.12. Power Supply Cord – Used to connect the control panel to the electric power supply (230-1-60). The electric power supplied to the control panel is for the pump/motor (the hoist is connected separately to its own electric power supply).

1.2.13. Hoist Connection Cord – Used to connect the Electric Hoist to the control panel. Conveys control from the pendant to the hoist's contactors.

1.2.14. Limit Switch – Senses whether the Pivoting Beams are acceptably positioned or if they are over-traveled. The limit switch is incorporated into the control of the hoist's up contactor to prevent over-travel in the up direction.

1.3. Theory of Operation

1.3.1. Initial Start-Up: Refer to the schematic diagram of Fig. 1. The system pressure is zero and the Motor/Pump (1) & (2) is off, and the Accumulator Discharge Valve (6) is closed. When the on/off button on the Control Panel is pressed, the Motor/Pump will

start. The pressure at the Pump (2) suction (green line) will drop causing hydraulic fluid to flow from the Reservoir, through the Reservoir Strainer (3) and into the Pump. The Pump discharges hydraulic fluid through the Check Valve (A) and into the system thereby pressurizing all lines in red. This happens quickly, and results in a pressure spike on the System Pressure Gauge (11). When the spike ends and pressure evens out, the hoses and components have been filled and pressurized with hydraulic fluid. The Accumulator (9) now begins to slowly fill with hydraulic fluid and system pressure will continue to increase slowly – this will show on the System Pressure Gauge. At this point the Pressure Control Valve (7) will start to control the pressure of the hydraulic fluid admitted to the Hydraulic Cylinder (12). This will show on the Cylinder Pressure Gauge (8). The pressure of the hydraulic fluid admitted to the Hydraulic Cylinder will be controlled according to the position of the control knob on the Pressure Control Valve. The pressure on the Cylinder Pressure Gauge will stabilize at the setting determined by the control knob. If a higher pressure at (8) is desired, turn the Pressure Control Valve knob clockwise and more hydraulic fluid will be admitted to the Hydraulic Cylinder (12) thereby increasing the pressure at (8). If a lower pressure at (8) is desired, then turn the Pressure Control Valve knob counter-clockwise and hydraulic fluid will be relieved from the Hydraulic Cylinder (12) into the reservoir via the blue line, thereby reducing the pressure at (8).

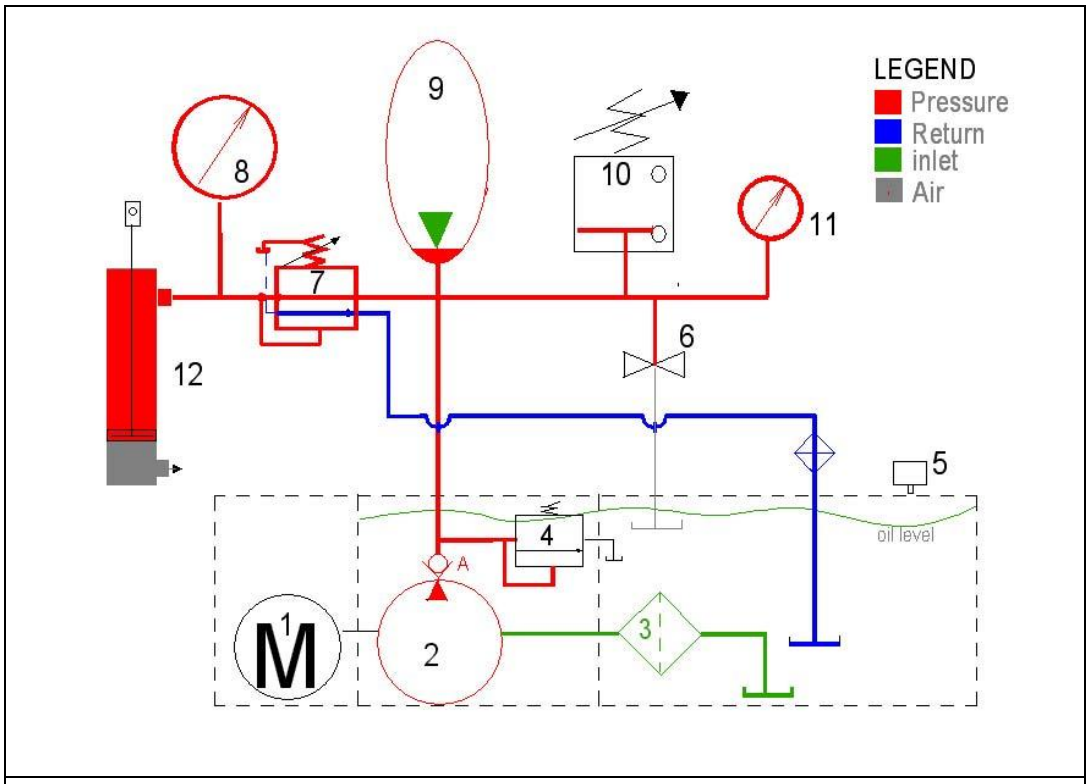

Fig. 1

1.3.2. Operating – No Load Testing: Refer to the schematic diagram of Fig. 2. With the Accumulator Discharge Valve (6) still closed, as the Motor/Pump (1) & (2) continues to

operate, the system pressure as shown on (11) will continue to increase. When the pressure at (11) reaches the Set Point of the Pressure Switch (10), the Motor/Pump will de-energize and stop operating. At this point the system pressure (11) is stable. However, as the Pressure Control Valve (7) attempts to control the pressure at (8) & (12), it will oscillate slightly. This may show as a slight dither of the needle on the Cylinder Pressure Gauge (8). This causes hydraulic fluid to be admitted through (7) to the Hydraulic Cylinder (12) and then subsequently bled from the Hydraulic Cylinder through (7) to the Reservoir via the blue line. The result is that the hydraulic fluid slowly bleeds from the system into the Reservoir until pressure at (11) reaches the low setting of the Pressure Switch (10), at which time the Motor/Pump is turned on to replace the hydraulic fluid into the system and restore system pressure. The electro-hydraulic system will continue to cycle on and off in this manner as its normal operation.

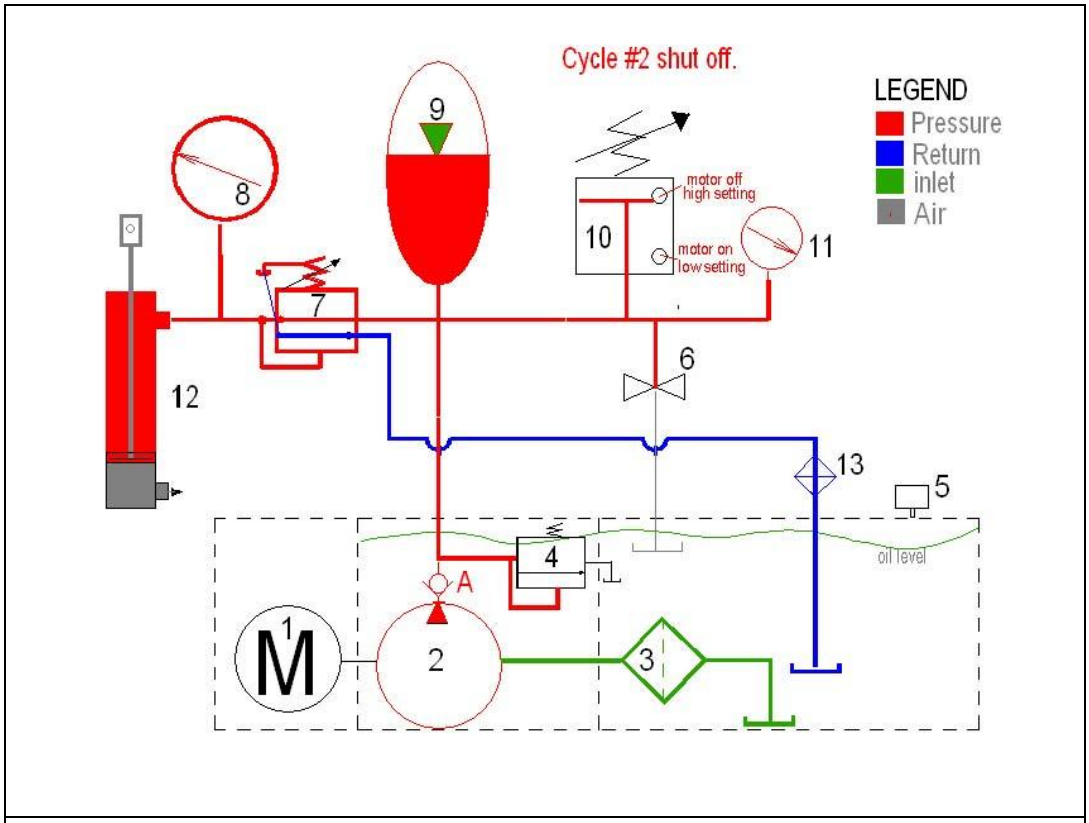

Fig. 2

1.3.3. Operating – Load Testing: Refer to the schematic diagram of Fig. 2. With the Accumulator Discharge Valve (6) still closed, when a hoist that is mounted in the DHLT for testing is operated in the UP direction, the travel of the hoist's hook results in a force that acts to extend the Hydraulic Cylinder. As this force extends the Hydraulic Cylinder, the volume in the Hydraulic Cylinder decreases. When this happens, pressure in the Hydraulic Cylinder and at (8) will begin to increase. When the Pressure Control Valve (7) senses this increase in pressure, it opens the pathway through the Pressure

Control Valve to the Reservoir via the blue line and relieves hydraulic fluid from the Hydraulic Cylinder to the Reservoir. In this way, the pressure at (8) is controlled at the constant value corresponding to the position of the control knob on the Pressure Control Valve. With the pressure at (8) maintained at a constant value, the reaction of the Hydraulic Cylinder results in a constant force resisting the hoist's UP operation.

When the hoist is operated in the DOWN direction, the travel of the hoist's hook causes the force on the Hydraulic Cylinder to decrease. The Hydraulic Cylinder responds to this reduced force by retracting. As the Hydraulic Cylinder retracts, the volume in the Hydraulic Cylinder increases. When this happens, pressure in the Hydraulic Cylinder and at (8) will begin to decrease. When the Pressure Control Valve (7) senses this decrease in pressure, it admits more hydraulic fluid from the Accumulator (9). In this way, the pressure at (8) is controlled at the constant value corresponding to the position of the control knob on the Pressure Control Valve. With the pressure at (8) maintained at a constant value, the reaction of the Hydraulic Cylinder results in a constant force that accommodates the hoist's DOWN operation by maintaining a constant force on the hoist even as its hook travels in the DOWN direction.

Note that when the hoist is operating/traveling in the DOWN direction, hydraulic fluid is depleted from the Accumulator, and this causes system pressure to decrease. If the system pressure falls low enough to cause the Motor/Pump to begin operating, it may be possible that the rate at which hydraulic fluid is admitted to the Hydraulic Cylinder is not enough to maintain the pressure at (8). If the pressure at (8) goes below its control point, then the force on the hoist will be lower than required. Therefore, when the hoist is operating/traveling in the DOWN direction, and the Motor/Pump starts up, watch the pressure at (8) and if it begins to decrease, stop and wait for the system pressure to be fully restored.

2. OPERATING PROCEDURE

2.1. Before Operation

2.1.1. Ensure that both the caster's pivot and wheel locks are engaged (See Fig. 3).

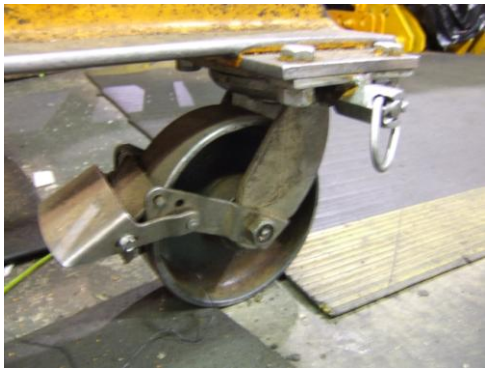

Fig. 3 – DHLT Caster

2.1.2. Installing the hoist on the DHLT as follows:

2.1.2.1. The DHLT comes equipped with a winch. Use the winch to lift heavier products into place. Be smart. Do not lift anything that could possibly injure you.

2.1.2.2. Suspend the hoist from the appropriate link on the Upper Beam: Hoist capacity 5 Tons or less use the link labeled 5 Ton; hoist capacity greater than 5 Tons, but not more than 10 Tons use the link labeled 10 Ton (See Fig. 4).

Fig. 4 – Upper Beam Links

2.1.2.3. Engage the bottom hook, of the hoist that is to be tested, on to the corresponding master link on the lower arm. These links are directly below the links on the upper beam.

2.1.2.4. Refer to Table 1 and Fig. 5. Make connections in accordingly.

Table 1 - Connections			
Connection	Electric Hoist	Air Hoist	Manual Hoist
Hoist Controls	Use appropriate connection cable to connect hoist controls to the tester Control Panel	No connections – use hoist controls as-is.	No connections – use the hand chain or lever equipped with the hoist.
Hoist Power	Use the hoist's power cable to connect to the appropriate power supply for the hoist.	Connect the hoist to an appropriate source of compressed air.	N/A
Tester Power	Connect the tester's power supply cord to appropriate power (standard tester requires 230V single phase power).		

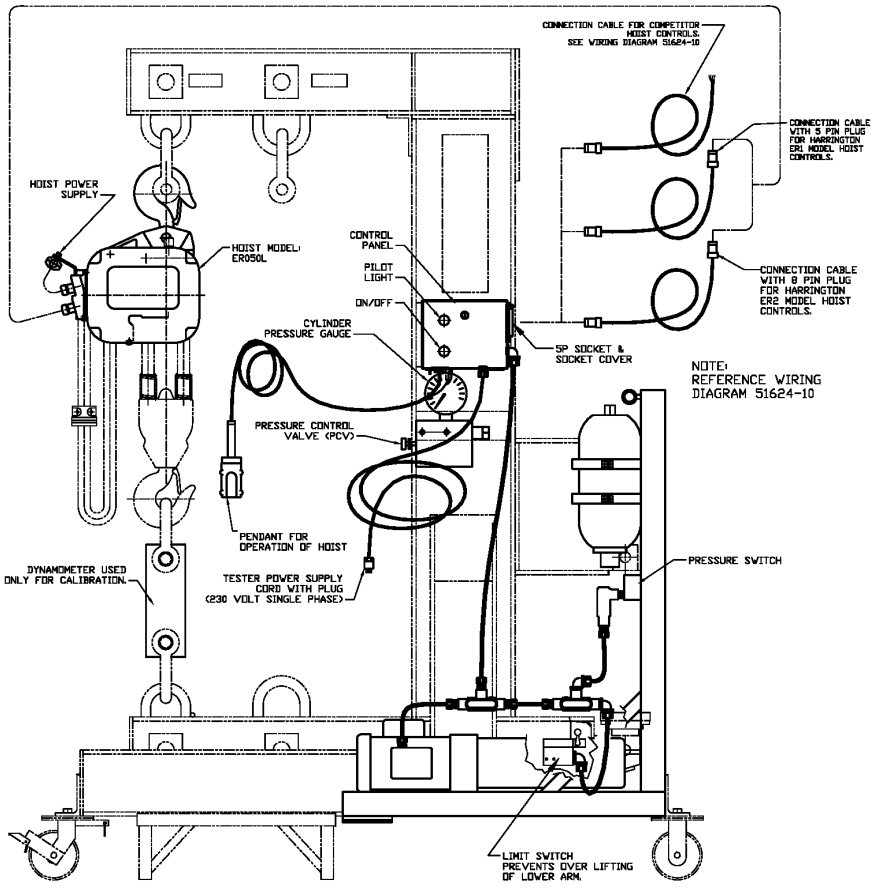

Fig. 5 – Electrical Connections

2.2. Performing a Test

2.2.1. Turn on the tester by depressing the red ON/OFF button on the control panel (Refer to Fig. 6). When the tester is on, a green pilot light will illuminate.

Fig. 6 – Tester Control Panel

2.2.2. Ensure the Accumulator Discharge Valve is closed. Allow the pump to fill the Accumulator. The Accumulator is filled when pressure switch automatically shuts off the pump motor.

2.2.3. Refer to Fig. 7. The cylinder pressure is adjusted with the Pressure Control Valve. While viewing the Cylinder Pressure Gauge, adjust the cylinder pressure to the corresponding setting for the capacity that is being tested (obtain this pressure value from the calibration chart). By setting the cylinder pressure to the corresponding capacity, you are setting the tester to 125% of the rated capacity.

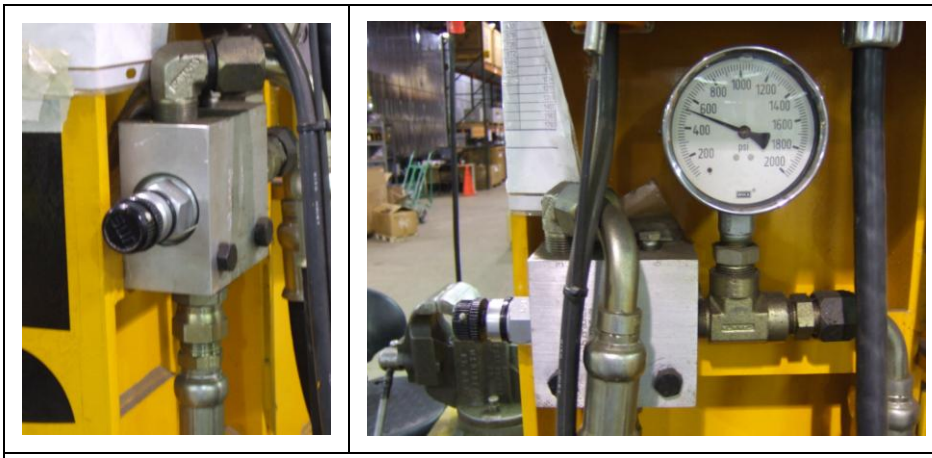

Fig. 7 – Pressure Control Valve (left) and Cylinder Pressure Gauge (right)

2.2.4. Operate the hoist to perform the test.

2.2.4.1. Electric Hoist: Execute a dynamic test by operating the hoist according to the required test protocol by using the pendant that is connected to the tester's Control Panel.

WARNING: If the hoist is not connected through the tester in accordance with 2.1.2.3, the limit switch is not enabled and will not protect against over-lifting and consequential damage. In this case, when the hoist is operated in the UP direction, the operator ***must*** watch the lower arm and stop the hoist before the lower arm touches the limit switch. Otherwise, the lower arm will continue to travel and serious damage to the tester will result.

2.2.4.2. Air Hoist: Execute a dynamic test by operating the hoist according to the required test protocol by using the hoist's pendant.

WARNING: When testing an air hoist the limit switch is not enabled and will not protect against over-lifting and consequential damage. Therefore, when the hoist is operated in the UP direction, the operator ***must*** watch the lower arm and stop the hoist before the lower arm touches the limit switch. Otherwise, the lower arm will continue to travel and serious damage to the tester will result.

2.2.4.3. Manual Hoist: To conduct a static test no operation of the hoist is required; in step 2.2.3 the load on the hoist was set to 125% of the hoist capacity, so a static test began at that point. To conduct a dynamic test, operate the hoist UP and DOWN according to the required test protocol.

WARNING: When testing a manual hoist the limit switch is not enabled and will not protect against over-lifting and consequential damage. Therefore, when the hoist is operated in the UP direction, the operator ***must*** watch the lower arm and stop the hoist before the lower arm touches the limit switch. Otherwise, the lower arm will continue to travel and serious damage to the tester will result.

2.3. Routine Shut-Down and Start-Up

2.3.1. Shut-Down

2.3.1.1. Turn off the tester by pressing the On/Off button on the Control Panel. Pilot light will go off, and, if the pump had cycled on, it too will go off.

2.3.1.2. Do Not open the Accumulator Discharge Valve. The system pressure will gradually dissipate as the Pressure Control Valve bleeds oil to the reservoir.

2.3.2. Start-Up

2.3.2.1. Press the On/Off button on the test stand control panel. Pilot light will energize and pump will start.

2.3.2.2. System pressure will increase to approx. 2,400 psi at which point the pump will stop. Tester is now ready for testing.

3. INSPECTION, MAINTENANCE, AND TROUBLESHOOTING

3.1. Inspection

3.1.1. Daily Inspection (Pre-Start):

(a)	Oil Leaks – Fittings	Tighten or repair.
(b)	Oil Leaks - Components	Determine cause. Repair or replace as necessary
(c)	Pump/Motor Abnormal Sound	Determine cause. Repair or replace as necessary
(d)	Pressure Switch Setting - ON	Confirm pump turns ON between 1700 to 1800 psi. Adjust if necessary.
(e)	Pressure Switch Setting – OFF	Confirm pump turns OFF between 2350 to 2450 psi. Adjust if necessary.
(f)	Loose bolts/nuts	Tighten any bolts or nuts that are found to be loose.

3.1.2. Monthly Inspection – Daily Inspection plus the following:

(a)	Deformation – Frame & Load Bearing Parts (e.g., shackle)	If deformation or cracks found, replace deformed or cracked part.
(b)	Oil Level	Discharge Accumulator and extend the Cylinder. Confirm oil level is within 25 mm of top of reservoir. Add oil if necessary.
(d)	Limit Switch Function	Confirm that pivot beam properly engages limit switch when hoist lifts lower beam too high. Confirm that when limit switch engaged by pivot beam the hoist UP circuit is disabled and hoist DOWN circuit still functions.
(e)	Reservoir Vent Cap	Confirm clean and unobstructed.
(f)	Motor Fan Cover	Confirm air inlet grill of Motor Fan Cover is clean and unobstructed.

3.1.3. Annual Inspection – Daily Inspection plus Monthly Inspection plus the following:

(a)	Oil	Obtain sample of oil. Determine if oil change is required.
(b)	Accumulator Pressure Charge	<<later>>

3.2. Maintenance

3.2.1. Calibration: Ensure the tester is calibrated annually. Refer to Section 4 below.

3.2.2. Tightening of Fasteners: Ensure fasteners are re-tightened on a monthly basis.

3.2.3. Oil Filter: Replace oil filter annually.

3.3. Troubleshooting

3.3.1. Cannot set proper pressure by control valve

a.	Defective or damaged Control Valve	Repair by replacing the control valve cartridge.
b.	Pressure Switch improperly adjusted.	Reset the ON and OFF setting of the Pressure Switch.

3.3.2. Motor/Pump Continues Running

a.	Pressure Switch OFF setting is greater than pump relief valve setting.	Adjust so that: • Pressure Switch OFF setting is between 2350 psi and 2450 psi. • Pump relief valve setting is 2500 psi.

3.3.3. Large Difference Between "UP" and "DOWN" values during calibration

a.	Load cell malfunction	Use properly functioning and calibrated load cell.
b.	Load cell re-zeroed during calibration	Zero the load cell only one time just before beginning calibration procedure.
c.	Air is mixed with the oil in the hydraulic system.	Use hoist to operate the DHLT in normal manner (exercising the pivot beam up and down) – this action removes air from the hydraulic system.
d.	Mechanical binding of Pivot Beam or Hydraulic Cylinder	Make repairs or replacements to eliminate the mechanical binding.

3.3.4. Blown Fuses

a.	Wiring problem causing short circuit.	Repair wiring problem to eliminate short circuit.
b.	Power supply voltage too low.	Connect to power supply of proper voltage.
c.	Defective or damaged pump creates motor overload.	Repair or replace to eliminate motor overload.
d.	Clogged or obstructed Oil Filter or Reservoir Strainer creates difficult pumping and motor overload.	Replace Oil Filter or clean Reservoir Strainer to restore easy pumping and eliminate motor overload.

4. CALIBRATION PROCEDURE

4.1. Scope

4.1.1. Includes calibration of the load test function.

4.1.2. Excludes setting the pressure switch and setting the limit switch.

4.2. Collect Data

4.2.1. Assemble 5 Ton Electric Chain Hoist and properly calibrated Force Measuring Device (Load Cell or Dynamometer) in test stand in accordance with section 2.1. Make sure the Force Measuring Device has been properly zeroed.

4.2.2. Execute steps 2.2.1 and 2.2.2.

4.2.3. Use the Pressure Control Valve to adjust the pressure on the Cylinder Pressure Gauge to approximately 150 psi.

4.2.4. Operate the hoist so that the lower beam is horizontal.

4.2.5. Refer to the Tester Calibration Data Sheet (Fig. 8). Set the Cylinder Pressure indicated on the Tester Calibration Sheet by using the Pressure Control Valve. For each Cylinder Pressure, observe the Force Measured by the Force Measuring Device, and record same on the Tester Calibration Sheet. The method for setting and recording is as follows.

4.2.5.1. UP Test Measurements: Starting from a pressure slightly below 200 psi, slowly increase the pressure until 200 psi is reached. Record the force in pounds as the "up" value. Repeat this for each pressure listed on the data sheet.

4.2.5.2. DOWN Test Measurements: Starting from a pressure slightly above 1300 psi, slowly decrease the pressure until 1300 psi is reached. Record the force in pounds as the "down" value. Repeat this for each pressure listed on the data sheet.

4.2.5.3. Calculate and record the Average for each Up/Down pair of recorded values.

Date: _____

Serial Number: _____

Cylinder Pressure (psi)	Force (lbs) Measured by Load Cell					
	5 Ton Link			10 Ton Link		
	Up	Down	Average	Up	Down	Average
200						
300						
400						
500						
600						
700						
800						
900						
1,000						
1,100						
1,200						
1,300						

Fig. 8 – Tester Calibration Data Sheet

4.3. Prepare Calibration Chart

4.3.1. Refer to the calibration spreadsheet (DHLT Cal rev00.xls, provided on CD included with the tester documents). Enter the date and the DHLT serial number in the designated areas in the upper left-hand area of the calibration spreadsheet.

4.3.2. Enter the "Average" values from the Tester Calibration Data Sheet into the corresponding yellow-colored cells of the calibration spreadsheet. This will cause the spreadsheet to (i) generate two lines on the graph area of the spreadsheet, and (ii) enter values in the table area (load vs. pressure) of the spreadsheet.

4.3.3. Confirm that the two lines generated on the graph are linear, or close to linear (they will be linear if their R^2 values are very close to 1). If not, investigate the cause, correct, and obtain new test data.

4.3.4. Print the spreadsheet table (load vs. pressure) and attach it to the DHLT in a manner that is visible to the operator.

5. SETTING THE PRESSURE SWITCH

> **WARNING**: This operation involves working in close proximity to electrically energized components. Contact with these energized components can cause injury and death. To avoid these hazards:
> - Be absolutely aware and sure of which components are electrically energized.
> - DO NOT come into contact with any electrically energized components.

5.1. To perform this operation, the tester must be turned on. The tester should not be in use for any other operation such as calibration or performing a load test.

5.2. Refer to Fig. 9. Remove the two small covers on the top of the Pressure Switch. This allows access to the two adjustment screws. One is is labeled "Circuit 1" and the other is labeled "Circuit 2."

5.2.1. Circuit 1 Adjusting Screw: Adjusts the system pressure at which the pump motor cycles on. Also known as the (a) "cycle on" setting, and also the (b) "low" pressure setting.

5.2.2. Circuit 2 Adjusting Screw: Adjusts the system pressure at which the pump motor cycles off. Also known as the (a) "cycle off" setting, and also the (b) "high" pressure setting.

Fig. 9 – Pressure Switch Adjusting Screws

5.3. Setting the Adjusting Screws

5.3.1. Circuit 1 Adjusting Screw (Cycle On / Low): Adjust this screw so that when the system pressure drops to 1750 psi (±50 psi) the pump motor is turned on. Do this as follows.

5.3.1.1. With the system pressure above 1800 psi, partially and slowly open the Accumulator Discharge Valve. This will bleed hydraulic fluid into the reservoir thereby reducing the system pressure.

5.3.1.2. As the system pressure drops, the pump motor will turn on. Note the pressure at which the pump motor turns on. If this pressure is outside of 1700 to 1800 psi, then adjust the Circuit 1 Adjusting Screw: turn clockwise to decrease the setting; turn counterclockwise to increase the setting.

5.3.2. Circuit 2 Adjusting Screw (Cycle Off / High): Adjust this screw so that when the system pressure increases to 2400 psi (±50 psi) the pump motor is turned off. Do this as follows.

5.3.2.1. With the system pressure below 2350 psi, partially and slowly open the Accumulator Discharge Valve. This will bleed hydraulic fluid into the reservoir thereby reducing the system pressure. When the pump motor begins to run, close the Accumulator Discharge Valve and allow the system pressure to increase.

5.3.2.2. As the system pressure increases, the pump motor will turn off. Note the pressure at which the pump motor turns off. If this pressure is outside of 2350 to 2450 psi, then adjust the Circuit 2 Adjusting Screw: turn clockwise to decrease the setting; turn counterclockwise to increase the setting.

5.3.2.3. Reinstall both screw covers on the Pressure Switch.

6. RECOMMENDED SPARE PARTS

6.1. Table 2 is a list of recommended spare parts for owners/users of the tester to have on hand to support maintenance and repair activities.

Table 2 – Recommended Spare Parts

Harrington PN	Description	Supplier	Supplier PN	Qty per tester	Notes
9006252	Fuse, 15A, Time Delay	Ferraz-Shawmut	ATDR15	2	1
9010505	Oil Filter ASSY – 10 Micron, 15 psi bypass & 200 psi max.	Kaman	SF110	1	1
9010504	Oil Filter Element	Kaman	1A9021	1	1
---	Pressure Switch	---	---	1	2
---	Oil	Exxon	Humble Hydraulic Oil H46	~ 3.4 Gal.	3
9010503	Cartridge for Control Valve	---	---	1	2

Notes:
1. Source from Harrington using Harrington PN, or source locally using Supplier PN.
2. Source only from Harrington.
3. Source locally using Supplier PN.

END