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Turning Parts Changers Into TROUBLESHOOTERS!

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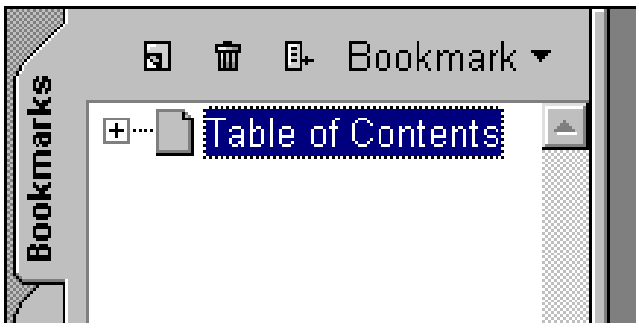

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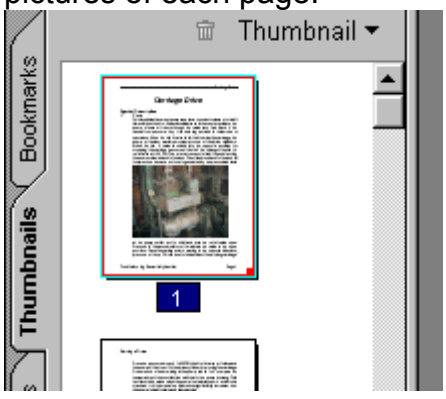

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(770) 464-0777

GPM Hydraulic Consulting, Inc.

P.O. Box 689

Social Circle, GA 30025

www.gpmhydraulic.com

gpm@gpmhydraulic.com

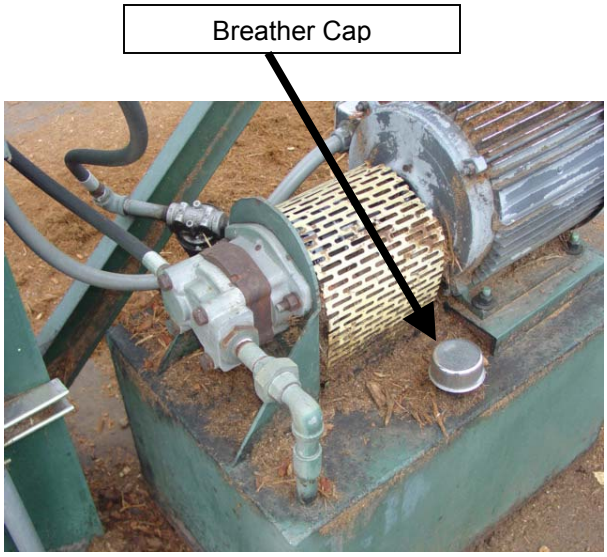
Bin Door Hydraulic Preventive Maintenance Schedule

Make several copies of this schedule and keep them handy for performing regular maintenance checks.

Date

The Bin Door hydraulic system is quite simple and should require very little maintenance. Unless problems are encountered, maintenance will mostly include filter changes and oil changes. The filter should be changed on a scheduled basis. Record the date of the last filter change here and on the filter.

Date of last filter change



Check the breather cap. The breather cap on the Bin Door is the spring type. It should be checked and cleaned at least monthly and replaced annually. If it is not replaced regularly, the spring can lose its tension and, though the cap itself may be clean, it will allow contaminants to enter the reservoir. Record the date when the breather was replaced here and on the breather.

Breather Cap Clean?

Date Last Replaced

Board Jump Chain Outfeed Hydraulic Preventive Maintenance Schedule

Make several copies of this schedule and keep them handy for performing regular maintenance checks.

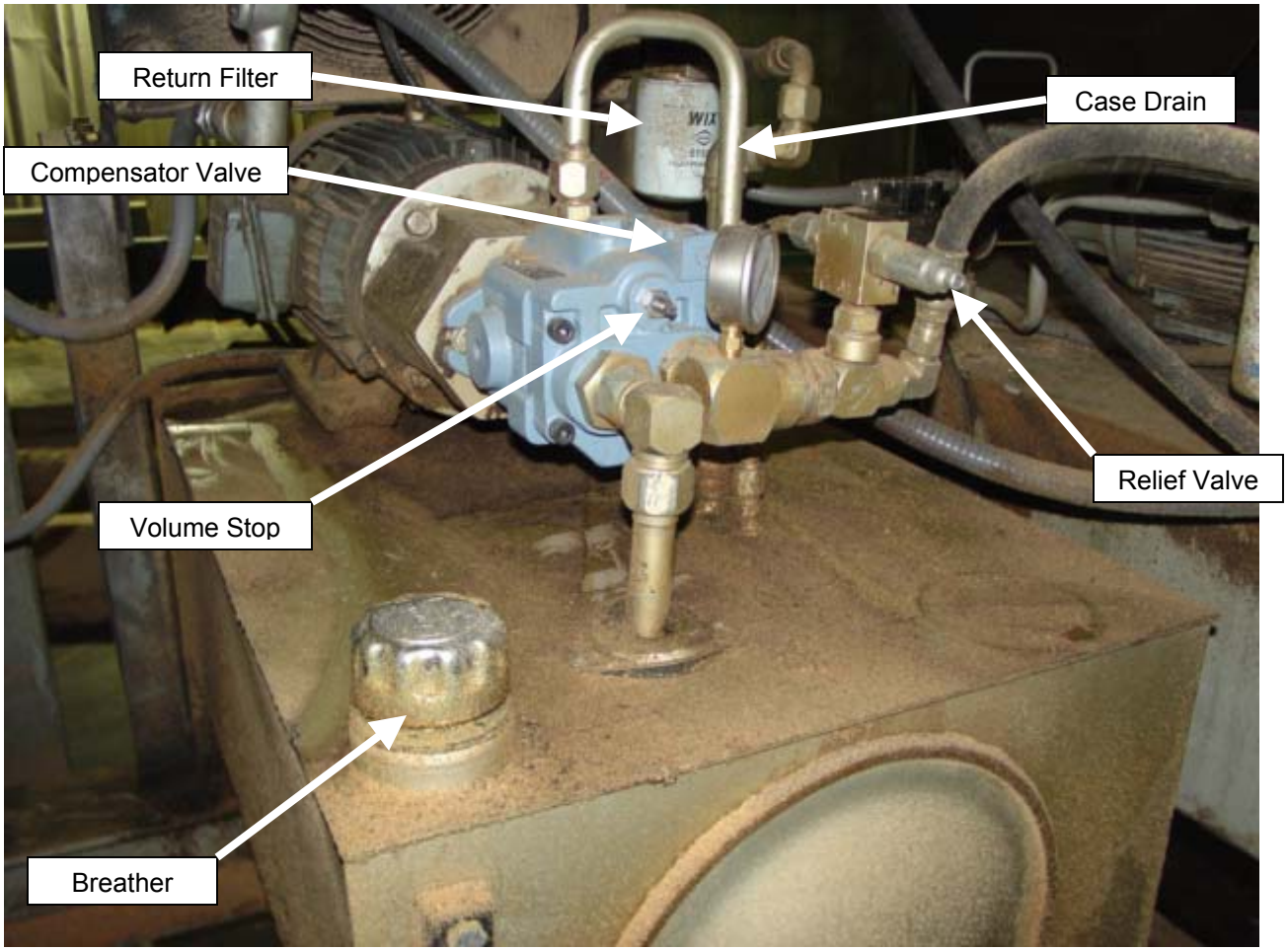
Date

Observe the machine operation and record the minimum and maximum operating pressures. Since the Board Jump Chain Outfeed uses a pressure compensating pump, the pressure should not vary significantly during operation. A sharp drop in pressure (more than 100 – 200 PSI) during a cycle is indicative of a flow problem. Items to check in this case include:

- Case drain flow – measure case flow to determine if the pump is worn
- Pump compensator valve – disassemble the valve to ensure that the spool is not stuck, the orifice in the spool is clear and the spring is not bent or broken.
- Compensator setting – the pump compensator should be set 200 PSI above the pressure required to move the heaviest load.
- The volume stop may be out of adjustment. Turn the volume stop counterclockwise to increase the maximum flow of the pump, clockwise to decrease.
- Synchronization of flow controls in the system – if one or more of the system flow controls is open too wide, its associated actuator can move too rapidly and rob flow from other actuators in the system.
- Plugged suction strainer – this will be accompanied by cavitation (see below).
- Relief valve stuck open

Max PSI

Min PSI



Pressures should be set regularly on this machine, particularly when problems are encountered but at least quarterly when seasons change. Pressures set too low will result in stalls when moving heavy loads. Pressures set too high will result in excess force as actuators are deadheaded. This will greatly increase the shock in the system and eventually show up as leaks. The procedure is as follows:

1) Place the heaviest load the machine will be expected to move.
2) As the load is moving, reduce the pressure by turning the pump compensator counterclockwise until the load stalls.
3) Record the pressure at which the system stalls.
4) Shut the machine down.
5) Turn the system relief valve counterclockwise to a very low pressure.
6) Turn the pump compensator clockwise to a very high pressure.
7) Restart the machine – fluid should now be dumping across the system relief at a very low pressure.

8) Turn the system relief valve clockwise until it is dumping at 450 PSI above the pressure recorded in step 3.
9) Turn the pump compensator counterclockwise to reduce the pressure to 200 PSI above the pressure recorded in step 3.

Listen to the sound of the pump. A steady high pitched whining sound is evidence of cavitation. Cavitation occurs when the pump is unable to draw as much fluid as it is attempting to deliver. This can occur if the suction strainer is plugged or if the oil is too cold and the viscosity is too high. If there is a more erratic high pitched whine that changes in pitch with changes in the machine, the pump may be aerating. Aeration occurs when outside air is introduced into the suction side of the pump. An air leak in the suction line is usually the cause. Squirt oil the length of the suction line. An interruption in the aeration will locate the air leak. When a pump is aerating, there is often a sound similar to marbles rattling inside the pump and foaming of the oil may also be present.

OK Cavitating Aerating

Check the pump case flow. Do this by measuring the temperature of the suction line and the case drain line with a temperature gun. Work the following formula to determine case flow:

$$\frac{(T_{\text{Case Drain Line}} - T_{\text{Suction Line}})}{\text{PSI X .0093}}$$

Where “PSI” is the system operating pressure. The result will be the case flow of the pump in gallons per minute. A relatively new pump should bypass no more than about 1 – 3% of its total output. If the pump flow is reduced by as much as 10%, it should usually be replaced.

Case Flow

Check the temperature of the relief valve tank line. The tank line of the Board Jump Chain Outfeed relief valve should never be hot. If it is, either it has become stuck open or it is improperly adjusted with respect to the pump compensator. The proper setting of the system relief is 250 PSI above that of the compensator.

Relief Valve Temperature

Check the return line filter. This filter should be checked and changed on a scheduled basis. The filter schedule should be determined by oil analysis, not by

the reading of the dirt indicator. The date of the last filter change should be recorded here and on the filter.

Date Of Last Filter Change

Check the breather cap. The breather cap on the Board Jump Chain Outfeed is the spring type. It should be checked and cleaned at least monthly and replaced annually. If it is not replaced regularly, the spring can lose its tension and, though the cap itself may be clean, it will allow contaminants to enter the reservoir. Record the date when the breather was replaced here and on the breather.

Breather Cap Clean?

Date Last Replaced

Record the oil temperature. While it is normal for the oil temperature to increase whenever ambient temperature does, excessively high oil temperature indicates bypassing in the system. Places where bypassing may be occurring can include:

- System relief valve
- Internally in the pump (check the pump case drain)
- The compensator may have been set above the relief valve.
- Directional valve spools
- Actuators

The source of the excess heat can be determined using the temperature gun. This is best done shortly after startup before overheated oil can be circulated throughout the system. Under no circumstances should the oil temperature be allowed to exceed 140^{o}F. Above this temperature, most hydraulic oils will begin to break down and leave varnish deposits.
Check the oil level (with any cylinders fully retracted). If the oil level is low, there must be a leak in the system.

Oil Level

Inspect for leaks in the system and list below:

Inspect the hoses in the system. Are any of them rubbing on another hose, part of the machine or the structure? If so, list below. Check the length of the hoses. Unless required by the movement of the machine, hydraulic hoses should be no longer than about four feet. Hoses that are longer than four feet should be replaced by a length of hard pipe.

Inspect the pipe clamps. Proper hydraulic clamps should be used – conduit and beam clamps are unacceptable.

Proper clamps?

Properly spaced (approximately every 5' and within 6" of a termination)?

List any other problems you have noticed that should be addressed:

Cant Runaround Jump Chain Outfeed Hydraulic Preventive Maintenance Schedule

Make several copies of this schedule and keep them handy for performing regular maintenance checks.

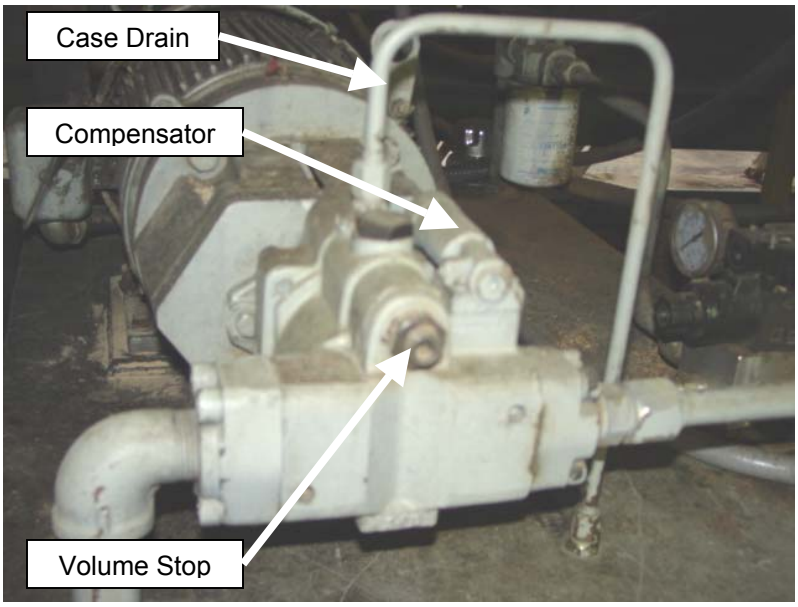
Date

Observe the machine operation and record the minimum and maximum operating pressures. Since the Cant Runaround Jump Chain Outfeed uses a pressure compensating pump, the pressure should not vary significantly during operation. A sharp drop in pressure (more than 100 – 200 PSI) during a cycle is indicative of a flow problem. Items to check in this case include:

- Case drain flow – measure case flow to determine if the pump is worn
- Pump compensator valve – disassemble the valve to ensure that the spool is not stuck, the orifice in the spool is clear and the spring is not bent or broken.
- Compensator setting – the pump compensator should be set 200 PSI above the pressure required to move the heaviest load.
- The volume stop may be out of adjustment. Turn the volume stop counterclockwise to increase the maximum flow of the pump, clockwise to decrease.
- Synchronization of flow controls in the system – if one or more of the system flow controls is open too wide, its associated actuator can move too rapidly and rob flow from other actuators in the system.
- Plugged suction strainer – this will be accompanied by cavitation (see below).
- Relief valve stuck open

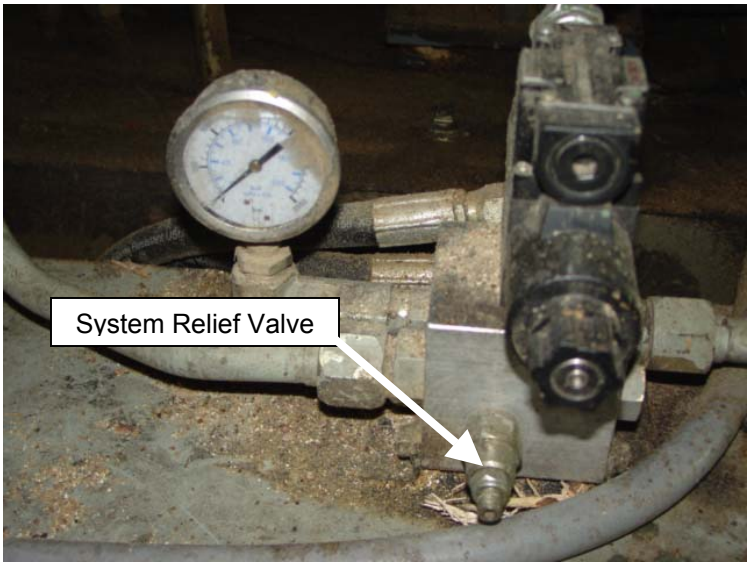
Max PSI

Min PSI



Pressures should be set regularly on this machine, particularly when problems are encountered but at least quarterly when seasons change. Pressures set too low will result in stalls when moving heavy loads. Pressures set too high will result in excess force as actuators are deadheaded. This will greatly increase the shock in the system and eventually show up as leaks. The procedure is as follows:

1) Place the heaviest load the machine will be expected to move.
2) As the load is moving, reduce the pressure by turning the pump compensator counterclockwise until the load stalls.
3) Record the pressure at which the system stalls.
4) Shut the machine down.
5) Turn the system relief valve counterclockwise to a very low pressure.
6) Turn the pump compensator clockwise to a very high pressure.
7) Restart the machine – fluid should now be dumping across the system relief at a very low pressure.
8) Turn the system relief valve clockwise until it is dumping at 450 PSI above the pressure recorded in step 3.
9) Turn the pump compensator counterclockwise to reduce the pressure to 200 PSI above the pressure recorded in step 3.



Listen to the sound of the pump. A steady high pitched whining sound is evidence of cavitation. Cavitation occurs when the pump is unable to draw as much fluid as it is attempting to deliver. This can occur if the suction strainer is plugged or if the oil is too cold and the viscosity is too high. If there is a more erratic high pitched whine that changes in pitch with changes in the machine, the pump may be aerating. Aeration occurs when outside air is introduced into the suction side of the pump. An air leak in the suction line is usually the cause.

Squirt oil the length of the suction line. An interruption in the aeration will locate the air leak. When a pump is aerating, there is often a sound similar to marbles rattling inside the pump and foaming of the oil may also be present.

OK Cavitating Aerating

Check the pump case flow. Do this by measuring the temperature of the suction line and the case drain line with a temperature gun. Work the following formula to determine case flow:

$$\frac{(T_{\text{Case Drain Line}} - T_{\text{Suction Line}})}{\text{PSI X .0093}}$$

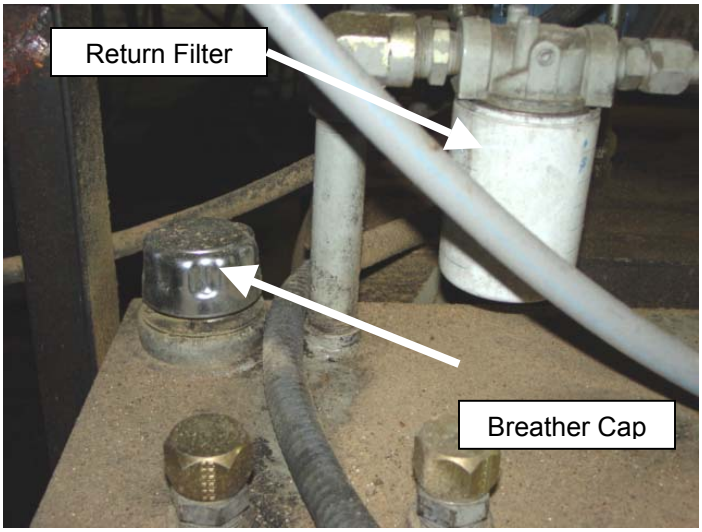
Where "PSI" is the system operating pressure. The result will be the case flow of the pump in gallons per minute. A relatively new pump should bypass no more than about 1 – 3% of its total output. If the pump flow is reduced by as much as 10%, it should usually be replaced.

Case Flow

Check the temperature of the relief valve. The tank line of the Cant Runaround Jump Chain Outfeed relief valve is not exposed, but the valve itself should be no hotter than the pressure port outlet of the pump. If it is, either it has become stuck open or it is improperly adjusted with respect to the pump compensator. The proper setting of the system relief is 250 PSI above that of the compensator.

Relief Valve Temperature

Check the return line filter. This filter should be checked and changed on a scheduled basis. The filter schedule should be determined by oil analysis, not by the reading of the dirt indicator. The date of the last filter change should be recorded here and on the filter.



Date Of Last Filter Change

Check the breather cap. The breather cap on the Cant Runaround Jump Chain Outfeed is the spring type. It should be checked and cleaned at least monthly and replaced annually. If it is

not replaced regularly, the spring can lose its tension and, though the cap itself may be clean, it will allow contaminants to enter the reservoir. Record the date when the breather was replaced here and on the breather.

Breather Cap Clean?

Date Last Replaced

Record the oil temperature. While it is normal for the oil temperature to increase whenever ambient temperature does, excessively high oil temperature indicates bypassing in the system. Places where bypassing may be occurring can include:

- System relief valve
- Internally in the pump (check the pump case drain)
- The compensator may have been set above the relief valve.
- Directional valve spools
- Actuators

The source of the excess heat can be determined using the temperature gun. This is best done shortly after startup before overheated oil can be circulated throughout the system. Under no circumstances should the oil temperature be allowed to exceed 140^{o}F. Above this temperature, most hydraulic oils will begin to break down and leave varnish deposits.

Check the oil level (with any cylinders fully retracted). If the oil level is low, there must be a leak in the system.

Oil Level

Inspect for leaks in the system and list below:

Inspect the hoses in the system. Are any of them rubbing on another hose, part of the machine or the structure? If so, list below. Check the length of the hoses. Unless required by the movement of the machine, hydraulic hoses should be no longer than about four feet. Hoses that are longer than four feet should be replaced by a length of hard pipe.

Inspect the pipe clamps. Proper hydraulic clamps should be used – conduit and beam clamps are unacceptable.

Proper clamps?

Properly spaced (approximately every 5' and within 6" of a termination)?

List any other problems you have noticed that should be addressed:

Debarker Hydraulic Preventive Maintenance Schedule

Make several copies of this schedule and keep them handy for performing regular maintenance checks.

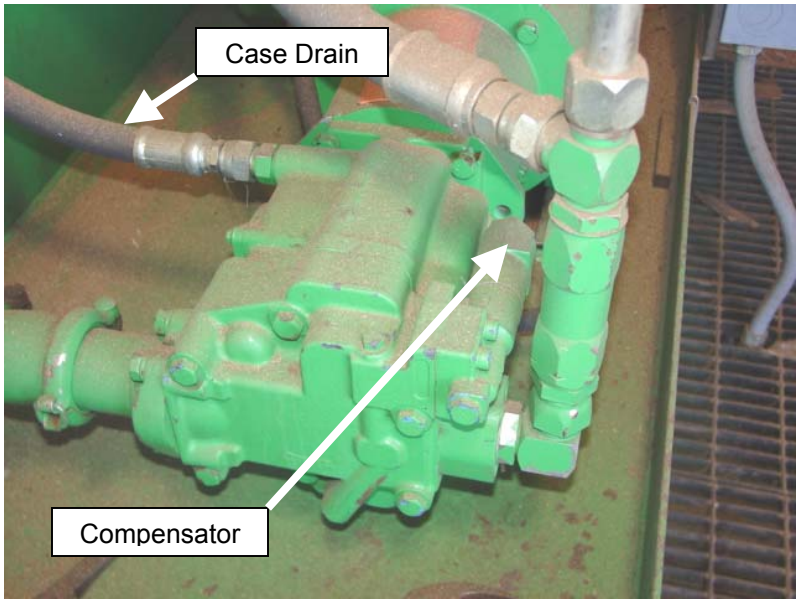
Date

Observe the machine operation and record the minimum and maximum operating pressures. Since the Debarker uses a pressure compensating pump, the pressure should not vary significantly during operation. A sharp drop in pressure (more than 100 – 200 PSI) during a cycle is indicative of a flow problem. Items to check in this case include:

- Case drain flow – measure case flow to determine if the pump is worn
- Pump compensator valve – disassemble the valve to ensure that the spool is not stuck, the orifice in the spool is clear and the spring is not bent or broken.
- Compensator setting – the pump compensator should be set 200 PSI above the pressure required to move the heaviest load.
- Synchronization of flow controls in the system – if one or more of the system flow controls is open too wide, its associated actuator can move too rapidly and rob flow from other actuators in the system.
- Plugged suction strainer – this will be accompanied by cavitation (see below).
- Relief valve stuck open

Max PSI

Min PSI



Pressures should be set regularly on this machine, particularly when problems are encountered but at least quarterly when seasons change. Pressures set too low will result in stalls when moving heavy loads. Pressures set too high will result in excess force as actuators are deadheaded. This will greatly increase the

shock in the system and eventually show up as leaks. The procedure is as follows:

1) Place the heaviest load the machine will be expected to move.
2) As the load is moving, reduce the pressure by turning the pump compensator counterclockwise until the load stalls.
3) Record the pressure at which the system stalls.
4) Shut the machine down.
5) Turn the system relief valve counterclockwise to a very low pressure.
6) Turn the pump compensator clockwise to a very high pressure.
7) Restart the machine – fluid should now be dumping across the system relief at a very low pressure.
8) Turn the system relief valve clockwise until it is dumping at 450 PSI above the pressure recorded in step 3.
9) Turn the pump compensator counterclockwise to reduce the pressure to 200 PSI above the pressure recorded in step 3.

Listen to the sound of the pump. A steady high pitched whining sound is evidence of cavitation. Cavitation occurs when the pump is unable to draw as much fluid as it is attempting to deliver. This can occur if the suction strainer is plugged or if the oil is too cold and the viscosity is too high. If there is a more erratic high pitched whine that changes in pitch with changes in the machine, the pump may be aerating. Aeration occurs when outside air is introduced into the suction side of the pump. An air leak in the suction line is usually the cause. Squirt oil the length of the suction line. An interruption in the aeration will locate the air leak. When a pump is aerating, there is often a sound similar to marbles rattling inside the pump and foaming of the oil may also be present.

OK Cavitating Aerating

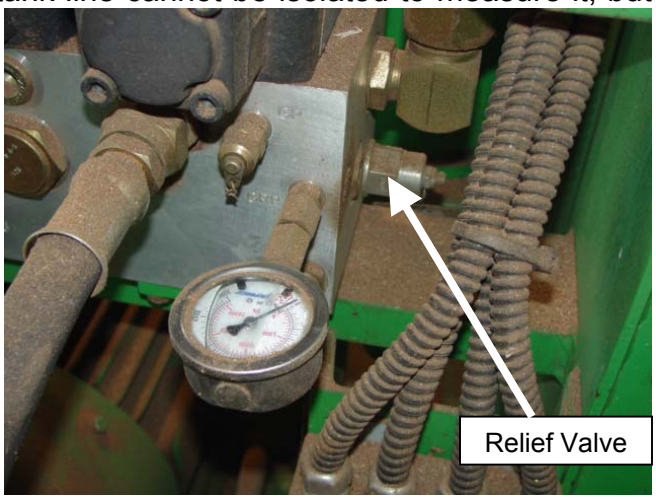
Check the pump case flow. Do this by measuring the temperature of the suction line and the case drain line with a temperature gun. Work the following formula to determine case flow:

$$\frac{(T_{\text{Case Drain Line}} - T_{\text{Suction Line}})}{\text{PSI X .0093}}$$

Where “PSI” is the system operating pressure. The result will be the case flow of the pump in gallons per minute. A relatively new pump should bypass no more than about 1 – 3% of its total output. If the pump flow is reduced by as much as 10%, it should usually be replaced.

Case Flow

Check the temperature of the relief valve. Since the Debarker relief valve is mounted in the valve manifold, its tank line cannot be isolated to measure it, but the valve itself should be no hotter than the pressure line near the pump. If it is, either it has become stuck open or it is improperly adjusted with respect to the pump compensator. The proper setting of the system relief is 250 PSI above that of the compensator.



Relief Valve Temperature

Check the accumulator precharge. In the absence of designer recommendations, our recommendation is to set the accumulator precharge to half of the compensator setting. The precharge should be set with the machine shut down and the accumulator dump valve open. If set properly, the accumulator will fill with oil during operation and the nitrogen will compress to one third its original size. Heat should therefore be felt two thirds of the way up the accumulator and the top one third should be cooler. Precharge should be checked monthly.

Top 1/3 hotter than bottom 2/3?

Current precharge

Check the return line filter. This filter should be checked and changed on a scheduled basis. The filter schedule should be determined by oil analysis, not by the reading of the dirt indicator. The date of the last filter change should be recorded here and on the filter.

Date Of Last Filter Change

Check the breather. The breather on the Debarker is an element type with no dirt indicator. It should be checked and cleaned at least monthly and replaced at least every six months. If it is not replaced regularly, it can become plugged and either unfiltered air can enter from some other point or the pump could be damaged. Record the date when the breather was last replaced here and on the breather.

Breather Cap Clean?

Date Last Replaced

Record the oil temperature. While it is normal for the oil temperature to increase whenever ambient temperature does, excessively high oil temperature indicates bypassing in the system. Places where bypassing may be occurring can include:

Level Indicator With Thermometer

- System relief valve
- Internally in the pump (check the pump case drain)
- The compensator may have been set above the relief valve.
- Directional valve spools
- Actuators

The source of the excess heat can be determined using the temperature gun. This is best done shortly after startup before overheated oil can be circulated throughout the system. Under no circumstances should the oil temperature be allowed to exceed 140^{o}F. Above this temperature, most hydraulic oils will begin to break down and leave varnish deposits.

Check the oil level (with any cylinders fully retracted). If the oil level is low, there must be a leak in the system.

Oil Level

Inspect for leaks in the system and list below.

Inspect the hoses in the system. Are any of them rubbing on another hose, part of the machine or the structure? If so, list below. Check the length of the hoses. Unless required by the movement of the machine, hydraulic hoses should be no longer than about four feet. Hoses that are longer than four feet should be replaced by a length of hard pipe.

Inspect the pipe clamps. Proper hydraulic clamps should be used – conduit and beam clamps are unacceptable.

Proper clamps?

Properly spaced (approximately every 5’ and within 6” of a termination)?

List any other problems you have noticed that should be addressed:

Dip Tank Hydraulic Preventive Maintenance Schedule

Make several copies of this schedule and keep them handy for performing regular maintenance checks.

Date

The Dip Tank hydraulic system is quite simple and should require very little maintenance. Unless problems are encountered, maintenance will mostly include filter changes and oil changes. The filter should be changed on a scheduled basis. Record the date of the last filter change here and on the filter.

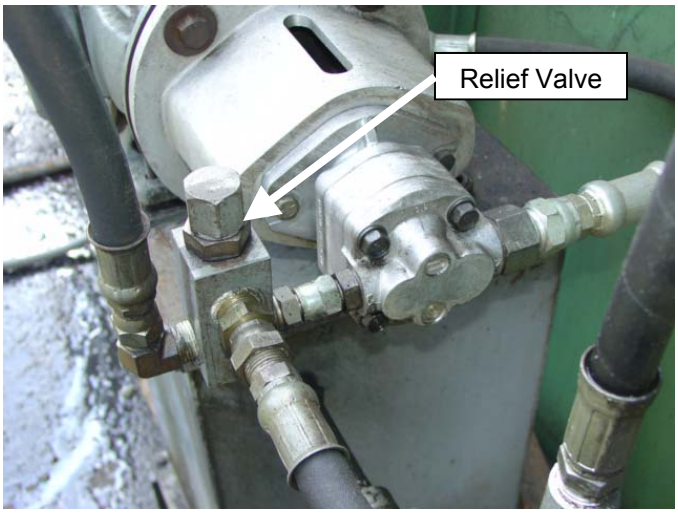
Date of last filter change

Check the breather cap. The breather cap on the Dip Tank is the spring type. It should be checked and cleaned at least monthly and replaced annually. If it is not replaced regularly, the spring can lose its tension and, though the cap itself may be clean, it will allow contaminants to enter the reservoir. Record the date when the breather was replaced here and on the breather.

Breather Cap Clean?

Date Last Replaced

Check the temperature of the relief valve tank line. It should never be hot. If it is, it may either be stuck open or out of adjustment. The procedure for adjusting the relief valve is as follows:



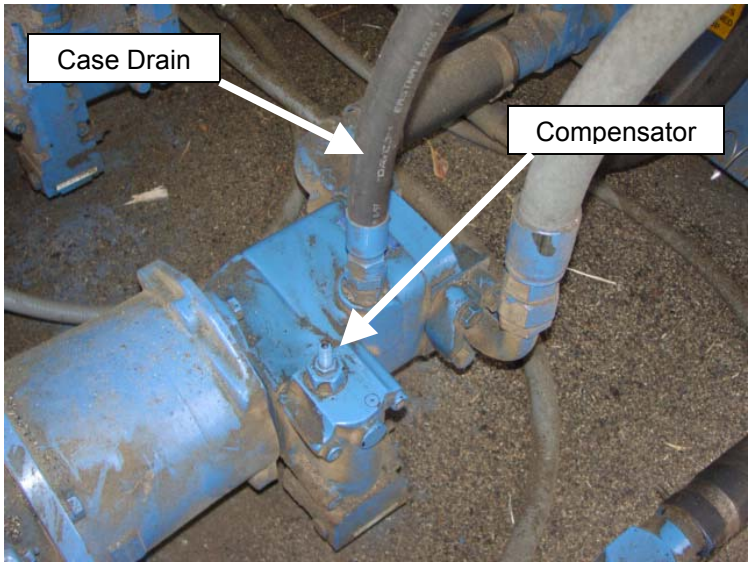
1) Deadhead the flow so that fluid dumps across the relief valve
2) Install a pressure gauge upstream of the relief
3) Turn the system on and adjust the relief valve until the heaviest load stalls. Record the pressure. Increase the pressure 200 PSI above that amount.

Check for leaks and list them here:

List any other problems that need to be addressed:

Edger Hydraulic Preventive Maintenance Schedule

The Edger hydraulic power supply has two pressure compensating pumps connected in parallel. There are two schools of thought about the proper pressure settings for these pumps. Both have merit. The first is to set both pumps to identical pressures. This causes both pumps to stroke at the same time and wear evenly. If this is the method used, both pumps should operate at about the same temperature and should sound about the same. The second is to set the pressures 75 – 100 PSI apart. When this is done, the pump set highest will do most of the work. The pump set at the lower pressure will remain de-stroked most of the time and will suffer minimum wear. It will output only when the system demands flow from it as evidenced by a drop in system pressure. At any time during operation, it can be determined if both pumps are stroking by observing the pressure gauge. The checks listed below should be performed at least monthly. Make several copies of this schedule and keep them handy for performing regular maintenance checks.



Date

Observe the machine operation and record the minimum and maximum operating pressures. Since the Edger uses pressure compensating pumps, the pressure should not vary significantly during operation. A sharp drop in pressure (more than 100 – 200 PSI) during a cycle is indicative of a flow problem. Items to check in this case include:

- Case drain flow – measure case flow to determine if the pump is worn
- Pump compensator valve – disassemble the valve to ensure that the spool is not stuck, the orifice in the spool is clear and the spring is not bent or broken. If the pressures are set identically, the trouble could be in either compensator. If they are set apart, it can be determined which pump has the stuck compensator or is severely worn by observing system pressure. If system pressure is normal except for when flow demands are high, then the problem is with the pump set at the lower pressure. If system

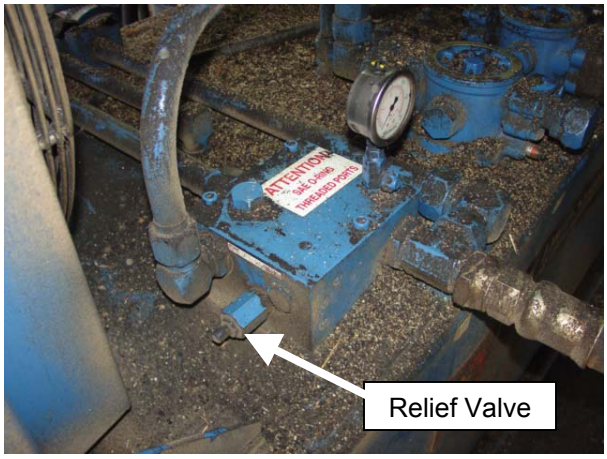
pressure is 75 – 100 PSI below normal before it drops out, the problem is with the pump set at the higher pressure.

- Compensator setting – the pump compensators should be set 200 PSI above the pressure required to move the heaviest load if their settings are identical. If they are set apart, the lower pressure setting should be 200 PSI above maximum load pressure and the higher setting should be 275 – 300 PSI above maximum load.
- Synchronization of flow controls in the system – if one or more of the system flow controls is open too wide, its associated actuator can move too rapidly and rob flow from other actuators in the system.
- Plugged suction strainer – this will be accompanied by cavitation (see below).
- Relief valve stuck open

Max PSI

Min PSI

Pressures should be set regularly on this machine, particularly when problems are encountered but at least quarterly when seasons change. Pressures set too low will result in stalls when moving heavy loads. Pressures set too high will result in excess force as actuators are deadheaded. This will greatly increase the shock in the system and eventually show up as leaks. In the absence of designer recommendations, we recommend that the lower setting of the pump compensators be set 200 PSI above the maximum load pressure, the higher setting 75 PSI above the lower and the system relief 250 PSI above the higher compensator setting. If the pumps are set to identical pressures, isolate the pumps from each other before making adjustments. Pumps can be damaged by turning them backwards. If the pumps are set apart from each other, isolate the pump that is to be set at the higher pressure and set the lower pressure first. Then set the higher pressure. The procedure is as follows:



1) Place the heaviest load the machine will be expected to move.
2) As the load is moving, reduce the pressure by turning the pump compensator counterclockwise until the load stalls.
3) Record the pressure at which the system stalls.
4) Shut the machine down.

5) Turn the system relief valve counterclockwise to a very low pressure.
6) Turn the pump compensator clockwise to a very high pressure.
7) Restart the machine – fluid should now be dumping across the system relief at a very low pressure.
8) Turn the system relief valve clockwise until it is dumping at 450 PSI above the pressure recorded in step 3.
9) Turn the pump compensator counterclockwise to reduce the pressure to 200 PSI above the pressure recorded in step 3.

Listen to the sound of each pump. A steady high pitched whining sound is evidence of cavitation. Cavitation occurs when the pump is unable to draw as much fluid as it is attempting to deliver. This can occur if the suction strainer is plugged or if the oil is too cold and the viscosity is too high. If there is a more erratic high pitched whine that changes in pitch with changes in the machine, the pump may be aerating. Aeration occurs when outside air is introduced into the suction side of the pump. An air leak in the suction line is usually the cause. Squirt oil the length of the suction line. An interruption in the aeration will locate the air leak. When a pump is aerating, there is often a sound similar to marbles rattling inside the pump and foaming of the oil may also be present.

OK Cavitating Aerating

Check the pump case flow. Do this by measuring the temperature of the suction line and the case drain line with a temperature gun. Work the following formula to determine case flow:

$$\frac{(T_{\text{Case Drain Line}} - T_{\text{Suction Line}})}{\text{PSI X .0093}}$$

Where “PSI” is the system operating pressure. The result will be the case flow of the pump in gallons per minute. A relatively new pump should bypass no more than about 1 – 3% of its total output. If the pump flow is reduced by as much as 10%, it should usually be replaced.

Case Flow

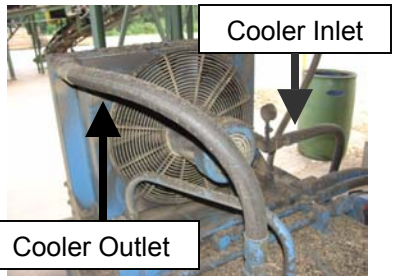
Check the temperature of the relief valve. Since the tank line of the valve is not exposed, temperature must be measured at the valve itself. The relief valve should be no hotter than the pressure port of the pump. If it is, either it has become stuck open or it is improperly adjusted with respect to the pump compensators. The proper setting of the system relief is 250 PSI above that of the compensators (or of the higher set compensator if the pumps are set apart).

Relief Valve Temperature

Check the accumulator precharge. In the absence of designer recommendations, our recommendation is to set the accumulator precharge to half of the higher compensator setting. The precharge should be set with the machine shut down and the accumulator dump valve open. If set properly, the accumulator will fill with oil during operation and the nitrogen will compress to one third its original size. Heat should therefore be felt two thirds of the way up the accumulator and the top one third should be cooler. Precharge should be checked monthly.

Top 1/3 hotter than bottom 2/3?

Current precharge



Cooler Fins Must Stay Clear

Cooler Gauge

Check the temperature of the inlet and the outlet lines of the cooler. If the cooler is functioning properly, the outlet line should be significantly cooler than the inlet. If there is only a small difference, either the cooler does not have good air flow or a portion of the cooler has become partially plugged. If the cooler becomes badly plugged, a significant pressure drop will be noted on the gauge at the inlet. An air cooler can rupture if the pressure drop across it exceeds 150 – 200 PSI.

Temperature Drop Between Cooler Inlet and Cooler Outlet

Good Air Flow?

Cooler Pressure Gauge Reading

The recirculating cooling and filtering pump is a fixed displacement gear pump and should require minimal maintenance. The best indication of its performance is the current draw of the electric drive motor. When the pump is bypassing severely, it will draw significantly less current. Measure the current draw of the drive motor with an ammeter while the pump is functioning properly.

Current Draw

Check the return line, recirculating and pressure filters. These filters should be checked and changed on a scheduled basis. The filter schedule should be determined by oil analysis, not by the reading of the dirt indicator. This is especially important on the edger because of the extremely tight tolerances of the valves. An oil sample port is mounted on the side of the reservoir. To begin an oil analysis schedule, start at 13-week intervals and adjust the time between samples according to the results. Filters should all be changed at the same time. The date of the last filter change should be recorded here and on the filter.

Date Of Last Filter Change

Check the breather cap. The breather cap on the Edger is an element type. It should be checked monthly to make sure the indicator is not stuck and replaced whenever the indicator shows red. Record the date when the breather was replaced here and on the breather.

Breather Indicator OK?

Date Last Replaced

Record the oil temperature. While it is normal for the oil temperature to increase whenever ambient temperature does, excessively high oil temperature indicates bypassing in the system. Places where bypassing may be occurring can include:

- System relief valve
- Internally in one of the pumps (check the pump case drains and current draw on the recirculating pump)
- One of the compensators may have been set above the relief valve.
- Valve spools
- Actuators

The source of the excess heat can be determined using the temperature gun. This is best done shortly after startup before overheated oil can be circulated throughout the system. Under no circumstances should the oil temperature be allowed to exceed 140^{o}F. Above this temperature, most hydraulic oils will begin to break down and leave varnish deposits.

Oil Temperature

Check the oil level (with any cylinders fully retracted). If the oil level is low, there must be a leak in the system.

Oil Level

Inspect for leaks in the system and list below.

Inspect the hoses in the system. Are any of them rubbing on another hose, part of the machine or the structure? If so, list below. Check the length of the hoses. Unless required by the movement of the machine, hydraulic hoses should be no longer than about four feet. Hoses that are longer than four feet should be replaced by a length of hard pipe.

Inspect the pipe clamps. Proper hydraulic clamps should be used – conduit and beam clamps are unacceptable.

Proper clamps?

Properly spaced (approximately every 5’ and within 6” of a termination)?

List any other problems you have noticed that should be addressed:

Gang Saw Hydraulic Preventive Maintenance Schedule

There are two identical Gang Saw units. The sound and operating temperatures of both units should remain similar. If either machine begins to make sounds that the other does not or begins to operate at a higher temperature than the other, this should be cause for concern. The checks listed below should be performed at least monthly on each machine. Make several copies of this schedule and keep them handy for performing regular maintenance checks.

Date

Observe the machine operation and record the minimum and maximum operating pressures. Since the Gang Saw uses a pressure compensating pump, the pressure should not vary significantly during operation. A sharp drop in pressure during a cycle is indicative of a flow problem. Items to check in this case include:

- Case drain flow – measure case flow to determine if the pump is worn
- Pump compensator valve – disassemble the valve to ensure that the spool is not stuck, the orifice in the spool is clear and the spring is not bent or broken.
- Compensator setting – the pump compensator should be set 200 PSI above the pressure required to move the heaviest load.
- Synchronization of flow controls in the system – if one or more of the system flow controls is open too wide, its associated actuator can move too rapidly and rob flow from other actuators in the system.
- Plugged suction strainer – this will be accompanied by cavitation (see below).
- Relief valve stuck open

Max PSI

Min PSI

Pressures should be set regularly on this machine, particularly when problems are encountered but at least quarterly when seasons change. Pressures set too low will result in stalls when moving heavy loads. Pressures set too high will result in excess force as actuators are deadheaded. This will greatly increase the shock in the system and eventually show up as leaks. The procedure is as follows:

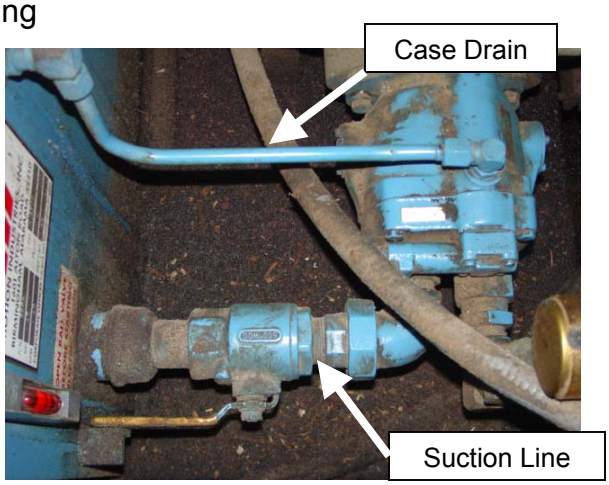
1) Place the heaviest load the machine will be expected to move.
2) As the load is moving, reduce the pressure by turning the pump compensator counterclockwise until the load stalls.
3) Record the pressure at which the system stalls.
4) Shut the machine down.

5) Turn the system relief valve counterclockwise to a very low pressure.
6) Turn the pump compensator clockwise to a very high pressure.
7) Restart the machine – fluid should now be dumping across the system relief at a very low pressure.
8) Turn the system relief valve clockwise until it is dumping at 450 PSI above the pressure recorded in step 3.
9) Turn the pump compensator counterclockwise to reduce the pressure to 200 PSI above the pressure recorded in step 3.

Listen to the sound of the pump. A steady high pitched whining sound is evidence of cavitation. Cavitation occurs when the pump is unable to draw as much fluid as it is attempting to deliver. This can occur if the suction strainer is plugged or if the oil is too cold and the viscosity is too high. If there is a more erratic high pitched whine that changes in pitch with changes in the machine, the pump may be aerating. Aeration occurs when outside air is introduced into the suction side of the pump. An air leak in the suction line is usually the cause. Squirt oil the length of the suction line. An interruption in the aeration will locate the air leak. When a pump is aerating, there is often a sound similar to marbles rattling inside the pump and foaming of the oil may also be present.

OK Cavitating Aerating

Check the pump case flow. Do this by measuring the temperature of the suction line and the case drain line with a temperature gun. Work the following formula to determine case flow:



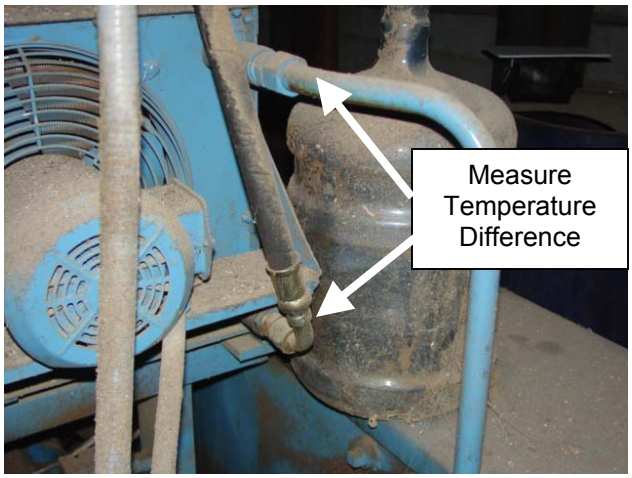
$$\frac{(T_{\text{Case Drain Line}} - T_{\text{Suction Line}})}{\text{PSI X .0093}}$$

Where “PSI” is the system operationg pressure. The result will be the case flow of the pump in gallons per minute. A relatively new pump should bypass no more than about 1 – 3% of its total output. If the pump flow is reduced by as much as 10%, it should usually be replaced.

Case Flow

Check the temperature of the relief valve. The Gang Saw relief valve is mounted on the directional valve manifold, so its tank line cannot be measured. The relief valve should be no hotter than surrounding components.

Relief Valve Temperature



Check the temperature of the inlet and the outlet lines of the cooler. If the cooler is functioning properly, the outlet line should be significantly cooler than the inlet. If there is only a small difference, either the cooler does not have good air flow or a portion of the cooler has become plugged. Since there is no bypass check valve, a plugged cooler can easily rupture. A pressure drop across the cooler of 150 – 200 PSI can rupture it.

Temperature Drop Between Cooler Inlet and Cooler Outlet

Good Air Flow?

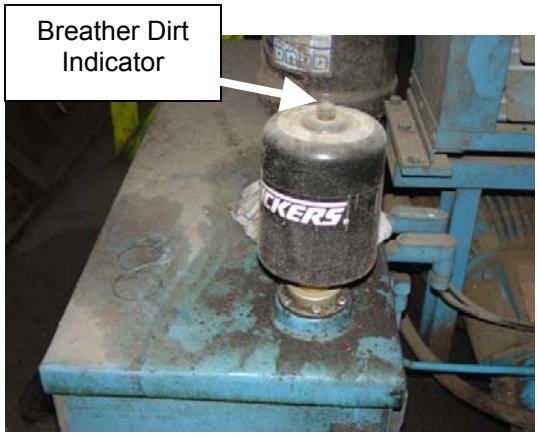
Check the return line filter. This filter should be checked and changed on a scheduled basis. The filter schedule should be determined by oil analysis. The date of the last filter change should be recorded here and on the filter.

Date Of Last Filter Change

Check the dirt indicator on the breather. When the indicator shows red, the breather cap should be replaced. Record the date when the breather was replaced here and on the breather.

Indicator OK?

Date Of Last Breather Change



Record the oil temperature. While it is normal for the oil temperature to increase whenever ambient temperature does, excessively high oil temperature indicates bypassing in the system. Places where bypassing may be occurring can include:

- System relief valve
- Internally in the pump (check the pump case drain)
- The compensator may have been set above the relief valve.
- Directional valve spools
- Actuators

The source of the excess heat can be determined using the temperature gun. This is best done shortly after startup before overheated oil can be circulated throughout the system. Under no circumstances should the oil temperature be allowed to exceed 140^{o}F. Above this temperature, most hydraulic oils will begin to break down and leave varnish deposits.

Oil Temperature

Check the oil level (with any cylinders fully retracted). If the oil level is low, there must be a leak in the system.

Oil Level

Inspect for leaks in the system and list below:

Inspect the hoses in the system. Are any of them rubbing on another hose, part of the machine or the structure? If so, list below. Check the length of the hoses. Unless required by the movement of the machine, hydraulic hoses should be no longer than about four feet. Hoses that are longer than four feet should be replaced by a length of hard pipe.

Inspect the pipe clamps. Proper hydraulic clamps should be used – conduit and beam clamps are unacceptable.

Proper clamps?

Properly spaced (approximately every 5’ and within 6” of a termination)?

List any other problems you have noticed that should be addressed:

Head Saw Setworks Hydraulic Preventive Maintenance Schedule

Make several copies of this schedule and keep them handy for performing regular maintenance checks.

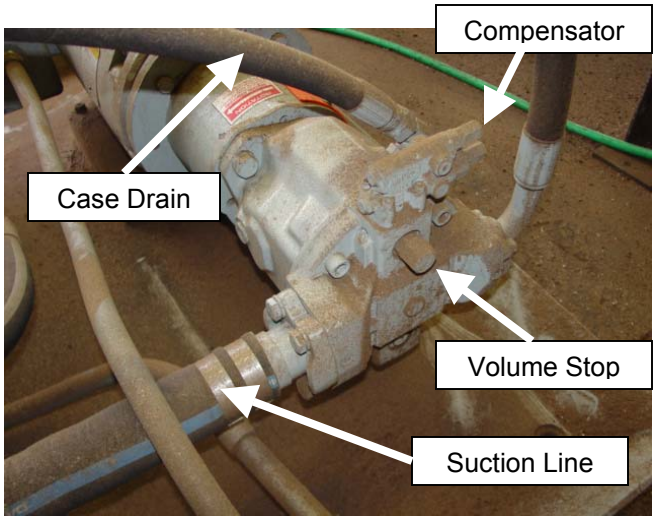
Date

Observe the machine operation and record the minimum and maximum operating pressures. Since the Head Saw Setworks uses a pressure compensating pump, the pressure should not vary significantly during operation. A sharp drop in pressure (more than 100 – 200 PSI) during a cycle is indicative of a flow problem. Items to check in this case include:

- Case drain flow – measure case flow to determine if the pump is worn
- Pump compensator valve – disassemble the valve to ensure that the spool is not stuck, the orifice in the spool is clear and the spring is not bent or broken.
- Compensator setting – the pump compensator should be set 200 PSI above the pressure required to move the heaviest load.
- The volume stop may be out of adjustment. Turn the volume stop counterclockwise to increase the maximum flow of the pump, clockwise to decrease.
- Synchronization of flow controls in the system – if one or more of the system flow controls is open too wide, its associated actuator can move too rapidly and rob flow from other actuators in the system.
- Plugged suction strainer – this will be accompanied by cavitation (see below).
- Relief valve stuck open

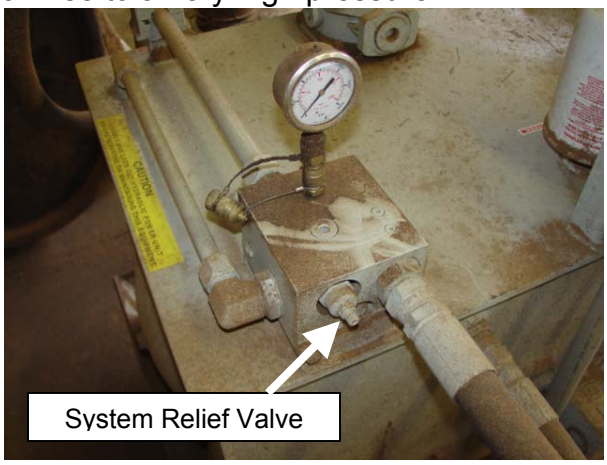
Max PSI

Min PSI



Pressures should be set regularly on this machine, particularly when problems are encountered but at least quarterly when seasons change. Pressures set too low will result in stalls when moving heavy loads. Pressures set too high will result in excess force as actuators are deadheaded. This will greatly increase the shock in the system and eventually show up as leaks. The procedure is as follows:

1) Place the heaviest load the machine will be expected to move.
2) As the load is moving, reduce the pressure by turning the pump compensator counterclockwise until the load stalls. The Head Saw Setworks uses a Rexroth Pressure Compensating pump with a dual compensator assembly. The second compensator is for a load sensing package that is not installed. Make all adjustments to the inner compensator. The compensator valve farther from the pump body (the one on top) should be kept turned fully clockwise.
3) Record the pressure at which the system stalls.
4) Shut the machine down.
5) Turn the system relief valve counterclockwise to a very low pressure.
6) Turn the pump compensator clockwise to a very high pressure.
7) Restart the machine – fluid should now be dumping across the system relief at a very low pressure.
8) Turn the system relief valve clockwise until it is dumping at 450 PSI above the pressure recorded in step 3.
9) Turn the pump compensator counterclockwise to reduce the pressure to 200 PSI above the pressure recorded in step 3.



Listen to the sound of the pump. A steady high pitched whining sound is evidence of cavitation. Cavitation occurs when the pump is unable to draw as much fluid as it is attempting to deliver. This can occur if the suction strainer is plugged or if the oil is too cold and the viscosity is too high. If there is a more erratic high pitched whine that changes in pitch with changes in the machine, the pump may be aerating. Aeration occurs when outside air is introduced into the suction side of the pump. An air leak in the suction line is usually the cause. Squirt oil the length of the suction line. An interruption in the aeration will locate the air leak. When a pump is aerating, there is often a sound similar to marbles rattling inside the pump and foaming of the oil may also be present.

OK Cavitating Aerating

Check the pump case flow. Do this by measuring the temperature of the suction line and the case drain line with a temperature gun. Work the following formula to determine case flow:

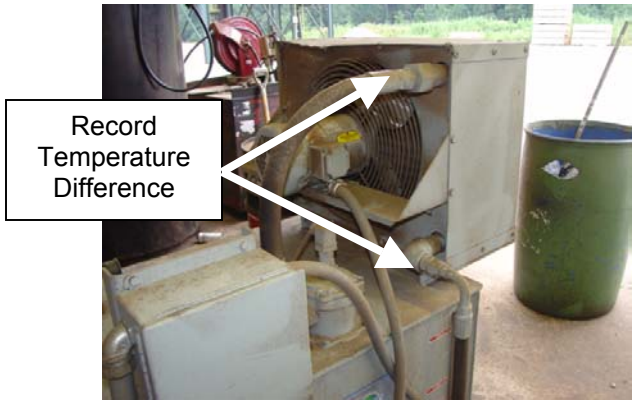
$$\frac{(T_{\text{Case Drain Line}} - T_{\text{Suction Line}})}{\text{PSI X .0093}}$$

Where "PSI" is the system operating pressure. The result will be the case flow of the pump in gallons per minute. A relatively new pump should bypass no more than about 1 – 3% of its total output. If the pump flow is reduced by as much as 10%, it should usually be replaced.

Case Flow

Check the temperature of the relief valve. The tank line of the Head Saw Setworks relief valve is not exposed, but the valve itself should be no hotter than the pressure line of the pump. If it is, either it has become stuck open or it is improperly adjusted with respect to the pump compensator. The proper setting of the system relief is 250 PSI above that of the compensator.

Relief Valve Temperature



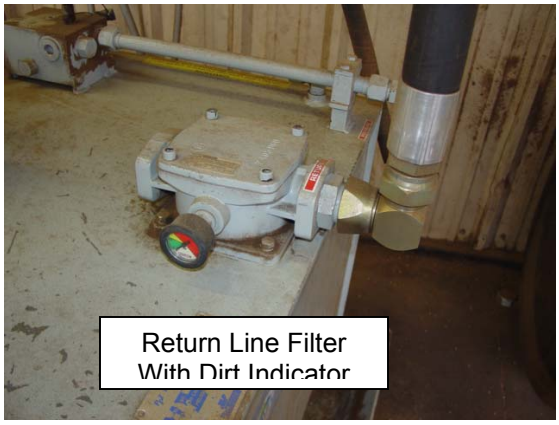
Check the temperature of the inlet and the outlet lines of the cooler. If the cooler is functioning properly, the outlet line should be significantly cooler than the inlet. If there is only a small difference, either the cooler does not have good air flow or a portion of the cooler has become partially plugged. If the cooler becomes badly plugged, it could become ruptured.

Temperature Drop Between Cooler Inlet and Cooler Outlet

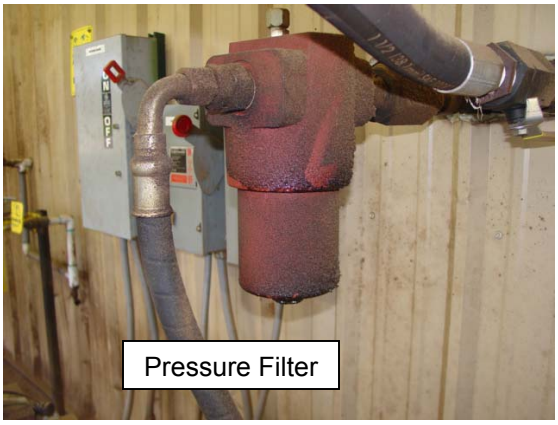
Good Air Flow?

The recirculating cooling and filtering pump is a fixed displacement gear pump and should require minimal maintenance. The best indication of its performance is the current draw of the electric drive motor. When the pump is bypassing severely, it will draw significantly less current. Measure the current draw of the drive motor with an ammeter while the pump is functioning properly.

Current Draw



Return Line Filter
With Dirt Indicator



Pressure Filter

Check the return line filter and the pressure filter. These filters should be checked and changed on a scheduled basis. The filter schedule should be determined by oil analysis, not by the reading of the dirt indicator. Change both filters at the same time. The date of the last filter change should be recorded here and on the filters.

Date Of Last Filter Change

Check the breather. The breather on the Head Saw Setworks is an element type with no dirt indicator. It should be checked and cleaned at least monthly and replaced at least every six months. If it is not replaced regularly, it can plug and either air will enter the system from some other point (bringing in unfiltered, contaminated air) or the pump may

suffer damage. At the next breather change, a breather with a dirt indicator should be considered. Record the date when the breather was replaced here and on the breather.

Breather Clean?

Date Last Replaced

Record the oil temperature. While it is normal for the oil temperature to increase whenever ambient temperature does, excessively high oil temperature indicates bypassing in the system. Places where bypassing may be occurring can include:

- System relief valve
- Internally in the pump (check the pump case drain)
- The compensator may have been set above the relief valve.
- Directional valve spools
- Actuators

The source of the excess heat can be determined using the temperature gun. This is best done shortly after startup before overheated oil can be circulated throughout the system. Under no circumstances should the oil temperature be allowed to exceed 140^{o}F. Above this temperature, most hydraulic oils will begin to break down and leave varnish deposits.

Oil Temperature

Check the oil level (with any cylinders fully retracted). If the oil level is low, there must be a leak in the system.

Oil Level

Inspect for leaks in the system and list below.

Inspect the hoses in the system. Are any of them rubbing on another hose, part of the machine or the structure? If so, list below. Check the length of the hoses. Unless required by the movement of the machine, hydraulic hoses should be no longer than about four feet. Hoses that are longer than four feet should be replaced by a length of hard pipe.

Inspect the pipe clamps. Proper hydraulic clamps should be used – conduit and beam clamps are unacceptable.

Proper clamps?

Properly spaced (approximately every 5' and within 6" of a termination)?

List any other problems you have noticed that should be addressed:

Infeed Jump Chain Hydraulic Preventive Maintenance Schedule

Make several copies of this schedule and keep them handy for performing regular maintenance checks.

Date

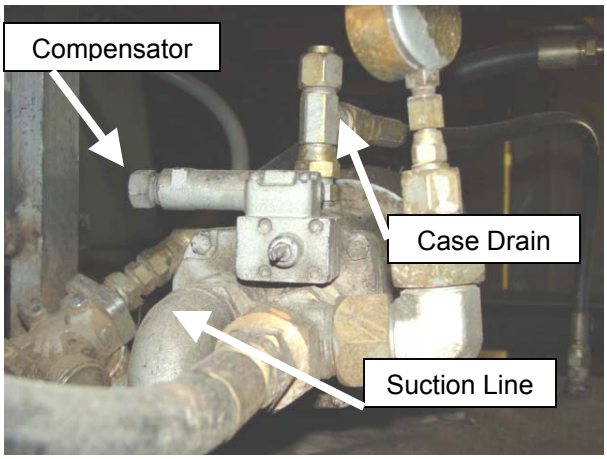
Observe the machine operation and record the minimum and maximum operating pressures. Since the Infeed Jump Chain uses a pressure compensating pump, the pressure should not vary significantly during operation. A sharp drop in pressure (more than 100 – 200 PSI) during a cycle is indicative of a flow problem. Items to check in this case include:

- Case drain flow – measure case flow to determine if the pump is worn
- Pump compensator valve – disassemble the valve to ensure that the spool is not stuck, the orifice in the spool is clear and the spring is not bent or broken.
- Compensator setting – the pump compensator should be set 200 PSI above the pressure required to move the heaviest load.
- Volume stop adjustment – turn the adjustment clockwise to reduce the maximum output of the pump, counterclockwise to increase it.
- Synchronization of flow controls in the system – if one or more of the system flow controls is open too wide, its associated actuator can move too rapidly and rob flow from other actuators in the system.
- Plugged suction strainer – this will be accompanied by cavitation (see below).
- Relief valve stuck open

Max PSI

Min PSI

Pressures should be set regularly on this machine, particularly when problems are encountered but at least quarterly when seasons change. Pressures set too low will result in stalls when moving heavy loads. Pressures set too high will result in excess force as actuators are deadheaded. This will greatly increase the shock in the system and eventually show up as leaks. The procedure is as follows:



1) Place the heaviest load the machine will be expected to move.

2) As the load is moving, reduce the pressure by turning the pump compensator counterclockwise until the load stalls.
3) Record the pressure at which the system stalls.
4) Shut the machine down.
5) Turn the system relief valve counterclockwise to a very low pressure.
6) Turn the pump compensator clockwise to a very high pressure.
7) Restart the machine – fluid should now be dumping across the system relief at a very low pressure.
8) Turn the system relief valve clockwise until it is dumping at 450 PSI above the pressure recorded in step 3.
9) Turn the pump compensator counterclockwise to reduce the pressure to 200 PSI above the pressure recorded in step 3.

Listen to the sound of the pump. A steady high pitched whining sound is evidence of cavitation. Cavitation occurs when the pump is unable to draw as much fluid as it is attempting to deliver. This can occur if the suction strainer is plugged or if the oil is too cold and the viscosity is too high. If there is a more erratic high pitched whine that changes in pitch with changes in the machine, the pump may be aerating. Aeration occurs when outside air is introduced into the suction side of the pump. An air leak in the suction line is usually the cause. Squirt oil the length of the suction line. An interruption in the aeration will locate the air leak. When a pump is aerating, there is often a sound similar to marbles rattling inside the pump and foaming of the oil may also be present.

OK Cavitating Aerating

Check the pump case flow. Do this by measuring the temperature of the suction line and the case drain line with a temperature gun. Work the following formula to determine case flow:

$$\frac{(T_{\text{Case Drain Line}} - T_{\text{Suction Line}})}{\text{PSI X .0093}}$$

Where “PSI” is the system operating pressure. The result will be the case flow of the pump in gallons per minute. A relatively new pump should bypass no more than about 1 – 3% of its total output. If the pump flow is reduced by as much as 10%, it should usually be replaced.

Case Flow

Check the temperature of the relief valve. Since the relief valve of the Infeed Jump Chain is in the valve manifold, it shares a tank line with the directional valves and cannot be isolated to measure temperature. The valve itself, however, should never be hotter than the pressure line near the pump. If it is, either it has become stuck open or it is improperly adjusted with respect to the

pump compensator. The proper setting of the system relief is 250 PSI above that of the compensator.

Relief Valve Temperature

Check the return line filter. This filter should be checked and changed on a scheduled basis. The filter schedule should be determined by oil analysis, not by the reading of the dirt indicator. The date of the last filter change should be recorded here and on the filter.

Date Of Last Filter Change

Check the breather cap. The breather cap on the Infeed Jump Chain is the spring type. It should be checked and cleaned at least monthly and replaced annually. If it is not replaced regularly, the spring can lose its tension and, though the cap itself may be clean, it will allow contaminants to enter the reservoir. Record the date when the breather was replaced here and on the breather.

Breather Cap Clean?

Date Last Replaced

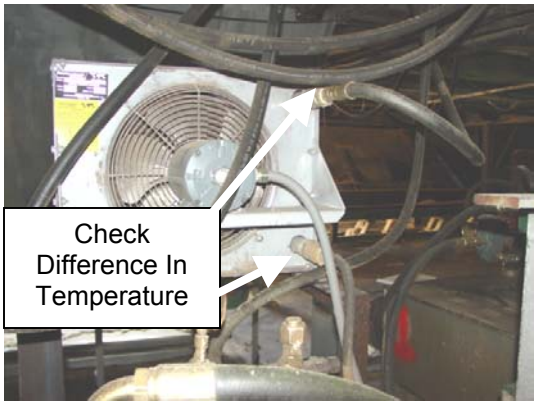
Record the oil temperature. While it is normal for the oil temperature to increase whenever ambient temperature does, excessively high oil temperature indicates bypassing in the system. Places where bypassing may be occurring can include:

- System relief valve
- Internally in the pump (check the pump case drain)
- The compensator may have been set above the relief valve.
- Directional valve spools
- Actuators

The source of the excess heat can be determined using the temperature gun. This is best done shortly after startup before overheated oil can be circulated throughout the system. Under no circumstances should the oil temperature be

allowed to exceed 140°F. Above this temperature, most hydraulic oils will begin to break down and leave varnish deposits.

Oil Temperature



Check the difference in temperature between the inlet and outlet lines of the cooler. There should be a noticeable difference if the cooler is functioning properly. If the difference is only slight, the cooler may be partially plugged. If the cooler becomes badly plugged, it could rupture. If there is no temperature difference at all, the trouble could be the air flow through the fins. In order for an air cooler to operate efficiently, you must be able to see daylight through the fins.

Difference in temperature between inlet and outlet

Good air flow?

Check the oil level (with any cylinders fully retracted). If the oil level is low, there must be a leak in the system.

Oil Level

Inspect for leaks in the system and list below:

Inspect the hoses in the system. Are any of them rubbing on another hose, part of the machine or the structure? If so, list below. Check the length of the hoses. Unless required by the movement of the machine, hydraulic hoses should be no longer than about four feet. Hoses that are longer than four feet should be replaced by a length of hard pipe.

Inspect the pipe clamps. Proper hydraulic clamps should be used – conduit and beam clamps are unacceptable.

Proper clamps?

Properly spaced (approximately every 5’ and within 6” of a termination)?

List any other problems you have noticed that should be addressed:

Linear Positioner Unit Infeed Hydraulic Preventive Maintenance Schedule

Make several copies of this schedule and keep them handy for performing regular maintenance checks.

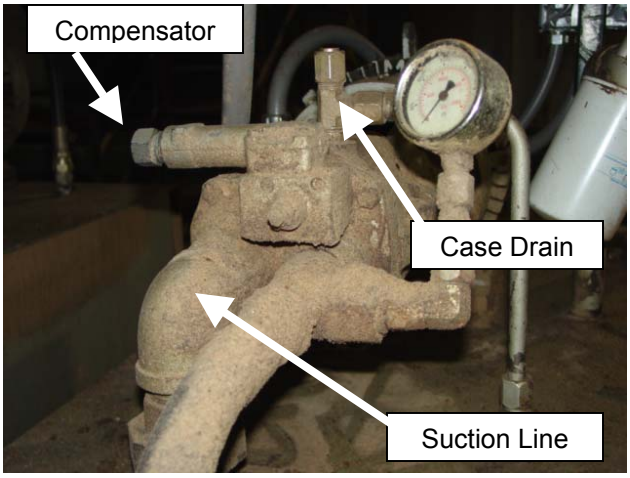
Date

Observe the machine operation and record the minimum and maximum operating pressures. Since the Linear Positioner Unit Infeed uses a pressure compensating pump, the pressure should not vary significantly during operation. A sharp drop in pressure (more than 100 – 200 PSI) during a cycle is indicative of a flow problem. Items to check in this case include:

- Case drain flow – measure case flow to determine if the pump is worn
- Pump compensator valve – disassemble the valve to ensure that the spool is not stuck, the orifice in the spool is clear and the spring is not bent or broken.
- Compensator setting – the pump compensator should be set 200 PSI above the pressure required to move the heaviest load.
- Volume stop adjustment – turn the adjustment clockwise to reduce the maximum output of the pump, counterclockwise to increase it.
- Synchronization of flow controls in the system – if one or more of the system flow controls is open too wide, its associated actuator can move too rapidly and rob flow from other actuators in the system.
- Plugged suction strainer – this will be accompanied by cavitation (see below).
- Relief valve stuck open

Max PSI

Min PSI



Pressures should be set regularly on this machine, particularly when problems are encountered but at least quarterly when seasons change. Pressures set too low will result in stalls when moving heavy loads. Pressures set too high will result in excess force as actuators are deadheaded. This will greatly increase the shock in the system and eventually show up as leaks. The procedure is as follows:

1) Place the heaviest load the machine will be expected to move.

2) As the load is moving, reduce the pressure by turning the pump compensator counterclockwise until the load stalls.
3) Record the pressure at which the system stalls.
4) Shut the machine down.
5) Turn the system relief valve counterclockwise to a very low pressure.
6) Turn the pump compensator clockwise to a very high pressure.
7) Restart the machine – fluid should now be dumping across the system relief at a very low pressure.
8) Turn the system relief valve clockwise until it is dumping at 450 PSI above the pressure recorded in step 3.
9) Turn the pump compensator counterclockwise to reduce the pressure to 200 PSI above the pressure recorded in step 3.

Listen to the sound of the pump. A steady high pitched whining sound is evidence of cavitation. Cavitation occurs when the pump is unable to draw as much fluid as it is attempting to deliver. This can occur if the suction strainer is plugged or if the oil is too cold and the viscosity is too high. If there is a more erratic high pitched whine that changes in pitch with changes in the machine, the pump may be aerating. Aeration occurs when outside air is introduced into the suction side of the pump. An air leak in the suction line is usually the cause. Squirt oil the length of the suction line. An interruption in the aeration will locate the air leak. When a pump is aerating, there is often a sound similar to marbles rattling inside the pump and foaming of the oil may also be present.

OK Cavitating Aerating

Check the pump case flow. Do this by measuring the temperature of the suction line and the case drain line with a temperature gun. Work the following formula to determine case flow:

$$\frac{(T_{\text{Case Drain Line}} - T_{\text{Suction Line}})}{\text{PSI X .0093}}$$

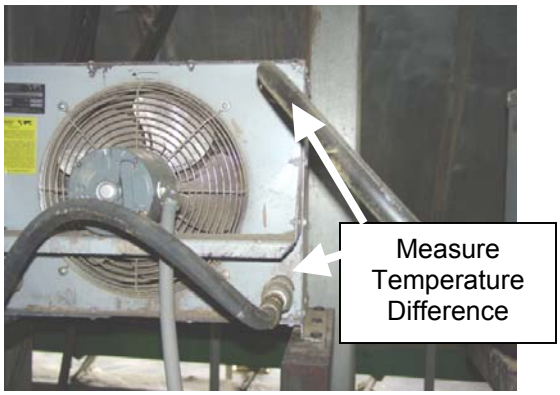
Where “PSI” is the system operating pressure. The result will be the case flow of the pump in gallons per minute. A relatively new pump should bypass no more than about 1 – 3% of its total output. If the pump flow is reduced by as much as 10%, it should usually be replaced.

Case Flow

Check the temperature of the relief valve. Since the relief valve of the Linear Positioner Unit Infeed is in the valve manifold, it shares a tank line with the directional valves and cannot be isolated to measure temperature. The valve itself, however, should never be hotter than the pressure line near the pump. If it is, either it has become stuck open or it is improperly adjusted with respect to the

pump compensator. The proper setting of the system relief is 250 PSI above that of the compensator.

Relief Valve Temperature



Check the temperature of the inlet and the outlet lines of the cooler. If the cooler is functioning properly, the outlet line should be significantly cooler than the inlet. If there is only a small difference, either the cooler does not have good air flow or a portion of the cooler has become partially plugged. If the cooler becomes badly plugged, it is possible that the cooler could rupture.

Temperature Drop Between Cooler Inlet and Cooler Outlet

Good Air Flow?

Check the return line filter. This filter should be checked and changed on a scheduled basis. The filter schedule should be determined by oil analysis, not by the reading of the dirt indicator. The date of the last filter change should be recorded here and on the filter.

Date Of Last Filter Change

Check the breather cap. The breather cap on the Linear Positioner Unit Infeed is the spring type. It should be checked and cleaned at least monthly and replaced annually. If it is not replaced regularly, the spring can lose its tension and, though the cap itself may be clean, it will allow contaminants to enter the reservoir. Record the date when the breather was replaced here and on the breather.

Breather Cap Clean?

Date Last Replaced

Record the oil temperature. While it is normal for the oil temperature to increase whenever ambient temperature does, excessively high oil temperature indicates bypassing in the system. Places where bypassing may be occurring can include:

- System relief valve
- Internally in the pump (check the pump case drain)
- The compensator may have been set above the relief valve.
- Directional valve spools
- Actuators

The source of the excess heat can be determined using the temperature gun. This is best done shortly after startup before overheated oil can be circulated throughout the system. Under no circumstances should the oil temperature be allowed to exceed 140^{o}F. Above this temperature, most hydraulic oils will begin to break down and leave varnish deposits.

Oil Temperature

Check the oil level (with any cylinders fully retracted). If the oil level is low, there must be a leak in the system.

Oil Level

Inspect for leaks in the system and list below:

Inspect the hoses in the system. Are any of them rubbing on another hose, part of the machine or the structure? If so, list below. Check the length of the hoses. Unless required by the movement of the machine, hydraulic hoses should be no longer than about four feet. Hoses that are longer than four feet should be replaced by a length of hard pipe.

Inspect the pipe clamps. Proper hydraulic clamps should be used – conduit and beam clamps are unacceptable.

Proper clamps?

Properly spaced (approximately every 5' and within 6" of a termination)?

List any other problems you have noticed that should be addressed:

Log Turner Hydraulic Preventive Maintenance Schedule

Make several copies of this schedule and keep them handy for performing regular maintenance checks.

Date

Observe the machine operation and record the minimum and maximum operating pressures. The Log Turner uses fixed displacement pumps and unloads the flow through the directional valves when it idles. The pressure should drop very near 0 PSI at idle and build to a pressure proportional to the weight of the load during operation. Significant drops in pressure (more than 100 – 200 PSI) coupled with load stalling during operation indicate a flow problem. Possible causes can include:

- Internal pump bypassing
- Contaminated check valves in the “P” ports of one or more of the directional valves
- Accumulator precharge or ruptured bladder
- Plugged suction strainer – this will be accompanied by cavitation (see below).
- Relief valve stuck partially open or improperly set

Max PSI

Min PSI

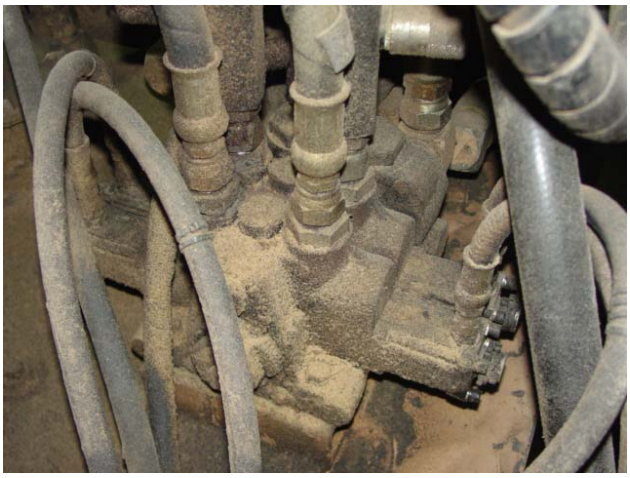
Pressures should be set regularly on this machine, particularly when problems are encountered but at least quarterly when seasons change. Pressures set too low will result in stalls when moving heavy loads. Pressures set too high will result in excess force as actuators are deadheaded. This will greatly increase the shock in the system and eventually show up as leaks. The procedure is as follows:

1) Place the heaviest load the machine will be expected to move.
2) As the load is moving, observe the highest pressure reached on the gauge
3) Shut the machine down
4) Deadhead the flow so that the only path back to tank is through the relief valve
5) Turn the relief counterclockwise to a very low pressure and start the machine
6) Gradually increase the relief valve setting until the pressure reading is 200 PSI above the pressure observed in step 2

Listen to the sound of the pump. A steady high pitched whining sound is evidence of cavitation. Cavitation occurs when the pump is unable to draw as

much fluid as it is attempting to deliver. This can occur if the suction strainer is plugged or if the oil is too cold and the viscosity is too high. If there is a more erratic high pitched whine that changes in pitch with changes in the machine, the pump may be aerating. Aeration occurs when outside air is introduced into the suction side of the pump. An air leak in the suction line is usually the cause. Squirt oil the length of the suction line. An interruption in the aeration will locate the air leak. When a pump is aerating, there is often a sound similar to marbles rattling inside the pump and foaming of the oil may also be present.

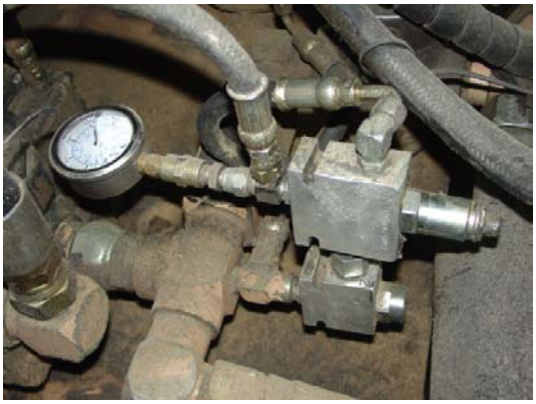
OK Cavitating Aerating



Measure the temperature of the pump case. If the pumps are bypassing internally, there will be an increase in pump case temperature. A measurement while the pump is functioning properly can be a good benchmark. Another strong indication of pump wear is the current draw of the drive motor. Since it is easier to turn a pump with worn clearances, there will be a drop in current draw as the pump wears. Since the load changes, be sure to always measure at the same load pressure.

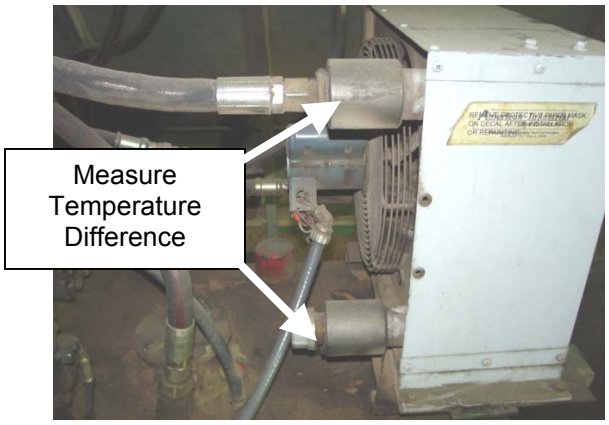
Case Temperature

Current Draw



Check the temperature of the relief valve tank line. The tank line of the Log Turner relief valve should never be hot. If it is, either it has become stuck open or it is improperly adjusted. The proper setting of the system relief is 200 PSI above that of the pressure required to move the heaviest load.

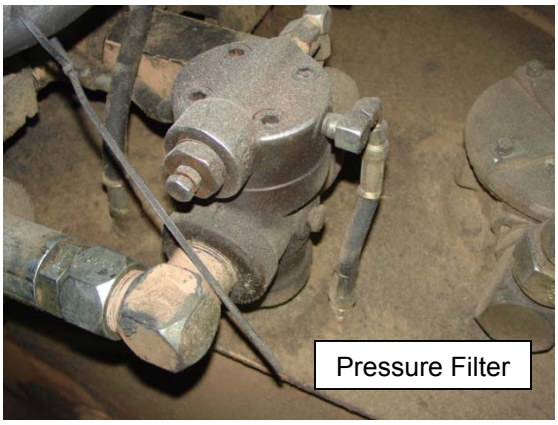
Relief Valve Tank Line Temperature



Check the temperature of the inlet and the outlet lines of the cooler. If the cooler is functioning properly, the outlet line should be significantly cooler than the inlet. If there is only a small difference, either the cooler does not have good air flow or a portion of the cooler has become partially plugged. If the cooler becomes badly plugged, it is possible that the cooler could rupture.

Temperature Drop Between Cooler Inlet and Cooler Outlet

Good Air Flow?



Check the return line filter and the pressure filter. These filters should be checked and changed on a scheduled basis. The filter schedule should be determined by oil analysis, not by the reading of the dirt indicator. When replacing filters, replace them both at the same time. The date of the last filter change should be recorded here and on the filter.

Date Of Last Filter Change

Check the breather. The breather on the Log Turner is an element type with no dirt indicator. It should be checked and cleaned at least monthly and replaced at least every six months. If it is not replaced regularly, it can plug and unfiltered air can enter the reservoir from some other point such as the access plates. Pump damage can also result from a plugged breather. Record the date when the breather was replaced here and on the breather.

Breather Clean?

Date Last Replaced

Record the oil temperature. While it is normal for the oil temperature to increase whenever ambient temperature does, excessively high oil temperature indicates bypassing in the system. Places where bypassing may be occurring can include:

- System relief valve
- Internally in the pump (check the pump case temperature and current draw)
- Directional valve spools
- Actuators

The source of the excess heat can be determined using the temperature gun. This is best done shortly after startup before overheated oil can be circulated throughout the system. Under no circumstances should the oil temperature be allowed to exceed 140^{o}F. Above this temperature, most hydraulic oils will begin to break down and leave varnish deposits.

Oil Temperature

Check the oil level (with any cylinders fully retracted). If the oil level is low, there must be a leak in the system.

Oil Level

Check the accumulator precharge at least monthly. In the absence of designer recommendations, we recommend that the accumulator be precharged with dry nitrogen to half of the relief valve setting. Feel the sides of the shell. If the accumulator is functioning properly, the nitrogen will be compressed to one third its original size during operation. Since nitrogen does not conduct heat very well, more heat

should be felt on the bottom two thirds than on the top one third. Since the Log Turner accumulator is mounted on its side, the “top” of the accumulator is considered to be the end with the Schrader valve for adjusting precharge. If heat is felt across most of the accumulator shell, it is undercharged. Heat only near the bottom indicates that the accumulator is undercharged. If no heat at all is felt, either the accumulator is precharged above the system pressure or the bladder has ruptured.

Where is heat felt?

Current precharge

Inspect for leaks in the system and list below:

Inspect the hoses in the system. Are any of them rubbing on another hose, part of the machine or the structure? If so, list below. Check the length of the hoses. Unless required by the movement of the machine, hydraulic hoses should be no longer than about four feet. Hoses that are longer than four feet should be replaced by a length of hard pipe.

Inspect the pipe clamps. Proper hydraulic clamps should be used – conduit and beam clamps are unacceptable.

Proper clamps?

Properly spaced (approximately every 5’ and within 6” of a termination)?

List any other problems you have noticed that should be addressed:

Resaw Hydraulic Preventive Maintenance Schedule

Make several copies of this schedule and keep them handy for performing regular maintenance checks.

Date

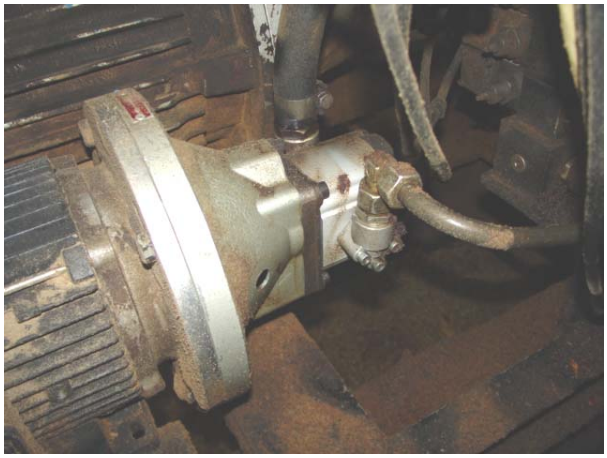
Observe the machine operation and record the minimum and maximum operating pressures. For actuators driven by the pressure compensating pump, the pressure should not vary significantly during operation. A sharp drop in pressure (more than 100 – 200 PSI) during a cycle is indicative of a flow problem. Items to check in this case include:

- Case drain flow – measure case flow to determine if the pump is worn
- Pump compensator valve – disassemble the valve to ensure that the spool is not stuck, the orifice in the spool is clear and the spring is not bent or broken.
- Compensator setting – the pump compensator should be set 200 PSI above the pressure required to move the heaviest load.
- Synchronization of flow controls in the system – if one or more of the system flow controls is open too wide, its associated actuator can move too rapidly and rob flow from other actuators in the system.
- Plugged suction strainer – this will be accompanied by cavitation (see below).
- Relief valve stuck open

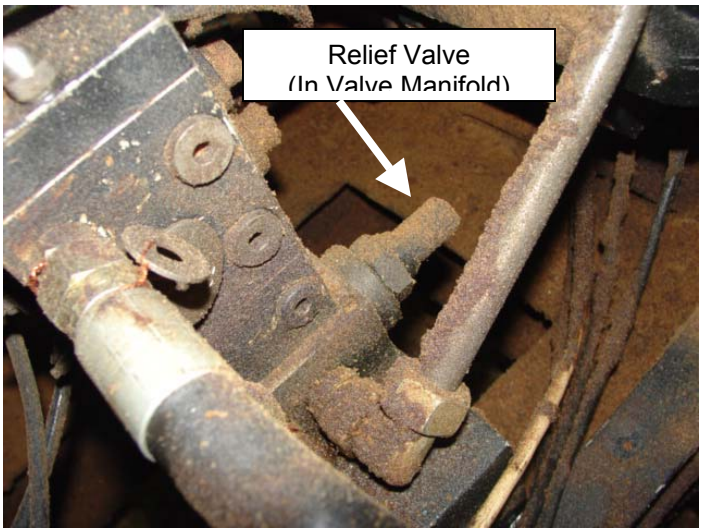
Max PSI

Min PSI

Pressure in the lines driven by the fixed displacement Lamborghini pump will vary anywhere from 0 PSI to the setting of the relief valve. Since the flow from this pump is unloaded back to tank whenever the arms are not moving, there should not be significant heat buildup. To measure the relief valve setting, fully extend any one of the arms and hold it in position. The setting of the relief valve should appear on the gauge. Record it here.



Relief Valve Setting

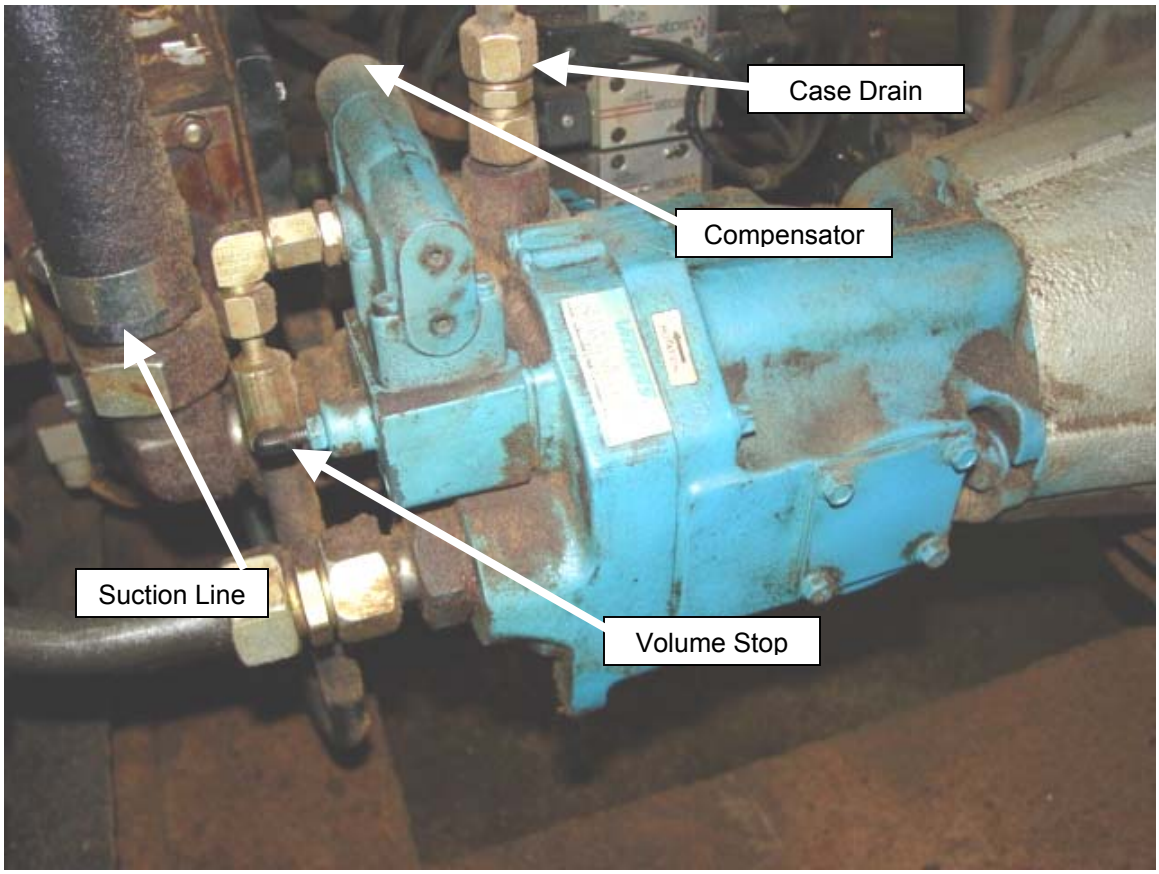


Pressures should be set regularly on this machine, particularly when problems are encountered but at least quarterly when seasons change. Pressures set too low will result in stalls when moving heavy loads. Pressures set too high will result in excess force as actuators are deadheaded. This will greatly increase the shock in the system and eventually show up as leaks. The procedure is as follows:

1) Place the heaviest load the machine will be expected to move.
2) As the load is moving, reduce the pressure by turning the pump compensator counterclockwise until the load stalls.
3) Record the pressure at which the system stalls.
4) Shut the machine down.
5) Turn the system relief valve counterclockwise to a very low pressure.
6) Turn the pump compensator clockwise to a very high pressure.
7) Restart the machine – fluid should now be dumping across the system relief at a very low pressure.
8) Turn the system relief valve clockwise until it is dumping at 450 PSI above the pressure recorded in step 3.
9) Turn the pump compensator counterclockwise to reduce the pressure to 200 PSI above the pressure recorded in step 3.

Listen to the sound of the pumps. A steady high pitched whining sound is evidence of cavitation. Cavitation occurs when the pump is unable to draw as much fluid as it is attempting to deliver. This can occur if the suction strainer is plugged or if the oil is too cold and the viscosity is too high. If there is a more erratic high pitched whine that changes in pitch with changes in the machine, the pump may be aerating. Aeration occurs when outside air is introduced into the suction side of the pump. An air leak in the suction line is usually the cause, but a bad shaft seal can cause the fixed displacement pump to aerate as well. Squirt oil the length of the suction line. An interruption in the aeration will locate the air leak. When a pump is aerating, there is often a sound similar to marbles rattling inside the pump and foaming of the oil may also be present.

OK Cavitating Aerating



Check the pump case flow. Do this by measuring the temperature of the suction line and the case drain line with a temperature gun. Work the following formula to determine case flow:

$$\frac{(T_{\text{Case Drain Line}} - T_{\text{Suction Line}})}{\text{PSI X .0093}}$$

Where "PSI" is the system operating pressure. The result will be the case flow of the pump in gallons per minute. A relatively new pump should bypass no more than about 1 – 3% of its total output. If the pump flow is reduced by as much as 10%, it should usually be replaced.

Case Flow

The fixed displacement pump has no case drain. Instead, measure the current draw of the electric drive motor while the pump is relatively new and use this reading as a benchmark for future checks. This check should be made while the flow is dumping across the relief valve. If the pump is suspected to be bad, divert the flow from the tank line into a container so it can be viewed. Turn the pressure down very low on the relief valve, deadhead the circuit so that oil must

dump across the valve and observe the flow. Even a bad pump will deliver most of its flow at low pressure. Gradually increase the pressure setting of the relief valve and again observe the flow. If increasing the pressure to normal operating pressure results in a significant decrease in flow, the pump is worn and must be replaced.

Current Draw

Check the temperature of the relief valve tank line. The Resaw relief valve is mounted in the valve manifold. This line will probably be a little warm at times, but should never be excessively hot (above 130^{o}F) If it is, either it has become stuck open or it is improperly adjusted with respect to the pump compensator. The proper setting of the system relief is about 900 PSI.

Relief Valve Tank Line Temperature

Check the return line filter. This filter should be checked and changed on a scheduled basis. The filter schedule should be determined by oil analysis, not by the reading of the dirt indicator. The date of the last filter change should be recorded here and on the filter.

Date Of Last Filter Change

Check the breather cap. The breather cap on the Resaw is the spring type. It should be checked and cleaned at least monthly and replaced annually. If it is not replaced regularly, the spring can lose its tension and, though the cap itself may be clean, it will allow contaminants to enter the reservoir. Record the date when the breather was replaced here and on the breather.

Breather Cap Clean?

Date Last Replaced

Record the oil temperature. While it is normal for the oil temperature to increase whenever ambient temperature does, excessively high oil temperature indicates bypassing in the system. Places where bypassing may be occurring can include:

- System relief valve
- Internally in one of the pumps (check the pressure compensating pump case drain and the current draw of the electric drive motor on the fixed displacement pump)
- The compensator may have been set above the relief valve.
- Directional valve spools
- Actuators

The source of the excess heat can be determined using the temperature gun. This is best done shortly after startup before overheated oil can be circulated throughout the system. Under no circumstances should the oil temperature be allowed to exceed 140^{o}F. Above this temperature, most hydraulic oils will begin to break down and leave varnish deposits.

Oil Temperature

Check the oil level (with any cylinders fully retracted). If the oil level is low, there must be a leak in the system.

Oil Level

Inspect for leaks in the system and list below:

Inspect the hoses in the system. Are any of them rubbing on another hose, part of the machine or the structure? If so, list below. Check the length of the hoses. Unless required by the movement of the machine, hydraulic hoses should be no longer than about four feet. Hoses that are longer than four feet should be replaced by a length of hard pipe.

Inspect the pipe clamps. Proper hydraulic clamps should be used – conduit and beam clamps are unacceptable.

Proper clamps?

Properly spaced (approximately every 5' and within 6" of a termination)?

List any other problems you have noticed that should be addressed:

Sawset Positioner Hydraulic Preventive Maintenance Schedule

Make several copies of this schedule and keep them handy for performing regular maintenance checks.

Date

Observe the machine operation and record the minimum and maximum operating pressures. Since the Sawset Positioner uses a pressure compensating pump, the pressure should not vary significantly during operation. A sharp drop in pressure (more than 100 – 200 PSI) during a cycle is indicative of a flow problem. Items to check in this case include:

- Case drain flow – measure case flow to determine if the pump is worn
- Pump compensator valve – disassemble the valve to ensure that the spool is not stuck, the orifice in the spool is clear and the spring is not bent or broken.
- Compensator setting – the pump compensator should be set 200 PSI above the pressure required to move the heaviest load.
- Synchronization of flow controls in the system – if one or more of the system flow controls is open too wide, its associated actuator can move too rapidly and rob flow from other actuators in the system.
- Plugged suction strainer – this will be accompanied by cavitation (see below).
- Relief valve stuck open

Max PSI

Min PSI

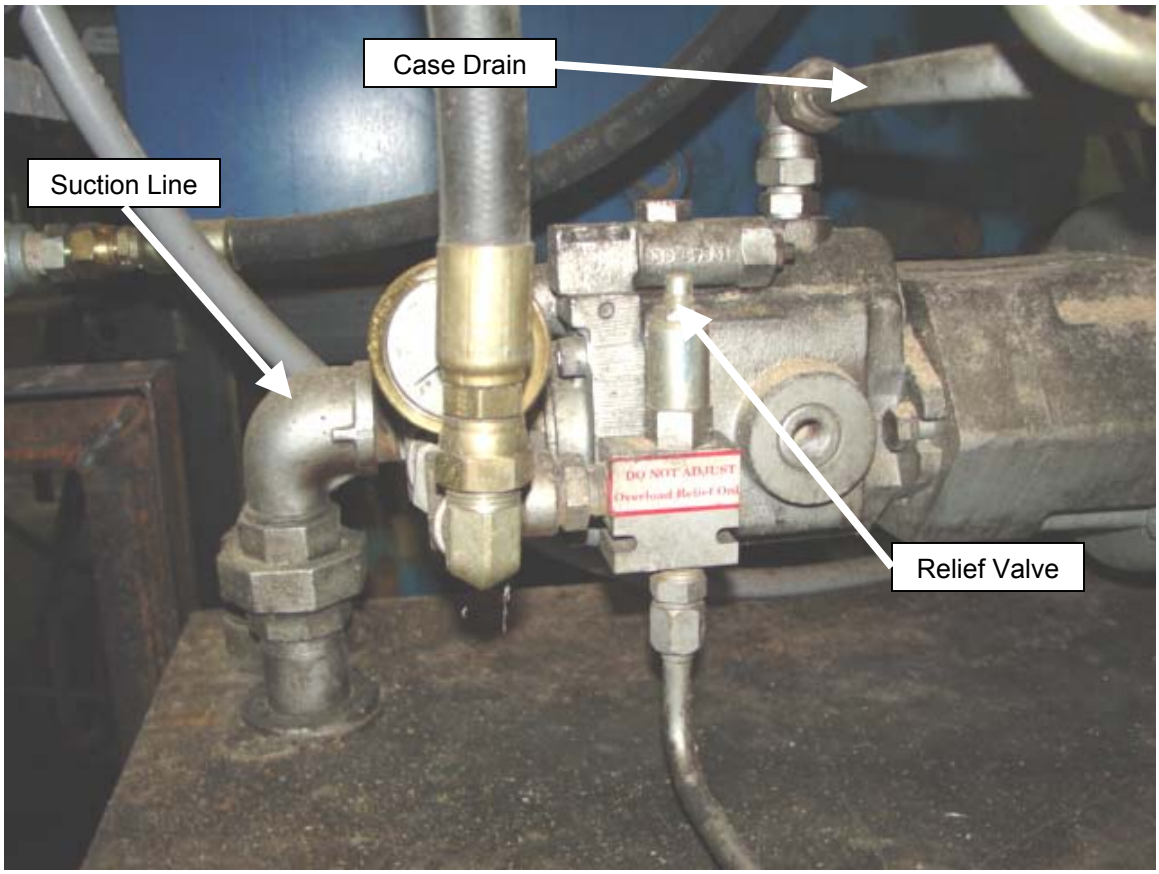
Pressures should be set regularly on this machine, particularly when problems are encountered but at least quarterly when seasons change. Pressures set too low will result in stalls when moving heavy loads. Pressures set too high will result in excess force as actuators are deadheaded. This will greatly increase the shock in the system and eventually show up as leaks. The procedure is as follows:

1) Place the heaviest load the machine will be expected to move.
2) As the load is moving, reduce the pressure by turning the pump compensator counterclockwise until the load stalls.
3) Record the pressure at which the system stalls.
4) Shut the machine down.
5) Turn the system relief valve counterclockwise to a very low pressure.
6) Turn the pump compensator clockwise to a very high pressure.
7) Restart the machine – fluid should now be dumping across the system relief at a very low pressure.

8) Turn the system relief valve clockwise until it is dumping at 450 PSI above the pressure recorded in step 3.
9) Turn the pump compensator counterclockwise to reduce the pressure to 200 PSI above the pressure recorded in step 3.

Listen to the sound of the pump. A steady high pitched whining sound is evidence of cavitation. Cavitation occurs when the pump is unable to draw as much fluid as it is attempting to deliver. This can occur if the suction strainer is plugged or if the oil is too cold and the viscosity is too high. If there is a more erratic high pitched whine that changes in pitch with changes in the machine, the pump may be aerating. Aeration occurs when outside air is introduced into the suction side of the pump. An air leak in the suction line is usually the cause. Squirt oil the length of the suction line. An interruption in the aeration will locate the air leak. When a pump is aerating, there is often a sound similar to marbles rattling inside the pump and foaming of the oil may also be present.

OK Cavitating Aerating



Check the pump case flow. Do this by measuring the temperature of the suction line and the case drain line with a temperature gun. Work the following formula to determine case flow:

$$\frac{(T_{\text{Case Drain Line}} - T_{\text{Suction Line}})}{\text{PSI X .0093}}$$

Where “PSI” is the system operating pressure. The result will be the case flow of the pump in gallons per minute. A relatively new pump should bypass no more than about 1 – 3% of its total output. If the pump flow is reduced by as much as 10%, it should usually be replaced.

Case Flow

Check the temperature of the relief valve tank line. The tank line of the Sawset Positioner relief valve should never be hot. If it is, either it has become stuck open or it is improperly adjusted with respect to the pump compensator. The proper setting of the system relief is 250 PSI above that of the compensator.

Relief Valve Temperature

Check the return line filter. This filter should be checked and changed on a scheduled basis. The filter schedule should be determined by oil analysis, not by the reading of the dirt indicator. The date of the last filter change should be recorded here and on the filter.

Date Of Last Filter Change

Check the breather cap. The breather cap on the Sawset Positioner is the spring type. It should be checked and cleaned at least monthly and replaced annually. If it is not replaced regularly, the spring can lose its tension and, though the cap itself may be clean, it will allow contaminants to enter the reservoir. Record the date when the breather was replaced here and on the breather.

Breather Cap Clean?

Date Last Replaced

Record the oil temperature. While it is normal for the oil temperature to increase whenever ambient temperature does, excessively high oil temperature indicates bypassing in the system. Places where bypassing may be occurring can include:

- System relief valve
- Internally in the pump (check the pump case drain)
- The compensator may have been set above the relief valve.
- Directional valve spools
- Actuators

The source of the excess heat can be determined using the temperature gun. This is best done shortly after startup before overheated oil can be circulated throughout the system. Under no circumstances should the oil temperature be allowed to exceed 140^{o}F. Above this temperature, most hydraulic oils will begin to break down and leave varnish deposits.

Oil Temperature

Check the oil level (with any cylinders fully retracted). If the oil level is low, there must be a leak in the system.

Oil Level

Inspect for leaks in the system and list below:

Inspect the hoses in the system. Are any of them rubbing on another hose, part of the machine or the structure? If so, list below. Check the length of the hoses. Unless required by the movement of the machine, hydraulic hoses should be no longer than about four feet. Hoses that are longer than four feet should be replaced by a length of hard pipe.

Inspect the pipe clamps. Proper hydraulic clamps should be used – conduit and beam clamps are unacceptable.

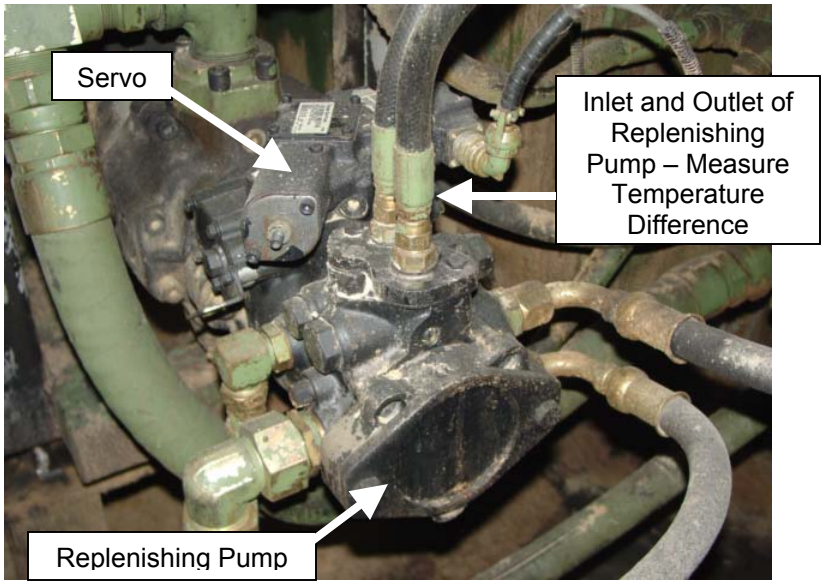
Proper clamps?

Properly spaced (approximately every 5’ and within 6” of a termination)?

List any other problems you have noticed that should be addressed:

Skragg Mill Hydraulic Preventive Maintenance Schedule

The Skragg Mill uses a hydrostatic drive. The hydrostatic drive is a closed loop hydraulic system. Unlike conventional hydraulic systems, the hydrostatic drive utilizes a bi-directional pump. The pump is capable of stroking completely from full reverse to full forward as determined by stroking cylinders. A servo valve mounted on the top of the pump controls the stroking cylinders. Oil that is bypassed in the system is replenished by a gear pump mounted at the front of the main pump and turned by the same electric drive motor. System pressure limits are preset internally, effectively emulating a pressure compensating pump. Maintenance and adjustments are intentionally limited by design, thus the underlying causes of hydraulic failures must be adhered to more rigidly to avoid trouble in the first place.



The most critical concern is cleanliness of the oil. The oil should be sampled and analyzed regularly. To begin an analysis cycle, start with 13-week intervals and adjust according to the results. Use the results of the analyses to determine filter schedules and oil change schedules.

Date

Record the pressure at the gauge of the relief valve while the system is functioning properly. The setting of this valve determines proper replenishment of oil that has bypassed in the system. If the pressure drops too low, not enough oil will be replaced by the replenishing pump and the main pump assembly will suffer damage. Whenever a drop

from normal pressure is observed, the pressure at the relief should be reset to normal immediately.

Pressure

Listen to the sound of the pumps. A steady high pitched whining sound is evidence of cavitation. Cavitation occurs when the pump is unable to draw as much fluid as it is attempting to deliver. This can occur if the suction strainer of the replenishing pump is plugged or if the oil is too cold and the viscosity is too high. If there is a more erratic high pitched whine that changes in pitch with changes in the machine, the pump may be aerating. Aeration occurs when outside air is introduced into the suction side of the pump. An air leak in the suction line is usually the cause. Squirt oil the length of the suction line. An interruption in the aeration will locate the air leak. When a pump is aerating, there is often a sound similar to marbles rattling inside the pump and foaming of the oil may also be present.

It may be necessary to use a stethoscope to determine which pump is making an improper sound. If the gear pump is cavitating, the source of the cavitation should be located and corrected immediately before the gear pump is destroyed. If left unchecked, damage to the main pump will occur. If the main pump is cavitating, check the temperature of the gear pump. It could be bypassing severely internally and delivering a reduced flow. Record the temperature difference between the inlet and outlet of the gear pump when it is functioning normally to compare when it appears to be bypassing. If the gear pump does not have an increased temperature gain, the problem is likely to be the pressure filter.

Main Pump Cavitating Or Aerating?

Replenishing Pump Cavitating Or Aerating?

Temperature Gain Across Replenishing Pump

Since excess replenishing oil is dumped into the main pump case, the flow of the case drain will not be a reliable indication of the condition of the main pump. It is therefore necessary to measure the current draw of the electric drive motor to determine the pump condition. An initial check of the current draw should be

made while the system is functioning properly to be used as a benchmark. Then make monthly checks to track the performance. Checks should be made in five different modes for comparison since the pump is bi-directional and variable displacement:

Current Draw At Idle

Current Draw At Full Forward under no load

Current Draw At Full Forward under full load

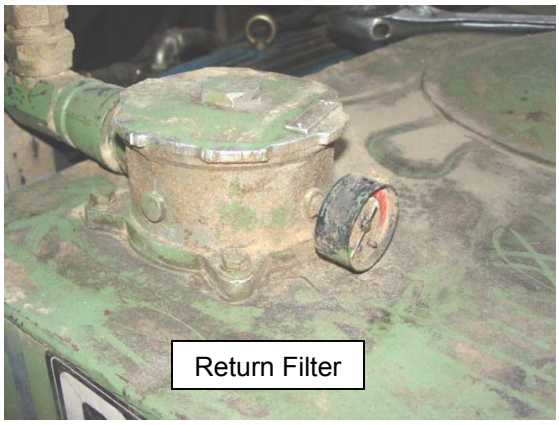
Current Draw At Full Reverse under no load

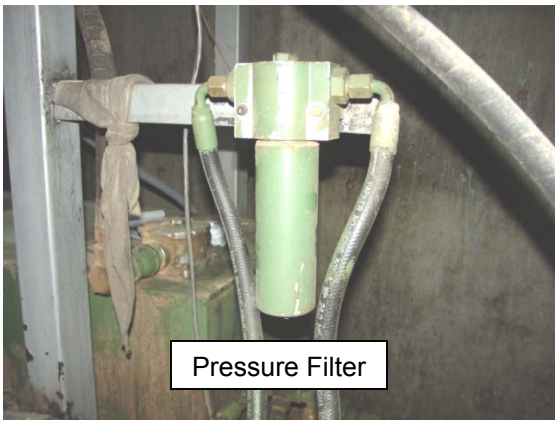
Current Draw At Full Reverse under full load

Check the temperature of the inlet and the outlet lines of the cooler. If the cooler is functioning properly, the outlet line should be significantly cooler than the inlet. If there is only a small difference, either the cooler does not have good air flow or a portion of the cooler has become partially plugged. If the cooler becomes badly plugged, it is possible that the cooler could rupture.

Temperature Drop Between Cooler Inlet and Cooler Outlet

Good Air Flow?


Return Filter


Pressure Filter

Check the return line filter and the pressure filter. These filters should be checked and changed on a scheduled basis. The filter schedule should be determined by oil analysis, not by the reading of the dirt indicator. The date of the last filter change should be recorded here and on the filter.

Date Of Last Filter Change

Check the breather cap. The breather cap on the Skragg Mill is the spring type. It should be checked and cleaned at least monthly and replaced annually. If it is not replaced regularly, the spring can lose its tension and, though the cap itself may be clean, it will allow contaminants to enter the reservoir. Record the date when the breather was replaced here and on the breather.

Breather Cap Clean?

Date Last Replaced

Record the oil temperature. While it is normal for the oil temperature to increase whenever ambient temperature does, excessively high oil temperature indicates bypassing in the system. Places where bypassing may be occurring can include:

- Relief valve
- Internally in the pump (check the current draw of the electric drive motor)
- Actuators

The source of the excess heat can be determined using the temperature gun. This is best done shortly after startup before overheated oil can be circulated throughout the system. Under no circumstances should the oil temperature be allowed to exceed 140^{o}F. Above this temperature, most hydraulic oils will begin to break down and leave varnish deposits.

Oil Temperature

Check the oil level. If the oil level is low, there must be a leak in the system.
Oil Level

Inspect for leaks in the system and list below:

Inspect the hoses in the system. Are any of them rubbing on another hose, part of the machine or the structure? If so, list below. Check the length of the hoses. Unless required by the movement of the machine, hydraulic hoses should be no longer than about four feet. Hoses that are longer than four feet should be replaced by a length of hard pipe. This is a particular problem on the Skragg Mill. Gradual replacement of hoses with hard pipe should be considered.

Inspect the pipe clamps. Proper hydraulic clamps should be used – conduit and beam clamps are unacceptable.

Proper clamps?

Properly spaced (approximately every 5’ and within 6” of a termination)?

List any other problems you have noticed that should be addressed:

Skragg Outfeed Hydraulic Preventive Maintenance Schedule

Make several copies of this schedule and keep them handy for performing regular maintenance checks.

Date

Observe the machine operation and record the minimum and maximum operating pressures. Since Skragg Outfeed uses a pressure compensating pump, the pressure should not vary significantly during operation. A sharp drop in pressure (more than 100 – 200 PSI) during a cycle is indicative of a flow problem. Items to check in this case include:

- Case drain flow – measure case flow to determine if the pump is worn
- Pump compensator valve – disassemble the valve to ensure that the spool is not stuck, the orifice in the spool is clear and the spring is not bent or broken.
- Compensator setting – the pump compensator should be set 200 PSI above the pressure required to move the heaviest load.
- Synchronization of flow controls in the system – if one or more of the system flow controls is open too wide, its associated actuator can move too rapidly and rob flow from other actuators in the system.
- Plugged suction strainer – this will be accompanied by cavitation (see below).
- Relief valve stuck open

Max PSI

Min PSI

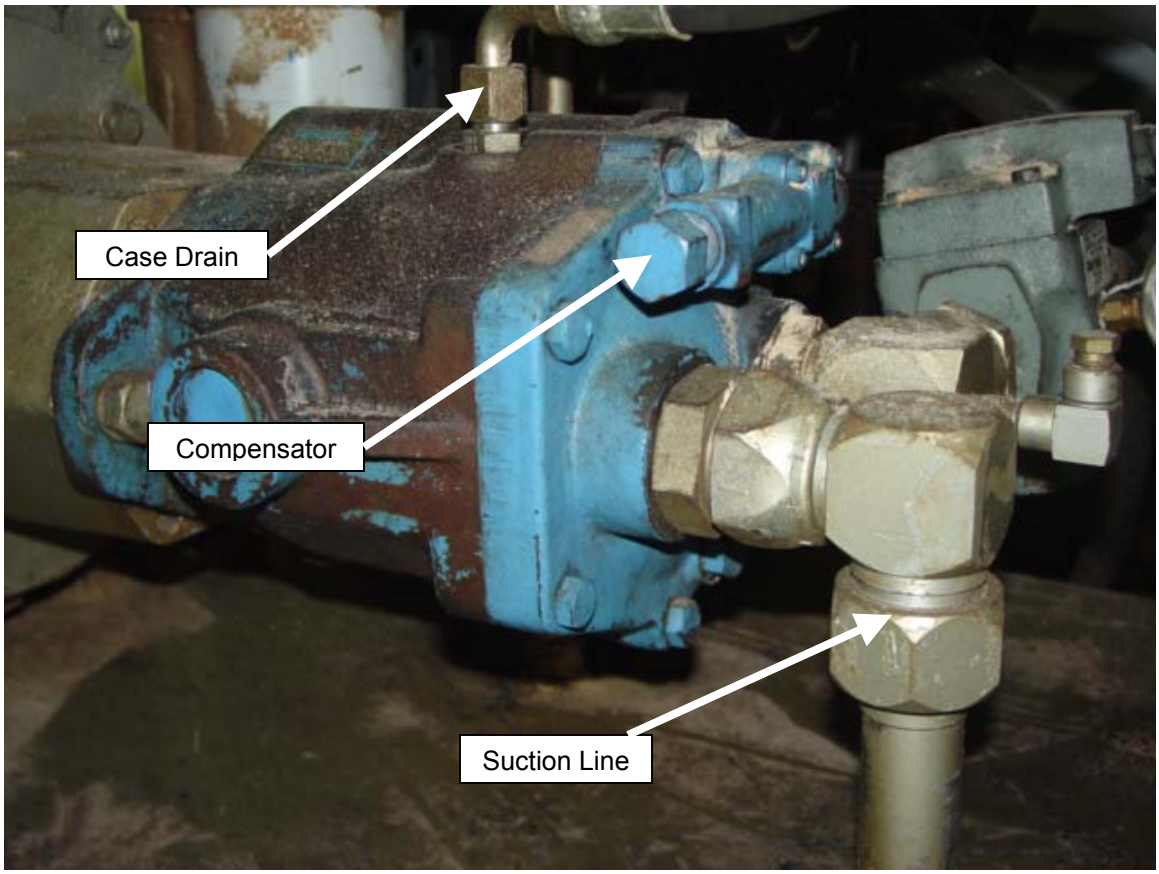
Pressures should be set regularly on this machine, particularly when problems are encountered but at least quarterly when seasons change. Pressures set too low will result in stalls when moving heavy loads. Pressures set too high will result in excess force as actuators are deadheaded. This will greatly increase the shock in the system and eventually show up as leaks. The procedure is as follows:

1) Place the heaviest load the machine will be expected to move.
2) As the load is moving, reduce the pressure by turning the pump compensator counterclockwise until the load stalls.
3) Record the pressure at which the system stalls.
4) Shut the machine down.
5) Turn the system relief valve counterclockwise to a very low pressure.
6) Turn the pump compensator clockwise to a very high pressure.
7) Restart the machine – fluid should now be dumping across the system relief at a very low pressure.

8) Turn the system relief valve clockwise until it is dumping at 450 PSI above the pressure recorded in step 3.
9) Turn the pump compensator counterclockwise to reduce the pressure to 200 PSI above the pressure recorded in step 3.

Listen to the sound of the pump. A steady high pitched whining sound is evidence of cavitation. Cavitation occurs when the pump is unable to draw as much fluid as it is attempting to deliver. This can occur if the suction strainer is plugged or if the oil is too cold and the viscosity is too high. If there is a more erratic high pitched whine that changes in pitch with changes in the machine, the pump may be aerating. Aeration occurs when outside air is introduced into the suction side of the pump. An air leak in the suction line is usually the cause. Squirt oil the length of the suction line. An interruption in the aeration will locate the air leak. When a pump is aerating, there is often a sound similar to marbles rattling inside the pump and foaming of the oil may also be present.

OK Cavitating Aerating



Check the pump case flow. Do this by measuring the temperature of the suction line and the case drain line with a temperature gun. Work the following formula to determine case flow:

$$\frac{(T_{\text{Case Drain}} - T_{\text{Suction Line}})}{\text{PSI X .0093}}$$

Where “PSI” is the system operating pressure. The result will be the case flow of the pump in gallons per minute. A relatively new pump should bypass no more than about 1 – 3% of its total output. If the pump flow is reduced by as much as 10%, it should usually be replaced.

Case Flow

Check the temperature of the relief valve tank line. The tank line of the Skragg Outfeed relief valve should never be hot. If it is, either it has become stuck open or it is improperly adjusted with respect to the pump compensator. The proper setting of the system relief is 250 PSI above that of the compensator.

Relief Valve Temperature

Check the temperature of the inlet and the outlet lines of the cooler. If the cooler is functioning properly, the outlet line should be significantly cooler than the inlet. If there is only a small difference, either the cooler does not have good air flow or

a portion of the cooler has become partially plugged. If the cooler becomes badly plugged, it is possible that the cooler could rupture.

Temperature Drop Between Cooler Inlet and Cooler Outlet

Good Air Flow?

Check the return line filter. This filter should be checked and changed on a scheduled basis. The filter schedule should be determined by oil analysis, not by the reading of the dirt indicator. The date of the last filter change should be recorded here and on the filter.

Date Of Last Filter Change

Check the breather cap. The breather cap on the Skragg Outfeed is the spring type. It should be checked and cleaned at least monthly and replaced annually. If it is not replaced regularly, the spring can lose its tension and, though the cap itself may be clean, it will allow contaminants to enter the reservoir. Record the date when the breather was replaced here and on the breather.

Breather Cap Clean?

Date Last Replaced

Record the oil temperature. While it is normal for the oil temperature to increase whenever ambient temperature does, excessively high oil temperature indicates bypassing in the system. Places where bypassing may be occurring can include:

- System relief valve
- Internally in the pump (check the pump case drain)
- The compensator may have been set above the relief valve.
- Directional valve spools
- Actuators

The source of the excess heat can be determined using the temperature gun. This is best done shortly after startup before overheated oil can be circulated throughout the system. Under no circumstances should the oil temperature be allowed to exceed 140^{o}F. Above this temperature, most hydraulic oils will begin to break down and leave varnish deposits.

Oil Temperature

Check the oil level (with any cylinders fully retracted). If the oil level is low, there must be a leak in the system.

Oil Level

Inspect for leaks in the system and list below:

Inspect the hoses in the system. Are any of them rubbing on another hose, part of the machine or the structure? If so, list below. Check the length of the hoses. Unless required by the movement of the machine, hydraulic hoses should be no longer than about four feet. Hoses that are longer than four feet should be replaced by a length of hard pipe.

Inspect the pipe clamps. Proper hydraulic clamps should be used – conduit and beam clamps are unacceptable.

Proper clamps?

Properly spaced (approximately every 5’ and within 6” of a termination)?

List any other problems you have noticed that should be addressed:

Star Kicker Hydraulic Preventive Maintenance Schedule

Make several copies of this schedule and keep them handy for performing regular maintenance checks.

Date

Observe the machine operation and record the minimum and maximum operating pressures. Since the Star Kicker uses a pressure compensating pump, the pressure should not vary significantly during operation. A sharp drop in pressure (more than 100 – 200 PSI) during a cycle is indicative of a flow problem. Items to check in this case include:

- Case drain flow – measure case flow to determine if the pump is worn
- Pump compensator valve – disassemble the valve to ensure that the spool is not stuck, the orifice in the spool is clear and the spring is not bent or broken.
- Compensator setting – the pump compensator should be set 200 PSI above the pressure required to move the heaviest load.
- The volume stop may be out of adjustment. Turn the volume stop counterclockwise to increase the maximum flow of the pump, clockwise to decrease.
- Synchronization of flow controls in the system – if one or more of the system flow controls is open too wide, its associated actuator can move too rapidly and rob flow from other actuators in the system.
- Plugged suction strainer – this will be accompanied by cavitation (see below).
- Relief valve stuck open

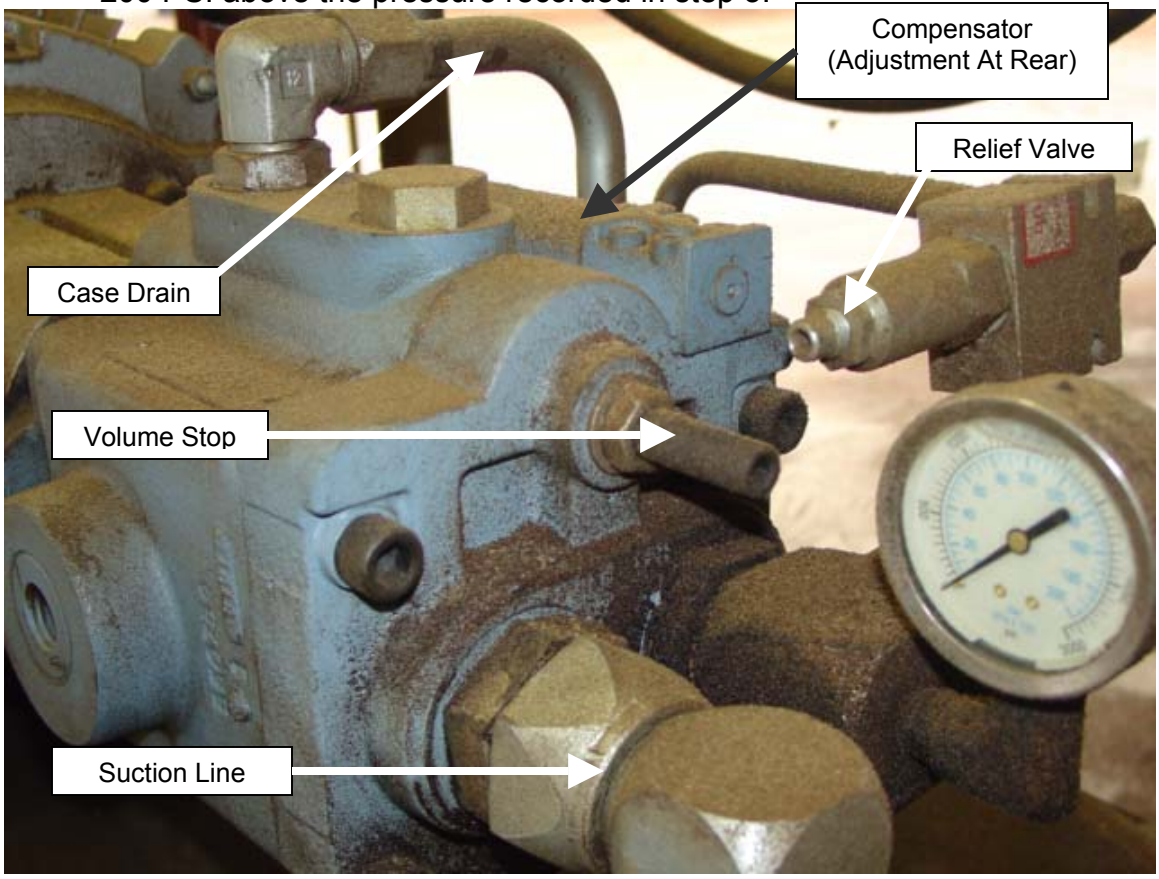
Max PSI

Min PSI

Pressures should be set regularly on this machine, particularly when problems are encountered but at least quarterly when seasons change. Pressures set too low will result in stalls when moving heavy loads. Pressures set too high will result in excess force as actuators are deadheaded. This will greatly increase the shock in the system and eventually show up as leaks. The procedure is as follows:

1) Place the heaviest load the machine will be expected to move.
2) As the load is moving, reduce the pressure by turning the pump compensator counterclockwise until the load stalls.
3) Record the pressure at which the system stalls.
4) Shut the machine down.

5) Turn the system relief valve counterclockwise to a very low pressure.
6) Turn the pump compensator clockwise to a very high pressure.
7) Restart the machine – fluid should now be dumping across the system relief at a very low pressure.
8) Turn the system relief valve clockwise until it is dumping at 450 PSI above the pressure recorded in step 3.
9) Turn the pump compensator counterclockwise to reduce the pressure to 200 PSI above the pressure recorded in step 3.



Listen to the sound of the pump. A steady high pitched whining sound is evidence of cavitation. Cavitation occurs when the pump is unable to draw as much fluid as it is attempting to deliver. This can occur if the suction strainer is plugged or if the oil is too cold and the viscosity is too high. If there is a more erratic high pitched whine that changes in pitch with changes in the machine, the pump may be aerating. Aeration occurs when outside air is introduced into the suction side of the pump. An air leak in the suction line is usually the cause. Squirt oil the length of the suction line. An interruption in the aeration will locate the air leak. When a pump is aerating, there is often a sound similar to marbles rattling inside the pump and foaming of the oil may also be present.

OK Cavitating Aerating

Check the pump case flow. Do this by measuring the temperature of the suction line and the case drain line with a temperature gun. Work the following formula to determine case flow:

$$\frac{(T_{\text{Case Drain Line}} - T_{\text{Suction Line}})}{\text{PSI X .0093}}$$

Where "PSI" is the system operating pressure. The result will be the case flow of the pump in gallons per minute. A relatively new pump should bypass no more than about 1 – 3% of its total output. If the pump flow is reduced by as much as 10%, it should usually be replaced.

Case Flow

Check the temperature of the relief valve tank line. The tank line of the Star Kicker relief valve should never be hot. If it is, either it has become stuck open or it is improperly adjusted with respect to the pump compensator. The proper setting of the system relief is 250 PSI above that of the compensator.

Relief Valve Tank Line Temperature

Check the temperature of the inlet and the outlet lines of the cooler. If the cooler is functioning properly, the outlet line should be significantly cooler than the inlet. If there is only a small difference, either the cooler does not have good air flow or a portion of the cooler has become partially plugged. If the cooler becomes badly plugged, it is possible that the cooler could rupture.

Temperature Drop Between Cooler Inlet and Cooler Outlet

Good Air Flow?

Check the return line filter. This filter should be checked and changed on a scheduled basis. The filter schedule should be determined by oil analysis, not by the reading of the dirt indicator. The date of the last filter change should be recorded here and on the filter.

Date Of Last Filter Change

Check the breather cap. The breather cap on the Star Kicker is the spring type. It should be checked and cleaned at least monthly and replaced annually. If it is not replaced regularly, the spring can lose its tension and, though the cap itself may be clean, it will allow contaminants to enter the reservoir. Record the date when the breather was replaced here and on the breather.

Breather Cap Clean?

Date Last Replaced

Record the oil temperature. While it is normal for the oil temperature to increase whenever ambient temperature does, excessively high oil temperature indicates bypassing in the system. Places where bypassing may be occurring can include:

- System relief valve
- Internally in the pump (check the pump case drain)
- The compensator may have been set above the relief valve.
- Directional valve spools
- Actuators

The source of the excess heat can be determined using the temperature gun. This is best done shortly after startup before overheated oil can be circulated throughout the system. Under no circumstances should the oil temperature be

allowed to exceed 140^{o}F. Above this temperature, most hydraulic oils will begin to break down and leave varnish deposits.

Oil Temperature

Check the oil level (with any cylinders fully retracted). If the oil level is low, there must be a leak in the system.

Oil Level

Inspect for leaks in the system and list below:

Inspect the hoses in the system. Are any of them rubbing on another hose, part of the machine or the structure? If so, list below. Check the length of the hoses. Unless required by the movement of the machine, hydraulic hoses should be no longer than about four feet. Hoses that are longer than four feet should be replaced by a length of hard pipe.

Inspect the pipe clamps. Proper hydraulic clamps should be used – conduit and beam clamps are unacceptable.

Proper clamps?

Properly spaced (approximately every 5' and within 6" of a termination)?

List any other problems you have noticed that should be addressed:

Trim Saw Hydraulic Preventive Maintenance Schedule

There are three identical Trim Saw units. The sound and operating temperatures of all three units should remain similar. If any machine begins to make sounds that another does not or begins to operate at a higher temperature than another, this should be cause for concern. The checks listed below should be performed at least monthly on each machine. Make several copies of this schedule and keep them handy for performing regular maintenance checks.

Date

Observe the machine operation and record the minimum and maximum operating pressures. Since the Trim Saw uses a pressure compensating pump, the pressure should not vary significantly during operation. A sharp drop in pressure (more than 100 – 200 PSI) during a cycle is indicative of a flow problem. Items to check in this case include:

- Case drain flow – measure case flow to determine if the pump is worn
- Pump compensator valve – disassemble the valve to ensure that the spool is not stuck, the orifice in the spool is clear and the spring is not bent or broken.
- Compensator setting – the pump compensator should be set 200 PSI above the pressure required to move the heaviest load.
- The volume stop may be out of adjustment. Turn the volume stop counterclockwise to increase the maximum flow of the pump, clockwise to decrease.
- Synchronization of flow controls in the system – if one or more of the system flow controls is open too wide, its associated actuator can move too rapidly and rob flow from other actuators in the system.
- Plugged suction strainer – this will be accompanied by cavitation (see below).
- Relief valve stuck open

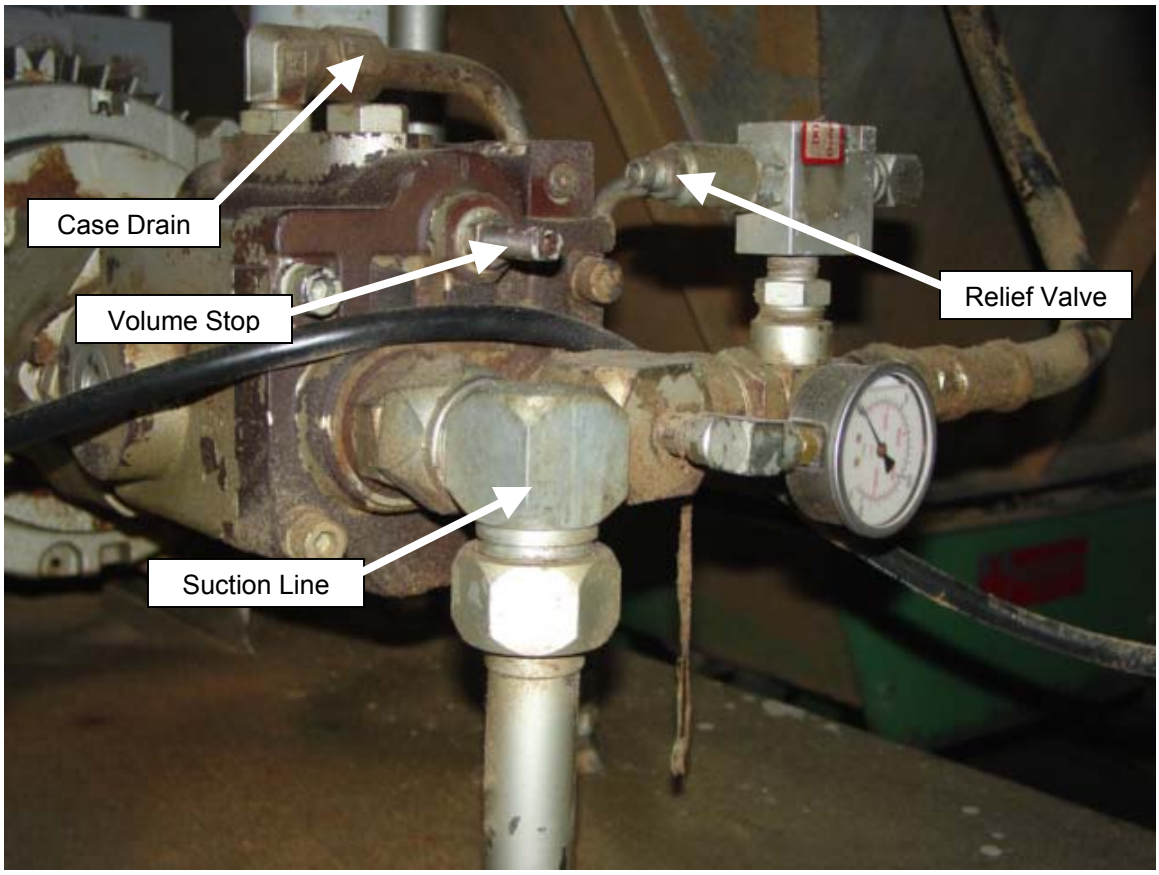
Max PSI

Min PSI

Pressures should be set regularly on this machine, particularly when problems are encountered but at least quarterly when seasons change. Pressures set too low will result in stalls when moving heavy loads. Pressures set too high will result in excess force as actuators are deadheaded. This will greatly increase the shock in the system and eventually show up as leaks. The procedure is as follows:

1) Place the heaviest load the machine will be expected to move.

2) As the load is moving, reduce the pressure by turning the pump compensator counterclockwise until the load stalls.
3) Record the pressure at which the system stalls.
4) Shut the machine down.
5) Turn the system relief valve counterclockwise to a very low pressure.
6) Turn the pump compensator clockwise to a very high pressure.
7) Restart the machine – fluid should now be dumping across the system relief at a very low pressure.
8) Turn the system relief valve clockwise until it is dumping at 450 PSI above the pressure recorded in step 3.
9) Turn the pump compensator counterclockwise to reduce the pressure to 200 PSI above the pressure recorded in step 3.



Listen to the sound of the pump. A steady high pitched whining sound is evidence of cavitation. Cavitation occurs when the pump is unable to draw as much fluid as it is attempting to deliver. This can occur if the suction strainer is plugged or if the oil is too cold and the viscosity is too high. If there is a more erratic high pitched whine that changes in pitch with changes in the machine, the pump may be aerating. Aeration occurs when outside air is introduced into the suction side of the pump. An air leak in the suction line is usually the cause. Squirt oil the length of the suction line. An interruption in the aeration will locate

the air leak. When a pump is aerating, there is often a sound similar to marbles rattling inside the pump and foaming of the oil may also be present.

OK Cavitating Aerating

Check the pump case flow. Do this by measuring the temperature of the suction line and the case drain line with a temperature gun. Work the following formula to determine case flow:

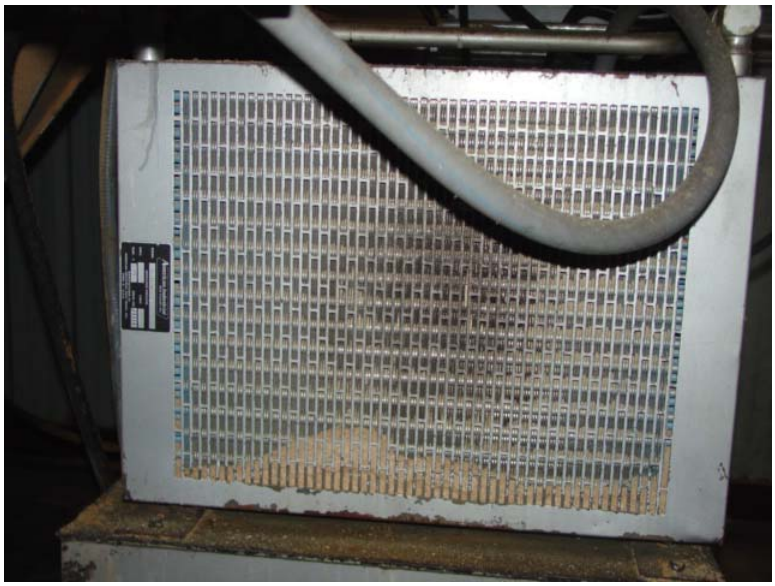
$$\frac{(T_{\text{Case Drain Line}} - T_{\text{Suction Line}})}{\text{PSI X .0093}}$$

Where "PSI" is the system operating pressure. The result will be the case flow of the pump in gallons per minute. A relatively new pump should bypass no more than about 1 – 3% of its total output. If the pump flow is reduced by as much as 10%, it should usually be replaced.

Case Flow

Check the temperature of the relief valve tank line. The tank line of the Trim Saw relief valve should never be hot. If it is, either it has become stuck open or it is improperly adjusted with respect to the pump compensator. The proper setting of the system relief is 250 PSI above that of the compensator.

Relief Valve Tank Line Temperature



Check the temperature of the inlet and the outlet lines of the cooler. If the cooler is functioning properly, the outlet line should be significantly cooler than the inlet. If there is only a small difference, either the cooler does not have good air flow or a portion of the cooler has become partially plugged. If the cooler becomes badly plugged, oil will bypass the cooler through the check valve. Feel the check valve or measure it with the temperature gun. It should stay cool at all times. If it is hot, oil is bypassing the cooler.

Temperature Drop Between Cooler Inlet and Cooler Outlet

Good Air Flow?

Check Valve Open (hot)?

Check the return line filter. This filter should be checked and changed on a scheduled basis. The filter schedule should be determined by oil analysis, not by the reading of the dirt indicator. The date of the last filter change should be recorded here and on the filter.

Date Of Last Filter Change

Check the breather cap. The breather cap on the Trim Saw is the spring type. It should be checked and cleaned at least monthly and replaced annually. If it is not replaced regularly, the spring can lose its tension and, though the cap itself may be clean, it will allow contaminants to enter the reservoir. Record the date when the breather was replaced here and on the breather.

Breather Cap Clean?

Date Last Replaced

Record the oil temperature. While it is normal for the oil temperature to increase whenever ambient temperature does, excessively high oil temperature indicates bypassing in the system. Places where bypassing may be occurring can include:

- System relief valve
- Internally in the pump (check the pump case drain)
- The compensator may have been set above the relief valve.

- Directional valve spools
- Actuators

The source of the excess heat can be determined using the temperature gun. This is best done shortly after startup before overheated oil can be circulated throughout the system. Under no circumstances should the oil temperature be allowed to exceed 140^{o}F. Above this temperature, most hydraulic oils will begin to break down and leave varnish deposits.

Oil Temperature

Check the oil level (with any cylinders fully retracted). If the oil level is low, there must be a leak in the system.

Oil Level

Inspect for leaks in the system and list below:

Inspect the hoses in the system. Are any of them rubbing on another hose, part of the machine or the structure? If so, list below. Check the length of the hoses. Unless required by the movement of the machine, hydraulic hoses should be no longer than about four feet. Hoses that are longer than four feet should be replaced by a length of hard pipe.

Inspect the pipe clamps. Proper hydraulic clamps should be used – conduit and beam clamps are unacceptable.

Proper clamps?

Properly spaced (approximately every 5’ and within 6” of a termination)?

List any other problems you have noticed that should be addressed:

Tyrone Berry Carriage Hydraulic Preventive Maintenance Schedule

Make several copies of this schedule and keep them handy for performing regular maintenance checks.

Date

The Tyrone Berry Carriage is a unique and efficient design. It is very reliable and can be expected to deliver many years of service if properly maintained. The two most common causes of failure in this system are heat and contamination. Heat problems in the Tyrone Berry Carriage are almost always the result of improper pressure settings.

The system pressure will vary widely during operation of the carriage, but it should never exceed 1950 PSI. Monitor the pressure for a few minutes and record the highest pressure here. If the pressure exceeds 1950 PSI, even for a brief time, reset the pressures at the earliest possible opportunity.

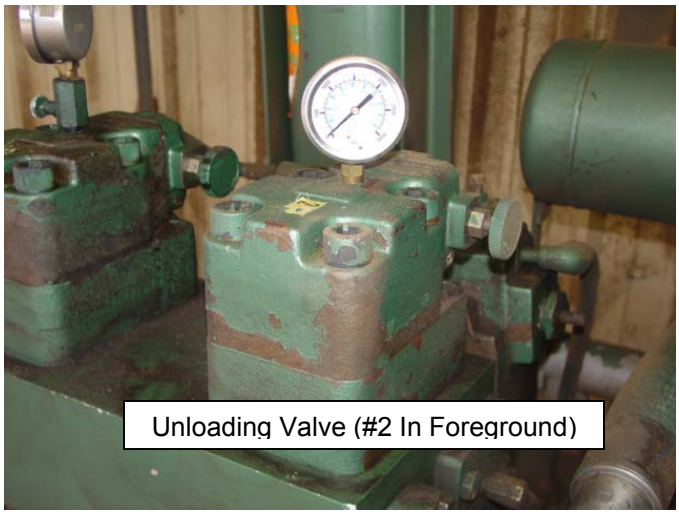
Max PSI

At least quarterly, check and set all of the pressures in the system. Pump section No. 2 should unload whenever the system pressure exceeds 1400 PSI. Pump section No. 1 should unload whenever the system pressure exceeds 1800 PSI. Idle pressure in the system should therefore be 1800 PSI. Both unloading valves should be dumping pump flow back to tank, so the tank lines should both be warm.

Record Idle Pressure

Record Temperature Of Each Unloading Valve

Watch the gauge as the carriage accelerates. When the flow path is opened, the large piston accumulator will discharge into the cylinder to provide flow. As the carriage picks up speed and the volume inside the accumulator is spent, the pressure will drop. When pressure drops to 1485 PSI, the No. 1 unloading valve should close.



Unloading Valve (#2 In Foreground)

Does No. 1 Close at 1485 PSI?

There will likely be an initial pressure increase as the No. 1 pump flow is added to the system, then pressure should continue to drop as the carriage accelerates further. When system pressure drops below 1190 PSI, the No. 2 unloading valve will close.

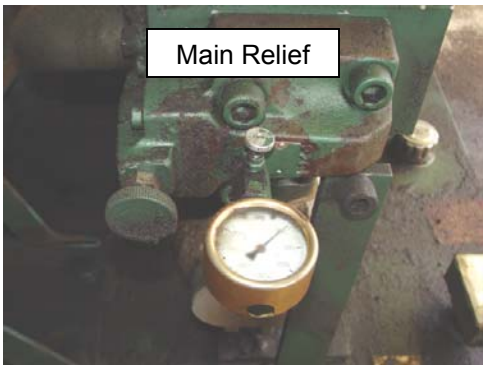
Does No. 2 Close At 1190 PSI?

When the carriage stops, pressure will build again in the system as the accumulator fills. Watch the gauge climb. When the pressure reaches 1400 PSI, the No. 2 unloading valve should open.

Does No. 2 Unload At 1400 PSI?

When the pressure reaches 1800 PSI, the No. 1 unloading valve should open.

Does No. 1 Unload At 1800 PSI?



The pressures in the Tyrone Berry Carriage are critical for efficient operation. If they are off even 100 PSI, severe temperature increases can be noted, particularly when there is high ambient temperature.
Procedure for setting pressure:

1) Close the accumulator dump valve
2) Turn the main system relief valve counterclockwise to a very low pressure
3) Turn unloading valve No. 2 counterclockwise to a very low pressure
4) Turn unloading valve No. 1 clockwise to a very high pressure
5) Turn on the power, pull control lever to full open and hold carriage against the bumper so that oil dumps across the main system relief. Set the relief to 1950 PSI
6) Turn unloading valve No. 1 counterclockwise to a very low pressure
7) Turn unloading valve No. 2 clockwise until the gauge reads 1400 PSI
8) Turn unloading valve No. 1 clockwise until the gauge reads 1800 PSI

Check the accumulator precharge. The recommended precharge is 550 – 600 PSI. There is a gauge at the top of the accumulator. This gauge will drop to the accumulator precharge with the system shut down and the accumulator dump valve open. The piston accumulator can become overcharged as it is used. Oil can bypass around the piston and collect on top of it. If this occurs, attach the charging rig to the accumulator, open the bleeder valve and bleed off all of the nitrogen with the system under pressure. When the nitrogen is all bled off, oil will exit the bleeder valve until the piston reaches the top of the accumulator. Once

all of the oil is forced out, shut down the power, open the accumulator dump valve and add nitrogen until the precharge is 550 – 600 PSI.

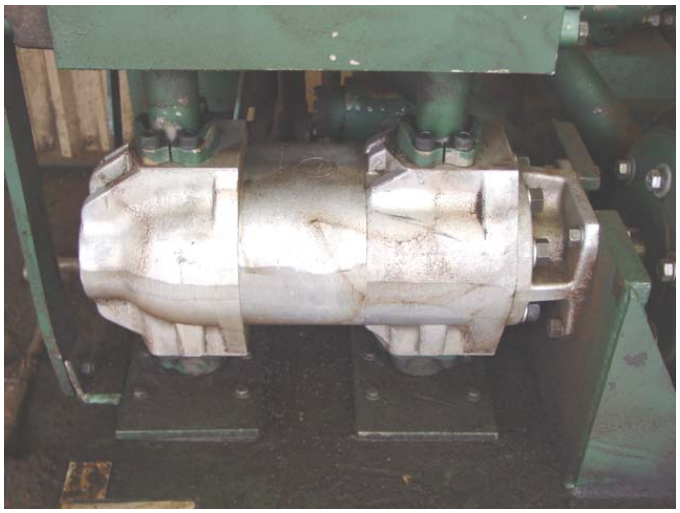
Accumulator Precharge

Check the temperature of the inlet and the outlet lines of the cooler. If the cooler is functioning properly, the outlet line should be significantly cooler than the inlet. If there is only a small difference, either the cooler does not have good air flow or a portion of the cooler has become partially plugged. If the cooler becomes badly plugged, oil will bypass through the check valve. Feel the check valve. If it is hot, oil is bypassing the cooler and it may need to be flushed.

Temperature Drop Between Cooler Inlet and Cooler Outlet

Good Air Flow?

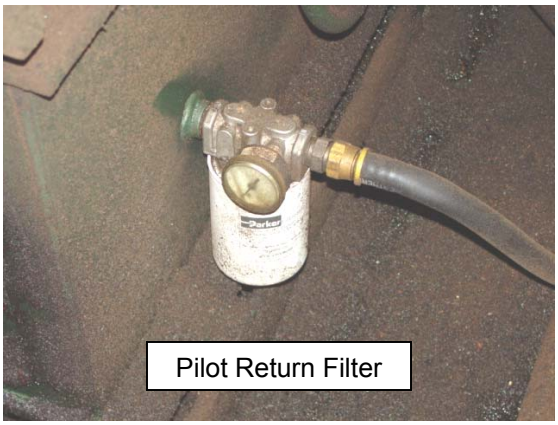
Check Valve Cool?



A strong indication of pump wear on the carriage is reduced current draw of the electric drive motor. Measure the current draw with an ammeter while the pumps are relatively new and track the condition of the pumps by checking monthly and recording here. Since the system pressure varies widely, be sure to check current draw while the system is at idle.

Current Draw

Check the filters. These filters should be checked and changed on a scheduled basis. The filter schedule should be determined by oil analysis, not by the reading of the dirt indicator. Change all filters at the same time. The date of the last filter change should be recorded here and on the filters. Under no circumstances should a filter be left in place more than 180 days.



Pilot Return Filter

Date Of Last Filter Change

Check the breather cap. The breather cap on the Tyrone Berry Carriage is the spring type. It should be checked and cleaned at least once a month and replaced annually. Failure to replace the breather cap regularly will result in weakening of the spring. If this occurs, even though the cap itself may be clean, contaminants may enter the reservoir. Record the date it was last replaced here and on the breather.

Breather Cap Clean?

Date Breather Last Replaced

REMEMBER THAT COMPONENTS DAMAGED BY CONTAMINATION WILL NOT BE COVERED UNDER THE TYRONE BERRY CARRIAGE WARRANTY!
Record the oil temperature. While it is normal for the oil temperature to increase whenever ambient temperature does, excessively high oil temperature indicates bypassing in the system. Places where bypassing may be occurring can include:

- System relief valve or one of the unloading valves
- Internally in one of the pumps
- Valve spools
- The large travel cylinder
- The pilot circuit

The source of the excess heat can be determined using the temperature gun. This is best done shortly after startup before overheated oil can be circulated throughout the system. Under no circumstances should the oil temperature be allowed to exceed 140^{o}F. Above this temperature, most hydraulic oils will begin to break down and leave varnish deposits.

Oil Temperature

Check the oil level (with any cylinders fully retracted). If the oil level is low, there must be a leak in the system.

Oil Level

Inspect for leaks in the system and list below.

Inspect the hoses in the system. Are any of them rubbing on another hose, part of the machine or the structure? If so, list below. Check the length of the hoses. Unless required by the movement of the machine, hydraulic hoses should be no longer than about four feet. Hoses that are longer than four feet should be replaced by a length of hard pipe.

Inspect the pipe clamps. Proper hydraulic clamps should be used – conduit and beam clamps are unacceptable.

Proper clamps?

Properly spaced (approximately every 5’ and within 6” of a termination)?

List any other problems you have noticed that should be addressed: