Pressure Relief Valve User Manual

For use with Weatherford's Pressure Relief Console

5/16/2017

Pressure Relief Valve User Manual D000966683

Contents

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MANUAL CONVENTIONS

Warning - describes a possibly dangerous situation. Disregard can lead to sever injury, death or damage to equipment.

Caution - describes a possibly dangerous situation. Disregard can lead to minor injury or minor damage to equipment.

Notice - describes a possibly harmful situation. Disregard can cause a dangerous situation or sub-optimal performance. This sign also marks useful operating hints.

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1.0 General Description

The Pressure Relief Valve (PRV) control system releases excess pressure from a fluid circulation system when it detects an over-pressure event. The Weatherford part number is 02570314. It is certified for use in ATEX zone 1 hazardous environments.

The PRV console caries a SIL 2 rating however, two buffer manifolds must be placed in series for the system to have complete redundancy. The SIL rating is only valid when using 2 buffer manifolds in series.

The two relief vales will operate simultaneously and without warning. Always maintain a safe distance from the moving parts.

The following operating limits must be strictly adhered to.

Operating Limit	Value
Minimum Ambient Temperature	-20C
Maximum Ambient Temperature	40 C
Maximum Accumulated Hydraulic Pressure	2200 psi
Nominal Accumulated Hydraulic Pressure	2000 psi
Maximum Nitrogen Pre-charge	1005 psi
Minimum Nitrogen Pre-charge	985 psi
Minimum Air Pressure	100 psi
Maximum Air Pressure	150 psi

Table 1 – Operating limits

The following table documents the ATEX ratings and part numbers of the PRV enclosures. Substitutions are not allowed without engineering approval.

Do not open enclosures while system is energized in a hazardous area. Enclosures may only be opened in hazardous area after system has been de-energized for 15 minutes, and permit to work is in place.

Enclosure	Location	Atex Zone	ATEX IECEx Markings	JDE Part #
Integrated Computer Unit (ICU)	Main Console	Zone 1	KEMA 01 ATEX 2145 X II 2G Ex db eb IIB T4 Gb IECEx KEM 07.0051 X Ex db eb IIB T4 Gb -20 C <= Ta <= +40 C	02600321
Power Supply	Main Console	Zone 1	KEMA 01 ATEX 2145 X II 2G Ex db eb IIB T4 Gb IECEx KEM 07.0051 X Ex db eb IIB T4 Gb -20 C <= Ta <= +40 C	026000320

Table 2 – Enclosure Certifications

The following table documents the ATEX ratings and part numbers of the PRV external devices. Substitutions are not allowed without engineering approval.

Device	Location	Atex Zone	Atex Marking	JDE Part #
Hydac 5000 psi Pressure	Main Console	Zone 0	ATEX KEMA 10ATEX0100 X II 2G Ex d IIC T6, T5 Gb IECEx KEM 10.0053X Ex d IIC T6, T5 Gb -40 C <= Ta <= 140 C	02575461
Hydac 200 psi Pressure	Main Console	Zone 0	ATEX KEMA 10ATEX0100 X II 2G Ex d IIC T6, T5 Gb	02575459

			IECEx KEM 10.0053X Ex d IIC T6, T5 Gb -40 C <= Ta <= 140 C	
Sun Solenoids	Main Console	Zone 1	ATEX SIRA 10ATEX 5067X Ex mb IIC T3 gb IECEx 10.0006X Ex mb IIC T3 gb	02575488

Table 3 – Device Certifications

The following table documents the part numbers of the PRV cables and hoses. Substitutions are not allowed without engineering approval.

Do not connect or disconnect cables when the system is energized. Do not connect or disconnect hoses when there is accumulated pressure. Obtain a permit to work before assembly or disassembly if necessary.

Cable	Description	From	To	JDE Part #
Remote Sensor Cable	Gray with 7 pin connector	Main Console	Buffer manifold	02638849
Fiber Optics Cable	Gray with fiber optics connectors	Main Console	Control room	?
Hydraulics hose	Twin hoses with quick disconnects	Main Console	Buffer Manifold	?

Table 4 – Cables and Hoses

2.0 Assembling & Connecting the Equipment

The equipment is split between three locations: the safe area, the main console, and the buffer manifold. The equipment must be situated such that all cables and hoses reach their termination points. The Main Console must also be within reach of AC power and air supplies.

Once the equipment is placed in its final position it is time to interconnect the pieces. All cables and hoses are uniquely keyed and will not fit anywhere they do not belong. All cables and hoses must be routed where they do not create a tripping hazard and cannot be pinched or otherwise damaged. Cables and hoses must be secured in place.

The maintenance section outlines what must be checked before each job. The hydraulic accumulators must be pre-charged with nitrogen, for example. More information can be found in the hydraulics section of this manual.

NOTICE

The bypass valve can be opened to relieve trapped pressure when connecting hoses to the console but be sure to close the valves once the hoses are attached. Consult the hydraulics section in this manifold for the location of the bypass valves.

The following table outlines all interconnections. They can be made up in any order. All cables and hoses listed here must be connected before continuing.

Cable/hose	Description	From	To
Valve Open/Close hoses (times 2)	Hydraulic supply and return for opening and closing the pressure relief valve	Main Console	Buffer Manifold
Remote Sensor Cable (times 2)	Signal cable for pressure and proximity sensor	Main Console	Buffer Manifold
Power Cables (times 2)	Power supply cables	Electrical Distribution center	Main Console
Fiber Communications cable	Bi-directional Communications with OneSync	Safe area	Main Console
Air Supply	Supplies air to the hydraulic pump	Rig air	Main console

Table 5 - Interconnections

Once all of the hoses and cables are connected it is safe to turn on electrical power. The power disconnect switches are located inside the main console on the lower left. Turn them clockwise to power on the console.

The HMI will take some time to boot up. Once it is running go to the alarm page and consult the trouble shooting section of this manual to ensure there are no malfunctions that will need repairs.

WARNING

Once the troubleshooting step has been completed it is safe to build hydraulic pressure. Ensure the pressure bleed points are closed. Ensure the valve mechanisms are unobstructed and warn personnel to stay clear of the

mechanisms because that the system is about to pressure up. Consult the hydraulics section in this manual for details.

Open the supply air to the HPUs.

Monitor the hydraulic pressure and set the maximum hydraulic pressure to 2000 psi using the air pressure regulators. The regulators should have identical settings.

If there are no outstanding alarms the system is now operational.

3.0 TROUBLESHOOTING & ALARM MESSAGES

The HMI has an alarm page that indicates system warnings and alarms. It can be shown by pressing the “Alarm” button on the HMI. Alarms give insight into the PRV systems internal health. Alarms detected by both PLCs are duplicated.

A combination of two alarms can render the system inoperable. If, for example, alarms 10 and 11 are both raised then the system is incapable of relieving pressure because neither PLC can open the relief valve. One must exercise insight to determine if the PRV system is still capable.

Repair times are expected to be less than 100 hours for any given failure. The longer this system runs with a failure, the more chance it has of having a double failure. It is important to repair this unit as soon as possible to lessen the chance of the system becoming non-functional during operations.

All faults are assumed critical unless stated otherwise.

3.1 CONNECTION FAULTS

The HMI will display a message with error number 139-144 if it cannot connect to the PLCs. This could be caused by a faulty cable, or Ethernet switch. The system can still be operated remotely using the OneSync software. A qualified technician and safe atmosphere is required to correct communication errors.

The follow table shows the IP addresses of all of the devices in the PRV system. The PLCs and HMI will respond to pings from the Onesync computer.

Device	IP Address	Subnet
PLC1	192.168.79.86	255.255.255.0
PLC2	192.168.79.87	255.255.255.0
HMI	192.168.79.85	255.255.255.0
Onesync	192.168.79.x (varies)	255.255.255.0

Table 6

3.2 01 POWER SUPPLY 1 FAULT

This alarm indicates that powers supply one is not producing power. The problem could be that it is not switched on.

3.3 02 POWER SUPPPLY 2 FAULT

This alarm indicates that powers supply two is not producing power. The problem could be that it is not switched on.

3.4 03 HMI FUSE (F3) IS BLOWN

There is no power emanating from the HMI fuse, F3. This alarm is typically only viewable from the OneSync software.

3.5 04 FIBRE ETHERNET SWITCH FUSE (F4) IS BLOWN

The Ethernet switch that routes communications to OneSync has a blown fuse, F4. This alarm is typically only viewable from the HMI.

3.6 05 COPPER ETHERNET FUSE (F5) IS BLOWN

The Ethernet switch that routes communications to the HMI has a blown fuse, F5. This alarm is typically only viewable from the OneSync software.

3.7 06 INPUT FUSE 1 (F6) IS BLOWN

The input fuse 1, F6 is blown. This will de-energize PLC 1, the PRV 1 proximity sensor, the hydraulic fluid level, and pressure transducer 5. If in service when this fault is raised pressure transducer 5 should be disabled until the fuse can be replaced.

3.8 07 INPUT FUSE 2 (F7) IS BLOWN

The input fuse 2, F7 is blown. This will de-energize pressure transducer 6, air pressure and PRV 1 close pressure. If in service when this fault is raised pressure transducer 6 should be disabled until the fuse can be replaced.

3.9 08 INPUT FUSE 3 (F8) IS BLOWN

The input fuse 3, F8 is blown. This will de-energize PLC2, the PRV 2 proximity sensor and pressure transducer 7. If in service when this fault is raised pressure transducer7 should be disabled until the fuse can be replaced.

3.10 09 INPUT FUSE 4 (F9) IS BLOWN

The input fuse 4, F9 is blown. This will de-energize pressure transducer 8, hydraulic pressure, and PRV 2 close pressure. If in service when this fault is raised pressure transducer 8 should be disabled until the fuse can be replaced.

3.11 10 PLC 1 DIGITAL OUTPUT FUSE (F10) IS BLOWN

The PLC1 digital output fuse, F10 is blown. This will impede PLC 1 from opening the PRV valves. Replace the fuse as soon as possible.

3.12 11 PLC 2 DIGITAL OUTPUT FUSE (F11) IS BLOWN

The PLC2 digital output fuse F11 is blown. This will impede PLC 2 from opening the PRV valves. Replace the fuse as soon as possible.

3.13 12 HYDRAULIC FLUID LEVEL LOW

This indicates that the hydraulic fluid has dropped below the float level. It could alternatively be an electrical circuit failure.

3.1413 PRESSURE TRANSDUCER 5 RANGE FAULT

This indicates that the signal received from the pressure transducer 5 is not within acceptable range. If in service when this fault is raised, pressure transducer 5 should be disabled until it can be replaced.

3.1514 PRESSURE TRANSDUCER 6 RANGE FAULT

This indicates that the signal received from the pressure transducer 6 is not within acceptable range. If in service when this fault is raised, pressure transducer 6 should be disabled until it can be replaced.

3.1615 PRESSURE TRANSDUCER 7 RANGE FAULT

This indicates that the signal received from the pressure transducer 7 is not within acceptable range. If in service when this fault is raised, pressure transducer 7 should be disabled until it can be replaced.

3.1716 PRESSURE TRANSDUCER 8 RANGE FAULT

This indicates that the signal received from the pressure transducer 8 is not within acceptable range. If in service when this fault is raised, pressure transducer 8 should be disabled until it can be replaced.

3.1821 PRV 1 IS VENTING PRESSURE

This indicates that PRV 1 has detected an over pressure situation and is relieving pressure in response.

3.1922 PRV 2 IS VENTING PRESSURE

This indicates that PRV 2 has detected an over pressure situation and is relieving pressure in response.

3.20 23 HYDRAULIC PRESSURE LOW

This indicates that the hydraulic pressure is below operating pressure.

3.21 24 PRV 1 CLOSE PRESSURE DEVIATION

This indicates that the PRV 1 close pressure differs from the supplied hydraulic pressure by more than 20 psi. On a hot day this could indicate fluid expansion. Excess pressure can be released through the bypass valve.

3.22 25 PRV2 CLOSE PRESSURE DEVIATION

This indicates that the PRV 2 close pressure differs from the supplied hydraulic pressure by more than 20 psi. On a hot day this could indicate fluid expansion. Excess pressure can be released through the bypass valve.

3.23 26 ONESYNC IS NOT COMMUNICATING

This indicates that the OneSync software is not connected.

3.24 27 AIR PRESSURE IS LOW

This indicates that the air pressure has dropped below a reasonable operating pressure.

3.25 28 SETPOINT IS TOO HIGH

This indicates that an attempt was made to set the Set Point Pressure above 1600 psi. The pressure will still be relieved at 1600 psi. Change the Set Point Pressure to a reasonable value.

3.26 29 PRESSURE TRANSDUCER 5 IS DISABLED

This indicates that pressure transducer 5 is disabled and will not contribute to the over pressure sensing.

3.27 30 PRESSURE TRANSDUCER 6 IS DISABLED

This indicates that pressure transducer 6 is disabled and will not contribute to the over pressure sensing.

3.28 31 PRESSURE TRANSDUCER 7 IS DISABLED

This indicates that pressure transducer 7 is disabled and will not contribute to the over pressure sensing.

3.29 32 PRESSURE TRANSDUCER 8 IS DISABLED

This indicates that pressure transducer 8 is disabled and will not contribute to the over pressure sensing.

3.30 33 HYDRAULIC PRESSURE IS TOO HIGH

This indicates that the hydraulic pressure is above 2200 psi. The regulated air pressure must be turned down until the hydraulic pressure cannot reach this level.

3.31 34 PLC ERROR

The PLC has a hardware fault that must be corrected. A qualified technician must investigate and repair the cause of this error.

3.32 SENSOR BLIND

The pressure sensors PT5- PT8 are all disabled or out of range.

4.0 THE HUMAN MACHINE INTERFACE (HMI)

The HMI is located on the top of the PRV console and is protected by a steel cover. All PRV functions can be accesses through the HMI. The HMI displays all error conditions and the current sensor readings.

Great care must be taken when modifying process values in a working system. It is highly recommended that the PRV process values be input before the PRV is placed in-service and not changed while in-service.

The HMI will not prevent you from changing process values while in-service but one should do so with extreme care. The PRV could start venting pressure immediately if an erroneous value is sent to the PLC.

The HMI has 2 main pages: Alarms and Setup; and several help pages. The Alarms page shows the current active alarms. The Setup page is where the Set Point Pressure is entered. It also shows the current values for all of the sensors in the PRV system.

3.33 THE ALARMS PAGE

The Alarms page, shown below, displays a list all the alarms active in the PRV system. There should never be any alarms active while the system in in-service. Information on specific alarms can be found in the troubleshooting section.

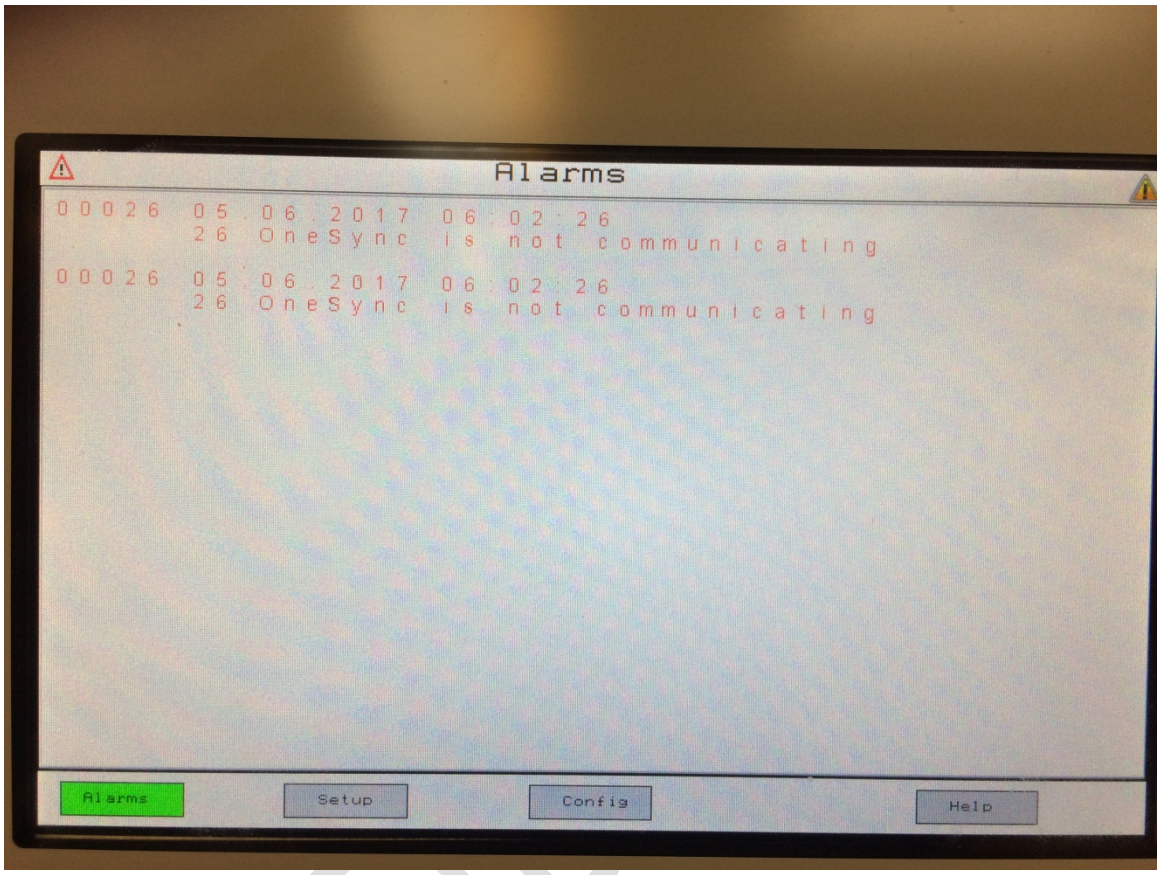

Figure 1 – Alarms Page

The Setup, Config, and Help buttons change the page as advertised.

3.34 THE SETUP PAGE

The Setup page, shown below, has the Set Point Pressure, the sensor enable and disable functions. It also displays the current sensor values.

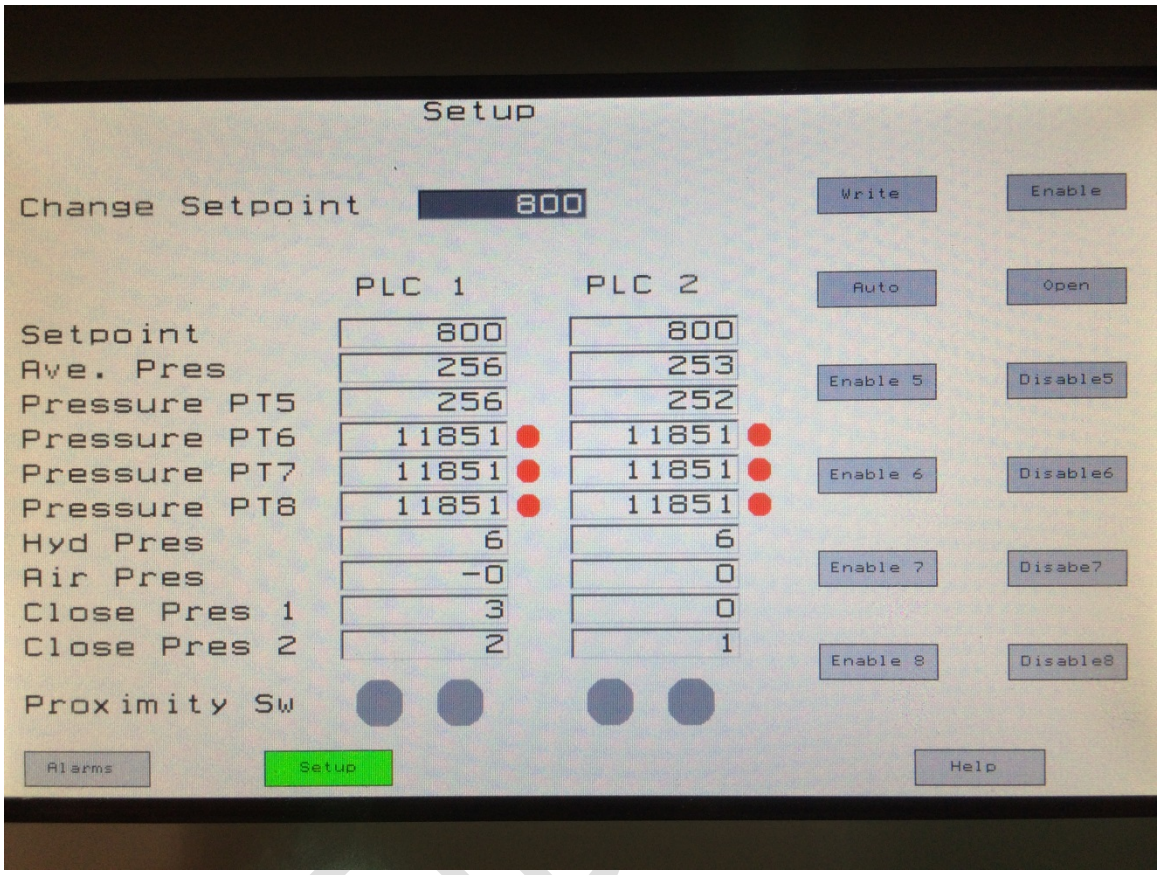

Figure 2 – Setup Page

The Alarms, Config and Help buttons change the page as advertised.

The Set Point Pressure is the pressure at which the PRV will open the valves and vent pressure. The two PLCs should always show the same value. If the value is different in each PLC rewrite the desired Set Point value using the process below.

To change the Set Point Pressure enter the desired value in the “Change Setpoint” entry box. The new value must be less than 1600 psi.

Figure 3 – Enter Set Point

Press the top right “Enable” button. You will see green “Enabled” text above the “PLC 1” and “PLC 2” text shown in figure 2. The PLCs will continue to be write-enabled for 5 seconds. It is vital that both PLCs show that they are write-enabled. If not, wait 5 seconds and try again.

While both PLCs are write-enabled, press the “Write” button. This will write the new Set Point Value to both PLCs. If the new Set Point value does not appear under both PLCs, repeat the write process until they do. The new Set Point value is immediately active and displayed as soon as it is written.

The PRV can be set into “Automatic” (Auto) and “Open” mode. In Automatic mode the PRV valves remain closed until the Set Point Pressure is exceeded. In Open mode the PRV valves open and remain open until the mode is changed back to Automatic.

WARNING

Open mode is for testing and inspections only. The system shall remain in Auto Mode while operating with pressurized mud.

To change the PRV into Automatic mode press the “Enable” button and then press the “Auto” button. The “Enable” button works as described above.

To open the PRV press the “Enable” button and then press the “Open” button. The “Enabled” button works as described above.

Individual pressure sensors can be disabled if they are, for example, demonstrating erratic behavior. There are 4 “Disable” buttons down the right side of the page. The top button disables PT5, the second PT6, the third PT7, and the fourth PT8. Disabled sensors do not contribute to the PRV open and close conditions.

To disable a sensor press the “Enable” button to write-enable the PLCs and then press the corresponding disable button for the sensor. The red indicator next to the sensor reading in figure 2 indicates that the sensor is disabled.

Individual pressure sensors can be enabled if they are currently disabled. There are 4 “Enable” buttons to the left of the sensor disable buttons. The top button enables PT5, the second PT6, the third PT7, and the fourth PT8.

To disable a sensor press the “Enable” button to write-enable the PLCs and then press the corresponding enable button for the sensor.

5.0 THE HYDRAULIC SYSTEM

The PRV hydraulic power unit (HPU) uses air pressure to build hydraulic pressure. Inside the unit there are two air-over-hydraulic pumps. The pressurized hydraulic fluid is stored in accumulators and powers the pressure relief valves.

The hydraulic and pneumatic controls are located throughout the console. The majority of the controls can be accessed through the front, top and rear doors.

The front door exposes the main valve block as shown in the Figure 4 – Valve Block Front.

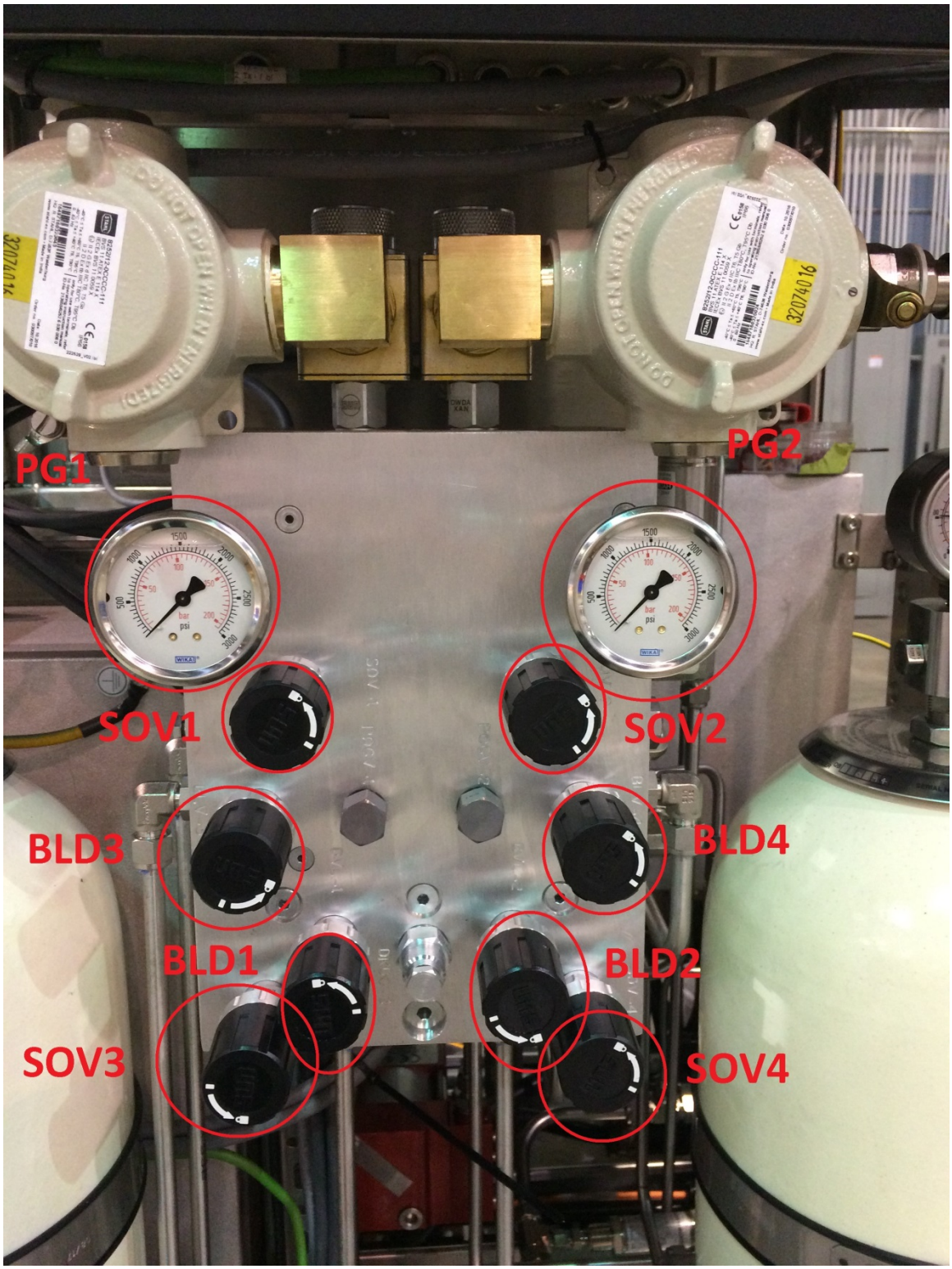

Figure 4 – Valve Block Front

Pressure Gauge 1: The pressure stored in accumulator 1. This pressure corresponds to the HMI PRV 1 close pressure.

Pressure Gauge 2: The pressure stored in accumulator 2. This pressure corresponds to the HMI PRV 2 close pressure.

Shutoff Valve 1: Normally open – used to shut off the output of pump 1.

Shutoff Valve 2: Normally open – used to shut off the output of pump 2.

Shutoff Valve 3: Normally open – used to shut off accumulator 1.

Shutoff Valve 4: Normally open – used to shut off accumulator 2.

Ball Valve 1: Normally closed – used to drain fluid from accumulator 1.

Ball Valve 2: Normally closed – used to drain fluid from accumulator 2.

Ball Valve 3: Normally closed – used to equalize pressure across PRV 1. Open to connect or disconnect PRV1 hydraulic hoses.

Ball Valve 4: Normally closed – used to equalize pressure across PRV 2. Open to connect or disconnect PRV2 hydraulic hoses.

The air pressure regulators, shown below, are located inside the front door and at the bottom of the enclosure.

The top view of the valve block shows the pressure relief adjusters.

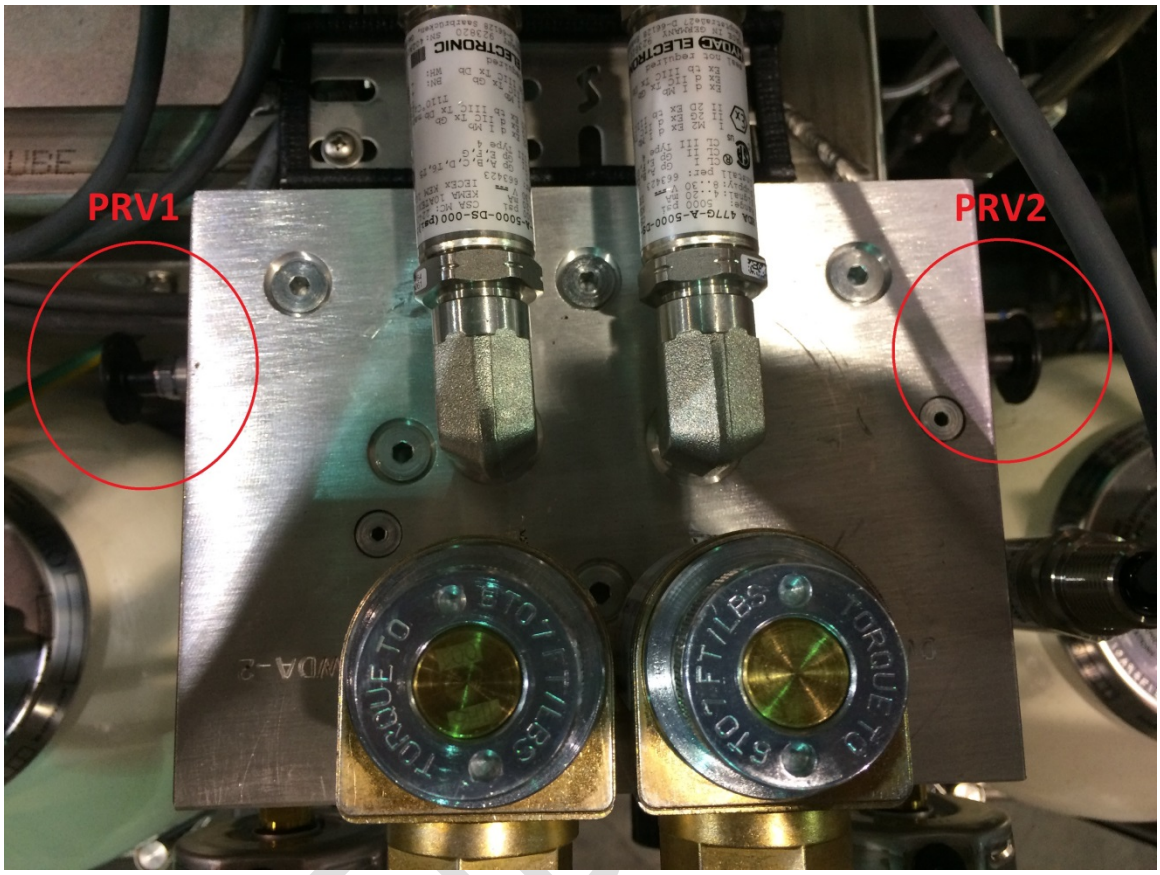

Figure 5 – Top View

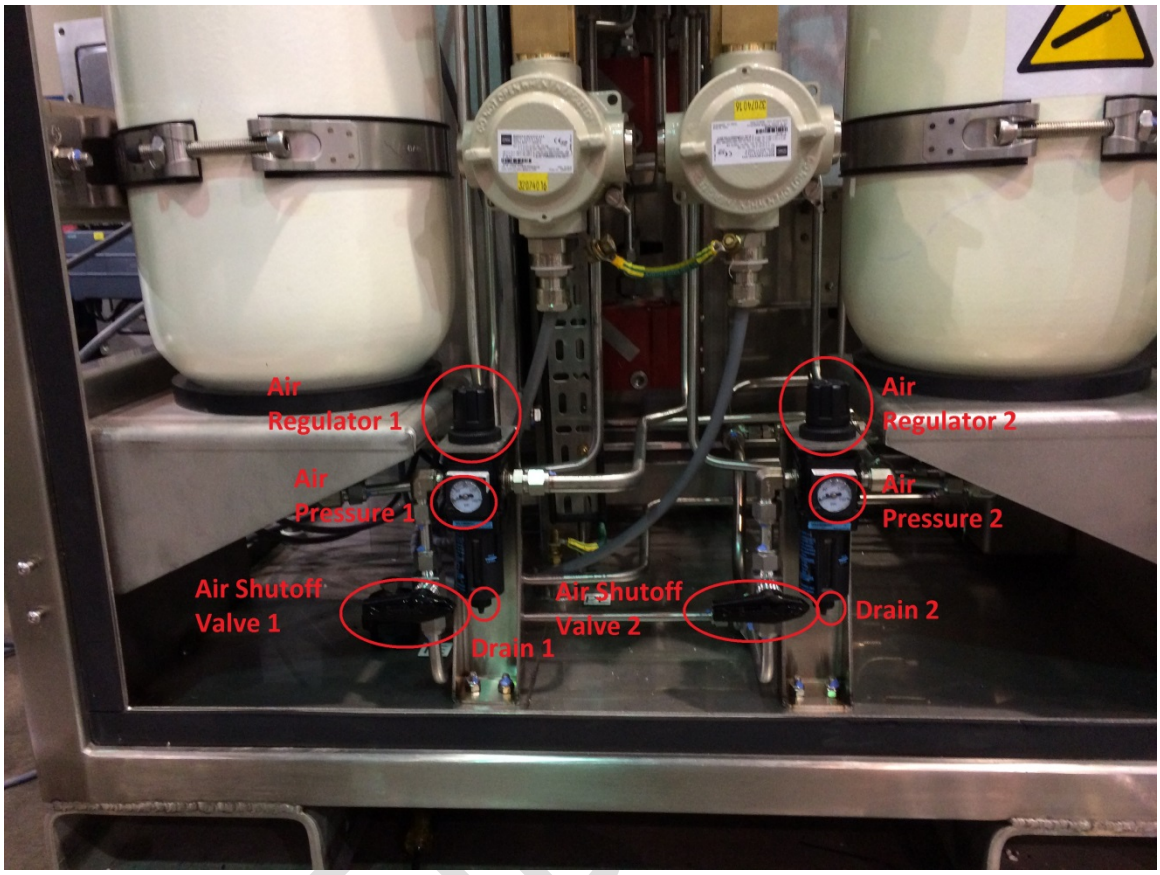

Figure 6 – Air Regulators

Regulator 1: Air pressure adjustment used to adjust hydraulic pressure from pump 1. Adjust to create 2000 psi of hydraulic pressure.

Regulator 2: Air pressure adjustment used to adjust hydraulic pressure from pump 2. Adjust to create 2000 psi of hydraulic pressure.

Regulated Pressure 1: The air pressure used to drive pump 1.

Regulated Pressure 2: The air pressure used to drive pump 2.

Drain 1, 2: The drain cocks for releasing trapped moisture. They can also be used to drain trapped air pressure while decommissioning.

Air Supply Valve 1: Normally open – used to cut air to pump 1.

Air Supply Valve 2: Normally open – used to cut air to pump 2.

There are some controls that can accesses through the back door.

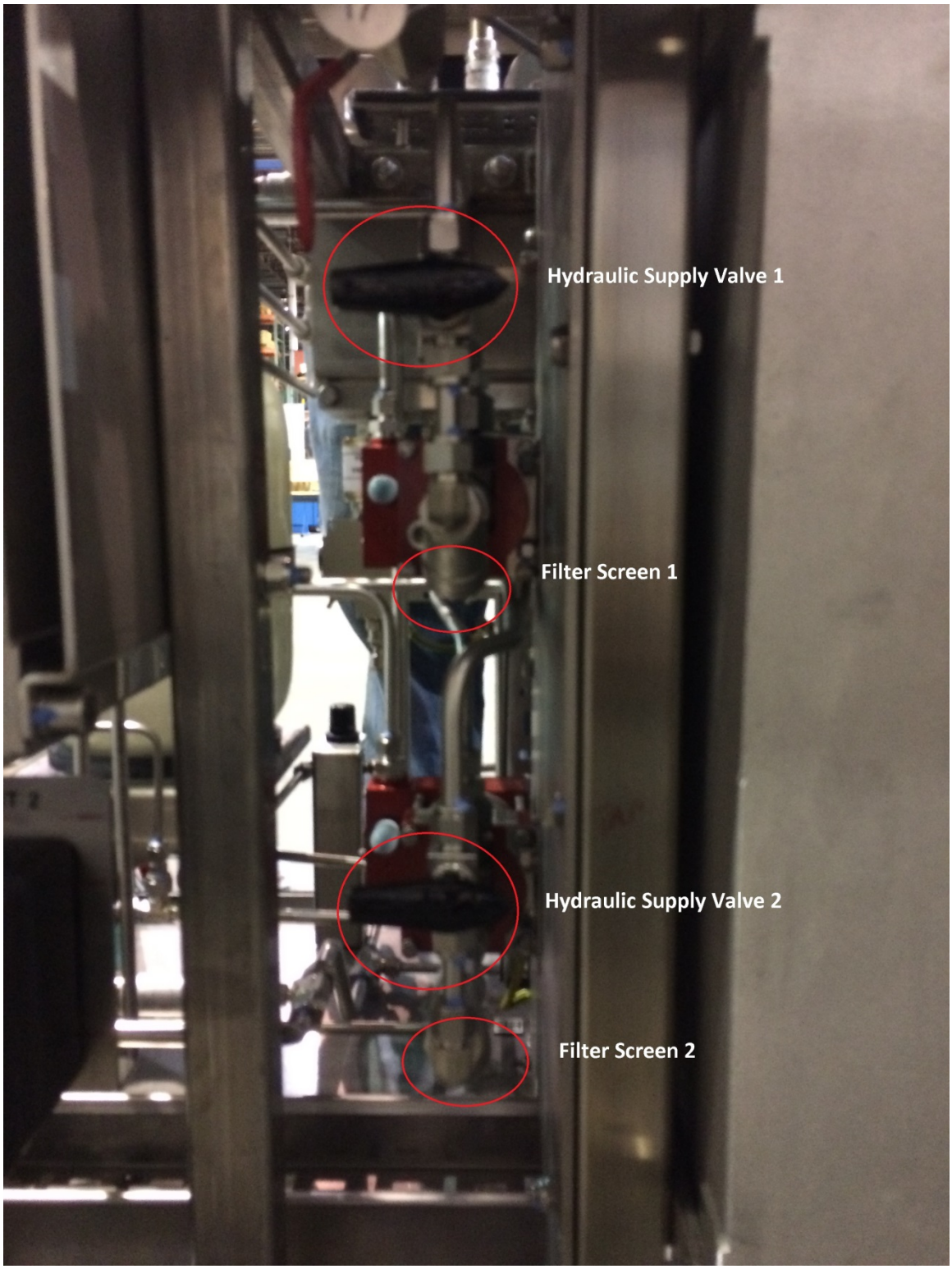

Figure 7 – Rear Hydraulics

Hydraulic Supply Valve 1: Normally open – used to cut the hydraulic fluid to pump 1.

Hydraulic Supply Valve 1: Normally open – used to cut the hydraulic fluid to pump 1.

Filter Screen 1: used to trap junk before it reaches pump 1.

Filter Screen 2: used to trap junk before it reaches pump 2.

The power disconnects are also accessed through the back door.

The hydraulic level sight glass is behind the rear panel.

Figure 8 – Sight Glass

The HMI, hydraulics filter and vent filter are located on the top of the console.

4.1 NITROGEN PRE-CHARGING

Before the system can be used the accumulators must be pre-charged with nitrogen to 1000 psi. This procedure is done with no air or hydraulic pressure in the system.

1. Open the accumulator drain valve.
2. Remove the access cap on the end of the accumulator.
3. Attach the accumulator filler tool.
4. Attach a pressurized nitrogen source. It will need a sufficient charge to pressurize the accumulator to 1000 psi.
5. Open the accumulator air valve by turning it counter clockwise.
6. Open the filler valve on the filler tool and **SLOWLY** fill the accumulator to 1000 psi.
7. Close the filler valve on the filler tool.
8. Close the accumulator air valve.
9. Remove the filler tool.
10. Replace the access cap.
11. Repeat for the other accumulator.

4.2 FILLING THE RESERVOIR

Use a mineral based hydraulic oil, fully miscible fluid appropriate for the environmental conditions and regulations. Fill to the top of sight gauge to allow room for heat expansion. The filter/filler is equipped with a breather.

4.3 SET THE HYDRAULIC RELIEF PRESSURE

The hydraulic relief pressure is the pressure at which the hydraulic fluid will be returned to the hydraulic tank. It is internal to the valve block and not to be confused with the external PRV.

The adjustment can be accessed through the front or top doors as seen in Figure 5.

This is a typical Allen key adjustment with a locking nut. The relief pressure must be set to 2200 psi.

1) Close SOV1
2) Increase the regulated air pressure at FRL1
3) Adjust the Allen key bolt until it the pressure is relieved at 2200psi.
4) Open SOV1
5) Adjust the regulated hydraulic pressure as described in section 4.4

6) Repeat for second pump and relief valve.

4.4 SET REGULATED HYDRAULIC PRESSURE

The HPU has a maximum hydraulic pressure of 2200 psi. The working pressure of 2000 psi is set using the air regulators shown in Figure 6 – Air Regulators. 2000 psi of hydraulic pressure is roughly 72 psi of air pressure.

1) Close SOV1
2) Increase the regulated air pressure at FRL1 until the hydraulic pressure reaches 2000 psi.
3) If the hydraulic pressure exceeds 2000 psi the regulated air pressure at FRL1 must be reduced and the excess hydraulic pressure bled through SOV1. The process can be restarted at step 1.
4) Once the regulated air pressure produces a stable 2000 psi of hydraulic pressure SOV1 can be opened.
5) Repeat for the second hydraulic pump.

It is important that the hydraulic pressure be limited by air pressure and not by the pressure relief valve in the valve block. If flow is heard at the relief valve when the hydraulic pressure is less than 2200 psi, the relief valve is out-of-adjustment or faulty. See section 4.3 to set the relief pressure.

4.5 PRIMING HYDRAULIC HOSES

Priming the hydraulic hoses is only necessary if the hoses have air trapped inside. New and recently maintained hoses could have trapped air.

To prime the hoses connect them to the console as normal, connect the far end of the hoses to each other making a complete circuit, and run the pumps to circulate fluid into them and air out.

4.6 VALVE TESTING

It is important to test the valves before putting the system in service. All of the electronics and full hydraulic pressure need to be available for this test.

1. Before testing the valves energize the PRV system and allow the accumulated pressure to build to 2000 psi.
2. Open the valves using the HMI or the Onesync software. See the HMI section of this manual.
3. Inspect the valves to ensure they are fully open and are not leaking hydraulic fluid.
4. Close the valves using the HMI of Onesync software. See the HMI section of this document.
5. If a problem was found, fix it and redo this test.

4.7 BLEEDING HYDRAULIC PRESSURE

To bleed the pressure from the unit first turn the Air Supply Valves off. It is not necessary to bleed the air pressure when also bleeding hydraulic pressure because the air will cycle through the hydraulic pumps. However, air pressure can be bled independent of hydraulic pressure by opening the drain valve on the bottom of each air filter. The air pressure can be checked using the regulated air pressure gauge also on the filter assembly.

Bleed the main accumulators using the needle valves on the valve block. Drain the pressure slowly to prevent damage the accumulator bladders. The pressure can be verified using the Hydraulic Pressure gauge on the top of the valve block.

4.8 BLEEDING THE NITROGEN PRE-CHARGE

The nitrogen must be released before the system can be transported. It is safe to release the nitrogen gas to the atmosphere from whence it came.

1. Open the accumulator bleed valves and drain any trapped fluid.
2. Remove the access cap on the end of the accumulator.
3. Attach the accumulator filler tool.
4. Open the accumulator air valve.
5. Open the bleed valve on the accumulator filler tool and bleed the nitrogen **SLOWLY**.
6. When the nitrogen has been exhausted, close the bleed valve on the accumulator filler tool.
7. Close the accumulator air valve.
8. Replace the access cap.
9. Repeat for each accumulator.

6.0 MAINTENANCE

5.1 HOURLY

1. Drain the moisture from the air dryers using the drain valves.
2. Check the bottom of the unit for signs of hydraulic leaks.
3. Check that the hydraulic pressure is around 2000 psi.

5.2 SHIFT CHANGE

1. Check hydraulic tank sight gauge for fluid level. See figure 8.
2. Compare sight gauges to HMI pressure readings.

5.3 PRE-JOB

1. Check cables and hoses for damage.
2. Check hydraulic filter screens for debris.

3. Check the hydraulic fluid level.
4. Check the accumulator nitrogen pre-charge on the top of the accumulators.

Revision History

Revision Number	Date	Description of Change
A		First release

Table 7 – Revision History