Pit Volume Totalizer (PVT) User Guide
US Version

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General Description

The Pason Pit-Bull Pit Volume Totalizer (PVT) system is a high-quality microprocessor-based instrumentation package, comprised of four main functions. The system measures, calculates, and displays signals from the main mud system, the trip tank system, the return flow system, and both main mud pumps.

Figure 1: PVT face plate

The Pason PVT system is specifically designed to withstand the harsh environmental extremes encountered in the American drilling industry. The main display unit is equipped with a 100-watt thermostatically controlled heater. This allows for operation in ambient temperatures down to -49°F without any degradation in performance.

The unit is water-resistant and is designed to operate reliably under the adverse conditions found on drilling rigs. All panel switches are environmentally sealed and have a water-tight panel seal installed to provide the ultimate in protection from the elements. The system is fully protected from input noise and overvoltage.

The Pason PVT system consists of two main units: the display unit and the junction box (J Box). The J Box is provided so that field wiring connections can be made in a safe, convenient location. The J Box also provides an excellent location for field personnel to troubleshoot the system.

The display unit is the heart of the system, containing all the controls, switches, and alarms. A 1" backlit Liquid Crystal Display (LCD) is provided for each main function monitored. A variety of information can be displayed about each function by using the panel switches on the unit. The volume and flow sections monitor either gain/loss readings or absolute values. The pump section monitors either strokes per minute, or total strokes for both pumps. The trip tank section monitors trip tank volume, individual fill volume, or total accumulated fill volume.

An alarm is provided for both volume and flow gain/loss deviations. The alarms are fully independent of each other and are adjustable. If one or both of the alarms are disabled, a red warning light (LED) will flash to remind the operator to turn the alarm back on as soon as possible. In addition to the volume and flow alarms, the trip tank system is provided with both a high and low alarm to assist the operator in filling or draining the trip tank.

1 Specifications

1.1 Display Unit Specifications

Input Power Requirements

Voltage	110 VAC, 50/60 HZ
Current	1.5 Amps

Environmental Specifications

Ambient Temperature	49 to 104 F
Relative Humidity	100% (Outdoor Use)
Max. Internal Temperature	234 F
Hazardous Area Classification	Class 1, Div. 2 (CSA)

Physical Specifications

Dimensions (W-H-D)	14¾" x 123/8" x 7¼" (Excluding Mounting Bracket)
Weight	35 lbs.
Mounting	Pipe Bracket
Box Material	1/16" Stainless Steel
Face plate Material	1/8" Aluminum with Lexan (Reverse Silk-Screened)
Viewing Windows Material	5 mil Safety Glass

Technical Specifications

Displays	4 Digit, 1" LCD (Backlit)
Display Accuracy	½" of Fluid Level
Volume Resolution	1.0 BBL
Pit Accuracy	½" of Fluid Level

Flow Resolution	1%
Trip Resolution	0.1 BBL
Pumps Resolution	1 Stroke/Minute
Chart Output	0 to 20 mA (Programmable)
Chart Output Resolution	8 Bit (0.4%)

Functional Specifications

Displayed Functions	Total Pit Volume Volume Per Tank Volume Gain/Loss Return Flow Percent Return Flow Gain/Loss Trip Tank Volume Individual Fill (Trip) Accumulated Fill (Trip) Strokes/Min. (Pump 1 & 2) Total Strokes (Pump 1 & 2)
Main Pits Monitored	Up To 8 Pits Plus Trip Tank
Volume Alarm Range	5 to 30 BBLs
Flow Alarm Range	2.0 to 5.5%
Chart Recorder Output	Volume, Flow and Trip (20 mA)
Alarm Horn	120 VAC Klaxon Type

1.2 J Box Specifications

Input Power Requirements

Input Voltage	14 VDC (Supplied Via Signal Cable)
Input Current	70 mA Typical (Limited to 100 mA)

Environmental Specifications

Ambient Temperature	-49 to 104 F
Relative Humidity	100% (Outdoor Use)
Max. Internal Temperature	Ambient + 36 F
Hazardous Area Classification	Class 1, Div. 2 (CSA)

Physical Specifications

Dimensions (W-H-D)	155/8” x 12¾” x 8”
Weight	13 lbs.
Mounting	Lugs (2)
Box Material	PolyGlass

Technical Specifications

Reference Voltage (Red to Black)	6.2 VDC (All Tanks–Open or Closed Circuit)
Short Circuit Current (Red to Black)	12 mA (All Tanks)
Signal Input Impedance (White)	100k ohm (All Tanks)
Open Circuit Voltage (Red To Black)	12 volts (Flow)
Short Circuit Current (Red To Black)	50 mA (Flow)

Open Circuit Voltage (Red To Black)	8.2 VDC (Pumps 1 & 2)
Short Circuit Current (Red To Black)	8.2 mA (Pumps 1 & 2)

Functional Specifications

Field Inputs	Main Pits (8) Trip Tank Flow Pumps (2)

2 Installation

2.1 Installing in Hazardous (Class 1, Div. 2) Locations

Non-Incendive Field Wiring for Class 1, Div. 2, Groups B, C, & D

All field wiring connections provided in the Pason PVT system J Box are classified as non-incendive and can be installed while the system is powered up or in the presence of hazardous gases, providing that the field sensors/wiring are approved for that purpose.

Equipment Suitable for use in Class 1, Div. 2, Groups B, C, & D

All equipment provided with the Pason PVT system is suitable for use in Class 1, Div. 2, Groups B, C, & D locations with the exception of the main power connector, which must be installed in a safe (non-hazardous) area (e.g., the doghouse).

Suitability of Associated Equipment

The following associated equipment may be connected to the non-incendive field wiring terminals without any further approval.

1. GEMS level switch or STI RPM series (for Main Tanks (8) and Trip Tank Sensors).
2. Micro-Switch LSX Type Enclosed Waterproof Limit Switches or Equivalent (Any Device With Only Switch Contacts–For Pump 1 and 2 Sensors).
3. A 1 to 2k ohm Non-Inductive Type Potentiometer Suitably Housed (for Return Flow Sensor).

2.2 Mounting the Equipment

Mounting the Display Unit

The display unit is equipped with a bracket for mounting on a 2” pipe. The unit should be mounted somewhere near the driller’s console, slightly above eye level. Select a location that provides maximum protection from any physical damage due to drilling activities. Also, there must be a suitable route for the system cables to feed through the driller’s console wireway. For maximum safety and reliability, run the cables in a manner that prevents damage during normal rig operation or rig moves.

Mounting the J Box

The preferred location for the J Box is in the pump house. However it can also be mounted under the sub-structure or on the tanks, if necessary. The location should also be selected so that there is access to wireways.

Mounting the Tank Sensor

Tank sensors should be mounted in mud tanks as far away from any agitator blades as possible. Short pieces of pipe should be welded to the bottoms of the tanks to prevent the bottom of the probe from moving around. Regardless, install suitable brackets at the top of the probe, so any lateral motion of the probe is prevented. Place probes clear of skimmers, tank walls, and fill pipes.

Mounting the Flow Paddle

The flow paddle is mounted to a saddle that is welded to the flow line during rig setup.

Note:

Proper flow paddle operation requires that the flow paddle be mounted above the level of the mud in the shaker tank. If this is not done, reliable readings are virtually impossible. Generally, the further up the pipe the flow paddle is mounted, the better it operates. On smaller rigs, it may not be necessary to install the flow paddle at all due to insufficient flow.

Installing Wiring and Cabling

Instructions for installing sensor wiring and interconnecting cables are given below.

Sensor Wiring

Sensors should be wired using a 3-conductor, 20 AWG, overall foil-shielded (with shield drain wire) type cable. The color combination of the cable is red, white, and black (CBL038). This color-coding should match the labeling in the J Box, as well as the color-coding used in the tank probes. The pump strokes, probes, and return flow sensor should have lead wires installed that correspond to this color code, thereby simplifying field installation. Lead wires inside the sensor housings can be connected using junction blocks.

Important:

When wiring the sensors, ensure that the shield does not touch the housing of the sensor, as this will result in a ground loop and may cause noise problems in the system. Also run tank wiring underneath tank gratings, and neatly tie the wiring to the bottom railings around the tanks. Sensor wires must not be run in the same cable trays used for high voltage because this can lead to abnormal voltages being induced into the signal cables (due to magnetic coupling), and a reduced level of safety for rig personnel.

Note:

Connect the wiring according to the color and sensor definitions as outlined on the J Box circuit board.

Once all connections have been made, any strain relief must be tightened so that a firm tug on the wire does not cause it to slip through the strain relief. At this point, the J Box lid may be secured, as no further installation is required.

Unused tanks must be shorted out ("jumpered") with a small wire between the white (W) and black (B) connections on the terminal J Box. If a flow sensor is not being used, the "flow" channel in the PVT J Box should also be "jumpered". A red PVT J Box plug (part #CON237) should be used for each unused tank and the flow, to preserve the integrity of the J Box seal.

Cable Installation

Interconnecting cables provided with the system are equipped with high-quality, military-style connectors. These connectors can provide many years of trouble-free performance, if properly installed and cared for. When running cables between system components, it is important that the free end of the cable be protected from mechanical abuse that can occur from being dropped, etc. It is also critical to protect the connector from water, dirt, oil, etc., so use cap protectors. It should reach its destination in a clean, dry, and undamaged state.

Note:

When running the system cables, do not use excessive force to pull the cables through openings in the rig: this can destroy the outer jacket of the cable.

Cables should be run in dry, out-of-the way locations. The cables are high-quality products with good resistance to oil, chemicals, sunlight, water, and temperature extremes; however, it is recommended that the cables be thoroughly cleaned between jobs to extend their lifespan.

If connector ends get dirty during installation, wash them with an electrical cleaner before they are assembled. The cleaner is available in aerosol cans (with a nozzle) and should be included as part of the field service equipment. Use an electrical contact cleaner that is safe for plastics.

Note:

Prior to assembling the connector, apply a small amount of dielectric grease to one half of the connector. This will help seal the connector and prevent the pins from corroding.

3 System Calibration

The Pason PVT is designed so that calibration is straightforward. No tools or meters are required. All span and zero adjustments are made at the display unit, using panel switches. Calibration factors are stored in non-volatile memory within the system, so if the unit is powered down, you do not have to recalibrate.

3.1 Calibration Mode

Note:

Calibration should only be performed by a Pason representative.

To calibrate the Pason PVT, install the dummy 4-pin military connector into the terminal marked Calibrate System on the underside of the PVT monitor.

Note:

The dummy connector can be thought of as a key, as it prevents unauthorized access to the system calibration routines.

If the dummy connector is lost, simply take a short piece of wire with the ends bared to the conductor and bend it into a “U”. Insert the ends into the two pins on the right-side of the calibration connector’s plug, achieving a calibration mode signal of 8888.

Once in calibration mode, the panel switches and displays take on different functions. The PUMPS display indicates the channel being calibrated. To change the channel, use the PUMPS ZERO switch to increase or decrease the channel shown on the PUMPS display.

Once you select the proper channel, use the **TRIP ZERO** switch to increase or decrease the reading for that particular channel. The speed at which the reading changes can be controlled by the FILL/ACCUM. switch (this can be thought of as a fast or slow control). When this switch is in the FILL position, the display changes quite quickly while in the ACCUM. position the display slows down considerably, thereby allowing the reading to be stopped at the exact desired location.

To further simplify calibration, the system is programmed so that the channel being calibrated shows up on the display that corresponds to that channel, while non-related displays are blank. The channel number that corresponds to the trip tank span is shown on the PUMPS display. In addition to the switches described above the flow, the ZERO switch is used to set the flow zero point.

3.2 Calibrating the Volume System

Calibration of the volume system is done on a tank-by-tank basis. The basic procedure is as follows:

1. Multiply the length, width, and height of the tank together to arrive at the tank volume.
2. Pull the probe float all the way to the top of the tank and secure it.
3. Set the corresponding reading on the PVT monitor to match the calculated tank volume.

Note:

The height measurement is obtained by *measuring the distance from the bottom of the tank to the center of the float*; therefore, if the tank grating has been used as the "top" of the tank, it is necessary to subtract half the thickness of the float from this measurement to arrive at the true tank height. It is not necessary to compensate for the probe zero offset error when calculating tank volumes, because the Pason PVT software automatically adds the correct amount to the tank volume to compensate for this.

3.3 Calibrating the Flow System

To calibrate the flow system follow this procedure:

1. Set the system to calibrate mode (see Calibration Mode on page 15).
2. Use the **PUMP ZERO** switch to select channel 10 (Flow).
3. Place the flow paddle arm in the bottom position.

Figure 2: Flow paddle arm in the bottom position (zero flow)

4. Press down the **FLOW G/L ZERO** switch. The flow zero point has now been established.

5. Set the flow span by holding the flow paddle arm in the top position (maximum flow).

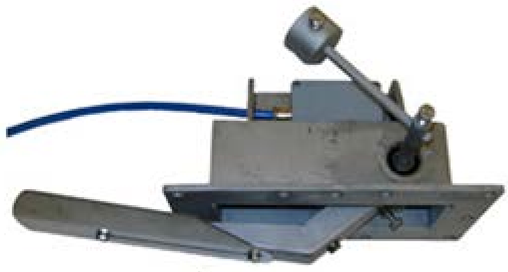

Figure 3: Flow paddle arm in the top position (maximum flow)

6. Use the **FILL/ACCUM. ZERO** switch to set the span to the desired value. The flow span is usually set to read from 0 to 100, however, this may vary depending on the application.

Note:

The flow zero point must be set before the flow span is set.

3.4 Calibrating the Trip System

Calibrating the trip tank is identical to calibrating the main mud tanks

1. Select channel 9 on the **PUMPS** display.
2. Pull the probe float up to the top of the tank and secure it in this position.
3. Measure from the bottom of the tank to the middle of the float to find the tank height.
4. Calculate the tank volume (L*W*H).
5. Use the **FILL/ACCUM. ZERO** switch to set the trip tank reading to the calculated volume.

Note:

It is not necessary to compensate for the probe zero offset error (0.558 ft) when calculating trip tank volume. The system automatically calculates and compensates for this.

At this point, set the trip high alarm level.

1. Use the **PUMP ZERO** switch to select channel 11.
2. Use the **FILL/ACCUM. ZERO** switch to adjust the setting until it reads about 1.25 BBLs less than the trip tank volume (full). This will allow the operator a few seconds to reach the fill pump switch.
3. Remove the dummy connector from the Calibrate System terminal, thus returning the system to Run mode. This completes the calibration process.

Note:

You may have to reset the string weight in the **Weight on Bit Trace** on the DHC.

Calibration Channels

Setting	Channel on PVT 1.03 and lower	Channel on PVT 2.0 and higher
Tanks 1-8 Span Setting	1-8	1-8
Trip Tank Span Setting	9	9
Flow Zero and Span Setting (see note below)	10	10
Trip Tank High Alarm Setting	11	13
Decimal Places (CDN)	12	14
Horn Sleep Feature (On, Off)		11
Horn Sleep Delay		12

Table 1 Calibration Channels

Note:

Set the Flow Zero before Flow Span; Use the FLOW G/L ZERO switch to set the flow zero point.

Calibration Switches

Switch	Function in calibration mode
P1/P2 - Zero Switch	Select the channel to be calibrated
Fill / Accum. Zero Switch	Increase/decrease settings
Flow G/L Zero Switch	Set the Flow Zero Point (Channel 10)
Fill / Accum. Switch	Adjust the rate of change (fast/slow)

Table 2 Calibration Switches

Note:

The selected channel is displayed on the PUMPS display.

4 System Operation

4.1 Operating the Volume System

The volume system consists of:

- Eight tank switches
- A volume alarm switch (to enable/disable the alarm)
- An alarm level setting control
- A volume/gain-loss switch (to select which function to display)
- A gain-loss zeroing switch
- A warning light to indicate that the alarm is disabled
- A flow and volume alarm “snooze” feature (PVT versions 2.0 and higher)

The eight tank switches are used to sum up the active tanks in the system. They are also used to isolate individual tanks or to remove a tank from the active system, if required.

The volume alarm is set to indicate gain/loss readings that exceed the limit. The alarm level setting should reflect the maximum allowable gain. Fluid gains are usually exponential in nature (as a result of gas rising in the wellbore), while fluid losses are generally linear in nature and therefore not nearly as critical. For example, on a 13,123 ft. hole, if 1 BBL of gas is forced into the wellbore (at the bottom), an alarm setting of 2 BBLs will detect a problem when the gas bubble reaches about 6,562 ft. However, if the alarm is set at 4 BBLs,the gas bubble will rise to a depth of 3,280 ft. before an alarm is triggered. This represents a 50% difference in warning time and clearly demonstrates how critical the gain setting can be.

Analysis of fluid losses shows that alarm settings are far less critical. For example, if a rig’s mud system contains a total of 628.9 BBLs of mud, an alarm setting of 0.5 BBL triggers the alarm to go off when 0.5% of the total fluid has been lost. And an alarm setting of 1 BBL triggers an alarm when 1% of the total fluid has been lost. Clearly, the difference between these two figures is not very significant.

The VOLUME/GAIN-LOSS switch is provided to allow the operator to display either totalized mud volume or volume gain-loss. The volume alarm is active regardless of which position this switch is in. During normal operation, this switch should be in the gain-loss position, as this provides the most critical information.

The GAIN-LOSS ZERO switches are used to periodically zero the gain-loss reading. This is necessary if mud is added to the system, or if the reading has drifted down to the alarm level due to normal drilling operation.

Note:

The GAIN-LOSS ZERO switches only operate when the switch is set to the GAIN-LOSS position. This allows you to observe the gain-loss reading before zeroing it out.

The volume alarm switch on the left-side of the panel allows the alarm to be disabled when the mud volume is not stable enough for proper operation. When the volume (or flow) alarm is disabled, the panel warning light (LED) blinks to remind you to turn the alarm back on as soon as possible.

The volume/gain-loss readings are displayed on a 1”, 4-digit LCD (Liquid Crystal Display). The maximum volume that can be displayed is 5,031 BBLs, while the maximum gain-loss that can be displayed is ±628.9 BBLs.

If an alarm condition is present (volume), the horn sounds to indicate an alarm has occurred (volume or flow).

Note:

The red LED blinks when one or both alarms are set to OFF (VOLUME or FLOW).

The volume alarm “snooze” feature is available for RigComm compatible PVTs running firmware version 2.0 and higher. This feature allows you to temporarily mute the volume alarm. The PVT can be set to snooze the alarm for between 1 and 10 minutes. When the alarm is snoozed, “SLEEP” is displayed on the VOLUME LCD. For more information on the snooze feature, see DOCU196 PVT Alarm Snooze Quick Tips at help.pason.com.

Note:

The channel configuration was changed for PVT firmware versions 2.0 and higher. See Table 1 Calibration Channels on page 19.

4.2 Operating Flow System

The flow system operates in a manner very similar to the volume system. Flow is displayed as a percentage of full rather than as a volume.

Proper operation of the flow system requires some knowledge of the flow sensor (paddle) as well as some of the conditions encountered in the return flow system. The flow paddle consists of a paddle that rides on the surface of the mud and is attached to a shaft, which rotates a potentiometer, thereby producing a signal corresponding to shaft position. The purpose of the flow paddle is to produce a signal that is *related* to the amount of mud flowing in the return line. For example, if the pump rate is doubled, the reading on the monitor roughly doubles. The flow system doesn't give an exact value for the return flow system (affected by slope, temperature, viscosity, obstructions, etc.), but it establishes a relative number (benchmark) for normal flow conditions. This number may increase or decrease depending on variables such as viscosity or temperature, but if you are aware of these factors, you gradually get used to interpreting the data supplied by the flow system.

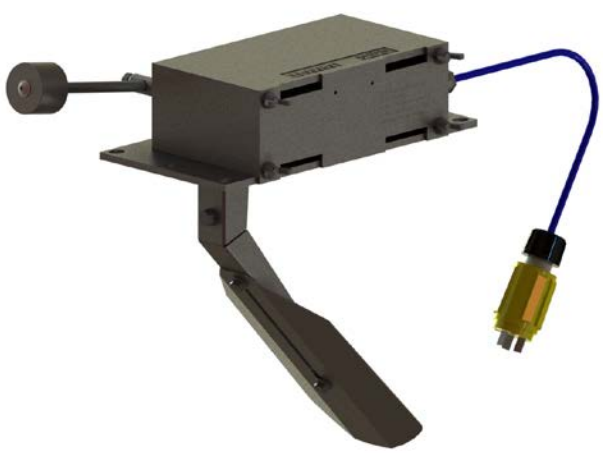

Figure 4: Pason flow paddle

The flow paddle is calibrated so that the output varies from 0 to 100% as the flow paddle moves from its bottom position through to its top position. The alarm level setting is a percentage of the full flow line as opposed to a percentage of the actual flow reading. For example, if a flow line is calibrated to read from 0

to 100% and the normal reading is 20%, then an alarm level of 5% will cause an alarm to occur at 15% or 25%, depending on whether an increase or decrease has occurred.

Setting the alarm level varies from rig to rig, as some rigs have very smooth flow lines, while others are quite turbulent. The alarm level should be set as low as possible without causing alarms due to normal turbulence. The flow alarm can be disabled so that operations such as tripping or adding pipe can be performed without causing the alarm to go off. When the flow alarm is disabled, the panel warning light blinks to remind the operator to turn it back on as soon as possible.

Note:

On some rigs with very flat flow lines or obstructions that cause “shaling”, it may not be possible to achieve a reliable flow reading. In cases like this, it may be better not to install the flow paddle at all.

The flow alarm “snooze” feature is available for RigComm compatible PVTs running firmware version 2.0 and higher. This feature allows you to temporarily mute the volume alarm. The PVT can be set to snooze the alarm for between 1 and 10 minutes. When the alarm is snoozed, “SLEEP” is displayed on the VOLUME LCD. For more information on the snooze feature, see DOCU196 PVT Alarm Snooze Quick Tips at help.pason.com.

Note:

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4.3 Operating While Tripping

The PVT can be used with a trip tank system (see the section below), or when used with the EDR, it can be used on a strokes to fill basis (see Strokes to Fill on page 26).

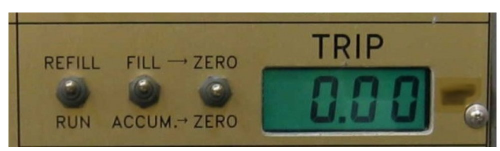
Trip Tank System

The Pason PVT trip tank instrumentation allows you to monitor three separate aspects of the trip operation: the trip tank volume, individual fills volume, and the total accumulated fill volume. First fill the trip tank to the specified level. Then you can monitor the actual trip tank volume by placing the REFILL/RUN switch in the REFILL position.

Once the trip tank has been filled, initialize the trip monitor. Assuming that this tank is the first tank of the trip operation, the initialization procedure is outlined in the following steps.

1. Place the **REFILL/RUN** switch in the RUN position.
2. Place the **FILL/ACCUM** switch in the ACCUM position.
3. Use the **ACCUM. ZERO** switch to initialize (zero) the ACCUM reading.
4. Place the **FILL/ACCUM** switch in the FILL position.
5. Use the **FILL ZERO** switch to initialize (zero) the FILL reading.

When the stands have been removed from the hole and a hole fill is required, the trip display shows the amount of mud being pumped into the hole. When the display shows that the required amount of mud has been pumped into the hole, the pump is shut off and the FILL ZERO switch is used to zero the FILL reading again. The quantity of mud that was pumped into the hole is retained by the system for addition to subsequent fill operations. The FILL/ACCUM switch can be switched over to ACCUM. at any time to see the total amount of mud that has been pumped down the hole.



If you wish to see the actual volume of the trip tank, you may place the REFILL/RUN switch in the REFILL position. However, don't do this while mud is being pumped down the hole. When the REFILL/ RUN switch is in the REFILL position, any change in the trip tank volume is not reflected in the total accumulated reading. This allows you to refill the trip tank during multiple tank trips.

Important:

During multiple tank trips it is important that the REFILL/RUN switch be placed in the REFILL position when refilling the tank. If this is not done, the amount of mud pumped from the main system into the trip tank will be subtracted from the total accumulated reading.

Forgetting to switch from RUN to REFILL during multiple tank trips should not be a problem because the only way to see the actual trip tank volume (when filling the tank) is to place the switch in the REFILL position. Conversely, forgetting to switch back to RUN when the tank has been refilled should not be a problem, as the only way to get a zero reading on the fill display is to have the switch in the RUN position.

In addition to the above features, the trip tank system is also equipped with high and low alarms. The low alarm is used to warn you that the trip tank level has decreased to approximately 1.44 ft. in height (not adjustable). If the alarm is triggered during a fill operation, this allows the fill to be safely completed without running the tank dry. The high alarm is used to warn the operator to shut the fill pump off to prevent overflowing the trip tank. The high alarm is based on volume and should be set during system setup by a Pason field technician. The high alarm is normally set to go off at about 1.25 BBLs before the tank is full, to allow the operator a few seconds to disable the fill pump.

Strokes to Fill

Fill strokes counts strokes until the PVT flow rises above a set threshold. FILL STROKES resets to zero each time the pumps restart, so it counts the strokes to fill the hole each time the pumps are run. TOTAL FILL accumulates the FILL STROKE to fill during the entire trip sequence. To set up count strokes to fill, follow these steps from the DHC:

1. Press **TOOLS**, then **PVT SETUP**. Toggle until the display shows FILL. This will allow the driller to see the number of strokes it takes to fill up the hole. FILL will be displayed in the TRIP window.
2. Press **TOOLS**, then **HOLE FILL**, and set the flow threshold, and zero the fill strokes.

FLOW THRESHOLDS represents the percentage flow reads when the computer stops counting fill strokes. The default is 4%.

FILL represents the number of strokes from the time the pump came on, until the flow percentage exceeds the flow threshold.

3. To view past FILL STROKES and TOTAL FILL, locate the traces on the DHC.

Note 1:

Running pumps other than to fill the hole will cause the system to function improperly. Unplug the sensor to a pump if it must pump to roll the pits.

Note 2:

Cumulative pump strokes on the PVT display continue to count all pump strokes. To see the CUMULATIVE STROKES TO FILL, look at the TOTAL FILL trace on the DHC.

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4. Trip the pipe.
5. Start the pump to fill the pipe.
6. The pump stroke for that fill will be displayed in the TRIP window, and on the DHC as FILL STROKES.
7. When FLOW exceeds the flow threshold, FILL STROKES will stop counting.
8. Stop the pump.
9. Trip more pipe.
10. Start the pump to fill the pipe.
11. The FILL STROKES display will be reset to zero and start counting.
12. When the flow percentage equals the flow threshold, the FILL STROKES displayed in the TRIP window will stop counting again.

4.4 Operating the Mud Pump System

Select the function to be monitored by using the SPM/TOTAL switch to select either strokes per minute or total strokes. Next, select the pump to be observed by using the P.1/P.2 switch.

The system monitors and keeps track of total strokes for both pumps, even when both pumps are running simultaneously. If it is necessary to zero a total stroke reading, select the total stroke function, and then select the desired pump. Use the corresponding ZERO switches to clear the reading.

The number of strokes per minute is continuously monitored for both pumps, and therefore no waiting period is necessary when switching from one pump to the other. The number of strokes per minute is calculated on a on a stroke-by-stroke basis. This means that the update time for strokes per minute (spm) is tied directly to pump speed. For example, a pump running at 30 spm will be updated every 2 seconds.

5 System Maintenance

5.1 Maintenance Warnings

This equipment has been approved for use Class 1, Division 2 areas.

Important:

Substituting components may impair suitability for Class 1, Division 2, thereby resulting in an explosion hazard. If you are not absolutely certain about the suitability of replacement parts, contact the manufacturer before proceeding.

Caution:

If the main display unit has to be opened for service, first disconnect the power and ensure the area is known to be non-hazardous. Failure to observe this precaution can result in an explosion hazard.
The main display unit of the system operates at line voltage (120 VAC), which constitutes a shock hazard. If it is necessary to troubleshoot the system with the power on, use extreme caution. Once the problem has been identified, remove the power. Do not attempt to replace or disconnect any parts while the power is on.

5.2 Troubleshooting

The majority of problems encountered in the field are related to damaged field sensor wiring or improperly installed/maintained cables and connectors. Sensors can also become faulty due to their placement and environment.

Troubleshooting the Volume System

If the volume reading on the display unit is erratic, or reading too high/low and the rest of the system appears to be functioning properly, the problem is likely a broken or shorted sensor wire. Use the traces on the DHC to determine where any historical spikes occurred.

Important:

Always check the data cable connection from the PVT to the J Box first. You should only see 3-4 threads.

Note:

The VOL/G/L switch should be set to the VOL function. If the display reads zero, start turning the tank switches on one at a time, and check to see if the readings are abnormal. This quick check often isolates the faulty tank circuit, thereby eliminating the need to check all the tank sensors and wiring. If one tank circuit gives abnormal readings, you can determine if the problem is in the sensor wiring, the probe, or is an internal system problem.

A quick way to determine if the problem is internal is to disconnect the faulty circuit (inside the J Box) and replace it with a known good circuit. For instance, if Tank #5 is giving problems, disconnect the wiring to Tank #5 and replace it with the sensor wiring from a tank that is working properly. Then return to the PVT monitor and see if the problem still exists. If this fixed the problem, check the wiring, sensor, and J Box.

If the problem still exists, check the sensor wiring. Following the wire from the probe to the J Box usually uncovers a damaged area on the wire. If no problem is apparent, try replacing the wire, since it may be faulty inside. If this procedure indicates an internal system problem, check the main signal cable and its connectors. If the connectors appear to be installed correctly (not loose), remove them, and check for any sign of moisture, corrosion, dirt, etc. If evidence of contamination is found, clean and lubricate the connectors. Replace the connectors and try the system again. If the problem persists, follow the cable from the PVT monitor to the J Box while looking for any signs of damage.

If only one tank circuit is acting up, the problem is probably due to probe/wiring troubles. If more than one tank circuit is acting up, the problem is probably the module, data cable, or PCB board. If readings differ between the DHC and the PVT, the problem is probably a faulty cable or module.

To replace the electronics module:

1. Disconnect the power.
2. Remove the 16 face plate screws.
3. Remove the face place using Tool 132 (PVT Face plate pry bar).
4. Locate the module in the upper left corner of the box, and then remove it by disconnecting the three d-sub connectors using a small screwdriver. Also remove the screws holding the module in place.
5. Switch out the module, ensuring all screws are tightened.
6. Replace the leads.
7. Turn on the power and try the unit.

If the unit still doesn’t work, return it to Pason for inspection.

Troubleshooting the Flow System

If the flow display reading is abnormal and the rest of the system seems to be working properly, the problem is likely in the sensor wiring or sensor. A quick way to test the complete flow system from the J Box to the sensor is to connect the flow wiring to one of the tank-input connectors (in the J Box). The trip tank is the best choice as the FILL ZERO switch can be used to establish a zero point.

After hooking up the wiring, check the PVT monitor to see if the display shows a reasonable figure. If not, the problem lies in the field wiring or the sensor. As a last resort, return to the PVT monitor and ensure the display is functioning properly. If not, the problem is in the sensor wiring. Check the wiring from the flow sensor to the J Box and repair or replace it. The system should work. If the problem is found to be an internal one, go to Troubleshooting the Volume System on page 28 to determine the next course of action.

Troubleshooting the Mud Pumps System

Pump strokes are sent from the EDR (if the pump stroke sensors are connected to the EDR). If strokes are present on the DHC but not on the PVT monitor, check the 4-pin connecting cable (CBLASS002).

Note:

Pump strokes can come from either the PVT or the EDR. If the strokes are coming from the EDR and are not showing up on the PVT, there could be a communications problem between the two systems. If the strokes are coming from the PVT (mechanical switches) the problem could be the wiring, J Box, or PVT.

If the problem is found to be an internal system problem, use a mechanical stroke counter to verify that strokes are being recorded correctly.

General Troubleshooting

If the system is acting up, follow these steps to isolate the problem:

1. Ensure that the unit is plugged in and that the power outlet is working.
2. Inspect the AC plug for loose wiring or corrosion.
3. Check the power to the J Box by hooking up a voltmeter between the circuit board mounting plate and the binding post on the circuit board (marked V+). The voltmeter should read approximately 14.3 volts. If the reading doesn't match, the

main signal cable should be inspected for damage. If any problems are found with the cable it should be repaired or replaced, even if no visual damage is evident. Also check for loose or dirty connectors.

4. Return to the J Box and repeat the power test (If the results are still not correct, the problem is likely with the power supply in the main display unit.)
5. If the system does nothing when plugged in, the problem is most likely a blown fuse. There are two fuses in the system. The first (½ amp slo-blo) protects the transformer supply, and the second (2 amps) protects the horn and the heater. If the system is completely dead, then the ½ amp fuse is most likely blown. To replace the fuse, **DISCONNECT THE POWER** to the system and remove the face plate. If the new fuse blows after the power is turned back on, then the cause must be isolated. **DO NOT SUBSTITUTE A LARGER FUSE**, as doing so leads to larger problems.
6. Test the power outlet. The voltage measured at the outlet should be between 110 and 125 VAC. If this isn't the case, corrective action must be taken. If the power outlet is functioning properly, the problem is likely in the power supply. Disconnect the main power and remove the display unit face plate. Replace the power supply. Temporarily replace the face plate, using 2 or 3 screws and try the system again.
7. If the problem is still present, remove the face plate and replace the electronics module.
8. If the system is still not working, return it to Pason for further testing.

Troubleshooting Summary

The best place to start troubleshooting is at the J Box, where the problem can be isolated to either the field side or the system side of the J Box. Problems on the field side of the J Box are easily narrowed down by substitution of known good parts or simulators. Problems on the system side can usually be broken down into three problem areas: power supply, electronics module, or data cables. If only one function is acting improperly, the problem is likely an electronics or cable problem. If the whole system is acting up, the problem is likely a power supply problem. If in doubt as to what component is at fault when servicing the PVT monitor, replace the power supply first. If this does not fix the problem, leave the new power supply in place and replace the electronics module. This is the safest method to use, as it prevents new parts from being damaged by old parts that are malfunctioning.

Note:

Problems with the display board are usually self-evident (e.g., missing display segments etc.).

Remember that the majority of problems are on the field side of the J Box, so ensure that this part of the system is tested before opening the PVT monitor. It is also important to eliminate any possibility that the power cord, power connector, or power outlet is causing the problem before opening the PVT monitor.

Note:

Take proper precautions when opening the PVT monitor, as there is sufficient voltage (120 VAC) to constitute a shock hazard.

When replacing the face plate, be sure to tighten the screws down evenly and in a random pattern. Failure to do this could cause damage to the gasket or the face plate, resulting in a box that leaks.

If the general procedures outlined in this section are followed, troubleshooting the system should be a relatively straightforward task. It has been shown that an intimate knowledge of the internal electronics is not necessary for field servicing.

The most common problems with the PVT are as follows:

- The 4-pin cable is screwed into the 5-pin connector (P1/P2) on the PVT.
- The data cable is not screwed in all the way, or it’s cross-threaded.
- The Woodhead connector is missing the ground pin.
- There’s electrical interference between the PVT and DC cables strung too closely to the PVT.