

ELECTRONIC MEMORY RECORDER (EMR) GAUGE STANDARD SERVICE PROCEDURE



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Private

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DESIGN

1.1 Introduction of Tool

The Electronic Memory Recorder (EMR) Gauge is widely used for well testing as it provides time-based downhole pressure and temperature data during flowing or shut in condition for reservoir monitoring and production forecast.

Common type of pressure and temperature surveys services provided by Dimension Bid (M) Sdn. Bhd. associated with EMR Gauges, specifically PPS28, are Static & Flowing Gradient Survey (SGS & FGS), Pressure Build Up (PBU) Survey, Injectivity and Injection Fall Off Test (IFO).



1.2 Tool Specification

Mechanical	
Outside Diameter	0.75"(19 mm)/1.0"(24.5 mm) / 1.25"(31.75 mm)
Overall Length	21" (533.4 mm)
Housing Material	Inconel 718 / Stainless Steel 17-4
Communications	USB/RS232
Environmental	
Service	H2S service
Pressure Ranges	Up to 20,000 psi
Pressure Accuracy	±0.02% (full scale), ±0.015% (full scale) Typically
Pressure Resolution	0.01 psi
Over pressure Capacity	105% (full scale)
Pressure Drift	<1 psi/ year
Temperature Rating	150°C (302°F), 177°C (351°F)
Temperature Accuracy	±0.2°C
Temperature Resolution	0.01°C
Over Temperature Capacity	110% (full scale)
Electronic	
Sensor Type	Quartz
Power Source	1 or 2 AA or C lithium packs
Data Set Contents	Time / pressure / temperature
Memory Capacity	1,000,000 data sets standard
Sample Rate	0.1 second to 18 hours per sample

1.3 Review Client Requirement

1. Finalize job program with client. Confirm on the objective, station stop depth and sampling rate.
2. Gather the following information:
 - a. H2S & CO2 content
 - b. BHT & BHP
 - c. WHP and MEWHP
 - d. Tubing Tally
 - e. Well Survey: Depth, Deviation, Maximum Dog Leg(s)
 - f. Casing/ tubing depth, minimum restriction, Casing size, Weight
 - g. Well History, Schematic, Datum Depth, TVDBDF to TVDSS or Mean sea level to BDF
 - h. Latest well test result for tool lift calculation prior to FGS.

1.3 Confirm Requirements can be Met

1. Confirm the operation is within tool specifications.
2. Inform the client on the limitation of the tools, equipment, well condition and etc.

1.4 Generic Main Tool Planning

1. Please discuss with FSM on the availability of the equipment.

PREPARE

2.1 Pre-Mobilization

1. Operation Engineers will notify upcoming jobs from certain clients. They will forward the work program to CHS Coordinator (CHSC).
2. CHS Coordinator will follow up with the LOI and issue an instruction to start preparing the personnel and equipment movement. Tools and equipment required for mobilization are identified based on client's work program.
3. Once the LOI is received, CHSC will appoint FE in-charge for the dedicated job to prepare tools and equipment.
4. FEs and Lab Technicians are responsible to perform thorough inspection on the EMR and any other equipment. For the EMR gauges the specific operating procedure (SOP) must be followed. All bench test and chamber test result must be properly recorded and documented.
5. Lab technicians will produce the checklist, which then will be verified by the FE in-charge. The tools and equipment will be handed over to Material Coordinator (MC) for shipping arrangement. Lab technicians will liaise with MC regarding the shipment.
6. FE in-charge should compile all the input data related to the job.

2.2 Assembling EMR Components

1. Collect the components of the EMR Gauge
 - a. PPS28 memory gauges
 - b. USB Communication Box
 - c. Crossover for tandem gauge runs
 - d. Battery Tester
 - e. Lithium Battery Pack
 - f. O-ring grease
 - g. O-ring consumable
 - h. Hand tools

2.3 Downhole tools

2.3.1 Prepare PPS28 Gauge

1. Ensure the gauge has completed maintenance process and tagged as **READY TO GO**.
2. Perform visual check outside housing for any damage, bending, dents, or scratches.



Good Condition



Bad Condition

3. Visual check the gauge receptacle part; either 4-pin or 6-pin.
4. Remove the battery housing and inspect for any visible damage on communication port pins.
5. Avoid rotating the electronic section with respect to the sensor.
6. Inspect the O-rings conditions. Replace if necessary.
7. Verify the tools and the components herein as in **Figure 1** are thoroughly cleaned from dirt and grease.
8. Use air gun or WD-40 and spray the sensor port to avoid any clog.

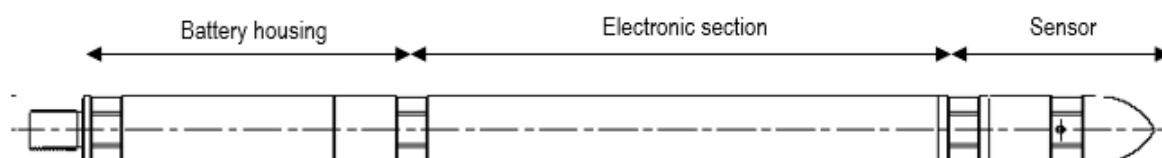


Figure 1. EMR Gauge Main Parts

2.4 Downhole accessories

Under normal circumstances, no extra downhole accessories are required for EMR survey job. However, certain surveys, such as PBU and IFO, will be conducted with longer period of time and require the gauges to be left downhole till the survey completed. This made the utilization of instrument hanger necessary to hang the EMR gauges at the selective and landing nipple.

Instrument hanger will be set with the running tools with specific completion profile and will be retrieved with the pulling tools. Type of instrument hanger that currently available in Dimension Bid is X/XN lock mandrel. This type of instrument hanger is set by X-Line running tool and can be retrieved by GS pulling tool.

2.4.1 Instrument Hanger, X/XN-Lock Mandrel

1. Perform visual check for any damage especially on the key profile.
2. Make sure the tool, figure on the right, was tested and functioning well.
3. Ensure tool inspection was done as per SLS maintenance manual.

2.4.2 Shock Absorber

1. Perform visual check outside housing for any damage.
2. Make sure it is in good shape and functioning well.
3. Ensure tool inspection was done as per SLS maintenance manual.

2.4.3 X-Line Running Tool

1. Perform visual check for any damage especially on the key profile.
2. Make sure the running tool was tested and functioning well.
3. Ensure tool inspection was done as per SLS maintenance manual.

2.4.4 GS Pulling Tool

1. Perform visual check for any damage especially on the key profile.

2. Make sure the pulling tool was tested and functioning well.
3. Ensure tool inspection was done as per SLS maintenance manual.

2.5 PPS SmartView Software

2.5.1 System Requirement

1. Required software: PPS SmartView V6.1
2. Before installing the SmartView software, computer system should be ready with operating systems no older than Windows 2000.

2.5.2 Software Installation via CD-ROM

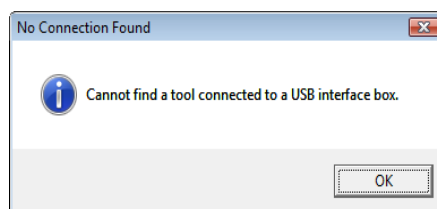
1. Insert the SmartView software CD into CD drive.
2. To view the CD contents, click on *My Computer* icon and choose the Compact Disc icon.
3. Double click the *SETUP.EXE* icon to launch the SmartView installation.
4. Follow the instructions to finish the installation process.

2.5.3 Software Installation via Downloaded File

1. Go to PPS web site (www.pioneerps.com). Click on *Support* menu, and select *Downloads*.
2. Enter the required user name and password provided by PPS to access to the files.
User name: ppsGauges
Password: #pps3744
3. Download the compressed file and extract it to hard drive.
4. Double click the *SETUP.EXE* icon to launch the *SmartView* installation.
5. Follow the instructions to finish the installation process.

2.5.4 Launching SmartView Software

1. Click on PPS SmartView shortcut from the Pioneer Petrotech Services Inc\PPS SmartView program group.
2. By default, the software will automatically detect the USB interface box connected to the computer and the type of tool connected to the USB interface box.
3. After about 15 seconds, if no tool was detected or immediately, if no USB interface box was detected, the following message will be displayed.



2.6 Operational check

2.6.1 Inspecting Gauges



To ensure gauges are functional, a regular inspection (Bench Test) is necessary before

each operation.

1. Connect a PPS USB communication box interface to the gauge as in **Figure 2** and a computer to download data and check if the record data is normal.



PPS28 gauges may have a different receptacle (4-pin or 6-pin), please make sure proper plug on the USB communication box is used for connection and the red dot is aligned.



Figure 2. USB communication box connected to gauge

2. Run PPS SmartView by repeating steps 1-3 in [2.5.4](#).
3. Use *Diagnostics* in *Options* tab to test the gauge and click *Start* button (**Figure 3**).

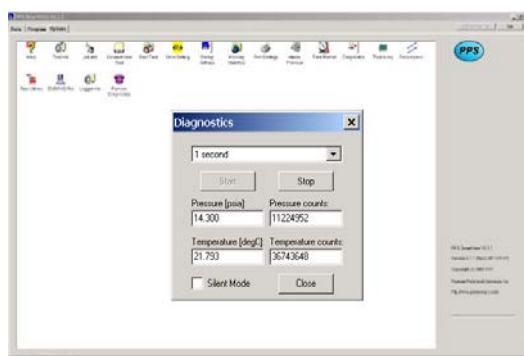


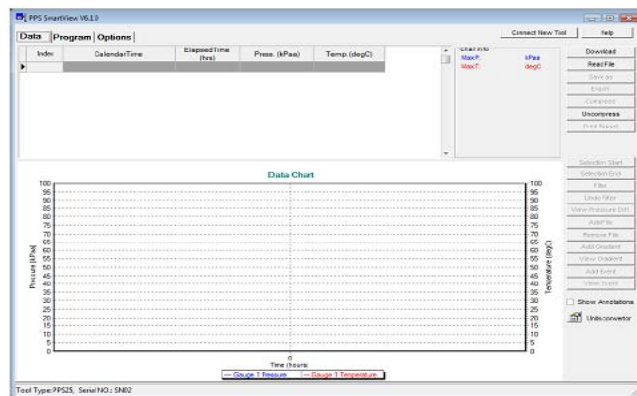
Figure 3. Diagnostics Tab



The pressure and temperature reading should be within acceptable range of atmospheric pressure, 14.7 psia \pm 5 psia, and ambient temperature.

2.6.2 Programming Gauge

1. Connect a PPS USB communication box interface to the gauge as in **Figure 2** and a computer.
2. Repeat 1-3 in [2.5.4](#).
3. The SmartView main window shown below will be displayed next.



4. Ensure the displayed tool type and tool serial number matched with the connected gauge.
5. Click the *Program* tab on the top side of the window to switch to Program page (**Figure 4**)
6. Insert the desired sampling rate and survey duration depending on the job program.

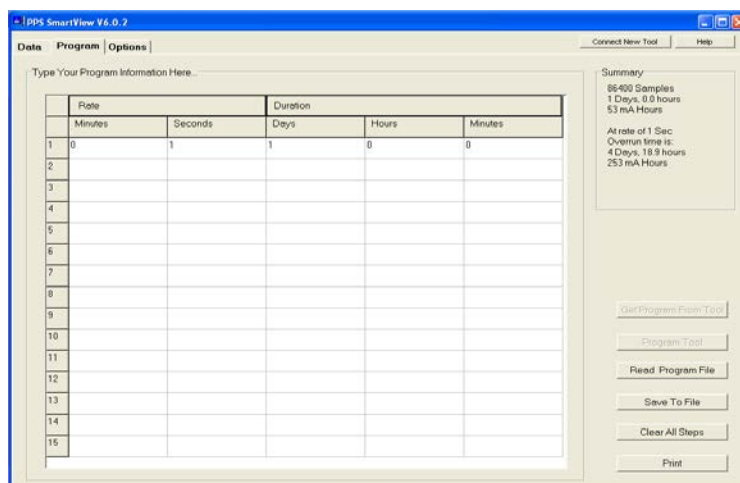
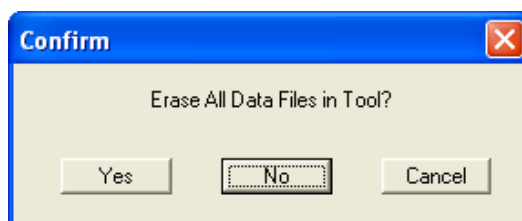


Figure 4. Program page

7. Click *Program Tool* and choose *Yes* when a confirmation dialog box below pop-up in order to clear all previous jobs from the gauge memory. Alternatively, click *No* to program the tool and keep all the data files inside.



8. The tool is successfully programmed and ready for the operation.

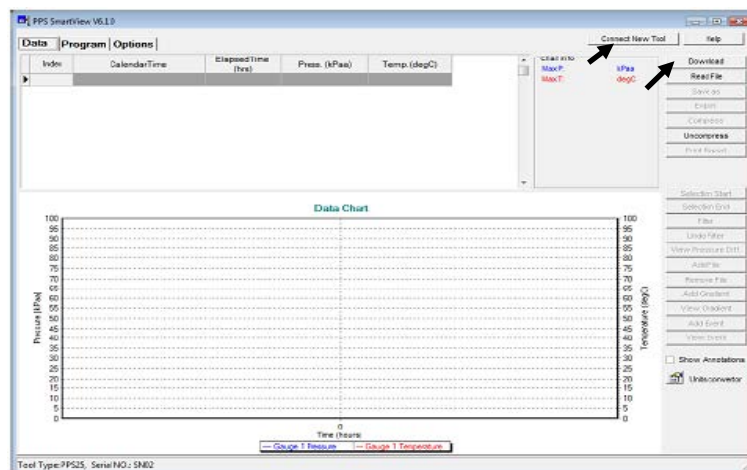


Make sure all the previous files have been downloaded before proceed with clicking Yes in Step 7 as this is an irreversible process.

 For more information about programming gauges, please refer PPS SmartView Manual.

2.6.3 Downloading Data

1. Connect a PPS USB communication box interface to the gauge as in **Figure 2** and a computer.
2. Repeat 1-3 in [2.5.4](#).
3. Click *Connect New Tool* at the top of displayed main window to ensure the tool is properly connected with laptop.



4. Click *Download* to retrieve data from tool and pressure and temperature data will be displayed next on the main window.
5. Click the *Save As* button to save the pressure and temperature file to a specified directory.
6. A message will pop up to notify once the saving process is completed.

2.6.4 De-passivate and Test Lithium Battery

1. Check battery consumption record with table in [5.8](#) to ensure it is sufficient for the job.
2. Perform physical check on the battery and record any abnormality in the tracking.
3. Plug in lithium battery into battery tester as below and the battery's LED will turn on.



4. Press the De-passivate button for 15 seconds or monitor until the displayed voltage stop increasing before releasing the button.
5. If the battery voltage is lower than 3.2V, repeat previous step.
6. Change the battery if the voltage reading is still below than 3.2V
7. If the voltage is above 3.2V, battery is *Ready to Go*. Store it properly.



DO NOT DE-PASSIVATE if the battery voltage is 0V. De-passivation of the battery must be done once a month for the battery in the storage or not to use for a long period.

2.6.5 Performing Bench Test

1. Remove the battery housing from the gauge.
2. Connect the lithium battery to the gauge. The battery has only one way of alignment with the gauge connector to minimize potential damage. Therefore, align the lug on the battery with the slot on gauge connector. Ensure the red dot is aligned.
3. Record the time the battery was plugged to the gauge.
4. Monitor the LED on the battery flash 16 times indicating the gauge has been initialized.
5. Complete a bench test for 10 mins, along with slight shock test using rubber mallet.
6. Carefully remove the housing and battery from gauge after bench test is completed.
7. Follow steps 1-6 as in [2.6.3](#) and check the pressure and temperature reading.
8. All bench test result must be properly recorded and documented.



The pressure and temperature reading should be within acceptable range of atmospheric pressure, 14.7 psia \pm 5 psia, and \pm 1 degC ambient temperature.

EXECUTE

3.1 Wellsite preparation

1. Verify all the equipment, tools, consumables, and accessories with pre-mob checklist/inventory upon arrival at wellsite.
2. Discuss with Wireline Supervisor regarding the job planning.
3. Confirm well and hole properties with Wireline Supervisor.
4. Review well history for any restriction/HUD encountered during the last well intervention.
5. Prepare the EMR gauge, lithium battery, and prepare PPS SmartView.
6. Prepare *Sequence of Events* worksheet accordingly as per clients' job program.
7. Perform tool lift calculation based on the latest well test result prior to FGS.
8. Review Job Hazard Analysis (JHA) and apply Permit to Work (PTW).



Tool lift calculation is mandatory prior to intervene a flowing well in a safe manner to prevent floating tool and tool blow-out.

3.2 Rig floor operational check

1. Make up the PPS28 gauge, used the crossover for tandem gauge runs.
2. Perform quick bench test as per [2.6.5](#).
3. Check for anomalies, reliability and consistency by comparing the data between the gauges.
4. Any tool-related problem encountered during bench test; inform base/lab technician and Wireline Supervisor immediately before proceed with PPS28 troubleshooting procedure.
5. Prepare problem report and request for tool or spares replacement if there is difficulty in solving the problem.
6. Otherwise, program the gauge as per client's program by following steps in [2.6.2](#).

3.3 Wireline Preparatory Work

To prevent any hiccup while performing EMR survey job, tubing clearance must be conducted to clear any obstruction until set depth.

1. Prepare wireline surface equipment.
2. Ensure master valve and crown valve is fully closed prior to opening tree cap.
3. Rig up PCE and pressure test up to client's requirement, i.e. 3000 psi for 15 minutes.
4. Make up wireline toolstring as per job program and zero at Tubing Head Flange.
5. Run in Hole (RIH) with Drift or Gauge Cutter to No-Go depth or top of plug (refer to well schematic). Record the No-Go depth and Pull out of Hole (POOH).
6. RIH with sinker bar to tag Total Depth (TD) or Held-Up Depth (HUD). Record TD and POOH. (This procedure is ONLY valid for a long string well).
7. For a short string well, RIH sinker bar to 3 meter below No-Go nipple.
8. Reconfirm the status of Sliding Side Door (SSD) by running shifting tool, if necessary.

9. Before perform Flowing Gradient Survey (FGS), conduct dummy run with appropriate toolstring configuration in flowing condition (weight and length), ONLY after performing Tool Lift Calculation. This is to ensure the toolstring weight is adequate enough to overcome the flowing upward force during operation.
10. Retrieve the Wireline Retrievable Surface Control Subsurface Safety Valve (WR-SCSSV) / Insert valve if the well is fitted with insert valve per standard procedure.

3.4 Toolstring Configuration

3.4.1 Standard Assembly

1. Wireline Toolstring (varies depending on TCC and dummy run)
2. Knuckle Joint
3. PPS28 Gauges (2 units in tandem)

3.4.2 Assembly with Instrument Hanger

1. Wireline Toolstring (varies depending on TCC and dummy run)
2. Running Tool
3. Instrument hanger; Lock mandrel with shock absorber
4. EMR Gauges (2 units in tandem)



Refer [Appendix 5.1](#) for figure.

3.5 General Procedures for Instrument Hanger

3.5.1 X-Line Running Tool

1. X Lock Mandrel and Subsurface Flow Control Device is pinned onto the Running Tool.
2. It is then placed in the Selective Position and run into the well via slickline.
3. When the tools are pulled up through X Nipple, the Locating Dogs engage the lower end of the Polished Packing Bore.
4. An upward strain on the wire causes the Running Tool to shift into Controlled Position, and then the Lock Mandrel and Running Tool are pulled up through the Landing Nipple.
5. The Lock Mandrel is then set by lower it into the Landing Nipple.

3.5.2 GS Pulling Tool

1. GS pulling tool is pinned with brass pin.
2. The tools are lowered into the well via slickline.
3. Stop RIH when the tools reach the set depth and latch onto the Lock Mandrel.
4. An upward jar on the wire causes the Lock Mandrel to shift upward and then the Lock Mandrel and Pulling Tool are pulled up.
5. The instrument hanger is now released and can be pulling out.

3.6 General Logging Procedures

Before the beginning of any work, ensure that all equipment comply with the client's Safety Standards. Conduct pre-job safety meeting with all personnel involved on location detailing program, pressure limitation, safety procedures, and personnel responsibilities.

3.6.1 Static Gradient Survey

The objective of Static Gradient Survey is to acquire the static bottom hole pressure and temperature for reservoir management purposes. This survey is performed under shut in condition, after the well had been stabilized for 12-24 hours (depending on client's requirement). A predetermined gradient depth is normally stated in client's work program.

Operation Procedures:

1. Shut in well for required duration prior to SGS.
2. Make up assembly to be run as in [3.4.1](#).
3. Repeat steps in [2.6.2](#) and record battery hook-up time. Make sure the housing is tightened by using appropriate spanner.



Try to initiate both gauges at once to ease the synchronizing files process when they are retrieved from the tools.

4. Record the atmospheric pressure and temperature for 10 minutes prior to RIH.
5. Open well and record SITHP for 10 minutes
6. RIH with average speed of 30 m/min to set depth.
7. Start log up and perform SGS at designated station stops as per jobs program.
8. POOH with average speed of 30 m/min to surface. Record SITHP for 10 minutes before bleed off and disconnecting gauges from toolstring.
9. Retrieve gauges and follow steps in [2.6.3](#).
10. QC the survey results. If the data is unsatisfactory and uninterpretable, discuss with Supervisor for possibility of re-run.
11. Rig down from well. Remove the fusible cap from the SSV and connect the Control Line to platform panel prior to handover to production team.



SGS must be conducted from Bottom to Top or POOH.

3.6.2 Flowing Gradient Survey

The objective of Flowing Gradient Survey is for data acquisition, subsurface surveillance, and gas lift optimization purposes. It is run in a stable flowing condition. A predetermined gradient depth normally stated in client's specific work program.

Operation Procedures:

1. Flow the well with specified choke size, as per job program, until stabilized prior to rigging up wireline and performing well test.
2. Monitor FTHP and PCP. Once stabilized, proceed with 4 hours well test.

3. Meanwhile, make up assembly to be run as in [3.4.1](#).
4. Repeat steps in [2.6.2](#) and record battery hook-up time. Make sure the housing is tightened by using appropriate spanner.



Try to initiate both gauges at once to ease the synchronizing files process when they are retrieved from the tools.

5. Record the atmospheric pressure and temperature for 10 minutes prior to RIH.
6. Open well and record SITHP for 10 minutes. Closely monitor and record FTHP, PCP, and flowrate throughout the survey.
7. RIH with 30m/min and proceed with carry out FGS at the designated station stop.
8. POOH with average speed of 30 m/min to surface. Record FTHP for 10 minutes before bleed off and disconnecting gauges from toolstring.
9. Retrieve gauges and follow steps in [2.6.3](#).
10. QC the survey results. If the data is unsatisfactory and uninterpretable, discuss with Supervisor for possibility of re-run.
11. Rig down from well. Remove the fusible cap from the SSV and connect the Control Line to platform panel prior to handover to production team.



FGS is usually conducted from Bottom to Top or POOH, but varies with client's request.

3.6.3 Injectivity Test & Injection Fall-Off Test

These tests are conducted in injector wells in order to determine the magnitude of reservoir parameters such as skin and permeability in the area around wellbore. Fall-Off Test is usually preceded by an injectivity test.

Operation Procedures:

1. Shut in well prior to set gauge and record Injection Pressure (ITHP)
2. Make up assembly to be run as in [3.4.2](#).
3. Repeat steps in [2.6.2](#) and record battery hook-up time. Make sure the housing is tightened by using appropriate spanner.




Try to initiate both gauges at once to ease the synchronizing files process when they are retrieved from the tools.

4. Refer to [3.5.1](#) prior to RIH running tool.
5. Open well and RIH 30m/min with the assembly to set depth (Landing nipple nearest to survey zone). Set the instrument hanger properly and followed by pull test.
6. POOH with speed 30m/min to surface.
7. Close well, bleed off pressure and break off tool.
8. Rig down wireline lubricator and BOP. Remove the fusible cap from the SSV and connect the Connect Line to platform panel.

Injectivity Test Procedures (subject to change, depending on client's job program):

1. Communicate with production team to re-initiate water injection and gradually increase injection THP until it reaches the specified TARGET RATE as indicated in the Work Program.
2. Continuously inject water for 4 hours.
3. Record the target rate, injection THP and injection rate at 30-minute intervals.

 *For step-rate test, the injection rate is increased to next injection rate, instead of constant injection rate, until complete testing for all specified rates.*

4. Stop injection and wait for 15 minutes with the gauges still at the set depth. Record the SITHP after 15 minutes.
5. Proceed with Fall-Off Test (if required). Otherwise, proceed with *Gauge Retrieval Procedure*.

Fall-Off Test Procedures (subject to change, depending on client's job program):

1. Communicate with production team to re-initiate water injection to desired injection rate for a minimum of 12 hours or TWICE of shut-in time.
2. Monitor and record the injection THP and injection rate for every 1-hour interval.
3. Shut-in water injection for 24 hours by closing the wing valve and manifold block valve on the injection flow line.
4. Record the SITHP at every 30 minutes for the first 4 hours and at every hour for the remaining 20 hours.

Gauge Retrieval Procedures:


1. Prepare Pulling Tool toolstring prior to Lock Mandrel + EMR Gauges retrieval.
2. Refer to [3.5.2](#) for Lock Mandrel retrieval procedure.
3. Retrieve gauges and follow steps in [2.6.3](#).
4. QC the survey results. Re-run if it is unsatisfactory and uninterpretable.
5. Rig down from well. Remove the fusible cap from the SSV and connect the Control Line to platform panel prior to handover to production team.

3.6.4 Pressure Build Up Test

The objective of Pressure Build Up (PBU) test is to determine reservoir parameters such as skin, permeability, and reservoir pressure. The data acquired after a producing well is shut in.

Operation Procedures:

1. Shut in well prior to set gauge.
2. Make up assembly to be run as in [3.4.2](#)
3. Repeat steps in [2.6.2](#) and record battery hook-up time. Make sure the housing is tightened by using appropriate spanner.

 *Try to initiate both gauges at once to ease the synchronizing files process when they are retrieved from the tools.*

4. Refer to [3.5.1](#) prior to RIH running tool.
5. Open well and RIH 30m/min with the assembly to set depth (Landing nipple nearest to survey zone). Set the instrument hanger properly and followed by pull test.
6. POOH with speed 30m/min to surface.
7. Close well, bleed off pressure and break off tool.
8. Rig down wireline lubricator and BOP. Remove the fusible cap from the SSV and connect the Connect Line to platform panel.

Build-Up Test Procedures (subject to change, depending on client's job program):

1. Communicate with production team to flow well with specified choke size for 24 hours.
2. Record the Flowing Tubing Head Pressure (FTHP), Flowing Tubing Head Temperature (FTHT), Production Casing Pressure (PCP), and gaslift injection pressure at every 30 minutes intervals for the first 4 hours.
3. Conduct well test for final 4 hours of flowing period.
4. Shut in well by closing the wing valve and diverter valve for 24 hours. Isolate gas lift and any chemical inhibitor. Record THP and THT every 30 minutes during shut in for the first 2 hours.
5. Prepare Pulling Tool toolstring prior to Lock Mandrel + EMR Gauges retrieval.
6. Refer to [3.5.2](#) for Lock Mandrel retrieval procedure.
7. Retrieve gauges and follow steps in [2.6.3](#).
8. QC the survey results. Re-run if it is unsatisfactory and uninterpretable.
9. Rig down from well. Remove the fusible cap from the SSV and connect the Control Line to platform panel prior to handover to production team.

3.7 Field Data Processing & Delivery



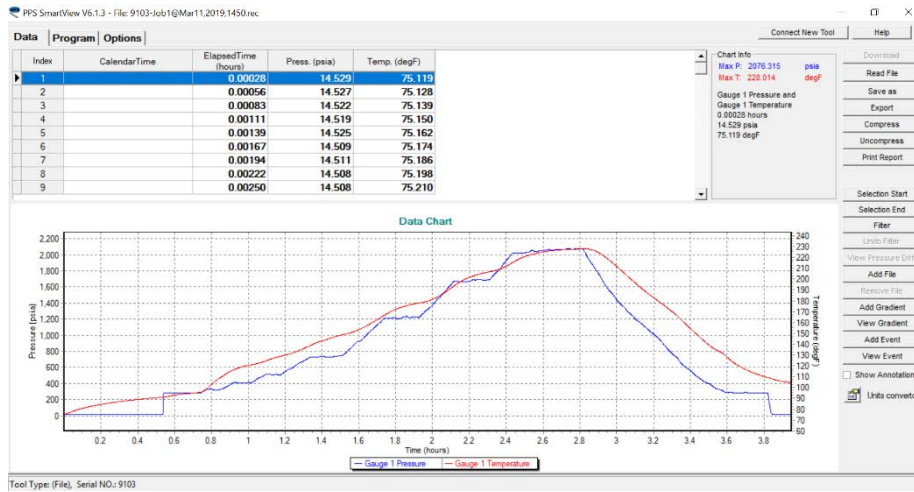
Data must be sending to Client and town within 24 hours after completing the survey.

3.7.1 Data Quality Check

1. Compare the THP reading on surface gauge with the reading recorded by EMR Gauge at lubricator which should be similar or close.
2. Check the data set of gauges covering the entire logging.
3. Each survey is conducted with 2 gauges for quality check. Pressure difference between both gauges must not exceed 5 psi during entire survey. Temperature difference between both gauges must not exceed 1 degC during entire survey.
4. Check for anomalies on plotted graph for both gauges. If found pressure and temperature spike, noisy or unexpected reading, please remark. Inform client if the anomalies jeopardize the data integrity.
5. Ensure tubing head pressure and production casing pressure reading should maintain pressure from start until the end of survey.

3.7.2 Quick Look Report from PPS SmartView

- Repeat steps 1-6 in [2.6.3](#) as the pressure and temperature data displayed as below.



Add Start Time:

- Go to *Options*, click on the *Start Time* icon or right click at the pressure and temperature table, and select *Start Time*.
- Insert values for Date and Time (battery hook-up time). Click *Add* at the following dialog window.

Add Job Info:

- Under *Options*, select *Job Info* and insert all necessary information related to the survey.
- Click *OK* once done.

Job Information

Well Information | Test Information | Gauge Information | Completion Information

Client Name:

Client Address:

Well Name:

Well Location:

Field/Pool:

Reservoir:

Well ID:

License Number:

Drilling Leg:

Formation Name:

Packer: Yes No

Tubing in Well: Yes No

Flow Path:

Well Fluid Type at Test Date:

Well Type:

KB Elevation [m]:

CF Elevation [m]:

Ground Elevation [m]:

Inside Diameter of Production Tubing [mm]:

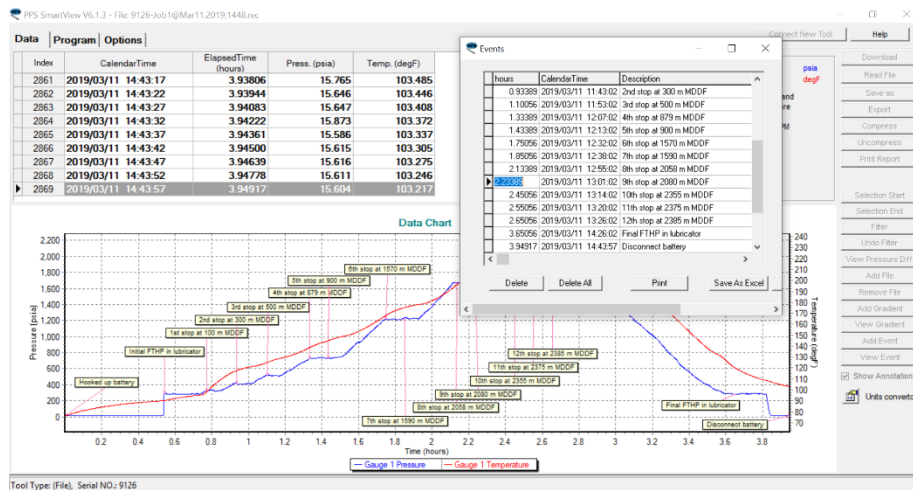
Inside Diameter of Production Casing [mm]:

Outside Diameter of Production Tubing [mm]:

Import SaveAsExcel OK Cancel

Add Event:

1. Click on *Data* to display the pressure and temperature window.
2. Click at the station stop time or station stop on the graph.
3. Click *Add Event* at right corner.
4. Enter the station stop and its respective depth. Once finish, click *Save*.
5. To display the added event on the graph, click on *Show Annotations*.
6. Drag and sort the annotation neatly prior to generating the report.



Units Setting:

1. Go to *Options*, click on the *Units Setting* icon or right click at the pressure and temperature table, and select *Units Setting*.
2. Ensure the correct units are selected. Click *OK*.

Units Setting

Pressure Units
 kPaa psia atma bara MPaa kga/cm2
 kPag psig atmg barg MPag kgg/cm2

Temperature Units
 DegC DegF

Decimal Places for Pressure/Temperature: 3

Depth Units
 Feet Metres

Time Units
 hours Minutes

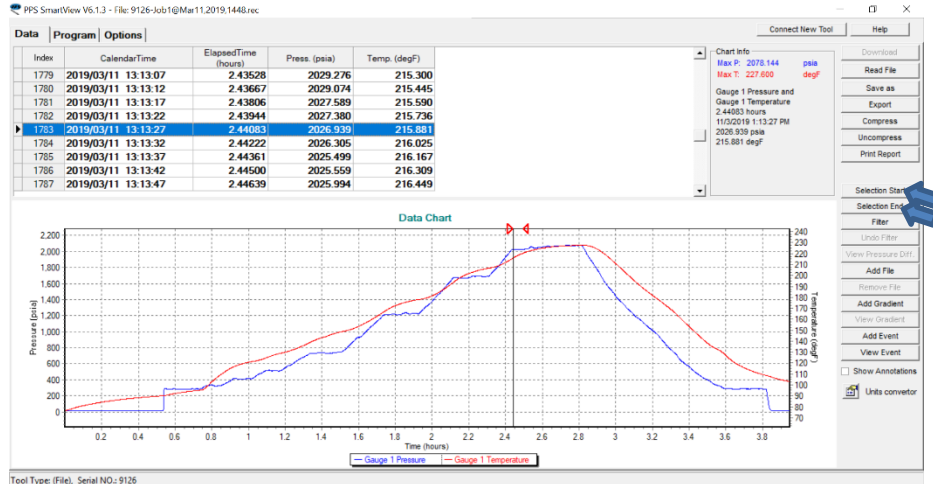
OK Cancel

Save as ASCII file:

1. Go to *Export* and select the *Text file with calendar time* format from the drop-down list.
2. *Save* the file to a specified directory.

Add Gradient for SGS & FGS (Optional and upon client’s request):

1. On the pressure data, click on the beginning of the first station stop and click *Selection Start*.
2. Then click on the end of the first station stop and click *Selection End*.



3. Click *Add Gradient* and fill the displayed window with survey type (flowing or static), measured depth, and true vertical depth with correct units.
4. Proceed with *Add Gradient with Avg. Value*.
5. Repeat steps 1-5 until the last station stop.
6. Click on View Gradient to display the pressure gradient curve as below. For SGS, liquid level estimation can be added by clicking on *Liquid Level*. Then click *Detect* followed by *Add*.



Generate Report:

1. Click *Print Report* and select *Cover Pages*, *Graph*, and *Data Table* (necessary).
2. The rest are optional.
3. Click *Save as PDF* to save it to a specified directory.

3.7.3 Data delivery without Interpretation

1. Refer to the recorded time in EMR running sheet for reference prior to key in all **sequence of event** during survey.
2. Key-in all the well info which includes well and reservoir zone name, location and date.
3. Export the raw data into ASCII format.
4. Key in the pressure and temperature data into **SGS/FGS Survey Table** provided.
5. Print and compile all raw data in ASCII file, sequence of event, well test result (for FGS) and Quick-Look Report in PDF format. Put them in one folder.
6. Wireline operator / FE must submit the survey data to Client Site Representative (CSR) and provide one (1) softcopy for CHS database.
7. Field Service Manager (FSM) must ensure the softcopy to be sent to CHS department once Wireline Operator returns to base or crew change.

3.7.4 SGS & FGS Data Delivery with Interpretation

1. Before proceeding with result interpretation, FEs must gather relevant well or reservoir data i.e. TVD data, reservoir gradient and datum depth, obtained either directly from client or from previous survey records if available.
2. Depending on the unit used for the survey, either *feet* or *meter*, open the specific SGS or FGS template.
3. Fill up the necessary information in the tab **Input**:
 - Survey Details
 - Gauge Details (Max pressure & temp for both gauges)
 - Completion Details
 - Gas-lift depth (if there is any)
 - Reservoir information (sand zone, datum etc)
 - Producing Zone Interval

Gas-Lift Depth

GLM	Depth (m MDDF)	Depth (m TVDBDF)	Depth (ft TVDBDF)
GLM #1	655.7	629.678	2065.975
GLM #2	1057.5	991.795	3254.079
GLM #3	1421.9	1321.784	4336.775
GLM #4	1813.1	1628.581	5343.375
GLM #5	2243.8	1869.713	6134.528

Gas-Lift Depth

GLM	Depth (m MDDF)	Depth (m TVDBDF)	Depth (ft TVDBDF)
GLM #1	655.7	629.678	2065.975
GLM #2	1057.5	991.795	3254.079
GLM #3	1421.9	1321.784	4336.775
GLM #4	1813.1	1628.581	5343.375
GLM #5	2243.8	1869.713	6134.528



Do not fill the grey cells as they will be calculated automatically.

4. If the well is producing from more than one zone, add the zones into *Producing Zones* table.
5. Continue filling up the *Gradient Stop & Gauge Data* table.

DESCRIPTION	MD			Pressure		Temp	
	ft-RKB	start	end	psia	degF	psia.	degF.
Lub	57	14:31	14:41	289.522	89.755	291.379	88.724
1st Grad Stop	262	14:43	14:48	308.380	104.041	311.753	105.848
2nd Grad Stop	656	14:51	14:56	335.765	122.580	339.132	122.444
3rd Grad Stop	1312	15:01	15:06	380.192	133.501	383.315	133.888
4th Grad Stop	2592	15:17	15:22	450.137	145.640	453.101	145.485

6. Update the *Directional Drilling Survey* by deleting the data in MD and TVD column, starting with cell K5 & L5 and replace them with new well's data. Do not delete anything from the black cell (column M).

Dir. Drilling Survey		
ft MDDF	ft TVDDF	ft MDDF
0.00	0.00	0.00
138.75	138.75	138.75
237.18	237.18	237.18
335.61	335.61	335.61

Dir. Drilling Survey

ft MDDF	ft TVDDF	ft MDDF
0.00	0.00	0.00
138.75	138.75	138.75
237.18	237.18	237.18
335.61	335.61	335.61

	m-MDBDF	ft-MDBDF	ft-TVD BDF	ft-TVDss
Datum depth (I-30/62E)	2586.20	8485.33	6106.60	5984.54
Survey Depth	2370.00	7775.97	5627.77	5505.71
Midperf Depth (I-30)	2407.00	7897.37	5709.04	5586.99
Midperf Depth (I-62E)	2621.00	8599.501	6183.91	6061.85
Reservoir Gradient	0.1733	psi/ft		

	9246		9084	
Fluid grad at survey depth	0.1913	Psi/ft	0.1903	Psi/ft
P @ surv. depth	1051.9800	Psia	1051.2270	Psia
P @ mid perf (I-30)	1067.5239	Psia	1066.6915	Psia
P @ mid perf (I-62E)	1158.348	Psia	1157.052	Psia
P @ datum (I-30)	1136.433	Psia	1135.601	Psia
P @ datum (I-62E)	1144.9477	Psia	1143.6513	Psia

- Take the average pressure gradient of the bottom most fluid column for *Reservoir Gradient*.
- For example, the bottom most fluid column in the table below is water. Therefore, the *Reservoir Gradient* was calculated by taking the average of pressure gradients that are within the range of 0.4 psi/ft, excluding any outliers such as the 0.636 psi/ft and 0.312 psi/ft.

9103			
Pressure psia	Temperature degF	Press Grad (Psi/ft)	Tem Grad. (Deg F/ft)
289.522	89.755		
308.380	104.041	0.092	0.069
335.765	122.580	0.070	0.047
380.192	133.501	0.071	0.017
450.137	145.640	0.078	0.014
452.954	148.239	0.090	0.083
474.777	151.710	0.093	0.015
496.163	155.303	0.099	0.017
527.969	159.055	0.095	0.011
572.484	161.978	0.089	0.006
580.751	168.624	0.404	0.325
689.887	195.020	0.429	0.104
880.720	206.923	0.420	0.026
1077.785	221.920	0.421	0.032
1092.535	226.424	0.636	0.194
1495.085	245.038	0.415	0.019
1504.567	249.046	0.410	0.173
1827.693	262.856	0.406	0.017
1834.682	263.847	0.609	0.086
1845.918	264.429	0.312	0.016

Water column, average dP/dZ = 0.402 psi/ft = Reservoir Gradient

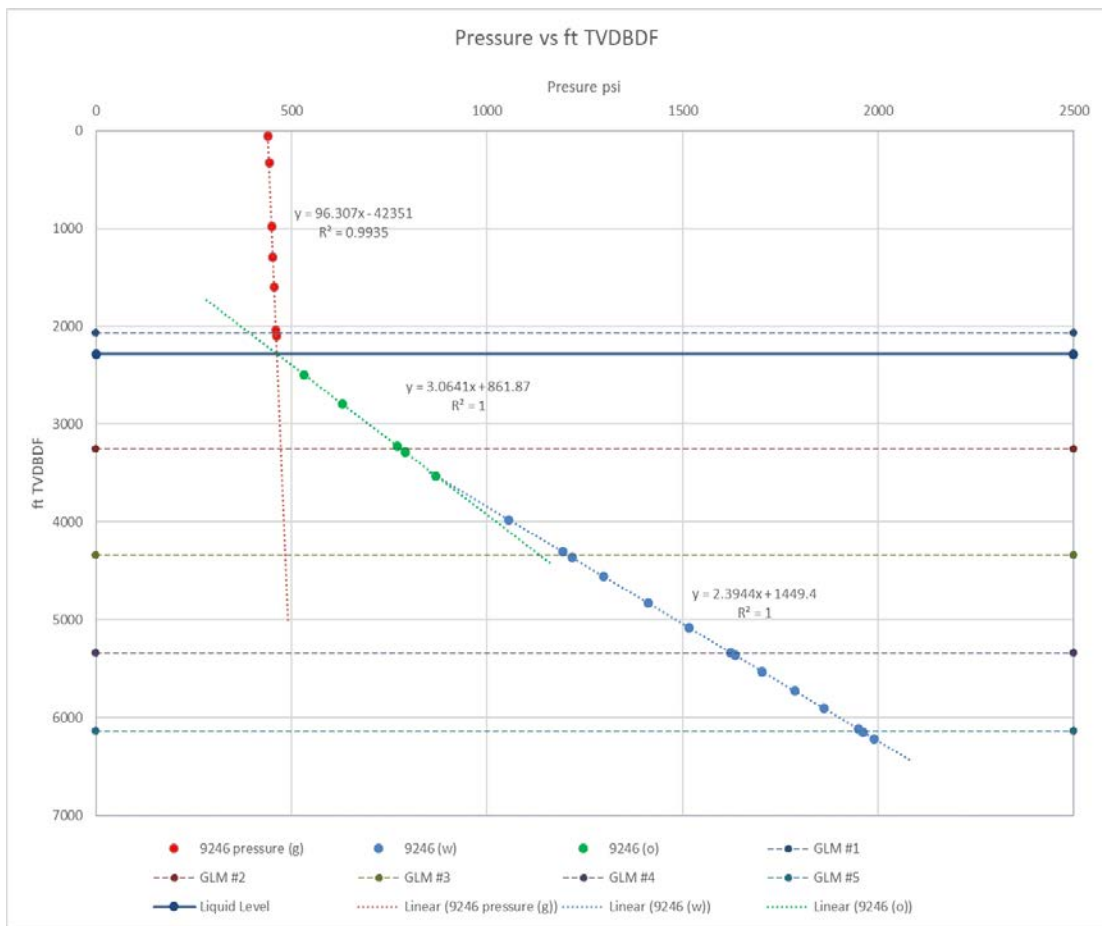
- The mid perf pressure and datum pressure were calculated using the following formula:

$$\text{Midperf Pressure} = (\text{Midperf Depth} - \text{Survey Depth}) * \text{Gradient @ Survey Depth} + \text{Pressure @ Survey Depth}$$

$$\text{Datum Pressure} = (\text{Datum Depth} - \text{Midperf Depth}) * \text{Reservoir Gradient} + \text{Midperf Pressure}$$

17. Solve for Liquid level in **Input** for SGS:

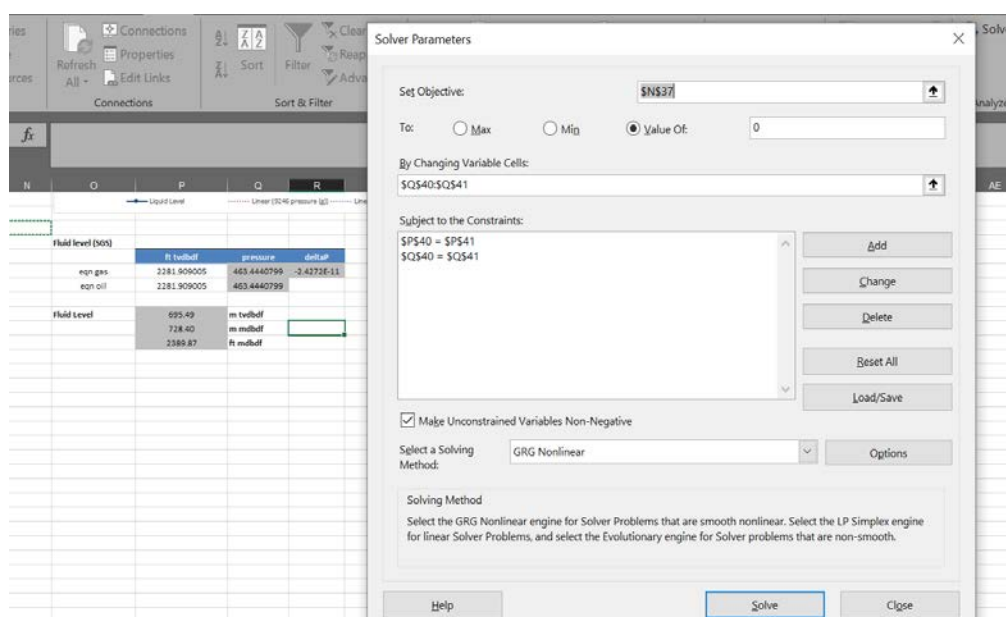
- Right click on the scatter plot and select the current pressure data range of a fluid phase based on their respective pressure gradient
- Gas: 0.1 psi/ft or less, Oil: 0.174 to 0.486 psi/ft, Water: 0.433 to 0.5 psi/ft
- Add trendline for those fluid phases. Display the equation and R-squared value on the scatter plot.
- Extend the trendline backward/forward to estimate the GOC & OWC.



- Insert the trendline equation into the **Fluid Level** section as below with **Pressure** as the x-variable.

Fluid level (SGS)		ft tvdbdf	pressure	deltaP
Private Copyright	eqn gas	2281.909005	463.4440799	-2.42721E-11
	eqn oil	2281.909005	463.4440799	

- Click on *Data* on the Excel's ribbon and select *Solver*.
- If the *Solver* is not already loaded, go to *File > Options*.
- Click *Add-Ins*, and then in the *Manage* box, select Excel Add-ins. Click *Go*.
- In the *Add-Ins* available box, select the *Solver Add-in* check box, and then click *OK*.
- Once loaded, the *Solver* command is available in the *Analysis* group on the *Data* tab.
- Launch *Solver Add-Ins* and set the following parameters.



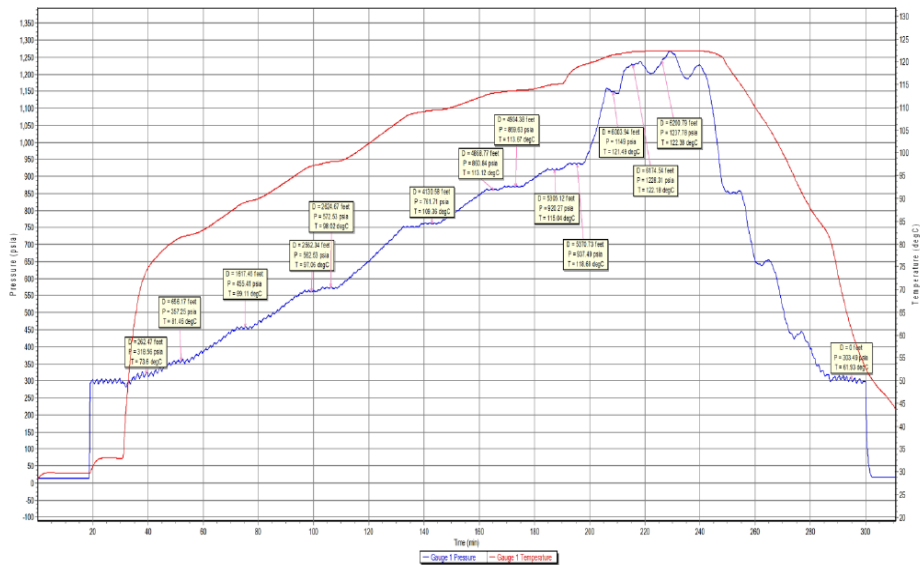
- Parameters: Set Objective: N37 (deltaP)
To the Value Of: 0
By Changing Variable Cells: Q40:Q41 (pressure)
Constraints: P40 = P41 (ft TVDBDF), Q40 = Q41 (pressure)
- Click *Solve* and *Keep Solver Solution*.

18. For FGS, no liquid level can be observed in flowing condition. Right click on the scatter plot and select the current pressure data range of a fluid phase based on their respective pressure gradient
19. The obtained liquid level for SGS will be appeared in *TVD* tab under the *Liquid level* section.
20. Update the *Graph* tab by selecting the respective range of a fluid phase based on their pressure gradient.
21. Ensure all the gas lift depth was displayed on the plot and pressure and temperature curves for both gauges are overlying each other (or within acceptable range of difference, ± 5 psi.
22. Copy and paste snapshot of Gauge data for both gauges in *Result Graph* tab.

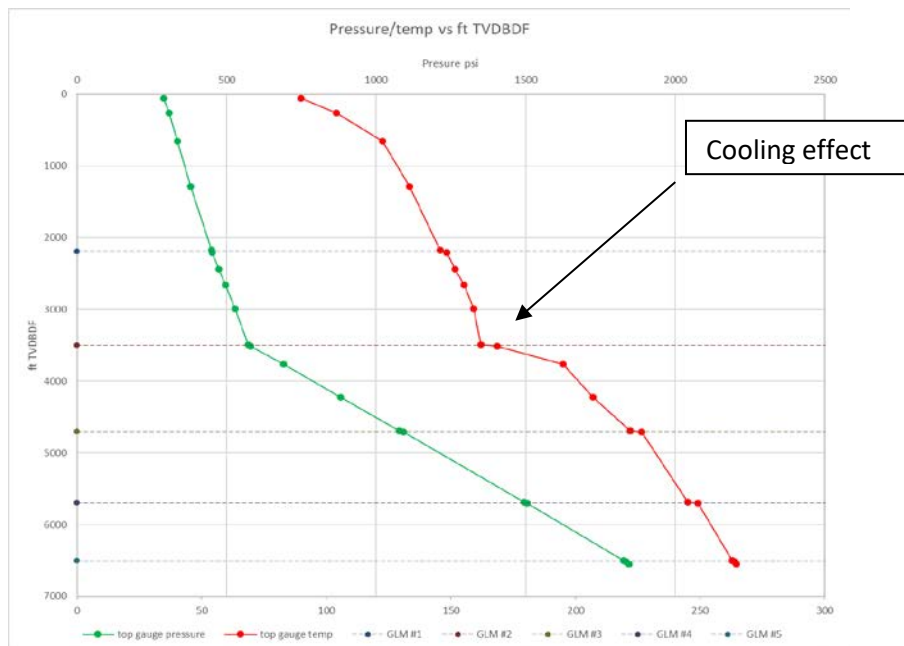
Result Graph For FGS @ LrT-A10U Using PPS-28 Gauge # 9084

Max. Pressure : 1268.63 psia

Max. Temperature : 252.34 degF



- 23. Update the rest of the tabs; *SOE, LQC, Schematic, DOR, Pressure Monitor, Well test* (for FGS), and page number for *Table of Content*.
- 24. Observed any cooling effect on FGS curve and mentioned it in *LQC* tab.



- 25. Once everything is completed, save the report as PDF.
- 26. Be sure to include raw data in ASCII format, pressure & temperature plot and bench test results (graph) for ease of clients.
- 27. The interpretation output shall be reviewed and compared with previous result.
- 28. FE should proceed to Draft Report if the interpretation results appear to be solid and unswerving.

29. Client representative will review the Draft Report. FE will proceed with Final Report once client satisfied with the result.
30. The Final Report should be compiled in three (3) hardcopies & softcopies. Two (2) copies for the clients and the other for DB's database.

i *Data must be sending to Client and town within 24 hours after completing the survey.*

3.7.5 Pressure Transient Data Delivery

1. The raw data from all gauges are downloaded and gathered. All data are converted to ASCII files afterward as in [3.7.2](#).
2. Required data to be submitted by FE to Log Analyst for further pressure transient analysis;
 - a. ASCII files
 - b. Sequence of Events (SOE)
 - c. Well Test Results
3. Log Analyst should proceed to Draft Report if the interpretation results appear to be solid and unswerving.
4. Client representative will review the Draft Report. Log Analyst will proceed with Final Report once client satisfied with the result.

3.8 Post Survey Maintenance Procedures

1. Ensure the gauge is clean from any debris, dirt, and grease.
2. Inspect all the O-rings for any damage and replace if necessary. It is recommended that the O-rings seals be changed after each downhole test.
3. Change the O-rings and parbacks at the top and bottom of electronic section as in **Figure 5**.
4. Clean O-ring groove. Use lacing cord in installing the new O-ring to ensure the O-ring is not damaged. Apply O-ring grease.

i *The parback must be positioned on both side of the O-ring and only used for 6-pin PPS28 gauge*

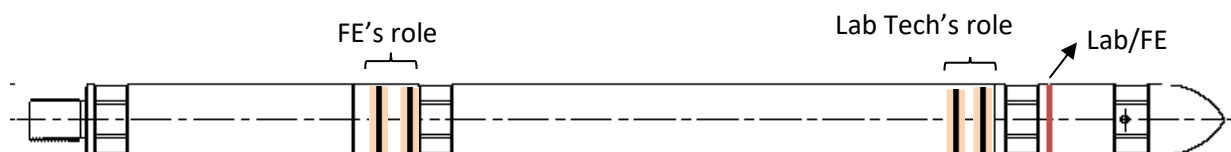


Figure 5. Parbacks and O-rings location for 6-pin gauge

Legend: O-ring 119 Parback O-ring 118

5. For 4-pin PPS28, O-rings 212 are used instead of 119, and no parback is required.
6. Check the spring loaded beside banana plug is in good condition and well contact to the battery when loaded inside battery housing.
7. Make sure the gauges are ready to be stored and run for the next job.
8. Disconnect the battery and store it separately.

9. Fill in the EMR Maintenance Checklist with the bench test graph for record for future reference.

3.9 Post Job Logistics

1. After completing the maintenance, make sure all the EMR gauges are safely packed inside the Pelican case.
2. Carry out final check utterly and specify the quantity of consumables and accessories for future reference. Request for additional items should the materials is in short supply.
3. Discuss with Wireline Supervisor concerning the next EMR job. If there is no other planned job, FE need to send back the EMR gauges to base and prepare Material Transfer Request (MTR) documentation.


CLOSE

4.1 Post Job


1. Post Job Maintenance
2. Post Job Reporting and Paperwork.
3. Submit any lessons learnt and improvement suggestion to FSM.
4. Attend debriefing with FSM.

4.2 PPS 28 SSP Summary and Op-Check

PPS28 SSP Summary Checklist:

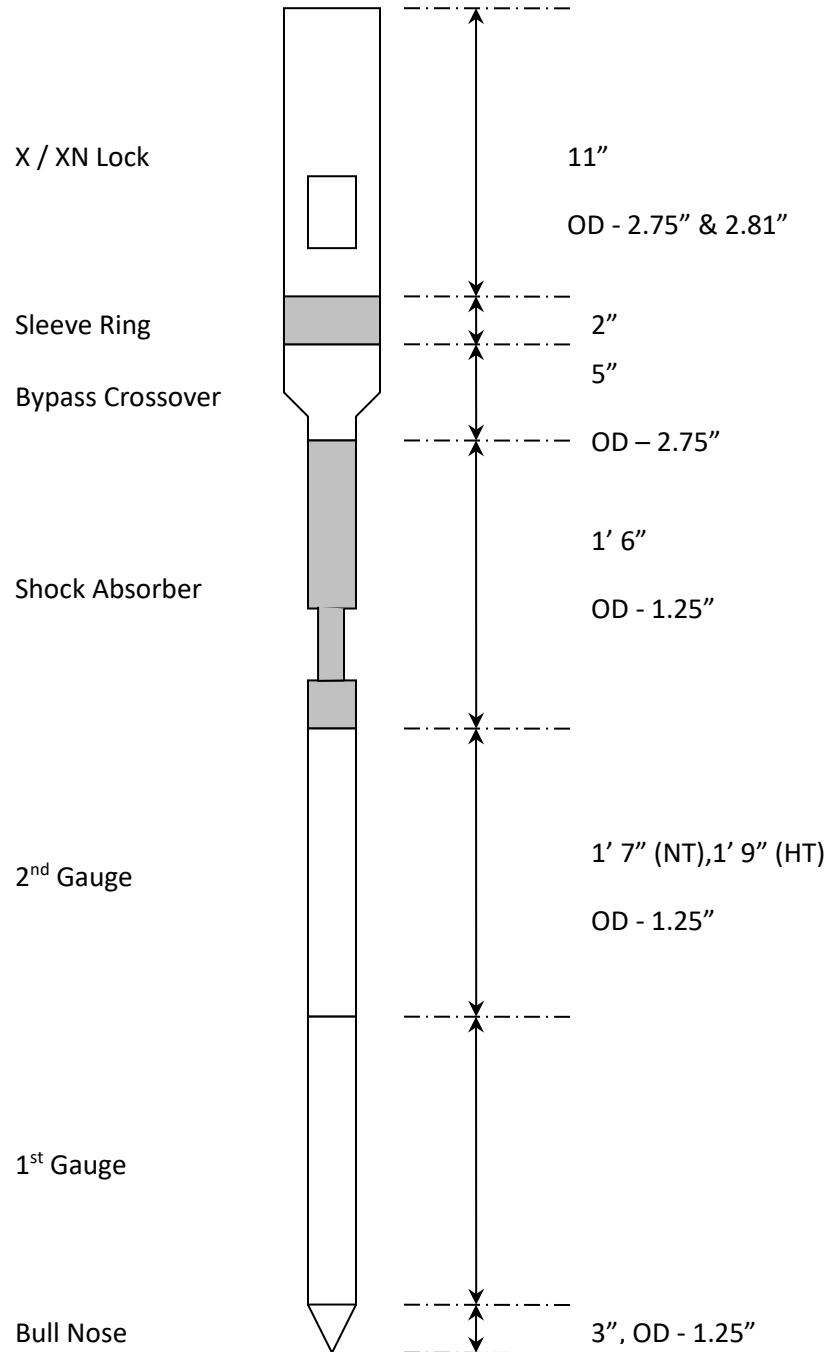
PPS28 SSP CHECKLIST			
At Base: Design & Prepare			
Design	Client has provided the well information, confirmed the station stop depth and signed the work program.	<input type="checkbox"/>	
	Confirm the operation is within tool specifications.	<input type="checkbox"/>	
	Client already been informed on the limitation of the tools, equipment, well condition and etc.	<input type="checkbox"/>	
	Ensure availability of the required tool configurations.	<input type="checkbox"/>	
Prepare	Discussed with CHS FSM on the availability of the EMR Gauge	<input type="checkbox"/>	
	For PBU and IFO survey, discussed with SLS FSM or OE on the availability and functionality of the downhole accessories: Lock Mandrel, Shock Absorber, Running Tool, and Pulling Tool.	<input type="checkbox"/>	
	Prepare all the tools and accessories as per maintenance manual. Verify with the lab side on the maintenance.	<input type="checkbox"/>	
	Ensure all the consumables, spare parts, hand tools, and programming tools are already in the package.	<input type="checkbox"/>	
	Prepare PPS SmartView (Refer to Op-Check Checklist)	<input type="checkbox"/>	
Perform EMR Opcheck (Refer to Op-Check Checklist)	<input type="checkbox"/>		
At Well Site: Execute			
Rig Up	Confirm well and hole properties with Wireline Supervisor. Review well history	<input type="checkbox"/>	
	Make sure the well is stable and has been shut in for specific duration depending on the job program	<input type="checkbox"/>	
	For FGS, make sure the well is stable and flowing with specified choke size.	<input type="checkbox"/>	
	Ensure tubing clearance is conducted prior to RIH EMR gauge.	<input type="checkbox"/>	
	Perform EMR Opcheck (Refer Opcheck Checklist)	<input type="checkbox"/>	
	Prepare Sequence of Events (SOE) corresponding to the designed station stop	<input type="checkbox"/>	
	Program EMR gauges sampling rate and duration accordingly	<input type="checkbox"/>	
	Make-up EMR gauge toolstring as per program (with or without instrument hanger)	<input type="checkbox"/>	
	Ensure FIT for lock mandrel, shock absorber, running tool, and pulling tool were done as per maintenance for IFO & PBU run	<input type="checkbox"/>	
	De-passivate battery prior to RIH (voltage must be >3.2V)	<input type="checkbox"/>	
Hook-up battery and record gauges initiation time after the battery LED flashed 16 times.	<input type="checkbox"/>		
Zero bottom toolstring at Tubing Head Flange (THF)	<input type="checkbox"/>		
Dummy FGS	Perform tool lift calculation to ensure tool weight is sufficient to overcome flowing upward force.	<input type="checkbox"/>	
	Ensure the tool is not floating and RIH smoothly	<input type="checkbox"/>	
	Monitoring the running weight, hanging weight, and pick up weight	<input type="checkbox"/>	
Actual EMR Run	Perform EMR survey run as per SSP	<input type="checkbox"/>	
	Conduct 4 hours well test if needed (refer job program)	<input type="checkbox"/>	
	RIH with average speed of 30m/min to set depth	<input type="checkbox"/>	
	SGS & FGS	Start log up to all station stops, not exceeding 30 m/min.	<input type="checkbox"/>
		Complete all station stops for SGS & FGS	<input type="checkbox"/>
		Closely monitor the THP and PCP to make sure it is maintained throughout the survey for data quality check	<input type="checkbox"/>
	PBU & IFO	Set instrument hanger at the specified accessories and confirmed by pull test	<input type="checkbox"/>
		POOH with average speed of 30m/min to surface	<input type="checkbox"/>
Communicate with production team to flow or inject or shut in the well for PBU & IFO test.		<input type="checkbox"/>	
RIH GS pulling tool to retrieve the instrument hanger once the designed test is completed		<input type="checkbox"/>	
POOH to surface, not exceeding 30 m/min.	<input type="checkbox"/>		
Post Job	Clean the tool during rig down while it hangs out from lubricator	<input type="checkbox"/>	
	Rig down toolstring and retrieve gauge	<input type="checkbox"/>	
	Download data and perform data QA/QC as per SSP	<input type="checkbox"/>	
	Generate ASCII files and quick-look report from PPS SmartView to be submitted to client for draft report	<input type="checkbox"/>	
	Submit ASCII files, SOE and Well Test Result to Log Analyst for Pressure Transient Analysis (PBU & IFO)	<input type="checkbox"/>	
Return to Base: Close			
Close	Generate final gradient survey report with/without interpretation depending on client's requirement	<input type="checkbox"/>	
	Arrange de-mobilization of the equipment back to base.	<input type="checkbox"/>	
	Complete Post Job Maintenance and Reporting	<input type="checkbox"/>	
	Submit any lessons learnt and improvement suggestion to FSM.	<input type="checkbox"/>	
	Attend debriefing with FSM.	<input type="checkbox"/>	
Name:	<i>write your name here</i>		
Date:	<i>dd/mm/yyyy</i>	Signature: <i>sign here</i>	

PPS28 Op-Check Checklist:

PPS28 OP-CHECK CHECKLIST		
PPS SmartView		
Software	Computer operating system no older than Windows 2000	<input type="checkbox"/>
	PPS SmartView V6.1 or later is installed	<input type="checkbox"/>
	No error while launching and operating the software	<input type="checkbox"/>
Lithium Battery		
De-passivate	Check the battery consumption record to ensure it sufficient for the job	<input type="checkbox"/>
	Battery's LED turn on when the battery is plugged into battery tester	<input type="checkbox"/>
	De-passivate battery for 15 seconds or until the displayed voltage stop increasing	<input type="checkbox"/>
	De-passivate again if the voltage is still lower than 3.2V	<input type="checkbox"/>
	Replace the battery if the voltage reading is still below than 3.2V	<input type="checkbox"/>
PPS28 EMR Gauges		
Bench Test	Connect EMR gauge with laptop through USB communication box and launch PPS SmartView	<input type="checkbox"/>
	Ensure the correct serial number of gauge is detected by PPS SmartView	<input type="checkbox"/>
	Check the functionality of the gauge by run the <i>Diagnostics</i> window and verify the output	<input type="checkbox"/>
	Program the gauge to test it for 10-15 minutes (refer SSP)	<input type="checkbox"/>
	Hook-up battery to the gauge. Ensure the red dots between the battery and the gauge receptacle.	<input type="checkbox"/>
	Monitor the LED on the battery flash 16 times indicating the gauge has been initialized	<input type="checkbox"/>
	Record gauge start time	<input type="checkbox"/>
	Apply vibration/shock test on gauge	<input type="checkbox"/>
	Download data from gauge once bench test completed (refer SSP)	<input type="checkbox"/>
	The output should be within acceptable range of atmospheric pressure, 14.7 psia ± 5 psia, and ambient temperature.	<input type="checkbox"/>
Record and document the bench test results	<input type="checkbox"/>	
Name:	<i>write your name here</i>	
Date:	<i>dd/mm/yyyy</i>	Signature: <i>sign here</i>

APPENDICES

5.1 EMR Toolstring with Instrument Hanger



5.2 Sequence of Events Template



SEQUENCE OF EVENTS - LRA-05U SGS SURVEY

Company	VPSB		
Field	LRT-A	SITHP (psia)	426 psi
Well No	LRA-05U	PCP (psig)	370 psi
Tubing	3-1/2"	THF to RKB	14.4 m
Well Type	Oil Producer	Max Deviation	74 deg
Survey Date	12-Oct-18	Fluid Level	281 m-TVDDF
Survey Objective	SGS survey		
Survey Duration	8.73 Hours		

Time (Hrs)	Events	Remarks
8:50	Programmed both gauges.	5sec/sample
8:56	Hooked up battery to gauges	
8:58	Hooked up gauges to wireline tool string.	
9:04	Record initial atmospheric pressure in lubricator for 10 minutes.	
9:14	Open Crown Valve and record initial SITHP in lubricator for 10 minutes.	426 psi
9:24	RIH with line speed of 30 m/min to 1st Station Stop 2648 m-MDDF	
11:13	1st Stop - Stop at 2648 m-MDDF (20 mins)	
12:35	POOH gauges to next station stop	
12:40	2nd Stop - Stop at 2605 m-MDDF (5 mins)	
12:45	POOH gauges to next station stop	
12:48	3rd Stop - Stop at 2585 m-MDDF (5 mins)	
12:53	POOH gauges to next station stop	
13:38	4th Stop - Stop at 2200 m-MDDF (5 mins)	
13:43	POOH gauges to next station stop	
13:56	5th Stop - Stop at 2079 m-MDDF (5 mins)	
14:01	POOH gauges to next station stop	
14:03	6th Stop - Stop at 2059 m-MDDF (5 mins)	
14:08	POOH gauges to next station stop	
14:34	7th Stop - Stop at 1700 m-MDDF (5 mins)	
14:39	POOH gauges to next station stop	
14:50	8th Stop - Stop at 1525 m-MDDF (5 mins)	
14:55	POOH gauges to next station stop	
14:57	9th Stop - Stop at 1505 m-MDDF (5 mins)	
15:02	POOH gauges to next station stop	
15:33	10th Stop - Stop at 1000 m-MDDF (5 mins)	
15:38	POOH gauges to next station stop	
15:48	11th Stop - Stop at 875 m-MDDF (5 mins)	
15:53	POOH gauges to next station stop	
15:55	12th Stop - Stop at 855 m-MDDF (5 mins)	
16:00	POOH gauges to next station stop	
16:20	13th Stop - Stop at 500 m-MDDF (5 mins)	
16:25	POOH gauges to next station stop	
16:48	14th Stop - Stop at 200 m-MDDF (5 mins)	
16:53	POOH gauges to next station stop	
17:04	15th Stop - Stop at 80 m-MDDF (5 mins)	
17:09	POOH gauges to lubricator	
17:18	Record final SITHP in lubricator for 10 minutes.	
17:28	Closed well and bleed off pressure	
17:40	Disconnect battery and download the data	

Note:

- All data successfully downloaded and good data obtained

EMR Gauge	:	S/N 9084 (Bottom)		S/N 9246 (Top)	
Max. Pressure	:	2445.516 psi	psia	2445.886	psia
Max Temp	:	237.774 °F	degF	237.720	degF

Prepared by:

Client Representative:

Field Engineer

Wireline Supervisor

5.3 Troubleshoot

Hardware Problems

<i>Symptoms</i>	<i>Possible Problems</i>	<i>Solutions</i>
LED does not flash after the battery is installed	Battery was not installed correctly	Unplug the battery and plug it back in again
	Battery has not been activated	Activate the battery
	Battery has not enough power	Battery has not enough power
	Memory is Full	Erase the memory
	Gauge is defective	Return the gauge for check and repair
SmartView software doesn't detect the gauge, or the gauge was detected, but it stopped communicating	Gauge is not properly connected to the computer	Make sure the gauge is connected according to the instructions. Refer to Software Manual for more information.
	COM port is locked	Reboot computer and restart the software.
	Software or drivers are corrupt or damaged	Upgrade to latest software version or reinstall (ensure USB devices disconnected).
	Interface box is defective	Use another interface box.
	Gauge is defective (Try connecting to another gauge to confirm)	Return the gauge for check and repair
Date recorded to memory is noisy	Low voltage of the battery	Check the battery voltage or change the battery
Data is out of the gauge specification	Sensor clog	Use air gun or WD-40 to clear the clog. Inject pig tail sensor with hydraulic oil
	The gauge may need to be recalibrated	Use the Diagnostics function to check if the gauge is sending the correct data, verify with the calibration records.
Could not download job files	Record files are corrupt	Use the "DUMP" function to dump memory of the gauge and then send to PPS for data retrieving.

Data Page

<i>Symptoms</i>	<i>Possible Problems</i>	<i>Solutions</i>
The 'Download' button is disabled	Communication with the gauge was not established	Follow the troubleshooting tips in the hardware section above to make sure the gauge is connected properly.
All buttons except 'Download', 'Read File' and 'Uncompress' are disabled	No active data file is loaded.	Follow the troubleshooting tips in the hardware section above to make sure the gauge is connected properly.
'Selection Start', 'Selection End', 'Add Gradient' and 'Add Event' buttons are disabled	No active data file is loaded.	Download a data file from the gauge or read data from the file.
	No point is clicked in the graph.	Click on the graph to select a data point.
'Delete from the beginning to the clicked point' and 'Delete from the clicked point to the end' radio buttons in the Filter dialog are disabled	No point is clicked in the graph.	Close the Filter dialog, click on the graph to select a data point and then open the Filter dialog again.
'Delete selection' radio button in the Filter dialog is disabled	No selection is defined in the graph.	Close Filter dialog, define the selection (refer to Section 4.1.4 for more information) and then open the Filter dialog again.

Program Page

<i>Symptoms</i>	<i>Possible Problems</i>	<i>Solutions</i>
The 'Get Program from Tool' and 'Program Tool' buttons are disabled	Communication with the gauge was not established	Follow the troubleshooting tips in the hardware section above to make sure the gauge is connected properly.
The 'Save To File' and 'Print' buttons are disabled	No program is active.	Define at least one program or read a program from the file

5.4 Plan Preventive Maintenance

As part of Dimension Bid – Cased Hole Services quality management requirement, all equipment and tools to be used for client must be reliable with traceable calibration record. It is our main priority of DB-CHS to serve our clients with the best quality and reliable tools in order to acquire high quality data. To meet this objective, the standard tools testing and calibration procedure had been established and implemented by CHS team accordingly. The gauges are subjected to PPM every 6-months to maintain its reliability and accuracy. This involves physical inspection on internal electronic section, sensor port, and will be tested using Oven and Pressure Chamber Test. If the result from the Oven and Pressure Chamber Test is off, the gauge needs to be re-calibrated by the manufacturer.

5.4.1 Chamber Test

This document was proposed as a benchmark for Lab Technicians and Field Engineers distinctively for Electronic Memory Recorder (EMR) gauges. It is compulsory for Lab Technicians and Field Engineers to perform the EMR gauges Chamber Test and documenting the result as part of the Preventive Maintenance. Local amendments to this standard may be required, depends on client request or concern, but should not be substituted for the steps defined here.

Pre-Test Procedure:

Before the beginning of any work, ensure that all equipment comply with the client's Safety Standards. Conduct pre-job safety meeting with all personnel involved on location detailing program, pressure limitation, safety procedures, and personnel responsibilities.

1. Wear proper PPE to prevent any injury.
2. Make sure EMR gauges physically been checked and serviced. Ensure all connection O-rings in good condition and sensor port cleaned from any debris.
3. Make sure the EMR gauges calibration still valid.
4. Performed bench test and record the atmosphere pressure as reference.
5. Barricade working area at least 5 ft from Pressure Chamber.
6. Perform physical inspection to Pressure Chamber. Make sure the Chamber cap O-ring in good condition.

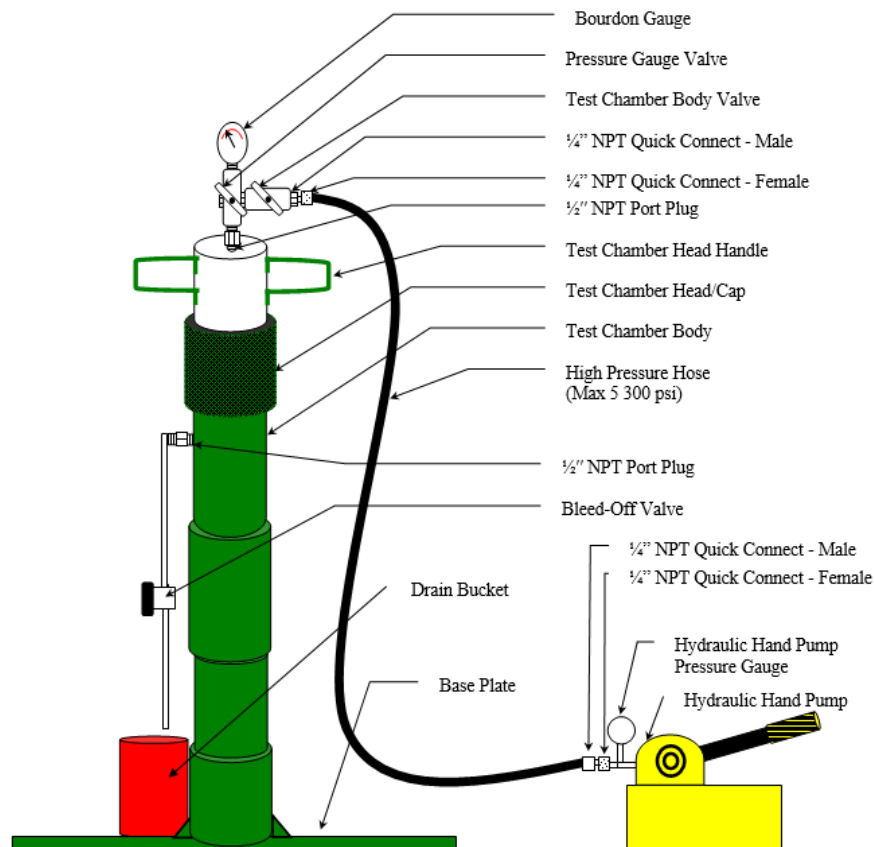


Chamber Cap O-ring should be replaced every 3 tests performed.

7. Observe any anomaly or damage in Chamber body and cap such as crack, pitting etc.
8. Make sure the chamber filled with hydraulic oil $\frac{3}{4}$ of the chamber volume (avoid air bubble).
9. Check all fittings and manifold connections (from hand pump to pressure chamber) to ensure all connection properly tightened (c/w Teflon tape).
10. Test bleed point to make sure it is not blocked and hand pump in good working condition.
11. Make sure the calibration for Bourdon gauge used on the chamber cap still valid.

Chamber Test Procedure:

1. Program 2 EMR gauges for 2 hours duration time with 1sec/sample sampling rate.
2. Ensure sure the batteries are de-passivated has more than 3.2 Volt.
3. Hook up the battery, record the start sampling time and tighten the gauge housing properly.
4. Setup the chamber test equipment as below. Open up the chamber cap and put in the gauges carefully into the chamber.



5. Setup Record the time when the EMR gauges fully submerge in hydraulic oil.
6. Close the Chamber Cap properly (hand tight) and perform second inspection on all tubing connection, fitting joints and Bourdon gauge fitting.
7. Start applies the pressure by using hand pump to 200 Psi (monitor Bourdon and hand pump gauge). Lock the pressure and stay for 2 minutes. Monitor all connection and fitting while increasing the pressure and during 2 minutes 'stay time' to ensure there is no leak.
8. Record the start time, end time and applied pressure read by the Bourdon gauge for the 2 minutes 'stay time' and also remark any anomaly.
9. Repeat steps 7 and 8 for pressure reading of 400Psi, 600Psi and 800Psi.
10. Increase the pressure to 1000Psi (monitor the Bourdon and hand pump gauge), lock the pressure and stay for 10 minutes. Monitor all connection and fitting while increasing the pressure and during 10 minutes 'stay time' to ensure there is no leak.

11. Record the start time and end time and the applied pressure read by the Bourdon gauge for the 10 minutes 'stay time' and also remark any anomaly.
12. Repeat steps 9 and 10 for pressure reading of 1500Psi, 2000Psi, 2500Psi and 3000Psi.

Post Test Procedure:

1. Bleed off the pressure in the chamber after completed all the *Chamber Test Procedure*.
2. Check the Bourdon gauge reading and bleed point to ensure the chamber has been depressurized.
3. Open the cap slowly and check for any trapped pressure.
4. Pull out the EMR gauges carefully and clean up the gauges before removing the housing.
5. Disconnect the battery from EMR gauges and record the end sampling time.
6. Download the EMR gauges and fill up the Chamber Test Form below.

CHAMBER TEST FORM

Bourdon Gauge (Psi)	Time			Gauge #1 (S/N)		Gauge #2 (S/N)	
	Dur. (mins)	Start	End	Pres (Psi)	Temp (°F)	Pres (Psi)	Temp (°F)
200	2						
400	2						
600	2						
800	2						
1000	10						
1500	10						
2000	10						
2500	10						
3000	10						

Tested by,

Reviewed by,

 Name:

Position:

Date:

To Location:

 Name:

Position:

Date:

5.4.2 Re-calibration

1. Identify gauge which needs to be calibrated by referring to the Calibration Master List.

i *From supplier, it's recommended to send the gauges for calibration at least once a year. For Dimension Bid, gauges will be calibrated after 3 years.*

2. Prepare document needed in order to send out those gauges for calibration.
3. Update gauges status once shipment released and communicates with manufacturer for gauges calibration status.
4. Once completed calibration and gauges been retrieved, perform chamber test and bench test for clarification.

i *Feedback to supplier ASAP if bench test or chamber test result is unacceptable.*

5. Record each EMR calibration and keep in calibration file history to ease tracing the validity of calibration.

5.5 Lessons Learnt

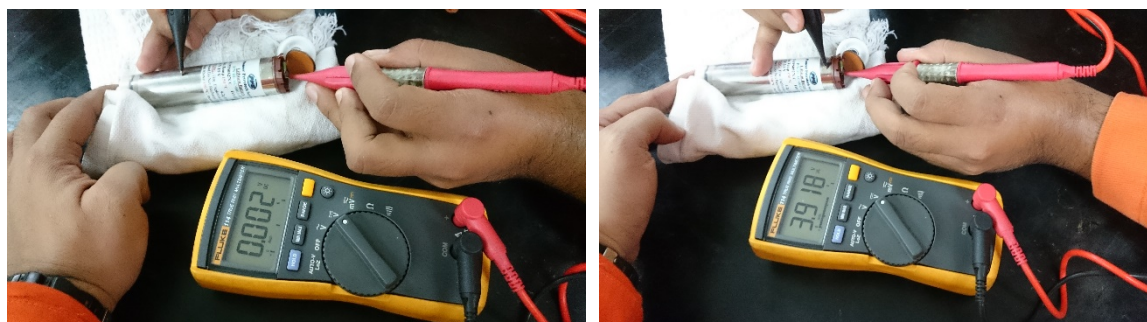
Case 1: Lithium battery downhole failure caused partial data recorded during the survey.

Incident 1: Lithium battery voltage dropped to 0V

Date	28.12.2016
Platform	Bunga Orkid Delta
Well	BOD 23
Job	Static Gradient Survey
BHA	Wireline toolstring + EMR Gauges

EMR Gauge 9103 with battery 0567 CC was used for this SGS Survey. Prior to RIH, bench test was performed to test the functionality of the gauge and showed good result. The battery was de-passivated and displayed voltage reading more than 3.2V.

However, no data was recorded once the gauge was retrieved on surface. The battery voltage dropped to 0V (no power indicated). Further investigation showed that this was due to the blown battery fuse as showed by **Figure 6** and **Figure 7**. This happened as the battery suddenly passivated below the required operating voltage and suddenly increased back causing overcurrent supplied while RIH.



Private

Figure 6. Battery tested with the blown fuse

Figure 7. Battery tested without the blown fuse

Incident 2: Lithium battery passivated downhole

Date	15.12.2018
Platform	Larut Alpha
Well	LRA-07U
Job	Flowing Gradient Survey
BHA	Wireline toolstring + EMR Gauges

6-pin EMR Gauge 9246 with Steatite battery 000034 was used for this FGS Survey. Prior to RIH, bench test was performed to test the functionality of the gauge and no anomalies was detected. The battery was de-passivated and displayed voltage reading more than 3.2V.

However, incomplete data was retrieved from the gauge after the FGS run. The downloaded data was also split into two files indicating the gauge was shut down and continued recording again for a while before completely shut down until the end of the survey. The first file showed normal data only until 8th gradient stop and no data recorded after that. Meanwhile, the second file showed erratic pressure data for 1.9 hours. Refer **Figure 8 & 9**.

Same battery and gauges were tested on surface for more than 8 hours along with vibration/shock test but unable to reproduce the error. The main cause for this problem was suspected due to the insufficient de-passivation applied on the battery. This caused the battery to suddenly passivated below the required operating voltage for the electronic board (minimum 3V) as well as the optimum voltage for the sensors that led to the erratic pressure output



Figure 8. First FGS file

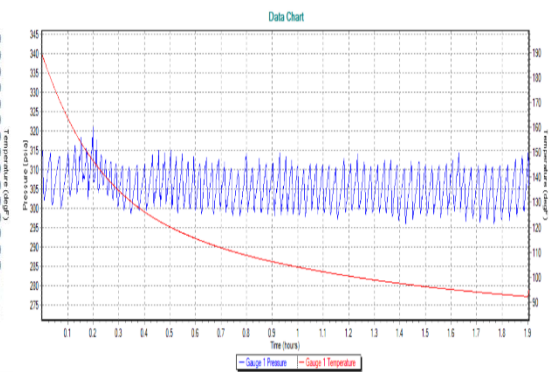


Figure 9. Second FGS file

Lesson Learnt: The lithium battery needs to be de-passivated as frequent as possible. This is because the passivation layer will result in voltage delay and cause the cell the voltage of the cell to drop rapidly. The cell will to reach its peak value and remain steady once the passivation layer is fully removed.

5.6 Best Practices & Precautions

1. Always de-passivate battery and ensure the voltage exceeds 3.2V before running survey.
2. Never de-passivate battery that has 0V voltage.
3. Perform tool lift calculations to ensure tool weight is sufficient to overcome upward force.
4. Always check O-ring conditions after every run.

5.7 Environment Different

O-ring seals

Fluorocarbon elastomers (Viton®) exhibit very good thermal and hydrocarbon resistance but can be attacked by a number of commonly encountered oilfield media. Corrosion inhibitors will cause embrittlement, while sour wells containing Hydrogen Sulphide (H₂S) and Carbon Dioxide (CO₂) may cause softening with consequent reduction in the elastomer's mechanical properties.

Hydrogenated Nitrile Rubbers (HNBR) have proven invaluable in extending the boundaries of elastomeric seals in aggressive environments. These materials display superior resistance to aggressive fluids such as sour crude oil or gas, lubricating oil additives and amine corrosion inhibitors where fluorocarbon (Viton®) seals are less effective.

Hence the type of O-ring used will depend on the environment. Under normal conditions Viton® can be used, however, in harsher environments, such as in sour wells, HNBR and chemraz will be more reliable.

H ₂ S or CO ₂ (%)	Pressure (kpsi)	Temperature (°C)	O-ring #1	O-ring #2	Bomb Well
None	< 25	< 177	Viton 90	Viton 90	Not Necessary
≤ 2	< 25	< 177	Aflas 90	Aflas 90	Not Necessary
2 - 10	< 30	< 200	Chemraz	Chemraz	Recommended
> 10	< 30	< 200	Chemraz	Chemraz	Necessary

The required O-rings sizes can be cross checked with the O-ring tables in the next section.

O-Ring Cross Check Table

Tool	EMR Gauge
Tool Code	PPS28

NO	SUBSECTION	O-RING SIZE			
		119	212	118	BACKUP O-RING
1	EMR Gauge 6-pin	4		1	4
2	EMR Gauge 4-pin		4	1	

NO	O-RING SIZE	TOOL REF	QUANTITY PER NO. OF RUNS				
			1	5	10	15	20
1	O-RING SZ-119	1	4	20	40	60	80

2	O-RING SZ-212	2	4	20	40	60	80
3	O-RING SZ-118	1,3	2	10	20	30	40
4	BACKUP O-RING 118	1	4	20	40	60	80

Conveyance in Deviated Wells

As wells become more highly deviated, or their profiles become more challenging, it is increasingly difficult to reach the targeted depths. Frictional resistance caused by the toolstring lying on the low side of the well can inhibit the operation from reaching lower depths.

Roller conveyance tools lift and support the toolstring off the low side of the well. Large rollers eliminate tool contact friction, making it easier to convey the toolstring to target depth and achieve the results expected.

5.8 Battery Consumption Table



Pioneer Petrotech Services Inc.
Unit Q, 1235 – 40 Ave. NE, Calgary, AB, Canada, T2E 6M9
Tel: (403)282-7669, Fax: (403)282-0509

1. PPS28 Gauge (G8B3/G7A2 Version)

177°C

- Operating current: 10.0mA
- Idle current: 1.0mA

Battery C 180°C (5.0Ah)

Sampling Rate (s)	mAs / sample	Total Points	Hours	Days	Note
1	10.0	1,800,000	500	20	
5	41.0	440,000	610	25	
10	46.0	390,000	1087	45	
15	51.0	350,000	1470	61	
20	56.0	320,000	1786	74	
30	66.0	270,000	2273	95	
60	96.0	180,000	3125	130	

Battery CC 180°C (10Ah)

Sampling Rate (s)	mAs / sample	Total Points	Hours	Days	Note
1	10.0	3,600,000	1000	40	
5	41.0	880,000	1220	50	
10	46.0	780,000	2174	90	
15	51.0	700,000	2941	123	
20	56.0	640,000	3571	149	
30	66.0	340,000	4545	189	
60	96.0	375,000	6250	260	

5.9 References

- Ahmad, A. (2017). *DBSB-CHS-01: Standard Operation Procedures for Electronic Memory Recorder (EMR)* (Rev. 2). Kemaman, Malaysia: Cased Hole Services, Dimension Bid Sdn Bhd.
- Ahmad, A. (2017). *CHS-EMR-SP001: EMR Programming and Downloading* (Rev. 2). Kemaman, Malaysia: Cased Hole Services, Dimension Bid Sdn Bhd.
- Ahmad, A. (2017). *CHS-EMR-SP002: EMR GAUGES CHAMBER TEST* (Rev. 2). Kemaman, Malaysia: Cased Hole Services, Dimension Bid Sdn Bhd.
- Ahmad, A. (2017). *CHS-EMR-SP005: Standard Operation Procedures for Instrument Hanger* (Rev. 2). Kemaman, Malaysia: Cased Hole Services, Dimension Bid Sdn Bhd.
- Cased Hole Services, Dimension Bid Sdn Bhd. (2016). *CHS-PCVL-160516: Problem Report – EMR Gauges S/N 9246 Recording Only 1.8 Hours of The Survey*. Kemaman, Malaysia.
- Cased Hole Services, Dimension Bid Sdn Bhd. (2017). *FORM 130 EMR – PPS28 Maintenance Checklist* (Rev. 1). Kemaman, Malaysia.
- Cased Hole Services, Dimension Bid Sdn Bhd. (2018). *Problem Report – EMR Gauge Incomplete Data While Logging*. Kemaman, Malaysia.
- Pioneer PetrotechServices Inc (2007). *PPS28 Gauge Power Consumption Table*. Calgary, Canada.
- Pioneer PetrotechServices Inc. *PPS SmartView User Manual* (Ver. 6.1.1). Calgary, Canada.
- Pioneer PetrotechServices Inc. *PPS28. Quartz Electronic Memory Gauge*. Calgary, Canada.

PPS28 SSP CHECKLIST



At Base: Design & Prepare

Design	Client has provided the well information, confirmed the station stop depth and signed the work program.	<input type="checkbox"/>
	Confirm the operation is within tool specifications.	<input type="checkbox"/>
	Client already been informed on the limitation of the tools, equipment, well condition and etc.	<input type="checkbox"/>
	Ensure availability of the required tool configurations.	<input type="checkbox"/>
Prepare	Discussed with CHS FSM on the availability of the EMR Gauge	<input type="checkbox"/>
	For PBU and IFO survey, discussed with SLS FSM or OE on the availability and functionality of the downhole accessories: Lock Mandrel, Shock Absorber, Running Tool, and Pulling Tool.	<input type="checkbox"/>
	Prepare all the tools and accessories as per maintenance manual. Verify with the lab side on the maintenance.	<input type="checkbox"/>
	Ensure all the consumables, spare parts, hand tools, and programming tools are already in the package.	<input type="checkbox"/>
	Prepare PPS SmartView (Refer to Op-Check Checklist)	<input type="checkbox"/>
Perform EMR Opcheck (Refer to Op-Check Checklist)	<input type="checkbox"/>	

At Well Site: Execute

Rig Up	Confirm well and hole properties with Wireline Supervisor. Review well history	<input type="checkbox"/>	
	Make sure the well is stable and has been shut in for specific duration depending on the job program	<input type="checkbox"/>	
	For FGS, make sure the well is stable and flowing with specified choke size.	<input type="checkbox"/>	
	Ensure tubing clearance is conducted prior to RIH EMR gauge.	<input type="checkbox"/>	
	Perform EMR Opcheck (Refer Opcheck Checklist)	<input type="checkbox"/>	
	Prepare Sequence of Events (SOE) corresponding to the designed station stop	<input type="checkbox"/>	
	Program EMR gauges sampling rate and duration accordingly	<input type="checkbox"/>	
	Make-up EMR gauge toolstring as per program (with or without instrument hanger)	<input type="checkbox"/>	
	Ensure FIT for lock mandrel, shock absorber, running tool, and pulling tool were done as per maintenance for IFO & PBU run	<input type="checkbox"/>	
	De-passivate battery prior to RIH (voltage must be >3.2V)	<input type="checkbox"/>	
Hook-up battery and record gauges initiation time after the battery LED flashed 16 times.	<input type="checkbox"/>		
Zero bottom toolstring at Tubing Head Flange (THF)	<input type="checkbox"/>		
Dummy FGS	Perform tool lift calculation to ensure tool weight is sufficient to overcome flowing upward force.	<input type="checkbox"/>	
	Ensure the tool is not floating and RIH smoothly	<input type="checkbox"/>	
	Monitoring the running weight, hanging weight, and pick up weight	<input type="checkbox"/>	
Actual EMR Run	Perform EMR survey run as per SSP	<input type="checkbox"/>	
	Conduct 4 hours well test if needed (refer job program)	<input type="checkbox"/>	
	RIH with average speed of 30m/min to set depth	<input type="checkbox"/>	
	SGS & FGS	Start log up to all station stops, not exceeding 30 m/min.	<input type="checkbox"/>
		Complete all station stops for SGS & FGS	<input type="checkbox"/>
		Closely monitor the THP and PCP to make sure it is maintained throughout the survey for data quality check	<input type="checkbox"/>
	PBU & IFO	Set instrument hanger at the specified accessories and confirmed by pull test	<input type="checkbox"/>
		POOH with average speed of 30m/min to surface	<input type="checkbox"/>
Communicate with production team to flow or inject or shut in the well for PBU & IFO test.		<input type="checkbox"/>	
RIH GS pulling tool to retrieve the instrument hanger once the designed test is completed		<input type="checkbox"/>	
POOH to surface, not exceeding 30 m/min.	<input type="checkbox"/>		
Post Job	Clean the tool during rig down while it hangs out from lubricator	<input type="checkbox"/>	
	Rig down toolstring and retrieve gauge	<input type="checkbox"/>	
	Download data and perform data QA/QC as per SSP	<input type="checkbox"/>	
	Generate ASCII files and quick-look report from PPS SmartView to be submitted to client for draft report	<input type="checkbox"/>	
	Submit ASCII files, SOE and Well Test Result to Log Analyst for Pressure Transient Analysis (PBU & IFO)	<input type="checkbox"/>	

Return to Base: Close

Close	Generate final gradient survey report with/without interpretation depending on client's requirement	<input type="checkbox"/>
	Arrange de-mobilization of the equipment back to base.	<input type="checkbox"/>
	Complete Post Job Maintenance and Reporting	<input type="checkbox"/>
	Submit any lessons learnt and improvement suggestion to FSM.	<input type="checkbox"/>
	Attend debriefing with FSM.	<input type="checkbox"/>

Name:	<i>write your name here</i>
Date:	<i>dd/mm/yyyy</i>
Signature:	<i>sign here</i>

PPS28 OP-CHECK CHECKLIST



PPS SmartView

Software	Computer operating system no older than Windows 2000	<input type="checkbox"/>
	PPS SmartView V6.1 or later is installed	<input type="checkbox"/>
	No error while launching and operating the software	<input type="checkbox"/>

Lithium Battery

De-passivate	Check the battery consumption record to ensure it sufficient for the job (Battery Tracking Record)	<input type="checkbox"/>
	Battery's LED turn on when the battery is plugged into battery tester	<input type="checkbox"/>
	De-passivate battery for 15 seconds or until the displayed voltage stop increasing	<input type="checkbox"/>
	De-passivate again if the voltage is still lower than 3.2V	<input type="checkbox"/>
	Replace the battery if the voltage reading is still below than 3.2V	<input type="checkbox"/>

PPS28 EMR Gauges

Bench Test	Connect EMR gauge with laptop through USB communication box and launch PPS SmartView	<input type="checkbox"/>
	Ensure the correct serial number of gauge is detected by PPS SmartView	<input type="checkbox"/>
	Check the functionality of the gauge by run the <i>Diagnostics</i> window and verify the output	<input type="checkbox"/>
	Program the gauge to test it for 10-15 minutes (refer SSP)	<input type="checkbox"/>
	Hook-up battery to the gauge. Ensure the red dots between the battery and the gauge receptacle.	<input type="checkbox"/>
	Monitor the LED on the battery flash 16 times indicating the gauge has been initialized	<input type="checkbox"/>
	Record gauge start time	<input type="checkbox"/>
	Apply vibration/shock test on gauge	<input type="checkbox"/>
	Download data from gauge once bench test completed (refer SSP)	<input type="checkbox"/>
	The output should be within acceptable range of atmospheric pressure, 14.7 psia \pm 5 psia, and ambient temperature.	<input type="checkbox"/>
Record and document the bench test results	<input type="checkbox"/>	

Name: *write your name here*

Date: *dd/mm/yyyy* **Signature:** *sign here*

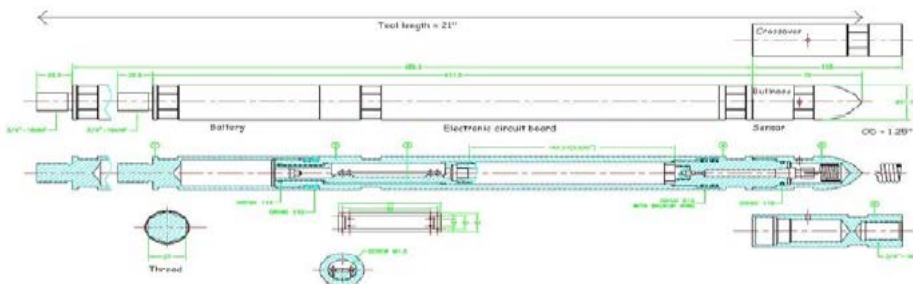
PPS28 FIT CHECKLIST



OBJECTIVE

- i - To conduct Fast Inspection of Tools (FIT) prior to performing job
- ii - To identify any anomalies/possible damage after run

TOOL DIAGRAMS



PRE JOB

1. Make sure the selected gauge tagged green "Ready to Go" indicating already completed maintenance process	<input type="checkbox"/>
2. Remove the Battery Housing and inspect for any visible damage at Communication Port pins	<input type="checkbox"/>
3. Inspect the O-ring 119 (6-pin) or O-ring 212 (4-pin) conditions. Replace if necessary. Ensure to use HNBR O-ring for sour wells	<input type="checkbox"/>
4. Apply O-ring grease	<input type="checkbox"/>
5. Use air gun or WD-40 and spray the sensor port to avoid any clog	<input type="checkbox"/>
6. De-passivate battery and bench test gauge (refer Op-Check Checklist)	<input type="checkbox"/>
7. Test every tool and equipment such as join cross over to ensure the compatibility and in good condition	<input type="checkbox"/>
8. Record tool and battery serial number	<input type="checkbox"/>

POST JOB

1. Clean the tool before disconnecting toolstring. Ensure the gauge is clean from debris, dirt, and grease	<input type="checkbox"/>
2. Observe for any anomalies/possible damage	<input type="checkbox"/>
3. Ensure there is no well fluid entry within the battery housing and at the Communication Port pin	<input type="checkbox"/>
4. Inspect O-rings and parbacks condition. Replace if needed	<input type="checkbox"/>
5. Clean O-ring groove	<input type="checkbox"/>
6. Ensure the spring loaded beside banana plug is still intact	<input type="checkbox"/>

Name:	<i>write your name here</i>		
Date:	<i>dd/mm/yyyy</i>	Signature:	<i>sign here</i>