

## MULTIFINGER IMAGING TOOL (MIT) CALIPER STANDARD SERVICE PROCEDURE



### Document Control

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Private

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**Private**

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**DESIGN**

**1.1 Introduction of Tool**

The Sondex Multifinger Imaging Tool (MIT) range has been designed to provide the most accurate tubing calliper measurements in the industry. The high quality of the data allows for 3 dimensional imaging and the calculation of rates of corrosion or scale deposition.

Common type of caliper surveys services provided by Dimension Bid (M) Sdn. Bhd are [MIT24F](#) and [MIT40F](#) for well 2-7/8" until 7".



**1.2 Tool Specification**

Mechanical	MIT24F	MIT40F
Outside Diameter	1-11/16"	2-3/4"
Make up Length	50.6"	54.4"
Housing Material	Inconel 718 / Stainless Steel 17-4	
Finger Lengths	7"	7" and 10"
Number of Fingers	24F	40F
Radial Accuracy	±0.02"	±0.025" (7") ±0.03" (10")
Radial Resolution	0.003"	0.005"(7") 0.007"(10")
Measurement Range	1-3/4"(Min) 7"(Max)	2.75"(Min) 10"(Max)
Circumferential Spacing	0.23"(Min) 0.92"(Max)	0.25"(Min) 0.92"(Max)
Finger Tip Radius	0.05"	0.06"
Finger Tip Width	0.063"	0.04"
Finger Contact Force	0.75lbs(Min) 1.25lbs(Max)	
Logging Speed	30ft/min(Min) 60ft/min(Max)	

Environmental		
Pressure Ranges	Up to 15,000 psi	Up to 20,000 psi
Temperature Rating	177°C (351°F)	
Electronic		
Current Consumption	Logging <30mA Motor <400mA	

### 1.3 Review Client Requirement

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1. Finalize job program with client. Confirm on the objective, type of caliper, and number of runs.
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

### 1.4 Confirm Requirements can be Met

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

### 1.5 Generic Main Tool Planning

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

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## PREPARE

### 2.1 Pre-Mobilization

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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 MIT and any other equipment. For the MIT the *Specific Operating Procedure (SOP)* must be followed. All bench test 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 MIT Tools

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1. Collect the components of the MIT tools.
  - a. Memory Battery Holder(ABM)
  - b. Ultrawire Memory Tool (UMT007/UMT003)
  - c. Casing Collar Locator (CCL); optional
  - d. Production Gamma Ray (PGR); optional
  - e. Multifinger Imaging Tool (MIT)
  - f. Ultrawire Memory Controller (UMU001)
  - g. Production Roller Centralizer (PRC)
  - h. Production Knuckle Joint (PKJ)
  - i. Bullnose with Terminator (BUL)
  - j. Depth Time Recorder (DTR)
  - k. MIT Calibration Jig
  - l. Lithium Battery Pack
  - m. O-ring grease
  - n. O-ring consumable
  - o. Spare part consumable
  - p. Hand tools

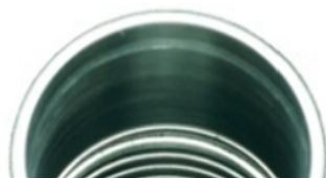
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## 2.3 Downhole tools

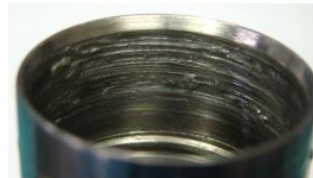
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### 2.3.1 Prepare MIT Tools

1. Ensure the MIT tool has completed maintenance process and tagged as **READY TO GO**. If not tagged, please consult with Lab technicians.



**Good Condition**



**Bad Condition**

2. Perform visual/physical check for any damage, bending, dents, or scratches for the tools received as in [2.2](#).
3. Inspect the O-rings conditions. Replace if necessary.
4. Verify the tools and the components herein as in [2.2](#) are thoroughly cleaned from dirt and grease.
5. Use air gun or WD-40 and spray the sensor port to avoid any clog.

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## 2.4 Downhole accessories

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### 2.4.1 X-Over from MIT tools to Wireline Tool

1. Discuss with Operation Engineer for the method of deployment of tools.
2. Identify the X-Over need to be used and perform fit test prior to mobilize to offshore.
3. Make sure the tool, figure on the right, was tested and functioning well.
4. Ensure tool inspection was done as per SLS/CTU/E-Line maintenance manual.

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## 2.5 MIT Software

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### 2.5.1 System Requirement

1. Required software:
  - a. Sondex Ultrawire Memlog
  - b. Sondex Warrior Acquisition
  - c. SNDXUSB.EXE (if not installed automatically)
  - d. SDSUSB.EXE (if not installed automatically)
  - e. HASP/Hardlock drivers (if not installed automatically)
  - f. Wiva and Wiper (Optional)
2. Before installing the required software, computer system should be ready with operating systems no older than Windows 2000. In addition, for Warrior 7, requirement for computer system is 32bit and 64bit for Warrior 8.

### 2.5.2 Software Installation via Downloaded File

1. Go to BHGE web site  
(<https://www.bhge.com/upstream/evaluation/wireline-products-and-equipment/downhole-equipment/wireline-software>)
2. You can install from SDS website as well  
(<http://www.scientificdata.com/downloads/Warrior-Software-Downloads.html>).
3. Download the latest software needed that compatible with your computer system.
4. Download the compressed file and extract it to hard drive. Every software file has the different password. Please consult with BHGE representative for the password. From SDS website, no need the password to extract the file.
5. Double click the **SETUP.EXE** icon to launch the software installation.
6. Follow the instructions to finish the installation process.

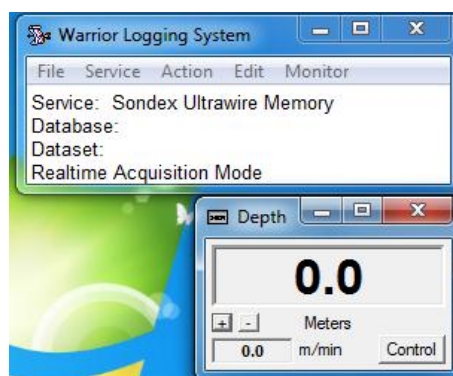
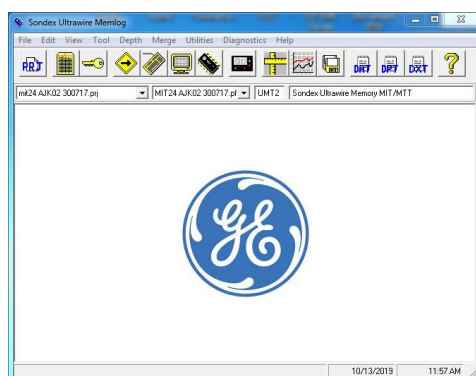
### 2.5.3 Launching MIT Software

#### Warrior 7 32bit Computer Operating System

1. Insert the key dongle. Open the Sondex Warrior folder and double click on *Control Panel* to launch.
2. Insert the *Key Code* at key authorization code area.
3. Double click on MIT Software shortcut at the desktop to launch.
4. The software will automatically detect key code inserted and will launch the software. If failed to launch, please check the code inserted.

#### Warrior 8 64bit Computer Operating System

5. Insert the key dongle. Open the Sondex Warrior folder and double click on *Control Panel* to launch.
6. At the license tab, import the key license available. License key are available in the CHS server *Y:\27\_Maintenance Record\5 - SOFTWARE KEY\2 - KEY LICENSE*.
7. Double click on MIT Software shortcut at the desktop to launch.
8. The software will automatically detect key code inserted and will launch the software. If failed to launch, please check the license key inserted.



## 2.6 Operational check

### 2.6.1 Inspecting MIT Tools



To ensure MIT Tools are functional, a regular inspection (Bench Test) is necessary before each operation. For MIT from WellSun, it's functional with Sondex platform.

1. Make up the BHA as below:

**UMT007+PKJ+PKJ+PRC+MIT+PRC+BUL**


2. Connect a **UMU001** to the UMT007 as in **Figure 1** and launch the Sondex Ultrawire Memlog and Warrior Acquisition.

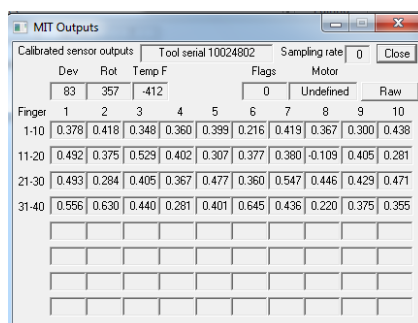


Make sure the red dot is aligned during connecting the USB to UMT007.



Figure 1 UMU001 to UMT007

3. At Sondex Ultrawire Memlog, click **Command Mode**  and the command will be sending to Warrior Acquisition.
4. At the Warrior Acquisition, go to **Edit** → **Tool Configuration** → **MIT** → **Motor Control** → **Open Tool**. Finger will be open as command.
5. At the Warrior Acquisition, go to **Monitor** → **Tools** → **MIT**. You can see the reading of each finger.



Calibrated sensor outputs			Tool serial 10024802		Sampling rate 0		Close			
Dev	Rot	Temp F	Flags		Motor		Raw			
83	357	-412	0		Undefined		Raw			
Finger	1	2	3	4	5	6	7	8	9	10
1-10	0.378	0.418	0.348	0.360	0.399	0.216	0.419	0.367	0.300	0.438
11-20	0.492	0.375	0.529	0.402	0.307	0.377	0.380	-0.109	0.405	0.281
21-30	0.493	0.284	0.405	0.367	0.477	0.360	0.547	0.446	0.429	0.471
31-40	0.556	0.630	0.440	0.281	0.401	0.645	0.436	0.220	0.375	0.355

Figure 2 Fingers Data

6. To close the finger, repeat step 3 to 4.

**2.6.2 Programming UMT007 for MIT**

1. Make up the BHA as per **Step 1** in [2.6.1](#).
2. Connect a UMU001 to the UMT007 as in **Figure 1** and a computer.
3. Launch Sondex Ultrawire Memlog and Warrior Acquisition.
4. At the Warrior Acquisition, select the service *Sondex Ultrawire Memory MIT/MTT*. Go to *Edit* and select *Toolstring*.
5. Please add the identified toolstring together with valid S/N and calibration.

 For MIT WellSun, you need to create new tool under the same tool model to avoid confusion between Sondex tool.

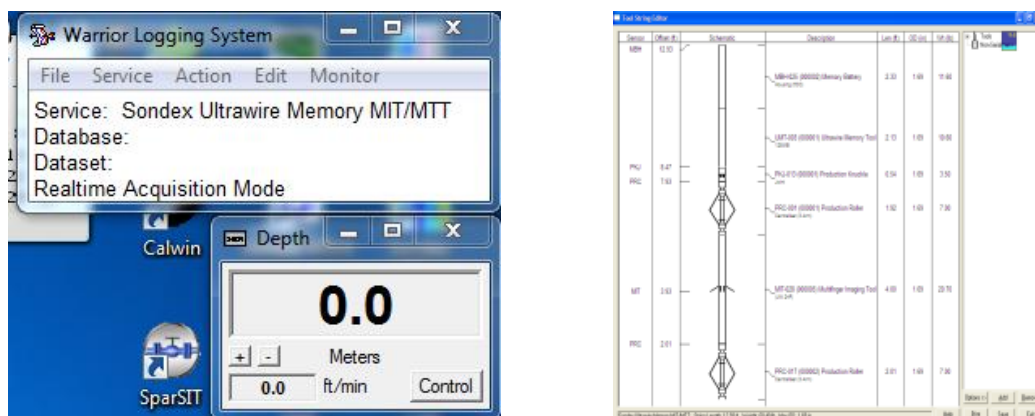





Figure 3 Toolstring Editor


6. Open the Sondex Ultrawire Memlog. Create *New Project* . 
7. Open the *Edit Profile*  to write the command. It's recommended to start with *OPEN*. Minimum *OPEN* suggested is 3 minutes. For MIT, *SETUP 12 bit* is used to avoid data compression.

		Tool Name	UMT	MIT
		UW Address	0	15
		Default Rate s	1.00	0.02
Start Time (DD:HH:MM:SS)	Profile Length (minutes)	Profile Type	Rate	Rate
00:00:00:00	3.00	OPEN		OPEN
00:00:03:00	1.00	SETUP		12-BIT
00:00:04:00	22.00	LOG	1.00	0.02
00:00:26:00	3.00	CLOSE		CLOSE

Figure 4 ProfileEditor

8. For *Calibration*, 3 minutes are recommended for every changes of Jig OD.



 For MIT WellSun, MIT Jig is in **mm**. You need to change the setting before operating this MIT.

9. Timing for LOG are based on depth and linespeed. *SLEEP MODE* is available if toolstring need to be make up separately. *MIT Programming Sheet* can be used to calculate the timing and memory used.
10. For the power consumption, 30 hours are estimated for 1 battery. *UMT Power Consumption Sheet* can be used to calculate the power consumption.
11. Click *Program Tool*  to program the UMT007 based on the profile setting.
12. Hook up the battery and perform the job.
13. You may refer to the *TM-MIT 2* for the detail programming.




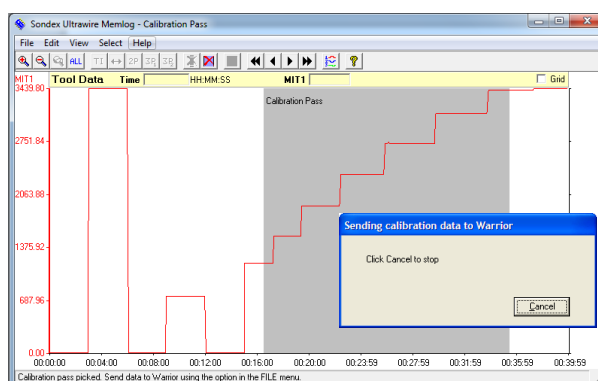
*Please note the hook up time to determine what time the finger will open and close.*

### 2.6.3 Downloading & Processing the Data

1. Connect UMU001 to the UMT007 as in **Figure 1** and a computer.
2. At Sondex Ultrawire Memlog, click *download the data* to download the data from UMT007. 
3. Click download the *DTR data* for the depth and linespeed data from DTR. 
4. You may refer to the *TM-MIT 2* for the detail downloading.

### 2.6.4 MIT Calibration

5. Click on *Calibration Pass*  on the Ultrawire Memlog software.
6. Select curves *MIT1* and Calibration Pass window will appear.
7. Use two cursors to highlight the start and stop points of the calibration pass as shown in **Figure 5**.



**Figure 5** Data Passes

8. Right click and select *Calibration Pass* window and then click Send Calibration Data to Warrior. Window as per above will appear. Maximize Warrior Acquisition window which concurrently with the Ultrawire Memlog.

- At Warrior Acquisition, go to **Action** → **Calibrate** → **MIT Calibration** → **Finger Calibration**. Click sample for every changes of finger reading ID. Once finish, QA/QC the reading and click accept calibration.

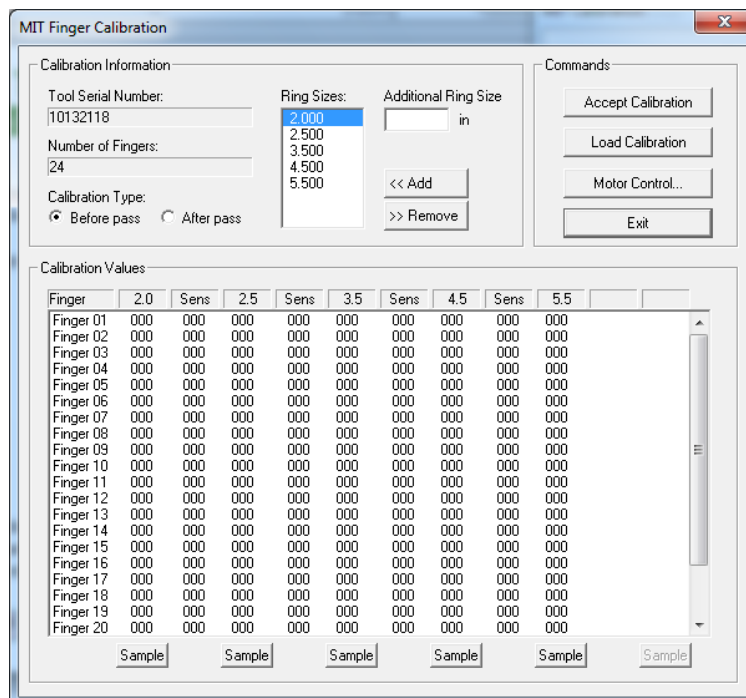



Figure 6 Calibration Interface

### 2.6.5 MIT Data Processing

- At Ultrawire Memlog, click on **Merge Data**  and merged **Tool Data** (MIT1) and **Depth Data** (LSPD,DPT). Go to **Options** and insert start time for tools. DTR time will automatically insert.
- Right click on the data to zoom for tie in the data. Recommended to use CCL data (if applicable), choose when the data start to spike and click as shown in **Figure 7**.

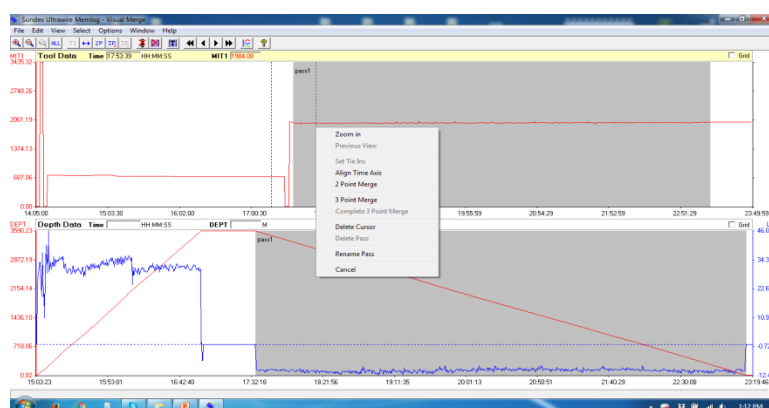

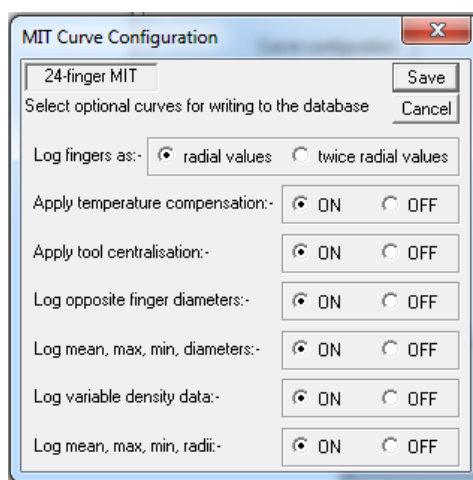


Figure 7 Merge Data Interface

- Repeat **Step 10** for the Depth data. Choose when the lspd /depth start to move and click.
- After finish, you may click **Tie In**  to tie in the Data and Depth data.
- To create passes, you may zoom either depth data or MIT data.

15. Click from start depth/data movement/spike then click at the end of depth/data movement/spike. Click **2P** to create passes. **2P**
16. Once complete, go to *file* and *Save Picked Passes to MRG file*. Then, exit.
17. Go to *Merge* and click *Output Passes*. Enter the RKB to THF prior to click *Output Passes*.
18. Ultrawire memlog will ask *Re-calculation*. Click yes. Data will be sending to the Warrior Acquisition for re-calculation. Click *file* and choose the **file.db**.
19. Click on *Current Calibration File* to insert the calibration file. Embedded is the calibration that already in the project file created before run.
20. Click *Edit* and choose *Tool Configuration* and select *MIT*.
21. Click *Curve Configuration* and make sure all are *On* as shown in **Figure 8**. Then, click *save*. Exit all.



**Figure 8** MIT Curve Configurations

22. Select Recalculation to maximum speed. If found finger reading abnormal, repeat **Step 17**.
23. At **Step 19**, click *Finger Status* and click which finger is bad and click accept. Then go to **step 20**.
24. On the log screen, click on *Option* then click on *Maximize*. Browse on *Presentation File* and select *mit24f.prs/mit40f.prs*, select Metric Depth and Vertical Scale.

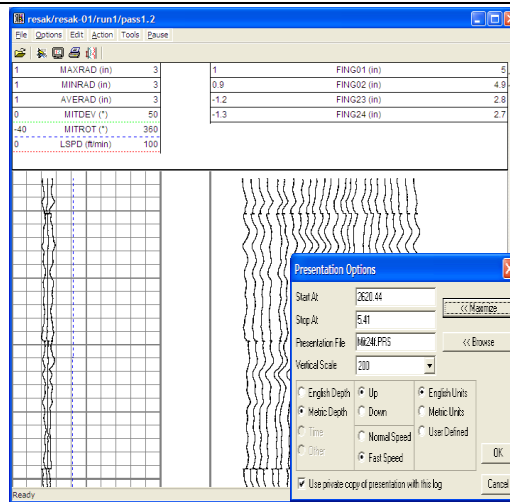


Figure 9 Interactive Plot View

25. Perform QA/QC on data. If the data is good, engineer will proceed to send the data to log analyst for further analysis and at the same time produce quick look report.

### 2.6.6 Depth Time Recorder Programming

1. Switch ON the DTR and DTR will show the picture as below. Make sure it's is **P+F Encoder**.

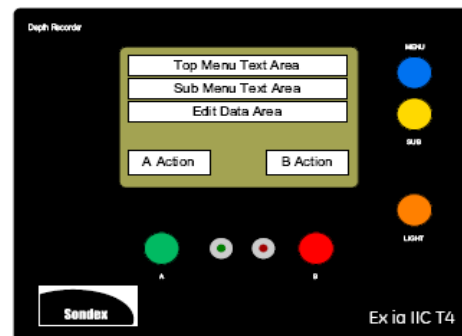
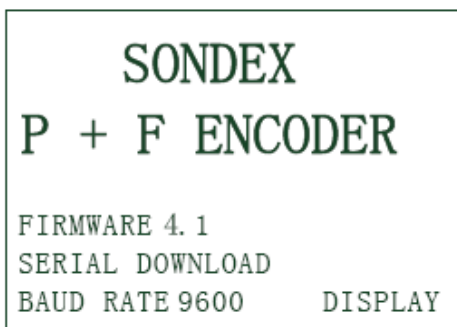



Figure 10 DTR Interface

2. To synchronize the DTR time with Laptop/PC, you need to connect the DTR via RS232 cable to the Laptop/PC.
3. Open the Sondex Ultrawire Memlog and click [DTR download](#) . Please check the com port and baud rate prior to click [Set DTR Time and Date](#).
4. To change the Depth Unit:

Sub Menu Text Area	Edit Data Area	'A' Action	'B' Action	Comments
DEPTH UNITS <sup>a</sup>	METRES or FEET	Not used	CHANGE	Press the 'B' button to toggle depth units between 'FEET' and 'METRES'
SET DEPTH FT SET DEPTH MT	+/-nnnnn.nn <sup>b</sup>	NEXT	SCROLL	<p>Sets the depth preset in the depth units displayed</p> <p>This will require the use of the 'A' button (annotated 'NEXT' and the 'B' button (annotated 'SCROLL')</p> <p>The 'FT'/'MT' is set in 'DEPTH UNIT' above</p>
WHEEL CIRC FT WHEEL CIRC MT	nn.nnnn <sup>a</sup>	NEXT	SCOLL	<p>Enter the circumference of the measure wheel in the displayed units of length</p> <p>This will require the use of the 'A' button (annotated 'NEXT' and the 'B' button (annotated 'SCROLL')</p> <p>The 'FT'/'MT' is set in 'DEPTH UNIT' above</p>

Figure 11 Depth Unit Editor

- Wheel Circ value can be calculated by dividing **Odometer/DTR** reading or 1 divide by the ratio stated at the odometer.
- For **Step 5**, you need to set wheel circ to **ONE** then zero DTR depth and odometer. RIH the tools (any tools) for 100 meter then compare the value read by DTR and odometer.
- For **Step 5**, you can also **measure the OD of counter wheel plus with wire**. Then, use the formula circumference.

$$\text{Circumference} = \pi \times \text{OD Groove with wire}$$

The value will be in inch. If you will run in feet or meter, you can convert to meter or feet. This value will be key in in Wheel Circ.

- To change the encoder pulse:

Sub Menu Text Area	Edit Data Area	'A' Action	'B' Action	Comments
ENCODER PULSES	nnnn <sup>a</sup>	NEXT	SCROLL	<p>Set the number of pulses per revolution of the shaft encoder</p> <p>This will require the use of the 'A' button (annotated 'NEXT' and the 'B' button (annotated 'SCROLL')</p>
ENCODER SENSE	REVERSE or NORMAL	Not used	CHANGE	<p>Allows the direction of rotation of the shaft encoder to be reversed.</p> <p>Press the 'B' button to toggle between 'REVERSE' and 'NORMAL'</p>

Figure 12 Encoder Pulse Editor

- Encoder pulse is stated at the encoder or provided by supplier. Two types of encoder used:
  - Big Encoder (ENCO09) – 0512**
  - Small Encoder (ENCO08) – 0100**

10. To change the AUX Recording menu:

Sub Menu Text Area	Edit Data Area	'A' Action	'B' Action	Comment
1 WEIGHT POUNDS	STATUS ON STATUS OFF	Not used	CHANGE	Press the 'B' button to change the status between 'ON' and 'OFF'
2 PRESS PSI	STATUS ON STATUS OFF	Not used	CHANGE	Press the 'B' button to change the status between 'ON' and 'OFF'
3 FLOW BPD	STATUS ON STATUS OFF	Not used	CHANGE	Press the 'B' button to change the status between 'ON' and 'OFF'
4 TEMP DEGC	STATUS ON STATUS OFF	Not used	CHANGE	Press the 'B' button to change the status between 'ON' and 'OFF'
5 INJECT BPD	STATUS ON STATUS OFF	Not used	CHANGE	Press the 'B' button to change the status between 'ON' and 'OFF'
6 PROD L/HOUR	STATUS ON STATUS OFF	Not used	CHANGE	Press the 'B' button to change the status between 'ON' and 'OFF'

*Figure 13 Auxiliary Editor*

- Once all setting been set, you may continue by pushing **blue** button until memory erase section. You need to clear the memory prior to record the new data.
- When all the data has been erased, push the **blue** button to continue to recording section.
- To start record, you need to push **green** and **red** button simultaneously.
- To stop logging, you need to push **yellow** and **hold** the button until the screen show the picture as in **Figure 10**.

### 2.6.7 Depth Time Recorder Downloading

- To download the data, you need to connect DTR via RS232 cable to Laptop/PC.
- Open the DTR section in Sondex Ultrawire Memlog and click [Download DTR Data](#).
- Please check the start time prior to save.

### 2.6.8 De-Passivate and Test Lithium Battery

- Perform physical check on the battery received and inform any anomaly observed. Used battery normally has the scratch effect on the top.
- Test the battery using multimeter. New battery will read above **19V**. If the reading is below than **14V**, it needs to **De-passivate**.



*Sensors operating at minimum voltage 13.5 V*

- For De-passivate, take an electrical meter and set it to read 20Vdc. Connect the meter across a 200Ω, 3W resistor. Connect the 200Ω resistor between the **+ve (red)** and **ground (black)** leads of the battery.

4. A passive battery will show only a small voltage reading on the meter. As the battery de-passivates and delivers more current the voltage will rise. This may take up to 20 minutes but would normally occur within 5 to 10 minutes.
5. Change the battery if the voltage reading is still below than 14V.
6. If the voltage is above 14V, battery is **READY TO GO**.



***DO NOT DE-PASSIVATE** if the battery voltage is 0V. De-passivation of the battery must be done if the battery not being used for a long time.*

### 2.6.9 Performing Bench Test

1. Please follow the step from [2.6.1](#) until step [2.6.5](#).
2. For the MIT24F, it's recommended to perform the calibration for:
  - a. **2"**
  - b. **2.5"**
  - c. **3.5"**
  - d. **4.5"**
  - e. **5.5"**
  - f. **6.5"**
  - g. **7"**.
3. For the MIT40F, it's recommended to perform the calibration for:
  - a. **4"**
  - b. **5"**
  - c. **6"**
  - d. **7"**
  - e. **8"**
  - f. **9"**
  - g. **10"**
4. Complete a bench test for all sizes (3 minutes each), along with slight shock test using rubber mallet. Please slot a time for shock test. Don't do the shock test during calibration in progress.
5. For the DTR, you may rotate clockwise and anti-clockwise the encoder to check the reading at DTR.
6. All bench test result must be properly recorded and documented.

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## EXECUTE

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### 3.1 Wellsite preparation

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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 MIT tools, lithium battery, and setting the MIT software.
6. Prepare **Sequence of Events** worksheet accordingly as per clients' job program.
7. Review Job Hazard Analysis (JHA) and apply Permit to Work (PTW).

---

### 3.2 Rig floor operational check

---

1. Make up the MIT tools and test the X-over provided by SLS/CTU/E-Line.
2. Perform calibration and bench test as per [2.6.1](#) until [2.6.4](#).
3. Check for anomalies, reliability and consistency of the data recorded.
4. Any tool-related problem encountered during bench test; inform base/lab technician and Wireline Supervisor immediately before proceed with MIT 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 MIT Caliper 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).



***If the clearance between tool and tubing is big and there is additional tubing below the No-Go, it's recommended to run the sinker bar until 2 meter above the EOT.***

6. RIH with sinker bar to tag Total Depth (TD) or Held-Up Depth (HUD). Record TD and POOH.



*This procedure is **ONLY** valid if the MIT need to be run out of casing*

7. For a short string well, RIH sinker bar to 2 meter below No-Go nipple.

8. Reconfirm the status of Sliding Side Door (SSD) by running shifting tool, if necessary.
9. Retrieve the Wireline Retrievable Surface Control Subsurface Safety Valve (WR-SCSSV) / Insert valve if the well is fitted with insert valve per standard procedure.



*Synchronization of DTR with SLS Odometer can be performed during slickline operation.*

### 3.4 Toolstring Configuration

---

#### 3.4.1 Standard Assembly

1. Wireline Toolstring (varies depending on TCC and dummy run)
2. Knuckle Joint
3. X-Over SLS to Logging Tools
4. Memory Battery Holder (ABM)
5. Ultrawire Memory Tools (UMT007)
6. Casing Collar Locator (CCL)- Optional
7. Production Gamma Ray (PGR) – Optional
8. Production Knuckle Joint (PKJ) – at least 1ea
9. Production Roller Centralizer (PRC) – PRC034 is recommended
10. Multifinger Imaging Tools
11. Production Roller Centralizer (PRC) – PRC034 is recommended
12. Bullnose with Terminator (BULL)

### 3.5 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.

#### 3.5.1 MIT Caliper Survey

The objectives of MIT Caliper are:

- To determine the level of corrosion inside the tubing
- To determine any anomaly found in the tubing such as deposition, possible hole and damage.

This survey is performed under shut in condition, after the well had been stabilized for 12-24 hours (depending on client's requirement).

#### Operation Procedures:

1. Shut in well for required duration prior to MIT Caliper Survey. Tubing clearance check must be performed prior to perform the survey.

- Repeat steps in [2.6.2](#) and record battery hook-up time. Make sure the housing is tightened by using appropriate spanner.



*Calibration must be performed prior to run and after run*

- Make up assembly to be run as in [3.4.1](#).
- Open the well and let the tool inside the lubricator for 5 minutes
- RIH with average speed of 30 m/min to set depth. The RIH speed might differ from the actual program thus read the program carefully. Also, vigilantly take several station stops to pick up pulling weight during RIH.
- Once at set depth, wait until tool open time and give 5 minutes allowance before starting the logging. Log MIT to 2 m-MDTHF at 10 m/min. Once at 2 m-MDTHF, wait for the tool close time and give 5 minutes allowance before POOH.
- Recover the MIT tools from lubricator. Download the data from UMT and DTR data.
- Perform the after job calibration to check the percentage of finger worn out. **Percentage allowable is less than 1% from the ID.** Please check the condition of fingers prior to perform after job calibration.
- Check the data reliability before rigging down all the equipment. If the data is not satisfactory, discuss with Supervisor for the possibility of re-run the MIT survey.
- Produce Quick Look Analysis and determine the condition of the tubing ID. Send the raw data together with Quick Look Analysis to the Log Analyst for Final Report.



*MIT **MUST** be conducted from the **Bottom to Top** or POOH. Do not attempt to go down if the tools stuck while POOH and fingers still open. Do not attempt to log down while fingers are still open. This may cause serious damage to the fingers.*

## 3.6 Field Data Processing & Delivery

---



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

### 3.6.1 Data Quality Check

- Follow the step from [2.6.3](#) for data processing.
- Check the data for all fingers. Observed the pattern of the finger reading. At the accessories and joint, the changes of patterns should be the same for all fingers.
- The gap between fingers should be as same as possible.
- Identify all the well accessories to tally with the well schematic.
- Cross check the finger's reading in the log vs nominal ID of the tubing.
- Perform depth shift/depth correlation on the MIT data. You may use the well accessories as a reference (TRSCSSV or No Go Nipple) for depth shift/depth correlation.
- Perform the after job calibration to check the percentage of finger worn out.



*Percentage allowable is less than 1% from the ID.*

8. Please check the condition of fingers prior to perform after job calibration. Notify the Log Analyst if the percentage is more than 1%.
9. If data is unsatisfactory, discuss with Log Analyst and Supervisor for the possibility of re-run.

### 3.6.2 Quick Look Report Submission

1. Fill up the template of the **MIT Quick Look Report**. Make sure the version is the latest.
2. Compile the report together with **Interactive Plot** and **after job calibration file.psc** that generate from the software.
3. Send the **Quick Look Report** to the client and all personnel in charge.
4. Send the **Raw Data and Calibration File** to Log Analyst for Final Report.

### 3.7 Post Survey Maintenance Procedures

---

1. Ensure the MIT Tools is clean from any debris, dirt, and grease. Use WD-40 to clean all debris, dirt, and grease.
2. Inspect all fingers and actuator for any damage and replace if necessary.
3. Inspect all additional tools for any damage and defect.
4. Inspect all the O-rings for any damage and replace if necessary. It is recommended that the O-rings seals be changed **every time for External O-ring** and **after 5 times for Internal O-ring**.
5. Please refer to the **Tool Maintenance Checklist** for the items need to be changed.
6. Record all the maintenance in the **Tool Utilization Record** and **Tool Maintenance Checklist**.

### 3.8 Post Job Logistics

---

1. After completing the maintenance, make sure all the MIT Tools 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 MIT Caliper Survey job. If there is no other planned job, FE need to send back the MIT Tools to base and prepare Material Transfer Request (MTR) documentation.

## **CLOSE**


### **4.1 Post Job**

---


1. Post Job Reporting and Paperwork.
2. Submit any lessons learnt and improvement suggestion to FSM.
3. Follow up with the logistic team for the equipment returned from location.
4. Perform bench test prior to handover the tool to Lab Technicians. If post job servicing not performed, please perform the post job maintenance before proceeding to bench test.
5. Attend debriefing with FSM.

**4.2 MIT SSP Summary and Op-Check**

**MIT SSP Summary Checklist:**

<b>MIT SSP CHECKLIST</b>		
<b>At Base: Design &amp; Prepare</b>		
<b>Design</b>	Client has provided the well information, confirmed the number of run, logging interval 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"/>
<b>Prepare</b>	Discussed with CHS FSM on the availability of the MIT Tools.	<input type="checkbox"/>
	For X-Over, discussed with SLS FSM or OE on the availability and functionality.	<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 Sondex Software (Refer to Op-Check Checklist).	<input type="checkbox"/>
	Perform MIT Opcheck (Refer to Op-Check Checklist).	<input type="checkbox"/>
<b>At Well Site: Execute</b>		
<b>Rig Up</b>	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"/>
	Ensure tubing clearance is conducted prior to RIH MIT Tools.	<input type="checkbox"/>
	Perform MIT Opcheck (Refer Opcheck Checklist).	<input type="checkbox"/>
	Prepare Sequence of Events (SOE) corresponding to the designed logging interval.	<input type="checkbox"/>
	Program UMT and duration accordingly.	<input type="checkbox"/>
	Make-up MIT toolstring as per program.	<input type="checkbox"/>
	Ensure FIT for X-Over from SLS/CTU/E-Line to MIT Tools.	<input type="checkbox"/>
	Hook-up battery and record MIT initiation time.	<input type="checkbox"/>
	Zero toolstring (CRP for MIT is at Finger) at Tubing Head Flange (THF).	<input type="checkbox"/>
<b>MIT Run</b>	Perform MIT Caliper survey run as per SSP.	<input type="checkbox"/>
	RIH with average speed of 30m/min to set depth.	<input type="checkbox"/>
	POOH to surface at 10m/min, not exceeding 18 m/min.	<input type="checkbox"/>
<b>Post Job</b>	Clean the tool during rig down while it hangs out from lubricator.	<input type="checkbox"/>
	Rig down toolstring and retrieve MIT Tools.	<input type="checkbox"/>
	Download data and perform data QA/QC as per SSP	<input type="checkbox"/>
	Perform After Job Calibration as per SSP	<input type="checkbox"/>
	Perform post job maintenance on MIT Tools	<input type="checkbox"/>
	Submit the Quick Look Report and Raw Data to Client and Log Analyst	<input type="checkbox"/>
<b>Return to Base: Close</b>		
	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"/>
<b>Name:</b>	<i>write your name here</i>	
<b>Date:</b>	<i>dd/mm/yyyy</i>	<b>Signature:</b> <span style="float: right;"><i>sign here</i></span>

**MIT Op-Check Checklist:**

<b>MIT OP-CHECK CHECKLIST</b>		
<b>PPS SmartView</b>		
<b>Software</b>	Computer operating system no older than Windows 2000, 32bit for W7 and 64 bit for W8	<input type="checkbox"/>
	Latest Warrior and Sondex Memlog Software is installed (Emeraude Software is optional).	<input type="checkbox"/>
	Ensure correct Warrior Key License entered.	<input type="checkbox"/>
	No error while launching and operating the software	<input type="checkbox"/>
	Check MIT tool have up to date calibration	<input type="checkbox"/>
<b>Lithium Battery</b>		
<b>De-passivate</b>	Check the battery condition received	<input type="checkbox"/>
	Check the battery voltage using multimeter (reading should be >19V)	<input type="checkbox"/>
	De-passivate battery (If the voltage less than 14V)	<input type="checkbox"/>
	Replace the battery if the voltage reading is still below than 14V (minimum requirement is 14V)	<input type="checkbox"/>
	For DTR, check the D-cell battery power and replace if it is low.	<input type="checkbox"/>
<b>MIT Tools</b>		
<b>Bench Test</b>	Connect MIT Tools with laptop through USB UMT001 and launch Sondex Ultrawire Memlog and Acquisition	<input type="checkbox"/>
	Check communication between laptop with UMT/DTR. Make sure no error while communicating.	<input type="checkbox"/>
	Synchronize the DTR time with laptop. Recommended to synchronize with FE personal watch	<input type="checkbox"/>
	Ensure correct/calibrated wheel circumference entered in DTR. Check the unit used same with wireline unit	<input type="checkbox"/>
	Test DTR and Encoder by rotating the shaft	<input type="checkbox"/>
	Hook up encoder and splitter to angle drive on wireline unit. Ensure encoder in correct position to avoid pin parted	<input type="checkbox"/>
	Ensure the correct serial number and layout added in toolstring configuration	<input type="checkbox"/>
	Check the functionality of the MIT Tools as per SSP and verify the output	<input type="checkbox"/>
	Program the MIT Tools for calibration as per SSP	<input type="checkbox"/>
	Hook-up battery to the MIT Tools. Ensure the sound 'Bip' at the UMT or observed fingers is opening	<input type="checkbox"/>
	Perform MIT Calibration as per SSP	<input type="checkbox"/>
	Apply vibration/shock test on MIT Tools	<input type="checkbox"/>
	Download data from UMT and perform calibration step as per SSP	<input type="checkbox"/>
	Perfrom QA/QC based on the results obtained.	<input type="checkbox"/>
Record and document the bench test results	<input type="checkbox"/>	
<b>Name:</b>	<i>write your name here</i>	
<b>Date:</b>	<i>dd/mm/yyyy</i>	<b>Signature:</b> <span style="float: right;"><i>sign here</i></span>

## APPENDICES

### 5.1 Sequence of Events Template

Time (hrs)	Event Description	Remarks
0930H	Programmed MIT Memory section.	
1006H	Hooked up battery to tool. Fingers opened as per program.	
1012H	Fingers closed as per program prior rigging up equipments.	
1020H	Hooked up MIT to wireline tool string.	
1030H	Open well.	3600 psig
1035H	RIH with line speed of 30 m/min to MIT set depth at 4193 m-MDDF.	
1235H	MIT at set depth 4193 m-MDDF and wait for MIT Fingers Open Time.	
1255H	MIT Fingers Open Time. Waited 5 minutes prior to logging up.	
1305H	Started logging MIT to depth 22 m-MDDF with speed of 10 m/min.	
1913H	MIT arrived at 22 m-MDDF. Waited for MIT fingers to close.	
1931H	MIT Fingers Close Time. Waited 3 minutes prior to POOH.	
1935H	POOH MIT into Lubricator.	
1940H	Closed well. Depressurize Lubricator and recovered MIT from Lubricator.	
1950H	Disconnected MBH memory from MPL.	
2000H	Downloaded MIT Memory and Depth Recorder (DTR).	

*Note: All MIT and Depth data were downloaded successfully. Survey depth is based on Wireline depth.*

I, the undersigned, justified that the above services and equipment have been provided.

Field Engineer	Client Representative
<hr/> Name: Mohd Azmi Ahmad Date: 28 May 2019	<hr/> Name: Saparmammed Bayramdurdyev Date: 28 May 2019

## 5.2 Troubleshoot

### Hardware & Software Problems

<i>Symptoms</i>	<i>Possible Problems</i>	<i>Solutions</i>
UMU001 failing to communicate with the UMT.	Software for UMU001 not installed	Install the software for UMU001
	USB failed to communicate	Unplug and plug the USB
	UMU001 problem	Change with the backup UMU001
Unable to launch the UW Memlog software and Warrio Acquisition	Wrong Key Code inserted	Confirm the Key Code to tally with key dongle
	Compatibility problem	Check the computer operating system to tally with software installed
	Software or drivers are corrupt or damaged	Upgrade to latest software version or reinstall (ensure USB devices disconnected).
Date recorded to memory is noisy	Low voltage of the battery	Check the battery voltage or change the battery
Data is out of the tools specification	Sensor/Tools Problem	Perform physical check on tools condition for any damage or defect. Refer to the tools manual for maintenance
	The MIT may need to be recalibrated	Check the condition of fingers. Replace if necessary and calibrate again
	Setting of software/service not correct	Please refer to the MN-UW memlog and MN-Warrior manual for setting
No data recorded	Battery blown	Change new battery
	UMT not recorded	Check the profile program or change with new UMT  Perform physical check on tool for any damage or defect

### 5.3 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 MIT are subjected to PPM **every 6-months** to maintain its reliability and accuracy. This involves physical inspection on internal electronic section, fingers condition, and will be tested using Oven for heat test. If the result from the Oven is off, the MIT Tools needs to **perform maintenance** or send to supplier for **major maintenance**.

### 5.4 Lessons Learnt

#### Case 1: MIT24F finger broken after survey.

##### Incident 1: 2ea MIT24F finger broken

Date	22 May 2017
Platform	Bunga Orkid Charlie
Well	BOC 14
Job	MIT24 Caliper Survey
BHA	Wireline toolstring + MIT24F BHA

During retrieve the MIT from lubricator, engineer found 2ea of MIT24F finger not properly close. When engineer try to open the fingers, he found that 2ea fingers were broke.

Engineer suspect the debris such as sand was blocking the spring and finger clamp that cause spring broke. Engineer perform servicing and change the finger.



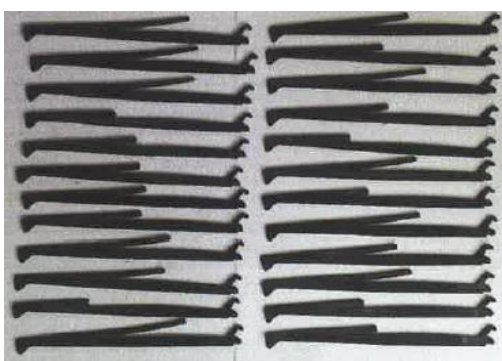
Figure 14. Spring broke

**Incident 2: 24ea MIT24F finger broke**

Date	23 May 2017
Platform	Bunga Orkid Charlie
Well	BOC 14
Job	MIT24 Caliper Survey
BHA	Wireline toolstring + MIT24F BHA

During retrieve the MIT from lubricator, engineer found 24ea of MIT24F finger not properly close. When engineer try to open the finger, he found that all the fingers spring already broke.

Engineer suspect the debris such as sand was blocking the spring and finger clamp that cause spring broke. Job was suspended due for the investigation. Sample of finger was sent to supplier for investigation. Detail of well condition and properties were check. Based on the investigation, supplier make the conclusion the finger broke were due to exposure to high content of Mercury (Hg) not because of blockage of debris. MIT fingers are following the NACE specification but it's has the limitation.



**Figure 15.** Spring broke

---

***Lesson Learnt: MIT fingers from Sondex are follow the NACE specification but mercury are very extremely corrosive. It's recommended to check the content of mercury and use chemical inhibitor to reduce the effect of mercury on tools.***

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## 5.5 Best Practices & Precautions

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1. Determine the well properties to make sure the tools are within the requirement.
2. Perform quick bench test prior to run.
3. Record the battery usage to avoid waste of battery.
4. Always perform before and after calibrations every run.
5. Check the fingers tip and actuator condition before and after every run.
6. Always check O-ring conditions after every run.
7. Make sure tools are cleaning and in good condition before storage and run.

## 5.6 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 (H<sub>2</sub>S) and Carbon Dioxide (CO<sub>2</sub>) 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 will be more reliable.

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

#### *O-Ring Cross Check Table*

Tool	MIT TOOLS
Tool Code	MIT24F

NO	O-RING SIZE	QUANTITY PER NO. OF RUNS				
		1	5	10	15	20
1	O-RING SZ-028	4	20	40	60	80
2	O-RING SZ-211	14	70	140	210	280
3	O-RING SZ-012	10	50	100	150	200
4	O-RING SZ-124	6	30	60	90	120
5	O-RING SZ-118	4	20	40	60	80
6	BACKUP O-RING 118	2	10	20	30	40
7	BACKUP O-RING 124	2	10	20	30	40

### **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.

### **Corrosion and Chemical Effect**

'NACE Specification' refers to the international standard **NACE MR0175 / ISO 15156**, which was originally written by the National Association of Corrosion Engineers. This standard lists materials that are suitable for use in H<sub>2</sub>S-containing environments in oil and gas production. 'NACE Spec' is a commonly used but often misunderstood phrase within the Wireline Logging industry. 'NACE Spec.' does not mean 'H<sub>2</sub>S Proof'.

**Hydrogen Sulphide** reacts with some metals releasing hydrogen into the structure of the metal and causing embrittlement. This is particularly significant with components that are already under stress or are required to deform elastically (e.g. springs). On some non-ferrous components the effect of H<sub>2</sub>S is merely surface discoloration and mild surface pitting which in general is no cause for concern.

**Carbon dioxide** dissolves in water to form a weak acid which may also corrode metal components and further complicate the effects of H<sub>2</sub>S. It is also common to see the effects of CO<sub>2</sub> on O-rings and similar elastomeric seals. The CO<sub>2</sub> penetrates the structure of the rubber at high pressure, but as the tool is retrieved from the well the pressure decreases rapidly and the O-ring becomes swollen. O-rings exposed to CO<sub>2</sub> in this manner should not be reused. Sondex can supply more resistant O-rings which, although more expensive, perform better in high CO<sub>2</sub> environments.


**Mercury** is extremely corrosive to some of the metals. Under very rare circumstances wells may produce native Mercury (Hg). This is due to two possibilities:

- a. Mercury has been used to lift trash from the well (rare nowadays due to environmental concerns)
- b. Mercury is freely flowing into the well - very rare but can happen.

**5.7 MIT Programming Sheet**

MEMORY MIT PROGRAM NO REPEAT SECTION (Corrosion/Scale Monitoring Tool)											
<b>VARIABLES</b>			Depth resolution = 0.027 ins		Well Name: SaA-6s						
Main Log Bott. Depth: 1982 m			= 0.696 mm		DATE: 1-Jul-14						
Main Log Top Depth: 2 m			Tool Type (24 or 40 only) = 24		<b>Start Time</b>						
R.I.H. Speed: 30 m/min			<b>*Changeable Items are BOLD and COLOURED BLUE</b>		<b>11:00:00 AM</b>						
Logging Speed: 10 m/min			24-Finger 1.11/16" tool: 3381.82 Bytes/s, 73 Readings/Sec								
Tool Data Rate: 3381.82 Bytes/s			40-Finger 1.11/16" tool: 4009.09 Bytes/s, 53 Readings/Sec								
Tool Instruction: M=OPEN, N=CLOSED											
Job Sequence	Program	Divisor	Position	Time mins	Bytes	Total Mem.	Cummulative Minutes	Cummulative Time	Tool Program	Real Time	Action
Tool Check/ Pre Srv. Cal.	M	20	Open	10.0	101,455	101,455	0.0	0:00:00	0:00:00	11:00:00 AM	Tool Opens
Start Rig Up	N	73	Closed	15.0	41,694	143,148	10.0	0:10:00	0:10:00	11:10:00 AM	Tool Closes
R.I.H	N	73	Closed	67.0	186,232	329,380	25.0	0:25:00		11:25:00 AM	Start RIH
RIH Insurance (Spare)	N	73	Closed	15.0	41,694	371,074	92.0	1:32:00		12:32:00 PM	
OPEN	M	1	Open	3.0	608,728	979,801	107.0	1:47:00	1:47:00	12:47:00 PM	Time Tool Opens
Main Log	M	1	Open	198.0	40,176,022	41,155,823	110.0	1:50:00		12:50:00 PM	Start Main Log
M/L Insurance (Spare)	M	1	Open	15.0	3,043,638	44,199,461	308.0	5:08:00		4:08:00 PM	
CLOSE	N	73	Closed	3.0	8,339	44,207,800	323.0	5:23:00	5:23:00	4:23:00 PM	Time Tool Closes
POOH	N	73	Closed	1.0	2,780	44,210,579	326.0	5:26:00		4:26:00 PM	Start POOH
Start Rig Down	N	73	Closed	0.0	0	44,210,579	327.0	5:27:00		4:27:00 PM	Rig Down
Post Survey Calibration	M	20	Open	0.0	0	44,210,579	327.0	5:27:00	5:27:00	4:27:00 PM	Time Tool Opens
End of Job				327.0	44,210,579		327.0	5:27:00	5:27:00	4:27:00 PM	Tool Closes / End
Equipment Cleaning, Download and Data Verification + Packing: 1 hour											
Tool Memory Size, KB	65535										
Available Memory in Bytes	67107840										
				<b>Start Time (HH:MM:SS)</b>	<b>Start Time (HH:MM:SS)</b>	<b>Profile Length (mins)</b>	<b>Tool Name</b>	<b>UMT</b>	<b>MIT</b>		
							<b>UW Address</b>	<b>0</b>	<b>15</b>	Open	3.0 * Fill In
							<b>Default Rate</b>	<b>1</b>	<b>0.02</b>	Log Open	7.0
							<b>Profile Type</b>	<b>Rate</b>	<b>Rate</b>	Close	94.0
				11:00:00 AM	0:00:00	3.0	Open			Log Close	3.0 * Fill In
				11:03:00 AM	0:03:00	7.0	Log Open	1	0.02	Open	3.0
				11:10:00 AM	0:10:00	94.0	Close			Log Open	213.0
				12:44:00 PM	1:44:00	3.0	Log Close	1	0.02	Close	2.0
				12:47:00 PM	1:47:00	3.0	Open			Log Close	2.0 * Fill In
				12:50:00 PM	1:50:00	213.0	Log Open	1	0.02	Open	2.0 * Fill In
				4:23:00 PM	5:23:00	2.0	Close			Log Open	-2.0
				4:25:00 PM	5:25:00	2.0	Log Close	1	0.02	Close	2.0 * Fill In
				4:27:00 PM	5:27:00	2.0	Open				
				4:29:00 PM	5:29:00	-2.0	Log Open	1	0.02		
				4:27:00 PM	5:27:00	2.0	Close				

**5.8 Battery Consumption Table**

UltraWire UMT BATTERY LIFE ESTIMATION																															
<b>Battery Information</b>										<b>Results:</b>																					
Battery Type	BEI																														
Power Rating	6.2	Ampere Hrs																													
Capacity Factor	80	%																													
Available power	4960	mAH																													
Self Drain per day	1.0	%																													
																															
				<table border="1"> <tr> <td>Total Available</td> <td>4960.0</td> <td>100.0</td> </tr> <tr> <td>Total Used</td> <td>447.3</td> <td>9.0</td> </tr> <tr> <td>Self Drain</td> <td>20.0</td> <td>90.6</td> </tr> <tr> <td><b>Total Left</b></td> <td><b>4492.8</b></td> <td><b>90.6</b></td> </tr> </table>																Total Available	4960.0	100.0	Total Used	447.3	9.0	Self Drain	20.0	90.6	<b>Total Left</b>	<b>4492.8</b>	<b>90.6</b>
Total Available	4960.0	100.0																													
Total Used	447.3	9.0																													
Self Drain	20.0	90.6																													
<b>Total Left</b>	<b>4492.8</b>	<b>90.6</b>																													
TOOL:	UMT	MIT	MTT	PRT	QPC	QPS	CCL	LS	PSR	FDR	FDD	PDC	HTU	DBT	PIA	CTF	CWH	RBT	Total												
CURRENT:	20	20	25	20	20	20	16	16	20	35	50	25	30	20	25	33	20	20	Current,mA												
TOOLS USED:	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40												
SLEEP/SETUP:	SLEEP	MOTOR	TRANS	This spreadsheet is to be used as a guide only. As battery life is dependent upon so many variables.																											
CURRENT:	1.5	343	52	Sondex cannot be held liable for consequences resulting from it's use.																											
																			Total Profile Length (hrs)	9.7											
																			V100 23 Sep 2006	A Boyter											
<b>UMT Start Time</b>			<b>Profile Length</b>		<b>Command</b>		<b>Capacity Factor Table, %</b>						<b>Total</b>			<b>Power Used</b>		<b>Cumulative</b>													
Date/Month/Year			Minutes		UMT Command		BEI		150 deg C		180 deg C		Current			mAH		mAH													
24hr Clock							Capacity		5.5 Ah		4.5 Ah																				
9/22/2006 23:15			3		Open		Ambient		70		70		343			17.15		17.15													
9/22/2006 23:18			3		Log		50 deg C		80		80		40			2.00		19.15													
9/22/2006 23:21			3		Close		100 deg C		70		80		343			17.15		36.30													
9/22/2006 23:24			140		Log		150 deg C		80		90		40			93.33		129.63													
9/23/2006 1:44			3		Open		<b>Instructions:</b>																								
9/23/2006 1:47			425		Log		Enter Battery Information, Estimate capacity factor allow ing.																								
9/23/2006 8:52			3		Close		for a Saftey margin.																								
9/23/2006 8:55					Sleep		Self drain is related to dow hnole temperature. For Lithium																								
9/23/2006 8:55					Sleep		batteries it is low .																								
9/23/2006 8:55					Sleep		Enter Tool Type, Tools used and Tool Current as in the final																								
9/23/2006 8:55					Sleep		test records																								
9/23/2006 8:55					Sleep		Enter Date and Tool Start time																								
9/23/2006 8:55					Sleep		Enter profile length minutes and Command as in UW Memlog																								
9/23/2006 8:55					Sleep		profile.																								
9/23/2006 8:55					Sleep		Computed answers are highlighted in yellow																								
9/23/2006 8:55			Profile End Time										Power Used:			447.27															

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## 5.9 References

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