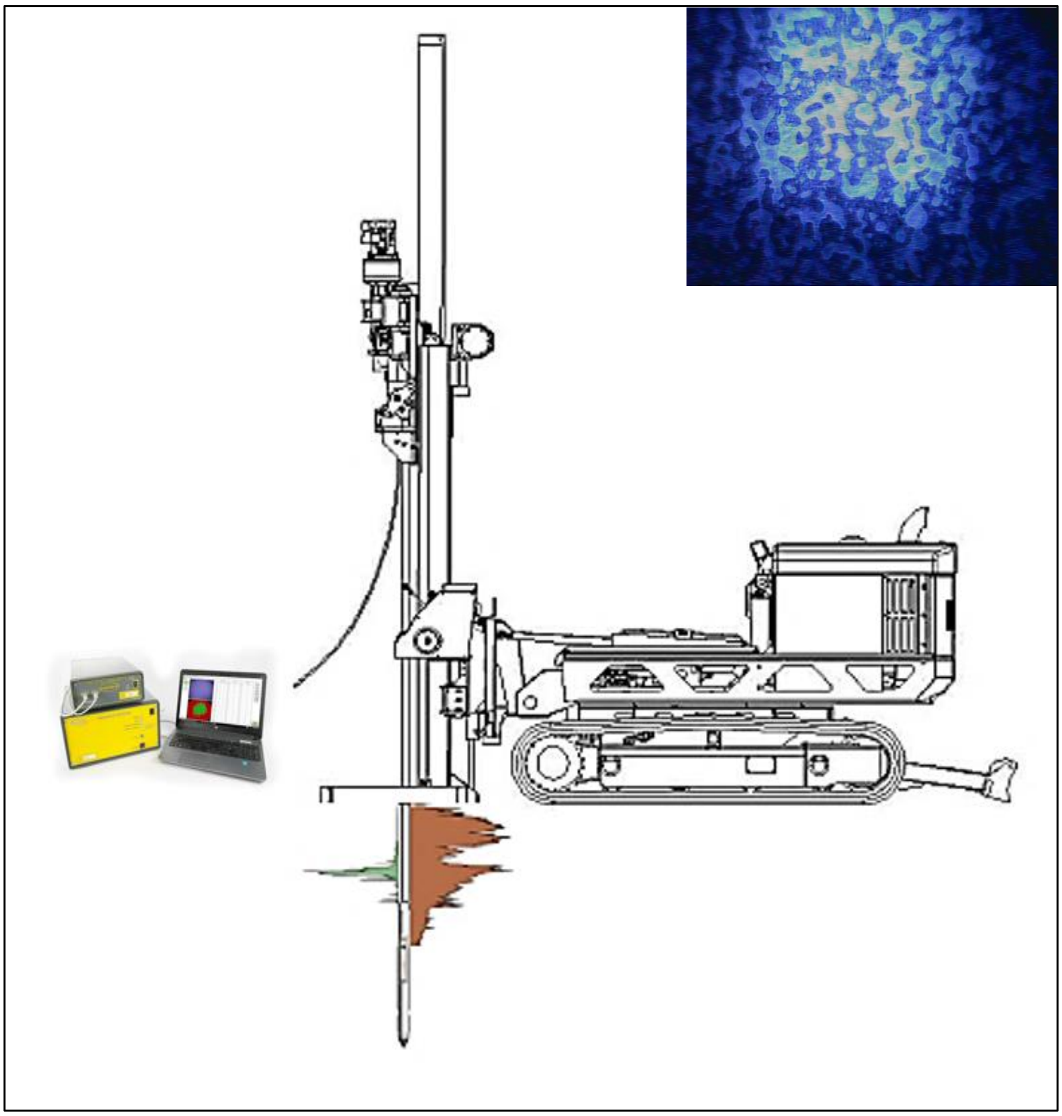
Geoprobe® Optical Image Profiler (OIP)

Standard Operating Procedure

Revision 2.1
PREPARED: January 2019



⚠CAUTION

CAUTION indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.

⚠WARNING

WARNING indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.

⚠DANGER

DANGER indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

1.0 Objective

This document serves as the standard operating procedure for the Geoprobe® Optical Image Profiler (OIP) system. In this procedure, the OIP system is used to measure the fluorescence response of polyaromatic hydrocarbons (PAHs) in the soil excited by ultraviolet (UV) light or green light for identifying non-aqueous phase liquid (NAPL) hydrocarbon fuels, oils, and tars. Additional information about the application of the OIP-UV system is available in an Open Access publication (McCall et al. 2018).

⚠CAUTION

- **The Optical Image Profiler UV (OIP-UV) probe contains an ultra-violet (UV) light source. Looking at the UV light source without proper UV eye protection will be harmful to your sight and should be avoided.**
- **The Optical Image Profiler Green (OIP-G) probe contains a green laser diode. The OIP-G is a Class 1 laser product (see below). Avoid exposure to the beam. Do not stare into the beam or view directly with optical instruments.**

See Appendix 2 for OIP-G output parameters

See Appendix 3 for OIP-G labels and label locations

2.0 Background

2.1 Definitions

Geoprobe®*: A brand of high quality, hydraulically-powered machines that utilize both static force and percussion to advance sampling and logging tools into the subsurface. The Geoprobe® brand name refers to both machines and tools manufactured by Geoprobe Systems®, Salina, Kansas. Geoprobe® tools are used to perform soil core and soil gas sampling, groundwater sampling and testing, electrical conductivity and contaminant logging, grouting, and materials injection.

**Geoprobe® and Geoprobe Systems® are registered trademarks of Kejr, Inc., Salina, Kansas.*

Optical Image Profiler (OIP) System: A system developed by Geoprobe Systems® for the detection of non-aqueous phase liquid (NAPL) hydrocarbon fuels, oils, and tars in the subsurface. The OIP system uses an UV or green light source to induce fluorescence of the polyaromatic hydrocarbons (PAHs) of the fuels, oils, and tars present in the soil. A down hole camera captures an image of the induced fluorescence. The captured image is then analyzed to determine the area of fluorescence. The NAPL hydrocarbon fuel, oil, or tar is measured as the percent area within the image that contains fluorescence.

Hydraulic Profiling Tool (HPT) System: A system manufactured by Geoprobe Systems® to evaluate the hydraulic behavior of subsurface soil. The tool is advanced through the subsurface at a constant rate while water is injected through a screen on the side of the probe. An in-line pressure sensor measures the pressure response of the soil to water injection. The pressure response identifies the relative ability of a soil to transmit water. Both pressure and flow rate are logged versus depth.

Optical Image Hydraulic Profiling Tool (OiHPT) System: A system manufactured by Geoprobe Systems® which combines the OIP system and HPT system. The tool allows for the collection of both OIP data and HPT data in a single advancement of the tool into the subsurface.

Class 1 Laser Product: Any laser product which during operation does not allow access to laser radiation in excess of the accessible exposure limit of Class 1 for the specific wavelength and emission duration. Accessible exposure limits are set by the IEC60825-1 and FDA 21 CFR standards. Class 1 is the lowest possible class for a laser product. Class 1 laser products are considered safe during operation, even in the case of directly viewing the beam.

2.2 Introduction

The OIP system has been developed by Geoprobe® for the detection of NAPL hydrocarbon fuels, oils, and tars present in the soil. NAPL may be detected as layers, ganglia, blebs or droplets of product in the formation matrix. The OIP probe includes an electrical conductivity (EC) array to measure bulk formation EC as the probe is advanced at a rate of 2 to 4ft/min. The OIP probe and logging system can quickly provide logs that are easily interpreted. The OIP system provides logs of percent area of fluorescence (%AF) along with images of fuel fluorescence with depth. The %AF logs and images are used to indicate the presence of NAPL and the EC logs may help define lithology.

The OIP-UV probe (Fig. 2.1) uses an UV light emitting diode (LED) with maximum intensity at 275nm (nanometers). The UV light from the LED passes through the sapphire window and onto the soil. If fuels (gasoline, diesel, etc.) are present in the soil the contained PAHs will absorb the UV light and emit fluorescence, often in the visible range. The camera captures the image of the visible fuel fluorescence. The captured image is then analyzed to determine the number of pixels in the image that indicate fluorescence typical of Light NAPL fuels and oils.

The OIP-G probe (Fig. 2.2) uses a green laser diode light source with maximum intensity at 520nm. The green light passes through the sapphire window and onto the soil. If coal tars, creosote or any heavy fuels or oils are present in the soil the contained PAHs will absorb the green light and emit fluorescence, typically in the orange to red wavelength range. An optical filter on the camera excludes any reflected green light from the light source. The orange to red wavelength fluorescence passes through the optical filter and the camera captures an image of the fluorescence. The captured image is then analyzed by the software to determine the number of pixels in the image that indicate fluorescence typical of heavy NAPL fuels, oils, and tars.

An EC array is built into the OIP probe. This allows the user to collect bulk formation EC data for lithologic interpretation. In general, the higher the electrical conductivity value, the smaller the grain size, and vice versa. However, other factors can affect EC, such as mineralogy, pore water chemistry (brines, extreme pH, seawater) as well as metallic objects in the soil. Targeted core samples should be collected to confirm lithologic interpretations based on EC logs.

Data is collected and is viewed in real time through the DI Acquisition software. The field instrument collects the electrical conductivity, probe rate, diagnostic parameters, and depth. The optical interface collects the fluorescence images. The field instrument and optical interface send the collected data to the laptop computer. The laptop computer stores and displays the collected data with depth through the DI Acquisition software. The laptop computer analyzes and stores the fluorescence images and displays the percent fluorescence with depth.

For OiHPT see the HPT Standard Operating Procedure (SOP) for operating the HPT system.

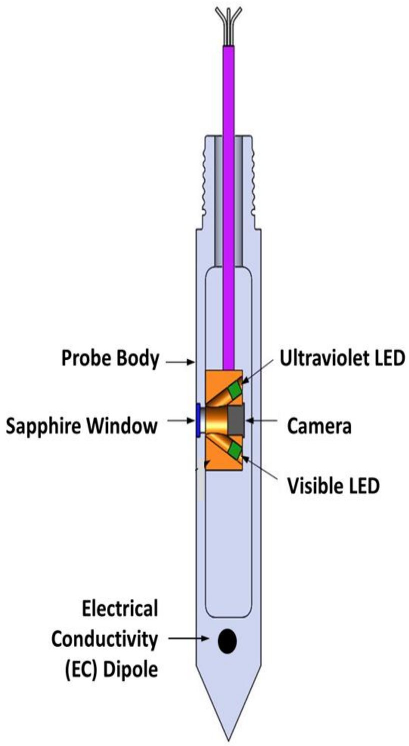


Figure 2.1 Drawing of the OIP-UV Probe

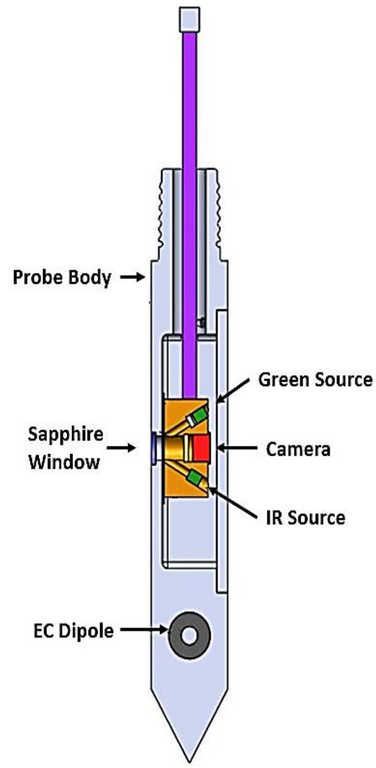


Figure 2.2 Drawing of the OIP-G Probe

3.0 Tools and Equipment

The following equipment is required to perform and record an OIP log using a Geoprobe® 66- or 78-Series Direct Push Machine. Refer to Appendix I for identification of the specified parts.

Basic OIP System Components	Quantity	Material Number
Field Instrument, 120V (Model FI6000)	-1-	213940
Field Instrument, 220V (Model FI6003)	*	213941
OIP Interface	-1-	224720
HPT Flow Module, 120V (Model K6300)	-**-	214091
HPT Flow Module, 220V (Model K6303)	*	214093
DI Acquisition Software	-1-	130063
OIP-UV Probe, OP6560	-x-	224739
OIHPT-UV Probe, OP6570	-1-	227466
OIP-UV Power Supply	-1-	224692
OIHPT-UV Power Supply	-**-	228265
OIP-G Probe, OP6710	-x-	228267
OIHPT-G Probe, OP6720	-**-	231346
OIP-G Power Supply	-**-	230392
OIHPT-G Power Supply	-**-	231345
1.75 in Connection Tube	-1-	219594
1.75 in Connection Tube with Friction Reducer	(optional)	225827
Drive Head 1.5 in Pin x 1.75 in SL Box	-1-	220545
Drive Head 1.75 in Pin x 1.75 in SL Box	-***-	220130
Trunkline Seal Spacer (pair)	1	207596
Trunkline Seal Yellow	1	207773
Trunkline Seal Red	-**-	211768
OIP Trunkline 150 ft.	-1-	226362
OIHPT Trunkline 150 ft.	-**-	228254
OIP Service Kit	-1-	226361
HPT Service Kit	-**-	205599
HPT Reference Tube 1.75 in Probe	-**-	212689
HPT Reference Tube 2.25 in Probe	**	211762
Stringpot, 100-inch	-1-	214227
Stringpot Cordset, 65-feet (19.8 m)	-1-	202884

*Use in place of 120V components if desired.

** For OiHPT

*** For use with 1.75 in rods

x No longer available. All OIP probes will be sold as OiHPT-UV or G probes.

3.1 Computer Hardware Requirements

Minimum	**Recommended or Higher**
i3 4th Generation 2.0GHz Processor 4Gb of RAM Windows 7	i5 6th generation 2.4GHz Processor 8Gb of RAM Windows 10

The latest DI software can be downloaded from the Geoprobe website

4.0 OIP Assembly

Probe Assembly

Refer to Appendix 1

4.1 Threading the Rods

1. Protect the ends of the trunkline to be threaded through the rods with electrical tape.
2. Probe rods must alternate directions prior to threading the trunkline.
3. The end of the OIP trunkline with longer leads to the chrome connectors is the downhole or probe end.
4. The probe end of the trunkline will always enter the male end and exit the female end of the probe rods.
5. The instrument end of the trunkline (shorter leads to the chrome connectors) will always enter the female end and exit the male end of the probe rods.
6. After the trunkline is through the probe rods make sure the downhole end is threaded through the male end of the drive head and connection tube prior to connecting to the probe.
7. The trunkline is now ready to connect to the OIP interface and to the OIP power supply and probe.

4.2 Instrument Setup

1. Connect the Field Instrument (FI6000), OIP Interface (OP6100), and laptop to an appropriate power source.
2. Connect the FI6000 to the OP6100 using the 62-pin communication cable inserted into the acquisition port of each instrument. See figure 4.1 for the OP6100 cables.

3. Connect the OIP EC Breakout Cable to the green terminal block connector on the FI6000 and OP6100.

4. Connect a USB cable from the back of the FI6000 to the back of the OP6100.

5. Connect the OIP Video/EC Cable to the OP6100 and to the up-hole end of the OIP Trunkline designated by a yellow, orange, brown and 2 red wires.

6. Connect the OIP Control Cable to the OP6100 and to the up-hole end of the OIP Trunkline designated by a white, grey, blue, green and black wire.

7. Connect two USB cables to the front of the OP6100. Wait before connecting the USB cables to the field laptop.

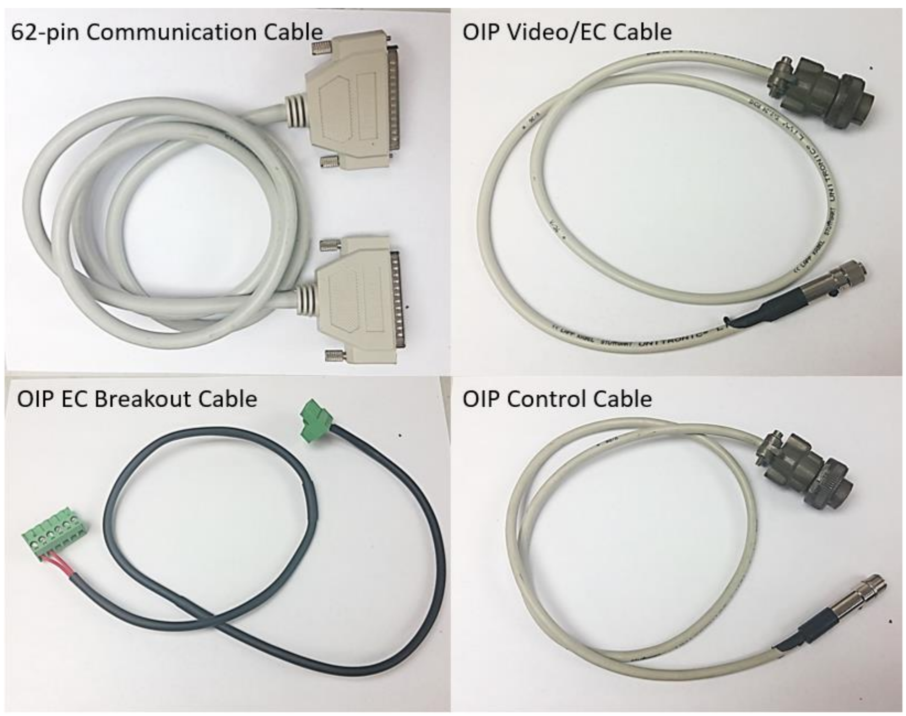


Figure 4.1 OP6100 cables excluding USB cables

4.3 Connecting the OIP Probe to the Trunkline

1. Connect the longer OIP Probe chrome connector lead to the OIP Power Supply. This connector pair is unique and will not connect to any other chrome connector (Fig. 4.2). This side includes the white, blue, red, green, and black wires.

2. Connect the shorter OIP Probe chrome connector lead to the OIP Trunkline chrome connector with the longest lead (Fig. 4.2). This side includes the yellow, black, and 2 red wires.

3. Connect the OIP Power Supply to the OIP Trunkline chrome connector with the shorter leads (Fig 4.2). The wires here will include the white, blue, green and black wires.

4. Wrap the collar of each of the chrome connector pairs with electrical tape (Fig. 4.3). This step will help to stop the chrome connector pairs from disconnecting during logging.

5. Loop and tape the wires from the longer of the OIP Probe chrome (Fig. 4.4).

6. Loop and tape the trunkline wires above the OIP Power Supply (Fig 4.5) such that the overall length from the top of the OIP probe to the jacket of the OIP trunkline does not exceed 2 ft.

7. Cover the connections with a 2ft. protective sleeve, such as a LB Liner Tube (MN223827) shown in Figure 4.6.

8. It is recommended to create a strain relief using tape below the water seal (Fig. 4.7).

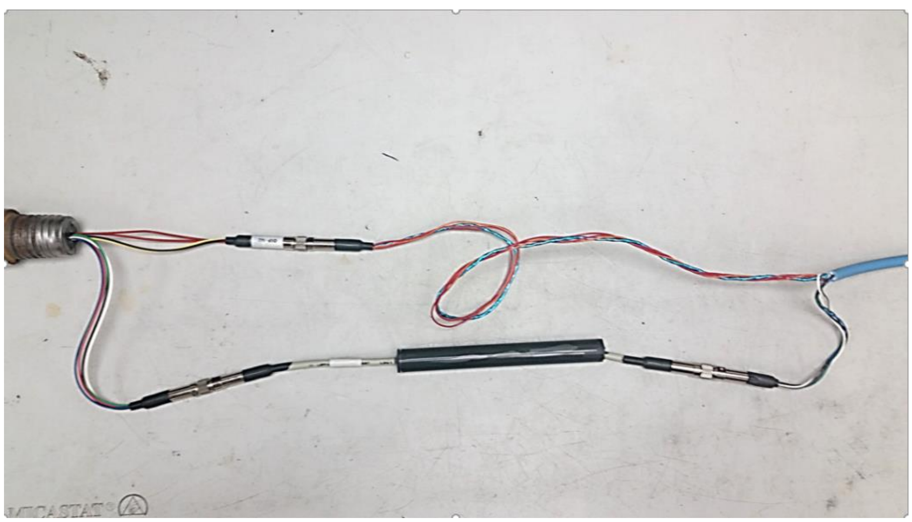


Figure 4.2 OIP Probe, OIP Power Supply and OIP Trunkline Connections

Figure 4.3 Taped Chrome Connector

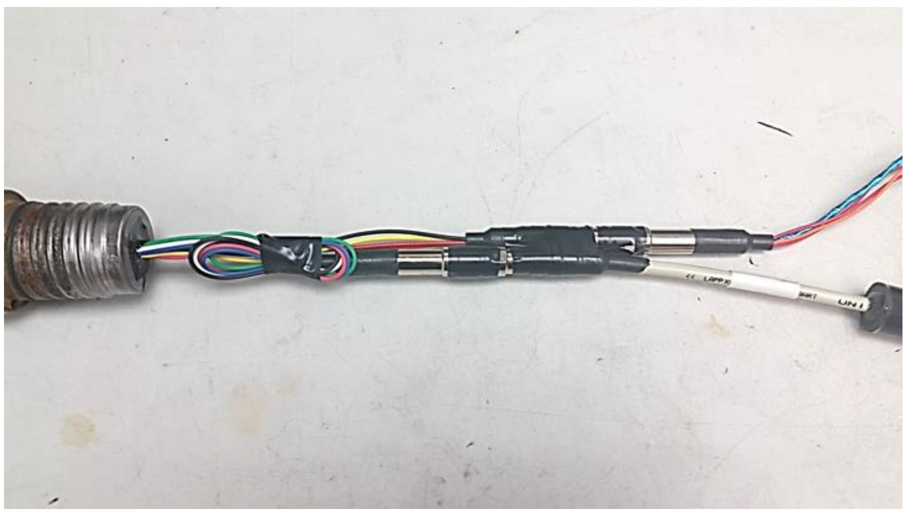


Figure 4.4 Looped OIP Probe Leads

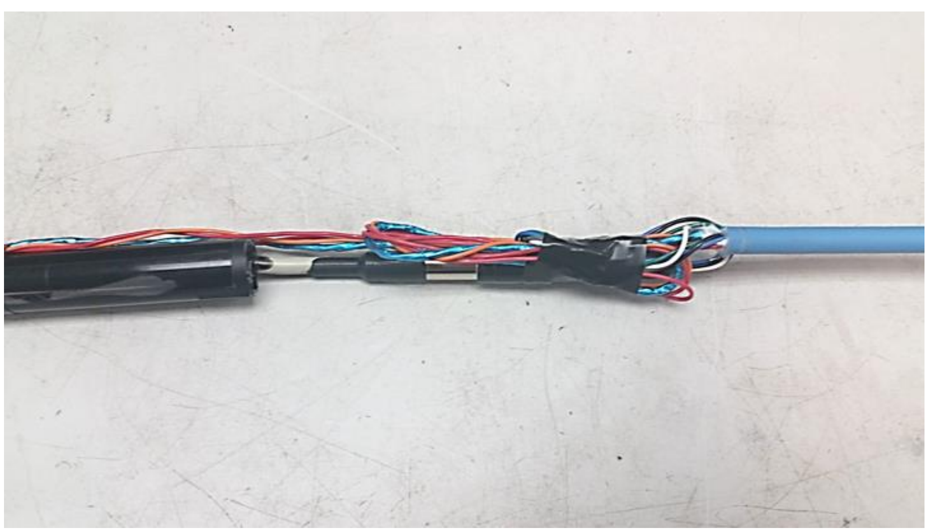


Figure 4.5 Looped OIP Trunkline Leads

Figure 4.6 Connection Liner Tube Sleeve

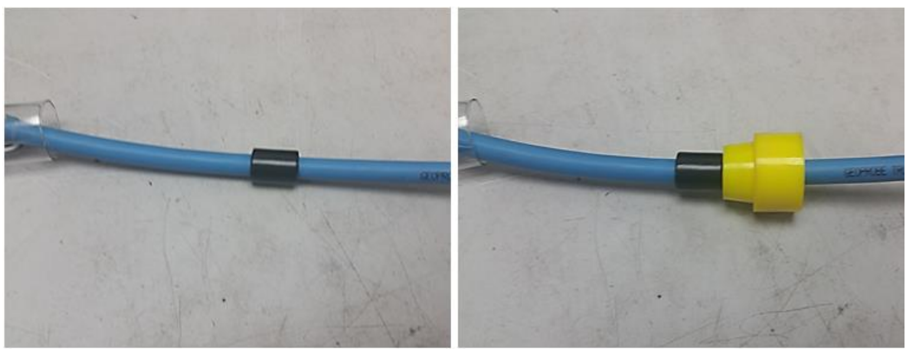


Figure 4.7 Trunkline Strain Relief and Water Seal

5.0 Field Operation

5.2 Starting the Software

1. Make sure the FI6000 and OP6100 are powered down. Make sure the two USB cables connected to the front of the OP6100 are not connected to the laptop.

2. Power on the FI6000.

3. Connect the two USB cables from the front of the OP6100 to the laptop. Wait for at least 1 minute or for the all the device drivers to install.

4. Power on the OP6100.

5. Start the DI Acquisition Software. DI Acquisition should open in OIP mode (Fig. 5.1).

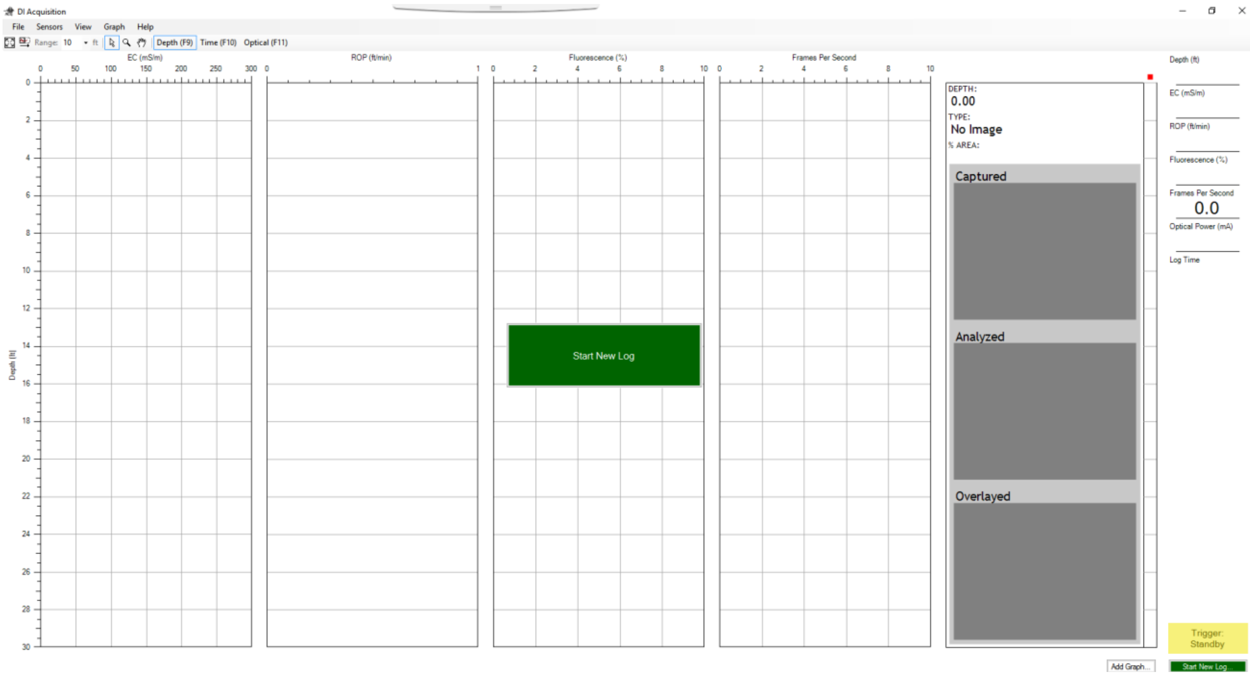


Figure 5.1 DI Acquisition in OIP mode

5.3 Running the Software

1. Select "Start New Log". The software will request log information which will be stored in the log file. Select "Browse" to name the log file and select the storage location (Fig. 5.2).

2. Select "Next". If the software has been run before it will show a list of previous settings including Stringpot length and rod length. If any of these have changed or you are unsure, select "No". If they are all the same select "yes". If you select "No" the software will have you select the proper settings after the quality assurance (QA) testing, if you selected "Yes" the selection of these settings will be bypassed.

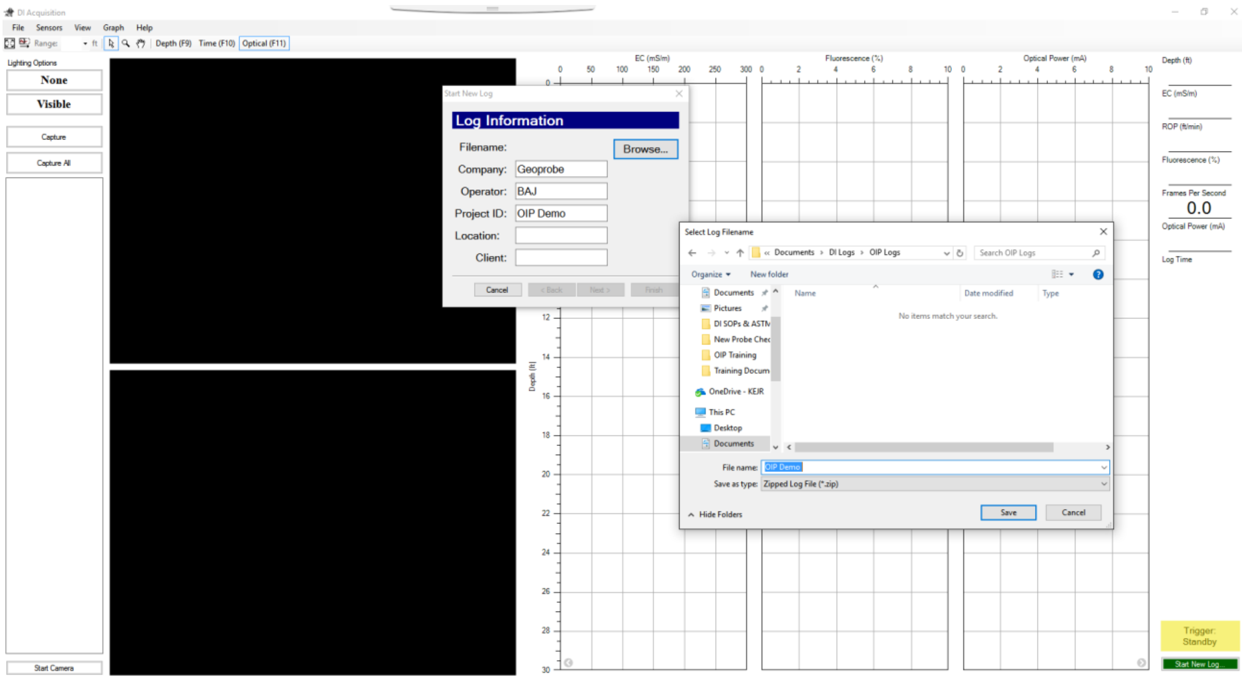


Figure 5.2 DI Acquisition Starting New Log

5.4 QA Testing the EC and OIP Systems

Both the electrical conductivity (EC) and OIP components must be tested before and after each log. This is required to ensure that the equipment is working properly and is capable of generating good data before and after the log.

For OiHPT see the HPT SOP for how to perform the HPT reference test and details for operation of the HPT system (Geoprobe 2015).

A. EC Load Test (Fig. 5.3)

1. Clean and dry the EC dipole as well as the probe body around the pin.

2. Place the low (brass) side of the EC Dipole test jig between the EC dipole and body of the probe and run the low test, hold for 5 seconds until the system captures the data.

3. Place the high (stainless steel) side of the EC Dipole test jig between the EC dipole and body of the probe and run the high test, hold for 5 seconds until the system captures the data.

If either the low or high test fail, see section 6.1 for troubleshooting assistance

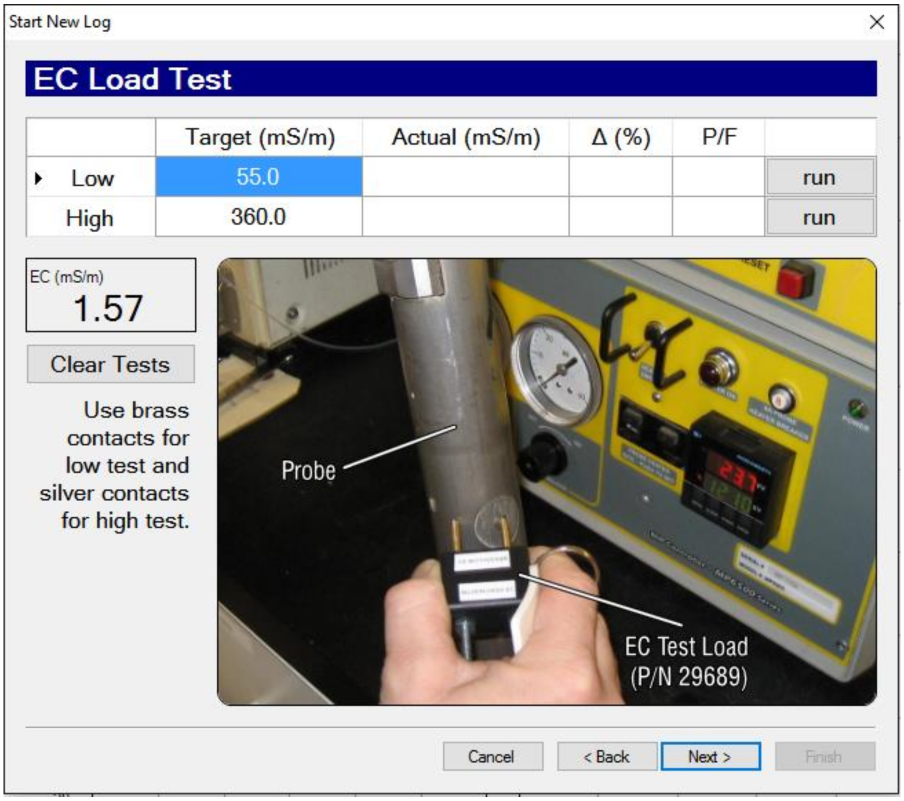


Figure 5.3 EC Load Test Window

B. Optical Test (Fig. 5.4)

The optical testing is done to ensure that the camera and light sources are working properly. The visible target is used to verify the camera's functionality and image focus. The black box test is used to verify that there are no objects or contaminants on the inside of the OIP window which could result in false positives. Diesel and motor oil are used to check the functionality of the UV light source and the camera detection. Please note, the optical test recommended values are not pass-fail and it is up to the operator to determine if the OIP probe is working properly.

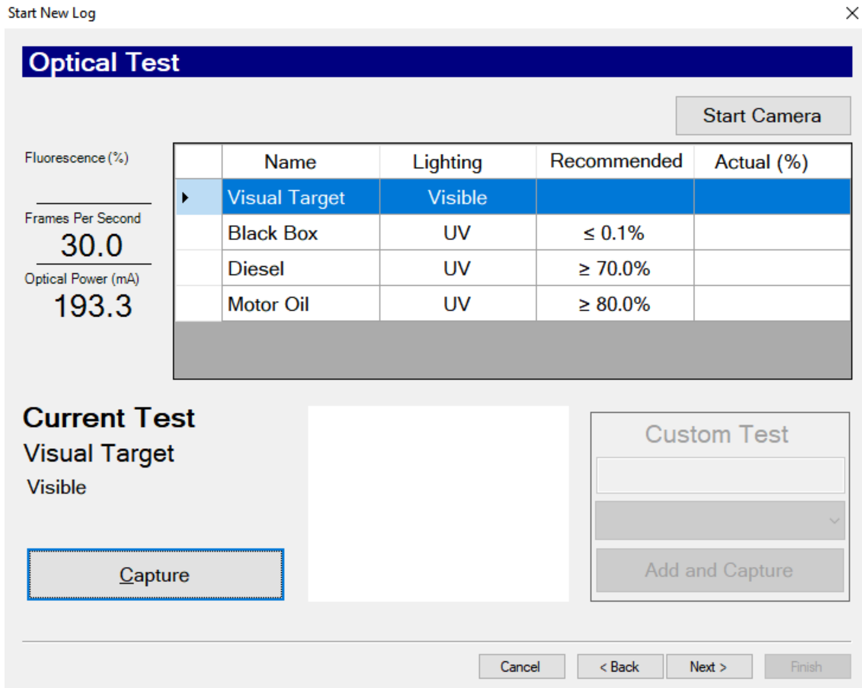


Figure 5.4 Optical Test Window

1. Fill two cuvettes with diesel and motor oil (Fig. 5.5)

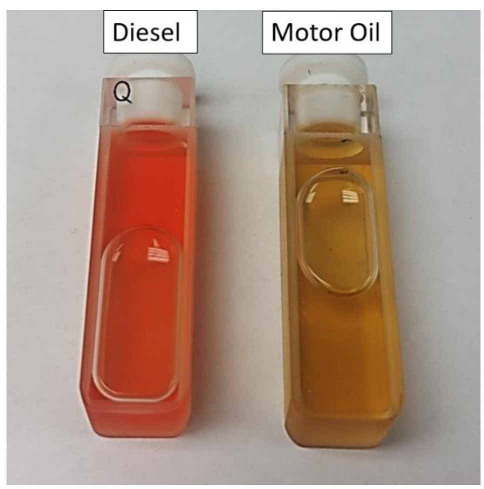


Figure 5.5 Cuvettes of Diesel and Motor Oil

2. Insert diesel and motor oil cuvettes in to the cuvette holder (Fig. 5.6)

Figure 5.6 Cuvette Holder Assembly

3. Place the visual target on the Cuvette Holder or a business card over the window. Using the camera display, verify that the image on the card is in focus and displaying the proper color. Capture the image for the visible target test (Figure 5.7).

4. Place an empty side of the Cuvette Holder over the window. Use the camera display to ensure that no external light is passing through the cuvette holder over the window (Fig. 5.8). Capture the image for the black box test. The measured fluorescence should be less than 0.1%.

5. Place diesel side of the Cuvette Holder over the OIP window. Use the camera display to ensure the cuvette is centered over the window (Fig. 5.9). Capture the image for the diesel test. The measured fluorescence should be greater than 70%.

6. Place motor oil side of the Cuvette Holder over the OIP window. Use the camera display to ensure the cuvette is centered over the window (Fig. 5.9). Capture the image for the motor oil test. The measured fluorescence should be greater than 80%.

7. Click “Finish” to complete the QA testing

If any of the fluorescence readings are outside of the expected ranges or the if the visible image is not in focus, see section 7.3 for troubleshooting assistance

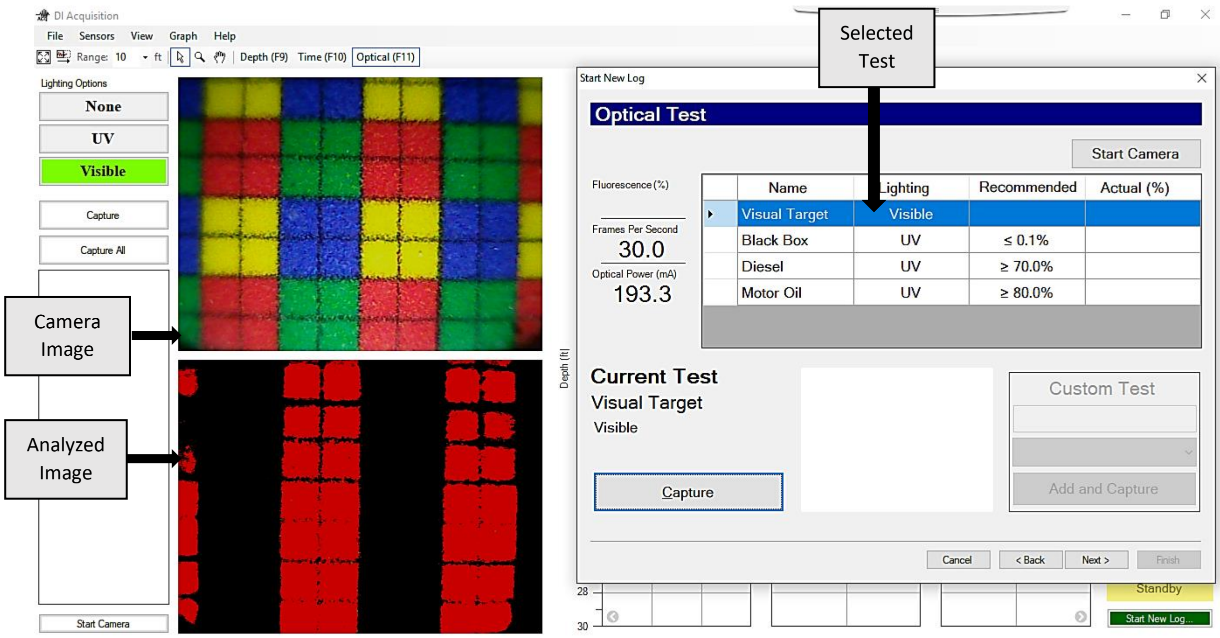


Figure 5.7 DI Acquisition OIP QA Screen with Visible Target

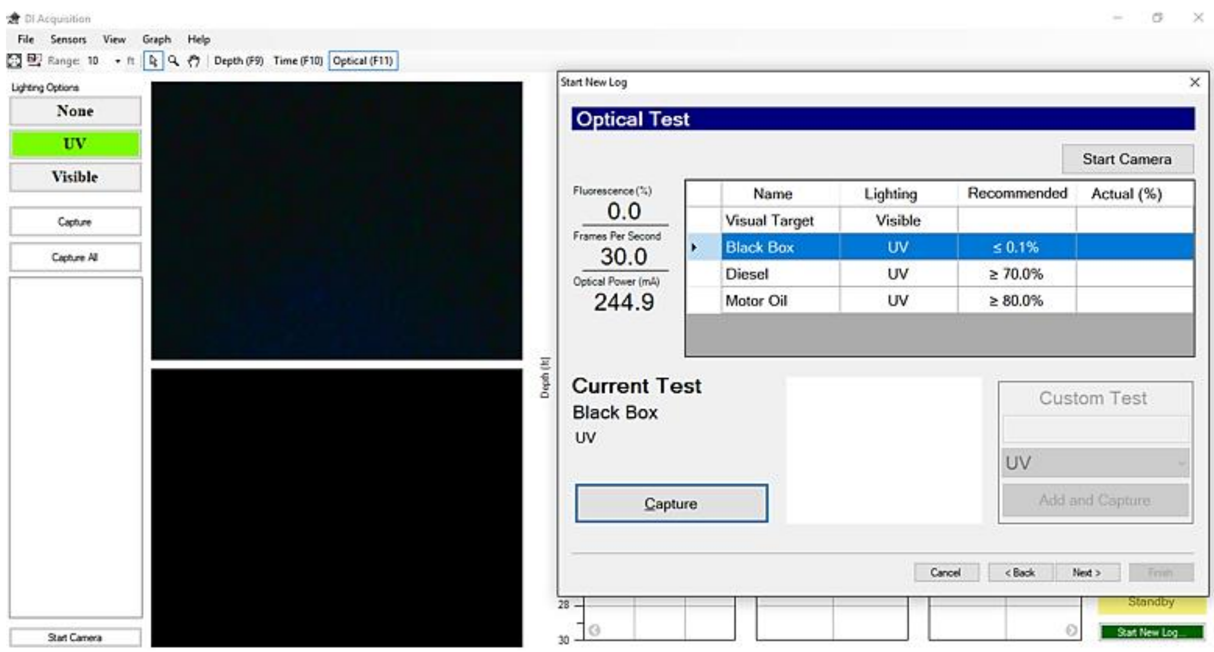


Figure 5.8 DI Acquisition OIP QA Screen with Black Box

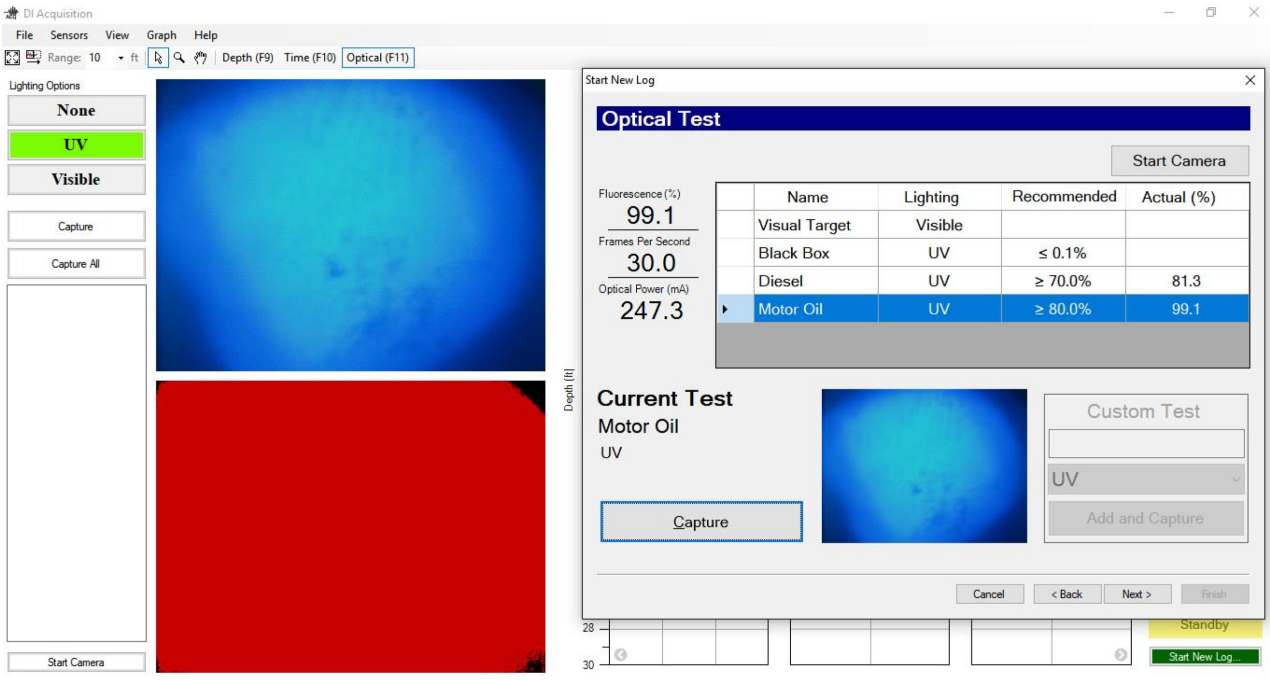


Figure 5.9 DI Acquisition OIP QA Screen with Motor Oil Cuvette

5.5 Running an OIP Log

It is strongly recommended to pre-probe the first 2-3 feet of each hole. Pre-probing each hole can help to avoid unnecessary stresses to the OIP probe components from hammering at the surface.

1. Place the rod wiper on the ground over the probing location and install the drive cushion in place of the anvil of the probing machine.

2. Place the probe tip in the center of the rod wiper and place the slotted drive cap on top of the OIP probe.

3. Adjust the probe so that it is vertical and advance the probe until the OIP Window is at the ground surface.

4. Click the trigger button in the lower righthand corner of computer screen. (The Trigger label will flash and the background will change from yellow to green).

5. Advance the probe at a rate of 2-4 ft./min (1-2 cm/s). If necessary, feather the hammer to maintain this advance rate.

6. After completing the log, press the trigger button again and select “Stop Log”.

7. Pull the rod string using either the rod grip pull system or a slotted pull cap. Run a post-log EC load test and the optical test (Section 5.4).

5.6 Still Captures

A still image can be captured at any depth during a log for each available light source. Still images allow for clearer images of the soil and hydrocarbon fluorescence. Only one still image for each available light source will be captured per .05 feet of depth. During the log, the DI Acquisition software will automatically capture a still image for each available light source during a rod change.

1. Stop the advancement of the probe

2. Select “Capture all” to capture a still image for each available light source. If the “Capture” button is selected a still image for the only current light source will be captured.

3. Wait for the captured stills to appear bellow the capture options (Fig. 5.10) and the light source to return to UV.

4. Restart the advancement of the probe

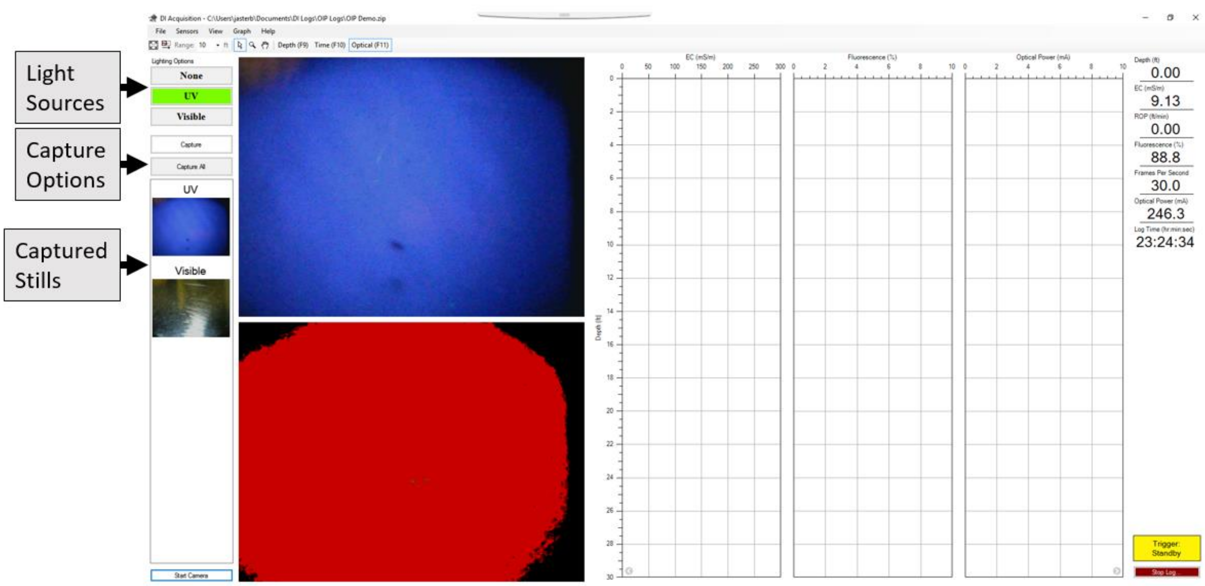


Figure 5.10

6.0 Maintenance

Maintenance should be performed in event that the optical cavity or window become contaminated with soil, water, or NAPL hydrocarbon or in the event of reduced or poor optical QA responses.

Turn off or disconnect power to the green laser diode anytime the OIP window is removed.

6.1 Cleaning the Optical Cavity

1. Remove the OIP window and window seal from the OIP Probe.

2. Turn the OIP probe so that the optical cavity is pointed down. Flush the optical cavity with water by using a syringe or squirt bottle to remove dirt and other particles (Fig 6.1). Wipe the internal surfaces with a Q-tip or soft brush.

3. Continue to flush and wipe the internal surfaces of the optical cavity until all dirt and other particle are removed.

4. Flush the optical cavity with methanol or alcohol to remove excess water and water spots from the internal surfaces (Fig 6.2).

5. Clean the optical lens in the optical cavity (Section 6.2).

6. Let the OIP probe dry for 1-2 hours before re-inserting the window seal and OIP window.

Figure 6.1: Flushing the optical cavity with water

Figure 6.2: Flushing the optical cavity with alcohol

6.2 Cleaning the Lens in the Optical Cavity

1. Wash the lens surface with methanol or alcohol and a Q-tip.

2. Allow the lens to dry.

3. Wipe and the lens with a clean dry Q-tip to remove any remaining surface spots.

6.3 Cleaning the OIP Window

1. Wash the backside of the OIP window with water or soapy water and a Q-tip (Fig. 6.3)
   If false positive fluorescence is present on the window in the black box test it may be necessary to use a mild abrasive cleaner such as “Comet” along with some water and a Q-tip to remove.

2. Flush the backside of the OIP window with methanol or alcohol to remove water and or soap.

3. Allow the OIP window to dry.

4. Wipe the backside of the OIP window with a clean Q-tip to remove any remaining surface spots.

Figure 6.3 Cleaning the OIP Window is soapy water

7.0 Troubleshooting

7.1 Bypassing the Trunkline

For testing and troubleshooting the OIP probe and power module the OIP trunkline can be bypassed.

1. Disconnect the trunkline from the OIP Video/EC cable and OIP Control cable connected to the back of the OP6100.
2. Connect the OIP Video/EC cable directly to the OIP Probe.
3. Connect the OIP Control Cable directly to the OIP Power Supply.
4. Connect the OIP Power Supply to the OIP Probe.

7.2 EC QA Troubleshooting

1. On the EC load test window (Fig. 5.3) select "Finish". The EC troubleshooting test (Fig. 7.1) will run if either EC load test has failed. The EC troubleshooting test will verify the FI6000's 10, 100, and 1000ohm EC calibration.
2. If any of the instrument calibration tests fail, the FI6000 will need to be recalibrated.
3. If all the instrument calibration tests pass, select the "back" button.
4. Verify the connections to the back of the FI6000 and OP6100 are securely connected (Section 5.1). The EC Breakout Cable must be connected between the FI6000 and OP6100 to read EC.
5. Clean and dry the EC dipole and re-run the EC load tests (Section 5.4.A).
6. If the EC load tests continue to fail, bypass the OIP trunkline (Section 7.1) and retest the OIP Probe again.

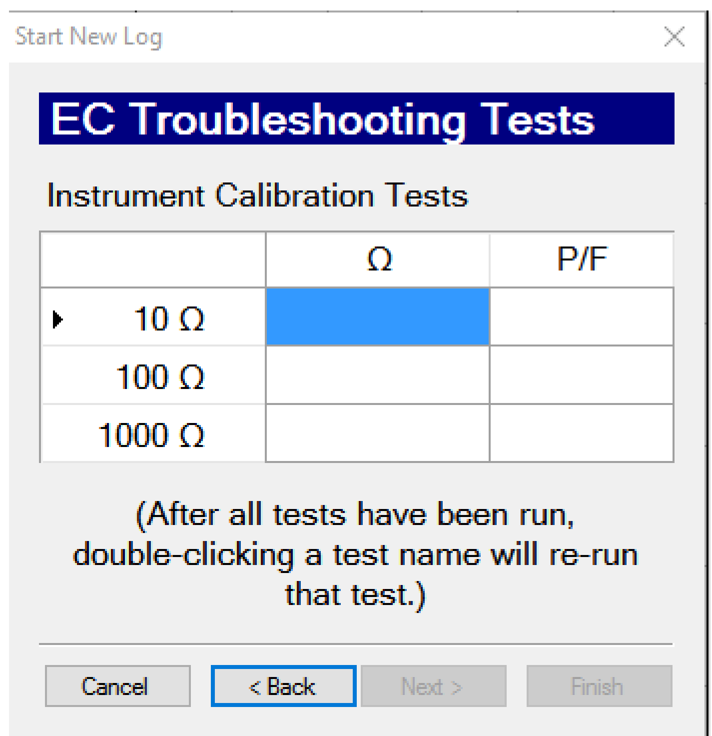


Figure 7.1

7.3 Optical Troubleshooting

A. Zero Frames per second (FPS) or No Camera Display

The measured FPS in the Direct Image Acquisition Software is a measurement of the FPS the computer receives from the frame grabber in the OIP Interface. The DI Acquisition software will measure 0 FPS and trigger a warning alarm if communication with the frame grabber is lost or if the frame grabber is not receiving video from the downhole camera.

No Frame Grabber Feed Detected

1. Confirm that the optical power measurement is greater than 180mA. If the optical power measurement is less than 180mA, the camera is not powering on. Use Section 7.3.B to troubleshoot the low optical power.

2. Check the "Devices and Prints" in the "Control Panel" of the field computer that the SensorRay 2253 driver is present and working properly. The status of the device driver can be confirmed by right clicking the device, selecting "Properties", and selecting the "Hardware" tab.
3. If the device driver is present and working properly, select the "Start Camera" button at the bottom left of the DI Acquisition screen or the top right of the OIP QA window.

No Down Hole Camera Feed Detected

1. Verify the connections to the Video/EC cable connected to the OIP Interface.

2. Bypass the OIP Trunkline (Section 7.1) and select "Start Camera". If the video feed recovers, the problem is like in the OIP Trunkline.

B. Low Optical Power

See Table 7.1 for the typical expected optical power readings

Table 7.1 Typical Optical Power Readings				
Individual Component Power Consumption			Mode Power Consumption	
275nm UV LED	~40mA		UV LED Mode	~240mA
Visible LED	~10mA		Visible LED Mode	~190mA
SM Camera	~180mA		No LED Camera Only	~200mA
OIP Power Supply	~20mA		LED but no Camera	~70mA
			OIP Power Supply Only	~20mA

Low optical power alarms will trigger if the optical power measurement drops below 150mA in any light source mode. The alarm will also trigger if the light source mode is in UV mode and the optical power measurement goes below 220mA.

OIP Test Module

The OIP Test Load (Fig 7.2) can be used to verify the functionality of the OIP Interface, OIP Trunkline, and OIP Power Supply. The expected response when using the OIP Test Load can be seen in Table 7.2. Connecting the OIP Test Load to the probe side of the OIP Trunkline or to the Control Cable of the OIP Instrument will test down hole power and light source selection. Connecting the OIP Test Load to the OIP Power Supply will test power to the OIP Probe components.

Figure 7.2 OIP Test Module MN228240

Table 7.2 OIP Test Module					
Connected to instrument or TL				**Connected to OIP Power Module**	
UV Mode	1 light	~190mA		UV Mode	~250mA
Visible Mode	2 lights	~190mA		Visible Mode	~205mA
No Source Mode	0 lights	~190mA		No Source Mode	~225mA

UV mode with power <220mA

1. Disconnect the OIP Control cable from the OIP trunkline. Wait for 30 seconds before reconnecting the OIP Control cable back to the OIP trunkline.

2. Verify the OIP Interface by connecting the OIP Test Load or by bypassing the trunkline (Section 7.1) and connecting a different OIP probe and OIP Power Supply directly to the OP6100. If the optical power measurements respond correctly the problem is likely in the trunkline or probe connections.

3. Connect the OIP Test Load to the probe side of the OIP Trunk line. If the optical power measurements and test lights respond correctly, the problem is likely in the OIP Power Supply or OIP Probe. Alternatively, the OIP Trunkline can be bypassed (Section 7.1) with the OIP Probe and Power Supply in question. If the optical power measurements respond correctly, the problem is likely in the trunkline.

4. Connect the OIP Test Load to the probe side of the OIP Power Supply. If the optical power measurements respond correctly, the problem is likely in the OIP Probe wires or OIP Probe components. Check for any damage to the OIP Probe wires. Alternatively, with the Trunkline bypassed (Section 7.1) with the OIP Power Supply and OIP Probe in question, switch out the OIP Power Supply. If the optical power measurement recovers, the OIP Power Supply in question may be damaged.

5. If the Power levels do not recover, switch out the OIP Probe. If the optical power measurement recovers, the OIP Probe in question may be damaged.

C. Black box and Visible Target QA Tests

If the black box shows fluorescence or the visible target image is not in focus the optical cavity will need to be cleaned.

1. Clean the inside of the OIP Window (Section 6.3)

2. Rerun the optical tests (Section 5.4.B).

3. If the probe tests continue to fail, clean the Optical lens inside the optical cavity (Section 6.2).

4. Rerun the optical tests (Section 5.4.B).

D. Diesel and Motor Oil Fluorescence

1. Verify the optical power measurement is greater than 235 mA, see table 7.1 for typical optical power readings.

2. Verify the black box and visible target tests pass.

3. Refill the two cuvettes of diesel and motor oil (SAE 30) with fresh fuel.

7.4 HPT System Trouble Shooting

Please see the HPT SOP for troubleshooting guidance for the HPT system (Geoprobe 2015).

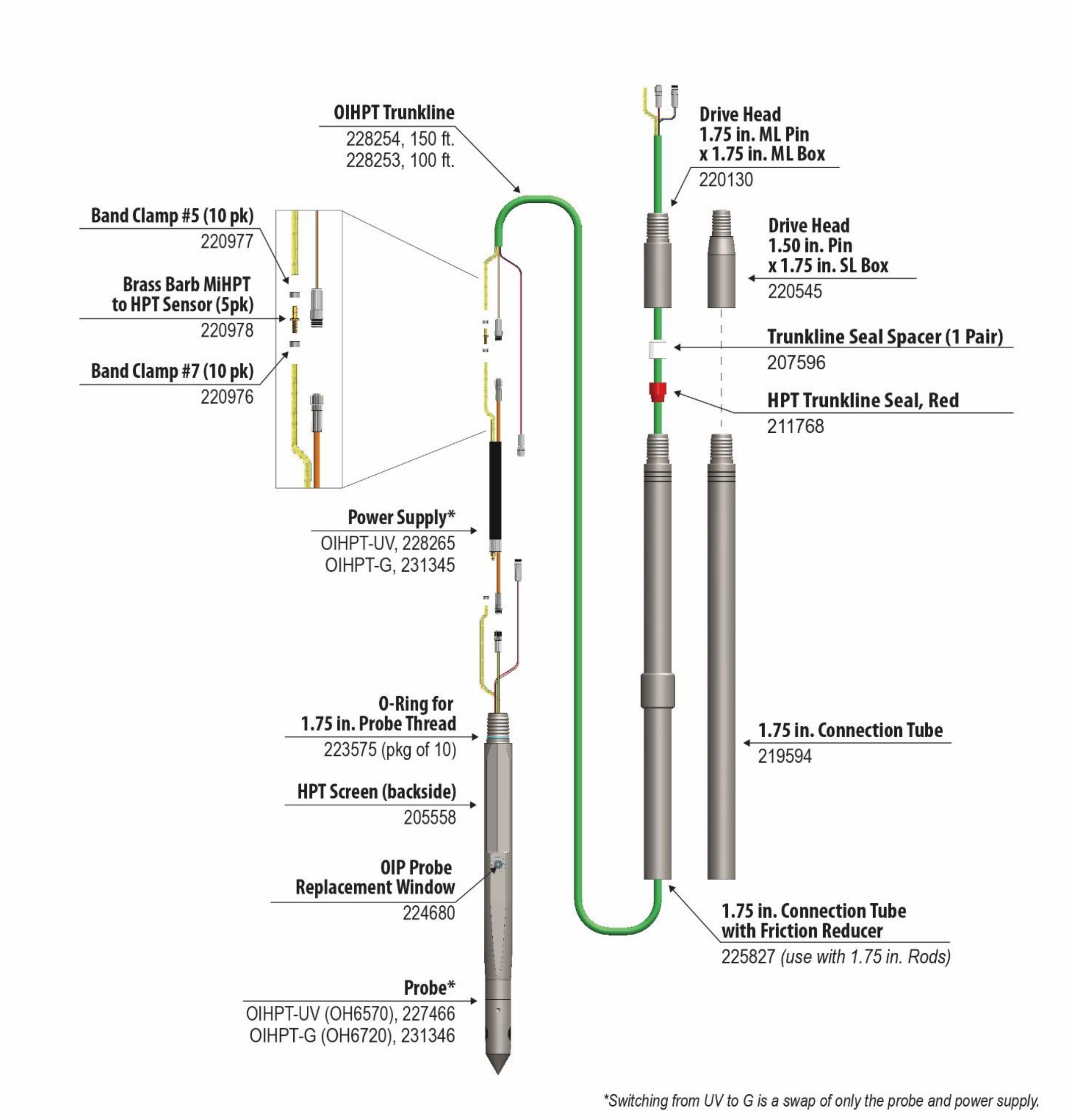
References

Geoprobe 2015. Geoprobe® Hydraulic Profiling Tool (HPT) System, Standard Operating Procedure. Technical Bulletin No. MK3137. January.

McCall, Wesley, Thomas M. Christy, Daniel A. Pipp, Ben Jaster, Jeff White, James Goodrich, John Fontana and Sheryl Doxtader. 2018. Evaluation and application of the optical image profiler (OIP) a direct push probe for photo-logging UV-induced fluorescence of petroleum hydrocarbons. Environmental Earth Sciences, Vol. 77:374. https://doi.org/10.1007/s12665-018-7442-2

APPENDIX 1

OIP Tool Configuration



**Running OIP Only

To run OIP only you need to plug off the HPT port on the probe and use the tools above or can substitute with the following:

- OIP only Power Supply UV-230392 or G-224692
- OIP only trunkline 100ft (224730), 150ft (226362), or 200ft (224731).
- A yellow water seal (207773) would be used with this trunkline.

APPENDIX 2

OIHPT-G Laser Output Parameters

Avoid exposure to the beam. Do not stare into the beam or view directly with optical instruments. Only use the associated OIHPT-G Power Supply with the OIHPT-G probe. Use of any other OIP Power supply may damage the OIHPT-G probe.

Laser Product Class: Class 1

Wavelength: 520nm ± 10

Max Optical Energy: 1.92µJ

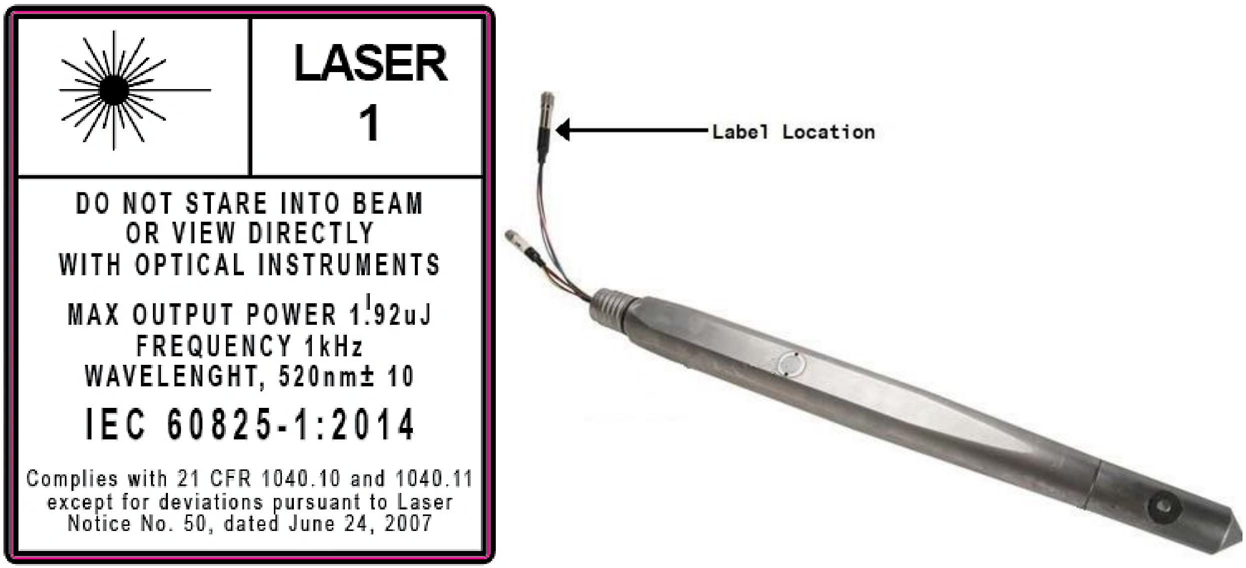
Pulse Frequency: 1 kHz

Pulse Duration: 400µS

Max Optical Energy through 7mm Aperture (aperture of the eye): 0.88µJ

APPENDIX 3

OIP-G Labels and Label locations



Warning and Certification Label and Label Location

Identification Label and Label Location

Note: The Identification label has been placed on the OIP-G product box due limited available space on the probe.

OIP-G Labels and Label locations

Aperture Label and Label Location

A DIVISION OF KEJR, INC.
-Corporate Offices-
1835 Wall Street • Salina, KS 67401
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www.geoprobe-DI.com