

## **DOWN HOLE VIDEO CAMERA AND BOREHOLE LOGGING SYSTEM USE**

**Purpose** This ENV Water Quality and Hydrology Group procedure describes procedures for the operation and maintenance of the Laval Borehole Video System and the Mount Sopris Borehole Geophysical Tools and Logging System (collectively referred to as the Borehole Logging System).

**Scope** This procedure applies to all ENV-WQH staff and contractors authorized to operate, assist, or maintain the Laval TV Camera and Borehole Logging System.

**In this procedure** This procedure addresses the following major topics:

<b>Topic</b>	<b>See Page</b>
General Information About This Procedure	3
Who Requires Training to This Procedure?	3
Background	5
Safety in the Field	6
Using the Video Camera System	7
Using the Borehole Caliper Tool	11
Using the Borehole Conductivity/Resistivity (Induction) Tool	16
Using the Gamma Tool	21
Using the Borehole Spontaneous Potential/Single Point Resistance Tool	24
Using the Water Sampler Tool	28
Using the Temperature and Fluid Resistivity Tool	32
Using the Optical Televiwer	35
Records Resulting from this Procedure	39

**Integrated work management** The work specified in this procedure is conducted in accordance with applicable Integrated Work Documents, in accordance with LANL IMP 300, Integrated Work Management for Work Activities.

### **CONTROLLED DOCUMENT**

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**Signatures**

First authorization review date is one year from Group Leader signature below; subsequent authorizations are on file in group office.

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Approved by. Signature on file _____ S. Rae, ENV-WQH Safety Committee Chair	Date: 3/13/06 _____
Approved by. Signature on file _____ S. Rae, ENV-WQH Group Leader	Date: 3/13/06 _____

## General Information About This Procedure

### Attachments

Number	Attachment Title	No. of Pages
1	Mount Sopris Instruments High Precision Winch	1
2	Coaxial Cable Connection for Video Camera System	1
3	Winch Control System – Black CE Box	1
4	LAVAL R-10 Control Unit	1
5	Coaxial Cable Connection for Borehole Logging Tools	1

### History of revision

This table lists the revision history and effective dates of this procedure.

Revision	Date	Description Of Changes
0	12/97	New document.
1	6/00	Annual review
2	10/01	Annual review
3	3/06	Annual review

### Who requires training to this procedure

ENV-WQH staff and contractors who operate and maintain Laval Borehole Video System and the Borehole Logging System require training before implementing this procedure.

### Training method

The training method for this procedure is self-study (reading) and **on-the-job** training by a previously trained individual. Training is documented in accordance with the procedure for training (ENV-WQH-QP-024, *Personnel Training*).

### Prerequisites

The following training is required prior to performing this procedure:

- EDS Training Plan 7559, ENV-WQH Video Borehole

## General Information About This Procedure, continued

**References** The following documents are incorporated into this procedure by reference:

- RRES-WQH-SOP-002, General Field Work
- RRES-ES-Field, General Field Safety for All
- ASTM D 6167-97: Standard Guide for Conducting Borehole Geophysical Logging: Mechanical Caliper
- ASTM D 6274-98: Standard Guide for Conducting Borehole Geophysical Logging – Gamma
- ASTM D 6726-01: Standard Guide for Conducting Borehole Geophysical Logging – Electromagnetic Induction

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**Note** Actions specified within this procedure, unless preceded with “should” or “may,” are to be considered mandatory guidance (i.e., “shall”).

## Background

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**Introduction** The WQH Geophysical Trailer contains a system built around the Laval Underground Surveys, Inc. video camera system, and the Mount Sopris Instrument Company's MGX-II digital geophysical logging tools. All instruments and computer software must be compatible with a single Mount Sopris precision-controlled downhole cable and winch. All specified instruments interface with this cable system, and software tools communicate with each vendor's products using proprietary protocols. All specified equipment has been configured to meet precision logging, inspection, and documentation requirements.

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**Equipment description**

The Logging System consists of the following equipment:

- Laval Underground Surveys, Inc., Model R-10 Control Unit
- R-10 dual cam downhole/sideview video camera
- CAM 211 small diameter down view only camera
- Mount Sopris Instruments high precision winch for geophysical logging systems (Attachment 1)
- Industrial VCR and 13-inch TV monitor and DVD
- 14-foot enclosed trailer
- 2 PGA Natural Gamma
- 2 PIA Polyinduction Probe
- 2 SAM Sampler
- MGX-II Digital Logging System
- 2 PCA Caliper
- 2 WQA Temperature and Fluid Resistivity
- Spontaneous Potential/Single Point Resistance Tool
- Optical Televiewer

The system is capable of logging boreholes from 2-24 inches in diameter, including those filled with air or water. This logging equipment is operated out of a 14 ft Wells Cargo tandem axle trailer.

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**Required personnel**

One supervising operator and one assistant operator are required to run the Borehole Logging System.

## Safety in the Field

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### **PPE**

The following personal protective equipment (PPE) must be worn by all personnel while the system is operating. This requirement shall apply to all operational personnel and visitors.

- Field boots (required at all times)
- Eye protection (optional)
- Hard hat and leather gloves (not required inside the trailer)
- Protective overalls (optional)
- Site-specific PPE, as required

## Using the Video Camera System

**Notes** Always run the smaller diameter camera to inspect borehole conditions before operating the larger diameter camera.

Ensure there is an adequate supply of DVD-R and VCR tapes on hand. Note that the VCR system is run as a back-up to the DVD system

**Connect cable** *Connect the coaxial cable (located on the side of the winch system to the center port (the 'MGX Logging' port)).* Reference photo (Attachment 2).

**Assemble the video camera system** To assemble the video camera system, perform the following steps:

Step	Action
1	Ensure all power switches for camera control and winch controls are in the OFF position.
2	Extend exhaust hose for generator and power up the generator.
3	Extend mast arm and center cable/cable head over hole. If drill rig is set up over the borehole, instruct driller to hang shive to run cable into hole. Ensure tool is centered in borehole/well.
4	Place bottom light source on camera carefully. Insert plastic lock ring in the opening where the camera meets the light source. You may add silicone grease as a lubricant, if necessary. <b>PRECAUTION:</b> Keep camera horizontal so camera lens does not slip out of stainless steel housing.
5	Place metal centralizer on the camera (if required by hole diameter). <ul style="list-style-type: none"> <li>• Screw each end in tightly.</li> <li>• Adjust diameter as needed.</li> </ul>
6	Place silicon grease on the O-ring at end of cable head and rotate camera onto cable head. <b>DO NOT</b> rotate the cable head or winch line.
7	Suspend camera over borehole/well by use of extended mast arm or sheave suspended by drill rig.

## Using the Video Camera System, continued

- Operate the video camera** Note the following precautions before operating the video camera:
- NEVER assemble or disassemble any parts on the camera while the power is on.
  - DO NOT power up trailer while the R-10 power switch is ON.
  - DO NOT hit the bottom of hole with the camera system.
  - Always use the small camera to assess borehole condition before operating the larger camera.
  - Use common sense when selecting winch speed. Raise and lower camera slowly in unknown or unstable borehole conditions.
  - For more detailed instructions, maintenance, trouble shooting, and detailed diagrams, see the Laval Underground Surveys R-10 and Color Cam 211 Instruction books located in the trailer.

To operate the video camera, perform the following steps:

Step	Action
1	Turn on winch control system (black CE box on counter above winch drum). Reference photo (Attachment 3).
NOTE : Controls referenced in steps 2 through 11 are located on the LAVAL R-10 control unit. Reference photo (Attachment 4).	
2	Turn LAMP VOLTAGE DOWN knob to the vertical position. This will put voltage at medium setting.
3	Turn selector knob to position number 2: camera voltage.
4	Turn power ON for the camera control system, VCR and DVD units, and monitor.
5	Lower the camera lens to desired datum and push the reset button on the LAVAL R-10 unit.  This will give a depth of 0'0" on the monitor. Use the VERT and HORIZ switches to move the depth display location on the monitor to the least obstructive view.

*Table continued on next page.*



## Using the Video Camera System, continued

Operate the camera, con't

Step	Action								
6	Set depth on black CE box:								
	<table border="1"> <thead> <tr> <th>Step</th> <th>Action</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>           Push "P" (program) then use the buttons directly below the LED readout to change digits display.            Example:           <ul style="list-style-type: none"> <li>• Push "3" until 0 is displayed.</li> <li>• Push "2" until 0 is displayed.</li> <li>• Push "1" until 0 is displayed.</li> </ul> </td> </tr> <tr> <td>2</td> <td>Push "E" (enter) and "R" (reset).</td> </tr> <tr> <td>3</td> <td>Use "Disp" (display) to toggle between depth and speed display.</td> </tr> </tbody> </table>	Step	Action	1	Push "P" (program) then use the buttons directly below the LED readout to change digits display. Example: <ul style="list-style-type: none"> <li>• Push "3" until 0 is displayed.</li> <li>• Push "2" until 0 is displayed.</li> <li>• Push "1" until 0 is displayed.</li> </ul>	2	Push "E" (enter) and "R" (reset).	3	Use "Disp" (display) to toggle between depth and speed display.
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2	Push "E" (enter) and "R" (reset).								
3	Use "Disp" (display) to toggle between depth and speed display.								
7	Change light intensity to adjust for borehole illumination by using LAMP VOLTAGE DOWN and/or LAMP VOLTAGE SIDE knobs.								
8	Move camera up and down the borehole by using the black CE box (winch control). <ul style="list-style-type: none"> <li>• Flip switch to choose between up and down.</li> <li>• Adjust speed as needed.</li> <li>• Ensure control is switched to LOCAL.</li> </ul>								
9	If using the larger dual view camera, rotate the camera and change rotation directions by using the ROT START/STOP, ROT-DIR, and SPEED knobs. DO NOT change rotation direction without first stopping the rotation.								
10	Record video: <ul style="list-style-type: none"> <li>• Place VCR/DVD media into VCR/DVD.</li> <li>• Hit the RECORD button on VCR/DVD at anytime while using the camera.</li> </ul>								
11	Run camera survey over desired depth intervals.								
12	Remove camera from borehole. When disconnecting camera from cable head, make sure power to camera is OFF. Screw end cap onto cable head for protection.								

*Table continued on next page.*

## Using the Video Camera System, continued

Operate the  
camera, con't

Step	Action
13	Pressure wash or wipe cable and tool to remove dirt and other foreign material.
14	Retract and secure mast. Applying tension to the cable, walk it back onto the winch drum and secure the cable head to the boom (retracted mast).
15	Turn power OFF on the Mount Sopris box, VCR/DVD, monitor, and LAVAL R-10 control unit.

## Using the Borehole Caliper Tool

**Connect cable** *Before operating the borehole caliper tool, connect the coaxial cable (located on the side of the winch system) between the center port and the "MGX Logging" port.* Reference photo (Attachment 5).

### Operate the Borehole Caliper Tool

To operate the borehole caliper tool, perform the following steps:

Step	Action
1	Connect caliper tool to the end of winch. The caliper tool requires both cable head crossover connectors.
2	Power up Trailer (control on wall by door to control room).
3	Power up winch controls by turning the power switch to the on position on both the MGX II yellow logger control panel and the black CE control panel.
4	Connect computer to yellow box with attached serial cable and power up the computer.
5	Double click on the MSLog icon to open the MSLog program. If dialogue boxes come up with a choice between using logger or computer settings, select logger settings and click ok.
6	In the Tool window select "2PCA Caliper no PGA". This will initiate the MchCurve, MCHNUM, and LASWRITER browser windows.
7	Select caliper arm length. Long arms are for holes 10-in or greater in diameter. Short arms give greater resolution in holes with diameters less than 10-in. Caliper arms can be changed by gently opening the arms and propping open. Use wrenches to unscrew arms. Use "soft" or "blue" LOC-TITE on the threads to secure the arms in place. Tighten arms with wrenches.
8	Check tool calibration by performing the following sequential steps: <ul style="list-style-type: none"> <li>• Insert end of tool in the 10.19-in calibration disc and click "On" button on the Tool window. Turning the tool on opens the caliper arms.</li> <li>• Click "Done" on Caliper operation window when the "Opening Caliper" timer window closes. If "Opening Caliper" timer window does not appear, wait two (2) minutes before proceeding.</li> <li>• In the Acquisition window, click "On" while in the Time Sampling mode. If the computer reading is within 0.1-in, then the calibration is acceptable and proceed to Step 11. If tool is out of calibration, then leave arms open and proceed to Step 10.</li> </ul>

*Table continued on next page.*

## Using the Borehole Caliper Tool, continued

Operating the  
Borehole  
Caliper Tool,  
con't

Step	Action	
9	Calibrate the caliper tool by performing the following steps:	
	<b>Step</b>	<b>Action</b>
	1	right click on top bar of the MCHNUM window and turn off "Use calibration".
	2	Right click the bar again and select Calibration Settings.
	3	With tool still in the 10.19-in calibration disc click "Use Current" button in Second Point box.
	4	Manually close the arms and insert tool in the 3.51-in calibration disc.
	5	"Use Current" in the First Point box then click "Store".
	6	Click Close the Calibration Settings window by clicking the "x" in the upper right hand corner. All browsers must be closed and restarted for new calibrations to take effect.
	7	Click on "Close All" button found on the Browsers & processors window.
8	Select and Start all three browsers.	
9	Check calibration again.	
10	TURN OFF TOOL and allow caliper arms to close. Click "Off" button on Tool window. Turning the tool off closes the caliper arms. Click "Done" on Caliper operation window when the "Closing Caliper" timer window closes. If "Opening Caliper" timer window does not appear, wait two (2) minutes before proceeding.	
11	Zero the tool by performing the following steps:	
	<b>Step</b>	<b>Action</b>
	1	Set the top of the lower connector to the reference point (e.g. ground surface).
	2	Click on the upper right hand button on the Depth window to reveal the next window.
	3	Click on the "Zero Tool" button. Display on computer will read 5.53 (ft) and display on yellow box will read 5.5 (ft).
4	Close large "Depth" window by clicking on "x" in upper right corner. <b>NOTE:</b> you may confirm "zero point" by measuring the full length of the tool (bottom of the tool to top of lower connector).	

*Table continued on next page.*

## Using the Borehole Caliper Tool, continued

**Operating the  
Borehole  
Caliper Tool,  
con't**

Step	Action
132	Set depth on black CE box: <ul style="list-style-type: none"> <li>• Hit "P" (program) then use buttons directly below digits to change display (e.g. push "3" button until 5 is displayed directly above, "2" button until 5 is displayed directly above, and "1" button until 3 is displayed directly above).</li> <li>• Push "E" (enter) and then "R" (reset).</li> <li>• Use "Disp" to toggle between depth and speed display.</li> </ul>
13	Move tool to desired depth. <ul style="list-style-type: none"> <li>• DO NOT LOG GOING DOWN!</li> <li>• DO NOT TURN TOOL ON UNTIL READY TO LOG UP!</li> </ul>
14	When tool is at desired depth, power up by performing the following sequential steps: <ul style="list-style-type: none"> <li>• Click the "On" button on the Tool window to open the caliper arms.</li> <li>• Click "Done" on Caliper Operation Window when the "Opening Caliper" timer window closes. If "Opening Caliper" timer window does not appear, wait two (2) minutes before proceeding. Tool box green light will come on when the tool is ready.</li> <li>• Click "On" in the Acquisition window while in Time Sampling mode to confirm that the tool is collecting data.</li> </ul>
15	Switch Sampling mode (in Acquisition window) to Depth up and click "On" button.
16	Record data by performing the following sequential steps: <ul style="list-style-type: none"> <li>• In Acquisition window, click Header button and enter all available information. At a minimum enter bit from, bit to, bit, casing from, casing size, casing to, company, date, depth drilled, depth logged, level, location, recorded by, type log, and well ID.</li> <li>• Click ok to close header window.</li> <li>• Click Record button, enter file name, and select destination folder.</li> </ul>

*Table continued on next page.*

## Using the Borehole Caliper Tool, continued

**Operating the  
Borehole  
Caliper Tool,  
con't**

Step	Action										
17	Pressure wash or wipe cable and tool to remove dirt and other foreign material.										
18	Begin logging. For best results, log at 15 ft/min or slower. Remember to switch Sampling mode to Depth up.										
19	At the end of the logging run, perform the following steps: <table border="1" data-bbox="527 598 1421 955"> <thead> <tr> <th>Step</th> <th>Action</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Click the "Stop" button located next to "Record" button</td> </tr> <tr> <td>2</td> <td>Click "Off" button in Acquisition window</td> </tr> <tr> <td>3</td> <td>Click "Off" button in Tool window. Clicking "Off" button on Tool window will close the caliper arms.</td> </tr> <tr> <td>4</td> <td>Click "Done" on Caliper operation window when the "Closing Caliper" timer window closes. If "Opening Caliper" timer window does not appear, wait two (2) minutes before proceeding.</td> </tr> </tbody> </table>	Step	Action	1	Click the "Stop" button located next to "Record" button	2	Click "Off" button in Acquisition window	3	Click "Off" button in Tool window. Clicking "Off" button on Tool window will close the caliper arms.	4	Click "Done" on Caliper operation window when the "Closing Caliper" timer window closes. If "Opening Caliper" timer window does not appear, wait two (2) minutes before proceeding.
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1	Click the "Stop" button located next to "Record" button										
2	Click "Off" button in Acquisition window										
3	Click "Off" button in Tool window. Clicking "Off" button on Tool window will close the caliper arms.										
4	Click "Done" on Caliper operation window when the "Closing Caliper" timer window closes. If "Opening Caliper" timer window does not appear, wait two (2) minutes before proceeding.										
20	The tool is now powered down and can be detached from the cable head. <b>NOTE:</b> DO NOT unhook the tool without turning off the MSLOG software. As an additional precaution, the yellow MGX II box may be turned off.										
21	To close MSLog right click anywhere on the dashboard (windows along left side of screen) and exit.										

## Using the Borehole Caliper Tool, continued

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**Disassemble the Borehole Caliper Tool** To disassemble the system, perform the following steps:

Step	Action
1	Unhook the caliper tool and clean it.
2	Place the caliper tool back in the PVC tube and strap it into the storage rack. The lower connector or protective cap must be left on the tool for protection.
3	Lower the boom and secure in the upright position.
4	Applying tension to the cable, walk it back onto the winch drum and secure the cable head to the boom.

**NOTE:** For more detailed instructions, maintenance, trouble shooting, and detailed diagrams, see the Operator Manual MSLog v.7 (or later) for the MGX II 5MCA-1000 and 5MGB-1000 MGX II Loggers, WNA Winch, 3WCA-1000 Winch Control, 2PCA-1000 PolyCaliper Probe and 2CAA-1000 Caliper Probe, and MGXII Tool Specific Operations Mount Sopris Instrument Co., Inc. documentation. Refer to ASTM Standard D 6167 for additional guidance.

## Using the Borehole Conductivity / Resistivity Tool

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**Connect cable** *Before operating the borehole conductivity / resistivity (induction) tool, connect the coaxial cable (located on the side of the winch system) to the center port (the 'MGX Logging' port). Reference photo (Attachment 5).*

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**Operating the Borehole Conductivity/ Resistivity (Induction) Tool** To operate the borehole conductivity / resistivity (induction) tool, perform the following steps:

Step	Action
1	Connect tool to the end of winch. The induction tool requires both cable head crossover connectors.
2	Loosen set screw on bottom end cap and remove cap. Attach 16-in stainless steel weight and tighten set screw.  <b>NOTE:</b> This step may be omitted if tool lowers into borehole without assistance.
3	Power up Trailer.
4	Power up winch controls by turning the power switch to the "On" position on both the MGX II yellow logger control panel and the black CE control panel.
5	Connect computer to yellow box with attached serial cable and power up the computer.
6	Double click on the MSLog icon to open the MSLog program. If dialogue boxes come up with a choice between using logger or computer settings, select logger settings and click ok.
7	In the Tool window select "2PIA 0-1000ms no PGA attached". This will initiate the MchCurve, MCHNUM, and LASWRITER browser; and MSIPROC processor windows.

*Table continued on next page.*

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## Using the Borehole Conductivity / Resistivity Tool, continued

**Operating the  
Borehole  
Conductivity/  
Resistivity  
(Induction)  
Tool, con't**

Step	Action	
8	Zero the tool by performing the following steps:	
	<b>Step</b>	<b>Action</b>
	1	Set the top of the lower connector to the reference point (e.g. ground surface).
	2	Click on the upper right hand button on the Depth window to reveal the next window.
	3	Click on the "Zero Tool" button. Display on computer will read 5.68 (ft) and display on yellow box will read 5.7 (ft).
4	Close large "Depth" window by clicking on "x" in upper right corner. <b>NOTE:</b> you may confirm "zero point" by measuring the full length of the tool (bottom of the tool to top of lower connector).	
9	Set depth on black CE box by performing the following sequential steps: <ul style="list-style-type: none"> <li>• Hit "P" (program) then use buttons directly below digits to change display (e.g. push "3" until 5 is displayed, "2" until 6 is displayed, and "1" until 8 is displayed).</li> <li>• Push "E" (enter) and then "R" (reset).</li> <li>• Use "Disp" to toggle between depth and speed display.</li> </ul>	
10	Power up by performing the following sequential steps: <ul style="list-style-type: none"> <li>• Click the "On" button on the Tool window. Tool box green light will come on when the tool is ready.</li> <li>• Click "On" in the Acquisition window while in Time Sampling mode to confirm that the tool is collecting data.</li> </ul>	
11	Warm up the tool for calibration by performing the following sequential steps: <ul style="list-style-type: none"> <li>• With the tool still turned on and sampling in Time Sampling mode, lower the tool into the borehole fluid. If no fluid is present, then lower tool to approximately 50-ft below ground surface, or at least 20 feet below any casing in the borehole.</li> <li>• Allow tool to equilibrate to borehole conditions for about 15 minutes.</li> <li>• Remove tool from borehole.</li> </ul>	
12	Loosen set screw on stainless steel weight and remove. Replace end cap before calibrating (if weight is being used).	

*Table continued on next page.*

## Using the Borehole Conductivity / Resistivity Tool, continued

**Operating the  
Borehole  
Conductivity/  
Resistivity  
(Induction)  
Tool, con't**

Step	Action																						
13	<p>Tool must be calibrated before each use. To calibrate the induction tool, perform the following sequential steps:</p> <ul style="list-style-type: none"> <li>• Right click on top bar of the MCHNUM window and turn off "Use calibration".</li> <li>• Right click the bar again and select calibration Settings.</li> </ul>																						
14	<p>Assemble calibration coil by performing the following steps:</p> <table border="1"> <thead> <tr> <th>Step</th> <th>Action</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Screw gray PVC pipe into the side with the small dial of the large, flat, white calibration disc.</td> </tr> <tr> <td>2</td> <td>Set dial to "0".</td> </tr> <tr> <td>3</td> <td>Instruct assistant to remove all metal from hands, wrists, arms, head, and neck.</td> </tr> <tr> <td>4</td> <td>Hold tool vertically above head as far from any metal as possible.</td> </tr> <tr> <td>5</td> <td>In the First Point box set reference to "0" and click "Use Current".</td> </tr> <tr> <td>6</td> <td>Set dial on calibration coil to "94".</td> </tr> <tr> <td>7</td> <td>In the Second Point box set reference to 94 and click "Use Current" then click "Store".</td> </tr> <tr> <td>8</td> <td>Close the Calibration Settings window by clicking the "x" in the upper right hand corner.</td> </tr> <tr> <td>9</td> <td>All browsers and processors must be closed and restarted for new calibrations to take effect. Click on "Close All" button found on the Browsers &amp; processors window.</td> </tr> <tr> <td>10</td> <td>Select and Start all three browsers and the one processor.</td> </tr> </tbody> </table>	Step	Action	1	Screw gray PVC pipe into the side with the small dial of the large, flat, white calibration disc.	2	Set dial to "0".	3	Instruct assistant to remove all metal from hands, wrists, arms, head, and neck.	4	Hold tool vertically above head as far from any metal as possible.	5	In the First Point box set reference to "0" and click "Use Current".	6	Set dial on calibration coil to "94".	7	In the Second Point box set reference to 94 and click "Use Current" then click "Store".	8	Close the Calibration Settings window by clicking the "x" in the upper right hand corner.	9	All browsers and processors must be closed and restarted for new calibrations to take effect. Click on "Close All" button found on the Browsers & processors window.	10	Select and Start all three browsers and the one processor.
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10	Select and Start all three browsers and the one processor.																						
15	<p>Move tool to desired depth and switch Sampling mode (in Acquisition window) to Depth up or Depth down and click "On" button.</p> <p><b>NOTE:</b> Do not attempt to log inside steel casing.</p>																						

*Table continued on next page.*

## Using the Borehole Conductivity / Resistivity Tool, continued

**Operating the  
Borehole  
Conductivity/  
Resistivity  
(Induction)  
Tool, con't**

Step	Action
16	<p>To record data, perform the following sequential steps:</p> <ul style="list-style-type: none"> <li>• In Acquisition window click Header button and enter all available information. At a minimum enter bit from, bit to, bit, casing from, casing size, casing to, company, date, depth drilled, depth logged, level, location, recorded by, type log, and well ID.</li> <li>• Click ok to close header window.</li> <li>• Click Record button, enter file name, and select destination folder.</li> </ul>
17	<p>Begin logging. For best results, log at 15 ft/min or slower. Remember to switch Sampling mode to Depth up or Depth down.</p>
18	<p>Pressure wash or wipe cable and tool to remove dirt and other foreign material.</p>
19	<p>At the end of the logging run, power down the tool by performing the following sequential steps:</p> <ul style="list-style-type: none"> <li>• Click the "Stop" button located next to "Record" button.</li> <li>• Click "Off" button in Acquisition window.</li> <li>• Click "Off" button in Tool window.</li> </ul> <p><b>NOTE:</b> DO NOT unhook the tool without closing MSLOG software. As an additional precaution the yellow MGX II box may be turned off.</p>
20	<p>To close MSLog right click anywhere on the dashboard (windows along left side of screen) and exit.</p>

## Using the Borehole Conductivity / Resistivity Tool, continued

**Disassemble  
the Borehole  
Conductivity/  
Resistivity  
(Induction)  
Tool**

To disassemble the system, perform the following steps:

Step	Action
1	Unhook the induction tool and clean it.
2	Strap the induction tool into the storage rack. The lower connector or protective cap must be left on the tool for protection.
3	Lower the mast arm and secure in the upright position.
4	Applying tension to the cable, walk it back onto the winch drum and secure the cable head to the boom.

**NOTE:** For more detailed instructions, maintenance, trouble shooting, and detailed diagrams, see the Operator Manual MSLog v.6 (or later) for the MGX II 5MCA-1000 and 5MGB-1000 MGX II Loggers, WNA Winch, 3WCA-1000 Winch Control, 2PIA -1000 Poly Induction Probe, and MGXII Tool Specific Operations Mount Sopris Instrument Co., Inc. documentation. Reference the ASTM Standard D 6726 for additional guidance.

## Using the Gamma Tool

**Connect cable** *Before operating the gamma tool, connect the coaxial cable (located on the side of the winch system) to the center port (the 'MGX Logging' port).*

Reference photo (Attachment 5).

**Operating the Gamma Tool** To operate the gamma tool, perform the following steps:

Step	Action										
1	Connect gamma tool to the end of winch. The gamma tool requires only one cable head crossover connector. Centralizer may be added if borehole conditions warrant.  <b>NOTE:</b> If using the SP/SPR functions in the gamma tool, wrap the cable head and adapter in electrical tape before lowering tool into the borehole.										
2	Power up trailer.										
3	Power up winch controls by turning the power switch to the on position on both the MGX II yellow logger control panel and the black CE control panel.										
4	Connect computer to yellow box with attached serial cable and power up the computer.										
5	Double click on the MSLog icon to open the MSLog program. If dialogue boxes come up with a choice between using logger or computer settings, select logger settings and click ok.										
6	In the Tool window, select 2PGA-1000 Gamma. This will initiate the MchCurve, MCHNUM, and LASWRITER browser windows.										
7	Zero the tool, perform the following steps: <table border="1" data-bbox="527 1360 1421 1740"> <thead> <tr> <th>Step</th> <th>Action</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Set the top of the tool to the reference point (e.g. ground surface).</td> </tr> <tr> <td>2</td> <td>Click on the upper right hand button on the Depth window to reveal the next window.</td> </tr> <tr> <td>3</td> <td>Click on the "Zero Tool" button. Display on computer will read 2.59 (ft) and display on yellow box will read 2.6 (ft).</td> </tr> <tr> <td>4</td> <td>Close large "Depth" window by clicking on "x" in upper right corner.</td> </tr> </tbody> </table>	Step	Action	1	Set the top of the tool to the reference point (e.g. ground surface).	2	Click on the upper right hand button on the Depth window to reveal the next window.	3	Click on the "Zero Tool" button. Display on computer will read 2.59 (ft) and display on yellow box will read 2.6 (ft).	4	Close large "Depth" window by clicking on "x" in upper right corner.
Step	Action										
1	Set the top of the tool to the reference point (e.g. ground surface).										
2	Click on the upper right hand button on the Depth window to reveal the next window.										
3	Click on the "Zero Tool" button. Display on computer will read 2.59 (ft) and display on yellow box will read 2.6 (ft).										
4	Close large "Depth" window by clicking on "x" in upper right corner.										

*Table continued on next page.*

## Using the Gamma Tool, continued

Operating the  
Gamma Tool,  
con't

Step	Action
8	<p>Set depth on black CE box by performing the following sequential steps:</p> <ul style="list-style-type: none"> <li>• Hit "P" (program) then use buttons directly below digits to change display (e.g. push "3" button until 2 is displayed directly above, "2" button until 5 is displayed directly above, and "1" button until 9 is displayed directly above).</li> <li>• Push "E" (enter) and then "R" (reset).</li> <li>• Use "Disp" to toggle between depth and speed display.</li> </ul>
9	<p>Power up tool by clicking the "On" button on the Tool window. Tool box green light will come on when the tool is ready. Confirm that the tool is collecting data by clicking "On" in the Acquisition window while in Time Sampling mode.</p>
10	<p>Move tool to desired depth (typically, collect data both as the tool is quickly lowered into the hole and more slowly as it is raised). In Acquisition window switch Sampling mode to Depth up or Depth down and click the "On" button.</p>
11	<p>To record data, perform the following sequential steps:</p> <ul style="list-style-type: none"> <li>• In Acquisition window, click Header button and enter all available information. At a minimum, enter bit from, bit to, bit, casing from, casing size, casing to, company, date, depth drilled, depth logged, level, location, recorded by, type log, and well ID.</li> <li>• Click ok to close header window.</li> <li>• Click Record button, enter file name, and select destination folder.</li> </ul>
12	<p>Begin logging. For best results, log at 15 ft/min or slower. Remember to switch Sampling mode to Depth up or Depth down as appropriate.</p>
13	<p>Pressure wash or wipe cable and tool to remove dirt and other foreign material.</p>

*Table continued on next page.*

## Using the Gamma Tool, continued

### Operating the Gamma Tool, con't

Step	Action
14	At the end of the logging run, power down by performing the following sequential steps: <ul style="list-style-type: none"> <li>Click the "Stop" button located next to "Record" button</li> <li>Click "Off" button in Acquisition window</li> <li>Click "Off" button in Tool window</li> </ul>
15	The tool is now powered down and can be detached from the cable head.  If a Spontaneous Potential/Single Point Resistance log is to be run: <ul style="list-style-type: none"> <li>Leave the tool attached</li> <li>Select 2PGA-1000 SPR, SP from the tool menu</li> <li>Refer to PROCEDURE FOR RUNNING A SPR/SP LOG.</li> </ul> <p><b>NOTE:</b> DO NOT unhook the tool without turning off the power on the computer. As an additional precaution, the yellow MGX II box may be turned off.</p>
16	To close MSLog, right click anywhere on the dashboard (windows along left side of screen) and exit.

### Disassemble the Gamma Tool

To disassemble, perform the following steps:

Step	Action
1	Unhook the gamma tool and clean it.
2	Place the gamma tool back in the storage box
3	Lower the boom and secure in the upright position.
4	Applying tension to the cable, walk it back onto the winch drum and secure the cable head to the boom.

**NOTE:** For more detailed instructions, maintenance, trouble shooting, and detailed diagrams, see the Operator Manual MSLog v.6 (or later) for the MGX II 5MCA-1000 and 5MGB-1000 MGX II Loggers, WNA Winch, 3WCA-1000 Winch Control, 2PGA-1000 Poly-Gamma Probe, MGXII Tool Specific Operations, MSLog v.6 for the MGX II, and MSLog v.6 for the MGX II Operator Manual. The ASTM Standard D 6274 can be referred to for additional guidance.

## Using the Borehole Spontaneous Potential/Single Point Resistance Tool

**Connect cable** *Before operating the spontaneous potential and single point resistance tool, connect the coaxial cable (located on the side of the winch system) to the center port (the 'MGX Logging' port). Reference photo (Attachment 5).*

**Operating the Borehole Spontaneous Potential/Single Point Resistance Tool** To operate the spontaneous potential and single point resistance tools, perform the following steps:

Step	Action
1	Connect gamma tool to the end of winch. The gamma tool contains the Spontaneous Potential (SP) and Single Point Resistance (SPR) tools. The SP/SPR tool requires only one connector. Wrap the cable head and adapter in electrical tape before lowering tool into the borehole.
2	Attach Mud Plug to green port on side of the yellow MGX II box. Put Mud Plug into a conductive fluid such as the cuttings or mud pit (hence the name "Mud Plug"). If a pit is not available or the plug cable can't reach, then a hole must be dug and filled with water. The goal is to complete a circuit with the downhole tool through the ground.
3	Power up Trailer.
4	Power up winch controls by turning the power switch to the on position on both the MGX II yellow logger control panel and the black CE control panel.
5	Connect computer to yellow box with attached serial cable and power up the computer.
6	Double click on the MSLog icon to open the MSLog program. If dialogue boxes come up with a choice between using logger or computer settings, select logger settings and click ok.
7	In the Tool window select 2PGA-1000 SPR, SP. This will initiate the MchCurve, MCHNUM, and LASWRITER browser; and the MSIPROC processor windows.

*Table continued on next page.*



## Using the Borehole Spontaneous Potential/Single Point Resistance Tool, continued

**Operating the Borehole Spontaneous Potential/Single Point Resistance Tool, con't**

Step	Action										
8	Zero the tool by performing the following steps: <table border="1"> <thead> <tr> <th>Step</th> <th>Action</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Set the top of the tool to the reference point (e.g. ground surface).</td> </tr> <tr> <td>2</td> <td>Click on the upper right hand button on the Depth window to reveal the next window.</td> </tr> <tr> <td>3</td> <td>Click on the "Zero Tool" button. Display on computer will read 2.59 (ft) and display on yellow box will read 2.6 (ft).</td> </tr> <tr> <td>4</td> <td>Close large "Depth" window by clicking on "x" in upper right corner.</td> </tr> </tbody> </table>	Step	Action	1	Set the top of the tool to the reference point (e.g. ground surface).	2	Click on the upper right hand button on the Depth window to reveal the next window.	3	Click on the "Zero Tool" button. Display on computer will read 2.59 (ft) and display on yellow box will read 2.6 (ft).	4	Close large "Depth" window by clicking on "x" in upper right corner.
Step	Action										
1	Set the top of the tool to the reference point (e.g. ground surface).										
2	Click on the upper right hand button on the Depth window to reveal the next window.										
3	Click on the "Zero Tool" button. Display on computer will read 2.59 (ft) and display on yellow box will read 2.6 (ft).										
4	Close large "Depth" window by clicking on "x" in upper right corner.										
9	Set depth on black CE box by performing the following sequential steps: <ul style="list-style-type: none"> <li>• Hit "P" (program) then use buttons directly below digits to change display (e.g. push "3" button until 2 is displayed directly above, "2" button until 5 is displayed directly above, and "1" button until 9 is displayed directly above).</li> <li>• Push "E" (enter) and then "R" (reset).</li> <li>• Use "Disp" to toggle between depth and speed display.</li> </ul>										
10	Power up tool by clicking the "On" button on the Tool window. Tool box green light will come on when the tool is ready. Confirm that the tool is collecting data by clicking "On" in the Acquisition window while in Time Sampling mode.										
11	Move tool to desired depth (typically, collect data both as the tool is quickly lowered into the hole and more slowly as it is raised). In Acquisition window switch Sampling mode to Depth up or Depth down and click the "On" button.										

*Table continued on next page.*

## Using the Borehole Spontaneous Potential/Single Point Resistance Tool, continued

Operating the Borehole Spontaneous Potential/Single Point Resistance Tool, con't

Step	Action
12	To record data, perform the following sequential steps: <ul style="list-style-type: none"> <li>• In Acquisition window click Header button and enter all available information. At a minimum enter bit from, bit to, bit, casing from, casing size, casing to, company, date, depth drilled, depth logged, level, location, recorded by, type log, and well ID.</li> <li>• Click ok to close header window.</li> <li>• Click Record button, enter file name, and select destination folder.</li> </ul>
13	Begin logging. For best results, log at 15 ft/min or slower. Remember to switch Sampling mode to Depth up or Depth down as appropriate.
14	Pressure wash or wipe cable and tool to remove dirt and other foreign material.
15	At the end of the logging run, power down by performing the following sequential steps: <ul style="list-style-type: none"> <li>• Click the "Stop" button located next to "Record" button</li> <li>• Click "Off" button in Acquisition window</li> <li>• Click "Off" button in Tool window</li> </ul> <p><b>NOTE:</b> DO NOT unhook the tool without turning off the power on the computer. As an additional precaution the yellow MGX II box may be turned off.</p>
16	To close MSLog, right click anywhere on the dashboard (windows along left side of screen) and exit.

*Table continued on next page.*

## Using the Borehole Spontaneous Potential/Single Point Resistance Tool, continued

### Disassemble the Borehole Spontaneous Potential/Single Point Resistance Tool

To disassemble, perform the following steps:

Step	Action
1	Unhook the gamma/SP/SPR tool and clean it.
2	Pace the tool back in the storage box.
3	Detach the Mud Plug from the control box and from the pit.
4	Clean the Mud Plug and return to storage.
5	Lower the boom and secure in the upright position.
6	Applying tension to the cable, walk it back onto the winch drum and secure the cable head to the boom.

**NOTE:** For more detailed instructions, maintenance, trouble shooting, and detailed diagrams, see the Operator Manual MSLog v.6 (or later) for the MGX II 5MCA-1000 and 5MGB-1000 MGX II Loggers, WNA Winch, 3WCA-1000 Winch Control, MGXII Tool Specific Operations, MSLog v.6 for the MGX II, Computer Software (IBM-PC), MSLog v.6 for the MGX II Operator Manual, and 2PGA-1000 Poly-Gamma Probe documentation.

## Using the Water Sampler

**Connect cable** *Before operating the water sampler tool, connect the coaxial cable (located on the side of the winch system) to the center port (the 'MGX Logging' port). Reference photo (Attachment 5).*

**Operating the Water Sampler Tool** To use the water sampler tool, perform the following steps:

Step	Action										
1	Connect water sampler tool to the end of winch. The water sampler tool requires both cable head crossover connectors.										
2	Power up Trailer (control on wall by door to control room).										
3	Power up winch controls by turning the power switch to the on position on both the MGX II yellow logger control panel and the black CE control panel.										
4	Connect computer to yellow box with attached serial cable and power up the computer.										
5	Double click on the MSLog icon to open the MSLog program. If dialogue boxes come up with a choice between using logger or computer settings, select logger settings and click ok.										
6	In the Tool window select "2SAM Sampler". This will initiate the MchCurve, MCHNUM, and LASWRITER browser windows.										
7	Click "On" in the tool window. Turning the tool on opens the sampler intake port. Click "Done" on the pop-up window when the timer window closes. If the pop-up window does not appear, wait two (2) minutes before proceeding.										
8	Once the sample intake port is open the unit is ready to be decontaminated by performing the following steps: <table border="1" data-bbox="527 1423 1421 1684"> <thead> <tr> <th>Step</th> <th>Action</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Without closing the sampler intake port, right click on the dashboard and exit. This will close the MSLOG.</td> </tr> <tr> <td>2</td> <td>Turn off yellow MGX II control unit.</td> </tr> <tr> <td>3</td> <td>Remove sampler tool from winch and disassemble.</td> </tr> <tr> <td>4</td> <td>Follow guidance in LANL-ER-SOP-1.08.</td> </tr> </tbody> </table>	Step	Action	1	Without closing the sampler intake port, right click on the dashboard and exit. This will close the MSLOG.	2	Turn off yellow MGX II control unit.	3	Remove sampler tool from winch and disassemble.	4	Follow guidance in LANL-ER-SOP-1.08.
Step	Action										
1	Without closing the sampler intake port, right click on the dashboard and exit. This will close the MSLOG.										
2	Turn off yellow MGX II control unit.										
3	Remove sampler tool from winch and disassemble.										
4	Follow guidance in LANL-ER-SOP-1.08.										
9	Reassemble sampler tool and reconnect to winch.										
10	Repeat Steps 1-7 above.										

*Table continued on next page.*

## Using the Water Sampler, continued

**Operating the  
Water  
Sampler Tool,  
con't**

Step	Action										
11	<p>Click “tool settings/commands” in tool window and close sampler intake port.</p> <p>Click “Done” on the pop-up window when the timer window closes. If the pop-up window does not appear, wait two (2) minutes before proceeding.</p>										
12	<p>Zero the tool by performing the following steps:</p> <table border="1"> <thead> <tr> <th>Step</th> <th>Action</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Set the top of the lower connector to the reference point (e.g. ground surface).</td> </tr> <tr> <td>2</td> <td>Click on the upper right hand button on the Depth window to reveal the next window.</td> </tr> <tr> <td>3</td> <td>Click on the "Zero Tool" button. Display on computer will read 2.50 (ft) and display on yellow box will read 2.5 (ft).</td> </tr> <tr> <td>4</td> <td>Close large "Depth" window by clicking on "x" in upper right corner. <b>NOTE:</b> you may confirm "zero point" by measuring the full length of the tool (bottom of the tool to top of lower connector).</td> </tr> </tbody> </table>	Step	Action	1	Set the top of the lower connector to the reference point (e.g. ground surface).	2	Click on the upper right hand button on the Depth window to reveal the next window.	3	Click on the "Zero Tool" button. Display on computer will read 2.50 (ft) and display on yellow box will read 2.5 (ft).	4	Close large "Depth" window by clicking on "x" in upper right corner. <b>NOTE:</b> you may confirm "zero point" by measuring the full length of the tool (bottom of the tool to top of lower connector).
Step	Action										
1	Set the top of the lower connector to the reference point (e.g. ground surface).										
2	Click on the upper right hand button on the Depth window to reveal the next window.										
3	Click on the "Zero Tool" button. Display on computer will read 2.50 (ft) and display on yellow box will read 2.5 (ft).										
4	Close large "Depth" window by clicking on "x" in upper right corner. <b>NOTE:</b> you may confirm "zero point" by measuring the full length of the tool (bottom of the tool to top of lower connector).										
13	<p>Set depth on black CE box:</p> <ul style="list-style-type: none"> <li>• Hit “P” (program) then use buttons directly below digits to change display (e.g. push “3” button until 2 is displayed directly above, “2” button until 5 is displayed directly above, and “1” button until 0 is displayed directly above).</li> <li>• Push “E” (enter) and then “R” (reset).</li> <li>• Use “Disp” to toggle between depth and speed display.</li> </ul>										
14	Move tool to desired depth.										

*Table continued on next page.*

## Using the Water Sampler, continued

Operating the  
Water  
Sampler Tool,  
con't

Step	Action								
15	When tool is at desired depth, power up by performing the following sequential steps: <ul style="list-style-type: none"> <li>Click the "On" button on the Tool window to open the sampler intake port.</li> <li>Click "Done" on Caliper Operation Window when the "Opening Caliper" timer window closes. If "Opening Caliper" timer window does not appear, wait two (2) minutes before proceeding. Tool box green light will come on when the tool is ready.</li> </ul>								
16	Wait five (5) minutes for sampler to fill with water.								
17	Click "tool settings/commands" in tool window and close sampler intake port.  Click "Done" on the pop-up window when the timer window closes. If the pop-up window does not appear, wait two (2) minutes before proceeding.								
18	Bring tool to surface.								
19	Pressure wash or wipe cable and tool to remove dirt and other foreign material.								
20	Collect water sample from valve at bottom of tool.								
21	Repeat sample runs as necessary (Steps 12 – 19) to collect requested volume.								
22	At the end of the logging run, perform the following steps: <table border="1" data-bbox="526 1228 1419 1543"> <thead> <tr> <th>Step</th> <th>Action</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Click "Off" button in Tool window. Clicking "Off" button on Tool window will close the sampler intake port.</td> </tr> <tr> <td>2</td> <td>Click "Done" on Caliper operation window when the "Closing Caliper" timer window closes. If "Opening Caliper" timer window does not appear, wait two (2) minutes before proceeding.</td> </tr> <tr> <td>3</td> <td>Detach sampler and clean.</td> </tr> </tbody> </table>	Step	Action	1	Click "Off" button in Tool window. Clicking "Off" button on Tool window will close the sampler intake port.	2	Click "Done" on Caliper operation window when the "Closing Caliper" timer window closes. If "Opening Caliper" timer window does not appear, wait two (2) minutes before proceeding.	3	Detach sampler and clean.
Step	Action								
1	Click "Off" button in Tool window. Clicking "Off" button on Tool window will close the sampler intake port.								
2	Click "Done" on Caliper operation window when the "Closing Caliper" timer window closes. If "Opening Caliper" timer window does not appear, wait two (2) minutes before proceeding.								
3	Detach sampler and clean.								

*Table continued on next page.*

## Using the Water Sampler, continued

<b>Operating the Water Sampler Tool, con't</b>	Step	Action
	23	The tool is now powered down and can be detached from the cable head. <b>NOTE:</b> DO NOT unhook the tool without turning off the MSLOG software. As an additional precaution, the yellow MGX II box may be turned off.
	24	To close MSLog right click anywhere on the dashboard (windows along left side of screen) and exit.

**Disassemble the Water Sampler Tool** To disassemble the system, perform the following steps:

Step	Action
1	Unhook the water sampler tool and clean it.
2	Place the water sampler tool back in the PVC tube and strap it into the storage rack. The lower connector or protective cap must be left on the tool for protection.
3	Lower the boom and secure in the upright position.
4	Applying tension to the cable, walk it back onto the winch drum and secure the cable head to the boom.

**NOTE:** For more detailed instructions, maintenance, trouble shooting, and detailed diagrams, see the Operator Manual MSLog v.6 (or later) for the MGX II 5MCA-1000 and 5MGB-1000 MGX II Loggers, WNA Winch, 3WCA-1000 Winch Control, and MGXII Tool Specific Operations Mount Sopris Instrument Co., Inc. documentation.

## Using the Temperature and Fluid Resistivity Tool

**Connect cable** *Before operating the temperature and fluid resistivity tool, connect the coaxial cable (located on the side of the winch system) to the center port (the 'MGX Logging' port). Reference photo (Attachment 5).*

**Operating the Temperature and Fluid Resistivity Tool** To operate the temperature and fluid resistivity tool, perform the following steps:

Step	Action										
1	Connect temperature/fluid resistivity tool to the end of winch. The gamma tool requires only one cable head crossover connectors. Centralizer may be added if borehole conditions warrant.										
2	Power up trailer.										
3	Power up winch controls by turning the power switch to the on position on both the MGX II yellow logger control panel and the black CE control panel.										
4	Connect computer to yellow box with attached serial cable and power up the computer.										
5	Double click on the MSLog icon to open the MSLog program. If dialogue boxes come up with a choice between using logger or computer settings, select logger settings and click ok.										
6	In the Tool window, select 2WGA Temp Fres. This will initiate the MchCurve, MCHNUM, and LASWRITER browser windows.										
7	Zero the tool, perform the following steps: <table border="1" data-bbox="527 1245 1421 1627"> <thead> <tr> <th>Step</th> <th>Action</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Set the top of the tool to the reference point (e.g. ground surface).</td> </tr> <tr> <td>2</td> <td>Click on the upper right hand button on the Depth window to reveal the next window.</td> </tr> <tr> <td>3</td> <td>Click on the "Zero Tool" button. Display on computer will read 2.06 (ft) and display on yellow box will read 2.1 (ft).</td> </tr> <tr> <td>4</td> <td>Close large "Depth" window by clicking on "x" in upper right corner.</td> </tr> </tbody> </table>	Step	Action	1	Set the top of the tool to the reference point (e.g. ground surface).	2	Click on the upper right hand button on the Depth window to reveal the next window.	3	Click on the "Zero Tool" button. Display on computer will read 2.06 (ft) and display on yellow box will read 2.1 (ft).	4	Close large "Depth" window by clicking on "x" in upper right corner.
Step	Action										
1	Set the top of the tool to the reference point (e.g. ground surface).										
2	Click on the upper right hand button on the Depth window to reveal the next window.										
3	Click on the "Zero Tool" button. Display on computer will read 2.06 (ft) and display on yellow box will read 2.1 (ft).										
4	Close large "Depth" window by clicking on "x" in upper right corner.										

*Table continued on next page.*



## Using the Temperature and Fluid Resistivity Tool, continued

**Operating the  
Temperature  
and Fluid  
Resistivity  
Tool, con't**

Step	Action
8	Set depth on black CE box by performing the following sequential steps: <ul style="list-style-type: none"> <li>• Hit "P" (program) then use buttons directly below digits to change display (e.g. push "3" button until 2 is displayed directly above, "2" button until 0 is displayed directly above, and "1" button until 6 is displayed directly above).</li> <li>• Push "E" (enter) and then "R" (reset).</li> <li>• Use "Disp" to toggle between depth and speed display.</li> </ul>
9	Power up tool by clicking the "On" button on the Tool window. Tool box green light will come on when the tool is ready. Confirm that the tool is collecting data by clicking "On" in the Acquisition window while in Time Sampling mode.
10	Move tool to desired depth (typically, collect data both as the tool is lowered into the hole and as it is raised). In Acquisition window switch Sampling mode to Depth up or Depth down and click the "On" button.
11	To record data, perform the following sequential steps: <ul style="list-style-type: none"> <li>• In Acquisition window, click Header button and enter all available information. At a minimum, enter bit from, bit to, bit, casing from, casing size, casing to, company, date, depth drilled, depth logged, level, location, recorded by, type log, and well ID.</li> <li>• Click ok to close header window.</li> <li>• Click Record button, enter file name, and select destination folder.</li> </ul>
12	Begin logging. For best results, log at 15 ft/min or slower. Remember to switch Sampling mode to Depth up or Depth down as appropriate.
13	Pressure wash or wipe cable and tool to remove dirt and other foreign material.
14	At the end of the logging run, power down by performing the following sequential steps: <ul style="list-style-type: none"> <li>• Click the "Stop" button located next to "Record" button</li> <li>• Click "Off" button in Acquisition window</li> <li>• Click "Off" button in Tool window</li> </ul>

*Table continued on next page.*

## Using the Temperature and Fluid Resistivity Tool, continued

### Operating the Temperature and Fluid Resistivity Tool, con't

Step	Action
15	The tool is now powered down and can be detached from the cable head.  <b>NOTE:</b> DO NOT unhook the tool without turning off the power on the computer. As an additional precaution, the yellow MGX II box may be turned off.
16	To close MSLog, right click anywhere on the dashboard (windows along left side of screen) and exit.

### Disassemble the Temperature and Fluid Resistivity Tool

To disassemble, perform the following steps:

Step	Action
1	Unhook the temperature/fluid resistivity tool and clean it.
2	Place the tool back in the storage rack.
3	Lower the boom and secure in the upright position.
4	Applying tension to the cable, walk it back onto the winch drum and secure the cable head to the boom.

**NOTE:** For more detailed instructions, maintenance, trouble shooting, and detailed diagrams, see the Operator Manual MSLog v.6 (or later) for the MGX II 5MCA-1000 and 5MGB-1000 MGX II Loggers, WNA Winch, 3WCA-1000 Winch Control, , MGXII Tool Specific Operations, MSLog v.6 for the MGX II, and MSLog v.6 for the MGX II Operator Manual.

## Using the Optical Televiewer Tool

**Connect cable** *Before operating the optical televiewer tool, connect the coaxial cable (located on the side of the winch system) to the center port (the ‘MGX Logging’ port). Reference photo (Attachment 5).*

**Operating the Optical Televiewer Tool** To operate the optical televiewer, perform the following steps:

Step	Action								
1	Verify that all power to the optical televiewer and winch system is off.								
2	Secure the winch system to a substantial anchor.								
3	Prepare the optical televiewer system: <table border="1" data-bbox="527 842 1421 1656"> <thead> <tr> <th>Step</th> <th>Action</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Fit the centralizers to the optical televiewer. <b>Notes:</b> <ul style="list-style-type: none"> <li>Centralizers should be fitted before attaching the televiewer to the cablehead and should always be fitted from the cablehead end to avoid damaging the optical window.</li> <li>The upper ring of the upper centralizer should be fixed a minimum of 21.65 in. from the top of the tool to reduce the possibility of interference with magnetometer readings.</li> <li>The “compression” ring of the centralizer (i.e., the one that is screwed tight) should always be fixed toward the top end of the sonde (see Attachment B) to avoid catching on a downhole obstruction when winching up.</li> </ul> </td> </tr> <tr> <td>2</td> <td>Thread the televiewer onto the head at the end of the winch cable. Ensure that it is attached securely.</td> </tr> <tr> <td>3</td> <td>Carefully carry the optical televiewer to the borehole and hang it vertically on the pulley. Center the televiewer above the borehole.</td> </tr> </tbody> </table>	Step	Action	1	Fit the centralizers to the optical televiewer. <b>Notes:</b> <ul style="list-style-type: none"> <li>Centralizers should be fitted before attaching the televiewer to the cablehead and should always be fitted from the cablehead end to avoid damaging the optical window.</li> <li>The upper ring of the upper centralizer should be fixed a minimum of 21.65 in. from the top of the tool to reduce the possibility of interference with magnetometer readings.</li> <li>The “compression” ring of the centralizer (i.e., the one that is screwed tight) should always be fixed toward the top end of the sonde (see Attachment B) to avoid catching on a downhole obstruction when winching up.</li> </ul>	2	Thread the televiewer onto the head at the end of the winch cable. Ensure that it is attached securely.	3	Carefully carry the optical televiewer to the borehole and hang it vertically on the pulley. Center the televiewer above the borehole.
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*Table continued on next page.*

## Using the Optical Televiewer Tool, continued

**Operating the  
Optical  
Televiewer  
Tool, con't**

Step	Action										
4	Connect the laptop computer to the digital logger with the serial cable.										
5	Plug the laptop computer, digital logger, and winch into a 110-volt power source.										
6	Power up the laptop computer.										
7	Power up the winch and digital logger.										
8	On the laptop, double-click on the "MSLog" icon to open the MSLog program.										
9	In the "Tool" window, select "OBI40-MGXII-[serial number]."										
10	Zero the tool, perform the following steps: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Step</th> <th>Action</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Using the winch controls, align the cablehead/televiewer interface so that its elevation matches that of the surveyed ground surface.</td> </tr> <tr> <td>2</td> <td>Click on the upper right-hand button on the "Depth" window to reveal the next window.</td> </tr> <tr> <td>3</td> <td>Click on the "Zero Tool" button. The computer display will read "5.18 ft." and the display on the digital logger will read "5.2 ft."</td> </tr> <tr> <td>4</td> <td>Close the large "Depth" window by clicking on the "x" in the upper right corner.</td> </tr> </tbody> </table> <p><b>NOTE:</b> You may confirm the "zero point" by measuring the full length of the tool (bottom of tool to cablehead/televiewer interface).</p>	Step	Action	1	Using the winch controls, align the cablehead/televiewer interface so that its elevation matches that of the surveyed ground surface.	2	Click on the upper right-hand button on the "Depth" window to reveal the next window.	3	Click on the "Zero Tool" button. The computer display will read "5.18 ft." and the display on the digital logger will read "5.2 ft."	4	Close the large "Depth" window by clicking on the "x" in the upper right corner.
Step	Action										
1	Using the winch controls, align the cablehead/televiewer interface so that its elevation matches that of the surveyed ground surface.										
2	Click on the upper right-hand button on the "Depth" window to reveal the next window.										
3	Click on the "Zero Tool" button. The computer display will read "5.18 ft." and the display on the digital logger will read "5.2 ft."										
4	Close the large "Depth" window by clicking on the "x" in the upper right corner.										
11	Power up the televiewer by clicking the "On" button in the "Tool" window. The "Tool Box" green light will come on when the televiewer is ready. Confirm that the televiewer is collecting data by clicking "On" in the "Acquisition" window while in "Time Sampling" mode. Click "Off" to stop sampling.										

*Table continued on next page.*

## Using the Optical Televiewer Tool, continued

**Operating the  
Optical  
Televiewer  
Tool, con't**

Step	Action
12	Use the winch controls to raise and lower the optical televiewer in the borehole. Flip the switch to choose between up and down, and adjust the speed as needed.
13	Move the televiewer to the desired depth and switch “ <i>Sampling mode</i> ” (in “ <i>Acquisition</i> ” window) to “ <i>Depth Up</i> ” or “ <i>Depth Down</i> ” and click the “ <i>On</i> ” button.
14	To record data: In the “ <i>Acquisition</i> ” window, click the “ <i>Header</i> ” button and enter all available information. At a minimum, enter “ <i>casing, date, depth, location, logged by, and well ID.</i> ” Click “ <i>Ok</i> ” to close the “ <i>Header</i> ” window. Click the “ <i>Record</i> ” button, enter the file name, and select the destination folder.
15	Begin logging at the appropriate sampling rate.
16	Pressure wash or wipe cable and tool to remove dirt and other foreign material.
17	At the end of the logging run, click the “ <i>Stop</i> ” button located next to the “ <i>Record</i> ” button, then click the “ <i>Off</i> ” button in the “ <i>Tool</i> ” window.
18	The tool is now powered down and can be detached from the cablehead. <b>NOTE:</b> Do not unhook the optical televiewer without turning off the power to the tool from the laptop computer. As an additional precaution, the digital logger may be turned off.
19	To close “ <i>MSLog</i> ,” right-click anywhere on the program dashboard (windows along left side of screen) and exit.
20	Unthread the optical televiewer from the cablehead and remove the centralizers.
21	Turn the power off on the winch, laptop computer, and digital logger.

*Table continued on next page.*

## Using the Optical Televiewer Tool, continued

**Operating the  
Optical  
Televiewer  
Tool, con't**

Step	Action
22	<p data-bbox="529 411 1412 478">Pressure wash or wipe cable and tool to remove dirt and other foreign material.</p> <p data-bbox="529 520 1404 768"><b>NOTE:</b> The optical televiewer can be configured for Azimuthal Resolution, Light Level, Shutter/Aperture Time, Chrominance Level, and White Balance mode. It also has options for Automatic Gain, Gamma Correction, and Image Enhancement. For more information on the adjustment of these features, see Advanced Logic Technology's "OBI40-Mk3 Optical Borehole Televiewer: Notes on Use and Operation, v. 3."</p>

## Records resulting from this procedure

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### Records

The following records generated as a result of this procedure shall be filed in a notebook that is permanently stored in the trailer, or maintained in the trailer filing cabinet.

- Logbook providing a summary of trip events, video well name and location, disposition of wastes, and other significant trip information

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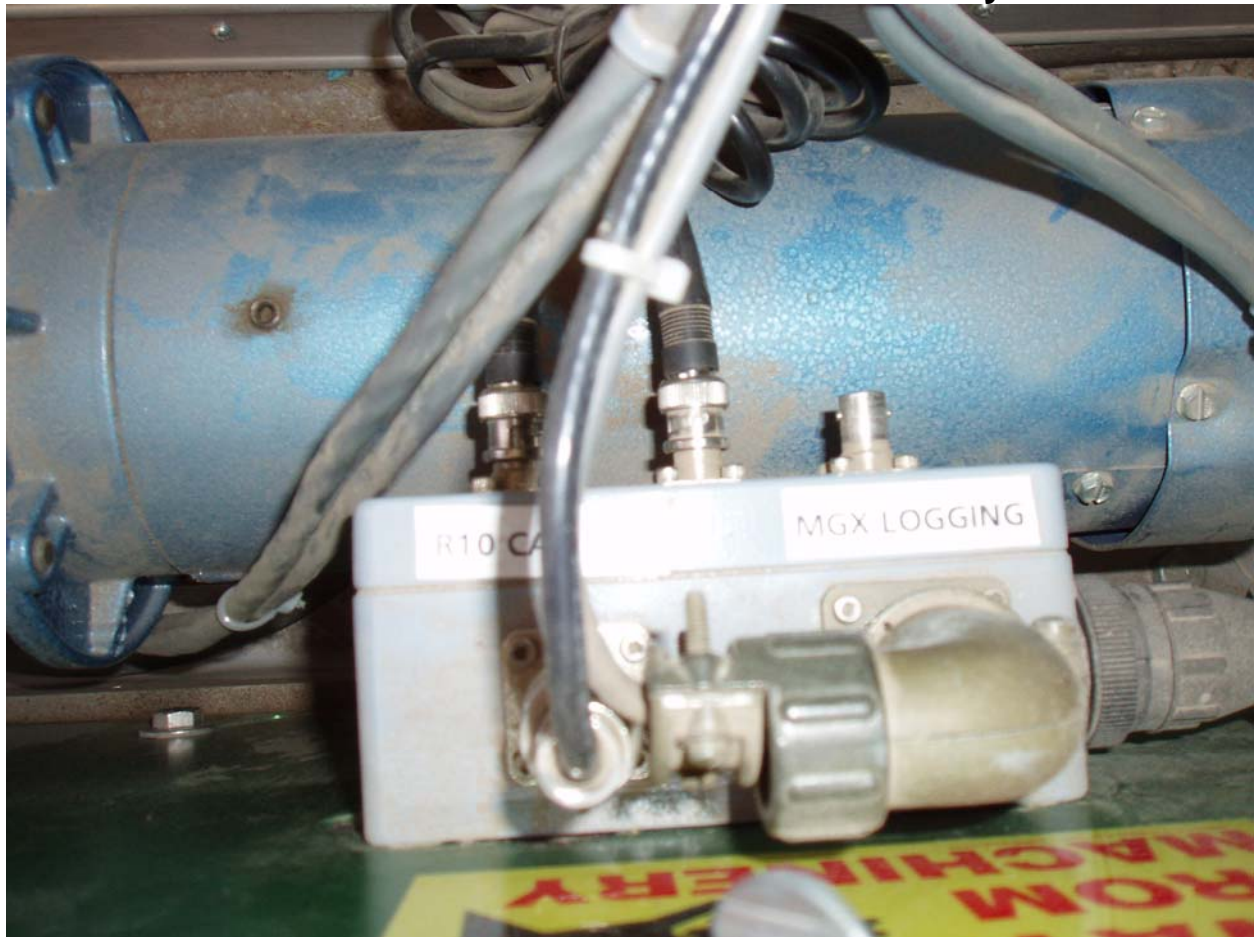


## Mount Sopris Instruments High Precision Winch





### Coaxial Cable Connection for Video Camera System





### Winch Control System – Black CE Box





### LAVAL R-10 Control Unit







## Coaxial Cable Connection for Borehole Logging Tools

