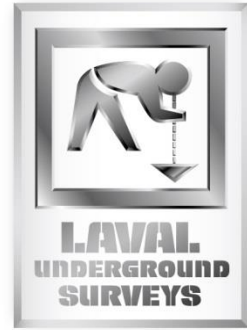


LAVAL UNDERGROUND SURVEYS



Water Well System And Components Operation Manual

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Table of Contents

Quick Start Guide	1
DC5150 Dual View Camera	1
DC5150 Cable Connections.....	2
Controller	3
Camlight	4
Removing Camlight	5
Installing Camlight.....	6
Survey Recommendations	7
CAUTION/ATTENTION.....	8
Maintenance Instructions	9
Post Operation	9
Storage	9
Description of Equipment	10
Overall	10
Camera	10
Control Unit.....	11
Using the Control Unit LCD Meters.....	12
LCD Monitors*	12
DVR.....	14
Keyboard Use and Charging.....	15
Helpful Tips	20
Electronic Counter Instructions	21
Normal Mode	21
Preset Mode.....	22
Position Mode	22
Standard Mode	23
Calibration Mode	23
Manual-Calibrate Mode.....	25
Status Mode	25
Winch	26
Winch Armored Cable.....	26
Electrical Slip-Ring.....	27
Cable-Metering Sheave.....	27
General Winch Maintenance	29

Speed Reducer Maintenance	29
Level-Wind Adjustment	29
Level-Wind Key Replacement	31
Brake Adjustment	31
Mechanical Counter Calibration	32
Hydraulic Power	34
Fluid Reservoir	35
Hydraulic Pump Power Switch	35
Winch Control Valve	35
Pressure Equalizing Valve	36
Hydraulic Motor	36
Overhead Boom	36
Operation Procedure	36
Securing the Overhead Boom	37
Overhead Boom Cable Sheave	38
Telescoping Inside Boom	38
Operation Procedure	39
Securing the Telescoping Boom	39
Telescoping Boom Cable Sheaves	40
Power Architecture	40
AC Generators	41
AC Power Cord	41
Safety Relay Box	41
Circuit Breaker Box	41
Electrical Power Strip	42
Motor Controller	42
Motor Controller Operation	42
DC Motor	43
Cablehead Replacement	44
Water Well Clarification	45
Troubleshooting	51
Checking the Cablehead for Leakage	51
Checking the 7 Pin Cable for Leakage	51
Warranty	53

Quick Start Guide

DC5150 Dual View Camera

Below is a diagram of the DC5150 with Centralizer Assembly and Cablehead (connector on the end of the Steel Armored Cable)

1. STEEL ARMORED COAXIAL CABLE
2. CABLEHEAD CONNECTOR
3. CENTRALIZER TOP COLLAR
4. CENTRALIZER TENSION ADJUSTMENT SPRINGS
5. CENTRALIZER BAND
6. CENTRALIZER ADJUSTMENT COLLAR
7. CENTRALIZER BOTTOM COLLAR
8. UPPER CAMERA HOUSING
9. SIDE VIEW PORT
10. SIDE VIEW HIGH INTENSITY CREE LEDS
11. SIDE VIEW CAMERA MODULE
12. DOWN VIEW HIGH INTENSITY CREE LEDS
13. DOWN VIEW CAMERA PORT

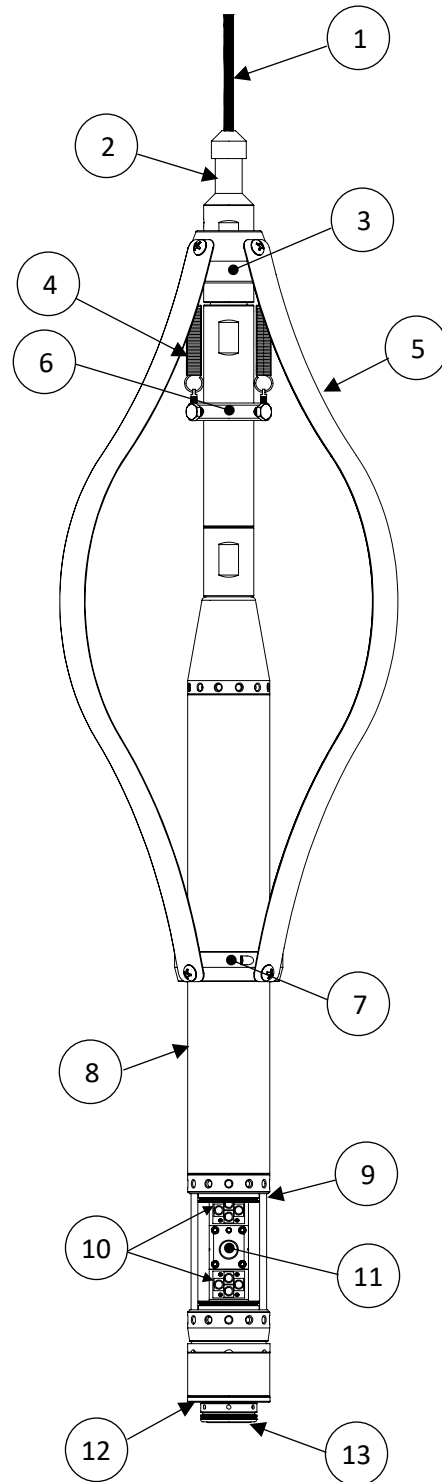


Figure 1

DC5150 Cable Connections

Below is a diagram that shows how the DC 5150 cables are connected to the system.

1. MONITOR
2. LUS-DVR RECORDER
3. CU 500 CONTROL UNIT
4. 7 PIN CONTROL CABLE #128966
5. WINCH MODEL 25/40
6. DB-15 CABLE
7. CONTROLLER #128844
8. STEEL ARMORED COAXIAL CABLE WITH CABLEHEAD
9. DC 5150 DUAL VIEW CAMERA

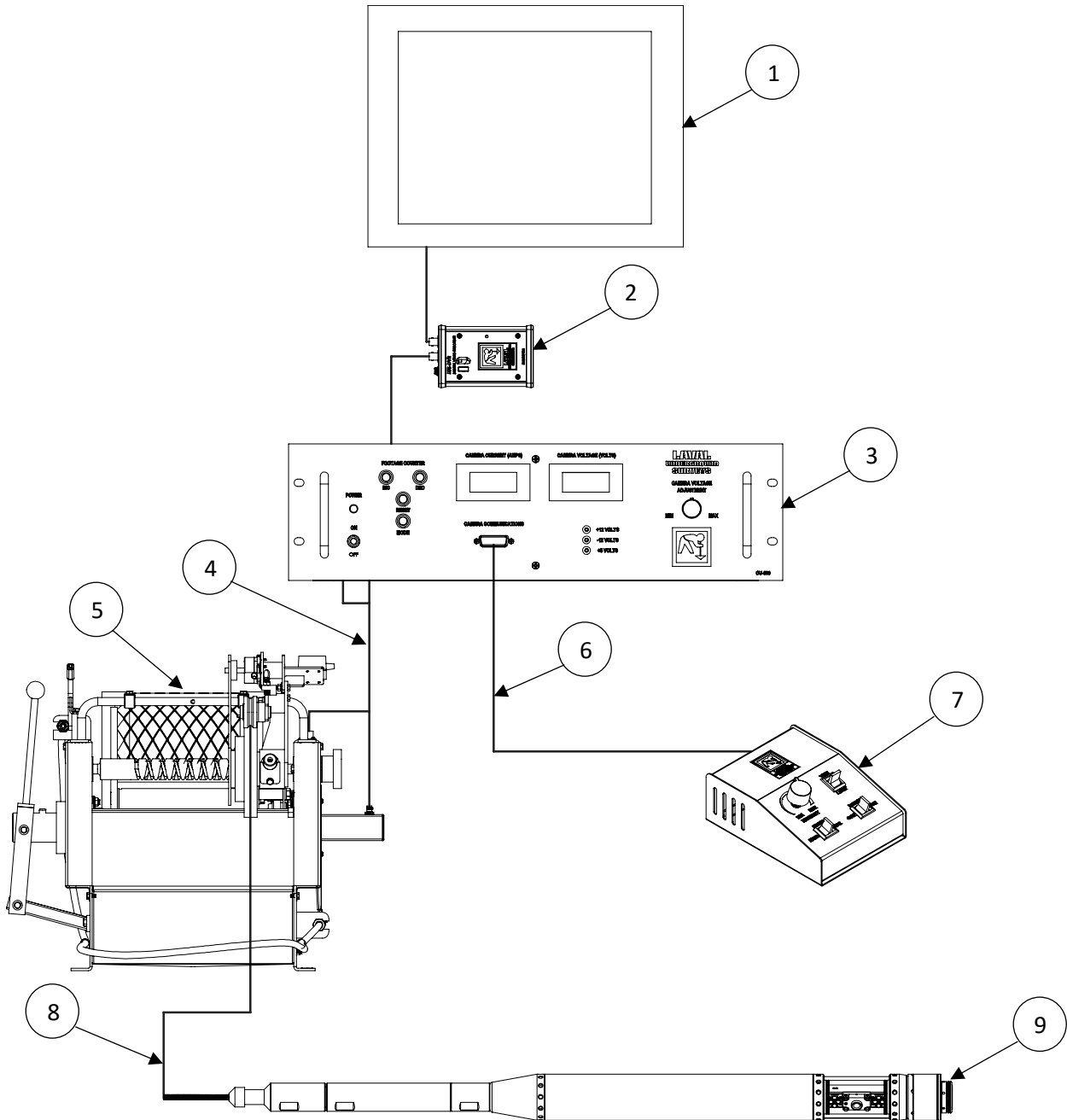


Figure 2

Controller

Below depicts the Controller that is provided for use with the DC5150.

1. FOCUS FAR/NEAR SWITCH - Both positions will continually focus near-far-near or far-near-far when held. Focus is only on Side View Camera.
2. LIGHT INTENSITY KNOB - Controls light level on selected view. Light level is remembered between switching views, knob position may not reflect current setting.
3. VIEW SWITCH - Toggles between down and side view.
4. LIGHT SWITCH - Toggles between three main settings. NORMAL: Sets down lights with down camera and side lights with side camera. REVERSE: Sets down lights with side camera and side light with down camera. DUAL: Both lights on with selected view.
5. ROTATE SWITCH - Rotates the side camera clockwise or counterclockwise. Note that the down camera rotates with the side camera.

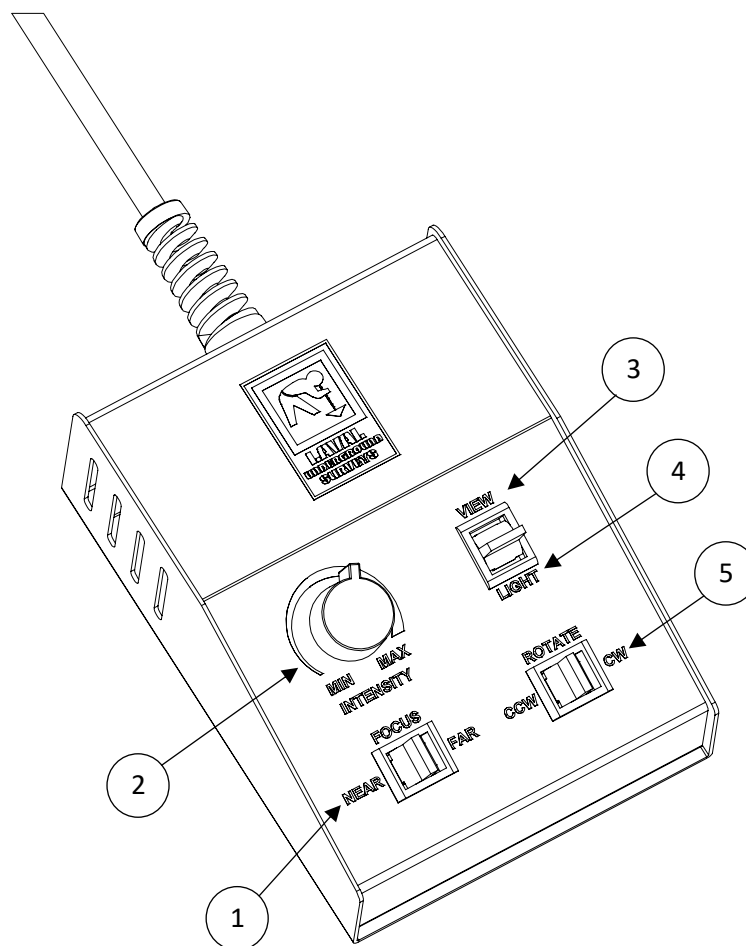


Figure 3

Camlight

Below depicts the optional Camlight forward view light head assembled with extended Centralizer Bands.

1. EXTENDED CENTRALIZER BAND
2. LIGHT BAR PLUG
3. LIGHT HEAD COLLAR
4. CAMLIGHT BAR
5. LAMP BEZEL ASSEMBLY

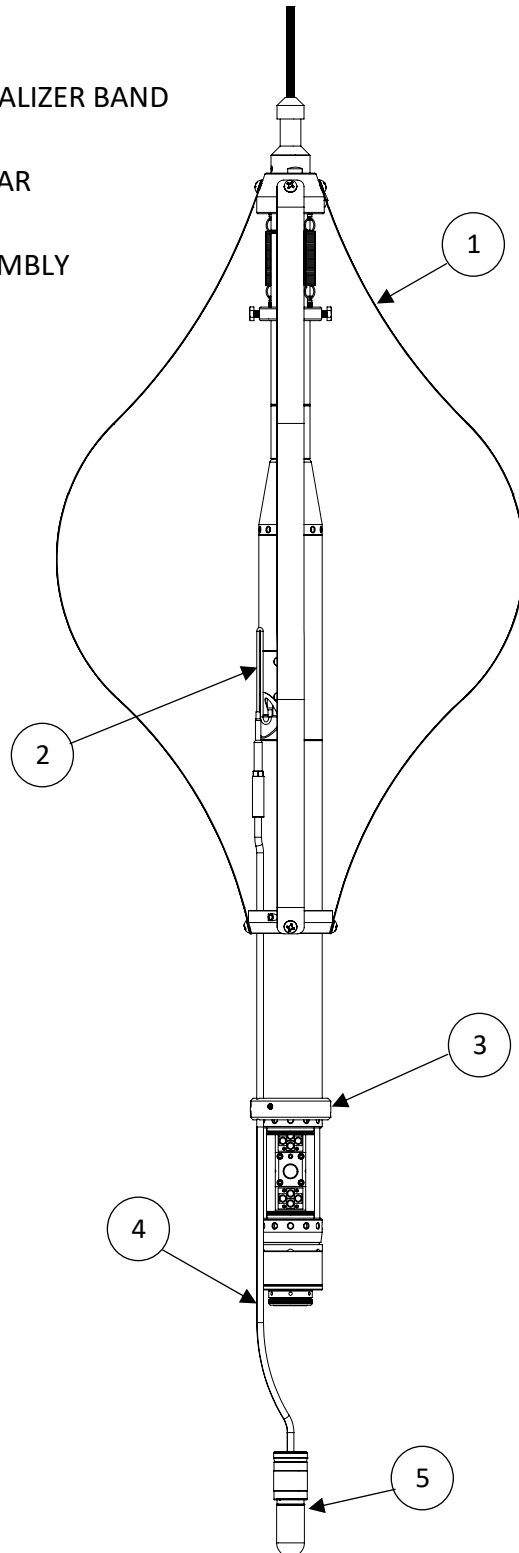


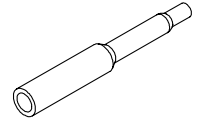
Figure 4

Removing Camlight

A “dummy plug” is provided with the Camlight and it is important to not discard it. After the Camlight is removed the dummy plug is installed to insulate the camera from the water.

To remove the Camlight Assembly:

1. Ensure all power is off before proceeding
2. Remove the Allen Head Screws (Figure 5 Item 7) holding the Plastic Cover (Figure 4 Item 6) over the Light Bar Plug (Figure 5 Item 5)
3. Disconnect Light Bar Plug (Figure 5 Item 5) from the camera
4. Install the Dummy Plug (Figure 6 Item 3) and replace the Plastic Cover (Figure 5 Item 4) with the Allen Head Screws (Figure 6 Item 6)
5. Loosen the Light Head Collar (Figure 5 Item 2) and remove it from the housing
6. Disconnect the Centralizer Bands (Figure 5 Item 4)
7. Loosen and remove the Centralizer Bottom Collar (Figure 5 Item 3)
8. Remove Light Bar (Figure 5 Item 1) and store properly to prevent damage
9. Place Centralizer Bottom Collar (Figure 6 Item 1) back onto the camera housing
10. Tighten the Bottom Collar (Figure 6 Item 1) and Bands (Figure 6 Item 2)



DUMMY PLUG

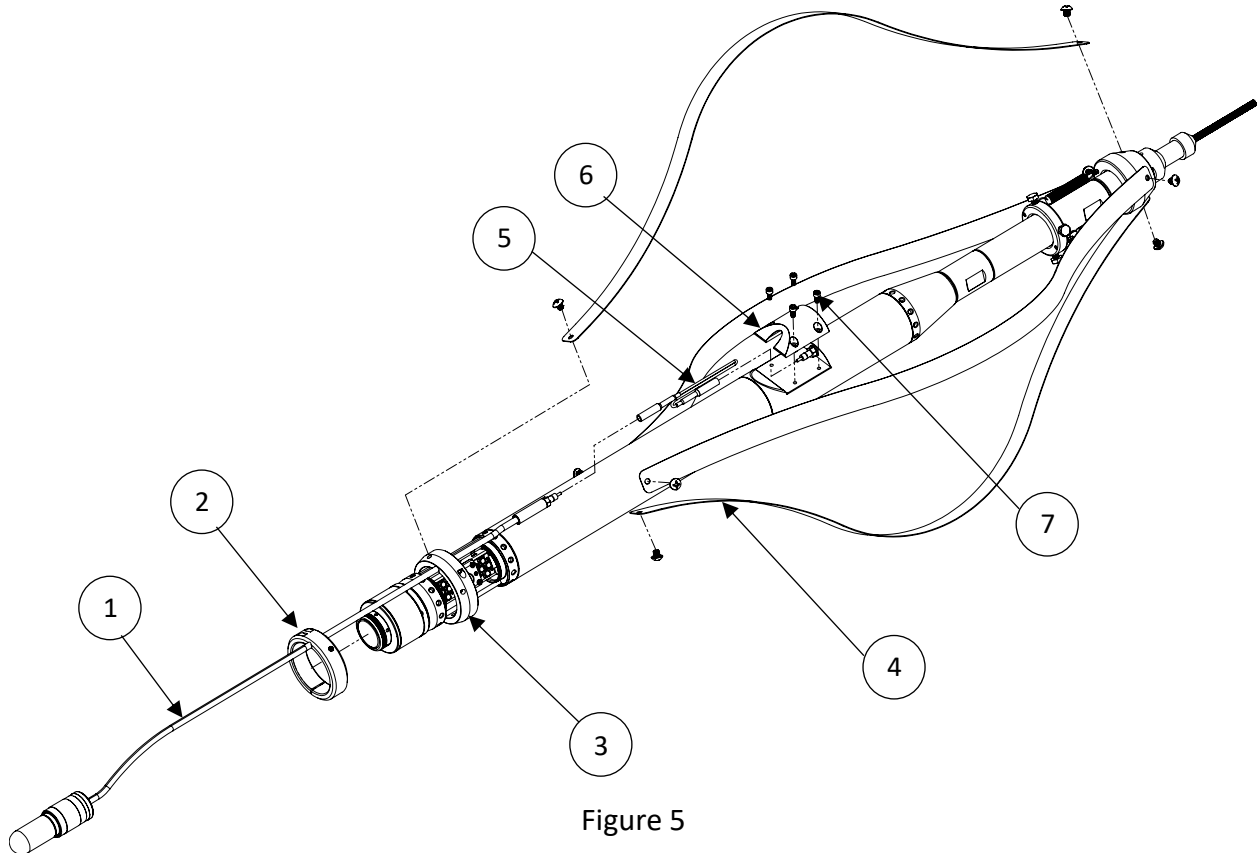


Figure 5

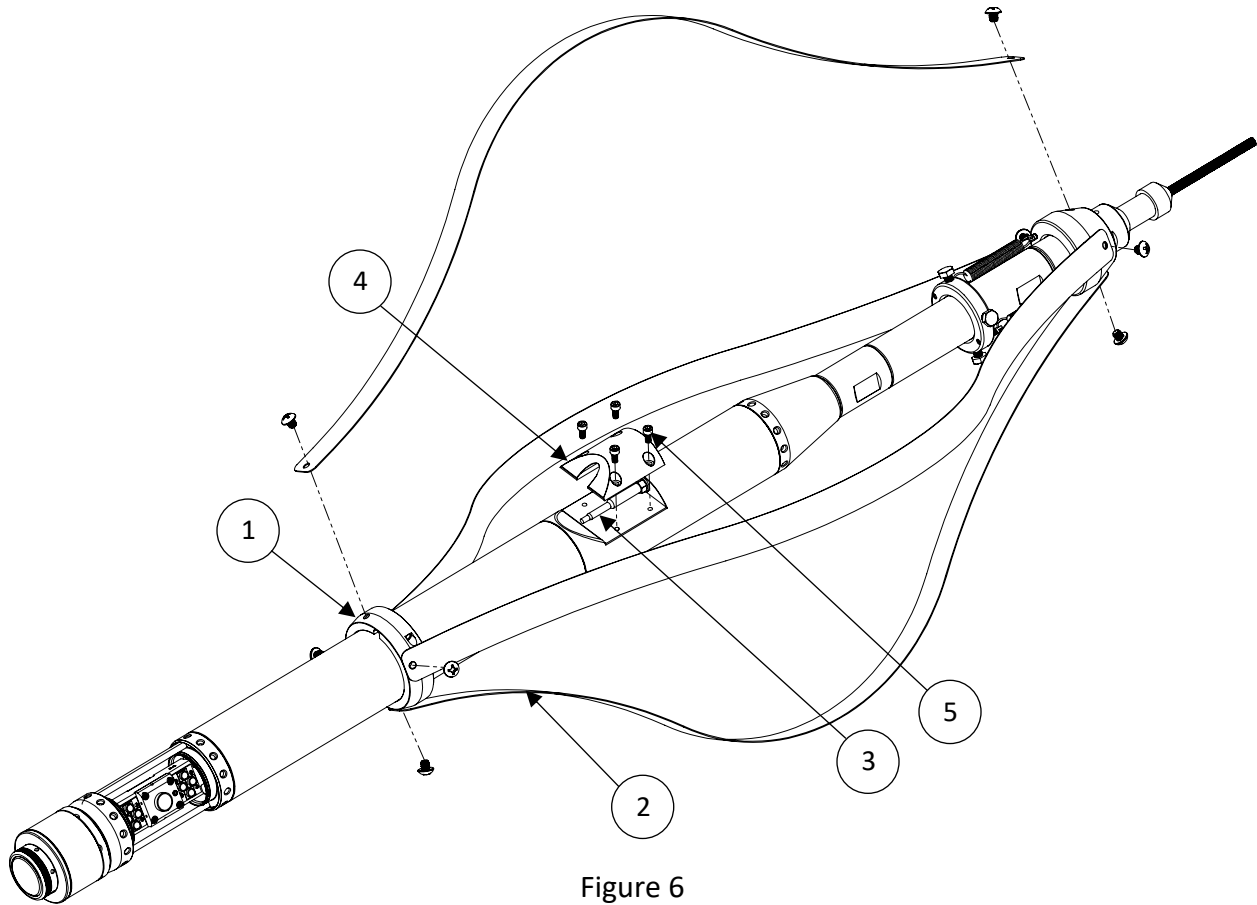


Figure 6
Installing Camlight

To install the Camlight Assembly:

1. Ensure all power is off before proceeding
2. Remove Centralizer Bands (Figure 6 Item 2) and Centralizer Bottom Collar (Figure 6 Item 1) from the housing
3. Place Light Bar into groove of Centralizer Bottom Collar and Light Head Collar, refer to Figure 5 Items 1, 2, & 3.
4. Slide Light Bar (Figure 5 Item 1) with Centralizer Bottom Collar (Figure 5 Item 3) and Light Head Collar (Figure 5 Item 2) onto housing
5. Secure both collars above the Side View Port refer to Figure 3 for example
6. Remove the Allen Head Screws (Figure 6 Item 5) holding the Plastic Cover (Figure 6 Item 4) over the Light Bar Plug
7. Remove the Dummy Plug (Figure 6 Item 3) and replace with the Light Bar Plug (Figure 5 Item 5)
8. Install the Plastic Cover (Figure 5 Item 6) with the Allen Head Screws (Figure 5 Item 7)
9. Ensure opposite end of Light Bar Plug (Figure 5 Item 5) is installed on the Light Bar (Figure 5 Item 1)

10. Adjust Light Bar (Figure 5 Item 1) to desired position and secure with set screws on both the Centralizer Bottom Collar (Figure 4 Item 3) and Light Head Collar (Figure 4 Item 2)

Survey Recommendations

The following are recommended procedures:

1. Before the Camera is lowered into the downhole or well, the Mechanical and Electronic Counters should be reset to zero at some arbitrary reference point relative to the camera housing and the top of the downhole or well.
2. Correct operation of the DVR should be verified by recording the first 10 feet (3m) of the inspection run and playing the recording back before proceeding.
3. Often a layer of oil will be encountered on top of the water surface, especially when inspecting oil lubricating pump well casings. If oil is anticipated, the outside of the angled viewing ports and the lamp cover on the Camlight must be soaped liberally with liquid detergent. The camera visibility will be restricted out of water, but once the oil layer is penetrated, the detergent may be washed off the viewing ports by pulling the camera up and down vigorously. This is best accomplished by manually pulling up and down on the cable at the top surface until the monitor picture clears. The oil should be wiped from the cable when pulling it up and the equipment cleaned with solvent.
4. If using a Winch that has a Clutch, care should be taken not to accidentally disengage the Winch Clutch when lowering or raising the camera. This will cause a free-fall which can be stopped by applying the Brake on the Winch. The Clutch should be re-engaged only after the Drum stops or is slowed to a low speed.
5. At least ten wraps should always be left on the Drum at maximum depths to keep the cable from tearing loose from the drum. The last layer of steel armored cable is painted red to show when the maximum depth is reached.
6. Due to the design of reset type Mechanical Counters, a difference between the Mechanical and Electronic (monitor display) Counts may appear when pulling OUT of the hole, especially during high speed returns.
7. If the Camera is operated in saltwater, all exterior surfaces of the housing, Cablehead, and Camlight should be thoroughly cleaned immediately after being pulled out of the downhole well.

CAUTION/ATTENTION

1. **NEVER POINT THE DOWN HOLE OR SIDE VIEW CAMERAS DIRECTLY AT THE SUN EITHER WHILE ON OR OFF**
2. **DO NOT** connect or disconnect the Camera or Camlight with the Control Unit Power switched **ON**.
3. **DO NOT** start the vehicle engine if the inverter switch is **ON**, if using an inverter.
4. **NOTE:** You **CANNOT** switch between **DOWN VIEW** and **SIDE VIEW** while the Camera is rotating.
5. **DO NOT** operate the camera system in salt water, acidic or contaminated wells. Whenever the camera and cable have been exposed to acidic or brine water, be sure to wash immediately after use with fresh water.
6. **NOTE:** any time the Control Unit is switched **OFF** or power is lost, the footage numbers (displayed on the monitor) will be lost.
7. **DO NOT** lodge the Camera in a crooked or bent casing or use the ROTATION function in such a situation.
8. **DO NOT** hit the bottom of the downhole or well with the Camera or Camlight.
9. Store the camera system in an indoor, dry, temperature-controlled environment. Preferably in the provided carry case. **DO NOT** expose the camera system to extreme temperatures during use or storage.
10. At least ten wraps of the Cable should always be left on the Reel Assembly Cable Drum at maximum depths
11. **DO NOT** overtighten the cablehead. Finger tighten when threading the cablehead into the camera, a wrench is not necessary.

Maintenance Instructions

Post Operation

1. Prior to removal from Cablehead, wash Camera with a low pressure sprayer (garden type) and wipe down
2. Remove Camlight and check o-ring condition and o-ring seal area for cleanliness
3. Remove Camera from Cablehead to check o-ring condition and o-ring seal area for cleanliness
4. Check Cablehead o-ring condition and o-ring seal area for cleanliness

Storage

1. Store Camera in a dry carrying case (if available place desiccant bags in case with camera)
2. Store Camlight to allow air drying (screw on lamp cover loosely to allow air flow for drying)

Description of Equipment

Overall

The DC5150 Deep Well Camera System can be used in wells and boreholes 3 to 30 inches (7.62 to 76.2cm) in diameter and down to a maximum depth of 5,000 feet (1,524 cm). In addition to the standard downhole view the camera offers a side-view perspective with continuous 360 degree rotation, with no external moving parts, in a single housing.

Light Emitting Diodes (LEDs) illuminate both the down-view and side-views with light intensity adjustment located on the joy stick. The LEDs are shock proof and provide ample light to see in most well conditions. Additional light is available with our cam-light accessory option.

The CU500 Deep Water System Controller serves as the video source, power supply, functions controller and counter. The control unit offers variable voltage to the well camera while displaying high voltage and camera current meters. The footage counter and video display can be calibrated in the field and allows the user to preset or reset the counter on the screen along with the ability to change the location of the numbers on the screen.

A single coaxial Cablehead Connector on the rear of the Camera is connected to the steel braided reinforced coax cable by a watertight pressure rated connector. The DC5150 system can be paired with a Model 25 or 40 winch and have the option of being hydraulic or electric (specified at time of order). An automatic level wind on the winch keeps the cable evenly distributed on the winch spool. Most system installations utilize an inverter to power all the components of the system off the vehicle's 12 volt battery.

The video out from the CU500 control unit can be connected into any recording devices or monitors. The most common system set up is the video out into one DVR recorder then into one or two monitors.

When the DC5150 system is mounted into some type of vehicle a boom arm is utilized to place the camera over the well without having to maneuver the vehicle too close. The two types offered are an overhead boom or an inside boom. Both styles telescope to reach the well or bore hole. The inside boom, like the name states, is located inside the vehicle and comes with a hand crank to make positioning easy for the operator. The overhead boom is located on top of the vehicle and swings 180 degrees to be locks in place for transit.

Camera

The DC5150 DUAL CAM provides a comprehensive, detailed survey of water wells, boreholes, underground storage tanks and mine shafts measuring 3"-30" in diameter to depths of 5,000

feet. In addition to the standard downhole view, it offers a side-view perspective with continuous 360° rotation (and no external moving parts). The camera uses specially designed long-life Cree L.E.D. lighting for both side and down views. Easily retrofit to single conductor video inspection systems. Standardized Cablehead allows interchangeable use of Laval cameras. Has a slimmer, lightweight design for easy handling. Sealed housing prevents condensation and water intrusion and designed for environments of temperature 32° to 150° F (0° to 65° C). Joystick control allows for easy operation and full-function, one-hand operation.

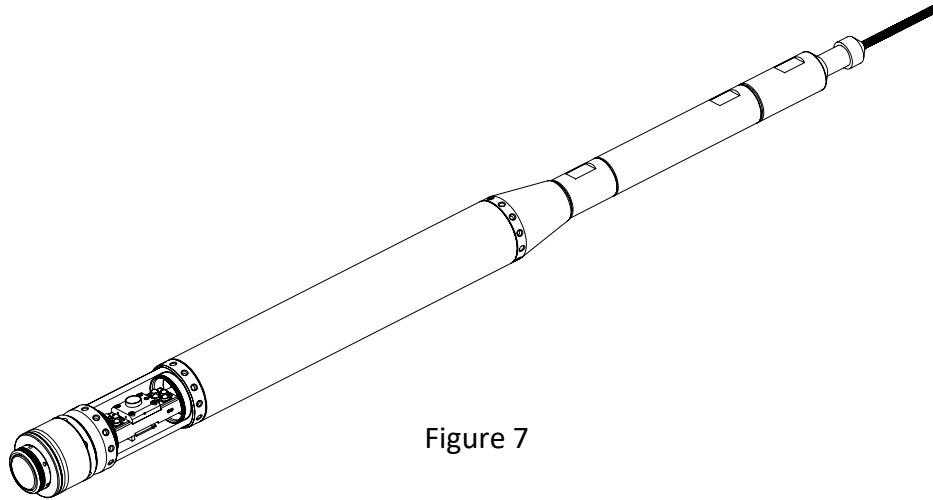


Figure 7

Control Unit

The Control Unit and Monitor are equipped for standard 19" panel mounting or provided within the optional cabinet and contain all of the necessary electronics and controls to operate the video and camera.

The front panel controls on the Control Unit are shown in Figure 8. The ON-OFF Switch (Figure 8 Item 2) routes power to the Camera and Camlight (if installed) when switched to the ON position. A Power Indicator Light (Figure 8 Item 1) indicates when power is supplied to the Lights and Camera.

The major components contained within the Control Unit include a high voltage power supply that provides 125-150 volts variable DC for operating the Camera (Figure 8 Item 13) and a smaller power supply that provides $\pm 12V$ DC and +5V DC from the 115 V AC input. The smaller power supply can be monitored by Voltage Indicator Lights Figure 8 Items 10, 11 and 12.

NOTE: Though Variable Camera Voltage is used to operate the camera. The Camera Voltage should never read less than 145 VDC (Figure 8 Item 9)

One plug-in printed circuit board is located in the Control Unit. The video board processes the video output from the camera and directs a composite video signal to the monitor. The board is powered by the low voltage power supply. This board also serves as the electronic footage counter system and it is also powered by the low voltage power supply. It functions to convert

pulses from the winch-mounted encoder into the footage figures displayed on the monitor transposed onto the video from the camera. The footage count is continuously displayed and counts forward when the camera is lowered and counts backward when the camera is raised. The reset button (Figure 8 Item 4) sets the displayed count to zero (0000) any time it is depressed.

An AC Voltage Input socket (Figure 8 Item 16) and a 3 amp rated circuit breaker (Figure 8 Item 14) for the AC input are located on the rear of the control unit (Figure 8). The DC high voltage circuit breaker is Figure 7 Item 15. The reel connector (Figure 8 Item 18) is a standard MS type connector for the cable between the control unit and the winch. The cable carries video, power, and the footage encoder signals between the control unit and the winch. The video output connector (Figure 8 Item 19) is used to connect the monitor or a DVR recorder to the control unit.

Using the Control Unit LCD Meters

The CAMERA VOLTAGE position shows the voltage to the camera. This voltage level is also determined by the position of the CAMERA VOLTAGE control on the front of the control unit. If camera voltage reads 0 check the circuit breakers in the back of the control unit and check for a short in the system.

In the CAMERA CURRENT position, the meter reads the amperage being drawn by the Camera and Camlight (if installed). A meter reading of 1.999 would indicate a short circuit at some point in the system. When the amp meter reads 0 the DC circuit breaker must be checked.

If any trouble with the system is encountered, the meter readings on both LCD Displays should be noted prior to shutting the system down to aid in trouble-shooting. Also note whether a footage number is being displayed on the video monitor screen before turning the system OFF.

LCD Monitors*

Laval Underground Surveys supplies a commercial-quality LCD monitor. For Monitor instructions for use and further monitor details please refer to the manufacturer's manual attached in the addendum.

*Specific features may vary depending on the monitor model supplied with your system.

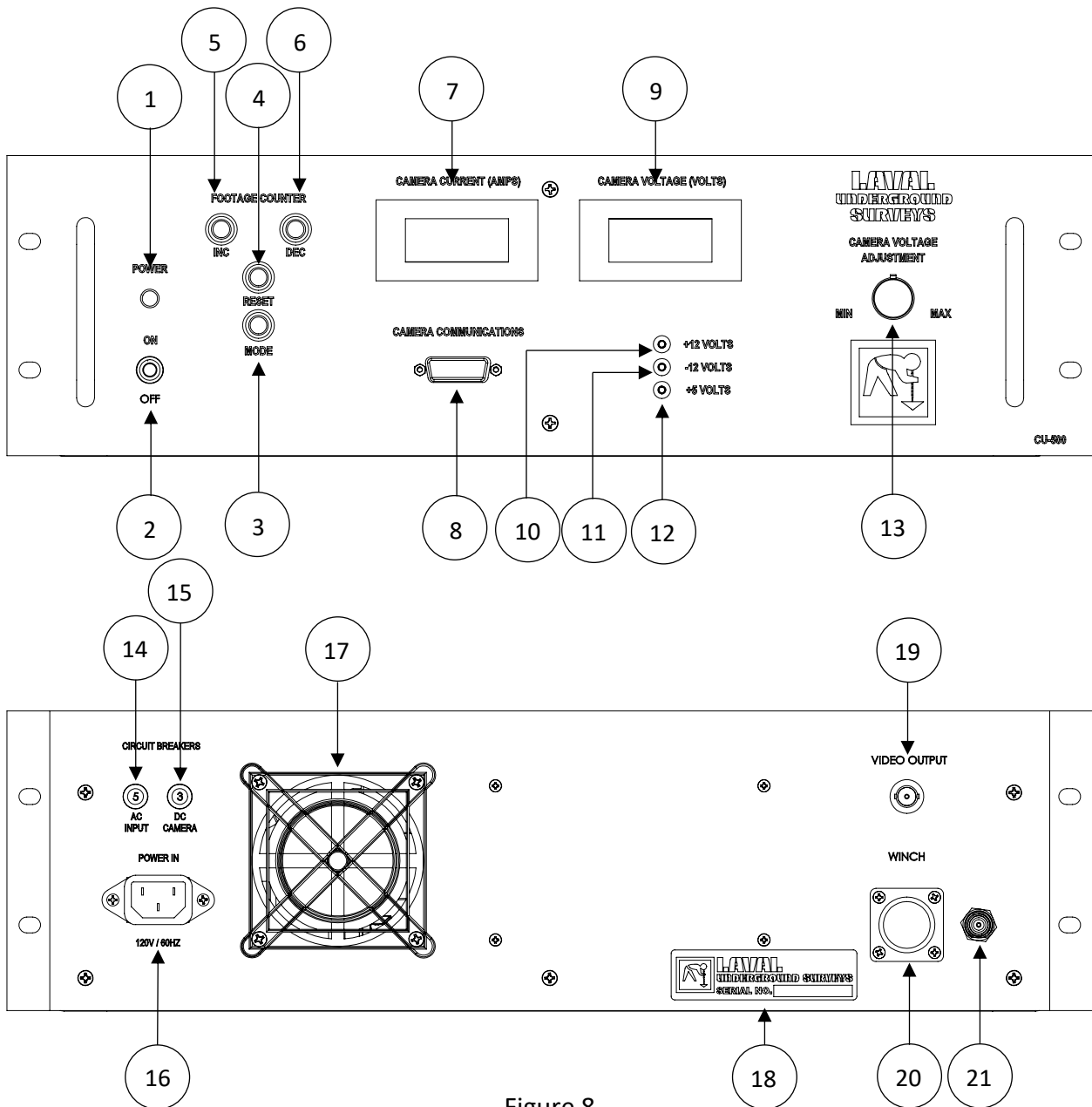


Figure 8

1. POWER INDICATOR LIGHT
2. POWER ON/OFF SWITCH
3. MODE - Button for Calibrating and Programming the Footage Counter
4. RESET- Reset on the Onscreen Depth Display to 0
5. INCrement - Manually adjust the onscreen count when in the Preset Mode
6. DECrement - Manually adjust the onscreen count when in the Preset Mode
7. CAMERA CURRENT - LCD Display for Camera Amperage
8. JOYSTICK COMMUNICATIONS - Joystick Connection Port for Camera Functions
9. CAMERA VOLTAGE - DV Voltage Display for Camera Voltage
10. +12 VOLTS - Voltage Indicator for 12VDC in the Control Unit

11. -12 VOLTS - Voltage Indicator for -12VDC in the Control Unit
12. +5 VOLTS - Voltage Indicator for 5VDC in the Control Unit
13. CAMERA VOLTAGE ADJUSTMENT - Camera Voltage Adjustment Knob
14. AC INPUT 5 AMP CIRCUIT BREAKER
15. DC OUTPUT 3 AMP CIRCUIT BREAKER
16. AC VOLTAGE INPUT
17. FAN - for cooling Control Unit
18. SERIAL NUMBER LABEL
19. BNC CONNECTOR - Video Output from Control Unit
20. 7 PIN CONTROL CABLE CONNECTOR - Carries Video, Functions, and Encoder
21. TNC CONNECTOR - High Power Voltage Output

DVR

The Digital Video Recorder (DVR) records video and audio to USB storage media and can capture snapshot images on-the-fly without interrupting recording. It has an internal real-time clock with battery backup that provides date and time information. Videos and snapshots are saved to a folder called DCIM on the USB devices. The DCIM folder is created if not present. The videos are recorded as .ts files and the snapshots are .jpeg files. File names are automatically generated by the real-time clock. The video bit rate can be tailored to match the user requirements and storage capacity.

Text overlays reflecting current date and time can be applied to appear in the recorded video. A single line of user defined text comments can be overlaid in the video. There are 5 user entered custom text lines.

The DVR has an internal 16GB USB storage device. This internal memory will store at least 8 hours of video. There is a USB jack on the panel for an external storage device. There is no limit on capacity of the USB storage devices; however, the devices need to be FAT 32 format. The DVR will simultaneously record to both the internal and external USB storage devices. **When either internal or external memory becomes full, an on-screen message will prompt the user to address the capacity of the internal or external memory before the recording option will resume.**

There is also a USB jack on the panel for plugging in a standard PC-type USB keyboard. A wireless mini keyboard is supplied with the DVR. There is a black 'receiver' for the provided mini keyboard inserted in a USB space on the control unit. It will have two letters on it that correlate with the mini keyboard. Without the receiver plugged into the control unit, the keyboard will not be able to function. **NOTE:** the keyboard and its USB receiver are paired and cannot be mixed with another set.

Keyboard Use and Charging

The internal battery is a non-replaceable Polymer Lithium-ion type. If no keys are pressed for more than 3 minutes, the keyboard goes into Sleep Mode. Because of Sleep Mode, the keyboard's battery will last many hours and even many days on one charge. The battery will retain a charge in Sleep Mode from 500 to 700 hours. To re-charge the battery, plug the charging cable into the keyboard and into any standard USB jack. The charging cable can be plugged into the RCAM panel to charge the battery and simultaneously operate the keyboard; however, the keyboard receiver must be plugged in to either the RCAM panel or the female-USB jack on the charging cable. The Green Power LED will flash when the battery power is low. The Red Battery LED will light up when the keyboard is being properly charged.

Keyboard Functions

Key	Function
Enter or Space Bar	Menu or OK
Up Arrow	Rewind Playback or Move Text Up
Down Arrow	Fast Forward Playback or Move Text Down
ESC (Escape)	Stop/Finalize Recording, Menu Back, or Playback Stop
R	Record Start or Pause Recording
S	Snapshot
P	Pause Record or Playback

Keyboard LED Indicators	Meaning	
YELLOW	RF Signal	ON=Transmitting
RED	Battery	Cable plugged in: ON=charging OFF=Fully charged
GREEN	Power	ON=Power on, OFF=Sleep Mode, FLASHING=Low Power
WHITE	CAPS LOCK	ON=Caps Lock Active, OFF=Caps Lock Inactive

The DVR is controlled using the keyboard and an on-screen menu system. After initial power-up, press the Space Bar or the Enter key to bring up the Top Menu. Then again, press the Space Bar or Enter key to go into one of the Sub Menus.

Getting Started

To start a recording press **R**. Press **R** a second time to pause a recording, before pressing **R** a third time to resume recording again to create one continuous video. To stop and finalize recordings press **ESC**. Finalization can take up to 2 minutes for long recordings. It is important to note that powering down before stopping/finalizing the recording can result in losing the recording. **A maximum video length of 1.5 hours is recommended to manage file size.** Press **S** at any time to take a snapshot image of the video. To add a text overlay before recording see the Overlays Section on page 16.

1. DVR HOUSING
2. KEYBOARD USB POWER LIGHT INDICATOR
3. WIRELESS KEYBOARD
4. RECEIVER
5. 9 VDC POWER ADAPTER
6. VIDEO IN BNC CABLE
7. VIDEO OUT BNC CABLE
8. EXTERNAL MEMORY USB

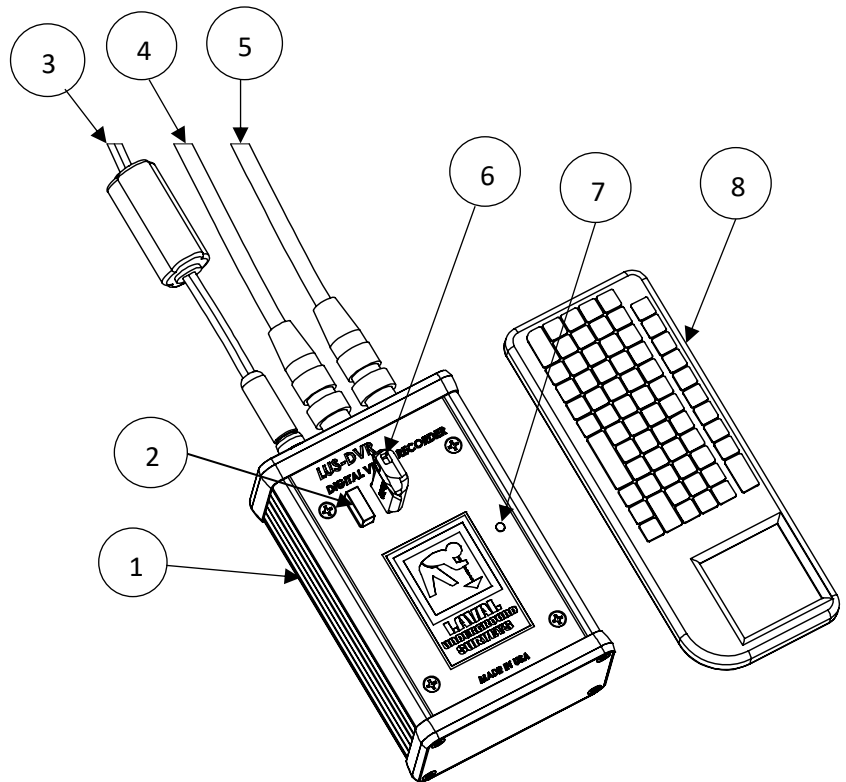


Figure 9

Menu Structure

Play Video

Play from internal

Play from external

If only the internal device is present, the files list from the internal device is displayed.

File selection is made using the up and down arrow keys. Pressing Enter or Space starts playback.

View Snapshots

Behavior is similar to “Play video”

Overlays

Primary Overlay

Allows selection of the size of the text from either 8x14 or 16 x 16. You can also select OFF which turns off the text display. The default setting is 16 x 16.

Setup Primary Overlay

Text

Allows selection of which text is displayed from date only, time only, time and date, custom text 1, custom text 2, custom text 3, custom text 4, or custom text 5. The default setting is time and date.

Custom Text

Allows the user to enter up to 5 custom text comment lines. Each line has a maximum of 40 characters.

Date Format

Allows selection of the format of the date display. The default setting is MM – DD – YYYY.

Time Format

Allows selection of the format of the time display.
The default setting is 24 hour format in HH: MM : SS.

Background

Allows selection of the background of the text from Black, Transparent, 50% black, or 75% black.

Move Up, Move Down, Move Left, Move Right

Allows the text to be moved on the screen.

Secondary Overlay

Allows selection of Title overlay, Coded overlay, Extra overlay, or off.

Setup Title/Coded/Extra Overlay

Edit Text

Allows the user to edit the preloaded text

Load

Allows the user to edit text that has been saved

Save

Allows the user to keep any changes to the text

Text Size

Allows selection of the size of the text from either 8x14 or 16 x 16. You can also select OFF which turns off the text display. The default setting is 16 x 16.

Background

Allows selection of the background of the text from Black, Transparent, 50% black, or 75% black.

Move Up, Move Down, Move Left, Move Right

Allows the text to be moved on the screen

File Management

Copy video from internal

Copy video from external

Copy snapshots from internal

Copy snapshots from external

Delete files from internal

Delete files from external

Rename files on internal

Rename files on external

If only the internal device is present, the external choices will not be shown.

Setup

Set Date/Time

This setting allows for setting up the battery backed-up real-time clock. The real-time clock is used to automatically generate file names for saved video files and snapshots. There is also an option of having the date/time overlay present in recorded video and snapshots.

Video

Video Standard

Allows selecting between NTSC and PAL video formats

Interpolate

Turning interpolation on gets rid of motion artifacts at an expense of some vertical resolution loss. The default setting is ON.

Video Bit Rate

Determines the compression level of recorded video. The higher the bit rate, the higher is the quality, the more space is required on the storage device. The selection is from 1000kbps to 5000kbps. The default setting is 3500kbps. At the default setting of 3500kbps, a minimum of 8 hours can be recorded onto a 16GB storage device.

Playback Seek

Adjust the amount of the time skipped when using Rewind and Fast Forward functions. Default is 10.

Snapshot Quality

Determines the compression level of snapshot. The higher the quality, the more space is required on the storage device. The available settings are 97 (best) down to 50. Default is 90.

Snapshot Overlay

Turning on this setting allows the text overlay to be shown in Snapshots. Default is On.

Recording Format

Determines the video format .ts or .mp4. Default is .ts, because there is no loss of data in the event of recording interruption, such as a loss of system power.

Record Storage Device

Allows the selecting the recording destination devices: internal, external, or both. The default setting is BOTH.

Set Language

Language can be set to English, French, German, Portuguese, or Spanish for the DVR menus only. Default is English.

System Information

Displays various system information, including firmware version, detected storage devices with free space available and allows system parameters to be reset, saved and loaded as follows.

Reset System Parameters

Resets all the parameter settings to Basic default settings. This option restores the DVR back to the Laval Underground Surveys factory settings.

Save System Parameters

Saves all the parameter settings to USB memory storage. *Only use this option if you wish to change the factory settings from Laval Underground Surveys.*

Load System Parameters

Loads all the parameter settings from USB memory storage. This option restores the DVR back to the saved settings.

Turn WiFi on

Setting allows streaming video over an unsecured network with a WiFi adapter when set up and turned on, for more information on how to set up please contact Laval.

Helpful Tips

- Press ESC to stop all recordings, playbacks, and to back out of menus. Pausing a recording and powering off will erase the unfinished recording.
- **A MAXIMUM VIDEO LENGTH OF 1.5 HOURS IS RECOMMENDED.**
- Turn the keyboard power off at the end of your use of the system to preserve longer battery life.
- After 3 minutes of not using the keyboard, the keyboard goes into Sleep Mode and all LED indicators will go out. Keys will not work until it wakes up which takes a few seconds. After it wakes up, the Green Power LED will light and the keys will work again.
- If the unit is not operating properly, restoring the setup settings back to Laval Underground Surveys factory settings may fix it. See *“Reset System Parameters” in the System Information section.*
- Monitor available free memory for both the internal and external storage in the System Information screen. If more space is need on the internal storage you can move files to the external storage by copying and then deleting them.
- Stop the movement of the camera (reeling up/down or rotating) when using the snapshot function for clearer pictures.
- Text overlays must be setup and typed in prior to the recording.
- **IMPORTANT:** When renaming video files, do not change or delete the file extension, the “.mp4” or “.ts” part of the name, as this may make the file in-accessible to the system. All video files must have the “.mp4” or “.ts” at the end of their file name. Likewise, the “.jpg” at the end of snapshots file names must be treated the same.
- Always keep the keyboard and its USB receiver paired together with one system, refer to the serial codes on them in the event that they are mixed with another set.
- Larger storage devices such as external hard drives will most likely need formatting to FAT32 to work with the DVR. Keep this in mind and test recording before going into the field.
- Video files recorded as .ts can be converted if they are not compatible with a video player, using a video converter. Converted files may not play back on the DVR.

Electronic Counter Instructions

In the normal operation mode after powering up the unit, the distance count is displayed on the screen along with the camera picture. The **RESET** button (Figure 8 Item 4) clears the count to zero.

The **MODE** button (Figure 8 Item 3) sequences through seven on-screen modes as follows:

Normal Mode ————— Distance measurement is displayed

Preset Mode ————— Preset specific distance measurement

Position Mode ————— Position distance measurement on screen

Standard Mode ————— Distance measurement standard of Feet (ft) or Meters (m)

Calibration by Reel Mode — Electronic reel calibration

Manual Calibrate Mode — Manual input of calibration number

Status Mode ————— Status of control unit internal information

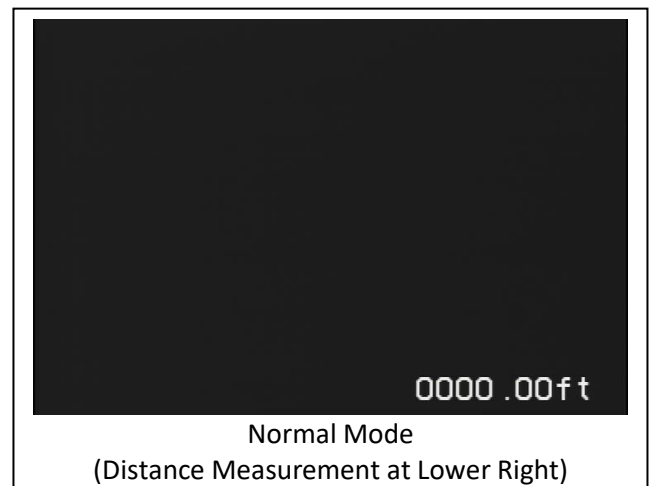
NOTE: in the normal operation mode, the **INC** and **DEC** buttons (Figure 7 Item 5 & 6) do not have any function; however, they do perform various functions in the other modes.

Normal Mode

Normal mode is the initial mode when power is turned on. Only the distance measurement is displayed on screen along with the video.

The **RESET** button (Figure 8 Item 4) resets the distance to zero.

The **MODE** button (Figure 8 Item 3) advances the menu to the Preset Mode.



Preset Mode

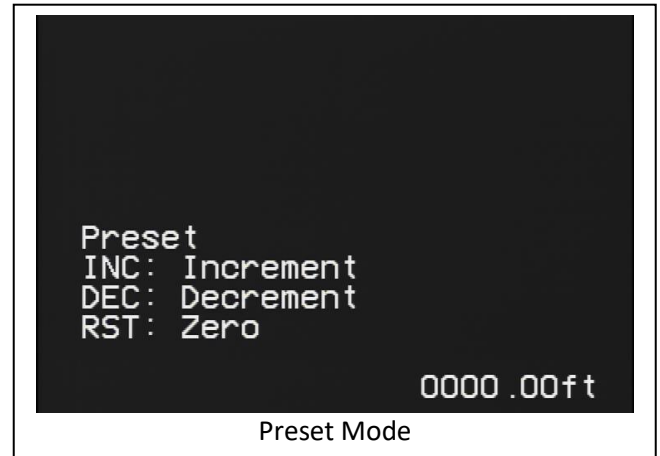
The Preset mode allows the distance count to be preset to a specific number. This provides a way to initially start counting with a number other than zero.

The **INC** button (Figure 8 Item 5) increases the count.

The **DEC** button (Figure 8 Item 6) decreases the count.

The **RESET** button (Figure 8 Item 4) sets the count to zero.

The **MODE** button (Figure 8 Item 3) exits this mode.



NOTE: Holding down the **INC** or **DEC** (Figure 8 Item 10) button causes it to increase or decrease repeatedly.

Position Mode

The Position mode allows positioning of the distance count to be one of five positions: top left, bottom left, bottom right, top right, or centered.

The **INC** button (Figure 8 Item 5) sequentially changes the position by moving the positions in a clockwise sequence.

The **DEC** button (Figure 8 Item 6) sequentially changes the position in a counter-clockwise sequence.

The **RESET** button (Figure 8 Item 4) sets the position to the 'home' position which is at the top left.

The **MODE** button (Figure 8 Item 3) exits this mode.



Standard Mode

The Standard mode allows the distance count unit of measurement to be either feet or meters.

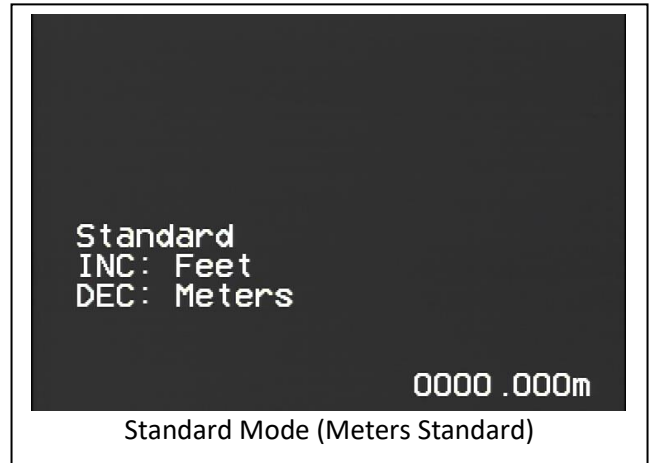
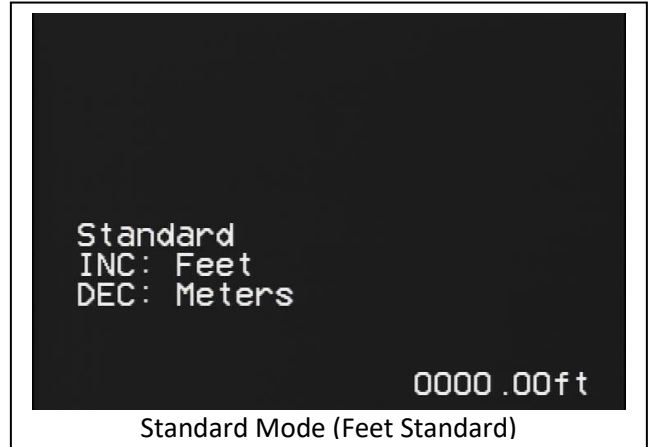
The **INC** button (Figure 8 Item 5) sets the standard to Feet.

The **DEC** button (Figure 8 Item 6) sets the standard to Meters.

The **MODE** button (Figure 8 Item 3) exits this mode.

NOTE: Standard Feet displayed distance is 4 whole digits with 2 decimal places (0000.00ft) which provides a resolution of .12 inches.

Standard Meter displayed distance is 4 whole digits with 3 decimal places (0000.000m) which provides a resolution of 1 centimeter.



Calibration Mode

The Calibration mode allows for software calibration of the distance measurement system of the reel. The calibration feature makes an automatic adjustment of the distance count based on a calculated calibration adjustment factor determined by the procedure. The default is 200 pulses per revolution but can handle up to 10,000 pulses per revolution.

The procedure is as follows:

1. Mark the cable. Before this electronic calibration procedure can be initiated, the cable must first be marked in two places with a 0-mark and a 100-foot mark. The 0-foot mark is closest to the end of the cable. The distance from the 0-mark to the end of the cable is not critical or important, but needs to be long enough to allow the mark to be positioned on the counter-wheel of the winch (usually 15 to 25 feet) while allowing the cablehead on the end of the cable to be free from idler rollers or sheaves. Black

electrical tape can be used for the markers, but be sure the tape will adhere well to the cable by degreasing the area before applying the tape.

Note: This procedure performs the calibration as the cable is "reeled out" as opposed to "reeled in". Since spiral wound cable does not give the same count between reeling in and reeling out, accuracy is generally desired for reeling out.

2. Position 0-mark. Once the cable is marked, reel the cable in so the 100-foot mark goes onto the reel and continue reeling the cable in to position the 0-mark on the counter wheel in a location that is easy and convenient to see. We are now ready to perform the electronic calibration procedure.

3. Press the **INC** (Figure 8 Item 3) to initiate the procedure. You will see "000000 **encCnt**" which indicates you are at the zero point of the count. You will see "0001.00 **Cnt/Ft**" which is the calibration number initial value.

```
000000 encCnt

0001.00 Cnt/Ft (2X PPR)

Calibration-by-Reel
INC: Start (Extend 100ft)
DEC: Set
MODE: Save/Exit

0000.00ft

Calibration-by-Reel Mode – INC pressed
```

4. Extend 100 ft. Reel out the cable carefully while maintaining constant tension on the cable. Continue reeling out until you come to the 100-foot mark at which point you slowly and accurately position this mark on the counter wheel in the same position where the 0-mark was started. You will see the **encCnt** has incremented to a number around 040000.

5. Press the **DEC** button (Figure 8 Item 6) to set the calibration number and you will see the **Cnt/Ft** update on the screen to be a number around 0400.00.

```
040012 encCnt

0400.11 Cnt/Ft (2X PPR)

Calibration-by-Reel
INC: Start (Extend 100ft)
DEC: Set
MODE: Save/Exit

7BEC.00ft

Calibration-by-Reel Mode – DEC pressed
```

6. Press the **MODE** button (Figure 8 Item 3) to save the calibration number and exit the Calibration-by-Reel procedure. The screen goes back to Normal Mode displaying only the distance measurement that will now show 0100.00ft.

NOTE: ALL SYSTEMS ARE CALIBRATED AT THE FACTORY.

Manual-Calibrate Mode

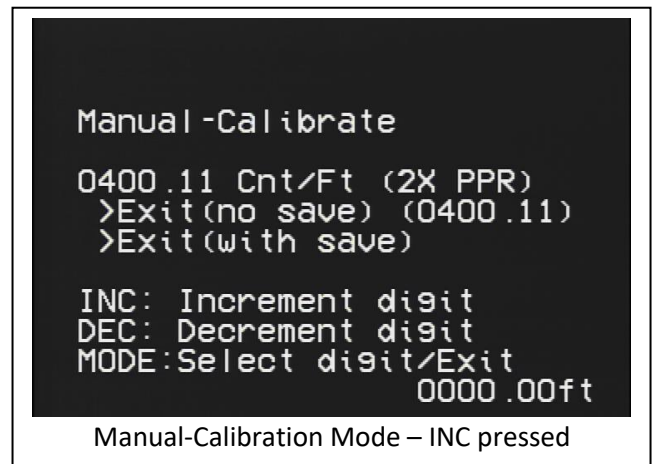
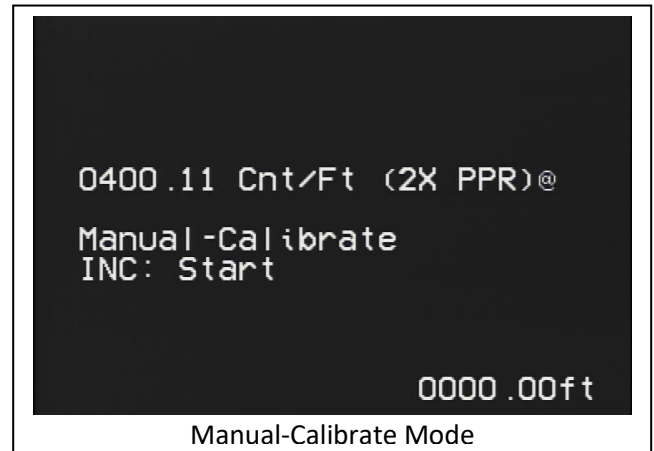
This mode allows for manual input of the calibration number. Before pressing the INC button, the current calibration number is shown as the “Cnt/Ft (2X PPR)” number.

If you see the "at sign (@)", this means the calibration number was set by the Calibration-by-Reel mode. If the "at sign (@)" is not there, this means it was set using the Manual-Calibrate mode. The “(2X PPR)” means the calibration number is two times the encoder PPR (Pulses Per Revolution). So for example, with a 200PPR encoder, the calibration number should be around 400.

Press the **INC** button (Figure 8 Item 3) to enter this mode.

While a digit is blinking, press the **INC** and/or **DEC** buttons to update that digit.

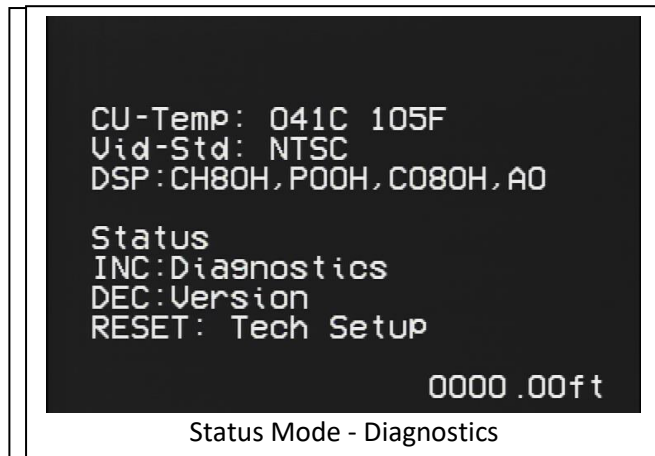
Use the **MODE** button to advance and select the next digit or to advance to the Exit menu items. You can choose to save or not save the updated calibration number.



Status Mode

1. Diagnostics. Press the **INC** button to display internal diagnostics information, Control Unit temperature in Celsius and Fahrenheit, the Video standard (NTSC or PAL), the DSP settings (CH:chroma, P:phase, C:color, A:agc).
2. Version Press the **DEC** button to display Firmware version.





3. Tech Setup is only for use by Laval technicians.

Winch

The custom winch supplied by Laval Underground Surveys (LUS) is manufactured for operating LUS video camera systems in water wells, boreholes, etc. The winch is driven by a low speed, high torque hydraulic or electric (optional) motor. Sources of hydraulic pressure

typically include the vehicle power steering pump or a fan belt driven pump. Electric motor power sources for winch operation are 120V 60 cycle AC (or 220V 50 cycle AC) or an AC generator.

Winch speed and direction are controlled by a 3-way directional valve with a hydraulic motor or a variable speed controller with an electric motor, located near the control station. A manually operated dog clutch engages and disengages the winch drive. A hand-operated, mechanical caliper brake for the cable spool is mounted on the winch frame.

CAUTION: NEVER operate the power winch without the cable spool safety shield in place.

Winch Armored Cable

The winch cable supplies power to the camera and lights, conducts video signals from the camera, and provides the means for lowering and raising the camera head assembly in downhole operations.

The cable is about ¼ inch in diameter and has a working strength of over 5,000 pounds. The inner coaxial conductor cable is specifically designed to carry the video signal over long distances. The outer armor has an inner wrap of high-tensile steel wires and an outer wrap of wires wound in the opposite direction to decrease the tendency of the cable to twist.

The camera end of the cable has a waterproof connector that fits into the camera housing. The winch end of the cable connects to an electrical slip-ring assembly on the winch spool shaft.

CAUTION: NEVER allow the cable to have less than one and one-half (1 1/2) layers on the spool. The cable at the slip-ring end is not anchored to the spool, of course, and it might tear free or become damaged if pulled or strained. The cable is painted red to notify the operator when maximum cable depth is reached.

Electrical Slip-Ring

The electrical slip-ring assembly transfers power and video signals to and from the winch cable through a 7-pin MS-type connector mounted in the winch chassis.

CAUTION: DO NOT attempt to disassemble the slip-ring assembly. It is factory sealed and watertight. If a problem with the slip-ring is suspected, contact Laval Underground Surveys.

Cable-Metering Sheave

A cable-metering sheave travels back and forth on a lead screw to level-wind the cable onto the spool. The sheave drives an electronic encoder that provides input for the footage counter display on the monitor. A mechanical counter is attached to the encoder to back up the electronic count.

NOTE: After individual use, the cable windings will not look or lay the same as they did when the unit was delivered from the factory. This is normal and expected. It does not affect the proper working of the cable or winch.

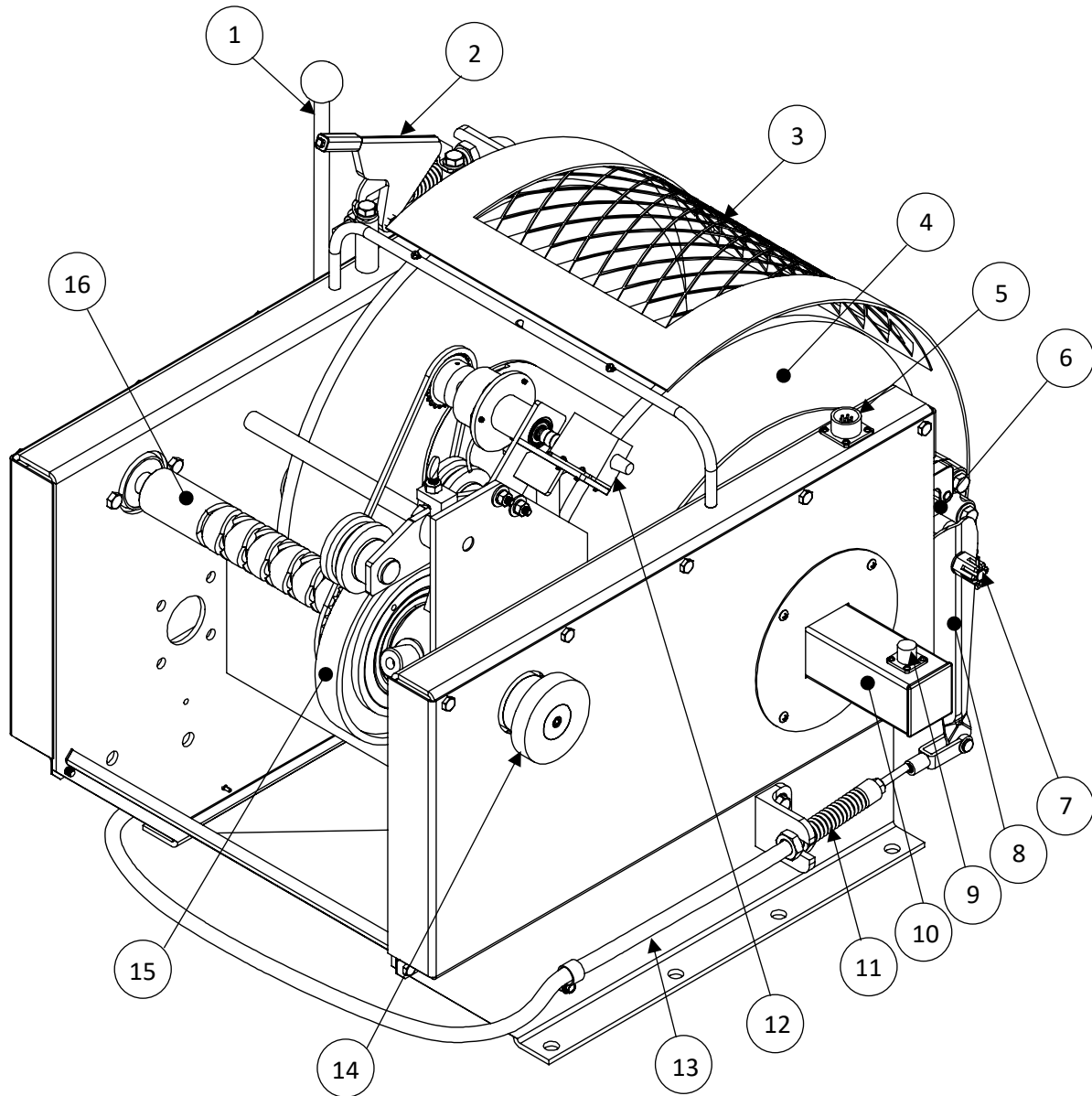


Figure 9

- | | |
|-------------------------|--------------------------------|
| 1. DOG CLUTCH HANDLE | 9. SLIP-RING CONNECTOR |
| 2. BRAKE HANDLE | 10. SLIP-RING ASSEMBLY |
| 3. SPOOL SHIELD | 11. BRAKE SLEEVE |
| 4. SPOOL | 12. MECHANICAL COUNTER |
| 5. 7 PIN CONNECTOR | 13. BRAKE CABLE |
| 6. BRAKE CALIPERS | 14. LEVEL-WIND ADJUSTMENT KNOB |
| 7. BRAKE ADJUSTMENT NUT | 15. COUNTER SHEAVE |
| 8. BRAKE LEVER ARM | 16. LEAD SCREW |

General Winch Maintenance

Periodic maintenance is necessary to keep the winch in good working order. Visual inspection to check for hardware security and general overall condition is a good practice.

NOTE: Bearings may bind if the grease becomes fouled with dirt or other contaminants.

Check the following:

1. Grease the drum bearings, periodically, with bearing grease.
2. The lead screw and guide bars must be cleaned and lubricated periodically.
3. Depending on the conditions and use, the chains should be serviced with chain oil once a year.

Speed Reducer Maintenance

The speed reducer (gearbox) requires no periodic maintenance, but occasional visual inspections to check for hardware security, leakage, and general overall condition is a good practice.

The speed reducer will accommodate sump temperatures from -10°F to +200°F without modification.

CAUTION: Do not add or change the gearbox oil after the unit is broken-in. Gearbox oil should only be changed when performing maintenance that requires gearbox disassembly.

IMPORTANT: If the gearbox oil should ever need changing use only Mobil SHC 634 (not Mobilgear 634), which is specially formulated for extremely long life.

Level-Wind Adjustment

If cable windings become uneven, gapped, or bunched, the level-wind counter-sheave assembly should be adjusted. The metal adjustment knob (Figure 10 Item 7) on the end of the level-wind axel engages and disengages to move the counter-sheave assembly back and forth.

To adjust the level-wind, pull and hold the adjustment knob (Figure 10 Item 7) out, then turn it to move the counter-sheave assembly so that the level-wind trails (follows) the cable windings on the spool. When correctly adjusted, the cable should lay, wrap by wrap, without gaps, overlays, or bunching.

1. BEARING ASSEMBLY
2. LEAD SCREW
3. COUNTER SHEAVE SPROCKET
4. COUNTER SHEAVE
5. KEY ASSEMBLY
6. BEARING ASSEMBLY
7. ADJUSTMENT KNOB
8. PRESSURE ROLLER
9. ADJUSTMENT BOLT
10. ADJUSTMENT THUMB SCREW
11. MECHANICAL COUNTER
12. ENCODER
13. ENCODER SHEAVE
14. GUIDE ROLLER

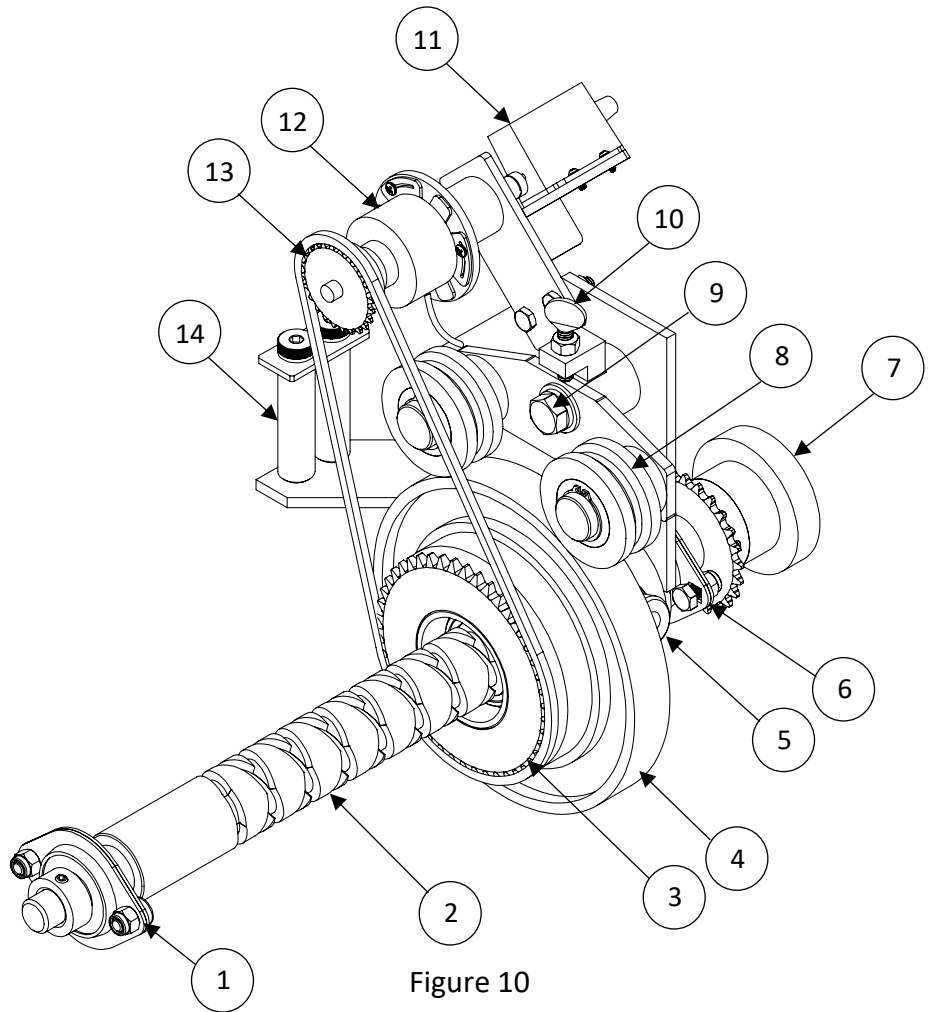


Figure 10

Level-Wind Key Replacement

With use, the level-wind brass key that tracks in the level-wind axel grooves will eventually wear down. To replace the level-wind brass key:

1. Remove the ¼-20 bolt, washer, and the metal keeper (Figure 11 Items 1, 2, and 3) holding in the small knob on the front of the counter-sheave assembly.

2. Remove the key assembly (Figure 11 Items 4, 5, and 6).

3. Remove the socket screw (Figure 11 Item 4) from the key holder (Figure 10 Item 5) and take out the worn brass key (Figure 11 Item 6).

4. Replace the old brass key with a new key from Laval Underground Surveys.

5. Re-insert and tighten the socket screw (Figure 11 Item 4) into the key holder and new brass key (Figure 11 Items 5 and 6).

6. Re-engage the key assembly (Figure 11 Items 4, 5, and 6), and then secure it with the ¼-20 bolt, washer, and the metal keeper (Figure 11 Items 1, 2, and 3).

7. Check the travel direction of the level-wind, and ensure it moves properly.

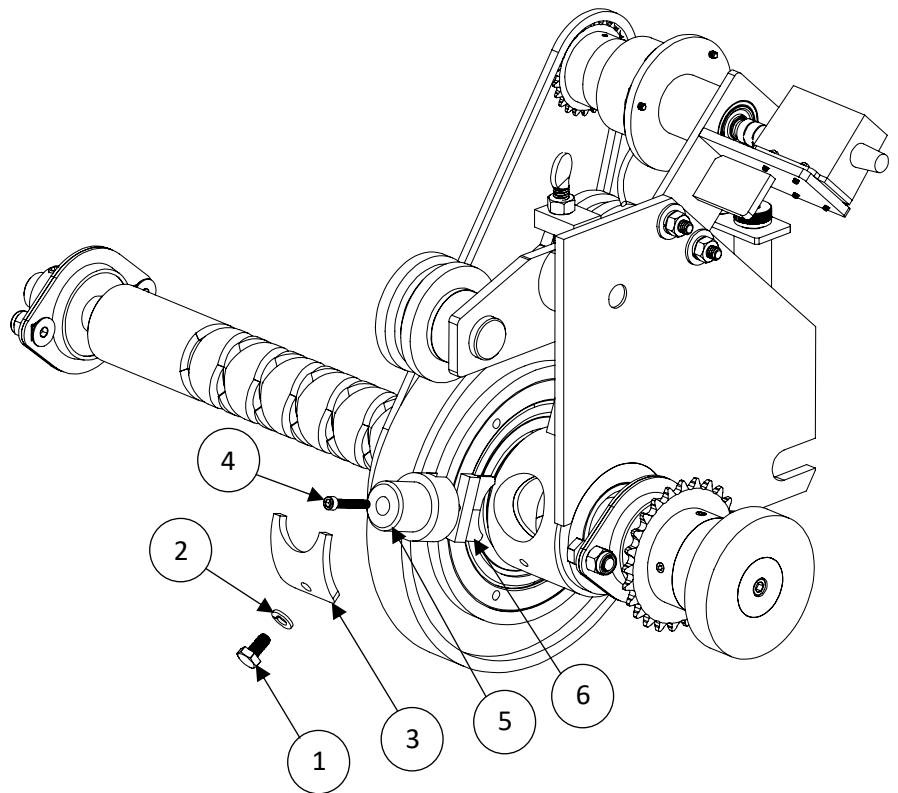


Figure 11

Brake Adjustment

If necessary, it is possible to adjust the mechanical caliper brake (Figure 9 Item 6) by tightening or loosening the adjusting nut (Figure 9 Item 7) on the brake lever arm (Figure 9 Item 8). The adjusting nut (Figure 9 Item 7) is slotted and secured with a cotter pin.

To tighten or loosen the brake action, pull the cotter pin, and turn the adjusting nut IN which will tighten the brake action or OUT to loosen the brake action. When properly adjusted, replace the cotter pin to secure the adjusting nut.

Mechanical Counter Calibration

In water well and other downhole situations, a successful survey requires accurate camera depth information. Actual cable footage should match the encoder footage counter readout. If necessary, the two pressure rollers that hold the cable on the counter-sheave can be adjusted to calibrate or recalibrate the encoder footage counter to match a known cable length.

1. Zero-out the mechanical footage counter to 00000 by turning the knob (Figure 12 Item 1) on the end of the counter.
2. Turn the counter-sheave (Figure 12 Item 5), by hand, backwards until all nines (99999) appear on the counter.

3. Turn the counter-sheave (Figure 12 Item 5) forward until the nines go out of sight and zeros just center on the counter. This sets the counter-sheave and the counter at the beginning of the rotation count.

4. Use a marking pen to mark the counter-sheave into quadrants (90°, 180°, 270°, and 360°) to facilitate calibration adjustment. Divide the upper quadrants into 15° angles, if better visualization is desired.

5. Pull out, straighten, and measure off 100 feet (or 30 meters) of cable. Mark the cable at each place with tape.

NOTE: Use a 100 foot (or 30 meter) tape measure, if possible. Using several short-measurements to mark off the 100 feet (or 30 meters) will multiply errors and throw off the calibration. Even an error of a few inches (or centimeters) will cause an inaccurate calibration.

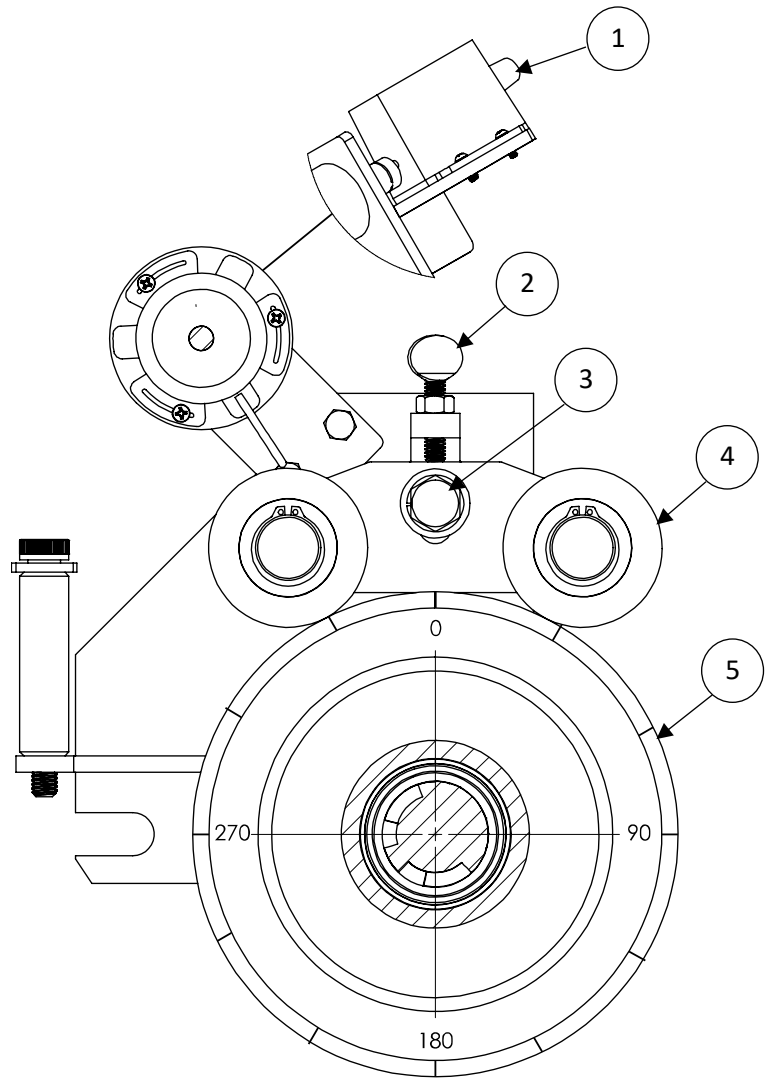


Figure 12

6. Rewind the cable and place the first tape mark under the bolt (Figure 12 Item 3) between the two pressure rollers (Figure 12 Item 4).

7. Set the mechanical footage counter at 00000 (Figure 12 Item 1).

8. Draw the cable out again until the second tape mark appears beneath the bolt (Figure 12 Item 3) between the two pressure rollers (Figure 12 Item 4).

9. Check the mechanical footage counter. It should read 0100 (or 0030 if measuring in meters). If it does, no calibration is necessary. STOP HERE.

If the counter reading does not match the cable length measures, adjustment of the pressure rollers is necessary. CONTINUE WITH THE FOLLOWING STEPS.

If the mechanical footage counter reading is too low, the pressure rollers need to be loosened on the counter-sheave. If the footage counter reading is too high, then the pressure rollers need to be tightened.

10. To adjust the pressure rollers (Figure 12 Item 4), loosen the adjustment bolt between them (Figure 12 Item 3).

11. Turn the adjustment thumb screw (Figure 12 Item 2) above the adjustment bolt to either tighten or loosen the pressure rollers against the counter-sheave.

12. After adjusting, re-tighten the adjustment bolt (Figure 12 Item 3) between the pressure rollers.

13. Adjust the pressure rollers in this method until an accurate footage reading is obtained, within an inch or two (or a centimeter).

NOTE: When the cable is re-wound, the counter may not show an accurate reading because of the cable spiral effect or slippage.

14. Recalibrate whenever necessary.

Hydraulic Power

Laval Underground Surveys (LUS) designs and installs custom-made hydraulic power systems for winch control in vehicles outfitted for operating its video camera survey systems. The hydraulic power system for the winch is hooked into the vehicle's power steering system. The basic components (Figure 13) are:

- Hydraulic Clutch Pump Kit
- Large Capacity Fluid Reservoir
- Power Switch Located on the Dash Board
- Winch 4 Way Control Valve (Forward/Reverse And Flow Speed)
- Pressure Equalizing Valve/Counter Balance Valve
- Hydraulic Motor On The Winch

Note: The vehicle engine and power steering system must be running to operate the winch hydraulic power systems.

Fluid Reservoir

Hydraulic power systems are equipped with a large-capacity fluid reservoir that is installed in the rear of the vehicle.

Caution: Always keep the fluid reservoir filled to the level of the screen.

Hydraulic Pump Power Switch

The Power Switch to turn on the hydraulic pump is located on the dashboard near the steering column. There is a red LED that indicates when the pump is turned on.

Caution: Always make sure that the hydraulic pump is off before driving the vehicle. DO NOT operate the vehicle if the selector valve control knob is pulled OUT or UP.

Winch Control Valve

The winch control valve combines forward and reverse drive with variable speed control. The control lever is mounted in the console counter where the system operator sits. The winch drive is easily controlled.

When the control lever is STRAIGHT UP, the winch drive is in NEUTRAL. When the control lever is pushed FORWARD, the winch drive moves FORWARD, letting the cable out. When the control lever is pulled BACK, the winch drive moves in REVERSE, winding cable back.

The speed of forward or reverse winch drive is variable. It is controlled by the distance the control lever is moved from the neutral position. The farther the control lever is moved from neutral, the faster the winch drives goes, whether forward or reverse.

Note: The control lever should be left in neutral when the hydraulic power system is not being used and the survey is completed.

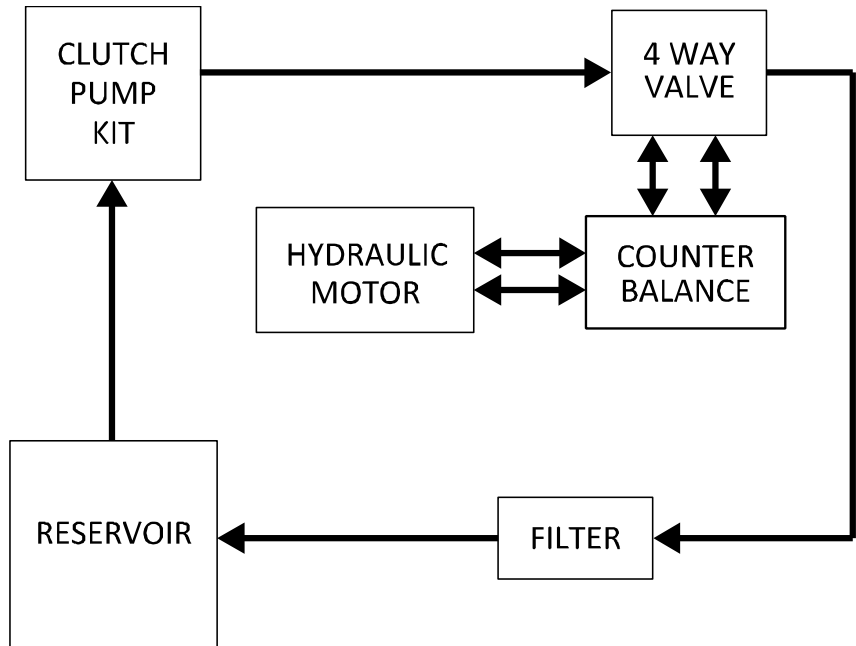


Figure 13

Pressure Equalizing Valve

Hydraulic power systems designed for winches used in Laval Underground Surveys' video camera systems for downhole inspections have a pressure equalizing valve between the selector control valve and the hydraulic motor on the winch. The pressure equalizing valve prevents the hydraulic motor from free-wheeling or "creeping."

Caution: The pressure equalizing valve is factory preset. DO NOT attempt to change the setting. If a problem in the pressure equalizing valve is suspected, contact Laval Underground Surveys for instructions.

Hydraulic Motor

Laval Underground Surveys installs a high quality hydraulic motor for winch drive in its hydraulically powered systems for downhole video camera surveys.

Note: Consult the hydraulic motor operations manual for instructions and specifications.

Overhead Boom

Laval Underground Surveys (LUS) custom manufactures and installs adjustable booms in vehicles outfitted for operating its video camera survey systems. The swing arm boom is mounted in the rear of the vehicle and extends through the roof. The swing arm swivels 360°. When driving, the swing arm is secured pointing forward over the roof of the vehicle. When used for survey work, the swing arm swivels out over the back of the vehicle.

The swing arm boom has three (3) main parts; the base, the swing arm, and the boom head. Two screw handle (one on the base and one on the swing arm) make adjustment easy. The screw handle on the stand allows the swing arm to swivel or be locked down. The screw handle on the swing arm allows the boom head to be extended and locked down.

NOTE: The swing arm boom adjusts to extent from about 5 to 7 feet. However, optional lengths are available on request.

Operation Procedure

1. Back the vehicle to within 5 to 7 feet (about 2 meters) of the well or downhole opening.
2. If tied down, untie the swing arm (Figure 14 Item 3) from the forward position over the vehicle roof.
3. Loosen base handle (Figure 14 Item 6) on the boom base (Figure 14 Item 7).

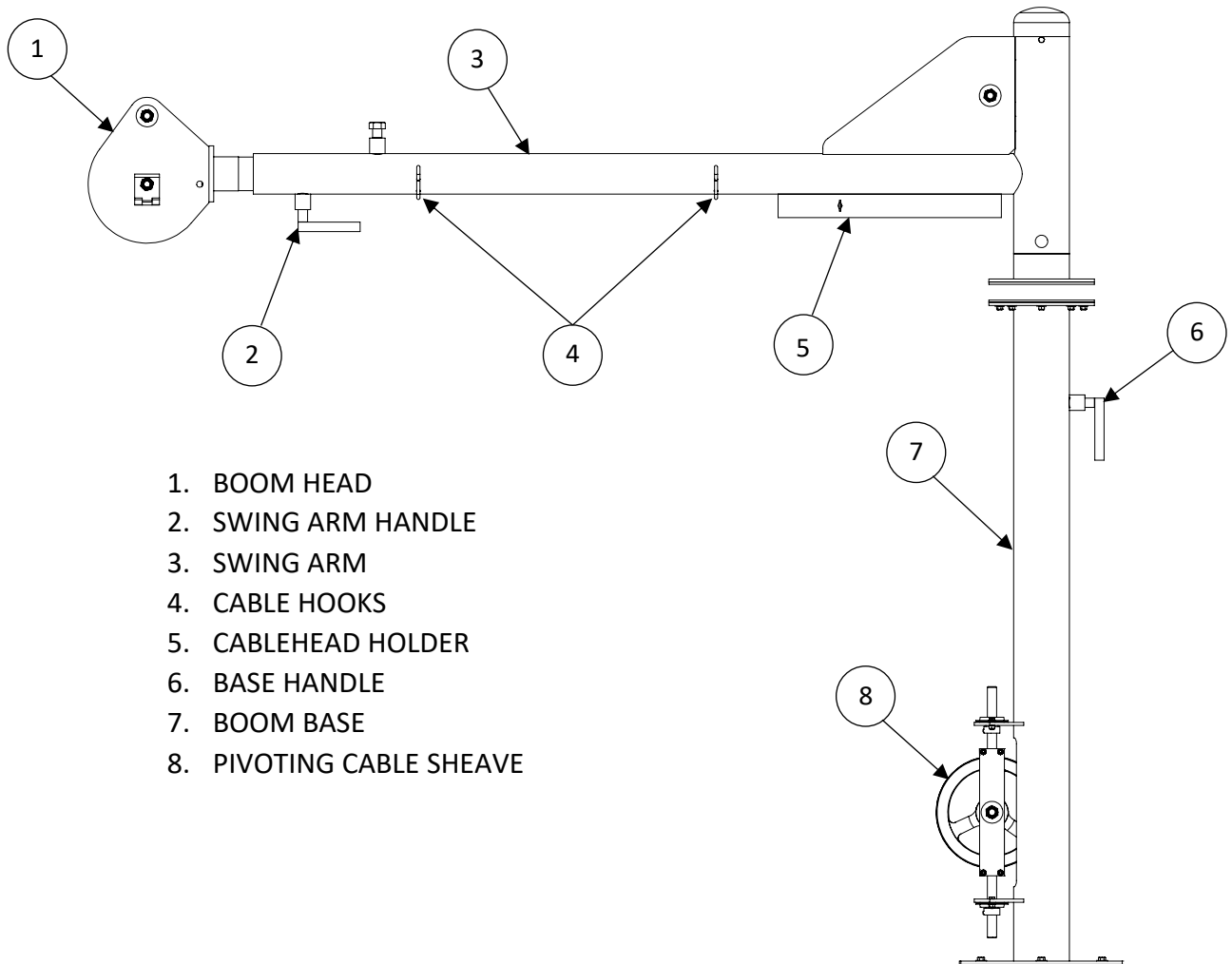
4. Pull the swing arm (Figure 14 Item 3) around toward the well or downhole.
5. Tighten the base handle (Figure 14 Item 6).
6. Loosen the swing arm handle (Figure 14 Item 2) on the swing arm.
7. Pull out the boom head (Figure 14 Item 1) until the end is directly over the well or downhole.
8. Tighten the swing arm handle (Figure 14 Item 2).
9. Complete survey.

Securing the Overhead Boom

After the survey is completed, the overhead boom should be secured forward, especially for traveling. To secure the swing arm boom forward, follow this procedure:

1. After disconnecting the camera from the cable, secure the cablehead in the cablehead holder (Figure 14 Item 5) and the cable in the cable hooks (Figure 14 Item 4).
2. Loosen the swing arm handle (Figure 14 Item 2).
3. Push the boom head (Figure 14 Item 1) back into the swing arm (Figure 14 Item 3) as far as possible.
4. Tighten the swing arm handle (Figure 14 Item 2) to secure the boom head.
5. Loosen the base handle (Figure 14 Item 6).
6. Swing and reposition the swing arm (Figure 14 Item 3) back over the roof of the vehicle.
7. Tighten the hand screw (Figure 14 Item 6) to secure the swing arm.
8. The swing arm may be tied down to better secure it.

WARNING: NEVER travel without securing the swing arm boom forward. Otherwise, it may swing wildly causing accident or injury. Make sure the end of the swing arm boom is well secured before driving the vehicle.



1. BOOM HEAD
2. SWING ARM HANDLE
3. SWING ARM
4. CABLE HOOKS
5. CABLEHEAD HOLDER
6. BASE HANDLE
7. BOOM BASE
8. PIVOTING CABLE SHEAVE

Figure 14

Overhead Boom Cable Sheave

The cable travels on a pivoting sheave (Figure 14 Item 8) at the point where it enters the boom stand from the winch. Check its operation before use.

NOTE: Clean and grease the sheave bearing as necessary to maintain smooth cable operation.

Telescoping Inside Boom

Laval Underground Surveys (LUS) custom manufactures and installs adjustable booms in vehicles outfitted for operating its video camera inspection systems. The telescoping boom is mounted in the rear of the vehicle behind the rear doors. Three (3) arms can telescope out of the boom stand. When secured for driving, the boom arms stand upright, telescoped down.

When used for survey work, the boom arms pivot down and telescope out. Many angle and length combinations are possible.

The entire telescoping boom assembly is mounted on a steel floor plate that pivots, right or left. In addition, the boom arms also pivot, from zero (vertical) to 90° (horizontal). The boom arms pivot downward (from vertical to horizontal) by pulling a draw-pin on the side and then turning the hand-cranked winch. Pre-drilled holes allow various preset angles to be used. Placing the draw-pin through the holes secures the boom arms at the desired angle.

The telescoping boom arms can be extended in various combinations: one arms extended, two arms extended, or all three arms extended, depending on the boom length needed. Each arm (extension) has a draw-pin to secure it either extended or not extended.

Operation Procedure

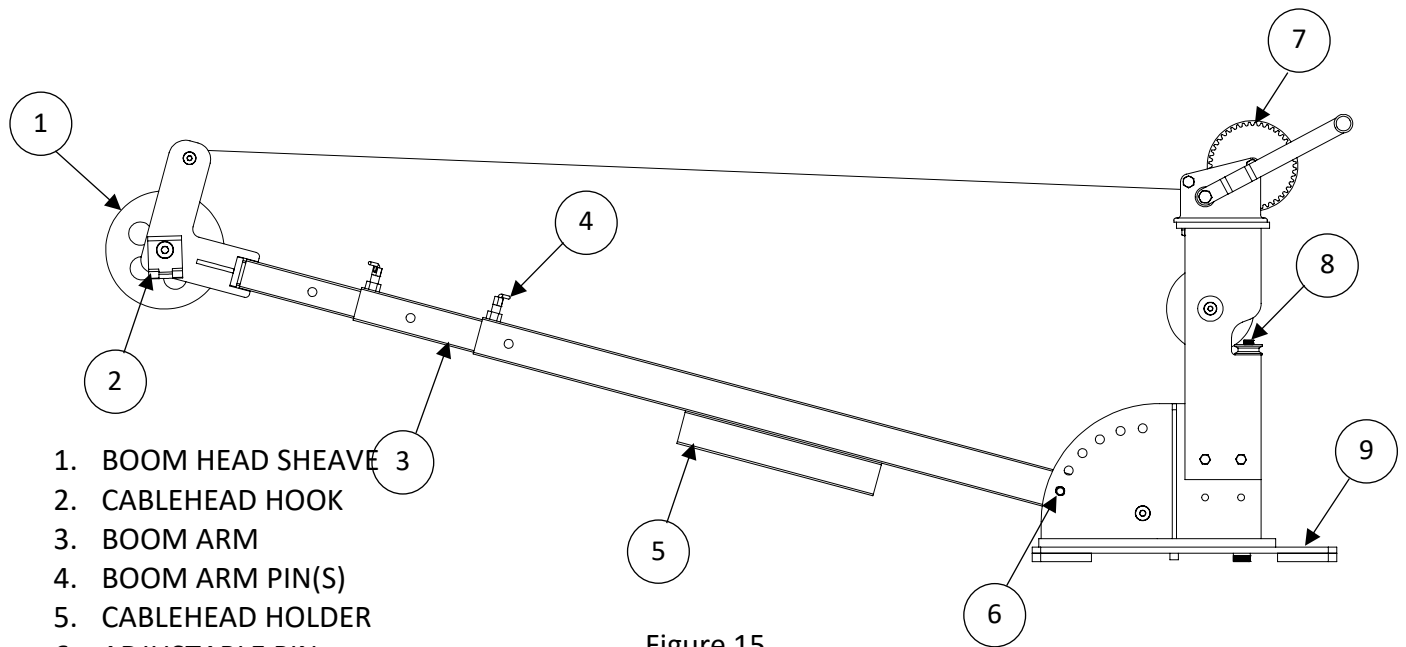
1. Back the vehicle to within 5 to 7 feet (about 2 meters) of the well or downhole.
2. Lower the boom arm (Figure 15 Item 3) downward using the hand winch (Figure 14 Item 7) and adjustable pin (Figure 15 Item 6) to secure it.
3. Pivot the boom assembly toward the well or downhole.
4. Extend the telescoping boom arm(s) (Figure 15 Item 3) to the length necessary to reach the well or downhole using the arm pins (Figure 15 Item 4) to secure them.
5. Adjust the boom angle, if necessary.
6. Complete survey.

Securing the Telescoping Boom

After the survey is completed, the telescoping boom should be secured; telescoped down and set again upright, especially before driving.

1. Telescope down the boom arms (Figure 15 Item 3) and secure them with the arm pins (Figure 15 Item 4).
2. Stand the boom arms upright using the hand winch (Figure 15 Item 7) and secure them with the adjustable pin (Figure 15 Item 6).

WARNING: NEVER travel without securing the boom assembly. Otherwise, the boom may swing or fall causing accident or injury.



1. BOOM HEAD SHEAVE
2. CABLEHEAD HOOK
3. BOOM ARM
4. BOOM ARM PIN(S)
5. CABLEHEAD HOLDER
6. ADJUSTABLE PIN
7. HAND CRANK
8. CABLE GUIDE ROLLERS AND SHEAVE
9. BASE PLATE

Figure 15

Telescoping Boom Cable Sheaves

The cable travels between sheave set at right angles (90°) to each other between the power winch and the boom arms. Check their operation before use.

NOTE: Clean and grease the sheave bearings, as necessary, to maintain proper and smooth cable operation.

Power Architecture

Laval Underground Surveys (LUS) designs and installs custom-manufactured electrical power systems in vehicles outfitted for operating its video camera survey systems. The DC motors and motor controllers of electrically powered winches are wired into the electrical power system.

The basic components are:

- an AC generator with a remote starter
- a safety relay box
- a circuit breaker box
- an electrical power strip
- a motor controller

- a DC motor on the winch

AC Generators

Laval Underground Surveys supplies quality AC generators upon request, either gasoline or diesel powered, capable of 120V AC or 220V AC, 4.5 to 7 watts peak power output. Any AC generator that is installed by LUS will produce electrical power sufficient for powering the winch, the video camera system, and the vehicle heating or cooling—whatever is necessary to meet the customer’s needs.

To meet design demands, three standard mounting options are used for AC generators:

1. inside the vehicle
2. on rails (through the side of the vehicle)
3. on the vehicle roof (for flywheel auxiliary models with hydraulic pump drive)

CAUTION: Operators must closely follow the AC generator manufacturer’s instructions and specifications to insure safe operation. Read the manual supplied with the AC generator before starting and operating the AC generator.

AC Power Cord

The electrical system is also designed to use AC power directly; 120V AC or 220V AC, if a source is available. The power cord plugs into the safety relay box mounted on the side of the vehicle.

CAUTION: Use only an approved or UL-listed AC power cord. Do not allow the cord to get wet.

Safety Relay Box

The safety relay box is designed to automatically give priority to accepting AC power from a direct power source. Power from the AC generator is accepted as secondary. This protects the electrical system from accidental power overload.

Circuit Breaker Box

The circuit breaker box has three (3) circuit breakers, minimum; one for the motor controller, one for the electrical power strip, and one for the air conditioner. Other circuit breakers are supplied as necessary to protect all components ordered with the entire electrical system.

Electrical Power Strip

The electrical power strip has receptacles for providing power to the TV monitor, camera, tape deck, video character generator, etc.

CAUTION: Read the specific manuals supplied with each component to learn proper and safe operation.

Motor Controller

The motor controller converts 120V AC to 90V DC (maximum) or 220V AC to 180V DC (maximum) to power the DC winch motor.

WARNING: NEVER operate the motor controller or electrical system in an explosive atmosphere (fumes, etc.).

The motor controller features a power ON/OFF switch, a power ON indicator light, an AC line fuse, and adjustable speed control, and a Forward/Brake/Reverse directional switch.

Motor Controller Operation

To start and run the DC motor forward:

1. Set the motor controller directional switch to the Brake position.
2. Switch ON the AC power. Turn ON the motor controller power switch. Note power ON indicator light.
3. Turn the directional switch to the Forward position.
4. Select motor speed on the adjustable speed control. Let the DC motor come up to the speed set.
5. Adjust motor speed as necessary during the survey.

To reverse the DC motor while it is running:

1. Turn the motor controller directional switch to the Brake position. Allow the DC motor to come to a complete STOP.

2. Turn the motor controller directional switch to Reverse. Let the motor come back up to the speed selected.

To temporarily stop the DC motor:

1. Turn the motor controller directional switch to the Brake position. Let the motor brake to a stop.

To turn the DC motor and the motor controller off:

1. Turn the motor controller directional switch to the Brake position. Let the DC motor brake to a complete stop.
2. Turn OFF the motor controller ON/OFF power switch. Check indicator light.

NOTE: Turning the power ON/OFF switch OFF without braking first will cause the motor to coast to a stop instead, unless it is loaded.

3. AC power may now be shut off, if desired.

NOTE: For maintenance and troubleshooting information, consult the DC motor controller operations manual.

WARNING: Only a qualified electrician or engineer should perform electrical maintenance or troubleshooting.

DC Motor

Laval Underground Surveys installs a quality DC motor to drive the winch for horizontal and downhole video camera surveys. 90V DC or 180V DC, $\frac{3}{4}$ to 1 $\frac{1}{2}$ horsepower, motors are available.

NOTE: Consult the DC motor operations manual for instructions and specifications.

Cablehead Replacement

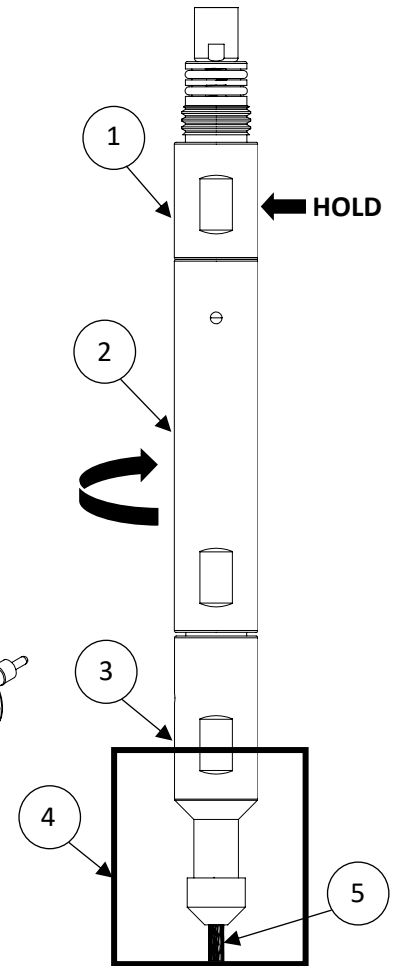
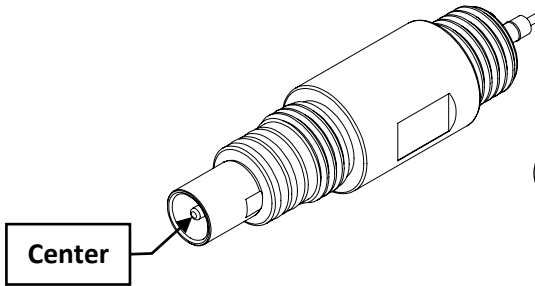
Secure the Cablehead in a bench vise grip with the stinger clamped.

Using the wrench flats, hold the contact subassembly with one wrench and grab the body with the other wrench.

Turn the body in a clockwise motion. The stinger is a left hand thread, so the Cablehead threads on and off as a turnbuckle. Hold the contact subassembly still while unthreading the body, both ends will unthread from the body.

Continue to disassemble the Cablehead by disconnecting the watertight connector and the ground lug.

Test the contact subassembly for leakage with a voltmeter set on Ω (Ohms). Place the positive lead (red) on the center of the UHF connector and the negative lead (black) on the housing of the Cablehead. If the voltmeter overloads there is no leakage and it does not need to be reassembled. If the voltmeter does not overload the contact subassembly needs to be taken apart and reassembled with a new connector and wire.

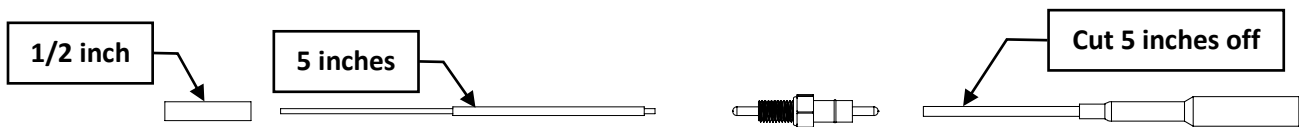


Repairing the Contact Subassembly:

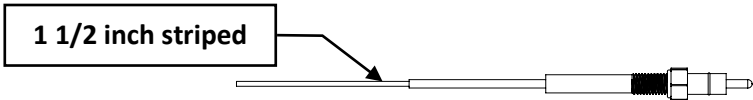
To take the contact subassembly apart, unscrew the bulkhead connector. Note this will break the wire and/or the solder connection to the UHF connector.

Then unscrew the UHF connector and discard both.

1. CONTACT SUBASSEMBLY
2. BODY
3. STINGER
4. BENCH VISE GRIP
5. STEEL CABLE



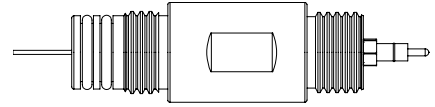
Locate the new bulkhead connector and tin the pin of the threaded end. Cut 5" off of the joy plug wire. Tin one end of the wire, then solder to the tinned end of the bulkhead connector.



Cut a 1/2 inch piece of 3/16 inch heat-shrink tubing, use it to cover the whole pin and wire solder connection. Apply heat to shrink the tubing to the wires and note that there should be adhesive that seals the end.

Strip the other end of the wire so that 1-1/2 inches is exposed.

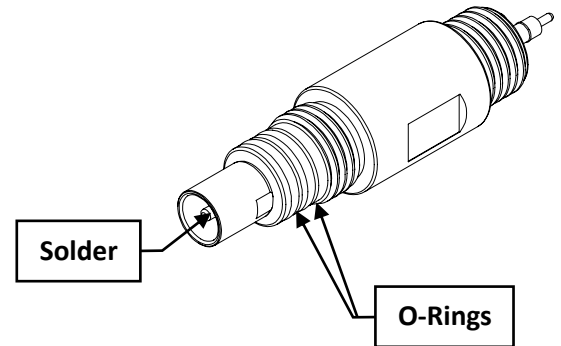
Tin the 2 inches of wire then insert the tinned end into the contact subassembly and thread in the bulkhead connector.



After hand tightening the bulkhead connector then use a wrench to turn the connector 1/2 a turn to cinch it in place.

Install the UHF connector by feeding the tinned wire through it then threading the UHF connector into the contact subassembly.

After the UHF connector is installed, solder the wire to the center of the UHF connector by filling the center with solder then trim the excess tinned wire off.



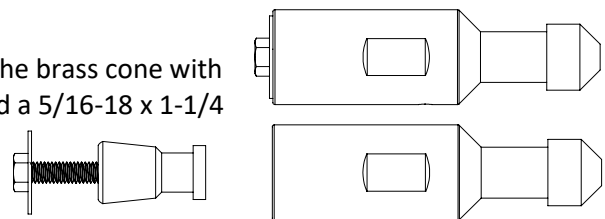
Install supplied new O-Rings to the contact subassembly.

Once the Cablehead stinger section is disconnected from the remainder of the Cablehead, try pushing the steel armored cable back through the center of the stinger. It may be necessary to cut the cable using a grinder with a cut-off wheel. Remember to use proper eyewear for this process. Cut the cable as close as possible to the rear of the stinger.

There are two method of removing the brass cone from the center of the stinger:

The first method is to use a 1/4 inch pin punch and a hammer and push it through with the cable still attached.

The second method is the remove the wires then tap the brass cone with a 5/16-18 thread (if it has not been already) and thread a 5/16-18 x 1-1/4 in long bolt on with a large washer. The tightening of the bolt should pull the brass cone out of the stinger.

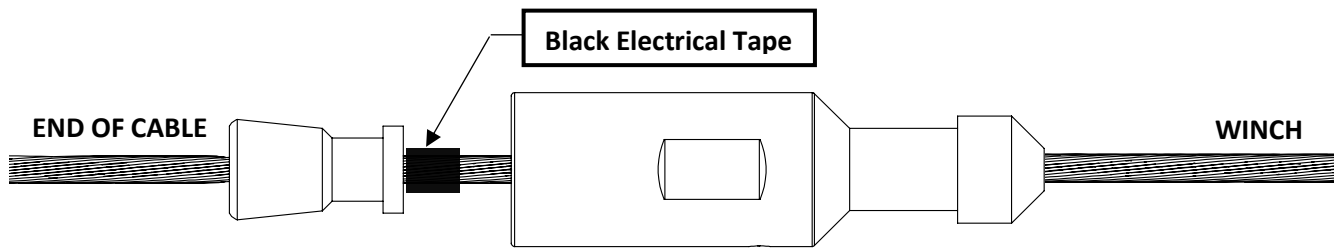


After removing the Cablehead pieces from the steel cable any damaged steel cable needs to be cut off, it is recommended to cut at least 10 feet off when replacing the Cablehead.

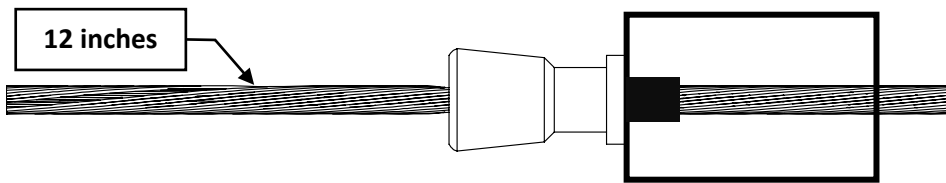
With a voltmeter set on Ω (Ohms), it is possible to check the cable for leakage. Place the positive lead (red) on the center of the coax and the negative lead (black) on the copper shield. If the voltmeter overloads there is no leakage.

Once the cable is cut, slide the stinger on the cable with the tapered end towards the winch.

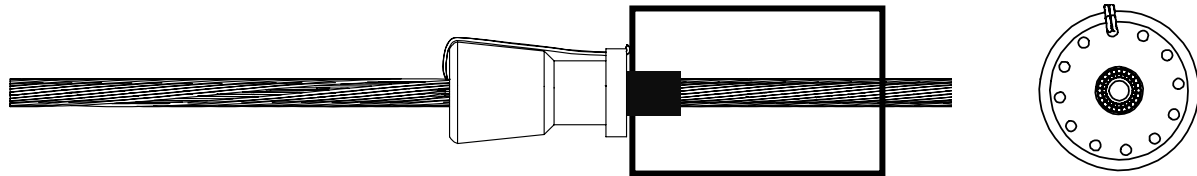
Measure back 12 inches from the end, and wrap black electrical tape around the cable.



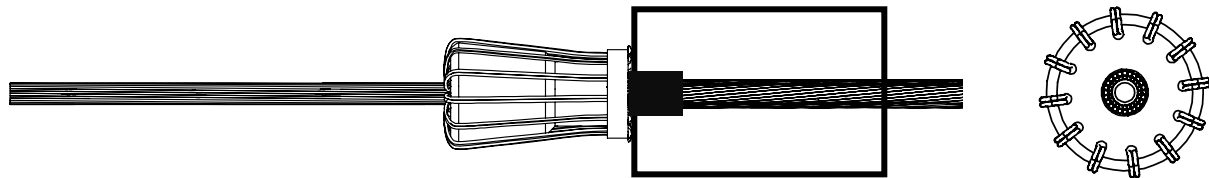
Place the brass cone on to the cable so it rests on top of the tape. It is recommended to place the cable in a vise grip such that the brass cone sits on top of the vise clamp.



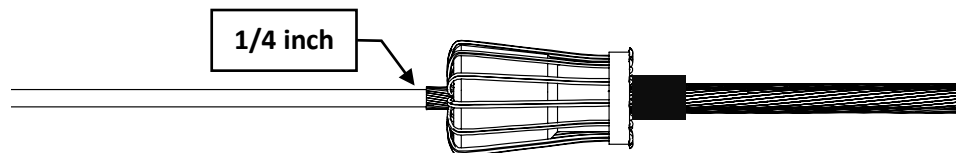
The armored cable has 24 outer strands. Separate one strand from the end of the cable and bend downward to the top of the brass cone. Bend the strand and feed it into the closest hole on the brass cone.



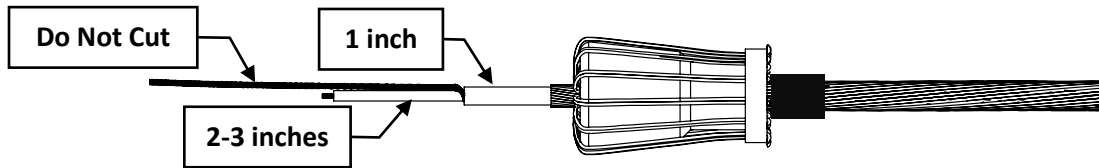
Notice that there are 12 holes on the cone; each hole will have 2 strands. Be careful not to overlap the strands. They should lie side by side evenly. Carefully bend the fed-through strands around the edge of the cone and cut the excess off as shown.



CAUTION: When pulling and bending the wires, be careful not to pull the wires through the side of the cone holes. The cone is brass.

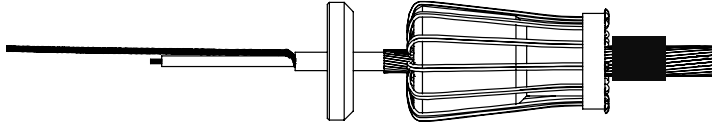


Cut back the inner armor to within 1/4 inch of the cone. Trim back the plastic covering on the center wire to within one inch of the cone.



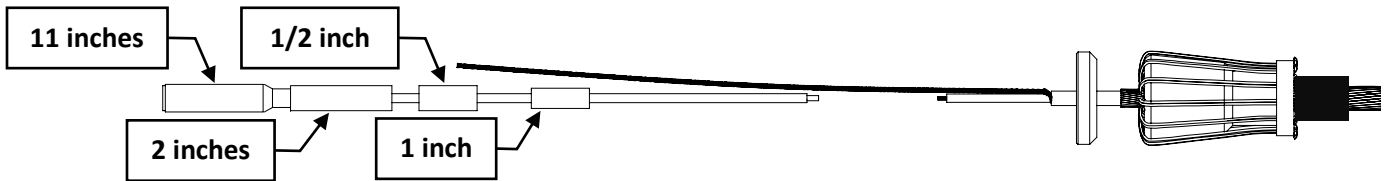
CAUTION: DO NOT cut the copper shielding under the plastic covering.

Once the plastic covering is cut, separate the center conductor and copper shielding. Twist the copper shielding wires together then cut the center conductor approximately 2-3 inches from brass cone.



Slide the brass washer over the wires. Note the direction of the beveled edge should be towards the cone.

Tinning the wires before soldering them together is helpful. To tin a wire the solder is wrapped around the wire, and then heated up with a soldering iron to make the solder flow into the wire.



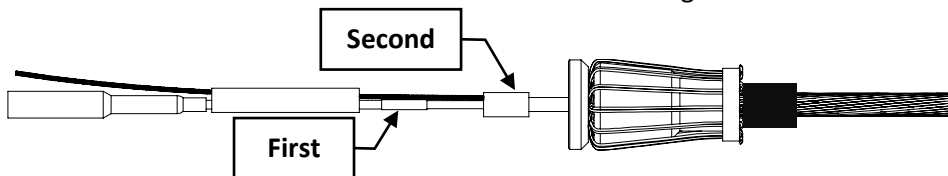
Cut the new joy plug connector to 11" long.

Cut a piece of 1/4 inch shrink tubing 1 inches in length.

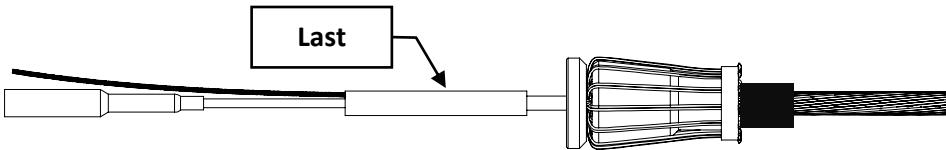
Cut a piece of the 3/16 inch shrink tubing 1/2 inch in length. Cut a piece of the 3/16 inch shrink tubing 2 inches in length.

Place all three pieces onto the joy plug watertight connector. Tin the center wire then solder it to the joy plug connector (with heat-shrink tubing on).

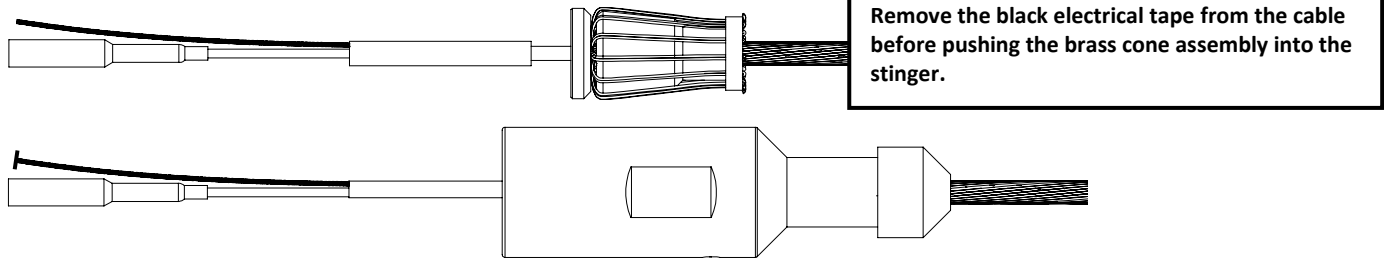
Heat-shrink the 3/16 inch tubing over the soldered connection of the joy plug and center wire. The adhesive should ooze out to the sides of the shrink tubing.



Slide the 1/4 inch tubing pieces over the copper shield so that they are covering the joy plug and shield. Heat-shrink the 1/2 long piece over the joint where the copper shielding is separated from the core.

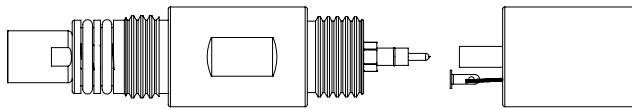


Place the last piece of tubing (2 inch long piece) so that it covers both of the smaller heat-shrunk pieces, as shown, then apply heat to shrink it in place.



Solder the grounding lug to the tinned copper shielding.

Push the brass cone assembly/strain relief into the "stinger" section.



Slide the body piece over the joy plug connector and copper ground. Connect the watertight joy plug to the contact subassembly and screw on the ground lug.

Place the Cablehead in a bench vise grip to finish the assembly. Remember, the stinger section is a left-hand thread. Thread the stinger onto the body only a half of a turn so that just the beginning of the thread is engaged.

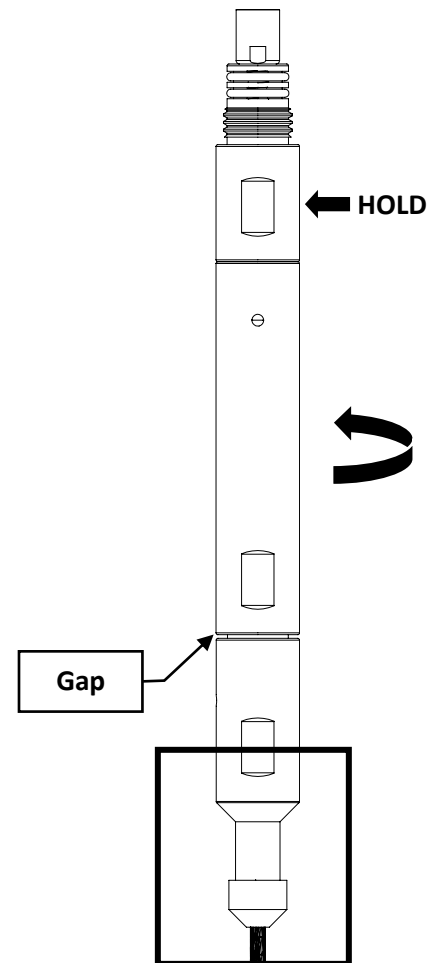
Ensure the excess length of wiring is tucked into the body before starting to thread the contact subassembly on.

Thread the contact assembly onto the body counterclockwise, only a half of a turn so that just the beginning of the thread is engaged.

Then begin turning the body section counterclockwise while holding the contact subassembly by hand. This should thread both ends onto the body portion at the same time.

When the Cablehead can no longer tighten by hand, turn the contact subassembly so that it is flush with the body. Use wrenches to tighten everything in place.

There should be a gap of about 1/16 inch between the stinger and the body, this is normal and expected.



Water Well Clarification

- There will be occasional wells containing water too dirty for viewing or photography. This condition is generally caused by colloidal particles (rust, dirt, minerals) in suspension in the water column. Often the dirt will settle out if the well is allowed to stand undisturbed for a period of 12 to 24 hours.
- If settling will not clear the water, replacing the well fluid with clear water is a rapid and safe way to achieve visibility. Even the flow from a garden hose for 4 to 12 hours will clear the well. The plan here is to add at least twice the volume of water in the well rapidly enough to force the dirty water back into the formation. Preferably, the water should be introduced below standing water level to avoid driving entrapped air into the fluid column in the well. If this is not possible, the top 40 to 200 feet of the below-water portion of the well will be full of gas bubbles, interfering with vision or photography. It will take a couple of hours for this area to clear after the water flow has been stopped.
- Turbid well water can be cleared by flocculation. This is a chemical process that forces an ionic exchange, causing the particles to migrate and clump until they are heavy enough to fall out like snowflakes.
- There are many commercial flocculants available that are generally used to clean up boiler water and municipal water supplies. Throughout the world we have found that certain soleplates used in conjunction with an increase in the pH of the well water will work under the greatest variety of conditions. Choose the combination that gives the heaviest flock and fastest clearing.
- Occasionally viewing through well water is hampered by algae or bacteria in the well. Particles are dislodged from the sidewalls by the passage of the camera, and the appearance on the screen or pictures is like being in a heavy snowstorm. Should you notice this occurrence contact Laval Underground Surveys regarding our line of well rehabilitation products, Boresaver.
- When the area you wish to see is buried, an air jet pump can quite successfully be used to remove the overburden. The action of this type of pump is so gradual it clears the adjacent water very well, often leaving the well in condition for immediate viewing.
- Obviously, a well with an actual flow through it, bringing in silt particles, will only clear during “off flow” conditions. This may be due to a season of the year, or in the case of a well field

or common water strata shared with other wells, a particular time of the day when the other pumps are off. Sometimes you can shut off the entire field to achieve a static condition; or in an Artesian field, turn on all the other pumps to stop the muddy flow.

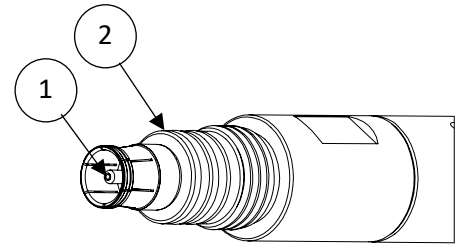
- Falling water generally only creates a problem near the surface because it drives air into the water column.
- Drilling mud in suspension is a very difficult problem, only occasionally curable by flocculation. It may require pumping the well clear.
- Well cleaning chemical and drilling detergents interfere with any chemical clarification process. Again, pumping until clear is the solution.
- Often a layer of oil will be encountered on the top of the water surface, especially when inspecting oil lubricated pump well casings. If oil is anticipated, the outside of the lens view ports can be soaped literally with a Liquid detergent. The Camera visibility will be restricted out of the water, but once the oil layer (often 20 feet deep) is penetrated, the detergent may be washed off the viewing port by raising and lowering the Camera. The oil should be wiped from the Cable and Camera when removing from the well.
- Air bubbles may accumulate on the Lens Port when first entering the water. Raise and lower the Camera until the bubbles are removed.
- Caution should be taken not to operate Laval Underground Survey cameras in contaminated, acidic, or salt environments. If the DC5150 camera and cable is exposed to a contaminated or salt intruded well, all exterior surfaces of the Housing, Cable, Cable Head and Centering Bands must be thoroughly cleaned and rinsed with fresh water immediately after being removed. Warranty to the system may be voided if damage occurs as a result.

Troubleshooting

Checking the Cablehead for Leakage

Using a voltmeter set on Ω (Ohms):

1. Place the positive lead (red) on the center of the UHF (Item 1) connector on the Cablehead.
2. Place the negative lead (black) on the housing of the Cablehead (Item 2) connector.
3. If the voltmeter overloads there is no leakage, no further testing needs to be done, and the Cablehead does not need to be reheaded. If the voltmeter reads any number of Ohms, continue.



4. Unscrew the body of the cablehead (Item 4).

NOTE: that the stinger (Item 5) is left hand threads and the contact subassembly (Item 3) is

right and **BOTH** ends should be unscrewed at the same time. It is recommended to place the stinger (Item 5) in a vice grip and to hold onto the contact subassembly (Item 3) while twisting the body piece (Item 4).

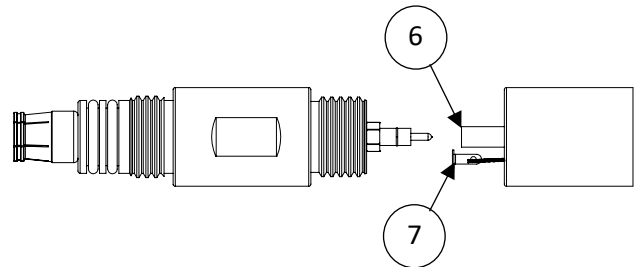
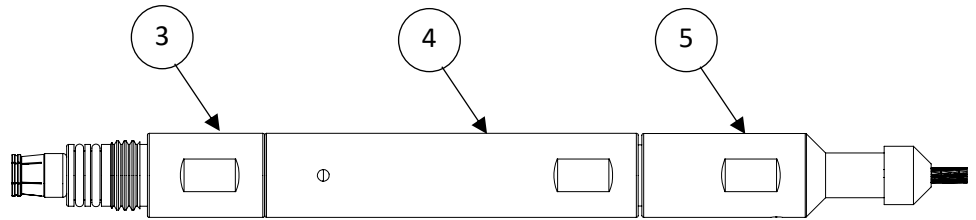
5. Disconnect the joy connector (Item 6) and ground lug (Item 7) from the contact subassembly end (Item 3).

6. Check the contact sub assembly again by repeating Steps #1 and #2, with the contact subassembly (Item 3) disconnected.

7. If the voltmeter overloads there is no leakage. If the voltmeter reads any number of Ohms, a Cablehead Repair Kit is needed.

8. Check the cable by placing the positive lead (red) on the joy connector (Item 6) and the negative lead (black) on the grounding lug (Item 7).

9. If the voltmeter overloads there is no leakage. If the voltmeter reads anything less than 20 Ohms a Cablehead Repair Kit is needed.



Checking the 7 Pin Cable for Leakage

Using a voltmeter set on Ω (Ohms):

1. Place the positive lead (red) on the pin of choice on the Control Unit connector on the 7 Pin Cable.
2. Place the negative lead (black) on the same pin of choice on the Winch connector on the 7 Pin Cable.
3. If the voltmeter does not display a number, that line is damaged. Check that both pins on both ends are fully forward (the same height as the rest).
4. Repeat for all pins

PART 128966 - 7 PIN CABLE

Winch

Control Unit

A ————— WHITE WIRE: COUNT ————— A

B ————— RED WIRE: 5 VDC ————— B

C ————— GREEN WIRE: COUNT ————— C

D ————— BLACK, BROWN, & SHIELD WIRES: GROUND ————— D

TNC SHIELD ————— COAXIAL SHIELD ————— TNC SHIELD

TNC CENTER ————— COAXIAL CENTER CONDUCTOR ————— TNC CENTER

Warranty

LAVAL UNDERGROUND SURVEYS warrants all products and materials manufactured by it and described herein to be free from defects in workmanship and materials for a period of one year from date of shipment, with the exceptions of fuses, improper battery maintenance, connectors, plugs, cable head, and the Imager.

Any article not manufactured by LAVAL UNDERGROUND SURVEYS and described herein is sold with only such warranties as are made by the manufacturer thereof. No other warranties expressed or implied, of merchantability, fitness for a particular purpose, or otherwise, are made by LAVAL UNDERGROUND SURVEYS other than those set out in the immediately preceding paragraphs.

All repairs shall be made by LAVAL UNDERGROUND SURVEYS at its factory or as otherwise authorized by LAVAL UNDERGROUND SURVEYS in writing. All unauthorized repairs will void warranties.

Warranty is void on any equipment that is abused, modified, or mishandled by customer.

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