

Sage

Precision oilfield products

Acoustic Fluid Logger

With High Pressure Wellhead

Reference Manual

Sage Technologies, Inc.

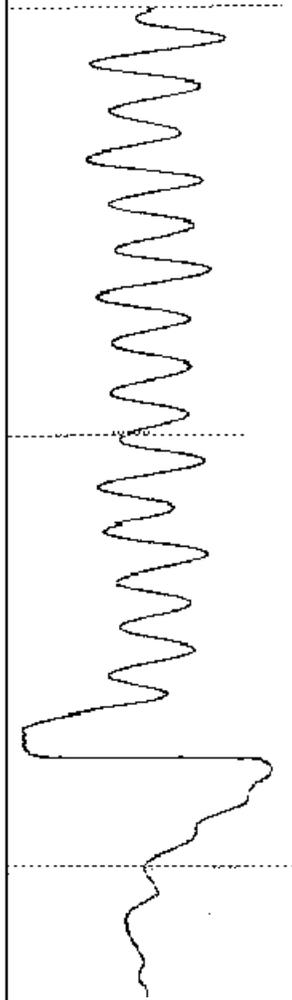
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Sage Technologies, Inc.
Field:.....
Lease:.....
Well Number:.....
Date:.....
Depth:.....
Acoustic Fluid Logger SN:0189



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How to contact Sage Technologies

For sales, service, or technical support, you may write our office at:

**Sage Technologies, Inc.
Attn: Customer Support
P.O. Box 1466
Grapevine, TX, USA 76099-1466**

Or you may call or FAX us at:

**Phone: 817-488-2579
FAX: 817-421-0607**

The phone numbers must be prefixed with the United States International dialing code if you are trying to contact us from outside the United States.

Or you may contact us via the Internet:

**Website: www.sageoiltools.com
Email: info@sageoiltools.com**

Introduction to Acoustic Fluid Logger

With High Pressure Wellhead and Microphone

The **Acoustic Fluid Logger** collects fluid level measurements on pumping oil and gas wells. Our intent is to allow consistent and accurate fluid level measurements without the need for any specialized knowledge. Therefore, there are no computers to operate. There is no need to make any filter adjustments. Our unit is rugged and operates largely on its own. With the push of a button, you have a fluid level.

The **Acoustic Fluid Logger**, in an advance over other fluid level devices, first stores its signals to memory and then prints them out to tape. This allows a very detailed view of the wellbore to be stored real time and then printed out. A simple count of tubing collars finds the distance to the liquid.

Also, we at **Sage Technologies, Inc.**, take the stance that “what you see is what you got.” The **AFL system** only outputs data that was gathered real time at the well head. No computer smoothing algorithms are applied to the data. We believe that our job is to faithfully reproduce the signals in your wellbore and that your job is to use that information to your advantage.

Included in the AFL system is the **High Pressure Wellhead**. Rated for working pressures of up to 5000 PSI, the stainless steel gas gun shoots a pulse of gas from the wellbore into the wellhead chamber; the return signals are received on the internal microphone and transmitted to your recording device via the microphone cable. The wellhead , with a 2 7/8” EUE thread, consists of a volume chamber, a valve assembly and a microphone. The gun may be easily disassembled for maintenance.

All of the products at Sage Technologies, Inc., are the result of years of field experience and technical innovation. In addition, our technical and training staff and our full repair shop stand behind each piece of equipment.

Included with your Acoustic Fluid Logger System

- 1 - Acoustic Fluid Logger
 - 6 – rolls thermal paper
 - 1 – Acoustic Logger System manual
 - 1 – wall-mount battery charger
 - 1 – microphone cable

- 1 – High Pressure Wellhead
 - 1 – Extra High Pressure Microphone
 - 1 – Microphone O-Ring Kit
 - 1 – Carrying Case
 - 1 – O-Ring tool

Other tools needed in the field

- 1 – 1 Set 11-point dividers

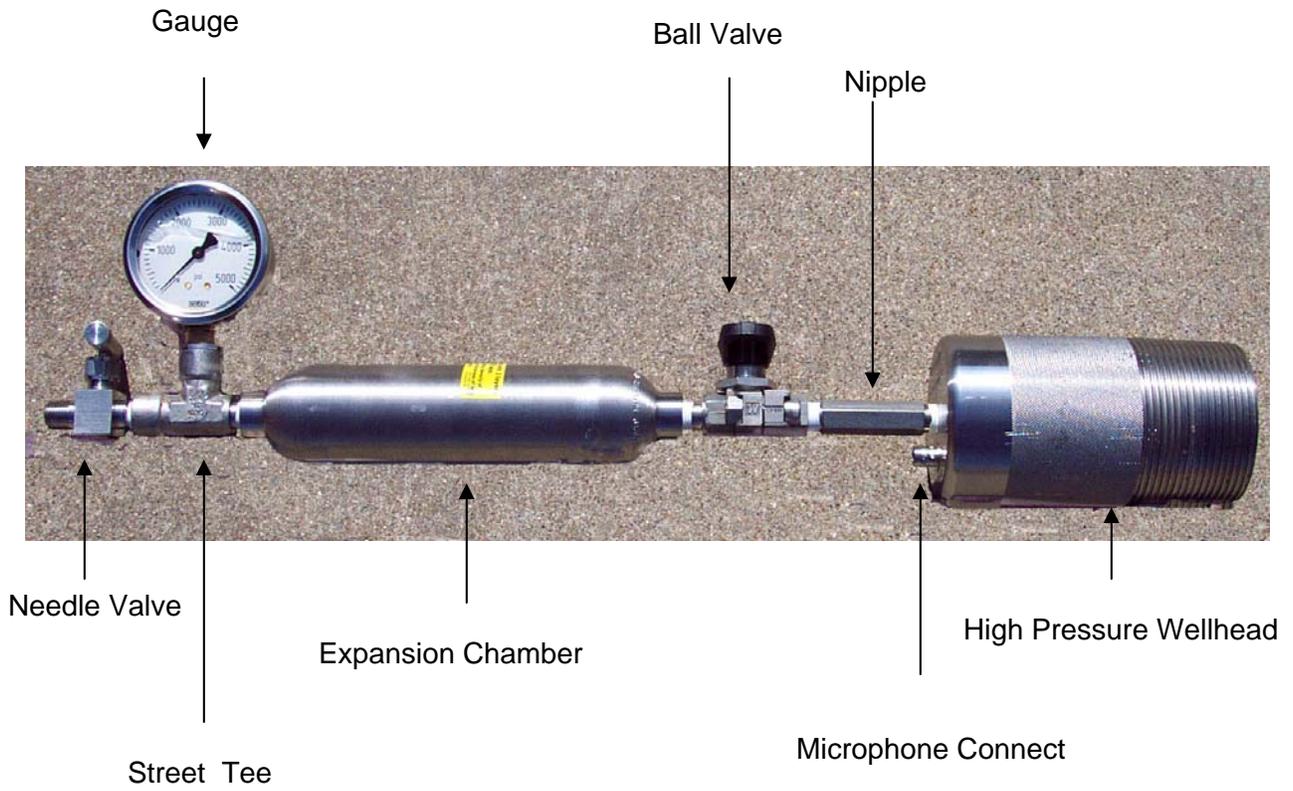
- Strap Wrench for installing wellhead

Shooting a fluid level

Quick start instructions

- Make sure both the needle and the ball valve are closed.
- Connect the High Pressure Wellhead to the annulus of the well.
- Open up well pressure slowly to the gun.
- Bleed the chamber down below wellbore pressure using the rear needle valve. Close the needle valve.
- If needed, shut in the casing flow line valve, so the shot will not go down the flow line. You may have to allow some settle time for the well to quiet down after this step.
- Connect the microphone cable between the Acoustic Fluid Logger and the high pressure wellhead.
- Turn on the Acoustic Fluid Logger unit and verify that the header prints as the paper advances.
- **Press 4 and then C.** This puts the unit in the ¼ compressed mode that makes the tape ¼ of its usual length. This allows you to quickly see if you have a valid fluid level without waiting for a long tape printout.
- **Press *** to put the unit in the standby mode. The header will advance a small amount and the unit is waiting for your manual shot.
- Shoot the gun by opening the forward ball valve (the one nearest the well) on the high pressure wellhead. The shot will be fired and the unit will start printing.
- Let the printer run until you have seen a valid fluid level kick. **Push Print** at this point to stop the tape.
- Inspect the chart for valid fluid and readable collars.
- If valid fluid is found, **push Print** to get an exact reprint of the same fluid level in its full-length form.
- Otherwise, follow the above procedures to shoot another shot on the well.

High Pressure Wellhead Gun

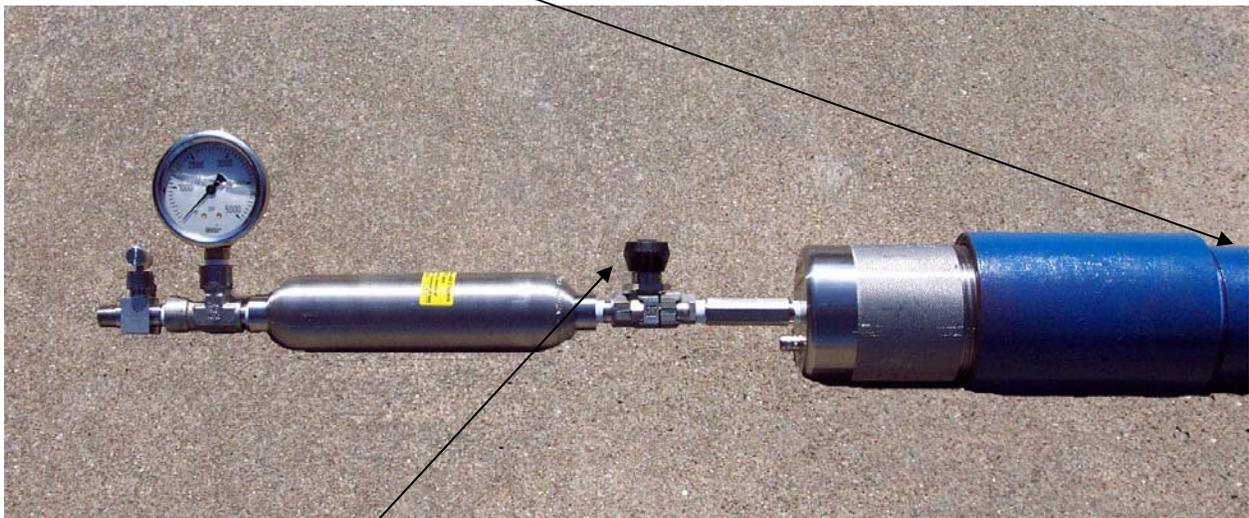


Fluid Level Set-up Photographs

- Mount the High Pressure Wellhead Gun on the well, as shown below.



- Open the **valve** from the wellbore to the gun.



- Open **ball valve** to allow pressure into the expansion chamber.



- Fill expansion chamber with wellbore pressure. The gauge will register pressure. Close the **ball valve** to seal off the expansion chamber from the wellbore.



- Use the **needle valve** to bleed down the pressure in the expansion chamber to below wellbore pressure by watching gauge. Close the needle valve once the correct pressure is reached.



- Attach the microphone cable from the gun to the unit, using the **microphone ports** on the gun and the unit.



- Turn on the unit with the on-off switch.



- The header will print on the paper tape after the unit is turned on.



- Press 4 C * on the keypad. The paper tape will advance and wait for a shot.



- Shoot the gun by opening the **ball valve**.



- The paper tape begins to run when the gun shoots. Let the tape run until a fluid kick is observed.

Removing gun from well

- To remove the gun from the well, start by shutting off wellbore pressure from the high pressure wellhead.



- Open the **ball valve** to connect all pressure passages in the high pressure wellhead.



- Slowly open the **needle valve** to remove all pressure from the high pressure wellhead.



- With the high pressure wellhead shut off from wellbore pressure, the **ball valve** open and the **needle valve** open, the unit is ready to be removed from the **wellhead**.
- Use the **strap wrench** to remove the unit from the well. Loosen gun from wellhead.

Keypad and Interface

1	2	3	Auto
4	5	6	Man
7	8	9	C
*	0	#	Print

* - Wait mode

The wait mode is the standard way to use the Acoustic Fluid Logger.

The **wait mode** allows you to use any manual gun – such as the High Pressure Wellhead -- with your Acoustic Fluid Logger. By **pressing *** you tell the unit that you will be using a manual gun. To put the unit into the wait mode, **press ***. Then fire a manual shot. When the unit senses that a shot has been fired, it begins to collect the signal.

The wait mode works in tandem with all of the normal operating modes on the Acoustic Fluid Logger. For example, **press 4 C** followed by ***** to place the unit in the 1/4 compression mode, waiting on a shot.

C - (Compressed)

Compressed allows you to print shorter, tighter echoes to tape. Using compressed allows a quick check for fluid level in the field. To use this mode, enter a number between 2 and 8 on the keypad, then **push C**. The number part of the entry is the divisor -- the fraction the unit will use to divide the tape length.

- **2 C** will give you a tape 1/2 the normal length.
- **4 C** is 1/4 the normal length.
- **8 C** is 1/8 the normal length, and so on. Use any number as the divisor -- 2 through 8.

For example, **Press 4 C** and then ***** to put the unit in the standby mode. Then shoot the gun. You will get an echo that is 1/4 the normal length. After identifying that you have a valid fluid level, push **PRINT** to stop the compressed echo and the printer. Then push **PRINT** again to reprint a full-length echo.

PRINT

PRINT has two functions, depending on whether the printer is currently printing or waiting.

- 1) If the printer is in the process of printing, pushing the **PRINT** key will stop the current signal from being printed and will return the Acoustic Fluid Logger to the ready state.
- 2) If the Acoustic Fluid Logger has printed the header and is waiting for instructions, pushing the **PRINT** key will print the current digitized signal in memory. If there is no signal, nothing will be printed.

AUTO

AUTO is used only if you have a remote fire gun.

Generally, the Acoustic Fluid Logger (AFL) is used with the High Pressure Wellhead – which is a manual gun. To use the Auto mode, you would need to have an AFL with an additional external gun port installed.

If a remote fire gun is to be used, first connect the remote fire gun cable. Then the operator presses **AUTO**, which produces a shot and a tape.

You may also use the compressed mode along with **AUTO**. For example, pressing **4 C**, then **AUTO** would produce a ¼ size tape with a remote fire **AUTO** shot. Or, enter any number between 0 and 255, and then push **AUTO**. Entering a small value number means that only the largest events will be seen. Entering a value of 255 means that the Acoustic Fluid Logger has been set to its maximum-gain value.

The number part of the entry sets only the initial value the Acoustic Fluid Logger will use to gather data for the first 1/4 second. After that, the Acoustic Fluid Logger automatically controls all sensitivity settings.

MAN (Manual mode)

MAN (Manual mode) turns off both the variable collar tracking and variable fluid tracking functions of the Acoustic Fluid Logger.

When in the **MAN** mode, the signal size is not controlled by the Acoustic Fluid Logger. This allows the operator to set the unit to a single setting, where it will remain for the duration of the shot. You may enter any value from 0 to 255. A small value means that only the largest events will be seen. A value of 255 means that the Acoustic Fluid Logger has been set to its maximum-gain value for the duration of the shot.

Normally, you might want to try a 5 setting on manual. This would turn down the response of the Acoustic Fluid Logger so that mainly what you would see would be early collars followed by the fluid kick. If this was not enough to register a fluid kick, then you would want to increase the number and try another shot. Since there is no gain control in the manual mode each signal is shown in its native size. This is sometimes useful for finding fluid.

*Note: Once you push **MAN** the unit immediately starts recording data. So, if you have a manual fire gun, you will have to calibrate the tape from the location of the shot blast on the tape, not from the start of the tape as usual.*

Well Analysis

Identifying the fluid level kick

These tips will help in reading and analysis of the fluid level information printed to tape by the Acoustic Fluid Logger.

- Fluid level is usually the ***deepest kick*** in the well.
- Fluid level is the ***only signal able to move*** on a collar count basis. (If the acoustic velocity of the gas in the well changes due to casing pressure changes, other signals in the well can appear to move, but only as far as return time is considered.)
- Check the fluid level by allowing the printer to run long enough to print out the second reflection of the fluid level at a distance equal to twice the original fluid level. A ***double reflection from the fluid level*** is an excellent confirmation of true fluid level.

What to do if more than one kick is observed

- Allow the casing pressure to build. And, the ***kick that moves*** on a collar basis will be the fluid level.
- ***Shut down the pumping unit*** and give the well noise time to die down (i.e., one to two minutes). Check for other sources of noise while this is going on. Then shoot the well again.
- ***Shut the casing flow line***. When the casing flow line is left open, sound also reflects down the flow line and sometimes can interfere with the shot taken on the well.
- ***Check the tubing tally*** for things like tubing anchor depth, liner depth, depth of special oversized tools in the string, etc.
- Do you have paraffin in this well? ***Paraffin*** rings can cause false fluid levels in wells even in the face of increasing backpressure.

Calculating depth to the fluid in collars

Tubing collars are easily identifiable on most wells. And, by using an **average joint length** for each tubing joint, along with the total number of observed joints, it is possible to calculate the depth to the fluid.

Methods for determining number of joints to the fluid level

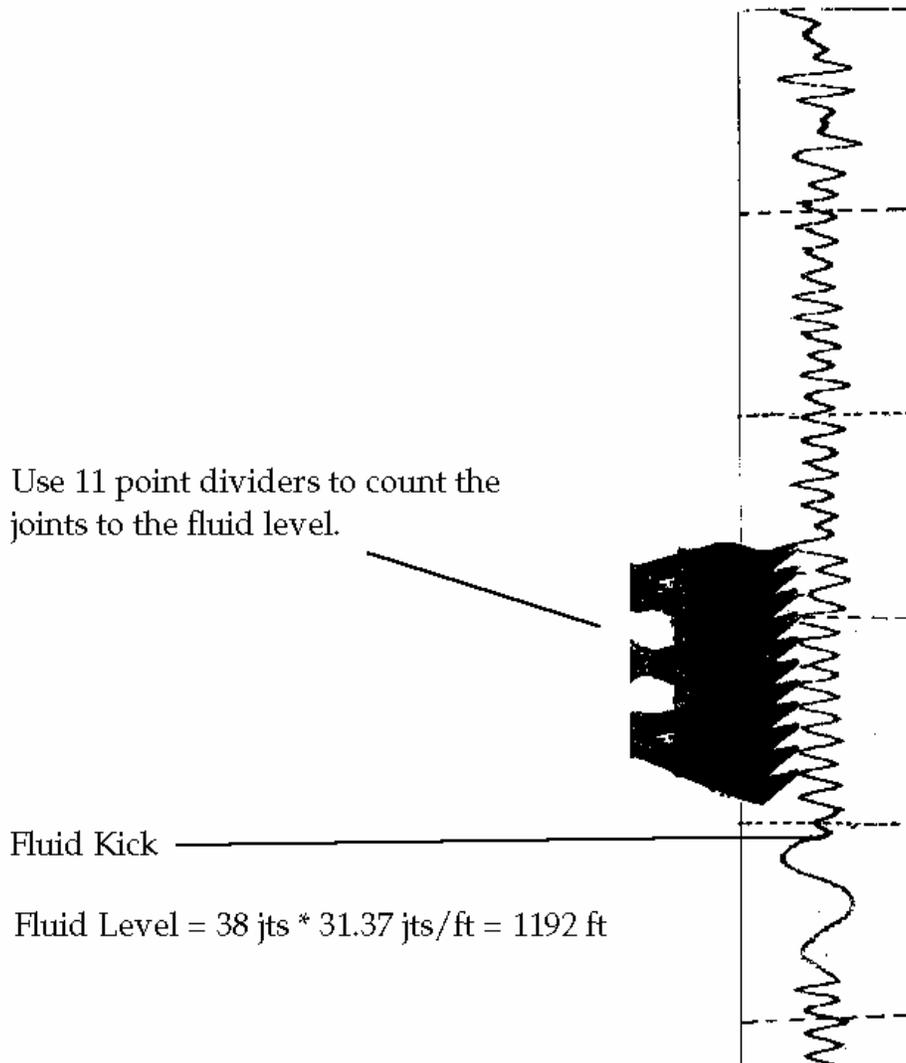
Use the *11-point dividers* included with the Acoustic Fluid Logger to count each collar from the surface to the fluid level. When collars are not present all the way to the bottom of the well, then the divider setting for the last readable collars should be used to estimate the remaining unreadable collars to the fluid level.

Since the Acoustic Fluid Logger stores charts digitally in memory and then prints after collection, there are no chart speed errors involved as with other fluid level devices.

Reading a Fluid Tape

Reading a Fluid Tape.

Sage Technologies Inc.
Field:.....
Lease:.....
Well Number:.....
Date:.....
Depth:.....
Acoustic Fluid Logger SN: 0189



Converting joints to fluid level in feet

Most accurate method

The *most accurate method* is to add the actual measured lengths from a tubing tally. This method is time consuming and on older pumping wells a tubing tally may no longer be accessible in the records.

Most common method

The *most common method* of getting the fluid depth is to multiply the number of collars by the average joint length. Remember that the depth to perforations is normally measured from the kelly bushing (K.B.) or from the rig floor.

Example:	in feet
K.B.	10.00
Hanger	.75
1 pup joint	6.12
180 joints tubing	5625.72
Anchor catcher	2.68
1 joint tubing	31.31
SN (seating nipple)	1.57
1 joint	31.45
Slotted Mud Anchor	28.90
Tubing Landed at	5738.50

$$5738.50 - 28.90 = 5709.60 \text{ feet}$$

Since the pump intake is at the top of the mud anchor we use all lengths from K.B. to the top of the mud anchor to determine the average joint length.

$$5709.60 \text{ feet} / 182 \text{ jts.} = 31.37 \text{ feet/jt}$$

The number of joints measured multiplied times the average joint length will give the fluid level in feet from the K.B.

When no joint length is available

When no average joint length is available, then using 31.00/jt is a rule of thumb, with the understanding that there are inaccuracies involved.

Questions and Answers

What affects collar readability?

- Shallow wells are the easiest on which to count the collars all the way down to the fluid level.
- Wells with higher casing pressure are easier than low pressure wells, i.e. wells under 15 psig.
- The tighter the fit between the casing and the tubing collars, the harder it is to get deep collars. Slim hole completions are some of the toughest, as it is very hard for the shot to make its way down the annulus area.

How do I know if the gun is leaking?

- Leaking Ball Valve - After setting the differential pressure in the chamber, the pressure quickly builds to the wellbore pressure with the ball valve closed. This means that the ball valve is leaking and should be replaced or rebuilt.
- After setting the differential pressure in the chamber, the pressure continues to decline. You may have a small leak in the system behind the ball valve. Take the system apart and rebuild and re-tape the system.

How do I know if the microphone is dead?

- Bleed the system down and remove the high pressure wellhead from the well. Connect from the unit to the high pressure wellhead with the microphone cable. Test the microphone by pressing **4 C** followed by **5 MAN**. This turns down the sensitivity of the unit. Then, cover the exposed end of the high pressure wellhead with the palm of your hand. Press and release the palm of your hand over the opening to generate a pressure pulse. Repeat several times, sealing and unsealing the hole with your hand. Remember that what you see on the tape is printed **after** it is recorded so wait a couple of seconds for a response. You should see an echo for each time the microphone was sealed and unsealed.

Why didn't I get a shot from the gun?

- Check that the wellhead had been bleed to the proper pressure.
- Did you open up the wellbore to the high pressure wellhead.
- Is the microphone cable hooked up properly?
- Is the unit turned?
- Is the battery charged?

Why won't the unit come on?

- Is the unit turned on?
- Is the battery charged?
- Did the header print? If so, the unit is on and something else is wrong.

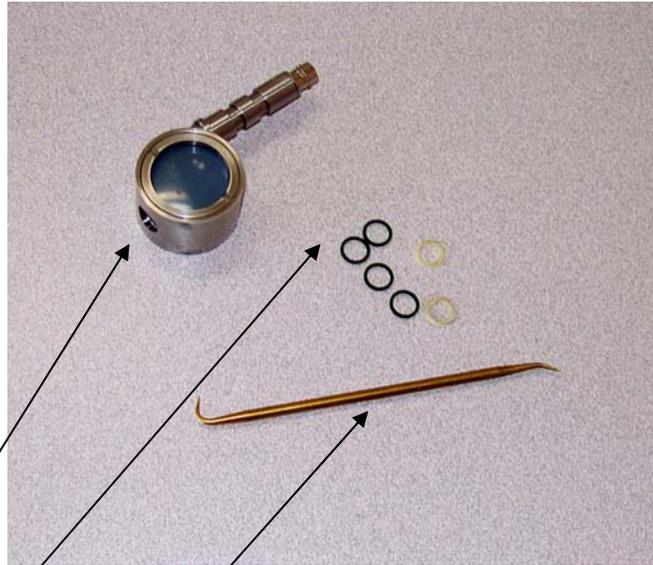
Why is the unit printing lightly or printing strange shapes?

- Has the unit been charged lately?

Care and Maintenance

High Pressure Wellhead - Maintenance Notes

Supplies needed for maintaining the High Pressure Wellhead are two sets of O-rings (four black backup o-rings and two hard white special o-rings). An o-ring tool is also provided with the unit, as shown below.



- Microphone, O-rings, O-ring tool



- To disassemble the gun for maintenance, first remove the **internal microphone**. To remove the internal microphone, first remove the microphone retainer bolt from the bottom of the gun, using a flathead screwdriver or your maintenance tool, as shown above.

- Remove the **retainer bolt**.



- Cut and remove worn or damaged O-rings from stem of microphone. Using the O-ring tool, replace with new O-rings in the following order: One Black Backup, One Special, and One Black backup. Complete the black-white-black pattern on each of the two indentations in the microphone stem, as shown below.
- **Black – White – Black** pattern of O-rings



- Grease all O-rings. Replace Microphone in High Pressure Wellhead. Replace and tighten retainer bolt.

Acoustic Fluid Logger - Maintenance

Charging the battery

The rugged, self-contained AFL unit requires a minimum of maintenance. Batteries should be charged regularly after each day's use, using the standard wall-mount charger that accompanies the unit. Usually an overnight charge will be sufficient. Simply insert the round, yellow end of the charger cable over the charger port on the unit and tighten the black thumb ring. Then plug the other end of the charger into a standard 110-volt, 60-Hz U.S.-type plug wall outlet. Adapters are available upon request for international applications.

Note: Keep the AFL on-off switch in the off position during charging.

Occasionally, a damaged battery will need to be replaced. We recommend shipping the unit back to our repair shop for replacement of the battery. While it is possible to replace the battery yourself, it is necessary to use extreme caution not to damage the internal circuit boards or to cut the cables. Prior to replacing the battery, however, efforts should be made to charge the unit with the accompanying battery charger for at least 24 hours.

Note: When storing the AFL unit, always make sure the switch is in the off position, to avoid running down the battery.

Loading thermal paper

Thermal paper rolls must be replaced as they are consumed.

To replace the thermal paper rolls, simply remove the old spool, then replace it with a new spool with the paper unrolling from the bottom, with the tail extending to the right. Place the tail over the silver bar on the printer unit. Turn on the unit, and the automatic paper sensor will see the paper as you push it under the platen. If necessary, release platen by pushing on silver thumb release that sits directly to the right of the paper tray on the unit. The paper will then thread through the printer and print a header strip when the unit is turned on.

Battery Replacement Procedure and Photographs

Supplies needed for changing the battery on the Acoustic Fluid Logger are: large flathead screwdriver, medium and small Phillips screwdrivers, 5/16" wrench, new 12-volt 7.0 amp standard motorcycle battery.

First, using the medium Phillips screwdriver, remove the four anchoring screws at the four corners of the Acoustic Fluid Logger Front panel, being careful to retain the lockwashers with the screws. (Caution: Dropping a lockwasher or screw into the unit could cause a short on the circuit board during use.)



Photo 1, Remove front panel from Acoustic Fluid Logger

Lift up the front panel, noting that cables connect it to the bottom panel of the unit. Do not disconnect the cables. Move the front panel to the side. Disconnect the red and black battery connections.

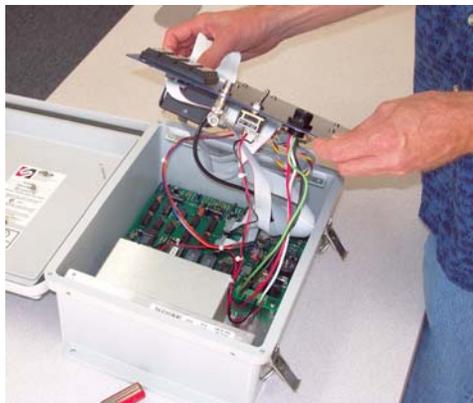


Photo 2, Set the front panel beside the unit

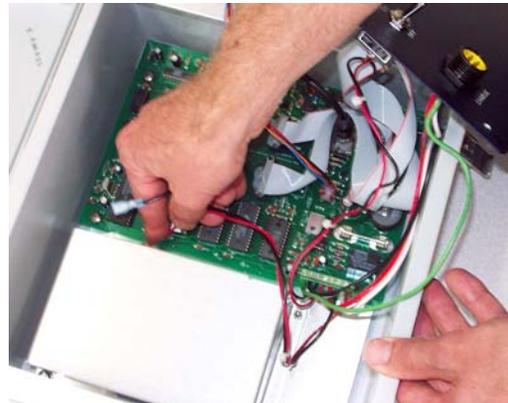


Photo 3, Remove red and black battery connection wires

Next, with the Phillips screwdriver, remove the screws from the four corners of the circuit board to disconnect the circuit board from the bottom plate. Again, be careful to retain all four screws and lockwashers. Then without breaking the wire or cable connections, carefully set aside the circuit board and front panel. This will expose the bottom battery plate.

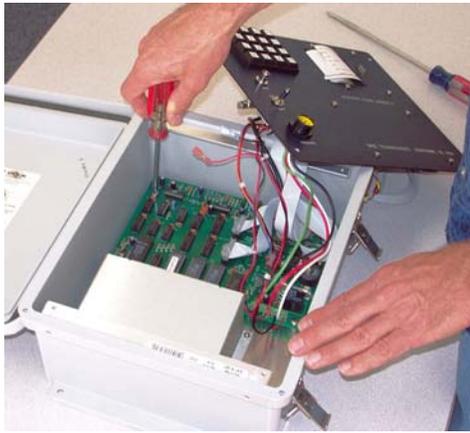


Photo 4, Remove four circuit board screws

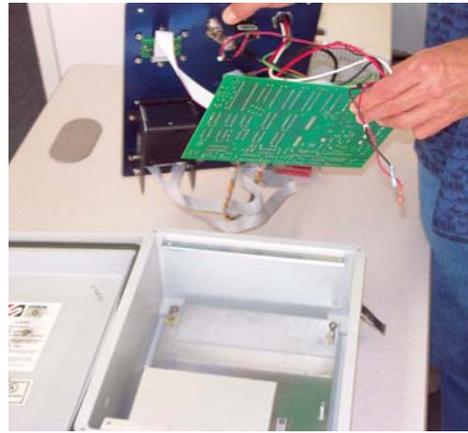


Photo 5, Remove circuit board and front panel

To remove the bottom battery plate, use the large flathead screwdriver to remove the four screws at the corners of the plate. Be careful to retain all four screws and flatwashers.



Photo 6, Remove bottom plate screws



Photo 7, Remove battery plate from box

Use the small Phillips screwdriver and a 5/16" wrench to remove the six screws that hold the battery box onto the bottom plate. Retain all six screws, lockwashers and nuts for reuse.

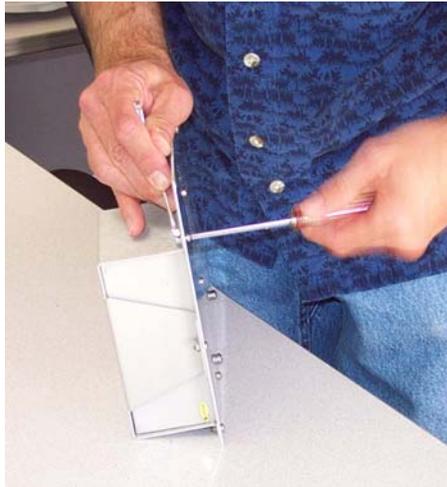


Photo 8, Remove all six battery box screws

The replacement battery is a standard motorcycle battery, and should be readily available at a motorcycle shop. Or if preferred, call Sage Technologies at 817-488-2579 for a replacement. The battery is a 12-volt 7.0 amp standard motorcycle battery.



Photo 9, Replace with standard motorcycle battery, 12-volt, 7.0 amp

Place the battery in the battery box, being careful to assure that the red battery connection faces away from the metal box, and the black connection fits down inside the battery box. When the battery box is placed back onto the bottom plate, the red battery connection will be next to the bottom plate, and the black connection will be toward the top. Note: Place the battery box so that the red connection facing the center of the battery panel, and is directly next to one of the 1/2" standoffs for the circuit board, as shown below.

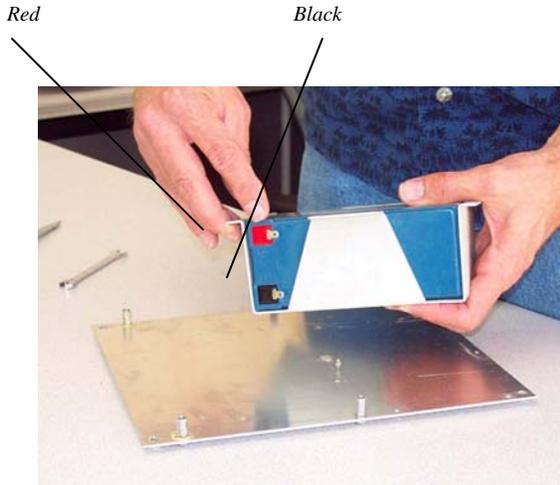


Photo10, Place red battery connection away from base of battery box

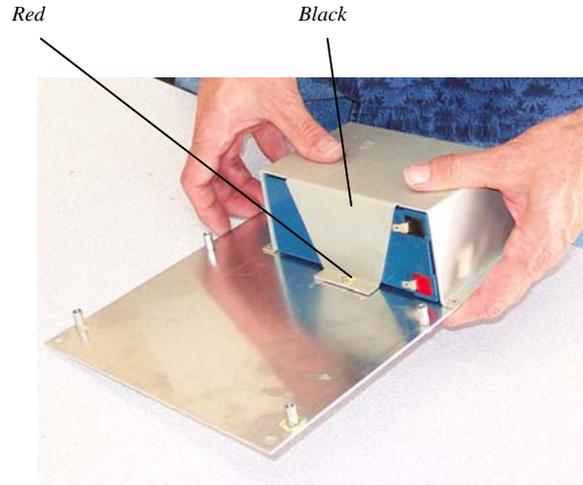


Photo11, Remove all six battery box screws

Replace screws in battery box, pushing screw through bottom plate and through battery box, then replacing the lockwasher and nut on top of the battery box side. Tighten all screws completely. (Note: Screws are #6-32, 3/8" if replacement of lost screws is necessary.)

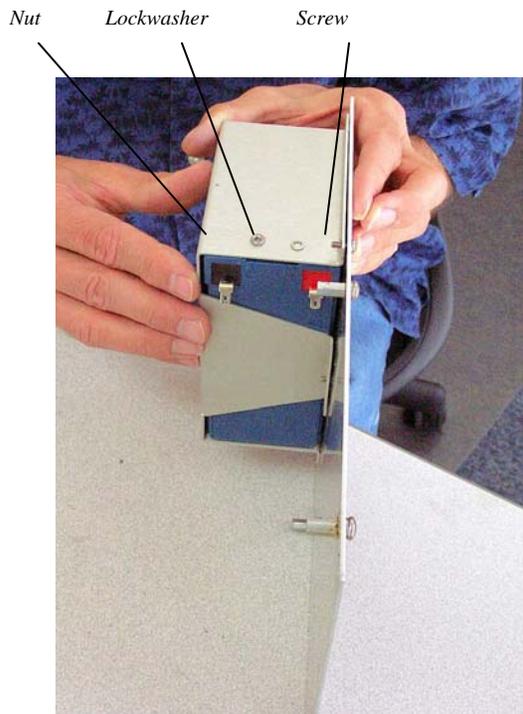


Photo 12, Replace lockwasher and nut on each of six battery box screws

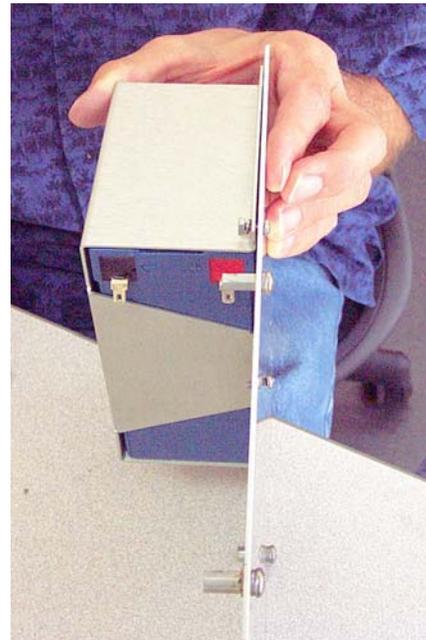


Photo 13, Tighten all six nuts with Phillips screwdriver and 5/16" wrench

To complete battery replacement, reassemble the unit, first reinstalling the battery box with the four #10 3/8" flathead screws and flatwashers. Second, reinstall the circuit board with the four #10 1/4" Phillips screws and lockwashers.

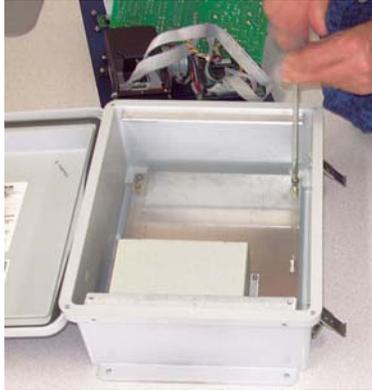


Photo 14, Reinstall bottom plate

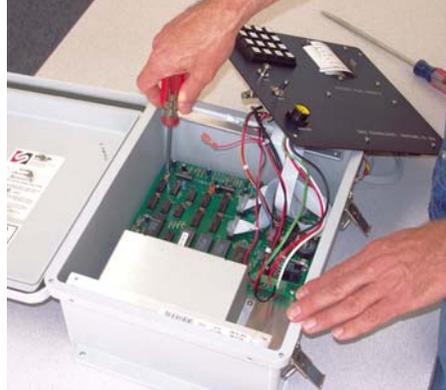


Photo 15, Reinstall circuit board

Next, reconnect the battery cables, being sure to connect the red cable to the red battery connection, and the black cable to the black battery connection. *Important: At this point tilt the box to one side to make sure no hardware has fallen into the box and is lodged under the circuit board. Remove any stray hardware to avoid shorting the circuit board.* Last, refit the top panel to the box, careful not to pinch and of the ribbon cables under the panel. Then, reinstall the front panel with the four #6-32 3/4" screws and lockwashers.

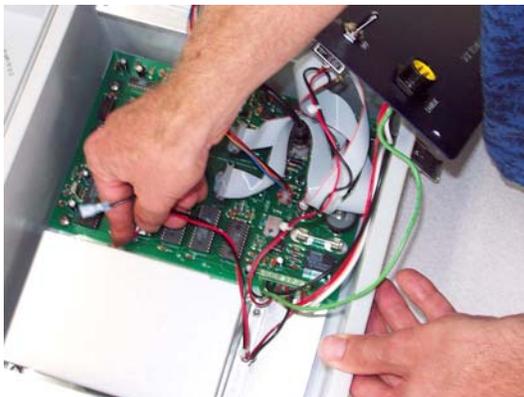


Photo 16, Reconnect battery wires, black cable to black connection and red cable to red connection

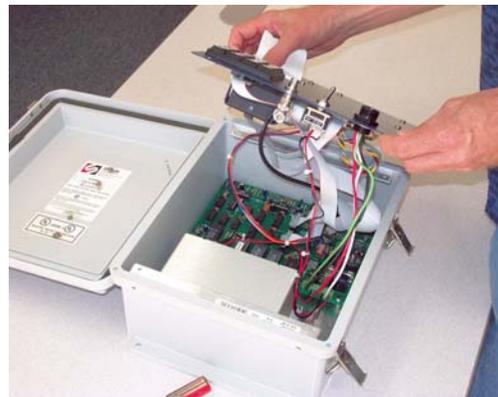


Photo 17, Reinstall front panel on Acoustic Fluid Logger

Sage Technologies, Inc., Limited Warranty

This Sage Technologies, Inc.'s product is warranted to be free from defects in material and workmanship for twelve (12) months from the date of original sale by Sage Technologies, Inc. to its customer. This warranty shall extend only to the electronic components incorporated in the product subject to this limited warranty and is available only to wholesale customers who purchase the product directly from Sage Technologies, Inc. The customer shall be solely responsible for all shipping, custom and duty charges necessary for transport of the product to and from Sage Technologies, Inc. and those charges must be prepaid by customer prior to Sage Technologies, Inc.'s obligation to receive the damaged product from customer and return the repaired product to customer.

Sage Technologies, Inc. provides no warranty service where it, in its sole judgment, determines that damage to the product is the result of customer's misuse, neglect or abuse.

Sage Technologies, Inc. does not warrant this product to consumers except when Sage Technologies, Inc. has sold directly to that consumer.

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For warranty service on Sage Technologies, Inc., equipment contact the Service Manager at:

Sage Technologies Incorporated
Attn: Service Manager
P.O. Box 1466
Grapevine, TX 76099-1466
Telephone: (817) 488-2579
Fax: (817) 421-0607

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