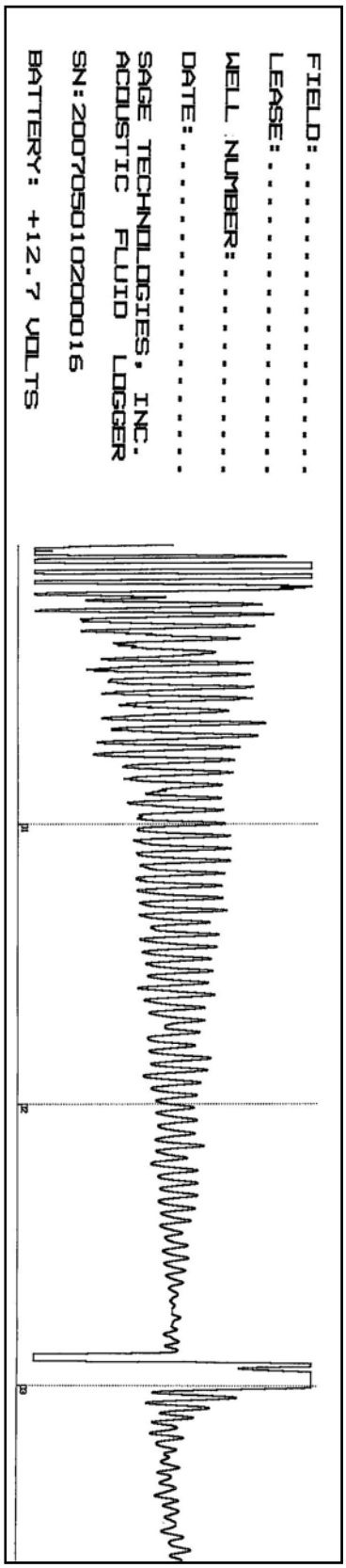
Acoustic Fluid Logger III

and

Pressure Pulse Gas Gun

Reference Manual



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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.

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Introduction to Acoustic Fluid Logger

With Pressure Pulse Gas Gun 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.

Included in the Acoustic Fluid Logger system is the **Pressure Pulse Gun and Microphone. The Pressure Pulse Gas Gun** is available in both the 1,500 psi and 3,000 psi versions. The stainless steel gas gun shoots a pulse of compressed CO^2 down the annulus of the well; the return signals are received on the internal microphone and transmitted to your recording device via the microphone cable. The gun consists of a volume chamber, a valve assembly and a microphone. Both gas guns allow the use of either an implosion or an explosion shot, so on higher pressure wells, the use of an external gas source is not required. The gun may be easily disassembled for maintenance. Adapters are available for all gas guns, to allow connection to any wellbore.

All of the products at Sage Technologies 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

- Acoustic Fluid Logger
    - 10 rolls thermal paper
    - Acoustic Fluid Logger System manual
    - Wall-mount battery charger
    - Microphone cable

- Pressure Pulse Gas Gun and Microphone
    - Charge hose for CO^2 bottle
    - 2 ½ pound CO^2 bottle, empty
    - 4" Spanner wrench
    - Service Tool (for valve core and o-ring maintenance)
    - Two 5/32" Allen wrenches
    - 3/16" balldrive wrench
    - O-ring and valve core repair/replacement kit
    - Waterproof carrying case

Other tools needed in the field

- CO^2 bottle must be filled with gas to provide the shot. Generally, the bottle should be weighed when empty, then filled to the specified product weight of the bottle. The standard bottle is a 2.5 lb. CO^2 bottle.

- 11-point dividers for echo calibration

- Adjustable wrench for the CO^2 hose and wellhead valves

- 9/16" wrench for the fittings

Shooting the pumping fluid level

Quick start instructions

- Close the backside valve on the well before set-up.
- Connect the Pressure Pulse Gas Gun to the annulus of the well behind the backside valve, using the spanner wrench provided.
- Open the backside valve to pressure up the gun.
- Push the gun's shuttle valve into the **load** position.
- Charge up gas gun chamber by feeding pressure into the gun from the CO^2 bottle through the charge hose to achieve a positive differential pressure. To do this, stab the charge hose into the "Fill" valve labeled on the side of the gun.
- Shut in the casing flow line valve, so the shot will not go down the flow line.
- Connect the microphone cable to both the Acoustic Fluid Logger and the Pressure Pulse Gun.
- 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 START** to put the unit in the standby mode. The header will advance a small amount and the unit will wait for you to shoot the gun.
- Shoot the Pressure Pulse Gun by pushing shuttle valve in the "Fire" direction. The unit will start printing.
- Let the printer run until you have seen a valid fluid level kick. **Press STOP** at this point to stop the tape.
- Inspect the resulting compressed tape 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.

Fluid Level Procedure

1. Mount the Pressure Pulse Gun to the wellhead, turning by hand at first. Finish tightening by inserting the spanner wrench provided into the notches in the gun and tightening the gun firmly to the wellhead. Use of Teflon tape on the gas gun threads will help achieve a better seal.

2. First, open the backside casing valve, shown below left. This will allow the compressed gas shot to travel down the wellbore to find the fluid. Next, close the casing flow line valve, shown below right. This prevents the compressed gas shot from going down the flow line instead of the wellbore.

3. Push the gun's shuttle valve into the load position by sliding the shuttle firmly toward "Load."

4. Open the valve on the compressed gas bottle. Charge up the gun: Press the stab-in connector on the charge hose into the "Fill" connection on the gun. **Note: When the charge hose stabs into the fill valve, some gas will blow back from the insertion point. This is normal, and helps keep the charge area free of debris.** The gun is now charged, and will be ready to fire when connected to the Acoustic Fluid Logger.

Well depth and other variables will affect the amount of pressure needed to charge the gun for a fluid level shot. In general, a shot of 100 to 200 psi above wellbore pressure should be sufficient.

5. Attach the microphone cable from the connector on top of the Pressure Pulse Gun to the microphone connection on the Acoustic Fluid Logger. Turn on the power switch on the Acoustic Fluid Logger; the paper will advance and print a header strip, and the on/off light will light. Note: In very bright conditions, the light on the front panel is difficult to see.

5. The header will print on the tape and the unit will wait to sense the compressed gas shot. For a quick check of a fluid level, press the keys "4 – C – Start" on the keypad. This will advance the tape slightly and set up the Acoustic Fluid Logger to print a compressed echo tape of ¼ the full size.

6. Fire the Pressure Pulse Gun by sliding the shuttle valve to the fire position. This is easily accomplished by pressing the shuttle valve with the heel of the hand.

7. The paper tape begins to print an echo trace after the gun is fired. Let the tape run until a fluid kick is observed. Collars inside the well will register on the tape, but the deepest kick will be the fluid level. After the 4 - C - Start (1/4 compressed) printout determines a fluid level, press “Stop” to stop the printout, then press “Print” to print a full-length tape.

Note: The Acoustic Fluid Logger III stores seven representations of each echo internally, each time the gun is fired. These echoes are ready to be printed individually, each offering different amplification levels of the well data. This feature takes into account the fact that all wells are different, with different variables affecting the operator’s ability to see the fluid level data. With differing amplification, the operator has seven different options that can be printed, and seven ways to look at the same fluid level. (See the Keypad and Interface section of this manual.)

8. When testing is complete, set-up procedures are reversed. To ensure the safety of the operator, when rigging down, first BE SURE to close the backside casing valve.

9. Before removing the gun from the well, BE SURE to turn the pressure bleed knob counter-clockwise to open the bleed valve and release pressure on the gun. Also, BE SURE to put the shuttle valve into the "Fire" position, to fully release pressure from the gun, as shown below. **The gauge on the gun must be returned to zero psi before you begin to remove the gun from the wellhead.**

10. To remove the gun from the casing, open the Pressure Bleed with the shuttle in the "Fire" position only. Use the Spanner wrench to loosen the gun from the wellhead. Once loose, the gun may be removed by hand. After the gun is removed from the wellhead, remember to open the casing flowline valve. Repack the gun and accessories into the black case for easy transport from the well site.

Pressure Pulse Gas Gun – Quick Instructions

Shooting a positive pressure wave:

- Push the shuttle valve to the “Load” position.
- Insert hose from the CO^2 bottle into the “Fill” connection on the gun. As you do this, pressure will increase on the gauge.
- When the desired pressure is reached, remove the hose connection from the fill connection. A **suggested shot size** is 100 to 200 psi above wellbore pressure.
- To fire the Pressure Pulse Gun, push the shuttle valve to the “Fire” position.

Shooting a reverse pressure wave:

Most wells with a casing pressure of above 100 psi can be shot using a reverse pressure wave. (this means letting gas travel from the well into the volume chamber of the gas gun).

- Place the shuttle valve in the load position.
- Open the pressure bleed to bleed gas from the internal volume chamber.
- Close the pressure bleed and move the shuttle valve to the “Fire” position. (You will notice that the gauge on top of the gas gun suddenly travels from zero to whatever the existing pressure is inside the casing.)
- This has produced a reverse pressure wave. The fluid level will also be reversed on the paper tape printout, and will kick UP on the paper tape, instead of kicking down as it does in a positive pressure wave.

To remove the Pressure Pulse Gas Gun from the casing:

- Close the casing valve.
- Check to ensure that the gas gun shuttle valve is in the “Fire” position.
- Check that the pressure bleed is open. Remove the gas gun from well using the spanner wrench.

Safety notice: If the Pressure Pulse Gun has been left in the “Load” position while opening the pressure bleed, you have only vented the gas inside the gun. Gas at pressure is still present between the gas gun and the casing valve. To remove this gas, open the pressure bleed and move the shuttle to the “Fire” position.

Pressure Pulse Gun – Gauge Quick-connects

Quick-connects are a useful accessory for applications that require quick-coupling and change-out of gauges on the Pressure Pulse Gun.

A high-pressure gauge allows the operator to get a quick check of shot size in higher pressure wells. A low-pressure gauge allows a check of casing pressure in low pressure situations. The quick-connects allow an operator to use a more accurate gauge for each situation. Also, the gauges rotate freely for easy viewing in any wellbore situation, from any angle.

To Couple the Quick-connect: Align stem with body. Push stem into body until it clicks. (See left photo.)

To Uncouple the Quick-connect: Pull the body sleeve on the quick-connect toward the stem (in other words, pull the sleeve away from the gun). (See right photo.)

Warning: System pressure must not exceed 250 psig (17.2) bar at 70° F (20° C) when coupling and uncoupling this product. When uncoupling single-end shutoff quick-connects, system pressure on the stem side will vent to atmosphere.

Good practices for operations of Swagelok Quick-connects

- Align bodies and stems when coupling or uncoupling.
- Support hanging hoses or other equipment to prevent side load.
- Re-lubricate stem seal o-rings periodically.

Caution: Do not rotate gauge when coupled. Do not insert foreign objects into uncoupled bodies or stems.

Adapter Connection -- 3,000 psi Pressure Pulse Gun

To 2" Line Pipe

1. In the fluid level set-up photographs below, the standard 3,000 psi Pressure Pulse Gun is being attached to standard 2" line pipe with the addition of pipe adapters. First, attach the adapters necessary to fit the gun to the wellhead. Make sure to tighten the adapter with a pipe wrench.

2. Hand-fit the gun to the adapter. Finish tightening the gun with the provided spanner wrench, which fits into the notches on the base of the gun body.

Keypad and Interface

1	**2**	**3**	**STOP**
4	**5**	**6**	**MAN**
7	**8**	**9**	**C**
START	**0**		**PRINT**

START

The start key puts the Acoustic Fluid Logger in the ready mode; it starts logging the microphone signal and looking for a shot to occur.

When a shot is sensed, the Acoustic Fluid Logger begins running the tape. The Start plot on the tape is a special square root of amplitude plot of the signal.

C - (Compressed)

Compressed allows you to print shorter, tighter echoes to tape. Using compressed mode allows a quick check for a 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 **START** to put the unit in the ready 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 **STOP** to stop the compressed echo and the printer. Then push **PRINT** again to reprint a full-length echo.

The Compressed feature allows the easy identification of major events on the tape – fluid levels and other wellbore features -- in a tight format normally seen only on computer displays.

PRINT

PRINT is used to print the echo in memory in one of the seven display modes.

PRINT – Prints the echo in the special square root of the amplitude manner.
1 PRINT – Prints the echo in the 1(minimum) amplified mode.
2 PRINT – Prints the echo in the 2 amplified mode.
3 PRINT – Prints the echo in the 3 amplified mode.
4 PRINT – Prints the echo in the 4 amplified mode.
5 PRINT – Prints the echo in the 5 amplified mode.
6 PRINT – Prints the echo in the 6 (maximum) amplified mode.

STOP

Stop is used to stop the current echo from printing.

MAN - (Manual mode)

MAN (Manual mode) is used to turn off the shot recognition and start recording immediately.

When in the **MAN** mode, the Acoustic Fluid Logger starts recording immediately when the **MAN** button is pushed. The tape will be printed in one of the standard seven display plots.

MAN – Starts the plot in the special square root of the amplitude mode.
1 MAN – Starts the tape in the 1 (minimum) amplified mode.
2 MAN – Starts the tape in the 2 amplified mode.
3 MAN – Starts the tape in the 3 amplified mode.
4 MAN – Starts the tape in the 4 amplified mode.
5 MAN – Starts the tape in the 5 amplified mode.
6 MAN – Starts the tape in the 6 (maximum) amplified mode.

*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.*

Special features of fluid level tapes

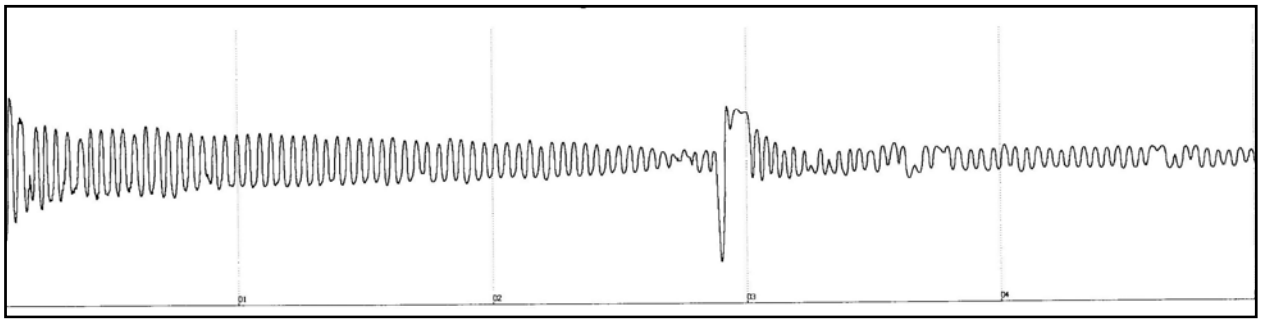
Seven amplification levels hone the accuracy of fluid tapes

Each time an echo is shot with the Acoustic Fluid Logger, it actually records seven different representations of the wellbore at the same time. Any or all of these representations can be printed through the use of the Acoustic Fluid Logger keypad.

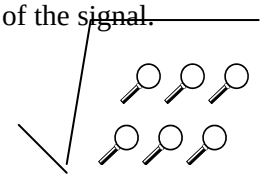
Here is an example of a single shot, where all seven representations are printed. Each time you take a fluid level shot on a well, you have the opportunity to print any or all of these seven tapes, with seven different amplifications of the signal, through the use of keypad commands. It may help to think of the seven amplification tapes as looking at the echo through a series of magnifying glasses of increasing power. If you like a certain amplification better than others, then that tape can be printed first. If you need to move up or down in amplification, then you can easily do so, without taking another shot on the well. Remember, the Acoustic Fluid Logger will hold the echo in memory, until the unit is turned off, or until another shot is recorded.

Following are seven keypad commands that will print the seven possible tapes. Note: It is assumed that you have an echo in memory – which means that the Acoustic Fluid Logger has been turned on and the gas gun has taken a shot on a well.

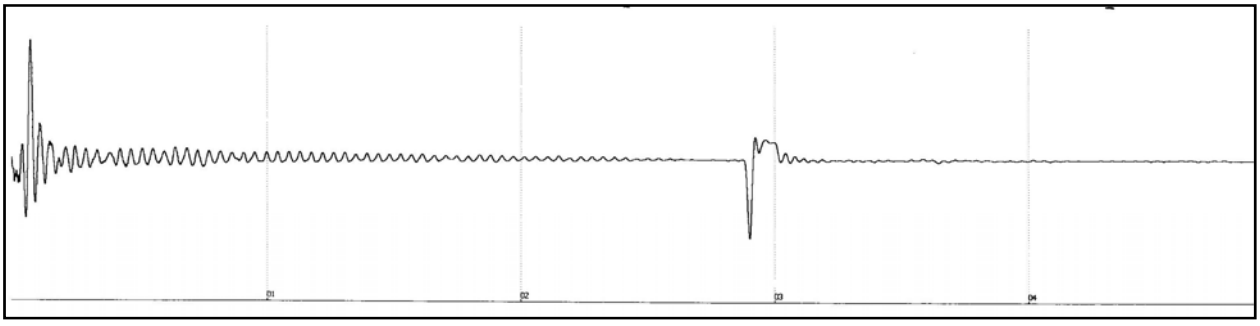
Command: Print



This command prints an overall plot, using the square root of the largest amplitude of the signal.

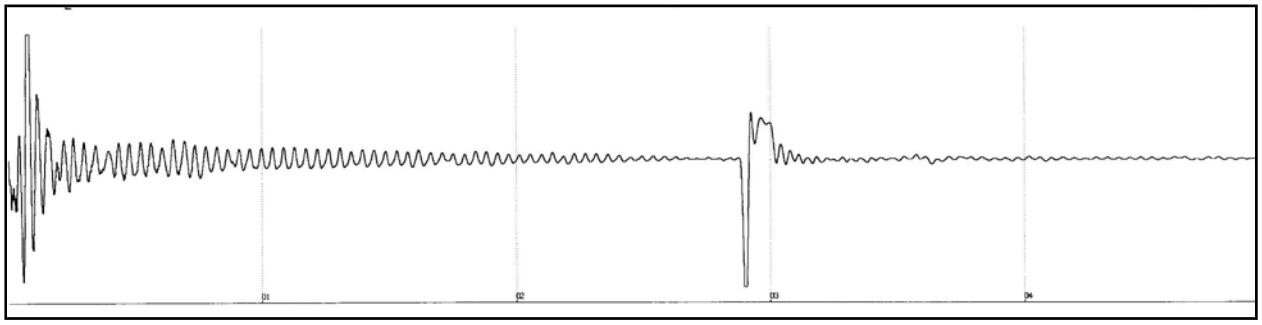


Command: 1 PrintCoC



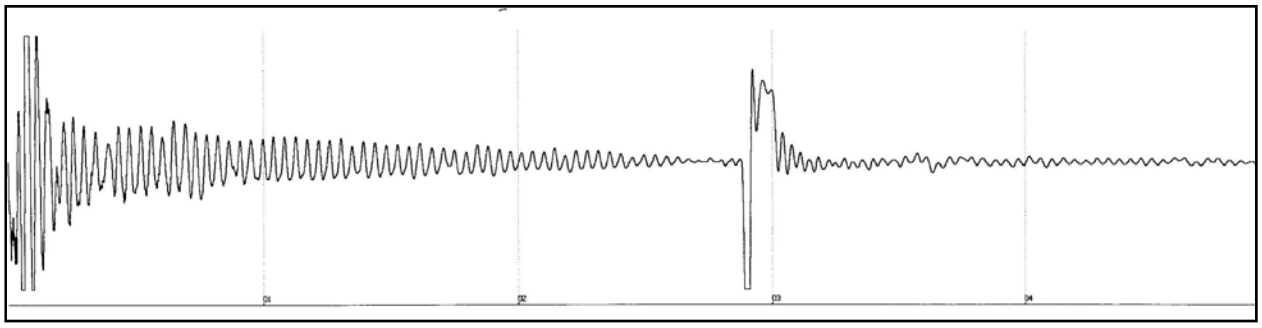
This command produces minimum amplification of the signal. 

Command: 2 Print



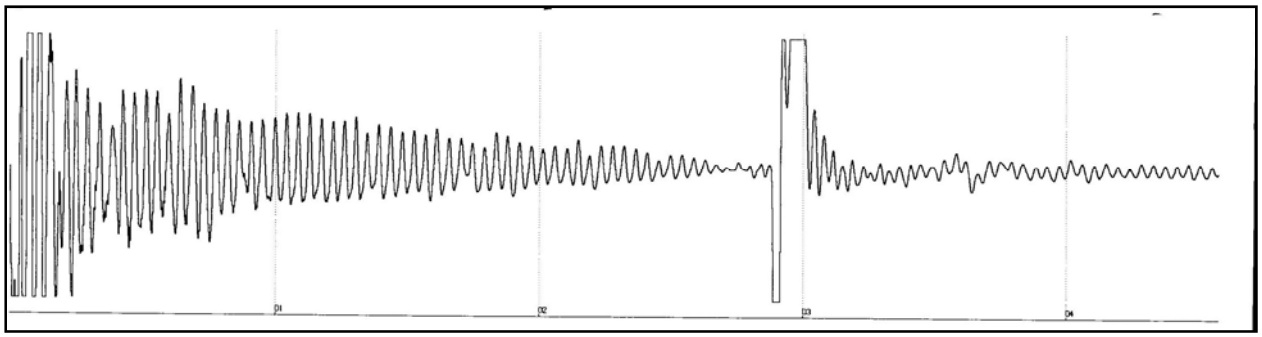
This is the second step in amplification of the signal.

Command: 3 Print



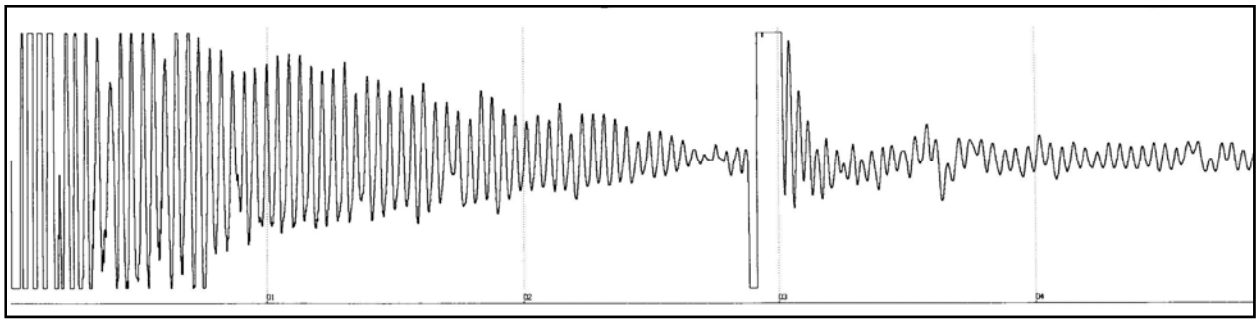
This is the third step in amplification of the signal.

Command: 4 Print



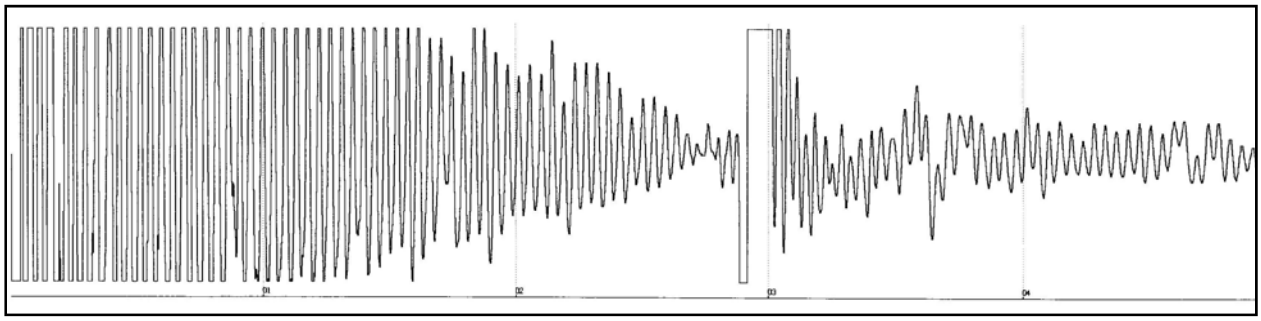
This is the fourth step in amplification of the signal.

Command: 5 Print



This is the fifth step in amplification of the signal.

Command: 6 Print



This is the maximum amplification of the signal.

Well Analysis

Identifying the fluid level kick

Remembering these few facts to make reading the fluid level tape easier.

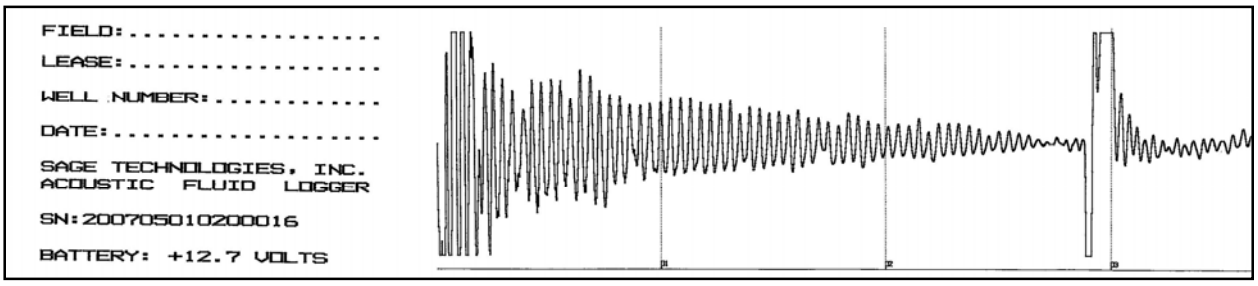
- The **fluid level** is usually the **deepest kick** in the well.
- When shooting fluid levels with a positive pressure wave (as if is with compressed gas), the fluid level always kicks **down** on the tape.
- The fluid level is the **only signal able to move** over time, on a collar count basis. (If 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

Many variables can affect the fluid level measurement on an oil or gas well, among them well depth, the size of the compressed gas shot, debris in the wellbore, and external noise, to name only a few.

- 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 five minutes). Check for other sources of external noise. 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 this can interfere with the gas shot moving down the wellbore.
- **Check the tubing tally** for things like tubing anchor depth, liner depth, depth of special oversized tools in the string, etc., for other objects that could show up as kicks on the fluid level tape.
- If there is **paraffin** in this well, be aware that paraffin rings can cause false fluid levels in wells, even in the face of increasing backpressure.
- Perforations in the well, or cracks in the casing, will kick **up** on the tape. Remember that the fluid level will kick **down**.

Reading the fluid level tape



The above example shows a quick view of the fluid level. The tape begins at the shot of the Pressure Pulse Gun, which is the first mark on the tape. The fluid level occurs at the deepest kick downward on the tape, just before the 3-second timing mark.

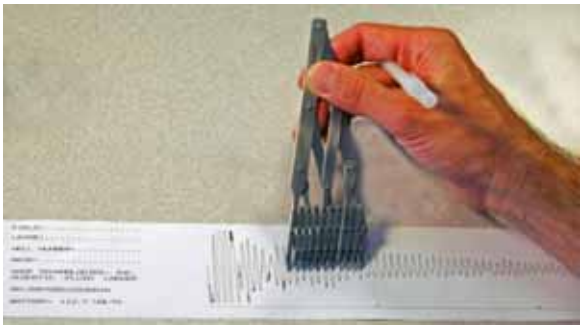
The fluid level will be measured by counting the collars between the first mark of the echo and the downward kick of the fluid level. This calculation of collars will be done on the full-size well echo tape.

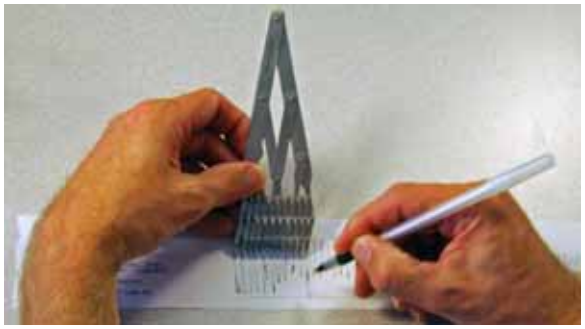
For example, if you are printing the above compressed tape, when you see the fluid level kick down, you know you have a fluid level. So, press Stop on the keypad, to stop the above tape from printing, and then **press Print, to print the full-size echo tape that can be used to calculate the fluid level depth.**

Calculating distance 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.

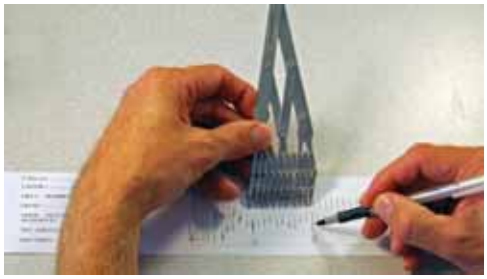
Once you have the full-size tape, you use the 11-point dividers to easily mark off sets of 10 collars on the tape. To set up the dividers, find a spot near the beginning of the tape where there are ten evenly spaced marks (these are the tubing collars registering on the tape). Move the points on the 11-point dividers to exactly line up with the downward points on the tape, (below left). This is the setting for your dividers, and on most wells, they should not need to be moved again for calibration. The dividers basically represent a 10-collar section of the well casing.





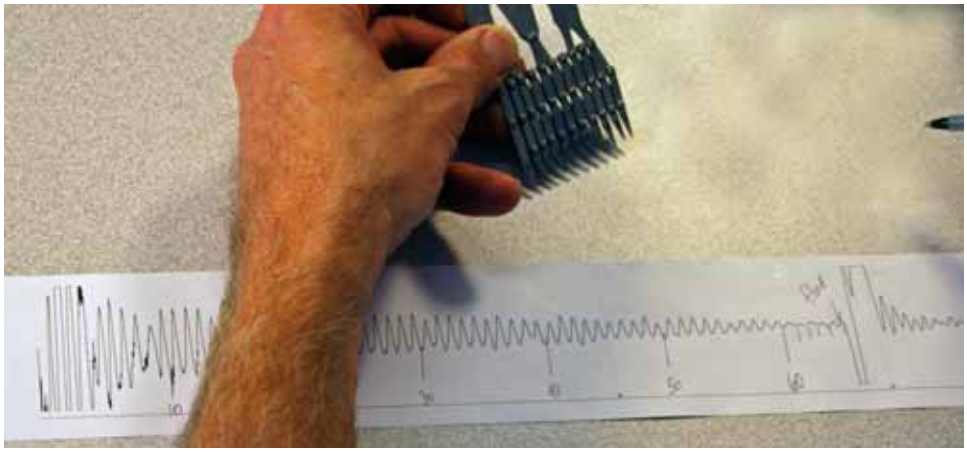
Place the left-most point of the now-pre-set dividers at the first mark on the tape (above right). This is where the gas gun fired the shot. Many times collars are not visible early on in tape due to a large shot size, and that is where the 11-point dividers are useful.

With a pencil, place a mark at the right-most point of the dividers. You have just marked the first ten collars on the well. Move the dividers to the right, now lining up the left-most point of the dividers with the pencil mark you just made. Again, put a pencil mark at the right-most point of the dividers (below left). This marks another 10-collar section of well casing.



Continue marking 10-collar sections on the tape. 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.

When you can no longer mark 10-collar sections, count the individual points on the dividers to the remaining joints to the fluid level (above right) – which is the biggest downward kick on the tape.



To calculate joints to fluid, simply count the marked sections, by tens, and add the last few joints to the fluid. That is the actual collar count – the joint-to-fluid measurement.

Calculating distance to the fluid in feet or meters

To calculate the distance to the fluid, multiply the number of joints by the length of the casing joint. (This length will be available on the completion sheet for the well.) This will be the distance to the fluid.

In the above example, there are 65 collars marked on the fluid level tape, and the casing joint length is 32, multiply 65 x 32, and the depth to the fluid is 2,080 feet.

Fluid depth – 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.

Fluid depth – 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 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 feet / 182 jts. = 31.37 feet/jt

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

Fluid depth -- 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.

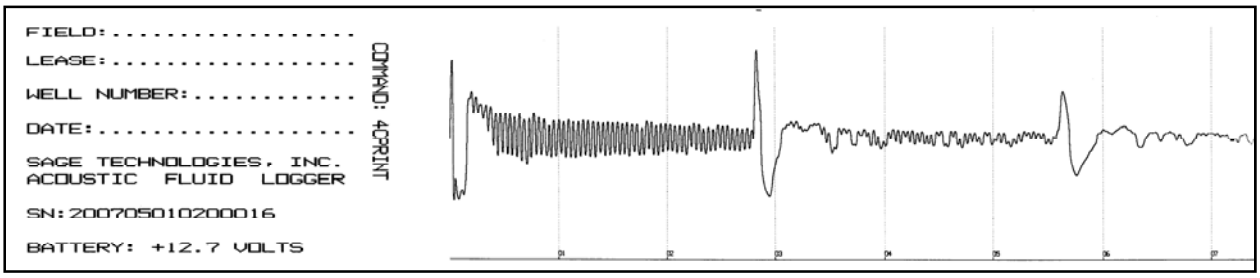
Shooting a Reverse Pressure Wave

The Pressure Pulse Gas Gun can be used to shoot both a positive pressure wave, using compressed bottle gas, and a reverse pressure wave, using gas from inside the well being tested.

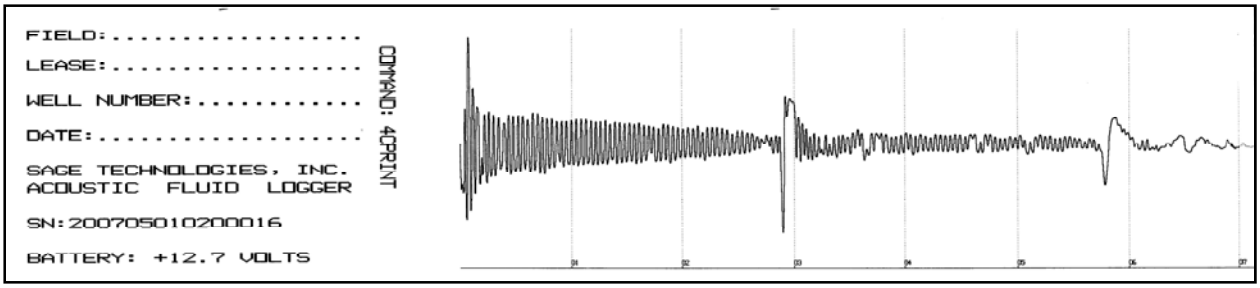
Important: A positive pressure wave will show the fluid level as the biggest kick **down** on the trace. A reverse pressure wave will show the fluid level as the biggest kick **up.**

The joints to the fluid level should be measured to the biggest downward kick on the positive pressure tape, and to the biggest up-kick on the reverse pressure wave tape.

In the two examples, the same well was tested on different days, once using a positive pressure wave, and once using a reverse pressure wave. The fluid level is visible as the largest kick on each tape, as a mirror image between the positive and reverse shots. (Tapes were printed in 4-compressed mode.)



Reverse Pressure Wave Tape – fluid level kicks up on tape



Positive Pressure Wave Tape – fluid level kicks down on tape

Shooting a reverse pressure wave shot

The procedure for shooting a reverse pressure shot is much like shooting a positive shot, except that gas escaping from the well is allowed to shoot into the gun chamber, instead of compressed gas shooting into the wellbore and then into the gun chamber.

To shoot a reverse pressure shot: Push the gun into load position, look at the gauge on top of the gun, and bleed down the pressure, with the relief valve, until the gauge reaches zero. Then close the relief valve. The well now has higher pressure inside it than the gun does, setting up the reverse shot. Put the fluid logger unit in standby mode, then fire the gun. Gas shoots from the wellbore into the gun, and the fluid logger will record the reverse shot.

Frequently Asked Questions

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 gas gun is leaking?

- After pressuring up the gun, does the gauge on the top of the gun continue falling in pressure? If so, you probably need to rebuild the gun.
- Sometimes, gas is not leaking from the gas gun, but from the connection to the wellhead. Be sure to apply several wraps of Teflon tape to the gun threads before attaching it to the wellhead. If pipe adapters are being used, tape these, also.

How do I know if the microphone is dead?

- If the paper tape signal remains flat after shooting the shot, the microphone may be dead.
- First, check the microphone cable for secure connection to both the fluid logger and to the gun. Also, look inside the microphone connector, to see is the metal pin inside the connection has been broken or damaged.
- Remove the microphone from the gun, by removing the microphone bolt inside the gun and pulling the microphone from the bottom of the gun. Hold the microphone on the stainless steel portion, being careful not to press on the round microphone discs, which cover the sensitive microphone crystals. Examine the discs for damage. A blown-out or caved-in disc indicates that the microphone needs to be replaced.
- If the microphone discs do not look damaged, but the microphone is full of debris and dirt, wipe down the microphone to remove the dirt. Carefully wipe off the microphone discs. Heavy dirt and debris on the discs can stop the microphone from operating properly.
- Examine the microphone o-rings for damage and replace them and lubricate with silicon or o-ring grease, then re-insert the microphone and tighten the microphone bolt. Repeat the well test to see if sensitivity has been improved. If not, the microphone needs to be replaced.

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

- Check bottle for CO^2.
- Did you charge up the gun? Check the gauge for pressure.
- Is the microphone cable fully connected to both the Acoustic Fluid Logger and to the gun?

- Is the Acoustic Fluid Logger turned on?
- Is the battery charged?

Why won't the unit come on?

- Is the battery charged?
- Is the unit turned on? Check for the on/off bulb to light when the unit is turned on.
- Did the header print? Check to see that the printer advances the paper and prints a header when the fluid logger power switch is turned on. If so, the unit is on and something else is wrong.

Why is the unit printing lightly or printing strange shapes?

- Has the Acoustic Fluid Logger been charged lately? A low battery charge can result in light printing. The thermal printer must have a charged battery to print the signal to the thermal paper. Try charging the unit overnight. If the unit still won't print, the battery needs to be replaced.

Why is the tape rolling, but not printing a trace on the paper ?

- Has the thermal paper been loaded correctly? Thermal paper is coated and printable on only one side. When loading paper, hold the roll in your left hand, with the tape coming off the bottom of the roll – in other words, when you pull on the tape with your right hand, the paper tail rolls out to the right and the **roll has paper coming off the bottom of the roll.**
- If the paper is loaded correctly and still not printing, is the paper yellowed or discolored? Thermal paper should not be stored in high temperatures or in sunlight, or it loses its printability over time. For best results, store extra thermal paper in the office, not in a hot work truck.

Pressure Pulse Gun – Maintenance

Most supplies needed for care and maintenance are included with the Pressure Pulse Gun at time of purchase:

- O-ring kit containing seven O-rings (two small black, two medium black, one small white and one large black) and 2 valve cores.
- Gun maintenance tool
- 3/16" ball-end socket
- Two 5/32" Allen wrenches

Also helpful for use in repair are the following supplies:

- Standard channel lock pliers
- Large flathead screwdriver
- Tube of silicon lubricant (found at most oilfield or auto supply stores.)

When disassembling the gun for maintenance, first remove the internal microphone. To remove the microphone, first remove the microphone retainer bolt from the bottom of the gun, using a flathead screwdriver, as shown below. Then pull the microphone out of the bottom of the gun, being careful to hold the microphone by the stainless steel sides so as not to damage the round microphone crystals.

If the microphone is dirty, wipe it clean, by holding the microphone by the stainless steel parts and by **avoiding** pressing on the circular microphone crystals on either side of the microphone head.

Disassemble the gun by removing the eight socket-cap screws on the top of the gun bonnet. Remove the screws in opposing fashion, using the ball-end socket, first removing one screw, then the one across from it (not adjacent to it), as shown below. Continue removing screws, alternating sides.

After removing the eight screws from the top, separate the bonnet top from the gun body for maintenance. Replace and grease the large O-ring on the gun bonnet top, as shown below right. Reassemble the top, again tightening opposing screws on the bonnet top to avoid o-ring damage.

Remove the Shuttle Valve assembly by using the two 3/8" Allen wrenches, as shown below. Pull the shuttle valve out of the bonnet.

Cut off damaged O-rings with an X-acto knife. Then replace the one clear and two black O-rings on the shuttle. The o-rings can be loaded onto the shuttle valve with the maintenance tool: separate the maintenance tool into two pieces, then screw the tapered piece of the tool into the end of the shuttle valve. The o-rings can then be pushed onto the end of the tool and slid onto the shuttle valve in order. The white o-ring is in the middle, between the two black o-rings. (These o-rings are supplied in the gun maintenance kit, which comes with the gun at time of purchase.)

When replacing any of the o-rings, wash the shuttle valve passage and grease the shuttle valve and the valve passage liberally with silicone lubricant. Reinstall the shuttle valve with the long end of the shuttle valve to the “Fire” side of the gas gun.

The inside of the gun may be cleaned by spraying it with petroleum solvent and/or by wiping the surface clean. Grease threads and O-rings liberally with lubricant before reassembling.

Replace the bonnet top on gun, aligning the microphone holes in the top and bottom. Replace and tighten screws as you would a flange -- tighten in opposing fashion by tightening one screw loosely, then the one across from it (not beside it). After all screws are tightened loosely, tighten with ball-end socket wrench, again in opposing fashion.

Before reinstalling the microphone, check the o-rings for damage, and replace if necessary. Lubricate the o-rings with silicone lubricant before sliding the microphone back into the gun and securing it with the microphone bolt.

For maintenance on the fill valve, remove it with the thick, notched end of the gun maintenance tool, turning counter clockwise. An o-ring and the valve core will be exposed under the fill valve. Remove the valve core with the tapered, notched end of the gun maintenance tool, turning counterclockwise. Replace the old valve core with a new one, and hand tighten, using the maintenance tool. Replace the o-ring, if necessary. Replace the fill valve and tighten securely.

Charge Hose - Maintenance

The charge hose that is used to charge the CO^2 bottle may occasionally need a change of its internal valve core, if the hose seems to be leaking air during a charge.

To determine if there is a leak in the charge hose, first, make sure the hose contains a Teflon washer in the large end connector, and that the large end connector is tightened securely to the CO^2 bottle with an adjustable wrench. Insert the charge hose in the gun. If after removing the charge hose from the gun, gas continues to exit from the charge hose, the valve core will need to be changed. Use one of the valve cores in the gun repair O-ring kit supplied at the time of purchase.

Carefully remove the charge hose tip from the charge hose, with the tip pointing downward, as shown below. Inside the tip, there will be a large o-ring, a flat washer, and a small o-ring. Save these to be re-installed later. (If they are missing or damaged, you will need to order a charge hose tip kit.)

With the gun maintenance tool, unscrew the internal valve core from the end of the charge hose, and replace it with a new valve core. Hand tighten securely. Then, rebuild the charge hose tip, as shown below, first placing the small o-ring in the bottom of the tip, followed by the flatwasher and then the larger o-ring. Insert the end of the charge hose into the tip and hand tighten securely.

CO^2 Bottle Set-up

Often the compressed gas bottle is fitted with the charge hose in the shop, and transported to the field with the hose attached. To set up the compressed gas bottle, first, make sure the bottle contains CO^2. A simple rule of thumb when filling the 2.5 pound bottle supplied with the Acoustic Fluid Logger System is to weigh the empty bottle, then fill it with 2.5 pounds of compressed gas.

When attaching the charge hose, first place the Teflon O-ring (attached to the charge hose at time of sale) is inside the charge hose connection on the large end of the black fill hose. Then, tighten the hose connection onto CO^2 bottle with an adjustable wrench.

Acoustic Fluid Logger - Maintenance

Charging the battery

The Acoustic Fluid Logger unit requires a minimum of maintenance. Batteries should be charged regularly after each day's use, using the wall-mount charger sold that accompanies the unit. Simply insert the round, yellow end of the charger cable over the charger port on the logger's front panel, and tighten the black thumb ring. Then plug the other end of the charger into a standard 110-volt wall outlet. (Adapters for 220 power are available as an optional accessory.) Usually an overnight charge will be sufficient.

Note: Keep the power switch in the off position during charging.

Occasionally, a damaged battery will need to be replaced. Instructions follow in the maintenance section of this manual for changing a battery. It is absolutely necessary to use caution not to damage the internal circuit boards or cut the internal wiring cables while changing a battery. 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 Acoustic Fluid Logger, always make sure the power switch is turned off, to avoid running down the battery.

Loading thermal paper

Thermal paper rolls must be replaced as they are consumed. The thermal printer built into the Acoustic Fluid Logger will operate for many years without maintenance if used with the thermal paper supplied with the unit and stocked by Sage Technologies. Common office paper rolls can damage the print head, and should be expressly avoided.

Most important: Thermal paper must be loaded into the machine properly, as it is coated on one side only, and **the paper will not print properly if loaded improperly**.

To load paper, hold the paper in your left hand, with the paper tail coming off the bottom of the roll and pull the tape out to the right with your right hand. Drop the roll of paper into the printer paper carriage in the top of the Acoustic Fluid Logger. Take the end of the paper and tear it off straight across.

Feed the paper under the silver bar, and on top of the black platen roller. Push the silver platen tab (on the front panel of the logger) to the right while feeding paper to the platen. Turn on the unit, and the paper should feed automatically. Use the silver-tab platen release to advance or straighten the paper manually.

Acoustic Fluid Logger and Pressure Pulse Gas Gun

Battery Replacement

Supplies needed for changing the battery on the Acoustic Fluid Logger are:

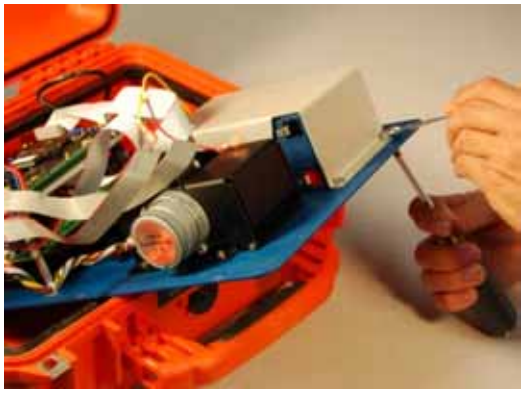
- Large flathead screwdriver
- Medium and small Phillips screwdrivers
- 5/16" wrench
- New 12-volt 7.0 amp standard motorcycle battery.

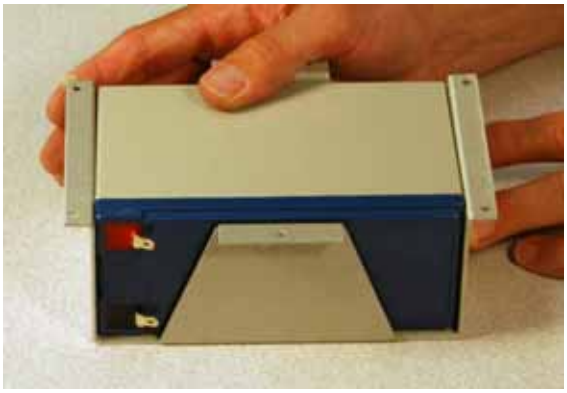
First, using the medium Phillips screwdriver, remove the ten outermost screws on the Acoustic Fluid Logger front panel – two on each side and three at the top and three at the bottom of the panel. These screws attach the front panel to the box.

Lift up the front panel, which will require shifting the panel to the side, to remove the entire panel and internal circuit boards and wiring from the box. Be careful not to disconnect the cables. Flip the panel over to allow access to the battery box. Disconnect the red and yellow battery wire connections from the battery. **Warning: DO NOT work on the front panel with the battery still connected.**

Use a small Phillips screwdriver and a 5/16" wrench to remove the six screws that hold the battery box to the back of the front panel on the Acoustic Fluid Logger, again being careful to retain all six screws, lockwashers and nuts for reuse. Be careful to retain the lockwashers with the screws. **(Caution: A dropped lockwasher or screw inside the fluid logger could cause a short on the circuit board during use.)**

The replacement battery is a 12-volt 7.0 amp standard motorcycle battery. 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 top plate, the red battery connection will then rest next to the top plate.





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.)

Reconnect the battery, making sure to connect the red battery connection wire to the red battery pole, and the black connection wire to the black battery pole. **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.**

To complete battery replacement, replace the front panel in the box, being careful not to cut any cables or wires. To keep box size down the front panel and internal electronics are a tight fit, and must be carefully slid back into position. Reassamble the unit, then reinstall the ten #6-32 1/2" front panel screws, remembering to fit each one with a lockwasher.

Accessories

Quick-change gauge adapters for Pressure Pulse Gun

Pipe adapters

Replacement Parts and Supplies

Battery

Charge hose for Pressure Pulse Gun

CO^2 bottle

11-point dividers

Fill valve

Microphone

Microphone Cable

Microphone tool and allen wrenches

O-ring kit for charge hose tip

O-ring kit for Pressure Pulse Gun

Spanner wrench

T-ball wrench

Thermal paper

Wall-mount Charger

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