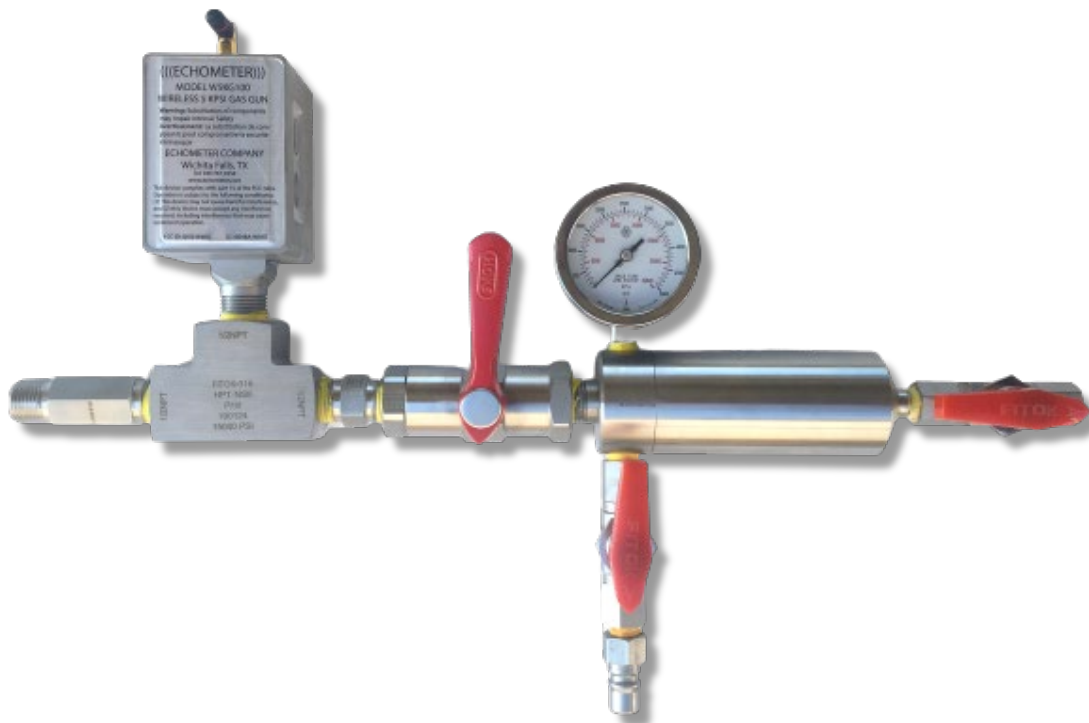




ECHOMETER

Wireless 5000 PSI Gas Gun with TAM Software Operating Manual



ECHOMETER COMPANY

5001 Ditto Lane

Wichita Falls, Texas, USA

Phone: +1 (940) 767-4334

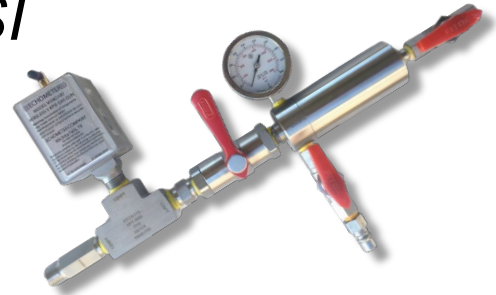
Email: info@echometer.com

Website: www.echometer.com

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Echometer Wireless 5000 PSI Gas Gun



Wireless 5000 PSI Acoustic Wellhead Attachment

Introduction

This operating manual contains information about the Echometer Wireless 5000 PSI Gas Gun including installation instructions, operating procedures, maintenance and troubleshooting, acquiring data on problem wells, record interpretation and technical references relating to the optimization of producing wells. Please read the manual before operating the instrument. Additional technical papers can be accessed from the Echometer Web page, www.echometer.com; these articles offer additional information on the use of acoustic fluid level instruments to optimize production. Please read these papers at your convenience.

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Safety Considerations

Read this manual before operating the equipment.

Please observe all safety rules when operating this equipment. The pressure ratings of the Echometer gas gun and all fittings, hoses, etc. should always exceed actual well pressure. Because the wellhead pressure normally increases during a build-up test, caution should be exercised that the well pressure does not exceed equipment pressure ratings.

Do not use worn or corroded parts. A used or corroded fitting may not withstand original pressure rating.

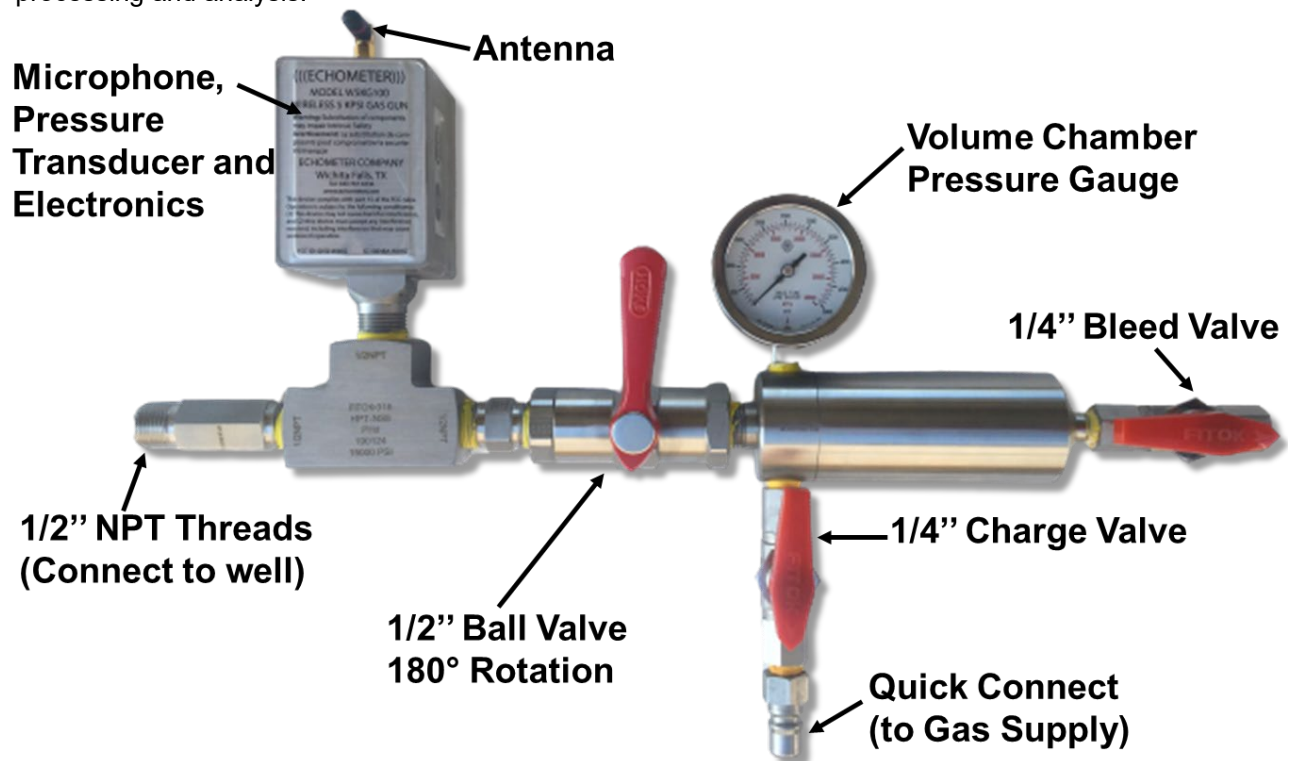
All safety precautions cannot be given herein. Please refer to all applicable safety manuals, bulletins, etc. relating to pressure, metal characteristics, temperature effects, corrosion, wear, electrical properties, gas properties, etc. before operating this equipment.

The tests should not be undertaken if the operator, the test equipment and the well are not in conditions to operate safely. This equipment should not be used if the operator is tired, ill or under the influence of alcohol, drugs or medication.

The user must read, understand and accept the conditions for using the Wireless 5000 PSI Gas Gun.

Description and Operation – Wireless 5000 PSI Gas Gun

The Wireless 5000 PSI Gas Gun (W5KG) is a self-contained acoustic fluid level data acquisition/transmission instrument. The Wireless 5000 PSI Gas Gun generates an acoustic pulse by manually rotating the ½” ball valve on the gun 180 degrees. The acoustic pulse is generated by using the well gas to implode into the volume chamber, or by loading the volume chamber with compressed gas to a pressure greater than the well pressure. A rapid 180 degree turn of the ½” ball valve releases the pressure differential and delivers the acoustic pulse to the well. A microphone housed in the gas gun detects the shot, echoes from mandrels and other wellbore reflections from any changes in cross-sectional area, and the liquid level echo. A pressure transducer located within the gas gun measures wellbore pressure and a thermistor is used to acquire temperature. A data acquisition and wireless transmission system records and transmits the initial impulse, subsequent acoustic reflections, and measurements for to a laptop computer located in a safe area for further processing and analysis.



The serial number of the Wireless 5000 PSI Gas Gun consists of the letters W5KG followed by four digits. For example: W5KG XXXX.

The standard unit is manufactured entirely with annealed 316 stainless steel and has a maximum working pressure of 5000 PSI. The Wireless 5000 PSI Gas Gun has been hydrostatic tested to 10,000 PSI.

Gas gun maintenance and part descriptions of the Wireless 5000 PSI Gas Gun are further detailed in this manual in the Maintenance and Cleaning section beginning on page 15.


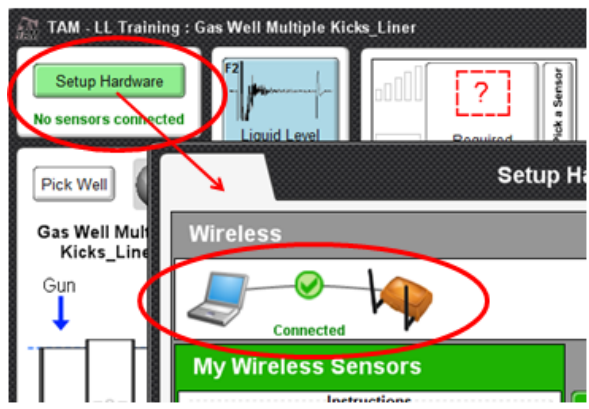
General Operation Procedures

The Wireless 5000 PSI Gas Gun is attached to the casing annulus or tubing head, and wireless communication between the gas gun and the Base Station via the TAM software on the laptop computer located in a safe area should be established. All valves between the casing annulus or tubing and the flow line should be closed to prevent the well gas from venting into the flow line causing excessive noise. The pressure differential on the gas gun volume chamber is achieved using either an Implosion method or an Explosion method. Using the Implosion method, the pressure pulse is generated by releasing gas from the well through the ½” ball valve into the gas gun volume chamber. Using the Explosion method, the gas gun volume chamber is filled with compressed gas. The pressure gauge on the gun is used to determine when the volume chamber is filled to a pressure in excess of the well pressure before opening the casing valve. Before firing the shot, the ¼” bleed valve should be closed, and the valve between the gun and the wellhead opened. A quick 180° rotation of the ½” ball valve releases the pressure differential which delivers an acoustic pulse to the well gas. A microphone housed in the gun detects the shot and the reflected pulses. An accurate strain gauge pressure transducer electronically indicates well pressure. A thermistor is used to acquire temperature. The acquired acoustic, temperature and pressure measurements are transmitted wirelessly to the Base Station and are displayed by the TAM software. When acquisition of data at the well is complete, the wellhead valves are returned to their original position, pressure on the gas gun is relieved using the ¼” bleed valve, and the gas gun is removed from the well. The following section illustrates in detail an Implosion mode of operation of the instrument and software, assuming the fluid level measurement is performed down the casing annulus.

Detail Operation of the Wireless 5000 PSI Gas Gun – Implosion Mode

The Wireless 5000 PSI Gas Gun is designed to be operated in either the IMPLOSION or the EXPLOSION mode. **Do not exceed 5000 PSI or safe working pressure at any time.**

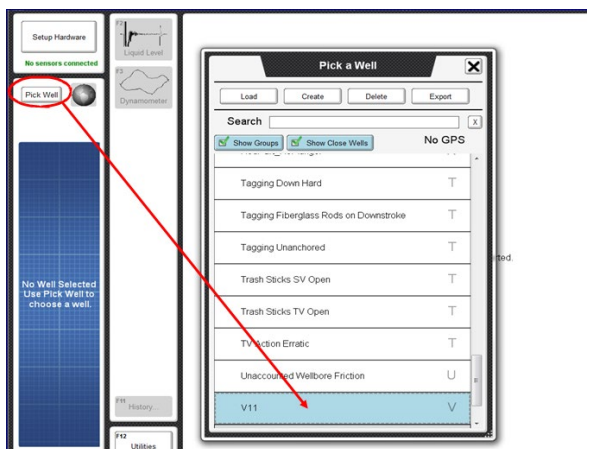
Steps to Shoot a Fluid Level

<p>Establish communication between the Base Station (Wireless Well Analyzer) and the Laptop.</p> <ol style="list-style-type: none"> 1. Turn on the Laptop. 2. Start the TAM software. 3. Plug the USB cable into the Laptop and into the Base Station. 	
<p>Setup Hardware in TAM will display “No Sensors Connected” in green when communication is made.</p> <p>Clicking the Setup Hardware button will bring up the Setup Hardware window.</p> <p>A checkmark between the Laptop and Base Station shows communication has been established.</p>	

Click the **Pick Well** button and select the well by double-clicking on the well name or by clicking the **Load** button.

If the well information does not exist, create a new well file by clicking the **Create** button and entering well name and required information.

You **MUST** pick a well before you can choose a test module (ie. Liquid Level or Dynamometer), or before you will see any sensors appear in the Sensor Bar across the top of the screen.



Prepare the Wireless 5000 PSI Gas Gun for attachment to the Well.

The working pressure of the gas gun is 5000 PSI. Do not install the gas gun on wells with pressures in excess of 5000 PSI.

Check the threads on the wellhead valve for corrosion, wear, or damage.

Apply Teflon tape and anti-seize compound (i.e. Thread-eze Ultra) to prevent galling of threads.



Attach the Wireless 5000 PSI Gas Gun securely to the Wellhead.

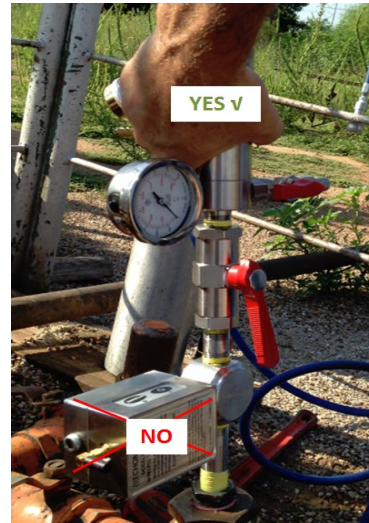
Rock and gently swivel the gun until the threads make a good connection to the valve before screwing the gun to the wellhead valve.

Do not jam or force the threads.



Hand tighten the gun onto the wellhead valve while gripping the volume chamber on the gas gun.

Do not apply force to the electronics box at any time in an effort to tighten or loosen the gun. An operator using the electronics box to attach the gun to the well will run the risk of damage to the electronics and the antennae.



Then securely tighten the gas gun to the wellhead using a wrench ONLY on the bottom 3" X 1/2" nipple.

Do not tighten using any other section of the gas gun or the operator will risk loosening the gas gun section connections.



Prepare the gas gun to perform a Zero Offset measurement of the Pressure Transducer in the gun.

1. The wellhead valve between the gas gun and the casing annulus should still be closed.
2. The 1/2" ball valve and the 1/4" bleed valve on the gas gun should be open to bleed pressure between the casing valve and the gun before obtaining the Zero Offset.
3. The Zero Offset measurement should be performed to atmospheric pressure – no pressure should be applied to the pressure transducer at this point.



Press the **Power** button to turn on the gas gun.

Counting the rapid flashing LEDs will provide the percentage of battery life remaining.
(Ex. 6 flashes = 60% power remaining)

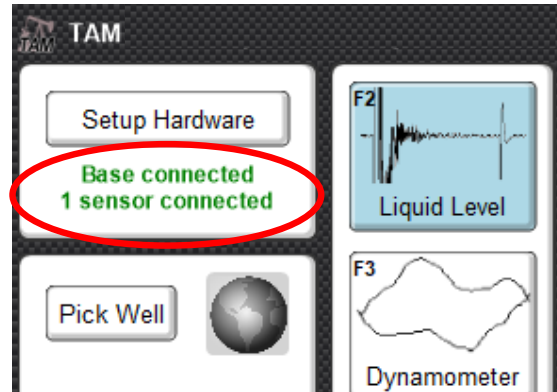
Return to the safe area to view the laptop screen.



TAM will detect the gas gun once it is powered on.

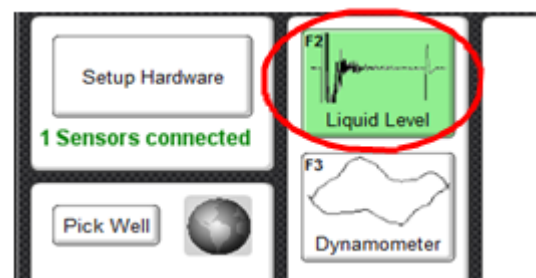
The number of sensors connected will appear under the **Setup Hardware** button in the software.

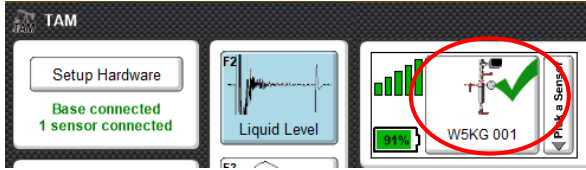
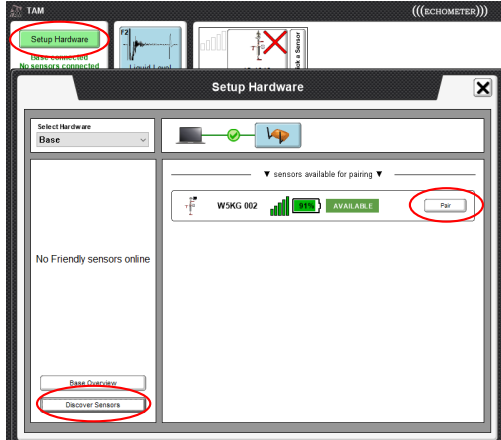
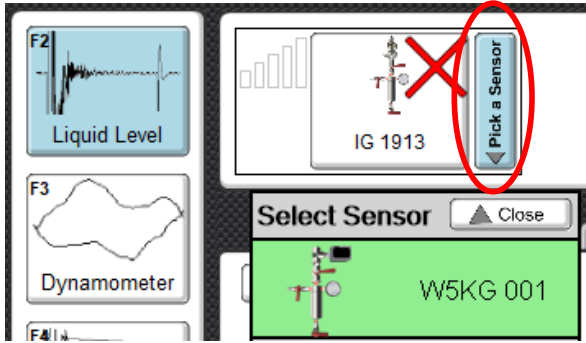
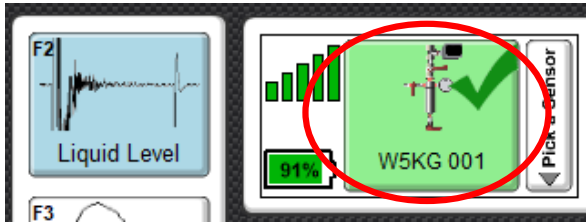
NOTE: For best signal detection and to cut down on signal interference, the larger antenna should be used on the Wireless 5000 PSI Gas Gun. See more on Signal Interference in the Troubleshooting section of this manual.



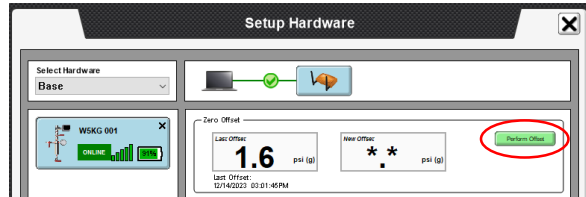
Select the Liquid Level module by clicking on the Liquid Level button or pressing F2.

Note: If the Liquid Level button is greyed out, click on Pick Well and make sure a well has been selected. A well must be selected first before the sensors will appear in the Sensor Bar.



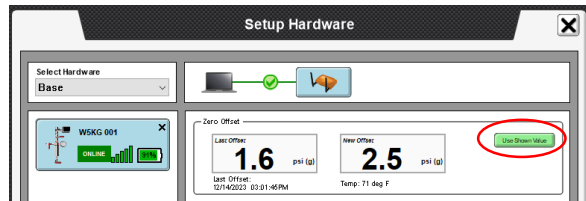
<p>In the Sensor Bar, a Wireless Remote Fire Gas Gun icon and information about the sensor is displayed.</p> <ol style="list-style-type: none"> 1. A green checkmark is displayed next to the icon inside the box when there is communication with the gas gun. 2. The S/N should appear as W5KG XXXX. 3. Battery power displays as percent battery power remaining. 4. Signal strength is displayed as colored bars above the battery percentage. 	
<p>In the event the Wireless 5000 PSI Gas Gun is not appearing in the Sensor Bar, click the Setup Hardware button. Click the “Discover Sensors” button, and then click the “Pair” button next to the Gun to move it to the left to the “Friendly Sensors” column.</p> <p>The W5KG should now appear in the Sensor Bar.</p>	
<p>If the correct sensor icon and serial number are still not displayed in the Sensor Bar, and multiple sensors have been used or are being used (i.e. Multiple Wireless Guns being used with one laptop), it may be necessary to click the “Pick a Sensor” button and choose the correct sensor serial number.</p>	
<p>Zero the Pressure Transducer.</p> <p>To Zero the Pressure Transducer inside the gun, access the Sensor Details screen by clicking on the gas gun icon in the Sensor Bar,</p> <p>Sensor Details info:</p> <ol style="list-style-type: none"> 1) Last and New Offset values 2) The pressure transducer coefficients 3) Sensor Firmware version 4) Rename Sensor box. 	

Click the **Perform Offset** button to perform a Zero Offset on the pressure transducer in the gun.



The New Offset value will be displayed. Once it stabilizes, click the **Use Shown Value** button to update the Last Offset date to the current date/time and offset value.

The New Offset box also displays a sensor temperature. The temperature value should be verified and is an excellent quality check on the sensor.



Prepare the Wireless 5000 PSI Gas Gun to fire an Implosion shot BEFORE starting the acquisition using full well pressure.

It is recommended that the well pressure is at least 100 PSI to successfully obtain an implosion shot. Well conditions and noise levels must also be considered.

If using the full well pressure to implode into the gas gun volume chamber, close all valves on the gas gun.

Open the wellhead valve between the gun and the well.

The volume chamber pressure should remain at 0 PSI when the wellhead valve between the gun and the well is opened. Otherwise the 1/2" ball valve on the gun is leaking and needs service.

In the adjacent picture, the gas gun is ready to fire. The pressure gauge reads 0 PSI in the volume chamber.



Prepare the Wireless 5000 PSI Gas Gun to fire an Implosion shot BEFORE starting the acquisition with partial well pressure.

If using only a partial differential of the well pressure:

1. On the W5KG, close the ¼" bleed valve, close the ¼" charge valve, leaving the ½" ball valve open.
2. Slowly open the wellhead valve between the gun and the well.
3. The pressure gauge on the volume chamber should read the well pressure.
4. Close the ½" ball valve on the W5KG.
5. Use the ¼" bleed valve to slowly bleed the volume chamber pressure down to the desired shot pressure.

In the adjacent picture, the gas gun is ready to fire. The pressure gauge reads 800 PSI. Assuming the well pressure is 1200 PSI, the Implosion pressure differential when the shot is fired would be 400 PSI.



Close the casing valve to the flow line.

Closing the casing valve allows the casing pressure to begin building for the pressure buildup measurement.

Closing any other valves also isolates the path between the gas gun and the well, which cuts down on additional background noise interference with the acoustic reflections.

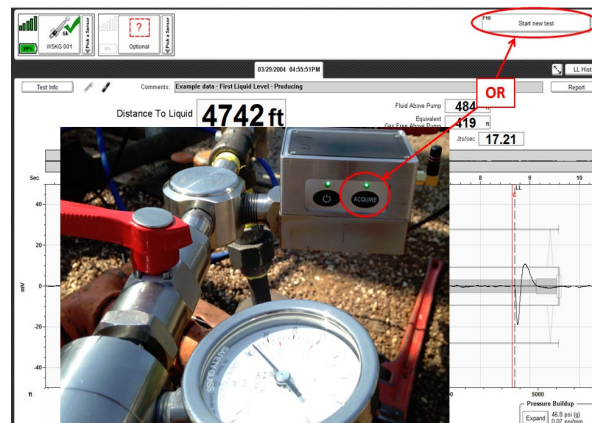


Start New Test

When the gun and well are prepared for the fluid level shot:

- 1) Click the **Start New Test** button in the TAM software on the laptop located in a safe area, or
- OR
- 2) Click the **Acquire** button on the Wireless 5000 PSI Gas Gun.

The **Acquire** button LED will turn green.



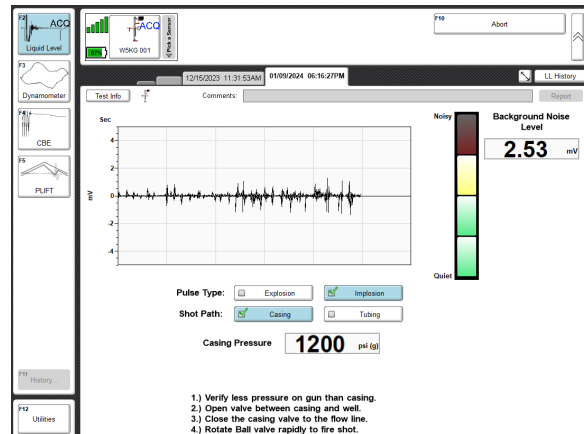
Acquisition Screen

Either method chosen to start the new test will take the software to the Acquisition screen.

Both the graph and the noise level bar are displaying background noise. Inspect the well noise displayed on the screen to verify proper instrument operation and well conditions.

From this screen, the software is waiting for the shot to fire to begin acquisition of the acoustic data.

Casing Pressure should display the current casing pressure on the well.



Fire the Shot

If the **Start New Test** button is pressed in the TAM software at the safe location, the operator has several minutes to walk over to the gas gun and manually fire the shot.

If the **Acquire** button is pressed on the gas gun to start the new test, the operator should **wait approximately three seconds** before manually firing the shot to allow the software time to prepare to detect the shot.

Rotate the ½" ball valve 180° in a quick and fluid motion to manually fire the shot.

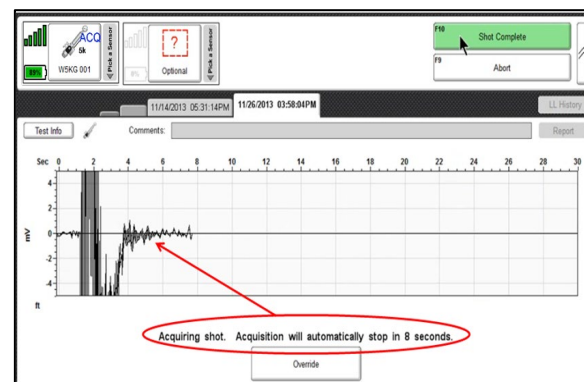


TAM Acquisition of Shot Fired

Once the shot is detected by the software, the message "Acquiring Shot" is displayed. Shot data is acquired for a predetermined number of seconds based on the well depth entered in the Well File.

If the Liquid Level is identified before the software stops the acquisition, the **Shot Complete** button may be pressed to stop the acquisition. The shot is automatically saved.

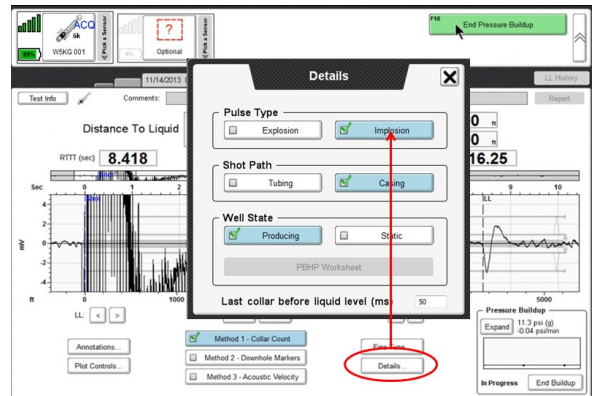
Note: If the shot pulse was not detected after the gun was fired, press the Abort button (to stop acquisition of the shot data), recharge the gun to a higher differential pressure and start the test again.



Once the acoustic shot acquisition is complete, Click the **Details** button in the TAM software and change the Pulse Type to **Implosion**.

Failure to select the correct pulse for an **Implosion** shot results in display of reverse polarity of the reflection kicks.

Other shot details can be verified or corrected by clicking the **Details...** button in TAM.



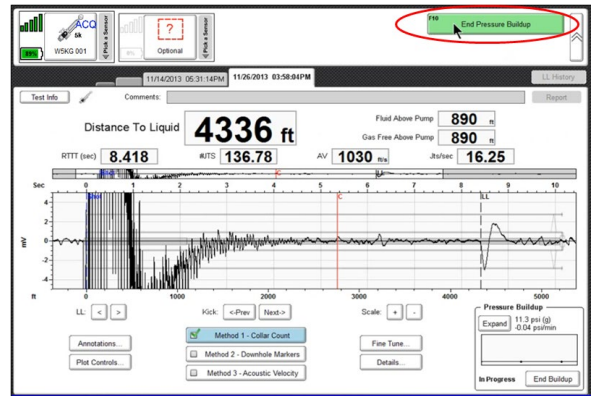
Pressure Buildup Measurements

Once the acoustic acquisition is complete, the shot is automatically saved.

TAM continues to acquire casing pressure measurements every 5 seconds for a maximum of 15 minutes or until manually stopped.

Typically, a 2 – 3 minute pressure buildup is sufficient.

Click **End Pressure Buildup** to end the test.



When finished obtaining acoustic tests:

1. Close the wellhead valve between the gas gun and the well.
2. Close the gas supply container valve (if external gas was used to charge the gun).
3. Open the 1/4" bleed valve, the 1/4" charge valve and the 1/2" ball valve to bleed gas from the gas gun, the volume chamber and the hose (if present) to atmosphere.
4. If present, disconnect the external gas supply by releasing the Quick Connect Fitting on the hose from the Quick Connect Fitting on the gas gun.
5. Remove the W5KG from the wellhead in the reverse order in which it was installed. Remember: Do not apply force to the electronics box at any time in an effort to tighten or loosen the gun. Use a wrench only on the 3" X 1/2" nipple.

Wireless 5000 PSI Gas Gun Operation – Implosion Mode

The Wireless 5000PSI Gas Gun (W5KG) is a general-purpose gas gun that can be used up to the working pressure of 5000 PSI. The gas gun is attached to a valve or fitting that opens into the casing annulus or tubing depending upon which is to be tested. The pressure pulse usually is generated by releasing gas from the well through the 1/2" ball valve into the volume chamber. Depending upon the well, a minimum well pressure of approximately 200 PSI is required for satisfactory operation. The differential pressure between the well and the volume chamber controls the size of the initial acoustic pulse. Generally, a differential pressure of 100 PSI should be sufficient. However, use sufficient differential pressure so that collar echoes are counted all the way to the liquid level and the liquid level signal is distinct.

OPERATING TECHNIQUE – IMPLOSION MODE

1. Verify that the well pressure is less than 5000 PSI. Open the valve to the well and bleed a small amount of gas from the well ONLY if it is safe and within your company regulations to do so. Check that liquid is not present at the surface valve. This also removes foreign particles and grease from the valve so that these foreign materials will not be released into the gas gun.
2. Attach the gas gun securely to the valve or fitting on the well.
3. Open the 1/2" ball valve, and close the 1/4" bleed valve and the 1/4" charge valve.
4. Open the well valve slowly and fully. For best results, the opening of the piping between the gas gun and the well should be 1/2" or larger. Needle valves and/or fittings with small openings will reduce the accuracy of acoustic liquid level depth measurements. The pressure gauge on the volume chamber indicates well pressure. Do not exceed 5000 PSI working pressure.
5. Close the 1/2" ball valve. Open the 1/4" bleed valve and bleed the volume chamber pressure so that the differential pressure between the volume chamber and the well is at least 100 PSI. A larger differential pressure will result in larger reflections from collars, anomalies and the liquid level. Close the 1/4" bleed valve. The pressure pulse is generated by rapidly rotating the 1/2" ball valve when a differential pressure exists across the 1/2" ball valve. The valve should be rapidly opened and closed by rotating the valve 180° from the closed position to the open position to the closed position.
6. The well can easily be re-tested by following the steps in (5). If collar echoes are not obtained all the way to the liquid level, use a larger differential pressure. Bleed the volume chamber pressure to 0 PSI if necessary.
7. When finished obtaining acoustic tests, close the valve to the well. Open both the 1/2" ball valve and the 1/4" bleed valve. Then, the W5KG can be removed from the well.

Wireless 5000 PSI Gas Gun Operation – Explosion Mode

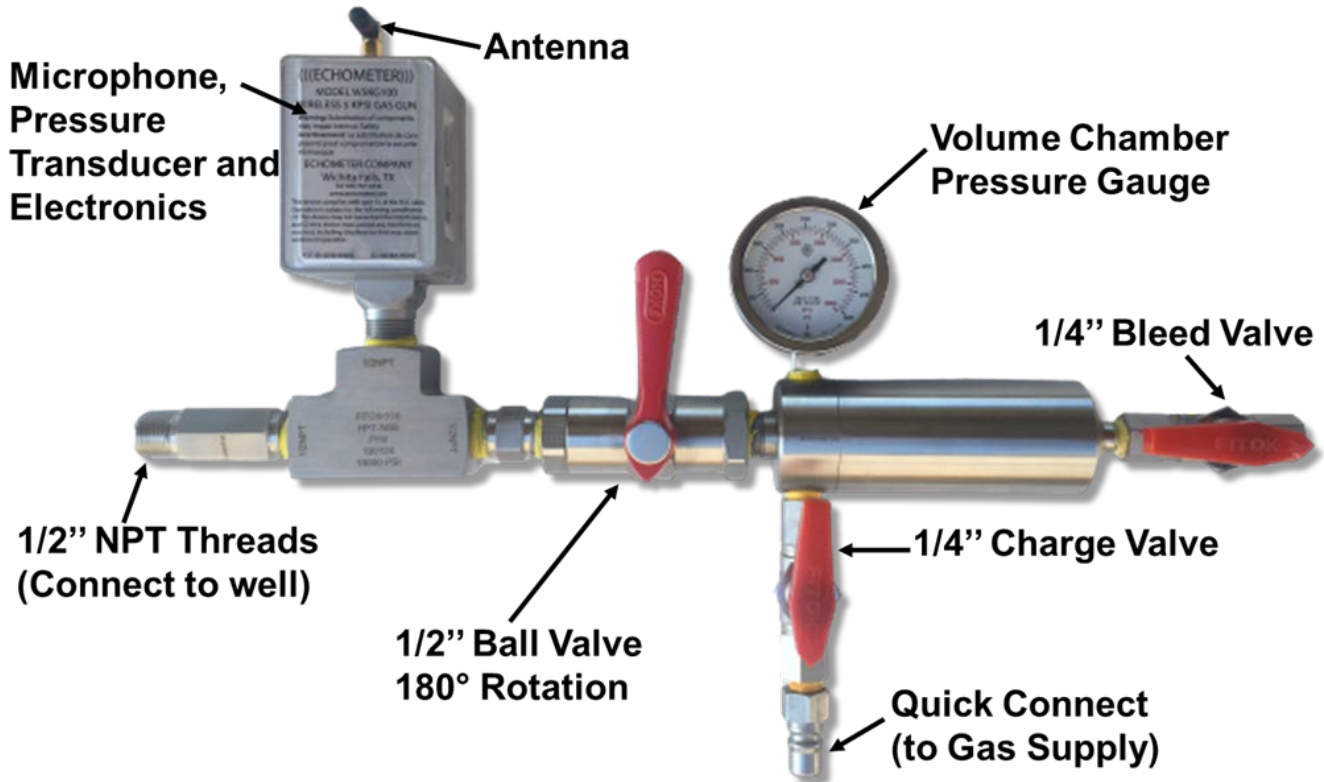
The 5000-PSI gas gun can be used in the explosion mode when the well pressure is low and does not permit satisfactory operation in the implosion mode. In the explosion mode, an external gas source is used to pressurize the volume chamber to at least 200 PSI in excess of well pressure. Then, this gas is rapidly released into the well to generate the acoustic pulse. The volume chamber can be pressurized using CO₂ gas or nitrogen gas. To pressurize the volume chamber, connect the high-pressure hose Quick-Connector Fitting from the CO₂ or N₂ supply bottle to the Quick-Connect Fitting located on the gas gun volume chamber (see figure below). With the 1/2" ball valve and the 1/4" bleed valve in the closed position, slowly open the 1/4" charge valve and pressurize the gas gun volume chamber to at least 200 psi above the well pressure. Close the 1/4" charge valve on the gas gun before firing the shot. The acoustic pulse is generated by rapidly rotating the 1/2" ball valve handle 180° and allowing gas to discharge from the volume chamber into the well.

OPERATING TECHNIQUE- EXPLOSION MODE

1. Verify that the well pressure is less than 5000 PSI. Open the valve to the well and bleed some gas from the well ONLY if it is safe and within your company regulations to do so. Check to insure that liquid is not present. This also removes foreign particles and grease from the valve so that these foreign materials will not be released into the gas gun.
2. Attach the gas gun securely to the valve on the well.
3. Open the 1/2" ball valve and close both the 1/4" bleed valve and the 1/4" charge valve.
4. Open the well valve slowly and fully. For best results, the opening between the gas gun and the well should be 1/2 inch or larger. Needle valves and/or small openings will reduce the accuracy of acoustic liquid level depth measurement. The pressure gauge on the volume chamber indicates well pressure. Do not exceed 5000 PSI working pressure.
5. Note the pressure in the volume chamber that is the well pressure. Close the 1/2" ball valve. To pressurize the volume chamber, connect the high-pressure hose Quick Connect Fitting from the CO₂ or N₂ supply bottle to the Quick Connect Fitting located on the gas gun volume chamber. Open the gas supply container valve. Add gas using the 1/4" charge valve to charge the volume chamber pressure at least 200 psi above the well pressure. Close the 1/4" charge valve to the gas supply before firing the shot. The pressure pulse is generated by rapidly rotating the 1/2" ball valve handle 180° when a positive differential pressure exists between the gas gun volume chamber and the well.
6. If satisfactory reflections are not obtained from the collars and the liquid level, try again with a higher pressure in the volume chamber. Do not exceed 5000 PSI.
7. When finished obtaining acoustic tests, close the well valve between the gas gun and the well. Close the gas supply container valve. Open the 1/4" bleed valve, the 1/4" charge valve and the 1/2" ball valve to bleed gas from the gas gun, the volume chamber and the hose to atmosphere. Disconnect the gas supply by releasing the Quick Connect Fitting on the hose from the Quick Connect Fitting on the gas gun.

Maintenance and Cleaning of the Wireless 5000 PSI Gas Gun

Very little maintenance is required for this gas gun except for inspection to insure the threads, parts, and materials are in good condition and have not been subjected to excessive wear or corrosion.



- **1/2" Thread** – Check threads on the wellhead valve for corrosion, wear or damage. Always use Teflon tape and anti-seize compound to protect the threads.
- **1/2" Ball Valve** – 180° rotation valve, the pressure pulse is generated by releasing gas from the well through the ball valve into the volume chamber or by discharging supplied gas from the volume chamber to the well.
- **1/4" Charge valve** - Used to pressurize the gas gun volume chamber.
- **1/4" Bleed Valve** - Used to release pressure from the gas gun volume chamber.
- **Pressure Gauge** – Measures the pressure in the volume chamber.
- **Electronics and Microphone Housing** – No field maintenance can be performed inside the electronics and microphone housing.
- **Antenna** – A set of short and long antennae are provided with the Base Station
- **1/4" Housing Bleed Plug** – The Housing Bleed Plug is located directly beneath the antennae and can be removed with a 1/4" Allen wrench to flush debris and grease from inside the Electronics and Microphone Housing. **NOTE:** If the plug is removed, the threads on the plug **MUST** be protected with anti-seize compound before placing it back on the housing. Please read further information and instructions on the following pages.
- **1/4" Charger Connector** – Use only the charger supplied by Echometer (P/N MS1600) to charge the W5KG.

Considerations for Care of the Wireless 5000 PSI Gas Gun

Please handle the W5KG with care. Mishandling the equipment could result in damage to the electronics and the antenna.

- 1) An operator should use caution when using the W5KG in wet weather. Moisture could seep into the electronics via the charger connector, or when exposed to prolonged moisture, around the corners of the membrane switch. The membrane switch contains the LEDs and buttons on the gas gun.
- 2) If the gun is to be used in questionable weather, it is recommended a plastic bag is wrapped around the electronics and microphone housing for protection from moisture damage to the sensor.
- 3) Send the equipment in to Echometer every 6 months to a year (depending on use) for routine maintenance and functionality checks.

Cleaning

When wells are chemically treated from the surface, the Echometer gas gun should be cleaned at the end of each day.

Recommendations for Cleaning the Wireless Remote Fire Gun – Do's and Don'ts

- Never submerge your wireless equipment in any form of liquid.
- DO NOT use brake cleaner on your wireless equipment.
- DO NOT use carburetor cleaner.
- DO NOT use B-12.
- **Use an Electronics Cleaner Degreaser sprayed onto a rag, then wipe the equipment down with the rag.** DO NOT spray directly onto the battery case, the antenna, or the membrane switch (where the Power, Acquire and Fire buttons and their corresponding LEDs are located).

Flushing the Wireless 5000PSI Gas Gun Housing through the ¼" Housing Bleed Plug

Due to the placement of the microphone within the housing, it is possible that grease or debris may become trapped and plug the housing. When this occurs, the operator will see a reduced or diminished response from the microphone. Sending the W5KG to Echometer bi-annually for routine maintenance and functionality checks is a good practice.

How to Flush the Wireless 5000 PSI Gas Gun through the ¼" Housing Bleed Plug:

Note: it is recommended that the operator wear safety glasses for this process, and be fully aware of the line of fire from the plug.

1. Remove the antenna from the Electronics and Microphone Housing to prevent it from being damaged.



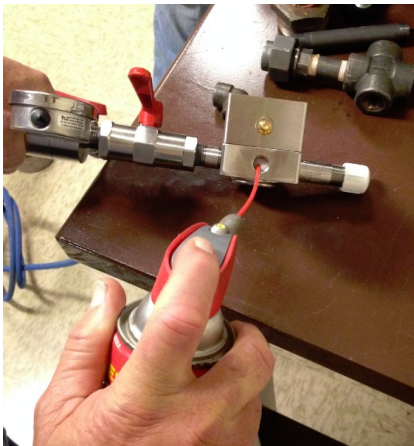
- Using a 1/4" Allen Wrench, remove the plug from the Housing.



- Place a 1/2" cap on the threads to completely seal the W5KG opening. The 1/2" Test Cap will not be a sufficient seal because the rubber bulb could be blown off with the pressure pulse when the gun is fired.



- Close** the 1/2" Ball Valve and the 1/4" Bleed Valve on the gas gun.
- Fill the Electronics and Microphone Housing with WD-40, Electronics Cleaner or similar solvent through the 1/4" plug opening. Fill slowly, allow the solvent to settle, and continue filling the Housing until the volume between the 1/2" ball valve and the capped end are full.

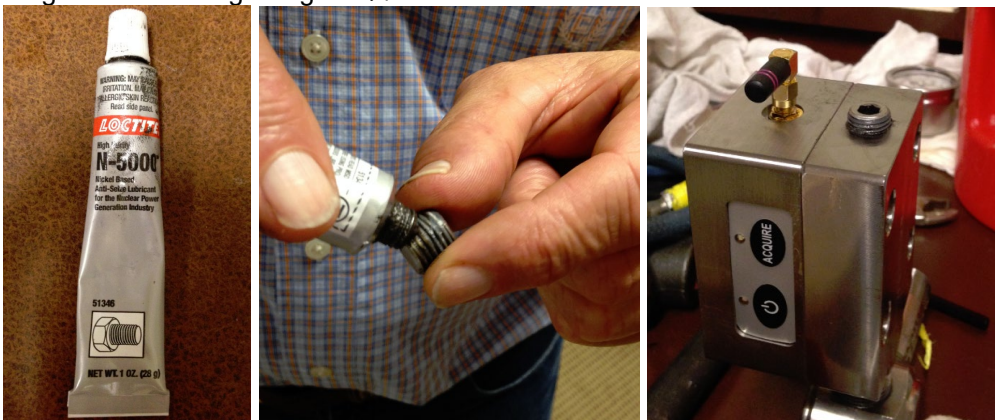


- Attach a 1/4" street elbow pipefitting or a hose (see picture below) in the 1/4" Bleed Plug hole. Wrap the threads with Teflon tape before attaching to prevent galling, and for easier removal from the Housing.

Place a bucket under the drain to catch fluids and debris.



7. Attach an external gas supply to the W5KG using the high pressure hose and quick connect on the W5KG.
8. Open the ¼" charge valve on the gas gun.
9. Fill the W5KG volume chamber with N2 or CO2 to a pressure between 50 – 100 PSI.
10. Fire a shot by rotating the ½" Ball Valve 180°. **Use caution** when firing the shot to be sure the pressure pulse and ensuing fluids and debris are diverted through the ¼" street elbow pipefitting or hose and contained in the bucket. If using a hose, secure the hose before firing the shot to prevent it from jumping when the shot is fired.
11. After the shot has been fired, open the ½" Ball Valve and continue to blow N2 through the gun for about 20 seconds to expel any remaining debris or solvent from the gun.
12. Disconnect the gas supply from the gas gun.
13. Remove the ¼" street elbow pipefitting or hose.
14. Coat the ¼" Bleed Plug with anti-seize compound provided with the W5KG, and reinstall the ¼" Bleed Plug on the Housing using the ¼" Allen wrench.



15. Perform the microphone response test again to verify that the microphone response problem has been solved. If not, please contact Echometer Co. for further instructions.

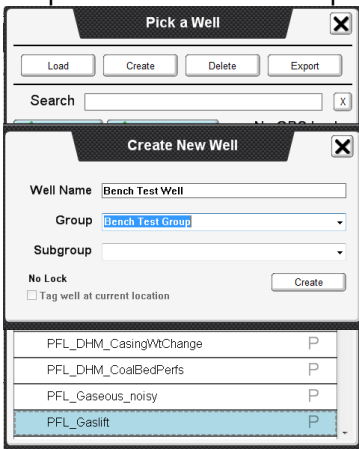
How to Test Microphone Response:

If an operator in the field begins experiencing issues with microphone response on the W5KG, some troubleshooting is required to pinpoint where the problem lies. To discount interference as a possible issue and further pinpoint the microphone itself, a bench test can be performed in-office to test the microphone response.

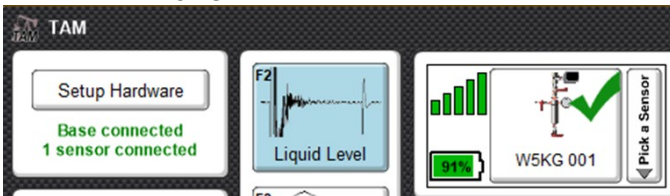
1. A ½” PVC Test Cap is sent along with every W5KG. Place the ½” Test Cap on the end of the gas gun.



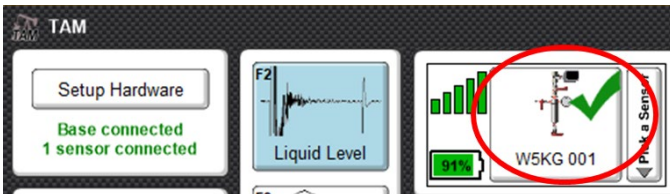
2. Setup communication between the Laptop and Base Station.
3. Choose any well from the Pick Well menu, or **Create** a Bench Test Well that can be used specifically for bench testing and troubleshooting the equipment. This same Bench Test Well can be used when testing the pressure transducer response, described later in this manual.



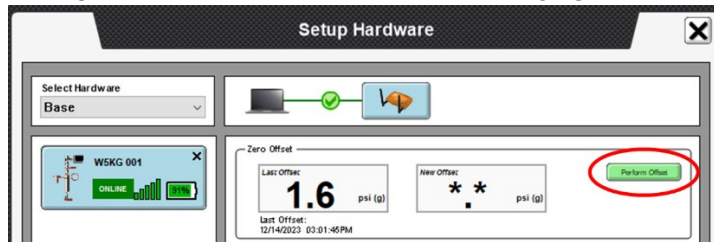
4. Turn on the W5KG and make sure the sensor is communicating and active in the Sensor Bar.



5. Click the W5K Gas Gun Button icon on the Sensor Bar.



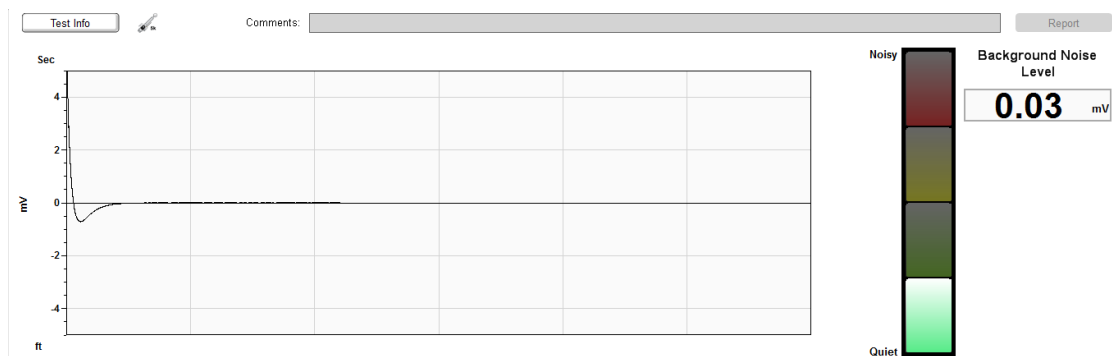
- a. Zero Offset – Perform a zero offset on the W5KG.



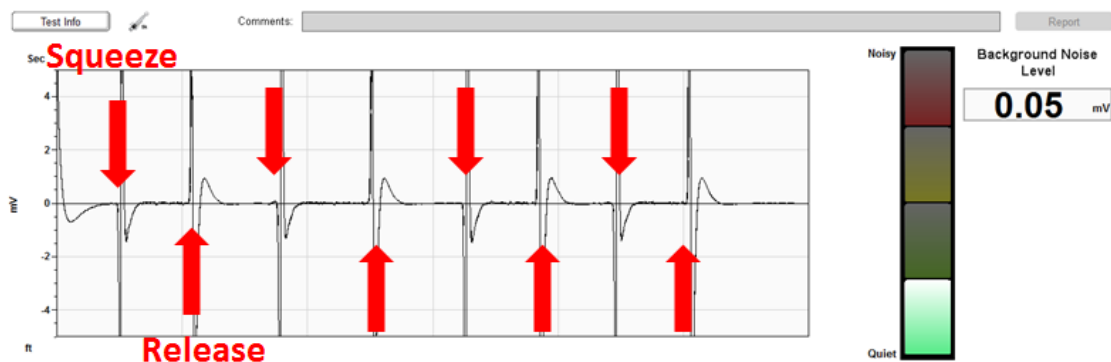
6. Start a New Test either from the Laptop, or by pressing the **Acquire** button on the gas gun.



7. When the Acquisition screen appears, the microphone is actively listening.

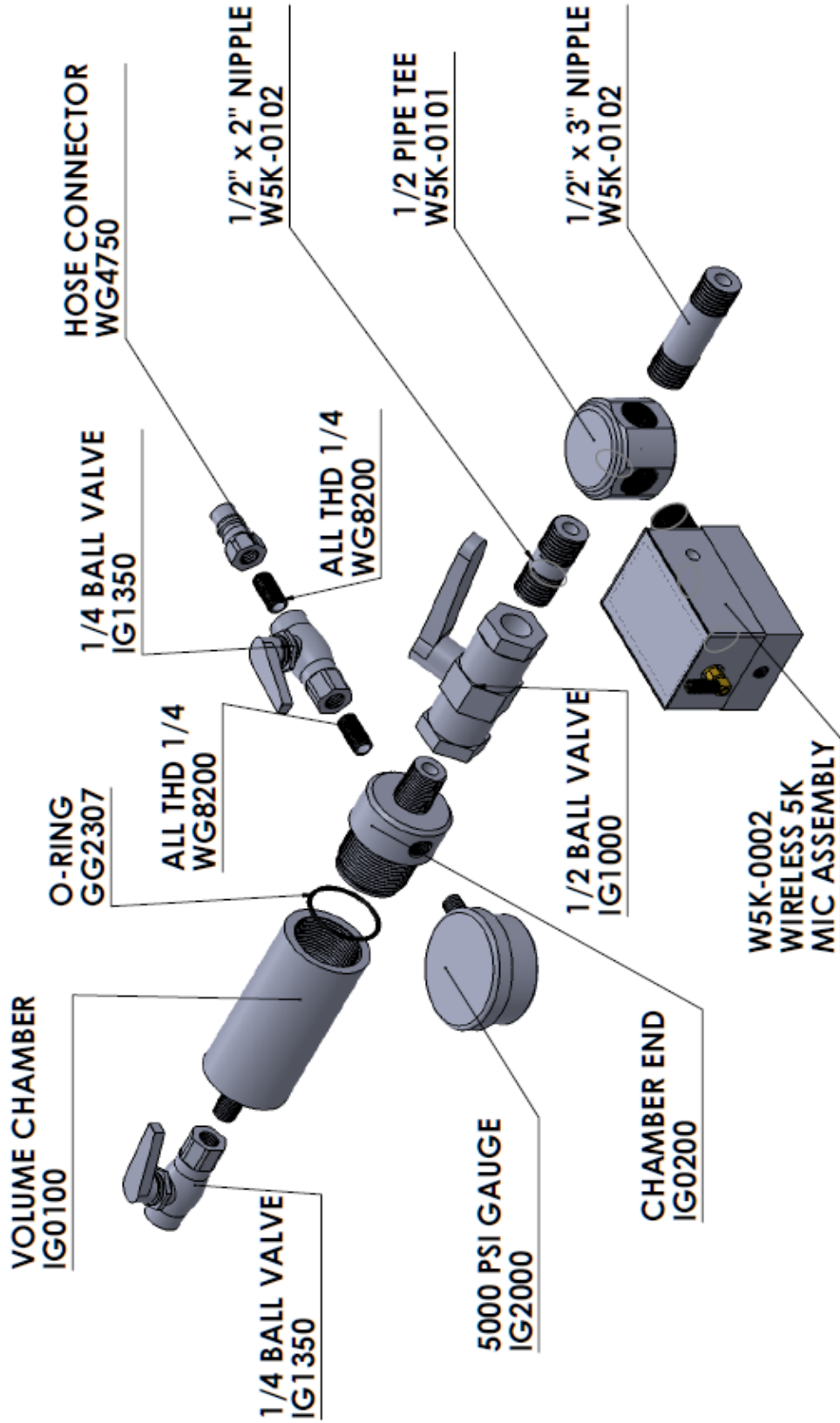


8. Squeeze and release the rubber bulb on the ½” Test Cap, noting the response in TAM. Squeezing the bulb results in a compression response (downkick or decrease in area) and releasing the bulb results in a rarefaction response (upkick or increase in area).



9. If a weak (very small amplitude) or no microphone response is seen, the Electronics and Microphone Housing may be plugged with grease or debris.

W5K Wireless 5K Gun Assembly
Rev A



Troubleshooting Proper Sensor Function (W5KG)

In order to troubleshoot problems occurring during fluid level acquisition, it is important to understand how the sensor should be behaving and interacting with the base station and TAM software before, during and after acquisition.

Prior to Shot Firing

The Base Station should be connected to the laptop located in a safe area. Both the Power and Status lights on the Base Station should be green. The Power light on the Base Station will remain full on green; the Status light will be flashing green.

The W5KG Power light should be flashing green. If the sensor is ready to acquire data, the light will flash approximately every half second. This is called the fast beacon mode. If the sensor has been sitting for five minutes without any activity, the sensor will go into slow beacon mode and the power button will only flash approximately every 4-5 seconds. The signal strength will not be displayed when the sensor goes into slow beacon mode.

To bring the sensor out of slow beacon mode, press the Power button once on the W5KG, or click the Start New Test button from the TAM software. Either will return the sensor to fast beacon mode and ready to acquire.

Shot Firing and Acquisition of Acoustic Trace

When the **Start New Test** button is clicked, the Base Station will send the command to the W5KG. The **Acquire** light on the W5KG will begin flashing green as the screen changes to the acquisition screen.

The Power and Acquire lights will continue flashing as the pressure buildup data is being recorded and until the **End Pressure Buildup** button is clicked.

Once Acquisition has Ended

Once the **End Pressure Buildup** button is clicked, the Acquire light will go off and only the Power light will continue to flash.

Troubleshooting LED Behavior on W5KG and Base Station

When the equipment is not functioning properly, or there is a problem with the sensor or sensor communication, the LED lights will help give an indication of the problem.

- 1) Upon initial Power- on of the W5KG, the normal light sequence is as follows:
 - The green **Power** light will flash, followed by the **Acquire** green light immediately afterward so that both green lights are illuminated.
 - Next, both lights will flash red once.
 - The Power light will then flash rapidly in green. Counting the rapid flashes will give a percentage of remaining battery power. (Example: 2 flashes = 20%, 8 flashes = 80%)
 - Finally, the **Power** light will begin flashing in fast beacon mode approximately every half second. It will continue to flash in this manner until 5 minutes has passed with no commands from the Base Station. After 5 minutes the sensor will go into slow beacon mode and the flashes will drop down to once every 4-5 seconds.
Note: Signal strength is not displayed when the sensor is in slow beacon mode.

- 2) If, when the W5KG is powered on, the lights on the sensor immediately begin flashing red, this could be an indication that the sensor did not properly boot up when the **Power** button was pressed.
 - The operator should press the **Power** button for 2-3 seconds to power the sensor down, and then press the **Power** button again to initiate the power up cycle.
 - After a few attempts, if the LEDs continue to flash red, contact Echometer or send the sensor in for further investigation by Echometer technicians.

- 3) Once the **Start New Test** button has been clicked, the **Acquire** light will begin flashing green. Once the shot is manually fired, if the TAM software does not respond or the **Acquire** light either stays full on green or turns red, it could be due to:
 - Bad communication between the W5KG to the TAM software and the Base Station.
 - The TAM software may have frozen and is not receiving information through the Base Station to the gun.
 - The gun has malfunctioned and is not responding to commands from the TAM software or manually.

An operator observing the previously described behavior can take the following steps:

- Press the **Power** button on the W5KG for 2-3 seconds to power down the sensor. Then restart the power up cycle and observe the proper booting up light sequence.
- The Base Station should be reset if needed by unplugging the USB cable from the laptop for five seconds and plugging it back in. If a red Status light remains on the sensor after multiple attempts at resetting the Base Station, contact Echometer for further instruction.
- If the problem initiated in the TAM software resulted in a software “crash,” please take the steps to report the crash to Echometer so that an investigation can be performed. All crash reports sent to Echometer are reviewed and considered for further action and improvement to the TAM software.

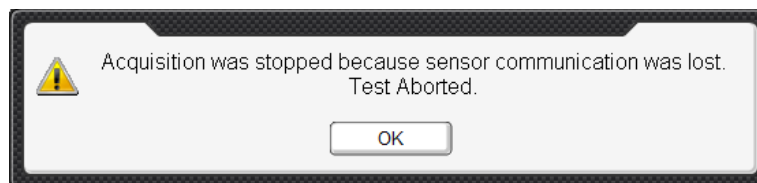
- 4) During acquisition of the acoustic trace, in the event the TAM software has not received any response from the W5KG during a three second time interval, the following message will be displayed:



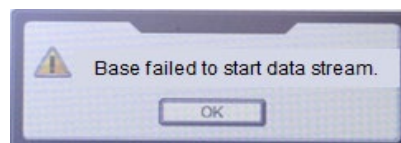
An operator observing the previously described behavior can take the following steps:

- Press the **Power** button on the W5KG for 2-3 seconds to power down the sensor. Then restart the power up cycle and observe the proper booting up light sequence.
- The Base Station should be reset by unplugging the USB cable from the laptop for five seconds and plugging it back in. If a red Status light remains after resetting the Base Station, contact Echometer for further instruction.
- The problem could be caused by radio signal interference. The operator should check for a clearer channel by following the instructions on the following page for Troubleshooting Interference or Poor Sensor Signal.
- If the problem initiated in the TAM software resulted in a software “crash,” please take the steps to report the crash to Echometer so that an investigation can be performed. All crash reports sent to Echometer are reviewed and considered for further action and improvement to the TAM software.

- 5) If communication between the Base Station and the laptop has stopped during acquisition (i.e. the Base Station has become unplugged, the cable is bad, or the USB port has failed), one of the following error messages will be displayed:



OR



If this situation occurs:

- Make sure the USB cable is secure between the Base Station and the laptop.
- Unplug the Base Station for 5 seconds and plug it back in to reset it.
- If the Power and Status lights are both green (the Status light should always be flashing green), restart the test and begin acquisition again.

Troubleshooting Interference or Poor Sensor Signal Level

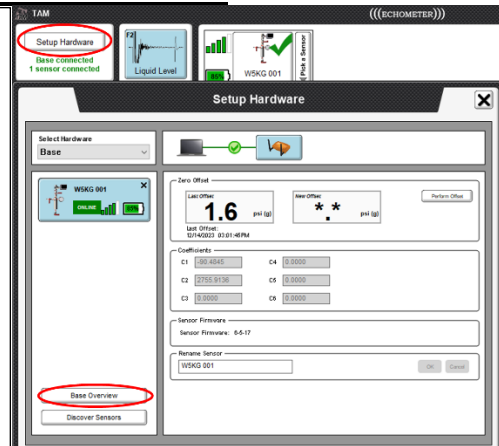
An operator working in a field with a high level of radio frequency signal traffic may experience interference with communication between their sensors and the Base Station. This will be evident by a poor signal level of sensors and possibly poor data acquisition or lost communication during acquisition.

- 1) Two different antenna lengths are provided with each W5KG. If problems arise with signal strength or interference, the longer antennas should be installed on both the W5KG and the Base Station.
- 2) Make sure the Base Station is within line of sight of the W5KG. Don't mount the Base Station under or behind a vehicle seat.
- 3) The Base Station radio frequency channel can be changed within the TAM software to help find a clear channel for better communication between the sensor and the Base Station.

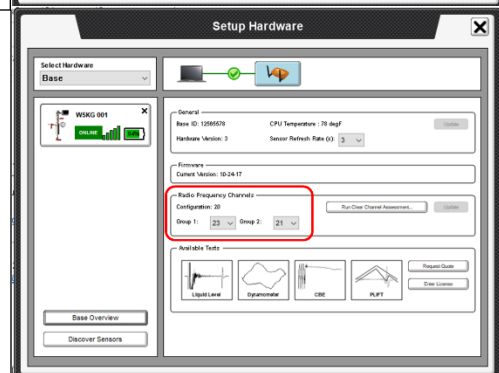
Take the steps on the following page "[Steps to Change the Radio Frequency Channel on the Base Station](#)" to change the radio frequency channel on the Base Station.

Steps to Change the Radio Frequency Channel on the Base Station:

Step 1 – Click the **Setup Hardware** button in the TAM software when the Base Station is connected. Inside the Setup Hardware screen, click the **Base Overview** button to open the Base Station detail information.

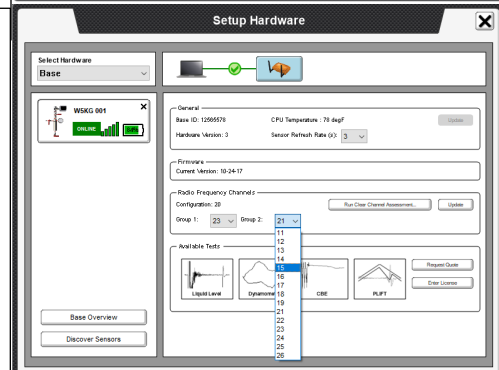


Step 2 – There are two Radio Frequency Channels on the Base Station for data acquisition. These two Radio Frequency Channels are what make it possible to shoot liquid levels while obtaining dynamometer data simultaneously. The channels, as displayed in the image as 23 and 21 for this example.



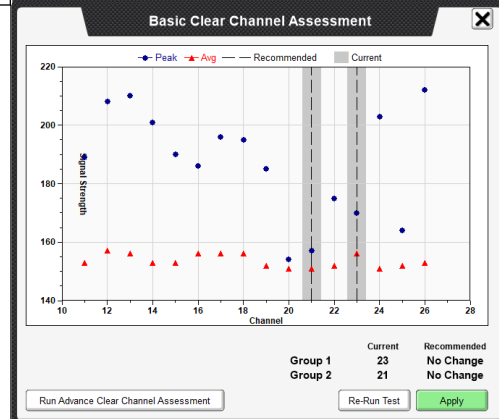
To change the Radio Frequency Channel of the Base Station, click on the dropdown box and select a different channel.

Group 2 RF Channel corresponds to the Liquid Level Channel and is used by the W5KG.



Step 3 – After selecting a different channel, click the “Update” button to save the new frequency channel selected.

If communication with the Base Station does not improve, click **Run Clear Channel Assessment** button. The software will analyze the spectrum and may recommend different channels. Click on Apply button to accept the channels recommended by the software.

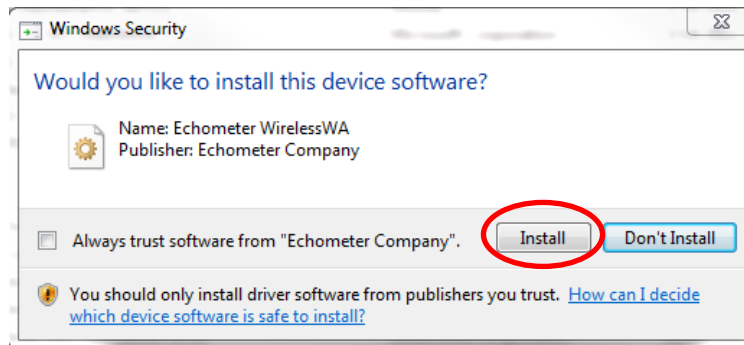


Allow TAM Software to Install/Update Device Driver for Hardware

When the TAM software is first installed on a computer that will be used for acquiring data or troubleshooting equipment, make sure to click **Install** when prompted during the installation. Windows Security automatically defaults to “Don’t Install” as seen below.

Failure to click **Install** and allow installation of the device software will prevent the software from recognizing the Wireless Base Station driver in the USB port, and the operator will be unable to acquire data using that computer.

A reinstall of the software will again prompt the user to install the driver software in the event this step is not performed on the initial install.





CARBON DIOXIDE CYLINDER

Echometer Part No. GG0430 & GG0470

CAUTION

DO NOT OVER FILL, fill cylinder based on weight of CO₂.
Contents under pressure.

Do not inhale gas or allow gas to touch skin. Gas becomes cold during use and can cause frostbite or other personal injury.

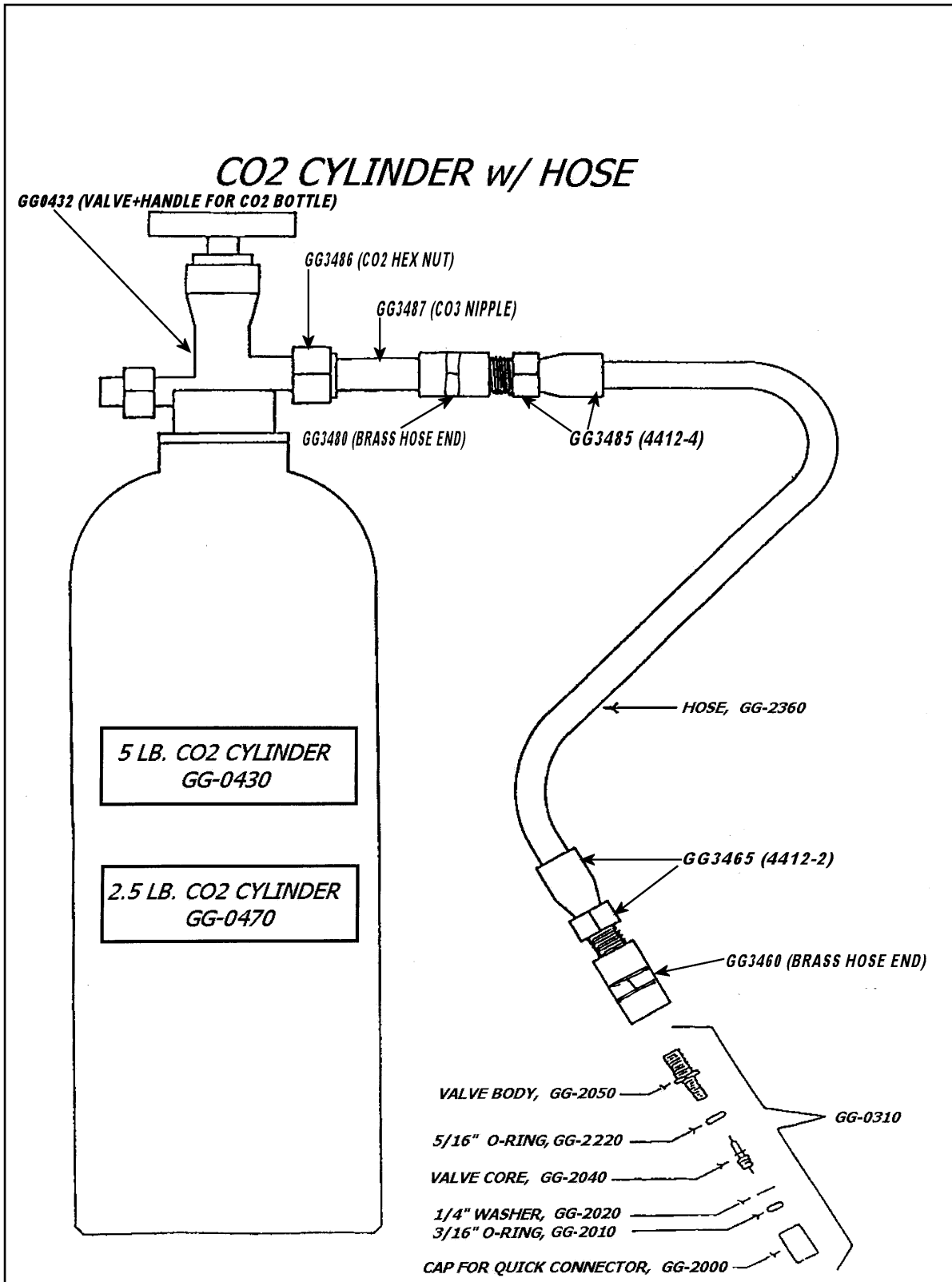
Metal parts of Cylinder can become extremely cold during use. Protect hands and other parts of body from direct contact with metal parts of Cylinder during use.

Contains carbon dioxide gas under pressure. Do not puncture or incinerate Cylinder. Do not expose to heat or store at temperature above 170 degrees F (76°C). Keep out of reach of children.

See details in operating manual.

Have Cylinder pressure hydro tested or replaced five years from date of stamp.

CO2 Cylinder Schematic With Part Numbers



CARBON DIOXIDE GAS INFORMATION (CO₂)

Carbon dioxide is a nonflammable, colorless, odorless, slightly acid gas. It is one and one-half times as heavy as air. CO₂ is used in the carbonation of soda pop, as an inert agent in fire extinguishers, in canned food products, and many other applications.

Below 88°F, confined CO₂ liquid and gas are in equilibrium at a vapor pressure shown in the table below. For example, a Cylinder of CO₂ liquid and gas at 59°F has a pressure of 723-psia. As gas is removed from the cylinder, the liquid vaporizes into a gas, which maintains the vapor pressure shown. When all of the liquid has been vaporized, the gas pressure will reduce as gas is withdrawn. Following is a table of the vapor pressure as a function of temperature.

<u>Temperature</u>		<u>Pressure</u>	
°F	°C	PSI	Bar
88	31	1053	73
59	15	723	50
32	0	490	34
5	-15	317	22
-22	-30	192	13

Above 88°F, CO₂ becomes a fluid. Liquid does not exist separate from gas. The pressure in the tank is an indication of the amount of CO₂ present in the tank. As the gas is used, the pressure will decline. At 90°F, the pressure in a full cylinder will be approximately 1100-psi.

The amount of CO₂ in a cylinder is determined by weighing the cylinder containing the CO₂ and then subtracting the weight of the empty cylinder which is shown on the cylinder. Below 88°F, the amount of CO₂ in the cylinder cannot be estimated by measuring the pressure unless the pressure is less than the vapor pressure shown on the graph. If the pressure is less than the vapor pressure, the Cylinder does not contain any liquid CO₂ and very little CO₂ remains in the Cylinder.

CO₂ is heavier than air and may collect in confined, unventilated areas. Do not permit a leaking cylinder in a closed automobile. CO₂ is the regulator of the breathing function, and an increase in the CO₂ inhaled will cause an increased rate of breathing. In high concentrations, CO₂ can paralyze the respiratory system. Do not breathe air having excessive amounts of CO₂.

Do not overfill a CO₂ Cylinder or dangerous pressures can result. Do not use CO₂ cylinders, which show any sign of wear, abuse, corrosion, worn threads or any mishandling.

CO₂ - PHYSICAL CONSTANTS

Density, Gas @ 70°F, 1atm	0.1144 lb/cu ft
Critical Temperature	87.8°F (31°C)
Critical Density	0.468 g/ml
Critical Pressure	1072-psia (73-atm)
Specific Gravity	1.53
Specific Volume @ 70°F, 1-atm	8.76 cu ft/lb or 15,000 cu in/lb or 950 cu in/oz

NITROGEN GAS INFORMATION (N₂)

Nitrogen comprises approximately 79⁰/₀ by volume of the air. It is found chemically combined in many forms in nature. Nitrogen will not burn and will not support combustion. Nitrogen is normally available in cylinders compressed to 2200-psi.

Nitrogen is used as an inert gas in electrical systems, the chemical industry, and in the food packaging industry. Nitrogen, also finds extensive use as an inert atmosphere and in the filling of some incandescent lamps.

Nitrogen is nontoxic but can asphyxiate human beings and animal life by displacing the necessary amount of oxygen in the air to sustain life.

ACOUSTIC LIQUID LEVEL DEPTH MEASUREMENT CONSIDERATIONS

Generally, a pressure regulator should be used with N₂ since the initial cylinder pressure is 2200-psi, which is normally in excess of the wellhead pressure rating or the maximum rating of some of the pressure gauges.

During pressure buildup testing, the pressure regulator should be set so that the pressure in the volume chamber will exceed the pressure on the casing annulus when the operator returns to check the equipment. Less gas will be used if the pressure regulator is set to a lower value.

HANDLING PRECAUTIONS

Never drop cylinders or permit them to strike each other violently.

Never tamper with safety devices in valves or cylinders. See your local gas supply dealer for other precautions.

N₂ - PHYSICAL CONSTANTS

Molecular Weight	28.016
Density @ 70°F, 1-atm	0.0724 lb/cu ft
Critical Temperature	-232.87°F (-147.15°C)
Critical Pressure	492.45-psia (33.5-atm)
Specific Volume @ 70°F, 1-atm	13.812 cu ft/lb or 23,867 cu in/lb