

IES Fast Speed Gauges



SCOTT A. AGER

SCOTT@IESGLOBALINC.COM



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IES, Inc.



Company Location

Navarre, Florida



Contact Information

Contact **Scott Ager** for questions regarding gauge maintenance, programming, applications, and gauge data.

Instrumentation and Engineering Services, Inc.
7552 Navarre Pkwy, Suite 42
Navarre, Florida 32566

Office: +1 850 515-1244
Cell: +1 850 206-1022
E-MAIL: scott@IESglobalinc.com
Web Site: www.IESrecorders.com
www.IESglobalinc.com



Analyzing Gauge Data

For more extensive gauge data analysis, you can contact Bob Haney* for more information at his email address:

520720@telus.net

*Robert “Bob” Haney is an independent consultant located in Calgary, Canada and is not an employee of IES, Inc.



Background of Scott Ager

- Co-Founder of IES in 1987
- IES designed and developed miniature, high shock instrumentation
- Designed and developed the original FAST, high speed pressure gauge for measuring the dynamic pressure when a propellant or perforating gun fired.
- Designed the Shock Mitigater
- Designed the Gauge Body and Drop Bar attachments.
- Developed the Gauge Software.



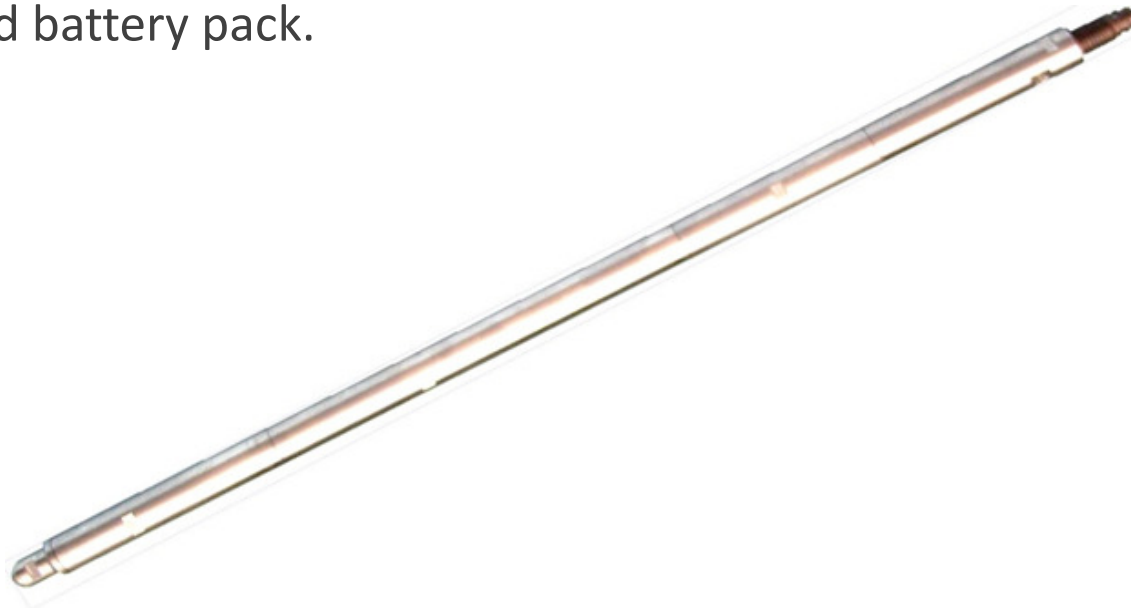
Gauge Definitions



Gauge Definitions

Gauge (High Speed or "Fast" Gauge)

- The Gauge is defined as the entire pressure tool, including the individual gauge sections, shock mitigator, OWR, pressure and RTD temperature sensors (w/ optional accelerometers), battery fixture, and battery pack.



Gauge Definitions

OWR (Oil Well Recorder Electronics)

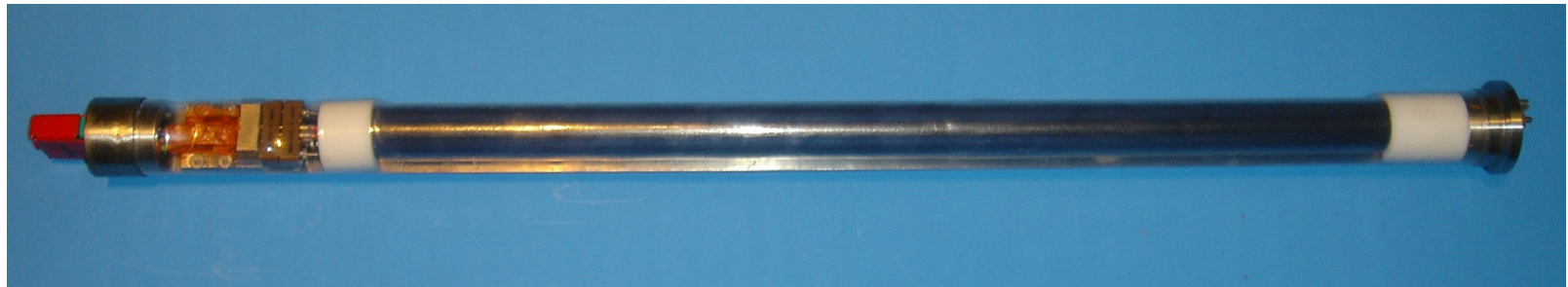
- The IES Recorder electronics is located inside the **OWR Section** of the Gauge.



Gauge Definitions

Battery Fixture

- The “metal frame” that holds the Battery Pack. It plugs into the OWR Section of the Gauge.



** Battery Pack Shown Installed



Gauge Definitions

Battery Pack

- The potted battery is used to power the Gauge. It is located inside the Battery Fixture.



Gauge Definitions

Interface Box

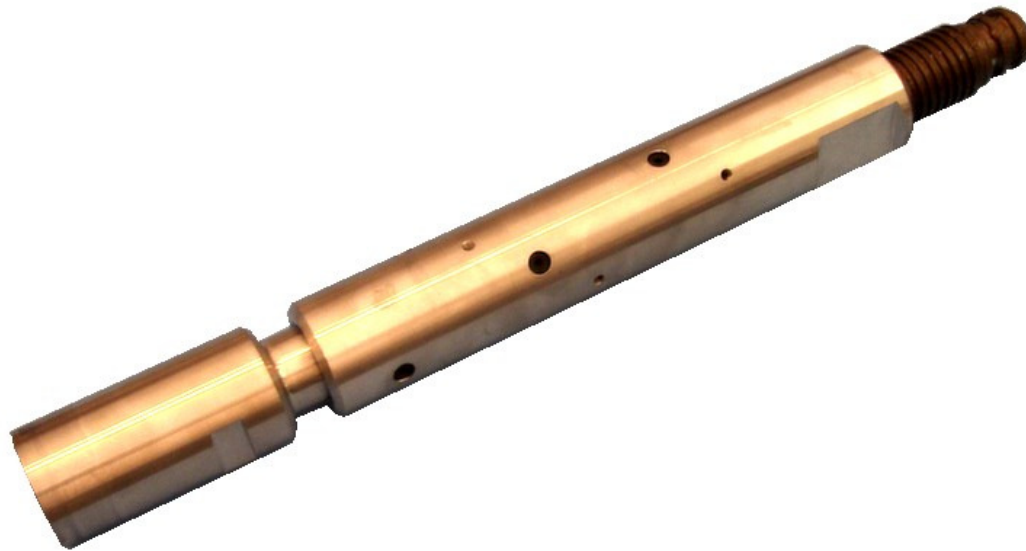
- The interface between the computer and the gauge. It is required to program the gauge and download the data.



Gauge Definitions

Shock Mitigater

- Used to reduce the high shock and vibration inside the Gauge when the guns are fired. It is installed between the Gauge and the Tool/Guns.



Gauge Specifications



Series 400 Gauge Specifications

Size and Weight

- 1-11/16" OD Gauge
 - 50" length, 25 lbs.
 - With Shock Mitigater, 67" length, 34 lbs.
 - Additional Battery Section: 17.5", 8 lbs.



Gauge Lease and Purchase Options

- 80°C and 120°C Gauges are available for Lease or Purchase
- 150°C and 175°C Gauges can ONLY be Leased
- Contact Scott Ager for more information on leasing

scott@IESglobalinc.com



Series 400 Gauge Specifications

- Memory: **Non-Volatile** (2 million data points)
- **ONE** or **TWO** Channels
- Temperature Ranges: **80°C, 120°C, 150°C, and 175°C**
- High Speed Sampling: Up to **115,000 data points per second**
- **130 milliseconds** of “pre” trigger FAST speed data saved.
- Frequency Response: **0–10,000 Hz**
- Max. Temperature Ranges: **80°C, 120°C, 150°C, and 175°C**
- Resolution: 0.024% of Full Scale (4096 steps of resolution)
For range of **0-30,000 psi**, the maximum data resolution is ± 8 psi
- Shock Rating: **$\pm 50,000$ G's of vibration**
- Uses 80°C Alkaline, 120°C, 150°C, and 180°C Lithium Battery Packs
- Uses Pressure, RTD, Low G (15G) and high G (60,000G) Accelerometers



Series 400 Sensor Options

Sensors:

- **High Pressure** (0-30,000 psi, 0-10,000 Hz response)
- **RTD** (temperature)
- **Low G Accelerometer**: used to measure tool movement (± 15 G's)
- **High G Accelerometer**: used to measure tool vibrations ($\pm 60,000$ G's)



400 Gauge Options

1- 11/16" OD Gauges¹, 150 °C and 175 °C (For Lease ONLY)

- **#IES-GAUGE-411**
 - 30,000 psi Pressure sensor, and Temperature RTD
- **#IES-GAUGE-412**
 - 30,000 psi Pressure sensor, Temperature RTD, and ±15G Accelerometer
- **#IES-GAUGE-413²**
 - 30,000 psi Pressure sensor, Temperature RTD, and ±60,000 G, and ±15G Accelerometers

¹ 1-11/16" OD Shock Mitigater (#IES-SM-11116) and Battery Fixture included.

² NOT AVAILABLE UNTIL 2016



Series 400 Gauge for Lease ONLY

- 80°C and 120°C Gauges can be Leased or purchased
- 150°C and 175°C Gauges can ONLY be Leased
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Placement of the Gauge



Placement of the Gauge

-Wireline

- Gauge is normally located below the gun.

-TCP

- Gauge can be located below the gun
- Gauge can be located above the gun
- Gauge Carrier is STRONGLY RECOMMENDED

-Drop Bar

- Gauge can be used as a “DROP BAR” to fire a gun, AND collect FAST Speed pressure / temperature data at the same time



Gauge Carrier



Gauge Carrier

Use separate Gauge Carriers for each gauge.

I suggest modifying an old perforating gun casing for use as a Gauge Carrier.

Make sure the Gauge Carrier is long enough to contain the entire Gauge Assembly, which consists of the Shock Mitigater, the Gauge, and two Battery Sections for running two battery Packs per gauge.



Gauge Carrier

ALWAYS use the **Shock Mitigater** inside the Gauge Carrier (unless you are using a High G Accelerometer).



Use “**reverse threads**” for the Gauge Carrier internal SUB.

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Gauge Carrier

Make sure there are a sufficient number of holes drilled in the Gauge Carrier to allow pressure to reach the Gauge's Pressure Ports unobstructed.



Gauge Carrier

Try to allow at least 1 inch clearance between the Gauge body and the inside of the Gauge Carrier, if possible.



Use some type of centralizer. I recommend using a VITON DISK as a spacer...

Gauge Carrier

The Gauge body must be “free floating” and **MUST NOT** come in contact with the inside wall of the Gauge Carrier. Metal on Metal contact between the Gauge and the Carrier could cause excessive vibrations and possibly damage the gauge.

The BULL NOSE Section of the Gauge should not come into direct contact with the bottom or sides of the Gauge Carrier. A **VITON DISK** spacer can be used at the BULL NOSE end of the Gauge as a “**CENTRALIZER**”.

ALWAYS FLUSH OUT ANY DEBRIS THAT COLLECTED INSIDE THE GAUGE CARRIER AFTER A JOB, BEFORE YOU REMOVE THE GAUGE.



Gauge Carrier

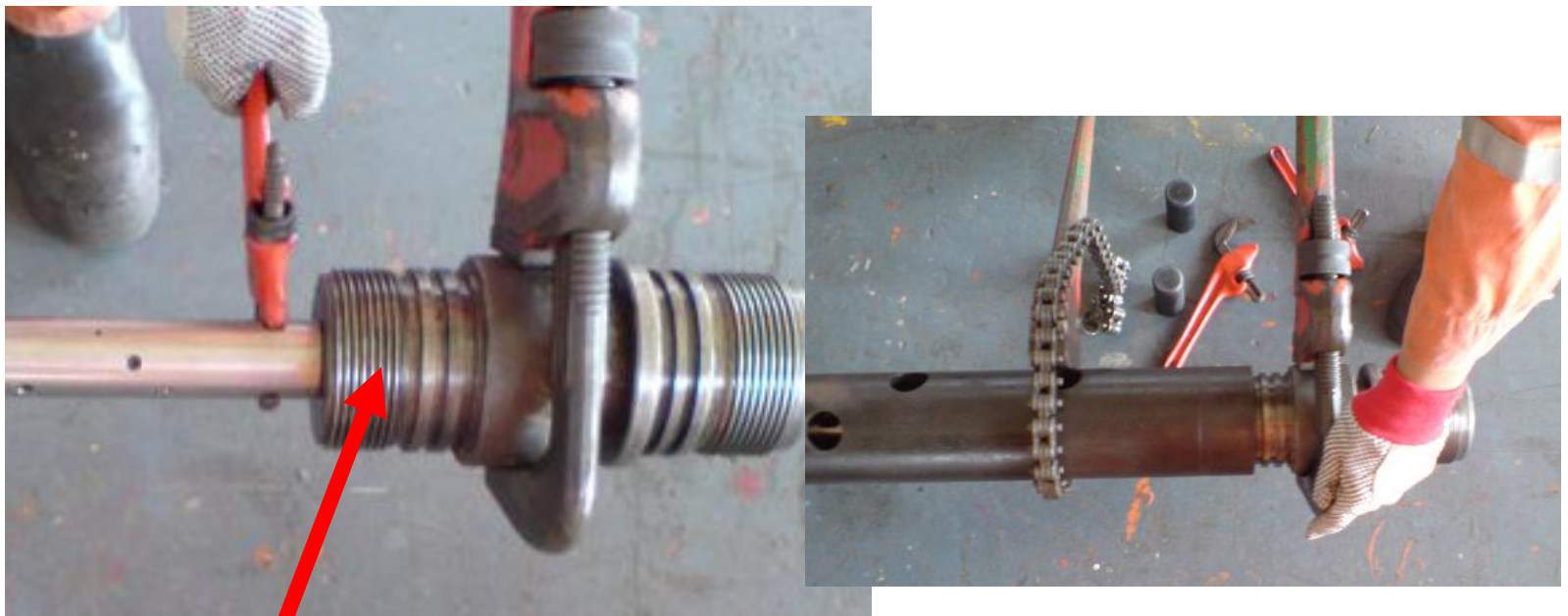
Important! Use “**reverse threads**” for the Gauge Carrier threads which connect the outer carrier casing, with the Carrier SUB assembly.

- When the Gauge Carrier’s outer casing is unscrewed and removed from around the Gauge, it should unscrew in the **OPPOSITE** direction from how the Gauge Sections are screwed together.
- **Reverse threads** prevents the Gauge sections from accidentally unscrewing when you are unscrewing and removing the Gauge Carrier outer casing. If a Gauge Section is loosened while the Gauge Carrier is being disassembled, it could disconnect the Gauge’s Battery Pack.



Gauge Carrier

Important! Use “reverse threads” for the Gauge Carrier.



Use “REVERSE” Threads



“Drop Bar” Gauge

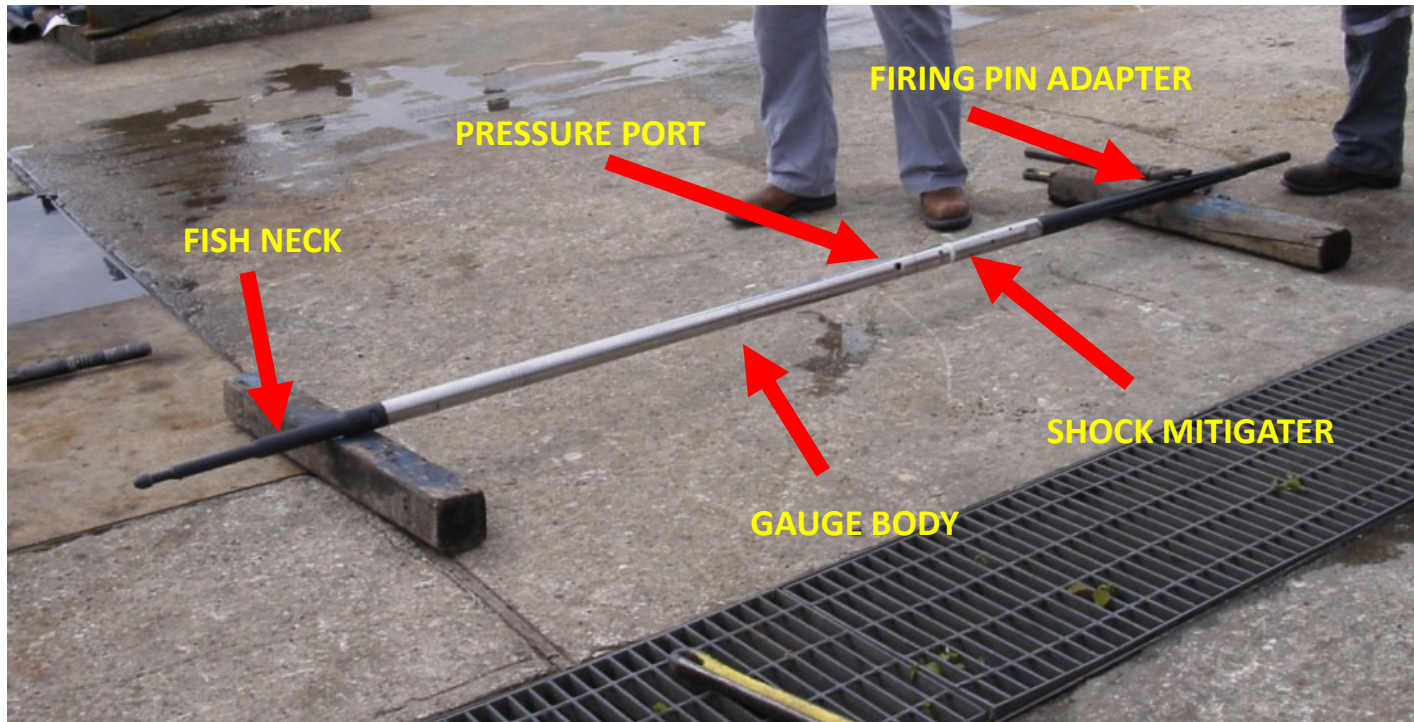
The 1-11/16”OD Gauge can be configured and used as a **DROP BAR**.

The Gauge DROP BAR can be used to fire the guns and record the Gun’s high speed pressure profile at the same time. It can be left in position to record the SLOW speed pressure data afterwards. Then the Gauge can be fished out of the well and the Data retrieved.

This data can also be use to determine if the Guns fired properly.



“Drop Bar” Gauge

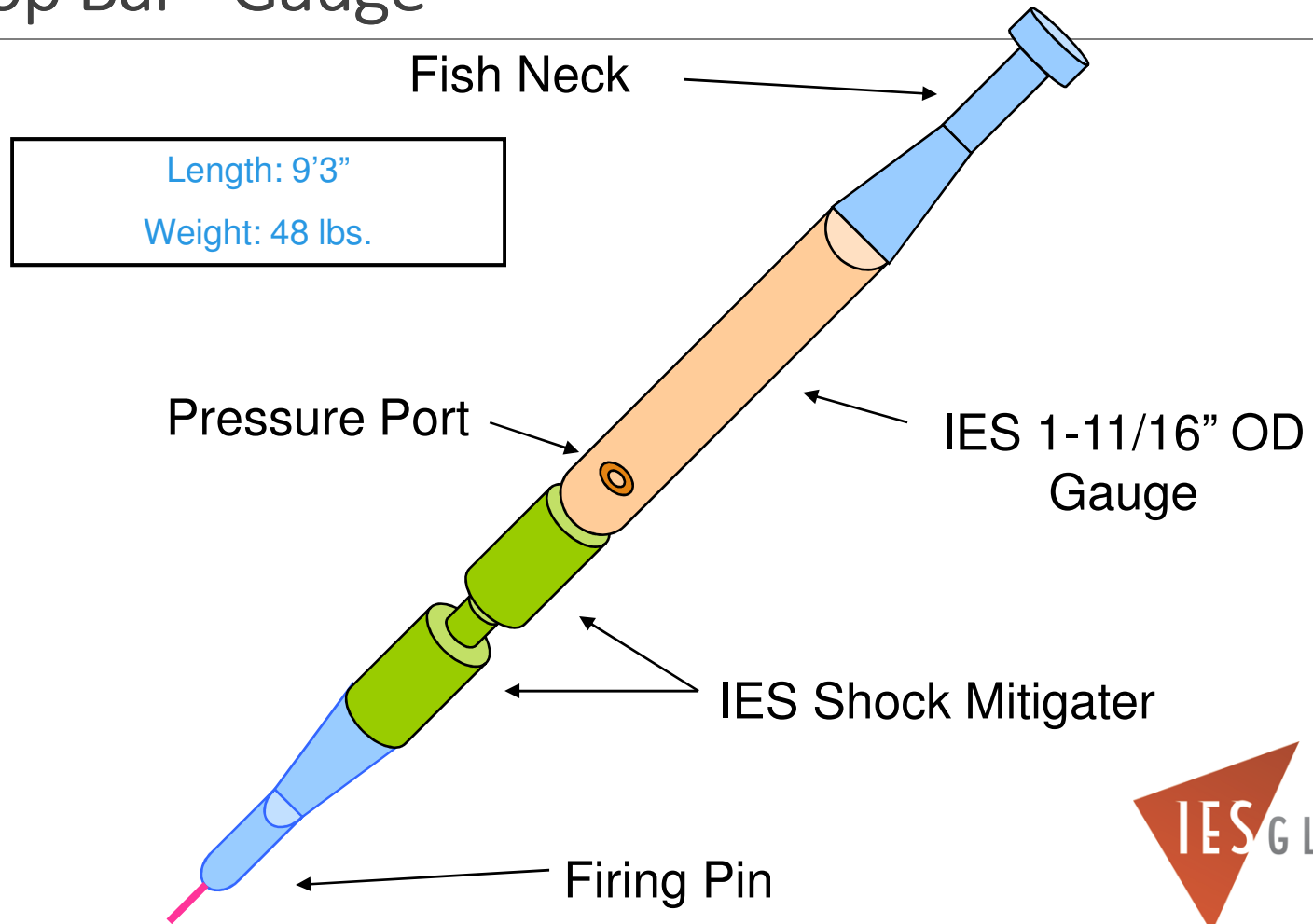


“Drop Bar” Gauge



Dropping the gauge

“Drop Bar” Gauge



“Drop Bar” Gauge

DROP BAR REQUIREMENTS

- The Gauge OD is 1.6875” (+0.020, -0.000), so the minimum recommended ID restrictions is 2.300” while the gauge is falling through air.
- **Their must be NO ID change in restriction while the gauge is falling through AIR.**
- The well must have a minimum of 100 feet of fluid covering the Firing Head.
- The Firing Head assembly should be vented to the Guns as close to the Pressure Port of the Gauge as possible when it strikes the Firing Head. This way the pressure from the Guns reaches the Gauge in the shortest distance possible.

NOTE: If you don't follow these restrictions for using the Gauge as a DROP BAR, any damage to the gauge is the CUSTOMERS responsibility...



“Drop Bar” Gauge

The Shock Mitigator must always be used



“Drop Bar” Gauge

The Pressure Ports of the Gauge will be in the “nose” of the gauge DROP BAR when the Gauge is dropped.



“Drop Bar” Gauge

The DROP BAR sub is designed to interface with a **5/8” sucker rod firing pin**.



“Drop Bar” Gauge

The DROP BAR sub can be purchased or Leased. The sub come as a pair with ordered.

The part number is #**IES-DB-58**



“Drop Bar” Gauge

Note: The Gauge must be programmed slightly different than normal.

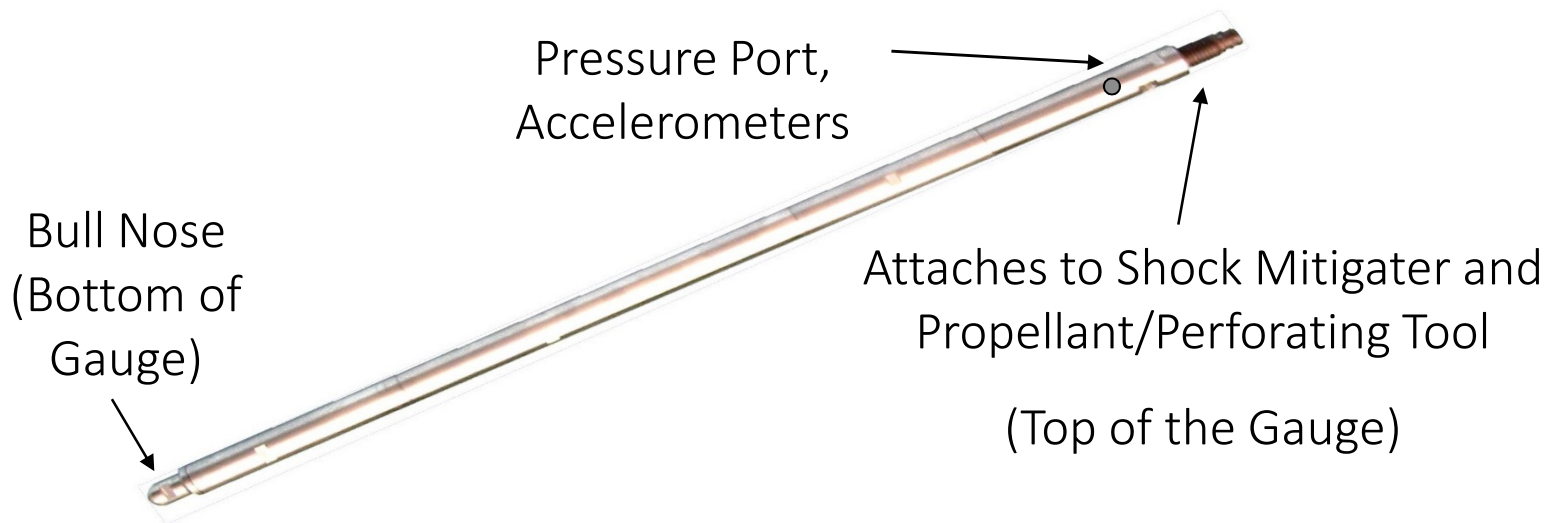
Please contact **Scott Ager** (scott@IESglobalinc.com) for more information concerning your DROP BAR settings and applications.



Gauge Sections

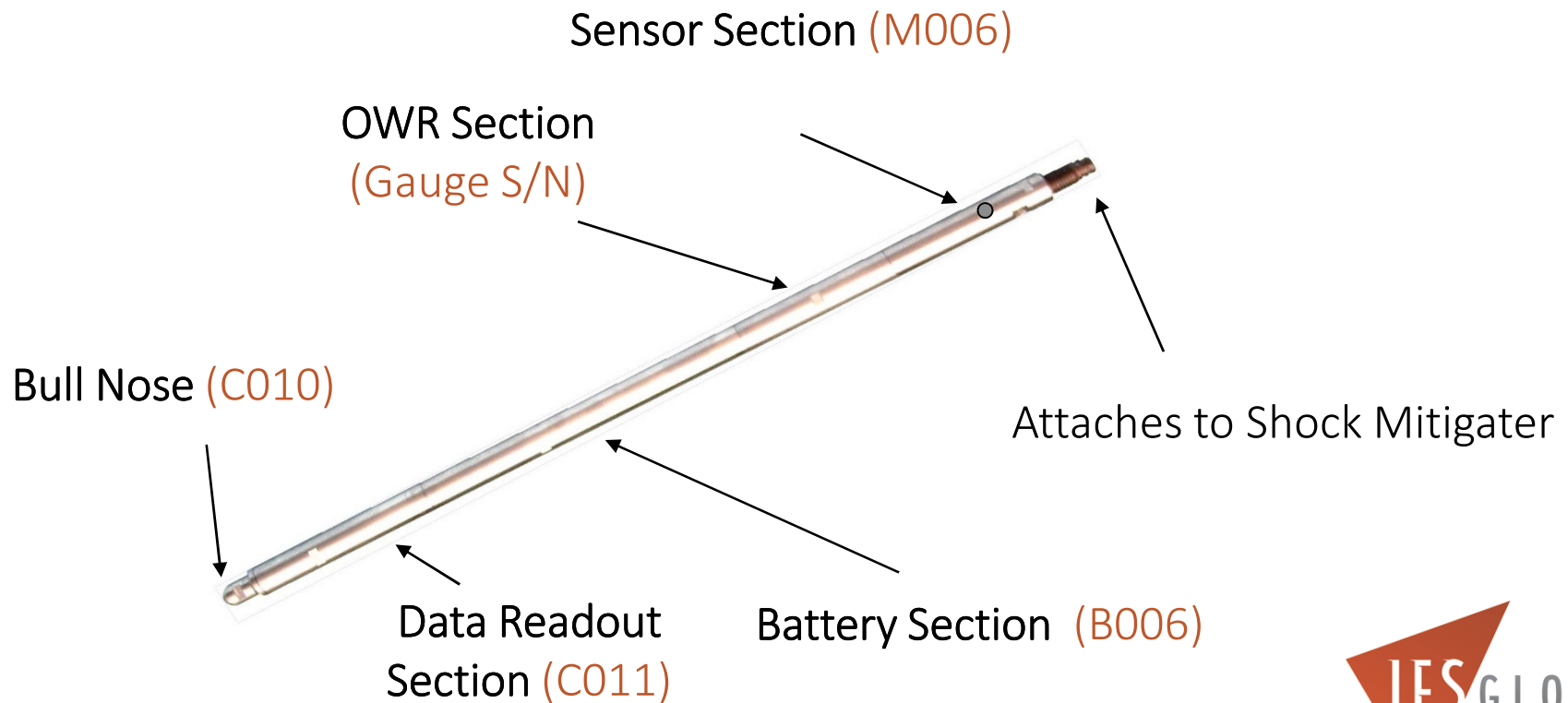


Gauge Installation



NOTE: The gauge can be oriented with the pressure port either up or down.

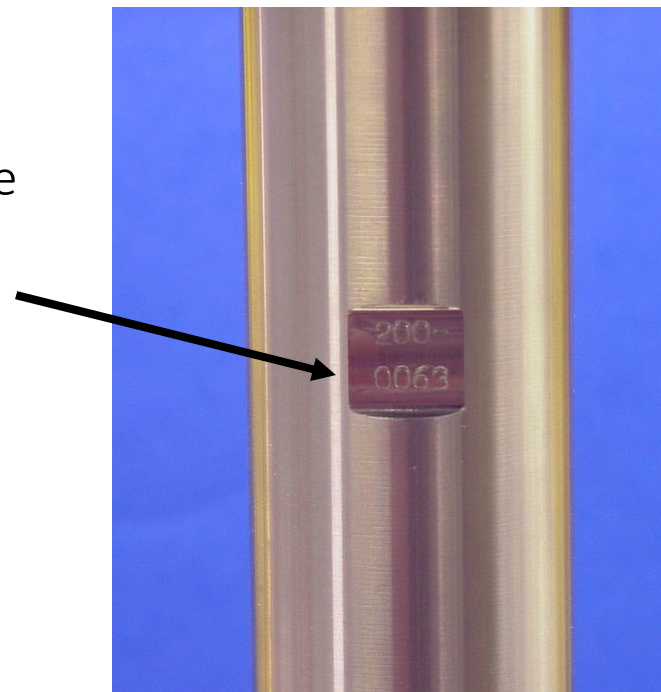
Gauge Sections



Gauge Section Part Numbers

The **Serial Number** of the Gauge is stamped in the wrench slots of the OWR Section.

The **Part Number** is stamped into the wrench slots of each Gauge Section



High Speed Pressure Data



High Speed Pressure Data

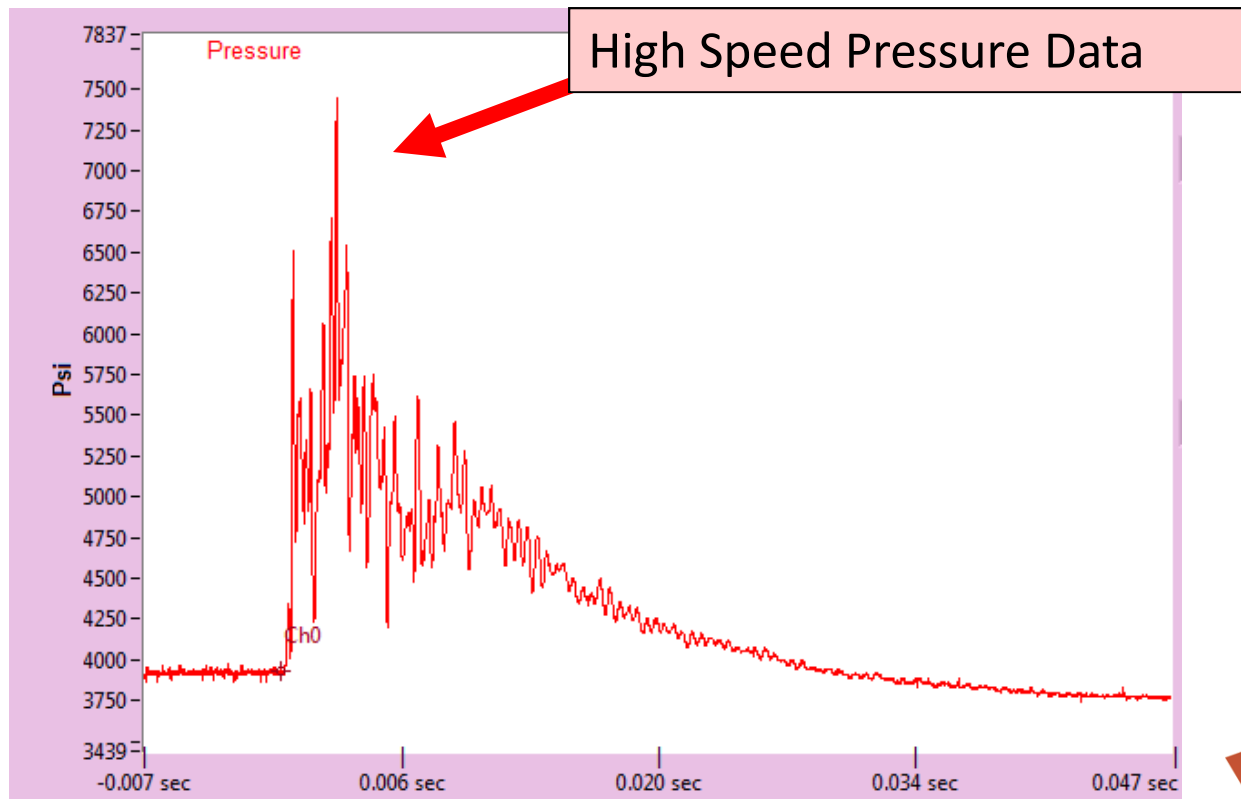
Uses of High Speed Gauge Pressure Data

(115,000 data points/ second)

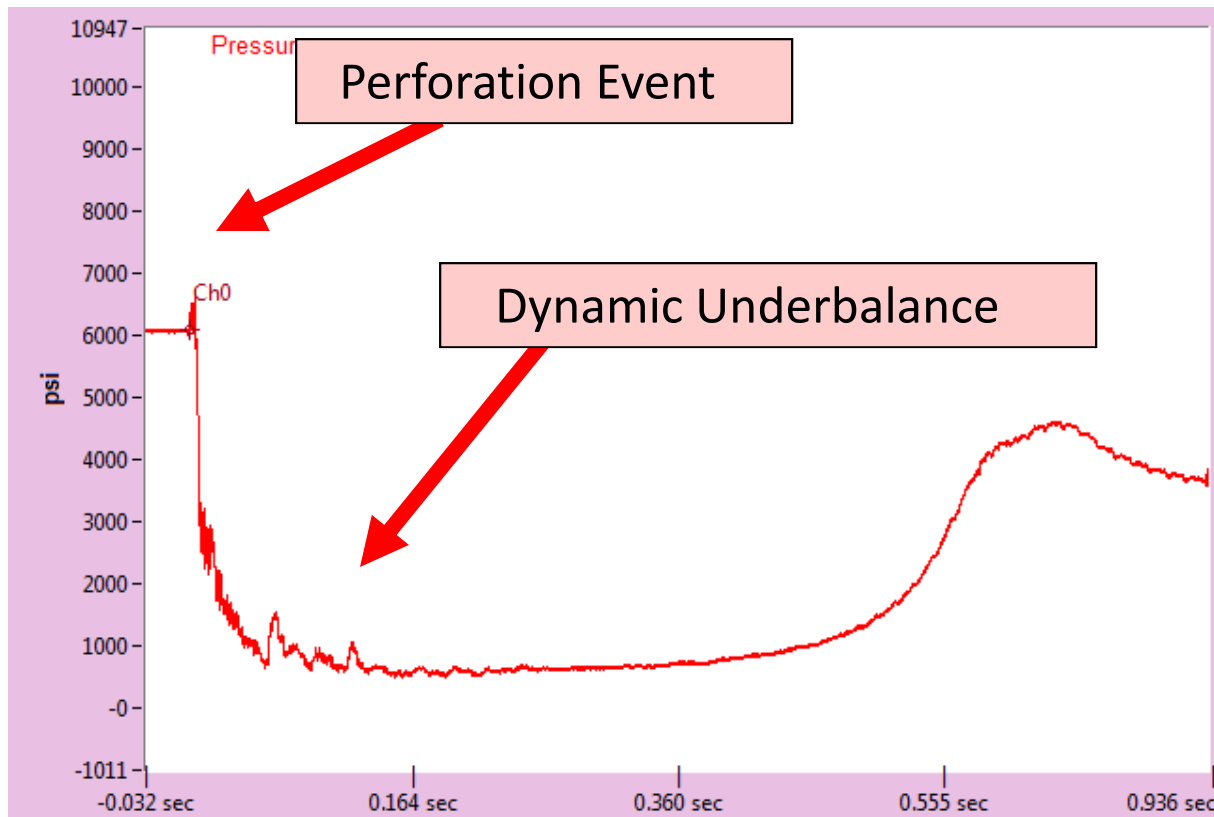
- Verify Propellant and Perforating Burn Job Models
- Verify Perforating Job Models
- Verify Underbalance and Overbalance Pressure Models
- Verify Pressures after the guns fire
- Measure Reservoir Pressures
- Record Tool Movement (Low G Accelerometer option)
- Record Tool Impact and Vibration (High G Accelerometer option)



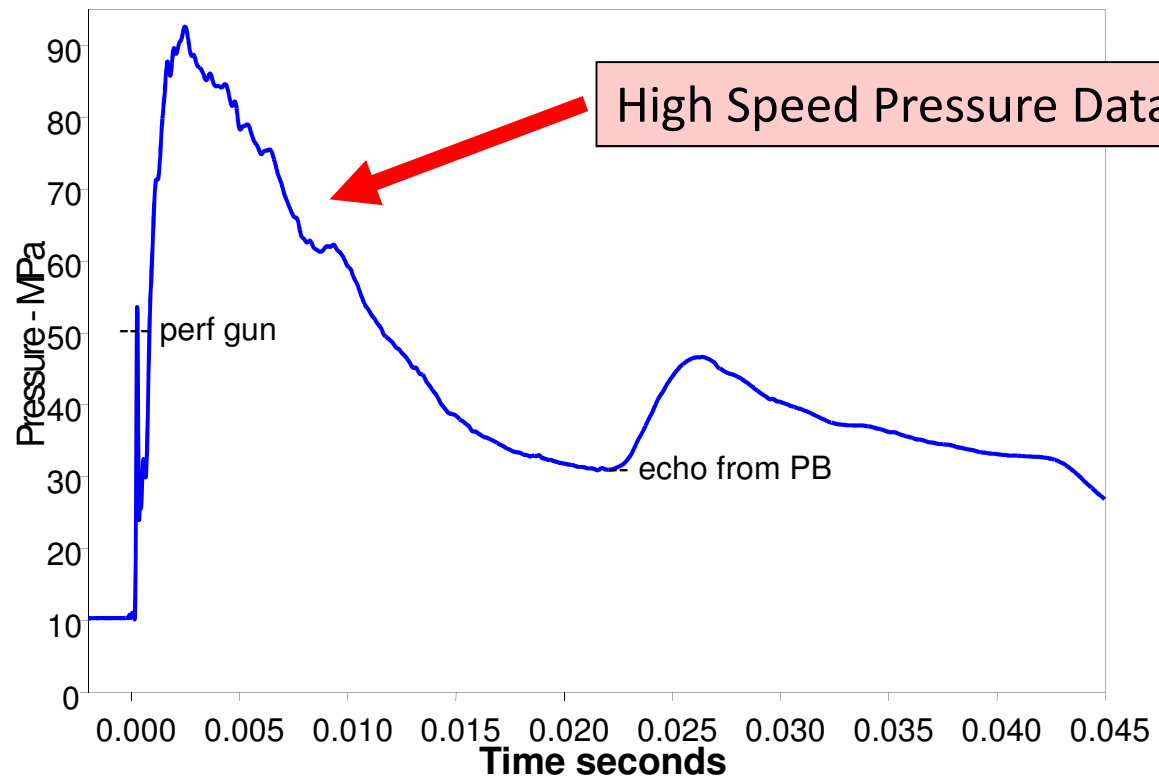
Perforation Gun



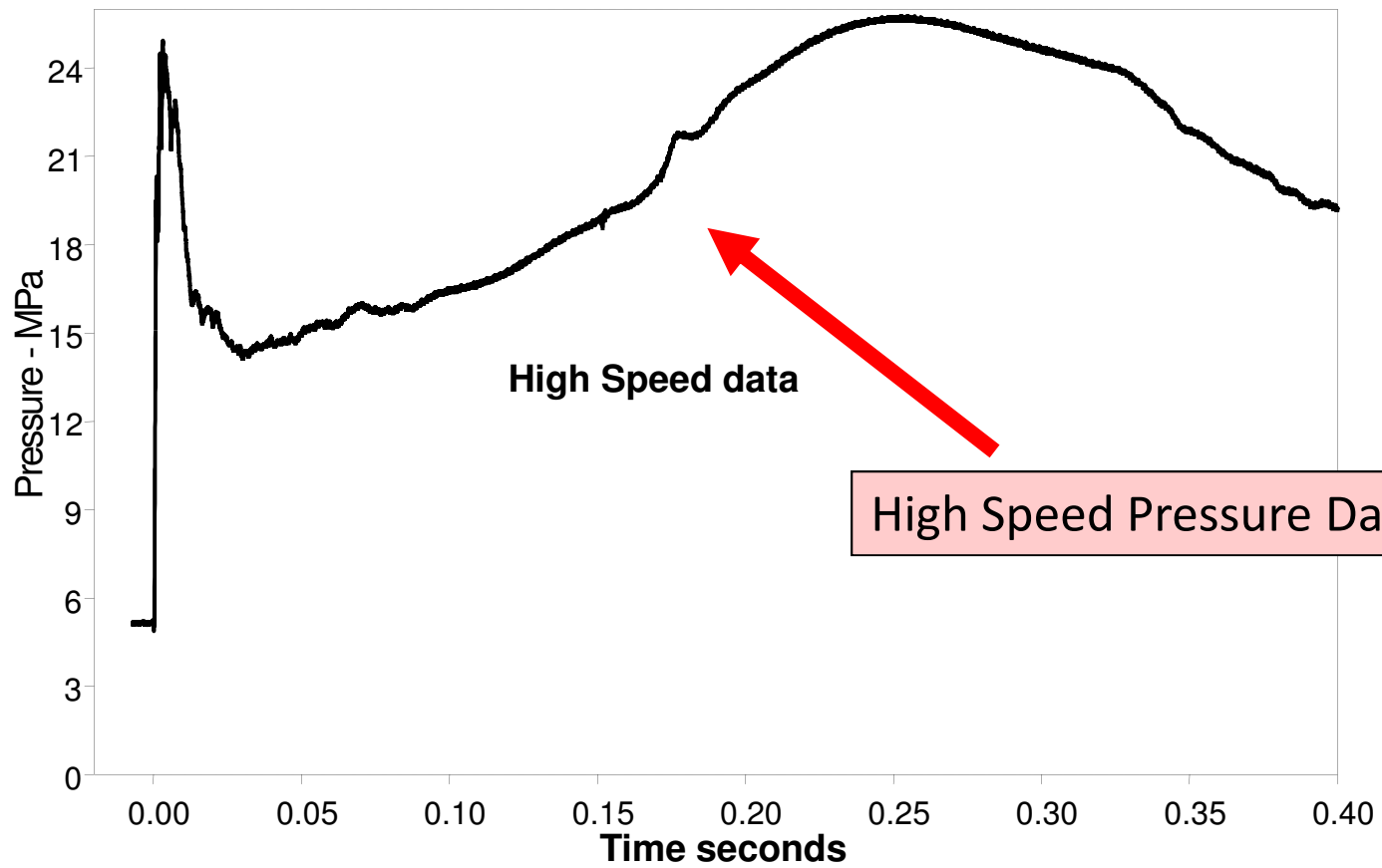
Dynamic Underbalance



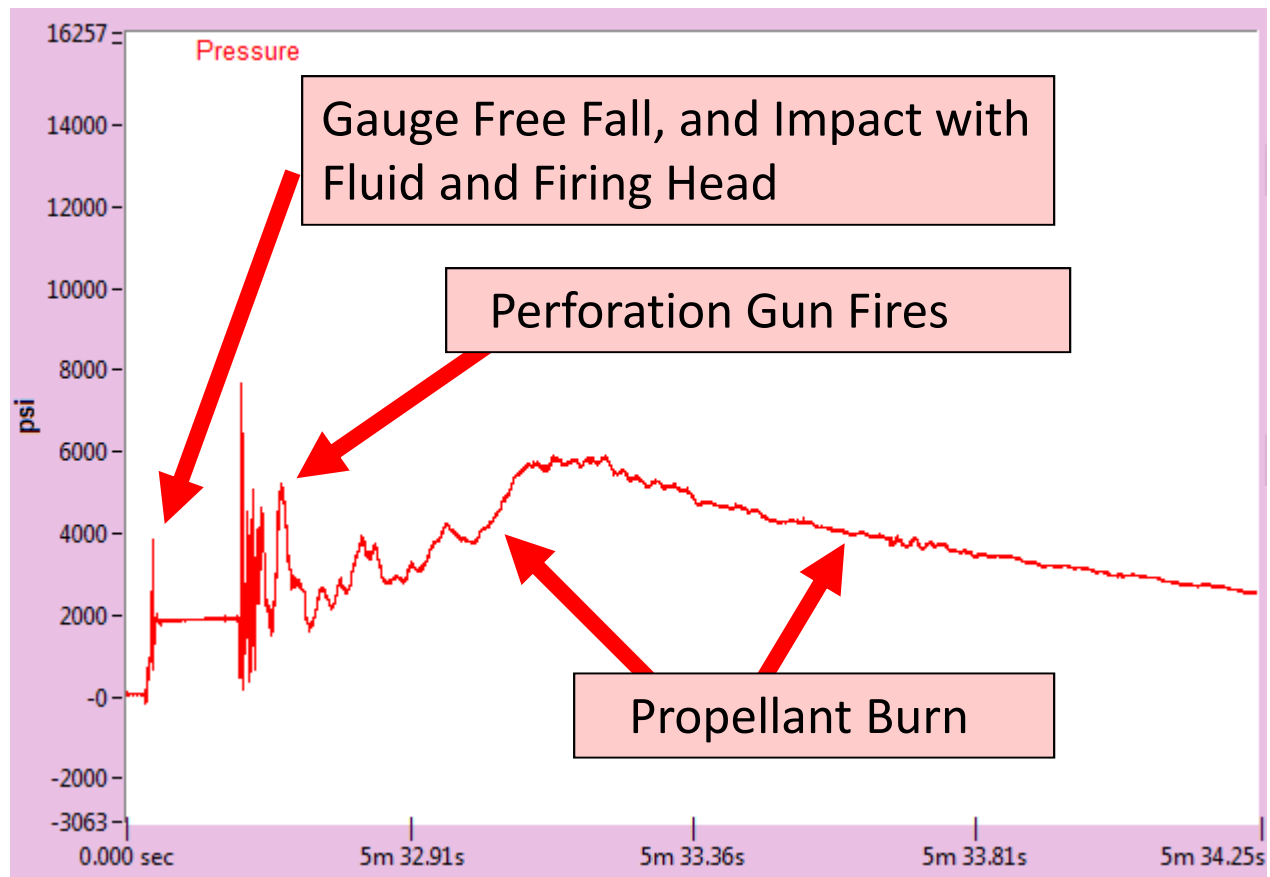
Perforation / Propellant Gun



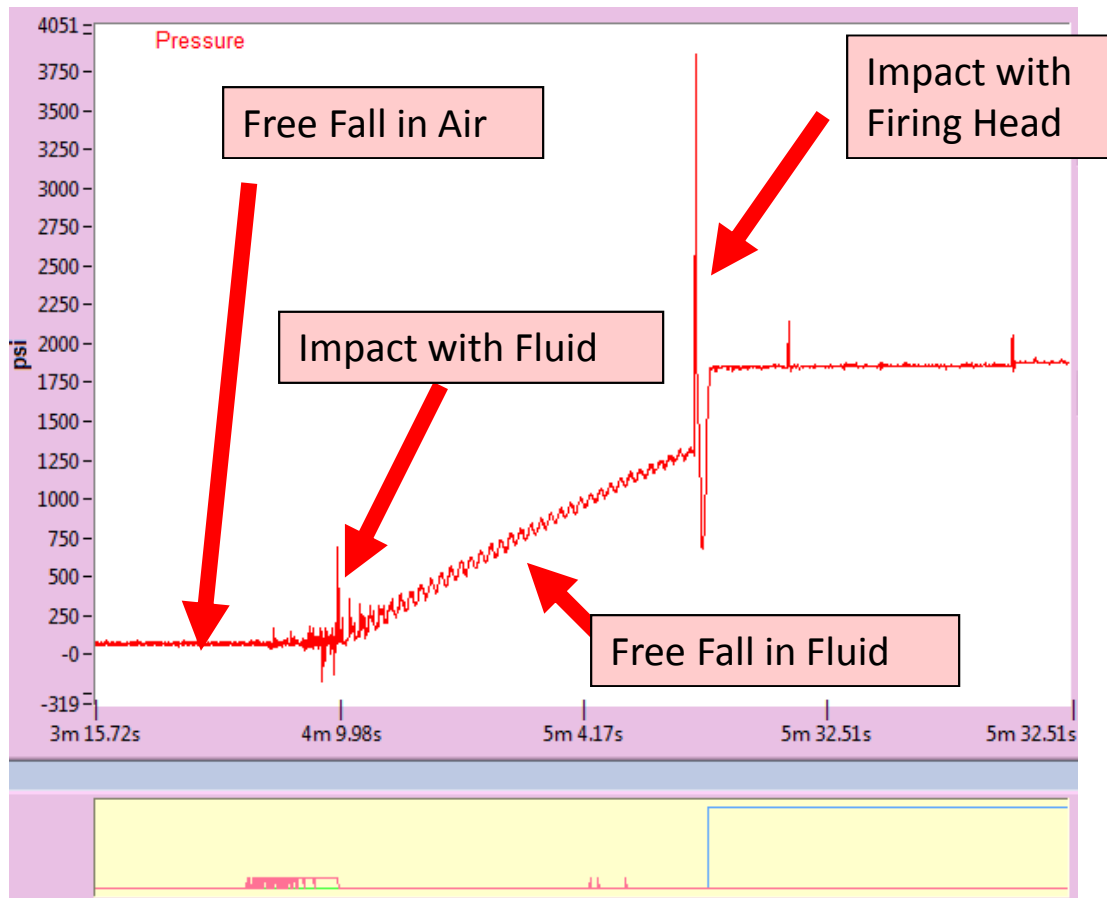
Propellant Gun



Drop Bar Gauge

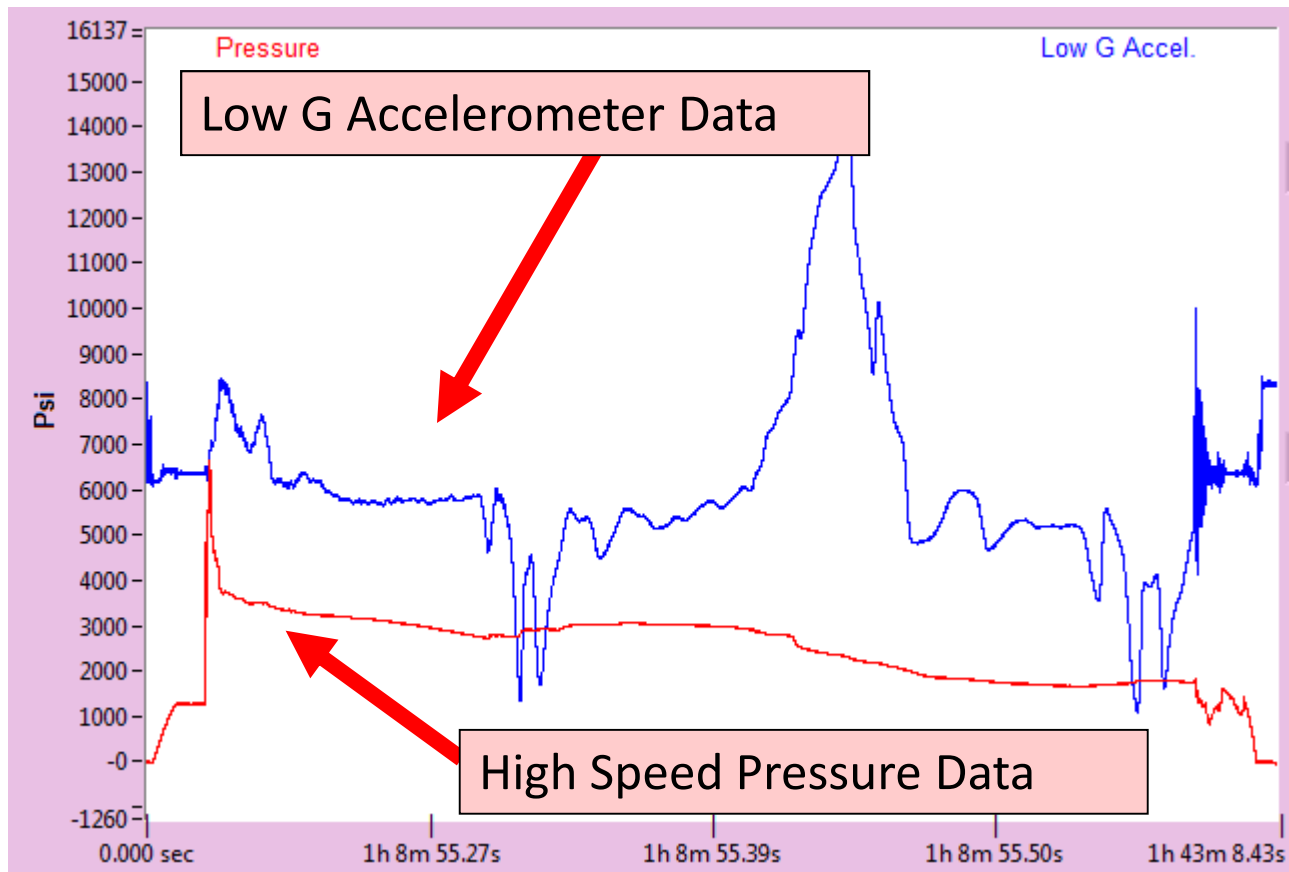


Drop Bar Gauge

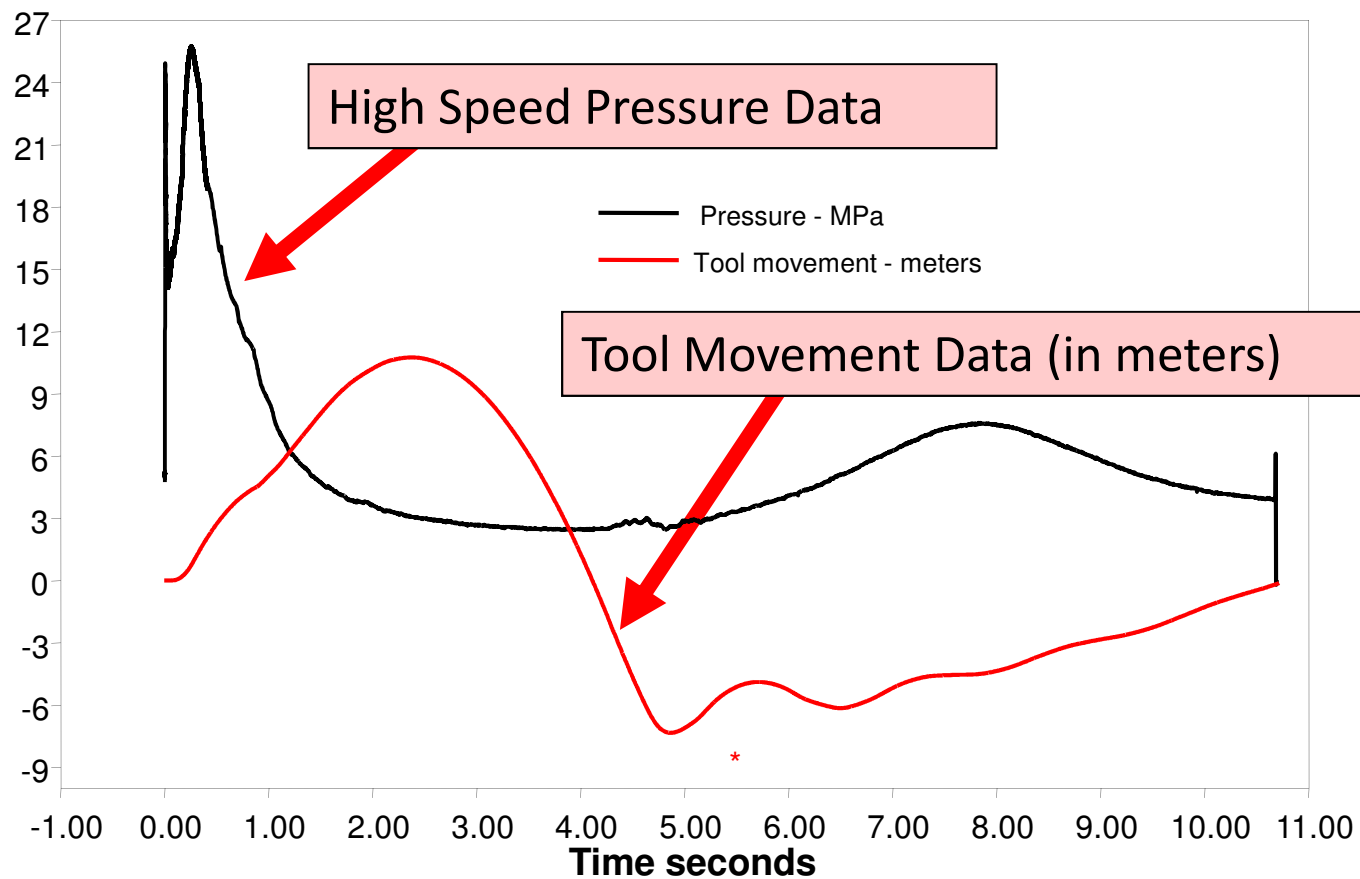


LOW G Accelerometer Data

— for Tool Movement (Model 400 Only)



Tool Movement Data Calculated from the Low G Accelerometer (Model 400 Only)



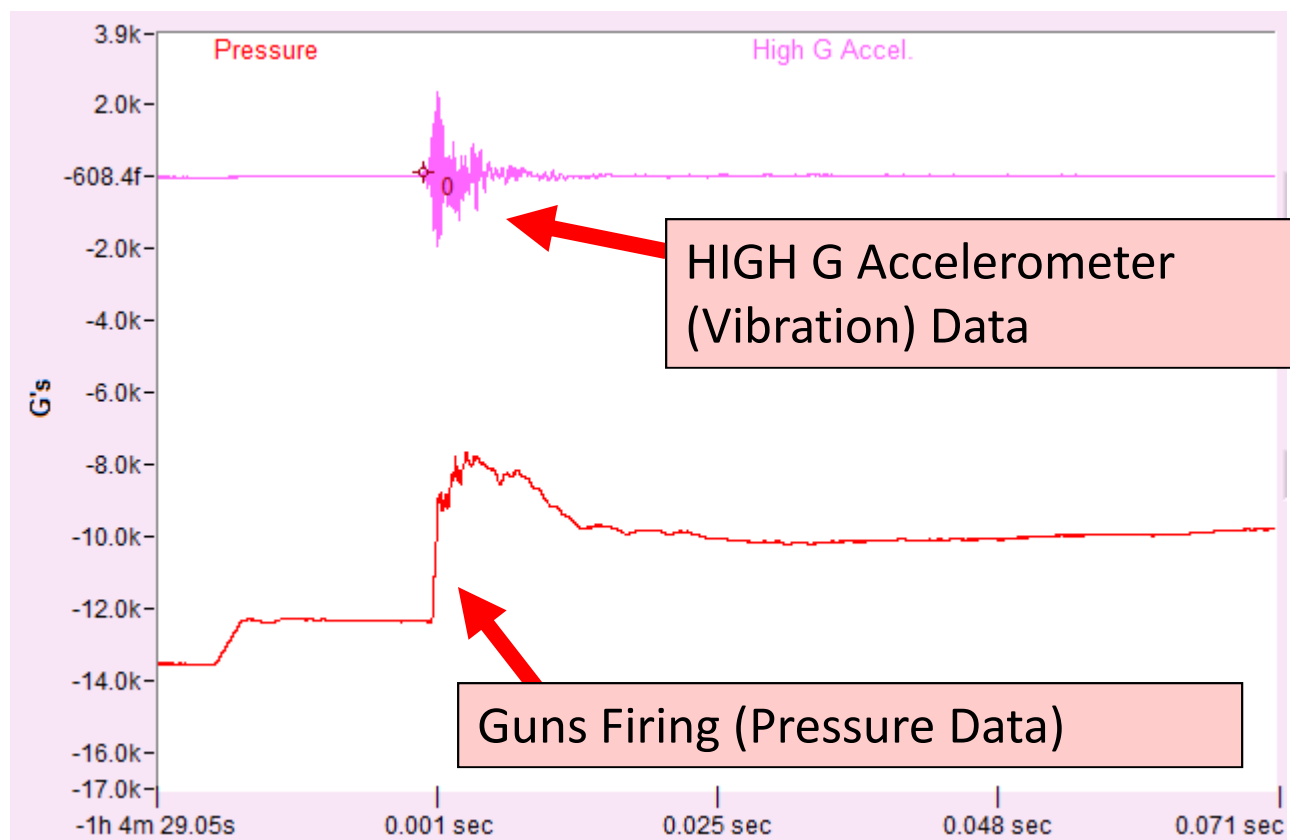
Tool Movement and Velocity Data can be Calculated from the Low G Acceleration Data

If you record Low G acceleration data with the series 400 gauge, you can integrate the data (FAST speed only), and it will give you the Velocity of your tool (feet/sec) vs. time.

If you integrate the Velocity data, that will give you the Distance traveled (feet) vs. time.



HIGH G Accelerometer Data – for Tool Vibration (Model 400 Only)

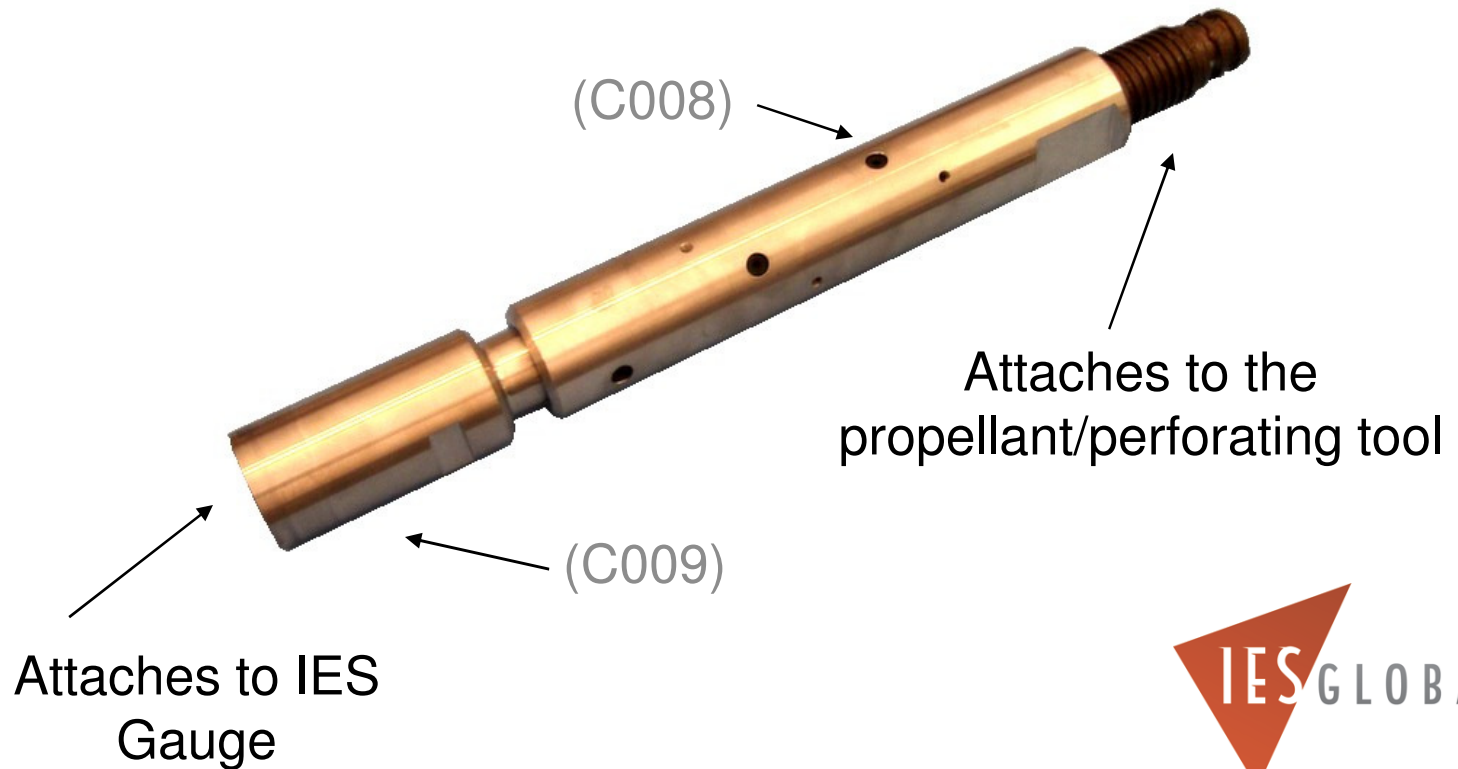


Shock Mitigater



IES Shock Mitigater

#IES-SM-11116, 1-11/16" OD



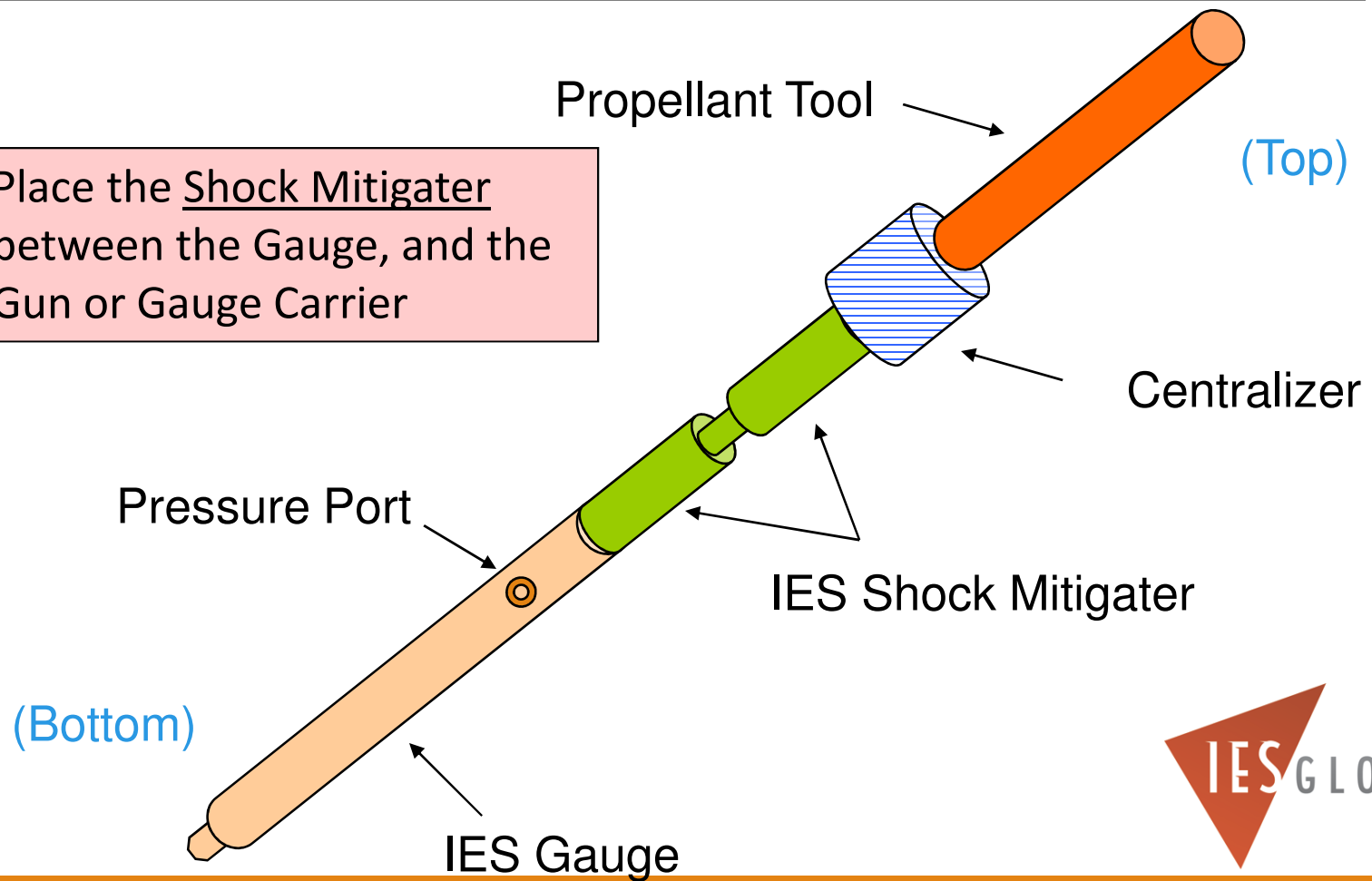
IES Shock Mitigater

- **USE is STRONGLY RECOMMENDED**
- Placed between the Gauge and the propellant/perforating tool
(NOTE: A “centralizer” must be used on the tool)
- Reduces the shock and vibration along the vertical axis by up to 10 times...
- **Increases** the life of the Gauge, OWR, sensors, and battery

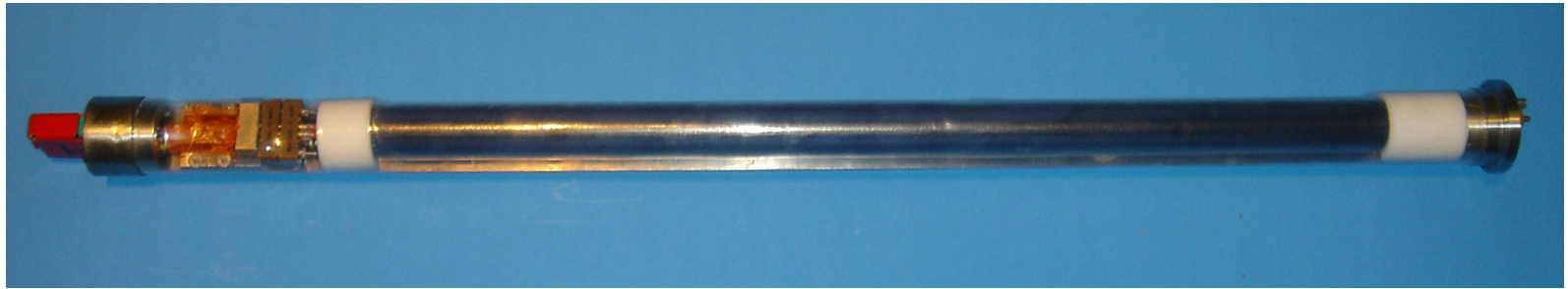


IES Shock Mitigater Location

Place the Shock Mitigater between the Gauge, and the Gun or Gauge Carrier



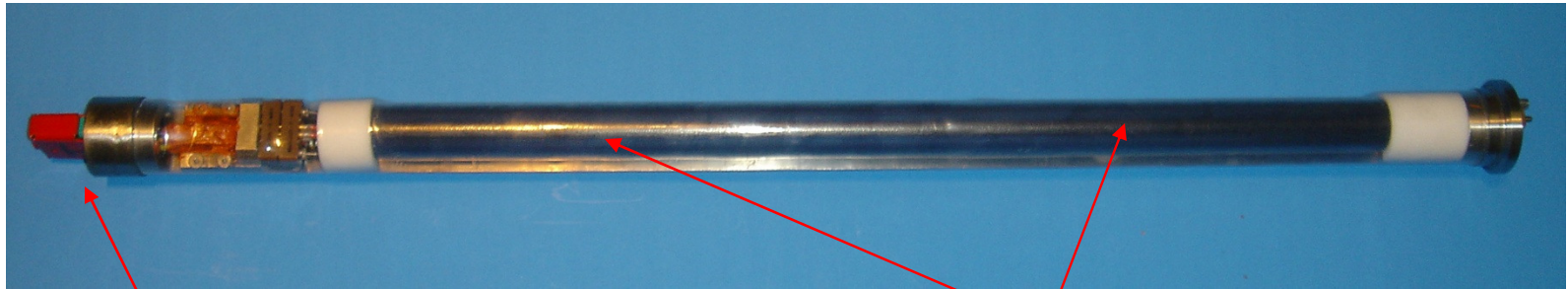
Battery Fixture



(LOCATED INSIDE THE BATTERY SECTION)

Battery Fixture

(Located inside the Battery Section)



"Red Kill Switch"

IES Potted Battery Pack
Installed



Battery Fixture

The Battery Fixture is used to hold the Battery Pack.

- It is located inside the **BATTERY SECTION** of the gauge (between the OWR Section and the Date Readout Section).

One or **Two** Batteries can be used with a Gauge

- It is **STRONGLY** recommended that you always run TWO batteries per gauge for redundancy
- An additional Battery extends the time downhole, and provides a backup battery
- An extra Battery Fixture, Battery Pack, and Battery Section is required for running TWO batteries.
- When using two batteries, the length of the gauge is increased by **17.5 inches**

Always use the Lithium Battery Packs supplied by IES.

- They are specifically designed for the IES gauge in a High Shock Environment.



Battery Fixture “Types”

There are **TWO** Types of Battery Fixtures available.

- The **120°C** Gauge comes with the **#IES-BAT-005** Battery Fixture
- The **150°C** and **175°C** Gauge comes with the **#IES-BAT-006*** Battery Fixture

*When using the Series 400 Gauge, use the #IES-BAT-006 battery fixture.

Additional Battery Fixtures can be purchased or Leased.



Battery Fixture “Types”

#IES-BAT-005 Battery Fixture (120°C).

- DO NOT USE for 150°C applications!
- Can be used with 80°C Alkaline or 120°C/150°C/180°C Lithium Battery Packs.



Battery Fixture “Types”

#IES-BAT-006 Lithium Battery Fixture (180°C).

- Can be used with all Series 300 and Series 400 Gauges
- Can **ONLY** be use with the 120°C, 150°C, or 180°C Lithium Battery Pack!
- **DO NOT** use with the Alkaline Battery Packs!



Battery Pack Options



Alkaline and Lithium Battery Packs

The 80°C Alkaline (*not for use with the Series 400 gauge*), 120°C Lithium, 150°C Lithium, and 180°C Lithium Battery Packs are all packaged inside a BLACK or dark colored tube.



Note: Be sure to read the Labeling on the Battery Pack so you know which Battery Pack you are using.



Battery Pack Options

80°C Alkaline Battery Pack

- #IES-BAT-BA2C

120°C Lithium Battery Pack

- #IES-BAT-BL32AA120

150°C Lithium Battery Pack

- #IES-BAT-BL32AA150 (for the Series 300)
- #IES-BAT-BL02AA150 (for the Series 400 ONLY)
- #IES-BAT-BL22AA150 - Double Power (for the Series 400 ONLY)

180°C Lithium Battery Pack (use only above 80°C)

- #IES-BAT-BL02AA180 (for the Series 400 ONLY)
- #IES-BAT-BL22AA180 - Double Power (for the Series 400 ONLY)

* Lithium battery packs CANNOT be used with the Series 200 gauges.



IES Fast Speed Gauges

