20th Annual Ground Vehicle Survivability Symposium

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Piezo Fuze Characterization

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Report Documentation Page

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Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

Agenda

- Review ARL Drop Test Method
- TARDEC Charge Circuit
- Temperature Effects on Fuze Sensitivity
- Alternate Modal Analysis Characterization

BLUF: Threat fuze sensitivity should be included in test planning for live fire evaluation and pre-detonation assessment.

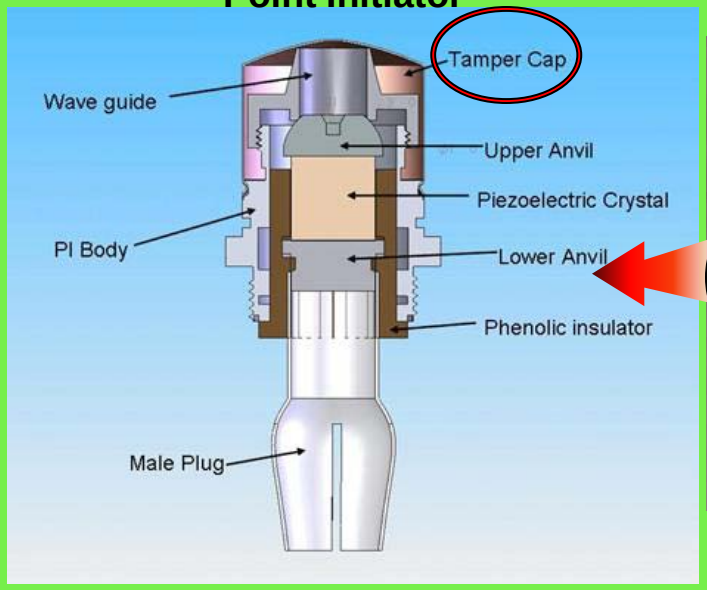
Point Initiator Characterization

Characterization of the Point Initiator's of Rocket Propelled Grenades allows TARDEC to sort threats for optimal test sequences and reduces uncertainty.

Drop Test Characterization Method is time consuming but required due to the variability in foreign threats

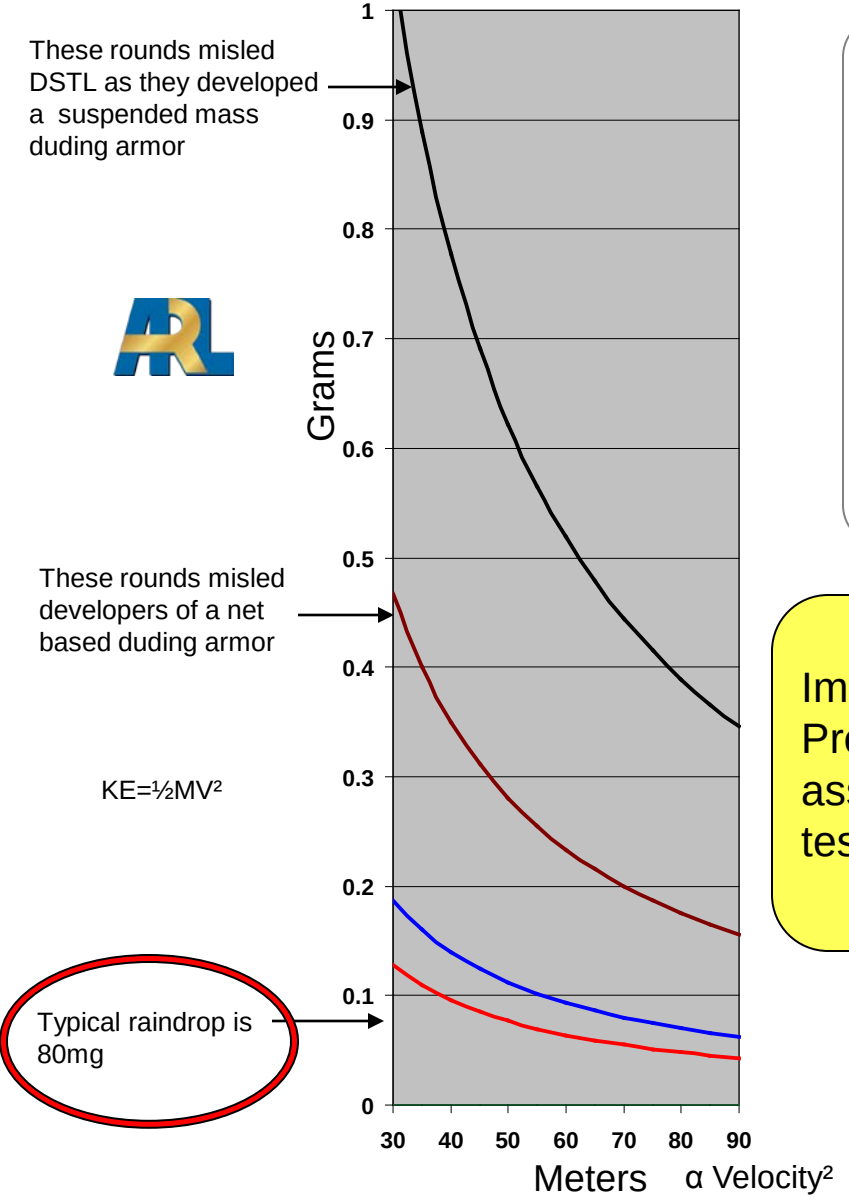
- Variability is a potential for misleading test results

Point Initiator



ARL Sensitivity Database

Grams on nose Vs distance from target for RPG-7Gs of different sensitivities



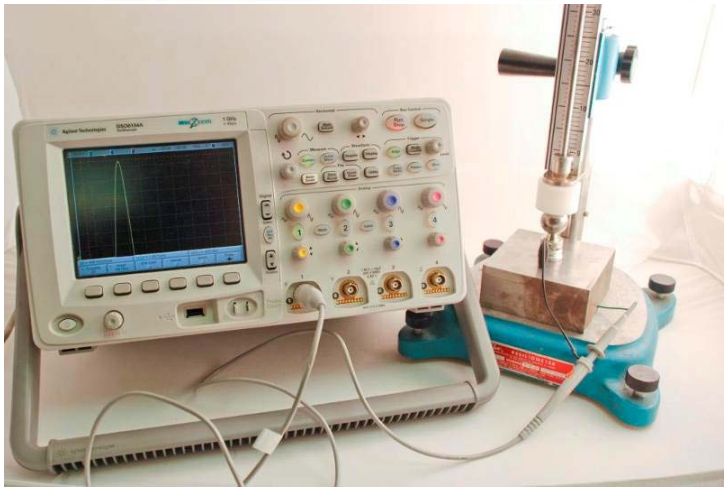
Instrument for non destructive testing of piezo before live fire tests

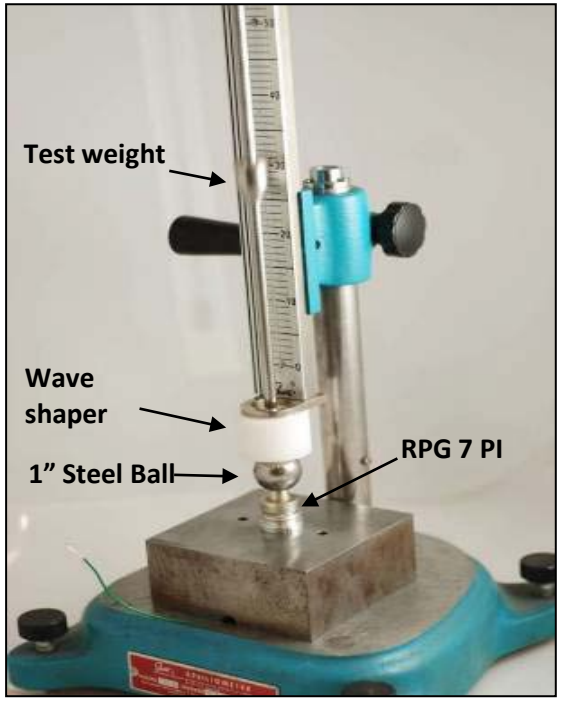
Important for Pre-detonation assessment in test planning

Point Initiator with Tamper Cap

Point Initiator with Tamper Cap Removed

ARL Drop Test Setup





U.S. Army Research Laboratory Test Method Setup

Equipment

- Vertical Rebound Resilience Tester
- Oscilloscope
- 100:1 Test Probe
- 1" Steel Ball Bearing
- 1" Thick Low Density Polyethylene Wave Shaper
- Steel Block Base

Setup Procedure & Test Procedure

- RPG-7 Point Initiator Sensitivity Test Operating Procedures prepared by Survice Engineering Company

Test setup and procedure optimization has been ongoing with ARL (continuous improvement).

RPG-7 Sensitivity Classifications

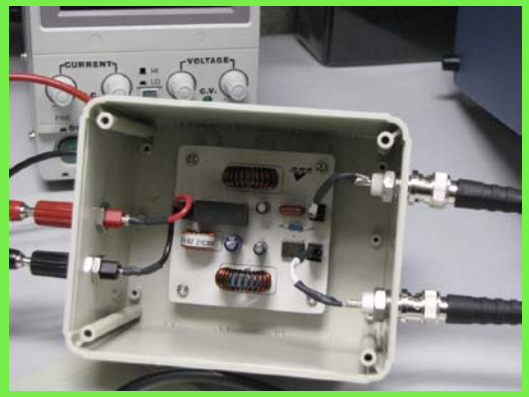
- Very Sensitive
- Sensitive
- Average
- Insensitive
- Very Insensitive

Charge Circuit

ARL recently improved the drop test method by adding a charge circuit

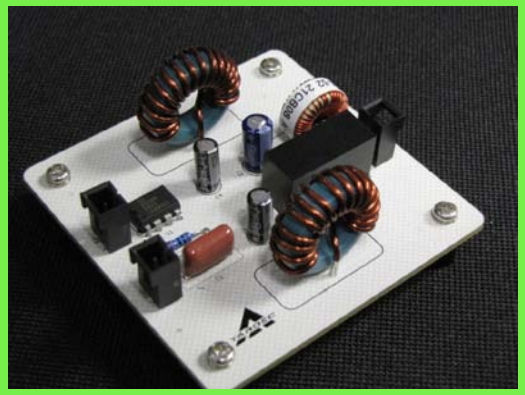
- Replaces the need to match the capacitance of the PI, Oscilloscope and Probe
- Prototype printed circuit board was designed by the GCVDI

•Charge Circuit data compared to Drop Test using the probe data - correlation is above 92%



Basic Charge Amp Circuit

- **Repeatability Variable / Challenges**



Temperature Effects

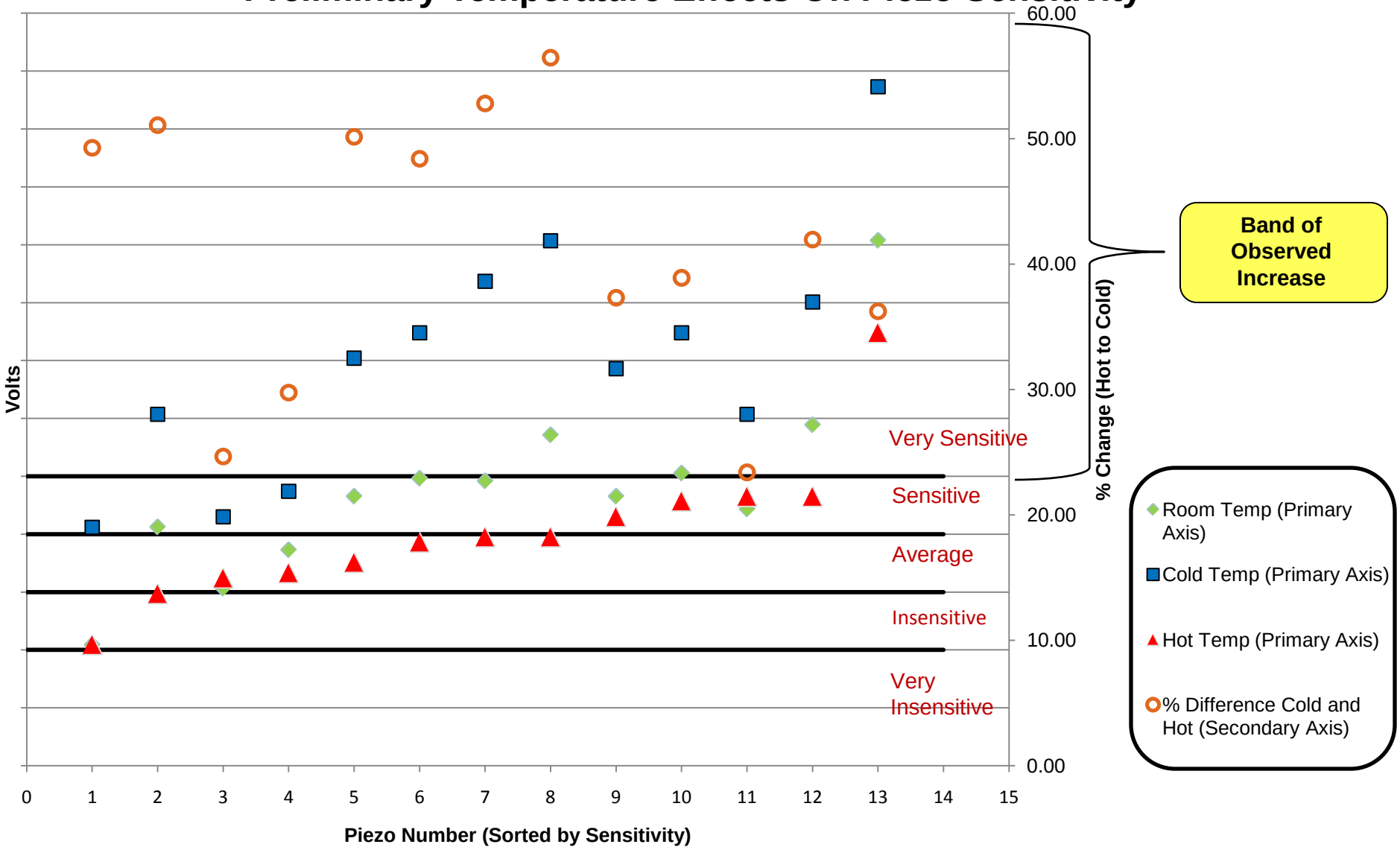
BLUF – Temperature is a significant factor of sensitivity: Notable effects have been observed in the sensitivity of the Point Initiators utilizing temperature ranges.

- The point initiators were tested in three different temperatures: Cold (near freezing), Hot (~120˚), and Room Temperature.
  - Baseline(Room Temperature ~75˚) was conducted with no environmental alterations.
  - Decreased temperatures (≈ 40˚ below baseline) were simulated using a freezer to cool the Point Initiators and steel block.
  - Increased temperatures (≈ 45˚ above baseline) were simulated using an oven to heat the Point Initiators and steel block.
- The Point Initiators were ran through the drop test characterization method after they have been subjected to the environmental condition being tested.

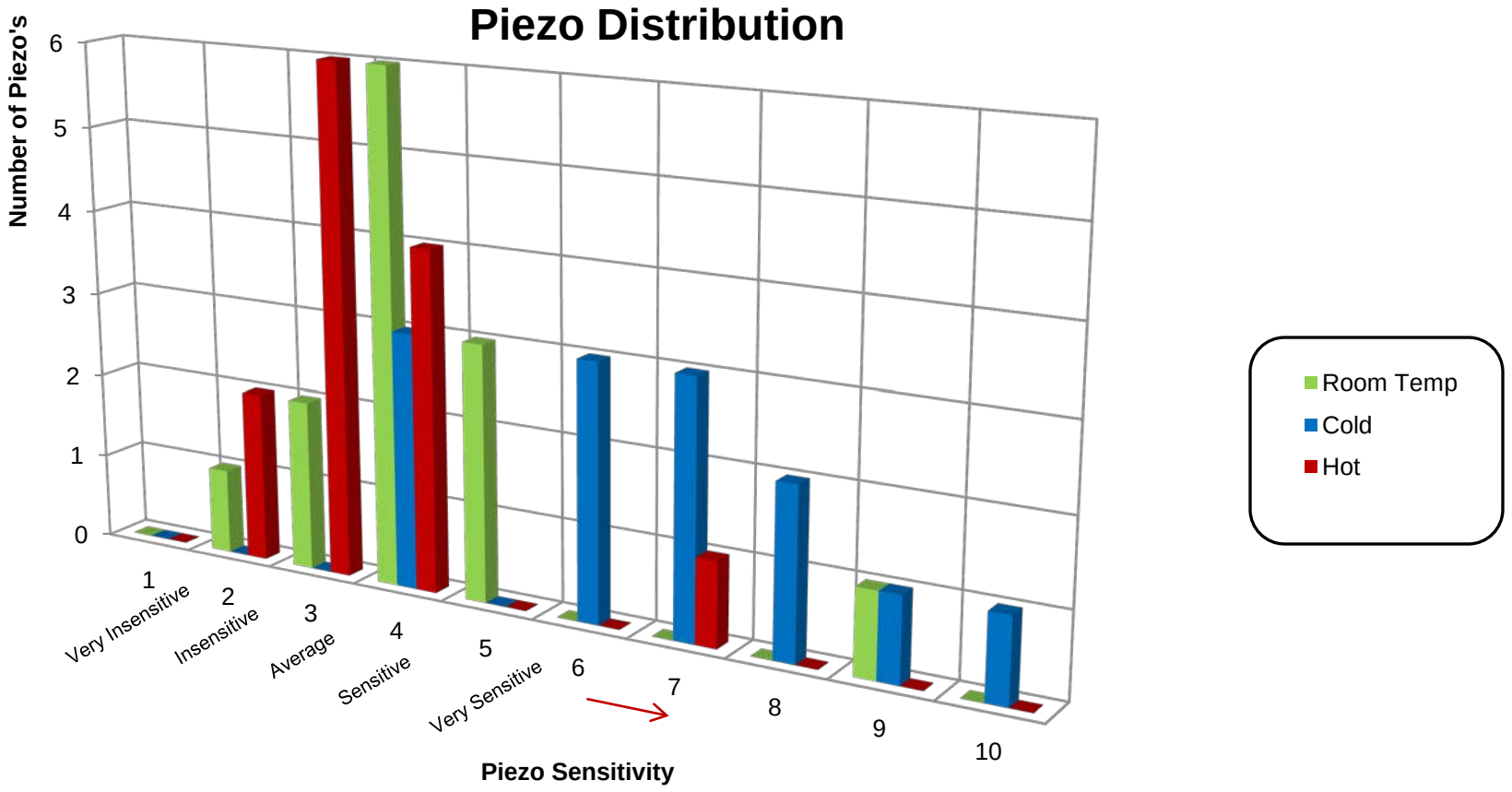
The sensitivity of the Point Initiator returned to the baseline sensitivity after returning to room temperature. Repeatable Effect

Temperature Variations

Preliminary Temperature Effects On Piezo Sensitivity



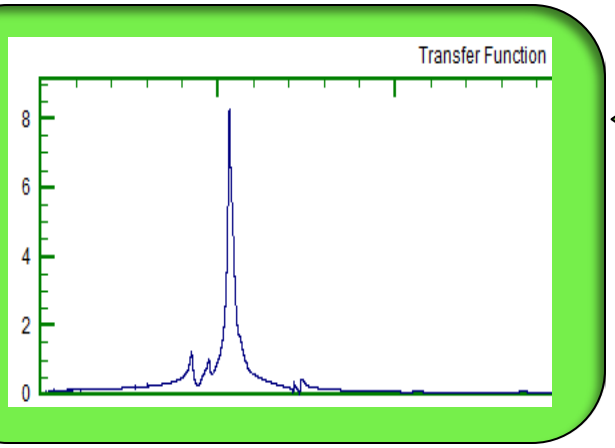
Temperature Variations



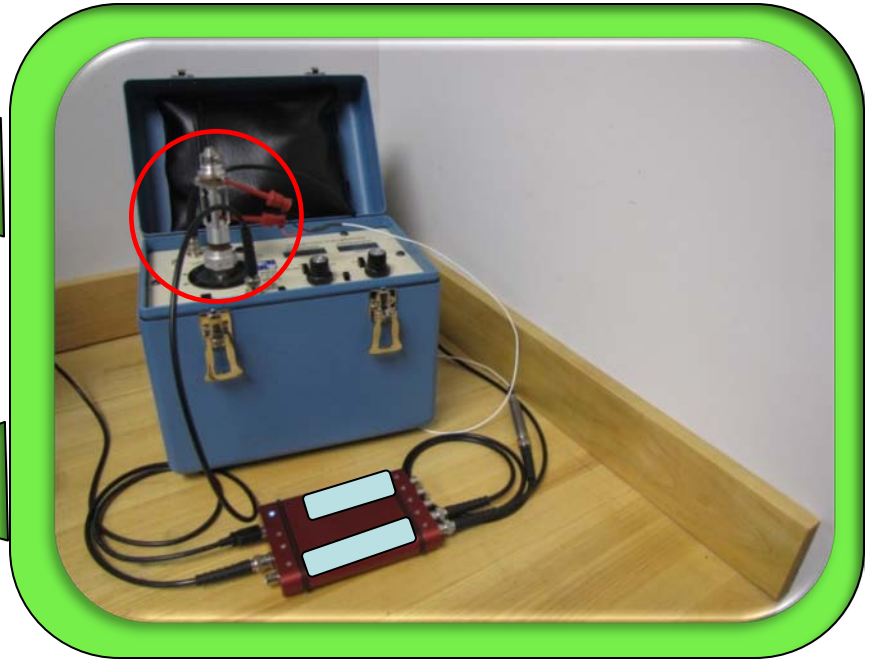
Three major reasonable considerations for future test planning for the relevant environment: Piezo Sensitivity, Altitude (Velocity), and Temperature (Increase in Piezo sensitivity).

Modal Method

The purpose of investigating the modal method is to determine if a non-destructive way of testing PI's is possible. If the Piezo output at its natural frequency correlates with the drop test data then it may be viable. The main advantage of the modal method would be that none of the natural characteristics of the Point Initiator are altered.



Modal Test Setup



Piezo Holder Assembly

Initial Modal Tests

Modal Test Procedure

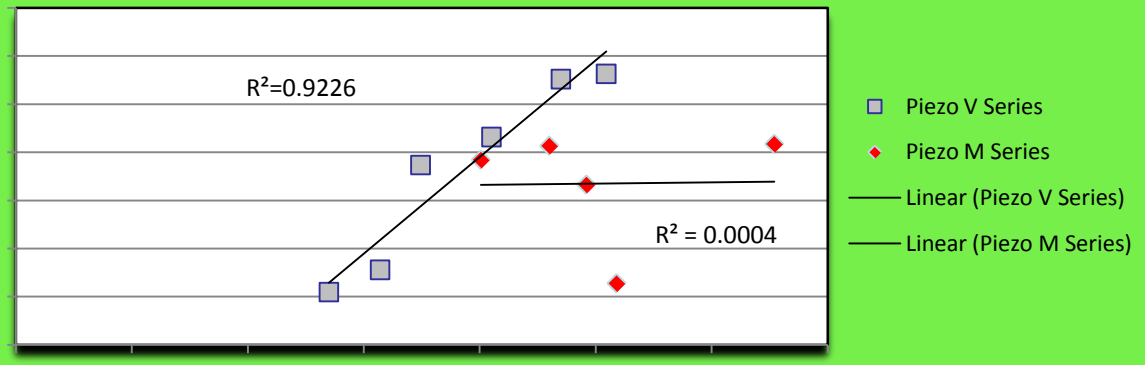
- Swept sine wave signal exciting the modal shaker
- Analyze the data using a real time analyzer (Fast Fourier Transform)
- Record the peak amplitude and frequency
- Compare modal results with data from drop test for potential correlation

Preliminary Observations

- The correlation of the V-Series was extremely high
- The correlation of the M-Series was extremely poor

Currently, these two series assemblies are believed to be identical. Observations have shown that the series data does not follow the same trendline. This may be due to different assembly procedures and /or different materials etc., and merits further investigation

Correlation of V-Series and M-Series to the ARL Drop Test Data using initial frequency spectra for discrimination



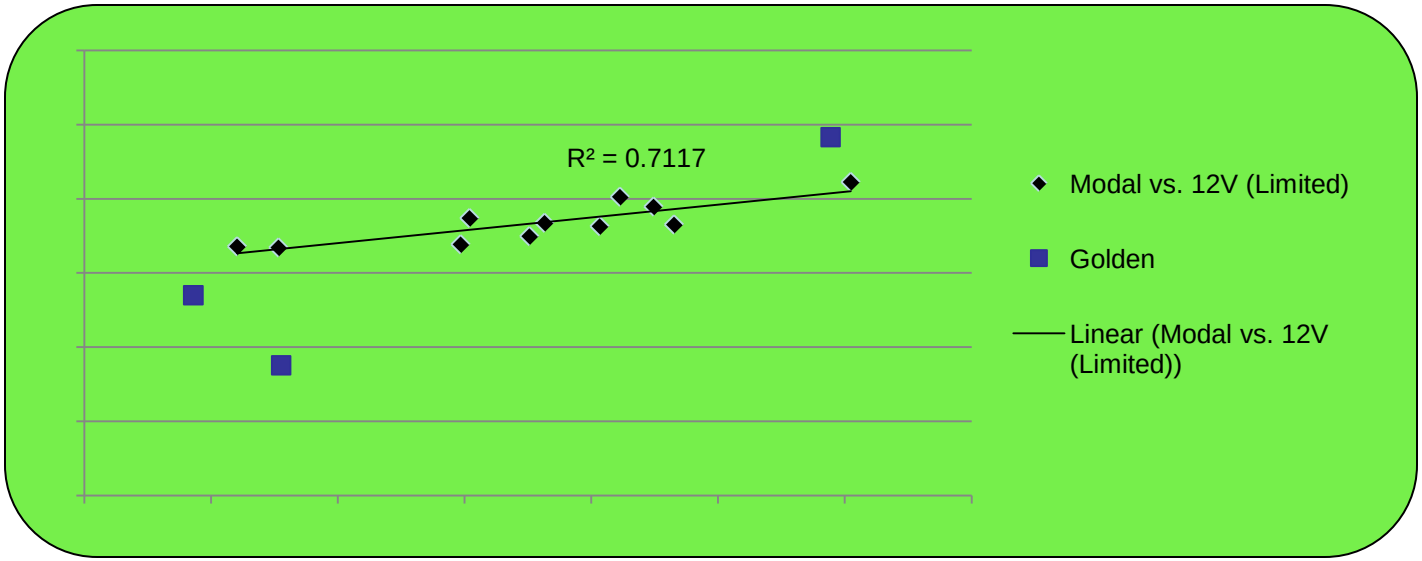
Modal Test

Repeatability

- Repeatability of the drilled fixture is increasing and is approximately 80%
- Mass of the fixture has an affect on the test setup

Correlation

- Correlation between the modal method and drop test method is increasing and currently around 70 %
- More samples are needed to gain a better understanding



Interesting results thus far, merits further investigation

Piezo Characterization

Questions ?