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Generic Hardware (GH) for explosive ranking, modeling and simulation

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Background

- Currently there is no system for ranking explosive IM performance based on the item of implementation
- Explosives testing in different platforms under varying conditions can not be compared accurately
- 3-D shock modeling could benefit from repeated validation and verification

IM Explosive Thrust

Purpose:

- Develop standard testing hardware and procedure to support IM Explosive down-selection, modeling and simulation and IM reaction confidence level

- Consolidate efforts of IM community (Gov. and Private) to standardize test hardware

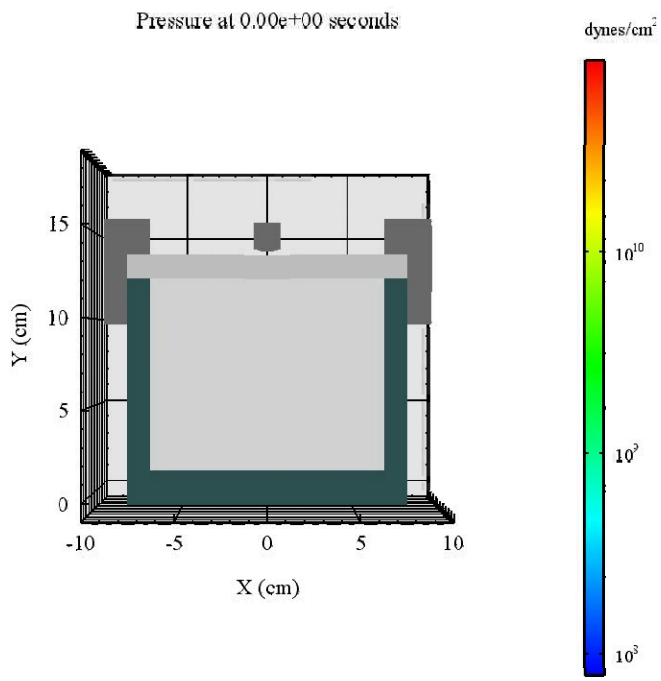
Technical Approach

- Utilize pressure gauges and impact plates (IP) of varying thicknesses to accurately asses an explosive's response to Bullet Impact, Fragment Impact, and Sympathetic Detonation
- Improve quality and accuracy of present modeling efforts dealing with explosive response to above stimuli
- Use GH prototypes as additional decision criteria for optimizing candidate groups for possible implementation
- By analyzing pressure data obtained by front and back gauges, gain an understanding of what is producing violence in non-detonation explosion and determine how to alter present formulations in order to mitigate this effect
- Use GH to augment testing in order to improve the confidence level of explosive reaction using statistical analysis

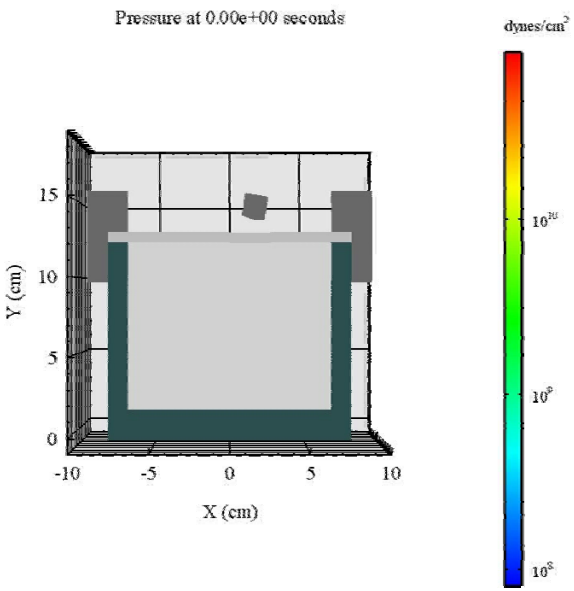
Accomplishments

- Conducted lab scale testing on instrumentation
- Conducted accuracy testing to ensure gauge reliability
- Coordinated with LANL to pool efforts in Shock modeling
- Coordinated gauge data with LANL to troubleshoot data results
- Conducted Fragment Impact test using PAX-195 on varying Impact plates to assess SDT
- Performed tests using GH to simulate 81mm (.300”IP) and 60mm (.150”IP) mortars loaded with PAX-195 (packaged and unpackaged)
- Achieved correlating results for both tests:
  - Packaged Results
    - Type V for the 81mm Mortar
    - Type IV for the 60mm Mortar

Modeling Effort



- Can clearly see the shockwave moving through the inert HE and reflection off steel



Shows that the explosives reaction to IM stimuli (FI) not only depends on the explosive itself but the geometry of the shell and point of impact

PAX-195 Fragment Impact Test

Changed Impact plate to show SDT vs. Less Violent reaction

Test 2=.15” Al plate (SDT)

Test 1=.500” Steel plate (V)

PAX-195 60mm test

No Packaging

Type I reaction

Identical Impact plates

Packaged

Violent Burn

Pressure increase

Type IV

HF 1 Steel in mortar (more brittle)

Tool Steel used for GHIP (shows bending due to pressure)

PAX-195 81mm tests

No Packaging

Type V

Identical IP

Packaged

Type V

Packaging includes:

Ammo can

Thin Carbon Fiber

.25” Cardboard

Planned Activities

- Load GH prototypes with TNT replacement candidates for correlation testing to be used for statistical analysis

- Develop a 50% point for TNT replacement candidates (3) in order for PM-CAS to possibly find different insertion opportunities for the candidate formulations

Summary

• Generic Hardware testing provides a controlled repeatable way of obtaining data for comparison and ranking (less problem with errors in the projectile impact point)

•GH designed to maintain confinement after impact to maintain any venting or slight delayed effect caused by friction

•Simplifies loading and testing of novel energetics

•Provides data vital to increase the accuracy of present shock models

• Provides quick and inexpensive way of generating new decision criteria for explosive ranking

•Due to design robustness GH is capable of multiple item testing for explosive implementation

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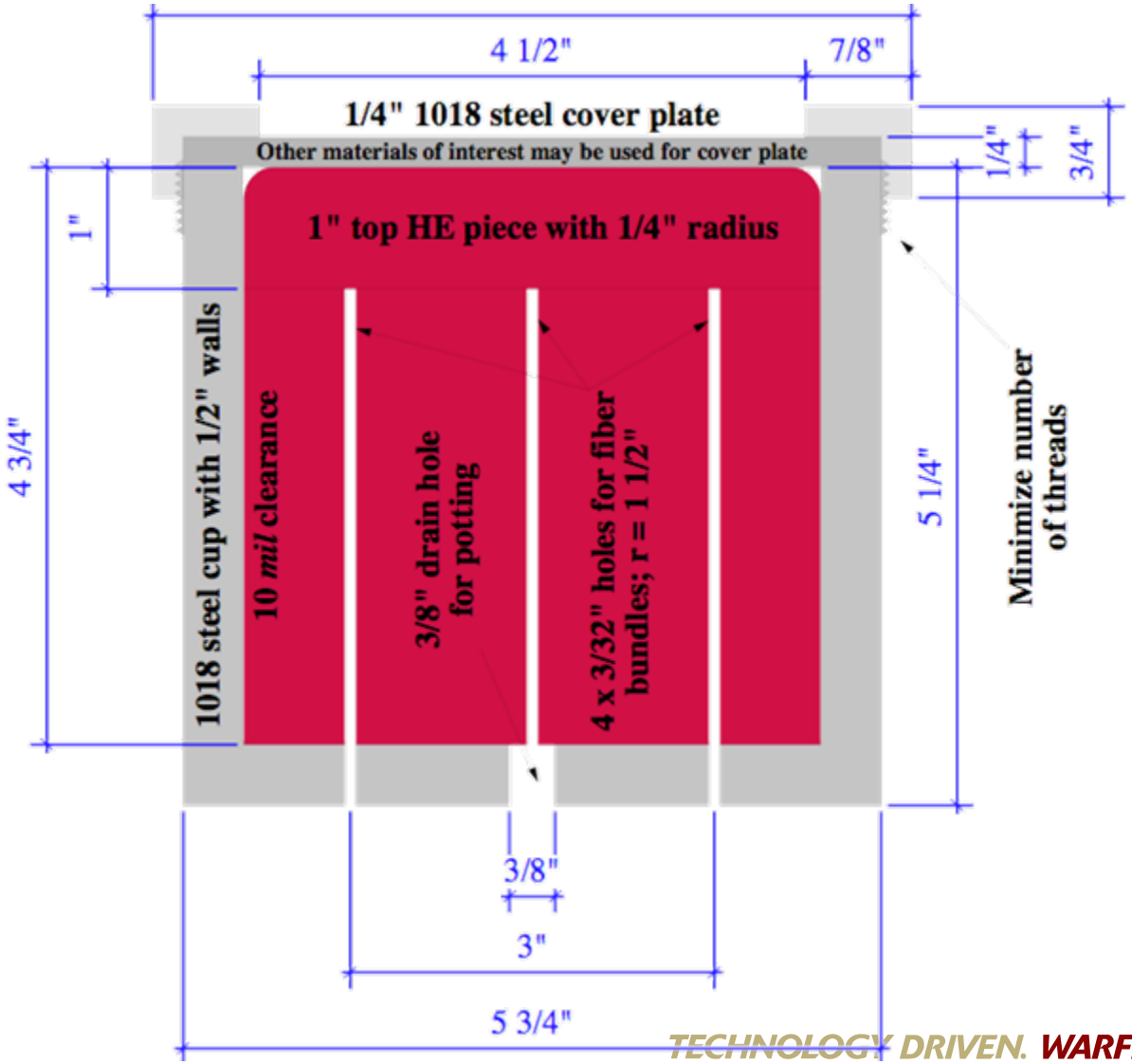
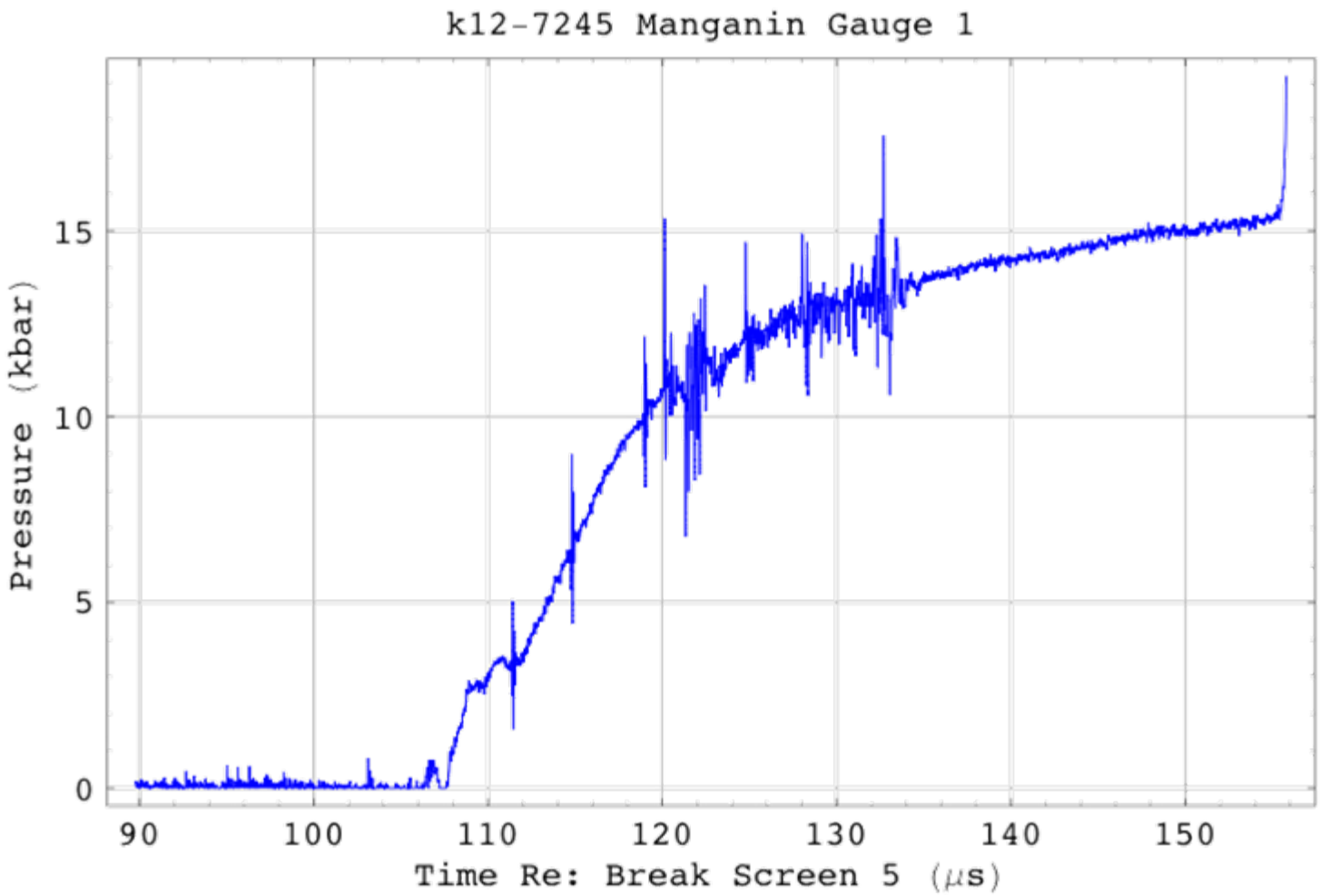
LANL Setup


4 1/2"
7/8"
1/4" 1018 steel cover plate
Other materials of interest may be used for cover plate
1/4"
3/4"
1"
1" top HE piece with 1/4" radius
1018 steel cup with 1/2" walls
10 mil clearance
3/8" drain hole for potting
4 x 3/32" holes for fiber bundles; r = 1 1/2"
4 3/4"
5 1/4"
Minimize number of threads
3/8"
3"
5 3/4"

Gauges at LANL

- gauge sits between materials of similar density
- Possible explanation for inaccurate results

Results


k12-7245 Manganin Gauge 1
Pressure (kbar)
0
5
10
15
90
100
110
120
130
140
150
Time Re: Break Screen 5 (μs)