Effect of Initiation Train Configuration on Single Shaped Charge Testing

IPS-14-14

Presented by:

Shaun Geerts

James Kinsey

International Perforating Symposium 2014

Galveston, TX

Core Lab
RESERVOIR OPTIMIZATION

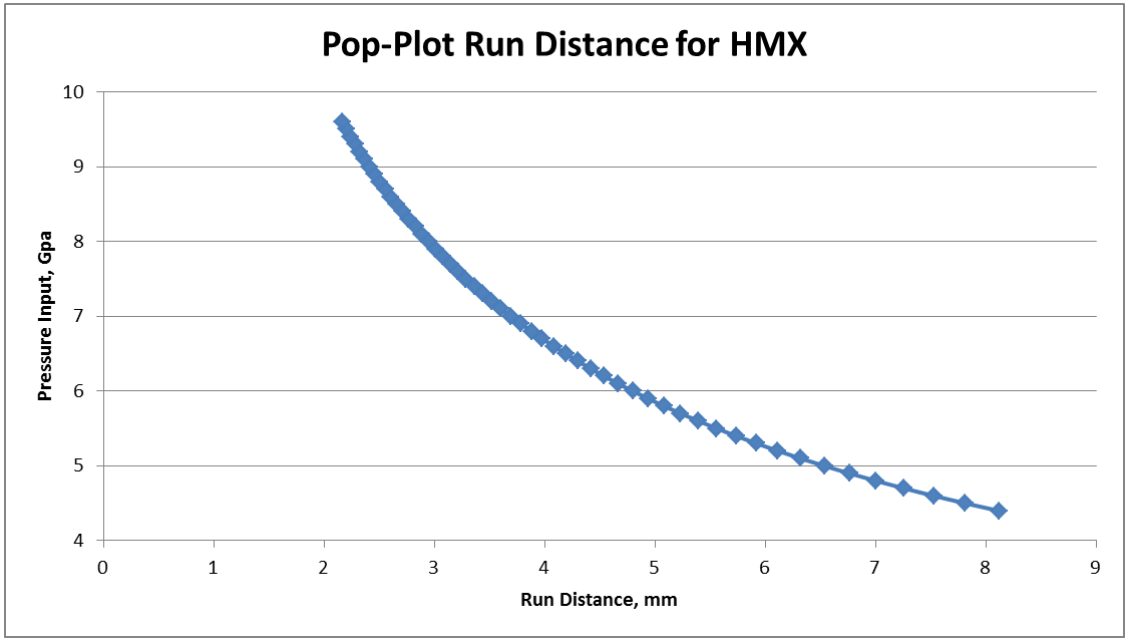
Owen Oil Tools

Abstract Summary

- Increased demand and reliance on single shaped charge testing for performance
  - Quality Control
  - Well Specific Simulation Testing
  - API RP19B Section 2
- No gun section requirements
  - Increased importance of ensuring proper initiation

Why is this important?

- From empirical data, theory shows HMX should achieve steady state detonation in 2-8mm or 0.07-0.31”
- Potential for decreased distance to negatively affect performance and increase erratic performance

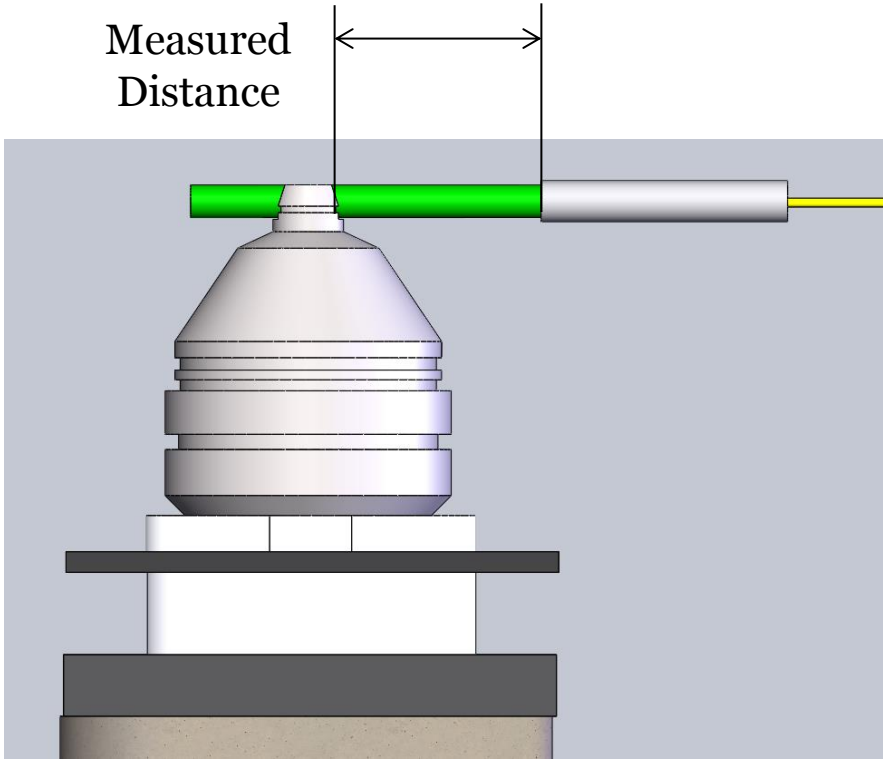


Test Series

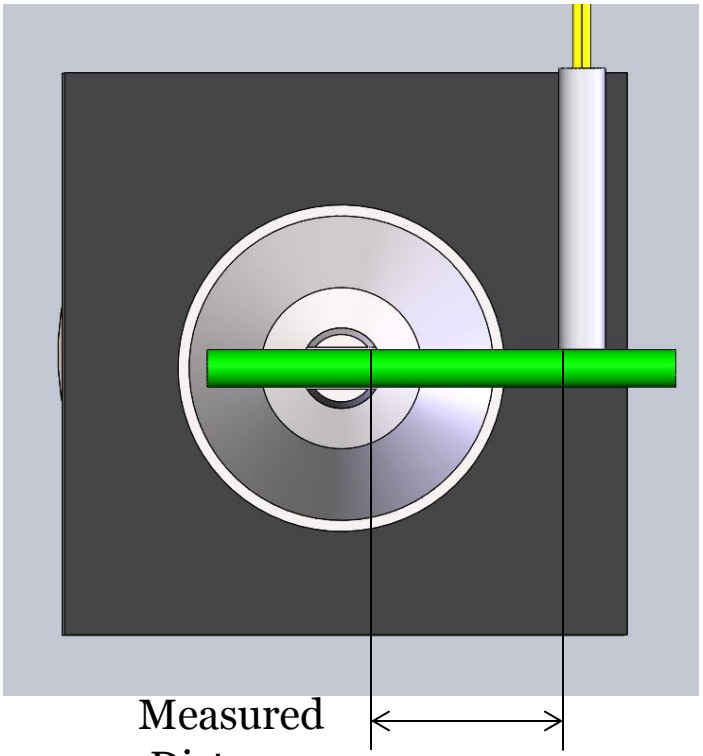
- For the test series 80 grain RDX XHV and 80 grain HMX XHV cord was used, since it is most commonly used in API testing
- One consistent charge used throughout testing
  - Average Standard deviation in QC concrete is
    - ~4.99% for penetration
    - ~5.4% for hole size
- Data Measurements
  - Casing plates were measured in the same four orientations for hole eccentricity
  - Aluminum bars were probed and measured with a depth gauge for total penetration

Testing Method

Parallel or In-line Firing



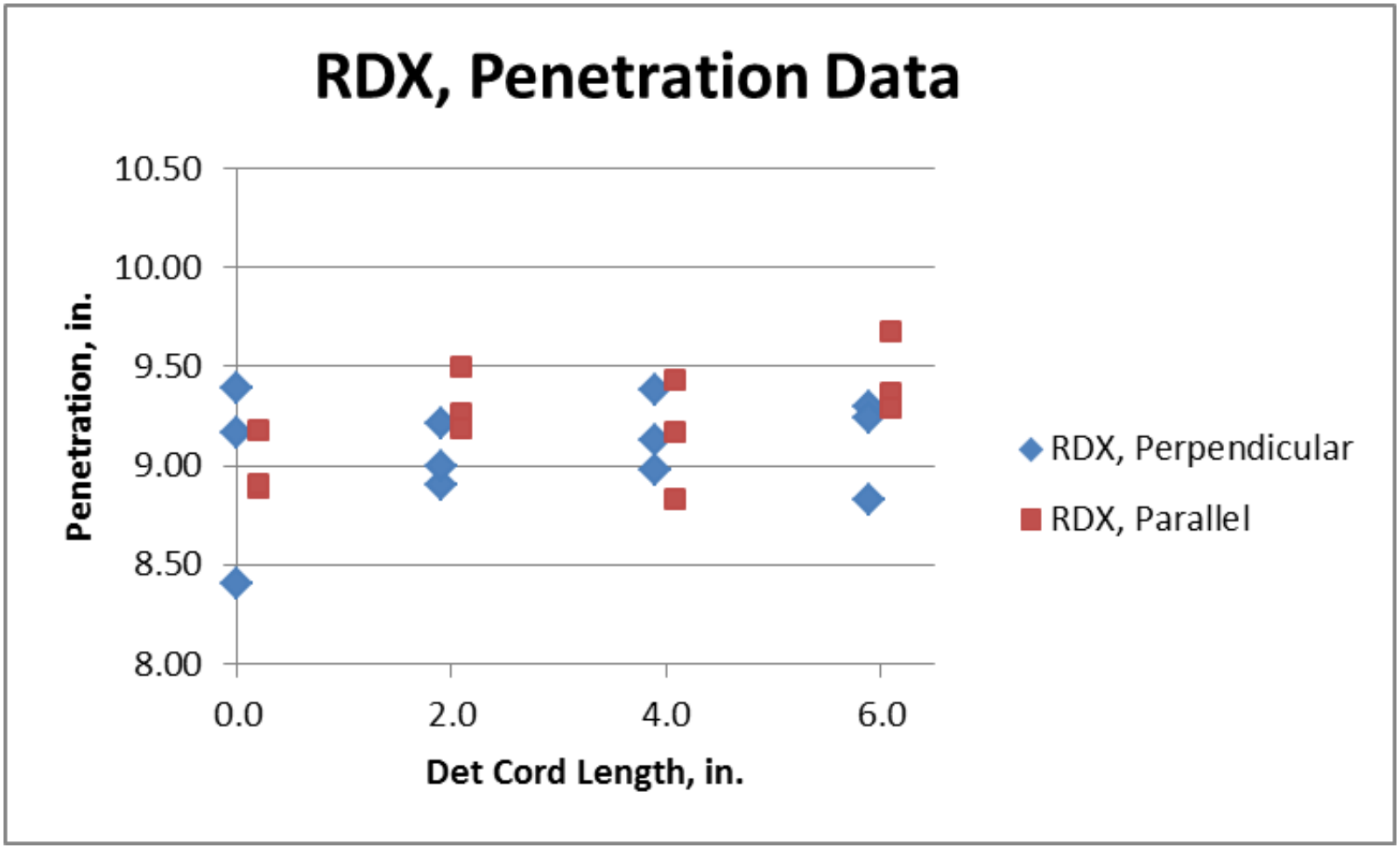
Perpendicular Firing



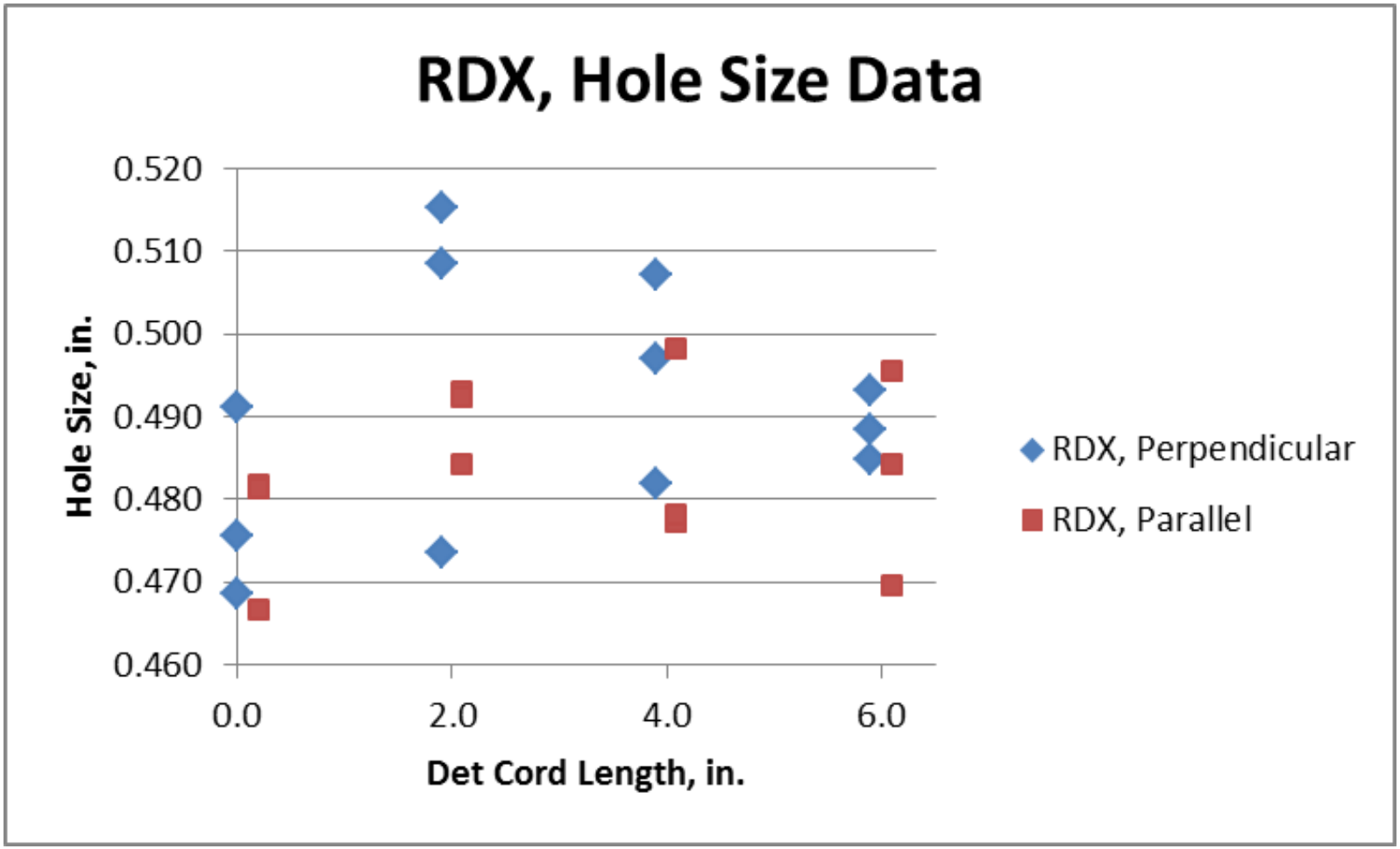
Variable Control

- All the same lot of liners and charges
- Shot into aluminum bar to reduce target variability, 6061 T6 511B
  - Solid 3” bar stock to eliminate lamination effects
- All from the same lot of detonating cord

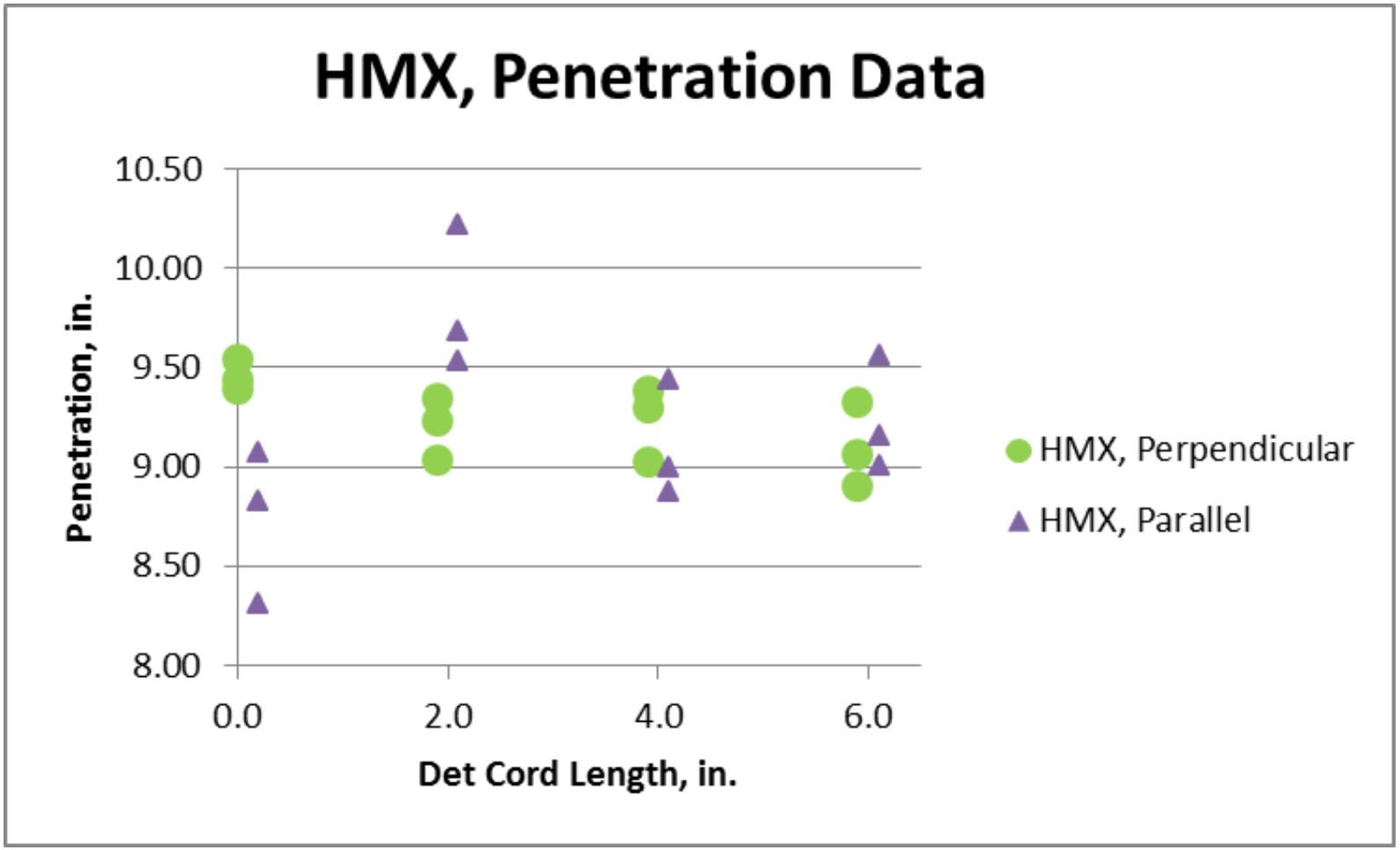
RDX Test Series - Results



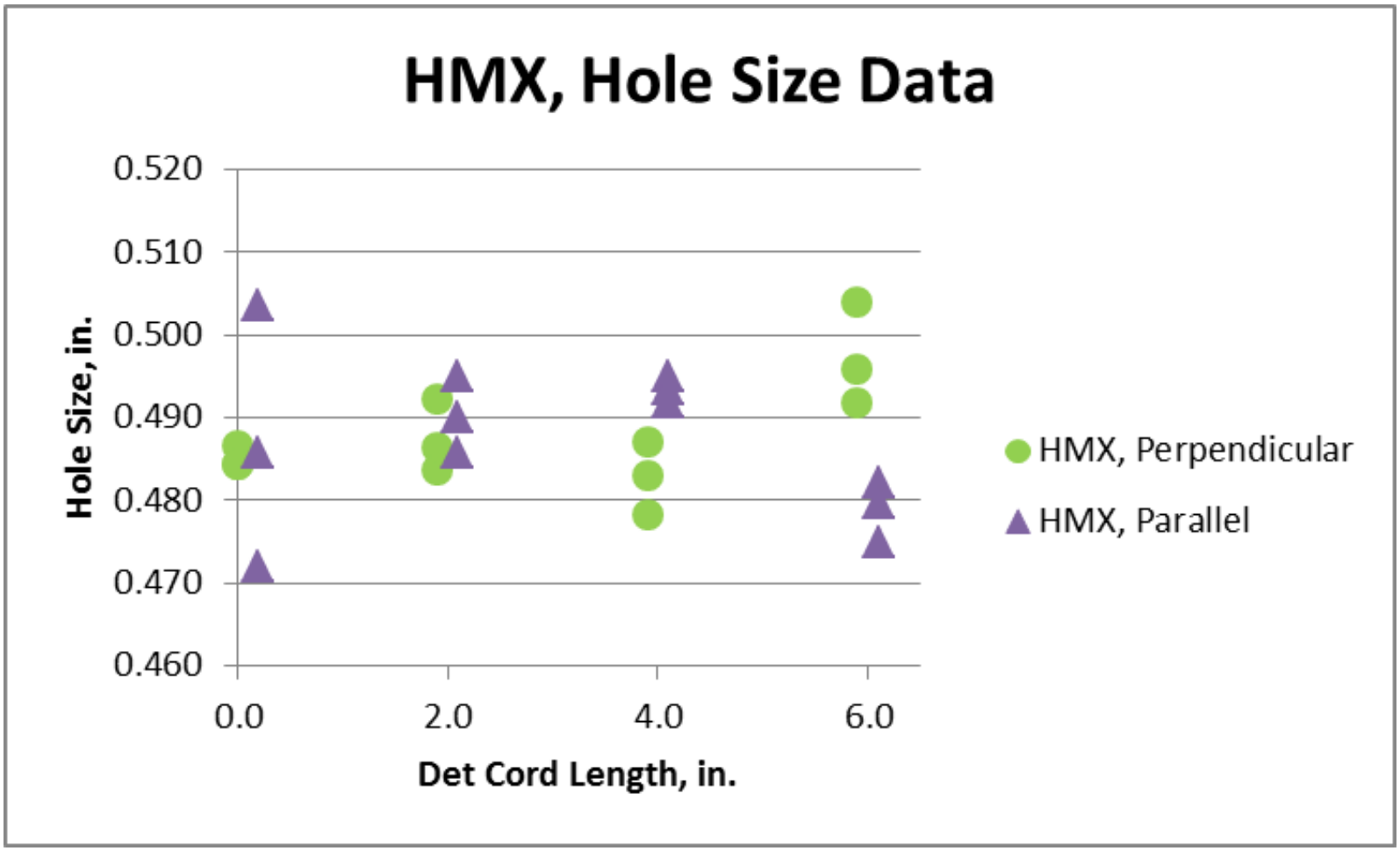
RDX Test Series - Results



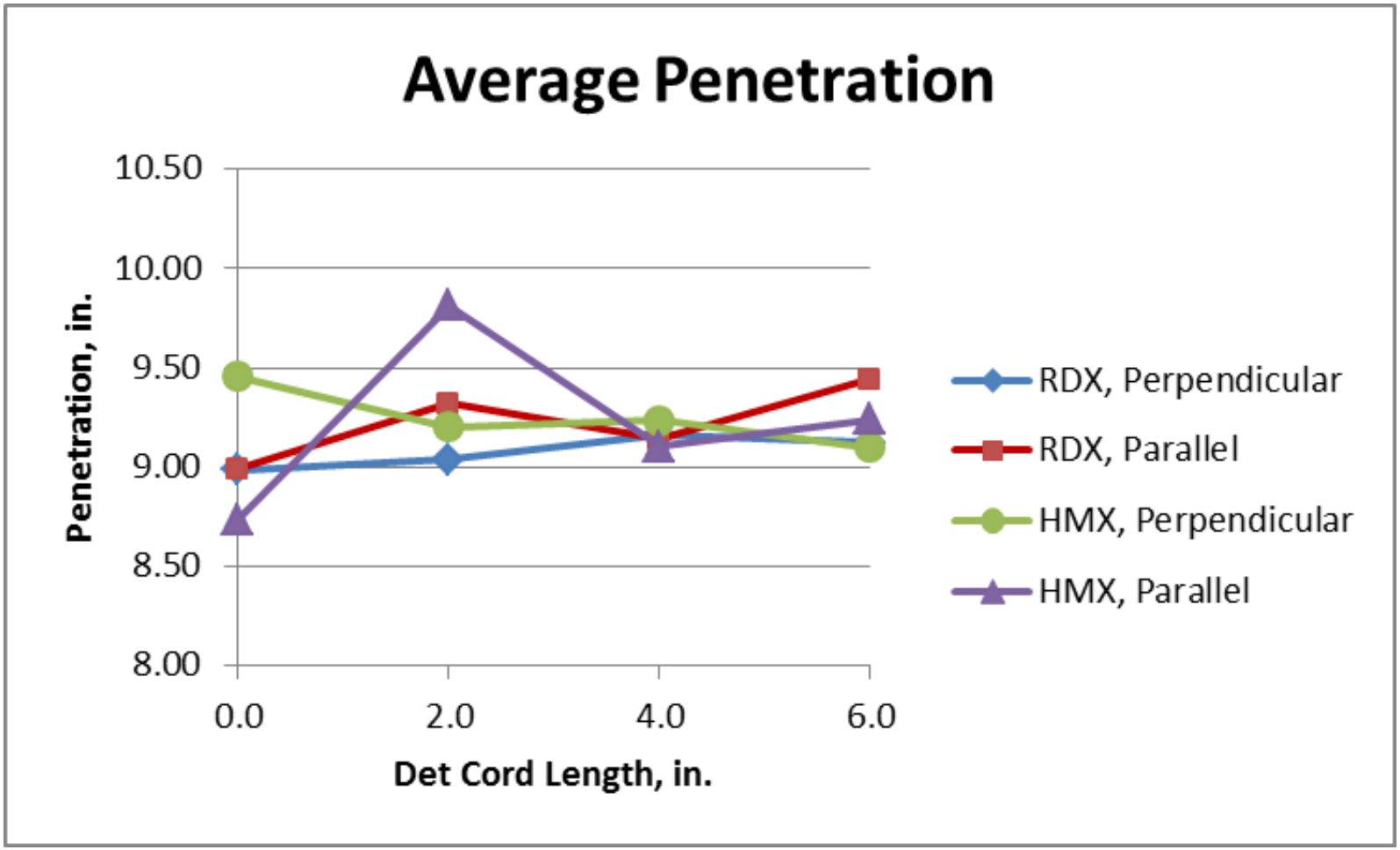
HMX Test Series - Results



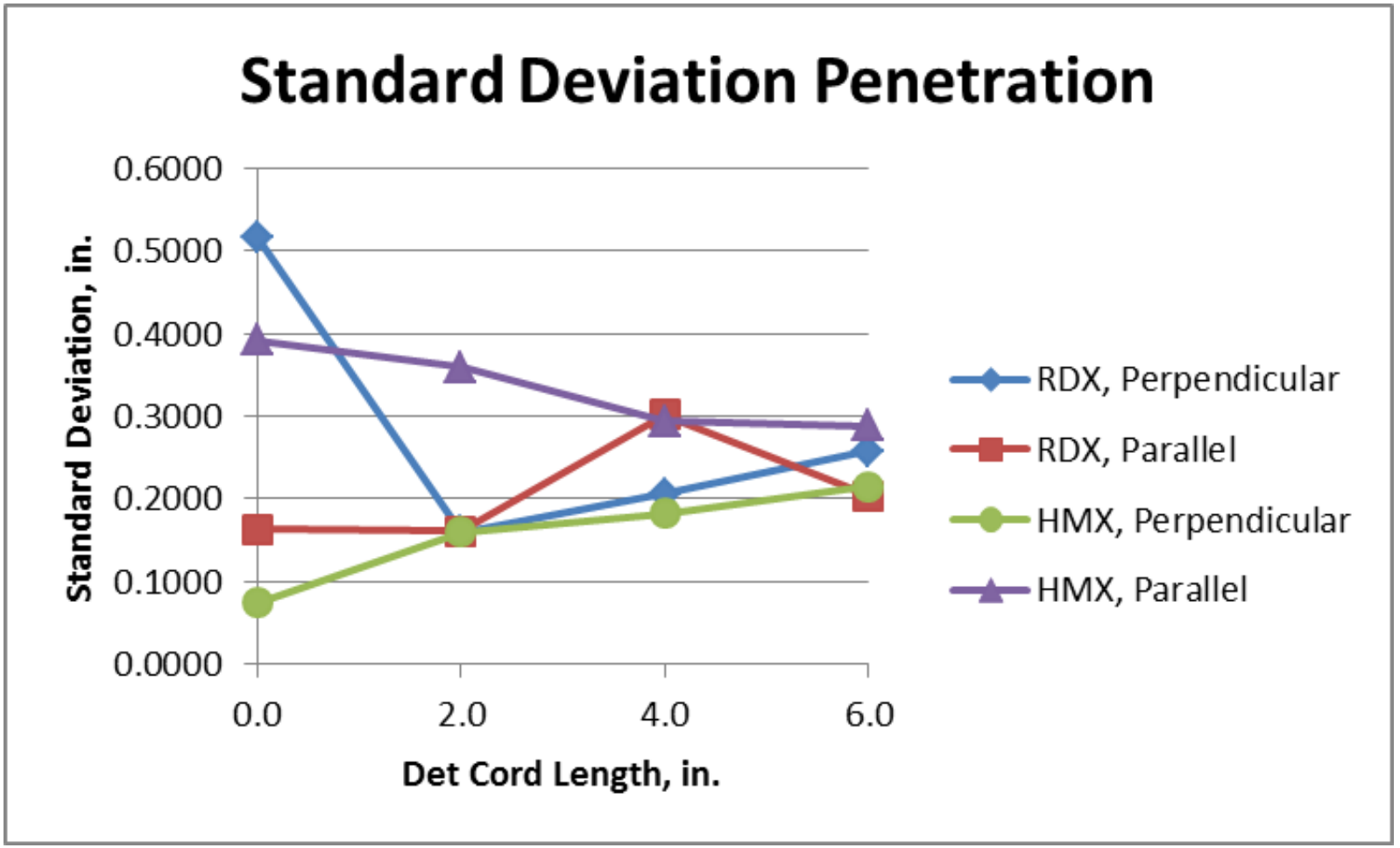
HMX Test Series - Results



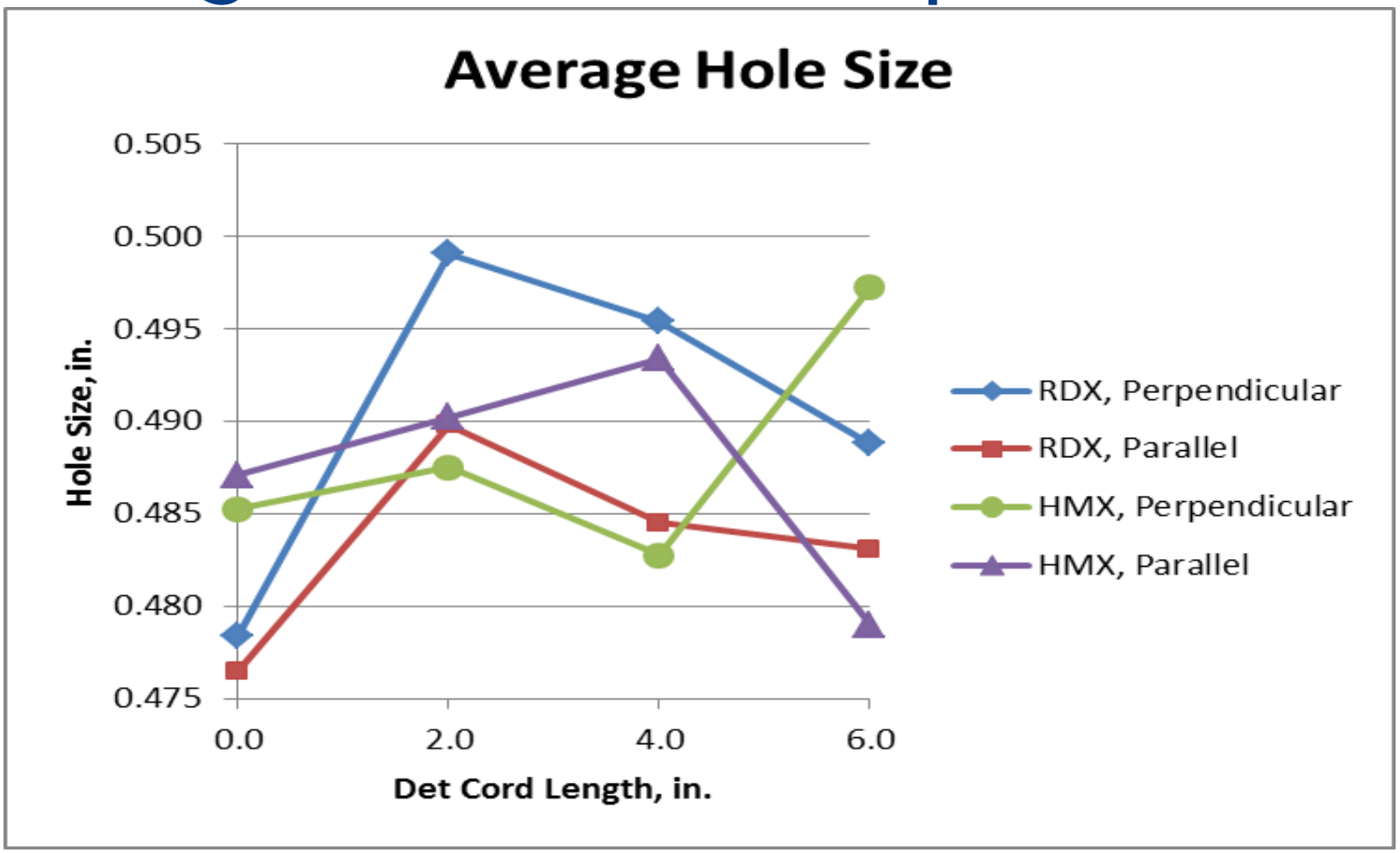
Average Penetration Comparison



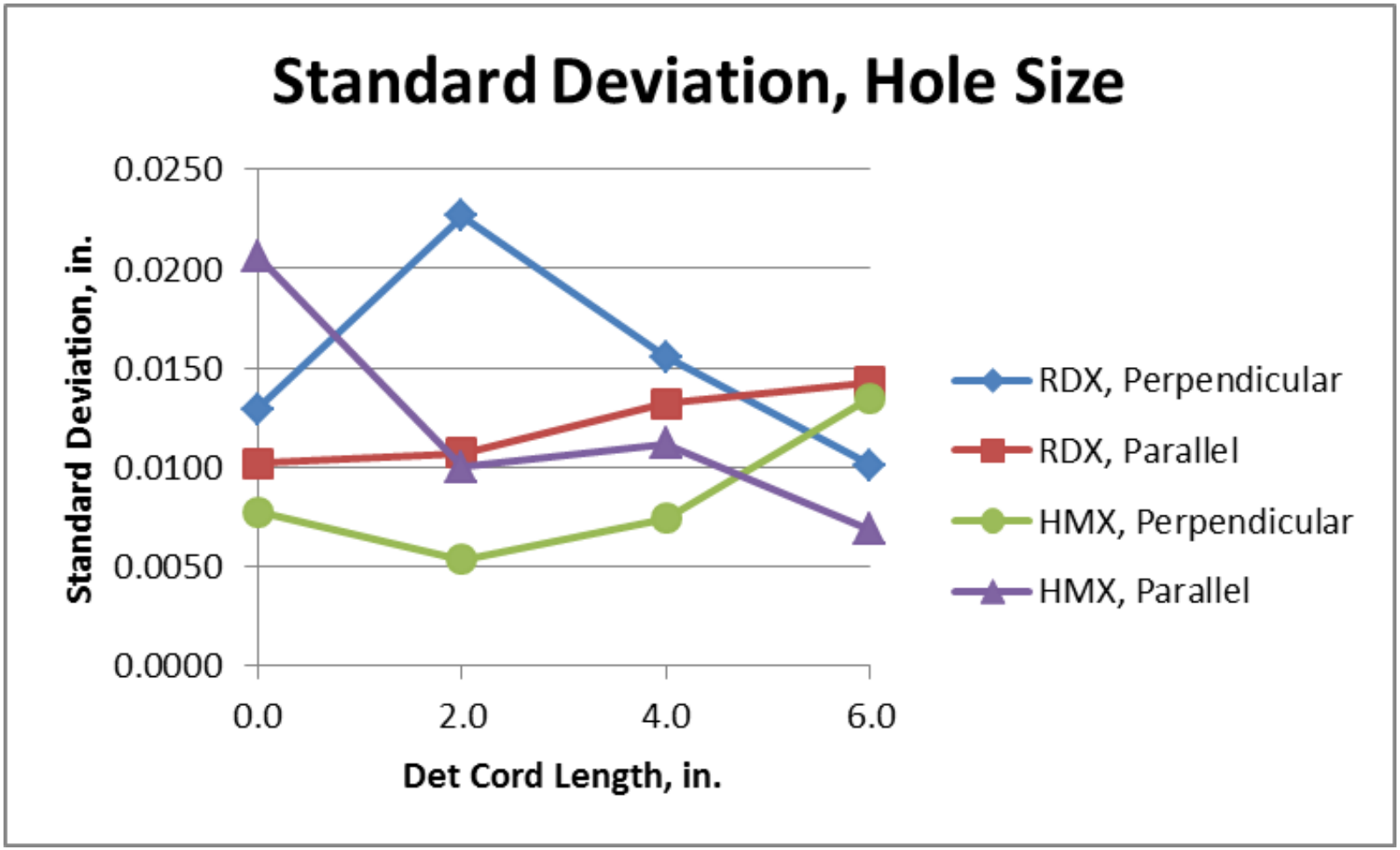
Penetration – Std. Deviation



Average Hole Size Comparison



Hole Size – Std. Deviation



Summary of Test Series

- In a majority of the cases there was a slight decrease in performance with a similar drop or slightly higher standard deviation as the distance from the detonator to the charge decreased

Conclusion

- The data presented shows a performance change from 6 inches to ~0 inches

Test Scenario	Penetration	Hole Size
RDX, Perpendicular	1.5%	2.2%
RDX, Parallel	4.9%	1.4%
HMX, Perpendicular	3.9%	2.4%
HMX, Parallel	5.6%	1.7%

- Initial findings show that decreased initiation cord length can have an effect on
  - 1-6% for penetration
  - 1-2.5% for hole size

- From the data presented there is not enough information to say with certainty this holds for every shaped charge due to variability as shown:
  - Liner and Charge geometry
  - External case geometry
  - Explosive Densities and sensitivities
  - Capsulated vs open faced

Future Testing & Considerations

- Testing results have the potential to be charge, style, and size specific
- Testing of other types of cord to see further effects
- Testing in numerous types of targets to see variation
- Cord velocity measurements to characterize natural variations in cord