Development of a Novel High Blast / High Fragmentation Melt Pour Explosive

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Background

- The vast majority of cannon lunched unitary warheads use melt pour explosives for cost and surge capability
- Traditional melt pour explosives have focused on fragmentation capability
  - TNT
  - Composition B
- A new family of low cost reduced sensitivity melt pour explosives based on 2,4-dinitroanisole, RDX or HMX and AP has been developed in response to IM requirements
  - PAX-21 - Composition B replacement (in production for 60mm mortar)
  - PAX-24 - TNT replacement
  - PAX-25 - Composition B replacement
  - PAX-28 - Dual purpose

Technical Approach

- Start with proven DNANs/AP system
  - Add Al for blast effect
  - Investigate levels of solids for performance/processibility
  - Evaluate effect of RDX versus HMX
- Compare to typical existing formulations
  - Composition B
  - PBXN-109
- Formulate the most promising compositions and test
  - Bench performance tests for fragmentation
  - Blast tests

Results

- A practical, dual purpose, melt pour explosive has been developed (PAX-28)
- Excellent blast characteristics
- Excellent bench scale fragmentation performance
- Good IM performance

Future Work

- Validate expected fragmentation performance
  - Pit tests in several fragmentation munitions
    - Quantity and mass distribution of fragments
  - Arena tests in target munitions based upon user requirements
    - Quantity, mass distribution, velocity and orientation of fragments
- Perform system level demonstrations
- Perform IM testing

Results: Initial Mixes

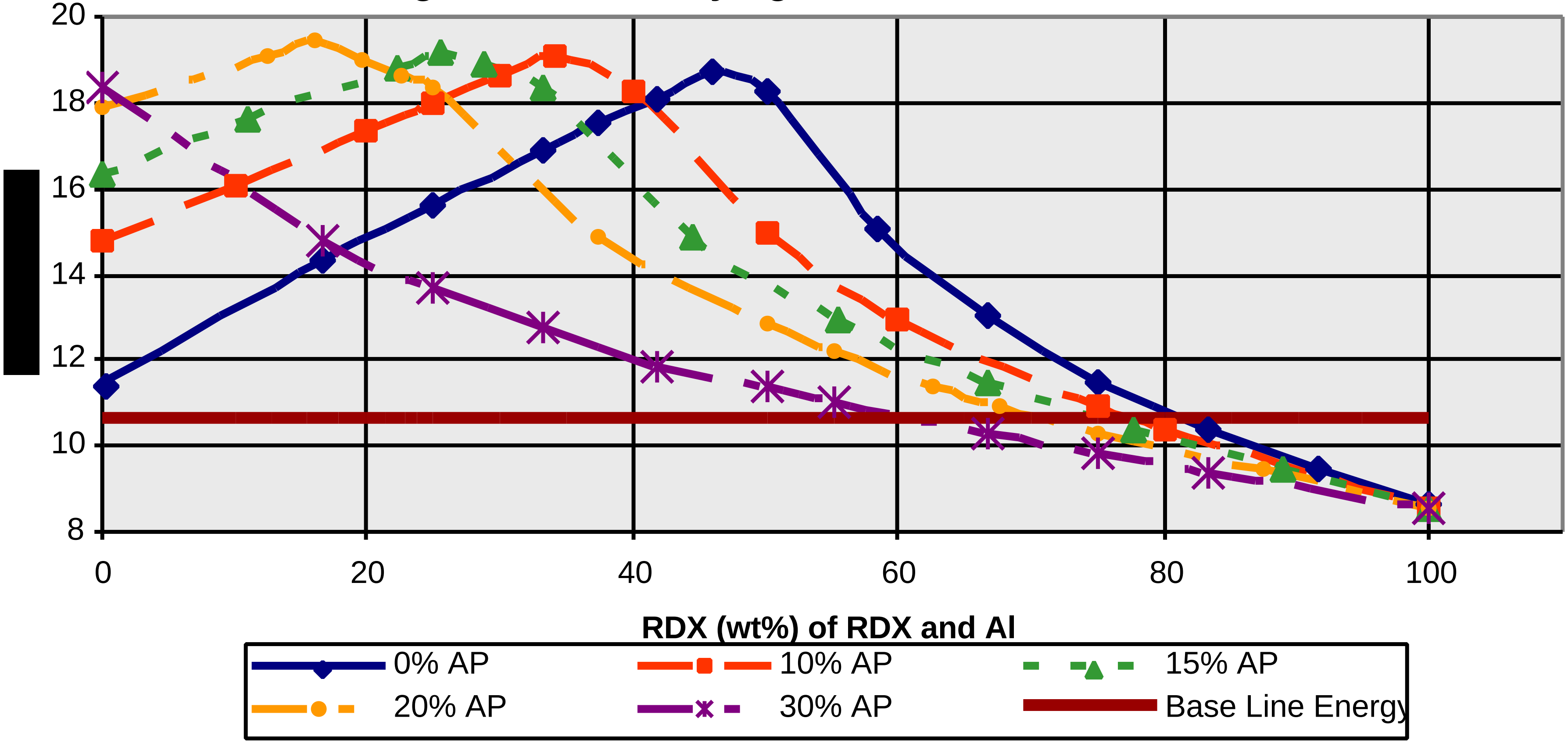
Table 1: Formulations Evaluated by Mix Number

Mix #	DNANs	RDX or HMX	AP	Al	RDX (wt%) Of RDX&Al
HMX Containing					
1	35	35	15	15	
17	35	35	15	15	
20	35	35	15	15	
RDX Containing					
30	40	20	20	20	50.00
31	40	30	20	10	75.00
32	40	30	15	15	66.67
33	40	50	0	10	83.33
34	40	30	0	30	50.00
35	40	10	0	50	16.67
36	40	0	0	60	0.00
37	40	27.5	0	32.5	45.83
38	40	17	10	33	34.00
39	40	11.5	15	33.5	25.56
40	40	6.4	20	33.6	16.00
41	40	0	30	30	0.00
42*	40	22.5	0	37.5	37.50
43*	40	40	0	20	66.67
44	40	12.5	10	37.5	25.00
45	40	25	10	25	50.00
46	40	5	15	40	11.11
47	40	15	15	30	33.33
48	40	5	20	35	12.50
49	40	10	20	30	25.00
50	40	7.5	30	22.5	25.00
51	40	25	20	15	62.50
52	40	13	30	18	41.94
53	40	16.5	30	13.5	55.00

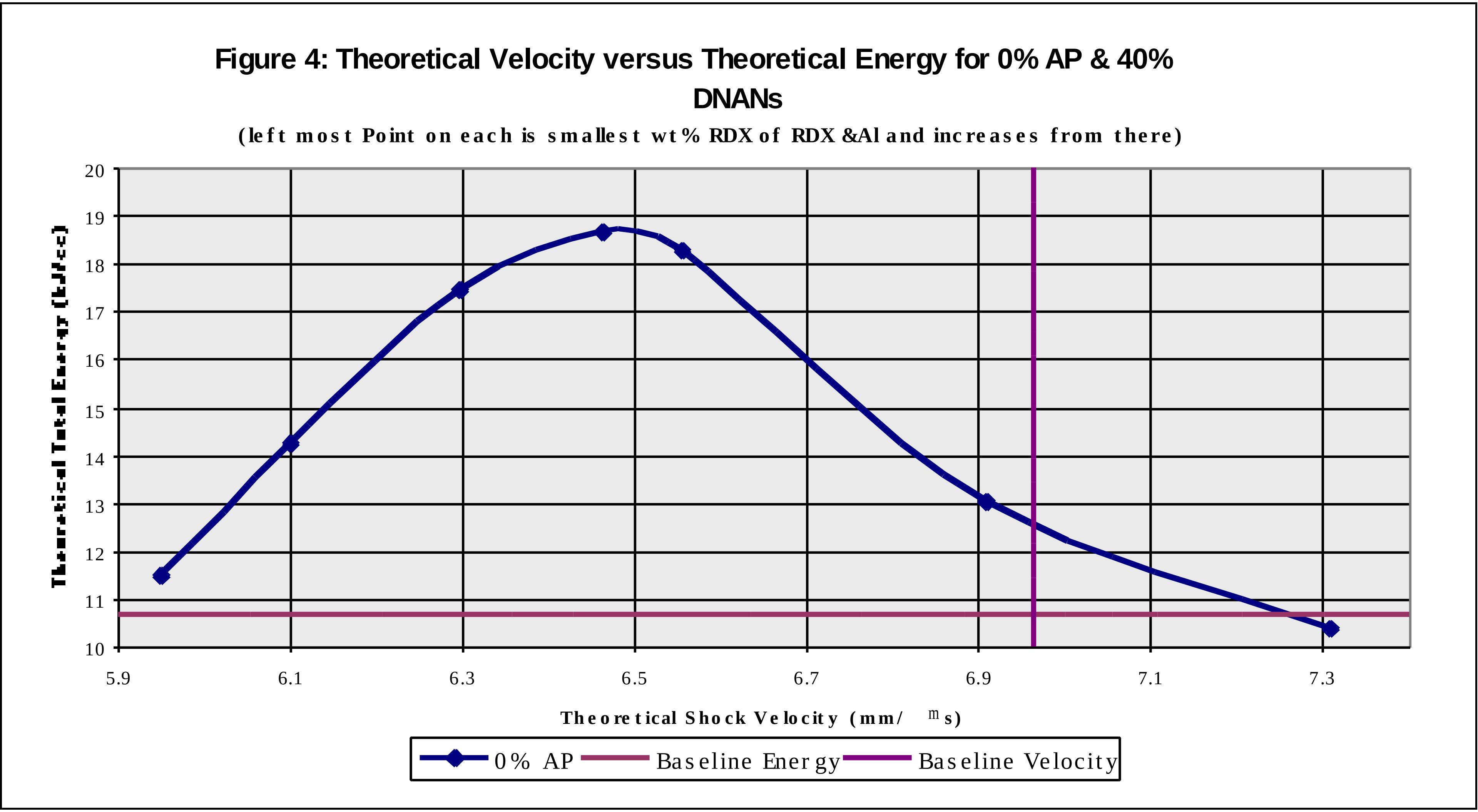
*Mixes were not made because it was determined that enough data was present on formulations containing 0% AP. These were fully evaluated theoretically.

Results: Total Energy – RDX v Al at varying levels of AP

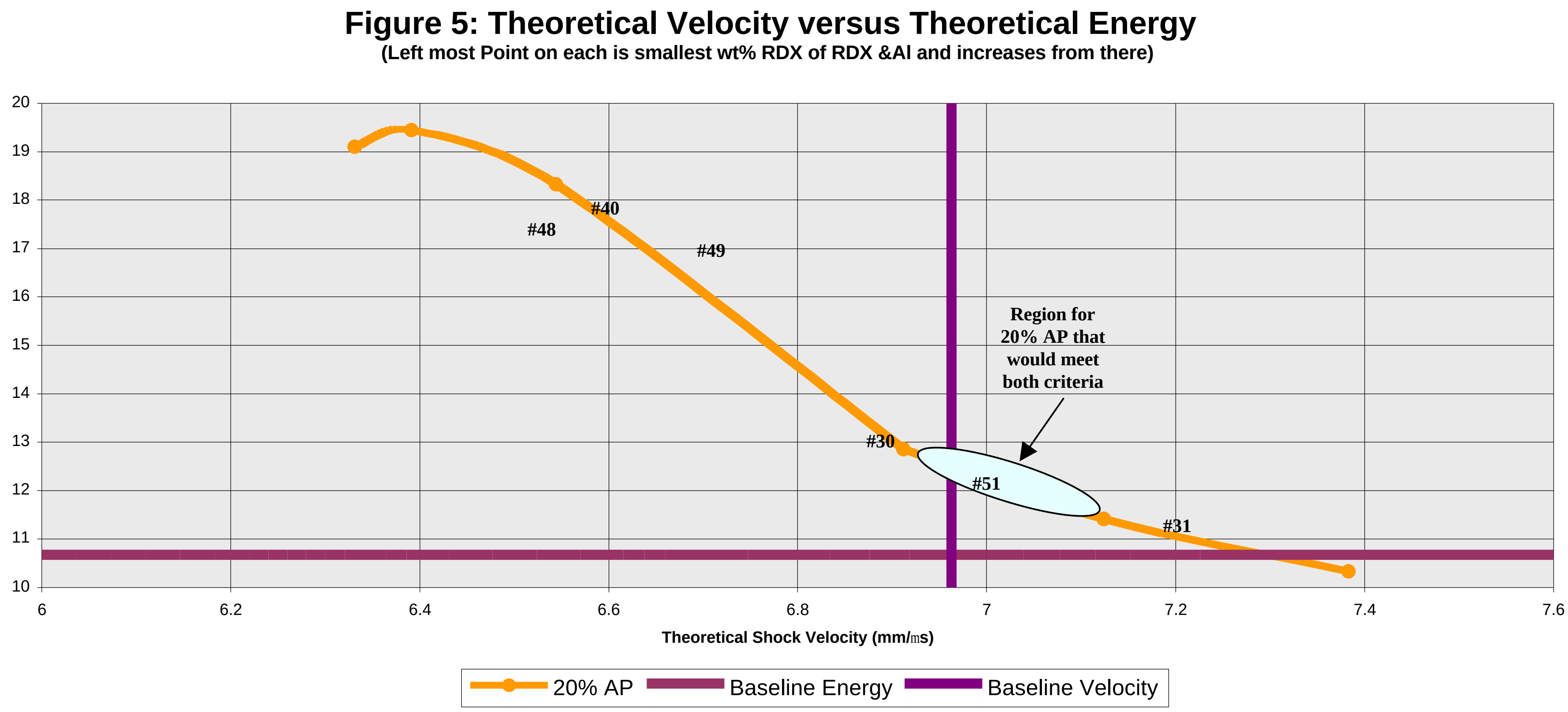
Figure 2: Theoretical Total Energy of Detonation as RDX is exchanged for Al at varying AP levels and 40% DNANs



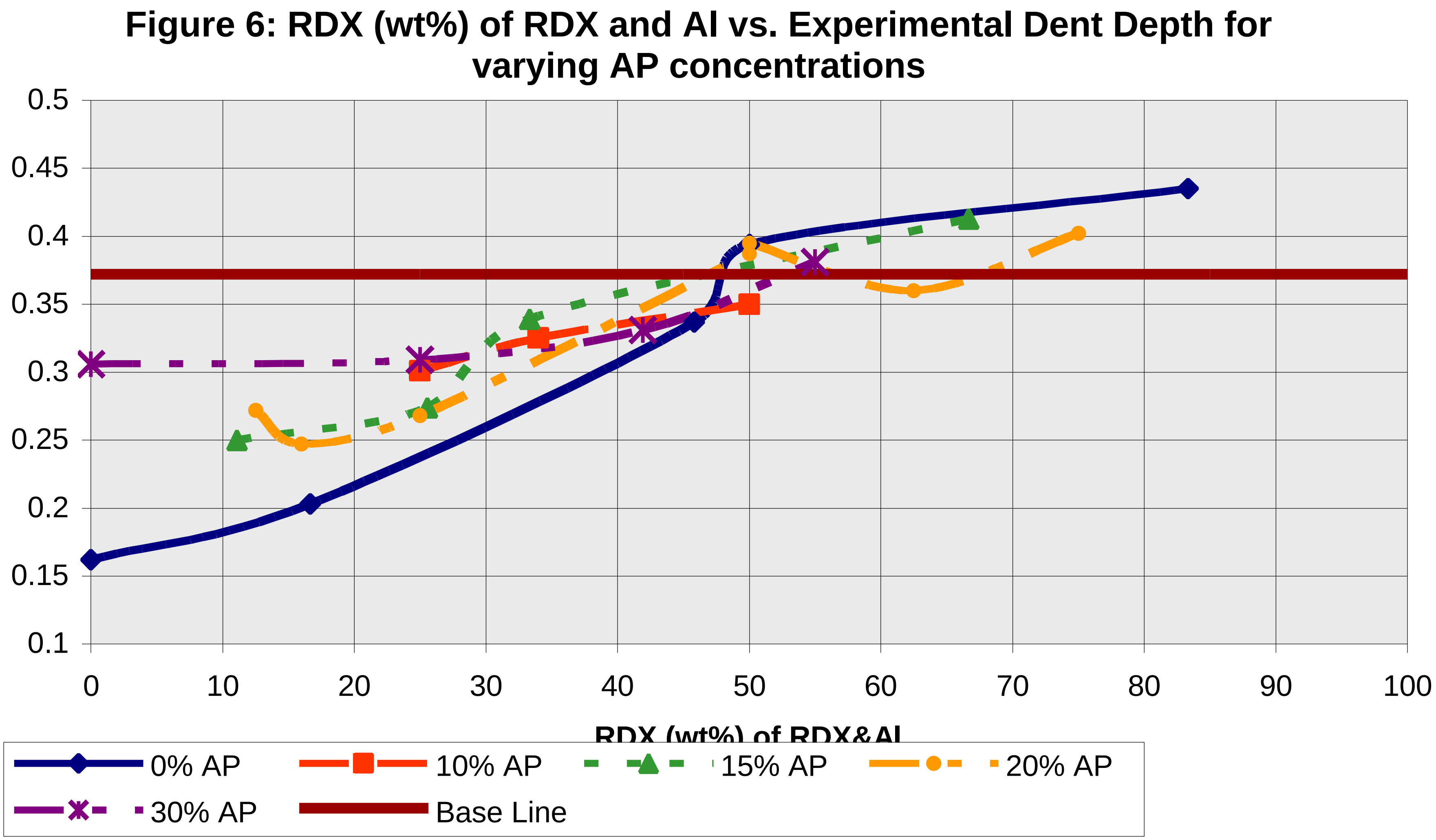
Results: Theoretical Velocity v Theoretical Energy



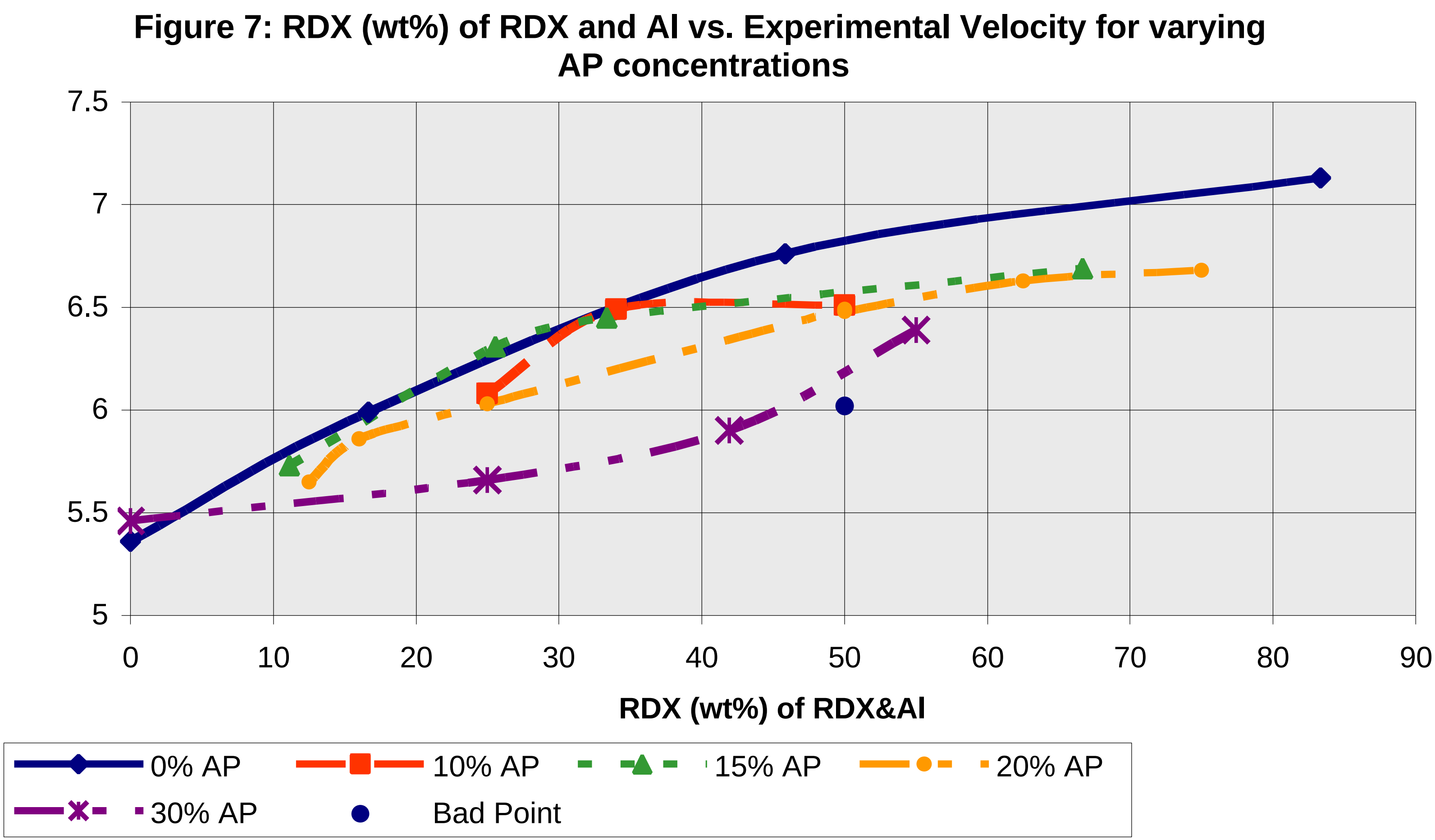
Results: Theoretical Velocity v Theoretical Energy



Results: Dent Depth



Results: RDX/Al Concentration v Experimental Velocity



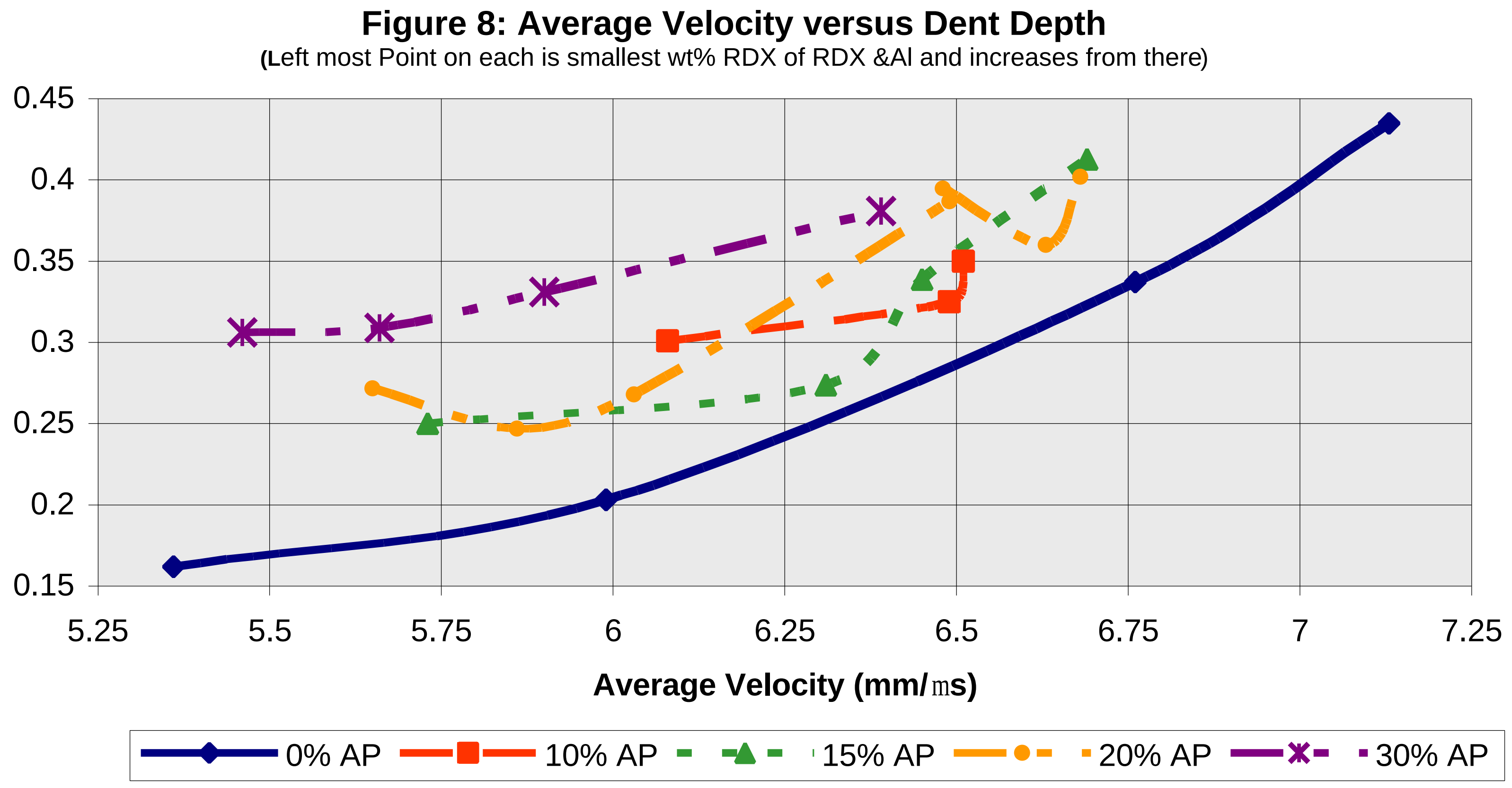
Results: Experimental Velocity & Dent v RDX

Table 6: Experimental Velocity and Dent Depth Increases With Increasing levels of RDX and Similar Levels of AP

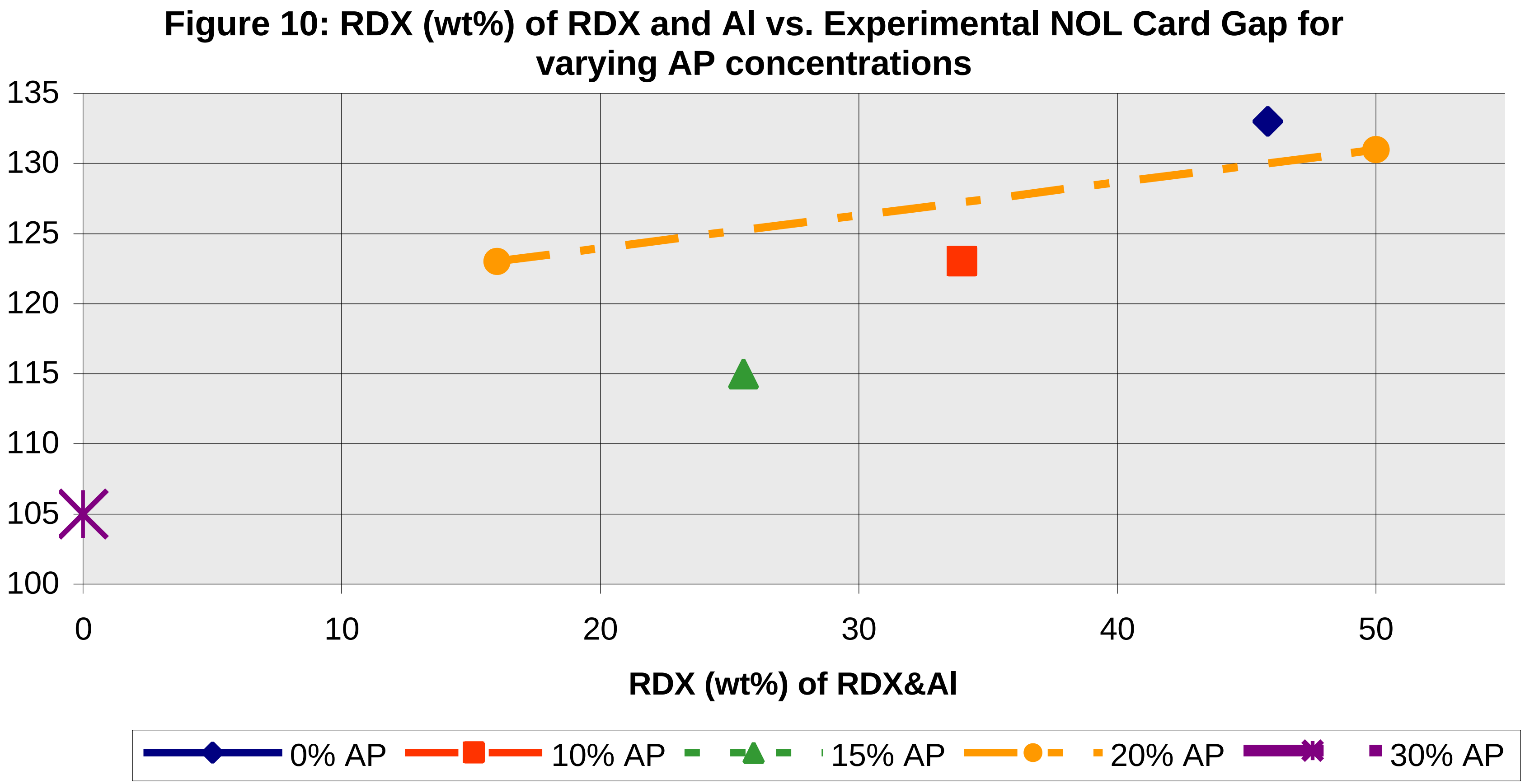
Mix #	RDX	AP	% velocity increased	% dent depth increased
44*	12.5	10		
38	17	10	6.3	7.4
45	25	10	6.6	14
46*	5	15		
39	11.5	15	9.2	8.8
47	15	15	11.2	26.3
49*	10	20		
30	20	20	6.9	32.2
31	30	20	9.7	33.3

* Mix numbers following in the same color set are percent of these i.e. the velocity of 38 is 6.3% greater than the velocity of 44

Results: Average Velocity v Dent Depth



Results: Card Gap



Results: The Bottom Line

Table 1. Average Peak Pressure

Explosive	Nominal N.E.W. (lbs)	Average Peak Pressure (psi)			
		10’	20’	30’	40’
Comp B	9.1	30.4	6.7	3.0	3.0
PAX-28	9.6	39.5	7.4	5.7	3.3
PAX-28	12.6	57.0	9.2	7.4	5.5

NEW used for PAX-28 was based upon an anticipated requirement

An equivalency factor of 1.62 was determined between Composition B and PAX-28

Results: Blast Equivalence Factors

Table 2. Factors for Equivalent Weight of Composition B

Explosive	Equivalent Comp B Factor
PBXN-109	1.19
Tritonal	1.09
AFX-777	1.47
AFX-757	1.39
PAX-28	1.62