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US Army Research Laboratory

# The Examination of the Aluminum Alloy 7017 as a Replacement for the Aluminum Alloy 7039 in Lightweight Armor Systems

by Tyrone L Jones and Brian E Placzankis

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*Weapons and Materials Research Directorate (ARL)*

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**14. ABSTRACT**
The aluminum alloy (AA) 7039 has been recognized as a serviceable armor plate alloy for years. However, the inherent stress corrosion cracking susceptibility of AA7039 has led to a need for a replacement. AA7017 (aluminum-zinc-magnesium) was created as a slightly stronger and more corrosion-resistant version of AA7039 for use in ground vehicle applications. Ballistic impact experiments evaluated the plate's ability to resist penetration under high-strain-rate loading. These experiments provide a gauge of penetration resistance for aluminum used in ground vehicle applications. This report focused on the dynamic investigation of 12.7- through 101.6-mm (0.5- through 4.0-inch)-thick plates, assessment of the penetration resistance, and the selection of a penetrative baseline for potential future 7000 series aluminum alloys.

**15. SUBJECT TERMS**
lightweight armor, aluminum, AA7017, AA7039, MIL-DTL-32505, MIL-DTL-46063H, ground vehicle

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# 1. Introduction

The use of aluminum alloys that demonstrate a combination of high strength, weldability, and corrosion resistance for vehicle structural applications has always been of interest to the Department of Defense. While aluminum alloy (AA) 7039 has been recognized as a weldable armor plate alloy for many years,[1] the inherent stress corrosion cracking susceptibility of AA7039[2] has led to a need for a replacement. Alcan Inc. addressed this issue further with a slightly stronger and more corrosion-resistant AA7017.[3]

This alloy has been successfully fielded on British and German armored ground systems and therefore became the basis for a fiscal year 2012 Office of the Deputy Assistant Secretary of Defense funded Foreign Comparative Test program to validate and ultimately transition AA7017 for availability in US acquisition. AA7017 (aluminum-zinc-magnesium) has demonstrated an excellent combination of mechanical properties, both quasi-static and at high strain rates.[4] The AA7039 and AA7017 chemical composition limits and mechanical property minimums[1,4] are listed in Tables 1 and 2, respectively. The enhanced properties make AA7017 a potential replacement for AA7039 and an aluminum alloy of interest for ground vehicle structural application. The ultimate goal of this study was to establish dynamic penetration performance for AA7017 when used in ballistic applications.

**Table 1 Chemical composition, weight percent**

| Elements | Symbol | 7017 alloy | 7039 alloy |
|---|---|---|---|
| Silicon | Si | 0.35 | 0.30 |
| Iron | Fe | 0.45 | 0.40 |
| Copper | Cu | 0.20 | 0.10 |
| Manganese | Mn | 0.05–0.50 | 0.10–0.40 |
| Magnesium | Mg | 2.0–3.0 | 2.3–3.3 |
| Chromium | Cr | 0.35 | 0.15–0.25 |
| Nickel | Ni | 0.10 | N/A |
| Zinc | Zn | 4.0–5.2 | 3.5–4.5 |
| Titanium | Ti | 0.15 | 0.10 |
| Zirconium | Zr | 0.10–0.25 | Not applicable |
| Other, min | (Mn + Cr) | 0.15 | Not applicable |
| Other, max. Each | . . . | 0.05 | 0.05 |
| Other, max. Total | . . | 0.15 | 0.15 |
| Aluminum | Al | Remainder | Remainder |

Note: Where single units are shown (except for Mn + Cr), these indicate the maximum amounts permitted.

**Table 2 Minimum mechanical properties**

| Thickness (mm) | Tensile strength (MPa) | | Yield strength, 0.2% offset (MPa) | | Elongation (%) | |
|---|---|---|---|---|---|---|
| | 7017 | 7039 | 7017 | 7039 | 7017 | 7039 |
| 12.7–38.1, including | 434 | 414 | 365 | 352 | 9 | 9 |
| 38.125–101.6, including | 414 | 393 | 345 | 331 | 8 | 8 |

All experiments of AA7017 were conducted in accordance with $V_{50}$ Ballistic Test for Armor (MIL-STD-662F).[5] This test methodology has been used for years to determine penetration resistance for aluminum alloys in ground vehicle applications.

## 2. Experimental Procedures

The $V_{50}$ is defined as the impact velocity at which the projectile is equally as likely to penetrate the target as it is to arrest. A 0.51-mm (0.020-inch) 2024 T3 aluminum witness plate is positioned 152 mm (6 inches) behind the target to determine the outcome of each shot. An impact is regarded as a complete penetration (CP), or loss, if the projectile or a resulting target fragment from impact creates a hole in the witness plate through which light can be observed. If an impact does not result in a CP, it is considered a partial penetration (PP), or win. To keep results as consistent as possible, only shots conforming to the following conditions were used to determine the $V_{50}$: The projectile must be unyawed; less than 2° of total yaw for armor-piercing (AP) rounds and less than 5° of total yaw for fragment-simulating projectiles (FSPs); and strike the target at least 2 projectile diameters from any previous impact or damage or the edge of the target. Total yaw is defined as the vector sum of the projectile's pitch and yaw and is listed as "Gamma" in the raw data in the Appendix. The $V_{50}$ is calculated by the arithmetic mean of an equal number of CPs and PPs within an 18-m/s (60 ft/s)-spread for a 2 + 2 $V_{50}$; a 27-m/s (90 ft/s)-spread for a 3 + 3 $V_{50}$; and as small of a spread as attainable for a 5 + 5 $V_{50}$.[5]

Projectile velocities for the determination of the $V_{50}$ were measured using 1 of 2 methods as shown in Fig. 1. The first method is an orthogonal flash X-ray system as described in detail by Grabarek and Herr,[6] which also measures pitch and yaw. The second method uses 3 infrared (IR) break screens and a chronograph. The velocity is calculated using the first and third screens with the middle screen used to check for bad readings. The flash X-ray method was used in situations with

projectiles that historically exhibit excessive yaw or if space did not allow for the use of the IR break screens. When the IR break screens and chronograph were used, the projectile velocity was corrected to the target-impact location using a correction factor based on an initial flash X-ray reading at the impact location. The correction was made using Eqs. 1 and 2 in lieu of utilizing air-drag factors.

$$\frac{\text{(X-ray velocity)}}{\text{(chronograph velocity)}} = \text{(correction factor)}. \quad (1)$$

$$\text{(correction factor)} \times \text{(chronograph velocity)} = \text{(corrected velocity)}. \quad (2)$$

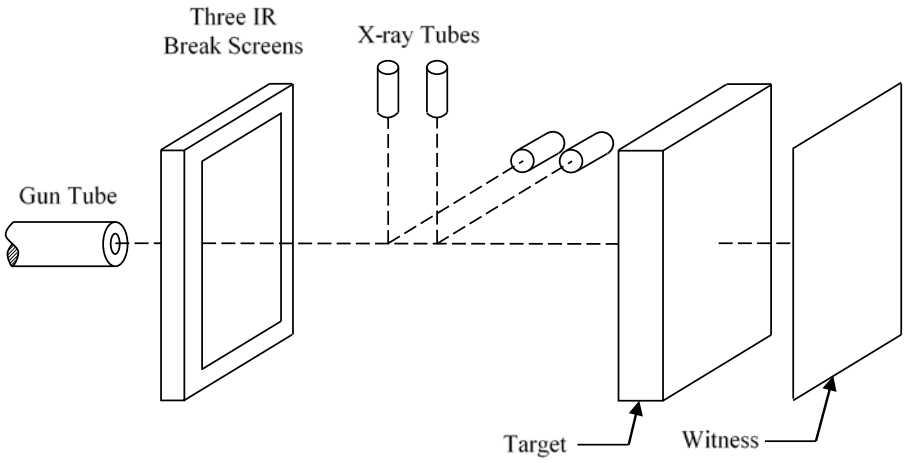


**Fig. 1 Typical test setup[7]**

## 3. Armor Piercing and Fragment-Simulating Projectiles

The US 0.30-cal. APM2, 0.50-cal. APM2, and the Soviet 14.5-mm BS41 are the 3 AP projectiles that were used in this study. Cross sections of these projectiles are shown in Fig. 2. The APM2 projectiles have hardened steel cores with hardness of Rockwell C61–66, whereas the BS41 has a tungsten carbide core. The physical characteristics of these projectiles are listed in Table 3. Additionally, a few experiments were repeated with the 0.30-cal. APM2 Test Parts Kit (0.30-cal. kit) round. This round is a US Army-authorized replacement for the historical 0.30-cal. APM2 due to the significant depletion of APM2 supply.

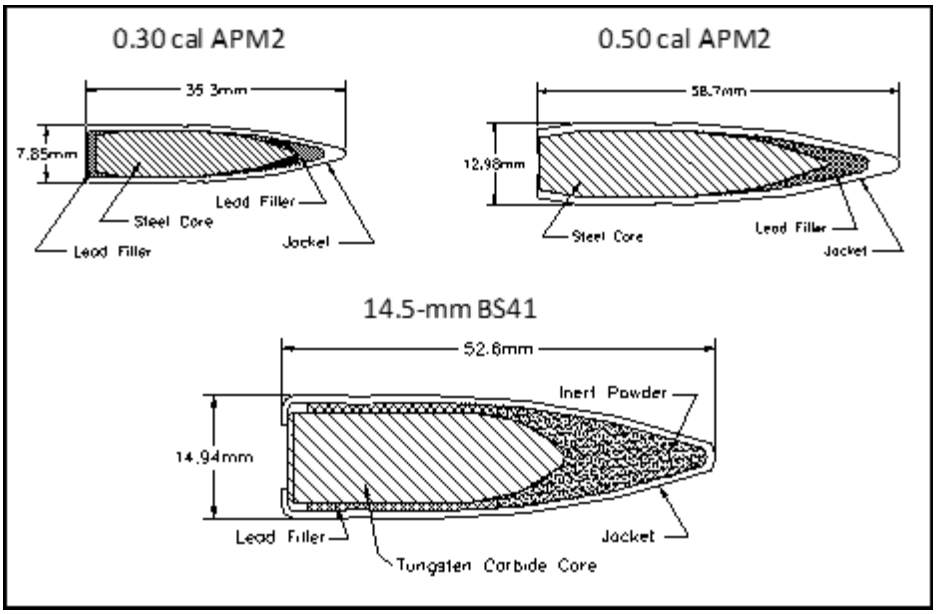


**Fig. 2 AP projectiles**

**Table 3 AP projectiles' physical characteristics[8]**

| Projectile type | Length (mm) | Projectile diameter (mm) | Weight (g) | Length (mm) | Core diameter (mm) | Weight (g) |
|---|---|---|---|---|---|---|
| 0.30-cal. APM2 | 35.3 | 7.85 | 10.8 | 27.4 | 6.2 | 5.3 |
| 0.50-cal. APM2 | 58.7 | 12.98 | 45.9 | 47.5 | 6.2 | 25.9 |
| 14.5-mm BS41 | 52.6 | 14.94 | 63.2 | 32.3 | 10.9 | 25.9 |

FSPs (Fig. 3) are a family of projectiles that are flat-nosed, right circular steel cylinders manufactured to MIL-DTL-46593B (MR).[9] These projectiles are used in material evaluations and acceptance testing to simulate performance against fragments produced from improvised explosive devices and artillery. Both 0.50-cal. and 20-mm FSPs were used for the evaluation of AA7039.

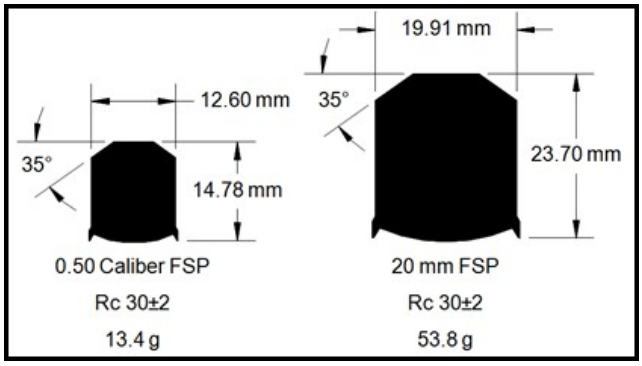


**Fig. 3 FSP projectiles[7]**

## 4. Results and Analysis

The results of the AA7017 ballistic evaluation were compared with the required ballistic limit acceptance curve of AA7039 published in MIL-DTL-46063H as a reference point. The experimental matrix for the penetration analysis is shown in Tables 4–9. The individual shot records are provided in the Appendix. Tables 4–9 provide the AA7017 experimental data generated.

**Table 4 The 0.30-cal. APM2, 30° obliquity $V_{50}$ ballistic limits for AA7017**

| Plate identification (ID) | Alloy temper | Nominal thickness (mm) | Actual thickness (mm) | $V_{50}$ (m/s) | Standard deviation (m/s) |
|---|---|---|---|---|---|
| 495867-3A1 | T6 | 12.70 | 12.88 | 476 | 6 |
| 459867-3A1[a] | T6 | 12.70 | 12.88 | 477 | 11 |
| 495867-1A2[a] | T6 | 12.70 | 12.88 | 485 | 9 |
| 495867-1A2 | T6 | 12.70 | 12.88 | 490 | 10 |
| K889 T7651 | T7 | 12.70 | 13.21 | 479 | 10 |
| 495871-5G1 | T6 | 19.05 | 19.33 | 631 | 7 |
| 495871-1G2 | T6 | 19.05 | 19.30 | 641 | 10 |
| K889 T7651 | T7 | 19.05 | 19.96 | 633 | 10 |

[a]0.30-cal. kit

**Table 5 The 0.30-cal. APM2, 0° obliquity $V_{50}$ ballistic limits for AA7017**

| Plate ID | Alloy temper | Nominal thickness (mm) | Actual thickness (mm) | $V_{50}$ (m/s) | Standard deviation (m/s) |
|---|---|---|---|---|---|
| 495871-1G2 | T6 | 19.05 | 19.30 | 558 | 6 |
| 495871-5G1 | T6 | 19.05 | 19.32 | 564 | 7 |
| K889 | T7 | 19.05 | 19.95 | 569 | 11 |
| 495880-4E2 | T6 | 25.40 | 25.52 | 659 | 10 |
| 495880-4E2[a] | T6 | 25.40 | 25.53 | 653 | 7 |
| 495880-4B1[a] | T6 | 25.40 | 25.48 | 660 | 6 |
| 495880-4B1 | T6 | 25.40 | 25.48 | 650 | 7 |
| 495892-1E1[a] | T6 | 38.10 | 38.40 | 857 | 7 |
| 495892-1E1 | T6 | 38.10 | 38.40 | 833 | 5 |
| 495892-1B2[a] | T6 | 38.10 | 38.31 | 847 | 7 |
| 495892-1B2 | T6 | 38.10 | 38.31 | 833 | 4 |
| K889 | T7 | 38.10 | 38.93 | 827 | 6 |

[a]0.30-cal kit

**Table 6 The 0.50-cal. APM2, 0° obliquity $V_{50}$ ballistic limits for AA7017**

| Plate ID | Alloy temper | Nominal thickness (mm) | Actual thickness (mm) | $V_{50}$ (m/s) | Standard deviation (m/s) |
|---|---|---|---|---|---|
| 495892-1E1 | T6 | 38.10 | 38.38 | 626 | 6 |
| K889-T7651 | T7 | 38.10 | 38.91 | 625 | 8 |
| 495905-2F1 | T6 | 50.80 | 51.13 | 727 | 6 |
| 495905-2G2 | T6 | 50.80 | 51.08 | 725 | 5 |
| K889-T7651 | T7 | 50.80 | 52.39 | 731 | 6 |
| 495930-2H1 | T6 | 63.50 | 63.98 | 839 | 9 |
| 495930-2K1 | T6 | 63.50 | 63.98 | 831 | 8 |
| 495935-1D1 | T6 | 76.20 | 76.66 | 920 | 7 |
| 495935-1D2 | T6 | 76.20 | 76.68 | 931 | 6 |
| K889-T7651 | T7 | 76.20 | 74.86 | 899 | 5 |

**Table 7 The 14-mm BS41, 0° obliquity $V_{50}$ ballistic limits for AA7017**

| Plate ID | Alloy temper | Nominal thickness (mm) | Actual thickness (mm) | $V_{50}$ (m/s) | Standard deviation (m/s) |
|---|---|---|---|---|---|
| 495935-1D1 | T6 | 76.20 | 76.65 | 864 | 8 |
| 495935-1D2 | T6 | 76.20 | 76.68 | 859 | 6 |
| K889-T7651 | T7 | 76.20 | 74.86 | 837 | 5 |
| 495953-1E1 | T6 | 88.90 | 89.47 | 948 | 8 |
| 495953-1E2 | T6 | 88.90 | 89.52 | 941 | 10 |
| 495959-1G1 | T6 | 101.60 | 102.65 | 1015[a] | . . . |
| 495959-1G2 | T6 | 101.60 | 102.46 | 1014[a] | . . . |
| K889-T7651 | T7 | 101.60 | 99.02 | 984 | 5 |

[a]Testing halted; reached max firing velocity of gun; high PP

**Table 8 The 0.50-cal. FSP, 0° obliquity $V_{50}$ ballistic limits for AA7017**

| Plate ID | Alloy temper | Nominal thickness (mm) | Actual thickness (mm) | $V_{50}$ (m/s) | Standard deviation (m/s) |
|---|---|---|---|---|---|
| 495871-1G2 | T6 | 19.05 | 19.29 | 660 | 8 |
| 495871-5G1 | T6 | 19.05 | 19.30 | 625 | 5 |
| K889-T7651 | T7 | 19.05 | 19.89 | 650 | 8 |
| 495880-4E2 | T6 | 25.40 | 25.50 | 1049 | 8 |
| 495880-4B1 | T6 | 25.40 | 25.48 | 1093 | 9 |

**Table 9 The 20-mm FSP, 0° obliquity $V_{50}$ ballistic limits for AA7017**

| Plate ID | Alloy temper | Nominal thickness (mm) | Actual thickness (mm) | $V_{50}$ (m/s) | Standard deviation (m/s) |
|---|---|---|---|---|---|
| K889 T7651, 469280A2 | T7 | 19.05 | 19.95 | 346 | 21 |
| 495880-4B1 | T6 | 25.40 | 25.48 | 462 | 9 |
| 495880-4E2 | T6 | 25.40 | 25.50 | 463 | 5 |
| 495892-1E1 | T6 | 38.10 | 38.38 | 903 | 7 |
| 495892-1B2 | T6 | 38.10 | 38.30 | 877 | 5 |
| K889 T7651, 46950640 | T6 | 38.10 | 38.93 | 903 | 19 |
| 495905-2F1 | T6 | 50.80 | 51.13 | 1301 | 8 |

Figures 4–9 showed the AA7017 experimental data generated compared with the AA7039 minimum $V_{50}$s. The AA7017 data displayed are the plots of $V_{50}$ as a function of the plate thickness. A line depicting the $V_{50\text{-}2\sigma}$ for AA7017 was plotted for comparison to the AA7039 acceptance requirement from the specification. This line represents a $V_{02}$ (2% probability that the plate will be defeated) rather than a $V_{50}$ (50% probability that the plate will be defeated). To ensure successful protection at a given thickness, the lower band of the 2σ distribution ($V_{02}$ line) is used to define minimum-acceptable performance. An experimental $V_{50}$ falling below this line is considered unacceptable.

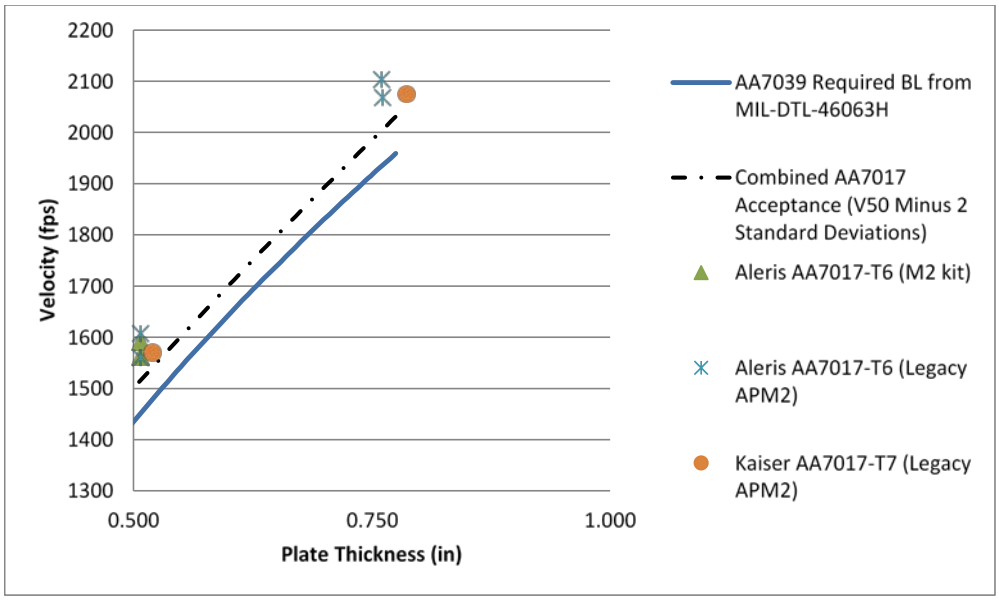


**Fig. 4 Ballistic penetration resistance of 0.30-cal. APM2 vs. AA7017 at 30°**

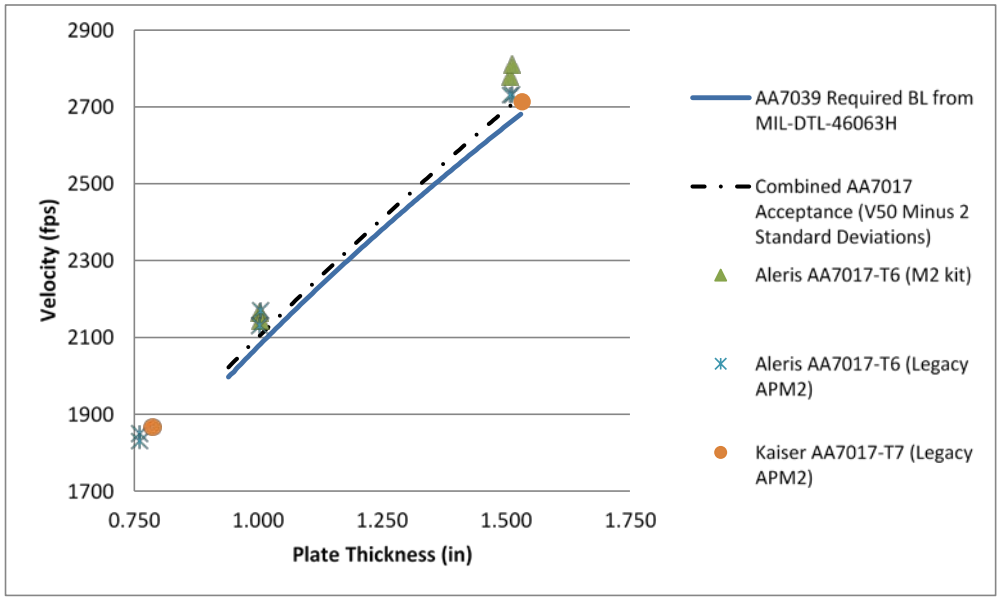


**Fig. 5 Ballistic penetration resistance of 0.30-cal. APM2 vs. AA7017 at 0°**

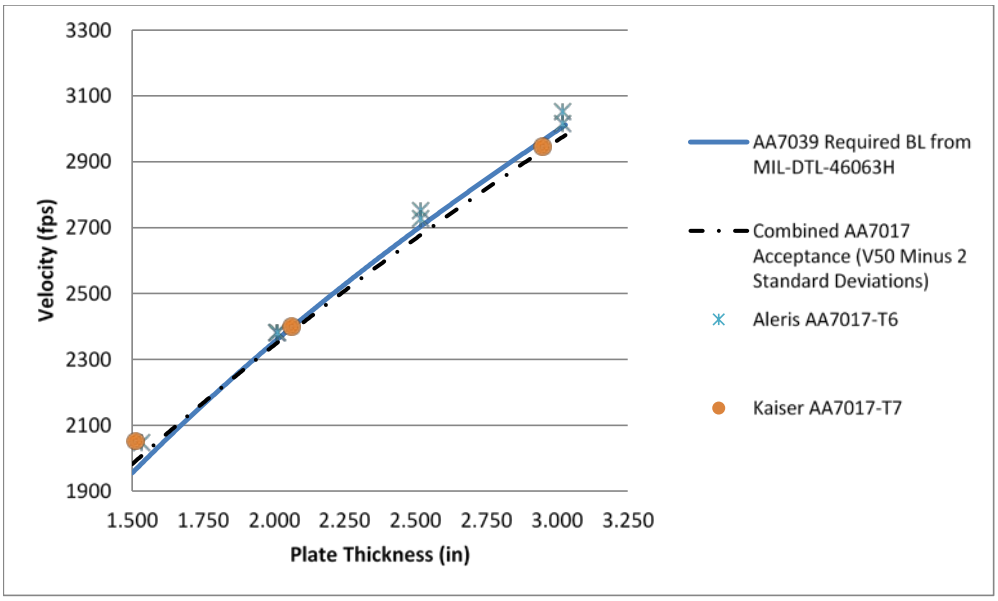


**Fig. 6 Ballistic penetration resistance of 0.50-cal. APM2 vs. AA7017 plate at 0°**

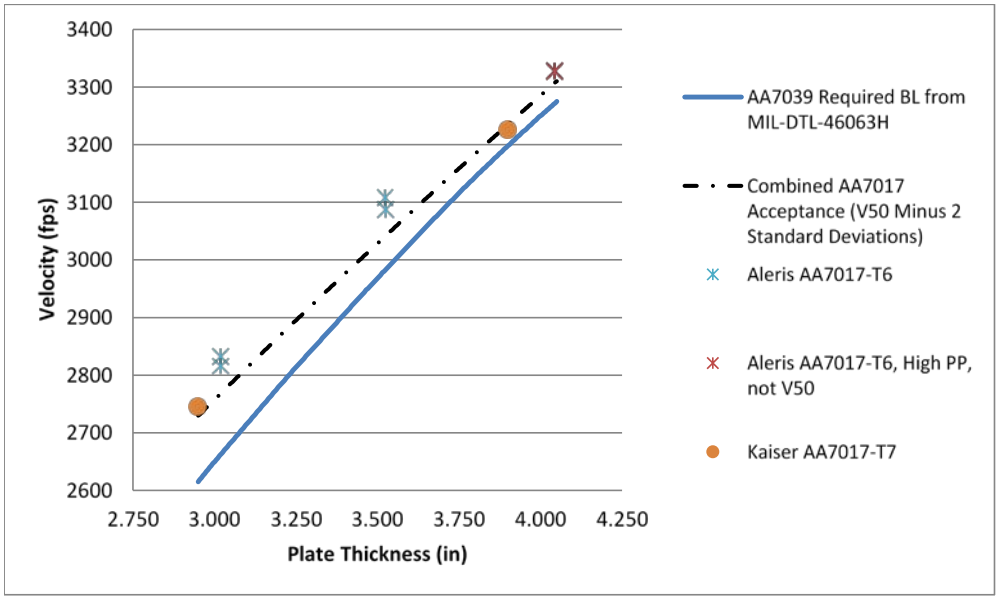


**Fig. 7 Ballistic penetration resistance of 14.5-mm BS41 vs. AA7017 plate at 0°**

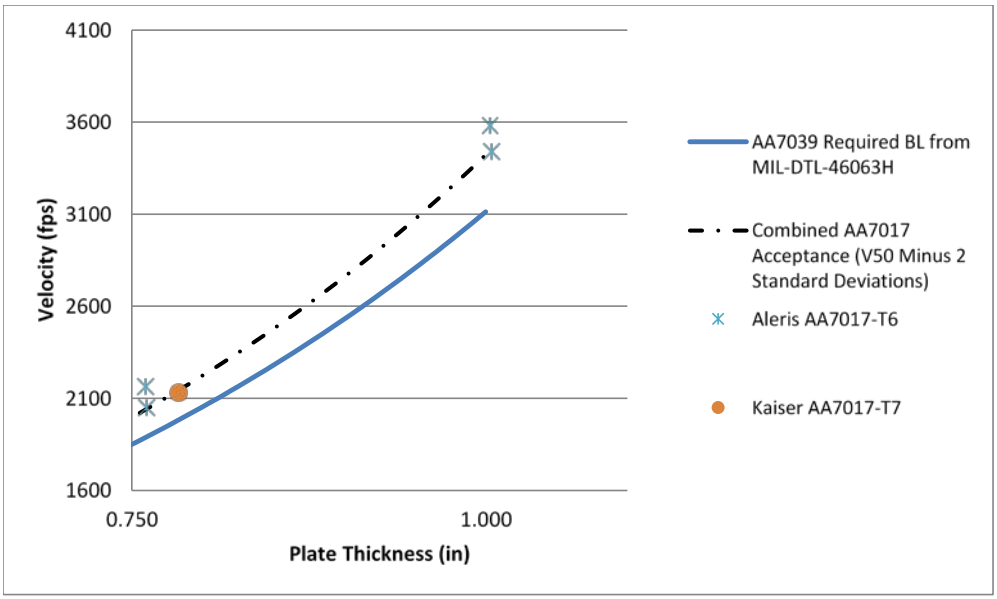


**Fig. 8 Ballistic penetration resistance of 0.50-cal. FSP vs. AA7017 plate at 0°**

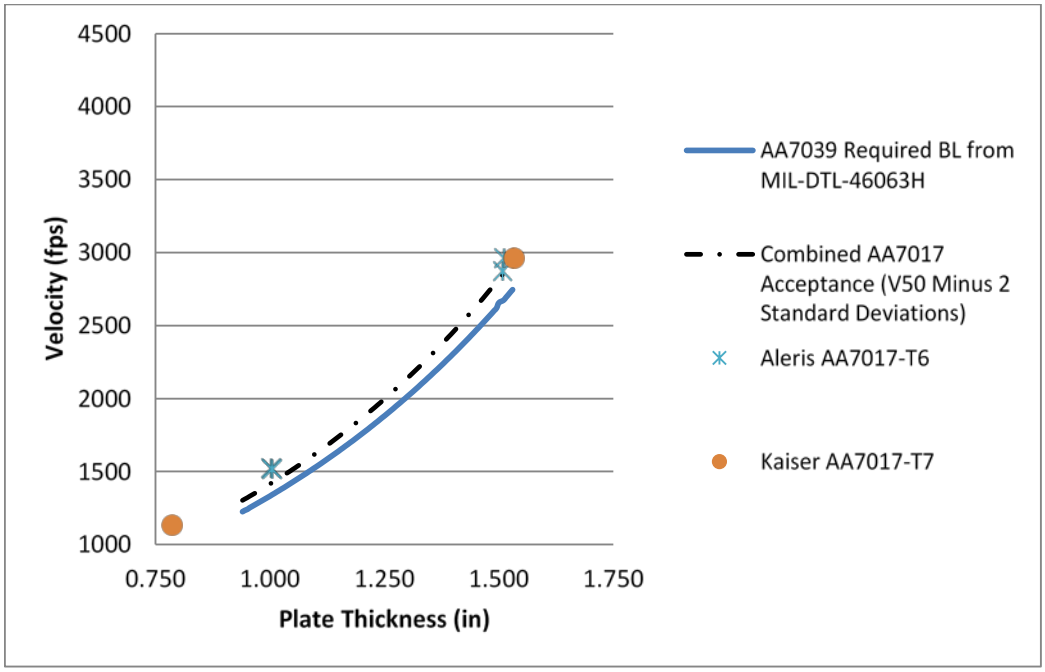


**Fig. 9 Ballistic penetration resistance of 20-mm FSP vs. AA7017 plate at 0°**

The data collected by the US Army Research Laboratory were then used to generate acceptance tables for MIL-DTL-32505. The acceptance velocities were calculated by fitting the $V_{50}$ data minus 2 standard deviations.

## 5. Conclusion

A dynamic experimental evaluation was performed on the AA7017 in the T6 and T7 tempers. This report has compared the performance of AA7017 against existing AA7039 military specification, aluminum-armor material. AA7017 outperformed AA7039 against both AP and FSP projectiles. The only exception is 0.50-cal. APM2 performance above 2.000 inches, where AA7039 exhibits a slightly higher performance. This report has also documented the calculations used to derive the acceptance tables included in the new military specification, MIL-DTL-32505. As a result of this research, AA7017 has been recommended as a replacement.

## 6. References


1. MIL-DTL-46063H. Armor plate, aluminum alloy, 7039. Aberdeen Proving Ground (MD): Army Research Laboratory (US); 1998 Sep 14.

2. Rinnovatore JV, Rorabaugh DT, Zalcmann A. Correlation determinations between stress corrosion characteristics of wrought 7039 aluminum armor and other alloy characteristics – ballistic performance, yield strength, and electrical conductivity. Frankford Arsenal (PA): Army Armament Command (US); 1975 Apr. Report No.: FA-TR-75026.

3. Alcan Inc. Registration Record Series. Teal Sheets. International alloy designations and chemical composition limits for wrought aluminum and wrought aluminum alloys. Alexandria (VA): The Aluminum Association, Inc.; 2015 Jan.

4. MIL-DTL-32505. Armor plate, aluminum, alloy 7017 weldable and 7020 applique. Aberdeen Proving Ground (MD): Army Research Laboratory (US); 2014 Nov 13.

5. MIL-STD-662F. $V_{50}$ ballistic test for armor. Aberdeen Proving Ground (MD): Army Research Laboratory (US); 1997 Dec 18.

6. Grabarek C, Herr L. X-ray multi-flash system for measurement of projectile performance at the target. Aberdeen Proving Ground (MD): Army Ballistic Research Laboratory (US); 1966 Sep. Report No.: BRL-TN-1634.

7. Gallardy D. Ballistic evaluation of 6055 aluminum. Aberdeen Proving Ground (MD): Army Research Laboratory (US); 2015 Sep. Report No.: ARL-MR-0904.

8. Mascianica F. Ballistic technology of lightweight armor. Watertown (MA): Army Materials Research Agency (US); 1964 Sep. Report No.: AMRA MS 64-07.

9. MIL-DTL-46593B (MR). Projectile, calibers .22, .30, .50, and 20 mm fragment-simulating. Aberdeen Proving Ground (MD): Army Research Laboratory (US); 2008 Aug 11.

## Appendix. Raw Data

This appendix appears in its original form, without editorial change.

## 0.30-cal APM2 Legacy

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **25-Mar-13** | | | | | |
| Plate #: | **495867-1A2** | | | Test Site: | **EF-106** | | | | | |
| Lot#: | **1A2** | | | | | | | | | |
| Avg. Thickness: | **0.507** | **"** | **12.878** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **137** | **HBN** | | | | | | | | |
| Obliquity: | **30°** | | | | | | | | | |
| Projectile: | **30cal** | **APM2** | **Lot #:** | TW18035 | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Chrono** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **490** | **m/s** | **1607** | **ft/s** | | | | | | |
| **High PP:** | **495** | **m/s** | **1624** | **ft/s** | | | | | | |
| **V50:** | **490** | **m/s** | **1608** | **ft/s** | | **# shots:** | **6** | | | |
| **Std Dev:** | **10** | **m/s** | **32** | **ft/s** | | **Spread:** | **26** | **m/s** | **85** | **ft/s** |
| **ZMR:** | **5** | **m/s** | **16** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| **490** | **1607** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12467** | | |
| 521 | **1709** | -- | -- | -- | CP | No | -- | 12468 | | |
| 514 | **1686** | -- | -- | -- | CP | No | -- | 12469 | | |
| 516 | **1692** | -- | -- | -- | CP | No | -- | 12470 | | |
| **495** | **1624** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12471** | | |
| **471** | **1545** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12472** | | |
| **492** | **1614** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12473** | | |
| **497** | **1630** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12474** | | |
| **496** | **1627** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12475** | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **18-Mar-13** | | | | | |
| Plate #: | **495867-3A1** | | | Test Site: | **EF-106** | | | | | |
| Lot#: | **3A1** | | | | | | | | | |
| Avg. Thickness: | **0.507** | **"** | **12.884** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **137** | **HBN** | | | | | | | | |
| Obliquity: | **30°** | | | | | | | | | |
| Projectile: | **30cal** | **APM2** | **Lot #:** | TW18035 | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Chrono** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **478** | **m/s** | **1568** | **ft/s** | | | | | | |
| **High PP:** | **472** | **m/s** | **1548** | **ft/s** | | | | | | |
| **V50:** | **476** | **m/s** | **1560** | **ft/s** | | **# shots:** | **6** | | | |
| **Std Dev:** | **6** | **m/s** | **20** | **ft/s** | | **Spread:** | **14** | **m/s** | **46** | **ft/s** |
| **ZMR:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| 445 | 1460 | -- | -- | -- | PP | No | -- | 12439 | | |
| **469** | **1538** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12440** | | |
| 497 | 1630 | -- | -- | -- | CP | No | -- | 12441 | | |
| 493 | 1617 | -- | -- | -- | CP | No | -- | 12442 | | |
| 449 | 1473 | -- | -- | -- | PP | No | -- | 12443 | | |
| 491 | 1610 | -- | -- | -- | CP | No | -- | 12444 | | |
| **472** | **1548** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12445** | | |
| 494 | 1620 | -- | -- | -- | CP | No | -- | 12446 | | |
| **483** | **1584** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12447** | | |
| **478** | **1568** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12448** | | |

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|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T7** | | | Date: | **14-Oct-10** | | | | | |
| Plate #: | **K889 T7651** | | | Test Site: | **EF-106** | | | | | |
| Lot#: | **T7651** | | | | | | | | | |
| Avg. Thickness: | **0.520** | **"** | **13.214** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **134** | **HBN** | | | | | | | | |
| Obliquity: | **30°** | | | | | | | | | |
| Projectile: | **30cal** | **APM2** | **Lot #:** | TW18035 | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Chrono** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **486** | **m/s** | **1594** | **ft/s** | | | | | | |
| **High PP:** | **471** | **m/s** | **1545** | **ft/s** | | | | | | |
| **V50:** | **479** | **m/s** | **1570** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **10** | **m/s** | **31** | **ft/s** | | **Spread:** | **18** | **m/s** | **59** | **ft/s** |
| **ZMR:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| **470** | **1542** | **--** | **--** | **1.12** | **PP** | **Yes** | **--** | **9931** | | |
| **486** | **1594** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **9932** | | |
| 465 | 1525 | -- | -- | -- | PP | No | -- | 9933 | | |
| **471** | **1545** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **9934** | | |
| **488** | **1601** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **9935** | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **26-Mar-13** | | | | | |
| Plate #: | **495871-5G1** | | | Test Site: | **EF-106** | | | | | |
| Lot#: | **5G1** | | | | | | | | | |
| Avg. Thickness: | **0.761** | **"** | **19.317** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **137** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **30cal** | **APM2** | **Lot #:** | TW18035 | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Chrono** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **566** | **m/s** | **1856** | **ft/s** | | | | | | |
| **High PP:** | **559** | **m/s** | **1834** | **ft/s** | | | | | | |
| **V50:** | **564** | **m/s** | **1851** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **7** | **m/s** | **24** | **ft/s** | | **Spread:** | **16** | **m/s** | **52** | **ft/s** |
| **ZMR:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| 550 | 1804 | -- | -- | -- | PP | No | -- | 12482 | | |
| **574** | **1883** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12483** | | |
| **558** | **1830** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12484** | | |
| **566** | **1856** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12485** | | |
| 554 | 1817 | -- | -- | -- | PP | No | -- | 12486 | | |
| **559** | **1834** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12487** | | |

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|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **26-Mar-13** | | | | | |
| Plate #: | **495871-1G2** | | | Test Site: | **EF-106** | | | | | |
| Lot#: | **1G2** | | | | | | | | | |
| Avg. Thickness: | **0.760** | **"** | **19.304** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **134** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **30cal** | **APM2** | **Lot #:** | TW18035 | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Chrono** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **562** | **m/s** | **1843** | **ft/s** | | | | | | |
| **High PP:** | **553** | **m/s** | **1814** | **ft/s** | | | | | | |
| **V50:** | **558** | **m/s** | **1830** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **6** | **m/s** | **21** | **ft/s** | | **Spread:** | **13** | **m/s** | **43** | **ft/s** |
| **ZMR:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |

| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** |
|---|---|---|---|---|---|---|---|---|
| 585 | 1919 | -- | -- | -- | CP | No | -- | 12476 |
| 533 | 1748 | -- | -- | -- | PP | No | -- | 12477 |
| **552** | **1811** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12478** |
| **565** | **1853** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12479** |
| **553** | **1814** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12480** |
| **562** | **1843** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12481** |

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|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-t7** | | | Date: | **12-Oct-10** | | | | | |
| Plate #: | **K889** | | | Test Site: | **EF-106** | | | | | |
| Lot#: | **K889** | | | | | | | | | |
| Avg. Thickness: | **0.786** | **"** | **19.952** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **128** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **30cal** | **APM2** | **Lot #:** | TW18035 | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Chrono** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **576** | **m/s** | **1889** | **ft/s** | | | | | | |
| **High PP:** | **566** | **m/s** | **1856** | **ft/s** | | | | | | |
| **V50:** | **569** | **m/s** | **1867** | **ft/s** | | **# shots:** | **6** | | | |
| **Std Dev:** | **11** | **m/s** | **36** | **ft/s** | | **Spread:** | **25** | **m/s** | **82** | **ft/s** |
| **ZMR:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| **580** | **1902** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **9915** | | |
| 500 | 1640 | -- | -- | -- | PP | No | -- | 9916 | | |
| 547 | 1794 | -- | -- | -- | PP | No | -- | 9917 | | |
| **559** | **1834** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **9918** | | |
| **566** | **1856** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **9919** | | |
| **580** | **1902** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **9920** | | |
| **555** | **1820** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **9921** | | |
| **576** | **1889** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **9922** | | |

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|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **3-Apr-13** | | | | | |
| Plate #: | **495871-1G2** | | | Test Site: | **EF-106** | | | | | |
| Lot#: | **1G2** | | | | | | | | | |
| Avg. Thickness: | **0.760** | **"** | **19.304** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **134** | **HBN** | | | | | | | | |
| Obliquity: | **30°** | | | | | | | | | |
| Projectile: | **30cal** | **APM2** | **Lot #:** | TW18035 | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Chrono** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **634** | **m/s** | **2080** | **ft/s** | | | | | | |
| **High PP:** | **642** | **m/s** | **2106** | **ft/s** | | | | | | |
| **V50:** | **641** | **m/s** | **2103** | **ft/s** | | **# shots:** | **6** | | | |
| **Std Dev:** | **10** | **m/s** | **34** | **ft/s** | | **Spread:** | **24** | **m/s** | **79** | **ft/s** |
| **ZMR:** | **8** | **m/s** | **26** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| 626 | 2053 | -- | -- | -- | PP | No | -- | 12521 | | |
| 660 | 2165 | -- | -- | -- | CP | No | -- | 12522 | | |
| **634** | **2080** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12523** | | |
| **633** | **2076** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12524** | | |
| 662 | 2171 | -- | -- | -- | CP | No | -- | 12525 | | |
| **642** | **2106** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12526** | | |
| **631** | **2070** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12527** | | |
| **655** | **2148** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12528** | | |
| **652** | **2139** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12529** | | |

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|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **2-Apr-13** | | | | | |
| Plate #: | **495871-5G1** | | | Test Site: | **EF-106** | | | | | |
| Lot#: | **5G1** | | | | | | | | | |
| Avg. Thickness | **0.761** | **"** | **19.329** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **137** | **HBN** | | | | | | | | |
| Obliquity: | **30°** | | | | | | | | | |
| Projectile: | **30cal** | **APM2** | **Lot #:** | TW18035 | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Chrono** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **634** | **m/s** | **2080** | **ft/s** | | | | | | |
| **High PP:** | **629** | **m/s** | **2063** | **ft/s** | | | | | | |
| **V50:** | **631** | **m/s** | **2069** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **7** | **m/s** | **23** | **ft/s** | | **Spread:** | **16** | **m/s** | **52** | **ft/s** |
| **ZMR:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| **629** | **2063** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12514** | | |
| 649 | 2129 | -- | -- | -- | CP | No | -- | 12515 | | |
| 645 | 2116 | -- | -- | -- | CP | No | -- | 12516 | | |
| **622** | **2040** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12517** | | |
| 646 | 2119 | -- | -- | -- | CP | No | -- | 12518 | | |
| **634** | **2080** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12519** | | |
| **638** | **2093** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12520** | | |

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|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T7** | | | Date: | **13-Oct-10** | | | | | |
| Plate #: | **K889 T7651** | | | Test Site: | **EF-106** | | | | | |
| Lot#: | **T7651** | | | | | | | | | |
| Avg. Thickness: | **0.786** | **"** | **19.964** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **128** | **HBN** | | | | | | | | |
| Obliquity: | **30°** | | | | | | | | | |
| Projectile: | **30cal** | **APM2** | **Lot #:** | TW18035 | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | **Chrono** | | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **639** | **m/s** | **2096** | **ft/s** | | | | | | |
| **High PP:** | **634** | **m/s** | **2080** | **ft/s** | | | | | | |
| **V50:** | **633** | **m/s** | **2075** | **ft/s** | | **# shots:** | **6** | | | |
| **Std Dev:** | **10** | **m/s** | **34** | **ft/s** | | **Spread:** | **24** | **m/s** | **79** | **ft/s** |
| **ZMR:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| 594 | 1948 | -- | -- | -- | PP | No | -- | 9923 | | |
| **619** | **2030** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **9924** | | |
| 660 | 2165 | -- | -- | -- | CP | No | -- | 9925 | | |
| **639** | **2096** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **9926** | | |
| **634** | **2080** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **9927** | | |
| **620** | **2034** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **9928** | | |
| **643** | **2109** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **9929** | | |
| **640** | **2099** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **9930** | | |

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|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **27-Mar-13** | | | | | |
| Plate #: | **495880-4E2** | | | Test Site: | **EF-106** | | | | | |
| Lot#: | **4E2** | | | | | | | | | |
| Avg. Thickness: | **1.005** | **"** | **25.521** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **126** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **30cal** | **APM2** | **Lot #:** | TW18035 | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Chrono** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **657** | **m/s** | **2155** | **ft/s** | | | | | | |
| **High PP:** | **653** | **m/s** | **2142** | **ft/s** | | | | | | |
| **V50:** | **659** | **m/s** | **2160** | **ft/s** | | **# shots:** | **6** | | | |
| **Std Dev:** | **10** | **m/s** | **32** | **ft/s** | | **Spread:** | **24** | **m/s** | **79** | **ft/s** |
| **ZMR:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| **672** | **2204** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12488** | | |
| 635 | 2083 | -- | -- | -- | PP | No | -- | 12489 | | |
| **657** | **2155** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12490** | | |
| **648** | **2125** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12491** | | |
| **652** | **2139** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12492** | | |
| 648 | 2125 | -- | -- | -- | PP | No | -- | 12493 | | |
| **653** | **2142** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12494** | | |
| 681 | 2234 | -- | -- | -- | CP | No | -- | 12495 | | |
| **669** | **2194** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12496** | | |

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|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **2-Apr-13** | | | | | |
| Plate #: | **495880-4B1** | | | Test Site: | **EF-106** | | | | | |
| Lot#: | **4B1** | | | | | | | | | |
| Avg. Thickness: | **1.003** | **"** | **25.476** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **131** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **30cal** | **APM2** | **Lot #:** | TW18035 | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Chrono** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **654** | **m/s** | **2145** | **ft/s** | | | | | | |
| **High PP:** | **656** | **m/s** | **2152** | **ft/s** | | | | | | |
| **V50:** | **650** | **m/s** | **2131** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **7** | **m/s** | **22** | **ft/s** | | **Spread:** | **15** | **m/s** | **49** | **ft/s** |
| **ZMR:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| **654** | **2145** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12510** | | |
| **641** | **2102** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12511** | | |
| **648** | **2125** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12512** | | |
| **656** | **2152** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12513** | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **1-Apr-13** | | | | | |
| Plate #: | **495892-1E1** | | | Test Site: | **EF-108** | | | | | |
| Lot#: | **1E2** | | | | | | | | | |
| Avg. Thickness: | **1.512** | **"** | **38.398** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **137** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **30cal** | **APM2** | **Lot #:** | TW18035 | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Chrono** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **837** | **m/s** | **2745** | **ft/s** | | | | | | |
| **High PP:** | **832** | **m/s** | **2729** | **ft/s** | | | | | | |
| **V50:** | **833** | **m/s** | **2733** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **5** | **m/s** | **16** | **ft/s** | | **Spread:** | **10** | **m/s** | **33** | **ft/s** |
| **ZMR:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| **837** | **2745** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **11269** | | |
| 785 | 2575 | -- | -- | -- | PP | No | -- | 11270 | | |
| 809 | 2654 | -- | -- | -- | PP | No | -- | 11271 | | |
| 817 | 2680 | -- | -- | -- | PP | No | -- | 11272 | | |
| **827** | **2713** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **11273** | | |
| **837** | **2745** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **11274** | | |
| **832** | **2729** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **11275** | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **4-Apr-13** | | | | | |
| Plate #: | **495871-1B2** | | | Test Site: | **EF-108** | | | | | |
| Lot#: | **1B2** | | | | | | | | | |
| Avg. Thickness: | **1.508** | **"** | **38.310** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **137** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **30cal** | **APM2** | **Lot #:** | TW18035 | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Chrono** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **833** | **m/s** | **2732** | **ft/s** | | | | | | |
| **High PP:** | **836** | **m/s** | **2742** | **ft/s** | | | | | | |
| **V50:** | **833** | **m/s** | **2731** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **4** | **m/s** | **13** | **ft/s** | | **Spread:** | **9** | **m/s** | **30** | **ft/s** |
| **ZMR:** | **3** | **m/s** | **10** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| **834** | **2736** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **11281** | | |
| 820 | 2690 | -- | -- | -- | PP | No | -- | 11282 | | |
| **827** | **2713** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **11283** | | |
| **836** | **2742** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **11284** | | |
| **833** | **2732** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **11285** | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T7** | | | Date: | **7-Oct-10** | | | | | |
| Plate #: | **K889** | | | Test Site: | **EF-106** | | | | | |
| Lot#: | **K889** | | | | | | | | | |
| Avg. Thickness: | **1.533** | **"** | **38.932** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **124** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **30cal** | **APM2** | **Lot #:** | TW18035 | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Chrono** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **830** | **m/s** | **2722** | **ft/s** | | | | | | |
| **High PP:** | **823** | **m/s** | **2699** | **ft/s** | | | | | | |
| **V50:** | **827** | **m/s** | **2713** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **6** | **m/s** | **21** | **ft/s** | | **Spread:** | **14** | **m/s** | **46** | **ft/s** |
| **ZMR:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| 959 | 3146 | -- | -- | -- | CP | No | -- | 9906 | | |
| 757 | 2483 | -- | -- | -- | PP | No | -- | 9907 | | |
| 809 | 2654 | -- | -- | -- | PP | No | -- | 9908 | | |
| 858 | 2814 | -- | -- | -- | CP | No | -- | 9909 | | |
| 841 | 2758 | -- | -- | -- | CP | No | -- | 9910 | | |
| **821** | **2693** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **9911** | | |
| **835** | **2739** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **9912** | | |
| **830** | **2722** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **9913** | | |
| **823** | **2699** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **9914** | | |

## 0.30-cal APM2 Kit

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **20-Mar-13** | | | | | |
| Plate #: | **495867-1A2** | | | Test Site: | **EF-106** | | | | | |
| Projectile Lot#: | **LC11J945S001** | | | | | | | | | |
| Avg. Thickness: | **0.507** | **"** | **12.878** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **137** | **HBN** | | | | | | | | |
| Obliquity: | **30°** | | | | | | | | | |
| Projectile: | **30cal** | **APM2** | **Kit** | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Chrono** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **485** | **m/s** | **1591** | **ft/s** | | | | | | |
| **High PP:** | **487** | **m/s** | **1597** | **ft/s** | | | | | | |
| **V50:** | **485** | **m/s** | **1591** | **ft/s** | | **# shots:** | **6** | | | |
| **Std Dev:** | **9** | **m/s** | **30** | **ft/s** | | **Spread:** | **27** | **m/s** | **89** | **ft/s** |
| **ZMR:** | **2** | **m/s** | **7** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| **488** | **1601** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12459** | | |
| 458 | 1502 | -- | -- | -- | PP | No | -- | 12460 | | |
| **478** | **1568** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12461** | | |
| 469 | 1538 | -- | -- | -- | PP | No | -- | 12462 | | |
| **487** | **1597** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12463** | | |
| **500** | **1640** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12464** | | |
| **473** | **1551** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12465** | | |
| **485** | **1591** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12466** | | |

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|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **19-Mar-13** | | | | | |
| Plate #: | **495867-3A1** | | | Test Site: | **EF-106** | | | | | |
| Projectile Lot#: | **LC11J945S001** | | | | | | | | | |
| Avg. Thickness: | **0.507** | **"** | **12.878** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **137** | **HBN** | | | | | | | | |
| Obliquity: | **30°** | | | | | | | | | |
| Projectile: | **30cal** | **APM2** | **Kit** | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Chrono** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **484** | **m/s** | **1588** | **ft/s** | | | | | | |
| **High PP:** | **476** | **m/s** | **1561** | **ft/s** | | | | | | |
| **V50:** | **477** | **m/s** | **1563** | **ft/s** | | **# shots:** | **6** | | | |
| **Std Dev:** | **11** | **m/s** | **35** | **ft/s** | | **Spread:** | **24** | **m/s** | **79** | **ft/s** |
| **ZMR:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| **463** | **1519** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12449** | | |
| 492 | 1614 | -- | -- | -- | CP | No | -- | 12450 | | |
| **485** | **1591** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12451** | | |
| **476** | **1561** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12452** | | |
| 451 | 1479 | -- | -- | -- | PP | No | -- | 12453 | | |
| 427 | 1401 | -- | -- | -- | PP | No | -- | 12454 | | |
| **484** | **1588** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12455** | | |
| **487** | **1597** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12456** | | |
| 453 | 1486 | -- | -- | -- | PP | No | -- | 12457 | | |
| **464** | **1522** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12458** | | |

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|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **27-Mar-13** | | | | | |
| Plate #: | **495880-4E2** | | | Test Site: | **EF-106** | | | | | |
| Projectile Lot#: | **LC11J945S001** | | | | | | | | | |
| Avg. Thickness: | **1.005** | **"** | **25.527** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **137** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **30cal** | **APM2** | **Kit** | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Chrono** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **656** | **m/s** | **2152** | **ft/s** | | | | | | |
| **High PP:** | **648** | **m/s** | **2125** | **ft/s** | | | | | | |
| **V50:** | **653** | **m/s** | **2143** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **7** | **m/s** | **23** | **ft/s** | | **Spread:** | **15** | **m/s** | **49** | **ft/s** |
| **ZMR:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| 665 | 2181 | -- | -- | -- | CP | No | -- | 12497 | | |
| **648** | **2125** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12498** | | |
| **662** | **2171** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12499** | | |
| **656** | **2152** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12500** | | |
| **647** | **2122** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12501** | | |

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|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **1-Apr-13** | | | | | |
| Plate #: | **495880-4B1** | | | Test Site: | **EF-106** | | | | | |
| Projectile Lot#: | **LC11J945S001** | | | | | | | | | |
| Avg. Thickness: | **1.003** | **"** | **25.476** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **131** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **30cal** | **APM2** | | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Chrono** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **659** | **m/s** | **2162** | **ft/s** | | | | | | |
| **High PP:** | **656** | **m/s** | **2152** | **ft/s** | | | | | | |
| **V50:** | **660** | **m/s** | **2164** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **6** | **m/s** | **21** | **ft/s** | | **Spread:** | **14** | **m/s** | **46** | **ft/s** |
| **ZMR:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| **659** | **2162** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12502** | | |
| 632 | 2073 | -- | -- | -- | PP | No | -- | 12503 | | |
| 635 | 2083 | -- | -- | -- | PP | No | -- | 12504 | | |
| **656** | **2152** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12505** | | |
| **655** | **2148** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **12506** | | |
| 681 | 2234 | -- | -- | -- | PP | No | -- | 12507 | | |
| 651 | 2135 | -- | -- | -- | CP | No | -- | 12508 | | |
| **669** | **2194** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **12509** | | |

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|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **28-Mar-13** | | | | | |
| Plate #: | **495892-1E1** | | | Test Site: | **EF-108** | | | | | |
| Projectile Lot#: | **LC11J945S001** | | | | | | | | | |
| Avg. Thickness: | **1.512** | **"** | **38.398** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **137** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **30cal** | **APM2** | **Kit** | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Chrono** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **860** | **m/s** | **2821** | **ft/s** | | | | | | |
| **High PP:** | **852** | **m/s** | **2795** | **ft/s** | | | | | | |
| **V50:** | **857** | **m/s** | **2811** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **7** | **m/s** | **24** | **ft/s** | | **Spread:** | **16** | **m/s** | **52** | **ft/s** |
| **ZMR:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| 843 | 2765 | -- | -- | -- | PP | No | -- | 11264 | | |
| **866** | **2840** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **11265** | | |
| **860** | **2821** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **11266** | | |
| **852** | **2795** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **11267** | | |
| **850** | **2788** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **11268** | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **3-Apr-13** | | | | | |
| Plate #: | **495892-1B2** | | | Test Site: | **EF-108** | | | | | |
| Projectile Lot#: | **LC11J945S001** | | | | | | | | | |
| Avg. Thickness: | **1.508** | **"** | **38.310** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **137** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **30cal** | **APM2** | **M2 Kit** | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Chrono** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **845** | **m/s** | **2772** | **ft/s** | | | | | | |
| **High PP:** | **850** | **m/s** | **2788** | **ft/s** | | | | | | |
| **V50:** | **847** | **m/s** | **2779** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **7** | **m/s** | **22** | **ft/s** | | **Spread:** | **16** | **m/s** | **52** | **ft/s** |
| **ZMR:** | **5** | **m/s** | **16** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| 857 | 2811 | -- | -- | -- | CP | No | -- | 11276 | | |
| **839** | **2752** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **11277** | | |
| **850** | **2788** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **11278** | | |
| **855** | **2804** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **11279** | | |
| **845** | **2772** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **11280** | | |

## 0.50-cal APM2

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **11-Mar-13** | | | | | |
| Plate #: | **495892** | | | Test Site: | **EF-110G** | | | | | |
| Lot#: | **1E1** | | | | | | | | | |
| Avg. Thickness: | **1.511** | **"** | **38.379** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **137** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **0.50cal** | **APM2** | | | | 16.68083 | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Xray** | | | | | | | | |
| | | | | | | | | | | |
| Low CP: | **630** | **m/s** | **2066** | **ft/s** | | | | | | |
| High PP: | **622** | **m/s** | **2040** | **ft/s** | | | | | | |
| V50: | **626** | **m/s** | **2052** | **ft/s** | | **# shots:** | **4** | | | |
| Std Dev: | **6** | **m/s** | **19** | **ft/s** | | **Spread:** | **12** | **m/s** | **39** | **ft/s** |
| ZMR: | **0** | **m/s** | **0** | **ft/s** | | | | | | |

| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** |
|---|---|---|---|---|---|---|---|---|
| 615 | 2017 | -- | -- | 0.25 | PP | No | -- | 14263 |
| **622** | **2040** | **--** | **--** | **0.50** | **PP** | **Yes** | **--** | **14264** |
| **619** | **2030** | **--** | **--** | **0.00** | **PP** | **Yes** | **--** | **14265** |
| **630** | **2066** | **--** | **--** | **0.00** | **CP** | **Yes** | **--** | **14266** |
| **631** | **2070** | **--** | **--** | **0.75** | **CP** | **Yes** | **--** | **14267** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T7** | | | Date: | **28-Jul-10** | | | | | |
| Plate #: | **K889-T7651** | | | Test Site: | **EF-108** | | | | | |
| Lot#: | **T7651** | | | | | | | | | |
| Avg. Thickness: | **1.532** | **"** | **38.913** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **124** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **0.50cal** | **APM2** | Lot #: | **RA5735** | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Xray** | | | | | | | | |
| | | | | | | | | | | |
| Low CP: | **624** | **m/s** | **2047** | **ft/s** | | | | | | |
| High PP: | **628** | **m/s** | **2060** | **ft/s** | | | | | | |
| V50: | **625** | **m/s** | **2049** | **ft/s** | | **# shots:** | **6** | | | |
| Std Dev: | **8** | **m/s** | **25** | **ft/s** | | **Spread:** | **20** | **m/s** | **66** | **ft/s** |
| ZMR: | **4** | **m/s** | **13** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| **633** | **2076** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **9250** | | |
| 570 | 1870 | -- | -- | -- | PP | No | -- | 9251 | | |
| **624** | **2047** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **9252** | | |
| 607 | 1991 | -- | -- | -- | PP | No | -- | 9253 | | |
| **628** | **2060** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **9254** | | |
| **631** | **2070** | **--** | **--** | **--** | **CP** | **Yes** | **--** | **9255** | | |
| 629 | 2063 | -- | -- | -- | CP | No | Disregard | 9256 | | |
| **613** | **2011** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **9257** | | |
| **619** | **2030** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **9258** | | |

## V50 Summary Sheet

Date: 3/27/2013 Engineer: Tyrone Jones Technicians: Koch/Walter

Contract Number

Test Facility: EF110 G

Target Description: AA 7017-T6 Plate ID #495905 Heat ID #2F1

Penetrator: .50 CAL AP M2 Weapon: AB21 .50 CAL

Requirements (ft/sec): Temp/Hummidity F/ %

| | Prop Type | | Xray or Chrono | | | Chrono Correction | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 37mm | | X-Ray | | | | Remarks | |
| Shot # | Prop Wt: | Grains | Vel (f/s) | Vel (m/s) | PP / CP | | Proj. Wt | | Gamma |
| 14299 | | 168 | 2438 | 743 | | CP | STD | | 0.25 |
| 14300 * | | 158 | 2357 | 718 | | PP | STD | | 0.35 |
| 14301 * | | 161 | 2380 | 726 | | PP | STD | | 0.90 |
| 14302 * | | 164 | 2400 | 732 | | CP | STD | | 0.56 |
| 14303 * | | 161 | 2394 | 730 | | CP | STD | | 0 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| BHN | 131 | | | | | | Thickness | | 2.013 |
| Low CP | f/s 2394 | m/s 730 | | | Vel Spread | f/s 43 | | | |
| High Partial | f/s 2380 | m/s 726 | | | ZMR | f/s 0 | | | |
| V50 | f/s 2383 | m/s 727 | * = Shots used for V50 | | | | | Avg | 2.013 |
| Std Dev | f/s 19 | m/s 6 | | | | | | | |

## V50 Summary Sheet

Date: 3/27/2013 Engineer: Tyrone Jones Technicians: Koch/Walter

Contract Number

Test Facility: EF110 G

Target Description: AA 7017-T6 Plate ID #495905 Heat ID #2G2

Penetrator: .50 CAL AP M2 Weapon: AB21 .50 CAL

Requirements (ft/sec): Temp/Hummidity F/ %

| | Prop Type | | Xray or Chrono | | | Chrono Correction | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 37mm | | X-Ray | | | | Remarks | |
| Shot # | Prop Wt: | Grains | Vel (f/s) | Vel (m/s) | PP / CP | | Proj. Wt | | Gamma |
| 14304 * | | 161 | 2370 | 722 | | PP | STD | | 0.56 |
| 14305 * | | 163 | 2389 | 728 | | CP | STD | | 0.50 |
| 14306 * | | 162 | 2364 | 720 | | PP | STD | | 0.35 |
| 14307 * | | 164 | 2400 | 730 | | CP | STD | | 0.35 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| BHN | 131 | | | | | | Thickness | 2.011 |
| Low CP | f/s 2389 | m/s 728 | | | Vel Spread | f/s 36 | | |
| High Partial | f/s 2370 | m/s 722 | | | ZMR | f/s 0 | | |
| V50 | f/s 2381 | m/s 725 | * = Shots used for V50 | | | | Avg | 2.011 |
| Std Dev | f/s 17 | m/s 5 | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T7** | | | Date: | **26-Jul-10** | | | | | |
| Plate #: | **K889-T7651** | | | Test Site: | **EF-108** | | | | | |
| Lot#: | **T7651** | | | | | | | | | |
| Avg. Thickness: | **2.063** | **"** | **52.388** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **128** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **0.50cal** | **APM2** | Lot #: | **RA5735** | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Xray** | | | | | 18.973666 | | | |
| | | | | | | | | | | |
| Low CP: | **734** | **m/s** | **2408** | **ft/s** | | | | | | |
| High PP: | **729** | **m/s** | **2391** | **ft/s** | | | | | | |
| V50: | **731** | **m/s** | **2399** | **ft/s** | | **# shots:** | **4** | | | |
| Std Dev: | **6** | **m/s** | **20** | **ft/s** | | **Spread:** | **14** | **m/s** | **46** | **ft/s** |
| ZMR: | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| **734** | **2408** | **--** | **--** | **0.56** | **CP** | **Yes** | **--** | **9243** | | |
| 715 | 2345 | -- | -- | 0.56 | PP | No | -- | 9244 | | |
| **724** | **2375** | **--** | **--** | **0.56** | **PP** | **Yes** | **--** | **9245** | | |
| **738** | **2421** | **--** | **--** | **0.71** | **CP** | **Yes** | **--** | **9246** | | |
| 714 | 2342 | -- | -- | 1.03 | PP | No | -- | 9247 | | |
| 716 | 2348 | -- | -- | 1.12 | PP | No | -- | 9248 | | |
| **729** | **2391** | -- | -- | **0.35** | **PP** | **Yes** | -- | **9249** | | |

## V50 Summary Sheet

Date: 3/28/2013 Engineer: Tyrone Jones Technicians: Koch/Walter

Contract Number

Test Facility: EF110 G

Target Description: AA 7017-T6 Plate ID #495930 Heat ID #2H1

Penetrator: .50 CAL AP M2 Weapon: AB21 .50 CAL

Requirements (ft/sec): Temp/Hummidity F/ %

| | Prop Type | 37mm | Xray or Chrono | X-Ray | | Chrono Correction | | Remarks | |
|---|---|---|---|---|---|---|---|---|---|
| Shot # | Prop Wt: | Grains | Vel (f/s) | Vel (m/s) | PP / CP | | Proj. Wt | | Gamma |
| 14308 | | 186 | 2671 | 814 | | PP | STD | | 0.35 |
| 14309 * | | 194 | 2730 | 832 | | PP | STD | | 0.25 |
| 14310 | | 196 | 2831 | 863 | | CP | STD | | 0.56 |
| 14311 * | | 195 | 2776 | 846 | | CP | STD | | 1.06 |
| 14312 | | 194 | 2808 | 856 | | CP | STD | | 1.50 |
| 14313 * | | 189 | 2719 | 829 | | PP | STD | | 0.75 |
| 14314 | | 191 | 2661 | 811 | | PP | STD | | 1.82 |
| 14315 * | | 198 | 2780 | 847 | | CP | STD | | 1.41 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| BHN | 134 | | | | | Thickness | | 2.519 |
| Low CP | f/s 2776 | m/s 846 | | Vel Spread | f/s 61 ** | | | |
| High Partial | f/s 2730 | m/s 832 | | ZMR | f/s 0 | | | |
| V50 | f/s 2751 | m/s 839 | * = Shots used for V50 | | | | Avg | 2.519 |
| Std Dev | f/s 31 | m/s 9 | | | | | | |

** = Calculated in m/s which resulted in 18m/s requirement

## V50 Summary Sheet

Date: 4/1/2013 Engineer: Tyrone Jones Technicians: Koch/Walter

Contract Number

Test Facility: EF110 G

Target Description: AA 7017-T6 Plate ID #495930 Heat ID #2K1

Penetrator: .50 CAL AP M2 Weapon: AB21 .50 CAL

Requirements (ft/sec): Temp/Hummidity F/ %

| | Prop Type | | Xray or Chrono | | | Chrono Correction | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 37mm | | X-Ray | | | | Remarks | |
| Shot # | Prop Wt: | Grains | Vel (f/s) | Vel (m/s) | PP / CP | | Proj. Wt | | Gamma |
| 14316 | | 193 | 2678 | 816 | | PP | STD | | 1.60 |
| 14317 * | | 198 | 2761 | 842 | | CP | STD | | 0.25 |
| 14318 * | | 196 | 2710 | 826 | | PP | STD | | 0 |
| 14319 | | 197 | 2769 | 846 | | CP | STD | | 0.35 |
| 14320 | | 195 | 2766 | 843 | | CP | STD | | 1.82 |
| 14321 | | 192 | 2645 | 806 | | PP | STD | | 1.35 |
| 14322 * | | 192 | 2734 | 833 | | CP | STD | | 1.25 |
| 14323 * | | 191 | 2705 | 825 | | PP | STD | | 1.27 |

| | | | | | | |
|---|---|---|---|---|---|---|
| BHN | 134 | | | | Thickness | 2.519 |
| Low CP | f/s 2734 | m/s 833 | | Vel Spread | f/s 56 | |
| High Partial | f/s 2710 | m/s 826 | | ZMR | f/s 0 | |
| V50 | f/s 2727 | m/s 831 | * = Shots used for V50 | | Avg | 2.519 |
| Std Dev | f/s 26 | m/s 8 | | | | |

## V50 Summary Sheet

Date: 4/1/2013 Engineer: Tyrone Jones Technicians: Koch/Walter

Contract Number

Test Facility: EF110 G

Target Description: AA 7017-T6 Plate ID #495935 Heat ID #1D1

Penetrator: .50 CAL AP M2 Weapon: AB21 .50 CAL

Requirements (ft/sec): Temp/Hummidity F/ %

| | Prop Type | | Xray or Chrono | | | Chrono Correction | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 37mm | | X-Ray | | | | Remarks | |
| Shot # | Prop Wt: | Grains | Vel (f/s) | Vel (m/s) | PP / CP | | Proj. Wt | | Gamma |
| 14324 * | | 212 | 2983 | 909 | | PP | STD | | 0.25 |
| 14325 * | | 217 | 3040 | 927 | | CP | STD | | 0.71 |
| 14326 * | | 215 | 3021 | 921 | | CP | STD | | 0.25 |
| 14327 * | | 213 | 3020 | 921 | | PP | STD | | 0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| BHN | 137 | | | | | | Thickness | 3.018 |
| Low CP | f/s 3021 | m/s 921 | | Vel Spread | f/s 57 | | | |
| High Partial | f/s 3020 | m/s 921 | | ZMR | f/s 0 | | | |
| V50 | f/s 3016 | m/s 920 | * = Shots used for V50 | | | | Avg | 3.018 |
| Std Dev | f/s 24 | m/s 7 | | | | | | |

## V50 Summary Sheet

Date: 4/2/2013 Engineer: Tyrone Jones Technicians: Koch/Walter

Contract Number

Test Facility: EF110 G

Target Description: AA 7017-T6 Plate ID #495935 Heat ID #1D2

Penetrator: .50 CAL AP M2 Weapon: AB21 .50 CAL

Requirements (ft/sec): Temp/Hummidity F/ %

| | Prop Type | | Xray or Chrono | | | Chrono Correction | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 37mm | | X-Ray | | | | Remarks | |
| Shot # | Prop Wt: | Grains | Vel (f/s) | Vel (m/s) | PP / CP | | Proj. Wt | | Gamma |
| 14328 | | 213 | 2998 | 914 | | PP | STD | | 0.25 |
| 14329 * | | 216 | 3051 | 930 | | PP | STD | | 0.35 |
| 14330 * | | 216 | 3027 | 923 | | PP | STD | | 0.25 |
| 14331 * | | 219 | 3069 | 935 | | CP | STD | | 1.03 |
| 14332 * | | 219 | 3065 | 934 | | CP | STD | | 0.35 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| BHN | 134 | | | | | | Thickness | 3.019 |
| Low CP | f/s 3065 | m/s 934 | | | Vel Spread | f/s 42 | | |
| High Partial | f/s 3051 | m/s 930 | | | ZMR | f/s 0 | | |
| V50 | f/s 3053 | m/s 931 | * = Shots used for V50 | | | | Avg | 3.019 |
| Std Dev | f/s 19 | m/s 6 | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T7** | | | Date: | **23-Jul-10** | | | | | |
| Plate #: | **K889-T7651** | | | Test Site: | **EF-108** | | | | | |
| Lot#: | **T7651** | | | | | | | | | |
| Avg. Thickness: | **2.947** | **"** | **74.860** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **128** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **0.50cal** | **APM2** | Lot #: | **RA5735** | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | **Xray** | | | | | | | | | |
| | | | | | | | | | | |
| Low CP: | **902** | **m/s** | **2959** | **ft/s** | | | | | | |
| High PP: | **895** | **m/s** | **2936** | **ft/s** | | | | | | |
| V50: | **899** | **m/s** | **2947** | **ft/s** | | **# shots:** | **4** | | | |
| Std Dev: | **5** | **m/s** | **17** | **ft/s** | | **Spread:** | **11** | **m/s** | **36** | **ft/s** |
| ZMR: | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| **895** | **2936** | **--** | **--** | **0.25** | **PP** | **Yes** | **--** | **9238** | | |
| **904** | **2965** | **--** | **--** | **0.5** | **CP** | **Yes** | **--** | **9239** | | |
| 885 | 2903 | -- | -- | 1.03 | PP | No | -- | 9240 | | |
| **902** | **2959** | **--** | **--** | **0.5** | **CP** | **Yes** | **--** | **9241** | | |
| **893** | **2929** | **--** | **--** | **--** | **PP** | **Yes** | **--** | **9242** | | |

## 14.5 mm BS41

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **20-Feb-13** | | | | | |
| Plate #: | **495935-1D1** | | | Test Site: | **EF-108** | | | | | |
| Projectile Lot#: | **ARL-02-C-0105** | | | | | | | | | |
| Avg. Thickness: | **3.018** | **"** | **76.651** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **137** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **14.5mm** | **BS41** | | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AL 2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Xray** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **870** | **m/s** | **2854** | **ft/s** | | | | | | |
| **High PP:** | **858** | **m/s** | **2814** | **ft/s** | | | | | | |
| **V50:** | **864** | **m/s** | **2832** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **8** | **m/s** | **25** | **ft/s** | | **Spread:** | **14** | **m/s** | **46** | **ft/s** |
| **ZMR:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| 778 | 2552 | -- | -- | 0.56 | PP | No | **--** | 11165 | | |
| 848 | 2781 | -- | -- | 0.00 | PP | No | **--** | 11166 | | |
| 898 | 2945 | -- | -- | 1.46 | CP | No | **--** | 11167 | | |
| **870** | **2854** | **--** | **--** | **1.25** | **CP** | **Yes** | **--** | **11168** | | |
| **858** | **2814** | **--** | **--** | **1.46** | **PP** | **Yes** | **--** | **11169** | | |
| **856** | **2808** | **--** | **--** | **0.50** | **PP** | **Yes** | **--** | **11170** | | |
| **870** | **2854** | **--** | **--** | **0.35** | **CP** | **Yes** | **--** | **11171** | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **25-Feb-13** | | | | | |
| Plate #: | **495935-1D2** | | | Test Site: | **EF-108** | | | | | |
| Projectile Lot#: | **ARL-02-C-0105** | | | | | | | | | |
| Avg. Thickness: | **3.019** | **"** | **76.676** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **134** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **14.5mm** | **BS41** | | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AL 2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Xray** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **858** | **m/s** | **2814** | **ft/s** | | | | | | |
| **High PP:** | **859** | **m/s** | **2818** | **ft/s** | | | | | | |
| **V50:** | **859** | **m/s** | **2816** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **6** | **m/s** | **20** | **ft/s** | | **Spread:** | **15** | **m/s** | **49** | **ft/s** |
| **ZMR:** | **1** | **m/s** | **3** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| 872 | 2860 | -- | -- | 1.41 | CP | No | **--** | 11172 | | |
| **859** | **2818** | **--** | **--** | **1.46** | **PP** | **Yes** | **--** | **11173** | | |
| **858** | **2814** | **--** | **--** | **1.58** | **CP** | **Yes** | **--** | **11174** | | |
| **866** | **2840** | **--** | **--** | **1.03** | **CP** | **Yes** | **--** | **11175** | | |
| 868 | 2847 | -- | -- | 1.77 | CP | No | -- | 11176 | | |
| **851** | **2791** | **--** | **--** | **1.82** | **PP** | **Yes** | **--** | **11177** | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T7** | | | Date: | **22-Feb-13** | | | | | |
| Plate #: | **K889-T7651** | | | Test Site: | **EF-108** | | | | | |
| Projectile Lot#: | **ARL-02-C-0105** | | | | | | | | | |
| Avg. Thickness: | **2.947** | **"** | **74.860** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **128** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **14.5mm** | **BS41** | | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | **Xray** | | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **836** | **m/s** | **2742** | **ft/s** | | | | | | |
| **High PP:** | **837** | **m/s** | **2745** | **ft/s** | | | | | | |
| **V50:** | **837** | **m/s** | **2745** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **5** | **m/s** | **18** | **ft/s** | | **Spread:** | **13** | **m/s** | **43** | **ft/s** |
| **ZMR:** | **1** | **m/s** | **3** | **ft/s** | | | | | | |
| | | | | | | | | | | |

| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 813 | 2667 | -- | -- | 0.56 | PP | No | -- | 9377 | | |
| 870 | 2854 | -- | -- | 0.25 | CP | No | -- | 9378 | | |
| **837** | **2745** | **--** | **--** | **0.90** | **PP** | **Yes** | **--** | **9379** | | |
| **836** | **2742** | **--** | **--** | **0.56** | **CP** | **Yes** | **--** | **9380** | | |
| **844** | **2768** | **--** | **--** | **0.79** | **CP** | **Yes** | **--** | **9381** | | |
| **831** | **2726** | **--** | **--** | **0.35** | **PP** | **Yes** | **--** | **9382** | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **26-Feb-13** | | | | | |
| Plate #: | **495953-1E1** | | | Test Site: | **EF-108** | | | | | |
| Projectile Lot#: | **ARL-02-C-0105** | | | | | | | | | |
| Avg. Thickness: | **3.523** | **"** | **89.472** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **140** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **14.5mm** | **BS41** | | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AL 2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Xray** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **951** | **m/s** | **3119** | **ft/s** | | | | | | |
| **High PP:** | **944** | **m/s** | **3096** | **ft/s** | | | | | | |
| **V50:** | **948** | **m/s** | **3108** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **8** | **m/s** | **25** | **ft/s** | | **Spread:** | **17** | **m/s** | **56** | **ft/s** |
| **ZMR:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| 926 | 3037 | -- | -- | 1.06 | PP | No | -- | 11178 | | |
| **951** | **3119** | **--** | **--** | **1.52** | **CP** | **Yes** | **--** | **11179** | | |
| 962 | 3155 | -- | -- | 0.71 | CP | No | -- | 11180 | | |
| **956** | **3136** | **--** | **--** | **0.79** | **CP** | **Yes** | **--** | **11181** | | |
| 957 | 3139 | -- | -- | 3.81 | CP | No | -- | 11182 | | |
| 924 | 3031 | -- | -- | 1.00 | PP | No | -- | 11183 | | |
| **939** | **3080** | **--** | **--** | **1.82** | **PP** | **Yes** | **--** | **11184** | | |
| 926 | 3037 | -- | -- | 0.56 | PP | No | -- | 11185 | | |
| **944** | **3096** | **--** | **--** | **0.25** | **PP** | **Yes** | **--** | **11186** | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **27-Feb-13** | | | | | |
| Plate #: | **495953-1E2** | | | Test Site: | **EF-108** | | | | | |
| Projectile Lot#: | **ARL-02-C-0105** | | | | | | | | | |
| Avg. Thickness: | **3.524** | **"** | **89.516** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **134** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **14.5mm** | **BS41** | | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Xray** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **938** | **m/s** | **3077** | **ft/s** | | | | | | |
| **High PP:** | **941** | **m/s** | **3086** | **ft/s** | | | | | | |
| **V50:** | **941** | **m/s** | **3087** | **ft/s** | | **# shots:** | **6** | | | |
| **Std Dev:** | **10** | **m/s** | **33** | **ft/s** | | **Spread:** | **24** | **m/s** | **79** | **ft/s** |
| **ZMR:** | **3** | **m/s** | **10** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| **932** | **3057** | **--** | **--** | **0.50** | **PP** | **Yes** | **--** | **11187** | | |
| **941** | **3086** | **--** | **--** | **1.03** | **PP** | **Yes** | **--** | **11188** | | |
| **938** | **3077** | **--** | **--** | **0.71** | **CP** | **Yes** | **--** | **11189** | | |
| **930** | **3050** | **--** | **--** | **0.75** | **PP** | **Yes** | **--** | **11190** | | |
| **952** | **3123** | **--** | **--** | **1.00** | **CP** | **Yes** | **--** | **11191** | | |
| **954** | **3129** | **--** | **--** | **0.71** | **CP** | **Yes** | **--** | **11192** | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **4-Mar-13** | | | | | |
| Plate #: | **495959-1G1** | | | Test Site: | **EF-108** | | | | | |
| Projectile Lot#: | **ARL-02-C-0105** | | | | | | | | | |
| Avg. Thickness: | **4.042** | **"** | **102.654** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **131** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **14.5mm** | **BS41** | | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Xray** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| **High PP:** | **1015** | **m/s** | **3329** | **ft/s** | | | | | | |
| **V50:** | **0** | **m/s** | **0** | **ft/s** | | **# shots:** | **1** | | | |
| **Std Dev:** | **0** | **m/s** | **0** | **ft/s** | | **Spread:** | **0** | **m/s** | **0** | **ft/s** |
| **ZMR:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| **986** | **3234** | **--** | **--** | **0.79** | **PP** | **No** | **--** | **11193** | | |
| **995** | **3264** | **--** | **--** | **1.03** | **PP** | **No** | **--** | **11194** | | |
| **1015** | **3329** | **--** | **--** | **2.06** | **PP** | **No** | **--** | **11195** | | |
| | | | | | | | | | | |
| | | ***Halted testing - maximum safe load for gun** | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **4-Mar-13** | | | | | |
| Plate #: | **495959-1G2** | | | Test Site: | **EF-108** | | | | | |
| Projectile Lot#: | **ARL-02-C-0105** | | | | | | | | | |
| Avg. Thickness: | **4.034** | **"** | **102.46** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **143** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **14.5mm** | **BS41** | | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Xray** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| **High PP:** | **1014** | **m/s** | **3326** | **ft/s** | | | | | | |
| **V50:** | **0** | **m/s** | **0** | **ft/s** | | **# shots:** | **1** | | | |
| **Std Dev:** | **0** | **m/s** | **0** | **ft/s** | | **Spread:** | **0** | **m/s** | **0** | **ft/s** |
| **ZMR:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| 1019 | 3342 | -- | -- | 8.62 | PP | No | High gamma | 11196 | | |
| 995 | 3264 | -- | -- | 2.00 | PP | No | -- | 11197 | | |
| **1014** | **3326** | **--** | **--** | **1.52** | **PP** | **Yes** | **--** | **11198** | | |
| | | | | | | | | | | |
| | | ***Halted testing - maximum safe load for gun** | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T7** | | | Date: | **23-Sep-10** | | | | | |
| Plate #: | **K889-T7651** | | | Test Site: | **EF-108** | | | | | |
| Projectile Lot#: | **ARL-02-C-0105** | | | | | | | | | |
| Avg. Thickness: | **3.898** | **"** | **99.016** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **121** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **14.5mm** | **BS41** | | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Xray** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **983** | **m/s** | **3224** | **ft/s** | | | | | | |
| **High PP:** | **984** | **m/s** | **3228** | **ft/s** | | | | | | |
| **V50:** | **984** | **m/s** | **3226** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **5** | **m/s** | **15** | **ft/s** | | **Spread:** | **11** | **m/s** | **36** | **ft/s** |
| **ZMR:** | **1** | **m/s** | **3** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| 950 | 3116 | -- | -- | 0.58 | PP | No | -- | 9383 | | |
| 1002 | 3287 | -- | -- | 0.71 | CP | No | -- | 9384 | | |
| **984** | **3228** | **--** | **--** | **0.35** | **PP** | **Yes** | **--** | **9385** | | |
| 1000 | 3280 | -- | -- | 0.25 | CP | No | -- | 9386 | | |
| **989** | **3244** | **--** | **--** | **0.35** | **CP** | **Yes** | **--** | **9387** | | |
| **983** | **3224** | **--** | **--** | **0.56** | **CP** | **Yes** | **--** | **9388** | | |
| 993 | 3257 | -- | -- | 0.00 | CP | No | -- | 9389 | | |
| **978** | **3208** | **--** | **--** | **0.25** | **PP** | **Yes** | **--** | **9390** | | |

## 0.50-cal FSP

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **21-Feb-13** | | | | | |
| Plate #: | **495871-1G2** | | | Test Site: | **EF-110G** | | | | | |
| Lot#: | **495871** | | | | | | | | | |
| Avg. Thickness: | **0.7595** | " | **19.291** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **134** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **0.50cal** | **FSP** | | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Xray** | | | | | | | | |
| | | | | | | | | | | |
| Low CP: | **658** | **m/s** | **2158** | **ft/s** | | | | | | |
| High PP: | **656** | **m/s** | **2152** | **ft/s** | | | | | | |
| V50: | **660** | **m/s** | **2164** | **ft/s** | | # shots: | **4** | | | |
| Std Dev: | **8** | **m/s** | **25** | **ft/s** | | Spread: | **17** | **m/s** | **56** | **ft/s** |
| ZMR: | **0** | **m/s** | **0** | **ft/s** | | | | | | |

| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 765 | 2509 | -- | -- | -- | CP | No | No x-rays, Velocity measured by hand | 14211 | | |
| 676 | 2217 | -0.75 | -0.50 | 0.90 | CP | No | -- | 14212 | | |
| 648 | 2125 | -0.50 | 0.50 | 0.71 | PP | No | -- | 14213 | | |
| 593 | 1945 | -- | -- | -- | CP | No | No x-rays, Velocity measured by hand | 14214 | | |
| **658** | **2158** | **0.50** | **0.75** | **0.90** | **CP** | **Yes** | **--** | **14215** | | |
| **656** | **2152** | **-0.25** | **0.50** | **0.56** | **PP** | **Yes** | **--** | **14216** | | |
| **654** | **2145** | **0.00** | **1.00** | **1.00** | **PP** | **Yes** | **--** | **14217** | | |
| **671** | **2201** | **-0.50** | **0.00** | **0.50** | **CP** | **Yes** | **--** | **14218** | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **21-Feb-13** | | | | | |
| Plate #: | **495871-5G1** | | | Test Site: | **EF-110G** | | | | | |
| Lot#: | **495871** | | | | | | | | | |
| Avg. Thickness: | **0.760** | **"** | **19.304** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **137** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **0.50cal** | **FSP** | | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | **Xray** | | | | | | | | | |
| | | | | | | | | | | |
| Low CP: | **622** | **m/s** | **2040** | **ft/s** | | | | | | |
| High PP: | **623** | **m/s** | **2043** | **ft/s** | | | | | | |
| V50: | **625** | **m/s** | **2050** | **ft/s** | | # shots: | **4** | | | |
| Std Dev: | **5** | **m/s** | **15** | **ft/s** | | Spread: | **10** | **m/s** | **33** | **ft/s** |
| ZMR: | **1** | **m/s** | **3** | **ft/s** | | | | | | |

| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** |
|---|---|---|---|---|---|---|---|---|
| 646 | 2119 | 0.50 | 1.00 | 1.12 | CP | No | -- | 14219 |
| 654 | 2145 | 0.00 | 1.50 | 1.50 | CP | No | -- | 14220 |
| 642 | 2106 | -0.50 | 0.50 | 0.71 | CP | No | -- | 14221 |
| **632** | **2073** | **0.00** | **0.50** | **0.50** | **CP** | **Yes** | **--** | **14222** |
| 612 | 2007 | 0.00 | 0.50 | 0.50 | PP | No | -- | 14223 |
| **623** | **2043** | **0.25** | **0.25** | **0.35** | **CP** | **Yes** | **--** | **14224** |
| **623** | **2043** | **0.25** | **-0.25** | **0.35** | **PP** | **Yes** | **--** | **14225** |
| **622** | **2040** | **0.50** | **0.50** | **0.71** | **PP** | **Yes** | **--** | **14226** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T7** | | | Date: | **29-Oct-10** | | | | | |
| Plate #: | **K889-T7651** | | | Test Site: | **EF-108** | | | | | |
| Lot#: | **T7651** | | | | | | | | | |
| Avg. Thickness: | **0.783** | **"** | **19.888** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **128** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **0.50cal** | **FSP** | | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Xray** | | | | | | | | |
| | | | | | | | | | | |
| Low CP: | **655** | **m/s** | **2148** | **ft/s** | | | | | | |
| High PP: | **645** | **m/s** | **2116** | **ft/s** | | | | | | |
| V50: | **650** | **m/s** | **2130** | **ft/s** | | **# shots:** | **4** | | | |
| Std Dev: | **8** | **m/s** | **25** | **ft/s** | | **Spread:** | **16** | **m/s** | **52** | **ft/s** |
| ZMR: | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| 607 | 1991 | -- | -- | 0.58 | PP | No | -- | 9464 | | |
| **657** | **2155** | **--** | **--** | **0.71** | **CP** | **Yes** | **--** | **9469** | | |
| 634 | 2080 | -- | -- | 0.35 | PP | No | -- | 9470 | | |
| **655** | **2148** | **--** | **--** | **0.25** | **CP** | **Yes** | **--** | **9471** | | |
| **641** | **2102** | **--** | **--** | **0.35** | **PP** | **Yes** | **--** | **9472** | | |
| **645** | **2116** | **--** | **--** | **0.56** | **PP** | **Yes** | **--** | **9473** | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **24-Feb-13** | | | | | |
| Plate #: | **495880-4E2** | | | Test Site: | **EF-110G** | | | | | |
| Lot#: | **495880** | | | | | | | | | |
| Avg. Thickness: | **1.004** | **"** | **25.502** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **126** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **0.50cal** | **FSP** | | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Xray** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **1055** | **m/s** | **3460** | **ft/s** | | | | | | |
| **High PP:** | **1042** | **m/s** | **3418** | **ft/s** | | | | | | |
| **V50:** | **1049** | **m/s** | **3441** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **8** | **m/s** | **27** | **ft/s** | | **Spread:** | **15** | **m/s** | **49** | ft/s |
| **ZMR:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |

| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 948 | 3109 | -- | -- | 0.71 | PP | No | No x-rays, Velocity measured by hand | 14195 | | |
| 956 | 3136 | -- | -- | 0.35 | PP | No | -- | 14196 | | |
| 972 | 3188 | -- | -- | 0.56 | PP | No | -- | 14197 | | |
| 998 | 3273 | -- | -- | 0.75 | PP | No | No x-rays, Velocity measured by hand | 14198 | | |
| 1038 | 3405 | -- | -- | 0.25 | PP | No | -- | 14199 | | |
| **1055** | **3460** | **--** | **--** | **10.28** | **CP** | **Yes** | **High gamma, bad yaw used because it is a CP** | **14200** | | |
| **1042** | **3418** | **--** | **--** | **0.90** | **PP** | **Yes** | **--** | **14201** | | |
| 1067 | 3500 | -- | -- | 0.79 | CP | No | -- | 14202 | | |
| 1105 | 3624 | -- | -- | 0.90 | CP | No | | 14203 | | |
| **1057** | **3467** | **--** | **--** | **0.75** | **CP** | **Yes** | | **14204** | | |
| 1223 | 4011 | -- | -- | -- | CP | No | No x-rays, Velocity measured by hand | 14205 | | |
| 946 | 3103 | -- | -- | 0.35 | PP | No | -- | 14206 | | |
| **1042** | **3418** | **--** | **--** | **1.25** | **PP** | **Yes** | **--** | **14207** | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **26-Feb-13** | | | | | |
| Plate #: | **495880-4B1** | | | Test Site: | **EF-110G** | | | | | |
| Lot#: | **495880** | | | | | | | | | |
| Avg. Thickness: | **1.003** | **"** | **25.476** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **131** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **0.50cal** | **FSP** | | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | **Xray** | | | | | | | | | |
| | | | | | | | | | | |
| Low CP: | **1100** | **m/s** | **3608** | **ft/s** | | | | | | |
| High PP: | **1086** | **m/s** | **3562** | **ft/s** | | | | | | |
| V50: | **1093** | **m/s** | **3583** | **ft/s** | | **# shots:** | **4** | | | |
| Std Dev: | **9** | **m/s** | **31** | **ft/s** | | **Spread:** | **18** | **m/s** | **59** | **ft/s** |
| ZMR: | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| **1100** | **3608** | **--** | **--** | **0.25** | **CP** | **Yes** | **--** | **14227** | | |
| 1004 | 3293 | -- | -- | 1.27 | PP | No | -- | 14228 | | |
| 1038 | 3405 | -- | -- | 0.50 | PP | No | -- | 14229 | | |
| 1057 | 3467 | -- | -- | 0.50 | PP | No | -- | 14230 | | |
| 1105 | 3624 | -- | -- | 0.00 | CP | No | -- | 14231 | | |
| 1036 | 3398 | -- | -- | 0.79 | PP | No | -- | 14232 | | |
| 1058 | 3470 | -- | -- | 0.50 | PP | No | -- | 14233 | | |
| **1083** | **3552** | **--** | **--** | **1.06** | **PP** | **Yes** | **--** | **14234** | | |
| **1086** | **3562** | **--** | **--** | **0.25** | **PP** | **Yes** | **--** | **14235** | | |
| **1101** | **3611** | **--** | **--** | **0.25** | **CP** | **Yes** | **--** | **14236** | | |

## 20 mm FSP

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T7** | | | Date: | **5-Aug-10** | | | | | |
| Plate #: | **K889 T7651, 469280A2** | | | Test Site: | **EF-108** | | | | | |
| Lot#: | **469280A2** | | | | | | | | | |
| Avg. Thickness: | **0.786** | **"** | **19.952** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **128** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **20mm** | **FSP** | | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Xray** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **330** | **m/s** | **1082** | **ft/s** | | | | | | |
| **High PP:** | **362** | **m/s** | **1187** | **ft/s** | | | | | | |
| **V50:** | **346** | **m/s** | **1135** | **ft/s** | | **# shots:** | **10** | | | |
| **Std Dev:** | **21** | **m/s** | **69** | **ft/s** | | **Spread:** | **50** | **m/s** | **164** | **ft/s** |
| **ZMR:** | **32** | **m/s** | **105** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| 300 | 984 | -- | -- | 1.03 | PP | No | -- | 9267 | | |
| 316 | 1036 | -- | -- | 0.50 | PP | No | -- | 9268 | | |
| **354** | **1161** | -- | -- | **1.75** | **CP** | **Yes** | **--** | **9269** | | |
| **330** | **1082** | -- | -- | **2.76** | **CP** | **Yes** | **--** | **9270** | | |
| **316** | **1036** | -- | -- | **2.93** | **PP** | **Yes** | **--** | **9271** | | |
| **318** | **1043** | -- | -- | **2.15** | **PP** | **Yes** | **--** | **9272** | | |
| **325** | **1066** | -- | -- | **1.03** | **PP** | **Yes** | **--** | **9273** | | |
| **362** | **1187** | -- | -- | **2.50** | **PP** | **Yes** | **--** | **9274** | | |
| 380 | 1246 | -- | -- | 2.51 | CP | No | -- | 9275 | | |
| **365** | **1197** | **--** | **--** | **0.35** | **CP** | **Yes** | **--** | **9276** | | |
| **360** | **1181** | **--** | **--** | **1.82** | **PP** | **Yes** | **--** | **9277** | | |
| **363** | **1191** | **--** | **--** | **0.25** | **CP** | **Yes** | **--** | **9278** | | |
| **366** | **1200** | **--** | **--** | **0.90** | **CP** | **Yes** | **--** | **9279** | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **31-Jan-13** | | | | | |
| Plate #: | **495880-4B1** | | | Test Site: | **EF-110E** | | | | | |
| Lot#: | **495880** | | | | | | | | | |
| Avg. Thickness: | **1.003** | **"** | **25.476** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **131** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **20mm** | **FSP** | | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Xray** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **453** | **m/s** | **1486** | **ft/s** | | | | | | |
| **High PP:** | **458** | **m/s** | **1502** | **ft/s** | | | | | | |
| **V50:** | **462** | **m/s** | **1517** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **9** | **m/s** | **31** | **ft/s** | | **Spread:** | **20** | **m/s** | **66** | **ft/s** |
| **ZMR:** | **5** | **m/s** | **16** | **ft/s** | | | | | | |
| | | | | | | | | | | |

| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 444 | 1456 | 1.00 | -1.00 | 1.41 | PP | No | -- | 1916 | | |
| 367 | 1204 | 0.00 | 1.00 | 1.00 | PP | No | -- | 1917 | | |
| 408 | 1338 | -0.25 | 0.25 | 0.35 | PP | No | -- | 1918 | | |
| 421 | 1381 | 0.25 | -0.25 | 0.35 | PP | No | -- | 1919 | | |
| 440 | 1443 | 0.00 | 0.25 | 0.25 | PP | No | -- | 1920 | | |
| **458** | **1502** | **-0.50** | **-0.25** | **0.56** | **PP** | **Yes** | **--** | **1921** | | |
| 487 | 1597 | -0.50 | -0.25 | 0.56 | CP | No | -- | 1922 | | |
| 473 | 1551 | -0.25 | 0.00 | 0.25 | CP | No | -- | 1923 | | |
| **472** | **1548** | **0.25** | **-0.50** | **0.56** | **CP** | **Yes** | **--** | **1924** | | |
| **453** | **1486** | **-0.50** | **0.00** | **0.5** | **CP** | **Yes** | **--** | **1925** | | |
| **456** | **1496** | **-0.25** | **0.25** | **0.35** | **PP** | **Yes** | **--** | **1926** | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **4-Feb-13** | | | | | |
| Plate #: | **495880-4E2** | | | Test Site: | **EF-110E** | | | | | |
| Lot#: | **495880** | | | | | | | | | |
| Avg. Thickness: | **1.004** | **"** | **25.502** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **126** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **20mm** | **FSP** | | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | **Xray** | | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **462** | **m/s** | **1515** | **ft/s** | | | | | | |
| **High PP:** | **463** | **m/s** | **1519** | **ft/s** | | | | | | |
| **V50:** | **463** | **m/s** | **1519** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **5** | **m/s** | **16** | **ft/s** | | **Spread:** | **12** | **m/s** | **39** | **ft/s** |
| **ZMR:** | **1** | **m/s** | **3** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| **462** | **1515** | **0.25** | **-0.25** | **0.35** | **CP** | **Yes** | **--** | **1927** | | |
| 447 | 1466 | 0.25 | 0.75 | 0.79 | PP | No | -- | 1928 | | |
| **458** | **1502** | **0.00** | **0.25** | **0.25** | **PP** | **Yes** | **--** | **1929** | | |
| **463** | **1519** | **0.25** | **-0.25** | **0.35** | **PP** | **Yes** | **--** | **1930** | | |
| **470** | **1542** | **0.00** | **0.25** | **0.56** | **CP** | **Yes** | **--** | **1931** | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **5-Feb-13** | | | | | |
| Plate #: | **495892-1E1** | | | Test Site: | **EF-110E** | | | | | |
| Lot#: | **495892** | | | | | | | | | |
| Avg. Thickness: | **1.511** | **"** | **38.379** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **137** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **20mm** | **FSP** | | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Xray** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **902** | **m/s** | **2959** | **ft/s** | | | | | | |
| **High PP:** | **900** | **m/s** | **2952** | **ft/s** | | | | | | |
| **V50:** | **903** | **m/s** | **2962** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **7** | **m/s** | **23** | **ft/s** | | **Spread:** | **16** | **m/s** | **52** | **ft/s** |
| **ZMR:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |
| | | | | | | | | | | |
| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
| | | | | | | | | | | |
| 821 | 2693 | -1.50 | -0.50 | 1.58 | PP | No | -- | 1932 | | |
| 862 | 2827 | 0.00 | -0.50 | 0.50 | PP | No | -- | 1933 | | |
| **900** | **2952** | **0.25** | **-0.25** | **0.35** | **PP** | **Yes** | **--** | **1934** | | |
| **902** | **2959** | **-0.25** | **0.25** | **0.35** | **CP** | **Yes** | **--** | **1935** | | |
| **913** | **2995** | **0.25** | **-0.75** | **0.79** | **CP** | **Yes** | **--** | **1936** | | |
| **897** | **2942** | **-0.25** | **-0.25** | **0.35** | **PP** | **Yes** | **--** | **1937** | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **12-Feb-13** | | | | | |
| Plate #: | **495892-1B2** | | | Test Site: | **EF-110E** | | | | | |
| Lot#: | **1B2** | | | | | | | | | |
| Avg. Thickness: | **1.508** | **"** | **38.303** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **137** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **20mm** | **FSP** | | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Xray** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **872** | **m/s** | **2860** | **ft/s** | | | | | | |
| **High PP:** | **881** | **m/s** | **2890** | **ft/s** | | | | | | |
| **V50:** | **877** | **m/s** | **2877** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **5** | **m/s** | **15** | **ft/s** | | **Spread:** | **9** | **m/s** | **30** | **ft/s** |
| **ZMR:** | **9** | **m/s** | **30** | **ft/s** | | | | | | |
| | | | | | | | | | | |

| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** |
|---|---|---|---|---|---|---|---|---|
| 910 | 2985 | 0.25 | 0.25 | 0.35 | CP | No | -- | 1939 |
| 906 | 2972 | 0.25 | 1.00 | 1.03 | CP | No | -- | 1940 |
| 916 | 3004 | -0.75 | 0.00 | 0.75 | CP | No | -- | 1941 |
| 912 | 2991 | 0.00 | -0.50 | 0.50 | CP | No | -- | 1942 |
| 906 | 2972 | -0.50 | 0.25 | 0.56 | CP | No | -- | 1943 |
| 888 | 2913 | 0.00 | -0.25 | 0.25 | CP | No | -- | 1944 |
| 848 | 2781 | 0.25 | 0.00 | 0.25 | PP | No | | 1945 |
| 842 | 2762 | 0.25 | 0.00 | 0.25 | PP | No | | 1946 |
| 858 | 2814 | -0.50 | -0.25 | 0.56 | PP | No | | 1947 |
| **872** | **2860** | **0.00** | **0.00** | **0.00** | **CP** | **Yes** | | **1948** |
| **881** | **2890** | **0.00** | **-0.50** | **0.50** | **CP** | **Yes** | | **1949** |
| **874** | **2867** | **-0.25** | **-0.50** | **0.56** | **PP** | **Yes** | | **1950** |
| **881** | **2890** | **-1.25** | **0.25** | **1.25** | **PP** | **Yes** | | **1951** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T7** | | | Date: | **5-Aug-10** | | | | | |
| Plate #: | **46950640-K889 & T7651** | | | Test Site: | **EF-108** | | | | | |
| Lot#: | **K889 & T7651** | | | | | | | | | |
| Avg. Thickness: | **1.533** | **"** | **38.932** | **mm** | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Hardness: | **124** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **20mm** | **FSP** | | | | | | | | |
| | | | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Xray** | | | | | | | | |
| | | | | | | | | | | |
| **Low CP:** | **868** | **m/s** | **2847** | **ft/s** | | | | | | |
| **High PP:** | **914** | **m/s** | **2998** | **ft/s** | | | | | | |
| **V50:** | **903** | **m/s** | **2962** | **ft/s** | | **# shots:** | **10** | | | |
| **Std Dev:** | **19** | **m/s** | **62** | **ft/s** | | **Spread:** | **57** | **m/s** | **187** | **ft/s** |
| **ZMR:** | **46** | **m/s** | **151** | **ft/s** | | | | | | |
| | | | | | | | | | | |

| **Striking Velocity (m/s)** | **Striking Velocity (ft/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **868** | **2847** | **--** | **--** | **1.82** | **CP** | **Yes** | **--** | **9280** | | |
| 839 | 2752 | -- | -- | 1.58 | PP | No | -- | 9281 | | |
| 852 | 2795 | -- | -- | 2.02 | PP | No | -- | 9282 | | |
| 860 | 2821 | -- | -- | 2.85 | PP | No | -- | 9283 | | |
| 863 | 2831 | -- | -- | 3.25 | PP | No | -- | 9284 | | |
| 874 | 2867 | -- | -- | 3.04 | PP | No | -- | 9285 | | |
| **879** | **2883** | **--** | **--** | **2.50** | **PP** | **Yes** | **--** | **9286** | | |
| 877 | 2877 | -- | -- | 2.80 | PP | No | -- | 9287 | | |
| **895** | **2936** | **--** | **--** | **3.04** | **PP** | **Yes** | **--** | **9288** | | |
| **891** | **2922** | **--** | **--** | **1.06** | **PP** | **Yes** | **--** | **9289** | | |
| **910** | **2985** | **--** | **--** | **0.35** | **PP** | **Yes** | **--** | **9290** | | |
| **925** | **3034** | **--** | **--** | **2.80** | **CP** | **Yes** | **--** | **9291** | | |
| **915** | **3001** | **--** | **--** | **0.35** | **CP** | **Yes** | **--** | **9292** | | |
| **918** | **3011** | **--** | **--** | **0.25** | **CP** | **Yes** | **--** | **9293** | | |
| **916** | **3004** | **--** | **--** | **2.50** | **CP** | **Yes** | **--** | **9294** | | |
| **914** | **2998** | **--** | **--** | **2.00** | **PP** | **Yes** | **--** | **9295** | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Target: | **AA7017-T6** | | | Date: | **18-Jun-13** | | | | | |
| Plate #: | **495905-2F1** | | | Test Site: | **EF-110G** | | | | | |
| Projectile Lot#: | | | | | | | | | | |
| Avg. Thickness | **2.013** | **"** | **51.130** | **mm** | | | | | | |
| Hardness: | **131** | **HBN** | | | | | | | | |
| Obliquity: | **0°** | | | | | | | | | |
| Projectile: | **20mm** | **FSP** | | | | | | | | |
| Setup: | **AA7017-Air(6")-AA2024(0.020")** | | | | | | | | | |
| Velocity Measurement: | | **Xray** | | | | | | | | |
| **Low CP:** | **1299** | **m/s** | **4263** | **ft/s** | | | | | | |
| **High PP:** | **1297** | **m/s** | **4255** | **ft/s** | | | | | | |
| **V50:** | **1301** | **m/s** | **4269** | **ft/s** | | **# shots:** | **4** | | | |
| **Std Dev:** | **8** | **m/s** | **27** | **ft/s** | | **Spread:** | **18** | **m/s** | **60** | **ft/s** |
| **ZMR:** | **0** | **m/s** | **0** | **ft/s** | | | | | | |

| **Striking Velocity (ft/s)** | **Striking Velocity (m/s)** | **Pitch (deg)** | **Yaw (deg)** | **Gamma (deg)** | **Result (PP/CP)** | **Used for V50** | **Comments** | **Shot #** |
|---|---|---|---|---|---|---|---|---|
| 4625 | 1410 | -- | -- | 0.56 | CP | No | -- | 14451 |
| 4350 | 1326 | -- | -- | 1.00 | CP | No | -- | 14452 |
| 4058 | 1237 | -- | -- | 0.56 | CP | No | *DISREGARD Shot for $V_{50}$; Witness broke from debris flying thru crack at back of target | 14453 |
| 4058 | 1237 | -- | -- | 1.50 | PP | No | -- | 14454 |
| 4043 | 1232 | -- | -- | 0.00 | PP | No | -- | 14455 |
| 4105 | 1251 | -- | -- | 1.75 | PP | No | -- | 14456 |
| 4131 | 1259 | -- | -- | 0.25 | PP | No | -- | 14457 |
| **4263** | **1299** | **--** | **--** | **2.30** | **CP** | **Yes** | **--** | **14458** |
| 4203 | 1281 | -- | -- | 0.75 | PP | No | -- | 14459 |
| **4248** | **1295** | **--** | **--** | **0.56** | **PP** | **Yes** | **--** | **14460** |
| **4255** | **1297** | **--** | **--** | **2.51** | **PP** | **Yes** | **--** | **14461** |
| **4308** | **1313** | **--** | **--** | **0.50** | **CP** | **Yes** | **--** | **14462** |

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## List of Symbols, Abbreviations, and Acronyms

| | |
|---|---|
| AA | aluminum alloy |
| AP | armor-piercing |
| CP | complete penetration |
| FSP | fragment-simulating projectile |
| ID | identification |
| IR | infrared |
| PP | partial penetration |

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K DOHERTY
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S GRENDAHL
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D LYON
RDRL WMP D
J RUNYEON
D PETTY
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