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5.56-mm M856 TRACER MINI ROUND ROBIN STUDY

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U.S. ARMY ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

Close Combat Armaments Center

Picatinny Arsenal, New Jersey

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5.56-mm M856 TRACER MINI ROUND ROBIN STUDY

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This report details the testing conducted to determine the amount of variation which exists in the 5.56-mm ballistic test results between U.S. Army Armament Research, Development and Engineering Center, Lake City Army Ammunition Plant, and Olin Ordnance, St. Marks, Florida. The testing included using the same 5.56-mm M856 tracer lot, test equipment; and 5.56-mm electronic pressures, velocity, and action time test barrels at all three sites and concluded that there was less than a 2% variation.
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OBJECTIVE

To determine the amount of variation that exists in 5.56-mm ballistic test results using the same U.S. Army Armament Research, Development and Engineering Center (ARDEC) test equipment at three various test site locations for hot, ambient, and cold temperature conditions.

BACKGROUND

On 9 December 1993, Lake City Army Ammunition Plant (LCAAP) submitted a Request For Waiver (RFW) M4S6000 (W0009-178-93) for acceptance of the 5.56-mm M856 tracer lot LC93K098-017 (referred herein as lot 017), which had failed the acceptance test criteria for minimum port pressure. Lake City AAP's Lot Failure Analysis Task Force concluded in the RFW M4S6000 (app A) that the failure was due to a variation in the port pressure, attributing the failure to test methods, and normal charge weight variation of the WC844T propellant. The U.S. Army Research, Development and Engineering Center approved RFW M4S6000, but was interested in determining how much variation actually existed in the electronic pressures, velocity, and action time (EPVAT) results from the testing conducted between the various test sites using the failed lot of M856 ammunition (lot 017), along with identical test equipment.

APPROACH

The approach taken in this study was to implement a test plan (app B) to determine the amount of variation that existed in ballistic test results using the same test equipment at ARDEC, LCAAP, and Olin Ordnance, St. Marks, Florida. The ballistic test results or characteristics which were examined were chamber pressure, port pressure, and velocity recorded for hot (+125⁰ ± 2⁰F), ambient (70⁰ ± 2⁰F), and cold (-65⁰ ± 2⁰F) temperatures. The methods to obtain this information were developed following the procedures set forth in the Small Caliber Ammunition Test Procedures (SCATP) - 5.56 mm (Heavy Bullet), revision B, section 7, for EPVAT testing; which is the procedure used for all Government lot acceptance testing. The samples from the failed M856 lot (lot 017) were fired at each test site location through three 5.56 mm, 1-in. to 7-in. twist Kart Precision Barrel Corp. manufactured EPVAT barrels, each using the same Kistler 6203 piezoelectric transducers, as well as, two Kistler 5400 dual mode amplifiers. This base lining was aimed at reducing the amount of variation that could be attributed to the equipment, thereby, amplifying any variation due to the test setup at each test site.
AMMUNITION

The M856 tracer lot, LC-93K098-017, which consisted of 257,657 rounds, was rejected for failing to meet the minimum port pressure requirement. The 5.56-mm M856 Tracer Cartridge Specification, MIL-C-63990C, paragraph 3.8 states, "the mean port pressure minus three standard deviations shall not be less than 12,700 psi for sample cartridges conditioned to 70° ± 2°F." The lot recorded a port pressure of 12,560 psi for its initial lot acceptance test and retested with a port pressure of 12,590 psi. All other ballistic parameters met their requirements during both lot acceptance tests (app C).

The failed tracer lot was the 17th lot produced bearing the interfix number 098. The interfix number represents the processes or methods with which the M856 cartridges were manufactured. This M856 lot was produced with cases manufactured on the Small Caliber Ammunition Modernization Program (SCAMP) line, primed on the SCAMP line, contained Building 2 bullet assembly module (BAM) bullets, were plate loaded in Building 4, had dip tip I.D., and were 100% gaged and weighed (G&W). In addition, two previous lots manufactured under interfix 098, loaded with the same propellant lot (49644) also failed to meet the minimum port pressure during lot acceptance, but both passed on their retest. The first of the two lots was lot LC-93E098-009, which initially recorded a port pressure of 12,360 psi and passed the retest with a value of 13,240, a difference of 880 psi. The second lot was LC-93F098-011, which recorded an initial port pressure value of 12,680 psi, with a retest value of 13,430 psi, which equates to a difference of 750 psi.

The WC844T propellant lot, 49644 (OMF91G-049644), that was loaded into lot 017, recorded a port pressure of 13,398 psi when it was presented for lot acceptance at Olin Ordnance, St. Marks, Florida in July of 1991 (app C). This represents an approximately 800 psi difference between the propellant lot tested at St. Marks and the M856 tracer lot 017, which was tested for acceptance at LCAAP.

The M856 Mini Round Robin study attempted to determine the cause of the differences in test results occurring between LCAAP and Olin, St. Marks.

PORT PRESSURE RESULTS

The minimum port pressure required for the 5.56-mm M856 tracer cartridge is 12,700 psi for the corrected average minus three standard deviations. The average port pressure at the temperature extremes (+125° ± 2°F and -65° ± 2°F) shall not be less than 11,400 psi and shall not vary more than ±1,500 psi from the average port pressure at ambient. A total of nine ballistic tests were fired at an ambient temperature (70° ± 2°F) over the course of the M856 Mini Round Robin study. These nine tests consisted of firing the three Kart EPVAT barrels at three test sites, out of which only one test failed to meet the minimum requirement with an average port pressure minus
three standard deviations of 12,657 psi (table 1). Olin Ordnance, St. Marks, recorded the lowest overall port pressure with a site average of 13,164 psi. This value was 85 psi lower than the LCAAP average for port pressure, not 800 psi greater as was previously recorded during the WC844T propellant lot acceptance.

A statistical analysis conducted on the data by the Product Assurance and Test Directorate, Quality Production Branch, ARDEC, demonstrated that the actual difference/variation between Olin, St. Marks and LCAAP equates to 85 psi with a confidence interval of ±48.5 psi. The data from the M856 Mini Round Robin confirms that lot 017 does meet the minimum port pressure requirement and that there was very little variation in port pressure results among the test sites with ARDEC and Olin, St. Marks showing the largest variation with a difference of 2.32%, and an average variation of 0.57% between the three barrels. Figure 1 displays the average port pressure for each barrel at each test site, along with the upper and lower honest significant difference (HSD) limits, which demonstrate the amount of spread the data reflects at each site. Failures of HSD intervals to overlap indicate evidence of differences in average performance.

A major discrepancy noted while testing at LCAAP concerned the port pressure correction factor which is applied to each EPVAT test barrel prior to ballistic testing. Each test barrel must fire reference ammunition in order to qualify the barrel and establish range and equipment corrections, prior to firing the ammunition lot for testing. In order for the barrel to qualify, the average port pressure value must be within ±2,000 psi of the assessed port pressure value of the reference lot. The original assessed port pressure value for 5.56 mm, heavy bullet reference lot LC-87000R-011 (R011) was 13,414 psi; however, at LCAAP, the assessed value being used for EPVAT barrel corrections was 14,114 psi, a difference of 700 psi. This adjustment to the assessed value for port pressure had been stated in a September 1991, memorandum from Fire Control and Small Caliber Systems Division notifying all activities of the change (app D). Olin, St. Marks, however, was never notified of this important change until the ARDEC engineer conducting the M856 Mini Round Robin study at St. Marks in May 1994 provided a copy of this memorandum.

CHAMBER PRESSURE RESULTS

No notable differences were discovered in the chamber pressure results at each of the test site locations (table 2). The chamber pressure requirements for the M856 tracer cartridge is a maximum average of 55,000 psi at ambient temperatures (70° ± 2°F), a maximum of 61,000 psi for the average plus three standard deviations and a maximum individual chamber pressure reading of 61,000 psi. The specification requirement for the average chamber pressure at the temperature extremes (+125° ± 2°F and -65° ± 2°F) shall not vary more than 7,000 psi from the average chamber pressure and the average chamber pressure at hot temperatures (+125° ± 2°F) shall be no greater than 60,000 psi.
All of the tests conducted during the Mini Round Robin study were below the maximum requirements. The highest average chamber pressure recorded was for Kart barrel 6 fired at ARDEC, which was 1,030 psi above the grand mean for all chamber pressures recorded. The actual variation or difference between LCAAP and St. Marks was 726 psi ± 187 psi. Figure 2 displays the average chamber pressure for each barrel at each test site, along with the upper and lower HSD limits.

VELOCITY

The 5.56-mm M856 tracer cartridge requirement for the average velocity is 2,990 ±40 ft/s with a standard deviation no greater than 40. The requirement for the average velocity at the two temperature extremes (+125° ± 2°F and -65° ± 2°F) shall not decrease by more than 250 ft/s.

All of the velocities recorded during the M856 Mini Round Robin study were similar among the various test sites (table 3). Olin, St. Marks recorded higher velocities for each barrel as seen in figure 3. The actual variation between LCAAP and Olin, St. Marks was 24 ft/s ± 7.6 ft/s, with the amount of variation between the test sites and the barrels being less than 1%, respectively. Two out of the three barrels tested at Olin, St. Marks exceeded the maximum M856 velocity requirement of 3,030 ft/s. However, each of the three barrels failed to qualify at Olin, St. Marks using 5.56 mm, reference lot R011. Each barrel went through the qualification procedure twice and both times failed to qualify for velocity. Testing was conducted with the non-qualified barrels anyway since these barrels had already been used at both ARDEC and LCAAP.

Technicians at Olin, St. Marks suggested that the distance between LCAAP's velocity screens be checked, but this scenario seems unlikely since the ARDEC and LCAAP test results demonstrate similar velocities. It was also noted that Olin, St. Marks uses Ohler Model 55 velocity screens, which are set 100 ft apart, centered at 78 ft, and are bolted to the floor. Lake City AAP uses ECI Model 6100 velocity screens, set 100 ft apart, centered at 78 ft, and are not fixed to the floor. Another issue that was discussed was that the value for velocity (2,983 ft/s) for reference lot R011 is assessed too high. Of the 260 reference rounds fired during the M856 Mini Round Robin study, through the same three Kart barrels, the average positive correction factor for velocity was 29.7 ft/s, where the SCATP cites a requirement of ±35 ft/s for barrel qualification.

ADDITIONAL TESTING

In addition to the testing outlined in the test plan (app B), further testing was performed on the failed lot at LCAAP and at Olin, St. Marks. After all testing had been completed at LCAAP, lot 017 was again fired through the ARDEC supplied test barrels; however, this time LCAAP transducers and charge amplifiers were used. The results in table 4 show that the velocities for each barrel were consistently lower, an
average of 9.7 ft/s, with the LCAAP test equipment than when compared with the ARDEC test equipment. Likewise, the port pressure was higher by an average of 226.6 psi with the LCAAP transducers than with the ARDEC transducers, which equates to a 1.7% increase. The chamber pressure was varied, but averaged out to a decrease of 289.6 psi, which is less than 1%. This test was done only at ambient temperatures.

After testing had been completed at Olin, St. Marks, additional testing was performed with lot 017 to compare an H-S Precision Inc. manufactured EPVAT barrel used in conjunction with St. Marks test equipment. The data located in table 5 displays those results which show that the ARDEC barrels shot much higher than the H-S barrel; however, only a 10-round sample was shot for this test based on ammunition availability.

This additional testing did demonstrate some variation, but on an overall scale the amount was less than 2.0%. This variation, like the small amount noted earlier, could possibly be attributed to experimental/operator error.

DISCREPANCIES

As the 5.56-mm M856 Round Robin study progressed from one test site to another, discrepancies in the test setup between sites were discovered. One of the major discrepancies dealt with the amount of torque applied to fasten the transducers to the barrel. The torque value required for tightening the Kistler 6203 transducer to the test barrel should be 130 inch-pounds (in.-lb) according to the 5.56 mm, SCATP. During the M856 Round Robin study, however, it was discovered that none of the test facilities used this value. A torquing force of 120 in.-lb was used at ARDEC, whereas, LCAAP and Olin, St. Marks both use a force of 105 in.-lb to torque their transducers, based on Kistler's recommendation to Fire Control and Small Caliber Systems Division, dated 16 April 1985 (app E). The amount of torque placed on the transducers has been known to influence the ballistic results obtained.

The charge amplifier setup also varied at each test location. The U.S. Army Armament Research, Development and Engineering Center sets the sensitivity range on the Kistler 5004 dual mode charge amplifier to read the voltage output directly in terms of pounds per square inch (psi) and the pressures are then read from an oscilloscope. Lake City AAP also uses the Kistler 5004 dual mode charge amplifier, but is set up to read the data directly from the transducer voltages and uses the Ohler System 82 ballistic computer to convert the data into pressure (psi). The Kistler 5004 dual mode charge amplifier requires a filter, which defines the pressure peak and averages the ballistic data. The U.S. Army Armament Research, Development and
Engineering Center uses the NATO approved 33 kHz filter, whereas, LCAAP uses a 180 kHz filter. The 180 kHz filter provides a higher reading, as much as 1,000 psi, by filtering out more of the noise. Whereas, Olin, St. Marks uses the Model 504E Charge Amplifier, an internal charge amplifier located in the Ohler System 82, which is set to the specific transducer sensitivity value and the frequency of the filter used was not known. The test technicians at St. Marks were unfamiliar with how to set up their Ohler System with external charge amplifiers, so the ARDEC charge amplifiers used in testing at ARDEC and LCAAP were not used. Both LCAAP and Olin, St. Marks use version 1.19 of the Ohler Slowfire software; however, LCAAP uses different setup parameters with the software due to the charge amplifier setup/transducer calibration differences.

The methods that the gunners at LCAAP and Olin, St. Marks follow also vary. The Olin, St. Marks gunners follow the prescribed SCATP procedure for the treatment of each test round that LCAAP gunners use (180°, stop, 180°). However, the Olin, St. Marks practice is to seat the round fully with thumb pressure; whereas, the LCAAP gunners seat the round with the bolt. In addition, the receivers at LCAAP have a "V" machined into the bolt which makes it easier to place the round in the chamber while keeping the bullet upwards.

Olin, St. Marks' weapon bays are more climate controlled than the gun bays at LCAAP. The weapon bays at Olin, St. Marks are conditioned to 70° ± 2°F eliminating the need to keep the test rounds in the holding boxes. Each weapon bay at Olin, St. Marks has a temperature controlled oven in it allowing the gunner to remove a single round from the oven and place it in the barrel. At LCAAP, the gunner must remove five rounds at a time from the temperature conditioning chamber, place them in a holding box and walk approximately 80 ft to the gun bay.

**CONCLUSIONS**

The 5.56-mm M856 Tracer Mini Round Robin consisted of firing approximately 1,000 rounds through multiple barrels with the same test equipment to determine the amount of variation that exists in ballistic results between test facilities at the U.S. Army Armament Research, Development and Engineering Center (ARDEC), Lake City Army Ammunition Plant (LCAAP), and Olin Ordnance, St. Marks, Florida.

The data that has been presented demonstrates that the variation in ballistic data due to equipment set-up between ARDEC, LCAAP, and Olin, St. Marks is negligible. Even with the number of discrepancies in test setup and equipment, the largest variation discovered was less than 2% and was attributed to EPVAT barrels, 006 and 010, and test locations, ARDEC and LCAAP. This 2% variation could be attributed to
set up and normal experimental error. The variation between port pressure results during the lot acceptance testing of the ammunition lot and the propellant lot equates to a 6% variation. This variation could be attributed to the chemical reaction which occurs with the ignition of the propellant in the cartridge upon firing.

RECOMMENDATIONS

Even though very little variation was found between the test sites, several discrepancies were discovered which could lead to larger variations in the future. This office will investigate the affects that various torque values have on barrels, as well as, ballistic results. The same should be done for the varying filter frequency on the charge amplifiers and the difference in weapon bay configuration between Lake City Army Ammunition Plant and Olin, St. Marks. In addition, this office will seek to assess reference lot R011 to determine that the values posted to that lot are valid.
Figure 1

Site by barrel interaction for port pressure*

*Corrected Average

HSD = Honest Significant Difference

HSD Delta = 133.23
Figure 2
Site by barrel interaction for chamber pressure*

*Corrected Average
HSD=Honest Significant Difference

HSD Delta = 1,422.15
Figure 3
Site by barrel interaction for velocity*

*Corrected Average

HSD=Honest Significant Difference

HSD Delta = 20.98
### Table 1
5.56-mm M856 mini round robin, lot LC-93K098-017, test results on port pressure

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<th>AVG + 3SD @ AMB</th>
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**PERCENT DIFFERENCES BETWEEN LOCATIONS**

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<td>ARDEC vs. ST. MARKS</td>
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<td>LCAAP vs. ST. MARKS</td>
<td>0.64% 0.72% 0.56% 0.65% 0.47%</td>
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*NOTE: All values corrected using 14,114 psi*
Table 2
5.56-mm M856 mini round robin, lot LC-93K098-017, test results on chamber pressure*

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<th>AVG - 3SD @ AMB</th>
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**BRL 006 AVGs**

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<th>MIN ChP @ AMB</th>
<th>EX VAR @ AMB</th>
<th>ChP VAR @ +125F</th>
<th>ChP VAR @ -65F</th>
<th>Corr Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARDEC</td>
<td>008</td>
<td>49996</td>
<td>2488</td>
<td>57461</td>
<td>42531</td>
<td>54087</td>
<td>42687</td>
<td>11400</td>
<td>2474</td>
<td>1487</td>
<td>487</td>
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<tr>
<td>LCAAP</td>
<td>008</td>
<td>49915</td>
<td>1128</td>
<td>53299</td>
<td>46530</td>
<td>51645</td>
<td>47780</td>
<td>3865</td>
<td>3403</td>
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<td>348</td>
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<tr>
<td>ST. MARKS</td>
<td>008</td>
<td>50797</td>
<td>1036</td>
<td>53906</td>
<td>47689</td>
<td>53070</td>
<td>48642</td>
<td>4428</td>
<td>3042</td>
<td>-1698</td>
<td>-145</td>
</tr>
</tbody>
</table>

**BRL 008 AVGs**

<table>
<thead>
<tr>
<th>TEST LOCATION</th>
<th>BARREL NO.</th>
<th>AVERAGE @ AMB</th>
<th>SD</th>
<th>AVG + 3SD @ AMB</th>
<th>AVG - 3SD @ AMB</th>
<th>MAX ChP @ AMB</th>
<th>MIN ChP @ AMB</th>
<th>EX VAR @ AMB</th>
<th>ChP VAR @ +125F</th>
<th>ChP VAR @ -65F</th>
<th>Corr Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARDEC</td>
<td>010</td>
<td>51775</td>
<td>1282</td>
<td>55622</td>
<td>47928</td>
<td>54151</td>
<td>49271</td>
<td>4880</td>
<td>847</td>
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<td>971</td>
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<tr>
<td>LCAAP</td>
<td>010</td>
<td>50822</td>
<td>1292</td>
<td>54698</td>
<td>46947</td>
<td>52832</td>
<td>47957</td>
<td>4875</td>
<td>2509</td>
<td>-2398</td>
<td>-272</td>
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<td>ST. MARKS</td>
<td>010</td>
<td>51083</td>
<td>1151</td>
<td>54537</td>
<td>47630</td>
<td>52828</td>
<td>49070</td>
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**BRL 010 AVGs**

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<th>BARREL NO.</th>
<th>AVERAGE @ AMB</th>
<th>SD</th>
<th>AVG + 3SD @ AMB</th>
<th>AVG - 3SD @ AMB</th>
<th>MAX ChP @ AMB</th>
<th>MIN ChP @ AMB</th>
<th>EX VAR @ AMB</th>
<th>ChP VAR @ +125F</th>
<th>ChP VAR @ -65F</th>
<th>Corr Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARDEC</td>
<td>AVERAGE</td>
<td>51190</td>
<td>1803</td>
<td>56599</td>
<td>45782</td>
<td>54341</td>
<td>46994</td>
<td>7347</td>
<td>1760</td>
<td>642</td>
<td>714</td>
</tr>
<tr>
<td>LCAAP</td>
<td>AVERAGE</td>
<td>50197</td>
<td>1171</td>
<td>53709</td>
<td>46685</td>
<td>52008</td>
<td>47760</td>
<td>4248</td>
<td>4106</td>
<td>-1496</td>
<td>-263</td>
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<tr>
<td>ST. MARKS</td>
<td>AVERAGE</td>
<td>50923</td>
<td>1181</td>
<td>54465</td>
<td>47381</td>
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<td>48364</td>
<td>4744</td>
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<td>455</td>
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**PERCENT DIFFERENCES BETWEEN LOCATIONS**

<table>
<thead>
<tr>
<th>TEST LOCATION</th>
<th>DIFFERENCE %</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARDEC vs. LCAAP</td>
<td>1.94%</td>
</tr>
<tr>
<td>ARDEC vs. ST. MARKS</td>
<td>0.53%</td>
</tr>
<tr>
<td>LCAAP vs. ST. MARKS</td>
<td>1.45%</td>
</tr>
</tbody>
</table>

*NOTE: All values are corrected averages.*
Table 3  
5.56-mm M856 mini round robin, lot LC-93K098-017, test results on velocity*

<table>
<thead>
<tr>
<th>TEST LOCATION</th>
<th>BARREL NO.</th>
<th>AVERAGE @ AMB</th>
<th>SD</th>
<th>AVG + 3SD @ AMB</th>
<th>AVG - 3SD @ AMB</th>
<th>MAX VEL @ AMB</th>
<th>MIN VEL @ AMB</th>
<th>EX VAR @ AMB</th>
<th>VEL VAR @ +125F</th>
<th>VEL VAR @ -65F</th>
<th>Corr. Factor</th>
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</thead>
<tbody>
<tr>
<td>ARDEC</td>
<td>006</td>
<td>3006</td>
<td>21</td>
<td>3070</td>
<td>2941</td>
<td>3034</td>
<td>2961</td>
<td>73</td>
<td>58</td>
<td>-44</td>
<td>19</td>
</tr>
<tr>
<td>LCAAP</td>
<td>006</td>
<td>3004</td>
<td>19</td>
<td>3060</td>
<td>2948</td>
<td>3042</td>
<td>2968</td>
<td>74</td>
<td>60</td>
<td>-40</td>
<td>22</td>
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<tr>
<td>ST. MARKS</td>
<td>006</td>
<td>3027</td>
<td>28</td>
<td>3112</td>
<td>2943</td>
<td>3071</td>
<td>2953</td>
<td>118</td>
<td>68</td>
<td>-54</td>
<td>38</td>
</tr>
<tr>
<td>BRL 006 AVGs</td>
<td></td>
<td>3012</td>
<td>23</td>
<td>3081</td>
<td>2944</td>
<td>3049</td>
<td>2961</td>
<td>88</td>
<td>62</td>
<td>-46</td>
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<tr>
<td>ARDEC</td>
<td>008</td>
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<td>91</td>
<td>52</td>
<td>-17</td>
<td>43</td>
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<tr>
<td>LCAAP</td>
<td>008</td>
<td>3002</td>
<td>20</td>
<td>3063</td>
<td>2942</td>
<td>3038</td>
<td>2957</td>
<td>81</td>
<td>54</td>
<td>-62</td>
<td>23</td>
</tr>
<tr>
<td>ST. MARKS</td>
<td>008</td>
<td>3031</td>
<td>18</td>
<td>3086</td>
<td>2976</td>
<td>3065</td>
<td>2996</td>
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<td>62</td>
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<td>36</td>
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<tr>
<td>BRL 008 AVGs</td>
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<td>3007</td>
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<td>-48</td>
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<tr>
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<td>3007</td>
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<td>-24</td>
<td>20</td>
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<td>LCAAP</td>
<td>010</td>
<td>3021</td>
<td>20</td>
<td>3082</td>
<td>2959</td>
<td>3054</td>
<td>2977</td>
<td>77</td>
<td>52</td>
<td>-74</td>
<td>24</td>
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<tr>
<td>ST. MARKS</td>
<td>010</td>
<td>3042</td>
<td>22</td>
<td>3109</td>
<td>2975</td>
<td>3093</td>
<td>3005</td>
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<td>BRL 010 AVGs</td>
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<td>-59</td>
<td>23</td>
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<tr>
<td>ST. MARKS</td>
<td>AVERAGE</td>
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<td>3102</td>
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<td>3076</td>
<td>2985</td>
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<td>65</td>
<td>-59</td>
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**PERCENT DIFFERENCES BETWEEN LOCATIONS**

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ARDEC vs. LCAAP</td>
<td>0.28%</td>
<td>0.13%</td>
<td>0.44%</td>
<td>0.05%</td>
<td>0.25%</td>
<td></td>
</tr>
<tr>
<td>ARDEC vs. ST. MARKS</td>
<td>1.08%</td>
<td>1.22%</td>
<td>0.94%</td>
<td>1.08%</td>
<td>0.83%</td>
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</tr>
<tr>
<td>LCAAP vs. ST. MARKS</td>
<td>0.80%</td>
<td>1.10%</td>
<td>0.51%</td>
<td>1.03%</td>
<td>0.58%</td>
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</tbody>
</table>

*NOTE: All values are corrected averages.*
Table 4
5.56-mm M856 mini round robin, lot LC-93K098-017,
transducer/test set-up comparison

<table>
<thead>
<tr>
<th>BARREL #006</th>
<th>Velocity (fps)</th>
<th>Standard Deviation</th>
<th>Port Pressure (psi)</th>
<th>Standard Deviation</th>
<th>Chamber Pressure (psi)</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARDEC TRANSDUCERS</td>
<td>3004</td>
<td>19</td>
<td>13282</td>
<td>88</td>
<td>49853</td>
<td>1092</td>
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<tr>
<td>LCAAP TRANSDUCERS</td>
<td>2998</td>
<td>24</td>
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<td>75</td>
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<table>
<thead>
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<th>BARREL #008</th>
<th>Velocity (fps)</th>
<th>Standard Deviation</th>
<th>Port Pressure (psi)</th>
<th>Standard Deviation</th>
<th>Chamber Pressure (psi)</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARDEC TRANSDUCERS</td>
<td>3002</td>
<td>20</td>
<td>13301</td>
<td>153</td>
<td>49915</td>
<td>1128</td>
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<td>LCAAP TRANSDUCERS</td>
<td>2995</td>
<td>19</td>
<td>13473</td>
<td>86</td>
<td>50173</td>
<td>1240</td>
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<td>DIFFERENCES</td>
<td>-7</td>
<td></td>
<td>172</td>
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<td>258</td>
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</table>

<table>
<thead>
<tr>
<th>BARREL #010</th>
<th>Velocity (fps)</th>
<th>Standard Deviation</th>
<th>Port Pressure (psi)</th>
<th>Standard Deviation</th>
<th>Chamber Pressure (psi)</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARDEC TRANSDUCERS</td>
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<td>1073</td>
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<td>312</td>
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AVERAGES          -9.67          226.67      -289.67            

*NOTE: All ballistic values are averages.

Table 5
5.56-mm M856 mini round robin, lot LC-93K098-017,
Kart versus H & S barrel comparison

<table>
<thead>
<tr>
<th></th>
<th>Velocity (fps)</th>
<th>Standard Deviation</th>
<th>Port Pressure (psi)</th>
<th>Standard Deviation</th>
<th>Chamber Pressure (psi)</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>KART BARRELS*</td>
<td>3033</td>
<td>23</td>
<td>13164</td>
<td>108</td>
<td>50923</td>
<td>1181</td>
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<tr>
<td>H-S BARREL</td>
<td>2970</td>
<td>26</td>
<td>12745</td>
<td>122</td>
<td>49918</td>
<td>1230</td>
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<td>DIFFERENCES</td>
<td>-63</td>
<td>-419</td>
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</table>

*NOTE: Average of 3 Kart Barrels.
APPENDIX A
REQUEST FOR WAIVER M4S600
MEMORANDUM FOR Commander, U.S. Army Armament Research, Development and Engineering Center, ATTN: SMCAR-BAT-IR, Rock Island, IL 61299-6000

SUBJECT: Request for Waiver (RFW) W0009-178-93, Cartridge, 5.56mm, SAWs Tracer, M856, Lot LC-93K098-017, Failed Port Pressure

1. The enclosed contractor RFW is forwarded for your disposition.

2. Contractor requests acceptance of cartridge that did not meet port pressure specification requirements. Subject cartridges are not significantly different from previous lots when port pressure was at 12,400 psi. Recommend lot be accepted as is without restriction.

3. No other safety, security, environmental or producibility issues noted.

4. The point of contact is Mr. K. McKee, SMCLC-QA, DSN 463-9162.

ORIGINAL SIGNED BY

Encl

MARY G. GOODWIN
LTC, OD,
Commanding

CF (w/encl):
SMCAR-ESW-S (R)
SMCAR-CCL-SP (Mr. J. E. Gaming) (D)
AMSMC-PAI-G/TEAM E (wo/encl) (R)
AMSMC-PDM-CA (R)
December 9, 1993

Department of the Army
Lake City Army Ammunition Plant
Independence, Missouri 64051-0250

Attention: Commander/SHCLC-QA

Subject: Request for Waiver (RFW) W0009-178-93, Cartridge, 5.56mm.
SAWS Tracer, M856, Lot LC-93K098-017, Failed Port Pressure

Dear Madam:

The subject Request for Waiver (RFW) is being submitted for acceptance of 5.56mm M856 SAWS Tracer lot #LC-93K098-017 (257,657 rounds). The lot, when presented for acceptance testing, failed the test for minimum port pressure. The Lot Failure Analysis Task Force assembled to investigate the root cause of the failure concluded the failure was due to variation in port pressure combined with a revised specification limit. The pressure variation was attributed to several factors including testing method and normal charge weight variation. Task Force findings and test data are attached to support this conclusion and Waiver request. It is important to note that all weapon cyclic rate requirements were met.

Acceptance of this waiver will not result in any adverse safety, security or environmental impacts.

Your review and concurrence is requested.

Very truly yours,

C. A. Hillen
Vice President & General Manager

D. J. Rohan
Director
Quality Assurance

DMP: rjp
Attachments
REQUEST FOR DEVIATION/ WAIVER

1. ORIGINATOR NAME AND ADDRESS
   Olin Corporation - Winchester Division
   Lake City Army Ammunition Plant
   Independence, Missouri 64051

2. DEVIATION/WAIVER NUMBER
   M496000

3. DESIGNATION FOR DEVIATION/WAIVER
   5.56mm M856

4. SPECIFICATIONS AFFECTED - TEST PLAN
   MIL-C-63990

5. BASELINE AFFECTED
   A. MOD/TYPE
      CASE CODE
      5.56mm M856
   B. SYSTEM
      93
   C. ITEM
      MIL-C-63990
   D. TEST PLAN
      9342865

6. OTHER SYSTEM/CONFIGURATION ITEMS AFFECTED
   a. MOD/TYPE
   b. SYSTEM
   c. ITEM
   d. TEST PLAN

7. DRAWINGS AFFECTED
   a. DRAWING
      CASE CODE
      93
   b. DRAWING NUMBER
      9342865

8. TITLE OF DEVIATION/WAIVER
   Cartridge, 5.56mm, SAMS Tracer, M856

9. WEAPON SYSTEM CODE OR DESIGNATION
   DAAA09-91-Z-0009
   CODE: 1CV77

10. CONTRACT NO. AND LINE ITEM
    DAAA09-91-Z-0009
    LOT NO.
    LC-93K098-017

11. PROCUREMENT CONTRACTING OFFICER
    DAAA09-91-Z-0009
    CONTRACT NO.
    1CV77

12. CONFIGURATION ITEM NOMENCLATURE
    a. MOD/TYPE
    b. SYSTEM
    c. ITEM
    d. TEST PLAN

13. CLASSIFICATION OF DEFECT
    a. DEFECT NO.
    b. DEFECT NO.
    c. DEFECT CLASSIFICATION

14. NAME OF LOWEST PART/ASSEMBLY AFFECTED
    Cartridge

15. PART NO. OR TYPE DESIGNATION
    Unknown

16. EFFECT ON COST/PRICE
    Unknown

17. EFFECT ON INTEGRATED LOGISTICS SUPPORT, INTERFACE OR SOFTWARE
    Unknown

18. DESCRIPTION OF DEVIATION/WAIVER
    See Attached

19. NEED FOR DEVIATION/WAIVER
    See Attached

20. SERIAL NUMBER(S) AFFECTED

21. SUBMITTING J.
    D. J. Rohan
    Director, Quality Assurance

22. APPROVAL/DISAPPROVAL
    a. RECOMMEND
    b. APPROVAL
    c. DISAPPROVAL

23. TITLE
    Director, Quality Assurance

DD Form 1694, JUL 88

Previous editions are obsolete

Figure 8. Request for Deviation/Waiver (DD Form 1694).
Attachment to Request for Waiver (RFW)
W0009-178-93, Cartridge, 5.56mm,
SAWS Tracer, M856, Lot LC-93K098-017,
Failed Port Pressure

December 9, 1993
Page 1 of 1

22. DESCRIPTION OF WAIVER

The lot failed to meet requirements of Military Specification MIL-C-63990,
paragraph 3.8, which states that the mean port pressure minus three standard
deviations shall not be less than 12,700 psi for sample cartridges
conditioned to 70 degrees plus or minus 2 degrees. This requirement was
changed from 12,400 psi to 12,700 psi with Amendment 1 dated 25 September
1991. The lot test results were 12,589 psi on the first test and 12,581 psi
on the retest. All other ballistic tests were within specification
requirements.

23. NEED FOR WAIVER

Several velocity and port pressure tests have been performed on this lot of
ammunition. Five tests were performed during the manufacturing of the
ammunition (Attachment 1). All of these tests met the specification
requirements.

Three tests, each on a separate gun barrel setup, were initially performed
as part of the lot failure analysis (Attachment 2). All of these tests met the specification
requirements.

An additional twenty-four tests were performed, three tests for each truck
of ammunition using different gun barrel setups (Attachment 3). All of
these tests meet the previous port pressure specification of 12,400 psi.
Only one test failed to meet the revised port pressure specification limit
of 12,700 psi (Attachment 4). This test can be shown to be statistically
different from all other tests performed (Attachment 5). A statistical
analysis of all the test data combined (240 observations) predicts no
cartridges to be out of specification (Attachments 6, 7 and 8).

The ammunition has passed all function and casualty testing including weapon
cyclic rates.

It was noted during failure analysis that some tests (including the lot
acceptance retest) had large standard deviations in port pressure.

The conclusion of the Failure Analysis Task Force was that an increase in
the port pressure standard deviation combined with the revised specification
limit caused the failed lot acceptance test. The increase in port pressure
standard deviation was attributed to random variations in pressure readings
carried by the testing system and normal variations in charge weight.

Recommendation

Based on testing performed prior to and after lot acceptance which show the
lot to be in conformance, it is recommended this lot be accepted as is.
### Two-Sample Analysis Results

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<tr>
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<th></th>
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</tr>
</thead>
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<td>240</td>
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<td>Average</td>
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<td>13596.2</td>
<td>13584</td>
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<tr>
<td>Variance</td>
<td>46075</td>
<td>27909.5</td>
<td>28595.4</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>214.651</td>
<td>167.061</td>
<td>169.105</td>
</tr>
<tr>
<td>Median</td>
<td>13273.5</td>
<td>13588</td>
<td>13580</td>
</tr>
</tbody>
</table>

**Difference between Means =** -292.104

Conf. Interval For Diff. in Means:

<table>
<thead>
<tr>
<th>(Equal Vars.)</th>
<th>Sample 1 - Sample 2</th>
<th>95 Percent</th>
<th>238 D.F.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Unequal Vars.)</td>
<td>Sample 1 - Sample 2</td>
<td>-399.74 -184.469</td>
<td>9.5 D.F.</td>
</tr>
</tbody>
</table>
| Ratio of Variances = 1.65087

Conf. Interval for Ratio of Variances:

| Sample 1 ÷ Sample 2 | 0 Percent |

**Hypothesis Test for H0: Diff = 0 vs Alt: NE at Alpha = 0.05**

Computed t statistic = -5.34737

Sig. Level = 2.09132E-7

so reject H0.
Process Capability Analysis

Process Capability for PPTEST.Port

Specification:

Upper
Nominal 13500
Lower 12700

Normal distribution:

Count 240
Mean 13584
Sigma 178.6

6.0-sigma limits:

+3.0 sigma
Mean 13584
-3.0 sigma 13048.2

Observed beyond spec.:

High
Low
Total

Estimated beyond spec.:

High
Low
Total

Capability indices:

CP
CR
CPK (upper) 1.64993
CPK (lower) 1.64993
K
CPM

* estimated parameter

Tail Area Probabilities

Distributions available:

(1) Bernoulli
(2) Binomial
(3) Discrete uniform
(4) Geometric
(5) Negative binomial
(6) Poisson
(7) Beta
(8) Chi-square
(9) Erlang
(10) Exponential
(11) F
(12) Gamma
(13) Lognormal
(14) Normal
(15) Student's t
(16) Triangular
(17) Uniform
(18) Weibull

Distribution number: 14

Mean: 13584

Standard deviation: 178.6

Area at or below 12700 = 3.723745E-7
Area at or below 12400 = 1.694916E-11
Area at or below 13584 = 0.5
Area at or below 13584 = 0.5
APPENDIX B
M856 MINI ROUND ROBIN TEST PLAN
5.56mm, M856 Tracer Mini Round Robin Test Plan

Date: 5/12/94

Purpose: To determine the amount of variation that exists in EPVAT test results utilizing the same test equipment at the following sites:

ARDEC - Picatinny Arsenal, NJ
LCAAP - Independence, MO
Olin - St. Marks, FL

Weapons: 3

1-in-7" 5.56mm, EPVAT Barrels

Ammo:

LC93K098-017 - 5.56mm, M856 Tracer 180 rds min
LC87F000R011 - 5.56mm, Reference, Heavy Bullet 120 rds max

Procedure:

1. The firing range shall be set-up IAW Section 7, Electronic Pressure, Velocity and Action Time (EPVAT), of the SCATP - 5.56mm (Heavy Bullet) Revision B, 12 Feb 93.

*Note: Velocity screens must be able to accommodate M856 Tracer rds.

2. Five warming (fouling) shots shall be fired prior to the first barrel assessment. After the last warming shot, the port and chamber pressure transducers shall be re-tightened to the appropriate torque level specified in Appendix B of the SCATP.

3. The first EPVAT barrel shall be assessed by firing 20 rounds of 5.56mm, Heavy Bullet Reference ammunition (LC87F000R011). An additional 20 rounds may be used for a retest if the barrel does not qualify on the first test.

4. After the barrel has qualified, 20 test cartridges (LC93K098-017) conditioned at an ambient temperature (70°F ± 2°F).

5. The following test data shall be recorded for each round fired:

   Chamber Pressure - nearest 100 psi
   Port Pressure    - nearest 10 psi
   Velocity         - nearest f/s
   Action Time      - nearest .01 ms

The number of cartridges fired may exceed twenty cartridges until a minimum of twenty pressure readings have been recorded.
5.56mm, M856 Tracer Mini Round Robin Test Plan
Date: 5/12/94

6. After the ambient test cartridges have been fired, the same barrel shall be used to fire 20 test cartridges conditioned at the hot temperature (125°F ± 2°F), followed by 20 test cartridges conditioned at the cold temperature (-65°F ± 2°F). The procedure prescribed in Step #4 shall be observed until the required number of pressure readings have been recorded for each test condition.

7. Repeat steps #2 - #5 for each additional EkvAT barrel.

*Note: The above test procedures shall be performed twice at LCAAP, so that each test condition is repeated for each EkvAT barrel.
APPENDIX C
LOT ACCEPTANCE DATA
# BALLISTIC TESTING

**ITEM:** Ctg., 5.56mm Tracer, M856  
**Lot No.:** LC-93K098-017  
**Acceptance:**  
- **1st SAMPLE**  
- **2nd SAMPLE**  
- **REWORK/REPAIR**  
- **WAIVER**  
**Propellant:** OLIN WC-844T  
**A. L. No.:** 49644  
**Chq. (GR5):** 26.4  
**Case:** Brass  
**Headstamps:** LC 97  
**Bulldozer:** Gilding Metal  
**Acceptance Date:**  
**Primer No.:** 41  
**Mix No.:** FA556  
**Primer Lot No.:** LC-931706-205  
**Igniter Mix:**  
**Casing:** Clad Steel

## FIRING TESTS

<table>
<thead>
<tr>
<th>RDS. FIRED</th>
<th>RECORD</th>
<th>SPEC. LIMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>3003</td>
<td>2990±40</td>
</tr>
<tr>
<td>20</td>
<td>±55</td>
<td>±250</td>
</tr>
<tr>
<td>20</td>
<td>±45</td>
<td>±250 (Avg.)</td>
</tr>
<tr>
<td>20</td>
<td>49000</td>
<td>30000</td>
</tr>
<tr>
<td>20</td>
<td>+1900</td>
<td>±125</td>
</tr>
<tr>
<td>20</td>
<td>+2600</td>
<td>±250</td>
</tr>
<tr>
<td>20</td>
<td>12700</td>
<td>13240</td>
</tr>
<tr>
<td>20</td>
<td>+410</td>
<td>±300</td>
</tr>
<tr>
<td>20</td>
<td>±80</td>
<td>±150</td>
</tr>
<tr>
<td>20</td>
<td>9.43</td>
<td>Max.</td>
</tr>
<tr>
<td>20</td>
<td>8.09</td>
<td>Max.</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
<td>Max.</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
<td>Max.</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
<td>Max.</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
<td>Max.</td>
</tr>
</tbody>
</table>

## FUNCTION

<table>
<thead>
<tr>
<th>RDS. FIRED</th>
<th>RECORD</th>
<th>SPEC. LIMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>M249</td>
<td>400</td>
<td>200</td>
</tr>
<tr>
<td>M16A2</td>
<td>400</td>
<td>200</td>
</tr>
<tr>
<td>M249</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>M16A2</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

## NON FIRING TESTS

<table>
<thead>
<tr>
<th>NO. TESTED</th>
<th>NO. FAILED</th>
<th>SPEC. LIMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

## WATERPROOF (VAC)

<table>
<thead>
<tr>
<th>NO. TESTED</th>
<th>NO. FAILED</th>
<th>SPEC. LIMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

## BULLET

<table>
<thead>
<tr>
<th>Extraction</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>0</td>
</tr>
</tbody>
</table>

## CASE

<table>
<thead>
<tr>
<th>Residual Stress</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>0</td>
</tr>
</tbody>
</table>

## TOTAL AUTHORIZED ROUNDS EXPENDED IN TESTS

| 2260 |

**REMARKS:** Bullet Integrity fired simultaneously with Function & Casualty.

**ECP:** M3Q3000
BALLISTIC ACCEPTANCE TEST
Small Arms Propellant Powder

Contract: DAAA09-91-C-0494
Tested in accordance with: MIL-P-3984H dated 13 Dec. 1989

OMF91G-049644
CALIBER: 5.56 mm
TYPE: Tracer
DATE: 07/30/91
USER: Lake City

Mfr. OLIN CORPORATION
Lot Number W884T - 817
Made at St. Marks, FL
Net Weight 62,600 lbs.
Charge Weight 26.7 gr.
Air Space +0.02 in.

RECEIVER NUMBER
Barrel Number
Port Gage
Chamber Gage
Fir. Pin Prot. (in.)
Fir. Pin Indent. (in.)
Head Space (in.)
Times Fired

VELOCITY
RIFLE
PRESSURE
GAGE

108
3
22531
22531
45564
45564
0.332
0.20
0.498
3428

Bullet Type: M856
Bullet Wt.: 60.5 gr.
Primer: Lake City
Ctg Case: Lake City

BLEN TEST
Rds
Corrected
VELOCITY @ 78' (ft/sec)
LIMTS

Average @ +70°F
20
2975
2990 ± 20

Standard Dev.
21
25 ft. Max

ff. @ +125°F
20
+44
-250' max from 70°
Any increase
acceptable.

diff. @ -65°F
20
-76

CHAMBER PRESSURE (PSI)

Average @ +70°F
20
51,403
53,000 psi Max

Standard Dev.
Xbar + 3σ
1,333
55,462
Xbar + 3σ ≤ 59,000

Max Ave.@+125°F
20
53,908
58,800 Max Average.

Diff. @ +125°F
20
+2,505
+6500 Max from 70°
Any decrease
acceptable.

Max Ave.@-65°F
20
47,573
-3,830

PORT PRESSURE (PSI)

Xbar-3σ @ +70°F
20
13,398

Diff. @ +125°F
20
-296

Diff. @ -65°F
20
-1,283

+2000 psi from 70°

ACTION TIME (ms)

Max Ind.@ +70°F
20
1.10
2.5 ms Max
individual at all

Max Ind.@ -125°F
20
1.07

Max Ind.@ -65°F
20
1.12

QUALITY ASSURANCE MANAGER

GOVERNMENT REPRESENTATIVE

This OLIN propellant LOT meets the ballistic test requirements:
**PROPELLANT DESCRIPTION SHEET**

OMF91G-049644

**Date:** 07/30/91

**Manufactured at:** Olin Corporation, St. Marks, FL

**Packed Amount:** 62,600 lbs

**Contract No.:** DAAA09-91-C-0494

**P.O. Number:**

**Specification:** Propellant is compliant with drawing 9378273, Rev. C dated 1 June 1989

---

**TESTS OF FINISHED PROPELLANT**

<table>
<thead>
<tr>
<th>Spec.</th>
<th>Result</th>
<th>TEST</th>
<th>Spec.</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrocellulose</td>
<td>Remainder</td>
<td>82.79 Nitrogen</td>
<td>13.00-13.20%</td>
<td>13.08</td>
</tr>
<tr>
<td>Total Volatiles</td>
<td>2.00% Max</td>
<td>1.12 Hygroscopicity</td>
<td>1.75% Max</td>
<td>NA</td>
</tr>
<tr>
<td>Dinitrotoluene</td>
<td>1.0% Max</td>
<td>0.1 Tin Dioxide</td>
<td>0.1% Max</td>
<td>0.0</td>
</tr>
<tr>
<td>Moisture/Volatiles</td>
<td>0.75-1.25%</td>
<td>0.97</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dibutylphthalate</td>
<td>3.50-6.00%</td>
<td>4.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sodium Sulfate</td>
<td>0.50% Max</td>
<td>0.05 Granulation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium Carbonate</td>
<td>0.25% Max</td>
<td>0.04 US Sieve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitroglycerine</td>
<td>9.00-11.20%</td>
<td>10.64</td>
<td>20</td>
<td>97% Min Thru</td>
</tr>
<tr>
<td>Diphenylamine</td>
<td>0.75-1.50%</td>
<td>1.02</td>
<td>25</td>
<td>On</td>
</tr>
<tr>
<td>Residual Solvent</td>
<td>1.20% Max</td>
<td>0.32</td>
<td>30</td>
<td>On</td>
</tr>
<tr>
<td>Heat 120°C SP</td>
<td>60' Minimum</td>
<td>100</td>
<td>35</td>
<td>On</td>
</tr>
<tr>
<td>Heat 120°C EXP</td>
<td>5 Hrs Min</td>
<td>5+</td>
<td>40</td>
<td>On</td>
</tr>
<tr>
<td>Dust &amp; Foreign</td>
<td>0.10% Max</td>
<td>0.02</td>
<td>25 TO 40</td>
<td>90% Min On</td>
</tr>
<tr>
<td>Graphite</td>
<td>0.4% Max</td>
<td>0.2</td>
<td>40</td>
<td>7.0% Max Thru</td>
</tr>
<tr>
<td>Bulk Density (gm/cc)</td>
<td>0.945-1.025</td>
<td>0.994</td>
<td>45</td>
<td>3.0% Max Thru</td>
</tr>
<tr>
<td>Potassium Nitrate</td>
<td>0.1% Max</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:**

PACKED: 07/29/91
SAMPLED: 07/29/91
TESTS FINISHED: 07/30/91
OFFERED: 07/30/91

---

QA Manager ____________________________ Government Representative ____________________________

Form: SM-QA-027
APPENDIX D

5.56-mm REFERENCE LOT PORT PRESSURE ADJUSTMENT
MEMORANDUM for AMSMC-QAM-P, ATTN: Cathy Doyle

SUBJECT: 5.56mm, M855 Reference Lot LC87F000R011 Assessed Values - Port Pressure Adjustment

Based on the past two (2) years use of 007 and 011 reference lots, there is clearly a 700 psi average difference between port pressure correction factors of the two lots. Since lot 011 has been averaging -800 psi correction factors since its assessment, it would be appropriate to adjust its assess value from 13,414 psi to 14,114 psi (700 psi higher). This will bring the two reference lots in line with each other. All activities using the 011 reference lot should be informed of this change.

ROBERT E. LEE
Chief, Sm Cal Armt Sys Branch
FC&SC Armt Sys Division

CF:
SMCLC-CA
SMCAR-CCL-S,
F. Puzycki
APPENDIX E
TRANSDUCER TORQUE VALUE CHANGE
April 16, 1985

Mr. Pat Taranto
US Army
AMSMC-QAF-1-(D)
Dover, NJ  07801

Dear Pat:

I am writing to confirm the following changes that have been recommended by KIAG (Kistler Instrumente AG, Switzerland) in the use of the 6203 and 6555.

The recommended mounting torque has been reduced to 10-12 Nm. The 12 Nm torque level should be considered a maximum allowable torque and should not be exceeded.

The type 6555 damping seal should be inspected after 100 rounds and replaced after 200 rounds.

If you have any questions on these changes, please do not hesitate to contact me.

Sincerely,

KISTLER INSTRUMENT CORPORATION

Paul F. Bussman
Sales Engineer

/wsm
DEPARTMENT OF THE ARMY
HEADQUARTERS, US ARMY ARMAMENT, MUNITIONS AND CHEMICAL COMMAND
ROCK ISLAND ILLINOIS 61290

SUBJECT: Supplemental ETVAT Acceptance Testing

Contracting Officer's Representative
Lake City Army Ammunition Plant
ATTN: SMCLC-EN
Independence, MO 64051-0330

1. Reference message 221500Z Apr 85 AMSHC-QAF-S (D) SAE (encl 1).

2. Request the operating contracting be advised of the subject testing requirement and take appropriate action to accomplish the requested testing.

3. The costs to perform the subject testing should be charged to the benefiting end item.

4. If sufficient funds are not available take no action and formally notify AMSHC-PCG-S by CLIN the additional funding required.

Encl

MARY J. ADAMS
Procuring Contracting Officer
DISTRIBUTION LIST

Commander
Armament Research, Development and Engineering Center
U.S. Army Tank-automotive and Armaments Command
ATTN: AMSTA-AR-IMC (3)
     AMSTA-AR-GCL
     AMSTA-AR-CCL-BP (10)
     AMSTA-AR-CCL-E
     AMSTA-AR-QAC-C (5)
     AMSTA-AR-QAW-P
Picatinny Arsenal, NJ 07806-5000

Administrator
Defense Technical Information Center
ATTN: Accessions Division (12)
Cameron Station
Alexandria, VA 22304-6145

Director
U.S. Army Materiel Systems Analysis Activity
ATTN: AMXY-SP
Aberdeen Proving Ground, MD 21005-5066

Commander
Chemical/Biological Defense Agency
U.S. Army Armament, Munitions and Chemical Command
ATTN: AMSCB-CII, Library
Aberdeen Proving Ground, MD 21010-5423

Director
U.S. Army Edgewood Research, Development and Engineering Center
ATTN: SCB-RTB (Aerodynamics Technology Team)
Aberdeen Proving Ground, MD 21010-5423

Director
U.S. Army Research Laboratory
ATTN: AMSRL-OP-CB, Technical Library
Aberdeen Proving Ground, MD 21005-5066

Chief
Benet Weapons Laboratory, CCAC
Armament Research, Development and Engineering Center
U.S. Army Armament, Munitions and Chemical Command
ATTN: SMCAR-CCB-TL
Watervliet, NY 12189-5000