Small Caliber Propellant Solutions for the U.S. Military

St. Marks Powder
A General Dynamics Company

May 19, 2010
A Leading Supplier Of Propellants For Military Applications

- BALL POWDER® Propellant Loaded in over 95% of U.S. Military small arms ammunition

- Loaded Internationally in over a dozen countries for their Small Caliber Military Applications

- Ability to develop and deliver propellants specifically tailored to customer requirements.
St. Marks Powder
Research and Development

Resources

- Dedicated pilot plant
- Analytical and process Laboratories
- Ballistic test ranges
- Modeling and simulation capabilities

Activities

- Product and Process development and optimization
- Technical services to customers
- Support to operation: process, products and materials
- Contract R&D
The St. Marks Quality Program:
Designed to Drive Continuous Improvement in Performance

Customer focused
Team management approach
Closed-loop design

Comprehensively integrated:
- Strategic planning
- Employee training and development
- Product design and development
- Supplier quality assurance
- Production
- Testing
- Customer service
- Performance review/improvement

ISO 9001 certified since 1994.
ISO 14001 and OHSAS 18001 certified in 2004.
Flash Reduced Pistol Ammunition for the U.S. Military

45 ACP

Applications – Ball, Frangible, Green Primer, Green Bullet

45 ACP M1911 Ballistic Specifications

Velocity 855 +/- 5 ft/s, Pressure 16,500 CUP max. avg.

- St. Marks Powder has developed a BALL POWDER® Propellant which meets 45 ACP specifications
- 45 ACP BALL POWDER® Propellant is designed to be clean burning with reduced flash
St. Marks Powder has developed propellant additives which reduce flash for 45 ACP ammunition.

Baseline

St. Marks BALL POWDER® Flash Suppressed Propellant
Flash Reduced Pistol Ammunition for the U.S. Military

9mm NATO M882

- The currently fielded WPR® 289 St. Marks BALL POWDER ® Propellant used in the 9mm NATO M882 cartridge is designed to be clean burning with reduced flash

St. Marks Powder Flash Testing in 9mm MANN Barrel
St. Marks Powder IR&D effort in short barrel 5.56mm

5.56mm BALL POWDER® Propellant
Standard 5.56mm M855 Projectile, 62.0 grains – IR&D testing in various length MANN Barrels

<table>
<thead>
<tr>
<th>Barrel Length</th>
<th>Propellant Development Candidate</th>
<th>Velocity @78 feet (ft/s)</th>
<th>Mouth Pressure (psi)</th>
<th>Port Pressure (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20&quot;</td>
<td>WC 844 (5.56mm M855 Baseline)</td>
<td>3,022</td>
<td>56,370</td>
<td>16,387</td>
</tr>
<tr>
<td>20&quot;</td>
<td>WCR 845®S/SMP® 843</td>
<td>3,017</td>
<td>54,822</td>
<td>16,373</td>
</tr>
<tr>
<td>20&quot;</td>
<td>SMP® 842</td>
<td>3,087</td>
<td>59,221</td>
<td>16,064</td>
</tr>
<tr>
<td>14.5&quot;</td>
<td>WC 844 (5.56mm M855 Baseline)</td>
<td>2,752</td>
<td>55,756</td>
<td>16,487</td>
</tr>
<tr>
<td>14.5&quot;</td>
<td>WCR 845®S/SMP® 843</td>
<td>2,756</td>
<td>54,855</td>
<td>16,582</td>
</tr>
<tr>
<td>14.5&quot;</td>
<td>SMP® 842</td>
<td>2,825</td>
<td>58,830</td>
<td>16,204</td>
</tr>
<tr>
<td>11.5&quot;</td>
<td>WC 844 (5.56mm M855 Baseline)</td>
<td>2,624</td>
<td>56,262</td>
<td>23,767</td>
</tr>
<tr>
<td>11.5&quot;</td>
<td>WCR 845®S/SMP® 843</td>
<td>2,610</td>
<td>53,698</td>
<td>24,156</td>
</tr>
<tr>
<td>11.5&quot;</td>
<td>SMP® 842</td>
<td>2,691</td>
<td>58,747</td>
<td>24,059</td>
</tr>
</tbody>
</table>
St. Marks Powder IR&D effort in short barrel 5.56mm

- St. Marks Powder has developed optimized BALL POWDER® Propellant solutions for reduced flash in short barrel applications

Propellant Development work in a 11.5” Mann Barrel without a Flash Suppressor

WC 844 (Baseline Propellant for 5.56mm M855 Ammunition)  
WCR 845®S/SMP® 843 Reduced Flash (Propellant Development Candidate)
5.56mm Subsonic/Flash Suppressed

Tested in HK416 Weapon @ 21.0 grns.

<table>
<thead>
<tr>
<th>Propellant</th>
<th>Temp</th>
<th>Velocity (ft/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHP 771 X7081</td>
<td>150°F</td>
<td>1,167</td>
</tr>
<tr>
<td></td>
<td>70°F</td>
<td>971</td>
</tr>
<tr>
<td></td>
<td>-20°F</td>
<td>834</td>
</tr>
<tr>
<td></td>
<td>-65°F</td>
<td>824</td>
</tr>
</tbody>
</table>

- All rounds functioned in a HK416 Weapon at all Temperatures
- Need to reduce velocity at 150°F to achieve subsonic velocity at all temperatures
7.62mm M118 BALL POWDER® Propellant

7.62mm M118 Long Range/Flash Suppressed

Projectile 175 grns., Propellant Charge 42.3 grns., 22” barrel

<table>
<thead>
<tr>
<th>Propellant</th>
<th>Temp</th>
<th>Velocity (ft/s)</th>
<th>Pressure (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMP® 768</td>
<td>160°F</td>
<td>2,624</td>
<td>64,000</td>
</tr>
<tr>
<td></td>
<td>70°F</td>
<td>2,603</td>
<td>58,800</td>
</tr>
<tr>
<td></td>
<td>-65°F</td>
<td>2,603</td>
<td>53,700</td>
</tr>
</tbody>
</table>

- SMP® 768 has enhanced Temperature Sensitivity over conventional propellants with excellent long term, hot temperature storage properties.
7.62mm M118 BALL POWDER® Propellant

Velocity and Storage Data of 7.62mm Rounds at Temperatures

21 fps velocity spread -65°F to +160°F using Standard 7.62 mm M118 Components
7.62mm M118 BALL POWDER® Propellant

- Excellent Storage Properties

<table>
<thead>
<tr>
<th>Storage Data</th>
<th>Velocity (ft/s)</th>
<th>Pressure (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 Days +70°F</td>
<td>2592</td>
<td>58700</td>
</tr>
<tr>
<td>30 Days +150°F/+70°F</td>
<td>14</td>
<td>-300</td>
</tr>
<tr>
<td>30 Days -40°F/+70°F</td>
<td>4</td>
<td>-200</td>
</tr>
<tr>
<td>Temperature Cycling</td>
<td>-10</td>
<td>-200</td>
</tr>
</tbody>
</table>
.338 Lapua BALL POWDER® Propellant Commercial Ammunition

.338 Lapua Enhanced Performance

Projectile 300 grns., Propellant Charge 98.5 grns., 24” barrel

<table>
<thead>
<tr>
<th>Propellant</th>
<th>Velocity (ft/s)</th>
<th>Pressure (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OBP® 715</td>
<td>2,750</td>
<td>65,000</td>
</tr>
</tbody>
</table>

- > 90 ft/s increase in velocity over factory rounds with BALL POWDER® Propellant
- Enhanced .338 Lapua has similar trajectory as 50 Cal., 650 grain commercial ammunition
.338 Norma BALL POWDER® Propellant Commercial Ammunition

.338 Norma Enhanced Performance/Flash Suppressed
Projectile 300 grns., Propellant Charge 94.5 grns., 24” barrel

<table>
<thead>
<tr>
<th>Propellant</th>
<th>Velocity (ft/s)</th>
<th>Pressure (psi)</th>
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<tbody>
<tr>
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<td>2,750</td>
<td>64,000</td>
</tr>
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</table>

- St. Marks Powder sets the standard in velocity for this cartridge. No other propellant can match the energy, velocity and accuracy
- Enhanced .338 Norma has similar trajectory as 50 Cal., 650 grain commercial ammunition

[Graph showing bullet drop over range in yards]
.50 Cal. BALL POWDER® Propellant Commercial Ammunition

.50 Cal. Enhanced Performance/Flash Suppressed
Projectile 650 grains., 36” barrel

<table>
<thead>
<tr>
<th>Propellant</th>
<th>Velocity (ft/s)</th>
<th>Pressure (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WC 869</td>
<td>&gt;3110</td>
<td>60,000</td>
</tr>
</tbody>
</table>

- > 200 ft/s increase in velocity over commercial .50 Cal., 650 grain ammunition using WC 869 (>14% increase in K.E.)
Conclusion

- St. Marks has fielded propellant technology to enhance performance and reduce muzzle flash for a variety of applications.
- St. Marks has a dedicated Research and Development group that is available to resolve technical issues.

  - Working on next generation of Small Arms Propellants for Increased Lethality, Improved Barrel Wear and Reduced Flash