The Los Angeles Silhouette Club

Cast Bullet Alloys and Obturation

By: Glen E. Fryxell

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Bullets cast of very hard alloys seem to be quite the rage these days, especially with the commercial bullet casters. Sure, hard alloys have their place, but there's not really much need for ALL cast bullets to have a Brinell hardness of 24, especially not for use in everyday sixguns. In fact, these hard bullets may well be inadvertently causing leading. How?

These commercial alloys are commonly too hard to "bump up" (or obturate) and seal the bore at typical revolver pressures. The resulting blow-by of the hot gases past the bullet's bearing surfaces can leave significant lead deposits in the barrel.

What is obturation and is it really an issue? Obturation is the plastic deformation of the cast bullet alloy due to the force of the expanding gases on the bullet's base. How do we know about it? Many years ago, some intrepid sixgunners fired lead bullet loads from barrel-less revolvers into snow banks, oiled sawdust and such. Recovered bullets showed significant evidence of base expansion. These experiments may not be conclusive, but they do suggest that cast bullets do indeed obturate, given that the alloy is appropriate for the pressures generated. In the intervening years, extensive experimentation has revealed the empirical correlation of 3 x 480 x Brinell Hardness Number (BHN) (or more simply, 1440 x BHN) as an estimate of the minimum peak pressure required for bullet obturation (the reason for the "3 x 480" format is the number "4 x 480" also has significance, and this format makes it easier to remember both formulae). Thus, a bullet with a BHN of 24 (typical of commercial hard-cast bullets) will not undergo plastic deformation and obturate until pressures exceed 34,000 psi.

So why are commercial cast bullets made so hard? Simple, hard bullets withstand the rigors of shipping much better than do soft bullets. Nobody wants to order cast bullets made of the ideal alloy for their pet .44 Special Triple Lock, only to have the bullets show up on their doorstep looking like chewed up pieces of bubble-gum. Also, the commercial caster has to make a product that is as generic as possible so it will satisfy the greatest number of customers, and hard bullets handle rough guns and sloppy loading techniques better than soft bullets. The bottom line is commercial cast bullets are usually cast to a BHN of 24 as a means of damage control, not because hardness makes for a better projectile.

Recently, I did a simple little experiment that demonstrates the concept of bullet obturation and the value of matching the alloy to the internal ballistics of the cartridge. Using the RCBS 45-255 Keith SWC mould, I cast one batch of bullets with wheel-weight alloy (plus about 1% tin), and a second batch using linotype alloy. The wheel-weight bullets weighed an average of 266 grains, while those cast of linotype weighed an average of 255 grains. All bullets were sized .452" and lubed with my homemade moly lube (equal parts beeswax and Sta-Lube Extreme Pressure Moly-Graph Multi-Purpose Grease), loaded over 9.0 grains of Universal Clays into W-W cases, and primed with Federal 150 primers. These .45 Colt loads were then test fired for velocity (all chronographing was done within a 1 hour period, under constant weather conditions). The results are summarized below:

Velocity Data From .45 Colt Trials with RCBS 45-255 Keith SWC				
Bullet/Gun	3" S&W M625	4 5/8" Ruger Black Hawk	6" S&W M25	7 1/2" Ruger Black Hawk
Linotype (255 gr)	838 fps	887 fps	872 fps	940 fps
WW (266 gr)	879 fps	942 fps	947 fps	999 fps
Difference	41 fps	55 fps	75 fps	59 fps

No, the numbers are not transposed. The lighter, harder bullet was traveling an average of 58 fps slower than the heavier, softer bullet in what was otherwise identical ammunition. The same amount of chemical energy was released each time the hammer fell, it's just a question of how efficiently that energy was converted into velocity. All else being equal, the lighter bullet should end up going faster, and the fact that it was found to be slower indicates that some of the energy was lost as a result of gas leakage around the linotype bullets. This is due to the fact that this .45 Colt load generates only moderate pressure (about 16,000-18,000 psi) and the linotype bullets (BHN 22) were too hard to "bump up" and seal the bore effectively, whereas the softer wheel-weight bullets were able to do so (wheel-weights have been variously reported to have a BHN between 9 and 12, I generally use 10 as being representative). Using the empirical correlation outlined above, the linotype bullets would require a peak pressure of almost 32,000 psi to seal the bore effectively, while the wheel-weight bullets accomplish this feat at a modest 14,000 psi (easily surpassed by this load). Clearly, the handgun hunter is better served with the more moderate alloy, since more weight and more velocity results in greater penetration and better wound channels.

- Glen E. Fryxell

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