

How to Develop Accurate, High Performance Handloads

Load Development

other By: Brian Pearce | October, 23

Case Inspection, Preparation and Priming

Before proceeding with load development for any cartridge, it is imperative to properly prepare cases. Previously fired cases should be inspected for defects, including splits in the mouth and body. Look for signs of case head separation (just forward of the head in the case body) in the form of a shiny area on the outside of the case, or it can be felt with a small L-shaped wire from inside the case. Cases with signs of corrosion may be weakened. If cases are older and have been stored with fired primers in place, corrosion inside the primer pocket can lead to primer pocket leakage (darkening around the outer edges of a fired primer). Brass with any of the above defects should be discarded, as it is somewhat risky to reload.



Bottleneck rifle cases are usually full-length sized, while those prepared for semiautomatic, pump action and certain lever-action guns are generally sized in a small base sizing die to assure proper chambering. Be certain that dies are adjusted correctly when performing this operation, or case life can be shortened and accuracy may suffer. (Most die manufacturers offer detailed instructions.) To obtain reliable chambering and proper bullet-to-case fit, straight-wall handgun cases should be full-length sized, and case length for rifle and handgun cartridges should be measured to be certain that they are within maximum limits and trimmed if necessary. Cases that are excessively long might not chamber or can cause dangerous pressures when fired. It is preferable to begin with cases from one maker and of the same lot number, which will give the most uniform results in determining pressure and accuracy.

Priming is an often overlooked step of handloading, but plays an important role in how ammunition performs. Generally



Case head expansion should be checked using calipers that are capable of measuring 0.0001 inch. High-pressure rifle cartridges usually expand .0003 to .0005 inch and are generally considered to be around 50,000 CUP.

primers should be seated .003 to .005 inch below flush. In this fashion the anvil legs should be in full contact with the bottom of the primer pocket and will give reliable ignition when struck by the firing pin.

Choosing the correct primer is also of paramount importance. Let's say we are handloading the .44 Magnum. Naturally it takes a Large Pistol primer, but many deduct that since it's a magnum cartridge it will require Large Pistol Magnum primers. Unfortunately it is not that simple. There are many excellent powders for loading the .44 Magnum that actually give better accuracy and less pressure when used in conjunction with standard primers. On the other hand, there are many other powders that need a Magnum primer to ignite correctly, and using a standard primer has proven (in laboratories) to produce erratic pressures and velocities. While the .44 Magnum has been used as an example, similar results can be seen with other cartridges, both pistol and rifle.



All cases should be carefully inspected for flaws or defects prior to handloading. The .45-70 case on the left is new but has a defect at the mouth, while the .45 Colt cartridge is flawed due to corrosion. Generally the best way to determine the ideal primer for pistol cartridges is to seek guidance from the powder manufacturer. The same advice applies to rifle cartridges, but logic would dictate that large capacity and most magnum rounds will perform better with a hotter Magnum primer, while smaller capacity and non-magnum rounds are generally best served with standard primers. After determining what powder (or powders) will be used, then the correct primer can be chosen.

Developing Loads for High-Pressure Bottleneck Rifle Cartridges

After cases are inspected, sized, trimmed (if necessary) and primed, let's begin developing a load. Unless one has education and experience at developing load. Unless one has education and experience at developing loads, published data should always be referenced. Do not use loads from unknown sources, which seems prevalent on the Internet. Most reloading manuals list powder charges that have been carefully pressure tested. The "beginning" or "starting" loads are usually at least 5 percent below maximum. Having experience at developing handloads for more than 150 different cartridges and many more guns than that, I must emphasize the importance of beginning with "starting" loads before attempting "maximum" loads. Not all guns for a given cartridge share identical dimensions. A short throat, an abrupt leade, tight groove diameter or other small

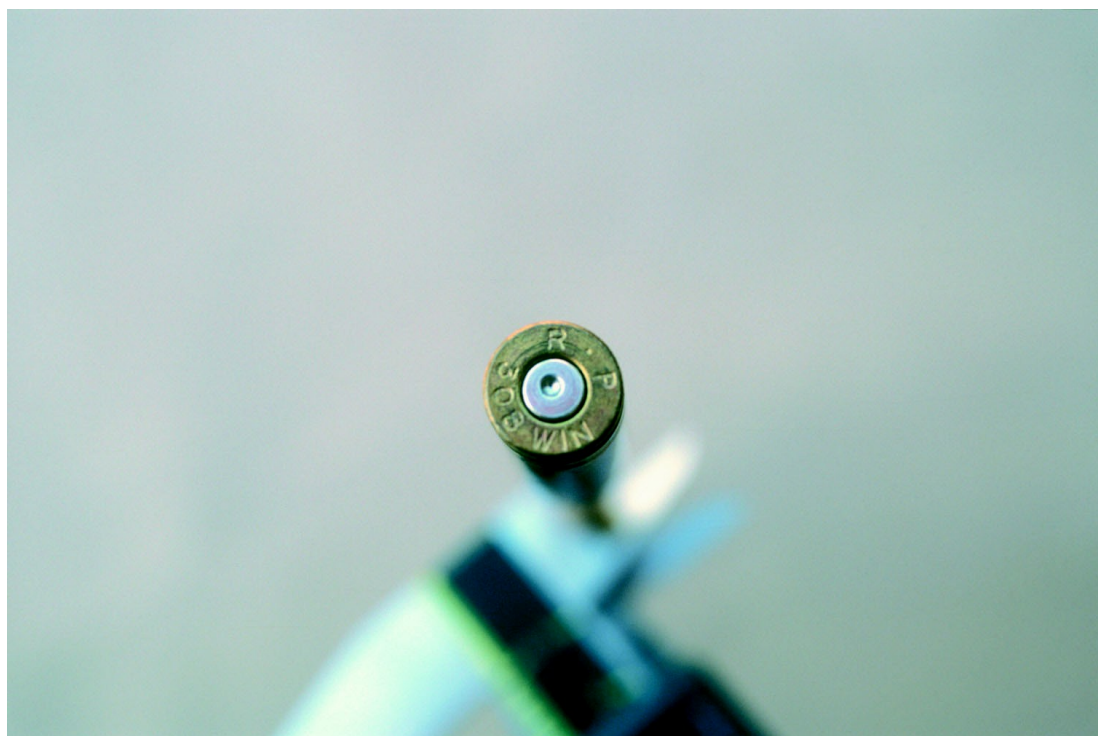


Proper priming will assure reliable ignition. Most companies recommend primers to be seated .003 to .005 inch below flush, allowing the anvil to be in contact with the bottom of the primer pocket. tolerance changes can cause pressures to spike in a given gun, while the same load was safe in the test gun or pressure barrel. Excess headspace, an out-of-spec firing pin or firing pin hole and other issues can cause a primer to rupture. Again, don't start with maximum loads.

After charging cases with a "beginning" powder charge, seat bullets to correspond with suggested SAAMI overall cartridge length; they should more or less duplicate factory ammunition lengths. (More on bullet seating depth and overall cartridge length in a moment.)

Fire a few rounds, carefully checking each case for signs of excess pressure. (This is where

achronograph is valuable in determining if a load is close to duplicating factory loads or the advertised velocity of the load you have selected. If speed is similar (and with correct powders), pressure is probably similar too. Contrary to what has been widely published, primer appearance is not always a good indicator of pressures, as there are simply too many variables. Nonetheless there should be no signs of rupturing. Primers that are pierced and/or cratered (wherein the firing pin indentation is pushed back) can indicate excess pressure but is often due to a rough firing pin that is incorrectly shaped or too long. Cratered primers are often the result of a poor fitting firing pin/firing pin hole or a firing pin spring that is too weak. Flattened primers do not necessarily indicate the load has excess pressure or is dangerous.



Flattened primers are common with factory ammunition and are not an indicator of high or excess pressure. This Remington .308 Winchester load has a flattened primer but is completely safe. Many factory loads fired in production rifles will have flattened primers. On the other hand, if one load is flattening primers more than another (at least if primers are of the same type and manufacture), it is probably generating more pressure. Another issue that can flatten primers excessively is excess headspace. If any of the above issues appear with your factory ammunition or handloads that are within normal load specifications, you should have a qualified gunsmith examine your rifle before proceeding.

At this point a blade-type caliper that is capable of measuring 0.0001 inch will prove a valuable tool in determining the safety and approximate pressure of your handload. If you are using new, unfired cases to develop your new load, case head expansion may vary more than cases that have been once-fired prior to developing loads. It is better to begin with once-fired cases, as their webs will be settled and readings will be more accurate. Cases should be of the same make, as hardness varies by manufacturer and so will case head expansion. Measuring the diameter of the head, just above the extractor slot but below the case body in the web area, before and after firing will give an indication of pressure. Most modern high-velocity bottleneck cartridges, such as the .243 Winchester, .270 Winchester, .308 Winchester as well as the 7mm Remington Magnum and similar rounds, will expand case heads .0003 to .0005 inch and are generally considered to be around 50,000 CUP (not psi). This is approximately equal to most factory loads and is generally considered maximum.

Assuming your starting loads are below maximum pressures, fire a few groups (from a proper sandbag rest) to see how that load is performing in your gun, then record their sizes. In an attempt to fine-tune the load, seating bullets out closer to the rifling will often, but not always, increase accuracy. The maximum overall cartridge length (or just how far we can seat bullets out) is usually determined by two factors in typical bolt-action repeating rifles. First, bullets must fit and function correctly in the magazine, and second they must chamber properly. Single-shot rifles are only affected by overall cartridge length, while tubular magazine guns (leverguns, pumps, etc.) must feed correctly and are sensitive to overall cartridge length.

Seating bullets out until they contact the leade or rifling often results in problems such as a stuck bullet in the bore when a



Primers should be carefully matched to the powder, or pressures can change significantly. Brian suggests studying powder manufacturers' recommendations in regards to using a standard or Magnum primer.

round is chambered and removed rather than being fired. And some labs report a spike (or increase) in pressures in certain types of firearms. I do not recommend seating bullets to contact the rifling in sporting arms, but they can usually be seated closer than factory loads. Begin by seating the bullet out, rather long, in a dummy case and see if it will chamber in your rifle. If the round won't readily chamber, turn the die's seater stem one turn deeper and again seat the bullet about .0300 inch deeper, then gently try to chamber the round.

Through trial and error, the exact maximum overall cartridge length can be determined for a specific rifle. The bullet should be at least .0010 inch off the rifling. Please note that the ogive profile of bullets varies considerably from one maker to the next and from one style to another. The point being the overall cartridge length will necessarily change from one bullet to the next to prevent bullets from contacting rifling. Again, record the group sizes after each change. (Seating bullets closer to the rifling often improves accuracy, but not always. Occasionally rifles will shoot better with bullets seated deeper.)



Choosing a suitable sizing die will help assure proper chambering of loaded rounds. The Hornady .223 Remington dies are “full length” making them suitable for most bolt actions, etc., while the RCBS “small base” dies are best for autoloading, pump and lever-action rifles.

The next logical step is to increase the powder charge, typically in 0.5-grain increments in small cases such as the .22 Hornet and .223 Remington, while cases similar in capacity to the .30-06 can be increased one grain at a time. Again, carefully check case head expansion using blade calipers and keep accuracy records. This helps establish a pattern if accuracy is increasing or decreasing with powder and velocity increases. In this manner loads can be fine-tuned to a specific rifle.

If this approach has not provided desirable results, and all possible accuracy problems with the rifle have been eliminated, the next step is to try different components including bullet, powder and primer combinations. Some guns will show a strong preference with given bullets but might not shoot particularly well with others. With experimentation, loads can usually be developed that will produce better accuracy than factory ammunition.

It should be noted that if ammunition is to be used in several rifles, loads should have similar overall specifications as factory loads to assure reliable feeding and chambering.

Tips for Developing Revolver and Pistol Cartridge Loads

The majority of pistol and revolver cartridges operate at much lower pressures than modern bottleneck rifle cartridges. For example, the .38 Special has an industry maximum average pressure of 17,000 psi, the .44 Special 15,500 psi, the .45 Colt 14,000 psi, while magnum rounds such as the .41 and .44 Remington Magnums generate 36,000 psi. The .45 ACP runs 21,000 psi or less. The point being, most handgun loads are low pressure when compared to bottleneck rifle cartridges and it is difficult to accurately assess pressures. The difference in case head expansion, at least on most cases, is undetectable using blade calipers (for example, a .38 Special load that is generating 15,000 psi versus another that is producing 25,000 psi). Careful examination of primers can help determine if one load is producing more or less pressure than another. A flattened primer is probably producing greater pressure than one that is “rounded” at the edges, but standard pressure loads in the .38 Special, .44 Special and .45 Colt cartridges will generally all have rounded edges.



This .32-20 Winchester cartridge was not flared enough at the case mouth and buckled while attempting to seat the bullet.

Many handguns are not especially strong, and firing loads that exceed their recommended pressure limits can cause damage to the gun and may be dangerous for the shooter (and explains why so much emphasis is put on knowing pressures). Always use credible published data and pay particular attention to the details. For example, using a .44 Magnum load exactly as shown but with the wrong primer can increase pressures by up to 11,000 psi. Also changing or substituting bullets of the same weight can significantly change pressures, but the increased pressure is very difficult to detect by most handloaders.

Another common mistake includes incorrect seating of bullets. Hornady and Speer offer 300-grain .44 Magnum bullets with a double cannelure, and there has been much data developed for the Ruger Redhawk with the bullet seated out and crimped in the lower cannelure. If these bullets are seated in the upper crimp groove, pressures will increase substantially and will probably be dangerous if the powder charges are not decreased. Again, attention to detail will help assemble safe loads.

With the above warnings out of the way, following are some suggestions to develop accurate, high-performing loads for your favorite handgun.

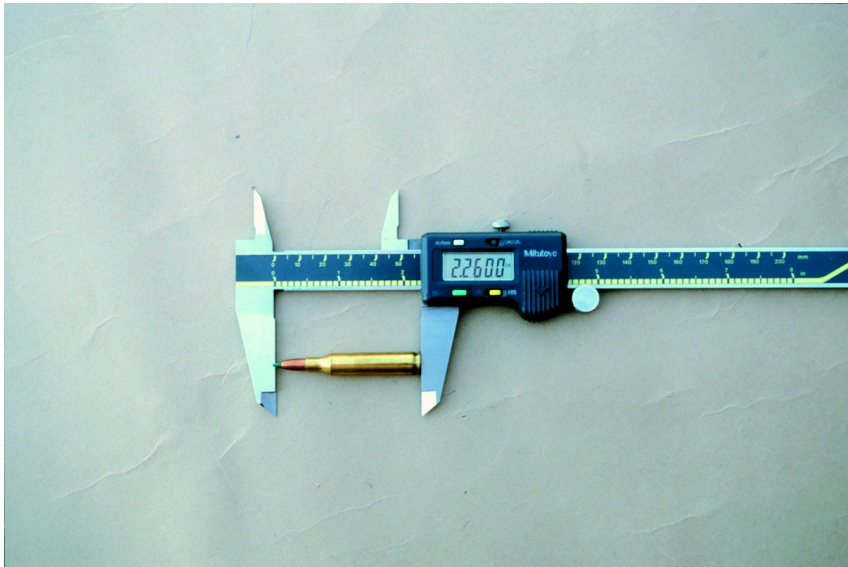
Begin with dies that are correctly dimensioned. The sizer die must reduce cases enough to allow proper chambering and



Ruptured primers are not always indicative that a load is developing excess pressures. A sloppy fitting firing pin or one that is too long can cause primers to rupture.

securely hold the new bullet. The expander ball should measure at least .004 inch smaller than bullet diameter to obtain proper bullet pull. (Some older dies had issues in these areas, while recently manufactured dies are generally good.) Revolver cartridges should receive a heavy roll crimp, but not so heavy that damage to the bullet or buckling or bulging of the case results. Autoloading cartridges, such as the .45 ACP, should be taper crimped to original specifications, as it headspaces on the case mouth. Focusing on uniformity starting with case preparation, priming, powder charge, bullet seating and crimping will aid in providing consistent and accurate ammunition.

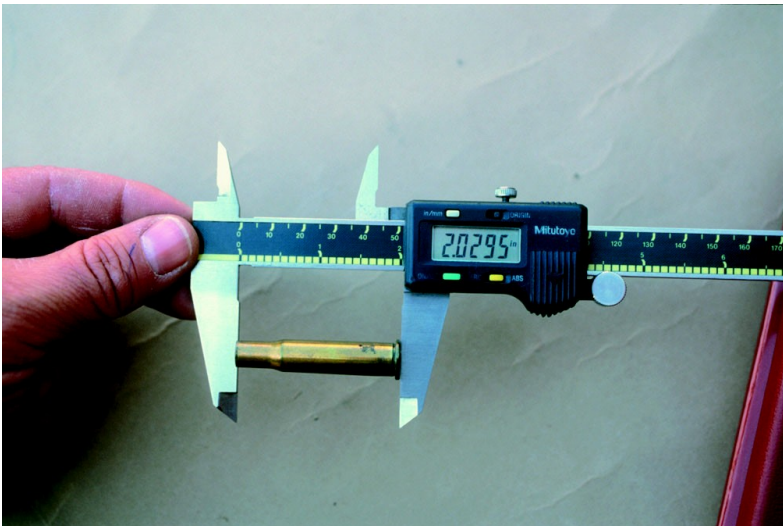
One problem that occasionally surfaces with straight-wall revolver cartridges includes the case mouth “biting” into cast bullets during the seat/crimp operation, which is often performed as one step. First make certain that the case mouth is being expanded sufficiently, which will allow the bullet’s base to be started into the case at least 1/16 inch and sometimes as much as 1/10 inch. If the die is adjusted correctly and the problem exists, bullets will need to be seated without any crimp applied, then as a separate step the crimp applied.



This .223 Remington handload exceeds overall cartridge length recommendations of 2.260 inches and may not work in some guns, but the rifle it was tailored to readily chambers and regularly produces ½ MOA groups.

Today there are dozens of great powders suitable for handloading revolver and pistol cartridges. Choose a powder designed to burn in the optimum range for a given cartridge. Fullhouse magnum revolver cartridges (such as .357, .41 or .44 Magnums) will thrive on slow-burning (relatively speaking) powders such as Hodgdon H-110, Lil'Gun, Alliant 2400, Winchester 296 or Western Powders/Ramshot Enforcer, Vihtavuori N110, etc. Cartridges such as the .45 Colt, .44 and .38 Specials or Magnum revolver cartridges loaded with midrange or reduced loads will thrive on medium burn rate powders such as Alliant Unique and Power Pistol, Hodgdon Universal Clays or similar powders. And even faster burning propellants, such as Winchester 231, Alliant Red Dot and Bullseye, will generally give excellent results. Likewise these medium to fast burn rate powders will also give top results in short, fat pistol cartridges such as the .45 ACP and .40 S&W.

Commercial bullet companies such as Hornady, Speer, Nosler, Sierra, Barnes (actually solid copper) and others offer top-rate jacketed bullets that generally shoot



Cases should be uniform and kept under maximum lengths or pressures may rise. This .30-30 Winchester case has been trimmed to 2.0295 inches, the recommended trim to length. accurately in a variety of handguns, although some guns may have a distinct preference for one over another. Trying each will help determine if your gun has a preference.

When it comes to cast bullets, designs and quality, commercial offerings vary so much that results can range from extremely poor to excellent. A complete discussion could fill volumes, but suffice to say that using proven designs that have been around for many decades will generally give the best results. (There is a reason certain cast bullet designs and loads have become and have remained popular for generations.)

The same as rifles, handgun loads should be checked for accuracy from a proper rest or comfortable shooting position. Again, through experimentation of bullet designs, weights, powder types and charges, handloads can duplicate and even exceed factory load performance in terms of accuracy and velocity. This article was reproduced by permission from LoadData.com.



Only handloading data from credible sources should be considered. Brian suggests current reloading manuals or data from dedicated journals such as Handloader