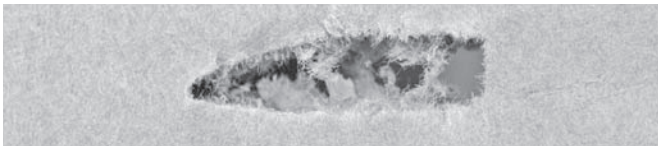
GunDigest

AR-15 BARRELS

Barrel Basics for AR-15 Rifles

AR-15 Barrels

The invention of rifling some centuries ago was not the boon you'd think. The problem was, how to get the bullet to grip the rifling, to be spun, without making loading a royal hassle? Riflemen in the age of the smoothbore musket were in great danger. First, loading was very slow, so they could not stand up to a unit of musket-armed men and trade fire. In the time the riflemen could fire, and then reload, a unit of musket-armed men could close the gap, fire and then charge. Second, rifles traditionally didn't have bayonets, so when the musket-armed men charged, the riflemen had to flee or be stabbed. Why no bayonets? Because the elaborate and physically-involved ramming of a bullet down a rifled bore made a mounted bayonet as much danger to the user as the intended target. Third, many musket-armed soldiers took it personally that riflemen aimed, and took great pleasure in bayoneting riflemen when they could.



The result of a bullet weight/ rifling twist mis-match. If you shoot a 75-grain Match bullet out of some 1/9 twist barrels, this is what you get.

The American Civil War changed much of that. The Minie ball, invented by a French Army officer, allowed for loading as fast as a smoothbore musket. Accuracy was good enough that units could be accurately fired upon at 300 yards, and individuals at 100. What transpired between old tactics and new weapons was slaughter: Units that charged across open ground, or stood their ground and traded fire, would suffer 10, 20 or even 30 percent casualties in short order. It wasn't unheard of for units in the Civil War to engage in a single attack, and suffer such casualties that they were for all military intents and purposes non-existent.

The Iron Brigade was a unit that amply demonstrated the problem. Mustered in August of 1862 with roughly a thousand men each, the "Black Hats" of the 2nd, 6th & 7th

Barrels are not made to a single, precise dimension. All production wanders in tolerances. The better the barrel, the tighter the tolerances, the higher the cost.

Wisconsin, 19th Indiana and the 24th Michigan Regiments went into the meat-grinder of the Civil War right away. Eleven months later, the 1,030 men of the 24th Michigan arrived in Gettysburg with 490 effectives. After the first day of combat, there were 99 left. The 2nd Wisconsin had the greatest percentage of losses of any unit in the war, while the 7th had the largest number killed. It was not at all unusual for a unit to suffer 10, 20, 30 percent casualties in a single engagement lasting less than an hour! And the war was fought with black powder (lots of smoke) and mostly muzzle-loading rifles. At close range.

The disparity between tactics and weaponry continued until WWI, where it reached its apex. But the legacy persisted for some time; that true riflemen needed long-range rifles to deal with their opponents at the maximum range possible. The AR-15 was one of the two weapons that changed that, the other being the AK-47. Combat is a chaotic, close-range affair, and most participants are not well-served with rifles capable of reaching long distances with great power.

But within the short (Almost always inside of 300 meters, and mostly 100 or less) distance of rifle combat, a rifle still needs to be accurate. And reliable. Lets look at what a barrel needs be, and what your AR barrel should be.

Parts Of The Barrel

As our model barrel, at least for the exterior, I'll be pointing things out on a DPMS barrel from Brownells. As a replacement barrel that you can plug in to replace one worn, abused or used up, they are one heck of a bargain. For about $150, you can have a barrel accurate enough to do you well in any match up to NRA High Power, limited only by your shooting skill. And as a chrome-moly steel, you can ream the chamber to adjust headspace if your bolt happens to produce less than minimum headspace when you first check it.

Any barrel is simply a steel tube. At the rear is the chamber, in the middle the bore, and the end is the crown. A barrel receives a cartridge, holds it for firing, launches a bullet along a known and predictable path, and does so for as long as the steel can take the work. All manufactured products must be made within specifications. Any product is made to within a maximum and minimum size. It simply isn't feasible or economically wise to make each and every part perfect, conforming exactly to the specifications drawn. So, each part will have a maximum and minimum size, with all parts falling within that spread. For example, we refer to the .223/5.56 as being a ".22" or using .224-inch bullets. Actually, the bullets can (depending on who is making them, and for what application) be any size from .2235 inches to .2245 inches

(DoD Photo)

Modern combat is often a chaotic, close-range affair. Sometimes a short-barreled rifle is useful. Sometimes the loss of velocity is a hindrance. We'll never have a "rifle for all seasons."

and the interior of the barrel, the bore, has another set of specifications. A match barrel may be held to a smaller spread, but there is still a spread. And a barrel may vary from one end to the other. Again, a Match barrel varies less, but if you were to measure a perfect barrel, and find the bore averages .22410 inches, it may vary between .22408 and .22412 inches along its length. A non-match barrel may vary from .22392 inches to .22415 inches or more. And most measuring instruments won't even register the fifth digit, so a barrel that measures between .2239 and .2241 could be quite good.

So, when we talk of a barrel being Match we simply mean the dimensions are held between a smaller spread of max and min.

Barrel Material

You'll see barrels touted as "stainless," "chromed," "match" and "G.I." And other terms as well. What they are telling you is what it is made of, how it is treated, and in some cases (as in the "GI" part) the general specifications of it.

A barrel is made of steel. Steel is iron with a small amount of carbon in it for hardness. If you want to flip through the specs, the American National Standards Institute can tell you more than you need to know about steel. There are all sorts of alloying metals that can be added. "Alloy" simply tells you that something besides iron and carbon are in there. It does not necessarily mean that it is a hard, tough or desirable steel. Some things harden it, some things make it easier to machine. Others add uniformity to the crystalline structure, making it easier to forge, heat-treat, machine or otherwise fabricate into barrels. Some alloying materials add corrosion resistance, others abrasion resistance. Carbon steel has no alloying components that reduce oxidation (rust). Stainless steel does have some, primarily chromium or nickel, or both. (A chrome steel is not the same as a chromed barrel) However, you cannot add enough of them to make a steel truly "stainless." By the time you have done so it is so soft it isn't useful as a steel, except for kitchen tableware.

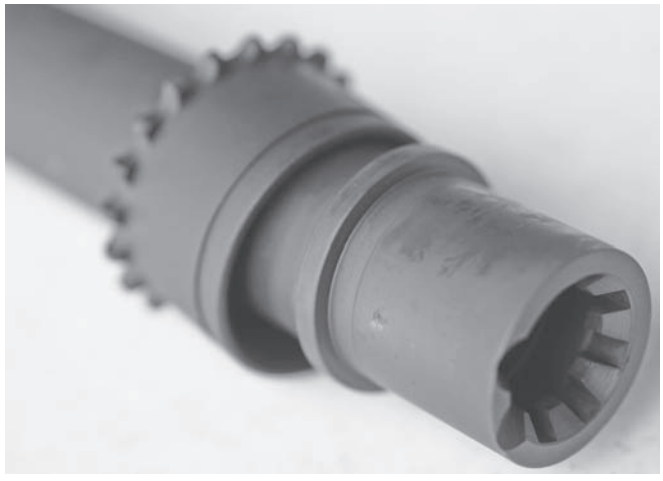
A chromed barrel has either the chamber, or the chamber and bore, plated with chromium. But not bumper chrome, instead a hard, tough layer of chromium that resists corrosion, abrasion and heat. Very early M-16 barrels had nothing, then briefly they had only chamber chromed to resist corrosion and aid extraction. Once the process was refined enough, the entire bore was chromed. A chromed bore is much tougher in the long run. However, the plating is not as uniform in thickness, coverage and smoothness to make it attractive to competition shooters. At least not the long-range ones. While three-gun shooters will often gladly use a chromed bore, serious long-range shooters will only use stainless Match barrels.

As for "GI," it means whatever the maker wants it to. Now, if they were to say Mil-spec, and quote a particular military specification, then that is different. The government has exacting standards, know as Military Specifications, or Mil-spec. If someone says their (barrel, extractor, shoelaces) is "mil-spec" then you can look up the spec cited and see just what they're claiming.

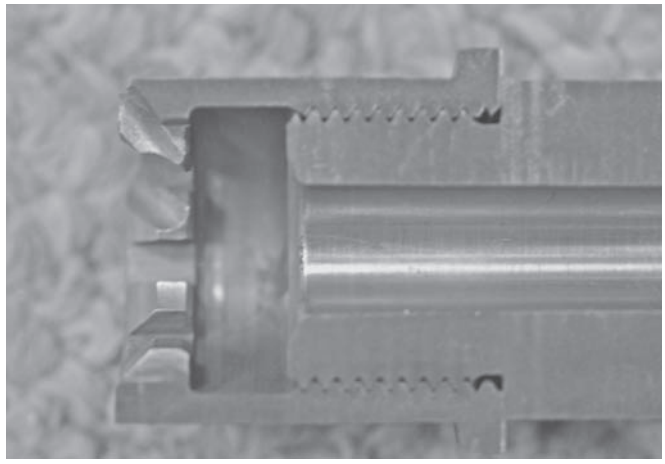
Barrel Extension

Unlike many other rifle designs, the AR-15 bolt locks to the barrel, and not the receiver. Specifically, to the barrel extension, a part that screws onto the barrel itself. In military rifles like the M-14 or the FN-FAL, even the competitor AK-47, the bolt locks against the receiver when it closes. Thus, the receiver takes the force of the bolt thrust on firing. The receiver thus must be stoutly constructed to take the stress of the cartridge firing. The AR-15 removes that stress, by having the bolt lock into the barrel extension, and thus the barrel itself. The receiver does not have to do anything more than guide the parts as they cycle back and forth. (And hold the sights, the magazine, fire control parts, etc. But you get the idea.) The barrel extension is composed of a much harder steel than the barrel. It has to be, because it takes the stress of firing, and it can be, because it is a compact part, easily fabricated. (Relatively speaking.)

The barrel extension is threaded, and screws onto the



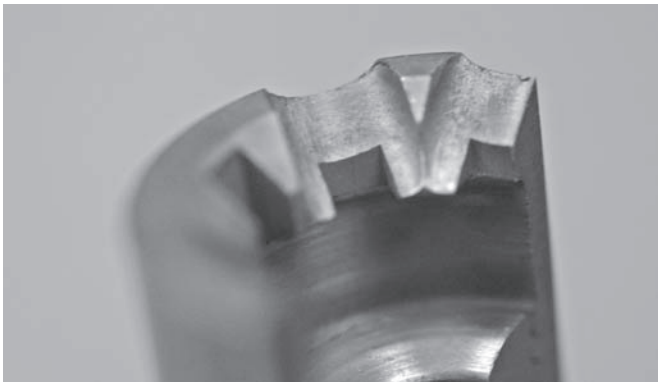
The barrel extension is what the bolt locks into. The barrel nut is what secures the barrel to the upper receiver.



This sectioned barrel shows the barrel extension, locking lugs and the rear of the chamber.

rear of the barrel. It contains the locking lug recesses, and a locating pin on top. The locking lugs of the bolt pass between the lugs of the barrel extension, and when the bolt turns its lugs pass in front of the extension lugs, locking the two together against the thrust of the cartridge.

The cartridge has to pass through all this on its way to the chamber. To make that possible, the barrel extension has a pair of feed ramps machined into it. The original feed ramps were only as long as the sidewall thickness of the barrel extension itself. That is, the ramps did not extend down past the barrel extension diameter. Occasionally, a rifle would be reluctant to feed, if the rounds stubbed against the vertical wall of the upper receiver below the barrel extension feed ramp. Colt solved this problem with the M-4 feed ramp. The ramp extends down below the barrel extension diameter, into the receiver. You can have problems in a parts gun if you combine an M-4 upper and a non-M-4 barrel or barrel extension. There, the non-ramped extension overhangs the ramped upper receiver, and you can have feeding malfunctions. The other combinations will not cause feeding problems due to the tolerance problems. Some create "faux M-4" ramps by machining the extension and upper to create an M-4-dimension ramp. Some worry that the cut exposes un-anodized aluminum. I have several rifles where I machined the ramp to solve a rare feeding malfunction (years before Colt did this, and registered it), and those particular uppers show no ill effects from the work. One is now on its third barrel, so it apparently is durable enough even after the modification.



You can see the feed ramps cut on this barrel extension.

The new Colt M-4 feed ramps cut deeper into the barrel extension, and into the upper receiver.

The M-4 extension and upper modification is a Colt-developed improvement, and a Colt-protected one.

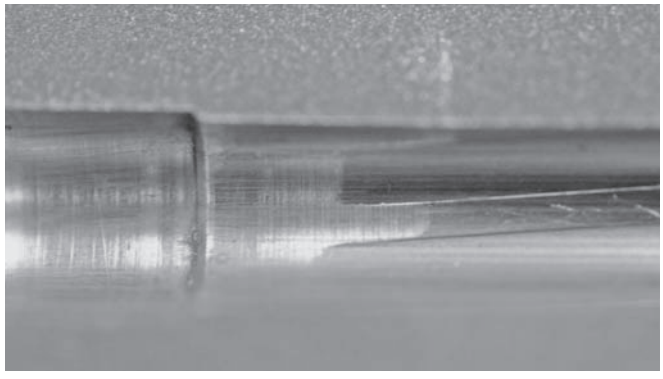
Do you need an M-4 ramp on your rifle? Colt found they needed to do it on the short-barreled rifles they were developing, which became their M-4 Carbine. What happened, was in some rifles, when firing full-magazines bursts, the last couple of rounds of M-855 would not feed reliably. Considering that in such a use, the rounds are rattling around in the magazine tube like it is a maraca, is it any wonder the last few would refuse to feed? Colt solved the problem with the altered ramps. They do not make the ramps on their full-size rifles. Unless your rifle occasionally stubs on feeding, you don't either.

Installing barrels onto extensions is easy in the manufacturing process: fit barrels and extensions into a torquing machine, tighten, then send off for gas port drilling, sight installation, etc.

Custom AR gunsmiths will commonly machine a barrel blank to fit it to a target gun, thread the rear, and tighten a barrel extension on. Rather than depend on someone making hundreds or thousands at a time, they make one, perfect. With a large and precise lathe, you can machine the barrel and extension so they are centered and parallel to the bore. The custom gunsmith will also go to the extra trouble of "clocking" the barrel. That is, machining it so the gas port drill breaks through into the bore centered in the bottom of a groove.

The Internal Barrel Parts

The chamber is composed of four parts, chamber, neck, throat and leade. The chamber is the part we all think of as the chamber. That is, the opening in the rear of the barrel where the case resides, up to and including the case shoulder. A tight (as in narrow) chamber will hold its cases with less play side to side, adding to accuracy. It will also allow less expansion, adding case life. However, a tight chamber can create malfunctions sooner, as it gets fouled, or if something gets in there like dust, dirt or grit. Too loose, and while reliable, accuracy and case life suffer. Accuracy, due to the case moving (a small amount, admittedly) and case life due to excessive expansion of the case on firing.



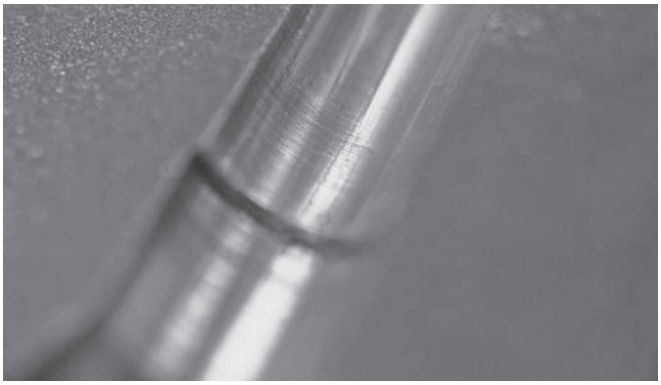
The chamber neck and leade.

What we term "headspace" is the gap between the breechface of the bolt, and the forward shoulder of the chamber, when the bolt is closed. It is independent of chamber diameter, which can be large or small regardless of headspace. Cases expand in all directions on firing. A chamber with excessive headspace reduces case life, as the case stretches on firing. When resized to bring it back to an acceptable size, the shoulder is shoved back. The next firing stretches it again. While the sizing sets the shoulder back, the stretch comes at the expense of the brass closer to the rim. After enough firings, it stretches more than it can hold, and breaks apart.

Chamber size is a delicate balance between case life and reliability. It is possible to exceed the limits in either direction. In years past it was common to advise reloaders new to the AR-15 to use "small base" dies in order to size their cases down enough to provide reliable function. We now know that small base dies simply mask the real problem, improper chamber size. If your AR proves unreliable, find out the real problem, and don't just over-work your brass to "deal" with it.

The "proper" distance between the bolt face and the forward shoulder of the chamber is a subject of much discussion. You see, headspace is not a single measurement, but a range. "More than this, but less than that" is headspace. How much is allowed by mil-spec, and commercial standards, differ.

The chamber neck is that portion of the chamber where the case neck, containing the bullet, rests. A chamber neck, as does the chamber, must be small enough to limit case expansion, but large enough to allow the rifle to operate reliably. Benchrest shooters commonly have chambers cut so tightly that their cases do not need to be resized after each firing. However, they use the same 20 cases over and over, and those cases are not just common-garden-variety cases. Each has been weighed, measured and hand-machined to be identical. The necks are all the same thickness and length, and correspond to the chamber neck thickness. They do not feed their rifle off-the-shelf ammunition. You, on the other hand, will be. Even if you reload, you will not be going to such lengths in your brass prep. Not unless you expect to go to the range to shoot 20 rounds, and return.



The front of the chamber neck, with the shelf of the neck-to-throat juncture visible. That shoulder is why you must make sure your brass is trimmed, if you plan to reload .223 ammo.

The throat is a short section of cylindrical area forward of the neck, that is smaller than the diameter of the case neck but larger than the diameter of the bullet itself. (It may be, and usually is, the same diameter as the bore diameter.) The portion of the cartridge forward of the case, i.e., the bullet, rests here. The throat is the bullet space, and allows the bullet to project out of the case and aid feeding. The bullet (any bullet except a wadcutter) has a forward portion smaller than its bearing surface. This forward bullet portion, the ogive, provides for lessened drag and a flatter trajectory. The bore must be relieved to accommodate it. How much depends on the bullet weight and length, shape and proportion. A shorter throat (all other things being equal) provides greater accuracy, as the bullet has less time to shift before entering the rifling. However, a short throat increases pressure, as the bullet "stalls" when it hits the rifling, and the momentary hesitation, as the powder burns, also stalls the pressure release created by the bullets movement.

Last in the chamber is the leade. Pronounced "leed", it is the angle of the onset of the rifling. The steeper the angle (as the bullet sees it) the greater accuracy. Again, it has to do partly with how much time and movement the bullet has to shift before the rifling controls it, and the uniformity of a steep leade as opposed to a gentle one. If you have a steep leade, it is easier to keep them all the same angle. If they are shallow, it becomes more of a problem to keep them the same. The differences, however, are minor.

Target shooters pay great attention to the length of the leade. It can have a large impact on accuracy, velocity and pressure. To measure leade, you use something like (or the very thing) the Stoney Point gauge. The gauge uses a modified case and holding fixture. You insert the gauge and a test bullet into the chamber. You them press the bullet forward until it stops. Lock the holder, remove the holder and bullet, and then measure overall length of the test bullet in the locked gauge. The difference between the loaded overall length (which will feed from the magazine) and the test length is the leade, or bullet jump. Long-range target shooters will load the bullets as long as needed to get the bullet as close to but not touching the rifling. Doing so increases useful accuracy and marginally increases case capacity. Such long bullets do not fit into magazines, and must be single-loaded.

When dealing with ammo 223 Remington and 5.56 NATO, aren't the same.

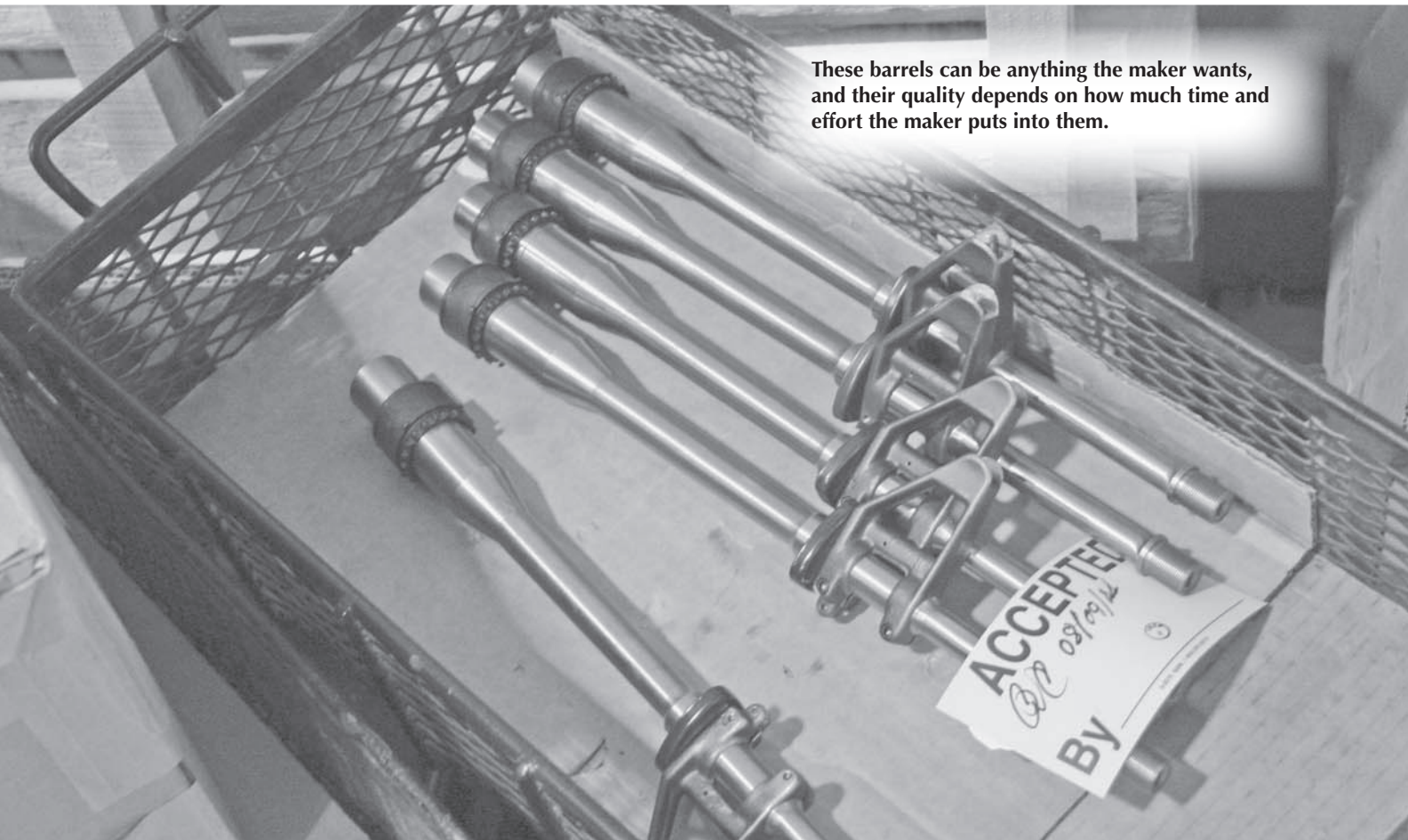
The Remington, designed as a long-range varmint cartridge, has a narrower neck, shorter throat and steeper leade. The idea is that if you are using your rifle to whack varmints at 300 and 400 yards, you need all the accuracy you can get. And since varmint hunters reload, they want long case life. On the other hand, military uses are not so exacting in the accuracy department. As long as a cartridge/rifle combination retains "minute of bad guy" accuracy to 300 yards, it is plenty

accurate enough. As an example, if a varmint shooter takes a shot at a prairie dog at 300 yards, and holds the crosshairs of his scope exactly on the center of the 'dog and has a perfect trigger press, he expects a hit. If the accuracy of the cartridge is only good for a 6-inch group (a lousy group, by the way, for a varmint rifle) he'll probably miss through no fault of his own. A soldier doing the same thing will have 100 percent hits on a standing man, and 50 percent hits on one attempting to hide. (People are bigger than prairie dogs.) A military rifle has to work for a long time, in harsh conditions, and has to deal with one more thing the prairie dog rifle doesn't: Tracers. In the military tracers are not just a means of giving a machinegunner feedback. Officers and NCOs will commonly have a magazine loaded with all-tracer ammo. If they see a target that the machinegunner should be dealing with, but the machinegunnner is otherwise busy, they'll begin shooting at the target with their rifle. As soon as the assistant gunner (or anyone nearby) sees the steady stream of tracers going out, they immediately inform the machinegunner, who shifts his fire. Tracer bullets are long. They are longer than regular bullets, to hold the burning trace compound.

Some makers clearly mark the chamber their rifle gets. There's no question about this one.

The long throat and gentle leade of the 5.56mm chamber allows the long tracer bullets to be fired without causing an increase in pressure. Without it, the tracer would either have greater pressure than regular 5.56mm ammunition (which is already high) or have to be loaded to less pressure, adversely affecting trajectory.

What this means is that if you have a rifle which has the chamber cut to 223 Remington dimensions, using 5.56 ammunition in it could cause an increase in chamber pressure. The increase might not be something to worry about. However, added to other pressure-increasing factors, it can cause problems. If you are shooting a dirty rifle, on a hot day, with ammunition loaded in soft cases, you could quickly cause a malfunction from soft brass being shorn off by the ejector. Excessive pressure could cause cases to stick and the extractor then fails to extract. Changing any single factor can reduce or eliminate the problem. Yes, you can use ammo with hard brass, but you don't always have that choice. And you certainly can't change the ambient temperature. As for cleaning, well, they all start clean, but they all get dirty soon enough. Get the chamber reamed, if you can. Luckily, all manufacturers who make chromed barrels make them in 5.56mm and not .223.



These barrels can be anything the maker wants, and their quality depends on how much time and effort the maker puts into them.

The Bore

The portion of the barrel the bullet itself travels down is the bore. A rifle bore is produced in one of three methods: broaching, buttoning, or hammer-forging. The basic method is simple: the barrelmaker produces a cylinder with a hole down the center. The exact method depends on the machinery used, but it is typical to drill the cylinder halfway from each end, then ream and polish to a finished dimension. The finished dimension is the diameter of the finished barrel to the tops of the rifling.

In broaching, a hooked cutter is pulled through the barrel, to cut away the grooves of the rifling. In the very early days of rifles, the broach would be a single hook, and would have to be pulled through the barrel repeatedly, gradually cutting each groove in turn to full depth. Once steel became uniform enough, and hydraulics came into common use, broaches could be made as single units. A broach (which can cost several thousand dollars or more, depending on size and quality) has many steps, each cutting deeper, and all four, five, six or however many grooves there are. Looking like a miniature, golden, Christmas tree, it broaches the barrel in one pass.

A button barrel operates in a different method. Instead of the blank being reamed to a size that matches the tops of the rifling, the blank is reamed to a dimension in between bore and groove diameter. Then, a hardened button is pushed or pulled through the bore. The button is shaped to the dimensions the finished bore will be, and it literally squeezes the steel into the shape of a rifled bore.

Hammer-forged barrels start much larger and shorter than the finished barrel. The reamed cylinder is placed in the multi-ton forge, and a mandrel, shaped to be the bore dimensions (sometimes even including the chamber) is placed in the blank. Then, the huge hammers of the forge pound the cylinder down until it has been squeezed around the mandrel and is shaped internally into a rifled bore. Then the mandrel is pulled out, and a new blank inserted.

Which is best? There is no simple answer. All can be accurate. All can be durable. Which a barrelmaker makes depends on what equipment he has.

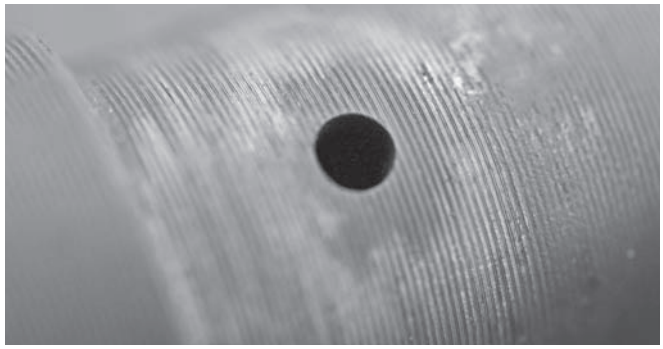
Chrome-lined barrels have their dimensions cut (or buttoned, or hammered) to account for the extra thickness the chrome will take up. If the chrome will plate to a thickness of .0005" (half a thousandth) then the bore and grooves have to be made a thousandth larger. (The bore is circular, the chrome plates all around, so a plating of half a thousandth makes the diameter a thousandth smaller.) You cannot have a regular bore chromed after it has left the plant. You either get a barrel that is already chromed, or you get a barrel that isn't.

Gas Ports

Forward of the chamber is the gas port. In order to work the action, the port bleeds gas back to the action. The port pressure on the Stoner system is quite high, on the order of 15,000 to nearly 20,000 psi depending on barrel length and gas port location. The gas is fed back to the carrier, where it launches the carrier back off the bolt to work the action. I've seen high-speed video of the action on an AR working, and it is impressive. At 1,000 frames a second, if the timing is right, you can see the spurt of gas that comes out of the vent holes on the side of the carrier. Apparently, if an assembler has been a bit too free with lubricant, the gases and burnt lubricant can obscure the rifle from the video camera for a few shots, until the lube gets burned off.

Gas ports are drilled to a set diameter according to the length of the barrel and the thickness of the barrel wall. All gas ports are not drilled to the same size. Almost no malfunction of the AR system can be cured by drilling the gas port to a larger diameter. The last thing I look at when a rifle is malfunctioning is the gas port diameter. Even if a rifle is being starved for gas, there are other things more likely (tipped front sight housing, pinched gas tube, worn gas tube tip) that should be checked first.

As the bullet slides past the gas port, the gas enters the front sight housing. But it also slams forward against the wall of the gas port. You can see the erosion on any barrel that has been shot more than a few hundred rounds. Gas port erosion has no discernable effect on accuracy. There may be 600-yard shooters who disagree, and feel that erosion harms accuracy. Were I in the position of vying with David



The gas port on a barrel. Resist the temptation to drill it out to a larger size to "increase reliability." There is almost no problem the AR is heir to that you solve by drilling the gas port.

The gas gets funneled out of the port, through the front sight housing, to the gas tube and thus the carrier.

Tubb for the Wimbledon Cup, I'd probably pay attention to gas port erosion. But for anything less demanding, it doesn't matter. I just had the opportunity to view a Colt M-4 barrel that has some serious mileage on it. The owner is a Sergeant with a multi-jurisdictional SWAT team, who supervises the training and deployment of an impressive number of officers. (Basically, he's in charge of a company-sized unit of SWAT cops. Think Urban Light Infantry, and you're on the right track.) His M-4 has been in use for a few years, and he's used it on raids (lots of scary stories and rounds at or on bad guys), training and competition. Despite the hard use, it is still fully capable of going 20 hits on 20 targets, out to 300 meters, on the National Guard range. The targets are a foot and a half wide, and two and a half feet tall, and Big Ed can easily drop them, using iron sights. The gas port was far beyond eroded. Instead of the simple concave erosion "tail" it had a trench eroded several gas port diameters forward of the port.

I was amazed to see it and told Ed that when he had the rifle re-barreled I wanted the old one so I could section it and photograph it. The trench was so long I couldn't even get all of it in the field of view of the borescope at once. I had to move the scope to see it all.

Muzzle

The crown of the muzzle is the last influence the barrel has on a bullet, and for good accuracy it must have as uniform an influence as possible. An uneven crown, or one worn through poor cleaning habits, allows a small puff of gas to escape on one side of the bullet as the bullet leaves. The bullet as it leaves the muzzle is in a delicate transition zone: it has to switch from barrel to air. Anything that disrupts that transition hurts accuracy.

You see, when a bullet is going down the bore, it is forced to rotate around its center of shape. Once in the air, it then transitions to rotating around its center of mass. A good bullet has the center of shape and mass very close to each other. (A perfect bullet would have them the same.) The bullet wobbles for a short distance until it "settles down." Anything that unduly influences the bullet before it settles down has a disproportionate effect on accuracy.

A perfect crown is best. To protect the crown, the military gets double-duty from the flash hider; it also acts as a crown protector.

On the muzzle, you can have a bare crown, as we saw on so many post-ban AWB/94 rifles. You can have muzzle with a flash hider, or a muzzle with a muzzle brake or compensator. All will shoot accurately.

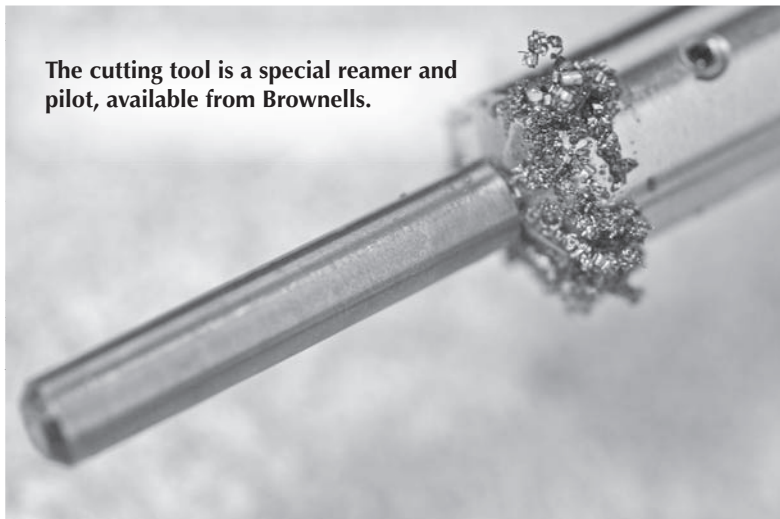
Rifling Twist

A smoothbore firearm is less accurate than a rifle because of the unstable nature of the non-rotating projectile. Basically, a shotgun slug is a knuckleball. But how much twist do you need? Sir Alfred George Greenhill, Professor of Mathematics of Woolrich, England, came up with a formula to calculate

The threads allow you to attach a flash hider, which not only hides the threads, but protects the crown.

It doesn't matter if the crown is crusty from powder residue. As long as it is even around its perimeter, the crown will not degrade accuracy.

If the crown has been nicked or dented, or mis-cut from the maker, re-cutting it can improve accuracy.



The cutting tool is a special reamer and pilot, available from Brownells.

weight that matters. If you take two bullets, one a flat-based round-nose, and the other a sharply pointed with boat-tail, of the same weight, they will have a different stability factor when fired from the same barrel.

You cannot have a barrel precisely rifled for a particular bullet. You have to compromise. But compromise is not bad, as the stability factor for a bullet can be in a wide range and produce acceptable, even excellent, accuracy. As long as your SF is over 1.3, you'll have good groups. Faster twists can degrade accuracy, but marginally, and only at severe twist rates. But dropping off the low end, accuracy quickly goes away.

In the AR, in 223 or 5.56, we have three general ranges of twist: 1/12, 1/9, and 1/7. there are other twists, some long-range shooters use a 1/8 twist in custom barrels, and the earliest ARs had barrel with a 1/14 twist. The 1/14 was abandoned when testing disclosed a problem: in very cold air, or after a moderate amount of use, the rifles lost accuracy. The twist was so marginal with 55-grain bullets that the added density of artic air caused a loss of accuracy. As many men and officers in the early 1960s would have had clear memories of dealing with night attacks by Chinese Communist troops in Korea, a loss of accuracy in the cold could not be borne. And the loss of accuracy from a moderate amount of use simply meant higher maintenance costs, but also a loss of accuracy early in a war. Again, not good.

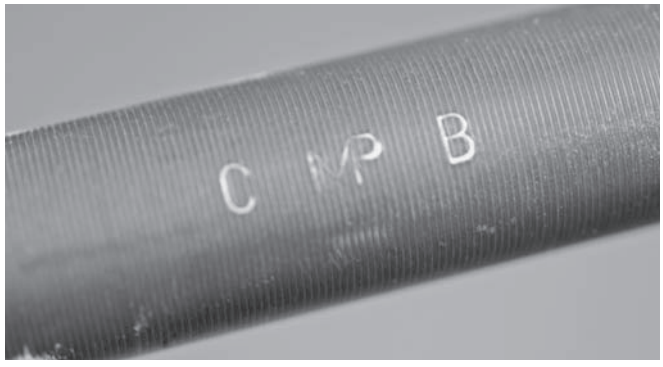
So, the twist was quickened to 1/12. Which provides plenty of spin to stabilize bullets up to about 60 grains. I've even had 1/12 barrels that shot the Winchester 63-grain softpoint bullets spectacularly well. But they cannot handle bullets any heavier or longer.

In testing for the M-16A2, the twist rate of 1/7 was settled on. Why? I've heard two reasons: one, that it was needed to stabilize tracer bullets. As we adopted the M-856 tracer well after settling on the 1/7 barrel, I doubt it. The other was that preliminary testing done in Europe for the SS-109 bullet used barrels with a twist as fast as 1/7. Since it worked with all lesser weights (the SS-109 tests went well beyond the 62 grains of the SS-109 and M-855, up to 100 grains) why not use the fastest twist with tested results?

So, where did the 1/9 come from? The Sierra 69-grain MatchKing bullet. When competition shooters were trying to make the AR shoot well in High Power matches, the 69 Sierra was the heaviest, and most accurate, bullet available. It needed more twist than 1/12, and 1/9 was plenty. So, custom barrel makers offered the new twist for competition shooters, and once it became the hot ticket, everyone had to have it. And why not? It still shot the 55-grain military ammo just fine, and it offered the option of more accurate, heavier bullets. And once something gets into the American shooter's mind, it takes decades to get it out.

So where does the 1/8 come in? Bullet stability. Or rather, too much of it. If you spin a bullet too fast, you can lose some accuracy. Not much, but to benchrest shooters and long-range shooters, any loss is "too much." Long-range shooters also have another problem: gyroscopic stability. As a bullet noses down at the end of its trajectory, the forces of drag and gyroscopic stability compete to control orientation. Drag wants to point it down. Gyroscopic stability wants to keep the nose pointed at the same spot in the sky it was directed at from the beginning. If the bullet is too stable, from excess rotation, then the bullet lurches from angle to angle as it noses down, degrading accuracy at the end of the trajectory. What's the problem? You ask. Well, if your target happens to be out on the end of the trajectory, then loss of accuracy couldn't come at a worse time. If, as well, the bullet happens to be slowing down enough to be going subsonic when this happens, accuracy, in the exacting technical description of long-range shooters "goes to hell."

The best makers mark their barrels. The data here tells you everything you need to know about this barrel.



No notation of twist, which in a military barrel usually means a 1/12 twist.

In the end, what twist you use depends on what you intend to shoot, how you'll shoot it, and how deep your wallet it. When you consider that a good barrel will last on the order of 3,000 rounds (for a varmint shooter) 5,000 (for a long-range target shooter) or 15,000 (three-gun competitor or duty rifle) the cost of the ammo itself far outweighs the cost of a barrel. Ammo costs between $90 per 1,000 rounds for reloaded ammo and $200 per 1,000 for good factory. The best can cost much more. If you take the highest normal cost, the varmint shooter will have put $600 of ammo down a barrel before accuracy may (I repeat, may) suffer. The three-gun shooter will have put $3,000 of ammo downrange. Now, many use

The "HBar" on this barrel means it is a heavyweight.

Everything you need to know: who, what chamber, what twist.

If you know the code, you know this barrel is a 5.56 chambered stainless ultra-match.

And makers who really care for their barrels don't stamp, they laser-etch. Cryogenic treatment of barrels improves their quality, but only if you start with a quality barrel

the cheaper ammo. Still, with barrels costing $150 to $300, the barrel costs less than the ammo. And the threshold of what is the end of the life of the barrel depends on the accuracy you expect: the varmint shooter wants serious sub-MOA accuracy. The long-range shooter will settle for nothing greater than one MOA, while the three-gunner is quite happy using a 2-MOA rifle, if it is rock-solid and dependable.

To increase barrel life, use a chrome-lined barrel. Also, don't overheat your barrel. Another way to look at it is time: how long will a barrel last? A varmint shooter can go through those 3,000 rounds of barrel life in a year. A long-range shooter might get two or three competition seasons out of a barrel. A three-gun shooter could likewise get two or three seasons out of a barrel. Those of you who do not shoot that much could spend a lifetime trying to wear out a barrel. Lets take as an example an officer in one of the Patrol Rifle course I teach: He goes through the three-day Operator's course, then the five-day Instructor's course. In the Operator's course he'll put 800 to 1,000 rounds through his rifle. (Or his department's rifle) In the Instructor's course, he'll do another 1,500. Then, every year as a patrol or supervisory officer until he retires, he might put as much as 100 rounds through that rifle. In 20 years on the job, the grand total will be 4,500 rounds. A SWAT officer might do more. He could do the equivalent of the Operator's and Instructor's course each year. (But don't bet on it.) At 2,500 rounds a year (a whole lot of shooting, by law enforcement standards) he'll be on the job seven years before he gets to the threshold the three-gun competition shooter thinks is reasonable.

And those who do not shoot even that much? Let's put it this way: a child born today would be eligible to run for the Presidency before your barrel is worn from shooting. But then, not all wear comes from shooting.

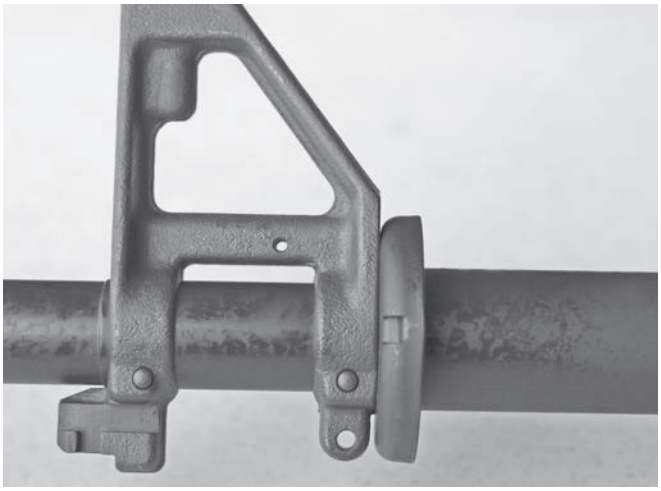
Barrel Externals

On the outside you'll often see the maker's marks as to twist rate, chamber type, and manufacturers name. If there are no markings, you should be suspicious. A super-match barrel made from a premium blank might not have any markings on it. Why take a hand-lapped tube and pound on the exterior with a set of stamps? But you'll know such a barrel by the quality of the machining and assembly. Be suspicious of the military-looking barrel with no markings. Why would someone make a barrel and not mark it? Some, like Colt, even mark the date of manufacture on the barrel. The M-4 Carbine Match Target they sent me had a barrel made at the same time as the rifle, marked 09/04.

You'll also see inspector's marks, proof marks, and other stamps on military, mil-spec or even "mil-spec" barrels.

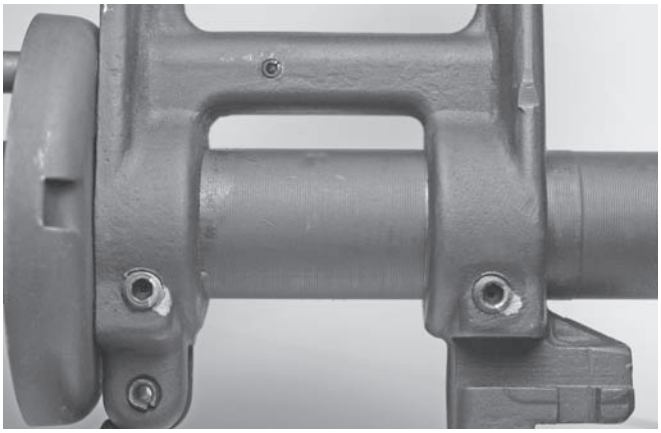
The next thing to look at is the front sight housing. Is it forged or cast? A forged housing looks rougher than a cast one, but many feel they are stronger. The important thing to look for is how is it attached? The best, original, and mil-spec method is with tapered pins. At the factory, the housing is pressed on the barrel, and then with the barrel and housing held in a fixture, the taper pin holes are drilled and reamed. Then the pins are driven home. Look at he pins. One side should have a larger head than the other. If you need to remove it, drive the pins out by striking the smaller heads.

Some barrels, especially older, cheaper ones, will have the front sight held on with a pair of roll pins. Roll pins aren't as strong, but that isn't a big deal. They are not as securely held in as taper pins, another "not a big deal." But they are an indication that whoever made the barrel didn't have the proper tooling to do taper pins, and did the simpler, drill a straight hole and drive a roll pin in method.



The mil-spec front sight attachment method is with a pair of taper pins.

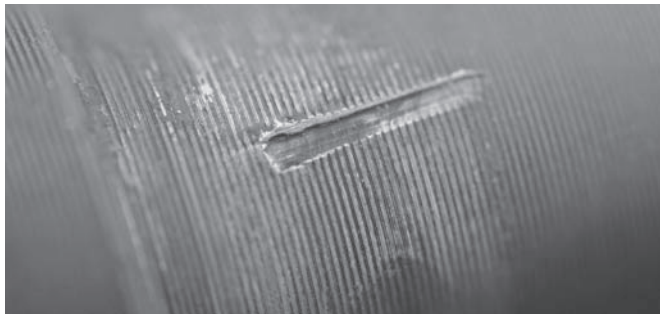
Forged front sight housings will generally have a rougher texture than cast ones.



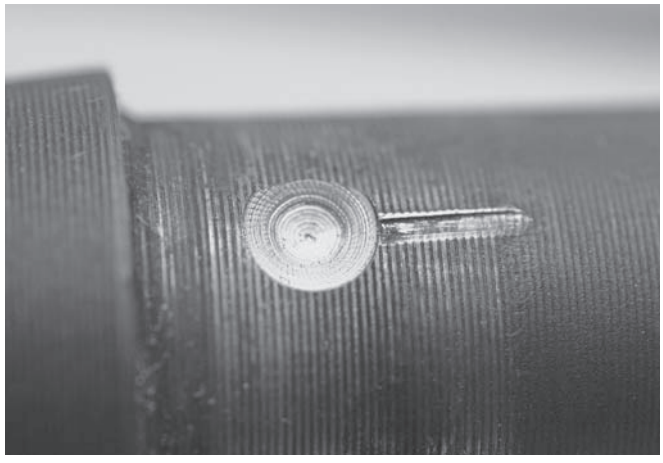
Some makers secure their front sight housings with four locking screws. The method works, but is not quite as durable as the original method.

The next two methods are controversial. Fulton Armory uses four allen-head screws to secure the front sight housing to the barrel. Armalite uses a special front sight housing where two larger screws clamp the housing around the barrel. Both use their method for a simple reason: It allows them to fine-tune the front sight housing installation so the front sight tip is "top dead center" over the barrel. They do that. However, the sight housing can tilt when struck. I worked on a rifle for a police department where the front sight housing had caught on a window when fired, and after that it was always unreliable in function. The recoil of firing, with the front sight caught on a window frame, had pulled the front sight housing forward enough to partially mis-align the gas port and front sight gas tube hole. I fussed over it quite a bit, getting the alignment correct, and securing it so it would not ever move again.

I would not have any problems using a rifle so configured, now that I'm aware of the implications. But if I was using it for duty or defense, I'd paint-in the front sight housing. With a paint witness mark, I could tell at a glance if the front sight housing had moved or tilted. If the witness mark was broken or out of alignment, I'd test the rifle before using it on duty.



The barrel with the locking-screw front sight housing that gave my client problems has this underneath the front sight housing. It had slipped, and closed the gas port.



I re-secured it with a drilled dimple, and tested thoroughly before sending it back.

What Barrel Should I Buy?

A discussion of barrels alone could fill this book. The simple answer is this: Unless your requirements are extreme, most anything will do. (Provided it is a quality barrel, and not some Third-World import reject junk) For those with a need for a compact rifle, get a 16-inch barrel. Otherwise, a 20 feels a bit softer in recoil, and gives you a bit more velocity. Unless you will be in severe-use conditions, a chrome-lined bore is optional. Stainless will serve you well for anything except actual combat, overseas, or defensive use on a boat. I've gotten a good service life and excellent accuracy out of chrome-moly steel barrels. You can't go wrong with a 1/9 twist rate, as it will stabilize anything up to the 69-grain Sierra MatchKing, and even some heavier bullets.

What about the chamber? Should you get a 5.56 chamber instead of a 223? Yes, but you don't always have a choice. All the makers who produce a chrome-lined barrel offer it in the 5.56 chamber, with the longer leade. Theoretically, the longer leade of the 5.56 chamber (the extra length of the bullet jump is also called "freebore") supposedly has a negative effect on accuracy. However, you have to ask yourself "how much?" Weatherby rifles have traditionally been made with large amounts of freebore, to help control the peak of the initial chamber pressure spike on firing. Weatherby rifles have always been known as accurate, and for a long time they have come with an accuracy guarantee.

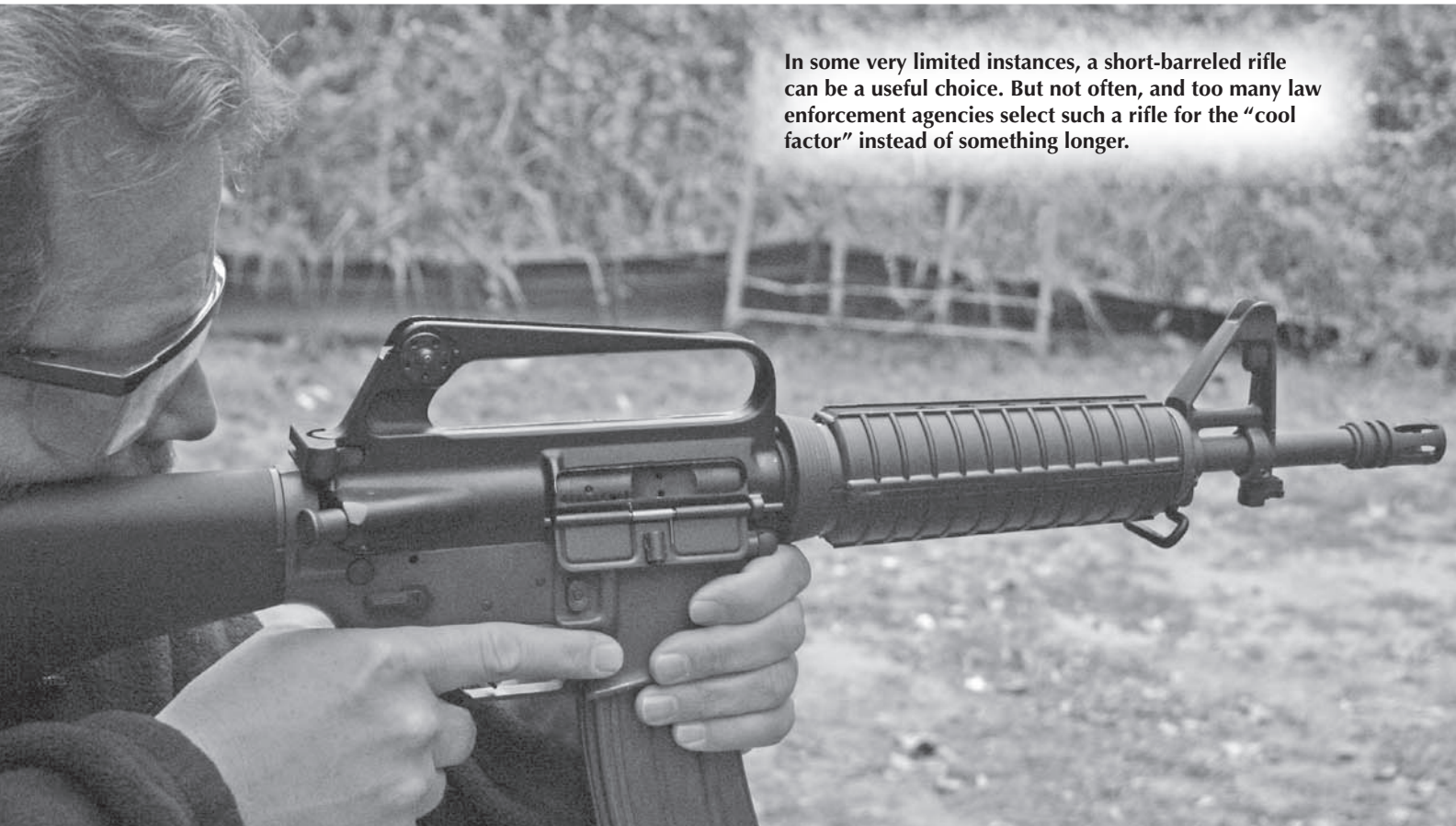
My choices, were I building particular rifles would be: for a duty or patrol carbine, I'd go with a lightweight 16-inch stainless barrel with a 1/9 twist. For an NRA High Power Service rifle, I'd get a stainless, 20-inch, 1/7 or 1/8 twist barrel, as heavy as I could get assembled. For a varmint rifle, I'd go back to a 1/9 twist, get a stainless barrel, and either a heavy for a prone, stationary varmint rifle, or a medium contour for a walking-around varmint rifle. Building an SPR, or a police marksman rifle, I'd shorten the barrel a bit to 18 inches, go with a medium contour, and 1/7 twist. The barrel would again be stainless. As you can tell, I'm partial to stainless barrels. However, if I were going to someplace dusty on a government contract, I'd be willing to give up a small and theoretical amount of accuracy for the durability of a chrome-lined barrel.

For USPSA three-gun competition, I'd have to first decide what category I'd be shooting in. A Tactical Division rifle would be a 16-inch, 1/9 stainless lightweight. Basically, a duty gun. An Open gun would be a fluted, 18-inch stainless barrel inside a carbon fiber freefloat handguard. (Think Clark Gator.) A Limited gun would, despite the name, would be more involved. It would be a medium to medium-light 20-inch barrel, with a shaved gas block, and a front sight on a housing out at the muzzle. Using only iron sights, I'd want the longest I could get.

And all of these will be built or tested in Volume 2.

Cleaning The Barrel

You can ruin a barrel from cleaning it. The typical method to ruin a barrel is simple: use a sectioned, steel, uncoated cleaning rod, with very tight patches or brushes, pushed from the chamber. Worse yet, use a patch so tight you have to hammer the rod to get it down the bore. If you want to follow the Hippocratic Oath in cleaning your barrel, "First do



In some very limited instances, a short-barreled rifle can be a useful choice. But not often, and too many law enforcement agencies select such a rifle for the "cool factor" instead of something longer.

A copper solvent will get the copper fouling out of your bore. Just don't let it sit in the bore too long, as some have been implicated in barrel etching.

The BoreSnake is great on the range, in training, or for a quick clean in the field when you don't have a lot of time. But a thorough cleaning takes more.

no harm" then use a one-piece, coated rod, a rod guide, and patches the right size.

If there is any subject in the shooting world filled with more supposition, voodoo and quasi-religious opinions, I haven't found it yet. In the old days, we'd clean our barrels until we had the powder residue out, and for those using ammo old enough, to get the corrosive primer residue gone. We didn't worry too much about jacket residue, as it was hard to see, difficult to clean, and didn't matter much. Back in the "old days" a hunter who could put three targeting shots on the target, better yet in a 2- or 3-inch cluster near the center, from the bench, at 100 yards, was good to go. Only benchrest rifles did better, and who wanted to be like them?

Today, with the improvements in rifle and ammunition quality, it is a rare bolt gun that doesn't do under 2 inches out of the box. With a little tuning and ammo selection, many will do an inch. It has become almost de rigueur to insist on a "one MOA" rifle as the minimum for any kind of serious hunting. A hunter who doesn't have such a rifle runs the risk of serious social ostracism. And so the quest for accuracy has crept into the combat rifle arena. Who wants to be using a rifle that isn't a "tackdriver" even in a tactical match? Who wants to admit they aren't serious enough about tagging that 200-yard plate to test for, ensure and keep the bore clean enough to deliver the accuracy needed?

There even used to be a school of thought that you wanted a bore fouled with a few rounds, to make sure it would be just as it was supposed to be for a second or third shot. We now know better, and the best barrels will not change their zero to any significant amount (1,000-yard competition shooters might disagree) from bare clean to the second or subsequent rounds. And proponents of the idea also wanted to avoid over-cleaning a bore, and wearing it with the brush or rod. Benchrest shooters were well known to be borderline loony about cleanliness, but when you're shooting five shots under a quarter-inch, every detail matters.

And then the idea of breaking-in a barrel sprang upon us. The idea was that you would use the bullets themselves to burnish out the microscopic burrs that machining created. Shoot a round (or two or three) and clean. Repeat to some stated number of rounds, then begin shooting groups. Repeat until the bore is broken in, or you die of boredom. I must admit that even I, Mr. Skeptic, tried it. Then I consulted my records. I found I had rifles that shot well without going through the laborious process. And I had some that were still average despite the process. Now, without a double-blind

study, requiring a couple of dozen rifles, volunteer shooters, a truckload of ammo, and a year or so, I can't tell you the truth or fiction of the process. I know that some barrel makers swear by it. And others aren't so sold on it. Me, I've adopted a less laborious process. Since everyone seems to be in the throes of naming things after themselves in the early years of the 21st century, I'll call it the "Sweeney Barrel Prep." I swab a barrel clean before I shoot it. Barrel makers ship barrels with preservative oil in the bore. Many rifle makers test-fire without cleaning it out, or re-swab bores after test-firing. I figure a minute spent swabbing the dust, lint, oil, powder residue from test-firing, and anything else that might have gotten in there is time well-spent. I then test-fire the rifle, shooting groups to get it sighted-in. If it won't shoot acceptable groups, then I look into the likely problems. If it does, I then put it in the cleaning cradle when I get home and go through the following process:

1) I swab the bore clean with a powder solvent.

2) I apply a copper solvent, with brush and patch, and clean until the patches come out clean. My current solvents of choice are Shooter's Choice Copper Remover, and Hoppes Copper Remover.

3) I load up a patch with J-B Bore compound, and scrub the bore for 25 passes. I replace with a fresh, loaded, patch and repeat.

4) I use powder solvent to remove the J-B residue.

That's it. After that, bores get cleaned when I have a chance to clean them, as in after a high-volume class, or annually. My process would no-doubt make a benchrest shooter cringe, but I'm not worried about the last few .001 inches of accuracy to be had.

Peculiarities Of The AR-15

While it is a rifle, like all other rifles, the AR-15 has some differences that you should be aware of. There are a few things you should pay attention to, in order to keep yours up to snuff.

Use A Solid Rod

Always a good idea, but so many ARs come with the jointed military cleaning rods. A jointed rod has two problems: it flexes more than a solid rod, and the joints don't always match exactly. A flexing rod thus presents a sharp edge of the overlapping rod ends to the bore, with the risk of more scraping. Also, avoid using aluminum rods. The soft aluminum can pick up grit that gets embedded in the surface, and then rubs against the bore.

The Dewey coated rods, the new Hoppes carbon fiber, or other such rods will not be such a problem. They'll still flex, but they won't rub and wear.

That said, there is a way to use a military rod and risk the wear from rubbing: do it the Marine way. I learned this from a shooter who learned it in the Marines. (I don't know if it is a approved method, or just the "gotta get it done fast while the Gunny isn't watching" method) Put your brush, or patched

You need cleaning supplies to clean a rifle barrel. The rod guide (top) keeps you from wearing the leade with your rod.

tip, in the end of three or four sections of rod, without a handle on them. Holding the upper in one hand, insert the rod, unpatched end first, in through the chamber end. Let the rod fall until the patch stops it. Then pull the rod out through the muzzle. You cannot flex a pulled rod. You are cleaning in the direction the bullet travels, something some shooters feel is important. And you cannot get a patch stuck this way. If it won't go through by being pulled, tap the butt end of the rod on the floor (or a handy rock, truck bumper, etc) and it will pop free. If you try to push a rod in with a patch that is too big, you can apply more pushing force to stick it than you can pulling force to un-stick it. If that happens, you can have a real problem getting the stuck patch out.

Use A Chamber Brush First

There isn't much point in scrubbing the bore clean, then finishing the job by scrubbing the crusty chamber and pushing crud into the clean bore. Scrub the chamber first, then the bore.

Use A Bore Guide

If you are using a proper one-piece rod, you can eliminate rod wear with a bore guide. A bore guide will minimize rod wear when using a sectioned rod. Without a guide, the rod will flex under a load. The flex usually comes at the worst spot possible: the throat and leade. The guide takes the load of the flex, and feeds the rod in through its end without flex. Bore guides are simple tubes that fit inside the upper, with a bore-sized hole through them for the rod and patch. Stuff the rod guide into the upper, then shove the rod with patch through the rod guide. The best guides have a witness window where you can apply solvent just before the whole thing enters the chamber, so you aren't wasting solvent on more of the inside of the rod guide than necessary.

Don't Fret About the Gas System

I know shooters who will only clean their ARs with the upper in the upright position, to avoid getting solvent and other stuff in the gas tube. They don't want to be (for instance) blowing left-over solvent and J-B bore compound back into the action, having left it in the end of the tube. First, how much could there possibly be? Sure, if you plugged

the muzzle and left the solvent standing in the bore, you'd end up with a tube full of solvent. And it would mostly drain out when you drained the bore, too. Considering how much powder residue gets blown back with each shot, in a couple of magazines you'd never notice any residue blown back from your cleaning process.

Also, you'll find military cleaning kits with pipe cleaners for cleaning the gas tube from the receiver end. As a means of keeping the D.I. happy, they are great. At any other time, they are a waste of time and effort. Now, were I stuck in a dust storm in Afghanistan or Iraq, I might be singing a different tune. But short of that (and even then, I'd wonder if it was really necessary) don't waste time. The same goes for the cute little brushes. Every class I'm at, I see something on the order of 50,000 rounds go downrange. I've never seen a rifle that was malfunctioning because someone didn't scrub the end of the gas tube.

Clean The Locking Lugs

You don't have to do them every time you clean. (Unless the D.I. or Gunny is going to be doing a white-glove inspection) Annually will do for most of us. If you live or work in a really dusty or grubby environment, then regular cleaning can be something you should tend to. But your rifle isn't going to stop working after a few hundred rounds because you failed to clean the lug recesses.

Wipe Out Of Upper And Lower

Or better yet, use a bucket full of solvent to scrub them clean. With a 5-gallon pail holding 3 or 4 gallons of mineral spirits, and a brush the right size, you can scrub the carbon out.

Avoid Lots Of Aggressive Solvents

One solvent in particular, Sweets 7.62, has a noticeable ammonia smell. It attacks copper deposits like mad. However, it has been implicated as having etched some bores when left on too long. "Too long" as in overnight or over several days. Soaking a bore for half an hour or an hour probably won't be a problem, but the risk is that you'll forget, get distracted, or be called away by someone or something. And then, a day or week later, you smack yourself on the forehead as you contemplate the remnants or your barrel. Any solvent that will dissolve copper has the potential to harm your bore, it is simply a matter of how long it takes. Many can be left in for days or weeks with no harm, but even they might cause problems if left in for a month. You think I'm kidding? I had to replace a barrel on a rifle where the owner had used rubber stoppers to plug the chamber and muzzle, and left the rifle standing with copper solvent for months after hunting season. (He wasn't happy with the accuracy he was getting, and the barrel was "obviously" inaccurate due to jacket fouling.) I don't know what it looked like before, but after it looked like a couple of miles of bad road.

Don't Worry About Jacket Fouling

Can there be too much? Yes. How much is too much? Your rifle will tell you, if you let it. Once you find a brand or load of ammo that your rifle shoots accurately, set some aside. Now and then, check the accuracy of your rifle with that load. When accuracy starts to drop off, scrub the bore down to bare bore, and check accuracy again. If it comes back to previous levels, then you had too much fouling. If it doesn't, maybe you've just worn your barrel out.

I have a loaner rifle that I take with me to classes. When there is time, I'll get in some trigger time in the drills and qual course. When someone's rifle goes down, I hand them mine and proceed to fix theirs. (That is usually why I'm there, as armorer as well as instructor.) In four years of classes with this rifle (I used another one before this one) it hasn't been cleaned much. It occasionally gets a brush or patch down the bore. The chamber gets brushed. Now and then someone squirts some lubricant in here or there. In all that time the rifle has never failed to work, and it still can shoot clean on the National Guard range computer pop-up course, with targets out to 300 meters.

If Possible, Free-Float That Barrel

Any barrel shoots better if it does not have variable external forces at work on it. Changing sling tension, hanging lights and stuff, or other abuses, can change the zero and group size of your rifle. One of the reasons the Clark Gator, the DSA and the Armalite varminter shot so well was that the barrel was simply hanging out in space, with nothing to interfere with it doing its work. If the competition allows it, get a tube handguard or a fiberglass or carbon fiber handguard, and get your barrel out there on its own.

Conclusion

Before you break the bank for a barrel that is "good enough" considers what you'll use it for, and how well you can shoot. I've shot plain, old military "pencil barrel" 20-inch, 1/12 chromed barrels that were more accurate than I was. And I've shot rifles with a barrel where the blank cost more than my rifle did, before someone got paid a lot of money to install it, that only shot as well as my rifles, with common barrels. If you aren't going for your High Master card in NRA High Power, spending a cool grand on a barrel and its installation is a waste of money. And if you're going for your Grandmaster card in USPSA Three-Gun competition, that grand is probably better spent on more practice ammo than on a barrel you'll burn up before the season is done.

In almost every case I've seen, money invested in practice ammo or lessons is better than money invested in a better barrel. If the one you have delivers, stick with it. If you've worn one out, think long and hard before you invest money moving up in barrels, unless you know for a fact that the old one just wasn't accurate enough and was holding you back.

CHAPTER FOUR

BARRELS

The full-diameter H-Bar barrel is a beast. At .959" under the handguards, you'll love the weight for recoil and prone shooting. In a 3-gun run-'n-gun match, however, it will be wearing.

The Troy folding front sight needs either a railed forearm or a gas block with a picatinny rail on top.

The burning question in the AR-verse is: "4140 or 4150?" Well, OK, three guys regularly wrangle about it on the internet in one or another forum, but it is something to think about. First, what are the differences? As you may know, steel is iron with a certain amount of carbon in it for hardness. The more carbon, the harder it is. (In the broadest possible brush strokes, yes. A lot more goes into hardness than carbon content, but unless you want a degree in metallurgy, use that as your working point.) The rest of the metals and other constituents in alloy steel are there for other reasons. Some to make it easier to machine, others to decrease oxidation, still others to make it springy without work-hardening and eventually breaking.

The first thing you have to be aware of is that it has been a long time since there was one 4140 or 4150 alloy. You can find at least six variants of "40" and seven of "50." They are both members of the low alloy chrome-maganese-moly family, with a touch of phosphorus, silicon and sulphur in them. They both are easily worked and machined in their unhardened state. And both are a royal pain in the butt to work after they have been heat-treated. The main difference? 4150 has a touch more carbon in it. The specs for 4140 allow for carbon between .38 and .43 percent. For 4150, carbon content is between .48 and .53 percent. So why the big ruckus? Simple: if you're going to be using your AR or M-16 as an impromptu SAW (as we've discussed elsewhere) as so many in the military seem wont to do, then a 4150 barrel will last a bit longer. When you're dealing with an otherwise intractable problem, a few more minutes can be all you need. If harder, higher alloy steel is better, why doesn't the military go with the better steel? And why would any of us settle for less?

Barrels with a short distance between the gas port and the muzzle can usually work just fine without involving your brother-in-law and his drill press. Test before drilling.

Ah, there's the rub. First, remember "mil-spec?" The Army can't go changing barrel steel alloy numbers without changing the spec. Do that, and the whole ball of wax might be up for grabs. No, best to leave the mil-spec alone. Besides, I had an interesting conversation with Mark Westrom, President of Armalite, on a related subject. We were discussing the barrel twist of ARs. At the time, the 1:7 was seen as not best. (That was well before Afghanistan, Iraq, and the Mk262, Mod 1 round.) He related that it would probably cost more to prove to the Army that the 1:9 barrel twist was better than the 1:7 than it would cost to change every barrel in inventory. You can imagine what it would cost to prove a particular barrel steel was superior. So, we stick with the state-of-the-art barrel steel, circa 1964. Why would any of the rest of us not use 4150? Cost, for one, and accuracy for another.

4150 is not a regular stocking item. It is enough harder to fabricate and to work, that anyone who can justify 4140 does so. Barrel makers want to make durable, but accurate, barrels. Anything that decreases accuracy is anathema. Anything that pushes up costs has to be justified in terms of useful life and accuracy. The government is perfectly happy with standard M-16 and M4 barrels that shoot 3 MOA. After that, they want durability. An NRA High Power shooter wants more than 3 MOA. A Master or High Master expects at least 1 MOA, and better if he or she can get it. The center X ring of the 600-yard target requires 1 MOA and the ten ring less than 2 MOA. You won't see any chrome-lined barrels on the 600-yard line at Camp Perry unless someone was forced into using them. But a 19-year-old Marine in Fallujah trying the whack that pesky RPG gunner down the block wouldn't notice the difference between a 1 MOA rifle and a 3 MOA rifle. So the government goes for durability.

What should you buy? That depends on what you need, and how much you're willing to pay. It is entirely possible to spend as much on a barrel alone as some are willing to spend on a complete rifle.

Barrel Length

Ah, the evergreen subject. Short barrels are cool. Except, you give up velocity. You also, once you go below a certain length, add legal restrictions. Let's say you have a burning desire for a shorter than kosher barrel. How to get it? First, determine if your State allows the possession of Short Barreled Rifles. In some places the SBR is more restricted than machineguns. (No, I'm not kidding.) In others, it is no big deal. Once you've determined that it is lawful for you to possess an SBR, you download or acquire from the ATFE the necessary form: a Form 1. There, you fill out the various boxes. You must note that the rifle was manufactured by whoever's name is on the lower. If the lower says "Bob's House o' Guns" then that's what you put down. Then, in the box of who is the maker of the SBR, you put in either your name or the name of the gunsmith doing the work. You send the form, the fingerprint cards, your check and your hopes off to the ATFE. There, they determine if you are legally allowed to possess a firearm, both in the general (as in no felony convictions, etcetera) and in particular, as in does your State allow SBRs.

You wait. You do nothing. You cannot acquire a short barrel, nor shorten yours, until you have the approved form back. Again, wait. Once it comes back approved, then you can deal with getting your barrel shortened, and the rifle, upper or barrel marked. That's right, marked. It has to be marked as being an SBR. Once approved, marked and done, you now have a short-barreled rifle. Except, what about all those other ARs you own?

(Let me pause here for a moment and insert the obligatory notice that I am not a lawyer, never have been, and haven't even played one on TV. Anyone who takes legal advice from a non-attorney is an idiot. Do be careful.)

I have written to the ATFE on this subject several times, and the advice they have given me has been consistent. (Which in itself is something of a minor miracle.) What they have told me is that it is perfectly legal to own an SBR and a non-SBR at the same time. What you should not do is also own an "unassigned" lower at the same time as owning an SBR. That is, a lower which does not have an upper to go with it. Two complete rifles, one an SBR and one not an SBR, and one lower without an upper, is cause for suspicion. Add an upper to that stray lower, and all is sweetness and light. However, never, under any circumstances, install the SBR'd upper on another lower. That is, consider the situation of AR "A" which is the registered SBR, and AR "B" which is not. Never put the upper of "A" on the lower of "B." Never.

I have had people earnestly argue that they paid to

The only way to be sure you're getting a 4150 steel barrel is to buy Colt or military. You'll pay for that option, however. Most of the rest of us find other alloys entirely acceptable.

The GG&G folding front sight, with its three clamping bolts. The side sling adapter is a nice addition.

have an SBR'd AR, and as long as they only had one, they were cool. Wrong. The ATFE has registered rifle "A" and its serial number as the SBR. Swap the upper from "A" to "B" and you have two SBRs: the registered one, and the unregistered one. It is, however, fine to put the upper of "B" onto the lower of "A." You've registered it as an SBR, but that doesn't mean it always has to be one. So, you could own a single AR, register it as an SBR, and own a number of uppers for it, not all of which are short-barreled. All kosher.

If you go to sell your SBR, you must comply with the NFA (National Firearms Registry) regs on the disposition of SBRs, machineguns, suppressors, etc. If, however, you get tired of it all, you have another out: write to the ATFE and request that your SBR be removed from the list of registered SBRs. You, of course, must then replace the short barrel with a suitably long one, and not retain said barrel. But once you do that, your rifle becomes just a rifle again, and it can be sold as if it were any other AR.

There is another price to be paid for an SBR, and that is velocity. You'll lose velocity going to a shorter barrel. How much depends on how "fast" or "slow" your particular barrel is, and how much velocity your ammo starts out with. But you'll lose some. You won't lose accuracy. If you have an accurate barrel, it will still be accurate when it is shorter. Resist the temptation and the lure of the gunsmith, to "open your gas port." Yes, it might need it. (More likely not.) But once opened it cannot be made smaller. Test your new SBR for proper function before you go and get the port drilled larger. If it works fine as-is, then leave it alone.

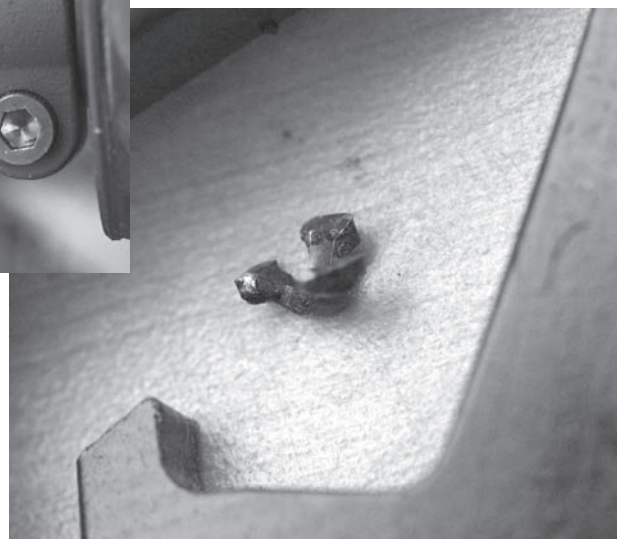
There are many rifles that have had their barrels shortened, and not needed the gas port tended to. In all cases, test function before getting out the drill set. I have shortened a number of 20" down to 16.5" and not yet had to mess with the gas port. It may well be that a 16.5" barrel and carbine gas tube, shortened to 11.5" or 10.5" might need the gas port opened, but don't just assume so and jump in with drills.

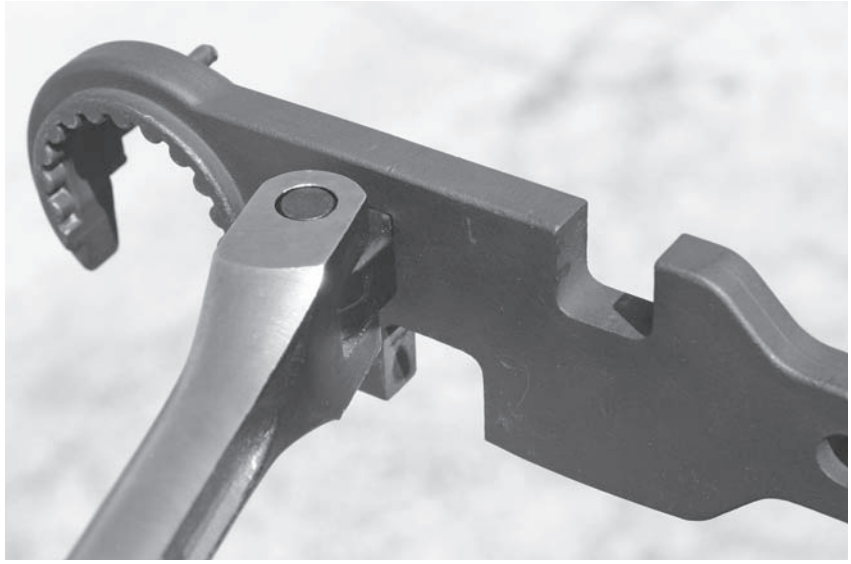
Machineguns

There was a time when you could do the same thing for a machinegun that we just described for an SBR. (Except the "removing from the list part." Once made a machinegun, it could never be un-made.) However, an amendment to the 1986 Firearm Owners Protection Act stopped the production of new machineguns. At least for us lowly taxpayers. If you send a Form 1 in to convert your AR to a machinegun, it will come back denied. Don't bother arguing, it has already been tested in the courts. The result, as could have been predicted by anyone who hasn't slept through Econ 101, is that machinegun prices have risen. Where an M-16 cost pretty much what an AR-15 did in 1986, now in 2006 a transferable M-16 costs on the order of $12,000 to $15,000. You want a machinegun? Either make a lot of money, or work to get the law changed.

The PRI folding front sight is neat, sturdy, robust and cool. High CDI points.

This anvil from a popped primer stopped the rifle cold. No trigger action, no shooting.





To turn the barrel nut you need a good wrench, not the wimpy little military one. A wrench for added leverage is nice, but not usually needed.

The impediments to a short-barreled rifle are not just economic and mechanical. You have legal considerations to attend to as well. Do it right, do it legally.

Barrel Weight

We all used to lust after heavier barrels. Back then, we used them in matches, in patrol, in defense and in training. Now, light barrels are back in. One item of the A2 upgrade of the M-16 was the "heavy out front" barrel. Why? Two things: one, the M-203 mounting system could not fit on a heavy profile barrel. So the barrel was left skinny underneath the handguards, or as skinny as it needed to be and still accept the M-203. Why didn't the A2 take a "slotted" barrel like the M4? Because the M4 hadn't been invented when the A2 was being discussed.

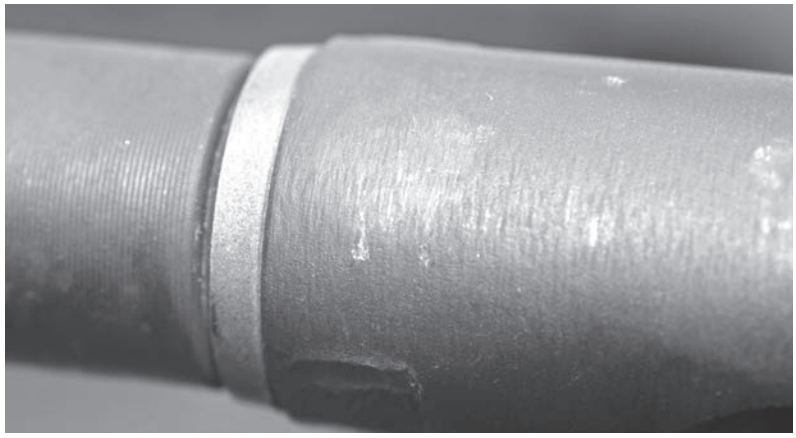
Why, then, is the barrel heavier out front? To prevent bending. The Vietnam War was still fresh in many minds when the A2 was being worked out. You know the "urban myth" of barrels being bent from rifles being used as prybars? No myth, that. I know people who were there and saw it. Also, it was thought that the barrels were bending right at the front sight housing from bayonet use. The idea was that the leverage of the bayonet was bending barrels right at the housing. Straightness gauges would sometimes not pass the front sight housing area when they were inserted from the muzzle. So, the barrels were made heavier there. Only afterwards did the experts discover that the reason the straightness gauges weren't passing the bore there was burrs from the gas port drilling. Me, I suspect that the insiders wanted heavier barrels, but knew they couldn't get them without good reason. So "bent barrels in bayonet training" became the reason.

My advice would be to get the lightest barrel you feel comfortable with. I have yet to see or hear a student at the end of a three-day or five-day rifle class proclaim to anyone who will listen, "I wish this rifle were heavier." Typically, they are prying off excess parts, bolt-on accessories and anything else to get the weight down.

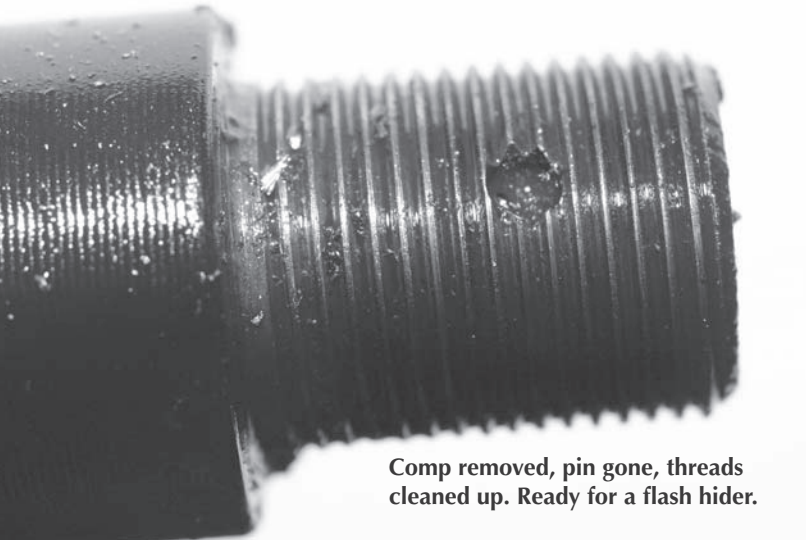
Now, a light barrel can shoot as accurately as a heavy. What happens, however, is that the lighter barrel heats

When it comes to AR work, and the gas tube in particular, the MOACKS is king. If you plan on working on ARs, get one. Get it now.

Many post-ban rifles had the comp secured with a blind pin, or in this case, a welded blind pin.



Here the cut-off tool on the lathe has dealt with the blind pin.



Comp removed, pin gone, threads cleaned up. Ready for a flash hider.

up faster. Accuracy can (not always will) decrease as a barrel heats up. What does happen, however, is that barrel life decreases the longer it stays hot, the hotter it gets, and the more it is fired when it is hot. If you are going to be doing lots and lots of shooting, heating up your barrel, heavier is better.

223 vs. 5.56

I know I covered this in Volume 1, but it bears repeating. Most manufacturers don't really know what chamber their rifles have. Except for a few like Colt, CMT, LMT or FN (the latter from whom you cannot purchase a rifle) who make honest-to-god mil-spec rifles, because they sell them to the military, or those who actually make their own barrels, like Olympic, all AR makers get their barrels from a barrel maker.

What chambering that maker uses is not something they disclose. That is, you cannot call up "XYZ Barrels" and ask them "do you provide .223 or 5.56 chambers to Bob's House of Guns?" No one talks. But barrels do. If you have a barrel with a .223 chamber, and feed it hot, mil-spec 5.56 ammo on a hot day when the rifle is crusty from lots of shooting, you risk popping a primer. The solutions are simple: stick with commercial .223 ammo, or open your chamber to 5.56. Get a gunsmith for this, and have him get a "Ned 5.56 reamer" from www.m-guns.com. It will only cut the leade, throat and neck of your chamber, and not otherwise change the headspace.

Headspace

I've heard, and read, some who say that headspace is a non-issue. That simply buying "mil-spec" barrels and bolts guarantees headspace. Well, maybe so, if you only buy one brand. If you only buy Colt barrels and Colt bolts, you can be sure of always being able to swap. Your odds go down buying a Colt barrel and say an FN bolt. And buy a Colt barrel and anyone else's bolt and there's no way to being sure without measuring. So, my advice is to always check headspace when assembling a new combo. Never assume the parts will work out OK, and be ready to exchange some parts if the combo doesn't work out and you don't/can't ream for proper headspace.

A .223 chamber that pops primers will eventually cause a malfunction. Not at every class, but often enough that we know what to look for when we find a rifle that won't shoot. Disassembly usually uncovers a mangled primer or the anvil of a primer, wedging the trigger immovable. Sometimes the popped primer ends up in the barrel extension, preventing the bolt from closing.

After-Ban rifles

When the Assault Weapons Ban was on, we couldn't always install barrels with threaded muzzles. And new rifles didn't have them. They were either left bare or had a brake soldered on. What to do if you want a flash hider? Selection of them is in the "Brakes and Comps" chapter, but if your barrel isn't threaded, we'll cover it here. Simply put, you need a lathe. You need a lathe with a chuck large enough to take the barrel with barrel extension installed. Without that much size, you are out of luck. How-to for those who don't know would take a whole chapter itself. So, this is your background and description for your machinist or gunsmith who wants to undertake the task.
First, remove the barrel from the upper. That means handguards off, gas tube off, barrel nut unscrewed, and barrel pulled out of the upper.

Next, open the jaws of the chuck and insert the chamber end of the barrel. Place it in the chuck so you get as flat a section under the jaws as possible. The delta ring will be between the chuck and the front sight housing. Put the muzzle end in a live or dead center on your tailstock. The barrel will try to flex away from the cutting tool. By using a center you also ensure your threads are concentric to the bore and not cut on the

Colt and other companies have made many short-barreled rifles. Customers want them, but not all are aware they can be fussy to run.

center of the exterior.

With the barrel secured, use lots of cutting lube and a medium speed. Turn the muzzle down to .495" for .650" length. Or, if there is a soldered-on brake, comp or muzzle nut, lathe-turn it off.

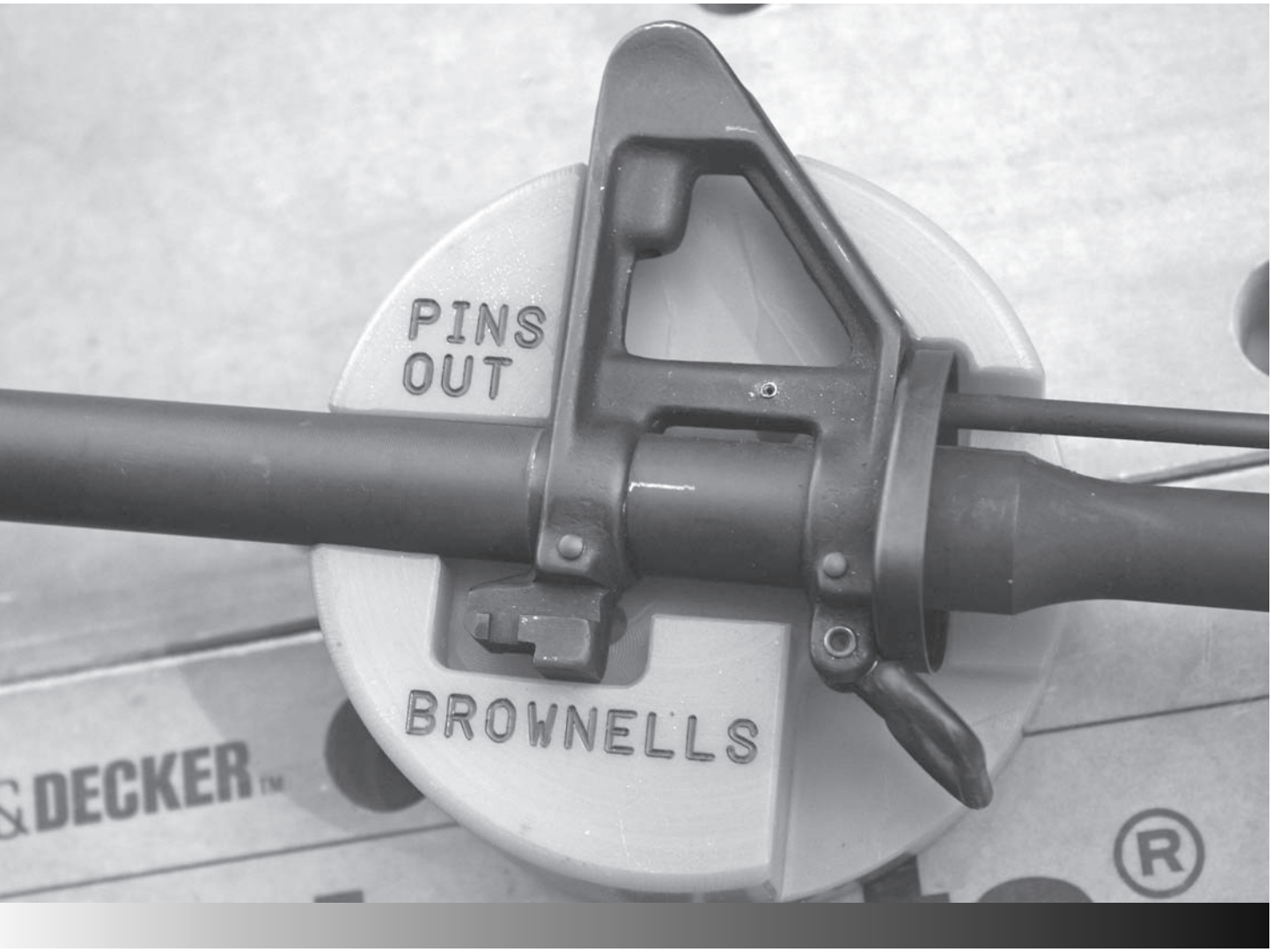
Change to a thread-cutting tool. Cut twenty-eight threads to the inch. Cut until your flash hider/comp wants to start. If your machinist/gunsmith is adept, he'll cut the final threads on the lathe. The rest of use will simply pull out our 1/2-28 die and hand-tap the final threads to fit.

Once cut, remove the barrel, hand-lap the crown clean (the center may have mussed up the crown a bit) and reassemble.

Voila! You have a threaded barrel.

Folding Sights

A new feature on the AR is the folding front sight. Why, you ask? The main reason is to get the front sight down out of the field of view of the optics. Me, I hardly ever notice the front sight in my field of view. But some shooters do. I'm sure, since it is there and in the optical path, that it makes a difference whether I notice it or not, but for some it is noticeable. And even objectionable. Another reason is that it makes the rifle just a tad more compact. If you are getting in and out of armored vehicles, or parachuting (also quaintly known as "jumping out of perfectly good government aircraft") then the slightly more compact rifle with a folding sight can be useful.



If you plan on doing any work on barrels, and removing or replacing the front sight housing, get the Brownells block. It would be worth it at twice the cost.

There are two ways to install a folding front sight, and both require that you remove the old one. So, get out your Brownells sight block, hammer and drift punch set, and get to work. Remove the handguards, drift out the gas tube pin, then the front sight pins, and tap or wrestle the old sight off.

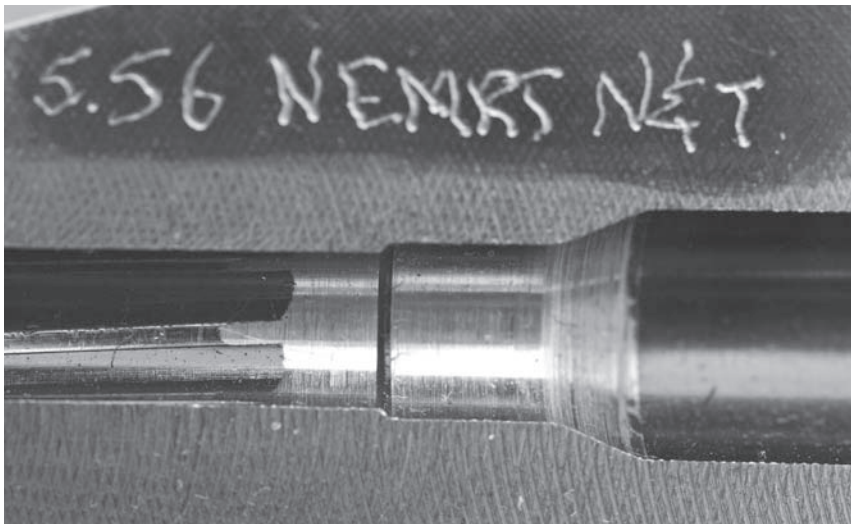
The new folding sights that replace the old sight are exemplified by either the GG&G or the PRI sights. They both use clamping bolts (the GG&G three, the PRI, two) to secure the sight. The GG&G has the added feature of a side-mount sling swivel. You can unbolt it if you don't need it or want to move it to the other side. To install a folding front sight assembly, install the rifle's old gas tube on the new sight first. Then slide on, snake the tube through the barrel nut, align the sight vertical and tighten the bolts. Take your allen wrench set to the range with you and zero the front sight by tipping it right or left to center groups. Then tighten and apply Loctite.

The second type uses either a gas block with a picatinny rail on it, or a low-profile gas block and the rail on the forearm as the sight location. For gas blocks with picatinny rails on them, you can look to any number of sources (e.g., J&T Distributing, DPMS, Armalite) and even compare them to each other in the Brownells' catalog. On top of them will go a folding sight like the Troy folding sight.

If you're using a folding front sight like the Troy, riding on the railed forearm, you don't need a standard front. You might not even want a picatinny-railed gas block. Low-profile gas blocks to the rescue! You can get one

Gas port diameters are a lot more forgiving that some give them credit for. Once drilled larger, throttling back too much gas is very difficult. Again, test before drilling!

The demo gauge shows where a ".223 to 5.56" reamer reams. The shoulder was not moved forward, just rubbed bright.

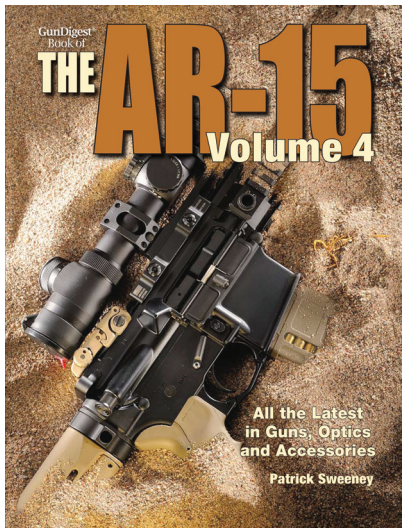


like the one that came on the 6.5 Grendel long range rifle. Or, call up Mark and the crew at Larue and get a really low-profile gas block. Just large enough to line up the gas tube, it comes in three inner diameters to match standard barrel sizes: .625", .750" and .875". Be slick, be cool, get your gas block pared down. Get a LaRue.

Barrel Tools

In all this, you'll have to have some way of holding the barrel or receiver, so you'll need either aluminum barrel blocks or the Peace River upper fixture from Brownells. Probably both, as you cannot always count on being able to use just one or the other. You'll need a crescent wrench to unscrew flash hiders, hammer and drift punches to remove pins, and a barrel nut wrench to remove the barrel from the upper. Do not settle for the simple "military armorers" plate, the flat plate with three studs in it. It is a field-expedient item only. Get a big wrench, like the one ASA used to offer until they went out of business. You want a multi-notch wrench that grabs and holds on to as many teeth of the barrel nut as possible. A wrench, torque or otherwise, for extra leverage is nice, but not absolutely necessary.

Some like to use anti-seize compounds on the barrel nut/receiver threads; others are just the opposite and want to use Loctite. I can understand both, but use neither. A little common oil on the threads will have the nut turning smoothly and not seize. And there is only one place on the basic AR where Loctite is called for: the carrier key screws. I also, as I mentioned above, use it on front sight housings that clamp in place.



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