The Use of Sound Suppressors on High-Powered Rifles

by Mark White

It should he stated at the outset that the phrase high-powered will cover those fairly efficient, non-magnum cartridges bracketed between the .223 and the .308 - the workhorses of the law-enforcement and military community. If one is going to suppress a sniper rifle, that rifle should he totally dedicated to suppressed fire. Using a rifle which is only occasionally silenced is an invitation to either a lawsuit or to poor field shooting, as any rifle will carry a different zero without a suppressor, as opposed to its zero with one.

A suppressed rifle should be stored and carried in its assembled, ready-to-go configuration. Many of us have seen movies in which a fitted case full of components (stock, action, barrel, forearm, scope, mount and silencer) was assembled in the field, and then used to complete an important assassination. This is pure *Hollywood*. No enforcement officer in his right mind would ever assemble a rifle on the spot on a callout at a crime scene and expect the weapon to hold its zero. It might, but such an occurrence would be an abnormality. And what would he the moral and legal consequences of a botched shot in a hostage rescue attempt? By the same token, some suppressors cause shots to stray with various degrees of tightness or looseness on a rifle's barrel.

The Single-Point Mount

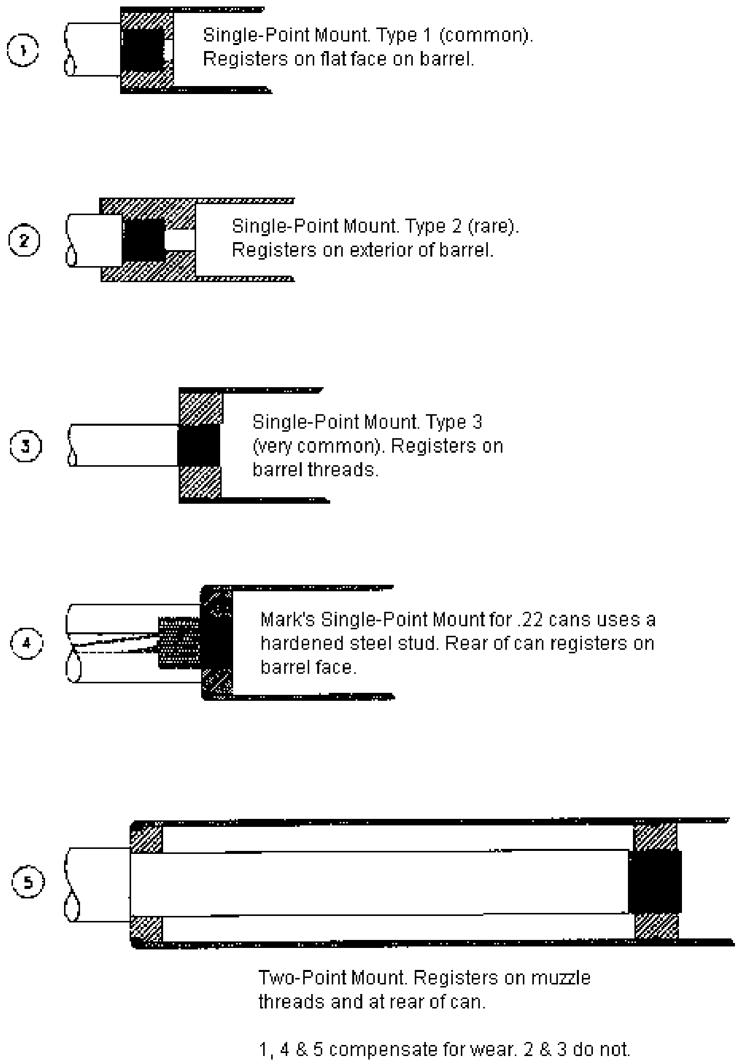
The muzzle and a massive outpouring of high-pressure propellant gas are the last things a bullet feels before it leaves the control of the shooter. The joint between suppressor and barrel should be as rigid as that between barrel and action. Often, the suppressor/barrel interface is conceived as an afterthought. The muzzles of most military barrels are fitted with small, steel flash hiders, weighing but 57 to 85 g or 2 to 3 ounces. Many manufacturers try to use the same kind of short, 12.7 mm or 1/2 inch diameter, threaded muzzle sections to mount suppressors that might weigh up to 1.8 kg or 4 pounds. It may be convenient to use flash hider threads, but such a tiny joint is very fragile, and lacks the strength and stability expected of a military or enforcement weapon. A small error in machined accuracy on a single-point mount can result in a disastrous misalignment problem near the muzzle of a suppressor.

A suppressor that is held at the rear by a single collet, or by a single section of threads, is said to be held by a single-point mount. If the threaded section is only 12.7 mm or 1/2-inch in diameter the strength factor is very low. If a heavy target barrel is used, the threads can be as large as 19 mm or 3/4 to 22 mm or 7/8 inch in diameter. In this case, the strength and stability factor is much improved. Unfortunately, many suppressed rifles with single-point mounts suffer from a wandering zero. There is, however, a better way.

The Two-Point Mount

The two-point mount usually attaches a barrel to its suppressor with threads at the muzzle, and with a collet, O-ring, or conical joint about 20 to 25 cm or 8 or 10 inches behind the muzzle. It is a vastly superior way to mount a muzzle can to a rifle barrel. The resulting joint is many times stronger than any single-point mount could ever be. Because of the geometry of a two-point mount, a small error in alignment will not progress into a much larger error at the suppressor's muzzle.

The common configuration has threads at the barrels muzzle, and the step for the rear of the can near the middle of the barrel. Tightening puts the suppressor in compression, and the barrel in tension - which we feel is the most conducive to accuracy. Another configuration has a threaded section in the center of the barrel, where the unthreaded muzzle stubs or jams into a socket in the middle of the suppressor. We feel that this configuration (with the barrel in compression) is not as conducive to accuracy, although it may ease manufacture of the suppressor. However, to our great surprise, we have seen suppressed .308 systems (with compressed barrels) that appeared to be fairly accurate. Yet another benefit exists with the two-point mount. Space behind the muzzle exists inside the rear chamber of the suppressor. That extra volume can be used for more effective suppression, without adding greatly to the overall length of the weapon in front of the muzzle.



Barrel Torque

Most rifles have barrels that impart a right-hand spin to their projectiles. Since most calibers accelerate their bullets to between 762 and 1036 m/s or 2,500 and 3,400 fps, and since most of this acceleration takes place within the first few inches, there is a sudden and violent twisting of the barrel in an opposite (left-hand) direction. This torque tends to cause a barrel held into its action with right hand threads to screw itself ever more tightly into its action with each shot. One can screw a barrel lightly into an action by hand. After several shots are fired the barrel will have driven itself tightly into its action, and it will take quite a bit of force to remove that barrel with a wrench.

That same torque tends to cause a suppressor to loosen if the suppressor is held in place with right hand threads, which seem to be the norm. One must be constantly vigilant to make sure that a rifle's suppressor remains tightly screwed in place. Especially before a critical shot. All Russian and German flash hiders (and some suppressors) are attached with left hand threads. Those made in the U.S. are usually held on with right hand threads.

Our testing has indicated that a rifle with a suppressor held in place with a properly executed, two-point, conical, tensioned barrel mount will remain in zero. This zero remains even after the suppressor has been removed for cleaning and replaced. As long as the replacement torque is about the same, the zero will be unaffected. We are talking about no discernable, cold shot shift after a day, week or year, at 180 m or 200 yards.

Bullet contact with any one baffle in a suppressor usually results in tumbling, with severe consequences for those baffles that remain downrange of the event. Since the smallest possible passage hole results in the greatest level of suppression, the pressure is on to keep internal baffle clearances to a minimum. More than one suppressor (held with a single-point mount) has been ripped free of its threads, and then violently launched downrange when baffle contact has caused internal bullet tumbling. Damage to the suppressor in such an instance is usually substantial. If this happens in the field the rifle may be undamaged, but it will have to be re-zeroed before it can be used effectively.

Moisture Accumulation and Weapon Storage

Water is a major byproduct of gunpowder combustion. A good suppressor will capture and retain a considerable amount of the liquid. Twenty shots from a .308 will cause about a teaspoonful of water to be captured. Whenever possible, the weapon should be carried and stored with the muzzle pointing straight down. The bolt or action should remain open to allow accumulated water to evaporate and vent. If the suppressor is removed as soon as the shooting stops, heat in the suppressor will rapidly dry most of the internal components.

Unfortunately, most rifles are traditionally stored muzzle-up. This causes water and trapped particulates to slowly release, where they will fall and lodge in the chamber area and bolt face. Burned gunpowder is quite dirty, and the inside of a suppressor is usually filthy. Cleaning is best accomplished by flushing the can in solvent, draining, and blowing the unit out with compressed air. One should get in the habit of storing a suppressed rifle by hanging it, muzzle-down. Even stainless steel components will rust if trapped water is not allowed to vent. This may result in a suppressor rusted tightly to its barrel. A bore with rust near its muzzle may lose its accuracy. Corrosion can occur quickly in a warm, moist environment. This is not an aspect to be ignored.

The Blast Baffle and Its Effect on Accuracy

The most critical moment in a bullet's flight path is just after it exits the barrel, where the highly elastic and more rapidly moving gasses overtake it and press upon its base. The first baffle in a suppressor is called, appropriately, the blast baffle. This is the most critical component in the entire baffle stack. The blast baffle is subject to a great deal of heat, stress and impact. Many baffles have asymmetrical surfaces, and these can bounce the blast of high-pressure gas around in a way that disturbs the stability of an exiting bullet. When we first started experimenting with asymmetrical S, Z and K style baffles this phenomenon became painfully obvious. Keyholing, tumbling and baffle contact were common because the bottle-shaped blast of muzzle gas overtook the exiting bullets, deflected off the asymmetrical surfaces, and then deflected the bullets. Accuracy was not good. Some manufacturers haven't learned this lesson yet, and their suppressors are plagued with inherent instability and resultant accuracy problems.

The blast baffle must have a perfectly symmetrical, coaxially aligned surface and bore. It must be made of fairly tough steel, stainless steel or inconel. If it is made of a soft material like copper, brass, titanium or aluminum, the high-velocity impact from unburned grains of powder will peen the surfaces - eventually reducing the size of the bore orifice to the point where destabilizing bullet contact results.

A properly designed blast baffle will strip and deflect much of the bottle-shaped blast of high-pressure gas that envelops and pursues the departing bullet. For this reason, one can logically expect an increase in practical accuracy when a properly designed suppressor has been installed. Also, the weight of a heavy steel unit tied to both the center and end of a rifle barrel does beneficial things for harmonic barrel vibration - dampening out much of it. These two factors greatly increase the practical accuracy potential of a suppressed rifle. The properly suppressed rifle becomes very stable and reliable. Larger internal clearances reduce the likelihood of baffle contact in the event that the suppressor or barrel get slightly damaged or bent.

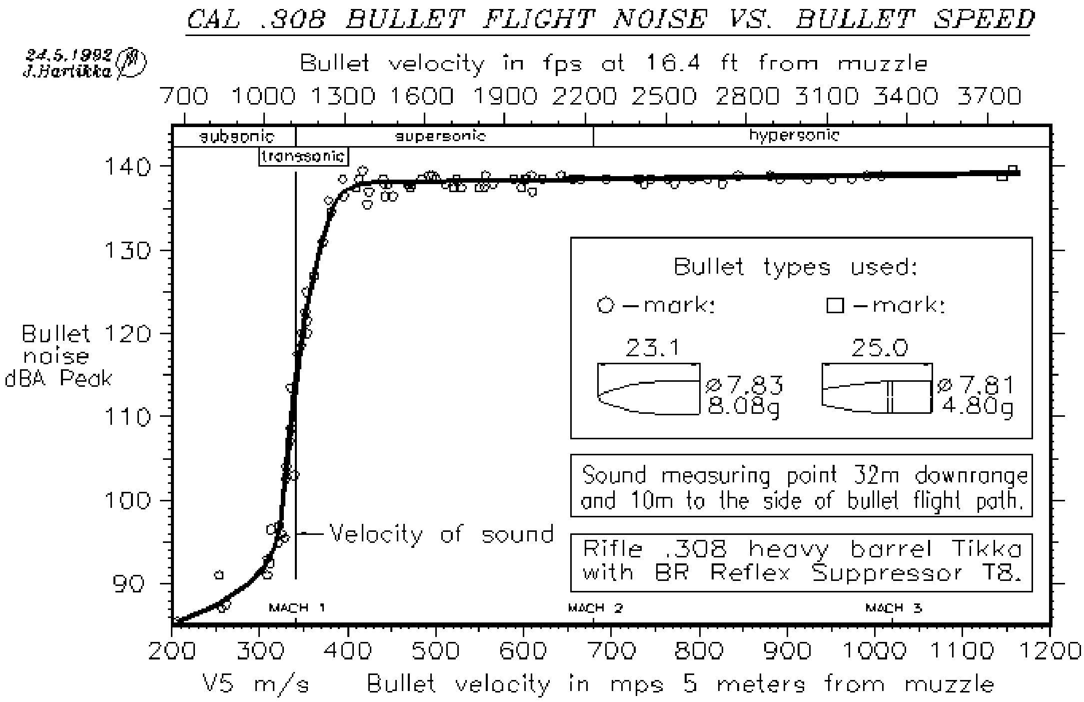
The Supersonic Crack

Any projectile moving through the air at a velocity greater than the speed of sound (332 to 340 m/s or 1,089 to 1,114 fps in dry, 18 C or 65 degree F air, depending on who one listens to) will create a supersonic crack. Temperature, humidity and atmospheric pressure variations play a role in raising or lowering the speed of sound by a small percentage. In a firearm which lacks a substantial muzzle report (being fired over an open field) the sound resembles the loud tearing of a bed sheet.

Two sounds are actually created, one from the front of the bullet, and one from the rear. Near trees and buildings the sound waves come back as a distinct crack or pop each time the speeding bullet passes some object with a vertical, reflective surface. Once the muzzle report has been diminished the supersonic boom becomes dominant. Curiously, the sounds will now appear to come from the target area, rather than the rifleman's position. Sound moves through our atmosphere at a relatively fixed rate. A sound wave will typically strike one ear a bit before the other.

The human brain is capable of detecting the difference in time between sound impacting one ear and then the other in an increment of as little as one/six-millionth of a second. With time and practice we soon learn to use this ability to pinpoint the source of a sound very accurately. Because a suppressed muzzle report is relatively quiet, the uninitiated will automatically home in on the loudest sound, which in this case is a sonic boom reflecting from the target area. The intense, sharp sound of the bullet's passage will seem much louder than the muzzle report to someone close to the flight path. Indeed, a rapidly moving .308 bullet will sound louder than a .22 LR pistol, to someone who is positioned a few feet from its flight path.

Smaller diameter bullets make less noise than larger diameter bullets. Supersonic is supersonic. A bullet traveling 366 m/s or 1,200 fps will make about the same noise as one traveling 1220 m/s or 4,000 fps. Projectiles that are .308 inch in diameter will be somewhat louder than .223 bullets. There is no technology which can remove the sound of a supersonic projectile, no matter what claims are made to the contrary.



Above is a nice chart relating to bullet noise and velocity that is worth looking at. Transonic is between 1,000 fps and 1,300 fps, and the noise level goes up very, very steeply between those velocities. The noise goes up very slowly between 700 and 1,000 fps, and then takes a dramatic jump to between 90 dB (which is virtually nothing) to almost 140 dB (which is major noise) at 1,300 fps. The noise levels were measured 10 meters to the side of the bullet's flight path. It is nice to see some serious, authoritative studies done on the subject. Measurements were taken all the way up to 3,800 fps, where the noise level increased slightly from that which existed at 1,300 fps.

For measuring this bullet flight sound diagram every .308 cartridge was handloaded prior to each shot. A T8 Scout suppressor is attached to a BR varmint rifle. Sound meter remote readout and loading equipment are shown beside the rifle. Contrary to previous belief it was found, that in practice the speed of sound (Mach 1) was not any sudden threshold to sonic crack. Results of these as well as of other Suppressor Project experiments are published in *Alan C. Paulson*'s book Silencer History and Performance, Vol. 1.

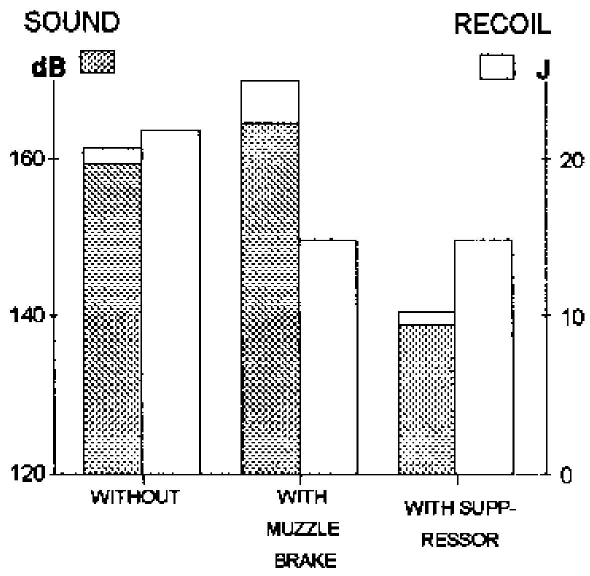
Sound Level and Recoil

Even though the supersonic crack remains, the overall sound level is greatly diminished. The report sounds like a rapid hiss of compressed air as the slowed gasses issue from the muzzle of the suppressor. The suppressed .223 and .308 rifles become quite comfortable to shoot without hearing protection.

Since propellant gas is responsible for about half of a rifle's recoil, and since that gas is captured and released slowly, the recoil level will be about half that of an unsuppressed rifle. A .308 has a propellant charge weighing about 50 grains. This is of course converted to 50 grains of gas, and this gas only moves forward about 60 cm or 2 feet before the suppressor baffles intercept it. The fact that the gas doesn't leave the muzzle of the suppressor at high speed is responsible for much of the reduction in recoil. The interception of forward momentum (which results when that gas is captured in the can) is responsible for much of the remainder of the reduction in felt recoil. In addition, the weight of the heavy can on the rifle's muzzle acts as a pendulum, limiting muzzle rise and swing as the rifle recoils, and then pivots around the shooter's body mass.

MUZZLE BRAKES? RECOIL? All brands of Suppressor Project tested muzzle brakes increased the shooter's exposure by 5 to 10 dB. The increase in noise exposure is proportional to the recoil reducing effect of the muzzle brake. Replacing it by even a modest suppressor may thus produce a considerable 20 dB improvement at the shooter's position. This principle is valid for all weapons equipped with muzzle brake. Suppressors reduced recoil energy by 20 to 30 per cent, or about as much as muzzle brakes. They also prevented muzzle climb of assault rifles, firing full-auto bursts or continuous rapid fire. The page Suppressors and Shooting Range Structures page tells more about the topic.

We have said all of this about recoil only because many people have a hard time understanding how 50 grains of gas can he responsible for as much felt recoil as 168 grains of rapidly departing bullet. The answer of course is that the bullet, being heavy and inelastic, issues forth at a relatively slow speed when compared to the lighter and (we are told) perfectly elastic gas. Since energy is a product of mass times the square of velocity, it can be seen that the gas doesn't have to exit many times faster than the bullet to equal its



energy. Empirically, we know that recoil from a suppressed rifle carrying a high powder charge is much gentler with a suppressor than without. All theoretical argument stops after that point. If a rifle hurts you to shoot it before suppression, it becomes quite comfortable to shoot after it's been suppressed.

It should be mentioned that (if a rifle was first sighted in, and then suppressed) the point of impact will be much lower and a bit to the left for a right-handed shooter. We need to say that again. The point of impact will not be the same if the previously zeroed rifle is used with (or without) its suppressor. A rifle simply cannot be zeroed in one mode and then used in the other. This is a serious liability issue for law enforcement snipers. Litigation specialists (lawyers) will hammer this point to exhaustion in a courtroom if a hostage rescue situation ever goes bad as a direct result of a botched shot, or if innocent bystanders are wrongfully injured.

The rifle, scope and suppressor must be regarded as a unit, and they must remain as a unit. If a number of suppressed rifles exist in an armory, they must be numbered, and the respective pieces must remain married, so that suppressors stay with their assigned rifles. Identical suppressors on identical rifles may be interchangeable without affecting cold shot zero, but an officer of the law should not take that chance.

Barrel Length and Overall Rifle Length

Most sniper rifles have barrels ranging from 61 to 76 cm or 24 to 30 inches in length. An effective suppressor needs from 20 to 30 cm or 8 to 12 inches of length in front of the muzzle in order to function properly. A 1.2 m or 4 foot long rifle can easily become a 1.5 m or 5 foot long rifle with the addition of a muzzle can, and this may be awkward in some situations. Most suppressed rifles have fairly short barrels in order to reduce the overall length. Expect to lose about 43 m/s or 140 fps when cutting a 66 cm or 26 inch, .308 barrel down to 51 cm or 20 inches. As a practical matter, most high-powered rifle barrels are cut to between 41 and 46 cm or 16 and 18 inches.

We have been taught from grade school that long barrels are much more accurate than short barrels, but this has no basis in fact. We personally find that an 46 cm or 18 inch barrel is a bit more accurate than a 66 cm or 26 inch barrel. The chamber, throat, crown and rifling are more important than barrel length. Subsonic rifle barrels may range from 20 to 30 cm or 8 to 12 inches in length. One does not need very much linear acceleration in order to reach a velocity of 300 m/s or 1,000 fps with a .308 bullet. Privately owned rifles in the U.S. must have barrels over 406 mm or 16 inches in length, or they will require a $200 Federal Tax Stamp and registration in order to remain legal.

A steel suppressor tube can be welded to a short barrel to avoid the tax and the hassle, as long as the overall length of the unit is beyond 406 mm or 16 inches. Soft solder or glue is not an acceptable alternative to welding. The intent of the U.S. BATFE ruling is that the assembly must be permanent, and not easily altered. To clear up confusion, shotgun barrels must be over 457 mm or 18 inches in length. Again, rifle barrels must be over 406 mm or 16 inches long. This is of no concern to police and military where the organization or unit (not the individual) actually owns the weapons, although LE agencies are still required to register these with ATF.

If you have a choice of bullet weight it is useful to know that heavier bullets operate more efficiently (than light bullets) out of a short barrel. A .223 barrel should have a 178 mm or 1 in 7 inch twist in order to stabilize the heavier 69 and 80 grain bullets. A .308 barrel (shooting 180 and 200 grain bullets) is best served with a 254 mm or 1 in 10 inch twist. The common 305 mm or 1 in 12 and 356 mm or 1 in 14 inch .308 twists won't stabilize any .308 bullet much heavier than the industry standard 168 grain, boat-tailed, hollow point, match projectile. If stability is a problem, round-nosed, flat-based bullets may be the answer. They are inherently more stable than sharply pointed, boat-tailed projectiles.

Subsonic bullets are not normally shot in combination with high-powered bullets. Because of softer recoil characteristics and less muzzle rise, a subsonic .308 can be expected to strike roughly 36 cm or 14 inches lower than a full-powered load at 90 m or 100 yards. Again, the issues of cold shot zero and liability raise their ugly heads. During WWII, subsonic rifle bullets were sometimes loaded and fired backwards in suppressed rifles. This resulted in an increase in both accuracy and terminal effectiveness.

Tactical users who must use factory ammunition will be best served with the 168 grain, Limited Penetration

(LP) round from Black Hills, unless they are shooting through steel or glass. The LP round duplicates other match rounds in accuracy and zero, but is designed to virtually explode upon impact, leaving no large fragments to exit the primary target and cause secondary injury to other individuals. The standard .308, 168 grain, match round has proven itself capable of penetrating over 40 layers of 13 mm or 1/2 inch sheetrock after exiting a primary target, a serious legal liability in the law-enforcement arena.

Suppressor Length, Volume and Profile

Design excellence aside, bigger is usually more effective. Volume can be achieved more effectively with diameter rather than length, but both are important. High-powered rifles require an exterior diameter of at least 38 mm or 1-1/2 inches, and a length in front of the muzzle of at least 18 to 25 cm or 7 to 10 inches. Some of Hartikka's designs dump the gas into a huge coaxial reservoir behind the muzzle, require only 3 to 5 inches ahead of the muzzle, and thus reduce overall length considerably. Subsonic rifles often require maximum suppression. Without a sonic boom it is possible to totally mask an event such as a gunshot.

Since high-powered projectiles will always generate their own noise, there is little point in trying for extreme suppression. A good suppressor exists to make shooting comfortable without hearing protection, and to mask the location of the shooter. Greatly reduced recoil and an increase in practical accuracy are side benefits.

Public Relations

The traditional visual profile of a muzzle can carries a public relations stigma that goes back to 1934, and is not easily overcome. It is possible to disguise the profile of a slender muzzle can by extending the tube all the way back to the receiver. On a high-powered rifle this adds weight and expensive stock work. To some, the penalty of money and weight is worth the effort. The diameter of a Remington or Savage action is 35 mm or 1-3/8 inch, which seems to be the inside limit for a rifle suppressor. We had such a suppressor built (35 mm or 1-3/8 in diameter by 61 cm or 24 inches long) on a Savage .223 varmint rifle with a laminated wood stock. The disguise was extremely effective. A public relations stigma did not follow this weapon. We took it to firing ranges and gun shows and brandished it in public. Unlike the typical rifle with a muzzle can, no one appeared alarmed by its presence.

Experts refused to believe it was anything but a bull-barreled target rifle, even after being told that it was suppressed. Unfortunately, the slim tube (extending a mere 20 cm or 8 inches in front of the muzzle) did not have the suppression rate that a normal 38 x 305 mm or 1.5 by 12 inch tube would have provided. A larger diameter action would allow a larger diameter tube to be installed without looking unusual. These actions are available, but they are more expensive. It is possible to have the tube larger in diameter than the action, but this looks unusual, thus the disguise is not as effective.

Gunfire noise is the most objectionable sound to the public at large. The louder it is, the more of a problem it creates in an urban area. A quieter sound is perceived as less lethal, and is therefore less objectionable. Where rifle fire must be used in an urban setting by law-enforcement personnel, a suppressor will greatly reduce the PR fallout, as long as it remains shielded from public view.

Heat Buildup

Typically, the hotter the suppressor gets with a single shot, the more effective it is. Full-auto fire with a suppressor will dramatically increase cyclic rate. It will also raise barrel temperatures considerably, because the hot gasses are trapped inside for a longer period of time. Full auto fire is best kept to two or three-shot bursts. As a general rule we don't expect machine guns to be very effective in a tactical scenario. Most perps will be behind cover by the third round.

Archive photo: If used with machine guns like this MG34, the interior heat absorbing area of a suppressor should be minimized instead of maximized to prevent it being damaged from overheating.

We are much more in favor of a single, carefully directed shot. We believe that accurate, effective, long distance tactical fire is more likely to occur with a bolt action rifle than with a bullet hose. The commotion associated with most machine guns is much more likely to draw attention than a single rifle shot, whether the firearms are suppressed or not.

Suppressor Construction and Materials

The metals most commonly encountered in suppressors are chrome molybdenum (usually 4130) steel, stainless steels, aluminum and titanium. Chrome moly steel is hard, tough and very durable. It takes non-reflective surfaces (Parkerizing) and holds paint very well. Paint is fast becoming the coating of choice, as it is corrosion resistant, and can he changed (to camo) or easily renewed as situations warrant. Bake-on polymers can be cured in an oven at 350 degrees F. Some of these coatings are very tough indeed, and serve well in extended firings.

Aluminum is light in weight (about a third the weight of steel) but it is fragile and doesn't take knocks, abuse and thread wear very well. Nor does it take heat well. It gets very soft and then fails and melts near 480 C or 900 degrees F. By contrast, steel won't melt until it reaches 1480 C or 2,700 degrees F.

Some aluminum cans are anodized, and then dyed black. The anodized coating looks good at first, but then gets beat-up and chipped. Aluminum does not take or hold paint very well, even after being sand blasted. Aluminum has a very high heat conductivity. This is a good property, because it will allow the material to rapidly absorb heat from the burned propellant gasses, reducing noise in the process. There is an old saying in the suppressor industry: "Put the fire out quickly, cool the gasses down."

Most aluminum is 6061-T6, which is much cheaper than steel, and moderately easy to machine, although it is sticky and tends to gall. End caps and baffles are usually machined out of 2024, which is soft and very easily cut. The alloy 7075 is sometimes used. It is hard, strong, more expensive, and abrasive to cut. Most aluminum will bend considerably before it finally breaks. The alloy 7075 cracks before it gives, and is not weldable The alloys 6061 and 2024 are weldable, but most aluminum cans are threaded and glued together. When an aluminum can fails it usually does so at the root of a threaded joint, at the blast area.

The softness of aluminum makes it very prone to wear at contact points, such as the threaded joint where it is screwed or locked on to a barrel. Gas erosion can be severe in a high-powered rifle. Aluminum also has a high co-efficient of expansion, and this can cause problems with zero, or with a rapid loosening of parts. It is so soft that axial alignment may eventually become a problem as threads get beaten loose and sloppy. Cast aluminum is very porous and weak, and should not be used.

Stainless steel has nickel and chrome alloyed in with the steel. It is more corrosion resistant than steel or aluminum. Stainless holds paint poorly, and also has a high coefficient of expansion. Stainless comes in many grades and hardnesses. The harder grades can he brittle. The softer grades are subject to thread wear and deformation from battering. Stainless is expensive and hard to machine. It is not available in the variety of sizes that one finds with aluminum and steel. Stainless has a fair degree of conductivity. It is not as reliable as steel. When a stainless can fails it usually does so along a seam, or at the root of a threaded joint in the blast area.

The commonly used type 304L series of stainless is dead soft, very corrosion resistant, easy to machine and welds beautifully. Its downfall is that it is easily deformed. If a can made of 304L is dropped or impacted in shipping or deployment it may easily he deformed, and this may affect axial alignment. Other commonly used stainless alloys, such as 316 and 321 tend to he harder and more resilient, but they are also much more difficult to machine and weld. There are literally hundreds of stainless alloys available, and they may have very different characteristics. Those used for some rifle barrels have high percentages of sulfur and lead, which improves machinability while decreasing wearability. The ideal stainless alloy would possess the ductility, machinability, resilience and weldability of 4130, chrome moly steel, yet be susceptible to corrosion.

Titanium is about half the weight of steel, has a very poor conductivity, is very expensive, is highly resistant to corrosion, and is almost as strong as steel. It is very difficult to machine. It destroys cutting tools because its abrasive nature combines with its poor conductivity to produce high heat buildup in cutting tools, softening their edges. Titanium takes and holds paint fairly well. It is about as shiny as stainless, but is a little darker in color. Titanium's light weight and strength are a plus. Extremely high cost and poor conductivity are a minus. There are several titanium alloys available, the most common of which is 3, 2.5 (pronounced three two five), containing 3 % aluminum, 2.5 % vanadium, and 94.5 % titanium, which is used in high-end bicycle frames. The alloy 6A4V90T is sometimes used in receivers and barrels. The bore life of a titanium barrel is not especially good.

Steel, stainless steel and titanium are very weldable using the TIG (tungsten, inert gas) process. Aluminum is also weldable, but it takes a high degree of skill and experience to do so effectively. Only steel and stainless steel are able to be welded to each other in a meaningful way.

Threading and Alignment

Suppressor manufacturers fall into two camps - *Threaders* and *Welders*. Neither likes the other, and both think that their own methods are vastly superior. Threading greatly weakens the tube. Welding is strong and permanent, but distorts the metal. Just as there is a constant and vigorous search for better and more complex baffles, so too does the controversy between welders and threaders rage.

There is usually a demand for a wide variety of suppressors, so individual manufacturers stock a variety of parts for different models, most of which have been turned out on CNC or automatic screw machines, in limited runs. The parts are kept in bins, and usually consist of a main tube or body (which is the registered, serially numbered part in the U.S.), a front end cap, a rear end cap, and a baffle stack - which may or may not be sequentially important.

If the baffle stack is sequential the larger spaces are usually towards the rear, near the barrel's muzzle, while the smaller spaces are probably in the front. So many cans have been taken apart by incompetents, and reassembled incorrectly, that the industry trend has been towards sealed units that can be cleaned by immersion in a solvent. Design rip-offs are common in the industry, thus welding and sealants are also used to mitigate intellectual thievery. Baffle design, optimal spacing and proportion are critical to performance. Patents abound, but they afford little protection in foreign countries. Often, patent drawings do nothing more than afford competitors baffle designs that they would otherwise have to purchase and destroy suppressors in order to obtain.

A can with a single-point mount relies on the rear end cap for all of its axial and angular alignment. The rear end cap was probably made on an automatic screw machine, and bored and threaded to take a barrel at the same time. It is critical to the alignment procedure that this was done with extreme accuracy, as a tiny amount of angular or axial misalignment can result in severe misalignment (and possible baffle contact) in a 25 cm or 10 inch long can.

The best way to bore and thread a rear end cap is to screw and glue (or weld) it into its suppressor tube first, and then place the entire unit in a lathe for the remainder of the machining. Few bother to do this, however, because it is much easier to take finished parts out of bins and assemble them. Line boring and threading in a lathe might mean having to refinish already completed parts. We have seen a 18 cm or 7 inch long can from a prominent manufacturer that had 3 degrees of angular misalignment after it was mounted on its dedicated barrel. This may not sound like much, but try to remember the sometimes-close tolerances between bullet path and baffles.

If the rear end cap had been welded instead of threaded on, the chances are better that the unit had been bored and threaded on a lathe after assembly. Welding induces distortion as the liquid metal cools, solidifies and shrinks, so it is nearly impossible to successfully thread the bore of a rear end cap before welding. Almost all of the angular and axial alignment problems we see today are related to a single point mount on a rear end cap that has been improperly machined prior to being assembled. Again, tubes that have threaded rear end caps are prone to fatigue and a possible massive failure at the root of the last inside thread, at the blast chamber. Pressure is low near the front of the can; thus we rarely see a failure at this point, unless there is baffle contact and bullet tumbling.

Most two-point mounts have the threaded portion (commonly called "*the nut*" or "*the spide*r") located in a more central portion of the suppressor tube. This threaded portion is very important, as it holds the entire can in place - usually by pulling it tightly against the rear end cap. There are many methods of holding the nut in place, and none of them are without their problems: A snap ring may be inserted in a groove in the center of the tube, but this groove weakens the tube near the blast chamber. The nut must also be pinned in place, or it will rotate.

The nut can be plug-welded through holes drilled in the tube, but the welding process slightly distorts (bends) the tube, even if 4 or 6 welds are placed in direct opposition to each other. The welded or threaded rear end cap can push a thin section of tubing against the nut, but that nut must still be pinned or glued in place or it will rotate. Lastly, the nut can be silver soldered or brazed in place, but the area is tough to see through smoke and fume inside the tube, hence it is difficult to be sure that a proper bond has been achieved. The soldering process may distort the tube. One must be careful to boil out the tube in water afterwards, to remove corrosive salts left by the soldering flux.

The barrel which mates to a suppressor must be turned in a lathe. Threads are best turned with a cutting tool as the barrel rotates between centers, but I have also seen satisfactory results obtained with a die-holding fixture in a carriage or tailstock. Machine threading on a lathe with a single point cutting tool is often called single pointing, which is not to be confused with a single-point mount. It is felt in the industry that single point threads are the most accurate. Rolled threads are the strongest, as they are forged during the process of rolling between two dies.

Few barrels are either straight or symmetrical, and this is another possible source for angular or axial misalignment. A practiced eye can spot a barrel with a crooked bore. If the muzzle is clear and open, one can peer down the headstock as the barrel spins in a lathe to get a good idea about how true the bore is. Short, thick barrels are easier to deal with than long, thin ones. Barrels which are fluted are often bent during the fluting process if they are not properly supported and frequently rotated. Fluting has ruined many otherwise perfectly good barrels. Most fluting is purely decorative in nature, and normally performs no useful function; no matter what manufacturers claims are made to the contrary.

Many schemes have been devised to seal a rear end cap where it joins its barrel. A tight mechanical seal is usually effective, but sometimes rubber or silicone (high heat) O-rings (or sealants like pipe dope) are used as a backup, in the event that the suppressor loosens as it is being used. For the sake of reliability and cold shot accuracy, it is critical that a suppressor not loosen on its barrel.

Cut-away suppressor model for Valmet M62 assault rifle: BR-Tuote suppressors were invented by Finn Juha Hartikka and are welded together of tough steel. The primary expansion chamber is huge, and almost 2" in diameter. The gas generated during the firing sequence is dumped into and trapped within the huge rear chamber, which acts like a reservoir. Here, the gas lessens in pressure considerably, and slowly leaks out the front, past the compact baffle stack. The can is a deceptively simple design that has metal only where it is needed, and not where it isn't. Mounting is typically a *two-point* system.

A section of small-diameter tube leads back from the muzzle of the weapon. This tube or pipe eliminates the *gas-sealing* problem, which we usually solve with a 45-degree cone and carefully machined surfaces, and which leaks if it is not tight. The tube ties the middle of the can to the rear, making the unit stronger without adding significant weight. Hartikka's all-steel can is fairly light and very tough. He calls it a reflex design, as it forces the gas backwards, around the barrel, thus taking good advantage of wasted space without increasing the overall length of the weapon significantly. Instead of blasting forward, the gas is trapped and allowed to bleed off slowly, greatly reducing the noise of the weapon. For more, see Sound Tech Newsletter.

If a bullet path is not perfectly straight the holes in suppressor baffles will have to be enlarged to accommodate. Due to angular dispersion, those baffles nearest the muzzle can have holes which are smaller. We live in a real world, not a theoretical one. Most barrels have bent bores. Most bores do not lie in the true center of a barrel. Most suppressors are not perfectly aligned. Threads wear. Welding distorts. That's why we have tolerances, and sometimes situations require that those tolerances be increased.

Tight baffle holes are more important near the rear, where high-pressure gas exists, than they are near the front. Asymmetrical baffles usually work best when they line up parallel to each other. Some manufacturers have a method of holding those baffles in proper alignment. Some just drop them into a tube and hope that they stay aligned.

Front end caps are either welded in place, or screwed in. If the manufacturer wants to be able to get back inside the can at a later date he will use a weak glue or ISPBA (intermediate-strength, proprietary bonding agent - also known as *Blue Loctite*). If he wants the end caps to stay, he will use a stronger glue, or HSPBA (higher-strength, proprietary bonding agent - IE *Red Loctite*). Aluminum does not glue well, even with 2-ton psi epoxy. If the can gets hot from rapid use most adhesives will loosen and eventually fail: Even secret, high-strength proprietary bonding agents will eventually give up and work loose at the rear end cap, where most of the heat and shock are concentrated.

Summary

It is difficult to summarize a complex topic in its entirety. Those who use high-powered sniper rifles have every right to expect those rifles to be dependably accurate. A properly suppressed rifle must be constructed with a serious commitment to both suppression and reliable accuracy from the outset. This usually means a steel or stainless steel silencer mounted to a short, heavy barrel with a robust, two point mount. One can expect both barrel and silencer to exact a combined penalty of at least 1.8 to 2.3 kg or four to five pounds in weight, and an extra six inches in overall length.

Continued and diligent practice on a regular basis are vital to a mission. Practice should he held at night and during inclement weather, as well as on warm, sunny days. Only a few rounds need be expended, but they should all be accurately and carefully delivered. One should always look through the bore to ensure that it is clear before a callout or deployment. Wasps and other insects have a nasty habit of building mud nests in inconvenient places, and a plug of mud can be disastrous to bullet placement.

Always store the weapon muzzle-down. The suppressed rifle must remain dedicated to suppressed fire only.

To do otherwise compromises cold shot reliability. The benefits of a suppressed system include a low profile, relative obscurity, increased accuracy, decreased recoil, greater stability, and a lower likelihood of detection in the field.

Subsonic Knowledge

This article will deal with choosing, loading and using accurate subsonic rifles. Unlike the more powerful supersonic rifles, whose bullets generate their own supersonic crack, subsonic rifles are capable of delivering very quiet, almost undetectable, accurate fire. The sound of a subsonic bullet whizzing through the air at 300 m/s or 1,000 fps is very quiet indeed, certainly less than an arrow from a bow at 60 m/s or 200 fps.

We won't get heavily into the science of it, but a velocity of 1,000 fps (or roughly 300 meters per second) has long been considered optimal, since well before World War II. Any slower, and we're leaving precious velocity on the table. Any faster, and one runs the risk of breaking into the sound barrier (335 m/s or 1,100 fps) in a hot environment, where gunpowder burns more effectively. A warm barrel or a hot cartridge can easily push velocity up another 45 m/s or 150 fps even though the cartridge contains a bullet of the same weight and powder charge.

With a properly designed system, the loudest sound will be that of the bullet strike. With effective suppressor technology we can all but eliminate the sound of a muzzle blast. By hovering around 1,000 fps we can virtually eliminate bullet flight noise. The only thing left is the plop of bullet impact, which can be quite loud on occasion.

Power Level

Subsonic bullets travel much slower than high-powered rifle bullets. Since the formula for energy squares velocity, it can be seen that the subsonic bullet must try to make up for the loss of power with mass, clever bullet design and accurate shot placement. One standard formula divides velocity squared by a factor of 450,400. That, times the bullet weight in grains, will equal energy in foot pounds. Let's take a 200 grain, .308 bullet and crunch some numbers. At 2,400 fps that bullet will deliver 2,558 foot pounds of energy. At 1,000 fps the same slug will only deliver 444 foot pounds of energy.

A 300 grain, .44 Magnum bullet driven at 1,000 fps will delivery 666 foot pounds of energy. A 55 grain, .223 bullet will develop 1,250 foot pounds of energy at 3,200 fps. While the energy of a .223 on paper may be twice that of the .44 Magnum, the 44's greater mass and deeper penetration will prove far more deadly on large animals. In the 1960's the friends and family of the Ruger empire spent quite a bit of time in Africa with their .44 Magnum, semi-auto carbines. Most who used those .44 carbines were very impressed with their lethality. The .44 is a lot more effective than the paper ballistics would lead one to believe. For those who enjoy playing with calculators, a factor of 2.2 times the proposed bullet weight in grains, will equal foot pounds of energy at a velocity of 1,000 fps.

Barrel Length and Porting

One doesn't need much barrel length to develop a minimal 300 m/s or 1,000 fps of velocity with a heavy, large caliber bullet. A 20 to 25 cm or 8 to 10 inch tube will provide plenty of acceleration. For the record, a good 25 cm or 10 inch barrel is fully as accurate as a much longer one. One more time, with feeling, a 25 cm or 10 inch barrel is fully as accurate as a 76 cm or 30 inch barrel. We often note a significant increase in accuracy when we cut a 61 cm or 24 inch barrel back to 25 cm or 10 inches. A proper chamber, adequate rifling twist rate and a perfect muzzle crown are all more important than barrel length.

If porting (holes drilled in the barrel to bleed propellant gas) is used as one of the devices to reduce the noise of a suppressed firearm, it is recommended that the barrel be from 25 to 30 cm or 10 to 12 inches in length. Porting, when properly executed, can reduce a suppressor's overall report by as much as 40%. All ports should carry a substantial 45 degree bevel at the bore interface, or they will shave off copper or lead from the bullets, which will pack up the primary expansion chamber and the ports themselves. If a suppressor eventually weighs 3.6 kg or 8 pounds more than it used to, there is a good chance that sharp or burred ports are at fault. Many manufacturers bevel the outside of each port, but this does little or nothing to cure the problem. Beveling the inside of each port is not easy, but it must he done.

For private ownership in the U.S., a pistol barrel may be of any length. A rifle barrel must be over 406 mm or 16 inches long. Any shorter, and a $200 Federal tax stamp (and a Form 4) will be due on private ownership. Municipality, county or state ownership of a short barreled rifle or suppressor will of course require federal registration, but no tax stamp will be due.

Caliber Selection and Bullet Shape

Since velocity is rigidly fixed, the most important area of the selection process will be based on the assigned role of the firearm. Plinkers and target shooters are well served with the common .22 LR round. It's cheap, quiet, available and accurate. The high-speed .22 LR round is transonic, which means that it starts out faster than 335 m/s or 1,100 fps (supersonic) but then its velocity decays into the area where parts of the bullet are supersonic, and parts are not.

Aguila's 60-grain subsonic round (named Aquila SSS, for sniper, subsonic) will reliably cycle in Ruger's MK II 512 pistol, and in bolt-action rifles like the 77/22. In most semi-auto rifles we have found that the short case retracts from the chamber before the firing cycle is totally completed, causing a loud noise to emanate from the action area. The same thing occurs with the longer barreled MK II pistols (beyond 5.5").

The slow 1 turn in 16" twist in existing barrels may not always stabilize the heavier projectiles in colder temperatures. This could result in hunting, tumbling and keyholing, although we haven't noticed this at warmer temperatures. Accuracy is fair, but not remarkable. The SSS ammo is very quiet in a suppressed weapon with a muzzle can. At 80 degrees F we got 790 fps out of a 5" MK II barrel, 850 fps out of a 10" barrel, and about 730 fps out of a 24" barrel.

The stopping power of the slow-moving SSS appears substantially greater than typical 40-grain, .22 LR loads. So far, the round-nosed, flat-based bullet seems to be stable when penetrating almost any medium. We got 5 to 6" groups at 100 yards with a factory 77/22 varmint barrel, and ¾" groups with our faster twist barrels. More on Sound Tech Newsletter.

When a bullet travels through the transonic range the frictional pull trying to slow it down is from four to five times greater than the pull that exists at subsonic velocity. Simply put, this differential pull causes instability. A stable, round-nosed, flat-based bullet (like the .22 LR) will he less accurate in the transonic range. Inherently unstable, hollow-point, boat-tailed bullets (with the preponderance of mass to the rear) will lose all stability in the transonic range, tumbling end-over-end and losing any semblance of accuracy at that speed.

Thirty years ago, those who drove Chrysler vehicles on slippery roads in the northern states found that, in a situation where control was lost, the vehicle would spin and settle into a rear end-first attitude, because the rear end was heavier than the front end. Those who drove Ford products (which typically had less rear-wheel traction on ice) soon learned that the heavier front end caused the vehicle to be more stable in a spin. Its natural movement in a minimal traction situation was front-end first. Sharply pointed bullets have the heaviest end at the rear, and they take a much greater spin rate to keep them pointed in the right direction. Bullets with blunt points and hollow bases (Like hollow-based wadcutters) are inherently stable in flight. They fly straight, even without spin.

In terms of effectiveness on live targets, it is very hard to beat a blunt-nosed or flat-tipped bullet. Put another way, a subsonic bullet that is a true cylinder will deliver more shock, hemorrhage and trauma than any other shape. Sharply pointed and round-nosed projectiles will slip right through, while causing minimal damage. It has been said that some .30 caliber projectiles are designed to expand at 300 m/s or 1,000 fps, but this remains to be proven to my satisfaction.

Sharply pointed bullets will penetrate deeply at subsonic velocities - pushing nerve tissue and blood vessels aside, rather than cutting them. Unless the bullet hits the base of the brain or a major nerve center, the animal will run away, usually to die a slow and agonizing death. Most pointed and round-nosed .30 caliber rifle bullets are totally lacking in knockdown power at subsonic velocities. We hear the same stories of subsonic .30 caliber bullet inadequacies over and over again, and are frankly quite tired of them. Subsonic .30 caliber bullets will not expand in large animals. The only effective .30 caliber subsonic bullet will have a totally flat front end.

For those entities involved with animal control, the subsonic .22 LR round is relatively humane (meaning it kills quickly) and effective on animals weighing up to roughly 20 pounds. On snakes and small vermin the Remington Subsonic, hollow-point round is fairly effective. It usually stays subsonic, even in long, unported barrels, and is fairly accurate. On very small rodents a round called the .22 CB Long offers reduced bullet weight and less penetration. It is not a very accurate round, but works OK for squirrels in attics and pigeons inside barns at close range. It will sometimes penetrate a sheet metal roof, so one must be careful regarding a backstop.

On larger, tougher animals CCI's SGB (small game bullet) offers extreme accuracy and deep, effective penetration. Unlike high-velocity hollow points, which often fragment and perform poorly, the SGB is one of the first modern attempts at scientific design in a rimfire cartridge. Its bullet is of hardened lead, with a solid, but slightly flattened tip. If I were going to pack a small .22 rifle into a wilderness survival kit, it would he accompanied by a large supply of SGBs. They work well on small animals, and work better than any other .22 LR round on larger animals. Until someone comes up with a .22 LR wadcutter (I hope CCI is listening) the SGB will remain the most effective .22 rimfire round available.

The next step up the ladder of higher subsonic energy is the move to a .30 caliber weapon. The .308 is a logical place to start, and (with a light charge of fast powder) it can he effective in a weapon that is designed to he both subsonic and supersonic. A 254 mm or 1 in 10 inch twist will stabilize up to a 200 grain, round-nosed, flat-based bullet. However, the extra room in the .308 case provides a substantial cushion, which can cause problems with efficiency and consistency. The most ideal situation results when a cartridge case is just big enough to hold its charge of powder and a bullet, with no room to spare. In the 1960's a fellow named Joe Apache necked a .223 case up to .30 caliber. The result was an interesting cartridge called the .30 Apache, which sat ignored for quite a number of years.

Eventually the use of suppressors burgeoned in the U.S. and Grendel Arms (now known as Keltec) began experimenting with a similar case in a suppressed M16. The concept eventually developed into what is now known as the .300 Whisper. That small .30 caliber cartridge will easily launch a bullet as heavy as 250 grains at a subsonic velocity. Not surprisingly, the longer, heavier bullets have to be spun at a full turn in 146 to 195 mm or 6 to 8 inches in order to stabilize at low velocity.

Again, it has been said that some of these heavy bullets will expand at subsonic velocity, but I've seen absolutely no evidence of it. Indeed, they usually perform like a knitting needle, poking a small, straight hole, in one side and out the other, wasting 90 percent of their limited energy beyond the primary target. I've heard the word tumble used in conjunction with the .300 Whisper, but I've not seen that happen either. The heavy bullets are capable of extreme penetration, but I have seen absolutely no indication towards tumbling. Many have had great expectations for the subsonic Whisper cartridge, but until they develop a flat point for a hard, .30 caliber bullet, I feel that they will continue to he disappointed.

Dr. *Martin Fackler*, founder of *International Wound Ballistics Association*, devoted a considerable amount of research, study and experimentation to the subject of subsonic bullets. Based on his own and other research going back 200 years, Dr. Fackler (in a nutshell) concluded that hollow points and expanding bullets are a waste of effort. One can do no better than to use a simple, hard-cast lead bullet with a totally fiat nose, and with sharp edges at the transition between the flat face and the cylinder walls. Such a bullet does not move through the air with the extreme ease of a VLD (very low drag) bullet, but its terminal effect is considerable.

The next logical step up in caliber is to .338. In the early 1970's, *Max Atchisson* of Georgia cut off the shoulder of a .223 case and trimmed it to an overall length of 35.9 mm or 1.412 inches. The result was a case mouth of the perfect size for a .338 bullet. Called the *.338-223 Straight*, the cartridge is of great interest. Like the *.300 Whisper*, it will launch a heavy bullet very quietly. I am told that either of these efficient bullets will arrive at a target 300 yards distant with a loss of less than 100 fps. Those who are used to supersonic bullets will find this astounding, but one must remember that it takes a lot of energy to break the sound barrier on a continuous basis. A subsonic bullet that isn't wobbling in flight is the Honda Civic of the firearms world. It moves through the air with a velocity decay rate roughly one-fourth the rate of a supersonic bullet. Until we get a flat-nosed .338 bullet, this cartridge will also suffer from the same knitting needle-like effect.

We could stop to visit with the .38, but I'm going to bypass that and settle on the .44, which is really .43 (actually .429) caliber. Ruger now makes a lever-action and a bolt-action rifle, both of which are chambered in the powerful .44 Magnum cartridge. We've been waiting for twenty years for these rifles, and are immensely pleased that they are finally on the market. Wadcutters and flat-nosed, cast bullets are available in weights from 185 to 300 grains. For those who hand cast, the weights range from 80 to 362 grains.

Since factory ammunition is usually too fast, the subsonic .44 Magnum rifle is a handloading proposition. Fortunately, Mike Dillon's Square Deal press is affordable, and cranks satisfactory rounds out at a prodigious rate. The twist in Ruger's .44 barrel is 508 mm or 1 turn in 20 inches, which seems to stabilize 300 grain bullets effectively. It should be mentioned that, while barrel leading can be a problem with lead bullets driven beyond 426 m/s or 1,400 fps, it will not be a problem with lubricated, hard-cast bullets driven to 300 m/s or 1,000 fps. We should also mention that we've been buying plain-based, hard-cast, lubricated lead bullets from Brownells, and that we shoot them backwards in order to get the maximum effect.

Midway, Dillon and quite a number of other suppliers sell swaged or cast lead, lubricated bullets for both the .44 and the .45. We don't care about ballistic coefficient nearly as much as we care about terminal performance, which has been rated as nothing short of excellent by contractors, animal control officers and park rangers. The flat-nosed .44 delivers a mighty whack. It has excellent knockdown power. It isn't a good 300 yard/meter weapon, but remember, we're talking subsonic here. Any bullet that moves at a sedate 300 m/s or 1,000 fps will have a rainbow-like trajectory much beyond 100 yards. Little velocity is lost, and the weapon is still very accurate at extreme range, but finding the proper elevation adjustment can be tricky.

The powders of choice have been the time-honored Unique and a powder made in Finland by Vihtavuori Oy called N 310. The Germans developed a very fast powder for their suppressed rifles during World War II, and this may be a very close duplicate of that powder. It should be mentioned that the Finns turned some of their subsonic rifle bullets backwards for better accuracy and improved terminal performance. They also developed a system using a few drops of solvent to dissolve the upper layer of their fast powder. After this solvent evaporated, the powder was thus sealed into the rear of large-volume cartridge cases. A bullet was then seated and heavily crimped in place. This helped to achieve better combustion and improved uniformity. Prior to this a filler, such as nitrated cotton fiber or kapok, had been used on large-volume shells. The solvent was a stroke of genius because it rapidly evaporated, did the job very effectively, and left nothing extra inside their suppressors.

Interestingly, we were using N 310 powder in a *Thompson Contender*, which developed the disconcerting habit of opening up by itself each time it was fired. Curiously, no damage occurred, and the bullets hit the target as though nothing was amiss. The standard pistol primers did not indicate any sign of high pressure. The velocity was 300 m/s or 1,000 fps, out of a 21 inch, unported barrel. After this happened several times in a row we switched to Unique (a slower powder) and the problem went away.

H & R and *NEF* also make a single-shot, break-open carbine, chambered in either .44 Magnum or .45-70. These rifles are more robust than the Thompson Contender, and remain closed when fired, regardless of the load. At a mere $150, these are the cheapest games in town. Don't think that inexpensive means unreliable or inaccurate. These are very reliable, accurate weapons. More so than the expensive and finicky Contender.

Dating back to 1873, the .45 Colt is a close cousin to the .44. This rimmed cartridge offers 10% greater frontal area. The caliber and the cartridge were the end product of a lot of cut-and-try research. The .45 Colt may be old, but it certainly isn't obsolete. Many who hunt deer with a revolver feel that the .45 Colt is as close to perfection as one can get. We really like the cartridge, but are having a hard time finding rifles we like with the .45 Colt chambering. Winchester and Marlin both make lever-action rifles, but the feed tube is tied to the barrel and gets in the way of the suppressor. We've been buying .45 Colt barrels with a 356 mm or 1 in 14 inch twist from Bullberry in Utah for the single shot Thompson Contender. We look forward to the day when H & R, RUGER and NEF make their rifles in .45 Colt.

The .45-70 cartridge seems like an obvious step beyond the .45 Colt. We've suppressed this round but are not as happy with it as we are with the .45 Colt. The Colt has a slug with a .451 inch diameter and is available with bullet weights up to 425 grains. As a cartridge, the Colt is compact and easily loaded. Its case walls are heavy and durable. The current popularity of cowboy action shooting make the .45 Colt cartridges readily available, and inexpensive. The .45-70 has a bit more capacity than we really like, and its case walls are quite thin near the mouth. The mouth is easily bent or deformed. We've crumpled and ruined quite a number of .45-70 cases while attempting to resize or seat bullets. The diameter of the .45-70 is .458 inches. Cast bullets are available in weights up to 645 grains, which ought to be plenty for almost any situation we can envision in North America.

Some have attempted to suppress the mighty .458 Winchester Magnum. That is truly a waste of effort, as there is absolutely no difference between the subsonic .458 and the subsonic .45-70, other than that the .45-70 is more efficient because its case capacity is smaller. We're not saying no to either the .45-70 or the .458, it's just that we like the .45 Colt a lot more. The .44 Magnum and the .45 Colt suppressed rifles are perfectly suited to the task of quietly harvesting or removing animals weighing between 100 and 600 pounds. Both cartridges are supremely accurate and very efficient at subsonic velocities. The ideal weight of bullet will drive completely through the animal in question, remaining just under the skin on the far side. This is a close to perfection as it gets. The .44 Magnum and the .45 Colt have excellent knockdown power when loaded with bullets having absolutely flat front ends.

The only possible improvement over the .44 and the .45 Colt would be a move to the legal maximum diameter in the U.S., which would be .50 caliber. Interestingly, the French were among the first to do this in the 1870's, when they fitted one of the first metallic silencers to a .50 caliber Remington Rolling Block pistol. The.50 Remington (M71 Army) used black powder to drive a 300 grain lead bullet along at a sedate 183 m/s or 600 fps.

The powder was corrosive, and the suppressor would have to be boiled out with soap and water, and then oiled after use, or it would eventually be destroyed by corrosion. Rimmed .50 caliber cartridges can be made from 50-70 brass, an expensive and laborious tasks. A wadcutter bullet would have to he designed in .50 as this is not an item which is readily available. The .50 caliber offers almost 20% greater frontal area over the .45. A bullet weighing between 400 and 1,000 grains would seem appropriate for this caliber. Again, we have been very happy with the .44 and the .45 Colt, and find a need for anything beyond these two cartridges unlikely.