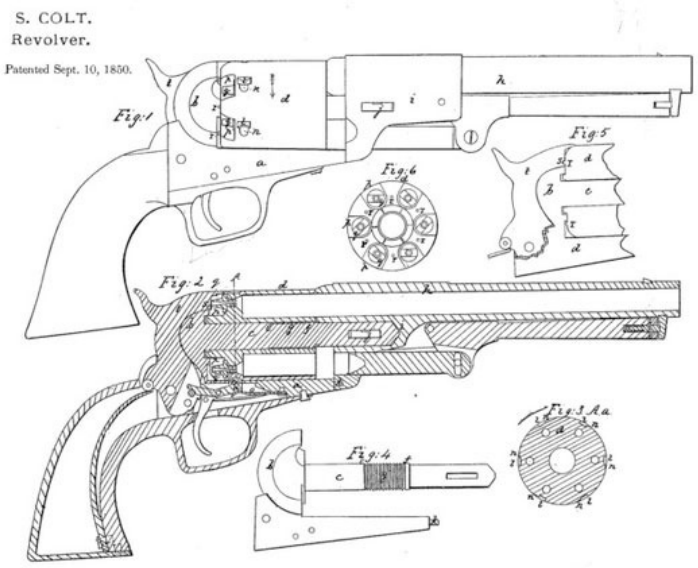
Firearms

A Quick and Dirty Guide For the Non-Shooting Writer



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Legal Info

This document and the information in it is presented for the amusement of the reader, and for writers as a resource to use in writing. It should not be construed in any fashion to be complete, thorough, or accurate (hence the name Quick and Dirty Guide), and it most certainly should not be used as any kind of instructional manual for real firearm use. Whatever use you make of it, do so at your own risk. Objects in mirror may be closer than they appear. Use a condom.

Implied Spaces, by Walter Jon Williams, is quoted by kind permission of Walter Jon Williams.

Revision History

v2.3: Lots of nit-picky details I have friend Greg Hallock to thank for pointing out.
Finishing, polishing.

v2.2: Finally write Firearms and Culture.

v2.1: General cleanup.
Replaced gun safety rules, as the NRA was not forthcoming with permission to use theirs.
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v2.0: General cleanup, overhaul of the ebook version(s).
Added the definition of Gunpowder.
Corrected the spelling of Blount.
Added the cover.
Added Designing your Own
Added The Strange Tale of the M16
Added entries on Silencers and Suppressors.

v1.1: Per the suggestions from writer S. Hutson Blount:
Changed the definition of Carbine.
Added a short discussion of shotgun gauge.
Revised discussion of hydrostatic shock, and the damage mechanism of bullets.

Added revision history.
Changed the title to reflect that this is a treatment of small arms, rather than cannon.
Having so changed the title, I also added a definition of Small Arms.
Clarified muzzle vs breach loading
Expanded definition of Cartridge.
Expanded the Foreword #1/Disclaimer.
Moved, expanded, and cleaned up the paragraph about black powder to smokeless.

Foreword #1 – Disclaimer:

I'm a writer, not a gun expert. I've shot a bit, and read extensively, but I've never been in the military nor been with the police, nor fired a firearm in anger, nor shot at anything living. I'm very good at sounding reasonable, but it's entirely possible I'm full of shit. If you find spots where I am, PLEASE LET ME KNOW. I am a cyberpunk writer by trade, and cyberpunk and gun-nuttery go hand in hand, so I've done my research, albeit not always with the best of resources (Wikipedia). What I'm putting down here is the basic distillation of that research, along with places to start. But please, don't stake your life on anything I say here. Also, in no way do I intend to offer legal advice. If you own or intend to own firearms, make sure you know YOUR local laws, and how YOUR local authorities are interpreting them. Check your state and local government websites. They'll usually spell it out. The right to keep and bear arms in the United States is a matter that has been hotly politicized, and combing facts from propaganda strewn by both sides is tricky. I try to refrain from the politics involved in this discussion, but at times they're unavoidable.

Foreword #2 – Gun Safety:

I realize we're writers, and some writers may never encounter a firearm in their lives. I also realize that those who will/do encounter them probably (hopefully) already know this stuff. I'm saying it again here for a couple reasons. First, It does matter whether your characters handle guns properly or like amateurs who watch too much tv. It's a flavor thing. Not everyone will get it, but your firearm-savvy readers will. The other reason is obvious: firearms are power tools for killing things. They're very good at it, and they're *around*. If I put the safety rules here, and if those rules are obeyed by someone in your work, and if one person reads that and manages *not* to shoot themselves or someone else by accident, hey, we've maybe saved someone's life. High five. These rules are based on those originally given by Col. Jeff Cooper, and adopted in one variation or another by the U.S. Military, the NRA, and so on.

DON'T POINT THE GUN AT ANYTHING YOU DON'T WANT TO KILL. Accidental discharges happen. If you deal with guns long enough, you'll have one. When you do, this rule will keep you and yours and all the strangers around you alive. Sweeping others with the muzzle of your firearm, whether by accident or deliberately, is putting their lives at risk, and characters should respond accordingly. Also pay attention to what's *behind* your target. Misses and overpenetration happens.

KEEP YOUR FINGER OFF THE TRIGGER AND OUT OF THE TRIGGER GUARD UNTIL YOU'RE READY TO FIRE. THE single worst trope in Hollywood is the cop/soldier/cowboy carrying a firearm with finger on the trigger, looking for something to shoot at. Real cops and soldiers are trained NOT TO DO THIS, because otherwise it's way too easy for people to get killed by accident. They keep their trigger fingers on the side of the trigger guard, if there is one.

ANY GUN IS LOADED UNTIL YOU PERSONALLY CHECK IT. CHECK that any firearm

you're handed or pick up is unloaded CHECK EVERY TIME. Set the safety. Don't take anyone's word for it. It's loaded unless you yourself have checked it THIS TIME."<someone> didn't know the gun was loaded" has been the epitaph for far too many people. If you don't know how to unload the thing, ask, or don't pick it up. If someone hands you a loaded firearm without telling you, or worse, they tell you it's not loaded, say something. (Be polite.) They just put your life in danger.

I also strongly suggest hearing protection when practice-shooting. Having hearing damage sucks.

Foreword #3 – How Much of This Stuff Do I Really Need?

Sometimes I get a little carried away. When I read science fiction, I read the story, but I also keep asking questions like “How does that work?” “Why does it have that limitation?” And especially, “Could that really be done some day?” I was profoundly disappointed at a young age to discover that most of the science I learned from Star Trek was bullshit. Not undefined, not might be possible some day when science advances, but pure, unadulterated bullshit. By contrast, when Mamoru Oshi, director of the 1995 Anime *Ghost in the Shell* was preparing for the task, he and some of the production staff went to a shooting range outside Japan and tried various automatic weapons and discovered, among other things, that bullets do not make the great sparks against most surfaces that we’ve been led to believe. When I found out that detail, I gained a lot of respect for that director. He’d taken an extra step to make his anime believable.

As a result, when I set out to write science fiction of my own, I make sure that I have answers to those questions. For my fiction, I know, at least to where it drops into science I don’t understand, how these things work, what constraints real science puts on them, and thus, I know why characters do a given thing with a given technology, even if I made the technology up. A great example of this: In my first novel, I planned to have my main character hijack a derelict satellite and use it for surveillance. When I mentioned this to a friend of mine who worked in satellite tracking, he pointed out that operational derelict satellites are a contradiction in terms. If a satellite works well enough to use its camera, to point it and track with it, then it will be in service. Keeping satellites in orbit, he told me, is expensive. This kind of wrecked the scene I had in mind. However, instead of a relatively boring scene where the main character does a low-stakes breakin of a satellite nobody cares about, I instead wrote a very high stakes scene where the main character and the male friend she’s suddenly found herself sleeping with (it makes sense in the novel) have to break into a city network and take over some street traffic cameras, and do some serious imaging science with them. I got the opportunity to put my main character and her boy toy on a run, put him in danger, have her emotionally tangled about it, have her emotionally tangled about breaking the law, and simultaneously show off what a badass technologist she really was early in the game so her later exploits become believable. The fact that my imaging science is um… a little broken is probably ok. I’ve been called on it exactly once, and that only because I described the scene to a guy who is doing his PHD thesis on imaging and optics and had read and understood the papers I was working from. My friend in the satellite business? He thought it was great. :) Mike, the guy in the satellite

business, is dead now, but when I write science fiction, I still try to keep my science tight enough that he would have had to at least do a lot of research to tell me I'm wrong. So it is with guns. I like shooting. I have gun nut friends. They will tell me if I get my firearms outside believability. So I'm careful to stay plausible.

Here's the thing. You don't have to know everything in this document to write a story with a gun in it. If the gun in question is never fired, and your POV character doesn't know anything about guns, then you don't need anything in this document except maybe some part names, and the safety rules above. If you're writing a police procedural about a guy who's murdered and the forensic analysis on the weapon that was used on him, then you're going to need to know soup to nuts what the gun is, what it does, what kind of hole it makes in someone, how far its effective range is, and so forth and so on, because forensic analysis is all about that kind of fiddly detail. Most likely you'll want somewhere in between. If you're dealing with a professional armed person – bodyguard, police officer, CSI, soldier, gun nut – I want to make sure you've got the lingo to make them sound right. If you build your own science fiction projectile weapons, hey, I'm hoping what's here will help you put ones together that are believable but still interesting and different. What I'm throwing out here is enough information that you can get by for fairly cursory stuff, and that you'll have the terminology and understanding to dig in to serious research if you need to go deep.

Orientation:

Front: the end bullets come out of.
Rear: the end you hold on to the firearm from, if you're smart.
Top/upper: the part that's toward the sky when the gun is in aiming position.
Bottom/lower: the part toward the ground when the gun is in aiming position.

Terminology:

Firearm terminology is a slippery thing. Because small arms evolved from cannon, a lot of artillery terminology has migrated from the latter to the former and undergone quite a lot of semantic drift – that is, terms in common with artillery terms may mean something entirely different in the small arms world. This document is focused on small arms, since the author's knowledge of artillery is extremely limited. Another reason the terminology tends to be slippery is that the vast majority of the evolution of firearms has occurred since the turn of the 19th century, which means the modern science of advertising has always been a factor. Such terms as submachinegun and assault rifle are examples of marketing terms becoming generic. (Both weapons would probably best be called fully automatic carbines.)

Automatic: A firearm that, having fired, loads another cartridge from a magazine or a clip. (see: Magazine, Cartridge). Automatic is typically used to refer to what is technically a semi-automatic firearm - that is, a firearm that fires one cartridge per trigger pull. An automatic, in even less technical terms, refers to a semi-automatic pistol. A machinegun, by contrast, is a fully automatic weapon, and fires an arbitrary number of cartridges per trigger pull. Automatic is, confusingly, sometimes used to describe a rate of fire (we were pinned down by automatic weapon fire) and this typically suggests machinegun fire. (see: Machinegun.) Semi-automatic pistols come in single and double action flavors, much as their revolver predecessors did. A single action semi-automatic requires the hammer or striker to be pulled back by hand before a cartridge already in the chamber may be fired. The process of automatically reloading such a pistol will also recock the hammer for subsequent shots, and manually cycling the reloading mechanism will also cock the hammer. Double action semi-automatic pistols do not require this extra step. Automatic is one of the most misused technical terms in firearms, especially by news people and Congresscritters who don't know what they are talking about.

Assault Rifle: A very fuzzy marketing term. Practically no two sources can agree on what an assault rifle is, so I'm going to put my working definition out. An assault rifle is a fully automatic weapon firing an intermediate cartridge between pistol and battle rifle at relatively short ranges. They are optimized for urban and other highly mobile combat environments by being themselves lightweight, having relatively large magazines, having relatively high rates of fire, and above all, firing ammunition which is also lightweight, allowing an individual soldier to carry more of it. Muddying the term is the fact that many types of assault rifles now limit automatic fire to three (or

so) round bursts, and that many semi-automatic weapons derived from assault rifles are referred to as assault rifles by politicos and the press, to the point that in California whether a given semi-automatic carbine is an assault rifle or not may depend on what color it is painted.

Bayonet: A knife or short sword attached to the muzzle end of a rifle. Still used today, though more for intimidation value than real military value, they were invented when long arms (rifles and muskets) were muzzle loaded and had slow rates of fire. Angry populations with sharp objects found it much more difficult to overrun troops armed with bayonets than they did when those troops would fire one volley and were defenseless for 3 or 4 seconds while reloading. To attach a bayonet to a rifle is called fixing the bayonet.

Bolt-action: almost always a rifle type (there are some pistols), in which a new cartridge is loaded into the rifle by the shooter manually unlocking the bolt in some fashion, pulling it back to eject the spent cartridge, and pushing it forward to load the new cartridge. Bolt actions are also used in single-shot rifles, requiring the extra step of inserting a cartridge into the chamber of the rifle before closing the bolt.

Breach: literally a breach (hole) in the back of a firearm in which ammunition can be placed, then the breach closed by some means prior to firing. The earliest cannon were cast in one piece by bell makers with no such breach and were loaded from the muzzle instead. Breach loading firearms were invented in the 16th century, but muzzle loading persisted in most firearms through the mid 19th century. Virtually all modern firearms are breach loaded. (Reproductions of antique types and perhaps Metal Storm™ type firearms being the only exceptions I can think of.)

Caliber: literally the diameter of the bullet in 1/100 of an inch. So a .38 caliber round would be approximately .38 inches in diameter. If the diameter of a bullet is important, be sure to look up its actual diameter, as the "name" caliber is often rounded up or down. .38 special projectiles are actually .357 inches or so in diameter, for example. Note that the barrel of a weapon chambered to fire such a projectile must be slightly larger so the projectile can pass through, and that the projectile will expand slightly in the barrel, forming a tight seal and engaging the rifling, if any. The meaning of caliber changes when referring to cannon, when it refers to the length of the barrel, expressed in multiples of the bore size. So a 16" 50 caliber would be 16 inches x 50 would be nearly 67 feet long. This is a battleship main gun. European firearms and ammunition, as well as NATO standard firearms and ammunition have their diameters measured in mm. It seems that only in America do we keep the old standard alive.

Cartridge: a container with the propellent charge, some means of igniting it, and the bullet. Cartridges were originally made of paper, in the era of muzzle loading firearms. You bit the end of the paper cartridge off, poured the powder down the muzzle of the weapon, then shoved the bullet,

paper and all, down on top of it, then rammed the bullet and paper down with the ramrod. (Note that this sequence had a ton of variations, especially depending on whether you're looking at flint-lock or percussion weapons. If you're using a muzzle loading historical firearm in your story, it behoves you to look up what exactly it is, and what its loading procedure is.) Modern metallic cartridges were introduced to the market by Smith and Wesson in the mid 1850s. Metallic cartridges are traditionally made of brass, though steel and aluminum have been used. The metallic cartridge contains a primer at the flat end, typically fulminate of mercury wrapped in a thin metal coating, which explodes when struck. They also contain the propellant, called gunpowder, (see: Gunpowder), followed by the projectile, which is attached to the end of the cartridge in a variety of ways. The whole assembly is waterproof, convenient to carry, and very stable if not exposed to fire or sharp impacts on the primer. A centerfire cartridge has the primer only in the center of the back of the cartridge, whereas a rimfire cartridge can be struck anywhere on the back including the rim to fire. Shotgun cartridges are similar, but much larger and longer, as they contain the shot (pellets) as well as the gunpowder and primer inside the case. Shotgun cartridges also contain wadding between the shot and the propellant in order to assure that all the shot accelerates to full velocity before leaving the barrel.

Case: the empty brass part that's left after a cartridge is fired. Also used as part of cartridge anatomy for loaded cartridges. 'This cartridge won't chamber. The case is bent.'

Caseless: A great deal of research was put into manufacturing caseless ammunition in the 1980s, along with weapons to fire them. It has proven more challenging than originally thought. As it turns out, the metallic cartridge absorbs a great deal of the heat of firing the cartridge and then allows that heat to be ejected with the spent case. Plastic cased ammunition is starting to appear in some military applications, and Metalstorm has perfected a mechanism where cartridges are stacked, without a case, inside the barrel of a weapon and fired electrically from frontmost to backmost. But most of the firearms in modern times are still cased, as they have been for a hundred and fifty years or so. Science fiction weapons (especially in my cyberpunk) are often caseless. cf: M41 Pulse Rifle from the movie Aliens.

Carbine: a shorter long arm than a rifle, typically with less power in exchange for a smaller, lighter, handier form factor, originally for use on horseback. They sometimes fire the same cartridge as their full sized rifle counterparts, frequently with less velocity due to a shorter barrel. Carbine is one of those fuzzy terms, and the best single definition I've heard is "a shorter version of a weapon currently in the inventory." While assault rifles themselves are often carbine sized, there is now the m4 assault carbine, a shorter version of the M16 assault rifle, itself shorter than the Spencer Carbine of the American Civil War.

Chamber (n): The part of a gun that the cartridge goes in - a gun is chambered for the size - both diameter and length - cartridge it takes. A revolver has several (typcially six) chambers in a

revolving cylinder. The chamber (and barrel) will usually be slightly larger than the projectile to allow for expansion.

Chamber (v): to put a round in the chamber of a firearm. Most often used when semi-automatic weapons are being discussed, as they will hold several cartridges besides the one in the chamber, or they can be empty except for the one in the chamber.

Clip: A mechanism for holding multiple cartridges, now largely supplanted by magazines. Clips traditionally have no moving parts and are not enclosed. An M1 Garand was a clip-fed infantry rifle used in WWII, wherein a clip held 8 cartridges, was inserted from the top of the rifle, and was ejected by the rifle when empty with a characteristic ping that informed the enemy you were dry. Since true clip-fed weapons are largely extinct, the term has become synonymous with magazine, even though purists (like me) will continue to consider it incorrect.

Gauge: May refer to shot size (see: Shot) or the caliber of a shotgun. In the latter use, a gauge of n means that a lead ball with that diameter weighs 1/n avoirdupois pounds. This is not a very useful measure. Fortunately, the folks at wikipedia did the math, and came up with this approximation, based on the density of lead: 4.2416cm x 1/the cube root of n. Thus, the bore of a 12 gauge shotgun is about 1.85cm, or about 3/4 of an inch. The gauge system actually is an extension of the system used to measure cannon. A given cannon might be a 12 pounder, thus firing a 12 pound ball of lead. So a 12 gauge shotgun, loaded with a round ball, would be a 1/12 pounder.

Gunpowder: Black Powder, that mixture of sulfur, sodium or potassium nitrate, and charcoal, was apparently discovered by Chinese alchemists in the 9th century, and propagated around the world very quickly after that. Its various forms were *the* propellant for firearms until the turn of the 20th century, when modern smokeless powders were invented. Note that "gunpowder" in countries other than the United States usually refers only to black powder, and that black powder appears, likewise, to be an Americanism. Other English speaking countries tend to use the brand name, such as cordite or ballistite, or more recently just propellant for what Americans would call smokeless powder.

Smokeless Powder is a chemical explosive similar to dynamite, based on nitroglycerine, nitrocellulose, and other late 19th century explosive compounds. Most of its combustion products are gasses, as opposed to some 55% particulates as in black powder, leading to its "smokeless" designation. It is a precisely engineered explosive, both chemically and in terms of its particals, and burn rates can vary drastically.

There are significant differences between smokeless and black powder, the most important being that it can produce much higher pressures in a firearm than black powder. Thus, it is usually not a good idea to load modern smokeless ammunition in a black powder antique firearm unless one knows that a. the ammunition has been designed for black powder firearms or b. that the firearm was so heavily made originally that it is known to handle the higher pressures of smokeless

ammunition without damage, or one is using a specially formulated smokeless powder intended as a black powder replacement.
Smokeless powder's higher pressures allow for much higher velocities of projectile, giving flatter trajectories and allowing smaller projectiles to produce the same muzzle energy.

Jam: Cartridges are fairly close tolerance parts. There are a variety of ways, varying by gun type and ammunition type for a cartridge to get stuck in loading, a spent case to get stuck unloading, and so forth. Basically the firearm won't load or unload and won't fire, and requires work on the firearm before it's useable again.

Lever action rifles: still manufactured, this design dates to the 1860s Winchester, where a lever below the receiver is moved by the shooter to eject a spent cartridge and load a new one.

Long arm, Long Weapon: Any firearm which is not a pistol. Long arms can be rifles, shotguns, assault rifles, muskets, phaser carbines, etc.

Machinegun: a fully automatic (see: Automatic) weapon that fires multiple cartridges per trigger pull. In its generic form, a machinegun refers to any weapon which does so, however technically a machine gun also fires a rifle cartridge and is mounted on a tripod or similar mechanism, with controls that restrict its movement. A submachinegun fires a pistol cartridge, and is handheld. An assault rifle, which lacks the word "machinegun" in its name, is nevertheless a fully automatic weapon which is hand-held and fires a cartridge between rifle and pistol cartridges in power. Most modern infantry weapons are, in fact, assault rifles - M16 (and its modern M4 derivative), AK47 and its entire extended family of derivatives, and so forth are assault rifles. Further muddying the waters is the M14 automatic rifle, which fired rifle cartridges in fully automatic form. The truth is the words machinegun and submachinegun were marketing terms, the latter invented to describe what exactly a Thomson Submachinegun (Tommy gun) was to a military not inclined to purchase it. Likewise assault rifle is a marketing term. Semi-automatic and fully automatic along with the caliber of round fired are technical terms describing what the firearm /does/.

Magazine: a device which holds multiple cartridges and feeds them into the mechanism of a repeating arm, such as a bolt-action, semi-automatic or machinegun. Magazines are usually partially or fully enclosed and usually too expensive to be considered disposable. (Unless you're in the movies or really being shot at). Magazines are often conflated with clips. (see: Clip.)

Misfire: in muzzle loading firearms, when the trigger was pulled but the main powder charge would not go off, leaving powder and bullet still in the barrel. Potentially very dangerous, as in the heat of battle, a soldier might then reload the firearm and successfully trigger the rearmost charge underneath the new one. Black powder rifles had a screw you could put on the ramrod to screw

into the lead ball and pull it out.
In cartridge fed firearms, it's the same process, but somewhat easier to rectify and much more difficult to miss.

Musket: an unrifled long-arm, superseded by rifle-muskets, a term which evolved to the word "rifle."

Muzzle Loader: The original firearm type, loaded from the muzzle rather than the breach. Muskets, rifles, and pistols were made this way. Muzzle loaders ceased being front-line military weapons during the American Civil War.

Revolver: one of the earliest repeating firearm designs, in which multiple cartridges (typically 6) are stored in a revolving cylinder that is rotated between the barrel and the hammer/firing pin. Revolvers rotate the cylinder automatically as the hammer is cocked. Single action revolvers require a separate step before firing of pulling the hammer back, or cocking it. Double action revolvers cock the hammer during the trigger pull.

Rifle: Literally to cut grooves into the barrel of a firearm to impart a spin to the projectile, giving it gyroscopic stabilization. Commonly used as a shortening of rifled musket or rifle-musket to describe a long arm firing a single projectile to which such a spin has been imparted. Rifling refers to the groves (or ridges, or flats within the barrel) that impart the spin. Comparison of rifling marks on the bullet is one of the main mechanisms of ballistic matches, as they are ground individually per gun, and have unique wear cycles based on that gun's individual history.

Round: Fuzzily used either for bullets (when fired) or for unfired cartridges.

Shot: small pellets, traditionally of lead, used in a cartridge in place of a bullet. When fired, shot amounts to lots of small bullets. Shot is sized by gauge which is separate from the gauge of a shotgun. Buckshot and Birdshot are gauged differently. Buckshot tends to be quite large (up to .38 inches per pellet and 5 pellets per ounce) and is intended for shooting deer. Birdshot, as the name might suggest, is for shooting at birds, and ranges from FF to #9, largest to smallest. BB, by the by is a birdshot designation, and the pellets are exactly the size of BBs as fired from a BB gun. A BB shot shell will have a lot more of them, and they'll be lead, though. Note that this is not the same as artillery shot, which designates a solid projectile. The artillery equivalent for what we call shot in the small arms world would be called grape shot or canister.

Shotgun: A large bore (usually) long arm, often with an unrifled barrel, designed to fire shot shells rather than solid projectiles. Shotguns come in the usual repeating rifle types, single shot, double barreled (over and under or side by side.) Having said these things, there are rifled shotguns,

there are shotgun pistols, and there are solid projectiles (pumpkin balls or more often just slugs) meant to be fired from unrifled or rifled shotguns. Modern shotgun cartridges are the only ammunition commonly found with a mostly-plastic case.

Silencer: Common name for a suppressor, and the original term for the device as marketed by its inventor, Hiram Percy Maxim, who also invented the automotive silencer, (muffler in American English) to which it is related. (see: Suppressor.)

Small Arms: another somewhat fuzzy term, depending on who you ask. The U.S. military definition is handguns or other firearms less than 20mm in caliber, including weapons one would not normally think of as man-portable, like the M2 50 caliber Browning machinegun. The BATF, by contrast, considers anything of .50 caliber or below a small arm, and anything above that a "destructive device," though they exclude shotguns, large bore sporting rifles, and muzzle loading black powder weapons. The former definition is probably more practical, as the latter is influenced by politics, subject to change, reinterpretation, and the whims of the BATF. For reference, the United Nations defines a small arm as a weapon which can be carried by one person. Presumably backpack nuclear weapons weren't intended here.

Suppressor: Structurally similar to automobile mufflers, which slow and/or suppress the propellant gas coming out of the barrel behind the bullet. These devices reduce, sometimes dramatically, the report of the firearm, that is, the sound caused by expanding propellant gasses. Modern suppressors, while effective at reducing the sound of a firearm's muzzle blast, may or may not reduce it sufficiently that the shooter does not need hearing protection – this is a matter of debate. Even absent the muzzle blast, however, firearms still do make considerable noise. The action will make the same sounds it makes when cycled by hand, only louder and faster. The bullet traveling through the air will make a sound as well, and if it exceeds the speed of sound, it will produce the characteristic crack independent of any suppressor.

Stovepipe: in a semi-automatic weapon, when the spent case doesn't get clear of the receiver before the receiver tries to close, thus jamming the spent case in the partly open action. They usually stick straight up, hence the name. They are usually caused by an underpowered cartridge (less powder than it was supposed to have) not moving the action as much as it was supposed to, or by a weak ejector spring.

Firearm Anatomy

Rifles: A rifle is a firearm fired from the shoulder. It typically fires a much more powerful cartridge than a pistol, since it weighs more and allows more of the shooter's body to absorb the recoil.

The stock: traditionally made of wood, consisting of a butt (the end that goes against your shoulder) a comb (the top of the stock where your cheek rests when aiming) the grip (where your hand goes, and where the trigger guard is) and a forestock - the part that holds up the barrel.

The receiver: (in 19th century and earlier weapons, often called the lock) - the action of the rifle, it receives bullets from the magazine and loads them into the chamber, and has some provision for firing them. This is usually done via a firing pin driven into the primer of a cartridge. The firing pin can be driven by a hammer on weapons so equipped, but may be directly spring-driven. Automatic weapons will have a moving part on or in the receiver that moves when the weapon is fired, using some of the energy of the cartridge to extract the cartridge and load the next one, but the exact mechanisms and part names vary widely.

The magazine: in repeating rifles of any type except clip fed, there will be some way of storing ammunition within the rifle. In lever action Winchester types and most repeating shotguns, this is often a tube running beneath the barrel, and is loaded from a gate in the receiver. In most modern rifles, this is a magazine that is inserted into a magazine well typically muzzle-ward of the trigger guard (but not always). Single shot rifles will not have a magazine, obviously.

The trigger, trigger-guard: These will be located in front of the grip.

The barrel: at one end of the barrel (frequently part of the receiver in modern weapons) is the chamber, in which the cartridge goes. Bullets come out the other end, which is called the muzzle, when the firearm is fired. The barrel of a modern firearm (except shotguns) is rifled, imparting a spin to the bullet as it passes through, which gyroscopically stabilizes the bullet.

Safety: Most firearms built after the turn of the 20th century will have a safety, which, if functioning correctly, will prevent the firearm from discharging if set. The mechanisms vary, and when worn, a safety can fail to function.

Sights: Vary from rifle to rifle. Iron sights are typically a small blade-shaped attachment at the muzzle and often a v shaped sight close to the comb of the stock, where it's convenient to peep through. Align the blade in the center of the V, put the blade just under where you want the bullet

to go, and assuming your sights are adjusted right for the wind and the distance, the bullet should go there.

Pistols: Like rifles, only lacking most of the stock, pistols are hand-held, limiting the recoil that can be controlled, and thus limiting the power of the cartridge.

Stock: A pistol is seldom said to have a stock. Since the 19th century, the stock has more or less been incorporated into the mechanism of the pistol's receiver. Nevertheless, a pistol has a butt, which is at the bottom of the grip. In semi-automatic pistols, this typically has the magazine well in the bottom, and magazines are loaded therein. The pistol also has grips (hence pistol grip). Ahead of the grip will be the trigger and (if present) a trigger guard, and the safety will be somewhere nearby. The barrel and the rest of the mechanism will be above and/or in front of the grip.

Receiver/action: Semi-automatic pistols have a receiver just like their rifle counterparts, and it does the same things. Revolvers typically aren't said to have receivers. They have cylinders instead. (see Revolver)

Sights: Pistols usually have iron sights as described for rifles, save that the rear sight (the one closest to the shooter's head) is mounted on the receiver or on the frame over the cylinder.

Mechanics

Firearms: Very briefly, this is how a firearm works. A bullet is fitted into a tube which is closed at one end and open at the other. An explosion or conflagration is triggered between the closed end and the bullet, and the expanding gasses create a pressure differential. The bullet moves toward the lower pressure. If the tube is rifled - carved with long spiral fluting inside - the bullet is forced to spin by its journey down the barrel. The spin creates gyroscopic stabilization for the bullet, exactly the way the fletchings on an arrow or the spiral throw of a football pass do. Really, it's that simple. The rest amounts to the mechanics by which those conditions are created, and the nature and speed of the bullet which is fired.

The first firearms added to this a small hole in the closed end, in which you poured a small amount of gunpowder and touched it off with a piece of slowmatch (like punk sold with fireworks). This fired the main charge in the closed end of the barrel. These were called matchlocks. Later modifications replaced the slowmatch with a spring loaded cover for the priming charge, and a flint and steel. These were called flintlocks. Still later modifications replaced the pan and the flint and steel with a nipple and a small copper cap filled with fulminate of mercury, which explodes when struck. The hammer struck the cap, the cap fired the main charge. These were called percussion caps, and by the way, the primer in a modern cartridge works exactly the same way. Still later firearms had multiple barrels with multiple charges, and you selected which one you wanted to fire. This evolved into multiple chambers with multiple percussion caps and just enough barrel to hold the charge. These chambers were rotated so that the one being fired lined up with the barrel. These were called revolvers. Revolvers, in turn, were among the first weapons to have their chambers drilled all the way through so that a metallic cartridge containing the propellant, primer, and bullet could be loaded in the back. And so forth and so on until we evolved firearms with metallic cartridges containing the bullet, propellant (gunpowder) and primer, and these are loaded automatically at a ridiculous rate by a wild assortment of mechanisms. A great many of these mechanisms, despite being obsolete, are still made, updated, and pushed forward. It comes to this. Firearms all do the same things. How they create the conditions, and the nature and speed of the bullet they fire are the only variations. Full circle. Metalstorm™ weapons are a tube with alternating bullets and propellant charges stacked from the closed end to some distance from the open end. The charge is initiated (fired) electrically on the outermost bullet, and away it goes. Subsequent rounds are fired the same way, and when the tube is empty, it's thrown out. Back to the very beginning in a lot of ways. (I've oversimplified a bit here, obviously, and I'm pretty much ignoring the history of artillery, which parallels what I've written, but did so at different times.)

Barrel Length and other Considerations: The length of the barrel of the firearm matters. Most cartridges are designed with a certain barrel length in mind to produce a given velocity. Thus, they have a propellant charge which will burn for a specific amount of time, so that the pressure in

the closed side of the barrel remains high longer, despite the increasing volume of the space as the bullet moves toward the muzzle. If a gun's barrel is shorter than this, the bullet will not reach its full velocity, and will not have its full range or energy on impact. Also, the shorter the gun is, the shorter the distance between the front sight (on the muzzle) and the rear sight (on the receiver), which means that aiming becomes less precise. While the former can be made up with faster burning propellants, the latter can't. Thus, a firearm with a very short barrel (say, three inches) is not going to have the accuracy, or likely the power and velocity of one with a more normal length barrel. Interestingly, this works in reverse as well. A pistol cartridge fired in a carbine, whose barrel might be twice the length the cartridge was designed for, may well have higher velocity and energy than expected, and will likely be easier to put on target accurately. This is why, for example, both revolvers and lever action rifles were chambered for the Winchester .44-40 cartridge, and why such weapons as the Ruger Police Carbine, firing either 9mm or .40S&W were made. In addition to offering the convenience of only carrying one type of ammunition, the longer weapon gave greater performance and accuracy.

The weight of a firearm matters. The lighter the firearm, the less moment of inertia it has to resist recoil. A catridge, when fired, produces a certain amount of recoil, both from the acceleration of the projectile forward and from the gasses behind it forming a rocket effect when the bullet leaves the barrel. The more the gun weighs, the more inertia this force has to overcome before the shooter must absorb it. In the barrel length example above, another advantage in accuracy for a rifle chambered in a pistol cartridge vs a pistol chambered in the same cartridge might be that the rifle's greater weight reduces the felt recoil, thus making it easier to put the rifle back on target for the next shot.

Ammunition:

Ammunition for firearms is a field with a whole lot of experimentation and a great deal of nonsense out there on the subject. The basics are these: There is a balance to be struck between bullet energy (mass times the square of the velocity all divided by 2). and controllability and portability. Nowhere is this more apparent than in handguns. Whereas a rifle is pressed against the shoulder, and allows the shooter to put his or her body weight and torso/leg strength against the recoil, a handgun is controlled (typically) with one hand, and as such cannot exceed the strength of that hand or it will wrench itself out of the shooter's grip, damage the hand, or merely bruise the hand badly enough that a second shot becomes very difficult. Additionally, there is a great deal of debate on the importance of the weight of bullets - generally speaking a heavier bullet will carry further, having more inertia, but this may be offset by its greater aerodynamic drag.

Much of the debate in matters of ammunition centers around lethality. In broad terms, the more energy a bullet has when it hits the target, the more damage it does. In real terms, however, any common firearm cartridge, from the lowly .22 long rifle through the ridiculously large 20mm cannon cartridge sometimes used in extreme sniper rifles will kill a human target if it hits them in the right place, and will fail to kill them if it doesn't. (Arguably, the more energy a bullet hits the target with, the bigger the right places. How you /avoid/ killing someone with a 20mm sniper rifle, assuming you aimed at them and fired, I'm not entirely sure.) Higher energy impacts (rifle, super-big handgun, assault rifle, and so forth) may cause damage by hydrostatic shock - incompressible liquids conducting the energy of the bullet's impact through tissues (this is a subject of great debate), but the primary mechanism for damage, especially for handguns, is that a fast moving piece of metal pokes a hole in some part of the target's body, and the target bleeds. The bigger the hole, the faster the bleeding. The greater circulation the part that was holed has, the faster the bleeding. If the part holed has a function that doesn't work well after big impacts (brain, nerves, joints) damage can also occur from this cause.

Bullets are evolved to try and do a number of conflicting things well. A bullet needs to have a small frontal area for good aerodynamics, but it needs a large frontal area to transfer as much energy to the target person as possible, thus making as big a hole as possible. But it may also need to penetrate body armor and/or bone, so it needs to be small and hard. Thus, different bullets for different purposes. Ball ammunition is simply a lead slug, roughly bullet shaped. It's a compromise between aerodynamics and impact, and it works through brute force. A big enough hunk of lead moving fast enough will make a big enough, deep enough hole. Hollowpoints or wadcutters (same thing) have a hollow nose that flattens out on impact. They're designed to make a bigger hole, and perhaps not carry through walls as readily if you miss. Full Metal Jacketed rounds are military rounds designed to meet the terms of the Hague convention, which requires that bullets not fragment on penetrating the body, making it simpler to patch the soldier up and keep them from dying once they are wounded. Shot shells are lots of balls flying at moderate velocity, that punch

lots of holes and make one's aim a little less critical as well.

(It bears noting that while the 5.56 NATO round is a full metal jacket, its shape and thin jacket were originally designed to circumvent the Hague convention. When the bullet hit a target, it would tumble and fly apart. Whether modern 5.56 NATO rounds exhibit this behavior, I don't actually know. The round has huge controversy around it, and has since its inception, and most of that controversy flows around whether it is lethal /enough/. The round was modified extensively by the U.S. military during adoption. The M16 and the 5.56 NATO round it fires are a whole separate topic.)

Shooting

Technique: Most of the firearm technique you see in the movies and on tv is bullshit, and frequently dangerous bullshit at that. It's designed to look cool, and nothing else. Mythbusters recently tried a number of Hollywood movie pistol stances – gangsta sideways shooting, shooting from the hip, double handed shooting, cross handed shooting – and none of them proved as accurate as shooting one pistol in your dominant hand, using the sights, or holding the pistol with both hands in the Weaver stance and using the sights.

Long Arm: This is how I was taught. 30 years ago. In the Boy Scouts. To shoot a rifle or a shotgun, stand with your off-hand shoulder about 3/4 toward the target. Raise the weapon to your shoulder and press the butt against your shoulder joint. Look through the sights. Typically for the iron sights, you'll have a blade on the muzzle of the rifle (the little dingus that sticks up from the centerline of the muzzle) and a v notch on the receiver somewhere close to your face. Adjust the v notch's height for the range and windage (how fast the wind is blowing and in which direction.) Line the top of the blade sight up with the top edges of the V and center the blade on the bottom of the V, and put your target right over the top of the blade sight. Take a normal breath. Let half of it out. Squeeze the trigger.

Pistol: I was never formally trained in pistol. This is my way. Hold pistol in your dominant hand either straight out from that side, with your dominant side's shoulder toward the target. Use the sights exactly the same way as the rifle sights above. Pull the trigger the same way. My father told me a trick that I have yet to try, but you may find it useful. If memory serves, he learned this trick in the army. Put your pistol on target. Now close your eyes and lower your pistol. Now raise it (still with eyes closed) until you think it's on target. Now open your eyes. Adjust your feet until it is on target. This is how your body wants to shoot. Learn this position, relative to your target, and you'll be able to put the gun on target faster and more accurately, because your mental image and reality will be in sync.

Caveats: There's a lot I don't know about shooting. The last time I went shooting, the aforementioned friend Mike borrowed our host's shotgun and, firing from the hip, hit four bowling pins at twenty meters in four shots. Firing from the hip means he had the butt of the shotgun roughly on his right hip, the barrel crossing his body centerline, with his left shoulder about three-quarters to the target, the forearm of the stock resting in his left hand, and shooting right handed. Somehow he was aware enough of the barrel line that he hit those pins better than I did shooting as I would shoot a rifle. Mike was cross-lateral dominant, meaning his left eye and right hand were dominant, and he said this made shooting from the hip much, much easier for him, something he'd discovered while in the National Guard. I don't know how he did it. I have no idea how he had such a good mental image of where that barrel was pointed that he could shoot that well. (He did say something to the effect that he couldn't do that again on a bet.) My point here is that it seems to

be entirely possible to have such a profound understanding of where the gun is pointed that you can aim without the sights. It's not the way to bet, but I've seen it done.

Experience:

Pistol: So there you stand, pistol in hand, aiming at a bowling pin about 7 meters away. (I've done this.) What is it like? Well, the pistol is dense. It's a solid chunk of precision machinery, and until recently any firearm had the most ergonomic considerations of any machine you're likely to encounter. They feel good in your hand. Sturdy. Powerful. They teach you to take a breath, and let half of it out as you squeeze the trigger, to cut down on jerking the trigger. (because jerking the trigger jars your aim.) So you squeeze. The first thing you notice is a loud crack and a sudden kick of the gun in your hand. Most pistols also climb when they fire, so the thing will try and pivot back and up in your hand. You feel this. It's like the gun has suddenly sprung to life, or like stopping yourself with your hand when you fall. It stings a bit. More as the caliber goes up. While you're noticing the recoil, and almost immediately after the crack of the cartridge going off, you'll hear a / smack/ if you hit your target. And the bowling pin will go flying. (Note: most of the energy of a bullet hitting flesh goes to tearing holes in the flesh. Bodies will /not/ go flying when shot. That's pure Hollywood, and was thoroughly debunked by Mythbusters. episodes 25 and 30. Bowling pins do it because they are made of wood and rather light.) It's a moment of gruesome thought when you realize you heard the bullet hit. Also, simultaneously with the crack and the smack from the bullet, if you're firing a semi-automatic, the slide (in most types) will jump back over your hand, perilously close to the web of your thumb, and the pistol's balance may shift drastically as it does. A well made semi-automatic is a fine weapon to shoot (which is a 180 degree change from my opinion in previous versions of this document). I have had good results with calibers up to .45ACP at targets up to 7 yards away (I said I wasn't that experienced a shooter), and having the next round just *there* and ready to fire certainly made it easy. I've had my thumb bitten by the slide (the downside of two-handed stances is where to put your off-hand thumb so it's out of the way), and shot enough that my wrist was sore from the impact. the rest of the evening. I've never been a pistol guy, but I'm warming to semi-autos these days.

Rifles: The sheer mass of a rifle makes the recoil of normal rounds much smoother and less violent. The overall impressions are the same. Aim, feel the rifle squirm in your arms, the crack, the smack of the bullet into the target, but it's all more distant from your body parts. After the noise is done, the next thing you notice is the smell of burnt powder. Modern smokeless powder has a metallic smell, kind of somewhat akin to burnt garlic without the sharpness at the top that makes your eyes water. Once you've smelled it, you'll always recognize it, but it's hard to describe when I haven't been shooting in a few years.

Shotguns: Right up until you squeeze the trigger, the difference between a rifle and a shotgun not that noticeable. Once you pull the trigger, you can't miss it. The recoil is much greater (painfully so) and the report (the sound) is much more like a boom or an explosion than the crack of rifle and

pistol fire. Two rounds through a friend of mine's Mossberg pump shotgun were enough for me. The pump action was very stiff and required considerable force to use, and the whole thing felt crude, imprecise, and poorly made. My shoulder was bruised as well.

Assault Rifles: I've fired exactly one assault rifle, but it was a classic, the AK47, firing 7.62x39 Russian, in semi-automatic mode. (Neither I nor my friends have the kind of license you need to own or use fully-automatic weapons.) The AK was a delight to shoot. Its recoil was very mild, it had large magazines, and was great for pulling the trigger and watching rounds go down-range. It was striking how small the AK47's stock was. It was a very compact beast, almost too small for me. One thing I did not manage to do with the AK47 was hit anything. The sights on most AK47s are said to be quite poor, and this one was no exception. For flinging lead in the general direction of your enemies, it's fine, but there are better choices for precision fire.

Learning to Shoot: I'll give two pieces of advice here. One: the shooting range makes a difference. An orderly, professional shooting range is a much safer, much less threatening way to learn shooting than an uncontrolled one where the idiots next to you may sweep you with their shotgun because they're not paying attention. You can also get a much better feel for how accurate your shooting is with a target than you can with bowling pins. Two: learn from people you trust. Learning from someone training for Olympic shooting sports is a far cry from learning from j random gun nut. If in doubt, I recommend formal training. Mine came from the Boy Scouts, but the NRA offers courses that look (on paper) entirely practical and designed to produce safe shooting habits, whatever your political inclinations.

Overall Impressions: There's a feeling of power you get shooting, a slight kick of adrenaline, and the gratification (if you've aimed well) of seeing a target well out of your reach affected by your actions. It can be strangely addictive, and chewing through a hundred dollars worth of ammunition in an afternoon focused on fire, aim, fire, reload, etc is not at all unreasonable. (Ammo isn't cheap.)

Afterwards, you have to clean the gun. It will be full of soot and scorchmarks and traces of lead I know are there but have never seen. They're designed to be stripped easily - taken apart, and there are specialized tools for getting the lead fouling and the carbon fouling (it's called fouling, yes) out. You then oil every metal part of the gun to keep it from rusting and put it away in a locked cabinet or a case, and if you live in a wet climate, having desiccant packets like the ones they ship with electronics in with your guns is not a bad idea. It's a somewhat messy, oily job, and some of the cleaners you use really stink of solvents.

Black powder is different, and it's been probably 30 years since I fired a black powder rifle. I remember it being very heavy, and the recoil kicked violently, and there was a cloud of smoke that stunk of sulfur. But I was a boy, and I'd only fired .22s before that.

Designing Your Own

"Do you mean to say [...] that our civilization has reached the point where we're hurling hostile universes *at each other?"* – Walter Jon Williams, *Implied Spaces*

If you look at the history of a weapon as an artifact, (eg: The Strange Tale of the M16) it tells about the people who made it, and the people who carried it without a lot of exposition. For my science fiction, I've come up with cheap disposable plastic handguns, knockoffs of knockoffs of bull-headed brute-force engineered weapons, very small, easy to conceal, variable lethality weapons, weapons evolved for killing in stealthy operations, and so forth and so on. These were all part of my fictional culture. They told the reader that life is cheap, that there are lots of solutions to a given technological problem, and that the American/NASA model of superior technology always wins may not necessarily be so. And no ray-guns among them.

The Problem with Ray Guns: Consider the laser. Lasers are real technology. But to generate *killing* power with one is tricky. Lasers produce a very tightly focused spot of energy on their target. If we assume we have enough heat to burn through the target, what then? If you burn a hole the size of a 10 penny nail clean through someone, odd are, they won't *die*. It's a small hole, and our bodies are pretty savvy about plugging small holes quickly.

The other problem with lasers is that if you know your enemy has fielded large numbers of them (a substantial investment) you can, with a change in your uniforms, shield against them. Laser hits my new uniform and… nada. It reflects off, and fails to transfer any energy to me. Any non-kinetic energy weapon is going to have this exact problem. We humans are fragile and squishy, but we're not *that* fragile and squishy. To do the kind of brute force damage that lethality is likely in a reasonable amount of time, you have to send an awful lot of non-kinetic energy at your target. For a phaser set on disintegrate to do what it does would require a ridiculous amount of energy for a hand-held (or even human-portable) device, and then the heat, steam, and possibly nuclear explosion would be incredibly destructive to anyone around the disintegrating target. Like the shooter.

There are special cases where a directed energy weapon might make sense – eyeballs, sensors, using masers against sensitive electronics and so forth – but unless you're asserting technology from a century in the future, or you're dealing with weapons the size of a 747's payload (as current anti-missile lasers tend to be) you're probably dealing with projectiles. They're highly evolved, well understood, and poking big-ish holes in human bodies gives you a lot of tissue death for comparatively little energy, primarily because the victim's blood runs out and all the otherwise undamaged cells die together. (Note that zombies, being dead, might be exceedingly hard to kill with firearms, as they must be physically dismembered instead of merely perforated. Alien life

forms might have similar issues. In these cases an energy weapon might be your only recourse. I suggest a flame thrower.)

Why Shouldn't I Just Make Technology and its Limitations Up? If you ever watched the original Star Trek, you've seen the problem with this. The phaser, which I picked on above, is a handheld weapon that can disintegrate anything made of matter *and* has a nifty stun setting so you don't have to kill anyone you don't want to. Great, right? Well no. Did you ever notice how, having established this weapon which has plot device level lethality, they're forced to make everything in the universe except the Enterprise crew immune to phasers? How many plots would have simply rolled over and died right there if phasers had worked as advertised? The Devil in the Dark? Horta disintegrates. Roll closing credits. Doomsday Machine? Enterprise blasts the thing into gory chunks. Roll closing credits. Obsession? The Immunity Syndrome? Same deal. If phasers worked as advertised, these stories end abruptly before the first round of commercials. Conscience of the King? Lenore shoots her father… oh wait, he does die right now. This is better than using a handgun how? Using real science gives you both advantages and disadvantages without having this kind of embarrassing handwaving of why your ultimate weapon doesn't work *today*. Magical devices require magical limitations. Plausible devices get their limitations from the real world.

But What About Quantum Teleportation/Hostile Universes/Etc? Truth be told, there's all kinds of science with potential for personal weapons: quantum teleportation, distorting the fabric of space time, etc etc. I'd get into those, but your imagination is as good as mine. This is a treatise on firearms, and I've already gone pretty far afield talking about ray guns and such. I think my methodology below applies broadly to hypertech weapons – What does the weapon do? What are the constraints of using it? How many of these constraints can be taken from real science? What kind of a mess/evidence does it leave? There's a whole other treatise to be done on making up hypertech weapons like like Walter's hostile universe gun (no really, it's a boggling idea. Read the book), but I'm probably not the guy to do it. Firearms I have some background in. Fringe physics? I'm on a lot shakier ground.

Methods for Plausible Firearms

So let's assume we're still well in the realm of projectile weapons, but instead of getting a weapon off the shelf (Aliens' Hicks and his shotgun) you'd like to have something a little more science fictiony, but still plausible. There's a lot of flexibility in "fire"arms in the propellent system. My personal favorite are fuel-air guns, which use a volatile fuel (such as alcohol) and air to generate the pressure inside the barrel to throw the projectile out at lethal speeds. The gun has a fuel injector and an ignitor. My first two novels are replete with these guns. My reasoning was that this propellant system allowed the weapon to hold more ammunition for the same size and weight, since oxidizer is by far and away the largest component of gunpowder. It also gave my characters business in checking that the weapon's fuel tank is full, and so forth. But you can push a projectile with electromagnetic force (rail and gauss guns), steam, compressed air, big rubber bands, or pretty

much whatever. The novel I'm working on just now, I have one heavy carbine that uses what amounts to a small fusion reactor to inject superheated gas plasma into the breach of the weapon, causing the air to expand at a high rate, generating the propellant force. I did the math one time and discovered that a heavy pistol/m16 round generates around about 7 horsepower of muzzle energy, so that's the amount of energy you need to create in your weapon /somehow/. This is where you can add the most science fiction into an otherwise more or less conventional firearm and still stay plausible.

Every firearm is a balance between size and weight of gun, size and weight of the ammunition (1 round isn't bad. A thousand rounds for an extended firefight? Heavy) how much ammunition it holds, how fast it fires, how accurate it is, how far it shoots, and how big a hole it makes in the target. If you really want to go with the physics, and you have the calculus to do it, all these formulae are available. Try Wikipedia. When figuring the recoil, remember to take the mass and inertia of the gun itself into account. That's the hard way to do it. That's how you start engineering real firearms.

I'm going to propose an easier way. Decide what category your weapon fits in. Is it a military weapon meant for use in cities? That probably makes it more in the assault rifle family. Is it a long range sniping weapon? Look at heavy long range hunting weapons like the .300 winchester magnum, or even the .50 BMG firing Barrett M82. Is it a small handgun meant to be concealed in a thong? Well, you know what to do. Look up several weapons in this class and get a feel for the muzzle energy levels, because that's going to tell you how much recoil (more or less) the weapon is throwing around verses its weight. Now pick whatever is important about the projectile to the story. Flip through Wikipedia's list of cartridges for projectiles about that size and that produce the muzzle energy for the class of weapon you're building. Use that round's velocity and specs.

As an example, let's say we want to build the M41 pulse rifle from Aliens. It's a classic science fiction projectile weapon, and we even have some specs on it from the movie. It fires, if memory serves, a 10mm light armor piercing explosive tipped caseless round. First, because the weapon is an assault rifle, we want to keep the power of the cartridge down in the range of assault rifles. Doing some research, we find that this range runs from 1500 or so joules of energy at the muzzle to about 2500 joules, and that the range has been slowly sliding up. (The howls of trouble with the 5.56 NATO round, which is at the lower end of this scale seem to be driving this evolution.) Bearing in mind that technology like muzzle brakes can reduce felt recoil dramatically (up to something like 50%), and this is the future we're talking about, we can run on the high side of this safely. (Be advised that muzzle brakes, in redirecting the gas of the shot, also redirect a huge amount of the noise. Hearing protection is even more important. On the flip side, suppressors (incorrectly known as silencers) also suppress the gas jet and can sharply reduce the felt recoil as well.) For the M41, let's chose an energy point around 3000 joules at the muzzle, reasoning that in however many years, advances in suppressors and real world needs for higher power would add the additional 500 joules of energy. Flipping through the cartridge list, we find a real world cartridge that has about the energy we want, and is about the right size: the .460 S&W magnum. (10mm is only about .40

caliber, but it's close enough.) This is a hunting pistol cartridge. It now becomes easy to look up things we need to know, like its range, how fast the round goes, whether it's supersonic or not. (It matters. Supersonic bullets have the characteristic rifle crack – a tiny sonic boom. If we're trying to shoot stealthily, that's a bad thing.) We can look up what NIJ armor level will stop it (if any) and so on. In retrospect we also know that the prop for the m41 pulse rifle was built around a Thompson Submachinegun, which fires .45 ACP rounds, so the specs we've chosen match the look of the prop nicely. As for armor piercing, explosive tipped and caseless, armor piercing explosive rounds do exist. They're called HEAP - High Explosive Armor Piercing, and once again, Wikipedia has a lengthy article about them.

Body Armor: Since this is a treatise on firearms, I'm not going to get into body armor in any great depth. The vast majority of shootings one encounters in fiction are against unarmored targets. I will point out a couple things about body armor though. First: wearing body armor is not like being the man of steel. Even though the armor stops the round from penetrating, and thus stops it from poking a hole in something important and thus keeps you from bleeding, the energy of the round hitting you has to go somewhere. It goes into the armor and you. By all accounts, this hurts. Second, the National Institute of Justice has standards for body armor, and they have a very thorough PDF available on the subject here: https://www.ncjrs.gov/pdffiles1/nij/223054.pdf. Given what you know about the round being fired at the character, you can look up what armor they have to be wearing, look up pictures of real world armor to see what it looks like, then make up something futuristic but plausible that does the same job and keeps your character alive.

The Strange Tale of the M16

I did the research that follows for a role playing game I was playing at one point, to make the case that just because a weapon is the standard of a given military does not necessarily mean it is better in any measurable way than weapons available to civilians. Certain of the facts below are subject to debate (and then some.) The lethality of the various types of ammunition fired by the m16 and its derivatives were the subject of intensive debate at the time this summary was written and remain so today. If you're curious about my sources, they are a book called The Mortal Error, which delves into AR15/M16 ballistics and history at some length to back up its primary assertions, and of course, Wikipedia. I have no personal experience with an AR15/M16 derived weapon.

In 1957, Armalite Inc.'s Eugene Stoner developed the AR15. It was designed to be America's first assault rifle. It was lighter, and fired a much lighter cartridge than the rifles it was to replace, and yet it was relatively lethal due to very careful engineering of the rifling in the barrel (that gives the bullet its spin) combined with a projectile that tended to both tumble and fly apart when hitting a living target. (Both of which skirt the terms of the Hague convention.) It was relatively reliable when fed the proper ammunition, and produced massive, destructive wounds and high lethality. The AR15 has a gas tube that runs from close to the muzzle, where it picks up propellant gasses, back to the bolt, where that gas is used to open the breach, eject the round, and load the next round. Quite a few semi and fully automatic firearms are gas operated, but most have a piston close to the initial gas vent, and a rod running back to the mechanism in the receiver. Not so with the AR15.

In 1964, the Johnson administration forced the military to adopt the AR15, much against the military's will. The military had just completed extensive R&D on the M14 rifle, and had just finished essentially forcing NATO to accept the 7.62 NATO standard round. For reasons known only to themselves, the military, in adopting the AR15 as the M16, changed the weapon's rifling to reduce its spin, and chose to feed it much dirtier ammunition than it was designed for. The result was a weapon with reduced lethality, and that jammed a lot, causing untold (and unverified) numbers of casualties in the Vietnam war to be found dead next to partially disassembled rifles that they were frantically trying to unjam.

In 1967, the M16A1 was introduced. This was an attempt to improve the reliability of the M16 by making subtle changes to the weapon's internals. The reliability did improve slowly.

In the early 1980s, the M16 A2 was introduced. The M16A2 had more internal refinements, and also marked the introduction of a slower, heavier round to try and recover some of the lost lethality. It also marked the end of fully-automatic fire in the M16 in favor of three round bursts, after the discovery that after the third round in automatic fire, most rounds are wasted. The result was a heavier, more complex weapon.

The M16A4 is similar in most respects to the A2 (the A3 was a specialty version), save that it has a different rail at the top for attaching scopes and such to.

The M4, most associated with the wars in Iraq and Afghanistan, is essentially a variant of the M16A4 with a shorter barrel (thus lowering the velocity of the round, reducing its energy even further) and a different stock, but apparently allowing fully automatic fire (instead of 3 round bursts). Rounds used in the M4 have undergone tremendous evolution in an attempt to make them penetrate armor effectively and give them back some of their lethality.

Troops in the field in Afghanistan today are carrying nearly the same weapon their fathers and mothers carried in Desert Storm in 1990, and that their grandfathers carried in Vietnam.

There have been numerous trials of more advanced weapons to replace the M16 and its offspring, or to revise it to fire a larger, more powerful round. Many of them have sported better lethality, much better reliability, and so on. None have been adopted. And this, in the most expensive military ever fielded on planet Earth.

Large military organizations chose their weapons for a variety of factors, many of which have nothing to do with the efficiency, effectiveness, reliability, and so forth of the weapons. Politics become involved throughout the process, and in the end, the weapon is manufactured by the lowest bidder.

It is perhaps fitting that the weapon of the war that embodied the 1960s should itself so embody the culture of 1960s America – an age where technological improvement was often marred by the toxic politics of the day, and where appearance, ideology and money were more important than lives. It was an age of change, particularly in the military, and that change was often not at all welcome. Many of those factors are still in play today, as are the descendants of the M16 itself. In a story, one might imply a whole lot about a given culture just from a comment or two by a soldier about his or her rifle.

Firearms and Culture

Guns make a loud noise not unlike fireworks on the Fourth of July. They are jailer's sidearm and escapee's magic key. They are the tools of the oppressive police state, the invading army, the terrorist attack, and the bank robber and also the tools of the resistance, the brave defenders, antiterrorist heroes and law enforcement. They are an extension of the human hand and the human will, and in fiction especially, the tradition of Checkhov's Gun says that if there's a gun shown, it will be used. It should come as no surprise that more civilized cultures are very conflicted about guns and less civilized ones simply tend to be armed. Since I write hard-ish science fiction, I want my social dynamics to have at least a passing familiarity with realism, and to get there we should probably take a quick look at the real world. You should know that I am an American who grew up in Wyoming, and because of where and when I grew up, the days of the Wild West were still in living memory. You should know that despite this, I've always been a creature of the suburbs.

Guns Without Violence: Since this document is about the use of firearms in fiction, I've mostly focused on the violent uses of guns. Fiction is a violent place, and as the news media says, if it bleeds, it leads. Nonviolent gun uses, by contrast, do not involve using the gun to point at another human being or threaten to point at another human being, or in any particular way to use the existence of the gun as a means to get power over another human being. Non-violent gun uses are like non-violent power screwdriver uses. For these purposes, the gun is simply a tool to do a job. Just as there are various types of computer geek centered around the that particular tool, there are also various types of gun geeks.

Accuracy geeks have firearms as precision tools for putting bullets into targets as precisely as possible. This motivation is no different from the precision bow and arrow folks, or for that matter folks who like to be super-good at darts. Hunters have firearms for shooting wild game, often with the intent of eating it later. For them, it's a tool for securing food at the end of a long hike in the woods, a connection with nature (and the food chain) in a way that most of us in modern civilization have not experienced. (I've never actually hunted anything, but I think understand the attraction.) Gun geeks have firearms because they are fascinated by the machines themselves, by the history, and the mythology.

Reenactors are history geeks. They own weapons from another time and learn to use them because they want to get closer to a given moment in history, to smell it, to feel it, to hear it, and so on.

Some gun geeks are hot-rodders, who hot-rod their guns with wildcat cartridges loaded beyond normal pressures and velocities to see what the new combination will do.

Most firearm owners in America today fall into one or more of these categories. They're not the

ones that get the headlines, and they don't make terribly interesting stories. It is also true that what I call gun geeks tend to *sound* violent when confronted with gun control advocates, even if most of them aren't.

Thoughts on Guns, Violence, and Power (in no particular order):

Normal Level of Violence. Each of us has a level of violence with which we are comfortable. We learn as children, in school, from tv, and so on, how much violence is acceptable to give and receive. Think about it. You probably think nothing of swearing at another driver in the privacy of your car, but to his or her face you're very likely to be a lot more circumspect, however much you may *want* to impugn their parentage the way you did in private. Why is it you're so much more inhibited face to face? Because you've been conditioned practically since birth with the same thoroughness as toilet training not to be more violent than the normal level permissible to the people raising you. (There's a whole discussion of this as it relates to behavior online that is, unfortunately, not germane to this document.) You're inhibited by this conditioning from escalating the level of violence with the other driver because when you exceed their normal violence level – or your own – one or both of you could do something unpredictable and unthinking, so both of you automatically back off and work things out rationally. Bullies feed on this. They live with a higher level of violence knowing that most people will back off and avoid violence or the thread of violence (a threat display) if they can. Law enforcement uses this to their advantage as well to control situations. They walk into a situation with a dominant demeanor and all the symbols of their job (uniform, badge, nightstick, gun), assert strongly, and watch for people who don't automatically back down. (If one makes a threat display to a police officer after they've established control of the scene, one is not likely to enjoy the result.) This is how we confront each other and how we resolve those confrontations nonviolently. For most of us, for most of our lives, this mechanism will keep us out of trouble in ways we aren't even aware of. (I highly recommend Marc MacYoung's lectures and/or website about what violence is, why Hollywood usually gets it wrong, and the whole threat/violence avoidance mechanism – http://www.nononsenseselfdefense.com/)

Consider, however, what happens if you notice a person near you is carrying a gun. They never mention it, they never gesture towards it, it's never more than *there*, but there are two different reactions going on because of it. For the unarmed person, the level of violence has just gone up, sharply. Here is someone who is tooled up to kill you. That sudden fear sticks with you. Been there. Done that. I wasn't arguing with anyone, just standing in line behind a lady at the gas station and noticed the revolver in her purse. The armed person, by contrast, believes that if the level of violence escalates out of control, they're likely to win, because they are tooled up to kill you. For them, having the gun *de-escalates* the situation, which is probably why they carry it in the first place. They feel safer. Which is better? Which is more rational? It depends on which end of the gun you're on. Understanding this difference in power and escalation is important if you are arming a character, doubly important if they are packing visibly, and it probably goes a long way toward understanding why we in America are so divided on guns. What makes it worse is that these

reactions and asymmetric escalation are largely non-rational. They happen whether we think they *should* or not.

An armed society is a polite society. This Heinleinism, unlike others, seems to be true. When you *know* someone is tooled up to kill you, even if you're similarly tooled up, you tend to be a lot less interested in getting belligerent. One notices at well run shooting ranges how friendly and *polite* everyone is. Everyone's aware how bad things could get if the situation were to get significantly violent, and lowers their acceptable level of violence internally. When my wife and I went shooting with friends recently, she remarked that well yes, this probably was a perfectly safe place to put her purse down on the table behind the firing line and turn away from it, and she was right.

The obvious exception is the Wild West Bar™ where everyone is armed and most are drunk. (Our Victorian ancestors drank like frat boys.) Once upon a time, I was at a presentation from a fellow in his 80s who could remember the Wild West times (it ended later than one might think in Wyoming.) He pointed out that Hollywood never got Western gunfights right. First, both shooters were usually so drunk they could hardly stand, and second they were usually just outside arm's reach of each other when the shooting started, so they could be sure the other would hear the insults. (As Marc MacYoung says, the word 'motherfucker' is never part of de-escalation) The classic street shootout is a thing of myth and as far as I can tell, most real shootouts resemble entirely their modern counterparts. Two armed, belligerent drunks are in a bar and one of them gets killed. The great gunslinger sheriffs were dealing with what looks a lot more like organized crime without the mythology. As one might suspect if one has read my recent fiction, I prefer my Wild West de-mythologized. See also: Unforgiven, the movie.

"You cannot invade the mainland United States. There would be a rifle behind every blade of grass." It's a good quote, truly. Whoever said it was almost certainly *not* Isoroku Yamato, the Japanese Admiral who led the Pearl Harbor attack. Likewise the saying that a well armed populace is the last defense against tyranny. In modern times neither of these really holds much water due to a newish personal saying of mine: "They have air support. You do not. It is impossible for you to win." The armed population *can* wage a guerrilla war against their government that forces the government to negotiate (See also: Vietnam), but in truth it's a no-win situation for both sides and ideally they can come up with a better solution before the shooting starts.

Still, it is a deeply rooted belief that a government whose people are armed has a lot harder time pushing them around. Fiction, particularly video games and movies, embrace this idea, because it's a good way to build a hero from someone who acts remarkably like a violent terrorist. There is also the matter that unless there's a local ammunition manufacturing capability or a huge amount of ammunition stockpiled, the armed population is likely to run out of ammunition before they are melded into a competent military force. And then there's the matter of training.

As I asserted above, most people, when confronted with violence far in excess of their comfort

level, freeze up, panic, or respond completely inappropriately. Being a warrior is a skill, and it is much more than weapon proficiency. From what I've read and seen about various special forces training, a great deal of it is about raising the trainee's normal level of violence to dull the shock of it, and about forcing the trainee to rehearse doing the right thing so many times that when the real stress comes, the automatic, unthinking reaction is the right one. Civilians don't have that kind of training, and if we're wise, we don't want it. It's not appropriate to our environment.

"You'd think they were taking away their ***ks or something" As one reads MacYoung, one becomes aware that threat displays and backing down are very much a part of (particularly) male human behavior and pecking order establishment. Guns feed into this a great deal, as described above in Normal Level of Violence, so when the brother of a friend of mine; himself former special forces (if memory serves) and the one who reminded me that most civilians are not mentally prepared to handle violence at the mass combat level; said this in our recent discussion of recent magazine size limits, *I was forced to agree with him.* In a sense, they are. To a Freudian (which I am not) a gun is blatantly phallic both in form and function. Freud had a thing about phalluses, and can be largely ignored in my opinion, especially in light of the fact that the best shot I know is a middle-aged female accountant. Still. The fact that soldiers have been lionized as brave *men* up until quite recently feeds into the whole definition of masculinity as strong, violent, destructive, conditioned to a comfort level with violence, and ready to kill. Just as Zulu warriors under Shaka were not allowed to have sex until they'd washed their spears in the blood of an enemy, guns, for some men, are a symbol of their strength, their virility, their masculinity, and one need only squint one's eyes a little watching soldiers of any recent revolution shaking their rifles at the sky and discharging them in the air to imagine Shaka's warriors. Once upon a time a man proved his worth in war. This DNA is still in our species.

"It's a Liberal/Gun Nut/Gun Grabber/Gun Maker/Racist/Anti-American (Pick your Favorite**) Conspiracy!"** People are strange about firearms. As I said above, these machines effect us on deep, non-rational levels, and when your guts are screaming that something is *wrong*, it's hard to think rationally. Some people are deathly afraid of firearms. They're afraid that the possession by people they don't know of the means to kill them puts their lives at risk. Even when presented with the obvious, that more people own cars and you're at least as likely to die in a car wreck as be shot, they don't listen, can't listen, only hear the tragic tales of mass shootings, murders and suicides. Most of the anti-gun organizations feed on these people, and go to great care to feed their paranoia. On the other side are the people who believe their guns are their right, that everyone else in the country is out to deprive them of their guns, that this is the first step to large scale abrogation of the Constitution, that they'd be left defenseless against the crazies that surround them, and so forth and so on, and they have the NRA and other "pro-gun-rights" organizations to feed on them and feed their paranoia. The fact that these two far-out sides of the debate fall upon opposing political sides is not an accident. Politicians have found that great wellsprings of money are available by kowtowing to one or the other group. No matter which side of the spectrum one falls into, there's a kernel of truth and a whole lot of extremist bullshit that serves somebody else if you look close

enough. Example: the great American conspiracy theory, about who really shot John F. Kennedy, sprang from a book funded by the KGB specifically to stir up trouble. If that's not meat for a novel, I don't know what is.

"Set Phasers to Stun." One might expect (and it was greatly feared) that less-lethal weapons would increase the frequency that such weapons are used, at least in police hands. Thus far, the studies I've seen don't bear this out. According to the DOJ, everywhere less lethal weapons have been deployed in police agencies, the numbers of injuries to both police and suspects has declined sharply. There is clear potential to abuse them (and plausible fiction is all about potential), though unlike lethal weapons, the victim is still around to complain about being attacked unnecessarily.

Firearms and Crime. Some lose statistics (drawn from multiple sources, including Wikipedia, so apply appropriate salt). According to the FBI, in 1970, the overall murder rate per 100,000 people in the U.S. was about 7.9. In 2011, it was a little more than half that at 4.7. The absolute numbers of murders also declined, from about 16,000 in 1970 to about 15,000. (The FBI's statistics vary by a few thousand depending on which report you look at.) The total number of victims declined by about 9%, despite a population increase of about 53%. Of those murders in 2011, about 8500 (somewhere between 50% and 75% depending on which report you read) were committed with firearms. By contrast, in 2011, the total rate of vehicular fatalities was about 10.38 per 100,000 people or about 32,365 total lives lost. In short, in 2011, your odds of dying in a vehicular fatality of any kind were 0.01%, and your odds of being murdered by any method were 0.0047%. If you drew one hand of poker in all of 2011, you were twice as likely to draw four of a kind than you were to die in a vehicular fatality, and about four times more likely to do so than to be murdered by any means. In the real world, the kinds of events we're talking about are vanishingly rare.

If it Bleeds, It Leads. Are we writing nonsense? Are we amping up the violence to try to compete with the news, and generally promoting the growth of violence? Is what's happening out there partially our fault? Not from the crime statistics above. Despite the bloodshed on TV and in video games rising dramatically (see Normal Level of Violence above) the murder rate has declined, spiking slightly in the last couple years due most likely to the recession. The Japanese play just as many violent video games as Americans do, but their murder rate is far lower. I think the data is in, and it doesn't seem to be our fault.

Nevertheless, having had actual, real deaths occur in my life, I can say that in my earlier fiction I was awfully cavalier about killing, dying, and most especially the scars it leaves on the survivors. One dead body is a big deal. Nearly every human being has friends, family, lovers, pets. They're part of a web of the living, and their death will send shockwaves through it. We can have small bodycounts and still have a big story. There should, in my opinion, be a cost to a killing, and it should be part of the story.

Use:

So you want to have person A kill person B, what type of weapon should you use? Whatever is handy. More rounds on target are better, as the odds of the target surviving go down sharply with each round that hits him or her. Dirty Harry carried a .44 magnum. James Bond traditionally carried a .32 automatic, which he used with great precision. Mobsters and the Mossad are said to have used .22 long rifle for assassinations. (At close range, usually to the head.) Generally speaking, the larger the caliber, the larger the firearm, both to hold the rounds and to offset the recoil with their own inertia, and the bigger the mess they make of their targets. .38 special revolvers, .32 and .380 semi automatics will fit in a pocket or a purse comfortably. .357 magnum revolvers and 9mm semi-automatics will probably need some kind of holster to carry and some clever engineering if they're not to leave a bulge in your clothes. .44 magnum and .45 semi-automatics will need a holster /and/ be visible through clothing unless you're wearing a bulky jacket over them. .22-.38 are considered low powered, although lots of dead people can attest that they're powerful enough. 9mm is considered the best compromise between power, controllability, and lethality by the U.S. Military. .40S&W is the FBI's choice. .357 magnum says you can handle a bit more recoil for better lethality. A .45 auto says you're old school and probably ex-military from the 80s or before. A .44 magnum says you're a poseur, or into the macho thing and anything heavier than .44 magnum is pure Hollywood unless you're hunting bears. Humans are not hard targets, unless they're wearing body armor. It doesn't take a monster cartridge to kill someone.

The larger the cartridge, the larger the gun and the smaller (in capacity) the magazine. The same goes for rifles, though they have the added factor of range to consider. For reference, a standard pistol shooting range is about 20 meters (for practicing). Small bore rifles have shooting range distances of about 50m, and full bore hunting and military rifle ranges will seldom be short of 100m, and may be as long as 2000m.

That said, a surprising number of people survive getting shot. Even penetrating gunshot wounds to the head have a five percent survival rate (three percent with meaningful quality of life afterwards.) Shot does not necessarily equal stopped, and neither of those necessarily equal dead. If you want to make sure your character being shot dies, shoot them again. I've heard (but cannot now find) a statistic that your odds of surviving drop by 25% with each additional shot. Location matters, obviously. So does blind luck. If you do a web search you can find all kinds of pictures of the scars of gunshot wounds. Being hit should leave a mark, possibly a disability, unless you're writing for Hollywood.

If you're writing pre-20th century, be aware that the change from black powder to smokeless powder happened in the 1890s through the early teens. Example: the standard military calibers in America today are the 5.56 NATO, which is about .223 caliber and weighs about 4 grams; the 7.62 NATO, which is about .30 caliber, and weighs about 9 grams, and in pistols, the 9mm parabellum,

which is about .35 caliber and weighs about 7.5 grams. In the American Civil War, the Union standard issue Springfield (rifled) Musket was .58 caliber minnieball weighing about 32 grams. In the American Revolution, the British standard issue musket was the smooth bored Brown Bess musket, firing a .75 caliber ball weighing about 42 grams. The big difference is velocity. A rifle seals tighter to the ball than a smooth-bored musket. (Also minnieballs were shaped like bullets and designed to expand from pressure and seal the bore of the rifle.). This results in higher velocity. and this, in turn reduces the bullet mass required. When smokeless powder came out, pressures went up, velocities went up sharply, and again, bullet masses dropped accordingly. (Reduced bullet mass means the soldier can carry more ammunition, and also brings the recoil back into manageable levels.

So it's been 16,500 words or so (hooray for automatic numbers), for something that started out as a short bit on gun technology and terminology in an email to a friend. Hope this is helpful to all y'all. As of mid 2014, (now) this document has been under construction for about two and a half years, and some of it reuses research that is much older still. Since I failed to take notes on my sources when writing it originally, there is no earthly way I'm going to be able to list them all now. I will list websites and books I quote extensively enough to remember, websites I think are full of good, related information, and so on.

Janes Guns Recognition Guide. Currently in its 5th edition, I have the first edition dating from 1996. It's a fabulous reference, and covers most of the firearms made since the advent of smokeless powder. It's really designed for law enforcement types, since they might encounter /any/ smokeless powder firing small arm made in the last century in their work, so it's a bit dry, and includes detail on operation and disassembly as well as snippets of history.

Wikipedia: There is a lot of expertise in Wikipedia, but articles may as easily be poorly researched, based on fundamental misunderstandings, outright propaganda, or simply wrong. I used them extensively for this document, but I did check their facts.

The U.S. Department of Justice and the FBI do a lot of research on crime, and a certain amount of that is devoted to firearms. These organizations both use firearms and are frequently on the receiving end of them, so it's expertise they have. Their websites are searchable, and are surprisingly forthcoming. (As is the CIA's website, especially in the job opening listings. Fascinating reading.)

The Mortal Error: The Shot that Killed JFK, by Bonar Menninger is the book from which I drew much of The Strange Tale of the M16, but I first read about that topic in a magazine article years before. I did basic fact checking as best I could with the Internet. Wikipedia has fairly complete summary of the book, though not of the chapters about the AR15/M16.