High Power Rifle: F Class

A Primer

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A NOTE FROM THE AUTHORS

The intent of this document is to provide new shooters a basic understanding of the F Class shooting discipline as practiced within the rules set by the National Rifle Association. It will be assumed that the reader is familiar with basic firearms safety and marksmanship, and has at least read about basic reloading practices.

This is not an advanced guide to cracking the top spot at Nationals, it's a shortcut for new competitors — we hope that a little knowledge can prevent a lot of frustration and wasted money.

Some of this guide is specific to the 600 yard Mid Range matches held at the Eastern Nebraska Gun Club. Much of it is general in nature.

This primer is a work in progress. It is a challenge to summarize the sport and provide enough depth of information to be useful without getting bogged down in detail. If after reading this, you have any questions or ideas for improvement (even if it's just a typo we missed), please don't hesitate to contact Damon Cali at damon@bisonballistics.com.

INTRODUCTION

What is F Class?

F Class is a subdivision of High Power Rifle shooting in which shooters shoot at paper targets at known distances at medium and long range at a slow fire pace. Where traditional High Power Rifle shooters use slings without additional support, F Class shooters may use either bipods or front rests in combination with rear sand bags. Because the additional support allows for greater precision, the F Class targets have smaller scoring rings than their traditional High Power Rifle counterparts.

Although there are a variety of courses of fire available within the rules (in the US, the primary sanctioning body is the NRA), in practice most F Class shooting is at either 600 yards (mid range) or 1,000 yards (long range). Competitors shoot slow fire (typically 1 minute is permitted per shot), and targets are scored between each shot, allowing the shooter to see where his previous shot hit the target.

A typical match might consist of three 20-shot strings for a total of 60 shots for record. Additionally, two or more sighters are allowed prior to the record shots for each string of fire (the exact number of sighters depends on the particular match).

Each shot is scored (X's count as 10's, and are used as tie breakers), and the competitor's score is that total for all of his shots. Sighters are fired and scored just like normal shots, but they do not count towards the competitor's score.

Rules - Open vs TR

F Class competitors are broken into two equipment classes - Open and TR (Target Rifle). Both classes shoot the same targets and follow the same course of fire. The difference lies in the rifles and supporting equipment.

TR: TR rifles must be chambered in .223 Remington or .308 Winchester. Any bullet weight is allowed. TR rifles must use bipods as a front rest. The total weight of a TR rifle must be less than 8.25 kg (about 18 pounds), which includes the weight of the bipod.

Open: Open class rifles may use any caliber under .35. They may use either a bipod or a front rest. The weight limit is 10 kg (about 22 pounds), which does not include the rest, but does include a bipod, if used.

For full details on F Class rules, shooters are encouraged to review the official rule book, which can be found online at https://rulebooks.nra.org/documents/pdf/compete/RuleBooks/HPR/hpr-book.pdf

Shooters are classified by the NRA with the following classifications, in increasing order of achievement: Marksman, Sharpshooter, Expert, Master, High Master. At larger matches, shooters compete against other shooters of the same classification. New shooters are classified as Masters until they have enough shots recorded to be reclassified. There are separate classifications for mid-range long-range, but not for TR or Open.

BALLISTICS

We'll start with ballistics because even a basic knowledge of ballistics will be helpful when choosing equipment and when reloading. This primer is not meant to be a mathematical course in ballistics. That said, that's exactly where we'll start. Don't worry, it will be brief. This section is fairly technical, however. But don't let that intimidate you. Absorb what you can, and come back for the rest later. You don't have to know this stuff cold to shoot competitively, and there is a summary of practical knowledge at the end of the section.

If you think back to high school physics class, you may recall Isaac Newton made some fuss about his second law of motion. It's worth digging that information back up out of your brain and thinking for a minute about what exactly Sir Newton meant when he said that force is equal to mass times acceleration.

$$\boldsymbol{F = ma}$$

In the context of basic ballistics, we have two forces to deal with - gravity and atmospheric drag, which combine to make $\boldsymbol{F}$. We also know that the bullet has a certain weight. That's the $\boldsymbol{m}$. What we really want to know is where the bullet goes, which is determined by a, the bullet's acceleration (or deceleration, which is just acceleration in the opposite direction) - $\boldsymbol{a}$. If we know the bullet's weight and the forces acting on it, we can calculate the bullet's acceleration, which will allow us to calculate exactly where the bullet is at any given time.

Notice that we can rewrite Newton's law as

$$\boldsymbol{a = F/m}$$

So lets think about what this means. It means that if we increase the force on the projectile, we increase the acceleration (or deceleration). This means more drag force means more deceleration. That seems intuitive enough.

Also notice that if we increase the mass of the projectile, we decrease the deceleration. So heavier bullets should maintain their velocity for longer, all else equal.

That's pretty much the basic physics behind all ballistics. The math gets much more complicated, but the concepts do not.

What is Drag?

So what is drag? Drag, as we said, is a force that acts on the bullet, tending to slow it down. At the atomic level, drag is the result of the bullet colliding with air molecules.

Drag depends on the bullet's cross-sectional area, its shape, the air density, and its velocity. Air density, in turn, is dependent on temperature, pressure, and humidity, so those factors impact drag indirectly. Notice that bullet weight does not impact drag. Two bullets with the same shape and size moving at the same speed will be subjected to the same drag force, even if one bullet is half the weight of the other.

Lets look at each of these factors and examine them in a little more detail.

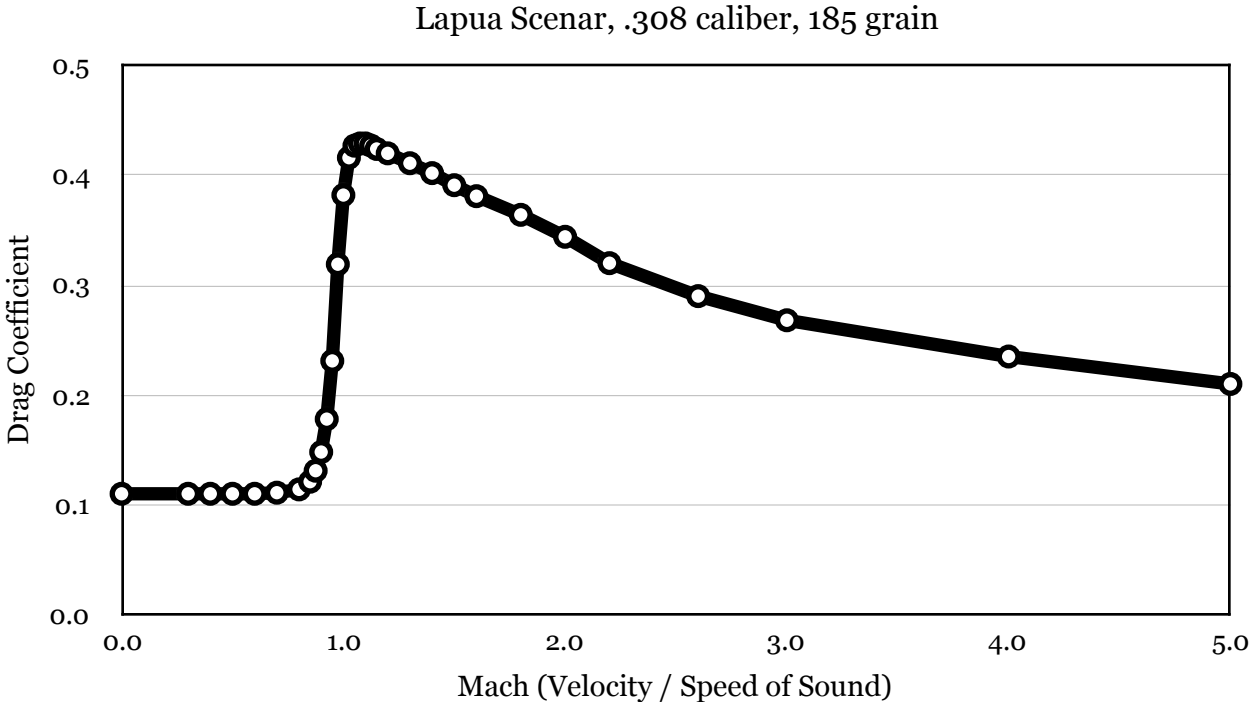
Cross sectional area. This is simple. Look at the bullet from the pointy end. It's a circle. The bigger that circle, the higher the drag force.

Air Density. Since it's the air molecules bouncing off the bullet that cause drag, it seems to reason that higher air density (more molecules to push through) would cause more drag, and that is exactly how it works.

- Lower air temperature means higher air density.
- Higher absolute atmospheric pressure (also known as station pressure) means higher air density.
- Lower humidity means higher air density. (Lots of people get this backwards. Water molecules are lighter than other air molecules, so if you replace air molecules with water vapor, it gets lighter.)
- Higher air density means higher drag.

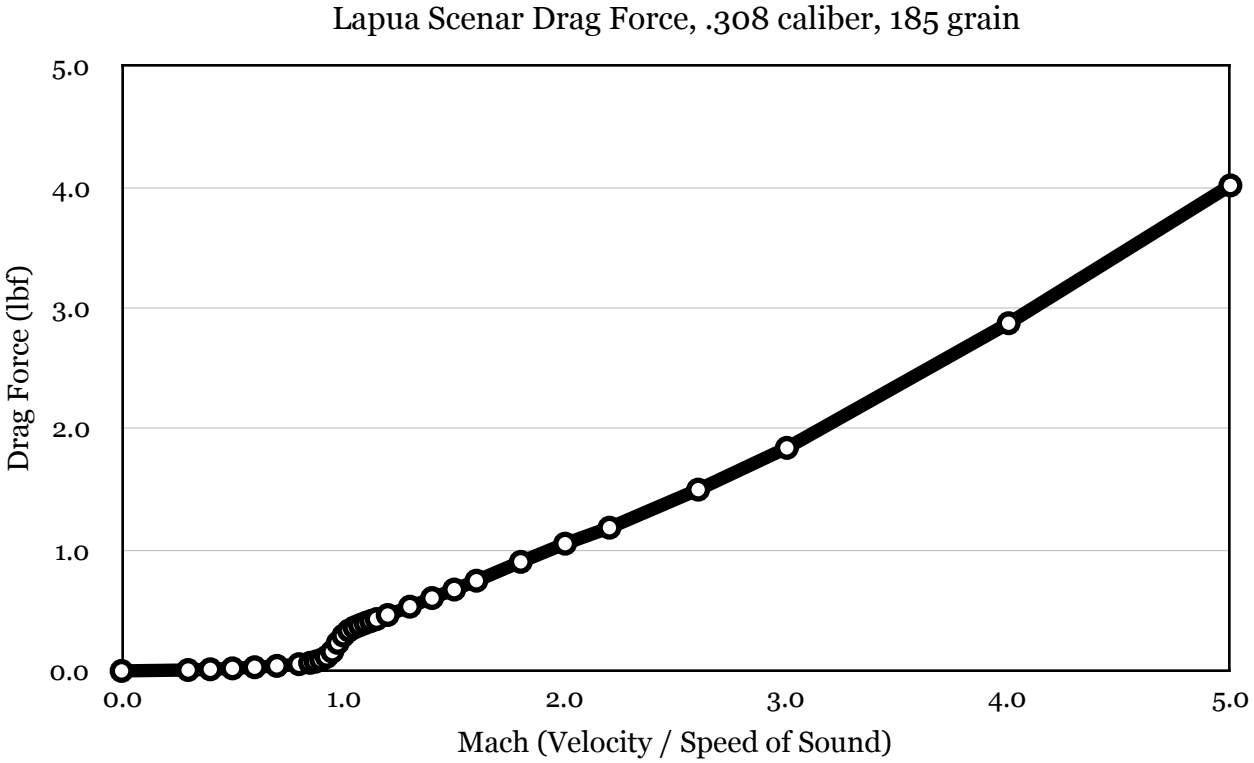
Humidity has a negligible impact on air density. You can safely ignore it. Temperature has a small but real effect at a given shooting location. What matters the most, however, is pressure, which can vary significantly at different altitudes. To get the most accurate predictions from a ballistics calculator, it's important to have good local pressure ("station", or "absolute" pressure, not what the weatherman reports) and temperature data. You can get this data from a Kestrel-type device. Or if you're cheap, a thermometer and hand held altimeter will do just as good a job.

Shape and Velocity. This is a little more complicated. Two bullets of the same caliber (that is, with the same cross sectional area) can have experience very different drag forces if they are shaped differently. Sleek, pointy bullets with boat tails have less drag than blunt rounded bullets. How the shape impacts the drag force is beyond the scope of this primer. Just know that



the shape matters.

The way engineers describe this effect is to use a value known as a drag coefficient, C_D. C_D is a number that is dependent on the shape of the projectile. To further complicate things, the drag coefficient for a given bullet is highly dependent on its velocity. The above plot shows the relationship between drag coefficient and velocity for a Lapua Scenar bullet. This is often referred to as a drag curve or a drag function.



Notice that the drag coefficient is low at subsonic speeds. Near mach 1 (the speed of sound), the drag coefficient spikes up dramatically, and then decreases as velocity increases. Note that this does not mean that the drag force decreases as velocity increases. Only the drag coefficient (the impact of the bullet's shape on drag) decreases. In reality, the velocity has a much bigger impact on drag force than drag coefficient, and the drag force almost always increases with increasing velocity.

So why does all this matter? It matters because when you use a ballistics calculator, it needs to calculate $\boldsymbol{F = ma}$ many, many times as the bullet flies from muzzle to target. That $\boldsymbol{F}$, as we'll recall, is pretty much drag. So the computer must figure out in great detail what the drag force is is in order to give an accurate trajectory. It needs the drag coefficient vs velocity chart in order to do that. So where does that come from?

It turns out that it needs to be measured for each and every bullet design. This is time consuming and expensive to do in a lab, although modern technology is bringing down the cost of equipment like doppler radars to the point where sporting ammunition companies can afford them. Still, it's an expensive endeavor and a lot of work.

What is a BC?

Another reason we care about the drag function is that it serves as a way to compare the ballistics of competing bullets. If we have two bullets of the same weight and caliber, we want the bullet that has the lower $\boldsymbol{C_D}$ at the velocities at which we will be shooting. Figuring this out is easier said than done - who wants to pore over ballistics charts when selecting a bullet? And how would you compare different velocities?

Ballistics engineers long ago figured out that no matter what bullet they were looking at, they all pretty much showed similar drag coefficient vs velocity characteristics. With some clever math they found that they could use a single standard drag curve for all bullets, and simply scale it by a factor called the *ballistic coefficient* (BC). Even better, they found a way of incorporating the

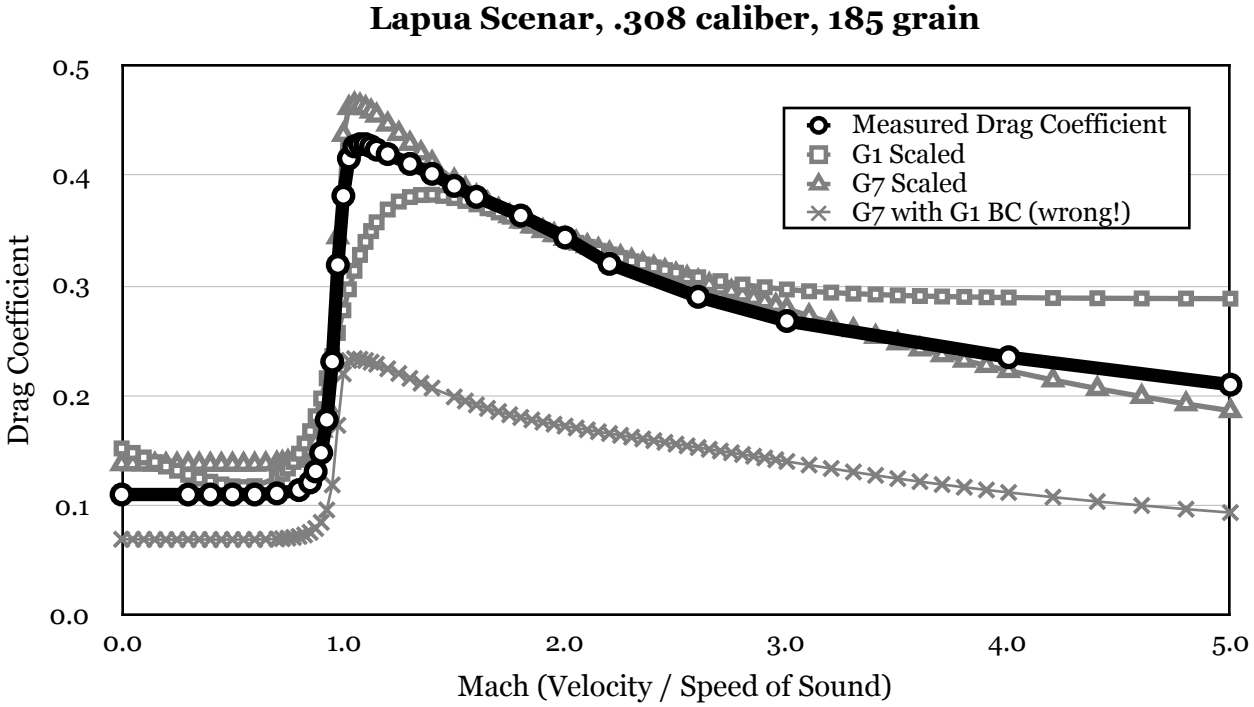
bullet's weight into BC. The benefits of this are huge. As long as the bullets' actual drag performance is similar to the standard drag curve, bullets can be compared to each other by comparing a single number - the BC. A bullet with a high BC will experience less deceleration than a bullet with a low BC if both are fired at the same velocity. (Unlike a drag coefficient, a high BC implies low drag). You don't need to know the bullet's weight, caliber, shape, length, or anything else. BC and velocity tell you everything you need to know to determine the ballistic performance of the projectile.

Repeated for emphasis:

The only things you need to know to calculate a bullet's trajectory are air density, BC, and velocity.

But what about that catch? "As long as the bullet's actual drag performance is similar to the standard drag curve…" Well for most bullets at F class ranges (out to 1,000 yards) it turns out that the standard drag function known as the G1 drag function does a pretty good job. It's not perfect, but it has been the standard in the shooting sports industry for decades. Every bullet manufacturer publishes G1 BC's and they can be directly compared.

A better alternative does exist, however. It's called the G7 drag function. For modern long range sporting ammunition, the G7 drag function is a slightly better fit than the G1 drag function, and will provide more accurate results. The G7 standard has only recently been pushed by some in the industry (Berger ballistician Bryan Litz being a vocal proponent). As a result, not every company publishes G7 ballistic coefficients. (A G1 coefficient can in no way be compared to a G7 - you must compare G1 to G1 or G7 to G7. Using a G1 BC with a G7 drag function will grossly underestimate the drag).



At the end of the day, however, at ranges under 1,000 yards, either standard will do. The accuracy of both standards is very good at the velocities we care about. Use a G7 if it's available,

but don't lose any sleep over it. It just so happens that both standards have very good agreement at the velocities we care about (typically between Mach 1.5 and Mach 3.0).

The wild divergence near Mach 1.0 is one of several reasons we like to keep our bullets supersonic all the way to the target.

How Wind Works

First of all, yes, wind will blow your bullets away from your point of aim at long range. By a lot, in some cases. Even at 600 yards, it's not uncommon to encounter wind conditions that deflect the bullet's impact by a couple feet, which is sure to ruin your score. At 1,000 yards, it's even worse. So understanding wind is critical to success in F class.

Wind is just air blowing on the side of the bullet, right? No. Wrong. This is a common misconception, but it's just now how it works. Think about it. We just got through saying that all you need to calculate a trajectory (including wind deflection), is BC, velocity, and air density. But BC is all about drag, so what about wind? If wind worked by blowing on the side of the bullet, we'd need some sort of "sideways BC" to account for it. We don't.

That's because what really happens is that the spin-stabilized projectile orients itself into the airflow. Think of the airflow as the combination of the bullet's velocity and the wind. As a result, from the bullet's perspective, all it sees is a head on air flow - which produces drag.

But since the bullet is now oriented slightly to the side (because the wind makes the overall air flow slightly sideways), the drag force is also pointing slightly to the side. (The drag force is always opposite the air flow by definition). The horizontal component of the drag force results in a horizontal deflection. The short version of this is that drag force is what causes wind deflection. That's all you need to know.

The takeaway from this is that just as BC is the best way to compare bullets' drop performance at range, it is also the best way to compare bullets' wind bucking performance. High BC bullets deflect less in the wind because they are more resistant to drag.

Stability & Twist

But what about this spin that keeps the bullet pointing into the air flow? We need it to keep the bullets from tumbling. The longer (or heavier) the bullet, loosely speaking, the more spin is required to keep it pointed the right way. In reality, even stable bullets swerve and yaw. That's ok as long as that swerving and yawing is small, and it is for properly stabilized bullets.

The things to remember about twist rates are that more twist will make your bullet more stable. A little more spin than is technically required to achieve stability can have a small positive impact on ballistic performance - you get a little better BC out of the bullet because it doesn't yaw quite as much. There are limits to this effect - a little extra spin helps reduce drag a little. More does not help.

So it's good to put a little extra spin on your bullets. On the other hand, more twist will give you a slight degradation in accuracy because the more you spin an unbalanced object, the more it will wobble. And since all bullets are imperfect, we don't want to spin them any more than we have to.

For F class and other long range shooting, it's generally preferable to use a faster twist because ballistics tend to be a more difficult problem than inherent rifle precision. Short range benchrest shooters tend to prefer the slowest twist they can get away with for the opposite reasons.

The easy way to go about choosing a twist rate is to look at the recommendations of the bullet manufacturers. They tend to be conservative and their recommendations are a good starting point for long range shooting. There are also online calculators that do a pretty good job of estimating the required twist rates as well. There is a lot more to stability than we've discussed here, but this is enough to get you started.

Further Reading

Ballistics is a huge topic, and we've just scratched the surface. For a much better treatment, Bryan Litz's *Applied Ballistics for Long Range Shooting* is by far the best book on the topic that is accessible to the non-engineer. As of this writing, the most up to date is the 3rd Edition. It is an indispensable educational source for both engineers looking for an introduction to ballistics and for everyone else. Bryan has a talent for describing the complexities of ballistics in a simple manner.

For those with the equivalent of an engineering or math degree who are looking for a more in depth treatment, Robert McCoy's *Modern Exterior Ballistics* is the standard text. McCoy summarizes the field with brevity and clarity, which made this book a instant classic. Make sure to get a copy of the 2nd edition, as the 1st edition is riddled with typos. Most of this book is heavy duty math, but there are some interesting sections that are accessible to the layman as well.

Suggested Calculators

There are a ton of ballistics calculators on the market. The most complete and basic one also happens to be the free and available on the JBM Ballistics' website (http://www.jbmballistics.com/). It more than meets the needs of the F Class shooter.

Summary

Because we covered a lot very quickly, lets summarize the things you need to know.

- Bullet trajectory depends on BC, muzzle velocity, and air density. Weight is already accounted for in BC.
- BC is a measure of a bullet's resistance to drag. High BC bullets are more drag resistant.
- Wind resistance and drag resistance are exactly the same thing. High BC bullets are more wind resistant.
- G7 BC's are preferable to G1 BC's, but only slightly. Use what you have available. You cannot compare G1 to G7 - they are different. Using a G1 BC with a G7 drag function (or vice versa) will give you wildly incorrect results.
- When shooting long range disciplines like F Class, use a fast enough twist rate to stabilize your bullet, and then a little more. This will get you the best ballistic performance possible from your bullets.

EQUIPMENT

One of the great things about F class is that it blends the technical demands of benchrest with the shooting skills of high power. To compete at the top levels of F class, you must have your equipment in order.

Rules

Before choosing your equipment, you need to decide which class you want to shoot in. In NRA F class there are two equipment classes - TR and Open (overseas rules may differ). For the specific rules, please see the NRA High Power Rifle rulebook. We'll summarize the important parts here:

> *TR:* TR rifles must be chambered in .308 Winchester or .223 Remington, and have a weight limit of 8.25 kg (about 18 pounds). TR rifles may use a bipod and rear bag. The weight of the bipod is included in the rifle's weight.
>
> *Open:* Open class rifles can be chambered in any caliber under .35 and weigh up to 10 kg (about 22 pounds). Open rifles may be shot off a front rest or a bipod (in addition to the rear bag). If the rest/bipod is attached to the rifle, it counts towards the rifle's weight limit.

One more important point - muzzle brakes are not allowed in either class. Please remove them from your rifle as a courtesy to the shooters next to you.

There are a few things to consider before choosing your equipment class. First is cost. A top of the line Open setup will cost slightly more than a top of the line TR gun, but only because a high end front rest costs significantly more than a high end bipod. Otherwise, from an equipment cost and cost to shoot, the classes are fairly similar. But Open will cost you a little more if you're on a budget.

TR takes a little more effort to shoot a good score than Open. This is due to the ballistic limitations of the allowed calibers, and to a slight advantage in gun handling ability granted by the heavier weight limit and use of a front rest. It is not uncommon to see very good TR shooters score better than average Open shooters. However, Open shooters have a clear advantage.

So really it comes down to what do you want to shoot. TR offers a respite from the arms race of choosing a cartridge that will outshoot the next guy, and provides an arguably more level playing field. On the other hand, not all .308's (or .223's) are equal and if you want to shoot competitively in TR, you'll need a very specific setup.

Open guns tend to look more like long range benchrest rifles. If you want to push ballistic limits and you enjoy technical details as much as shooting, then you'll be happier shooting Open.

Bottom line, pick a class and enjoy it. It really doesn't matter.

Caliber Selection

For TR, this isn't much to discuss. .308 Winchester is the easy choice, especially at 1,000 yard events. At 600 yards, a .223 set up to shoot the heaviest available bullets (90 grains as of this writing) can be very competitive with the .308s, and offers the advantages of being less expensive to shoot and a lot less recoil.

In Open class, the sky is the limit. Here's what you are after:

1) Low enough recoil to shoot 70 rounds a day and not regret it.

2) Low enough cost per round to shoot 70 rounds a day and not get yelled at.

3) Availability of high quality brass and appropriate (high BC) bullets

4) Pure ballistic performance

5) Reasonable barrel life.

At 600 yard matches, you'll find quite a few rifles chambered in 6mm BR, 6mm Dasher, 6mm XC, .260 Remington, 6.5 Creedmoor, 6.5x47 Lapua, and other similar cartridges. Given the proper bullets, they are all very capable and easy to shoot.

At 1,000 yard matches, you start to see the 7mm's take over, with the various flavors of the .284 Winchester being popular. The 7mms have a little more kick to them, and burn a little more powder, but the ballistics are hard to beat. You will see a few of these on the line at 600 yards as well, but they offer less of an advantage at Mid Range (300-600 yards).

Actions

Actions, honestly, are not that important, but people can be passionate about them.

First, there is nothing wrong with a stock Savage, Remington, or similar "hunting" grade actions. If you've got one, go for it. The Remington 700 is sort of the industry standard bolt action rifle and has a very robust aftermarket. A standard action can be competitive at the highest levels.

That said, there are nicer options. Various custom makers offer "clones" of the Remington 700 - essentially higher quality, closer tolerance copies of the design, with minor but significant tweaks in certain areas. Other "custom" actions are totally different designs. Things to consider when choosing an action are port location (right, left, or both), whether or not you want an ejector, the action's weight (especially for TR), available triggers, ease of maintenance, and how easy it is to single load a round. (All F Class matches require single loading - you may have a magazine, but you may not use it to load rounds). The vast majority of serious competitors choose single shot bolt actions. Having a magazine is not a deal killer, but a purpose made single shot is a little easier to work with on the firing line.

One note about AR's. You will see people shooting them and having a great time. They are more than capable of shooting at 600 or even 1,000 yards with the right bullets. However, you will not see them winning.

If you're not sure what you want, it's probably best to check out what other shooters are using and talk to them about what they like or dislike about their equipment. If possible, get behind the various options before you buy.

Stocks

Stocks are a personal matter, but there are some areas that you'll want to focus on.

First, the material. Fiberglass, wood laminates, and aluminum are all popular, and the choice is really one of preference. You should be far more concerned about the configuration of the stock than what it's made out of.

For TR, consider the weight. While this isn't a hard and fast rule, most competitors prefer to allocate as much of their weight limit to the barrel as possible, so a light stock is a good thing. The fore end of the stock needs to have a way to mount a bipod. Typically this is an Anschutz/ Freeland rail (they are similar specs, but not exactly the same). You will also see some setups

with picatinny rails or plain old sling studs as well. As long as it makes weight and securely attaches the bipod, you're good to go.

The butt the stock is also very important in TR. First, you want it straight - often stocks have some built in cast off that's helpful for position shooting, but it will make F class shooting a little more challenging. When the toe of the stock rides the rear bag, you want it to recoil straight back, not at an angle to the side.

Also, the angle of the toe matters. Some shooters prefer a level toe, and to make vertical adjustments of the sight picture by manipulating the bipod. Others prefer an angled toe so that vertical adjustments can be made by moving the rifle backward and forward in the bag, thereby raising and lowering the butt.

For Open class, you have a little more weight to play with, and shooters tend to focus on how well their rifle tracks in the bags. That means a benchrest-style wide fore end - something that is especially helpful for heavier calibers, which tend to torque more when you fire them.

You also have the same choices to make about the stock's toe, although with Open class rests, it's typically easier to make sight picture adjustments at the rest, so you'll see more level-toed stocks in Open class.

There is also no reason to avoid chassis style stocks or tube gun stocks. These are typically associated with traditional sling shooting or field shooting, but there's no reason they won't work very well as F Class stocks.

Triggers

A stock hunting trigger will work for F class. Most serious competitors, however, opt for an aftermarket trigger. This is one area you really need to consider when choosing an action. The Remington 700 and its derivatives have many, many options, while something like a Tikka has quite a bit fewer in spite of being a fine action. And if you want a Barnard Model P? Well, you are stuck with the Barnard trigger, so you better like it.

You'll see a wide variation in trigger weights and styles. Both two stage and single stage triggers are well represented on the line, and you'll see trigger weights from a couple ounces all the way up to a couple pounds. A crude guess would be that most competitors use a single stage trigger, and most shoot a trigger weight under a pound.

Triggers are very much a matter of personal preference, so as with actions, do your best to try a few before deciding on a purchase.

Barrels

A custom barrel fitted with a properly configured chamber is perhaps the single most important modification you can make to a rifle. Most F class competitors use the heaviest contour they can get away with and still have a barrel in the 28-32" long range. For TR, that means something similar to a medium or heavy Palma contour. On Open guns, you see quite a few untapered straight barrels of considerable heft.

The brand does not matter very much, assuming it comes from a reputable maker. Neither does the rifling configuration. Stainless barrels are by far the most common.

What does matter is the chamber. A good starting point is to tell your gunsmith that you will be shooting F class and that you want a no-turn neck throated for the bullets you want to use. Make sure to get a twist fast enough to stabilize those bullets.

For TR, there are some pretty standard places to start - if you want a .308, that might mean a 1:10" twist barrel throated to shoot 185 grain Berger Juggernauts or Hybrids. If you're a .223 shooter, you might settle on a 1:6.5" twist throated for 90 grain Berger VLD's.

Open class has more to consider because of the array of calibers being used, but ask around and see what other competitors are doing. Chances are very good that you'll want the same thing.

Scopes

The ideal F Class scope has high magnification - at least 36X, and preferably up to around 50X or so. It is useful to be able to favor one side of the X ring, and to do that you need to be able to see it clearly. You will also want 1/8 MOA clicks, as they offer the finest adjustment out of the commonly seen options. Reticles are a personal choice. Some competitors prefer the clean look of a simple cross hair or target dot, while others will make use of graduated reticles while dialing in sighters. You also will want a Second Focal Plane scope. F Class is a known distance, highly precise, slow fire discipline, and the finer reticle will be appreciated.

What you do not need to do is spend a lot of money. Fixed power Benchrest scopes from Weaver and Sightron can be had for under $500 brand new, and will suffice with very little disadvantage to the more expensive scopes.

Scope Mounts

Weight is really all you care about here. Get what you want. If it holds the scope, it's doing its job.

Bipods

There are a lot of bipods on the market. Without going into detail about specific models, they tend to fall into three categories.

First, you have tactical style bipods like the ubiquitous Harris. While not terribly popular among serious F class competitors, you do see them and you do see shooters shooting very well with them. The disadvantages of these is that hey tend to be narrower, and they usually require a specific shooting style ("loading the bipod") to shoot effectively, which may or may not be ideal. They are also not typically designed with the ultimate in light weight in mind.

Second, you have bipods designed specifically for F TR. They tend to be "ski type" bipods where the shooter uses the bipod more like a rest than a tactical style bipod. They also tend to be wider and more stable than tactical bipods. The only real downsides to these are that they tend to be more expensive and they're a bit awkward -you wont' want one to do double duty on your hunting rifle. The majority of bipods on the line tend to fall into this category.

Third, you have the "joystick" type bipods. These are also purpose designed for F TR, and have a "joystick" mechanism that allows the sight picture to be adjusted by your non firing hand. Usually the most expensive option, it's really a matter of personal preference and weight that will determine if a joystick bipod is what you want.

Front Rests

Open class competitors will want a front rest. The typical heavy front rest you can get at the sporting good store will do the job. But as with all things, you can spend a lot more for bells and whistles. The basic rests tend to be only crudely adjustable, and may or may not be as heavy as we'd like for F class. But they are certainly up to the task if you keep their limitations in mind.

The next step up is a higher quality (typically heavier) benchrest front rest. These are usually designed to accommodate 3" wide fore ends, and typically have some mechanism to adjust both

windage and elevation while shooting - at a bench. Sometimes these can be a little awkward to use in a prone position, so keep that in mind, as some configurations are a little more convenient than others.

At the high end there are several semi-custom (and very expensive) rests that are purposefully designed for F class. They're big, heavy, finely made works of art. These are not the sort of gear that's typically recommended for beginners due the cost and the specific nature of the features, but at the end of the day, they're just fancy rests. It's probably worth putting off the purchase of one of these until you've settled into Open class, and you have an idea of what exactly you want out of your front rest.

Rear Bags

Most shooters use benchrest-style rear bags are used for both TR and Open. Higher quality bags all work well, and you'll see all the manufacturers represented. There's not much to say about rear bags other than that heavy is good, and you want to pay attention to the height and configuration of the ears and make sure it's a good fit for your stock. Unfortunately, there's not a terribly good way to know which bags work for you other than to try them.

You will also see some shooters using softer "tactical" style sand bags that are designed to be squeezed by the non shooting hand to make fine sight picture adjustments. There is no right way to use a rear bag - you just have to test and practice to find out what works best for your shooting style and equipment.

Additional Gear

In addition to a rifle, bag and front rest/bipod, you will need some additional items.

Ammunition: Find out how many rounds you will need for the match before hand. don't forget to include sighters and any blow off (fouling) rounds you will need. It never hurts to bring a few extras in case there is any confusion on the line that requires more shots to be fired.

Shooting Mat: You don't technically need this, but almost everyone uses one. It keeps your clothes clean and provides for a little comfort, especially on concrete or wet surfaces.

Eye and Ear protection: This is obvious, but you really need this.

Open Bolt Indicator: Also called an Empty Chamber Indicator (ECI), this is nothing but a plastic flag designed to be inserted into the rifle's chamber so that it is rendered safe in a manner that is visually obvious. They are required.

Spotting Scope: You can use a spotting scope to read mirage if you want, but you will absolutely need one for scoring. If you don't have one, don't worry. You only need one for every three shooters, and the chances are good that someone will have one. But do bring one if you have one. A good quality 60-80mm scope around 25-30x is ideal. A Long Eye Relief eye piece is also nice to have so that it doesn't interferer with shooting glasses.

Folding Chair/Stool: You need somewhere to sit when scoring.

Tool kit: Make sure to bring whatever tools you need for your rifle. You would be surprised by how many matches are ruined by a loose screw here or there. Even if you don't need it, someone else will thank you for thinking ahead. A cleaning rod is also helpful in case of a stuck case or bullet.

Food and Water: A typical match lasts the better part of a day. Bring enough food and especially water to keep you going through the summer heat.

Sunscreen and bug spray: Don't forget sunscreen and bug spray for obvious reasons. A brimmed hat of some sort is also a great thing to have when the sun comes out.

Rain Gear: Some light rain gear comes in handy in case of bad weather, as does a small tarp to keep your gear dry.

Cash: Money for the entrance fee. Do not count on the match being able to take credit cards or checks.

Pen/Paper/Clipboard: Sometimes it's nice to take notes during a match. Some shooters like to log every shot. Others don't. In any case, it's good to be prepared with a pen, paper, and clipboard to note the conditions, zeros, and other bits of information that you find pertinent.

RELOADING

Precision Requirements for F Class

F Class is a precision rifle sport. There are no two ways about it - in order to be competitive, you need a very accurate, very consistent rifle. Consider that the X ring is about 1/2 MOA, and the 10 ring is about 1 MOA. A general rule of thumb is that in order to be competitive, you need a rifle capable of shooting 1/2 MOA for 20 shots. No flyers allowed. It's not uncommon to see 600 yard Open class scores of 600-35x win matches. TR matches tend to top out in the high 590's, but on a calm day, the best shooters will score a clean (200 out of 200) once or twice a day in calm conditions with the lowly .308 (or .223!).

This Primer assumes that the reader is already reloading and is familiar with basic reloading. This section exists to point out some of the details that are pertinent to F Class shooters.

Selecting Brass

Consistency is the aim when picking brass. The high end brands (Lapua, Norma, and the like) dominate F Class. It's pricey brass, but it's good, strong, and consistent. There's not much more to say about brass, other than to buy it in bulk, preferably all from the same lot.

There is one note about .308 brass from Lapua. They make a special match grade brass called "Palma" brass that is the same as their normal .308 brass, except it uses a small primer instead of a large primer. This provides for slightly improved ignition and greatly improved brass life. If you are shooting a .308, Lapua Palma brass is a no-brainer. The only downside is that erratic ignition can occur at very cold temperatures. This is not typically a problem at F Class matches, which tend to be in at least decent weather.

Selecting A Bullet

As we saw in the ballistics section, the only things we care about are BC and velocity. You want the most you can get of both. But high BC bullets tend to be heavy bullets, and heavy bullets tend to give up velocity to lighter bullets fired from the same rifle. So what do you chose? The high BC ones. At long range, the benefit of the high BC wins out over the slightly higher muzzle velocity of lighter alternatives.

Generally speaking, you will want something in the weights listed here:

Caliber	Recommended Bullet Weight
0.224	80-90
.243 (6mm)	105-115
.264 (6.5mm)	130-140
.284 (7mm)	170-180
0.308	185-200

F class competitors almost exclusively shoot hollow point boat tail match style bullets.

Note that these bullets are on the heavy end of those available for that caliber and will require a fast twist capable of stabilizing them. You won't get a 90 grain .224 bullet to stabilize out of a 14" twist. So make sure your rifle is capable of shooting these specialty bullets.

Selecting A Powder & Primer

There isn't much to powder and primer selection that is specific to F Class. Things to keep in mind are that in addition to good precision, your load also needs to have a high velocity, and very consistent velocity. At long range, ballistics become as important if not more so than the your load's intrinsic accuracy.

Measuring the variability of your velocity with a high quality chronograph is advised. Changing primers can be a good way to improve velocity variation if that is giving you trouble.

Also, keep in mind that you'll probably be shooting a rifle with a longer than "normal" barrel and very heavy bullets. That means the powders you select might be a little different from he ones you choose for your hunting rifles. QuickLOAD software is recommended as a valuable aid in selecting a powder, but it is not necessary.

Advanced Reloading

F Class matches are typically 60 rounds for record. That's a lot of shots you need to keep inside 1 MOA in order to score a perfect score. It's important to note that shooting a few 3-shot groups, noting that one or two are about 1/2 MOA does not mean you have a 1/2 MOA rifle. At least not in the sense that's required for F Class.

A competitive F Class rifle requires rigorous load development that will result in a rifle capable of holding 1/2 MOA 5-shot groups every time.

That's a pretty tall order, and one that can be discouraging for new shooters. But reloading is like any other skill to be learned. There are tricks and tips that can help make small improvements one step at a time.

Assuming you have a capable rifle, here is a list of topics you should look into if you feel like your reloading skills aren't living up to your rifle's potential.

Brass Sorting: Sorting brass by weight or capacity is something some shooters do to try to get more consistent internal case volumes, and hopefully more consistent velocities. Using high quality brass (like Lapua) eliminates the need for a lot of this work, but even the best brass has variations.

Bullet Sorting: First and foremost, do not mix bullet lots. Bullets vary significantly from lot to lot, and can have BC's that change by as much as a few percent between lots. That makes a big impact on the target at long range. Even within a single lot, it's not uncommon to find bullets of varying length (as measured from the bullet's base to a datum ring on the ogive, as measured by a comparator tool like the ones made by Hornady). Some brands need a little more sorting than others, but it doesn't take long to do and is worth the effort.

Bullet Trimming and Pointing: Due to manufacturing methods, bullets come out of the box with a tip that is a little ragged (inconsistent) and a little larger in diameter than is optimal. There are two operations you can perform to help this condition. The first is trimming, which is just using a special trimming tool to trim the ragged part of the meplat (bullet tip) back slightly, increasing consistency.

However, trimming the bullet increases the size of the meplat, which increases drag. So some shooters run the trimmed bullets through a pointing die to close the tip back up.

Trimming, pointing, or both can help increase the bullet's drag characteristics and/or consistency.

Neck Turning: Even good brass has a variable neck thickness. It's not uncommon to find brass that is one thousandth thicker on one side of the case than the other. This eccentricity is a hindrance when it comes to consistent seating force, and to starting the bullet into the lands as straight as possible. Shooters have found that neck turning can increase the uniformity of case necks for overall more consistent loads. There are lots of ways to trim necks, from hand held tools to full-sized lathes.

Chronographs: Keeping consistent velocities is an important part of long range shooting. If velocity varies too much, your groups will grow taller as range increases. So keeping an eye on velocity is something worth doing. One thing to note is that not all chronographs are created equal. The cheaper optical models can be more trouble than they're worth, and many aren't capable of measuring as accurately as we required. The Magnetospeed models that attach to your rifle's barrel are noted to be very accurate and convenient. However, attaching a weight to the end of the barrel can influence how it shoots, so they're not advisable during load development. The new Labradars are also reportedly very accurate, and perhaps even more convenient as you don't need to set it up down range or attach it to your rifle.

Internal Ballistics, Custom Chambers & QuickLOAD: When trying to get the most ballistic performance out of your rifle using heavy bullets in long throated chambers with longer than normal barrels, you will eventually figure out that reloading manuals don't give you quite the information that you need. QuickLOAD software is a program that calculates internal ballistics based on cartridge and barrel dimensions, bullet properties, and the propellant used. It's a very helpful tool when operating at the edge of reloading data, and can be an indispensable tool for keeping pressures at safe levels while getting the most out of your specialized equipment. It has a bit of a learning curve, but it's not terribly difficult to work with, and has a detailed instruction manual. The cost is about what a few reloading manuals would run, but it's worth quite a bit more.

SHOOTING A MATCH

Registration

The first step in shooting an F Class match is to find an F Class match. Most clubs that have decent sized matches are welcoming groups and are trying to make their matches known. Unfortunately, there is no central source or match calendar. You just have to ask around. If you don't know anyone shooting F Class, check out the forum section of http://accurateshooter.com , which is probably the most active online forum for F Class shooters. Someone there is usually eager to help a newcomer.

The next thing to do is contact the match director for the matches you're interested in attending. Running a match is a lot of work and the pay is typically zero. So do be respectful of the match director's time and do your research first. But they're doing this to help you, so don't be afraid to email/call if you need some help. Some matches will ask you to register before hand, while others allow you to show up the day of the match and shoot. When in doubt, let the match director know you'll be coming, and that this will be your first match.

For your first match, try to show up a little early. The extra time will let you get the hang of how things run, meet some people and give you some time to ask questions of the other competitors in a casual setting. Once the match begins, there's not a lot of time for talking. Do be respectful of others' wishes before the match. Some shooters love to talk, while others prefer to focus on the upcoming day's shooting.

Basic Range Prep

Before you show up, find the best load you can for your rifle (with appropriate long range bullets), and at the very least get a good 100 yard zero. If that's all you can do, also make sure to run your rifle's specs through a ballistics calculator to get a good idea of what your 600 yard zero will be. Ideally, try it out before hand. It's not a good time to spend your sighters trying to get on paper. In the worst case, wildly inaccurate shooters will be asked to stop shooting. A little preparation will help things go smoothly.

Equipment Check List

This should be obvious, but don't forget anything. We've all done it, but things run a little more smoothly when we don't. You can use this primer as a starting point. Matches typically involve an early morning drive, so the best time to get your equipment squared away is the night before. Do your reloading earlier if possible. Reloading under time pressure isn't smart.

Safety Brief

A match typically will include and introductory safety and operations brief by the match director before shooting starts. This is not something to skip or take lightly, as it will include information about the match day you need to know in addition to the important safety reminders. Once the brief is over, you will be organized into groups (typically 3 competitors) who will be assigned to a target for the day. The way this is done depends on the match, but you will be assigned a schedule where you will have one of three duties throughout the day. Shooting, Scoring, or Pit Duty. Every competitor will perform all three roles at some point. Remember - we are all required and obligated to call a cease fire at any time an unsafe condition is observed.

Shooting

Shooting is simple - it's what we're here for. You will have an opportunity to shoot "sighers", which are shots that are scored normally, but do not count towards your match score. Sometimes there are unlimited sighters, sometimes they are limited in number. Do use them to get your zero squared away, as once you "go for record" you cannot go back and use any unused sighters.

After sign in you will be assigned a target number and relay number. The target number designates where you will shoot, score, and pull targets. The relay number determines in which order you will do these tasks. Enter your target and relay numbers on your score sheet.

When it is your turn to shoot, you may bring your equipment (except rifles) to the firing line. DO NOT bring your rifle until the command, "Relay (#) bring your rifles to the line" is given by the Line Officer. You must keep the empty chamber indicator (ECI) in your rifle at all times until your block time begins. The Line Officer will give the command when the block time begins and firing is authorized. The 25 minute block time allows for 3 minutes of preparation and 22 minutes to fire two sighters and 20 rounds for record. Actual time spent in preparation is at your discretion. When the 25 minutes are up, the Line Officer will give the cease fire command if shooters are still firing. Any shots not fired will be scored as misses unless additional time is authorized by the Line Officer.

When your 22 rounds have been fired, insert your ECI and remove your rifle from the line as soon as possible. The Line Officer may not release the pit personnel (unseal the pits) until all rifles are off the line. After your rifle is removed, check and sign your scorecard and remove the rest of your equipment in a timely manner.

During firing, any communications from the shooter should be relayed through the scorer to the Line Officer. Such communications may include requests to score target, reverse spotter (from black to white), check scoring, change spotter size, speed up target service, and so on. Shooters are encouraged to communicate with their scorer so it is clear when the first shot for record is fired and both agree through the string of fire as to how many shots have been fired. This should eliminate missed shots by the scorer.

Shooters are reminded that all F Class shooting is loaded single shot, i.e. no magazine or semi-auto loading. Safe gun handling requires that ECIs be in all chambers until firing is authorized. Do not load ammunition unless the muzzle is pointed downrange at the targets. Keep fingers off the trigger until ready to fire. Anyone seeing an unsafe condition should call a cease fire. If a cease fire is called, unload rifles, insert ECIs and move back from the firing line. Additional information can be found in the High Power Rifle Rules on the NRA website.

Scoring

The competitor charged with scoring is the one responsible for recording the numerical value of the shots for the shooter throughout the string of fire. That is not the only duty of the scorer, but it is the main one.

Scoring requires a spotting scope and something to sit on. Before the match begins, the shooters in each target's squad should get together and decide how to set up scoring. The simplest method is to use one scope and chair for everyone through the match, if that is satisfactory to all.

The best way to set up is to sit behind the shooter in line with him and the target and close enough that you can communicate. At that time you should have the shooter's score card, preferably on a small clipboard, and a pen or pencil to write with. After each shot, as the target is hoisted the scorer observes the orange 5-inch scoring disc (or a black one if the shooter has requested it), enters the score on the shooter's score card and announces the score to the shooter. For the details of how and where to place the scoring marker, please refer to the NRA rule book (and feel free to ask for help from more experienced shooters). It's pretty straightforward.

Terminology is as agreeable to the participants, but the following is a common and efficient method. As the target is revealed the scorer announces: "Ten, five on", where 10 is the value of

the shot and 5 means the shot was the 5th shot of the record string. If both participants pay attention to the announcements, there should be no discrepancy between the number of shots fired and the number that are scored. If the shooter requests that the shot value not be called out, he forfeits the right to challenge the recorded score.

Unfortunately, there sometimes is a discrepancy especially when inexperienced shooters are scoring. If you will follow the procedure below it will eliminate most missed shots:

1. Do not look constantly through the spotting scope, but watch the shooter to see when he fires.

2. As soon as he fires watch his target to see that it is lowered for scoring. If it is not lowered within a few seconds, and it does not appear that a cross fire has occurred, ask the Line Officer to "mark target 5". He will then radio the pits and the target puller will be asked to pull the target down. Do this in a timely manner so the shooter doesn't have to do it for you. If you think a cross fire has occurred (someone shot the wrong target), stop and get it sorted out with the Line Officer.

3. As soon as the target is lowered, then look through the spotting scope to see the score as the target is raised. Check to see that the spotter (where the bullet hit) and value marker (the orange disc) agree. For example, if the spotter is in the x ring and the value marker shows 9, that needs to be resolved.

4. After marking and announcing the score, watch the shooter again for the next shot, and so on.

One method for coping with difficult winds is to fire all your shots as quickly as possible. With quick target service a shooter may shoot as many as 6 shots a minute, in which case it is easy for the scorer to miss a shot. A quick shooter may be firing while you are still recording the last score. Such a situation requires close attention. When your shooter has finished his string, add up his score and x count and enter it in the score box. Then sign your name on the scorer line and insure that the shooter signs his name on the shooter line.

Additional scorer duties include:

- Relay shooter's requests to the Line Officer.

- Verify that the rifle is unloaded and in a safe condition at the completion of a string of fire.

- Insure that the ECI (empty chamber indicator) is in place before the competitor's departure from the firing line.

- Insure that the score card is delivered to the statistical office at the completion of the match. Usually, this means turning the score cards into the Match Director all at once at the end of the day's firing.

All squares on the score sheet must contain either: and "x", the numerical score of that shot , or an "M" for a miss (do not use 0 for a miss). Sighters must be taken and scored for each match per NRA rules.

Pit Duty

As we just discussed, there is a competitor in the pits pulling and marking targets. This isn't always the most fun, but it's important to give a solid effort while in the pits, as the shooter is counting on brisk, consistent pit service.

After the shot is fired, you will see it hit the berm behind your target. That's when you pull the target down. If you have any doubt about whether a shot was fired, leave the target up. They will radio down to the pits if a shot is missed.

Pit service can be a stressful thing for new shooters, so take your time and don't be afraid to ask for help. You'll get the hang of it quickly once you see how it works.

Transportation to the pits is by private vehicle – please no walking. Keeping a match on schedule requires that changing out the pit crews happens as efficiently as possible. There is a parking area on the right side of the pits behind a berm.

Pit crew duties are at the command of the Pit Officer, who will be at a centrally located target and will have a radio for contact with the firing line. Firing may not commence until the pits are "sealed". This means all members of the pit crew are on the catwalk at their designated targets. The pits will be sealed before rifles are brought to the firing line and may not be unsealed until all rifles are removed from the line. If you have to use the restroom, do so before the pits are sealed to avoid delays.

Target supplies are located in black .50 caliber ammo cans. Each can contains the supplies for three targets and will be located at the center target of the three. This means your can will be located either at your target or at the one immediately to your right or left. Before firing starts, locate your can and remove 2 orange value markers, two each large and small spotters and black and white pasters (stickers to cover the bullet holes) to use at your position.

Prior to firing each member examines his target and pastes any visible bullet holes – black pasters in the black area and white pasters in the white area. When all targets are ready the Pit Officer will command all targets to half mast. At this position only the top half of the target is visible from the firing line, and this signals the Line Officer that the pits are sealed and ready.

On signal from the Line Officer, the Pit Officer commands "targets up", and firing begins. It is virtually impossible to see when a bullet strikes the target, so each pit crewman watches the bare earth of the impact zone immediately behind his target to determine when the shot arrives. Usually it is easy to see if a bullet hits. Sometimes (when it's damp out, for example), it can be more difficult. If you have any doubt, just wait. If a shot was fired, the line officer will radio to the pits and ask you to pull the target.

When you see the shot splash in the dirt, do the following:

1. Immediately lower the target.

2. Locate the new bullet hole and insert the spotter. Use the white side of the spotter in the black area and black side of the spotter in the white area for contrast.

3. On second and subsequent shots, put a paster over the old bullet hole – black on black, white on white.

4. Move the 5" orange value marker to the value of the most recent shot. If a shot touches a target ring line, even slightly, it should be scored as the higher value.

5. Raise the target.

With a little practice this can be done quickly and accurately. You should aim for 10 seconds or less. A good technique is to tear off a strip of 22 black pasters and keep them in your hand for quick use (2 sighters and 20 shots for record). As you use them up you can see how many shots remain. You seldom use the white pasters, but keep a few handy just in case. Also the spotters will get holes in them and it's a good idea to keep the white side pasted up.

After three rounds (60 shots + any sighters) the target centers are pretty well chewed up and need to be refaced. There will be target centers (the square section of the target containing all of the 9 ring and part of the 8 ring, about 15 inches square) and glue available for this purpose. For precision placement, spread the glue onto the target and place the new target center over the fresh glue. Make sure the target's rings and numbers line up with the center's, and then use the wall paper brush to smooth out bubbles or creases.

The main reason the targets need to be refaced is that the white scoring circles get covered up by black pasters. A little care in this area can make the faces last much longer. When you find a bullet hole in the white circle just cover it with the minimum amount of the paster necessary using the corner of the paster and keeping the rest of it off the circle.

When your pit period firing is complete, clean up your target and reface if necessary before leaving for the firing line.

A few words about safety:

Eye and ear protection are required for pit duty. The supersonic crack of the bullets is still very loud in the pits, and debris will fly about occasionally when a bullet strikes a spotter, a target frame, or the berm above the catwalk. A spotter hit by a bullet will be moving with enough velocity to leave a welt. You do not want to get hit in the eyes.

Occasionally a spotter or value disc may end up on the ground behind the target. DO NOT leave the catwalk to retrieve these while firing is going on. Although you are shielded from direct bullet strikes, the dispersal of debris or ricochets in this area is unpredictable.

If a thunderstorm is threatening, there is danger of lightning in the pit area. If this determination is made, quickly move all targets to the trailer, close the ammo cans, and take cover in the vehicles. We do not shoot in a steady rain because the water dissolves the glue that holds the targets together and prevents pasters from sticking to the face.

Stay hydrated ,especially on hot days. There is a water jug in the pits and near the firing line. Do not forget sunscreen during pit duty, as there lis little shade, especially earlier in the day.