

F Class Target Shooting Techniques

Level 1

Forward

This course comprises:

- Course Instruction contents (1 page)
- Course Instruction (20 pages)
- Shot Diagnostic Chart (1 Page)
- Learning Outcomes (2 pages)
- Assessment (8 pages)

This Course was originally designed to be delivered by a Certificate iv or higher Trainer and Assessor, comprising 1 full day, with the Training delivery taking the morning and the Assessment taking the afternoon.

The Course was envisaged to be an “in house” course for the Rosedale Rifle Range and its F Class shooters, however after some persuasion the course is being made available electronically. This is a far better outcome to benefit all F Class shooters, not just those based at the Rosedale Range and I endorse this increased exposure.

Please appreciate the difficulty in presenting a worded document versus a document being delivered by a Trainer. Many misconceptions and interpretations can be corrected in a Training situation or in a “one on one” Assessment.

Accept the document in the spirit in which it was written, and that is to increase the basic knowledge of all F Class shooters. If the reader takes away just one point from the Course that improves his/her shooting....then I will have achieved what I set out to do.

This Course is the culmination of many months of fact finding research and many years of refining shooting techniques by many people. It is most certainly not all my work. Thank you to the many people who have contributed their experience and knowledge to this project.

Rod Dolman
President
Rosedale Rifle Range

F Class Target Shooting Techniques

Level 1 course instruction

Contents

Safety.....	Page 1
Setting the rifle onto the front rest/bi-pod.....	Page 2
Front rest-prone shooting.....	Page 3
Front rest-bench rest shooting.....	Page 4
Setting the rifle onto the rear sand bag.....	Page 4
Geometry of the shooting position.....	Page 5
Behind the rifle.....	Page 6
Head position.....	Page 6
Holding the stock.....	Page 7
Cheek pressure.....	Page 7
Shoulder/butt position and pressure.....	Page 7
Trigger release/Pistol grip/Trigger finger.....	Page 8
Breathing.....	Page 9
Follow through.....	Page 10
Rifle scope.....	Page 10
Focusing the reticle.....	Page 10
Parallax.....	Page 11
Steps to reduce parallax.....	Page 12
Levelling the reticle.....	Page 12
Marrying the scope to the rifle.....	Page 13
Ballistics.....	Page 14
Rifling-twist.....	Page 14
Gyroscopic stability.....	Page 15
Ballistic coefficients.....	Page 16
Trajectory.....	Page 17
Minute of angle-MOA.....	Page 17
Atmospherics and wind.....	Page 18

F Class Target Shooting Techniques

Level 1 course instruction

This course is designed for prone and benchrest target shooting, to improve the shooters knowledge of:

- **Firearm Safety**
- **Knowledge of F Class Shooting Techniques and Equipment**
- **Marksmanship**

At the completion of this course you will be assessed for Level 1 F Class Target Shooting Techniques certification.

1. FIREARM SAFETY

As you have your firearms licence, you will have passed the required safety test. That test will not be repeated here and it will be assumed that the participant has the required safe attitude to own a rifle.

There is one word I associate with firearm safety:

- **RESPECT**

Respect for yourself, your rifle and your fellow competitors...the people around you.

It is a privilege to own a rifle, not a right. Be aware of the minute details of your rifle. You must know at all times the exact state of your rifle, where it is, where the bolt is, when it was last cleaned, how many rounds fired since it was last cleaned, the elevation and wind settings for your last shoot. Know everything there is to know about your rifle and be fussy and precise.

Keep dirt and water out of the barrel. Keep the bedding dry and clean. Grease the bolt lugs. The moment you do not respect your rifle is the very moment it will not respect you.

Safety is measured by ACTIONS....your actions!

NEVER, FOR ANY REASON, POINT A RIFLE AT ANYONE
TREAT EVERY RIFLE AT ALL TIMES AS THOUGH IT IS LOADED
LEAVE BREECH OPEN WHEN NOT FIRING
ALWAYS OBEY THE INSTRUCTIONS OF A RANGE OFFICER
KEEP FINGERS AWAY FROM TRIGGER UNLESS AIMING AT THE TARGET
REMEMBER....SAFETY IS NO ACCIDENT, **IT IS YOUR RESPONSIBILITY!**

We enjoy a sport where there is no room for error. Safety is paramount in everything we do.

Whilst at the Range, the Range Officer is the all knowing, merciless God of your universe. Safety procedures are there for a reason and they are not flexible. You must have a working knowledge of these safety procedures or your stay at the Range will be exceptionally short.

These safety procedures are outlined in the RANGE MEMBERS HANDBOOK. **READ IT!**

Whilst at the Range the chain of command is: Range Officer.....Scorer.....Shooter.
In the event of a misfire you **MUST** advise the SCORER, who will advise the RANGE OFFICER.

The SHOOTER will not start shooting until the SCORER has **CLEARLY** signalled to commence.....look at your scorer to get the signal to commence.

The SCORER is at all times under the direct control of the RANGE OFFICER.

2. SETTING THE RIFLE ONTO THE FRONT REST/BI-POD

Rifle with back bag
and F Class bipod



Bi-pod: There are 2 types of bi-pods. The “Harris” and “Atlas” type is a lightweight, flip down, swivel bi-pod with 2 adjustable legs. It attaches to the stock fore-end by lug attachment or bi-pod indented rail. When using this type of bi-pod, load the bi-pod up by forward and downward pressure. This will require a little shoulder pressure at the butt and a firm trigger hand grip.



Harris Bipod



F Class Bipod

The position of your left hand (for right-handed shooters....and vice-versa for left-handed shooters) is variable, depending on the calibre and your comfort position. For heavy recoil rifles many shooters prefer to hold the rifle stock with the left hand as an additional brace. This can interfere with accuracy unless your hold is controlled and precise. Refer to Section 4 for additional information.

The preferred method is left elbow on the ground with the left fore-arm tucked across the chest lightly touching the rear bag or right elbow. This method forms a rigid skeletal 3 point brace, with the rifle forming an extension of the skeletal structure.

Heavy recoil will cause a variety of additional control problems. If you have heavy recoil, consider a lighter projectile, "limb-saver" butt pad, recoil reducers, muzzle- break (where permitted) or even a smaller calibre. Target shooting is all about accuracy and little about the weight of the projectile or how fast it is going.....more about this subject in the ballistics section, but suffice to say at this point that bigger and faster is not always better.

The second type of bi-pod is the aluminium braced F-Class bi-pod that attaches to the stock fore-end by indented rail. This bi-pod construction is popular among target rifle shooters and weighs around 1.5kg, giving some added weight to the rifle and a more stable front rest system. For right handed shooters ensure the elevation adjustment knob on the rest is positioned to the left side of the rifle and is comfortably within reach when you are laying behind the rifle. This allows easy access for elevation adjustments. Do not hold or rest your hand on this adjustment knob when firing as this will cause flyers at 3 o'clock and 9 o'clock. These shots will appear to be windage shots and any windage correction may cause "bunny ears"a 3 and 9 o'clock shot either side of the center bull.

Front Rest-prone shooting: Setting your rifle up on a front rest can be time consuming. It is important the rest is placed firmly into the ground with the ground pins and levelled using the screw adjustments on each of the feet. Check the scope cross hairs are level to the target. Adjust if necessary. The front sand bag must be level on the front to rear axis. If this axis is tilted the stock fore-end will not make full and consistent contact with the bag and will cause elevation shots.

F Class Front Rest



If you are shooting from a concrete mound, remove the ground pins from the adjustable feet on the rest- if these are fitted, as these pins will substantially increase the height of your front rest and overall rifle height. Apart from the instability you run the risk of damaging the pins.

Once levelled, lock each of the feet into position using the locking nut on the leg screw adjustment. Lock the main adjustment wheel before shooting and use the rear leg screw for minor elevation adjustments.

It is common for the stock to settle into the rear sand bag after several shots and this will have the effect of marginally elevating your barrel. During your shoot, you may therefore need to re-set your elevation using the main wheel adjustment. Lock the wheel into position after adjustment.

During your shoot, check that the cross hairs remain horizontal throughout the shoot.

Do not over tension the front rest sand bag side lugs onto the rifle stock. It is essential your stock tracks smoothly to the rear under recoil across the sand bag. A front bag tight grip may "torque" the rifle – R/H barrel twist will push the stock and barrel high left – and this will result in flyers. A "Dry Glide" silicone lubricant spray will assist with this function. One application every 100 or so uses is usually more than sufficient.



Front Rest showing side tensioning screws



Front Stop Lug

Your front rest will have a stop lug fitted. Make sure the rifle is returned to the stop lug before each shot. Failure to do this may result in elevation shots. (see photos above)

Front Rest-benchrest shooting: Front rests designed for benchrest shooting will have screw pins on each foot of the rest, but will not have a ground pin attachment. Ensure your rest is firm and level with the rifle stock laying flat in the front bag. All the above comments are applicable.

3. SETTING THE RIFLE ONTO THE REAR SAND BAG

Your rear sand bag should be full and as firm as possible. Put the sandbag onto a firm base. With benchrest the table will suffice. For prone shooting the bag should ideally be placed onto a wooden/metal base that will not tilt or slide.



Rear Sand Bag in correct position



Rear Bag too far forward

If you shoot on a mat, cut a hole in your mat so the bag and base is on the ground. If you place the sandbag on your mat you may get "bounce" and elevation shots. Also sandbags vary in shape....you need to work out front from rear. The photo above shows the most popular position for this type of sandbag.

Place the rifle stock firmly into the sandbag ears with a small amount of pressure, keeping the sandbag positioned towards the rear of the rifle stock.

If the pistol grip hits the sandbag under recoil you will get elevation shots, so ensure the bag placement is well towards the rear of the stock for each shot. When using a bi-pod, it is common for the rifle to creep backwards over several shots due to recoil.....the bag may then slide unnoticed towards the pistol grip (see photo above).

If you start having unexplained elevation shots, check your rear bag for stability and position on your stock. Movement of any kind of the rear bag will have an impact on your shot.

4. GEOMETRY OF THE SHOOTING POSITION

Some F class shooters touch the rifle in as few places as possible when shooting. Others shoot the traditional method, with a firm hold, butt into the shoulder, firm pistol grip, body skeletal tri-pod etc. Others have a mixture of both.

You will see many and varied prone shooting styles and positions. In this section we will discuss the geometry of the prone position and most of these principals also hold true for benchrest shooting.

Remember the see-saw at the play ground. If you raise one end, the other end will drop. If the pivot point is centered on the plank, movement at one end is equal to movement at the other end in the opposite direction. Geometrically, any movement at the butt will result in movement at the end of the barrel (muzzle). Your bi-pod/front rest becomes the pivot point.

The rear sand bag rest, together with the front rest provides a reasonably stable shooting platform. If you remove the rear rest and shoulder the rifle, any butt/shoulder movement will produce pivotal movement at the muzzle. At 1000yds, 1mm of movement at the muzzle will move the impact point 900mm (almost 1 metre) on the target.....at 500yds, 1mm of movement at the muzzle will move the impact point 450mm (almost ½ metre) etc.

Most bi-pods/front rests are forward of the rifle's centre point, which means mathematically 1mm of movement at the butt does not transmit to 1mm of movement at the muzzle, however it's not that far off the mark.

The point is be constantly conscious of the stability of your rifle and remember Newton's 3rd law of motion: ***"For every action, there is an equal and opposite reaction"***.

If you are not totally comfortable and relaxed you will be putting your muscles under stress and ultimately and inexplicably shooting a poor score. Have you ever finished a poor shoot and said "I just didn't feel right, I wasn't comfortable"probably often.

Well, let me tell you I doubt whether on finishing a good shoot, you have ever said: "I just didn't feel right, I wasn't comfortable". In fact you would probably say just the opposite...."I felt good and relaxed!" Your position behind the rifle was right for you.

Incorrect position behind the rifle will cause muscle stress....pain and tension....spasms and fatigue....anxiety....at best this will result in a lack of ability to concentrate. Not a good start to your shoot, all because your position behind the rifle is wrong.

You may not consciously notice any “spasms or pain” but you will notice an occasional twinge. This is your body telling you something isn’t right. A twinge or ache in the trapezius muscles (from the base of your skull to between your shoulder blades) are usually the muscle group that indicates the prone/benchrest shooter is not in a comfortable position.

Whatever position you finally adopt, the essential underlying element is that you should be comfortable and relaxed. Ask yourself...could I lay for hours not moving in this position...could I sleep in this position? If the answer is no, you need to reassess your position.

Too many shooters ignore this element and constantly (and sub-consciously) blame other factors. Your shooting position is of paramount importance to a good score, so let’s look at these elements.

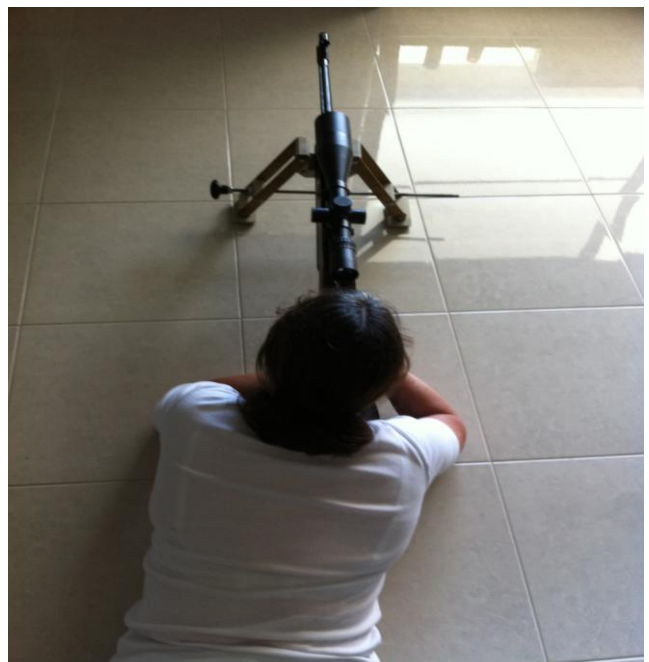
Behind the rifle:

If you lay at too great an angle to the rifle your skeletal structure will be out of alignment to the rifle, your shoulders will be out of line and you will wind up craning your head and neck to get a sight picture. Apart from twinging your trapezius muscles the cheek piece/ cone will bear a good amount of your head weight and at best your cheek pressure will be inconsistent. The rifle will not track correctly under recoil because of the inconsistent line, varying pressure points and, with recoil, you may even feel a slight “whip lash” on your neck muscle. If your neck muscles feel sore after a shoot....or the next day, you need to adjust your position behind the rifle.



Incorrect Position behind the rifle

Note: The hunching of the shoulders and acute angle of the left forearm to the stock. This could cause flyers at 4 and 5 o'clock.



Correct position behind rifle...relaxed

Note: Shoulders relaxed, head in correct position behind the scope. Left arm preferably tucked across the chest.

Your prone position should be as straight as possible in line with the rifle (5 -10 degrees is preferable), legs at a comfortable but slight angle (again 5-10 degrees), just so you don’t roll your hips. With this line your head will be directly behind the scope. (see photo above)

Head Position:

Do not crane your head along the cheek piece/cone of the stock, simply slide your body up to the rifle until your head is resting on the cheek piece and you have a good sight picture. You should be straight up and down on the cone of the stock, shoulders straight, neck straight. This is a major benefit of a straight prone position behind the rifle.

Holding the stock:

Your left arm is better positioned across your chest, lightly touching the rear bag, however.....If holding the stock with your left hand is preferable for you, understand the correct positioning of your hand under the rifle and please note the below suggestions are a "rough rule of thumb". Your final position is what your individual comfort dictates. If you cannot get comfortable....get up and start again.

With the straight prone position, your left and right elbows will be tucked in close to the rifle. Your left elbow should be approximately opposite the pistol grip/trigger area. Ideally the angle of your left arm at the elbow should be 35-45 degrees, and the lateral distance from your right hand to your elbow approximately the same distance as from your elbow to the rifle butt. This is approximate and is dependent on the shooters build.



Note: The position of the left elbow in relation to the trigger



Note: The thumb is straight along the axis of the barrel

Your left forearm and wrist should be longitudinally straight and only at a slight angle to the axis of the stock and barrel, with your left thumb comfortably running along the stock, pointing at the target. A firm grip is good. A tight grip may cause your thumb to put too much left pressure on the stock and this will cause flyers at 4 and 5 o'clock on the target.

The greater the angle of your left forearm and wrist to the stock (as in left photo page 6), the more likely you are to exert thumb and palm pressure, again causing 4 and 5 o'clock flyers on the target.

Cheek pressure:

By adopting the straight prone position your cheek pressure should be minimal. Too much cheek pressure will cause 12 o'clock flyers.

If you find your rifle is having intermittent unexplained elevation shots, inconsistent cheek pressure is a likely cause. There are other factors that may cause elevation shots, such as inconsistent shoulder/butt pressure and incorrect breathing....more on this below.

Shoulder/butt position and pressure:

The rear sand bag is an integral part of your stability platform. Many F Class shooters prefer their shoulder not to touch the rifle butt, leaving a good 2" (50mm) gap and allowing the rifle to track back along the rear bag just touching their shoulder under recoil.

If you prefer shooting with the traditional method, still use the rear sand bag and place your shoulder firmly but lightly against the butt. This may sound like a contradiction in terms, however the exact amount of shoulder pressure is critical to a good shot and is a variable from one person to another. Some of the critical elements that will determine your comfort zone with shoulder pressure is your build and recoil of the rifle, hence the importance of reducing that recoil to a minimum.....and good body positioning is a major factor in controlling recoil.

Top of recoil pad level with barrel



For correct body positioning, the top of your butt recoil pad should be level with your rifle barrel.

The curve of the rifle butt should fit neatly into your shoulder muscle and the position of the butt into your shoulder must be comfortably centered.....with a constant shoulder pressure throughout your shoot. Too much shoulder pressure will cause flyers at 8 o'clock.

The position of the butt into your shoulder is equally as critical as the shoulder pressure on the butt. If during your shoot you were to inadvertently raise your shoulder higher on the butt, it will cause 6 o'clock shots on the target. Similarly, if you were to drop your shoulder down towards the bottom of the butt a 12 o'clock shot on the target will result.

Different positions of the butt in your shoulder during a shoot will give you elevation shots perhaps more so than any other body position factor.

Use the technique of re-loading, without moving your head from the cheek piece, the butt on your shoulder or your left hand from the stock. It will take a lot of practise and is well worth the effort.

Whatever position and method you choose at the start of your shoot maintain that position and method for the entire shoot.

Trigger Release/ Pistol Grip/ Trigger Finger:

Trigger release should be a straight squeeze back parallel to the barrel. There are 2 types of trigger release grips.

Trigger finger parallel to the barrel



The first one is “dragging wood”, where your trigger finger is against the stock. Dragging wood is not a crime, providing you release the trigger the same each time. (Photo below at left)



“Dragging Wood”
Not a “crime” but adds another possible variable.



This position allows for a smoother trigger release technique

The second one is having your trigger finger out from the stock with air space between the stock and trigger finger. (Photo above at right).

For all triggers, the correct placement of your finger on the trigger is approximately opposite the bed of your finger nail. This is halfway between the tip of your finger and the first joint. Centre your finger on the trigger....if the trigger is curved, place your finger tip pad into the centre of the curve, not high or low on the trigger.

It is important your trigger is correctly adjusted for creep and weight. A trigger that creeps has a slight movement usually just before the shot breaks. This is unacceptable. Make sure the trigger is crisp when the shot is fired. You should always have a firm pistol grip. This will help in your trigger release.

If the palm of your hand is too high on the pistol grip, it will be impossible to have your trigger finger squeezing back parallel to the barrel and this can also lead to jerking the trigger. Your hand must be positioned on the pistol grip to enable your trigger finger to rest parallel to the barrel.

The best trigger release is a subconscious but controlled release, requiring no active thought to motivate. This will be achieved with practice. Once your brain says “shoot”, the controls kick in and the shot release becomes a slight rearward pressure of your trigger finger. Everything comes together in a micro-second as the shot is taken.

Trigger release should become a semi-automatic response to steady hold and a good sight picture. If hold or sighting deteriorate, stop, breathe normally, and begin cycle again.

Breathing:

Fitness is an important element of rifle shooting. Fitness will help you relax better under pressure by keeping your heart beat/body metabolism as low as possible. Fitness affects your mental awareness and control.

Correct breathing is essential for steadiness and good muscle control when shooting.

Maximum holding period for a fit person is 8 seconds, whereas for an unfit person it is 3 seconds. You must keep yourself fit if you wish to succeed at any level of shooting.

Breathing is a very important element of making a good shot. Breathing controls your body metabolism – anxiety levels, heartbeat, concentration, relaxation, muscle control, steadiness, clear sighting.

Breathe in normally, breathe out, hold breath at natural end of exhale. Settle. Fire shot. Follow through (follow through is explained below). Hold your breath for not longer than 6-8 seconds before firing. Ideally, fire your shot somewhere between 2 and 5 seconds during your hold period.

If your concentration decreases or your scope picture blurs or distorts....stop.....look away at something greenish, close your eyes, take 2-3 deep breaths and then begin breathing cycle again.

Follow Through:

Trigger release technique is important, but it is only a part of the overall technique of releasing the shot. After the shot has been released your finger should remain on the trigger during the follow through sequence.

Even with a small amount of shoulder pressure applied, most of the recoil will travel in a vertical direction. Your barrel will rise slightly and the rifle will momentarily move back toward your shoulder, very slightly increasing the shoulder pressure and then forward again. Through the scope you should see the crosshairs momentarily rise slightly on the target before returning back to your point of aim.

There should be no sideways movement through the scope. If there is, reassess your technique, position and hold.....in particular look for a loose trigger hand on the stock, a sprawled right elbow – move it closer in towards the stock, butt not firm in the shoulder, bad alignment of your body to the rifle.

With your finger still depressed on the trigger and your head still on the stock/cheek piece, **your crosshairs will return to the target and point of aim**. This is a good indicator of correct body positioning and shooting technique.

Remain in this position for 2-5 seconds. Regularly practise this technique as well as breathing and trigger release.

5. RIFLE SCOPE

A rifle scope should have:

- Parallax adjustment
- Variable magnification. 8-32 or 12-42 is good. At 42 power you should be able to see .308 holes in the target at 500yds and a matchbox at 1,000yds.
- Clear precision optics
- Built in 45 minutes of angle (MOA) elevation adjustment and 40 MOA windage. I would consider these as minimums.
- 56mm objective diameter....this provides maximum wide angle clarity and resolution across the entire magnification range. The greater the magnification, the less the brightness.
- Preferably 8 clicks to the minute turret adjustments

Preferably your scope should be waterproof, rugged construction (to take a knock or two) and the internal optics ability to take recoil. A scope with these features will usually come with a lifetime warranty.

Focusing the Reticle:

You must do this before adjusting for parallax.

Set the power zoom ring at the highest magnification. On rifle scopes with parallax adjustment, set the parallax to infinity (highest setting). Set the scope up looking at a blank white wall – this will eliminate any background effect.

Focus your eye onto the reticle. The reticle needs to be sharply defined. Turn the reticle focus ring until the sharpest reticle image is achieved. Be aware that staring at the reticle for an extended period of time during this process will cause your eye to compensate, resulting in a false indication of reticle focus....look away for a few seconds then re-try for best results.

Once you have a sharp, crisp and well defined reticle image, lock the focus adjustment into place. Mark this position with a dot of white-out or similar. Once your focal adjustment is set, a properly focused reticle will remain sharp for extended periods. Reticles may only need refocusing following impact or extreme recoil. Do not confuse the sharpness of the reticle image with target distortion, which is likely to be parallax.

If the reticle tends to fade in and out of focus during your shoot or you experience eye strain, that is an indicator the reticle is not properly focused for your eye.

You can further fine tune the focus by setting up a light tan or grey medium value target at 100-200yds and fine tune the focus slightly in either direction until the reticle image is sharpest.

Parallax:

Definition of parallax;

Parallax is the effect whereby the position or direction of an object appears to differ when viewed from different positions or angles.

A simple everyday example of parallax can be seen in the dashboard of motor vehicles that use a “needle” speedometer gauge. When viewed from directly in front, the speed may show exactly 100kph; but when viewed from the passenger seat the needle may appear to show a slightly different speed due to the angle of viewing.

Parallax affects optical instruments that view objects from slightly different angles...such as binoculars, rifle scopes microscopes, twin lens cameras etc.

For precision shooting, parallax must be eliminated. Parallax will cause significant inaccuracy with your shots.

Parallax is the apparent movement of the cross hairs in relation to the target as you move your eye across the ocular lens (rear lens) of the scope. A nod of the head up and down when looking at the target will quickly determine if parallax is present. Parallax is caused by the target and the reticle being on different focal planes within the scope and this will change with each range.

For a rifle scope, parallax occurs when the target image is formed either in front of or behind the reticle lens. The position of the objective lens (front lens) and the reticle lens (positioned internally in the scope) need to be adjusted to bring the target into the exact focal plane of the reticle.

This adjustment is made by moving the objective lens and on many scopes you will find this adjustment directly over the objective lens. On some scopes the parallax adjustment is mounted on the left side opposite the windage knob adjustment. This is not a target focus adjustment, it is a parallax adjustment.

It is important to note that in every scope there is always some parallax, albeit minute. It is virtually impossible to totally eliminate, particularly at the longer ranges. High quality scopes, comprising high quality optics, are equipped with a parallax adjustment that reduces parallax to minimal levels as low as 1/100th MOA, allowing exceptionally high accuracy.

In lower-quality scopes, there are other causes of parallax. Reticles that are not securely mounted will move under recoil and if allowed to move even one or two thousandths of an inch will continually have altering amounts of parallax that will vary from one shot to the next. Parallax is also caused by optical deficiencies in the objective lens and this can be identified by a different amount of vertical and horizontal movement of the crosshairs against the target. No adjustment of the scope will eliminate these faults or optical deficiencies.

The parallax adjustment is not a focus adjustment. When using the parallax adjustment, parallax is not necessarily eliminated just because the target focus becomes sharp, although usually this is the case at the shorter ranges of 300, 500 and 600yds. You may find at +1,000yds that parallax is eliminated when the scope is set just off focus using the parallax adjustment.

Nightforce scope with front parallax adjustment.

The distances marked on the scope are indicative only. This setting was for a 600yd shoot and can change marginally depending on atmospheric.

Some scopes have side parallax adjustment.



The greater the distance, the greater the parallax becomes. Particularly at the longer ranges of +800yds, significant continual sighting errors of up to 3 MOA can result if parallax is not removed.

Steps to reduce parallax:

1. Put your scope on the highest magnification that is clear of mirage.
2. Place your crosshairs on the lower part of the aiming mark, where the black meets the white of the target.
3. Finely adjust your reticle image....even if you have set it before.
4. Turn your parallax adjustment until the target is sharpest.
5. Move your head checking for the crosshairs moving on the target.
6. Adjust the parallax until you have no noticeable movement against the crosshairs.
7. Reduce your magnification back to a comfortable range setting.
8. Position your head on the cheek piece so that if you move your head back from the scope the image becomes smaller than the ocular lens. There is a small black band around the target. Centralize this image in the ocular lens, making the black band a perfect circle. If you sight each shot like this you will ensure your eye is in exactly the same place, helping to eliminate parallax.

Levelling the Reticle:

For precision shooting, the reticle and the rifle need to be squared, or plumb, to each other.

Any out of square condition can cause sighting errors that will be magnified even more at longer ranges.

There are various ways to achieve this, however the following is an efficient method:

Use a plumb line or some other known plumb vertical line at a distance from the rifle where you can see it clearly through the scope. A close distance of say 100yds would be good.

Ensure the rifle is level, using a small spirit level across the scope rail. Center the reticle on the plumb line and rotate the scope in the rings until the vertical line of the reticle is parallel with the plumb line.

Tighten all ring top screws evenly and torque the screws as per manufacturer's specifications.

When shooting ensure your cross hairs are level, not canted, if necessary using the top of the target frame as a level indicator for each shot. Level cross hairs are essential regardless of your type of front rest.

Marrying the scope to the rifle:

Yes, marrying is the term that best describes the event.

Despite popular belief, you cannot simply put a scope on a rifle and expect your point of impact to be at the crosshairs.

Set your rifle up on a front rest and rear sand bag, with the target at 300yds. Then bore sight the rifle so that the centre of the bore is looking at a point on the target 20" (½ metre) higher in elevation than the centre of the target. With an ICFRA target this is roughly the top of the black aiming mark. Without moving the rifle, position the crosshairs on the centre of the target. You have now bore sighted your rifle.

Bore sighting will put you on the target, however you will need to zero your rifle in at 300yds by firing several shots. Providing it's a reasonably calm day you can zero your rifle for both elevation and wind.

Having achieved this, you should now re-set your elevation and wind turrets to the zero mark. Take note of exactly where these settings are on your scope so that you can always go back to these settings. For example, with elevation, note how many full turns and points (MOA) it takes to turn the elevation turret to full down. By doing this you will always be able to re-set your scope elevation to 300yds. **This is an absolutely vital step.** If you do not know where your 300yd zero is **you should NOT be shooting.**

Do the same with your wind and write down what these settings are. Do yourself a favour and always return your elevation to the 300yd zero and the wind setting to zero at the end of every days shoot.

In the ballistics section we will discuss MOA at varying ranges, but at this point suffice to say your scope is now married to your rifle. If for any reason you change scopes or ammunition components, you will need to re-set your 300yd zero.

If for any reason you move the position of the scope on your rifle, or if you alter the position of the scope in the rings you will need to remarry the scope to the rifle. By sliding the scope forward or back in the rings you can alter both your elevation and wind zero by up to 7 MOA.....a significant change.

Having married a scope to one rifle does not mean the settings will be the same if you change the scope to another rifle. If you put a scope onto another rifle you will need to marry the scope to that rifle. A new barrel will also require a remarrying of the scope.

You should record the elevation settings of your scope for every range you shoot. This will give you almost exact elevation settings for each and every range.

Not all scopes have explicit alteration directions such as this.

You will note this scope has .25MOA increments.

Also note the side parallax adjustment on this Nightforce NXS 12-42 x 56 scope.



Your scope turrets will/should be marked in MOA. Some scopes have 4 clicks per MOA, some have 8 clicks per MOA. You need to know your scope characteristics like the back of your hand. Your scope turrets will have adjustment direction markings on them. You need to read this as “bullet impact”....for example if you hit low on the target and want to move your bullet impact higher, turn your elevation knob in the “up” direction.

For the purist only: This will have the visual effect of lowering your cross hairs in your scope and as you adjust your rifle up to re-center the cross hairs on the target, you will have slightly elevated your barrel which in turn will place your next shot higher on the target.

Some scopes are in mil-radians (mil-rad)...mainly military based scopes. Don't be concerned with mil-rads unless your scope is in mil-rads. The Schmidt and Bender PM 11 5-25 x 56 is a good mil-rad scope, however it is not ideal for F Class shooting. There are 10 clicks per mil-rad on the turrets and 1 mil-rad = 3.375 MOA. With this configuration 3 clicks on this scope = 1.012 MOA, close enough to be called 1 MOA. Each click is therefore 1/3rd MOA.

6. BALLISTICS

Ballistics is a subject that deserves a course all to itself, so only the basic elements of firearm ballistics will be covered in this course.

Rifling-Twist:

Rifling is the helix grooves inside the bore of a rifle.



These photos are different barrels and are taken from the Muzzle, showing a right twist barrel

Note the different shape of the lands in these barrels



A rifle barrel has grooves and lands which together form a twist in the barrel. The area without the grooves, with the smaller inside diameter, is called the lands.

The number of lands in a barrel differ, depending on the barrel manufacturer. Most target barrels have between 4 and 8 lands. Different barrel manufacturers have differing land shapes (see photos above).

If the grooves and lands progress in a clockwise direction looking down through the rifle's breech (bolt end), the twist is called right-hand. A counter clockwise progression is labelled left-hand. Most U.S. rifle and barrel makers use a right twist in their barrels. An exception is the Colt revolver, which has a left twist. Also most .303 Military rifles are left twist.

The twist is expressed as **slow** if the barrel length needed to complete one turn is long....for example 1 full turn of the projectile in 16" of barrel would be termed a slow twist. The twist is called **fast** if the barrel length needed to complete one turn is short.... for example 1 full turn of the projectile in 7" of barrel would be termed a fast twist.

If the rifling grooves make one complete turn in 10" of barrel length, it is called a ten-inch twist and is written as 1:10. The barrel may be any length....2" or 30", it would still be a 10" twist.

For example the Mauser SR86 in .308 calibre has a barrel twist of 1 turn in 12" (1:12) with a normal barrel length of 24". When fired, the bullet will make exactly 2 turns between chamber and muzzle. If the barrel was shortened or a longer barrel was fitted with the same twist, the number of turns to the muzzle would change, but it would still be a 12" twist.

A fast twist will cope accurately with heavy projectiles more so than a slow twist....for your calibre. For instance a 1:7 or 1:8 is a good accurate twist for a 5.56mm (.223) using 80gn projectiles, or a 6mmBR using 107gn projectiles.

A 1:12 or 1:13 is a good accurate twist for a 7.62mm (.308), using 155gn projectiles, as in F Class Standard. A 1:10 would better suit 180-200gn projectiles in this calibre, as in F/TR or Match Rifle.

A 168 gn, 7mm bullet in 7 x 284 calibre has incredible accuracy and has a very flat ballistics trajectory. A 168gn VLD bullet (very low drag) fired from a 28" barrel, with a 9" twist (1:9), is very capable of shooting a 5", 10 shot group at 1,000yds.....so let's look at the ballistics of the bullet:

The bullet leaves the barrel at just over 3000 feet per second, this is termed as muzzle velocity (MV) and would be written as MV: 3,000fps.

The bullet takes just over 1 second to travel the 1000yds to the target and spins 4,000 times in the process. That's 240,000rpm.

The faster your barrel twist, the faster the spin of your bullet. The high gyroscopic stability of the bullet is obviously essential.

Gyroscopic Stability:

The best analogy of what a bullet does on leaving the barrel can be found in a child's toy spinning top. Give the top a good spin and you will see it wobble and yaw momentarily before stabilizing in a spin.....a bullet leaving the barrel does exactly the same.

Something with gyroscopic action does not instantly go from zero rpm to just the correct rotation speed and stability. There will be an initial axis wobble and yaw that will smooth out very quickly. Even a bullet that will quickly stabilize may leave the muzzle at a yaw as much as 5 degrees.

In a target barrel with the correct twist for the bullet, the yaw is usually less than 1 degree.

Generally, rifles with a slow barrel twist, such as some hunting rifles, will stabilize bullets in less than 100yds but have poor stability at medium to long ranges. Whereas fast twist barrels may take slightly longer to stabilize, but will continue to have high stability at extreme ranges.

Again this can be easily seen in the child's toy spinning top. Spin the top slowly and it will settle quickly, but will soon develop a protracted yawing motion. Spin the top rapidly and it will take a moment or two to settle but will continue to spin unaffected substantially longer. Gyroscopic stability is a major factor in accuracy.

Target rifle fast twist barrels with correct hand loads specifically loaded to match standards for a particular calibre, projectile, barrel length and twist will have only microscopic yaw and will stabilize rapidly....the correct load, projectile and barrel twist will produce accurate shots from 30yds out to and beyond 1,200yds.

Ballistic Coefficients:

The ballistic coefficient (BC) is a measure of how well a bullet can overcome air resistance and maintain flight velocity. The higher the BC, the more efficient the bullet.

The 3 factors of a bullet that govern its BC are weight, shape and diameter.

A bullet with a high BC will spend less flight time over a given distance, all other factors being equal, so it will have less wind deflection. A higher BC brings a flatter trajectory and more velocity/kinetic energy at the target.

Most bullet manufacturers don't include BC information on the box and you may have to source this information to ensure your projectile is up to the standards you require.

There are 2 different BC calculations and projectile manufacturers will generally have one or both:

G 1 is the commercial method of gauging BC.

G 7 is the Military calculation method.

All drag tables were developed and proven by the military. G1 and G7 are both popular for commercial bullets. G1 is the most referenced for target rifle shooting bullets.

Don't be confused by these, they are simply different methods used to arrive at what is essentially the same information....however do not mix them up. The resulting numbers for each system are totally different.

Some examples below, taken directly from Berger projectile boxes:

5.56mm (.223), 80gn VLD (very low drag)

G 1 = .445

G 7 = .228

6mm, 108gn

G 1 = .511

G 7 = .262

6mm, 105gn, VLD

G 1 = .532

G 7 = .272

7mm, 168gn VLD

G 1 = .617

G 7 = .316

7mm, 180gn VLD

G 1 = .660

G 7 = .338

From the above information the 6mm 105gn VLD is a much better performer than the 6mm 108gn. However the Berger 7mm 180gn VLD bullets are among the best for BC and for long distance accuracy.

You will also notice from the table above that even a small incremental increase will substantially alter BC and consequently bullet performance. It is rare to find a projectile BC over .8

Trajectory:

This is the path a bullet takes from leaving the barrel to hitting the target. It is not a straight line, but a curved path. Most people know this, but a ballistics trajectory is infinitely more complex than most people realise.

For example the projectile makes a steeper curve on descending in the atmosphere than on ascending, since the horizontal resistance has affected it longer. The midrange trajectory height therefore is not at 50% of the down-range distance, but at about 55%.

Ballistics tell us the "Total drop over a given range is about 4 times the midrange height of the projectile". For example; "A cartridge with a midrange height of 2.5" in 200yds would have a total drop of 10" in the same 200yds." Conversely the exact same principal applies, in that for a target at 200yds, if you have a bullet drop of 10" then your midrange trajectory bullet height is only 2.5" above the line of sight from rifle to target.

This measurement can change marginally depending on the ballistics and trajectory curve, but for our purposes we will accept it as a rough rule of thumb.

Do not confuse bullet drop with bullet height above the line of sight, rifle to target. They are two separate measurements. For the target shooter it is interesting to know this information as you need to gauge the effect of wind on your projectile.

To illustrate this point for target shooting we will look at the trajectory curve for two different calibres over 1,000yds:

1: 155gn, .308 Sierra MatchKing HPBT projectile with a MV: 2,900 FPS. Bullet drop over 1,000yds is 383.9"....32 feet. Midrange height of projectile: 8-10 feet above the line of sight, rifle to target.

2: 168gn, 7mm Berger VLD HPBT projectile with a MV: 3010 FPS. Bullet drop over 1,000yds is 267.2"....22.3 feet. Midrange height of projectile: 5-7 feet above the line of sight, rifle to target.

Minute of Angle (MOA):

In F Class Target shooting a "MOA" is sometimes referred to as a "point"so don't be surprised to hear this terminology on the Range.

A circle is divided into 360 degrees. Each degree is divided into 60 minutes and each minute into 60 seconds.

Minute of Angle, as used in Target shooting, is one minute or 1/60th of a degree.

Draw a circle on an A4 sheet of paper. Now imagine that circle divided into 360 degrees and each degree into 60 minutes.....one minute makes up a very small part of that circle.

Take the centre of your circle and draw a "pie" cut section going up the page so that the top of the "pie" is several inches across. Imagine for a moment that this section is actually one MOA. If the distance from the centre of your circle to the circumference represents 1,000yds, mark off the approximate distances for 900, 800, 700, 600, 500 and 300yds across your pie section. Write these distances alongside the marks.

Now sit back and have a look at your diagram. If that “pie” section represented one MOA, you will note the size of a MOA at 300yds is proportionally smaller than that at 1000yds and the MOA size gradually increases as the range increases.

At 100yds one MOA is 1.0472”, rounded off to 1”. At 200yds one MOA is 2”, 300yds is 3”, 500yds is 5” etc.....this is a very easy way to remember MOA size at a given range.

If your rifle scope is 8 clicks to the minute, every time you adjust 8 clicks on your scope you are moving one MOA at the target. The size of a MOA varies with the range. For instance at 800yds, one MOA is 8”. On your rifle scope each click is therefore 1” on the target at 800yds.

If your scope is 4 clicks to the minute, then at 800yds each click is a movement of 2” at the target.

Most F Class rifles are capable of shooting sub MOA groups. Some rifles are capable of 1/3rd minute of angle groups.

7. ATMOSPHERICS AND WIND

Atmospherics can affect your elevation, albeit marginally, from day to day. Temperature, humidity and a stable/unstable atmosphere will all combine to affect the flight of your bullet.

Velocity, air pressure and temperature all effect bullet stability. A bullet will be less stable at low velocity, low altitude and low temperature.

Good record keeping is your best ally. Every time you shoot note the weather conditions of the day and your scope elevation after the shoot. Write it down in a book.....Rosedale, 800yds, 25c, high humidity, lazy to light easterly wind, stable atmosphere, elevation 15 points.

A stable atmosphere exists when there is a lid on the atmosphere, hazy sky and smoke from chimney stacks go up a few hundred feet and “hit a lid”....smoke levels out, high cirrus cloud. These types of weather conditions commonly occur in autumn and into winter and are usually good for shooting.

An unstable atmosphere exists when air can rise unimpeded high into the atmosphere. Indicators of this are a deep blue sky and smoke from chimney stacks rising very high and quickly, cumulus clouds. These types of weather conditions commonly occur in late spring and summer. Up-drafts and down-drafts are common.

Mirage is increased and tends to “boil” on these types of days. Conditions can make accurate shooting challenging.

Air density can affect the flight of your bullet. A dense air will tend to air drop your shot on the target. At 1000yds, a high air density day may drop your shot as much as 6” or ½ MOA. Conversely a low air density day can cause your shot to hit high on the target. High humidity actually lowers air density and may cause a slightly higher trajectory, depending on the day. Confusing, I agree, but true.

Keep your ammunition out of the sun on hot days. As you get towards the end of your shoot, the rifle chamber will be heated up and combined with already hot ammo from being left out in the sun, could give you higher than normal breech pressures, higher than normal MV and possible flyers. Try not to leave a round chambered for extended periods, as this will only serve to heat the round up even more.

Train in windy conditions at every opportunity, trying to learn something new each time you shoot. Remember.....anyone can shoot in perfect conditions. Train for the worst and hope for the best on the day.

If possible, take a little bit of time to study the wind conditions, even well before your shoot. More often than not you will find a pattern. Wait for the right conditions where possible. Shoot quickly but accurately....never shoot quicker than your technique allows....remember your follow through.

Apart from wind flags there are a host of other wind indicators. Wind on your face, grass, dust and flags at the target. If it's raining....look at the angle of the rain, above all- keep your ammo dry. Among other downfalls, wet ammo will give you elevation shots. An old beach/bathroom towel draped over the scope, breech, bolt and ammo box will give protection to the important parts.

A frontal wind will tend to lift your bullet slightly. A tail wind will tend to drop your bullet. Banks of light mist/fog will bring cold air and drop your bullet slightly. By what amount of drop or lift depends on the wind strength/temperature drop and this is purely an experience factor. Usually these changes are not huge....somewhere from $\frac{1}{2}$ MOA to $\frac{2}{3}^{\text{rd}}$ MOA, but if unseen could mean dropping to a bulls eye instead of a super V or centre bull.

Know your ICFA target dimensions for the range you are shooting. For instance on most targets, the distance from the target centre to the edge of the:

- X ring is 0.25 MOA
- Centre Bull is 0.5 MOA
- Bull is 1 MOA

These dimensions do change slightly from range to range, however if you use these you won't be that far out. For instance if you were to hit on the edge of the bull at 3 o'clock, an adjustment of one MOA left will bring you back into the X ring, given other factors haven't changed.

Where possible don't aim off. Always adjust your scope where practical and where possible. Let me give you an example:

- You aim in the centre and hit a high bull at 2 o'clock. You decide to aim off on the bull edge at 8 o'clock thinking this will bring you dead centre, but instead you hit another bull at 4 o'clock.....now where are you? Bring out the slide rule!
- You aim in the centre and hit a high bull at 2 o'clock. You come down $\frac{1}{3}^{\text{rd}}$ MOA and left $\frac{2}{3}^{\text{rd}}$ MOA and aim dead centre. Where ever you hit, simply adjust back to dead centre again. No need for the slide rule. If you always aim in the centre, there is never any confusion.

Aiming off can certainly bring its rewards, but do it in small increments.....like aim off within the X ring, at least until you gain experience in aiming off.

Another method used by some shooters is, after the first sighter, put your crosshairs on the center of the target and wind out to the spotter. This method relies on total stability of the rifle when winding out. Any movement of the rifle during the winding out process will result in total confusion. Unless you practice this method and gain experience using this method, it is not recommended that you use it.

This method is not able to be used on electronic targets. It is far more preferable for the shooter to know the size of the target and the capabilities of the scope and make the necessary adjustments accordingly.

Mirage at long range can be difficult to deal with. If your target is a blur, dial your magnification down until you have a clear view of the target.

Mirage can often be a good indicator of what the wind is doing or is going to do. Try to shoot on a steady mirage. Avoid shooting on a boiling mirage. A boiling mirage could be an indicator of a wind change. If you shoot on a boiling mirage you risk getting elevation shots and being caught on a wind change that hasn't yet reached the wind flags.

Attached in your handouts is a wind flag chart for .308 calibre using Sierra MatchKing projectiles HPBT, complete with alteration adjustments and mirage indicators. This is purely a rough guide, but will certainly get you a hit on the target. If you have a flatter shooting calibre than the .308, make adjustments. For instance the 6mmBR would be around $\frac{1}{2}$ these values. The 7mm x 284 would be around $\frac{1}{4}$ of these values. I would expect the .223 to be close to the values on this chart as the .223 is highly affected by atmospheric and wind at ranges longer than 300yds.

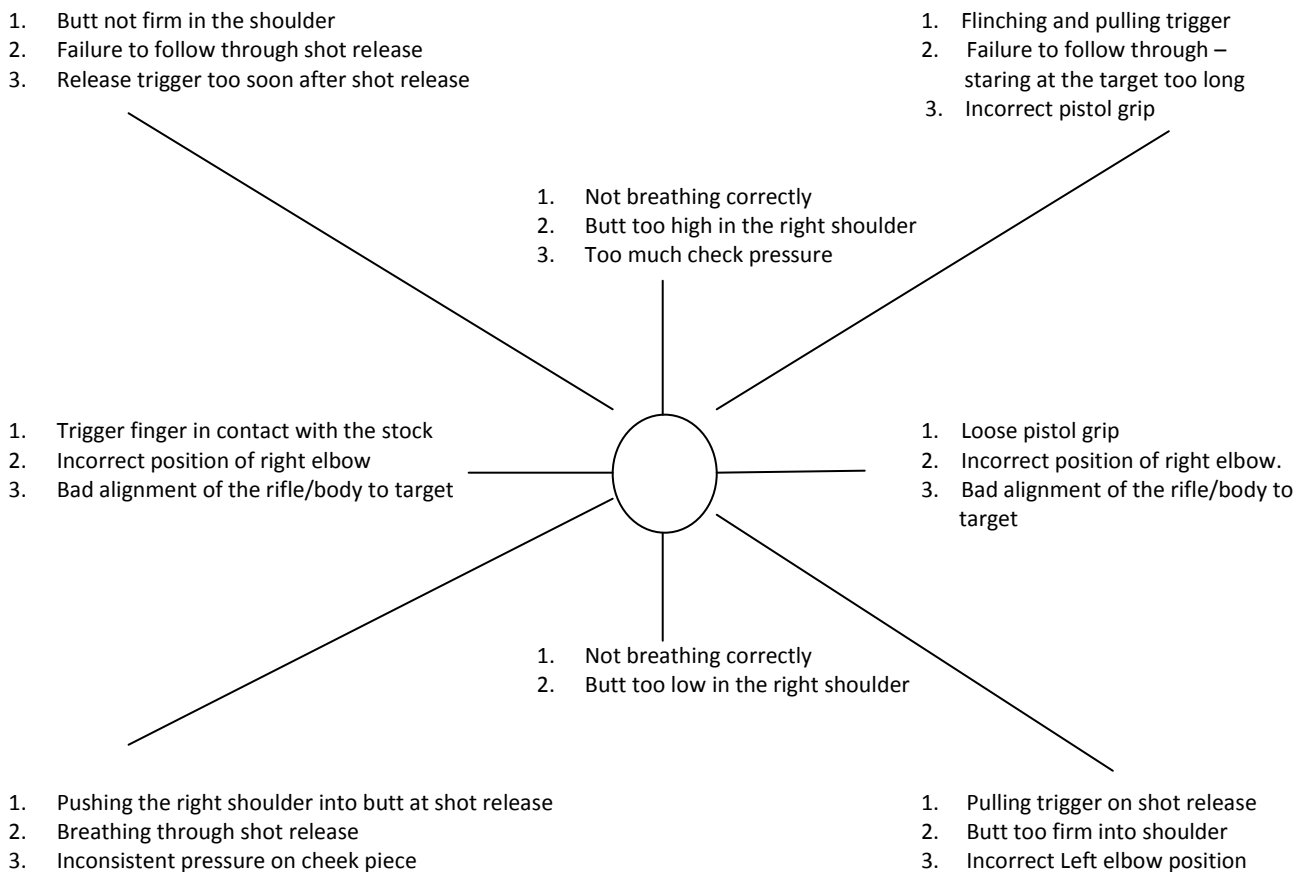
As a rough “rule of thumb” the wind direction and strength in the first 30% of your range is 60% of your total wind value. Gauge your wind MOA on this basis and you will be very close, particularly at the shorter ranges up to 800yds.

Be aware, however, at 1,000yds and longer that as your bullet is slowing, the wind at the target will have an increased effect. At the longer ranges it would pay to evaluate the wind at the target, more so than at the shorts.

SHOT DIAGNOSIS CHART

The individual cause of a misplaced shot is difficult to diagnose. There could be a variety of reasons, including incorrect RE-LOADING techniques, EXTERNAL forces (wind, mirage etc), MECHANICAL faults (poor bedding, barrel fouling).

Below is a chart indicating the most common diagnosis for misplaced shots. REMEMBER a misplaced shot may be caused by a combination of faults:



A good coach can better analyse positional faults and the keeping of an accurate diary is essential to help the coach in this process

F Class Target Shooting Techniques

Level 1 Learning Outcomes

Note: Learning outcomes are those elements of the course that participants are expected to know from having completed the course.

1. Safety:

- Describe the safety flag requirements at the Range
- Describe the chain of command whilst shooting at the Range
- Demonstrate the procedure for a misfire whilst at the Range
- Demonstrate the procedure for a miss on the target as:
 - 1/ Shooter
 - 2/ Scorer
- Demonstrate the actions of the shooter before commencing his/her shoot

2. Setting the rifle onto the front rest/bi-pod:

- Describe the 2 types of bi-pod used in F Class Target shooting
- Demonstrate elevation adjustment using an F Class bi-pod
- Demonstrate the technique used to level the front sandbag rest

3. Setting the rifle onto the rear sand bag:

- Demonstrate correct positioning of the rear sand bag

4. Geometry of the shooting position:

- Describe the effect on your muscles due to incorrect body positioning behind the rifle
- Demonstrate the most appropriate position behind the rifle, with particular attention to head position, left arm position, elbow positions, cheek pressure, shoulder/butt pressure.
- Describe the effect of too much cheek pressure
- Describe what is a major factor in minimizing recoil
- Describe the ideal position of your butt pad in relation to your rifle
- Describe the effect of having an inconsistent butt/shoulder position during your shoot.
- Demonstrate the 2 types of trigger release grips.
- Describe the effect of having your palm too high on the pistol grip
- Describe the beneficial effect of correct breathing
- Describe the breathing sequence before firing
- Describe the maximum length of time you should hold before firing
- Demonstrate the correct breathing sequence during shot release
- Demonstrate follow through
- Describe the effect of correct follow through

5. Rifle scope:

- Describe parallax
- Describe the effect of parallax whilst shooting
- Describe and demonstrate the process for adjusting the reticle focus
- Describe and demonstrate the steps to reduce parallax
- Describe a process for levelling the reticle
- Describe the process to zero your scope at 300yds
- Describe process to return your scope settings to your 300yd zero from any range setting

6. Ballistics:

- Describe rifling twist
- Describe lands and grooves
- Describe a rifling fast twist
- Describe the benefits of a fast rifling twist
- Describe the written terminology for rifling twist and muzzle velocity
- Describe gyroscopic stability
- Describe ballistic coefficient
- Describe 3 factors that govern the ballistic coefficient
- Describe the 2 different methods for calculating the ballistic coefficient
- Describe bullet trajectory
- Describe the meaning of midrange trajectory height and bullet drop
- Define MOA
- Calculate MOA in inches for a given range

7. Atmospherics and wind:

- Describe an unstable atmosphere
- Describe the effect of humidity on the flight of a bullet
- Describe several wind indicators apart from wind flags
- Describe the effect of a frontal wind on the flight of a bullet
- Describe the effect of a tail wind on the flight of a bullet
- Describe the effect of mirage
- Describe the steps in dealing with mirage using a rifle scope

F Class Target Shooting Techniques

Level 1 Assessment

Note: This course may only be assessed by Certificate 4 or higher qualified personal.

NAME: **NRAA UIN NUMBER:**

SAFETY:

- What safety flags are required before shooting at the Range?

.....

.....

- What is the chain of command whilst shooting at the Range?

.....

.....

- Describe the procedure for a misfire whilst at the Range?

.....

.....

- What is the procedure for a miss on the target as:

a. Shooter

b. Scorer

a.....

b.....

- What should the shooter do before commencing his/her shoot?

.....

- If you witness a breach of safety at the range what action will you take?

.....

SETTING THE RIFLE ONTO THE FRONT REST/BI-POD:

1. What are the 2 types of bi-pod used in F Class Target shooting?

.....

.....

2. Using an F Class bi-pod demonstrate elevation adjustment to the assessor

3. Using a front sandbag rest demonstrate the technique used to level the front sandbag rest to the assessor

SETTING THE RIFLE ONTO THE REAR SAND BAG:

1. Using the rear sand bag demonstrate correct positioning of the rifle in the rear sand bag to the assessor

2. What effect is caused by the stock settling into the rear sand bag?

.....

GEOMETRY OF THE SHOOTING POSITION:

1. What effect on your muscles would incorrect body positioning behind the rifle have?

.....

.....

2. Demonstrate to the assessor your prone position behind the rifle

3. What is the effect on the shot of too much cheek pressure?

.....

.....

4. What is a major cause of inconsistent cheek pressure?

.....

.....

5. What is a major factor in minimizing recoil?

.....

6. What is the ideal position of the butt pad in relation to your rifle?

.....

.....

7. What effect would the following rifle butt positions have during your shoot:

- a. If the rifle butt is positioned higher on your shoulder?
- b. If the rifle butt is positioned lower on your shoulder?

a.....

b.....

8. Demonstrate to the assessor the 2 types of trigger release grips

9. Demonstrate to the assessor the position of the pad of your right index finger on the trigger

10. What will be the effect of having your palm too high on the pistol grip?

.....

.....

11. What are the beneficial effects of correct breathing during shot release?

.....

.....

12. What is the correct breathing sequence up to and during shot release?

.....

.....

13. What is the maximum length of time you should hold before firing?

.....

.....

14. Demonstrate to the assessor the correct breathing sequence during shot release

15. Demonstrate to the assessor follow through

16. What is the effect of incorrect of correct follow through?

.....

.....

RIFLE SCOPE:

1. What is parallax?

.....

.....

2. What is the effect of parallax whilst shooting?

.....

.....

3. What is the correct process for adjusting the reticle focus?

.....

.....

4. Demonstrate the correct reticle focusing procedure to the assessor

5. What are the steps to reduce parallax?

.....

.....

6. Demonstrate the correct steps to correct parallax to the assessor

7. What is the process for levelling the reticle?

.....

.....

8. What are the steps to zero your scope at 300yds?

.....

.....

9. Describe a process to return your scope settings to your 300yd zero from any range setting

.....

.....

BALLISTICS:

1. What is rifling twist?

.....

.....

2. Describe lands and grooves

.....

.....

3. Describe a rifling fast twist

.....

.....

4. Describe the benefits of a fast rifling twist

.....

.....

5. What is the written terminology for a 12"rifling twist and 2,900 feet per second muzzle velocity?

.....

.....

6. What is gyroscopic stability?

.....

.....

7. When does bullet yaw occur?

.....

8. What is ballistic coefficient?

.....

.....

9. What are 3 factors that govern the ballistic coefficient?

.....

.....

.....

10. What are the 2 different methods for calculating the ballistic coefficient?

.....

.....

11. What are the origins of these 2 methods?

.....

.....

12. Describe bullet trajectory

.....

.....

13. What is the meaning of midrange trajectory height and bullet drop?

.....

.....

14. What is MOA?

.....

.....

.....

.....

15. What is the distance in inches of MOA at:

- a. 500yds
- b. 700yds
- c. 1000yds
- d. 1,200yds

ATMOSPHERICS AND WIND:

1. Describe an unstable atmosphere

.....

.....

2. What is the effect of unstable atmosphere on the flight of a bullet?

.....

.....

3. What is the effect of humidity on the flight of a bullet?

.....

.....

4. What are 3 wind indicators apart from wind flags?

.....

.....

.....

5. What is the effect of a frontal wind on the flight of a bullet?

.....

.....

6. What is the effect of a tail wind on the flight of a bullet?

.....

.....

7. What is mirage?

.....

.....

8. What effect does mirage have on target rifle shooting?

.....

.....

9. What are the steps you would take to reduce mirage using a rifle scope?

.....

.....