

## What are those squiggly little things I see running along the top of my target frame? Or what is mirage and how do I cope with it?

The problem of mirage haunts every shooter regardless of experience. Mirage is the culprit when you have a four shot group that looks like one bullet hole and the fifth shot shows up a half inch away. He's the same guy that directs the bullet to the 8 ring when all the rest are in the x ring. There are a lot of wrong ideas about mirage among the different shooting disciplines. Some shooters can ignore it completely; pistol shooters fall into this category. High Power competitors believe it's the wind that does all the damage and mirage is just an indication of which way the wind is blowing, at very long ranges it is a combination of both wind and mirage that affects accuracy. If all you are trying to do is hold 2 minutes of angle you don't need the information that follows. If, on the other hand, you want to shoot better than 1/2 MOA you need to learn to deal with mirage. I am not writing this to put anyone down, I am just reporting what I have learned from nearly a half a century of competition and what has worked for me. If you disagree with me so be it but I am too old to change my ideas and methods so I don't invite arguments.

First what is mirage? To answer that you need to take a glass full of water and put a spoon in it. Look at how the spoon handle appears to bend at the point it enters the water. This is an illusion caused by the difference in the index of refraction of air and water. The variation of air temperature between you and the target causes a change in the index of refraction of the air along your sight path. This bends the light causing the image of the target to be in a different place than the actual target. If you set your rifle in a solid rest, aim it at a target and sit and watch you will see the target appear to dance around under the crosshairs, obviously the target is not moving, it is the image that is moving. What you need to be able to do is determine by watching the mirage where the target is in relation to its image. It is essential that you be able to look at the running mirage and feel confident that you know exactly where the bullet will go when you touch it off. Imagine that you are on the last shot of the match and you have it won going away, time is running out, when conditions switch from lazy right to left mirage to a fast running left to right mirage at a forty five degree angle. You must have confidence in your judgment to hold where you know the target is in relation to the image you are watching and know that your last round will fall in the group. You can't think, "well I think it is over here two inches but I will play it safe and hold one inch". If you do that you are admitting defeat by accepting a one-inch group. You must fully accept the fact that the mirage is moving the image while the target is standing still and go for it

It is a common fault of young shooters who don't have confidence in their judgment to think that they can wait out conditions and shoot in the same condition each time. It can't be done.

It is impossible to remember all of the different variables (position of several wind flags, breeze on the back of your neck, mirage intensity and direction, density of clouds, etc.) for the 5 to 10 minutes it takes to complete a group.

What I hope to accomplish with this article is to tell you the method of training you can use to gain the confidence in your ability to look at a condition and know it is worth x amount and be totally confident that if you hold for the conditions your shot will go right in the group. No one can do it right every time but it is the champions who get it right the most. Any one with a little practice can look down range and tell the difference in conditions that will cause an inch of difference in the point of impact. To be a champion you must be able to detect a change that will move the point of impact a half a bullet hole.

Step one is to zero your rifle in ideal conditions. That might mean getting up at five in the morning and getting to the range while it is cool and calm and get the rifle to print right beneath the cross hairs. If your scope has adjustable knobs set them at zero so you know where it is hitting under perfect conditions. The next thing you will need is a couple of wind flags. No they are not to tell how much the wind is blowing your bullet. They are to tell you what angle the mirage is running at. The angle the mirage is running has an effect on where it's moving the image. For example the mirage is running at what looks like right to left at a certain speed. You would assume that it is moving the image to the left, which it is, but it may be running at an angle of 40 degrees down range at the same time. Knowing this you can assume it will not be moving the image quite as far to the left as you first thought, also, because it is running away from you it is pushing the image lower. Your challenge is to determine how far to the left and how far up to hold. One old rule is never ever shoot in a boil. That's pretty sound advice but how do you tell a boil from mirage that is running straight away or towards you, the answer, practice. While boiling mirage and running mirage look similar they will cause distinctly different movement of the image, one is raising the image and the other is pushing it down. During this exercise try to pick as many different conditions as possible so that you can learn what each condition will do.

You have a rifle that we know is hitting right under the cross hairs in ideal conditions and hopefully it will shoot ½ moa or better. It's hard to learn much if you can't trust the rifle. You have a good pedestal, sandbag and, if possible, a good spotting scope. A pair of wind flags set up at intervals down range. The afternoon is getting warm and your target frame looks like there are a bunch of mice feet running back and forth on top of it. You have brought a tablet and a pencil to take notes with. You write down the conditions as you see them and then mark where you think the bullet will hit on the target (in the beginning this is just a guess). Now it is time to test your judgment, you take a dead-on hold and fire one round . You look at the target and then at your tablet and see how far you were off and mark

your actual impact point in relation to the sketch you drew. Repeat the process again, sketch the target, mark where you think you will hit, load one round, take a dead-on hold and see where you hit. Be sure that you describe the conditions in as much detail as you can. As an example: rt. to lt. at moderate rate wind flag indicates 30 degree down range. It will take a little time to record the conditions, your guess and the actual impact point but this is time well spent, it will give you a chance to study your practice session in the evening and reflect on what you have learned. At this point shooting groups is a waste of time and ammo. Remember not to change your scope from where it was in ideal conditions. You can follow this routine as long as you want or until you are hitting right where you marked every time.

Now you are at the range and are ready to take the next step. Continue to observe the conditions and make a note of them but instead of taking a dead-on hold from now on you are going to figure where the target really is and hold off of the target image so that you will impact in the x ring. Take a shot and see where you hit. Mark your tablet and repeat. If you are accurate in your reading of the mirage and description of it and you take good notes you will be able to study your notes when you're not at the range and pick up things you might have missed while you were shooting. To make it easier and quicker you can develop a shorthand way to record information, I draw the waves of mirage large and widely spaced for slow mirage and smaller and shorter as the mirage speed increases. The purpose of this exercise is to reinforce your confidence that the mirage is doing what you know it is. A word about practice, there is a point in practice when it stops accomplishing anything and all you are doing is going through the motions. At this point it is a waste of time and does more harm than good. It is much better to quit while you are fresh and sharp than keep it up until you are past prime.

You have proceeded through steps one and two and by now you have a good idea where the target really is under most mirage conditions. It is a good idea to repeat both steps the first thing when getting to the range or when you shoot at a new range as it will reinforce your confidence and in the case of a strange range it will point out any peculiar traits of the range. The saying "hometown advantage" definitely applies to shooting, each range has its own subtle characteristics the homeboys have learned, a little time spent going back to the basics might reduce the "hometown advantage".

I will finish this off as though you were going to shoot benchrest competition because it covers shooting groups.

By now you are able to judge conditions and you know what is necessary to put the bullet where you want it to go. Now instead of shooting singles you are going to shoot groups. As you probably know in benchrest competition you have a record target and a sighter target.

You are allowed unlimited shots on the sighter target and can go back and forth between the record target and sighter target. While you are waiting for the "commence firing" command put the time to good use and study the conditions for as long as you can to determine what the prevailing conditions are. After the commence fire command wait until the prevailing conditions are running before you start. Shoot your first record shot with a dead-on hold and note where the shot went in relation to the conditions (some rifles require one or more fouling shots before they settle down so it's a good idea to fire a couple of shots into the sighter target first). Remember that you have your bullets printing right under your crosshair so when you fire the first shot it becomes your target, the location of your group in a benchrest match is unimportant so it is not necessary to try to put your first shot in the x ring. Now all you are shooting is a four shot group (because you are shooting at your first shot) while every one else is shooting five. This gives you an advantage right off the start. You watch conditions and determine where the target is (notice I said where the target is, not the image.) If conditions are changing fast you won't have time to go back to your sighter to verify what you think so you will have to go on guts. If the changes are slow then always go back to the sighter when you see a change and verify how much it is worth.

You will notice that I didn't tell you how to read mirage. If I had you wouldn't remember it till you got to the range. I hope I have given you some idea of how to train so that you know how to read it and you will remember it. I can't impress on you the importance in believing that your eyes are lying to you and that the target isn't really where you are seeing it .

There is a small trick that I have used that I will share with you. Your rifle scope is focused at the target and has a very shallow depth of field. That means that you are only seeing the mirage for a few feet at the target. The mirage can be running the opposite direction up range and you will never know it. If you stop down the objective lens by covering it and leaving a small hole in the center you will increase the depth of field and be able to see mirage over a larger area of the range. You can do this by using tape and leaving a hole in the center about the size of a dime.