

## SIGHT ADJUSTMENT AND ZEROING

By Gary Anderson, Director of Civilian Marksmanship Emeritus

Note: This article is one of a series of **On the Mark** articles on **Teaching Rifle Marksmanship to Young Shooters**. This article examines the instructional points that are recommended for coaches to use in teaching new shooters how to adjust their sights and zero their rifles.

Sight Adjustment or zeroing is the act of adjusting rifle or pistol sights so that shots fired with them hit the center of the target. One of the most obvious yet overlooked lessons in shooting is that **shot groups fired from precisely zeroed rifles produce the highest scores**. This should be obvious to all who have even a casual contact with target shooting, but many analyses of targets fired by less experienced rifle shooters show that failure to keep their rifles zeroed is one of their most common and costly errors.

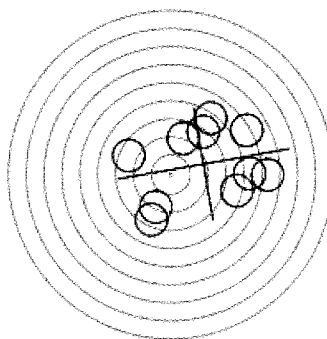
**When to Teach Sight Adjustment.** Sight adjustment, that is, how to precisely zero a rifle and keep it zeroed, is one of the things coaches of new shooters should teach early and well. In fact, if the supported position is used to do introductory or familiarization firing before advancing to the standing, prone and kneeling positions, the ideal time to teach sight adjustment is while new shooters are still firing with a support. Accurate sight adjustment requires that the shooter start with reasonably good shot groups. That is something beginners in standing or even prone may not achieve for some time. **Coaches should teach sight adjustment while the supported position is still being used and as soon as shot groups are nine ring or smaller on the BMC target.**

**Definitions.** When coaches teach sight adjustment to new shooters, several terms are used that should be explained at the beginning of instruction on this topic.

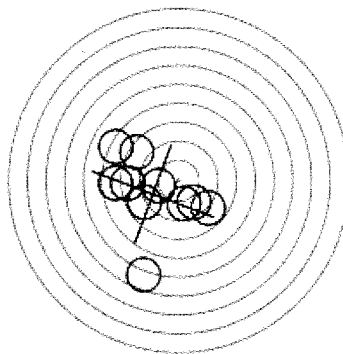
1. **Zeroed Rifle.** A rifle with sights adjusted so that when fired with a correct sight picture, shot groups are centered.

2. **Windage.** Sight adjustments that move shot groups left or right.

3. **Elevation.** Sight adjustments that move shot groups up or down.



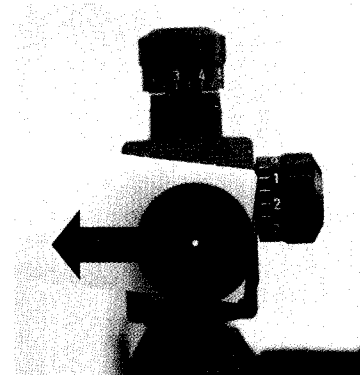
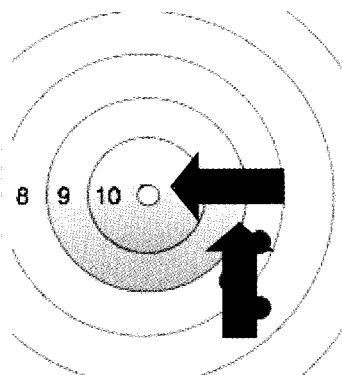
One of the most common new shooter errors is the failure to correctly zero their rifles. Sporter Class junior competitors fired these two shot groups on 10-bull targets and the Orion Scoring System scored them.



Orion functionality also produced these composite groups showing the centers of the groups as well as their vertical and horizontal axes. They illustrate how costly off-center shot groups can be.

4. **Rifle Zero.** The windage and elevation settings on a rifle sight that allow it to hit the center of the target when aimed and fired correctly.

**Sight Adjustment Responsibility.** New shooters should learn early that **shooters, not the coach, are responsible for keeping their rifles zeroed**. One of the outmoded images of junior rifle shooting is where



To move a shot group to the center of the target, the rear sight aperture must be moved in the same direction that the shot group must move.

the coach sits behind the shooters with the team's only spotting scope and tells shooters what sight adjustments to make. Since direct coaching like this is only allowed in BB gun competitions and during sighters in

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Sporter Class air rifle competitions, it is clear that all shooters will reach the point where they are on their own when it comes to adjusting sights and keeping their rifles zeroed. Coaches will do their shooters a big favor by teaching sight adjustment early and making it clear that each shooter is responsible for zeroing their own rifle.

### Sight Adjustment Principle.

The fundamental rule applying to all sight adjustments is that **to zero a rifle, the rear sight aperture must be moved in the same directions that the shot group must move.** If a shot group is low-right, the group must be moved up and to the left so the rear sight aperture must also be moved up and to the left. Conversely, a shot group that is high must be moved down, thus the rear sight aperture must be moved down.

### HOW SIGHTS WORK

After explaining definitions that apply to sight adjustment, the next step is to explain how target sights work. Sights on target rifles are precision instruments capable of exact adjustments that shooters can use to keep their shot groups centered on their targets. Features on target sights that all shooters must be familiar with are:

1. **Elevation Knob.** A round knob, usually on top of the rear sights, that moves shot groups up or down when turned.

2. **Windage Knob.** A round knob, usually on the right side of rear sights, that moves shot groups left or right when turned.

Sight	Distance	Target	Scoring Ring Distance - MOA	Clicks Per Scoring Ring
Daisy No.	5 meters	AR-4	5.00 MOA	6
5899	10 meters	BMC	5.26 MOA	6
	10 meters	ISSF	1.65 MOA	2
El Gamo, El	10 meters	BMC	5.26 MOA	12
Gamo Type	10 meters	ISSF	5.26 MOA	4
Savage MK-I	50 feet	BMC	3.45 MOA	15
FVT	50 feet	USA-50	1.05 MOA	5
Anschütz	10 meters	BMC	5.26 MOA	38
10-clicks/turn	10 meters	ISSF	1.65 MOA	12
	50 feet	USA-50	1.05 MOA	8

Note: Scoring ring distances are given in "minutes of angle" or MOA. 10-ring sizes may vary from other scoring ring sizes. The data for the Anschütz 10-click sight may be used as a guide for other precision sights, but it is best to check factory catalogs for exact data.

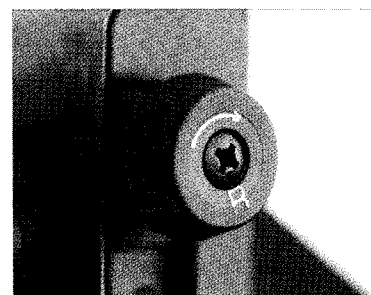
3. **Clicks.** Almost all sight knobs turn in increments called "clicks." Sight knobs are constructed so that clicks are felt as the knobs turn. Each click moves the rear aperture and the shot group a specific distance on the target. This makes it possible to calculate and make precise sight adjustments.

4. **Click Distances.** For beginning shooters, sight adjustment calculations are easier to understand if they are taught to make adjustments based on scoring ring distances, that is, how far one scoring ring is from the next. If they are told how many clicks of change are required to move a shot group center from one scoring ring to the next, it is easier to calculate how many clicks of elevation and/or windage to apply. The chart gives a general guide to how many clicks of change are required for common sights used by beginning shooters.

When determining the number of clicks per ring required for sights that are not shown, you may need to run a test by having a skilled shooter "shoot a box" from a supported or prone position. Fire



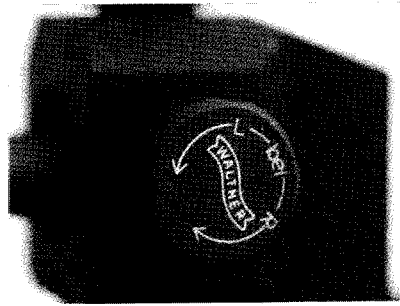
*New shooters need to understand how the elevation (top) and windage (right) knobs on their rear sights work.*



*Sights sold with rifles marketed by USA companies have arrows indicating the direction the shot/shot group will move when turned in that direction. Be sure to look carefully at the sight knobs, however, because some USA sights turn in the opposite direction from other USA sights.*

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three shots on the target being used for new shooter training, then apply 20 clicks of elevation, shoot three more shots, go 20 clicks left (or right), shoot three shots, go 20 clicks down, shoot three shots, and finally, go 20 clicks right (or left) and shoot three shots. The last 6-shot group should be in the same location as the first group and the distances between the four shot groups should be relatively equal. You should then be able to use these distances to calculate the number of clicks per scoring ring that are required for that particular sight.



*Sights sold with most rifles manufactured in other countries indicate the direction to move the shot/shot group based on where the shot group is located. If the shot group is "bei" or AT the right (R), turn the sight in that direction to move the shot group to the left.*

**Sight Knob Directions.** After deciding which direction to move a shot group and how many clicks of change to make, the next step is to apply that adjustment to the correct sight knob. This, however, is where it gets tricky. Some sights move shot groups down when they are turned clockwise, while other sights move shot groups down when turned counter-clockwise.

The same goes for windage adjustments. To make matters worse, sights made in the USA usually show the direction the shot group will move when turned in the direction indicated by the arrow, while sights made in Europe have arrows indicating where the shot/shot group is located. These sights, which are common on precision target rifles, have arrows indicating that the shot/shot groups are AT the left/right (bei L or bei R) or are AT high or low (bei H or bei T). Thus, when a shot/shot group is AT the left (bei L), turn the knob in the direction indicated by the L arrow and the shot group will move to the right.

The coach's duty in this case is to examine each sight that will be used by shooters in the program so that you can clearly explain which direction to turn the sight knobs to move shot groups in the desired direction. For beginners, it is a good idea to make up small

cards to give to each shooter for the rifle they are using that show which direction to turn the sights.

### CALCULATING SIGHT ADJUSTMENTS

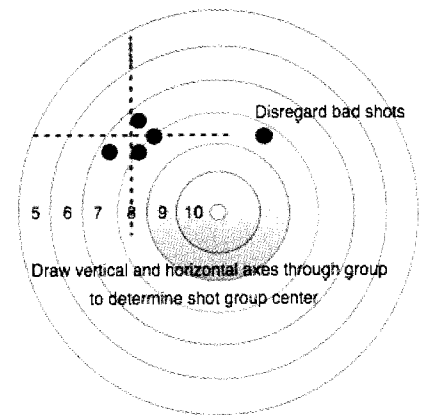
With an understanding of the basic principles of sight adjustment and how sights work, new shooters are ready to analyze their shot groups, calculate sight adjustments, apply those adjustments to their sights and test their calculations. The sight adjustment process follows these steps:

**1. Fire a Shot Group.** The first step in sight adjustment is to fire a shot group. Beginners should start with 5-shot groups. As shooters acquire more skill, three or even two-shot groups can be used. Ultimately, a highly skilled shooter who can precisely call shots can make adjustments based on one shot, but that ability is several months of practice away for new shooters.

At this stage, it is also best for shooters to fire their groups without attempting to use a spotting scope. That will come later.

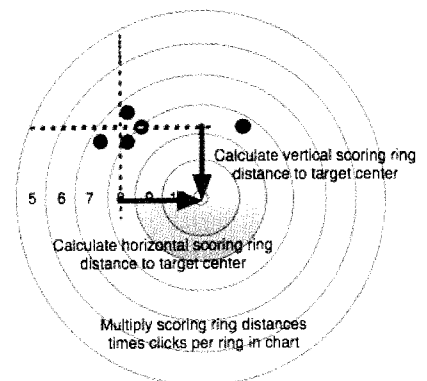
**2. Analyze the Shot Group.** After retrieving the target, determine where the center of the shot group is. If there is a flier that is clearly out of the group, disregard that shot and find the center of the good shots. Do this by drawing either a real or imaginary line through the group. The crossing point is the group center.

#### Analyze Shot Group



*After firing a tight shot group, the next step in calculating sight adjustments is to determine where the center of the group is.*

#### Calculating Sight Changes



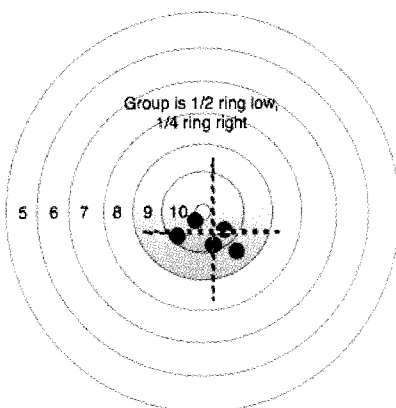
*After finding the group center, calculate the vertical and horizontal distances in scoring rings to the target center. For this shot group, the vertical distance is 2 rings (1/2 of the ten ring on this target is equal to one scoring ring distance) and the horizontal distance is 2 1/2 rings.*

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3. **Calculate Distances to Target Center.** Next, from the group center determine the distance from there to the center of the target in scoring ring units. Once you have those distances, multiply that value times the number of clicks per scoring ring that applies for the sight on your rifle. Get that number from the chart on page 5. If the shooter uses an El Gamo-type sight to fire on a BMC target, two scoring rings distance would require a 24-click change (2 rings x 12 clicks/ring). If the shooter uses an Anschütz 10-click sight on the USA-50 target, 2½ scoring rings would require a 30-click change (2.5 rings x 12 clicks/ring).

4. **Shoot Another Group and Change if Necessary.** Zeroing rifles is an art, not an exact science. This is especially true for beginners who do not consistently apply the same pressures on the rifle each time they get into position. For this reason, it is not unusual to fire a second group that is closer to the center, but still not centered. Every time a group is fired, it should be examined to determine if it is centered. Whenever shot groups are not centered, adjustments should be made.

### Adjust 2nd Group (If Necessary)



*This second group after sight changes scores 49x50, but it is not centered and another sight change should be made.*

## KEEPING RIFLES ZEROED

After teaching initial sight adjustment, the coach must be alert for opportunities to teach a second set of concepts to ensure that shooters keep their rifles zeroed, especially after they begin three-position shooting.

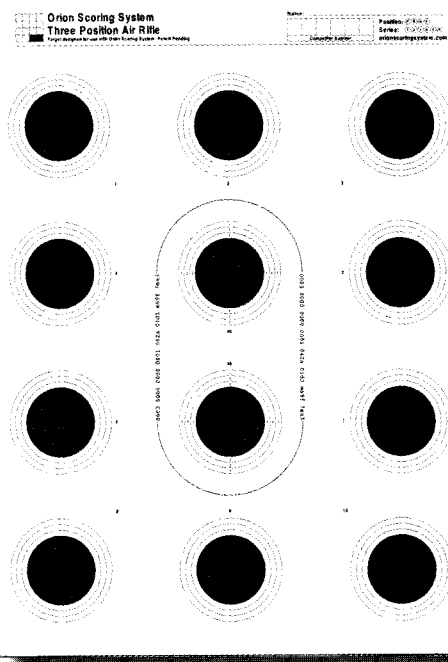
1. **Zeroes Change from Day to Day.** Just because a rifle was zeroed the last time it was fired does not mean it will shoot in the same place the next time. Shooters must be allowed to fire "sighter" groups each day when they begin shooting so they can check the zero on their rifles and make necessary adjustments. Later when they fire on the competition target, you can teach them that the two sighter bulls in the center of

the target are for shooting practice shots to confirm that their rifle is zeroed before they start firing record shots.

2. **Zeroes Change During Shooting Sessions.** When shooters fire a series of groups during a day of shooting, they must be alert for zero changes and make sight adjustments when necessary.

3. **Zeroes Change from Position to Position.** After shooters reach the point where they are shooting more than one position, they must understand that each position will probably have a slightly different zero. This is because the rifle is held down by sling tension in prone and kneeling, but not in standing or simply because of the rifle is held differently in the different positions. Young shooters should be encouraged to not only make zero changes when required in a new position, but they should record these changes so that when a consistent pattern emerges, they can apply standard changes before firing their first shots in a new position.

4. **10-Bull Competition Targets Present Special Challenges.** New shooters typically shoot their first groups on single bull or large targets like the BMC target. With five shots together in a single grouping, it is easy to determine where the shot group center is. When they advance to the competition target, they will shoot one shot on each bull (sometimes two shots are fired on each bull in practice) and they must learn to form a mental picture of where a group of the most recent three to five shots is located. When a series of shots strike off-center in the same direction, this is a significant sign that the rifle is not zeroed and that a sight change must be made.



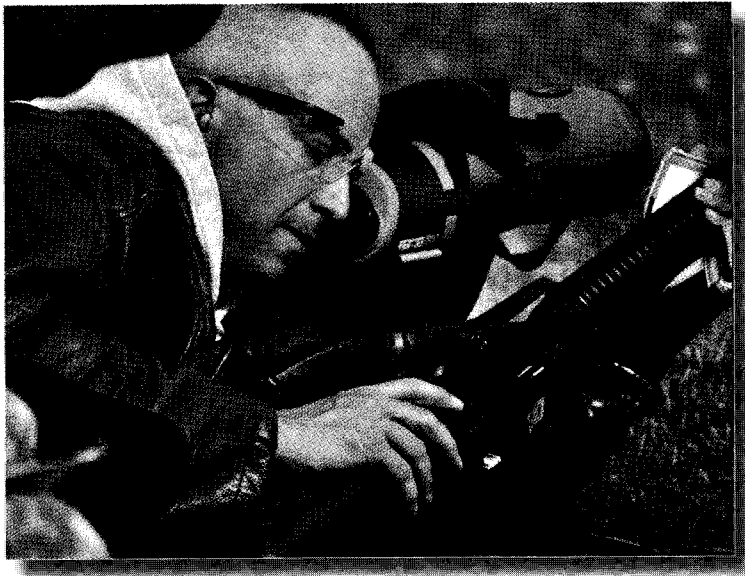
*10-bull air and smallbore rifle competition targets have two sighter bulls in the center that are used to confirm zeroes before shooting for record.*

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**5. Calling Shots and Sight Adjustment.** By the time new shooters advance to three-position shooting they should be taught how to “call their shots” and correlate their shot call locations to actual shot locations. Calling a shot means taking a mental snapshot of where the sights were pointed at the precise instant when the shot was fired. Shot calls should be made before looking in a telescope for the shot locations. Shot calls should describe the direction the shot was from center by using clock face directions and should, if possible, designate the scoring ring the shot should hit.

A shot that was seen as slightly low might be called as a “9 or 8 at 6 o'clock.” A high-left shot might be called an “8 or 7 at 10 o'clock.” Once a shooter becomes skilled at calling shots, this information can be used to keep the rifle zeroed and to evaluate shot technique performance.

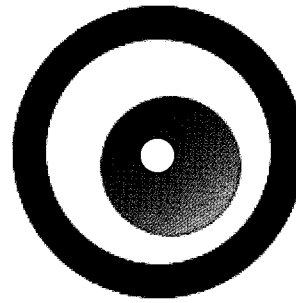
**6. Spotting Scope Use.** Every advanced shooter who fires on competition targets uses a spotting scope to check shot locations after each shot. By calling



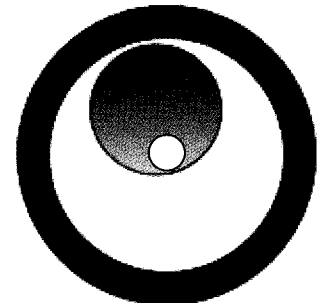
shots, tracking the locations of the most recent shots in relation to shot calls and making continuing small adjustments, usually only a click or two at a time, it is possible to keep shot groups well centered throughout a course of fire.

For new shooters, however, trying to use a spotting scope is more of a distraction than an aid. It is better to have them fire 5-shot groups and to check and make sight adjustments after firing the entire group. Once shooters reach the point where they are shooting three-position courses of fire, they should be ready

### SHOT CALLS



9 at 10 o'clock  
on competition target



9 at 5 o'clock  
on BMC target

*This graphic illustrates two mental snapshots or shot calls made by a shooter at the instants the rifle fired together with the locations where the shooter called those shots.*

to use a telescope to check their shots while they are firing.

One of the critical skills coaches must convey to their new shooters is the ability to analyze shot groups and adjust sights to place their shots as close as possible to the center of the target. The result will be shooters who achieve the best scores their shooting positions and shot techniques allow them to produce.

### About the Author

Gary Anderson, Director of Civilian Marksmanship-Emeritus, is a regular contributor to *On The Mark*. He served as DCM for 10 years and remains an effective advocate for firearms safety training and rifle practice. Gary's primary role at CMP has been to develop and sustain successful youth shooting programs at both regional and national levels.

