

Modern Scoring Systems

Modern Scoring Systems and Deciding Scoring Issues

By Gary Anderson, DCM Emeritus

Author Disclosure Statement

In this article I make several favorable references to the Orion Scoring System and the Orion match management system. The developer and distributor of Orion products is my son Dr. Erik Anderson. Since Orion is the only system of this type that is adapted for use in USA competitions, there are no competing systems, but I nevertheless want to make sure our family relationship is disclosed to any readers who are not aware of this.



This 5' x 7' stone stele now displayed in the Luxor Museum in Luxor, Egypt depicts what may be one of the world's first targets. Pharaoh Amenhotep II, who ruled Egypt from 1427 to 1401 BCE, is shown shooting arrows at a copper cylinder with an impressive group in the center of his target (lower right).

The history of target shooting with archery and firearms can be traced in part through the evolution of shooting targets and scoring systems. Ancient Egyptians used copper cylinders. Ancient Greeks shot at pigeons tied to tall poles. In the Middle Ages and early modern times, rifles were fired at round wooden targets, some beautifully painted with celebratory scenes. American frontiersmen used a slab of wood with a "mark" painted on it.* Long

range rifle shooting in the 19th century used iron targets that gave audible clangs when hit. Paper targets became common in the 19th century and continue to be used today. Electronic target (EST) development began in the 1970s and became mandatory for Olympic and international competitions by 1990. (*The name of this magazine, **On the Mark**, comes from the American frontiersmen's practice of "shooting at the mark.")

Scoring used in today's rifle and pistol competitions must be extremely accurate and scoring issues must be decided correctly to be sure all athletes receive the scores they actually fire. Shooting as a sport is also in competition with other sports so how fast and attractively scores are presented to competitors, coaches, spectators and internet audiences helps shooting compete favorably with other sports.

This ***On the Mark*** article is aimed at helping junior leaders and competition officials, as well as athletes, coaches and parents, understand modern scoring methods and how scoring issues are decided and to help them gain insight into how the presentation of competition results can make shooting more interesting and attractive. The article examines three components of scoring, 1) scoring methods, 2) match management systems and 3) the scoring process.

SCORING METHODS

Rifle and pistol shooting competitions use one of three methods of scoring, 1) manual scoring, 2) electronic or virtual image scoring (VIS) and electronic scoring targets (EST).

Manual Scoring

Manual scoring has been done for centuries by people using human vision and simple scoring aids such as templates, scoring gauges and magnifying scoring templates (Eagle Eye™). In manual scoring, competitors exchange scorecards and score each other's targets or a team of official scorers (usually volunteers) score all targets. Human scoring has the advantage of being cheap and simple, but it has the disadvantages of being slow and inconsistent.

Electronic Scoring (VIS)

Electronic or Virtual Image Scoring (VIS) scoring uses

a complex computer algorithm to score digital or virtual images of fired paper targets obtained from scanning or photographs. Orion Scoring Systems (<http://www.orionscoringsystem.com/orion/Home.aspx>) is the only firm producing VIS scoring that works on USA targets.

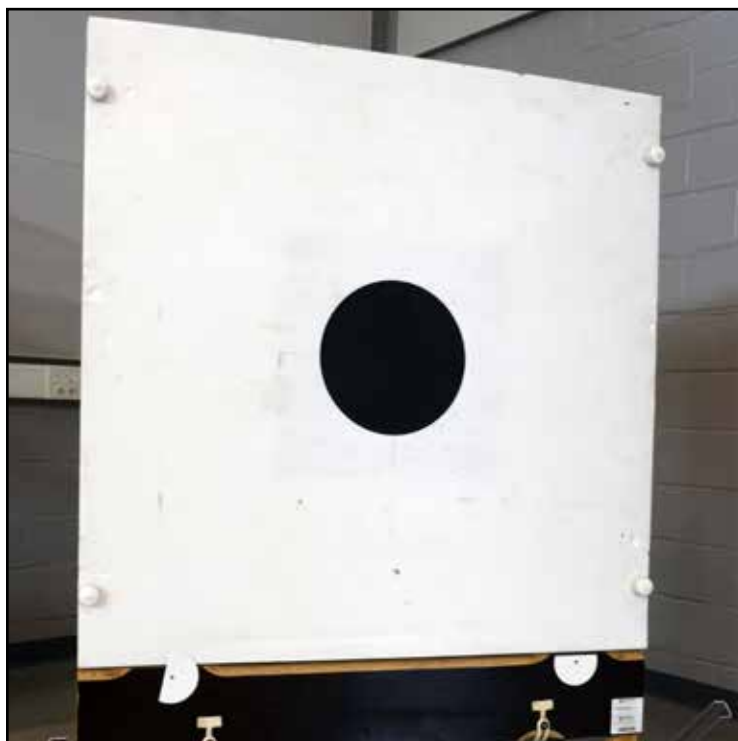
The Orion system is now in widespread use in schools and clubs and recently was used to score targets during the CMP's first Smallbore Rifle Championships at Camp Perry.



A Scoring Officer is using Orion VIS software to resolve scoring issues during the scoring of a target in the 2018 CMP Smallbore Rifle Championship.



Competitors in a Rimfire Sporter Match have exchanged scorecards and are scoring each other's targets.



A CMP KTS electronic highpower rifle target. Microphones in the four corners use sounds from projectiles passing through the target to locate and score shots.

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A COMPARISON OF SCORING METHODS

SYSTEM	SCORING ACCURACY	SCORING SPEED	PERSONNEL REQUIRED	PRESENTATION	ONLINE RESULTS	COST
Manual Scoring	+/- 0.100 to 0.200 mm w/ trained scorers	30 min. to 2 hours after a relay ends	One or two trained scorers per 10 firing points	Score posting is possible only after scoring	Possible with hand entry after scoring	\$75-150 for gauges, etc.
Orion/VIS	<+/- 0.100 mm	Scanning targets and scoring takes 1-2 minutes	One or two Statistical Officers familiar with Orion software	Scores and ranked results are on the internet as targets are scored	Online results integrated into software	\$1000 - \$1500 for a 30-40 point range
EST	<+/- 0.100 at 10m and 50'	Scores are displayed within milliseconds	One EST trained scoring officer plus one target officer	Realtime score viewing and ranked results.	Limited online results posting	\$3,000 - \$6,000 per firing point

CONCLUSIONS:

Scoring Accuracy: VIS and EST scoring is more accurate; manual scoring can be good or bad according to scorer skill, experience and concentration.

Speed: EST with instant score display has a clear advantage; VIS scoring is significantly faster than manual scoring.

Personnel Requirements. Manual scoring requires the most scoring officers; VIS requires someone familiar with Orion software; EST requires Technical Officers with special training.

Presentation. EST are clearly the best; VIS with integrated online posting supports results presentation immediately after scoring.

Online Results. Orion VIS is the best; EST online posting capabilities vary (CMP/KTS and Megalink EST systems generate HTML pages, but no hosting service; Sius EST generate online results when operated by factory technicians).

Note: The Orion MMS also provides coaching tools such as shot group analysis and individual athlete progress tracking.

Electronic Scoring Targets (EST)

EST use acoustical, laser or light beam systems and computer computations to precisely locate where a projectile passes through a target. EST scores are displayed within milliseconds to facilitate real-time spectator viewing. EST are installed in many leading U. S. shooting ranges including the CMP Competition Centers at Camp Perry and Anniston, the CMP Marksmanship Park at Talladega, Alabama and in CMP travel ranges.

The impact of the modern computer age with EST and VIS scoring has dramatically changed target scoring. With three different scoring methods to choose from, match sponsors must decide which scoring method best fits their needs and budget. Factors to be considered are scoring accuracy, scoring speed, personnel requirements, presentation possibilities, online results posting and costs.

The chart above compares the three scoring methods.

MATCH MANAGEMENT SYSTEMS

A foundation for scoring competitions is a Match Management System (MMS). A match sponsor's MMS must provide a means of recording competitor entries and scores and producing ranked results lists. The simplest MMS usually is a computer spreadsheet that records competitor names, contact information and scores and has a sorting capability to rank scores.

At the other end of the MMS spectrum are sophisticated MMS software systems that come with Orion Scoring Systems and some electronic targets. The Competition Tracker system that the CMP uses to manage its competitions falls in this category. These systems record

competitors, squad competitors, record competitors scores as they are scored or fired, break ties to rank competitors, provide on-line leaderboards during competitions and produce results lists that are automatically posted on internet websites.

THE SCORING PROCESS

Rifle and pistol competitions must follow a multi-step "scoring process" that begins with registering competitors (Preparation) and ends with the presentation of results (Final Results List). Steps in the scoring process are described below:

Preparation

The preparation phase of the scoring process involves creating a list or database of competitors. This phase also involves squadding competitors to specific relays and firing points. The match management system that records this information should be capable of producing printed or electronic Start Lists that link competitors' scores to their data records.

Scoring

When a competitor fires competition shots, they must be scored according to how far each shot is from the target center. Manual scoring uses printed scoring rings on paper targets to determine scores according to which scoring ring was hit or touched. VIS and EST score shots according to how far the center of the shot hole is from the center of the target.

Score Memory. After a shot is scored, its value must be recorded in a score memory. Manual scoring uses scorecards on which scores are recorded or the target itself may become a scorecard when scores are written on it. With VIS and EST scoring, scores with precise x/y coordinates are automatically stored in a computer memory.

Score Display. One of the best ways to enhance shooting's value as a spectator sport is to display scores when they are fired. EST does this, but instant display is not possible with paper targets. Highpower rifle comes close when scored shot values are signaled from the pits. When paper targets are used, spotting scopes can be used to see most scores, but final decisions on doubtful shots can only be made later.

Scoring in Tenths. Some modern shooting events where scores are high and there are many ties now use tenth-ring scoring instead of whole number scoring.



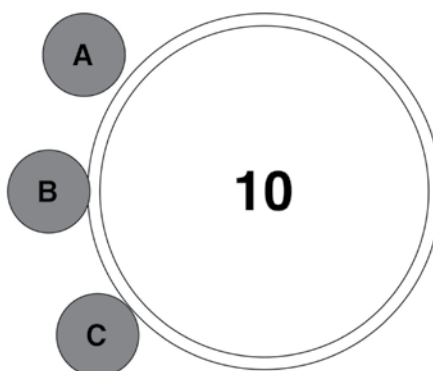
A pistol competitor records the values of all shot fired on the target on a scorecard that is turned in to the Statistical Office after the match.

This can be a much fairer way to score shots. Tenth ring scoring reduces the luck factor by ensuring that a shot that is just out (9.9) is not a match ending occurrence. The ISSF now requires 10m air rifle and 50m rifle prone events to be scored in tenths; finals have been scored in tenths for more than 30 years.

The problem with tenth ring scoring is that attempts to devise gauges to manually score shots in tenths were not successful. Only VIS and EST are capable of accurately scoring shots in tenth ring values.

Deciding Doubtful Shots

Doubtful shots are shots that are so close to scoring a higher value that the scoring method must make an "in-out" decision. Those decisions must be as precise as possible and be decided according to a uniform standard.



Scoring Doubtful Shots

- A - Shot does not touch outside edge of line. Scores lower value. Score = 9**
- B - Shot breaks scoring ring. Scores higher value. Score = 10**
- C - Shot just touches scoring ring. Scores higher value. Score = 10**

Scorer training is a necessary factor in obtaining accurate manual scoring. Scoring diagrams like this one are useful for teaching scorers what to look for.

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Manual Scoring. The first step in scoring shots manually is educating scorers. Rulebooks have diagrams to illustrate visual differences between shots that are “just out” and shots that touch or break the next scoring ring. Scoring gauges are a big aid for doing this during 10m and 50 ft. shooting if high quality target paper is used. When poor quality target paper is used or when targets are pasted on backer boards, scoring templates are usually more accurate. Scoring gauges should never be used to score torn shot holes or possible doubles.

VIS. Scoring virtual images of fired targets is done with a computer algorithm that scores clean shot holes to a precision of +/- 0.1 mm or less. Periodic improvements are made to the algorithm to get it to read irregularly torn shot holes correctly, but occasionally an irregular paper

tear will be misread by the computer. Computer images of those shots are evaluated by a Scoring Officer who can, if warranted, make manual corrections.

EST. To ensure that scoring decisions are precise and uniform, EST are required by international rules to score shots to a precision of +/- 1/2 of one decimal ring (0.125 at 10m). Targets are tested to confirm that they fulfill this standard. Proper target maintenance is also necessary to confirm that they continue to meet this standard.

Score Transfer

Shot scores and/or series totals must be recorded in the MMS. When manual scoring is used, scorecards must be transferred to the statistical office where someone manually enters scores in the MMS. VIS and EST automatically record all scores in their computer memories so no score transfers are necessary. Hand entering scores from scorecards is a potential source of errors that require subsequent correction.

Scoring Issues and Decisions

As scores are recorded in the MMS database, scoring issues or penalties that may change those scores must be decided and any necessary adjustments must be made. Score adjustments could come from penalties that were decided by Range Officers or adjustments required for irregular shots such as crossfires, possible doubles or multi-shot clusters as well as early, late, extra or missing shots.

Irregular Shot Documentation. A key to resolving scoring issues is documentation. The ISSF and CMP, for

AT&T 14:36

Submit Incident Report

Participant
Doyle, Jack (278584)

Internal Crossfire

7.12.6

First occasion per target athelte is not p...

Time
6/30/2018, 2:35:41 PM

Comments

Submit

One of the new innovations used in the 2018 CMP Smallbore Rifle Championships were electronic Incident Reports. Range Officers had special iPod apps that they used to document incidents and irregular shots and upload from the range to the Orion computer that recorded scores

SCORING ISSUES — FINDING DOUBLES

Which shot is the double? There were no excessive hits on other targets.

When a double is indicated, scorers must look for a slightly elongated shot hole. The arrow points to the double.

If shot hole is elongated, place ring on one side of shot hole. If the other side extends outside of the shot hole, it is the double.



Highpower rifle shooting uses shot spotters and shot value signals to display individual shot results within seconds after firing.

example, require match officials who encounter these issues to complete Range Incident Forms (RIFs) that identify the competitor and describe the issue or incident. Completed RIFs go to the statistical office so they can be used to resolve the issue or make score adjustments.

External Crossfires. An external crossfire is a shot fired by a competitor on someone else's target. Crossfires are extremely rare in 10m shooting, but are more common as distances increase. Crossfires in most competitions are scored as misses. The challenge in scoring crossfires is identifying them. When targets reach the statistical office, an RIF alerting them to a crossfire helps immensely. Some competitors will notify a Range Officer if they think they crossfired and some competitors who receive a crossfire will complain, but often a crossfire will not become apparent until the stage of fire is finished and a target has an extra shot. Techniques for resolving crossfires include:

- When EST are used for 50m or highpower rifle competitions, the exact times when shots are fired are analyzed by a trained official, who uses shot times to identify a crossfire shot and who fired it.

- In highpower rifle, rules for excessive and insufficient hits are used to resolve crossfires. Since these rules differ according to whether they apply to traditional highpower rifle or CMP Games events, it is best to consult the proper rulebook.

- When backing targets are used for 25m pistol or outdoor smallbore rifle shooting, crossfire shots and the competitors who fired them are identified by comparing shots on the target with shots on the backer. Crossfire shots are always offset a pre-determined distance to the left or right from the original shot hole.

Internal Crossfires. An internal crossfire occurs when competitors fire on targets with multiple bulls and place too many shots on one bull and too few on another. If a

competitor does this on an indoor 10-bull target, there is no penalty for the first two occurrences. If a competitor in a CMP Smallbore Rifle event fires an extra shot on one bull and one less shot on another bull, there is no penalty, but if the competitor does this two or more times there are 2-point penalties. The penalty for internal crossfires in Rimfire Sporter is more severe; the high ten are scored on targets with excessive hits, but targets with insufficient hits are scored according to how many shots are on the target.

Doubles and Shots Clustered Together. When multiple shots (usually 5 or 10) are fired on the same target bull, it is common for good shooters to shoot doubles (two shots going through the same shot hole) or groups of three or more shots where additional shots could have gone through the same enlarged shot hole. Since there is almost never a perfect double, doubles are easy to find if the scorer knows what to look for (see illustration). Competition rules provide for giving a competitor the benefit of doubt for a missing shot that may have gone through an enlarged shot hole formed by three or more shots when there are no excessive shots on adjacent targets (possible crossfires).

Missing Shots. When paper targets are used, missing shots usually turn out to be crossfires or, when inexperienced shooters are involved, off-target misses. When EST are used, a missing shot can also result from a target malfunction. 25m pistol targets should have backers on which missing shots can be located and 10m targets with witness strips must always have a missing shot on the paper strip. However, missing shots on 10m targets without witness strips (KTS) or 50m and highpower rifle targets without backers cannot be definitively proven. In those cases, match officials must decide what caused the missing shot and, based on available evidence, whether a provisional shot should be counted.

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SCORE DISPLAY POSSIBILITIES WITH ELECTRONICALLY SCORED TARGETS



After each shot, spectators can see shot scores fired by each competitor



Electronic leaderboard during an event shows changing competitor rankings



Preliminary results posting in range on LCD panel



Final Results posting on Finals Range show finals start list



During finals, finalists shots and current rankings are displayed on a video board

The advent of modern electronic scoring and match management systems gives match sponsors many new opportunities to use creative results displays to present the real excitement and drama of shooting competitions.

Other Irregular Shots. Competition rules for each discipline list other irregular shots and how to resolve them. There are early shots (before **START**), late shots (after **STOP**) and extra shots (competitor fires too many shots). The CMP offers Range Officer Training Courses for Bulls-eye Pistol, Highpower Rifle and Rimfire Sporter (<http://thecmp.org/training-tech/range-officer-training-course/>). Course students are taught how to resolve these and many other scoring issues.

Tie-Breaking

The next function that must be done after recording scores is to break ties and rank competitors. Each shooting discipline has specific tie-breaking rules. Tie-breaking rules are, in principle, similar and generally follow this sequence:

Rank	Competitor (Comp. Name)	Score	Position - Day 1	Position - Day 2	Position - Day 1	Position - Day 2	Aggregate
1	Hutch, Ryan (18234)	685.0 - 68	10.0 - 10	10.0 - 10	10.0 - 10	10.0 - 10	685.0 - 68
2	Zain, Kala (23616)	680.0 - 19	10.0 - 10	10.0 - 10	10.0 - 10	10.0 - 10	680.0 - 19
3	Orion, Antonio (19231)	675.0 - 20	10.0 - 11	10.0 - 10	10.0 - 10	10.0 - 10	675.0 - 20
4	Muller, Kuba (20214)	670.0 - 18	10.0 - 12	10.0 - 10	10.0 - 10	10.0 - 10	670.0 - 18
5	Edy, David (24271)	665.0 - 16	10.0 - 11	10.0 - 10	10.0 - 10	10.0 - 10	665.0 - 16

Final Results Lists for CMP competitions are posted in the CMP Competition Tracker. CMP Rules regard electronic results lists as official results.

1. The highest total score.
2. The highest number of Xs or inner tens.
3. The highest score on the last 10-shot series, then the next to the last 10-shot series, etc.
4. In finals, ties are broken with shot-by-shot sudden death shoot-offs.

Orion or EST software are programmed to automatically break ties according to the applicable rulebook.

Preliminary Result List Production

Once all scoring issues are resolved and ties are broken, a Preliminary Result List (PRL) must be produced. If manual scoring and recording is used, the PRL must be printed and posted on a range bulletin board. If Orion scoring is used, a PRL is automatically posted on the internet as soon as scoring issues are resolved. This PRL can be displayed on the range or it can be printed and posted. EST software also produces PRLs that can be displayed on the range or printed for posting. PRLs usually are posted with a "protest time" so competitors who do not feel a score is correct can submit a score protest or challenge.

Score Protests or Challenges

Score protests or challenges are like the instant replay reviews that are used in some sports to reconsider referee calls. In shooting, scoring challenges are used to review scoring decisions.

Manual Scoring. Challenges are decided by having a Scoring Officer who was not involved in the original scoring decision recheck a challenged shot.

VIS Protests. The correct way to decide VIS protests is for the Scoring Officer(s) to examine the original target image in the computer and decide whether the computer placed the scoring ring precisely over the actual shot hole.

Original targets are not used for rechecks because they can be altered during handling or even by manipulation. Scoring gauges should never be used to check a questioned shot hole because VIS scoring measures the distance of the shot from the target center, not its proximity to a scoring ring. When an irregularly torn shot hole caused the computer to misread the shot location, a Scoring Officer will make the necessary correction.

Point Buying. Giving competitors an opportunity to protest or challenge what they feel is an incorrect scoring decision is a fundamental protection against bad scoring. The score challenge system, however, can also be unethical because in practice only shots that were just out (9.9, 8.9, etc.) are challenged while the shots that were just in (10.0, 9.0, etc.) are never challenged. Score challenges unfortunately can become attempts at buying points. For this reason, many competitors make it a personal practice to never challenge close calls unless there is an obvious scoring error. They regard those calls as being like a baseball umpire's ball/strike calls. When scoring decisions are made by competent officials they are part of the game and should not be subject to rescoring.

EST. The rules do not permit protesting close shots scored with EST. Protests, of course, are possible when a target fails to register a shot, scores an unexpected zero or gives a completely erroneous score. Competition officials are trained to apply special rules to deal with these situations.

Final Results Lists

After any possible score protests or challenges are decided, the PRL becomes a Final Results List (FRL). If there is no final for the event, the FRL becomes the basis for presenting awards and letting everyone see how competitors finished. If there is a final, the FRL becomes a finals start list that identifies competitors who qualified for the final.

Finals Presentation

Finals conclude all Olympic and many 3-Position Air Rifle events. The CMP uses a final to conclude the President's Rifle National Trophy Match. The CMP also conducted finals as special interest events in its National Smallbore Rifle Championship. One of the great opportunities in conducting finals is to create a shooting theater where spectators, a finals CRO and script, target and results display systems, music and announcer commentary combine to present a "show." Then in-person and on-line spectators can enjoy the true excitement of shooting competitions.



The Rifle-Pistol Finals Range that will be used during the 2018 World Shooting Championship in Changwon, Korea. Finalists, coaches, Jury Members and Range Officers, pool photographers and TV cameramen are strategically located to focus attention on the athletes. An announcer and results display technology keep in-person, internet and TV livestreaming spectators informed about the competition. This becomes "sports presentation" for shooting at its best.

About the Author

Gary Anderson, Director of Civilian Marksmanship Emeritus, retired as the full-time CMP Director at the close of 2009. He continues to work with CMP as the senior marksmanship instructor. During his remarkable career, he won two Olympic gold medals, seven World Championships and 16 National Championships. He is a Vice President of the International Shooting Sports Federation, the President of USA Shooting, a former Nebraska State Senator and was one of the two Olympic Games Technical Delegates for Shooting during the 2012 Olympic Games in London.

In June, 2012, the International Olympic Committee awarded Gary Anderson the IOC's highest honor, the Olympic Order, "for outstanding services to the Olympic Movement."

In 2014, the CMP expanded their world-class air gun center at Camp Perry and renamed the facility the Gary Anderson CMP Competition Center, in honor of Anderson's contribution to the organization and the marksmanship community.

