# SILVER MOUNTAIN TARGET TESTS

**by**

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**with considerable help from**

***Steve Durham, Dudley Ford, Arthur Simpson, Mark Edge, Les Binnie.***

The Silver Mountain target system used in these tests was a G2 Shooters-Pac. The testing was initially intended simply to determine the precision of the Silver Mountain Target as an instrument for measuring the position of bullet holes but ended up being as much about the set-up of the system and the way set-up affects precision.

## HIGH PRECISION PRIMARY TESTING

**All measurements guaranteed to 0.5mm Precision on Corflute Test Sheets**

**308 projectiles were 155.5 gn Berger Fullbore Target**

**7mm RSAUM projectiles were 180gn Berger Hybrids**

| | |
|---|---|
| **DAY 1 MAREEBA June 8 2017**<br><br>**308 rifle, 2 X 30 shot groups at 900 yards** | **Imperfect setup but illustrates what may be expected if SMT is simply attached to existing target frame. Described in detail later.** |
| **DAY 2 MAREEBA July 13 2017**<br><br>**308 rifle, 30 shots each at 300 and 600 yards** | **Imperfect but better setup but again illustrates what may be expected if SMT is simply attached to existing target frame. Described in detail later** |
| **DAY 3 MAREEBA July 20 2017**<br>**7mm RSAUM 20 shots at 900y**<br>**308 rifle, 30 shots each at 900 and 300 yards** | **Close to perfect setup but with target frame not held rigid.** |
| **DAY 4 HERBERTON August 16 2017**<br>**7MM SAUM, 30 shots at 700 yards**<br>**308 rifle, 30 shots at 700 yards**<br>**308 rifle, 30 shots at 700 yards**<br>**308 rifle, 30 shots at 600 yards** | **As perfect a setup as possible which will exceed that used by nearly all Rifle Clubs.**<br>**Full descriptions are given later.**<br>**One shoot (indicated) deliberately used an incorrect setting to confirm the effect this had.** |

# SECONDARY TESTING

**Measured to lower precision to confirm Target Frame Movement effect.**

| | |
|---|---|
| **HERBERTON August 20 2017**<br><br>**Mixed calibres – 17 groups of 12 or 13 shots all at 600y.** | **High Precision measuring these approximately 200 shots in 17 individual shoots would have been prohibitive. Selected results have been included to illustrate the effect of non rigid target frames during typical shoots. This provides more evidence that deficiencies in Target Frame rigidity will be a limiting factor to most rifle clubs unless specifically addressed.** |

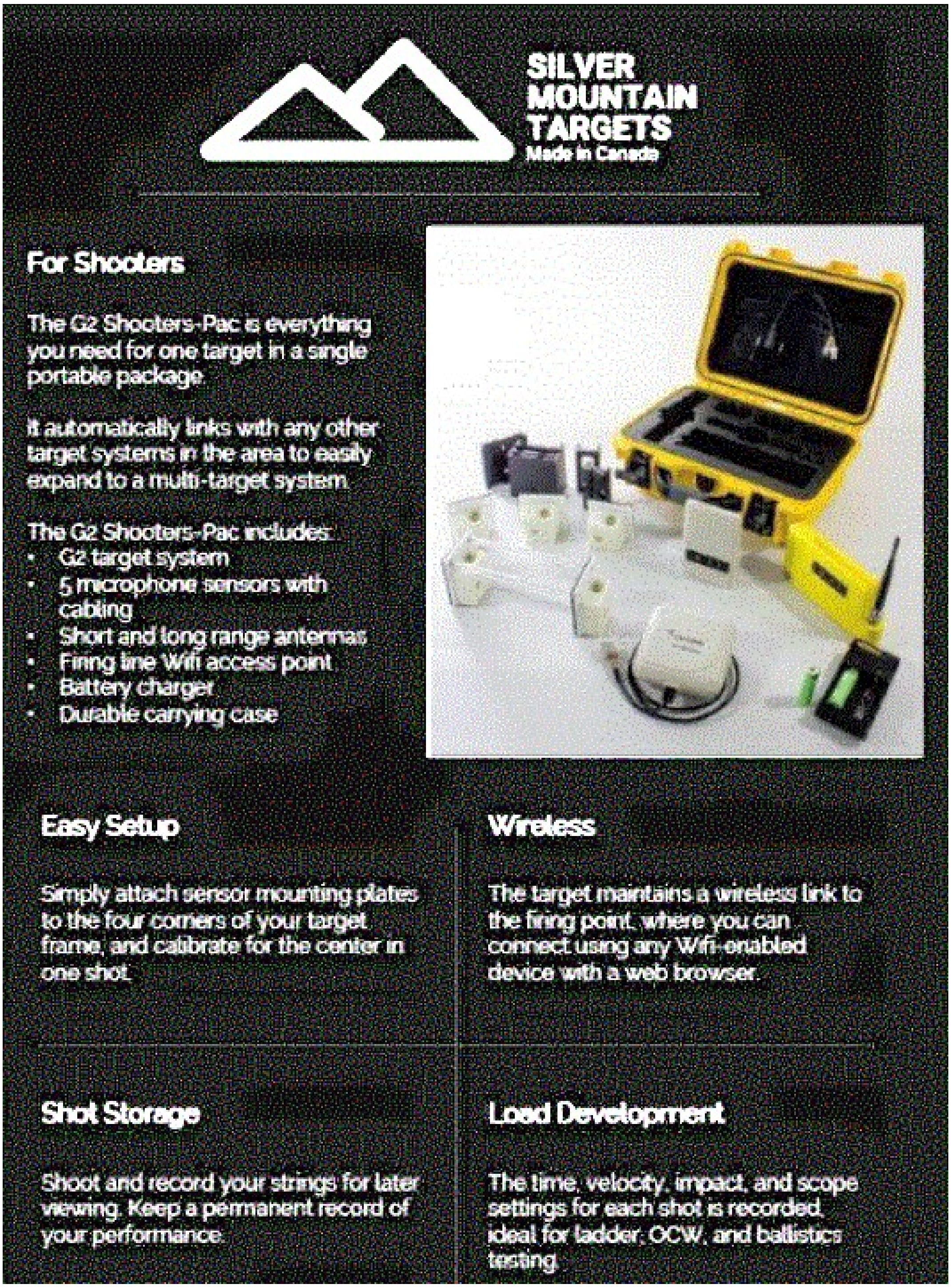
The final 22 pages of this report details each test, including raw measurements and enhanced Graphics illustrating all errors. It would be worth printing this out for reference as you read through the body of this report which is long and covers many topics.

This report represents a wealth of information but is limited in scope because of the facilities available to us and the sheer time and cost of testing involved. We consider that before SMTs are used for high level competition the State bodies need to undertake more testing with different cartridges at the very long ranges where Velocity falls off markedly.

The target was purchased by the Cairns & Inland District Rifle Association to be trialed at a number of the small clubs in North Queensland as an alternative to the bigger, heavier and more expensive closed chamber targets available from Hexta, OzScore and Kongsberg. The testing was stipulated as a condition of the purchase and, depending on the test results, the target would be either purchased by a local club or sold off.

The interest in SMT was driven by lower costs and easier set-up on existing target frames compared to closed eTargets. Hard evidence of their performance was non existent and what information was available was confusing. Some people were talking of excellent accuracy while others were not. Silver Mountain themselves state that an open sensor target only works with supersonic bullets, can never be as accurate as the enclosed frame type and further that accuracy degrades if the bullet speed is “too slow”, but that the difference is not worth spending money on.

Many small clubs see the most attractive thing about SMT as the advertised easy setup on existing target frames and buy accordingly. But in other literature, SMT also state that a good target setup is required and if it cannot be achieved to contact them.




***'Simply attach sensor mounting plates to the four corners of your target frame, and calibrate for the centre in one shot'.***

The original planned test of two groups of 30 shots each fired at 900 yards on the Mareeba rifle range turned into an expensive marathon of 11 groups fired at many distances on both the Mareeba and the Herberton ranges and a brief explanation is in order.

We were not involved with the purchase or the initial set up but it was reported to be settled in and working well. The results from the first test at 900 yards were not inspiring so a second test was carried out at 600 and 300 yards, again with mixed results. It was only after the second tests that we discovered the initial set up was poor and the tests were invalid for critical analysis.

## Can anything be learned from these imperfect tests ?

# YES !

Detailed under Day 1, Day 2 and Day 3, these tests typify the results that many – maybe even the majority – of SMTs in use are giving, simply because they have not been set-up as well as they could be.

## The whole concept of a perfect SMT set-up is totally different from paper or closed eTargets and it requires a very different mindset.

There had been operational problems with the unit so a decision was made to upgrade the firmware to the latest version before proceeding with further testing. Primarily with the software upgrade in mind, we made contact with the Australian SMT representative and the help we had from both Aubrey Sonnenberg and Daniel Chisholm was extensive and prompt. The new software install went well and seemed to fix the communication issues, and at this stage we were also made aware of a comprehensive list of requirements to be met for best target accuracy. Some we had met before but, for maximum accuracy, the necessity of entering uphill/downhill and range/target misalignment angles into the software was explained in detail.

A third set of tests was carried out at Mareeba incorporating all the suggested improvements with the exception that we were not able to hold the target frame rigid. To address this deficiency a fourth set of tests was conducted at Herberton where we were able to achieve all the requirements stipulated by Silver Mountain for maximum system accuracy and precision.

Before we look at the results in detail, let us investigate data collection.

# DATA ACQUISITION

**THE DETAILED TWO PAGE REPORTS OF EACH TEST AT THE END OF THIS DOCUMENT CONTAIN ALL PRIMARY DATA.**

## SHOOTING FROM THE MAREEBA 900 YARD MOUND.

All shots were accompanied with a LabRadar measurement of muzzle velocity. This is by far the most accurate way to measure velocity available to normal shooters. Comparisons between two and even three LabRadars (LRs) indicate a precision of better than 2 f/s.

Detailed test results always give **Mean Velocities and Velocity Standard Deviations in f/s.**
In a few special cases we have given individual shot Velocity data.

The SMT shoot is displayed on the computer during the shoot and finally
the SMT data has been extracted from the SMT Log file.

The testing procedure used is now well tried. You may read more detail on this if you wish.

Both the Procedure and short video may be downloaded at
https://sites.google.com/site/targettests2016/

Shot positions were recorded on Corflute sheets as was done for Townsville and all our other Tests.

This photograph is obviously not a SMT. It was extracted from the Townsville Kongsberg Report.

## THE DATA

First, of course, one must measure shot positions and calculate the RAW error components.

This involves accurately marking the orientation and centre of a removable test sheet attached to the target face.

Reported positions come from the SMT Log file but could have been read off the screen. Shooters work in error components measured Horizontally (X) and Vertically (Y) and we did likewise in mm.

Red lines indicate centre and orientation of test sheet.

Photograph from a different test.


**POSITIVELY IDENTIFYING SHOT HOLES REMOVES ANY CHANCE OF ERROR.**

The aiming mark may be slightly off centre after the test sheet has been attached with Velcro strips.

This does not matter for the testing as long as all measurements are taken with respect to the Absolute Target Centre which is seen above marked in red.

The real advantage of using this method is that the test sheet is robust and may be taken back for measurements on a special coordinate measuring machine with a precision of better than 1mm.

## MEASURING

The major tests involved about 350 shots measured to a high precision.

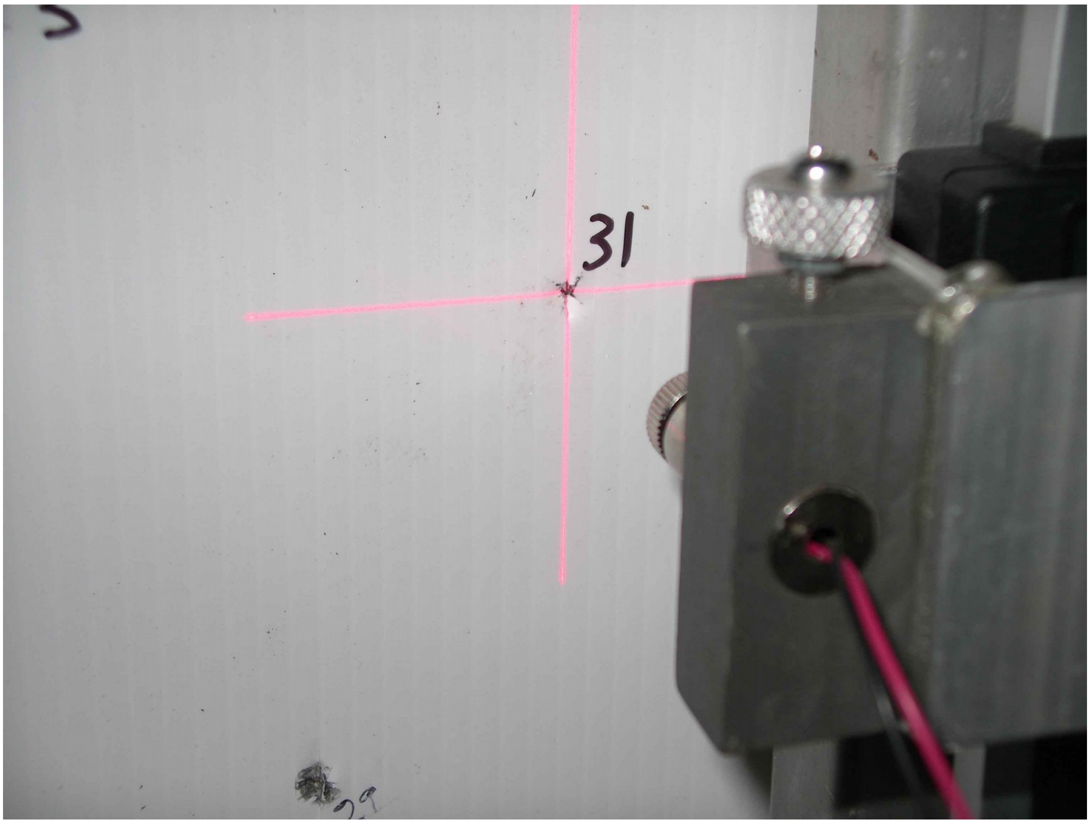
This would not be possible without a dedicated coordinate measuring machine.

Unfortunately,  some of the earlier tests were compromised by imperfect Target and Software set-up but did provide additional information on what can be expected from an imperfect set-up.


## MEASUREMENT PRECISION

Measurement guaranteed to better than 1mm
is painstaking and difficult.

The Laser beam visibly 'drops into bullet holes'  giving settings repeatable to ½ mm.




Tables of all measurements are given in the individual two page detailed reports.

# STATISTICAL AND GRAPHIC TOOLS USED TO REPRESENT THE DATA

Analysis of **rifle accuracy and precision** requires some Statistical methods. Various traditional graphic displays are also used such as Plots of Groups. Analysis and description of **eTarget accuracy and precision** is very similar. There is no getting away from some Statistics although they can be overwhelming and off putting. With this in mind we have developed various ways to present target accuracy and precision measurements in as simple and transparent a way as possible. The following attempts to explain each in more detail using a small imaginary test result for clarity.

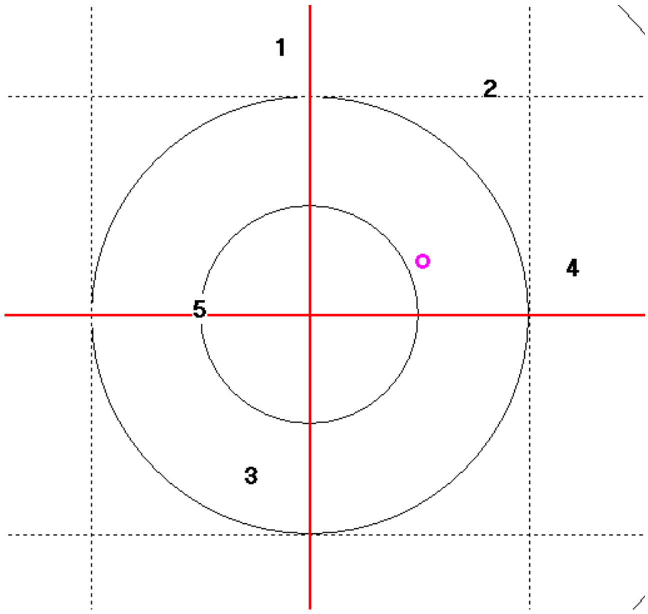
## SHOT POSITION MAP

Obviously makes it easy to relate measurement data to a position on the target.

Also shows at a glance the span of the test.

The dotted grid represents half minute squares.

NOTE that the 'Target' is a generic half minute target. Depending on the distance shot, this is often slightly different from ICFRA targets, especially at the shorter distances.




## RAW DATA PLOT

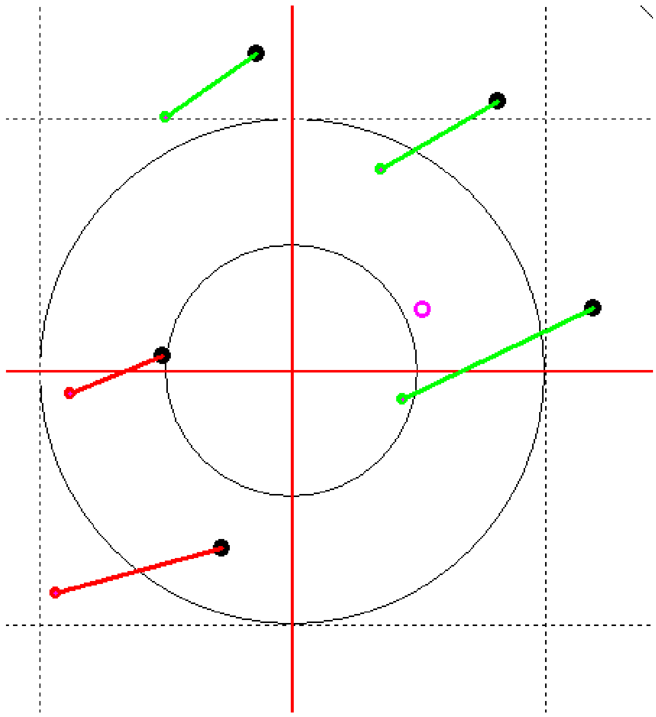
Shot holes are BLACK.
Target reported position is at the end of the line.

Green indicate closer to the centre.
Red indicate further from centre.

This example shows both a systematic error and a random error.

The group centre is indicated by a small purple circle.

We usually do not show these plots but they are the basis to understanding other plots.



## CENTRED ERROR PLOT

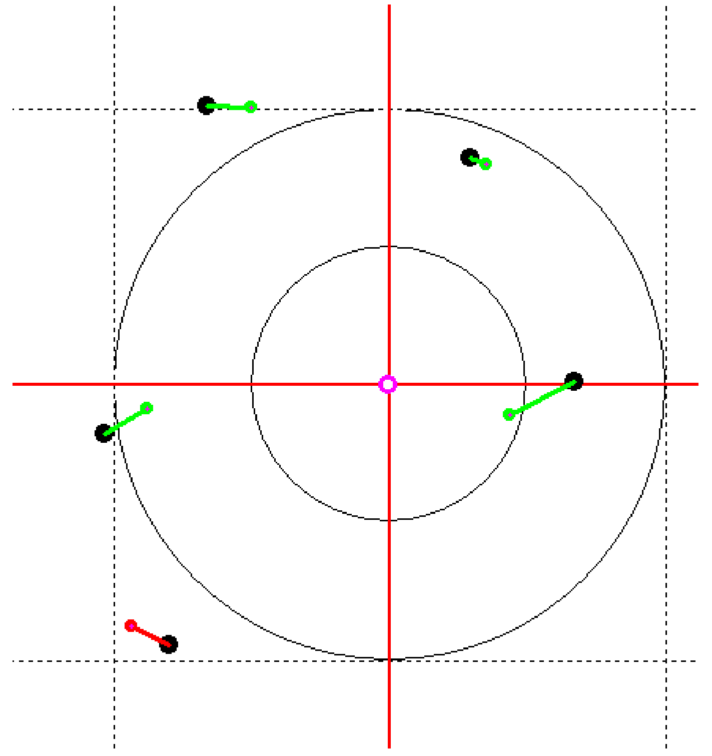
Shooters automatically take out the systematic error when they adjust the sights with sighting shots at the beginning of a shoot.

The equivalent is done here mathematically. The result then shows the remaining **Random component of the target error.**

No matter how well the Target is calibrated or zeroed the random component remains.

**Calibration or zeroing of a Target improves the mean position of the group but each shot is still uncertain by the same random error amount.**

It is this **VARIABILITY** of the target which is most important and demands statistical methods.

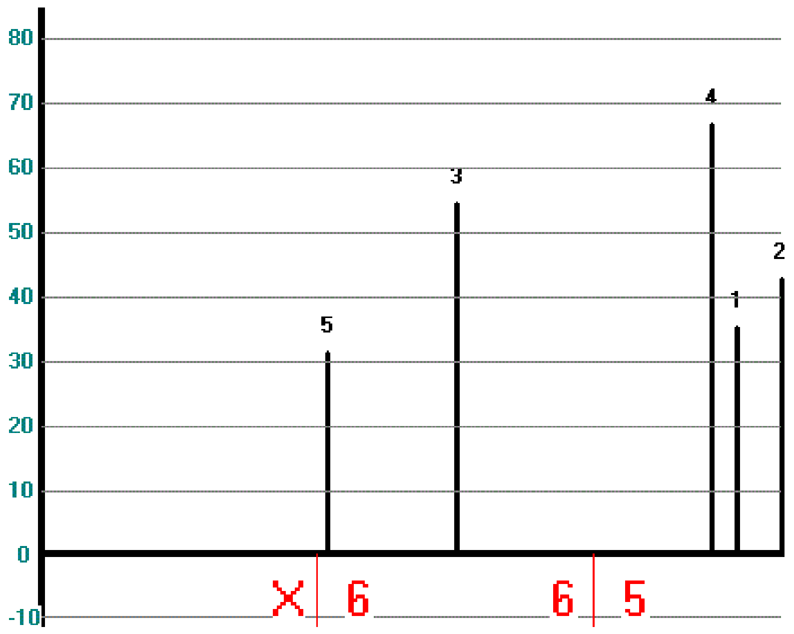


## ERROR BARS

The length of each bar represents the error measurement on the target. There are many ways this can be done. For example, errors may be measured by their X and Y components which is very convenient for calculations and analysis. Another possibility is Radial error.

We have chosen the **DIRECT or LINEAR CENTRED** error which is simply the length of the lines in the previous Centred Error Plot.

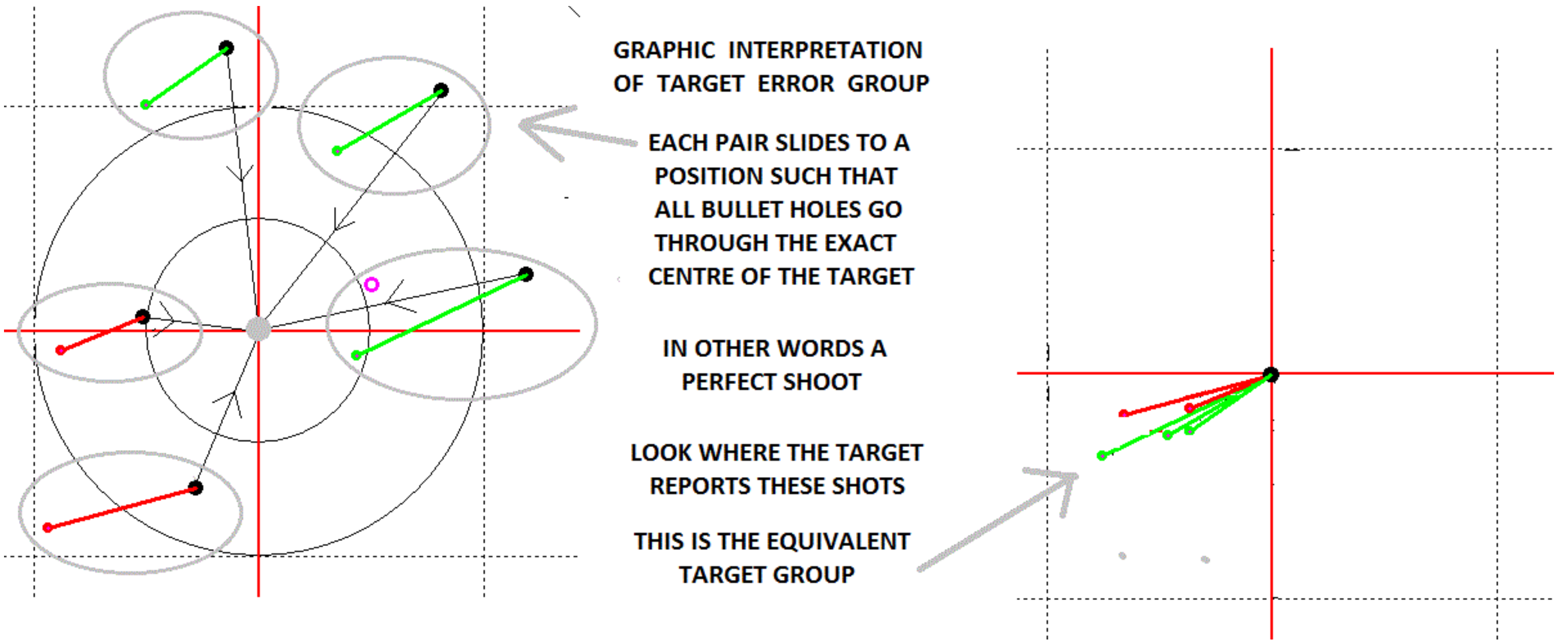
Linear Errors are never negative which is convenient. Wherever possible, we have arranged for the published error bar plots to be close to real size.




The error bars are always given in mm. Note the red 'shot values' which give some indication of the positions of the shots with respect to distance from target centre on ICFRA Targets.

This is probably the most useful Graphical representation of errors.

# EQUIVALENT TARGET RAW ERROR GROUPS



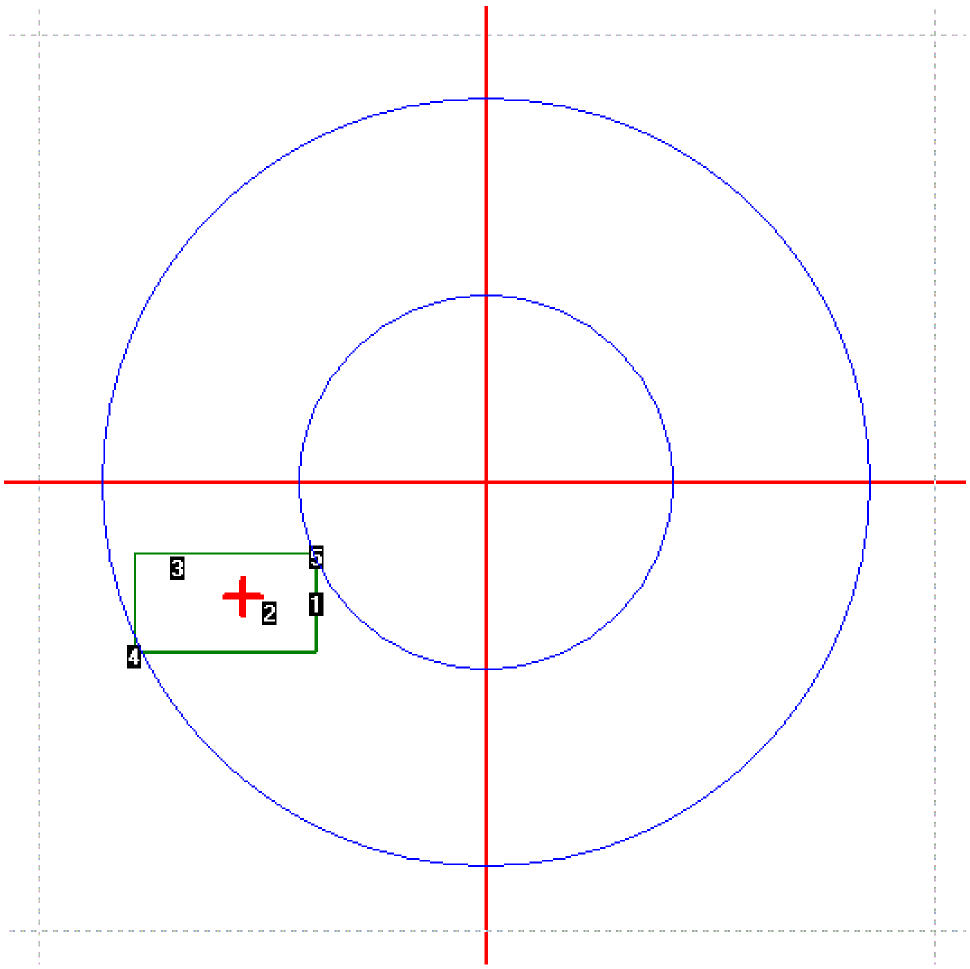

## RAW TARGET ERROR GROUP

This is recognisable as the same as that given above. In general, we want to avoid this Graphic because it is very easy to misinterpret.

**IT IS NOT A PLOT OF SHOT POSITIONS
BUT A REPRESENTATION OF ERRORS
SHOWING WHERE THE TARGET WOULD HAVE REPORTED THE SHOT HOLES IF ALL BULLETS WENT THROUGH THE CENTRE OF THE TARGET.**

Despite it's shortcomings, there are a few situations where this tells us a lot.

This shows both the systematic and random error at a glance compared to the size of the target centre rings.

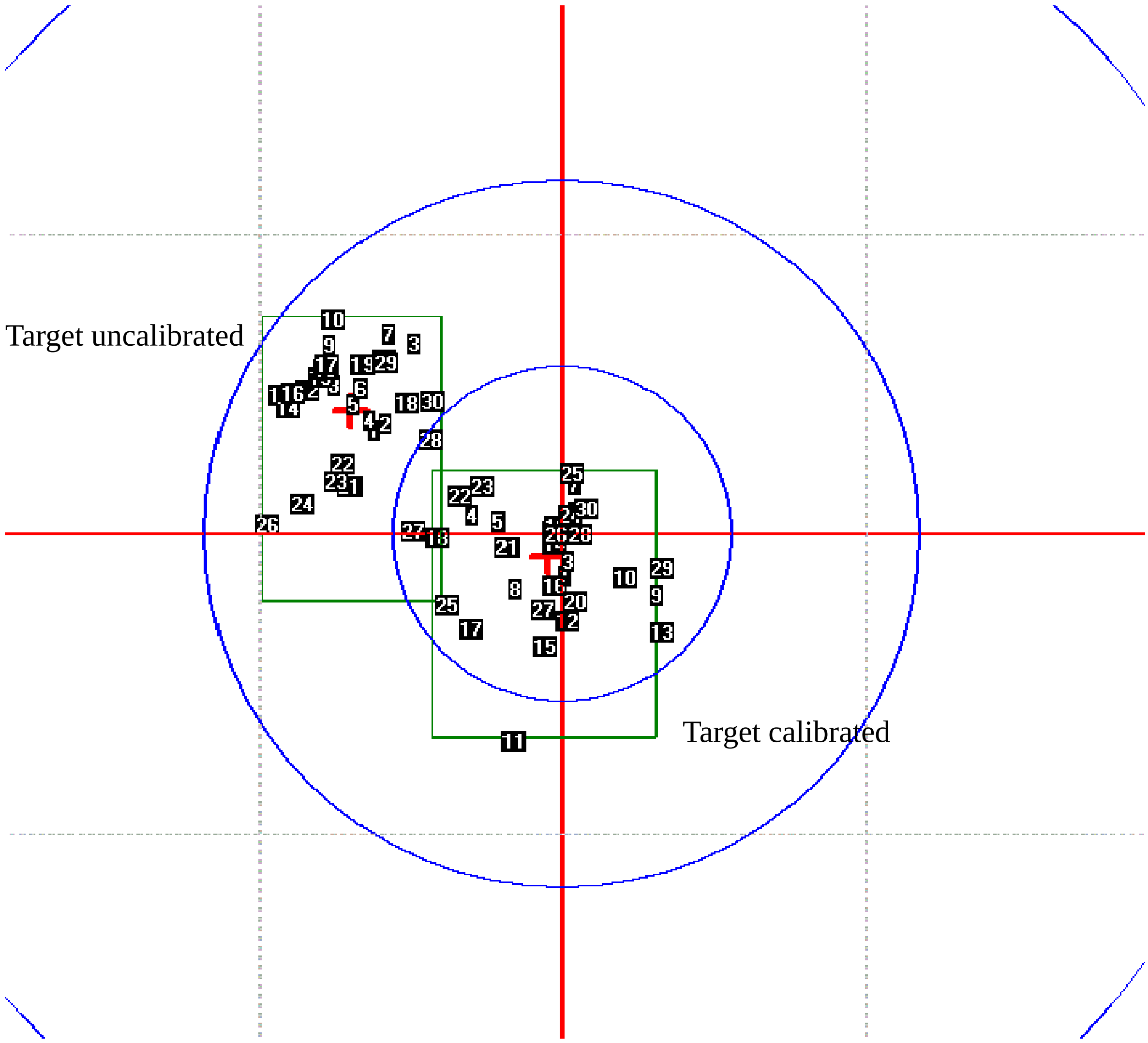


# CALIBRATION

'**Calibration**' according to the SMT manual:
**'sets the position of the aiming point relative to the microphones'.**

As illustrated below the process worked well but when talking to shooters we became aware that many misinterpret the role of 'calibration'. It could be that much of the variability in reported performance by users of SMT's is due to a misinterpretation of what 'Calibration' actually does.

We have invoked the concept of Target Error Groups to illustrate what Calibration does.




As explained previously, one can attribute an 'error group' not only to a rifle but also to an eTarget. Shooters seem to instinctively understand the concept of a 'group'. Above are overlaid the 'SMT Error Groups' for both an uncalibrated and a calibrated 30 shot test which have been shot from 900 yards with a 308 on the same range on the same day with the same rifle and ammunition. Target setup could have been better, but it illustrates perfectly that the process simply centres the group just like zeroing a rifle.

**NOTE THAT THE VARIABILITY OF THE REPORTED SHOT POSITIONS HAS BEEN IMPROVED LITTLE OR NOT AT ALL.**

It is the variability of the eTarget that limits the known accuracy of each individual shot.

**To put this another way, 'Calibration' adjusts and improves the mean position but the variability is still present. Because scoring is a function of EACH shot rather than the MEAN position of all shots, it is this variability that we must measure and assess.**

**If you use SMTs, by all means centre the group by 'Calibrating' the target.**

**But this does not change its variability.**

**Some SMT users may be firing a few 'Calibration' shots until they get one to coincide perfectly with a shot hole, then assume all subsequent shots will also be reported perfectly.**

**To assess the precision of any electronic target you must test its variability by firing a statistically significant number of shots onto a dimensionally stable test sheet then comparing the measured positions to the reported positions.**

**We suggest a minimum of 30 shots. Only this will tell you how good the target is for critical individual shot scoring purposes.**

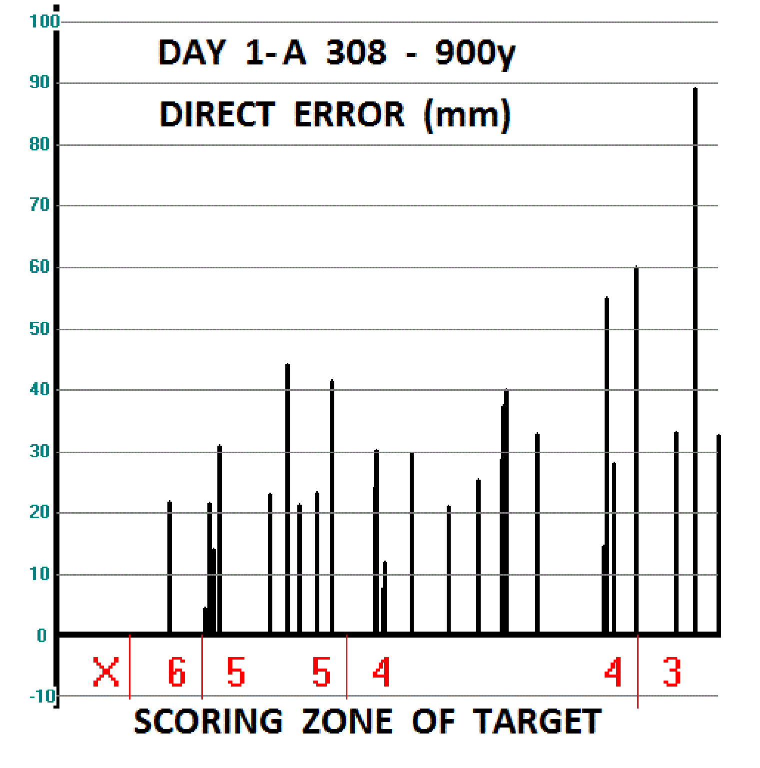
**This applies to ALL eTargets but, because shooters see this 'Calibration' visibly applied to SMT targets, the misconception seems more prevalent among SMT target users that the calibration process can make the target perfectly accurate.**

# DAYS 1, 2 AND 3

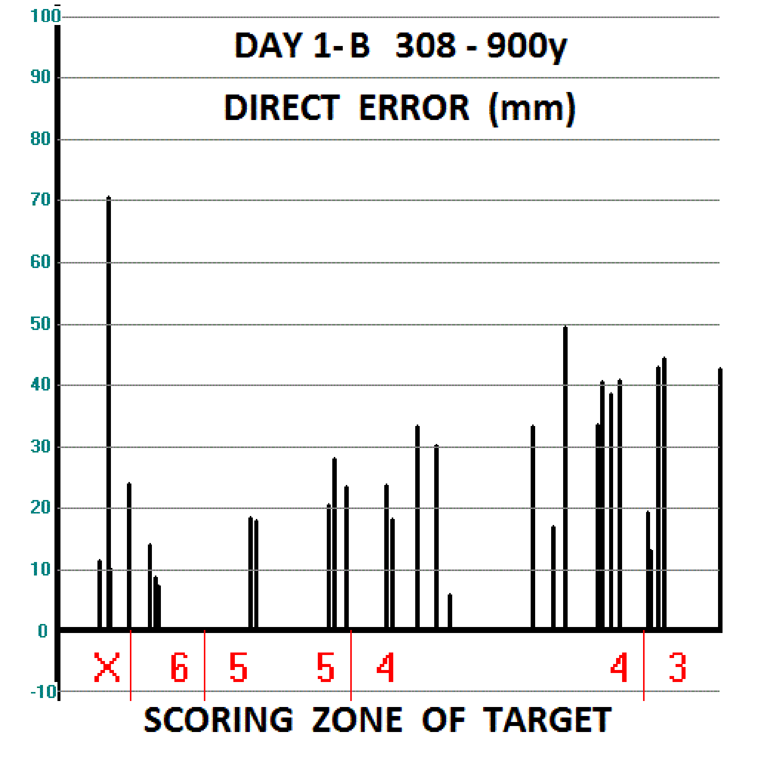
**These are grouped together because target set-up was imperfect.**

On both Day 1 and Day 2 there was no compensation for either vertical or horizontal range angles but **d**espite this, the Horizontal Target face misalignment was minimised by cross firing and was only about 1 degree beyond the SMT specified tolerance of 2 deg. It is quite likely that many SMT targets in use will be set up no better than this and it is instructive for people to know what to expect. For the Day 3 tests the chronograph assembly was shimmed true to the target face and the range was surveyed, with compensation for misalignment being entered into the SMT software. No attempt was made to prevent the target moving back and forth on the target machine.

**FULL DETAILED RESULTS ARE IN THE FINAL 22 PAGES OF THIS REPORT**




Before Calibration



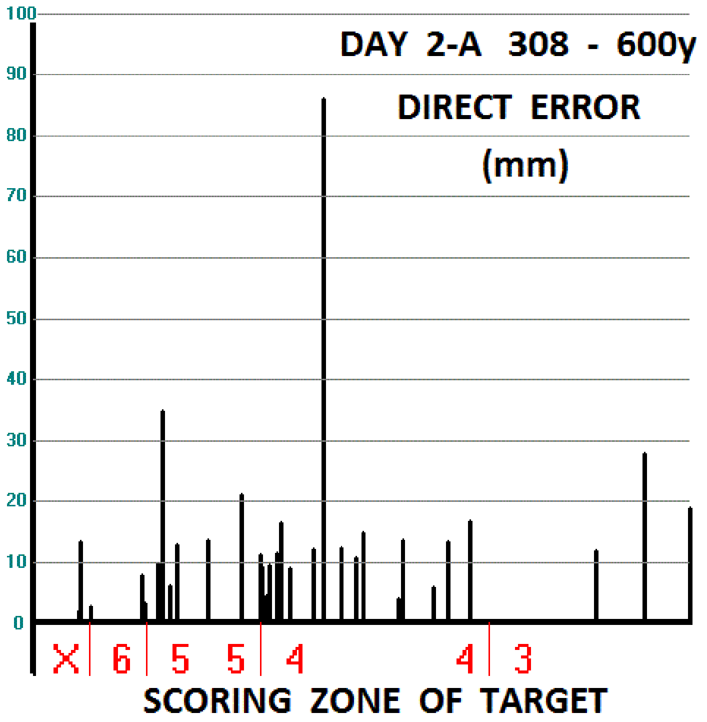

After Calibration

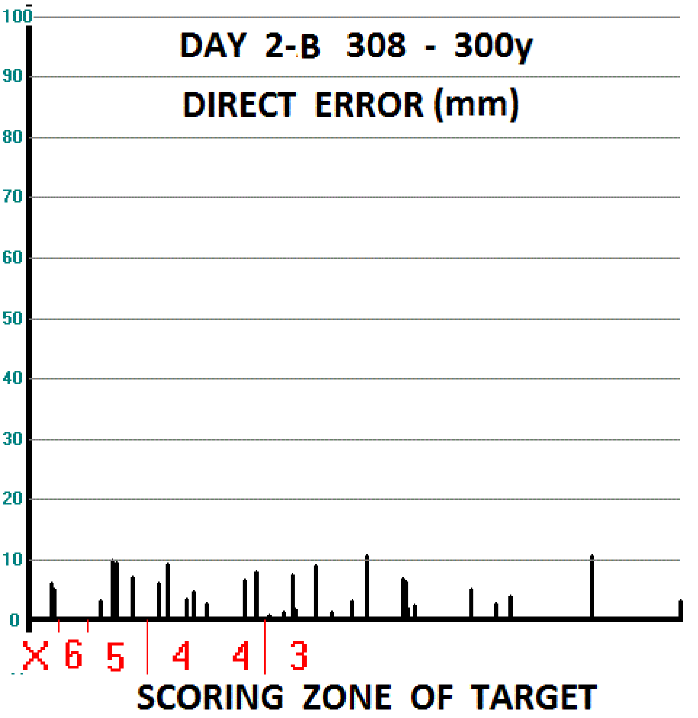
These are **CENTRED ERRORS** as seen by a shooter after centring rifle via sighting shots.

**NOTE THAT CALIBRATION HAS LITTLE OR NO EFFECT ON PRECISION**

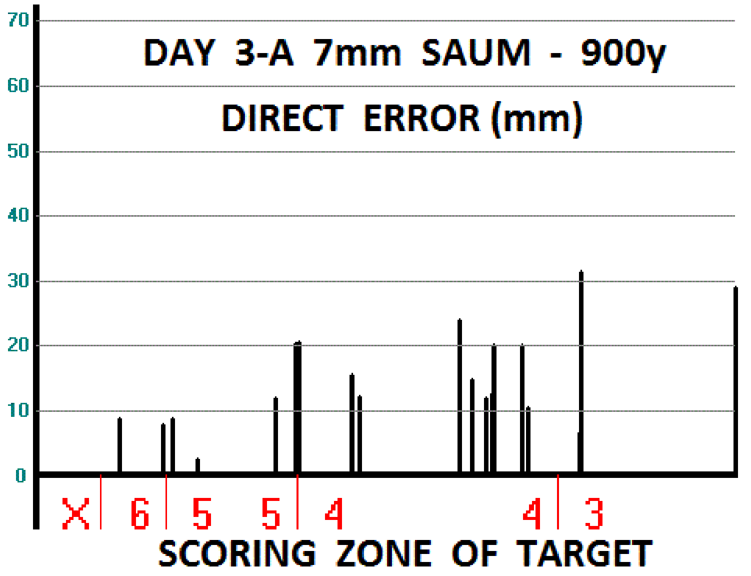
The test 308 had moderate muzzle velocity and a hot 308 would strike the target from 1000 yards with almost the same velocity. Although compromised, the **<u>variability</u>** we saw at 900 yards is still likely to be indicative of what to expect. We consider that more testing needs to be done at these longer distances and with different cartridges where Velocity falls off markedly.

**State bodies with access to 1000y RANGES should be involved in organising validation tests of ALL eTargets at these long distances.**

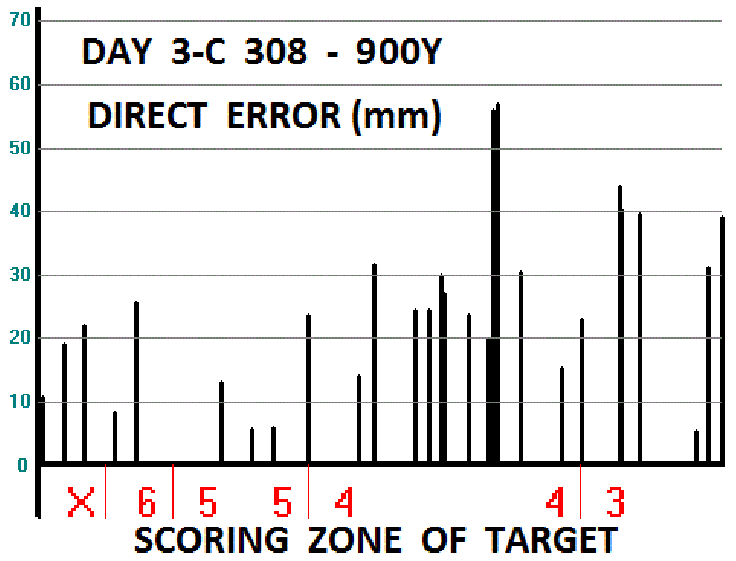



The following Day 3 tests were compensated for Range misalignment.

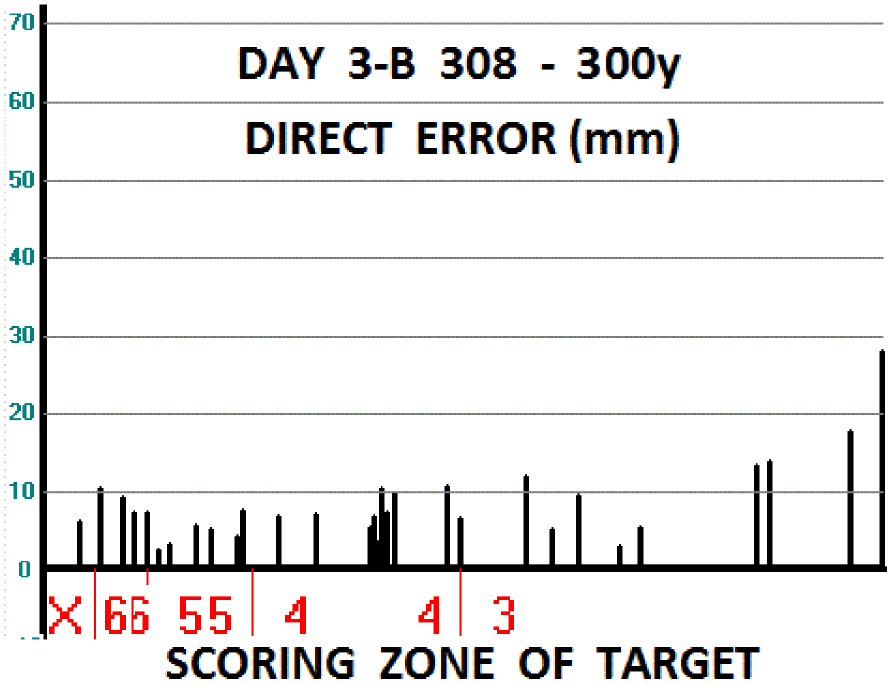



Arriving at target with a calculated velocity of 1925 f/s which is about **790 f/s above the speed of sound.**




Arriving at target with a calculated velocity of 1374 f/s which is about **235 f/s above speed of sound.**

**This pair of tests seems to indicate sensitivity to projectile terminal velocity and it would appear that the SMT precision starts to decline markedly well above the speed of sound (about 1135 f/s at the prevailing temperatures). Again, this begs further testing at long distances, especially if a mix of different cartridges is to be used.**




**Again, the target set-up is almost perfect except for slightly loose target frames. These Day 3 results are best compared with the Herberton tests which follow, where target frames were completely restrained.**

# HERBERTON

## IMPRACTICAL BUT PERFECT TARGET SETUP

### Herberton Target Machines

Most older Target Machines were built as lightly as possible for easy working. Additionally the slides are loose, again to promote ease of operation for target crews.

Even the newer types using ball bearing slides usually have loose tolerances and as light a frame as possible to save weight. The frame legs usually bend with wind gusts.

These work quite well with traditional paper targets and, provided they are strong enough, handle closed electronic targets with no problems.

**IT DOES NOT MATTER TO A PAPER TARGET OR CLOSED eTARGET THAT IT MOVES BACK AND FORTH IN A WIND OR IS NOT QUITE VERTICAL.**

**SILVER MOUNTAIN TARGETS HOWEVER DEPEND ON THE ARRIVAL OF A SHOCKWAVE OVER A PLANE SURFACE OF ACCURATELY KNOW ORIENTATION, PREFERABLY PERPENDICULAR TO THE LINE OF FIRE.**

In the background are two frames that have been rebuilt to take Hexta eTargets. Since these frames do not twist, they also present a truly flat surface for SMT attachment. They do, however, still lean and move back and forth responding to even slight wind pressure.

It is impractical and almost impossible to achieve perfectly flat, perpendicular, and rigid frames on these old manned marking pit style machines.

The best way, and perhaps the only way to obtain a perfect set-up would be to discard the classical Target Gallery and use no marking pit. Instead, low set thick posts could hold the target. Any new range installation should seriously consider this and do away with protective pits.

# DOES IT MATTER ?

**To answer this question we temporarily clamped and strapped the target frames during the SMT tests that are described below.**

# OUR  TEMPORARY  SOLUTIONS

CLAMPS STOP FRAME FROM
SLIDING DOWN

ROPES PULL TARGET
FRAME BACK TO
VERTICAL POSITION

TENSIONING STRAPS TAKE OUT
ANY PLAY IN SLIDING BEARINGS
AND ALSO ALLOW FINE
ADJUSTMENT OF VERICALITY

THEY  EFFECTIVELY
STOPPED ALL TARGET
MOVEMENT BACK AND FORTH IN THE
LIGHT WINDS EXPERIENCED DURING
THE TESTING

**COMPARE WITH THE ORIGINAL TARGET FRAMES WHICH NOT ONLY MOVE BACK AND FORTH BUT ALSO HAVE LEGS WHICH BEND AND TWIST**

# THE PERFECT SMT ALIGNMENT

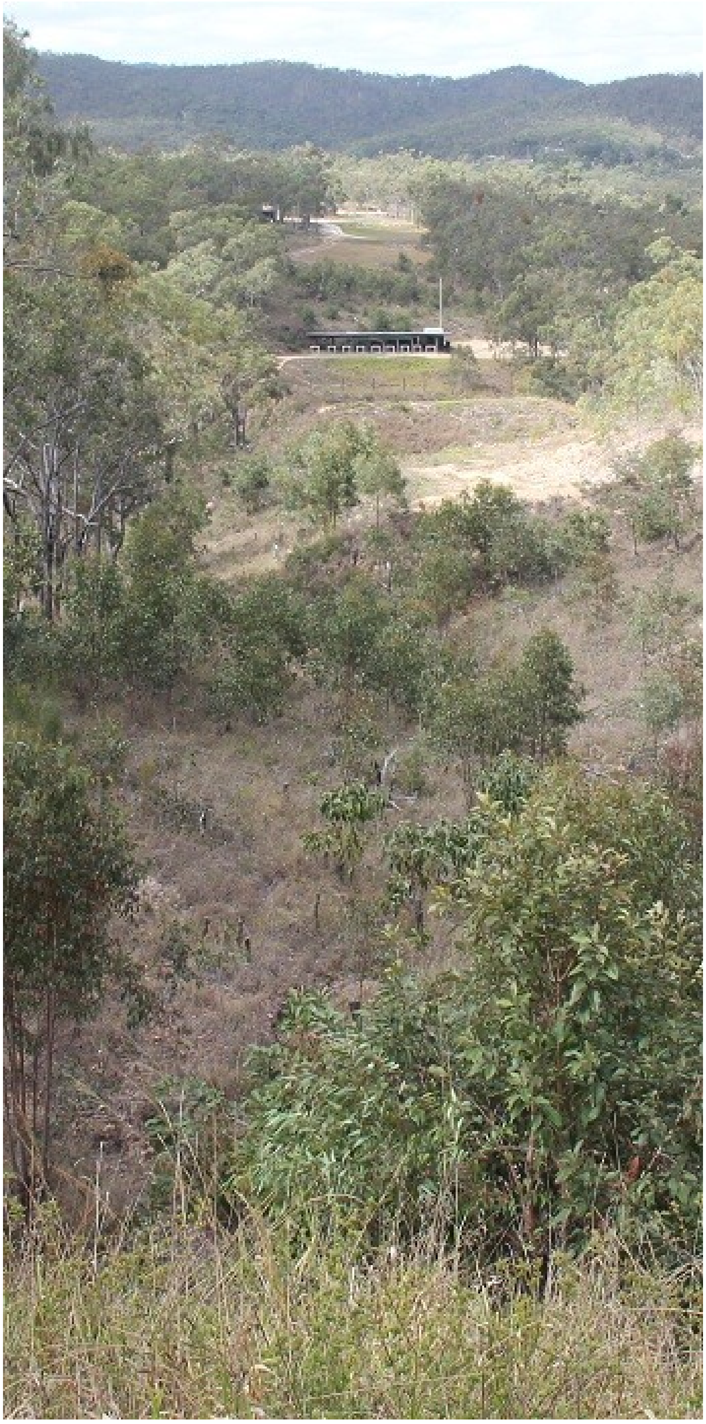
Rifle ranges are often not laid out square to the target as many were built or extended during WW1. Expanding suburbia and road development has often caused slight changes to the range orientation.

This is true of the Herberton Rifle Range and the horizontal misalignment is right on limit of the suggested maximum tolerance for SMT set-up of 2 degrees. The range is also built on hilly country and there are significant vertical angle departures from level.

SMT do stress that for the very best results, all of these should be correct. There is provision in the software to set values for horizontal misalignment and vertical departure from perpendicular.

Since the Target frames at Herberton are in pits, it was not easy to raise and sight along the target via a large square. Because of this, survey work was required to determine these angles. In any case, we wanted perfection and resorted to a theodolite.

**FIRST A LINE WAS LAID OUT PARALLEL TO THE TARGET FACE.**



Looking Back and Down from Mantlet.
NOTE very hilly ground.

Measuring angles.
Line was aligned parallel to target face.

Later, any remaining alignment errors dictated by the
Range Geometry were entered into software.

After survey, known mound positions were marked and Target Frames created in the SMT software for each distance of 600y and 700y.

| **Vertical uphill angle** | **Horizontal angle** |
| --- | --- |
| 600y 41 mils | 34 mils |
| 700y 36 mils | 34 mils |

The temperature sensor was then calibrated and fine tuned in software. This was in free air, but shaded.

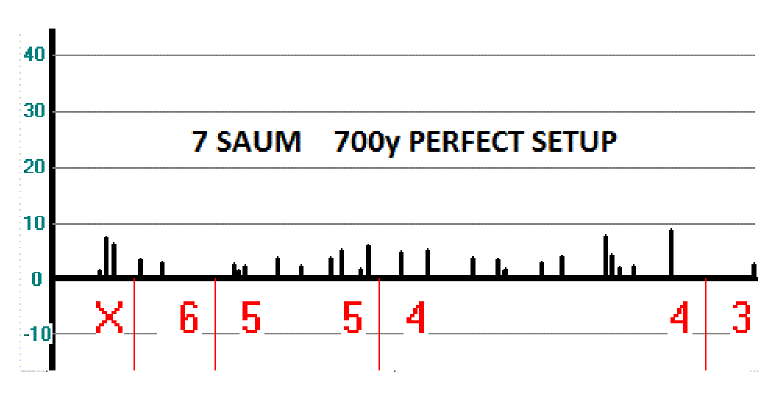
A Lab Radar was used for all of the Major Tests.
Wind conditions were unusually calm and never over 5 Km/h. Usually from the rear left.

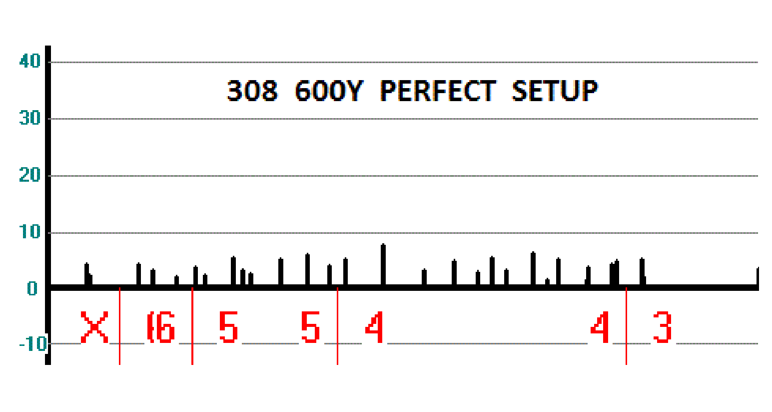
**After Calibration four Herberton test groups were fired**

1/ 700y 7mm RSAUM. 30 Shots with perfect settings.
2/ 700y 308. 30 Shots with perfect settings.
3/ 700y 308. 30 Shots with **deliberately reversed uphill angle correction**.
4/ 600y 308. 30 Shots with perfect settings.

# MAJOR HERBERTON TEST RESULTS SUMMARY

All error bars are in mm. with a guaranteed measurement precision of better than 1 mm. The Target set-up could not be improved so this represents the best possible result from an SMT target.

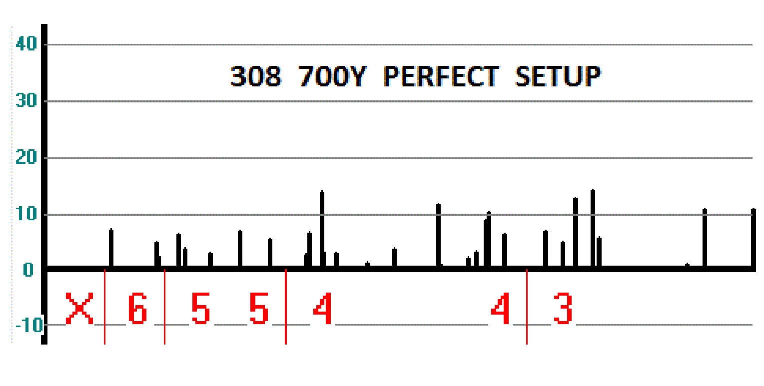


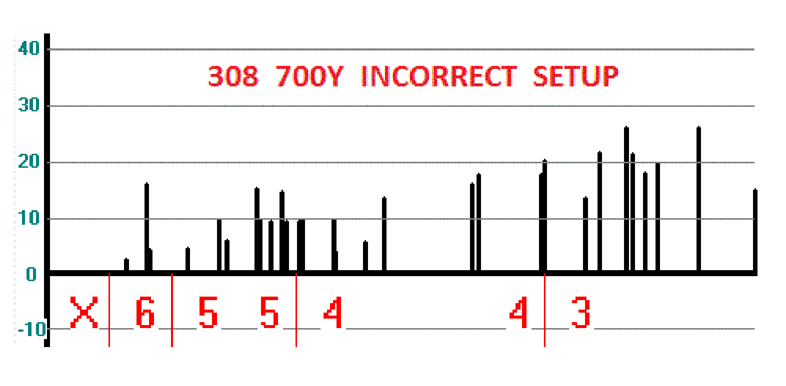

## CENTRED ERRORS

**As seen by a shooter after adjusting rifle sights via sighting shots.**

Note that the faster velocity 7mm RSAUM always gives smaller errors than a slower 308. In this case, the 7mm SAUM at 700y has comparable errors to that of the 308 at 600y. This is a general trend observed in other tests and is usually more pronounced at longer distances. Compare also the RSAUM 700y with the perfect 308 set-up at 700y shown below. The lower target Velocity of the 308 degrades target performance.




Uphill angle set in software = 36 mils



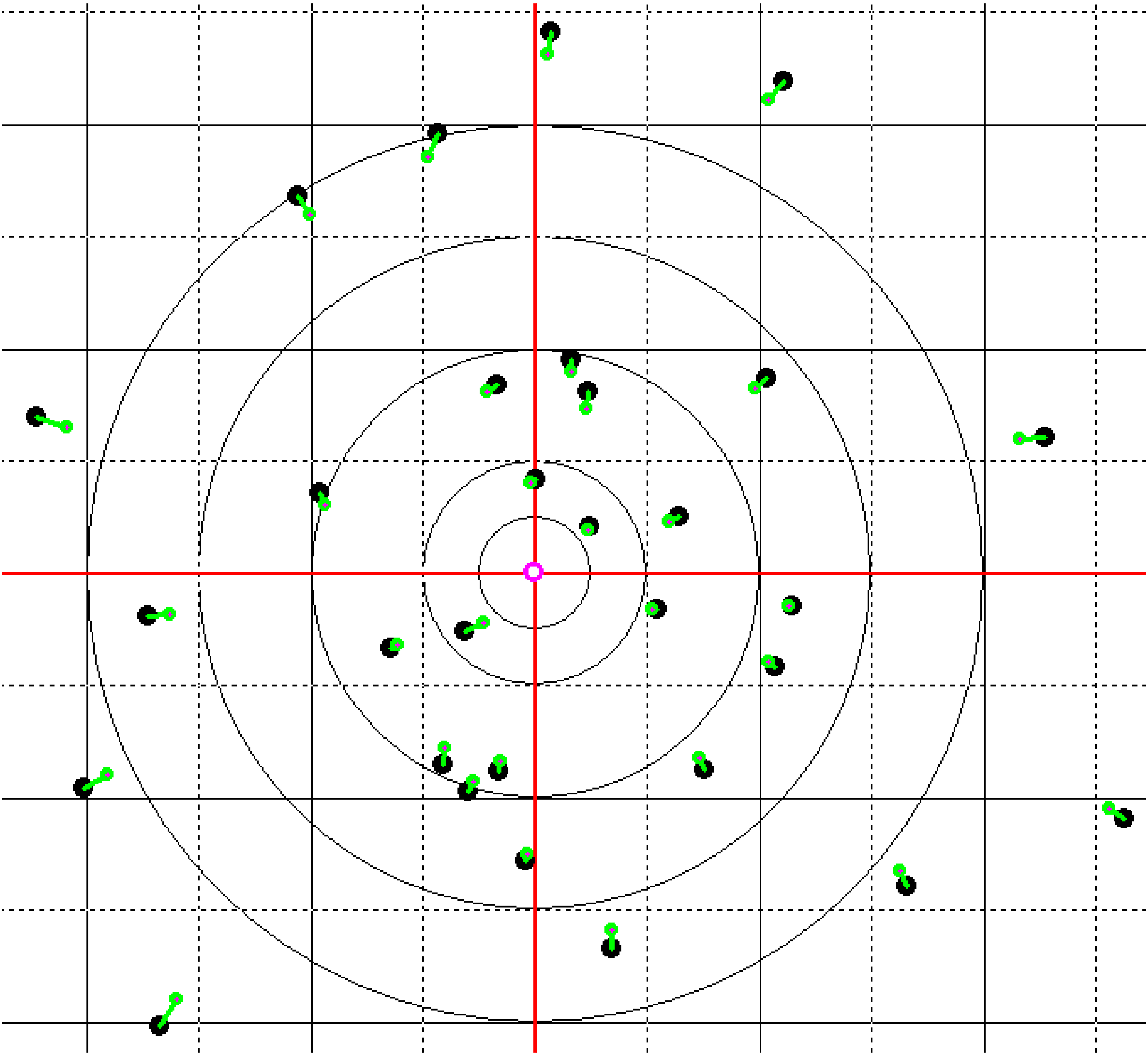

Uphill angle set in software = - 36 mils

We wished to confirm the effect of incorrect target set-up by comparing the results of a deliberately incorrect Vertical Angle. **AGAIN, THESE ARE CENTRED ERRORS** such as are seen by a shooter after adjusting rifle sights via sighting shots.

**The errors from the incorrect setting are obviously larger.**
**When centred, they also exhibit a characteristic pattern illustrated below.**

## FOR THE 308 AT 700Y WITH INCORRECT SETUP

**ALL SHOTS ARE REPORTED CLOSER TO THE CENTRE**



**Note how there is consistent contraction in the position of all or most shots.
Conversely, expansion occurs if the vertical Target Angle error is reversed.
Obviously, this may seriously impact on scoring.**

## INCORRECT VERTICAL ANGLE HAS ALSO CAUSED A DISTINCTIVE PATTERN OF SHOT POSITION ERRORS.

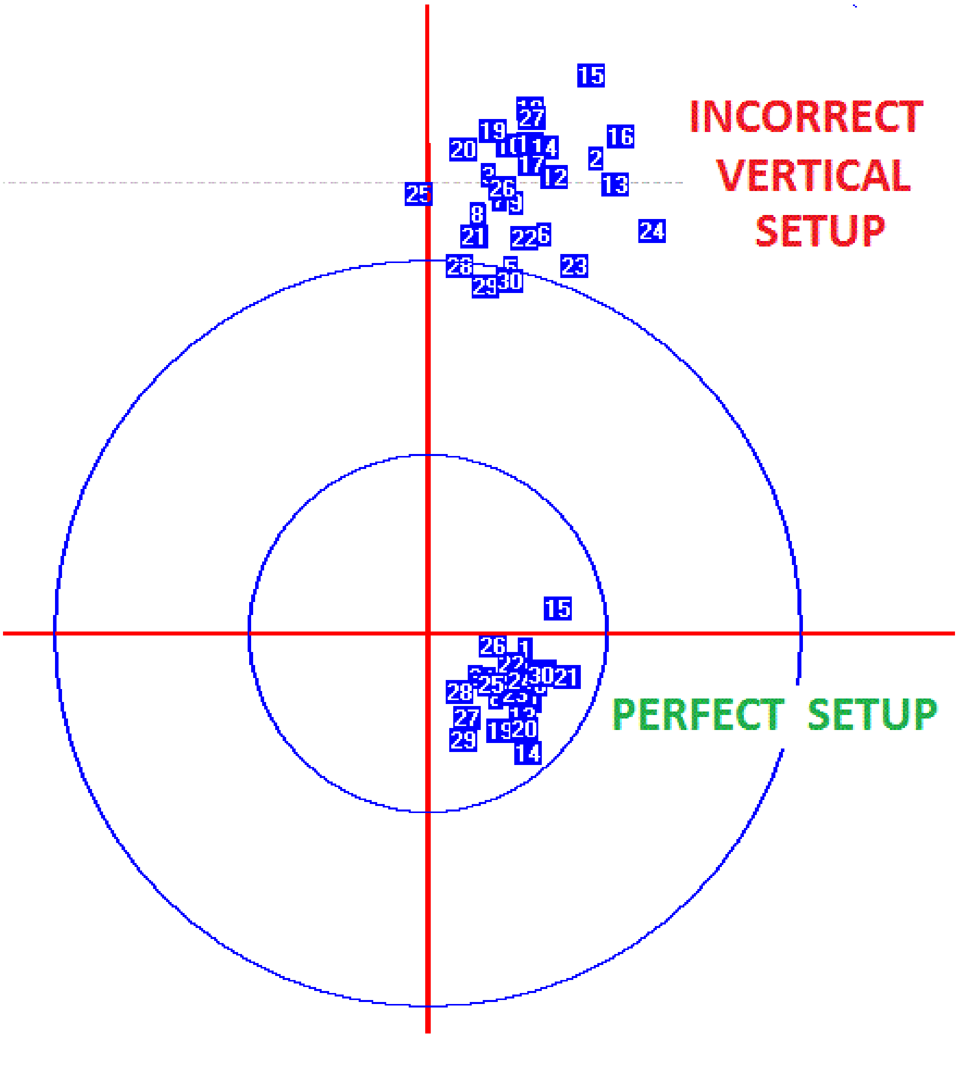
It is instructive to examine the type of error which is created here in more detail because it helps to explain what typically happens when target frames are not perfectly rigid and move and bend back and forth in a breeze.

To illustrate this, we again invoke the concept of Target Error Groups. These are the error groups for the two 308 tests at 700 yards and the effect is quite dramatic..

**This illustrates RAW ERRORS**

Normally we are only interested in CENTRED ERRORS because a shooter compensates for the displacement of the Target Error Group by rifle sight setting via sighting shots.

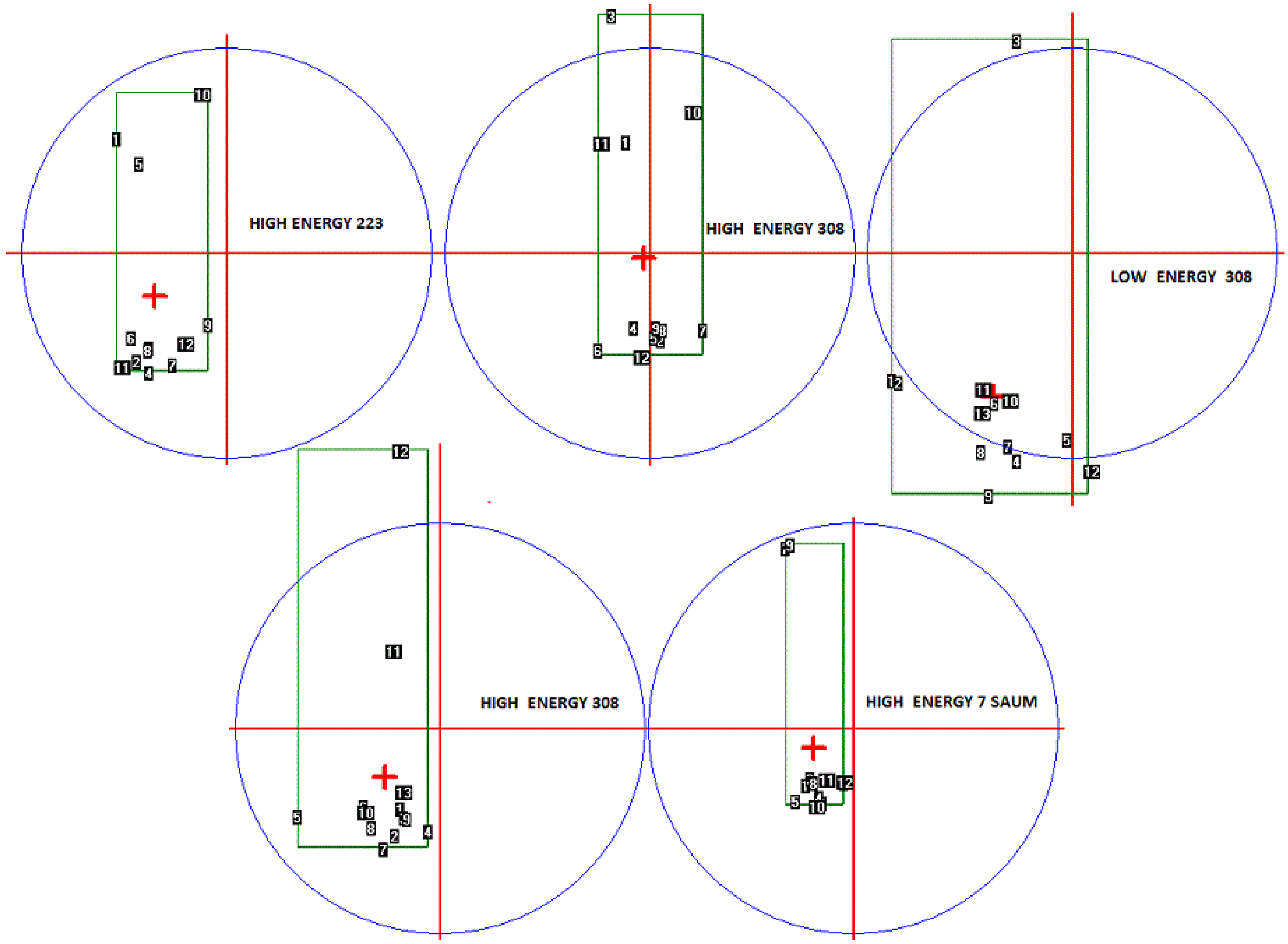
As long as the target vertical angle error remains constant, the effect on variability is only a small degradation.




**<u>NOTE</u> . THIS REPRESENTS AN EQUIVALENT TARGET ERROR GROUP AND IS NOT THE POSITION OF SHOTS ON THE TARGET, RATHER IT SHOWS WHERE THE TARGET WOULD REPORT SHOTS IF ALL PASSED THROUGH TARGET CENTRE.**

We may expect that a target which moves back and forth in the wind will experience incorrect vertical angles for some of the shots which should impact on shot positions in a similar way.

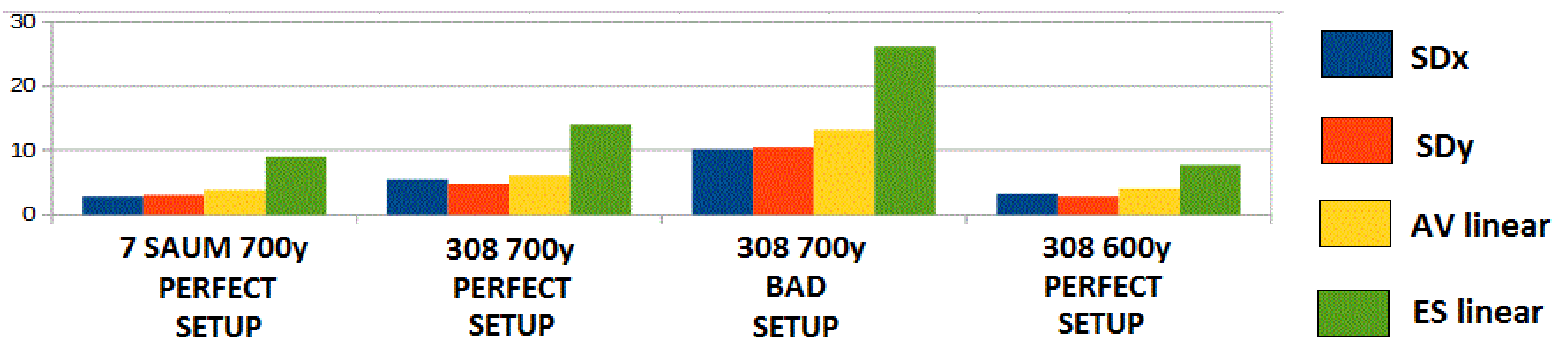
This was confirmed in the next tests. There were actually 17 of these groups shot in slightly gusty winds – mainly down range. Small gusts caused the target to depart from vertical during the shoots. In all other respects, the set-up was perfect. Because of the lower precision involved, only some of the results are shown below for illustration purposes but the trend is obvious and easily explained . Every now and then, the target frame bends back and forth giving shots with an elevation error. This adds to our knowledge of how well a SMT target needs to be set-up for optimum precision. One would expect a larger long range target to swing more.




ALL AT 600 y TARGET PERFECTLY SETUP EXCEPT ALLOWED TO SWING AND BEND BACK DURING LIGHT WIND GUSTS

While in these examples not many errors result in lost points, a shooter chasing fine control will be falsely adjusting elevation from the indicated shot positions. This will lead to confusion and a Coach would be tearing his hair out. Circles represent the X ring **.**

Since high precision mapping of approximately 200 shots spread over 17 individual shoots was prohibitive, the measurements were of a lower precision. But seventeen normal shoots were recorded and most **showed a similar 'Target Error Group'.** This trend nicely correlates to Target Frame bending and movement.




**SUMMARY OF HERBERTON ERROR SIZE STATISTICS (mm)**

# VELOCITY MEASUREMENT ASSESSMENT

The SMT gives a measure of projectile Velocity as it hits the target. This is a spin-off of the SMT needing a Velocity estimate to process the different shock waves impacting the target from different cartridges at different ranges.

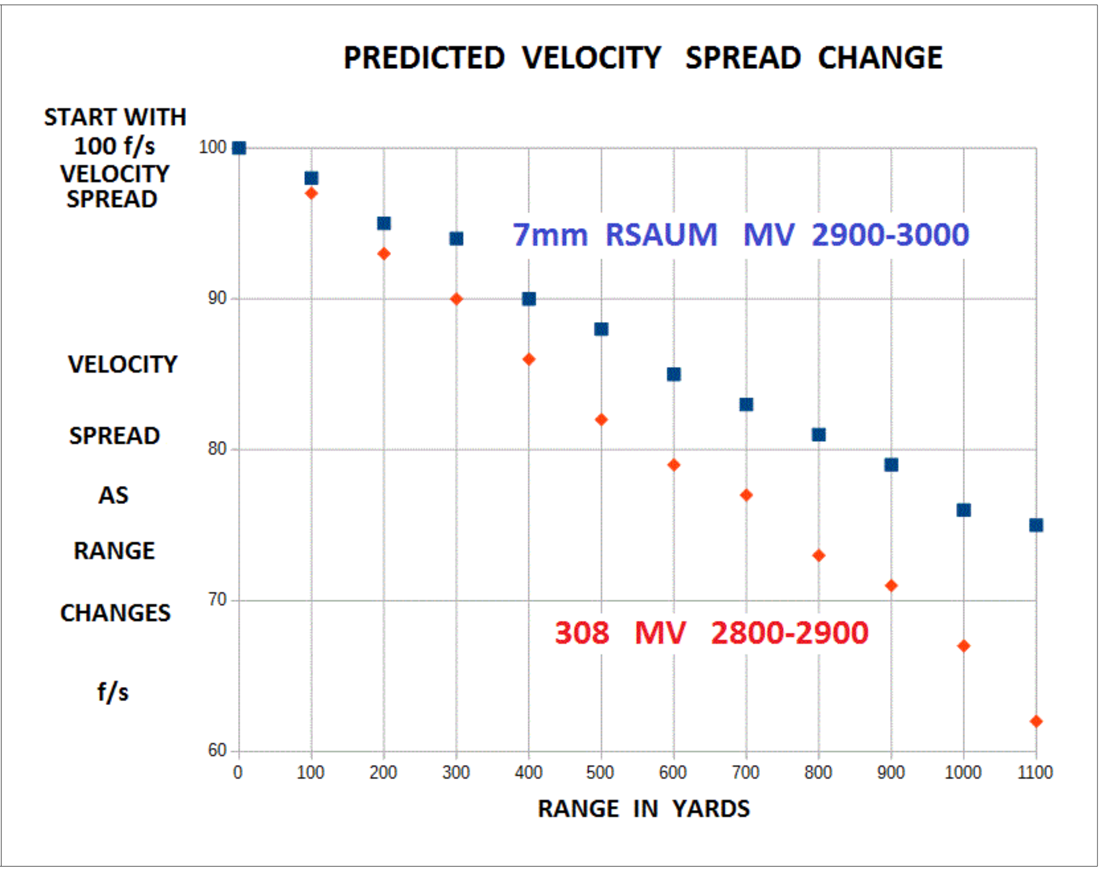
It is very hard to accurately asses the SMT reported velocity at the target. Other high precision methods of measuring this are difficult or only available to professionals with high powered Doppler Radar facilities. During the tests the muzzle velocity of each shot was measured with a LabRadar which is the best tool available to shooters. Experiments with three units side by side have shown a consistency close to +/- 1 f/s between different units.

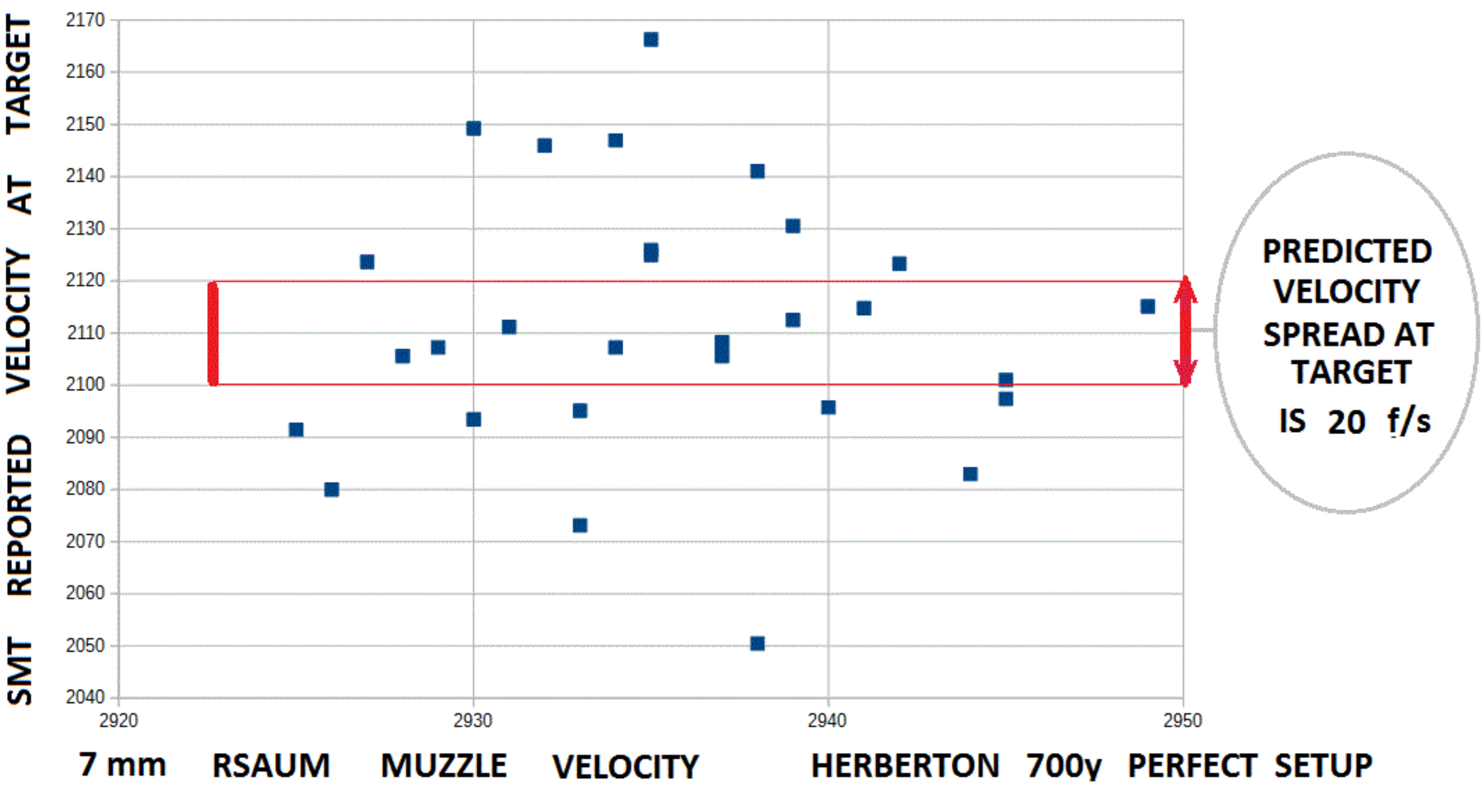
Perfect projectiles, launched at the same speed, in a perfect world, should arrive at the target with the same velocity. In practice, there will be a velocity spread when they are launched and when they arrive at the target.

Contrary to expectations, as distance increases, the velocity spread should decrease as the speed of the projectiles decreases. To understand this, consider that the projectile velocities are converging towards a limit of zero. The graphic below was generated from data by the Berger Ballistic Calculator (http://www.bergerbullets.com/ballistics/) using the manufacturers own G7 Ballistic Coefficient.

Thus, Over 900y, we expect the spread of the SAUM velocities will fall to about 79 percent of initial **spread** and the 308 will fall to about 71 % of initial spread assuming bullets fly uniformly.

Over 700y, we expect the **spread** of the SAUM will fall to about 83 percent of initial spread assuming bullets fly uniformly.





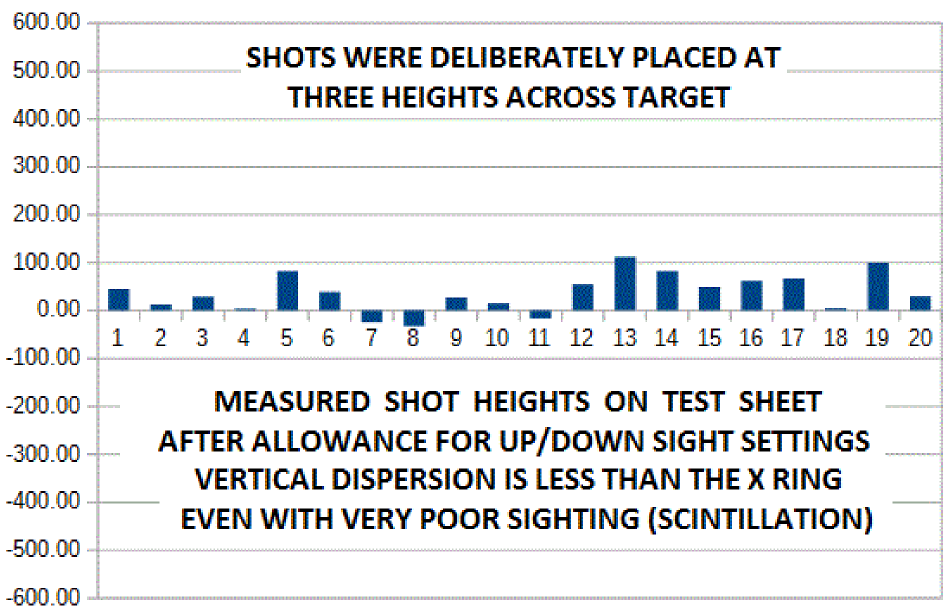

The above plot shows that the correlation between SMT reported velocities and Muzzle velocities is poor so it would seem that using **INDIVIDUAL SMT VELOCITIES** when investigating high accuracy ammunition is unwise. **MEAN SMT** velocity would probably be a lot more accurate and useful.

Of course, all of this depends on the various assumptions of perfectly uniform bullet flight and accurate ballistic calculations and the method is hardly definitive. Fortunately, we can at least partially confirm uniform bullet flight for the 7mm RSAUM because the rifle and the same batch of ammunition was never outside the 6 ring (with a high X count) for the entire 2017 NQRA Queens shoot. The validation of this claim is illustrated in the graph below.

More evidence of uniform bullet flight independent of any SMT measurements and calculations may also be inferred from the uniformity of the height of shot holes on a test sheet.

These shots were deliberately placed in lines at three heights across a test sheet at 900y.

Because the up/down rifle scope settings were known, the shot hole compensated heights may be calculated. All are in a narrow band of about X ring size despite the presence of serious sighting Scintillation (shooters mirage).



## COMPARISON OF HERBERTON MEAN VELOCITY DATA

| TEST | MEAN Muzzle Vo (LR) | Vo S Dev | V SMT S Dev | MEAN V Target Calculated | MEAN V SMT | V discrepency dV |
|---|---|---|---|---|---|---|
| 7 SAUM 700y PERFECT (20 shots) | 2936 | 6.1 | 25 | 2150 | 2111 | 39 f/s |
| 308 700y PERFECT (30 shots) | 2834 | 13 | 26 | 1790 | 1758 | 32 f/s |
| 308 700y Angle Error (72 mils) (30 shots) | 2854 | 10 | 14 | 1795 | 1662 | 133 f/s |
| 308 600y PERFECT (30 shots) | 2848 | 9.7 | 21 | 1935 | 1881 | 54 |

## Velocity and Target Setup

**These Tests at Herberton were carried out at similar ranges (700y and 600y) with three Perfect and one deliberately Imperfect Target setting. Mean Velocity figures are given in the detailed test reports.**

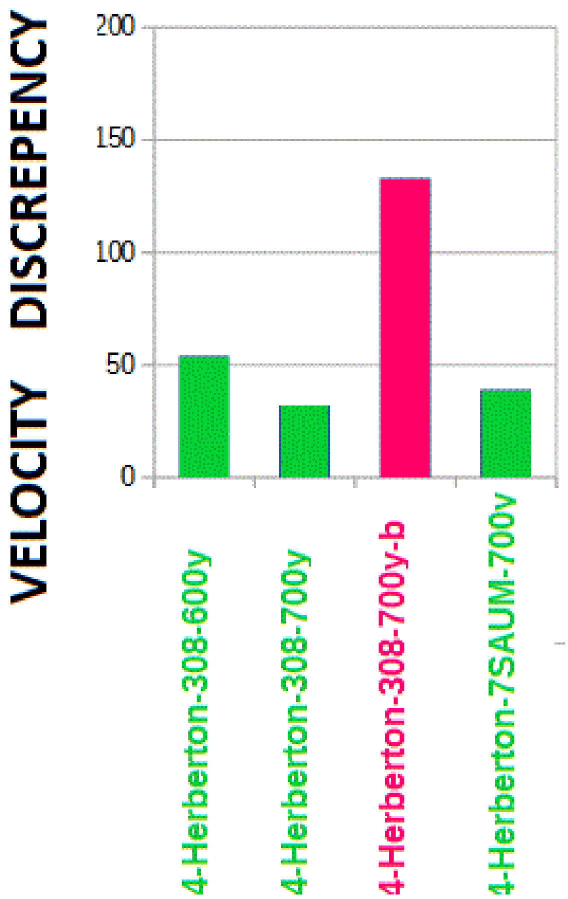
All calculations of expected Velocity at the target are from the Berger Online Ballistic Calculator using G7 Ballistic Coefficients as specified by Berger.

http://www.bergerbullets.com/ballistics/

Of course, this all depends on the assumption of perfectly uniform bullet flight and accurate ballistic calculations.

The Graphic does show that the SMT reported Velocity seems to correlate with Target Setup. The Red test was when the Y angle correction was deliberately reversed in software.

**MEAN**




**Difference Between Mean Reported Target Velocity And Mean Calculated Target Velocity**

The most likely consequence of all of this evidence is that the accuracy of the SMT chronograph is not up to the standard of refining quality ammunition although **MEAN** values of SMT Velocity may be useful for predicting reasonable Ballistic Coefficients of unknown projectiles, but

**ONLY WITH A PERFECT TARGET SETUP**

# SMT DAY 1 MAREEBA TEST 1 308-900Y 30 SHOTS IMPERFECT SETUP

| d | Ax | Ax SET | Ay | Ay SET | UPRIGHT | RIGID | Vo (LR) | Vsmt | Vcalc | Vo SD | Predicted Target V SD | SMT V SD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 900y | * | 0 mil | 12 mil | 0 mil | fair | Poor but little wind | 2825 | 1456 | 1437 | 13.5 | 9.7 | 17.2 |
| | | | | | | | mean | mean | mean | | | |

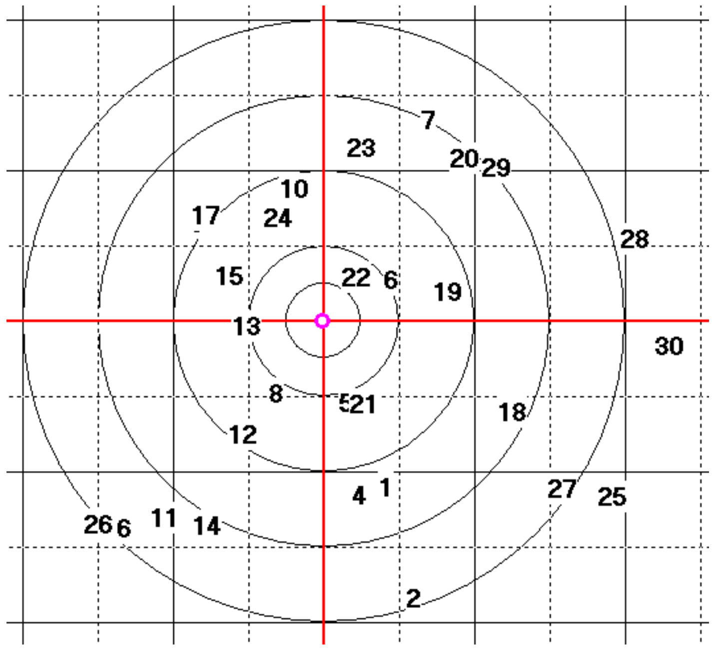
X SPAN 907.35 mm
Y SPAN 759.52 mm
CENTRE FITTED REPORT
X CENTRE SHIFT -88.20 mm
Y CENTRE SHIFT 52.38 mm
Shown Further from Centre 5
Shown Closer to Centre 25
SDx 19.79 mm
SDy 27.44 mm

**Berger 155.5 Fullbore Projectile**
*SMT Temp 20 – 21 during firing*
*Thu Jun 8 2017*

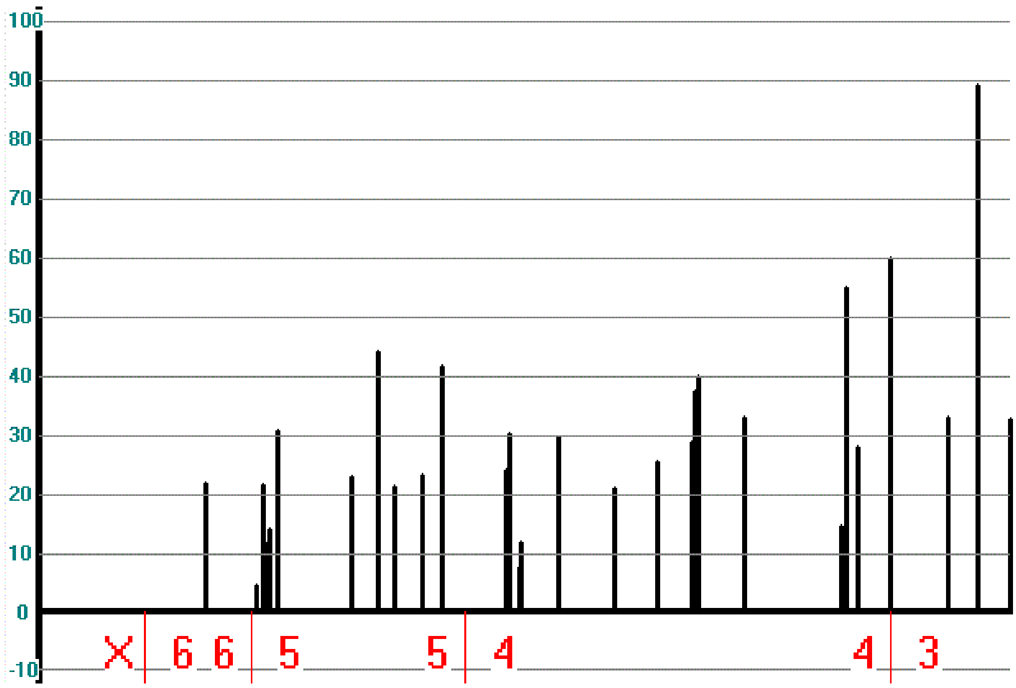
** See note on p2 of this test.*

| No | Impact X | Impact Y | Monitor X | Monitor Y |
|---|---|---|---|---|
| 1 | 8.25 | -200.79 | 87 | -246 |
| 2 | 51.76 | -376.08 | 126 | -424 |
| 3 | 172.4 | 316.31 | 234 | 234 |
| 4 | -33.86 | -212.22 | 47 | -262 |
| 5 | -55.87 | -65.31 | 31 | -122 |
| 6 | 14.91 | 129.47 | 99 | 66 |
| 7 | 74.04 | 383.44 | 147 | 297 |
| 8 | -165.97 | -51.21 | -71 | -116 |
| 9 | -292.9 | 219.36 | -196 | 138 |
| 10 | -139.03 | 273.69 | -41 | 181 |
| 11 | -346.15 | -248.71 | -226 | -309 |
| 12 | -221.87 | -116.18 | -113 | -179 |
| 13 | -214.23 | 56.67 | -111 | -11 |
| 14 | -278.88 | -261.27 | -162 | -316 |
| 15 | -242.21 | 136.43 | -141 | 65 |
| 16 | -420.83 | -264.88 | -306 | -326 |
| 17 | -279.41 | 232.23 | -179 | 159 |
| 18 | 207.47 | -80.18 | 275 | -137 |
| 19 | 103.51 | 110.57 | 189 | 37 |
| 20 | 132.06 | 322.14 | 209 | 247 |
| 21 | -27.31 | -67.3 | 64 | -89 |
| 22 | -40.41 | 133.27 | 53 | 102 |
| 23 | -32.59 | 339.85 | 64 | 316 |
| 24 | -164.61 | 227.36 | -54 | 213 |
| 25 | 366.68 | -214.3 | 417 | -186 |
| 26 | -450.42 | -259.62 | -325 | -265 |
| 27 | 287.69 | -202.11 | 352 | -205 |
| 28 | 402.96 | 194.22 | 460 | 153 |
| 29 | 180.79 | 307.76 | 257 | 234 |
| 30 | 456.93 | 24.73 | 513 | -33 |

*RAW MEASUREMENTS in mm*




*SHOT POSITIONS*
*Grid in minutes and half minutes (700 yards)*

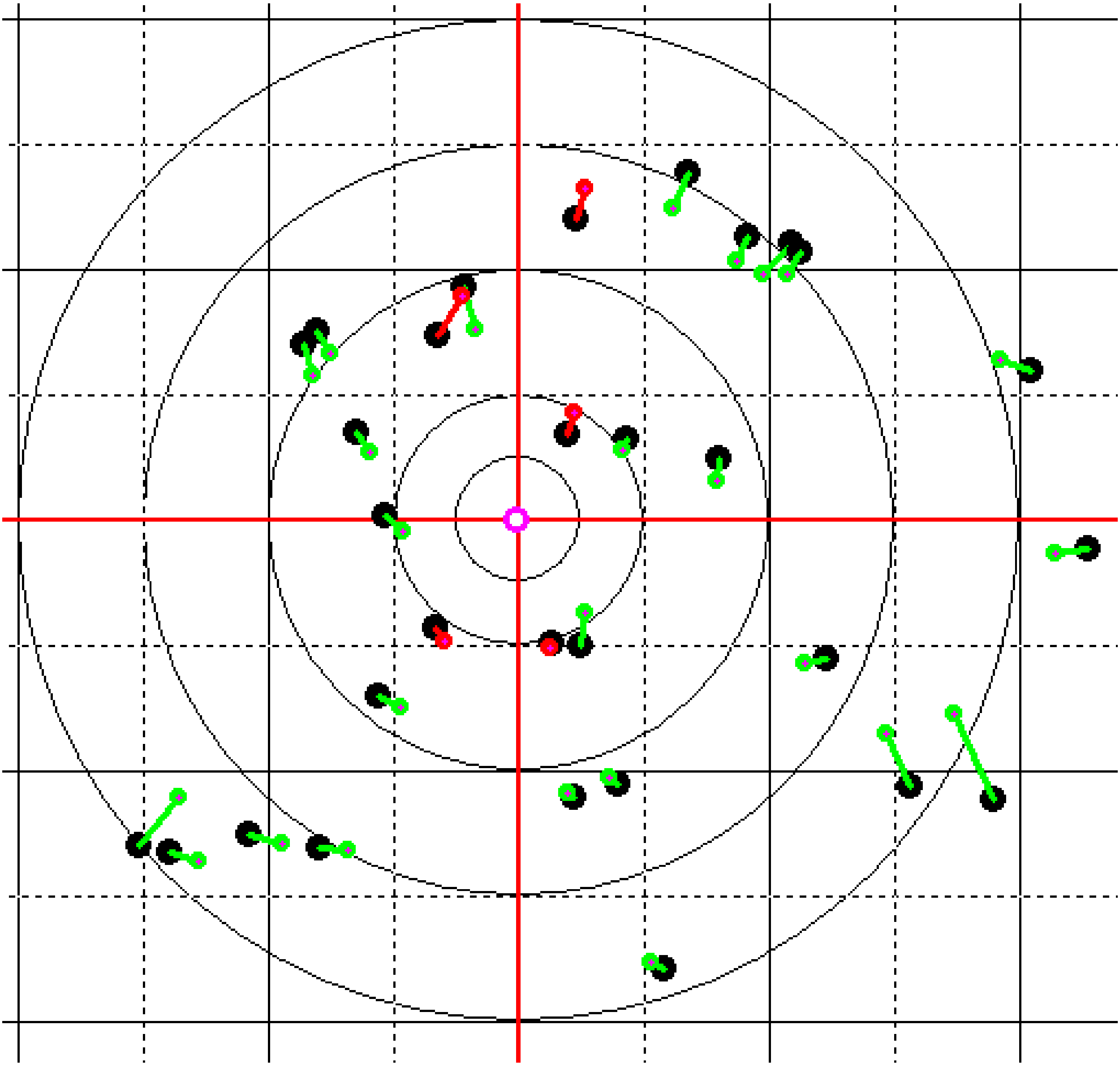



*X, 6, 5, 4, 3 indicate Score or how far shot is from the centre.*

## *BARS ARE REAL ERROR SIZE*

## *CENTRED ERRORS*

| X | Y | R | Lin |
|---|---|---|---|
| -9.45 | 7.17 | -8.55 | 11.86 |
| -13.96 | 4.46 | -7 | 14.66 |
| -26.6 | -29.9 | -39.8 | 40.05 |
| -7.34 | 2.6 | -2.41 | 7.79 |
| -1.33 | -4.31 | 4.51 | 4.51 |
| -4.11 | -11.09 | -11.8 | 11.83 |
| -15.24 | -34.1 | -37 | 37.32 |
| 6.77 | -12.4 | 0.98 | 14.14 |
| 8.7 | -29 | -23.7 | 30.26 |
| 9.83 | -40.3 | -40.8 | 41.49 |
| 31.95 | -7.91 | -17.9 | 32.91 |
| 20.67 | -10.4 | -9.35 | 23.15 |
| 15.03 | -15.3 | -16.9 | 21.44 |
| 28.68 | -2.35 | -16.2 | 28.77 |
| 13.01 | -19.1 | -20.1 | 23.07 |
| 26.63 | -8.74 | -15.5 | 28.03 |
| 12.21 | -20.9 | -22.6 | 24.16 |
| -20.67 | -4.44 | -16.8 | 21.15 |
| -2.71 | -21.2 | -12.6 | 21.36 |
| -11.26 | -22.8 | -25.4 | 25.4 |
| 3.11 | 30.68 | -30.3 | 30.83 |
| 5.21 | 21.11 | 20.8 | 21.74 |
| 8.39 | 28.53 | 28.61 | 29.74 |
| 22.41 | 38.02 | 22.35 | 44.13 |
| -37.88 | 80.68 | -71 | 89.13 |
| 37.22 | 47 | -56.9 | 59.95 |
| -23.89 | 49.49 | -47.2 | 54.95 |
| -31.16 | 11.16 | -24.5 | 33.1 |
| -11.99 | -21.4 | -24.3 | 24.52 |
| -32.13 | -5.35 | -32.1 | 32.58 |



*    *By deliberately crossfiring, we reduced the horizontal angle alignment error to about 3 degrees. This was measured by sighting from the target face to the firing point rather than from the Range orientation.*

*The SMT literature suggested this alignment should be better than 2 degrees but this was impossible and at this stage we knew nothing about internal software settings to compensate.*

***Thus the horizontal alignment was about 1 degree beyond the recommended limit.***

# SMT DAY 1 MAREEBA 308-900Y TEST 2 30 SHOTS IMPERFECT SETUP

| d | Ax | Ax SET | Ay | Ay SET | UPRIGHT | RIGID | Vo (LR) | Vsmt | Vcalc | Vo SD | Predicted Target V SD | SMT V SD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 900y | * | 0 mil | 12 mil | 0 mil | fair | Poor but little wind | 2825 | 1456 | 1437 | 13.5 | 9.7 | 17.2 |

X SPAN 930.45 mm
Y SPAN 940.91 mm
CENTRE FITTED REPORT
X CENTRE SHIFT -5.86 mm
Y CENTRE SHIFT -8.61 mm
Shown Further from Centre 3
Shown Closer to Centre 27
SDx 20.89 mm
SDy 21.93 mm

**mean mean mean**

**Berger 155.5 Fullbore Projectile**

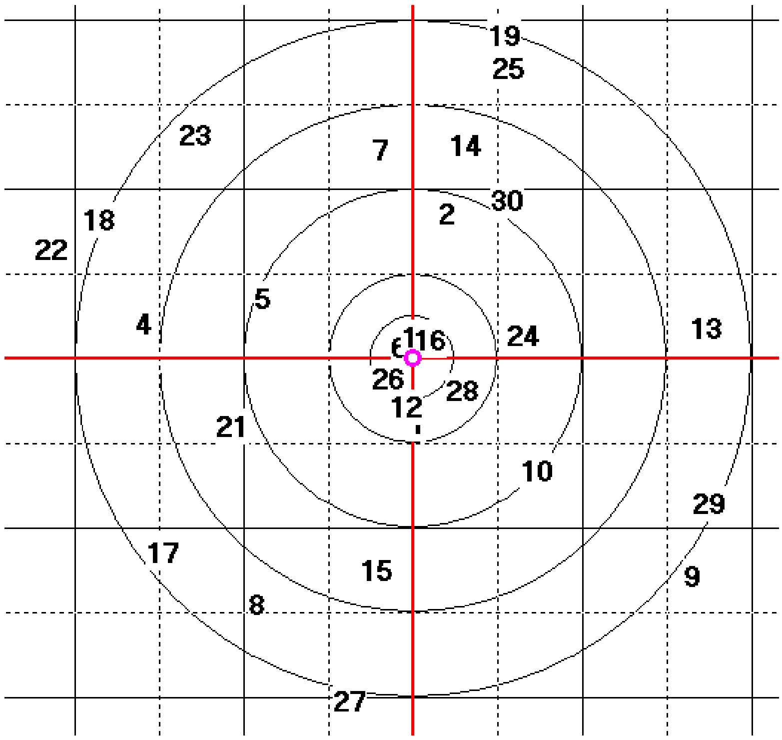
*SMT Temp 21 – 22 during firing*

*Thu Jun 8 2017*

** See note on p2 of this test.*

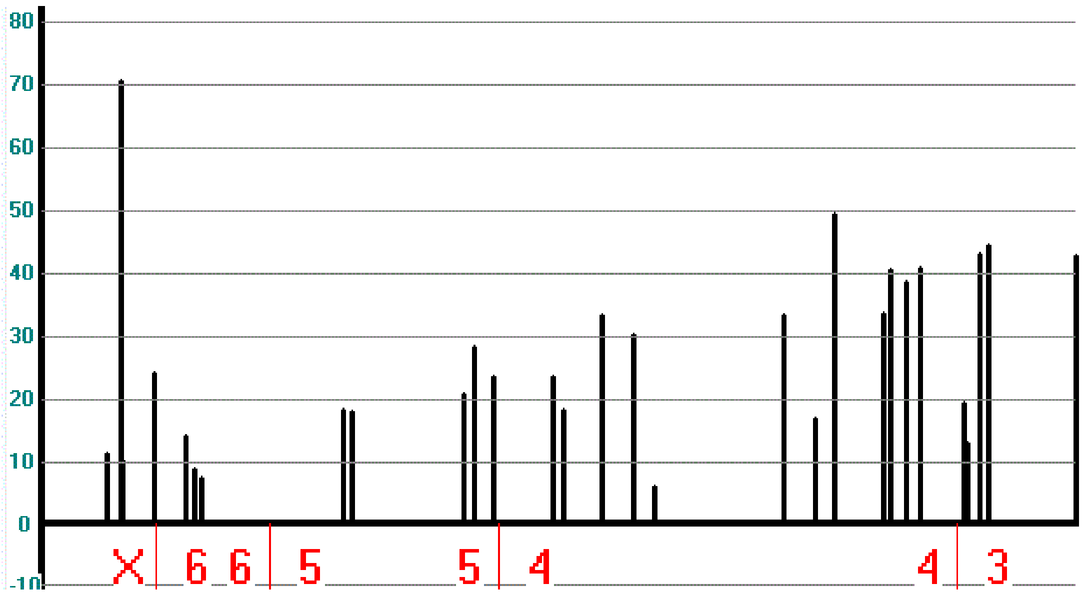
| No | Impact X | Impact Y | Monitor X | Monitor Y |
|---|---|---|---|---|
| 1 | -2.64 | -88.85 | -3 | -74 |
| 2 | 39.98 | 207.5 | 36 | 198 |
| 3 | 63.53 | -54.24 | 62 | -45 |
| 4 | -389.44 | 51.47 | -355 | 43 |
| 5 | -222.17 | 86.21 | -198 | 80 |
| 6 | -27.48 | 17.73 | -22 | 15 |
| 7 | -54.91 | 296.87 | -59 | 277 |
| 8 | -229.6 | -345.72 | -211 | -326 |
| 9 | 384.9 | -305.22 | 350 | -283 |
| 10 | 165.55 | -155.98 | 144 | -141 |
| 11 | -2.65 | 33.3 | 18 | 111 |
| 12 | -18.63 | -66.01 | -18 | -34 |
| 13 | 405.06 | 45.67 | 370 | 82 |
| 14 | 64.61 | 304.32 | 70 | 307 |
| 15 | -61.01 | -296.66 | -52 | -255 |
| 16 | 14.42 | 27.44 | 20 | 46 |
| 17 | -363.71 | -271.74 | -327 | -237 |
| 18 | -455.27 | 199.18 | -406 | 199 |
| 19 | 118.92 | 459.41 | 124 | 455 |
| 20 | 148.19 | 43.37 | 146 | 68 |
| 21 | -265.33 | -93.5 | -242 | -90 |
| 22 | -520.75 | 156 | -480 | 140 |
| 23 | -318.42 | 318.38 | -286 | 299 |
| 24 | 145.75 | 34.5 | 145 | 26 |
| 25 | 124.97 | 412.28 | 124 | 388 |
| 26 | -45.15 | -25.51 | -40 | -27 |
| 27 | -99.97 | -481.5 | -90 | -454 |
| 28 | 61.03 | -42.59 | 57 | -44 |
| 29 | 409.7 | -203.57 | 375 | -192 |
| 30 | 122.85 | 226.29 | 116 | 215 |

*RAW MEASUREMENTS in mm*




*SHOT POSITIONS*

*Grid in minutes and half minutes (700 yards)*

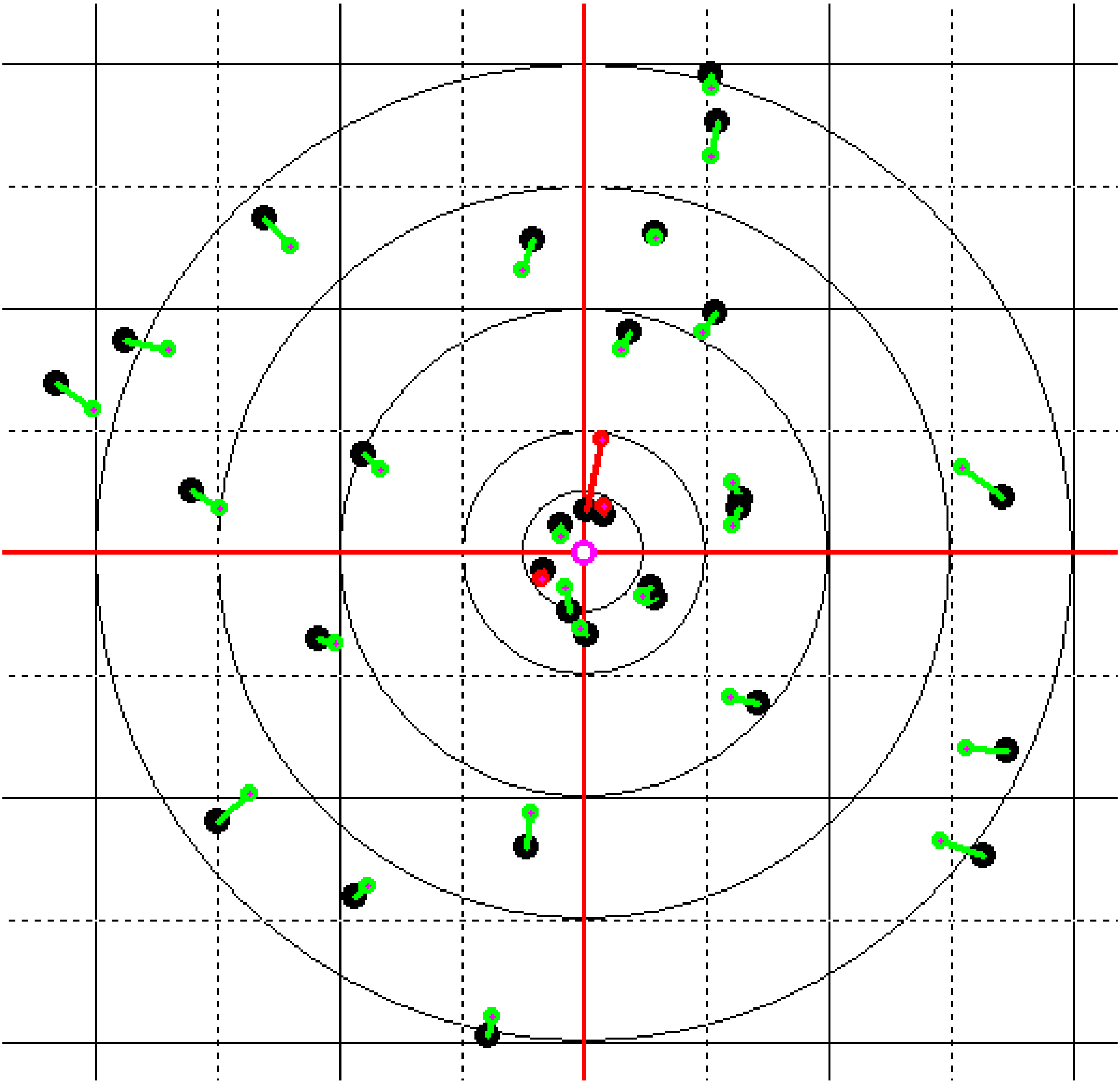



*X, 6, 5, 4, 3 indicate Score or how far shot is from the centre.*

## *BARS ARE REAL ERROR SIZE*

### *CENTRED ERRORS*

| X | Y | R | Lin |
|---|---|---|---|
| -6.22 | 6.24 | -7.38 | 8.81 |
| -9.84 | -18.11 | -20.3 | 20.6 |
| -7.39 | 0.63 | -6.14 | 7.41 |
| 28.58 | -17.1 | -29.8 | 33.3 |
| 18.31 | -14.8 | -22.1 | 23.56 |
| -0.38 | -11.34 | 8.4 | 11.34 |
| -9.95 | -28.5 | -27 | 30.16 |
| 12.74 | 11.11 | -15.9 | 16.91 |
| -40.76 | 13.61 | -40.3 | 42.97 |
| -27.41 | 6.37 | -24.3 | 28.14 |
| 14.79 | 69.09 | 64.91 | 70.66 |
| -5.23 | 23.4 | -23.7 | 23.98 |
| -40.92 | 27.72 | -37.8 | 49.42 |
| -0.47 | -5.93 | -5.79 | 5.94 |
| 3.15 | 33.05 | -33.2 | 33.2 |
| -0.28 | 9.95 | 3.35 | 9.96 |
| 30.85 | 26.13 | -40.4 | 40.44 |
| 43.41 | -8.79 | -43.3 | 44.29 |
| -0.78 | -13 | -12.6 | 13.04 |
| -8.05 | 16.02 | -4.66 | 17.93 |
| 17.47 | -5.11 | -13.5 | 18.2 |
| 34.89 | -24.6 | -40.1 | 42.7 |
| 26.56 | -28 | -38.6 | 38.59 |
| -6.61 | -17.11 | -7.56 | 18.34 |
| -6.83 | -32.9 | -33.11 | 33.59 |
| -0.71 | -10.1 | 9.64 | 10.12 |
| 4.11 | 18.89 | -19.3 | 19.34 |
| -9.89 | -10 | -1.72 | 14.07 |
| -40.56 | 2.96 | -37.3 | 40.66 |
| -12.71 | -19.9 | -23.6 | 23.61 |



*     *By deliberately crossfiring,  we reduced the horizontal angle alignment error to about 3 degrees.  This was measured by sighting from the target face to the firing point rather than from the Range orientation.*

*The SMT literature suggested this alignment should be better than 2 degrees but this was impossible and at this stage we knew nothing about internal software settings to compensate.*

*Thus the horizontal alignment was about 1 degree beyond the recommended limit.*

# SMT DAY 2 MAREEBA 308-300Y 30 SHOTS IMPERFECT SETUP

| d | Ax | Ax SET | Ay | Ay SET | UPRIGHT | RIGID | Vo (LR) | Vsmt | Vcalc | Vo SD | Predicted Target V SD | SMT V SD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 300y | 80 mil | 80 mil | 12 mil | 12 mil | fair | Poor but little wind | 2826 | 2299 | 2314 | 19.5 | 17.5 | 49.9 |
| | | | | | | | mean | mean | mean | | | |

X SPAN 522.92 mm
Y SPAN 610.72 mm
CENTRE FITTED REPORT
X CENTRE SHIFT 60.82 mm
Y CENTRE SHIFT 6.24 mm
Shown Further from Centre 14
Shown Closer to Centre 16
SDx 4.09 mm
SDy 4.59 mm

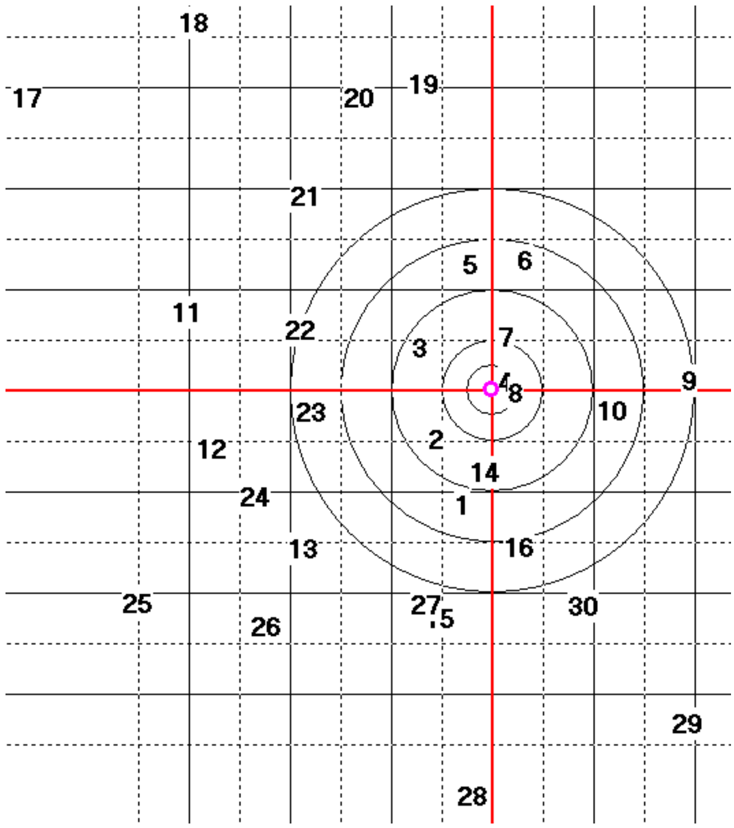
**Berger 155.5 Fullbore Projectile**

*SMT Temp 24 – 25 during firing*

*Thu Jul 13 2017*

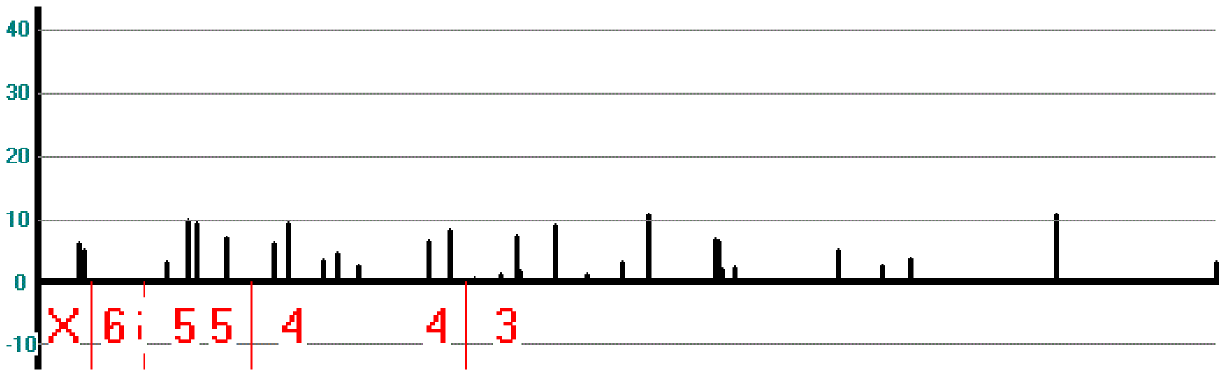
| No | Impact X | Impact Y | Monitor X | Monitor Y |
|---|---|---|---|---|
| 1 | 35.96 | -78.26 | -22 | -79 |
| 2 | 15.53 | -26.55 | -47 | -23 |
| 3 | 2.71 | 45.23 | -57 | 46 |
| 4 | 70.18 | 18.25 | 8 | 6 |
| 5 | 42.35 | 111.15 | -20 | 108 |
| 6 | 85.32 | 114.86 | 20 | 110 |
| 7 | 69.68 | 53.69 | 7 | 50 |
| 8 | 77.98 | 10.21 | 13 | 7 |
| 9 | 214.18 | 19.8 | 146 | 17 |
| 10 | 153.68 | -3.92 | 86 | -4 |
| 11 | -182.6 | 73.58 | -237 | 65 |
| 12 | -163.21 | -34.91 | -215 | -47 |
| 13 | -90.91 | -113.36 | -143 | -117 |
| 14 | 52.8 | -52.45 | -1 | -65 |
| 15 | 16.82 | -168.34 | -43 | -176 |
| 16 | 79.81 | -112.29 | 18 | -116 |
| 17 | -308.74 | 243.09 | -368 | 234 |
| 18 | -176.79 | 301.91 | -236 | 285 |
| 19 | 4.05 | 253.83 | -52 | 252 |
| 20 | -46.58 | 242.67 | -107 | 234 |
| 21 | -87.9 | 165.25 | -152 | 159 |
| 22 | -92.55 | 59.6 | -153 | 54 |
| 23 | -84.43 | -5.3 | -146 | -18 |
| 24 | -128.25 | -72.43 | -189 | -80 |
| 25 | -220.78 | -156.65 | -279 | -160 |
| 26 | -119.34 | -174.75 | -182 | -180 |
| 27 | 6.43 | -157.6 | -55 | -165 |
| 28 | 43.68 | -308.81 | -19 | -317 |
| 29 | 212.94 | -251.11 | 147 | -258 |
| 30 | 130.56 | -158.29 | 66 | -171 |

*RAW MEASUREMENTS in mm*




*SHOT POSITIONS*

*Grid in minutes and half minutes (700 yards)*

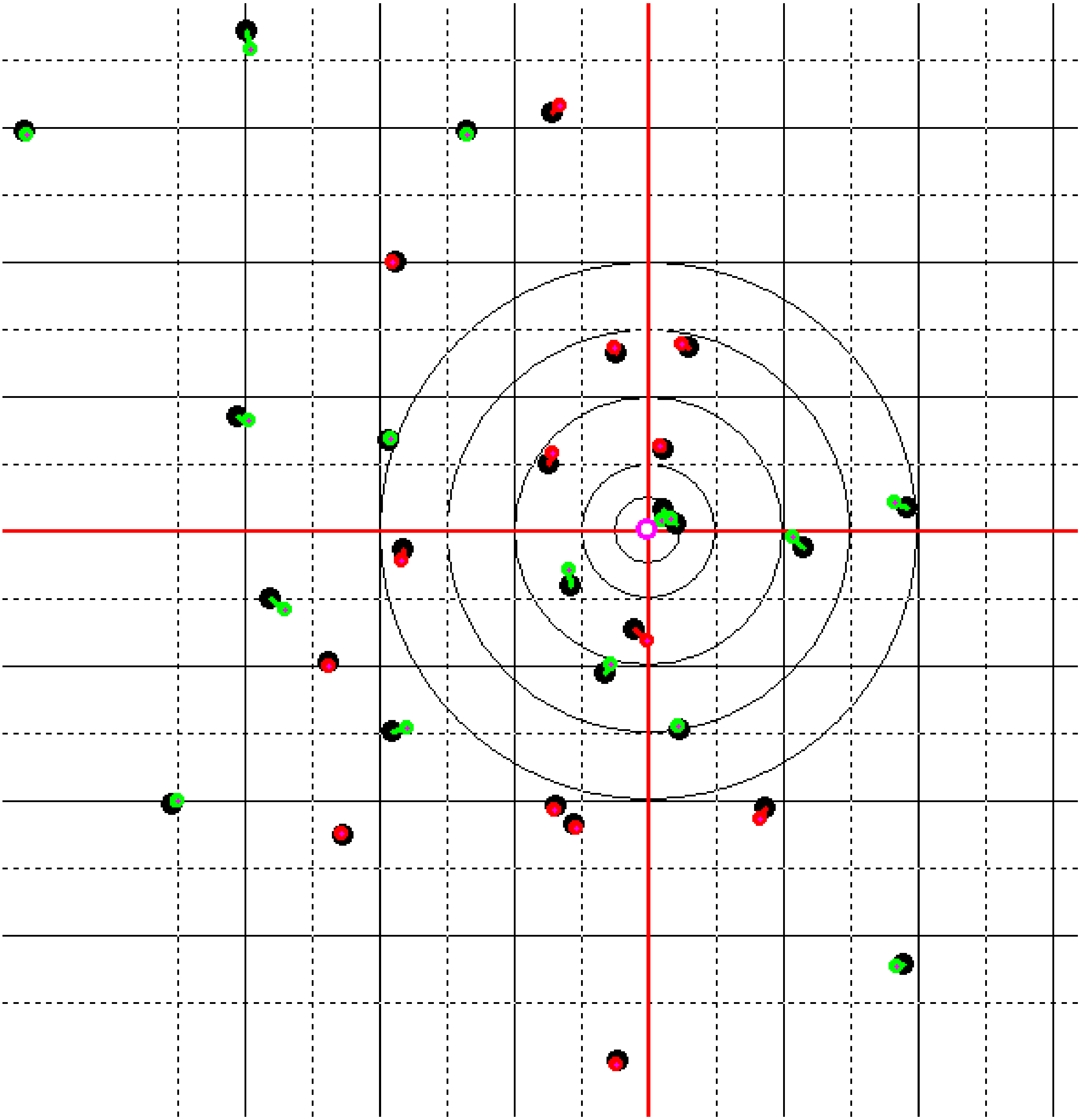



*CENTRED ERRORS*

*X, 6, 5, 4, 3 indicate Score or how far shot is from the centre.*

***BARS ARE REAL ERROR SIZE***

| X | Y | R | Lin |
|---|---|---|---|
| 2.86 | 5.5 | -2.8 | 6.2 |
| -1.7 | 9.79 | -6.4 | 9.94 |
| 1.11 | 7.01 | 7.03 | 7.09 |
| -1.4 | -6.01 | -2.78 | 6.17 |
| -1.5 | 3.09 | 2.16 | 3.45 |
| -4.5 | 1.38 | -1.72 | 4.71 |
| -1.9 | 2.55 | 0.02 | 3.15 |
| -4.2 | 3.03 | -3.51 | 5.15 |
| -7.4 | 3.44 | -6.9 | 8.12 |
| -6.9 | 6.16 | -6.68 | 9.22 |
| 6.42 | -2.34 | -6.81 | 6.83 |
| 9.03 | -5.85 | -7.54 | 10.76 |
| 8.73 | 2.6 | -7.09 | 9.11 |
| 7.02 | -6.31 | 9.39 | 9.44 |
| 1 | -1.42 | 1.58 | 1.74 |
| -1 | 2.53 | -2.55 | 2.71 |
| 1.56 | -2.85 | -3.03 | 3.25 |
| 1.61 | -10.67 | -10.2 | 10.79 |
| 4.77 | 4.41 | 4.75 | 6.49 |
| 0.4 | -2.43 | -2.46 | 2.47 |
| -3.3 | -0.01 | 1.33 | 3.28 |
| 0.37 | 0.64 | 0.12 | 0.74 |
| -0.8 | -6.46 | 1.03 | 6.51 |
| 0.07 | -1.33 | 0.62 | 1.34 |
| 2.6 | 2.89 | -3.8 | 3.88 |
| -1.8 | 0.99 | 0.15 | 2.09 |
| -0.6 | -1.16 | 1.08 | 1.31 |
| -1.9 | -1.95 | 1.59 | 2.7 |
| -5.1 | -0.65 | -2.96 | 5.16 |
| -3.7 | -6.47 | 2.28 | 7.48 |



# SMT DAY 2 MAREEBA 308-600Y 30 SHOTS IMPERFECT SETUP

| d | Ax | Ax SET | Ay | Ay SET | UPRIGHT | RIGID | Vo (LR) | Vsmt | Vcalc | Vo SD | Predicted Target V SD | SMT V SD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 600y | 80 mil | 80 mil | 12 mil | 12 mil | fair | Poor but little wind | 2818 | 1881 | 1844 | 13.2 | 10.4 | 34.4 |

mean mean mean

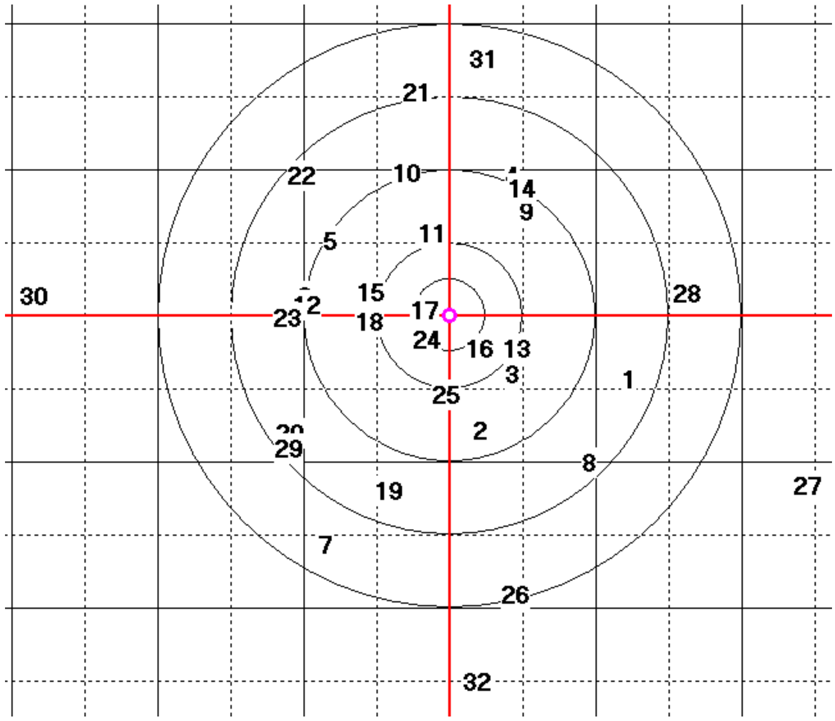
CENTRE FITTED REPORT
X CENTRE SHIFT 49.66 mm
Y CENTRE SHIFT -7.09 mm
Shown Further from Centre 9
Shown Closer to Centre 23
SDx 9.04 mm
SDy 18.20 mm

**Berger 155.5 Fullbore Projectile**
*SMT Temp 22 – 23 during firing*

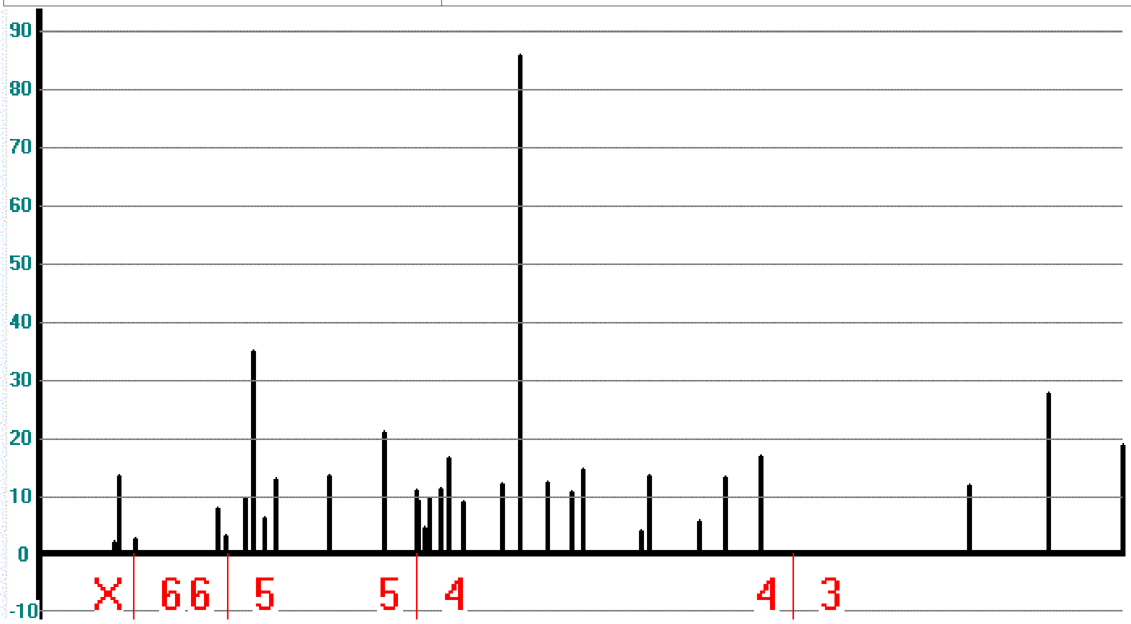
*Thu Jul 13 2017*

| No | Impact X | Impact Y | Monitor X | Monitor Y |
|---|---|---|---|---|
| 1 | 242.71 | -69.91 | 179 | 22 |
| 2 | 81.6 | -125.34 | 19 | -122 |
| 3 | 116.37 | -63.27 | 61 | -64 |
| 4 | 116.07 | 153.01 | 70 | 144 |
| 5 | -82.61 | 82.53 | -129 | 79 |
| 6 | -111.32 | 21.94 | -165 | 27 |
| 7 | -88.16 | -250.33 | -132 | -243 |
| 8 | 199.97 | -160.8 | 138 | -155 |
| 9 | 131.48 | 113.84 | 79 | 100 |
| 10 | -0.73 | 155.48 | -43 | 154 |
| 11 | 27.87 | 90.91 | -9 | 97 |
| 12 | -109.87 | 12.21 | -160 | 10 |
| 13 | 119.87 | -35.5 | 66 | -35 |
| 14 | 126.06 | 139.04 | 79 | 137 |
| 15 | -40.09 | 26.35 | -94 | 38 |
| 16 | 79.01 | -35.04 | 32 | -28 |
| 17 | 20.1 | 5.9 | -29 | 15 |
| 18 | -41.38 | -6.1 | -80 | 34 |
| 19 | -20.08 | -190.46 | -66 | -195 |
| 20 | -127.9 | -128.37 | -172 | -123 |
| 21 | 11.11 | 244.86 | -39 | 248 |
| 22 | -115.5 | 153.64 | -165 | 146 |
| 23 | -130.36 | -2.7 | -171 | 4 |
| 24 | 21.88 | -26 | -19 | -29 |
| 25 | 43.65 | -85.54 | -4 | -81 |
| 26 | 118.57 | -304.82 | 61 | -283 |
| 27 | 437.79 | -185.4 | 362 | -169 |
| 28 | 305.96 | 24.2 | 243 | 29 |
| 29 | -129 | -144.75 | -168 | -137 |
| 30 | -407.9 | 22.26 | -439 | 26 |
| 31 | 83.63 | 281.05 | 36 | 275 |
| 32 | 77.19 | -399.86 | 26 | -381 |

*RAW MEASUREMENTS*
*in mm*



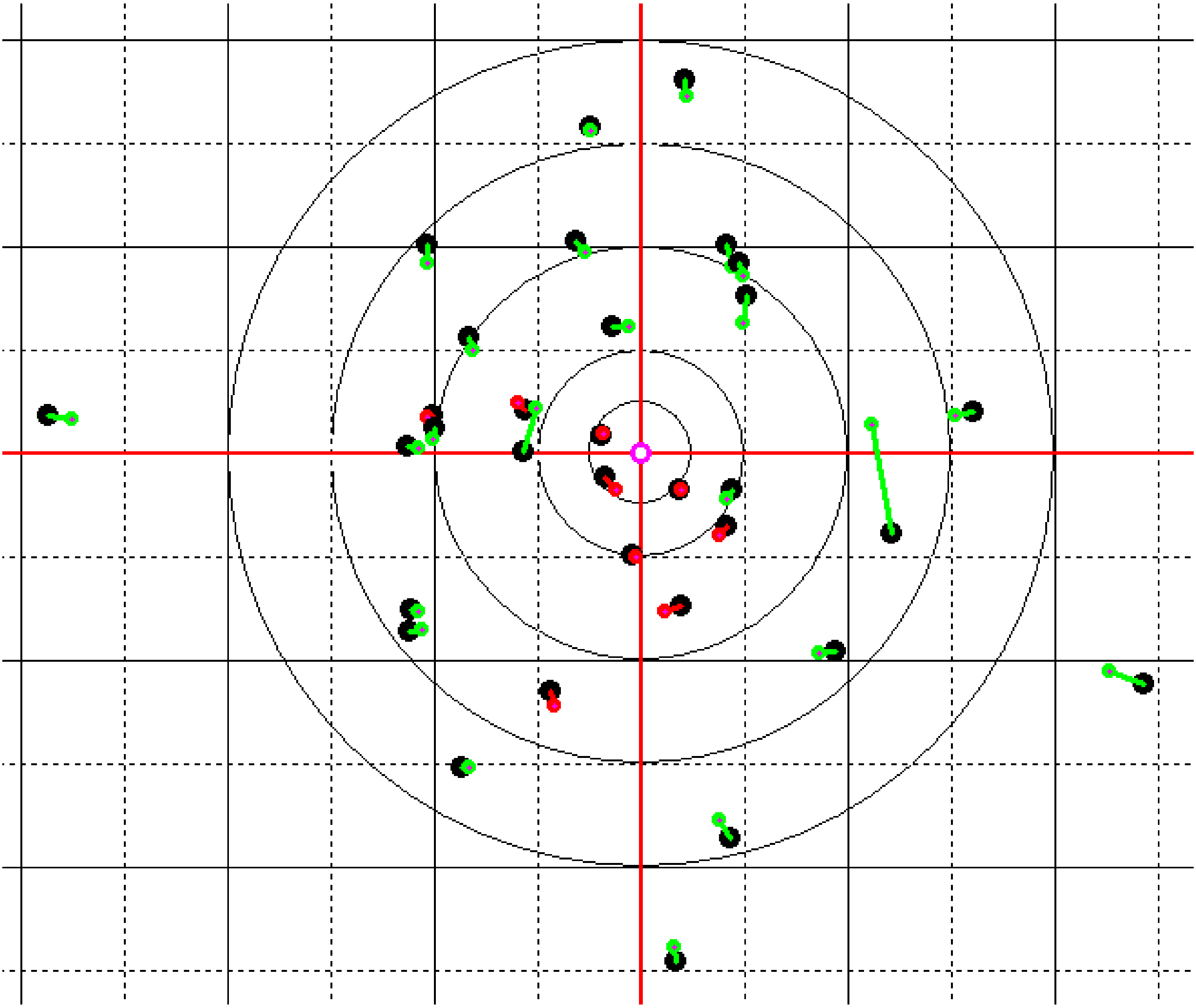

*SHOT POSITIONS*
*Grid in minutes and half minutes (700 yards)*




*CENTRED ERRORS*
*X, 6, 5, 4, 3 indicate Score or how far shot is from the centre.*
***BARS ARE REAL ERROR SIZE***

*CENTRED ERRORS*

| X | Y | R | Lin |
|---|---|---|---|
| 2.86 | 5.5 | -2.8 | 6.2 |
| -1.7 | 9.79 | -6.4 | 9.94 |
| 1.11 | 7.01 | 7.03 | 7.09 |
| -1.4 | -6.01 | -2.78 | 6.17 |
| -1.5 | 3.09 | 2.16 | 3.45 |
| -4.5 | 1.38 | -1.72 | 4.71 |
| -1.9 | 2.55 | 0.02 | 3.15 |
| -4.2 | 3.03 | -3.51 | 5.15 |
| -7.4 | 3.44 | -6.9 | 8.12 |
| -6.9 | 6.16 | -6.68 | 9.22 |
| 6.42 | -2.34 | -6.81 | 6.83 |
| 9.03 | -5.85 | -7.54 | 10.76 |
| 8.73 | 2.6 | -7.09 | 9.11 |
| 7.02 | -6.31 | 9.39 | 9.44 |
| 1 | -1.42 | 1.58 | 1.74 |
| -1 | 2.53 | -2.55 | 2.71 |
| 1.56 | -2.85 | -3.03 | 3.25 |
| 1.61 | -10.67 | -10.2 | 10.79 |
| 4.77 | 4.41 | 4.75 | 6.49 |
| 0.4 | -2.43 | -2.46 | 2.47 |
| -3.3 | -0.01 | 1.33 | 3.28 |
| 0.37 | 0.64 | 0.12 | 0.74 |
| -0.8 | -6.46 | 1.03 | 6.51 |
| 0.07 | -1.33 | 0.62 | 1.34 |
| 2.6 | 2.89 | -3.8 | 3.88 |
| -1.8 | 0.99 | 0.15 | 2.09 |
| -0.6 | -1.16 | 1.08 | 1.31 |
| -1.9 | -1.95 | 1.59 | 2.7 |
| -5.1 | -0.65 | -2.96 | 5.16 |
| -3.7 | -6.47 | 2.28 | 7.48 |



# SMT DAY 3 MAREEBA 7SAUM-900Y 20 SHOTS IMPERFECT

| d | Ax | Ax SET | Ay | Ay SET | UPRIGHT | RIGID | Vo (LR) | Vsmt | Vcalc | Vo SD | Predicted Target V SD | SMT V SD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 900y | 15 mil | 15 mil | 80 mil | 80 mil | fair | Poor but little wind | 2949 | 1750 | 1925 | 5.3 | 4.2 | 12.7 |
| | | | | | | | mean | mean | mean | | | |

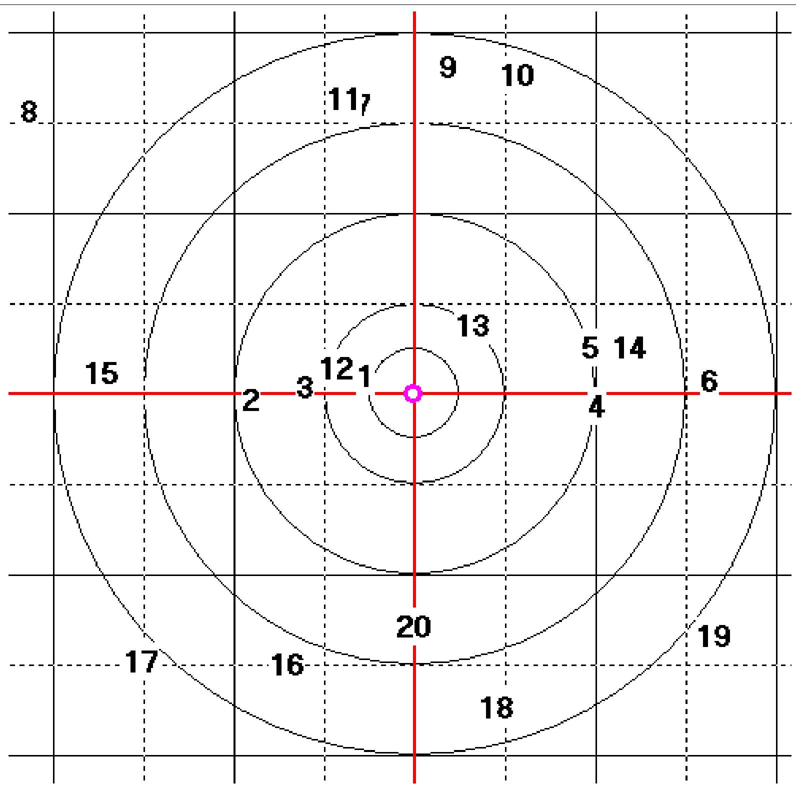
20 SHOTS at 900 Yards
X SPAN 904.58 mm
Y SPAN 849.70 mm
CENTRE FITTED REPORT
X CENTRE SHIFT 0.36 mm
Y CENTRE SHIFT 9.82 mm
Shown Further from Centre 16
Shown Closer to Centre 4
SDx 13.25 mm
SDy 11.14 mm

Berger 180 Hybrid Projectile
SMT Temp 25 – 26 during firing

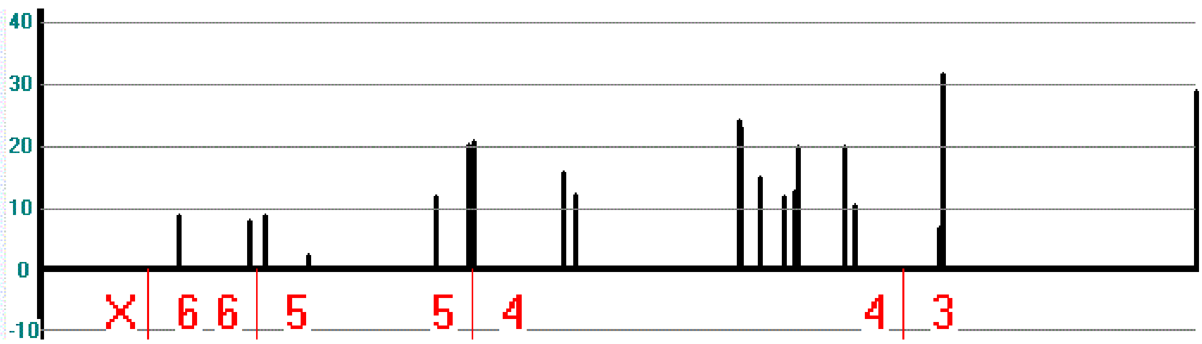
*Thu Jul 20 2017*

| No | Impact X | Impact Y | Monitor X | Monitor Y |
|---|---|---|---|---|
| 1 | -68.23 | 45.14 | -60 | 34 |
| 2 | -218.76 | 13.08 | -231 | 3 |
| 3 | -147.08 | 29.33 | -145 | 20 |
| 4 | 238.09 | 4.34 | 258 | -5 |
| 5 | 230.01 | 82.26 | 246 | 85 |
| 6 | 388.19 | 38.95 | 409 | 38 |
| 7 | -72.23 | 402.79 | -60 | 385 |
| 8 | -512.57 | 394.59 | -533 | 364 |
| 9 | 41.26 | 454.56 | 49 | 463 |
| 10 | 131.03 | 442.75 | 136 | 442 |
| 11 | -98.17 | 411.1 | -100 | 413 |
| 12 | -106.63 | 55.33 | -114 | 49 |
| 13 | 72.43 | 112.3 | 78 | 109 |
| 14 | 281.51 | 81.91 | 294 | 81 |
| 15 | -417.86 | 48.62 | -438 | 42 |
| 16 | -171.78 | -337.76 | -183 | -369 |
| 17 | -365.01 | -332.56 | -390 | -362 |
| 18 | 104.95 | -395.14 | 101 | -417 |
| 19 | 392.01 | -299.78 | 388 | -304 |
| 20 | -4.02 | -287.48 | -15 | -303 |

*RAW MEASUREMENTS in mm*



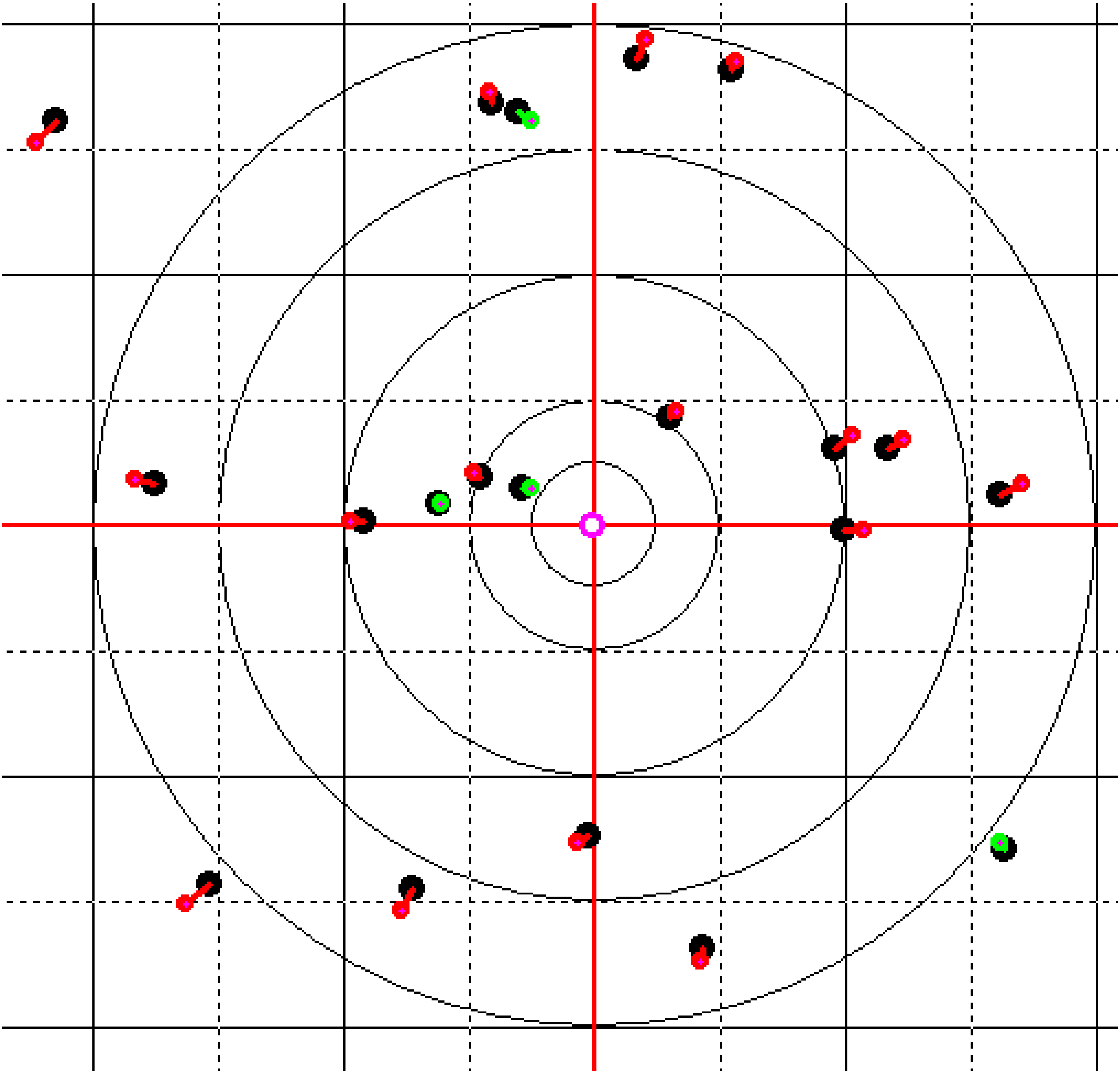

*SHOT POSITIONS*
*Grid in minutes and half minutes (700 yards)*




*CENTRED ERRORS*
*X, 6, 5, 4, 3 indicate Score or how far shot is from the centre.*

| X | Y | R | Lin |
|---|---|---|---|
| 8.59 | -1.32 | -8.46 | 8.69 |
| -12 | -0.26 | 11.76 | 11.89 |
| 2.44 | 0.49 | -2.48 | 2.49 |
| 20.3 | 0.48 | 19.92 | 20.27 |
| 16.4 | 12.56 | 18.11 | 20.61 |
| 21.2 | 8.87 | 21.06 | 22.95 |
| 12.6 | -7.97 | -9.69 | 14.9 |
| -20 | -20.77 | 5.27 | 28.89 |
| 8.1 | 18.26 | 19.23 | 19.97 |
| 5.33 | 9.07 | 10.36 | 10.52 |
| -1.5 | 11.72 | 11.75 | 11.81 |
| -7 | 3.49 | 7.31 | 7.83 |
| 5.93 | 6.52 | 8.64 | 8.81 |
| 12.9 | 8.91 | 13.86 | 15.63 |
| -20 | 3.2 | 19.8 | 20.04 |
| -11 | -21.42 | 23.94 | 24.02 |
| -25 | -19.62 | 31.14 | 31.49 |
| -3.6 | -12.04 | 10.73 | 12.57 |
| -3.7 | 5.6 | -6.41 | 6.68 |
| -11 | -5.7 | 5.52 | 12.06 |

***BARS ARE REAL ERROR SIZE***



# SMT DAY 3 MAREEBA 308-300Y 30 SHOTS IMPERFECT SETUP

| d | Ax | Ax SET | Ay | Ay SET | UPRIGHT | RIGID | Vo (LR) | Vsmt | Vcalc | Vo SD | Predicted Target V SD | SMT V SD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 300y | 15 mil | 15 set | 4 mil | 4 mil | fair | Poor but little wind | 2826 | 2300 | 2429 | 19.5 | 17.5 | 50.0 |
| | | | | | | | mean | mean | mean | | | |

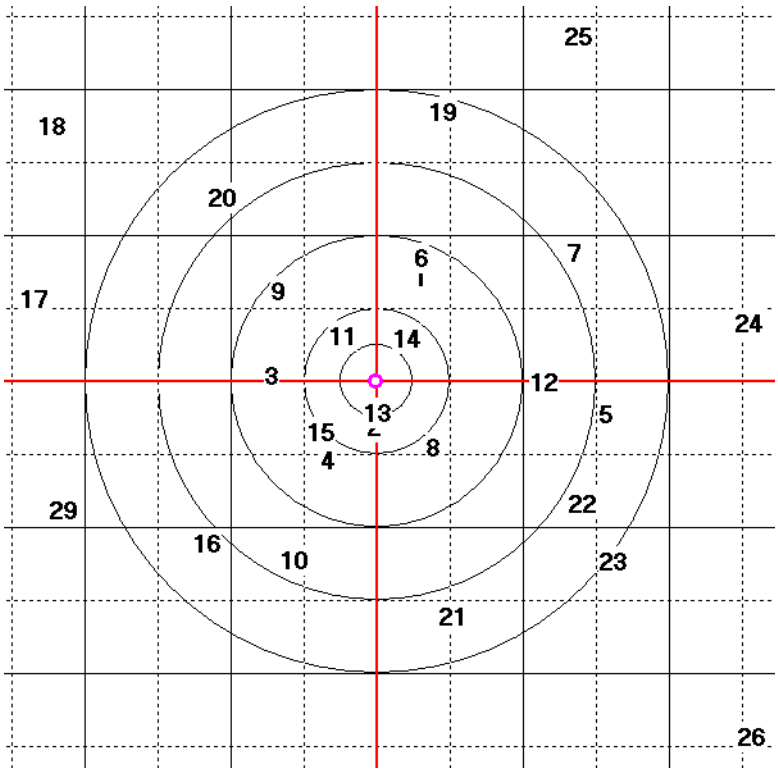
X SPAN 462.97 mm
Y SPAN 558.46 mm
CENTRE FITTED REPORT
X CENTRE SHIFT 0.87 mm
Y CENTRE SHIFT 3.92 mm
Shown Further from Centre 24
Shown Closer to Centre 6
SDx 5.96 mm
SDy 7.71 mm

Berger 155.5 Fullbore Projectile
SMT Temp 28 – 30 during firing

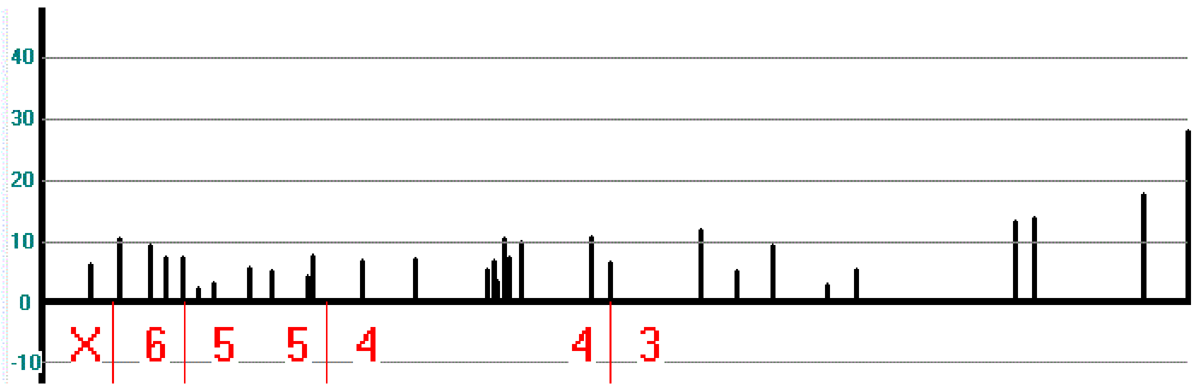
Thu Jul 20 2017

| No | Impact X | Impact Y | Monitor X | Monitor Y |
|---|---|---|---|---|
| 1 | 24 | 64.26 | 28 | 62 |
| 2 | -1.43 | -17.58 | 8 | -23 |
| 3 | -57.16 | 10.51 | -53 | 9 |
| 4 | -26.97 | -35.58 | -25 | -38 |
| 5 | 125.44 | -10.34 | 130 | -15 |
| 6 | 24.22 | 74.77 | 24 | 75 |
| 7 | 107.8 | 78.1 | 114 | 82 |
| 8 | 30.51 | -28.87 | 32 | -32 |
| 9 | -53.73 | 56.96 | -61 | 57 |
| 10 | -45.35 | -90.02 | -53 | -96 |
| 11 | -19.13 | 32.19 | -17 | 35 |
| 12 | 91.23 | 7.06 | 91 | 10 |
| 13 | 0.29 | -9.7 | 2 | -8 |
| 14 | 16.03 | 30.75 | 17 | 36 |
| 15 | -30.69 | -20.01 | -26 | -19 |
| 16 | -92.81 | -81.35 | -100 | -88 |
| 17 | -187.91 | 52.89 | -192 | 45 |
| 18 | -177.89 | 146.84 | -184 | 142 |
| 19 | 35.47 | 154.55 | 40 | 160 |
| 20 | -84.66 | 107.76 | -85 | 94 |
| 21 | 41.55 | -121.06 | 34 | -128 |
| 22 | 112.24 | -59.56 | 112 | -60 |
| 23 | 129.06 | -91.18 | 131 | -101 |
| 24 | 203.13 | 39.36 | 211 | 39 |
| 25 | 110.14 | 196.06 | 107 | 194 |
| 26 | 204.39 | -186.49 | 209 | -203 |
| 27 | -62.64 | -262.03 | -69 | -278 |
| 28 | -258.58 | -186.14 | -272 | -215 |
| 29 | -171.66 | -62.86 | -182 | -74 |
| 30 | -99.75 | 296.43 | -112 | 306 |

*RAW MEASUREMENTS*
*in mm*

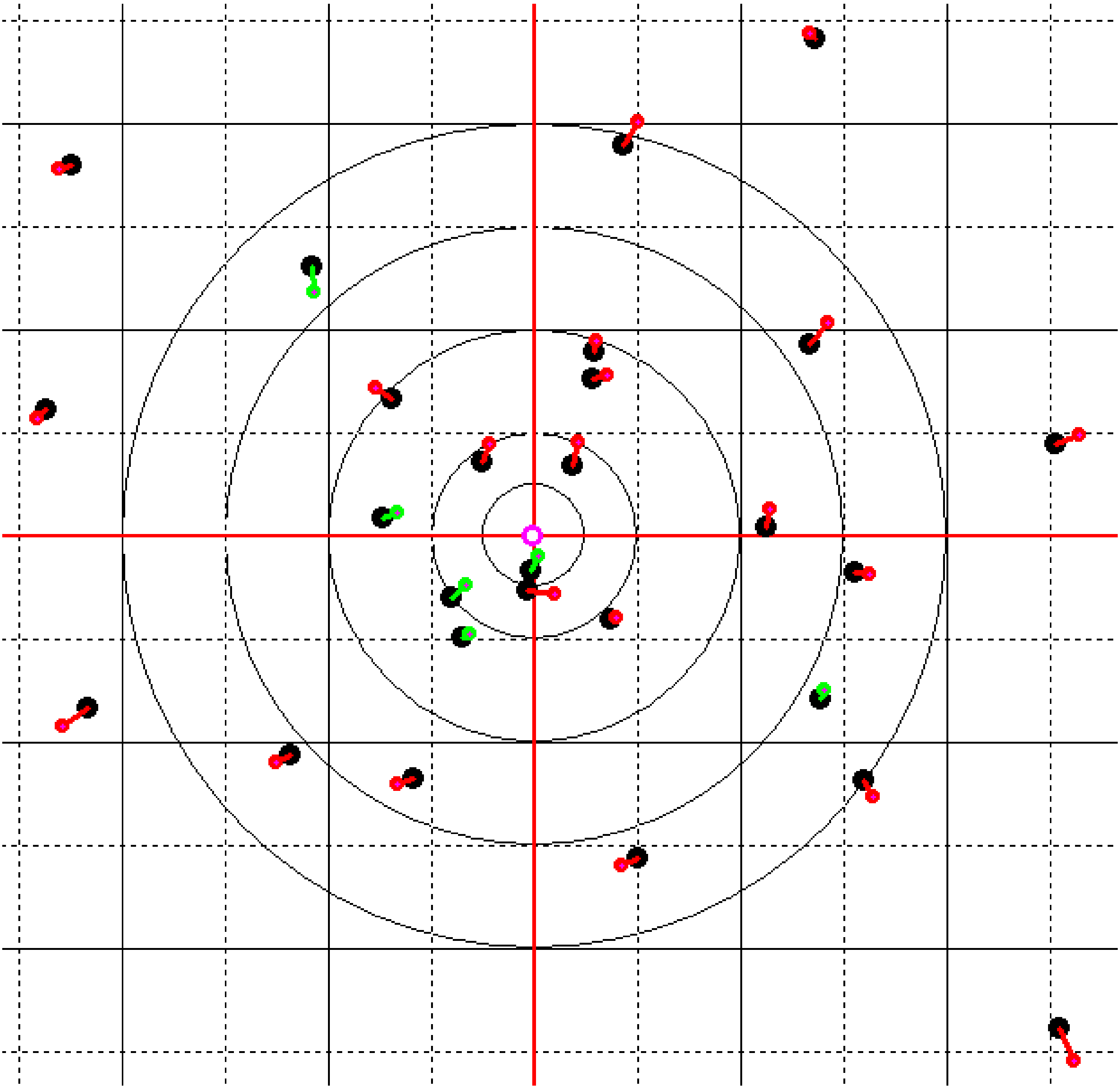



*SHOT POSITIONS*
*Grid in minutes and half minutes (700 yards)*




*CENTRED ERRORS*
*X, 6, 5, 4, 3 indicate Score or how far shot is from the centre.*
## *BARS ARE REAL ERROR SIZE*

| X | Y | R | Lin |
|---|---|---|---|
| 4.87 | 1.66 | 3.63 | 5.15 |
| 10.3 | -1.5 | 4.77 | 10.41 |
| 5.03 | 2.41 | -4.54 | 5.58 |
| 2.84 | 1.5 | -2.72 | 3.21 |
| 5.43 | -0.74 | 5.48 | 5.48 |
| 0.65 | 4.15 | 4.11 | 4.2 |
| 7.07 | 7.82 | 10.26 | 10.55 |
| 2.36 | 0.79 | 1.25 | 2.49 |
| -6.4 | 3.96 | 7.28 | 7.53 |
| -6.8 | -2.06 | 4.78 | 7.08 |
| 3 | 6.73 | 5.02 | 7.37 |
| 0.64 | 6.86 | 1.19 | 6.89 |
| 2.58 | 5.62 | -3.57 | 6.19 |
| 1.84 | 9.17 | 8.71 | 9.36 |
| 5.56 | 4.93 | -7.43 | 7.43 |
| -6.3 | -2.73 | 6.48 | 6.88 |
| -3.2 | -3.97 | 2.12 | 5.11 |
| -5.2 | -0.92 | 3.49 | 5.32 |
| 5.4 | 9.37 | 10.45 | 10.82 |
| 0.53 | -9.84 | -7.99 | 9.85 |
| -6.7 | -3.02 | 0.74 | 7.33 |
| 0.63 | 3.48 | -1.05 | 3.54 |
| 2.81 | -5.9 | 5.73 | 6.53 |
| 8.74 | 3.56 | 9.24 | 9.44 |
| -2.3 | 1.86 | 0.47 | 2.94 |
| 5.48 | -12.59 | 12.58 | 13.73 |
| -5.5 | -12.05 | 12.96 | 13.24 |
| -13 | -24.94 | 25.17 | 27.92 |
| -9.5 | -7.22 | 11.48 | 11.9 |
| -11 | 13.49 | 16.43 | 17.65 |



# SMT DAY 3 MAREEBA 308-900Y 30 SHOTS IMPERFECT SETUP

| d | Ax | Ax SET | Ay | Ay SET | UPRIGHT | RIGID | Vo (LR) | Vsmt | Vcalc | Vo SD | Predicted Target V SD | SMT V SD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 900y | 15 mil | 15 mil | 12 mil | 12 mil | fair | Poor but little wind | 2842 | 1374 | 1473 | 11.2 | 8.0 | 12.4 |
| | | | | | | | mean | mean | mean | | | |

X SPAN 1075.00 mm
Y SPAN 976.00 mm
CENTRE FITTED REPORT
X CENTRE SHIFT -28.14 mm
Y CENTRE SHIFT -44.52 mm
Shown Further from Centre 3
Shown Closer to Centre 27
SDx 17.68 mm
SDy 22.05 mm

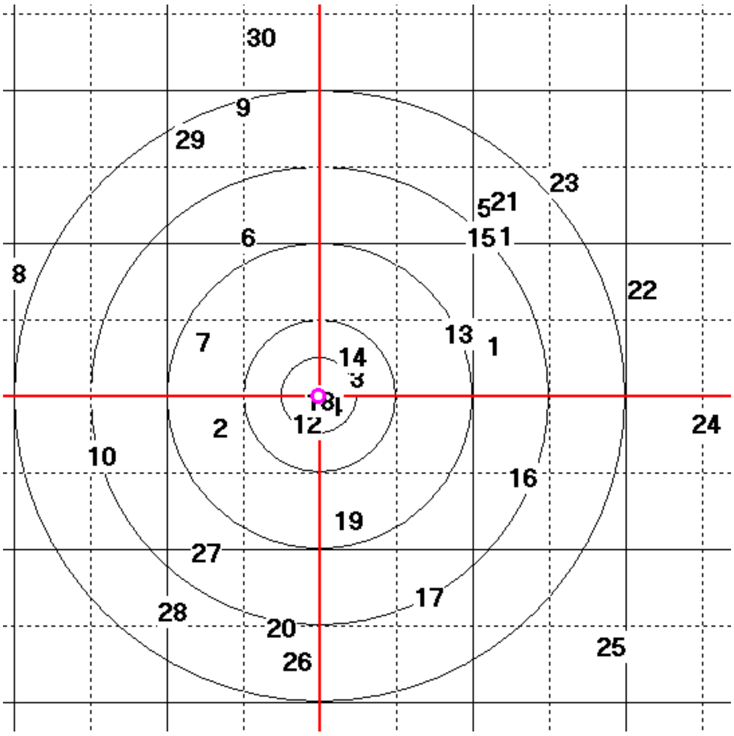
**Berger 155.5 Fullbore Projectile**

*SMT Temp 29 - 30 during firing*

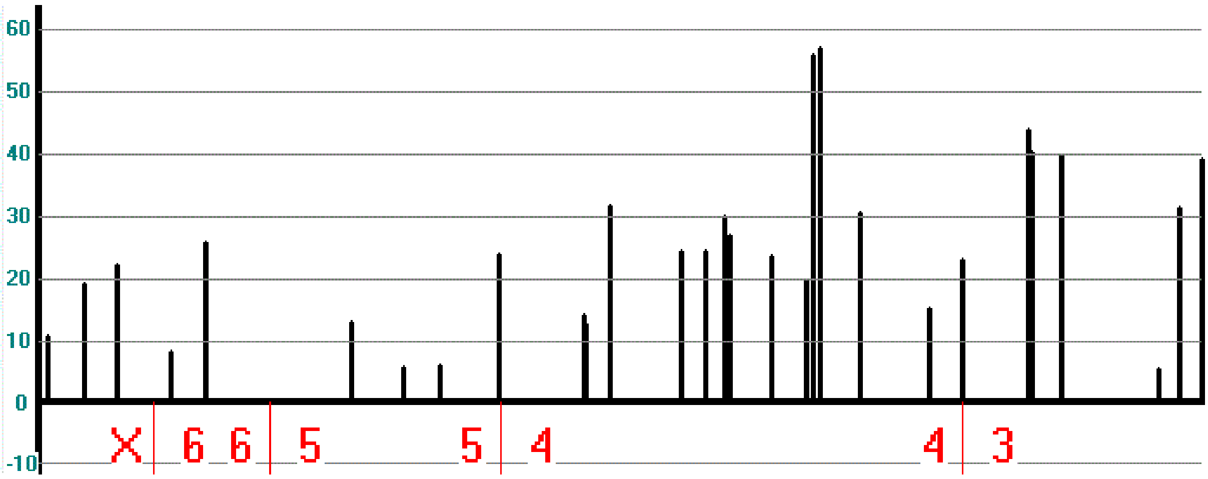
*Thu Jul 20 2017*

| No | Impact X | Impact Y | Monitor X | Monitor Y |
|---|---|---|---|---|
| 1 | 241 | 45 | 261.85 | 99.72 |
| 2 | -186 | -83 | -151.34 | -27.18 |
| 3 | 28 | -5 | 48.7 | 35.79 |
| 4 | -5 | -49 | 32.26 | 12.32 |
| 5 | 227 | 261 | 240.1 | 292.72 |
| 6 | -143 | 214 | -102.78 | 251.35 |
| 7 | -213 | 51 | -179.11 | 94.45 |
| 8 | -501 | 159 | -433.5 | 195.27 |
| 9 | -150 | 419 | -112.88 | 442.36 |
| 10 | -374 | -128 | -315.98 | -84.45 |
| 11 | 248 | 217 | 269.01 | 239.03 |
| 12 | -53 | -77 | -5.35 | -42.73 |
| 13 | 185 | 63 | 216.56 | 84.06 |
| 14 | 20 | 28 | 61.67 | 50.68 |
| 15 | 220 | 214 | 235.48 | 234.73 |
| 16 | 285 | -160 | 290.24 | -107.14 |
| 17 | 139 | -347 | 160.51 | -279.03 |
| 18 | -31 | -41 | -2.1 | -7.13 |
| 19 | 13 | -229 | 42.89 | -179.05 |
| 20 | -93 | -397 | -57.99 | -327.52 |
| 21 | 258 | 271 | 268.16 | 290.92 |
| 22 | 472 | 132 | 464.57 | 159.1 |
| 23 | 352 | 301 | 358.19 | 307.58 |
| 24 | 574 | -77 | 563.5 | -38 |
| 25 | 424 | -426 | 433.05 | -356.77 |
| 26 | -67 | -448 | -23.1 | -348.75 |
| 27 | -209 | -279 | -180.09 | -202.84 |
| 28 | -263 | -370 | -214.21 | -273.53 |
| 29 | -234 | 369 | -191.99 | 407.32 |
| 30 | -124 | 528 | -92.2 | 568.4 |

*AW MEASUREMENTS*
*in mm*

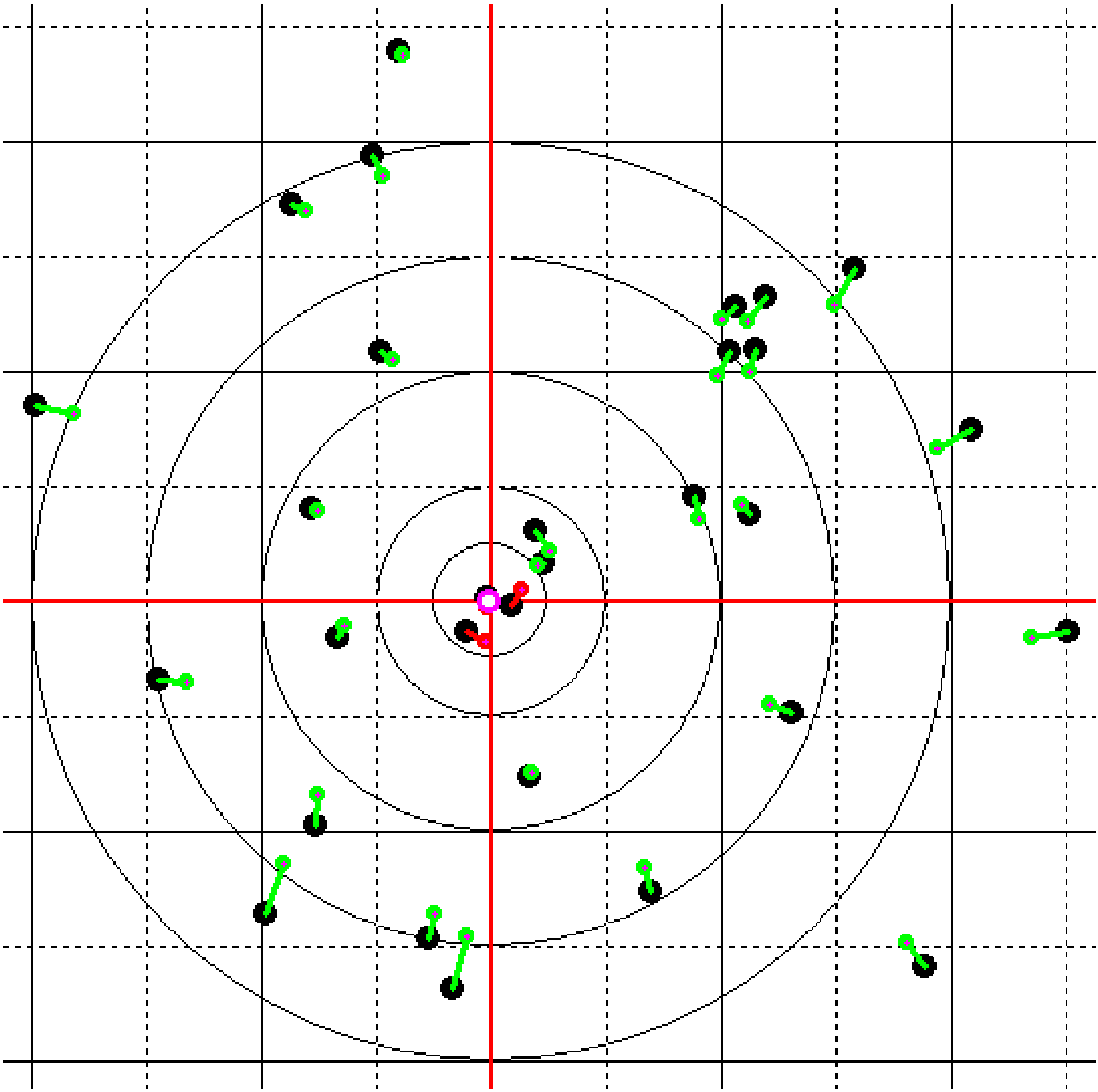


*SHOT POSITIONS*
*Grid in minutes and half minutes (700 yards)*




*CENTRED ERRORS*
*X, 6, 5, 4, 3 indicate Score or how far shot is from the centre.*
***BARS ARE REAL ERROR SIZE***

| X | Y | R | Lin |
|---|---|---|---|
| -7.3 | 10.2 | -4.91 | 12.53 |
| 6.52 | 11.3 | -10.1 | 13.05 |
| -7.4 | -3.73 | 7.64 | 8.32 |
| 9.12 | 16.8 | -18.9 | 19.11 |
| -15 | -12.8 | -19.2 | 19.75 |
| 12.1 | -7.17 | -13.3 | 14.05 |
| 5.75 | -1.07 | -5.85 | 5.85 |
| 39.4 | -8.25 | -40.1 | 40.22 |
| 8.98 | -21.16 | -23 | 22.99 |
| 29.9 | -0.97 | -28 | 29.9 |
| -7.1 | -22.49 | -20.7 | 23.59 |
| 19.5 | -10.25 | -5.32 | 22.04 |
| 3.42 | -23.46 | -3.52 | 23.71 |
| 13.5 | -21.84 | -25.6 | 25.7 |
| -13 | -23.79 | -26.1 | 26.95 |
| -23 | 8.34 | -23.7 | 24.37 |
| -6.6 | 23.45 | -24.4 | 24.37 |
| 0.76 | -10.65 | 5.99 | 10.68 |
| 1.75 | 5.43 | -5.56 | 5.7 |
| 6.87 | 24.96 | -25.9 | 25.89 |
| -18 | -24.6 | -30.4 | 30.47 |
| -36 | -17.42 | -39 | 39.61 |
| -22 | -37.94 | -41.7 | 43.83 |
| -39 | -5.52 | -37.2 | 39.03 |
| -19 | 24.71 | -31.1 | 31.22 |
| 15.8 | 54.73 | -56.8 | 56.95 |
| 0.77 | 31.64 | -24 | 31.65 |
| 20.7 | 51.95 | -53.2 | 55.9 |
| 13.9 | -6.2 | -13.2 | 15.2 |
| 3.66 | -4.12 | -5 | 5.51 |



# SMT HERBERTON 308-600Y 30 SHOTS PERFECT SETUP

| d | Ax | Ax SET | Ay | Ay SET | UPRIGHT | RIGID | Vo (LR) | Vsmt | Vcalc | Vo SD | Predicted Target V SD | SMT V SD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 600y | 34 mil | 34 mil | 41 mil | 41 mil | PERFECT | PERFECT NO WIND | 2848 | 1881 | 1935 | 9.7 | 7.6 | 21 |
| | | | | | | | mean | mean | mean | | | |

X SPAN 839.00 mm
Y SPAN 703.00 mm
CENTRE FITTED REPORT
X CENTRE SHIFT -22.00 mm
Y CENTRE SHIFT 0.01 mm
Shown Further from Centre 6
Shown Closer to Centre 24
SDx 3.20 mm
SDy 2.79 mm

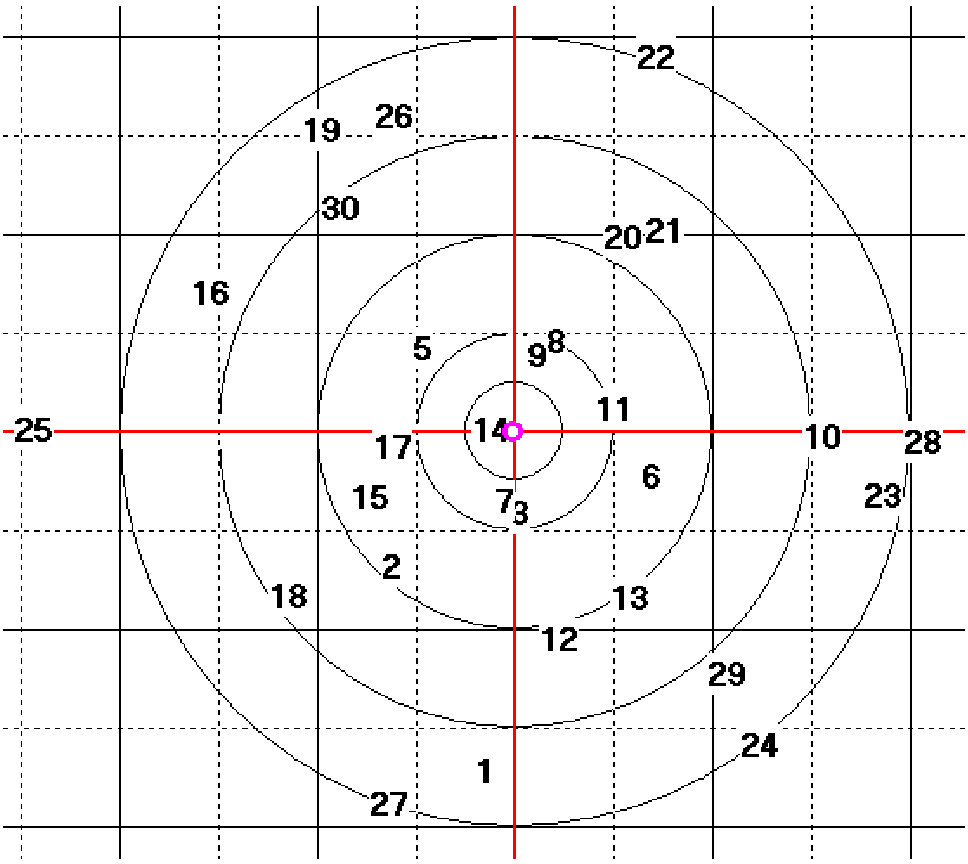
Berger 155.5 Fullbore Projectile
SMT Temp 26 – 28 during firing

Wed Aug 16 2017

| No | Impact X | Impact Y | Monitor X | Monitor Y |
|---|---|---|---|---|
| 1 | -53 | -311 | -30.47 | -304.8 |
| 2 | -140 | -118 | -122.34 | -114.04 |
| 3 | -19 | -67 | 1.55 | -64.04 |
| 4 | -44 | 12 | -19.41 | 15.31 |
| 5 | -111 | 88 | -86.15 | 89.5 |
| 6 | 104 | -33 | 123.59 | -33.8 |
| 7 | -35 | -57 | -16.97 | -58.92 |
| 8 | 15 | 94 | 37.84 | 91.66 |
| 9 | -4 | 81 | 17.85 | 78.78 |
| 10 | 264 | 4 | 283.6 | 8.72 |
| 11 | 68 | 30 | 93.37 | 31.94 |
| 12 | 17 | -187 | 34.74 | -184.36 |
| 13 | 83 | -148 | 103.95 | -143.99 |
| 14 | -47 | 11 | -22.53 | 10.83 |
| 15 | -162 | -53 | -134.98 | -52.26 |
| 16 | -312 | 140 | -288.67 | 139.12 |
| 17 | -141 | -5 | -113.49 | -5.24 |
| 18 | -239 | -146 | -212.27 | -145.56 |
| 19 | -207 | 293 | -183.5 | 293.28 |
| 20 | 76 | 192 | 94.46 | 185.11 |
| 21 | 116 | 199 | 135.67 | 196.6 |
| 22 | 108 | 361 | 128.45 | 359.47 |
| 23 | 322 | -51 | 345.41 | -54.48 |
| 24 | 206 | -287 | 223.08 | -287.38 |
| 25 | -479 | 11 | -460.51 | 10.11 |
| 26 | -139 | 307 | -112.59 | 304.38 |
| 27 | -144 | -342 | -117.69 | -342.57 |
| 28 | 360 | 0 | 376.99 | -0.22 |
| 29 | 175 | -220 | 195.73 | -223.01 |
| 30 | -190 | 220 | -166.69 | 217.42 |

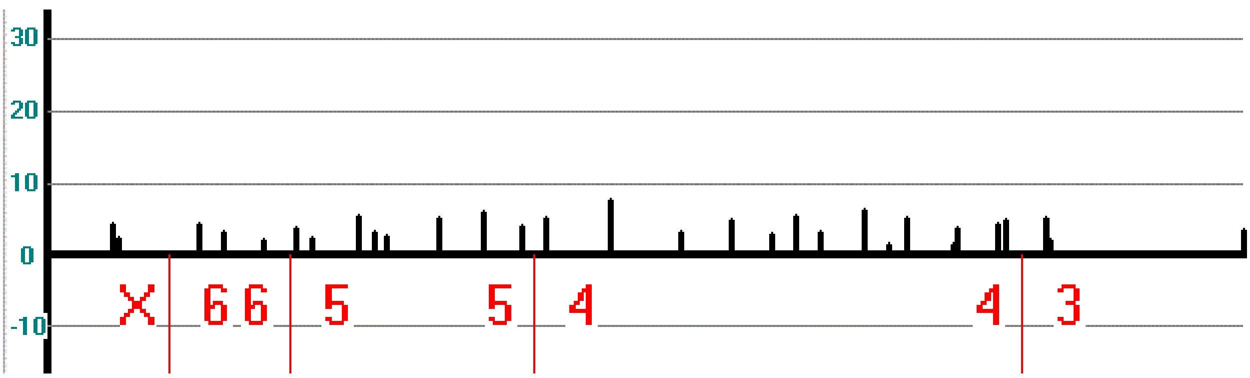
*RAW MEASUREMENTS in mm*

*SHOT POSITIONS*




*Grid in minutes and half minutes (600 yards)*

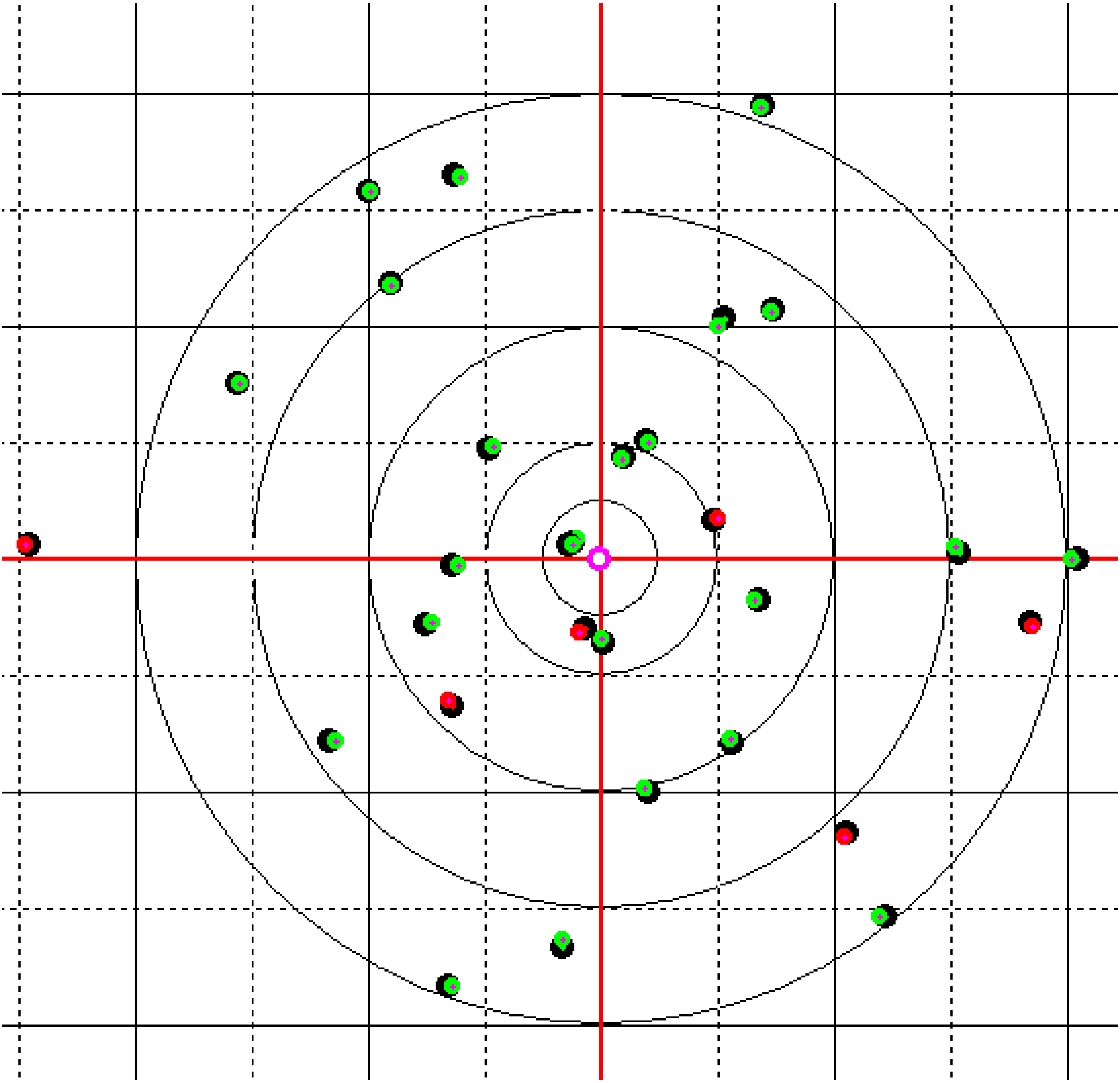
*CENTRED ERRORS*




*X, 6, 5, 4, 3 indicate Score or how far shot is from the centre.*

*BARS ARE REAL ERROR SIZE*

| X | Y | R | Lin |
|---|---|---|---|
| 0.53 | 6.21 | -6.24 | 6.24 |
| -4.34 | 3.97 | 0.43 | 5.89 |
| -1.45 | 2.97 | -2.94 | 3.31 |
| 2.59 | 3.32 | -0.7 | 4.21 |
| 2.85 | 1.51 | -1 | 3.23 |
| -2.41 | -0.79 | -2.11 | 2.54 |
| -3.97 | -1.91 | 3.02 | 4.4 |
| 0.84 | -2.33 | -1.89 | 2.47 |
| -0.15 | -2.21 | -2.2 | 2.21 |
| -2.4 | 4.73 | -2.3 | 5.31 |
| 3.37 | 1.95 | 3.82 | 3.9 |
| -4.26 | 2.65 | -3.36 | 5.02 |
| -1.05 | 4.02 | -3.91 | 4.16 |
| 2.47 | -0.16 | -2.37 | 2.47 |
| 5.02 | 0.75 | -4.96 | 5.08 |
| 1.33 | -0.87 | -1.57 | 1.59 |
| 5.51 | -0.23 | -5.49 | 5.51 |
| 4.73 | 0.45 | -4.18 | 4.75 |
| 1.5 | 0.29 | -0.56 | 1.53 |
| -3.54 | -6.88 | -7.73 | 7.73 |
| -2.33 | -2.39 | -3.28 | 3.33 |
| -1.55 | -1.52 | -1.94 | 2.17 |
| 1.41 | -3.47 | 1.93 | 3.74 |
| -4.92 | -0.37 | -2.72 | 4.93 |
| -3.51 | -0.88 | 3.49 | 3.62 |
| 4.41 | -2.61 | -4.02 | 5.12 |
| 4.31 | -0.56 | -0.94 | 4.34 |
| -5.01 | -0.21 | -5.01 | 5.01 |
| -1.27 | -3 | 1.43 | 3.25 |
| 1.31 | -2.57 | -2.83 | 2.88 |



# SMT HERBERTON 308-700Y 30 SHOTS PERFECT SETUP

| d | Ax | Ax SET | Ay | Ay SET | UPRIGHT | RIGID | Vo (LR) | Vsmt | Vcalc | Vo SD | Predicted Target V SD | SMT V SD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 700y | 34 mil | 34 mil | 36 mil | 36 mil | PERFECT | PERFECT DEAD CALM | 2834 | 1758 | 1790 | 13 | 10.4 | 26 |
| | | | | | | | mean | mean | mean | | | |

X SPAN 952.35 mm
Y SPAN 853.35 mm
CENTRE FITTED REPORT
X CENTRE SHIFT 18.93 mm
Y CENTRE SHIFT -12.92 mm
Shown Further from Centre 10
Shown Closer to Centre 20
SDx 5.35 mm
SDy 4.80 mm
MEAN (mm)SD (mm)

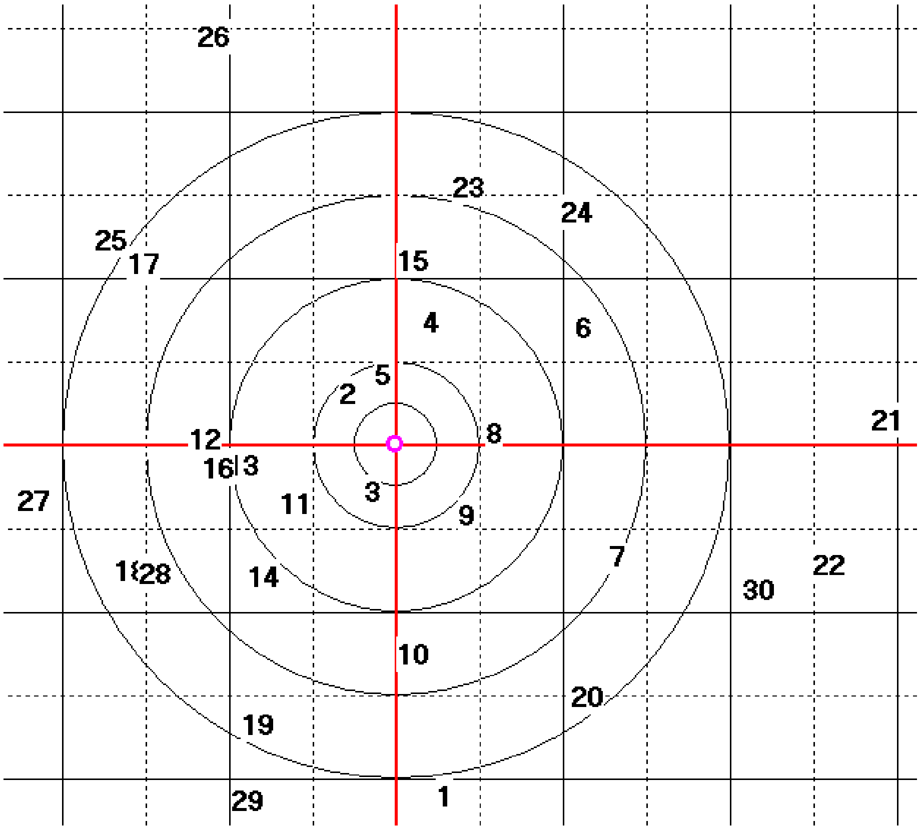
*Berger 155.5 Fullbore Projectile*
*SMT Temp 24 during firing*

*Wed Aug 16 2017*

| No | Impact X | Impact Y | Monitor X | Monitor Y |
|---|---|---|---|---|
| 1 | 70.75 | -396.71 | 49 | -390 |
| 2 | -37.97 | 53.32 | -52 | 66 |
| 3 | -9.2 | -56.31 | -21 | -44 |
| 4 | 55.5 | 133.94 | 36 | 140 |
| 5 | 1.43 | 73.81 | -19 | 85 |
| 6 | 226.23 | 127.23 | 206 | 140 |
| 7 | 263.36 | -128.29 | 241 | -114 |
| 8 | 125.66 | 9.08 | 110 | 24 |
| 9 | 95.07 | -83.01 | 70 | -71 |
| 10 | 34.5 | -237.49 | 14 | -227 |
| 11 | -96.18 | -69.51 | -118 | -56 |
| 12 | -196.61 | 2.84 | -214 | 13 |
| 13 | -155.42 | -26.35 | -175 | -8 |
| 14 | -132.65 | -150.82 | -157 | -134 |
| 15 | 34.71 | 201.29 | 8 | 203 |
| 16 | -182.07 | -29.99 | -203 | -19 |
| 17 | -266.35 | 198.8 | -291 | 209 |
| 18 | -280.97 | -144.55 | -298 | -131 |
| 19 | -138.34 | -315.96 | -154 | -295 |
| 20 | 228.34 | -284.93 | 207 | -262 |
| 21 | 564.5 | 24.5 | 535 | 38 |
| 22 | 499.11 | -138.04 | 480 | -126 |
| 23 | 96.57 | 283.2 | 77 | 297 |
| 24 | 218.08 | 255.06 | 196 | 268 |
| 25 | -302.59 | 224.83 | -317 | 236 |
| 26 | -187.55 | 452.42 | -201 | 456 |
| 27 | -387.85 | -65.33 | -396 | -46 |
| 28 | -253.55 | -147.34 | -261 | -135 |
| 29 | -150.1 | -400.93 | -159 | -378 |
| 30 | 419.52 | -166.41 | 395 | -153 |

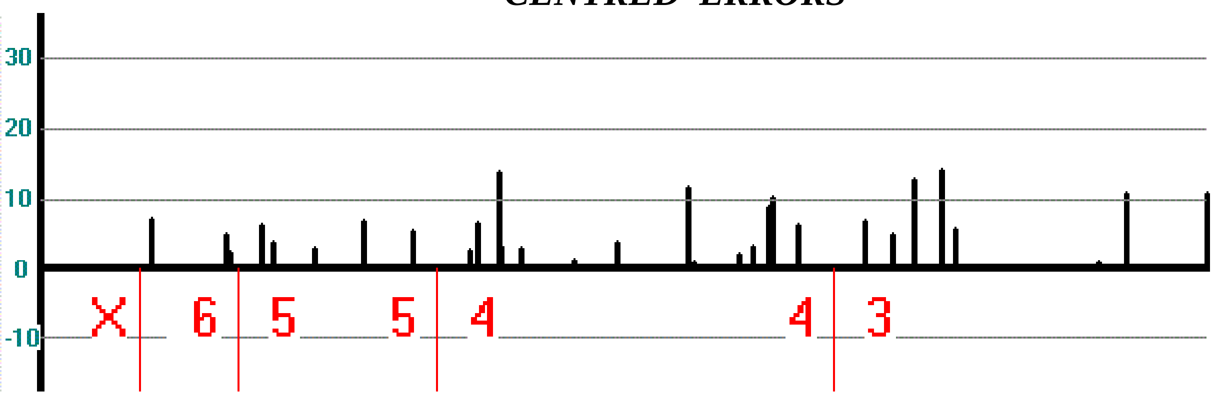
*RAW MEASUREMENTS in mm*

*SHOT POSITIONS*




*Grid in minutes and half minutes (700 yards)*

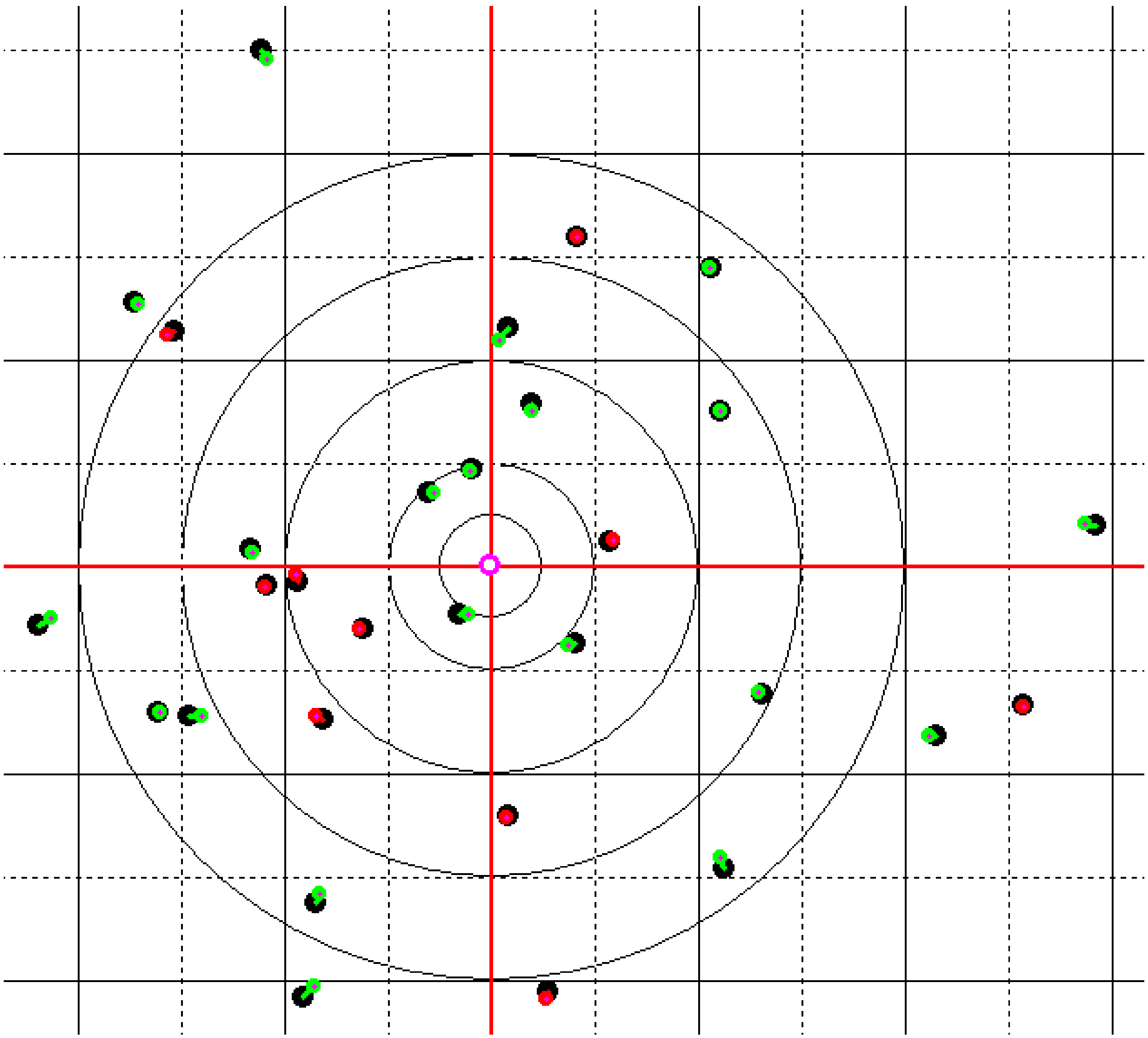
*CENTRED ERRORS*




*X, 6, 5, 4, 3 indicate Score or how far shot is from the centre.*

***BARS ARE REAL ERROR SIZE***

| X | Y | R | Lin |
|---|---|---|---|
| -2.82 | -6.21 | 5.64 | 6.82 |
| 4.9 | -0.24 | -2.44 | 4.91 |
| 7.13 | -0.61 | -1.84 | 7.16 |
| -0.57 | -6.86 | -6.71 | 6.89 |
| -1.5 | -1.73 | -1.66 | 2.29 |
| -1.3 | -0.15 | -1.15 | 1.31 |
| -3.43 | 1.37 | -3.69 | 3.69 |
| 3.27 | 2 | 3.71 | 3.83 |
| -6.14 | -0.91 | -4.64 | 6.21 |
| -1.57 | -2.43 | 2.2 | 2.89 |
| -2.89 | 0.59 | 2.45 | 2.95 |
| 1.54 | -2.76 | -1.91 | 3.16 |
| -0.65 | 5.43 | 0.75 | 5.47 |
| -5.42 | 3.9 | 1.53 | 6.68 |
| -7.78 | -11.21 | -12 | 13.65 |
| -2 | -1.93 | 2.04 | 2.78 |
| -5.72 | -2.72 | 2.71 | 6.33 |
| 1.9 | 0.63 | -2 | 2 |
| 3.27 | 8.04 | -8.65 | 8.68 |
| -2.41 | 10.01 | -9.11 | 10.29 |
| -11 | 0.58 | -10 | 10.58 |
| -0.18 | -0.88 | 0.02 | 0.9 |
| -0.64 | 0.88 | 0.66 | 1.09 |
| -3.15 | 0.02 | -1.87 | 3.15 |
| 4.52 | -1.75 | -4.61 | 4.85 |
| 5.48 | -9.34 | -11 | 10.83 |
| 10.78 | 6.41 | -11 | 12.54 |
| 11.48 | -0.58 | -10 | 11.5 |
| 10.03 | 10.01 | -13 | 14.17 |
| -5.59 | 0.49 | -5.45 | 5.61 |



# SMT HERBERTON 308-700Y 30 SHOTS IMPERFECT SETUP

| d | Ax | Ax SET | Ay | Ay SET | UPRIGHT | RIGID | Vo (LR) | Vsmt | Vcalc | Vo SD | Predicted Target V SD | SMT V SD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 700y | 34 mil | 34 mil | 36 mil | - 36 mil | PERFECT | PERFECT no wind | 2854 | 1662 | 1795 | 10.1 | 7.8 | 14.4 |
| | | | | | | | mean | mean | mean | | | |

X SPAN 903.00 mm
Y SPAN 824.00 mm
CENTRE FITTED REPORT
X CENTRE SHIFT -18.20 mm
Y CENTRE SHIFT -87.95 mm
Shown Further from Centre 0
Shown Closer to Centre 30
SDx 10.07 mm
SDy 10.53 mm

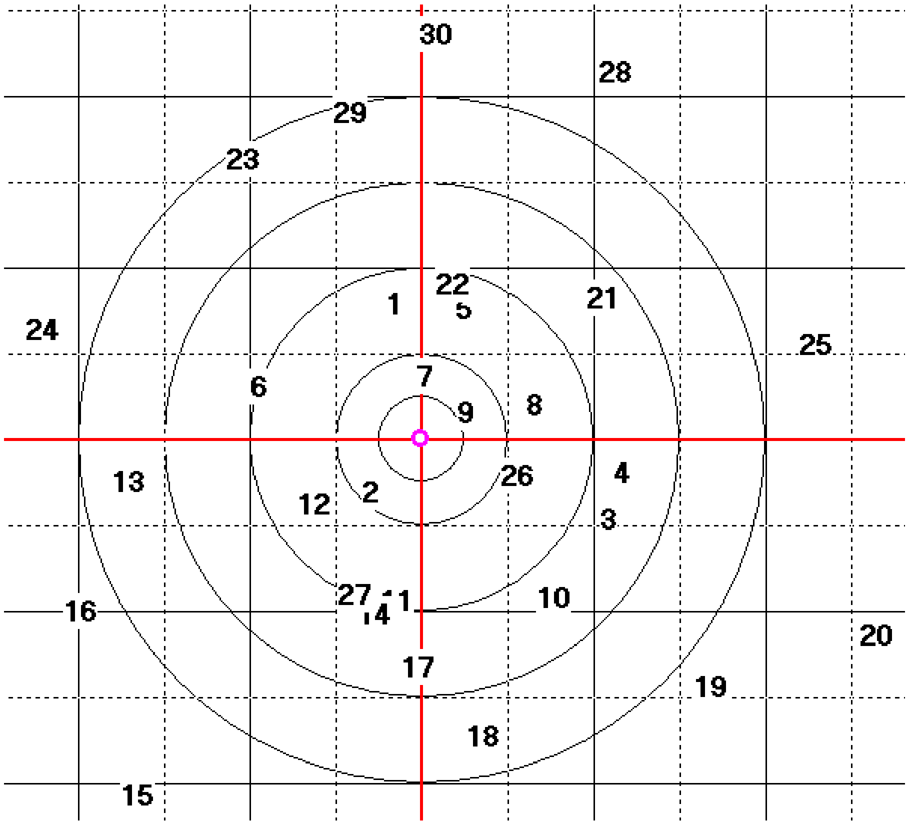
Berger 155.5 Fullbore Projectile
Wed-Aug 16 2017
*SMT Temp 25 – 28 during firing*

*Deliberately set incorrect vertical (Y) angle in software.*
*Horizontal (X) angle PERFECTLY set in software.*

| No | Impact X | Impact Y | Monitor X | Monitor Y |
|---|---|---|---|---|
| 1 | -50 | 68 | -39.95 | 150.91 |
| 2 | -76 | -136 | -42.93 | -41.8 |
| 3 | 182 | -165 | 194.01 | -74.05 |
| 4 | 196 | -115 | 210.11 | -27.35 |
| 5 | 26 | 63 | 42.28 | 135.83 |
| 6 | -197 | -22 | -174.18 | 57.37 |
| 7 | -18 | -11 | -3.74 | 75.3 |
| 8 | 102 | -41 | 111.82 | 42.27 |
| 9 | 27 | -50 | 44.45 | 35.54 |
| 10 | 122 | -251 | 137.12 | -153.96 |
| 11 | -48 | -253 | -28.97 | -155.71 |
| 12 | -138 | -150 | -114.36 | -59.25 |
| 13 | -339 | -124 | -303.18 | -34.81 |
| 14 | -73 | -269 | -51.29 | -172.4 |
| 15 | -329 | -464 | -298 | -353.34 |
| 16 | -392 | -266 | -355.27 | -167.27 |
| 17 | -25 | -326 | -5.62 | -232.59 |
| 18 | 45 | -400 | 64.11 | -295.95 |
| 19 | 291 | -347 | 302.7 | -247.3 |
| 20 | 471 | -292 | 476.87 | -195.66 |
| 21 | 175 | 74 | 182.99 | 152.93 |
| 22 | 12 | 89 | 29.78 | 167.58 |
| 23 | -215 | 225 | -187.35 | 298.12 |
| 24 | -432 | 41 | -389.02 | 121.07 |
| 25 | 406 | 24 | 402.95 | 111.33 |
| 26 | 83 | -118 | 96.64 | -29.6 |
| 27 | -94 | -247 | -74.6 | -144.57 |
| 28 | 189 | 320 | 194.28 | 393.23 |
| 29 | -99 | 276 | -88.64 | 345.35 |
| 30 | -5 | 360 | 9.96 | 430.22 |

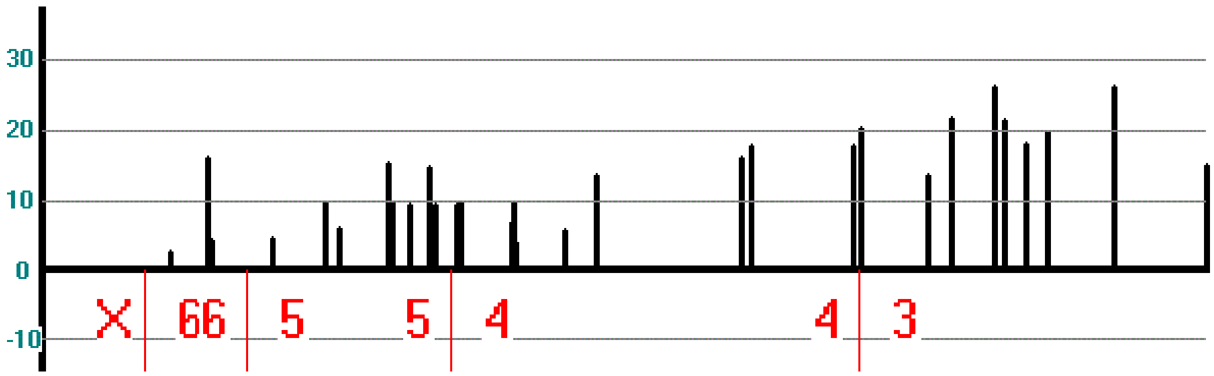
*RAW MEASUREMENTS in mm*

*SHOT POSITIONS*




*Grid in minutes and half minutes (700 yards)*

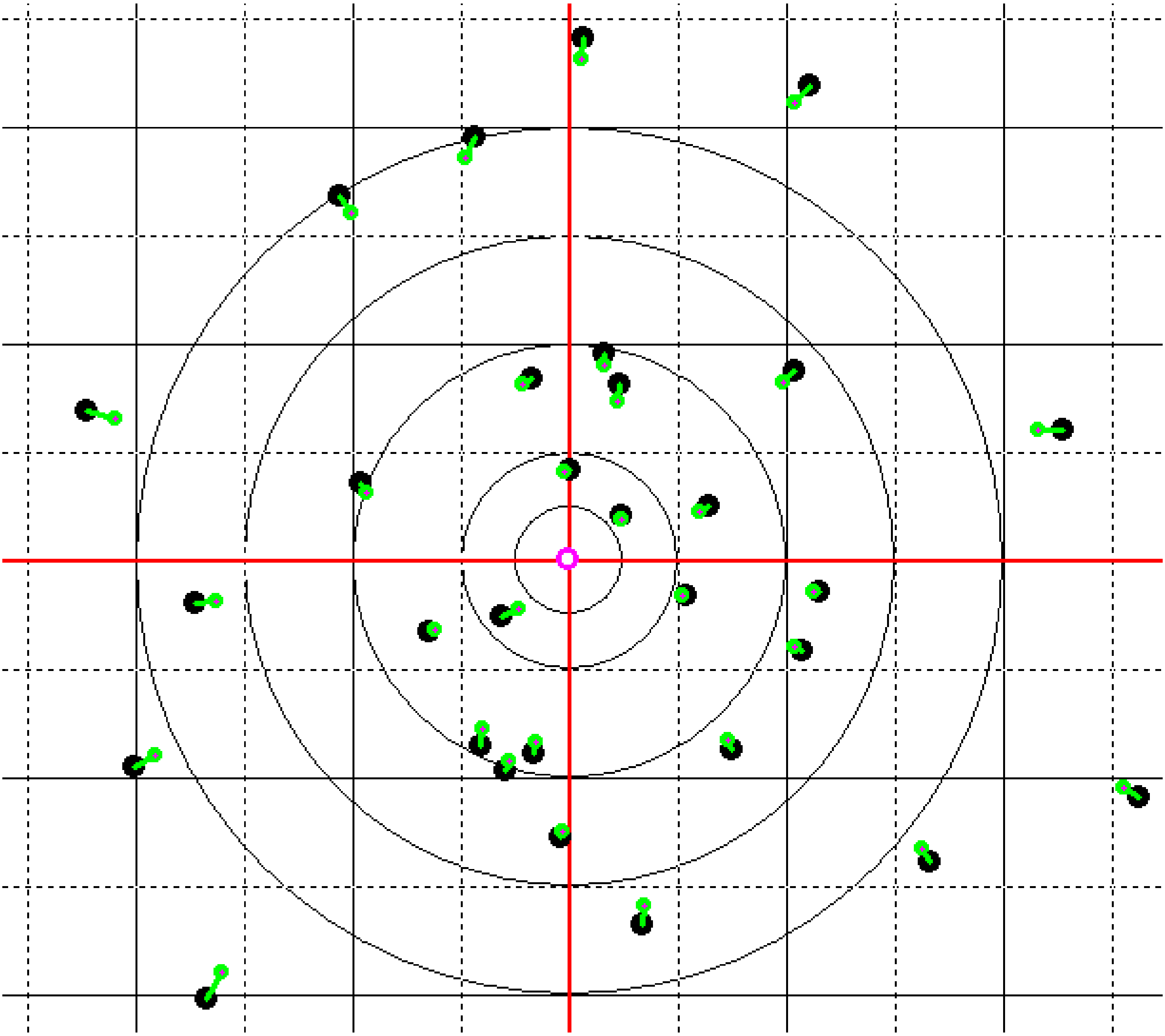
## *CENTRED ERRORS*




*X, 6, 5, 4, 3 indicate Score or how far shot is from the centre.*

## *BARS ARE REAL ERROR SIZE*

| X | Y | R | Lin |
|---|---|---|---|
| -8.15 | -5.04 | -2.34 | 9.58 |
| 14.87 | 6.25 | -15.52 | 16.13 |
| -6.19 | 3 | -6.87 | 6.88 |
| -4.09 | -0.3 | -3.99 | 4.1 |
| -1.92 | -15.1 | -15.16 | 15.24 |
| 4.62 | -8.58 | -6.92 | 9.74 |
| -3.94 | -1.65 | -0.91 | 4.27 |
| -8.38 | -4.68 | -9.5 | 9.6 |
| -0.75 | -2.41 | -2.21 | 2.52 |
| -3.08 | 9.09 | -9.06 | 9.6 |
| 0.83 | 9.34 | -9.27 | 9.38 |
| 5.44 | 2.8 | -6.12 | 6.12 |
| 17.62 | 1.24 | -17.64 | 17.66 |
| 3.51 | 8.65 | -9.33 | 9.34 |
| 12.8 | 22.71 | -25.58 | 26.07 |
| 18.53 | 10.78 | -21.36 | 21.44 |
| 1.18 | 5.46 | -5.53 | 5.59 |
| 0.91 | 16.1 | -15.72 | 16.13 |
| -6.5 | 11.75 | -12.63 | 13.43 |
| -12.33 | 8.39 | -14.65 | 14.91 |
| -10.21 | -9.02 | -13.62 | 13.62 |
| -0.42 | -9.37 | -9.36 | 9.38 |
| 9.45 | -14.8 | -17.58 | 17.58 |
| 24.78 | -7.88 | -26 | 26 |
| -21.25 | -0.62 | -20.69 | 21.26 |
| -4.56 | 0.45 | -4.41 | 4.58 |
| 1.2 | 14.48 | -13.25 | 14.53 |
| -12.92 | -14.7 | -18.85 | 19.58 |
| -7.84 | -18.6 | -15.86 | 20.18 |
| -3.24 | -17.7 | -17.73 | 18.02 |



# SMT HERBERTON 7SAUM-700Y 30 SHOTS PERFECT SETUP

| d | Ax | Ax SET | Ay | Ay SET | UPRIGHT | RIGID | Vo (LR) | Vsmt | Vcalc | Vo SD | Predicted Target V SD | SMT V SD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 700y | 34 mil | 34 mil | 36 mil | 36 mil | PERFECT | PERFECT , little wind | 2936 | 2111 | 2150 | 6.1 | 5.1 | 25 |
| | | | | | | | mean | mean | mean | | | |

X SPAN 603.00 mm
Y SPAN 572.00 mm
CENTRE FITTED REPORT
X CENTRE SHIFT -14.03 mm
Y CENTRE SHIFT 0.88 mm
Shown Further from Centre 19
Shown Closer to Centre 11
SDx 2.84 mm
SDy 3.09 mm

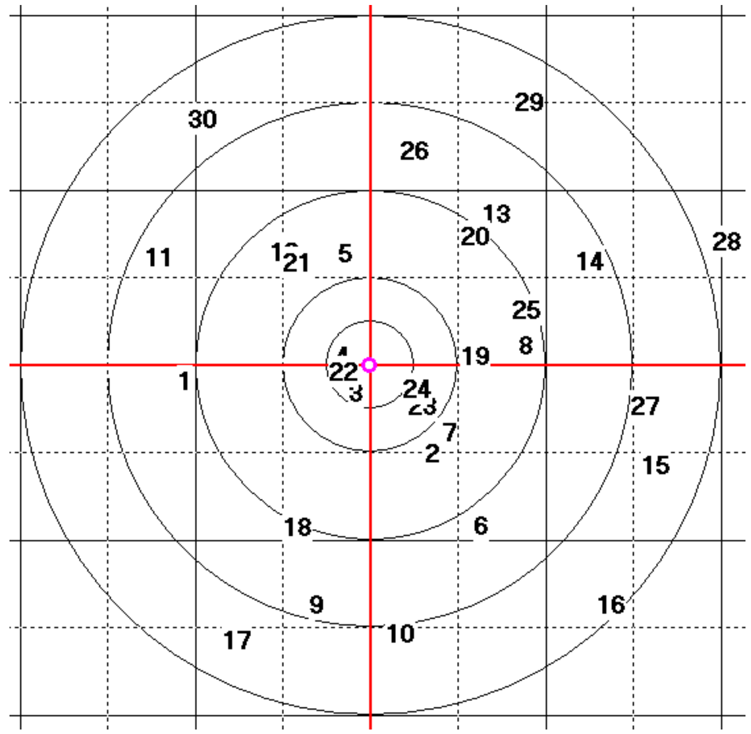
**Berger 180 Hybrid Projectile**
**Wed Aug 16 2017**

***SMT Temp 22 – 24 during firing***

| No | Impact X | Impact Y | Monitor X | Monitor Y |
|---|---|---|---|---|
| 1 | -213 | -8 | -198.8 | -13.14 |
| 2 | 49 | -85 | 62.69 | -87.33 |
| 3 | -31 | -20 | -18.07 | -22.06 |
| 4 | -45 | 18 | -25.48 | 14.36 |
| 5 | -42 | 127 | -29.66 | 129.59 |
| 6 | 101 | -162 | 113.25 | -167.34 |
| 7 | 68 | -63 | 84.23 | -65.5 |
| 8 | 149 | 29 | 160.36 | 32.62 |
| 9 | -73 | -246 | -62.29 | -247.55 |
| 10 | 14 | -277 | 28.05 | -280.71 |
| 11 | -241 | 123 | -225.59 | 122.51 |
| 12 | -108 | 129 | -91.56 | 130.95 |
| 13 | 117 | 170 | 133.56 | 173.56 |
| 14 | 216 | 119 | 228.7 | 116.75 |
| 15 | 286 | -97 | 292.72 | -95.22 |
| 16 | 239 | -246 | 250.87 | -255.43 |
| 17 | -159 | -284 | -145.62 | -289.23 |
| 18 | -95 | -163 | -81.38 | -163.55 |
| 19 | 95 | 18 | 106.72 | 17.24 |
| 20 | 94 | 146 | 107.95 | 151.07 |
| 21 | -95 | 118 | -81.28 | 119.35 |
| 22 | -45 | 2 | -23.81 | 2.7 |
| 23 | 38 | -34 | 50.87 | -32.09 |
| 24 | 33 | -16 | 43.44 | -17.07 |
| 25 | 149 | 68 | 162.48 | 68.86 |
| 26 | 30 | 237 | 47.52 | 237.35 |
| 27 | 275 | -34 | 292.41 | -32.84 |
| 28 | 362 | 140 | 378.65 | 139.63 |
| 29 | 152 | 288 | 167.55 | 285.25 |
| 30 | -195 | 270 | -182.69 | 267.9 |

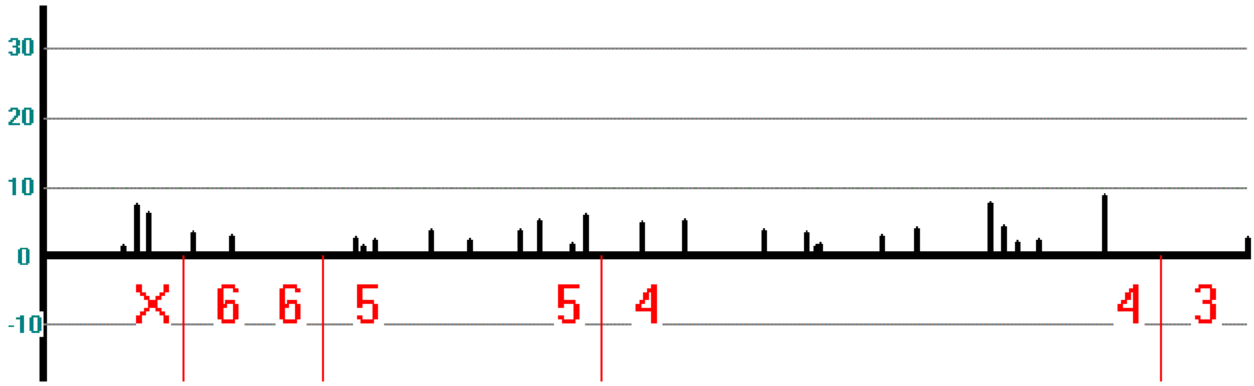
***RAW MEASUREMENTS in mm***

***SHOT POSITIONS***




*Grid in minutes and half minutes (700 yards)*

***CENTRED ERRORS***




***X, 6, 5, 4, 3 indicate Score or how far shot is from the centre.***

***BARS ARE REAL ERROR SIZE***

| X | Y | R | Lin |
|---|---|---|---|
| 0.17 | -4.26 | 0.15 | 4.26 |
| -0.34 | -1.45 | 1.4 | 1.49 |
| -1.1 | -1.18 | 1.47 | 1.61 |
| 5.49 | -2.76 | -5.73 | 6.15 |
| -1.69 | 3.47 | 3.82 | 3.86 |
| -1.78 | -4.46 | 3.59 | 4.8 |
| 2.2 | -1.62 | 2.36 | 2.74 |
| -2.67 | 4.5 | -1.72 | 5.23 |
| -3.32 | -0.67 | 1.95 | 3.38 |
| 0.02 | -2.83 | 2.82 | 2.83 |
| 1.38 | 0.39 | -1.13 | 1.44 |
| 2.41 | 2.83 | -0.02 | 3.72 |
| 2.53 | 4.44 | 5.1 | 5.11 |
| -1.33 | -1.37 | -1.85 | 1.91 |
| -7.31 | 2.66 | -7.76 | 7.78 |
| -2.16 | -8.55 | 5.44 | 8.82 |
| -0.65 | -4.35 | 3.98 | 4.4 |
| -0.41 | 0.33 | -0.01 | 0.52 |
| -2.31 | 0.12 | -2.26 | 2.31 |
| -0.08 | 5.95 | 5.49 | 5.95 |
| -0.31 | 2.23 | 1.66 | 2.25 |
| 7.16 | 1.58 | -7.26 | 7.34 |
| -1.16 | 2.79 | -2.79 | 3.02 |
| -3.59 | -0.19 | 1.06 | 3.59 |
| -0.55 | 1.74 | 0.34 | 1.82 |
| 3.49 | 1.23 | 1.14 | 3.7 |
| 3.38 | 2.04 | 2.98 | 3.95 |
| 2.62 | 0.51 | 2.62 | 2.67 |
| 1.52 | -1.87 | -1.15 | 2.41 |
| -1.72 | -1.22 | 0.24 | 2.11 |