

# Preliminary Report on 2020 Ammunition Lot 040-GGG-2020

17<sup>th</sup> August 2020

This is a preliminary report on the 2020 Ammunition. Further work including analysis of the velocity data remains to be done. An update to this report will be published once that work / analysis is completed

## Summary

**The 2020 ammunition appears for testing through the NRA accuracy proof equipment to be of very good quality with accuracy significantly better than the 2019 ammunition**

## General

A single production Lot was delivered to the NRA. We are informed by GGG that only one Lot of bullets were received from Sierra.

## Test Firings.

3 x 400 round cartons of ammunition were selected for testing by armoury staff. The cartons are numbered in approximate sequence of loading. One carton was therefore selected at random from early, middle and late in the production run; carton numbers 71, 840, 1321

The ammunition was test fired from the NRA Ammunition Testing Equipment on Friday 24<sup>th</sup> July. In total 240 rounds were fired in 24 groups of 10 shots from 4 test barrels, i.e., 80 rounds from each carton.

All groups were fired at 200 yds. The principle reasons for testing at 200 yds are :

- (i) If ammunition does not group at 200 yds it is most unlikely to group at longer distances
- (ii) Wind has little effect especially on sheltered range and therefore a valid statistical analysis of the groups can be carried out. (Unlike the ammunition manufacturers, the NRA is not fortunate enough to have 600m windless test range)
- (iii) The 200yd bull and V-bull were the 'tightest' of the NRA targets prior to changing to the ICFRA target at 300x target last year. 200x bull is 3.5" (1.67 MOA) and V-bull is 2.1" (1.0 MOA). Bull (and V-bull) sizes increase in a non-linear manner (in angular terms) with distance to allow for the increasing influence of wind etc. on a firer's group size (e.g., 200yd bull = 1.67 MOA, 600 yd bull = 2.07 MOA).
- (iv) Ammunition groups by contrast increase linearly with distance until transonic effects influence group size at long range. Group sizes at ranges greater than 200yds can therefore be calculated by simple arithmetic
- (v) 10 shot groups are fired since statistically they represent 97% of the size of a 20 shot group, in other words the expected increase in group size by firing 20 shot is 3%.

## Statistical Analysis of Groups.

Visual examination of the test groups shows ALL fit well within the 200 V-bull on Extreme Spread (centre to centre and also outside to outside).

All the groups were measured and the Mean Radius (MR) and Radial Standard Deviation (RSD) calculated. These are the two measures of group size which are statistically the most precise indicators of group size and least sensitive to number of shots fired.

### 040-GGG- 2020

Carton No.	Barrel No.	Groups Fired	MR mm	RSD mm
71	6	2	11.0	5.9
840	6	2	8.4	5.3
1321	6	2	8.8	3.7
			<u>9.4</u>	<u>4.9</u>
71	7	2	11.7	5.2
840	7	2	11.1	4.4
1321	7	2	9.9	5.9
			<u>10.9</u>	<u>5.2</u>
71	8	2	8.4	3.8
840	8	2	8.8	4.8
1321	8	2	8.4	3.8
			<u>8.5</u>	<u>4.1</u>
71	9	2	7.2	5.2
840	9	2	8.4	5.4
1321	9	2	8.8	3.6
			<u>8.1</u>	<u>4.7</u>
<b>Overall</b>			<b>9.25</b>	<b>4.74</b>

The conclusions which can be drawn from the analysis above are :

- (i) There is no statistical difference in accuracy across the Lot of ammunition; i.e., cartridges produced at the end of the production run give the same size groups as those produced at the beginning
- (ii) There is no statistical difference in accuracy between the four barrels used for testing despite barrels 6 & 7 having been in use for some years whereas barrels 8 & 9 are near new (round count 130)

## What do the Statistics mean in terms of Group Size?

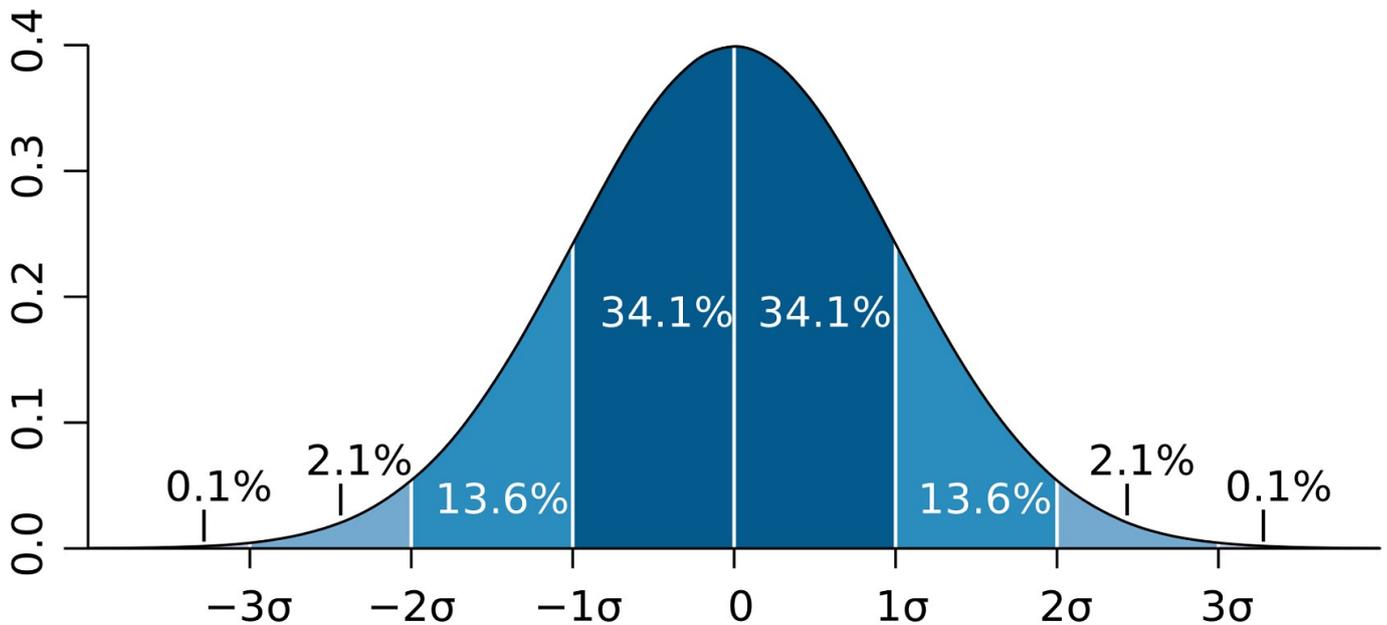
### (a) Mean Radius (MR)

The Mean Radius of a group is the radius of a circle in which 51.1% of the shots will lie. So in broad terms the size of group the ammunition is capable of shooting - **without any firer error** - is 4 x MR. For the 2020 GGG this equates to 10 shot groups sizes as shown in the table below.

### (b) Radial Standard Deviation

Those who recall their basic probability theory from school mathematics will be familiar with the concept of standard deviation in a population. Here, standard deviation is applied to the radial distance shots lie from the calculated group centre.

The dispersion of shots on a target due to variances between cartridges only, with no other external factors affecting the point of impact (firer, wind, rifle etc) is one of the very few examples in nature which genuinely produce a normal distribution curve.



Applied to ammunition the normal distribution curve shows that 68.2% of shots will lie within  $\pm 1$  one standard deviation ( $\sigma$ ) radially of the mean point of impact (group centre), 95.4% will lie within  $\pm 2$  standard deviations ( $2\sigma$ ) of the group centre, and 99.6% of shots will lie within  $\pm 3\sigma$  of the group centre.

**Thus RSD gives a better idea of the distribution of shots within the group than does MR.**

Group Size	040-GGG-2020		RSD (mm)		
	4 x MR		+/- 1	+/-2	+/-3
	mm	ins	68.2%	95.4%	99.6%
200yds	37.00	1.46	9.49	18.97	28.46
300yds	55.49	2.18	14.23	28.46	42.69
500yds	92.49	3.64	23.72	47.43	71.15
600yds	110.99	4.37	28.46	56.92	85.38

Applying this to the test results above RSD shows the distribution of shots within the group more explicitly than the cruder measure of MR; e.g. at 600yds, 99.6% of shots will lie within a circle 85.38mm diameter and only 0.4% of shots will lie further out, i.e., the ammunition is capable of better than 0.6 MOA groups

Comparison with the results from test firing the 2019 ammunition where RSD indicated 99.6% of shots would lie within a circle of diameter 121.29 (37% larger) indicates the expected accuracy of the 2020 ammunition is significantly better.

### **Photographs of Groups fired**

Attached to this report are photographs of the best group and worst group fired out of each of the 4 test barrels.

As can be clearly seen, the extreme spread of ALL groups is smaller than the 200x V-bull (2.1" / 53.3mm / 1 MOA) even when the extreme spread is measured from outside of shot to outside of shot rather than centre to centre.

### **Pressure Tests**

The ammunition has been tested by the manufacturer and the Birmingham Proof Laboratory and conforms to the specification agreed with the Proof House (Ptmax <= 3650 Bar) for ammunition issued by the NRA for use in Rule 150 compliant barrels.



6\_71\_1



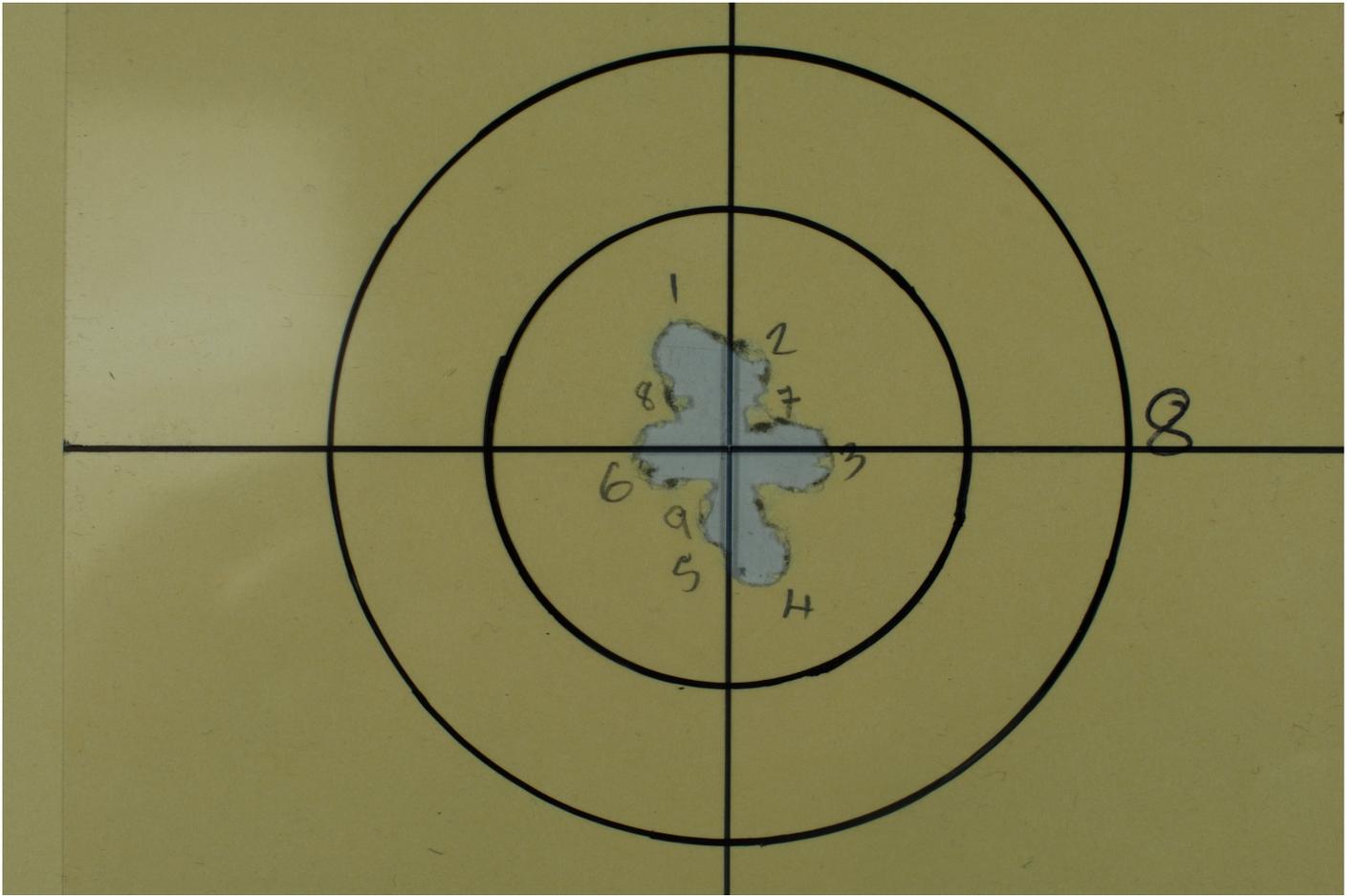
6\_1321\_17



7\_71\_19



7\_840\_4



8\_71\_13



8\_1321\_5



9\_71\_8



9\_1321\_23