

Preliminary Report on 2019 Ammunition Lot 080-GGG-2019

Friday 19th April 2019

This is a preliminary report on the 2019 Ammunition. Further work including sectioning of a sample of the bullets, critical examination of other cartridge components and analysis of velocity data remains to be done. An update to this report will be published once that work / analysis is completed

Summary

All loading parameters are very well controlled for factory ammunition.

Subject to the further testing and analysis yet to be carried out, performance from both the testing equipment and by skilled firers indicates the 2019 ammunition to be of good quality and comparable to previous lots (other than 2018).

General

A total of 600,000 rounds in a single production Lot were delivered to the NRA. We are informed by GGG that only one Lot of bullets were received from Sierra.

Pressure Tests

Samples of the ammunition have been tested at the British Proof Authority Laboratory at Birmingham. Pressures comply with the 3650 Bar limit for P_{tmax} in a CIP test barrel and the ammunition is therefore suitable for use in NRA specification target barrels. Furthermore pressure does not exceed the CIP limit of 4150 Bar for P_{tmax} when fired in an NRA Rule 150 minimum specification test barrel

Test Firings.

3 x 400 round cartons of ammunition were selected for testing. 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 216, 780, 1576

The ammunition was test fired from the NRA Ammunition Testing Equipment on Friday 12th April. In total 390 rounds were fired in 39 groups of 10 shots from 3 of the 4 test barrels, i.e., 130 rounds from each carton.

A further 80 rounds of the same specification ammunition as used by the 2019 GB Palma Team was also fired by way of comparison using 2 of the 3 test barrels used for the GGG tests.

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 the sheltered range and therefore a valid statistical analysis of the groups can be carried out. (Unlike the ammunition manufacturers, the NRA is not fortunate to have 600m windless test range)
- (iii) The 200yd bull and V-bull are the 'tightest' of the NRA targets, at 3.5" (1.67 MOA) and 2.1" (1.0 MOA) respectively. Bull (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 within the 200 V-bull on Extreme Spread.

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.

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Carton No.	Barrel No.	Groups Fired	MR mm	RSD mm
216	6	5	10.8	7.45
780	6	5	11.6	6.43
1576	6	5	9.5	7.32
			<u>10.7</u>	<u>7.1</u>
216	5	3	13.9	6.8
780	5	3	9.9	6.7
1576	5	3	11.4	7.4
			<u>11.7</u>	<u>7.0</u>
216	7	5	11.1	6.0
780	7	5	13.4	5.8
1576	7	5	11.0	6.7
			<u>11.9</u>	<u>6.2</u>
Overall			11.4	6.7

Berger 155.5 (Palma 2019) Handload

6	5	12.4	5.46
7	3	12.6	3.67
		<u>12.5</u>	<u>4.57</u>

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 three barrels used for testing
- (iii) The groups produced by the Berger handloads are almost identical in size to those of the GGG when MR is used as the comparator. The smaller RSD indicates that more of the shots are concentrated towards the centre of the group with the Berger bullets - a not unexpected result for carefully hand-loaded ammunition using bullets some 45% more expensive than Sierra 2155's

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 GGG this equates to 10 shot groups sizes as shown in the table below.

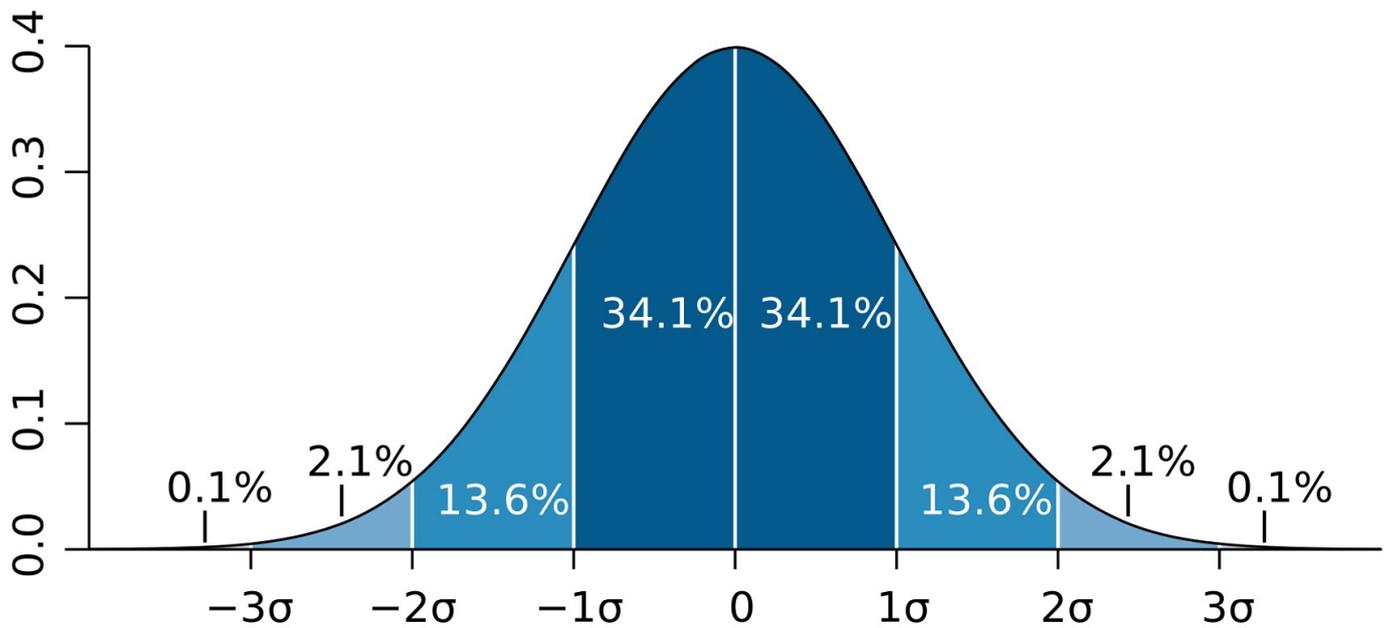
The apparently slightly larger group size with the Berger bullets should be viewed with some caution since the number of shots fired is significantly different - only 8 groups (80 shots) with Bergers compared with 39 groups (390 shots) with the Sierra.

Group Size	080-GGG-2019 MR		Berger 155.5 MR	
	mm	ins	mm	ins
200yds	45.6	1.79	50.4	1.98
300yds	68.4	2.69	75.6	2.98
500yds	114.0	4.49	126	4.96
600yds	136.8	5.39	151.2	5.95

(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 +/- 1 one standard deviation (σ) radially of the mean point of impact (group centre), 95.4% will lie within +/- 2 standard deviations (2σ) of the group centre, and 99.6% of shots will lie within +/- 3σ of the group centre.

Thus RSD gives a better idea of the distribution of shots within the group than does MR. Applying this to the test results :

Group Size	080-GGG-2019		RSD (mm)		
	MR		+/- 1	+/-2	+/-3
	mm	ins	68.2%	95.4%	99.6%
200yds	45.60	1.79	13.48	26.95	40.426
300yds	68.40	2.69	20.21	40.43	60.64
500yds	114.00	4.48	33.69	67.38	101.06
600yds	136.80	5.37	40.43	80.85	121.28

this 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 121.28 mm diameter and only 0.4% of shots will lie further out.

Firer Testing

Two members of this year's Palma Team each fired a Queens II with the 2019 Lot of ammunition, coaching each other. Their scores were 149.24 and 145.19 (4 points were lost to wind, 1 point to a nominated shot between the two firers). Scans of their score sheets will be published with the update to this report

Initial Component Testing & Analysis

Initial testing of cartridge components shows all loading parameters are well controlled and significantly better compared with the 2018 lot of ammunition.

Analysis of the basic data in the table below will form part of the updated report to follow

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	COAL Actual ins	BTO Variance 0.001"	Wt gn
Max	2.799	2.50	383.64
Min	2.792	-9.00	379.16
ES	0.008	11.50	4.48
Mean	2.795	-4.16	381.62
SD	0.002	2.67	0.92

Note : the values for BTO (Cartridge Base To Ogive length) are variance compared to the first cartridge measured which is taken as nominal zero.