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Sept 43
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NOTES ON THE PERFORMANCE OF THE BREN GUN.

1. Introduction.

The following notes are concerned with the characteristics and performance of the present L.M.G., the Bren gun. It has been pointed out that there are still some unsolved questions relating to the L.M.G., for instance:-

1. What is the optimum dispersion?
2. What is the optimum rate of fire?
3. Is the present method of applying the burst to the target the best possible?
4. Is the present length of burst the best possible?
5. Is tracer a real help, and how can it best be used?

It was felt that any attempts to investigate these questions would need to start from the present performance of the Bren gun, and Bren gunners. It was therefore decided to collect together a few notes on this subject.

It appeared at first to be a simple matter to look up the required information in manuals, but in fact the task proved to be considerably more difficult, and in order to get some of the data, experimental firing was necessary. The results, which are included in these notes, may be of use to others concerned with the performance of L.M.G.'s.

2. Weight.

	lbs.
Bren gun (without magazine)	25
Spare barrel	6 $\frac{1}{2}$
Amn. (50 rds)	3 $\frac{1}{2}$
Magazines (empty)	1
" (full)	2 $\frac{3}{4}$
Spare parts wallet	2 $\frac{1}{2}$
Holdall (including wallet)	10
Tripod	26 $\frac{1}{2}$

3. Rate of fire.

The cyclic rate of fire of the Bren is given in Military Training Pamphlet 23, part 1, as 450 rds/min and in Barlow & Johnson's 'Small Arms Manual' as 450 to 550 rds/min. 9 guns were timed by stopwatch, and gave an average rate of 550 rds/min with considerable variation. (The lowest rate was 400 and the highest 700). There was no apparent correlation between the rate of fire and the accuracy of the shooting.

4. Magazines.

The Bren can fire single shots or bursts from magazines of 28 rounds. A 100 round magazine was supplied for AA purposes, but has just been declared

obsolescent.

5. Length of burst and overall rate.

The standard length of burst (service burst) is given in M1 as 4 or 5 rounds. As an exception, the gunner is instructed to fire bursts of from 8 to 10 rounds at a moving enemy. For A. shooting, the whole magazine is fired in one burst.

The overall rate of fire with service bursts, including between bursts, is given in M1 as:-

rapid	112 rds/min	(4 magazines)
slow	28 "	(1 ")
single rounds	28 "	(1 ")

This rapid rate is on the high side: it can probably be reached only by a small percentage of Bren gunners. B & J give 3 magazines/min which is likely to be nearer the average figure. Tests of 3 gunners gave an average rate of this amount (3 magazines/min). It must be realized that any Bren gunner can fire 4 or more magazines in a minute: the question is whether he can do so if he conscientiously remains between bursts.

The difficulty of keeping magazines clean and avoiding the loss of great numbers of magazines in battle has led, recently, to a strong demand for a belt-fed M.M.G. with expendable bolts. As this would imply a change to rimless ammunition (the action for a rimmed amm. belt-feed being too complicated for a M.M.G.) it seems to be a matter for long-term policy.

6. Usability for sustained fire.

In the case of the Bren, this is limited by overheating of the barrel. Both M1 and B & J state that the barrel should be changed after firing 10 magazines at the rapid rate. It is interesting to note that this implies that, with the usual spare barrel which is generally available, 200 rounds could, if necessary, be fired in 6 minutes. After this the barrels would have to be cooled off (if tanks were available they could be cooled quickly). There appears to be no reason why this rate of fire could not be sustained indefinitely if extra spare barrels and a trough of water were available.

7. The 'accuracy' of the Bren.

What is commonly called the accuracy of the Bren is made up of several factors. In the case of the Bren fired from the bipod it can be analysed into:-

- (i) the dispersion of the shots in a burst from their M1
- (ii) the variations in the M1's of successive bursts with the same point of aim.
- (iii) The accuracy with which a Bren gunner can apply his bursts to a particular target and the amount of firing he needs to do so.

All these factors depend both on the man and the gun - we aim at obtaining average figures.

In the case of firing from the tripod the second factor is negligibly small and the first will depend on the gun alone.

8. Dispersion of a burst from the bipod.

We aim at firing the 90 per cent zones of an average burst of 5 rounds and for convenience we measure them as horizontal and vertical 90 per cent zones on a target at 25 yards range. The size of the horizontal and vertical zones is not in general the same, but as a first approximation we take in each case the mean of the two.

We can get information on the dispersion from 4 places.

- (i) SAT, vol 1, pamphlet 1, gives a diagram of 120 rounds fired at 500 yards from the bipod in service bursts. This corresponds to 2.7 ins. 90 per cent zone at 25 yards. No information is given concerning the standard of the gunner, but he must have been first class, for the lumping of some 30 bursts into the one pattern will naturally produce an increase in dispersion, so that the true figure should be less than 2.7 ins.
- (ii) The figures for 'testing' in SAT, vol 1, pamphlet 1, give a 3 ins. by 3 ins. group of 10 rounds fired in service bursts at 25 yards from the bipod by a skilled shot. By statistical rules we can say that this is equivalent to a 90 per cent zone of 3.5 ins.
- (iii) From the diagram (SAT vol 1, pamphlet 1, p 22) giving the 90 per cent beaten zone of a Bren fired from the bipod at 500 yards we obtain 3.2 ins.
- (iv) It is understood that the SAS, Bisley, classify Bren gunners unofficially into 2 in., 3 in. and 4 in. groups at 25 yards, a 'group' being 4 shots in a burst and the best 4 of 5 shots. This gives approximately, figures of 3.3 ins. and 4.1 ins. corresponding to 2 ins. and 3 ins. groupers.

Assuming that the first three of the above results refer to skilled shots, we should not be far wrong in taking the figure for an average Bren gunner to be about 3.7 ins. (corresponding to a 3.3 ins. group).

A sample series of firing has been carried out here and the groups carefully measured. In all 159 service bursts from various guns and gunners gave an average figure of 5 ins. This is greater than the theoretical estimate, but it must be remembered that our sample size was not very large.

9. Points arising from the above.

(i) It is assumed in the above calculations, as it is in SAT, that the dispersion of a gun is proportional to its range. This was confirmed in a test at 1,250 yards range (from tripods), the dispersion observed being approximately what would have been expected on a strictly proportional law.

(ii) The average horizontal dispersion was about 50 per cent greater than the average vertical zone. This result (for bursts of 5 at 25 yards from the bipod) contrasts with the more usual case of the vertical dispersion being the greater. All tripod shoots gave this more usual answer.

(iii) The question whether the dispersion of a burst increases with the number of shots in the burst is interesting. The belief is widely held that it does so. In all 28 long bursts of 9 or 10 shots were fired by various gunners. Comparing the average of each firer for short bursts with his average for long bursts, the long bursts gave on the average 3 per cent less dispersion than the short bursts. Statistically, we can say that there appeared to be no significant difference between the dispersions for long and short bursts.

A few (b) very long bursts of 15 rounds or more were fired, which gave the surprisingly low figure of 4.4 ins.

(iv) The types of group produced by a single burst of 5 or 10 rounds could be classified roughly into 3 types:-

- (a) a fairly compact group - about 40% of cases.
- (b) all the shots spread out into a line - about 30% of cases.
- (c) all the shots but one in a fairly compact group, but one shot wide - about 30% of cases.

It was found that in type "c" the wide shot was almost invariably the first shot fired. This was discovered by painting the tip of the first bullet with coloured wax.

10. Dispersion from the Tripod.

Corresponding figures for grouping dispersion from the tripod are more scanty. The only place in SAT is the diagram in vol. 1, pamphlet 1, of the cone of fire of 120 rounds at 500 yards fired in bursts of 30 rounds. This reduces to a 90% zone of 1.35 ins. at 25 yards.

A sample of 37 bursts of various sizes from various guns gave an average 90% zone of 1.96 ins.

It may be of interest to note that the figure for the Vickers M.M.G. given under 'testing' in SAT, vol. 1, pamphlet 1, is a $2\frac{1}{2}$ by $2\frac{1}{2}$ in. group for a burst of 10 rounds, which reduces to a 90 per cent zone of 3 ins.

11. Variation of the M.P.I.

An experiment was made to determine the variation of the MPI from burst to burst. 15 Bren gunners fired each a series of 9 or 10 bursts of 5 shots at targets at 25 yards. They were instructed to take deliberate aim for each burst, but not to attempt to correct the burst on to the aiming mark, i.e., to endeavour to take the same aim each time. The 90% zone of the MPI's was worked out for each firer. The average 90 per cent zones were: horizontal - 8.65 ins; vertical - 5.75 ins.

12. Accuracy of application.

It has not yet been possible to measure the accuracy with which the Bren gunner can apply his bursts to a target in the field. It is hoped that it will be possible in the future to obtain some figures for this, both for the normal method by observation of fire and for any other proposed method such as the use of tracer.

13. Range.

The range of the Bren is given as up to 1,000 yards on the bipod - more than this on the tripod. Mk. I Brens are sighted up to 2,000 yards, Mk. II to 1,800 yards, and there is no reason to suppose that the gun is not accurate up to this range. If streamlined ammunition were used it would presumably be possible to fire a Bren up to the ranges reached by a Vickers.

An experimental shoot was made at 1,250 yards from tripods. The target was 18 ft. square, and was hit at the third burst and thereafter. It might have been hit on the first burst, had proper allowance been made for the wind and for the fact that the Bren is apparently sighted too high at these ranges for the ammunition now issued. It is emphasized that the task set - of hitting a definite target at 1,250 yards - is considerably more difficult than the tactical role envisaged at these ranges, which would presumably be that of neutralizing an area. The beaten zone was calculated from the average size of the groups and reduces to 3 yds. broad by 7 $\frac{1}{2}$ yards long, which is smaller than that given for the Vickers gun with Mk. VIII Z amm. (5 yards by 123 yards at this range). An Infantry range-finder was used to estimate the range.

Another trial was made at 1,850 yards on a target 24 ft. square. The target was hit on the fourth burst, the range (found by range-finder) being correct from the first, but the allowance for wind being somewhat difficult to judge.

18th September, 1943.

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