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SHOOTING SIDEWAYS BY DAY AND NIGHT FROM HELICOPTERS WITH A SIMPLE SIGHT

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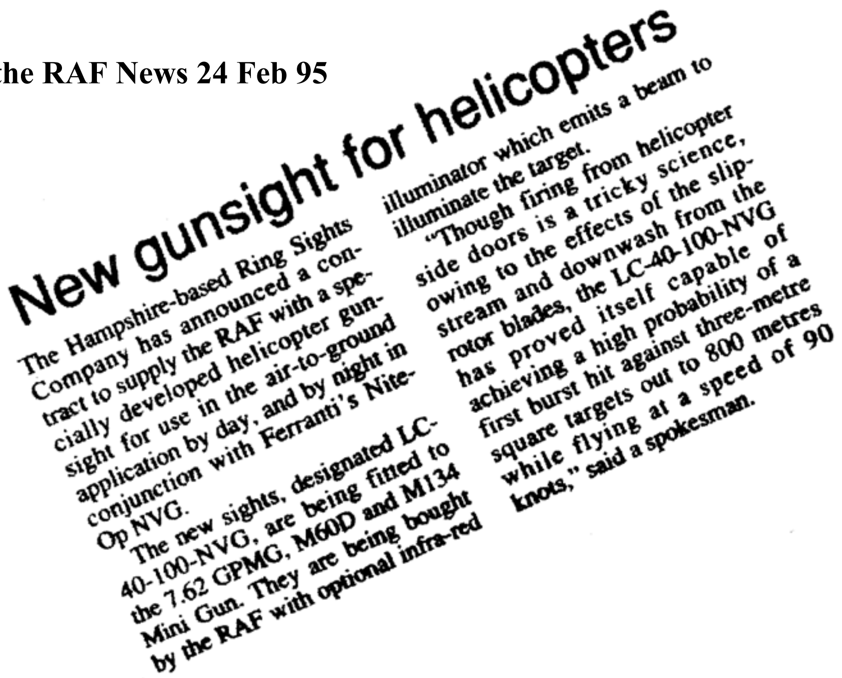
Extract from the RAF News 24 Feb 95



New gunsight for helicopters

The Hampshire-based Ring Sights Company has announced a contract to supply the RAF with a specially developed helicopter gunsight for use in the air-to-ground application by day, and by night in conjunction with Ferranti's Nite-Op NVG.

The new sights, designated LC-40-100-NVG, are being fitted to the 7.62 GPMG, M60D and M134 Mini Gun. They are being bought by the RAF with optional infra-red illuminator which emits a beam to illuminate the target.

"Though firing from helicopter side doors is a tricky science, owing to the effects of the slip-stream and downwash from the rotor blades, the LC-40-100-NVG has proved itself capable of achieving a high probability of a first burst hit against three-metre square targets out to 800 metres while flying at a speed of 90 knots," said a spokesman.

Shooting sideways from hels was a mistre
Until doing a trial called BISTRE.
After that the Ring Sight
Put the gunners aright
And the problem had passed into histre.

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Shooting sideways from helicopters

The story so far

Ring Sights have developed unit power sights since the mid-seventies for a variety of purposes, military and civilian. One of these, the RC-25, was licensed to Hall & Watts Ltd and sold, a decade ago, to the British Army for the .5" Browning HMG. Subsequently it has been used by the Army Air Corps for shooting sideways from helicopters. It is a reflex collimator sight using a lens to focus the graticule to infinity. The maximum lead available is 95 mils. The sight is filled with dry nitrogen and may need regular purging and refilling. For night use a betalight can be moved in front of the graticule (fixed brightness decreasing according to the half life of tritium).

Subsequently Ring Sights has developed a range of more robust solid glass sights including the LC-40-100 (see brochure). This has a patented solid glass optic with more lead available (150 mils). In 1992 CCTO (now the Air Warfare Centre) at Boscombe Down were planning a trial of sights for guns firing sideways from helicopters. Ring Sights was asked to provide a sight.

At that time they were considering laser sights which put a bright spot lined up with the gun so they asked for a central red spot in the Ring Sight (red to suit their Night Vision Goggles). This we did by modifying an existing LC-40-100 sight with a LED on the graticule. We pointed out that a spot does not assist in aiming off for lead, very necessary sideways from a moving helicopter, and that a cartwheel (or other) graticule can help the gunner to apply lead and elevation to suit the conditions: in addition a graticule enables the gunner to use "burst on target"
techniques to correct fire.

The first trial, BISTRE 1, established the superiority of the LC-40-100 sight over laser sights (Trial Report CCTO/72/253/Trials (Trial BISTRE) Jun 93). After this we modified and improved a succession of sights to optimise the use of NVG for target engagement by night. A further trial, BISTRE 2, confirmed that the sight met the RAF requirement. A batch has been made of which the RAF has bought forty.

In addition to the RAF we have briefed the Royal Navy helicopter officers at Yeovilton and Westland Helicopters at Yeovil. The Army Air Corps, after initial trials with a prototype, have got one of this first batch for evaluation of the production build standard. FN have adopted the LC-40-100-NVG as standard equipment in their new airborne weapon system (.50" M3) being launched at this year's Paris Air Show. Others have been provided, not necessarily for use in helicopters, to GIAT and FN for demonstration at IDEX this month.

The use of Ring Sight LC-40-100-NVG

The trajectory of a bullet fired sideways from a helicopter is affected by a number of factors all of which have to be allowed for if a target is to be engaged successfully with minimum collateral damage.

There are three basic methods of doing this:-

By hosepiping

Using a graticule projected to infinity

Using a sophisticated sight

Hosepiping involves no correction until after the time of flight i.e. there is a considerable lag between observation and correction. The correction is not done against any datum so the results are poor.

Using a graticule still involves the time of flight lag but at least the gunner has a frame of reference (the graticule) against which he can correct. In addition he starts (with the LC-40-100 as against a laser sight) by using as an aiming mark a point on the graticule which allows for the lead and elevation required to hit the target. He can observe the strike of the first rounds on the graticule and use "burst on target" for subsequent rounds. With experience he learns to allow for the conditions applying to a particular engagement.

A sophisticated sight does this for him. But, unlike the simple sight with a graticule, he may be unable to apply a correction quickly. This depends on the graticule pattern seen in the sight: a single dot or cross is probably inadequate. In addition the sight has to maintain the lead and elevation applying when the shots were fired: how does the sight know when to start computing
again? How long before the elevation and lead are correct? How good is the knowledge of the conditions, especially the wind all the way to the target?

Only trials will show whether a computing sight or a simple sight projecting a graticule is best. Since speeds are not high the gunner's brain is probably good enough for the task. With the simple sight he remains in control of the situation and is not at the mercy of a computer which must depend on the accuracy of its inputs to achieve success. If the inputs cannot be well enough defined the man, who can adjust to the situation, will win. A subsequent section examines one way to make things easier for the man.

We believe that the Ring Sight will enable gunners to teach themselves to shoot effectively.

Night shooting with Night Vision Goggles (NVG)

The gunner wears NVG at night: the pilot/commander is also usually wearing NVG too.

With the LC-40-100-NVG the target scene is viewed through the sight (for target acquisition the gunner can view over or past the sight and, having acquired the target, moves his head to look
through the sight). Because the graticule is at infinity it is seen against the target like a head up display. The surround of the optic is minimised by the design (and is out of focus) so even if the NVG objective is not quite in line the NVG (with an aperture of 22 mm or so) is not obscured. With binocular NVG the left objective is not obscured at all.

The beamsplitter in the LC-40-100-NVG is dichroic and is optimised to give maximum transmission except at the red wavelength of the LED array which lights the graticule at night.

The light from the LED array is reflected through the graticule by another dichroic surface optimised for this. It also transmits the ambient light to illuminate the graticule by day so no action is required by the gunner except to switch on the LED array. He can adjust the brightness to one of four levels: this is needed so that the NVG remain at the correct automatic gain setting for viewing the target. The brightness setting is not critical.

With the LC-40-100-NVG sight the gunner can engage a target by night as if it were day. His day training and experience carry through unaltered. He can do the same adjustment of fire by burst
on target.

How to make life easier for the gunner (ammunition optimisation)

The major aim off required is that for helicopter movement. The bullets start off with the velocity of the helicopter so this must be allowed for. But air resistance reduces this velocity as the trajectory proceeds. So the actual lead required is less than might have been expected.

Our initial calculations using 20 mm range tables show, surprisingly, that the aim off required is reasonably independent of the range. If this is indeed so, and it requires independent confirmation, it would simplify life for the gunner.7.62 mm calculations show that this is not the case with the
ammunition normally fired.

If engagement is to be made easier for the gunner with a consequent higher chance of a hit with the first burst, it seems worth optimising the external ballistics of the ammunition. This requires the use of a trajectory model.

The problem is akin to target engagement from a moving ship. We have published a Technical Note (Wind effects on moving guns: 24 Feb 95) which outlines the problem and has, at Annex A, our 20 mm calculations.

Training (and testing) using a simulator

Once a representative trajectory model is available, it is easy to create a simulator.

The LC-40-100-NVG sight is mounted on enough of the gun to provide realism. This is in turn mounted on a pintle fitted with the necessary means to transmit horizontal and vertical angles to
a ballistic box. This ballistic box applies trajectory information so that the tracer can be seen on a screen which has the target projected onto it moving as necessary to match the helicopter movement. Basic simulators are already available which can be modified.

While this system does not fully represent firing from a helicopter, it will launch gunners into understanding what to do in the air. It could also save money by eliminating trainee gunners who lack the necessary abilities to succeed. It could also be used to compare systems (and gunners) before doing live flying trials.

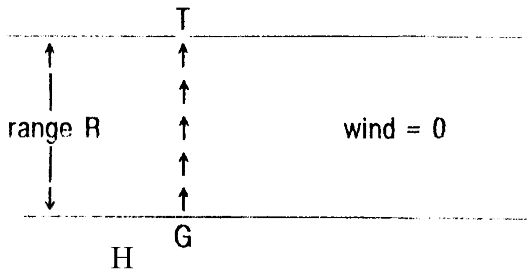
24 Feb 95

TECHNICAL NOTE

Wind effects on moving guns

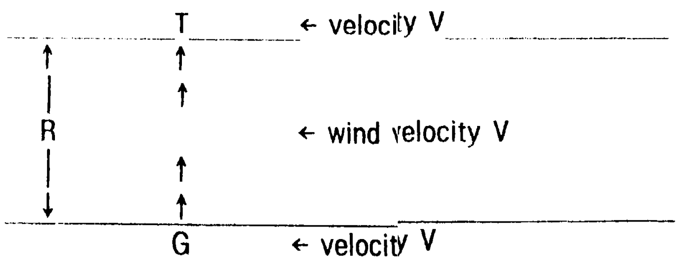
This note sets out the parameters of the effects of wind, target motion and gun speed on the trajectory of the bullet. In this note tangent elevation and drift will be ignored and the velocities (not air speed) are relative to the ground.

Case 1



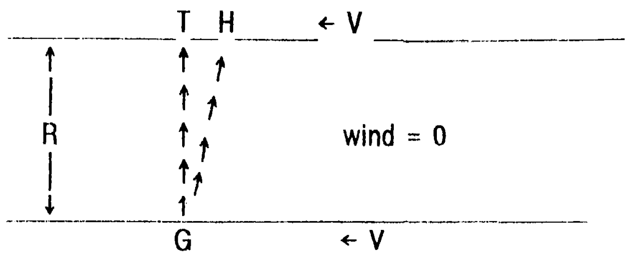
The gun (G) and the target (T) are stationary in still air. The gun is pointed and fired directly at the target and the round will follow the sight line and hit the target.

Case 2



The gun, target and wind are moving right to left with equal velocities V. The gun points directly at the target and the round will follow the sight line and hit the target. Since the wind and gun speeds are equal there is no wind pressure on the side of the round.

Case 3

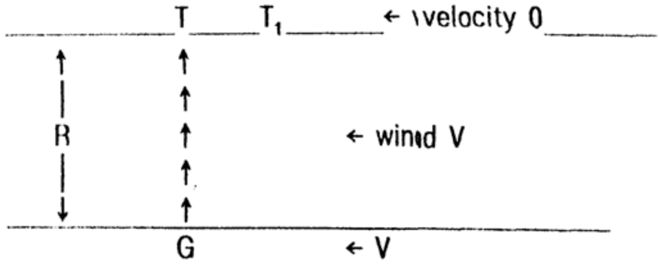


The gun and target are travelling right to left at speed V, the wind is 0 and the gun is pointed at the target.

The relative wind between the gun and the still air is V from right to left and, on emergence, the bullet is subjected to air pressure on its lefthand side and is pushed to the right of the target at H.

The distance TH divided by range R is equal to the aim off for cross wind shown in the range table multiplied by velocity V.

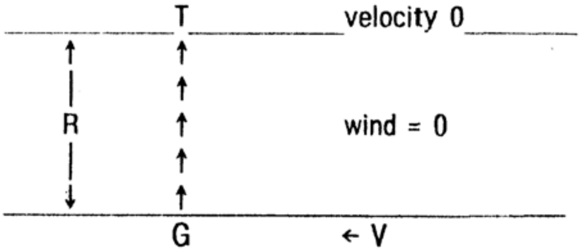
Case 4



The gun and the wind are moving right to left at velocity V. The target velocity is 0.

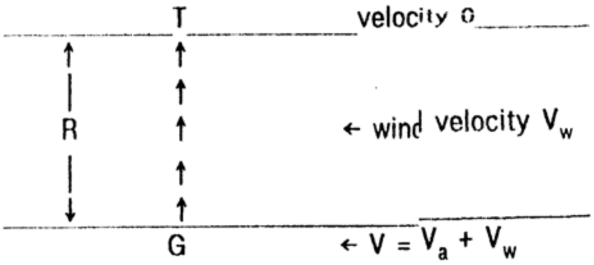
Thus the relative velocity of target to gun is V left to right. The position of the target after the time of flight is T_1 (the frame of reference being centred on the gun) thus the round will follow the path GT (as in Case 2) and will pass to the left of the target by a distance $T - T_1$ equal to the time of flight x V.

Case 5



Case 5 is a combination of Case 4 and Case 3 and the resultant error due to gun velocity V with zero wind and target velocities is the difference between TT_1 and TH which directionally have opposite signs and so the wind correction will reduce that for the gun velocity.

Case 6



In this Case the velocity applied to the gun is the air speed V_a + the wind speed V_w = $V_a + V_w$ and the deflection for relative velocity gun to target would be calculated $(V_a + V_w) \times t/R$.

The relative wind felt by the bullet would be V_a and so the deflection due to this cause would be as in Case 3 and the total deflection would be the algebraic sum these deflections.

An example is shown at Annex A based on the 20 mm Oerlikon.

20 mm Oerlikon

muzzle velocity 1050 metres/second

TE for 4500 metres 129.6 mils (7.4°)

from range table

range 1000 m	time of flight seconds	10 m/s cross wind * mils	10 m/s speed mils
0.0	0.0	0.0	9.5
0.5	0.53	1.1	10.6
1.0	1.21	2.6	12.1
1.5	2.09	4.5	13.9
2.0	3.33	6.8	16.7
2.5	4.72	9.5	18.9
3.0	6.44	12.2	21.5
3.5	8.41	14.7	24.0
4.0	10.65	17.4	26.6
4.5	13.24	20.2	29.4

* the "cross wind" is that due to helicopter movement