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A pocket fire-size estimator for aerial observers

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ABSTRACT

A pocket-size sighting tool can easily be fashioned from a 22.5-cm length of 3-mm welding rod. With it aerial observers can estimate ground distance and areas as a function of the aircraft's altitude.

RESUME

On peut facilement fabriquer un "stadimètre" de poche à incendies de forêts avec un tige de soudure longue de 22.5 cm et à diametre measurant 3 mm. Avec ce simple instrument, l'observateur voyageant en avion peut estimer la distance au sol et la superficie de l'incendie en fonction de l'altitude de l'avion.

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INTRODUCTION

Aerial observers must often estimate the size of features on the ground, such as the area of forest fires or the length of fire guards or retardant drops, without a suitable map providing the details needed to establish a size relationship.

Unrealistic estimates of initial fire size can result in the dispatch of insufficient or excess suppression forces and, entered into the fire report forms, complicate the statistical evaluation of fire data.

THE POCKET ESTIMATOR

PRINCIPLE OF OPERATION

A device (Fig. 1) was invented to assist the aerial observer or pilot in estimating the size of ground features observed from the aircraft. The Pocket Estimator is based on the principle of similar triangles under the assumption that the flying height over the feature to be measured is known (Fig. 2). The above-ground altitude (H-h) can be calculated fairly accurately by subtracting the ground elevation (h) as marked on the map from the temperature-corrected altimeter altitude (H).

The Pocket Estimator does not measure areas directly, it only provides a reference for lengths. Areas must be calculated from the established linear dimensions.

The Pocket Estimator is basically an angle gauge similar to a stick hypsometer (Chapman and Meyer 1949) or a Biltmore stick, but instead of a graduated stick the Pocket Estimator employs a smooth sighting post (Fig. 3) proportioned so that its length covers a distance on the ground equal to one-half of the flying height. A positioning arm keeps the

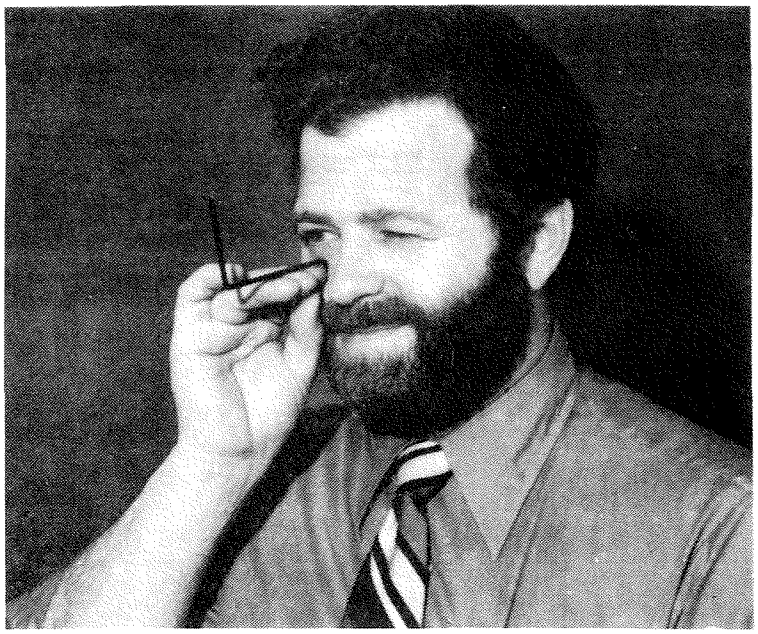
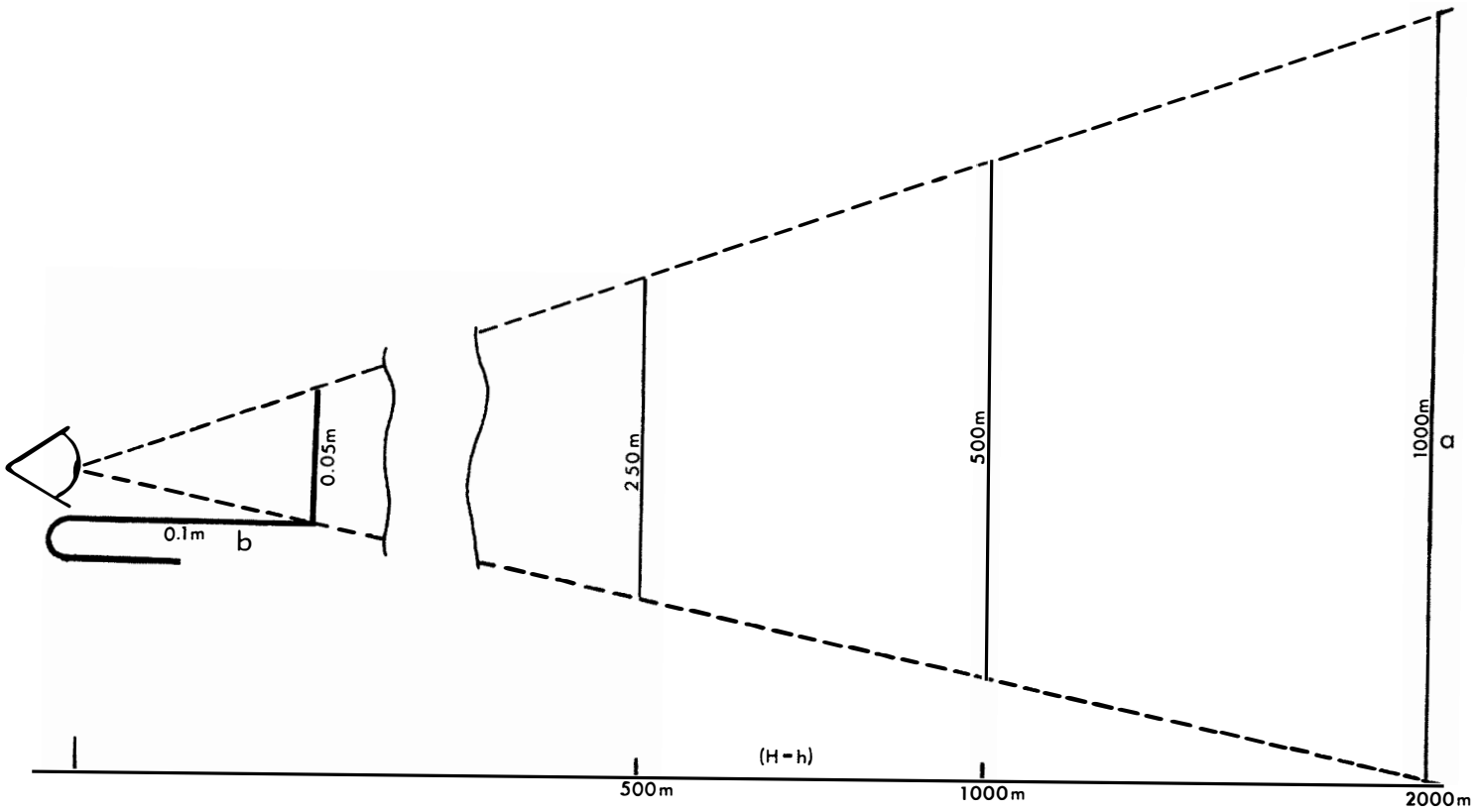


Figure 1. The Pocket Estimator, flat and compact to fit into shirt pockets.

sighting post at a constant distance from the eye. The end of the positioning rod is bent to form a safe eye rest and a handle, used to steady the Pocket Estimator against the observer's cheekbone (Fig. 1). Because the sighting post is only 10 cm from the eye it looks somewhat blurry when one sights over it. This results in a certain margin for error when projecting the post ends to the ground. However, considering that the other factors influencing area estimates, such as the irregular perimeter of areas to be measured, distance, and obliqueness of the area in relation to point of observation are also approximations, the Pocket Estimator is within the range of required precision.



$$b = (H-h)$$

$$a = \frac{b}{2}$$

a = measured distance on ground

b = flying height above ground

h = ground elevation

H = indicated altimeter altitude

Figure 2. The Pocket Estimator is a simple tool of triangulation.

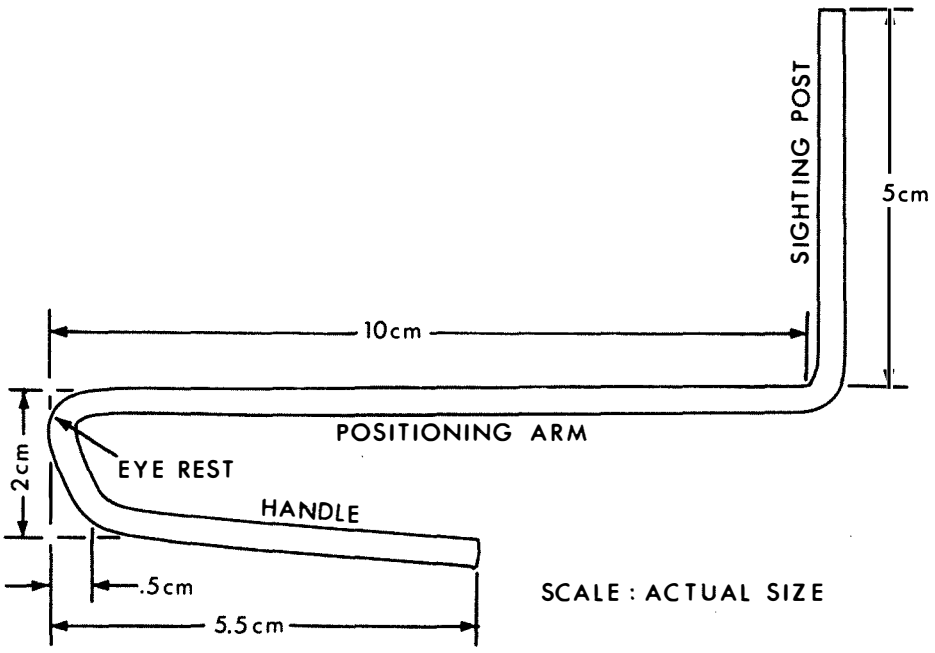


FIG. 3

Figure 3. Dimensions of the Pocket Estimator

DESCRIPTION

The Pocket Estimator consists of a 22.5-cm (9-in.) length of 3-mm (1/8-in.) diameter mild steel welding rod bent as shown in Fig. 3 to form a sighting post, positioning arm, eye rest, and handle. All bends are on the same plane to keep the device flat. Its outer dimensions are only 5 cm (2 in.) by 10 cm (4 in.), so that it fits readily into a shirt pocket, notebook, or map folder.

It is painted with black flat blackboard paint to eliminate unwanted reflections, with a dab of white paint at either end of the

sighting post to help in sighting. Luminous white paint could be considered for night observations by airline pilots.

APPLICATION

To take a measurement the observer holds the estimator by the handle and presses the eyerest firmly against his cheekbone immediately below his eye socket. Looking over the sighting post vertically down at the fire (or any other target) on the ground, the observer compares the target size to the length of the sighting post. For the purpose of measuring, the shape of the fire should be simplified into one or more squares or circles, and then the side of the square or the diameter of the circle measured in sighting post lengths (Fig. 4). It is useful to draw a rough sketch of the fire and show on it the sighting post lengths for later reference. Do not forget to mark down the altimeter altitude.

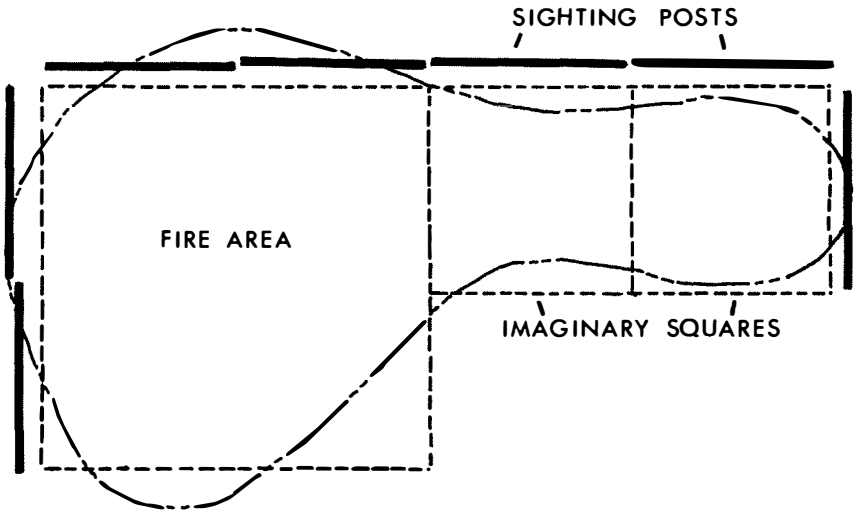


Figure 4. Divide fire mentally into squares or circles. Mark position of measured sighting post lengths as well as the altimeter reading for later reference.

The area for each square and circle is then calculated as follows:

1) Establish the distance covered on the ground by one sighting post length. It always equals one half of the aircraft's altitude above ground:

$$\frac{(H-h)}{2}$$

2) Using either formula $P\left(\frac{H-h}{2}\right)^2$ or $P\frac{\pi}{4}\left(\frac{H-h}{2}\right)^2$

where: H = altimeter altitude

h = ground elevation of target area

P = sighting post length

calculate the area of the square or circle in square metres. Ideally the aircraft's altitude should be selected to simplify area calculations. For example, if the altitude above ground is 200 m then one sighting post length covers on the ground 100 m, which is the side of a 1-ha square (100 x 100 m).

3) If the feature to be measured was divided into segments, calculate the area for each segment, total the number of square metres, and convert them into hectares (1 ha = 10 000 m^2). Multiply the number of hectares by 2.5 for an approximate conversion into acres.

Table 1 contains calculated square and circular areas for various measured sighting post lengths paired with altitudes in metres. The pocket on the inside back cover contains one Pocket Estimator with operating instructions and an abbreviated area calculations table.

Table 1. Area calculations for Pocket Estimator

Aircraft Altitude (metres)	Ground distance covered by one sighting post length (metres)	Calculated area for given number sighting post lengths (P)											
		For square areas[1]						For circular areas[2]					
		½P		1P		2P		½P		1P		2P	
		ha	acre	ha	acre	ha	acre	ha	acre	ha	acre	ha	acre
100	50	0.1	0.2	0.3	0.6	1.0	2.5	0.1	0.1	0.2	0.5	0.8	2.0
200	100	0.3	0.6	1.0	2.5	4.0	10.0	0.2	0.5	0.8	2.0	3.1	7.9
300	150	0.6	1.4	2.3	5.6	9.0	22.5	0.5	1.1	1.8	4.4	7.1	17.7
400	200	1.0	2.5	4.0	10.0	16.0	40.0	0.8	2.0	3.1	7.9	12.6	31.4
500	250	1.6	3.9	6.3	15.6	25.0	62.5	1.2	3.1	4.9	12.3	19.6	49.1
600	300	2.3	5,6	9.0	22.5	36.0	90.0	1.8	4.4	7.1	17.7	28.3	70.7
700	350	3.1	7.7	12.3	30.6	49.0	122.5	2.4	6.0	9.6	24.1	38.5	96.2
800	400	4.0	10.0	16.0	40.0	64.0	160.0	3.1	7.9	12.6	31.4	50.3	125.6
900	450	5.1	12.6	20.3	50.6	81.0	202.5	4.0	9.9	15.9	39.8	63.6	159.0
1000	500	6.3	15.6	25.0	62.5	100.0	250.0	4.9	12.3	19.6	49.1	78.5	196.4
1100	550	7.6	18.9	30.3	75.6	121.0	302.5	5.9	14.9	23.8	59.4	95.0	237.6
1200	600	9.0	22.5	36.0	90.0	144.0	360.0	7.1	17.7	28.3	70.7	113.1	282.7
1300	650	10.6	26.4	42.3	105.6	169.0	422.5	8.3	20.7	33.2	83.0	132.7	331.8
1400	700	12.3	30.6	49.0	122.5	196.0	490.0	9.6	24.1	38.5	96.2	153.9	384.8
1500	750	14.1	35.2	56.3	140.6	225.0	562.0	11.0	27.6	44.2	110.5	176.7	441.8
2000	1000	25.0	62.5	100.0	250.0	400.0	1000.0	19.6	49.1	78.5	196.4	314.2	785.4
2500	1250	39.1	97.7	156.3	390.6	625.0	1562.5	30.7	76.7	122.7	306.8	490.9	1227.2
3000	1500	56.3	140.1	225.0	562.5	900.0	2250.0	44.2	110.5	176.7	441.8	706.9	1767.2
4000	2000	100.0	250.0	400.0	1000.0	1600.0	4000.0	78.5	196.4	314.2	785.4	1256.6	3141.6
5000	2500	156.3	390.6	625.0	1562.5	2500.0	6250.0	122.7	306.8	490.9	1227.2	1963.5	4908.7
10000	5000	625.0	1562.5	2500.0	6250.0	10000.0	25000.0	490.9	1227.2	1963.5	4908.7	7854.0	19634.9

[1] P = side of square

[2] P = diameter of circle

REFERENCES

Chapman, H. H. and W. H. Meyer. 1949. Forest mensuration. American Forestry Series. McGraw Hill. New York. 522 pp.