98. (CMHA) Symbols and Abbreviations

The following symbols and abbreviations are used in computations:

a. A—Integrator presetting correction parameter. Used in correcting integrator presetting Q. Action necessary because of the rounding off of E_h to E.

b. B—Integrator presetting correction parameter. Used in correcting integrator presetting S. Action necessary because of the round off of E_h to E.

c. d—Indicates difference when used as a prefix.

d. E—Angle of elevation of the range-measuring accelerometer rounded to the nearest 0.1°.

e. E_h—Value of E corresponding to cutoff signal time t.

f. E_L—Easting of the launcher.

g. E_T—Easting of the target.

h. F—Time in seconds required for range accelerometer to achieve a velocity output of 720 meters per second. (F+.01 and F−.01—The upper and lower limits of the time interval in which F must lie.)

i. FS—Calibrated thrust in pounds from Thrust Unit log book.

j. h_L—Altitude of launcher location.

k. h_T—Altitude of target to include height of burst.

l. H—Velocity output of the lateral accelerometer at the end of 100 seconds. (H+.01 and H−.01—The upper and lower limits of the velocity output in which H must lie.)

m. I—The time set on the velocity timer for presetting Q in the range computer.

n. J—The time set on the displacement timer for presetting S in the range computer.

o. K_T—Geodetic azimuth of a line from launcher to target.

p. K—Aiming or firing azimuth. (Difference between K_T and K is due to the rotation of the earth.)

q. L—Dial setting for cutoff equation constant T.

r. M—Dial setting for cutoff equation constant N.

s. N—One of two cutoff equation constants.

t. N_L—Northing of the launcher.

u. N_T—Northing of the target.

v. P—Calibration value for presetting E in the missile.

w. Q—Missile's velocity presetting.

x. R_h—Effective range angle. Used in determining argument R_t for firing table entry and in computing the interpolation factor.

y. R_t—An adjusted R_h used only for firing table entry in computing the interpolation factor and times t_a and t_b.

z. R—Range angle determined by position of launcher and target.

aa. S—Missile displacement presetting.

ab. SI—Required specific impulse.

ac. SIO—Calibrated specific impulse from thrust unit log book.

ad. SIP—Change in specific impulse due to standard missile conditions.

ae. T—One of two cutoff equations.

af. t—Standard cutoff signal time corresponding to effective range angle R_h.

ag. TA—Alcohol temperature required.

ah. TB—Desired burning time.

ai. TC—Cutoff signal time.

aj. TT—Total computed flight time.

ak. TAO—Initial alcohol temperature.

al. TBM—Maximum burning time.

am. WL—Liftoff weight in pounds.

an. X—Alinement amplifier bias setting. Used to offset the effect of the component of the earth's rotation in the X axis.

ao. Y—Alinement amplifier bias setting. Used to offset the effect of the component of the earth's rotation in the Y axis.

ap. Z—Alinement amplifier bias setting. Used to offset the effect of the component of the earth's rotation of the Z axis.

aq. ϕ_L—Geodetic latitude of the launcher location.

ar. ϕ_T—Geodetic latitude of the target.

as. L—Geodetic longitude of the launcher location.

at. T—Geodetic longitude of the target location.

99. (CMHA) Determination of Basic Data

a. General.

(1) When the launcher and the target are not in the same universal transverse mercator grid zones (TM 5–241), the universal transverse mercator grid coordinates of one zone must be transformed into corresponding coordinates of the other zone before computing range angle, target azimuth, and launcher latitude.

(2) Target and launcher locations for distance and azimuth computations will normally be furnished the Redstone units in terms of universal transverse mercator grid coordinates. If locations are given in geographic coordinates only, the universal transverse grid coordinates can be computed by using volume I of the universal transverse mercator grid tables for the proper spheroid. Conversely, if locations are given in terms of universal transverse mercator grid coordinates they may be transformed by using volume II of the universal transverse mercator grid tables for the proper spheroid.

(3) For distance and azimuth computations, universal transverse mercator grid coordinates must be based on the same uni-

versal transverse mercator zone. Zone to zone transformation of universal transverse mercator grid coordinates for the target may be performed by using the formulas and tables in TM 5-241-2.

Note. At the present time, Army Map Service is planning to publish manuals which will permit the transformation over several zones by one computation.

b. Basic Data Obtained From Worksheets 1, 2, 3, and 4.

(1) The purpose of worksheet (WS) 1, which is applicable only after the coordinates of both firing position and target have been transformed to the same UTM zone, is to determine basic data which is used in subsequent computations. This consists of the geodetic latitude of the launcher location, the geodetic azimuth of the target, and the range angle. The range angle is a central angle between the launcher location and target, with its vertex at the center of the earth, and represents an equivalent range. This angle (corrected for launcher and target altitudes) is used in worksheet 4 to determine two cutoff time values which are used as arguments for entering the firing tables for all other parameters. Also, the range angle is used to determine a time interpolation factor which is applied to all subsequent parameter calculations. The target azimuth and latitude of launcher are used in worksheet 2.

(2) The purpose of worksheet 2 is to compute and assemble data which is used in subsequent computations.

(3) The purpose of worksheet 3 is to apply corrections to firing table values when the target or launcher or both are at other than sea level altitude. This is accomplished by calculating a value R_h which is used as the argument for determining the interpolation factor IF. This value R_h is expressed as a function of the range angle R. It is based upon the launcher location, target location, the altitudes H_L and H_T of the launcher and target respectively, the target azimuth K_T, and the latitude ϕ_L of the launcher.

(4) The computations on worksheet 4 have three functions:

(*a*) Determination of two values of t, t_a and t_b, from among those values of t tabulated in the R section of the firing tables.

(*b*) Determination of two range angles R_a and R_b, corresponding to the two values of t, t_a and t_b respectively.

(*c*) Determination of an interpolation factor (IF) using range angles R_a and R_b. This interpolation factor is used in subsequent computations.

c. Worksheet 1 (fig. 22).

(1) *Determination of basic data.* The purpose of Worksheet 1, which is applicable only after the coordinates of both firing position and target have been transformed to the same UTM zone, is to determine basic data which is used in subsequent computations. This consists of the geodetic latitude of the launcher location, the geodetic azimuth of the target, and the range angle.

(*a*) Lines 1, 2, 5, 6 — Known data consisting of northing$\times 10^{-6}$ and (easting—500,000)$\times 10^{-6}$ of launcher and target.

Line 3 — Determination of dN.

Line 7 — Determination of dE.

(*b*) Both of these values (lines 3 and 7) are used in determining direction (grid bearing) (line 11) and grid distance (line 13).

Lines 4, 8, 9 — These values are used in subsequent operations.

Note. Trigonometric tables to be used will have tabulated data for angles in degrees and decimal fractions of a degree instead of degrees, minutes, and seconds.

(*b*) Line 14 — The value ϕ_L is the geodetic latitude of the foot of the perpendicular from the launcher to the central meridian of the zone.

$\phi_L = \phi'_L - (VII)\ q_L^2$, where $q_L = 0.000001E_L$.

ϕ'_L is obtained from the appropriate TM 5–241–( ) series using N_L as the argument for entering the tables of function (I) if the launcher is in the Northern Hemisphere. If the launcher is in the Southern Hemisphere, use $(10{,}000{,}000 - N_L)$ as the argument. Inverse interpolation is required.

Lines 15, 16, 17 — Tables (VII), (XV), and (XVI) of appropriate volume II of TM 5–241–( ) series using the argument ϕ'_L.

Line 18 — Table (XVIII) is entered by using the argument of average northing (line 4). This table is located in the rear of the technical manuals listed in paragraph 97*c*, above.

DETERMINATION OF BASIC DATA

	(1)	N (Launcher) x 10^{-6}	6.646963	6	N_L x 10^{-6}
	(2)	N (Target) x 10^{-6}	6.654755	6	N_T x 10^{-6}
	(3)	(2) - (1)	0.007792	6	dN x 10^{-6}
	(4)	$\left[(1) + (2)\right] \div 2$ x 10^6	6650859	0	Mean Northing
	(5)	$(E_L - 500,000)$ x 10^{-6}	-0.153691	6	E'_L
	(6)	$(E_T - 500,000)$ x 10^{-6}	0.153368	6	E'_T
	(7)	(6) - (5)	0.307059	6	dE x 10^{-6}
	(8)	2 x (5)	-0.307382	6	$2E'_L$ x 10^{-6}
	(9)	(6) + (8)	-0.154014	6	$\left[2E'_L + E'_T\right]$ x 10^{-6}
Case I	(10)	(7) ÷ (3)		7	Positive value only.
Case I	(11)	$\tan^{-1}$ (10)		5	Use Case I When
Case I	(12)	cos (11)		7	(7) ≤ (3), numerically.
Case I	(13)	$\left[(3) \div (12)\right]$ x 10^6		0	R_g. Positive value only.
Case II	(10)	(3) ÷ (7)	0.0253762	7	Positive value only.
Case II	(11)	$\cot^{-1}$(10)	88°54636	5	Use Case II when
Case II	(12)	sin (11)	0.9996782	7	(7) > (3), numerically.
Case II	(13)	$\left[(7) \div (12)\right]$ x 10^6	307158	0	R_g. Positive value only.
	(14)	ϕ_L (Compute to nearest .1 of a second.)	59°57'31.2"		From DA TM 5-241-(1/2 (Appropriate spheroid) Col. (II): Argument: (1) x 10^6 in N Lat. *
	(15)	Table VII	4372	0	From DA TM 5-241-(1/2 (Appropriate spheroid) Argument: (14)
	(16)	Table XV	55799	0	From DA TM 5-241-(1/2 (Appropriate spheroid) Argument: (14)
	(17)	Table XVI	1816	0	From DA TM 5-241-(1/2 (Appropriate spheroid) Argument: (14)
	(18)	Table XVIII	0.012258	6	From DA TM 5-241-(1/2 (Appropriate spheroid) Argument: (4)
	(19)	$\left[(5)^2 + (5)(6) + (6)^2\right] \div 3$	0.0078571	7	

*If launcher is in Southern Hemisphere use as argument 10,000,000 - $\left[(1) \times 10^6\right]$

Page 1

Figure 22. (CMHA) Example of worksheet 1.

DETERMINATION OF BASIC DATA

	(20)	(18) x (19)	0.0000963 7	
	(21)	[1 + (20)] x 0.9996	0.9996963 7	Scale factor = k
	(22)	(15) x (19)	34 0	
	(23)	(4) - [30.8 x (22)]	6649812 0	In Southern Hemisphere use [10,000,000 - (4)] - [30.8 x (22)]
	(24)	Mean Radius Vector	6362321 0	Radius Vector Table. (Appropriate Spheroid) Arg. (23)
	(25)	(13) + (21)	307251 0	Sea Level Distance. Pos. only.
R	(26)	[57.29578 x (25)] ÷ (24) = R	2°76694 5	Range Angle
	(27)	$(5)^2$	0.0236209 7	
	(28)	(5) x (16)	9576 0	All values positive.
	(29)	(5) x (27)	0.0036303 7	All values positive.
	(30)	(17) x (29)	6.6 1	
	(31)	(3) x (9)	-0.00120 5	
	(32)	68.755 x (18)	843 0	
	(33)	[(31) x (32)] ÷ 3600	-0.00028 5	
	(34)	[(28) - (30)] ÷ 3600	-2°38039 5	-2° 22' 49.4" See Note 4
	(35)	(11) converted to grid az.	88°54636 5	Use Note 1.
	(36)	(35) + (33)	88°54608 5	
K_T	(37)	(36) + (34) = K_T	86°16569 5	See Note 2.
	(38)	(14)	59°95867 5	Converted to decimals of a degree. 1/60 (min) + 1/3600(sec)
	(39)	[(15) x (27)] ÷ 3600	0°02869 5	
ϕ_L	(40)	(38) - (39) = ϕ_L	59°92998 5	See Note 3.

NORTHERN HEMISPHERE

Note 1
1. If (3) is + and (7) is +, (35) = (11)
2. If (3) is - and (7) is +, (35) = 180° - (11)
3. If (3) is - and (7) is -, (35) = 180° + (11)
4. If (3) is + and (7) is -, (35) = 360° - (11)

Note 2 (Launcher in Northern Hemisphere)
1. When E < 500,000, use (-) sign for (34)
2. When E > 500,000, use (+) sign for (34)

Note 3 (Launcher in Northern Hemisphere)
ϕ_L is (+)

SOUTHERN HEMISPHERE

Note 1
1. If (3) is + and (7) is +, (35) = (11)
2. If (3) is - and (7) is +, (35) = 180° - (11)
3. If (3) is - and (7) is -, (35) = 180° + (11)
4. If (3) is + and (7) is -, (35) = 360° - (11)

Note 2 (Launcher in Southern Hemisphere)
1. When E < 500,000, use (+) sign for (34)
2. When E > 500,000, use (-) sign for (34)

Note 3 (Launcher in Southern Hemisphere)
ϕ_L is (-)

Note 4 Convert to degrees, minutes and seconds

Figure 22. (CMHA)—Continued

(2) The range of the missile is determined by using the precise angular relationship between two points on the sea-level surface of the earth with the vertex at the center of the earth. The process of converting the UTM coordinates to the range angle is as follows:

(*a*) Determine the scale factor K by solving the equation $K = k_o\ [1 + (\mathrm{XVIII})q^2]$ where $k_o = .9996$ is the scale factor at the central meridian. These computations are performed on lines 19, 20, and 21. (Because of long distances, the q^2 value in the above equation is replaced by an average q^2 denoted by $\bar{q}^2$.)

$$\bar{q}^2 = \frac{q_L^2 + q_L q_T + q_T^2}{3} \text{ (line 19)}$$

(*b*) Determine the mean radius vector by using the Radius Vector Table.

Line 23	Represents a correction value in distance necessitated by the curvature of latitude for points not located at the central meridian.
Line 24	The average northing minus the latitude curvature correction provides the argument for entering the Radius Vector Tables.
Line 25	The (line 13) grid range is corrected by the scale factor K to obtain the sea level distance.
Line 26	The constant, degrees per radian, times the sea level distance divided by the mean radius vector equals the range angle in degrees.

(3) The geodetic azimuth or K_T value is determined by using the following procedure:

(*a*) Step 1	Case I: $\tan t = \frac{DE}{DN}$ Case II: $\cot t + \frac{DN}{DE}$ (where t is the grid azimuth)
(*b*) Step 2	(T−t) correction due to curvature of long azimuth lines.
(*c*) Step 3	(C) correction for angle between grid north and true north.
(*d*) Line 11	Determines the bearing angle on $\frac{dE}{dN}$.

This value, when used with chart at bottom of the page (note 1), determines the grid azimuth of the target (line 35).

(e) $(T-t)$ correction is applied by solving the equation $(T-t)=L(N_T-N_L)$ where T=projected geodetic azimuth and $L=6.8755\times10^{-8}$ (XVIII) $(2E'_L+E'_T)$. These computations are performed on lines 9, 31, 32, and 33.

(f) Convergence (C) is applied by solving the equation $C=(XV)q_L-(XVI)q_L^3$. These computations are performed on lines 27, 28, 29, and 30.

Note. In this equation, q_L must be considered as positive only.

(g) Convergence (C) is converted to degrees, minutes, and seconds so that it may be applied to the grid azimuth of the orienting line on the FDC basic data record.

(4) Lines 38, 39, 40 solve the equation $\phi_L=\phi'_L-(VII\ q_L^2)$.

d. *Worksheet 2* (fig. 23).

(1) Section I is used to compute and tabulate the trigonometric coefficients sin ϕ_L, sin 2 ϕ_L, cos ϕ_L, cos 2 ϕ_L, sin K_T, cos K_T, sin 2 K_T, cos 2 K_T, and certain of their products as listed on the worksheet. It is also used to determine the force of gravity at the launcher (lines 22, 25–29) and certain trigonometric values which are used in the target azimuth equation (lines 19–21, 30–32). The value of each h_T on line 4 must include the altitude of the target plus the height of burst of the warhead above the target.

(2) Section II is used to determine the proper sign of the sine and cosine of the angles used in section I. The symbol α (alpha) represents the angle used to enter the trigonometric tables. For example, if the angle is 200°, alpha would equal 20°, and the sine of 200° would be the minus value of the sine of 20°, and the cosine of 200° would be the minus value of the cosine of 20°.

(3) Section III is used to tabulate values determined and used in subsequent operations.

e. *Worksheet 3* (fig. 24).

(1) Computations on worksheet 3 are performed as follows:

(a) Step 1—From worksheets 1 and 2, record on lines 1 through 5 the indicated values. Perform the computation indicated on lines 6 through 8.

(b) Step 2—Enter the firing tables and locate the appropriate R_h section. Record all values of $R_h(1)$ to $R_h(12)$ on worksheet 3 in the appropriate blocks, 9 through 20.

(c) Step 3—Perform the indicated computation, lines 21 through 32 to determine values for R_h and R_r.

SECTION I

(1)	K_T (From WS #1)	86°.16569	5
(2)	θ_L (From WS #1)	59°.92998	5
(3)	h_L	1235	0
(4)	h_T	730	0
(5)	2 x (1)	172°.33138	5
(6)	2 x (2)	119.85996	5
(7)	Sin (1)	0.9977616	7
(8)	Sin (2)	0.8654137	7
(9)	Sin (5)	0.1334434	7
(10)	Sin (6)	0.8672448	7
(11)	Cos (1)	0.0668714	7
(12)	Cos (2)	0.5010580	7
(13)	Cos (5)	-0.9910564	7
(14)	Cos (6)	-0.4978818	7
(15)	(12) (7)	0.4999364	7
(16)	(12) (11)	0.0335064	7

(17)	(14) (9)	-0.0664390	7
(18)	(14) (13)	0.4934289	7
(19)	(3) (4) x 10^{-6}	0.90155	5
(20)	(8) (3) x 10^{-3}	1.0687859	7
(21)	(8) (4) x 10^{-3}	0.631752	7
(22)	$(8)^2$	0.7489409	7
(23)	(10) (7)	0.8653036	7
(24)	(10) (11)	0.0579939	7
(25)	$(10)^2$	0.7521135	7
(26)	.051723 (22)	0.038737	6
(27)	.0000577 (25)	0.000043	6
(28)	(3) . 3086 x 10^{-5}	0.003811	6
(29)	9.78049 + (26) -(27) - (28)	9.81537 g_L	5
(30)	(16) (3) x 10^{-3}	0.0413804	7
(31)	(16) (4) x 10^{-3}	0.0244597	7
(32)	(16) (19)	0.0302077	7

SECTION II

	360 + ∝	450 + ∝	540 + ∝	630 + ∝
	∝	90 + ∝	180 + ∝	270 + ∝
Sin	+ Sin ∝	+ Cos ∝	- Sin ∝	- Cos ∝
Cos	+ Cos ∝	- Sin ∝	- Cos ∝	+ Sin ∝

(∝ less than 90°)

SECTION III

IF	0.2996	4

t_a	103
t_b	104

Figure 23. (CMHA) *Example of worksheet 2.*

(2) The parameter R_t is an adjusted R_h whose only function is as an argument for entry into the R section of the firing tables to determine the time interval within which the required range angle R must lie. Once R_t has served this function, it is never used again.

f. Worksheet 4 (fig. 25). Computations on worksheet 4 are performed as follows:

(1) Step 1—Using the value R_t (from worksheet 3) as the argument, enter the R section of the firing tables.

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(when filled in)

R_h

Worksheet 3

(1)	R (From WS 1)	2.°76694	5
(2)	h_L (3) From WS 2	1235	0
(3)	h_T (4) From WS 2	730	0
(4)	(15) From WS 2	0.4999364	7
(5)	(19) From WS 2 x 10^6	901550	0
(6)	$(2)^2$	1525225	0
(7)	$(3)^2$	532900	0
(8)	(7) x (3) x 10^{-4}	38902	0
(9)	$R_h(1)$	177.4206	4
(10)	$R_h(2)$	-35.8998	4
(11)	$R_h(3)$	453.2882	4
(12)	$R_h(4)$	19.1335	4
(13)	$R_h(5)$	0.0442	4
(14)	$R_h(6)$	0.0164	4
(15)	$R_h(7)$	-0.0242	4
(16)	$R_h(8)$	-0.0096	4

(17)	$R_h(9)$	-752.3912	4	
(18)	$R_h(10)$	-42.9201	4	
(19)	$R_h(11)$	-81.1256	4	
(20)	$R_h(12)$	10.1014	4	
(21)	[(9) + (10) (4)] (2)	196949	0	
(22)	[(11) + (12) (4)] (3)	337883	0	
(23)	(13) (6) + (14) (7) + (15) (5) + (16) (8)	8207	0	
(24)	[(21) + (22) + (23)] x10^{-8}	0.005430	6	
(25)	[(17) + (18) (4)] (2)	-955703	0	
(26)	[(19) + (20) (4)] (3)	-55535	0	
(27)	[(25) + (26)] x 10^{-8}	-0.010112	6	
(28)	1 + (27)	0.989888	6	
(29)	(1) + (24)	2.°772370	6	
(30)	(29) ÷ (28)	2.°80069	5	R_h
(31)*	(30) + [(4) x 10^{-2}]		5	R_t
(32)**	(30) - [(4) x 10^{-2}]	2.°79569	5	R_t

* Use for Short Ranges. $R < 1°.643$
** Use for Long Ranges. $R \geq 1°.643$

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(when filled in)

Figure 24. (CMHA) *Example of worksheet 3.*

(2) Step 2—Compare the R_t value with those values in the R(1) column of the R section of the firing tables.

(3) Step 3—Select the R(1) value closest to the R_t value. Extract the corresponding value of t and record this value in the t block of column (1).

(4) Step 4—Extract tabulated data for R(1), R(2), R(3), R(4), R(5), and R(6) opposite the t value determined in step 3. Record in column (1).

(5) Step 5—Extract appropriate values from worksheet 2 and record in column (2).

(6) Step 6—Cumulatively multiply column (1) by column (2) and record the cumulative total in column (4).

(7) This value is compared to the R_h value. If the total in column (4) is smaller than the R_h value, this column becomes R_a and t becomes t_a. If larger, it becomes R_b and t becomes t_b.

R

Worksheet 4

R_t 2° 79569
(From WS 3)

	(1) From Firing T	(2) From WS 2	(3) From Firing T	(4) ⓐ b	(5) a ⓑ
t	ⓐ b 103		a ⓑ 104		
R(1)	2.78720 (5)		2.82049 (5)	2.78720 (5)	2.82049 (5)
R(2)	0.01919 (5)	0.49994 (5) (15)	0.01981 (5)	+ 2.796794 (6)	+ 2.830394 (6)
R(3)	0.00026 (5)	-0.99106 (5) (13)	0.00027 (5)	- 2.796536 (6)	- 2.830126 (6)
R(4)	0.00027 (5)	0.49343 (5) (18)	0.00028 (5)	+ 2.796669 (6)	+ 2.830264 (6)
R(5)	0.01209 (5)	-0.49788 (5) (14)	0.01220 (5)	- 2.790650 (6)	- 2.824190 (6)
R(6)	-0.00009 (5)	0.05799 (5) (24)	-0.00010 (5)	- 2.790645 (6)	- 2.824184 (6)
			Total	2.79064 (5)	2.82418 (5)
				$(R_b - R_a) = \Delta R$	0.03354 (5)
			$(R_h - R_a) \div \Delta R = IF$		0.2996 (4*)

t_a	103 *
t_b	104 *

*Enter these values on WS 2

Figure 25. **(CMHA)** ***Example of worksheet 4.***

100. (CMHA) Determination of Presetting Data

a. General. Worksheets 5 through 15 are used for the determination of presetting data. The same basic pattern established in worksheet 4 is used for these 11 worksheets. Differences from the basic pattern are discussed in detail.

b. Worksheet 5 (fig. 26). Worksheet 5 is used to solve the formula $K = K_T + K(1) \text{ Sin } \phi_L + K(2) \text{ Sin } 2\phi_L \text{ Sin } K_T + K(3) \text{ Cos } \phi_L \text{ Cos } K_T + K(4) \text{ Sin } 2K_T + K(5) \text{ Cos } 2\phi_L \text{ Sin } 2K_T + [[(K(6) \text{ Sin } \phi_L + K(7) \text{ Cos } \phi_L \text{ Cos } K_T] h_L + [(K(8) \text{ Cos } \phi_L \text{ Cos } K_T] h_L h_T \times 10^{-3} + [K(9) \text{ Sin } \phi_L + K(10) \text{ Cos } \phi_L \text{ Cos } K_T] h_T] \times 10^{-3}$. The value of K is the aiming or firing azimuth that will be transmitted to the launcher. The differ-

K

		(1) From Firing Table	(2) From WS 2	(3) a	(4) b
K_T				86.°16569	(1) From WS 2
				(1) From WS 2	86.°16569
K(1)	a	-1.5444	0.86541	-84.82915	
	b	-1.5503	(8)		-84.82404
(K2)	a	-0.0044	0.86530	-84.82534	
	b	-0.0046	(23)		-84.82006
K(3)	a	1.0376	0.03351	+84.86011	
	b	1.0364	(16)		+84.85479
K(4)	a	-0.0004	0.13344	-84.86006	
	b	-0.0003	(9)		-84.85475
K(5)	a	-0.0004	-0.06644	+84.86009	
	b	-0.0004	(17)		+84.85478
K(6)	a	-0.0024	1.06879	-84.85752	
	b	-0.0023	(20)		-84.85232
K(7)	a	0.0088	0.04138	+84.85789	
	b	0.0088	(30)		-84.85269
K(8)	a	0.00011	0.03021	+84.85789	
	b	0.00010	(32)		+84.85269
K(9)	a	0.0053	0.63175	+84.86124	
	b	0.0052	(21)		+84.85597
K(10)	a	-0.0037	0.02446	-84.86115	
	b	-0.0036	(31)		-84.85589
			Total	84.8611	84.8559
				$(K_b - K_a) = \Delta K$	-0.0052

$\Delta K \times IF$ (WS 2)	-0.0016
$(\Delta K)(IF) + (K_a) = K$	84°8595
K	84° 51' 34.2" *

*Degrees, Minutes Seconds

Figure 26. (CMHA) *Example of worksheet 5.*

ence between K_T, the target azimuth, and K, the firing azimuth, is the correction for rotation of the earth.

(1) Step 1—Transfer the value of K_T from WS 1 and record it in the appropriate blocks under columns a and b.

(2) Step 2—Enter the firing tables, using arguments t_a and t_b previously determined on worksheet 4, in the K section and extract tabulated data for K(1), K(2), K(3), K(4), K(5), K(6), K(7), K(8), K(9), and K(10).

(3) Step 3—Record firing table data in column (1).

(4) Step 4—Record data from worksheet 2 in appropriate blocks of column (2).

(5) Step 5—Cumulatively multiply the items in column (1) by those in column (2) and record the total products in columns a and b.

(6) Step 6—apply interpolation factor and determine value for K. Convert K to degrees, minutes, and seconds.

c. Worksheet 6 (fig. 27).

(1) The purpose of worksheet 6 is to facilitate the solution of the formulas given below.

(*a*) Chart I.

1. $X=500\ (1-\cos\phi_L \cos K)$.

2. $Y=500\ (\sin\phi_L+1)$.

3. $Z=500\ (\cos\phi_L \sin K+1)$.

(*b*) Chart II. $E=E(1)+E(2)\cos\phi_L \sin K$.

(2) Chart I computations determine the alinement amplifier bias settings X, Y, and Z. These settings are necessary to offset the effects of the earth's rotation on the stable platform in the X, Y, and Z axes.

(3) Chart II is a procedure to determine the range accelerometer elevation angle above the local horizon. The setting or E value is rounded off to the nearest 0.1°. This is necessary because of setting limitations in the guidance equipment. The difference $(E-E_s)$ is applied as a correction to the parameters for velocity (Q) and displacement (S).

(4) Step 1—Complete Chart I.

(*a*) Line 1. Determine Sin value of azimuth K (from worksheet 5).

(*b*) Line 2. Determine Cos value of azimuth K (from worksheet 5).

(*c*) Lines 3 and 4. Record trigonometric coefficients from worksheet 2.

(*d*) Lines 5 through 9. Complete the indicated computations.

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Worksheet 6

Chart I

EARTH ROTATION BIAS

(1)	Sin K (WS 5)		0.99598	5
(2)	Cos K (WS 5)		0.08960	5
(3)	(8) from WS 2		0.86541	5
(4)	(12) from WS 2		0.50106	5
(5)	500 - 500 (4) (2)	X	478	0
(6)	500 + 500 (3)	Y	933	0
(7)	500 + 500 (4) (1)	Z	750	0
(8)	(4) (1)		0.49905	5
(9)	(4) (2)		0.04489	5

E

Chart II

		(1) From Firing Table	(2)	(3) (a)	(4) (b)
E(1)	a	39.042 3		39.042 3	
	b	39.139 3			39.139 3
E(2)	a	-1.731 3	0.49905 5	- 38.1781 4	
	b	-1.738 3	(8) Chart I		- 38.2717 4
			Total	38.1781 4	38.2717 4
				$(E_b - E_a) = \Delta E$	0.0936 4

	$\Delta E \times IF$ (WS 2) = $(\Delta E)(IF)$	0.0280	4
	$+E_a$	38.1781	4
	$(\Delta E)(IF) + E_a =$ E_h	38.2061	4
	E_h (to nearest 0.1) = E	38.2	1
	$E - E_h$	- 0.0061	4
	(44 - E) x 10 = P	58	0

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Figure 27. (CMHA) *Example of worksheet 6.*

(5) Step 2—Complete Chart II.

(*a*) Enter firing tables in E section (arguments t_a and t_b) and extract data for E(1) and E(2). Values for E(1) and E(2) are recorded in column (1).

(*b*) Extract data from Chart I (above), line 8 and record in column (2).

(*c*) Cumulatively multiply column (1) by column (2) and determine total for columns (a) and (b). Complete indicated computations.

(*d*) Apply interpolation factor. Determine value for E_b.
(*e*) Round off E to nearest 0.1°; this value is used on worksheet 14.
(*f*) Determine the difference $(E - E_b)$ and apply to worksheets 11 and 12.
(*g*) Determine the calibration setting P for presetting E in the missile.

d. Worksheet 7 (fig. 28).

(1) Worksheet 7 facilitates the solution of the formulas:
(*a*) $A = A(1) + A(2) \text{ Cos } \phi_L \text{ Sin } K_T$.
(*b*) $B = B(1) + B(2) \text{ Cos } \phi_L \text{ Sin } K_T$.

(2) The value A is a correction applied to the presetting Q (velocity). The value B is a correction applied to the presetting

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A

Worksheet 7

	(1) From Firing Table	(2) From WS 2	(3) a
A(1)	a -16.8 1		-16.8 1
A(2)	a -1.1 1	0.49994 (15) 5	-17.35 2
		Total	-17.35 2
		A	-17.4 1

B

	(1) From Firing Table	(2) From WS 2	(3) a
B(1)	a 944 0		944 0
B(2)	a 87 0	0.49994 (15) 5	987.5 L
		Total	987.5 1
		B	988 0

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Figure 28. (CMHA) *Example of worksheet 7.*

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