(7) The meter readings obtained in (6) above are compared with established standards which correlate the amount of target damage expected when the missile bursts at various distances from the target. When the amount of target damage has been determined, the EFFECTIVE switch, KILL switch, or INEFFECTIVE switch on the tactical control-indicator is depressed to signal to the AADCP the amount of target damage. If the EFFECTIVE switch is depressed, the EFFECTIVE indicator light will illuminate, and if the INEFFECTIVE switch is depressed, the INEFFECTIVE indicator light will illuminate. Indicator lights are not used with the KILL switch.

(8) When the events described in (1) through (7) above have occurred, the surface-to-air engagement cycle has been completed and the Improved NIKE–HERCULES System is ready for another engagement.

150 (C). Surface-to-Surface Mission

a. Surface-to-Surface Engagement. In normal surface-to-surface engagements, orders for surface fire originate at The Army Operations Center and are relayed to the AADCP which provides tactical control for individual Improved NIKE–HERCULES Systems. When a surface-to-surface mission is ordered, the AADCP sends the computed equipment settings for the engagement to the designated Improved NIKE–HERCULES System. The TTR is locked on the displaced aiming point, the MTR is set for the proper guidance cutoff, and fixed constants on the engagement are programmed into the computer. After launching, the missile is guided toward the fixed displaced aiming point which represents the target coordinates. At a predetermined time before the missile reaches the displaced aiming point, a final dive order is issued to the missile. The final dive order causes the missile to dive toward the target and onto a ballistic trajectory. Just before the missile reaches the radar masking line in its descent toward the target, guidance commands are terminated and the barometric fuze in the missile is armed. After guidance cutoff, the missile follows a ballistic trajectory until it reaches a predetermined altitude above the target. At this altitude, which has been calculated as the optimum detonation altitude for the type of missile warhead used and the type of target designated, the warhead is exploded by the barometric fuze in the missile. After warhead detonation, the Improved NIKE–HERCULES System is prepared for the next engagement. The procedures used in a surface-to-surface engagement are given in *b* through *p* below.

b. Initial Procedure. When instructions for a surface-to-surface mission are received from the AADCP, the Improved NIKE–HERCULES System is placed in blue alert status. In blue alert status the procedures given in (1) and (2) below are followed.

(1) All operating personnel man their equipment and perform the blue equipment status checks and adjustments specified in the SOP.

(2) The MISSILES PREPARED switch on the battery signal panel-indicator is set to B–XS and B–XL to determine the number of missiles in each missile-warhead configuration that are available for the engagement. The number of missiles available in each configuration is indicated on the MISSILES PREPARED meter when the switch is set to each position.

c. Mission and Missile Selection. The mission has been previously determined as a surface-to-surface (SS) type. Either the B–XS or B–XL missile-warhead configuration can be used in SS mission. The procedures for selecting the mission and missile and the procedures for conditioning the Improved NIKE–HERCULES System for the selected mission and missile are given in (1) through (3) below.

(1) The MISSION switch on the battery signal panel-indicator is depressed and set to SS. Setting the switch activates circuits that automatically condition the RCDC for SS operation and illuminates the MISSION—SS indicator

light on the battery signal panel-indicator.

(2) When the Improved NIKE–HERCULES System is integrated with the MISSILE MONITOR (AN/MGS–4), the MISSILE—REM—B–XS indicator light, or the MISSILE—REM—B–XL indicator light on the battery signal panel-indicator will illuminate to indicate the type of missile-warhead combinations to use in the engagement. The REMOTE indicator light on the tactical control-indicator also illuminates to indicate that a command has been issued by the AADCP. When illumination of this indicator light is observed, the ACKNOW switch is depressed, sending an acknowledgment signal to the AADCP and extinguishing the REMOTE indicator light. After acknowledging the signal from the AADCP, the MISSILE switch is set to the position corresponding to the illuminated indicator light. Setting this switch initiates the following events.

(*a*) A signal is sent to the missile tracking radar system to condition it for the type of missile selected and the MISSILE—NIKE B indicator light on the missile control-indicator group illuminates to notify operating personnel that a NIKE–HERCULES missile has been selected for the engagement.

(*b*) A signal is sent to the computer to condition it for the type of missile and warhead selected.

(*c*) The altitude plotting board on the battery control console is illuminated by red lights.

(3) If the engagement is to be locally controlled, the MISSILE switch on the battery signal panel-indicator is set to B–XS or B–XL in accordance with instructions from the AADCP or the SOP. The corresponding MISSILE—BTRY—B–XS indicator light or MISSILE—BTRY—B–XL indicator light on the battery signal panel-indicator illuminates. Setting the switch indicates the events described in 2 (*a*) through (*c*) above.

d. Equipment Conditioning. The procedures for conditioning the computer, MTR, and launching area for action after the selection of the mission and missile are given in paragraph 149*d*.

e. Launching Area Procedures. After receiving the mission and missile data from the RCDC, launching area personnel prepare the missiles which meet the selected missile requirements for a surface-to-surface engagement. After preparations have been completed, the barometric fuzes are set for the altitude specified by the RCDC.

f. Guidance Cutoff Setting. Normally, in surface-to-surface engagements, targets are located below the radar line of sight between the missile and the MTR. The radar line of sight is broken at low antenna elevation position due to radar masking caused by obstructions between the target and the MTR antenna. If this line of sight is broken while the missile is receiving guidance commands, the missile will fail-safe. To prevent fail-safe, guidance commands sent to the missile by the computer are terminated before the radar line of sight is broken by a guidance cutoff signal generated when the guidance cutoff switch on the MTR antenna is actuated. This switch is actuated when the antenna lowers in elevation to the preset guidance cutoff angle. The procedure for setting the guidance cutoff switch to the proper angle for the engagement is given in (1) through (6) below.

(1) The local antenna control, which is used to vary the antenna elevation angle, is connected to the LOCAL ANTENNA CONTROL UNIT connector J7 on the curbside of the azimuth drive equipment enclosure.

(2) The elevation dial illumination switch S1 on the track antenna support is depressed to illuminate the elevation dial on the elevation position transmitter.

(3) The ELEVATION knob and the elevation INCREASE–DECREASE switch on the local antenna control are oper-

ated until the guidance cutoff angle for the engagement is visible in the elevation dial eyepiece.

(4) The locking screw is loosened to unlock the guidance cutoff switch setting, and the adjustment screw is turned fully counterclockwise ensuring that the switch is adjusted to an angle less than the antenna.

(5) The adjustment screw is then slowly turned clockwise until the threshold light illuminates, indicating that the guidance cutoff switch is set to operate at the preset antenna elevation angle.

(6) The locking screw is tightened to lock the guidance cutoff switch setting.

g. Target Coordinate Settings. In a surface-to-surface engagement, the target is stationary and the TTR does not track the target. In order to supply the computer with target position information, the TTR is manually locked in azimuth, elevation, and range on a fixed displaced aiming point which represents the target coordinates for the engagement. The procedure for locking the TTR on the displaced aiming point is given in (1) through (9) below.

(1) The local antenna control is connected to the LOCAL ANTENNA CONTROL UNIT connector J7 on the curbside of the target track antenna support base.

(2) The elevation dial illumination switch S1 on the track antenna pedestal is depressed to illuminate the elevation dial on the elevation position transmitter.

(3) The ELEVATION knob and the elevation INCREASE–DECREASE switch on the local antenna control are operated until the specified antenna elevation angle for the engagement is visible in elevation dial eyepiece.

(4) After the antenna has been set to the specified elevation angle, the COORDINATE LOCK—ELEV switch on the electric light control is set to on position (up) to lock the antenna in elevation.

(5) The AZIMUTH knob and the azimuth INCREASE–DECREASE switch on the local antenna control are operated until the specified antenna azimuth angle is indicated on the azimuth dial.

(6) After the antenna has been set to the specified azimuth angle, the COORDINATE LOCK—AZ switch is set to on position (up) to lock the antenna in azimuth.

(7) The range MAN–ACQUIRE AID–TRACK AID–AUTO switch on the target antenna control group is set to MAN.

(8) The range handwheel is rotated until the range dial on the target range position transmitter indicates the specified range setting.

(9) After the TTR range circuits have been set to the specified range, the COORDINATE LOCK—RANGE switch on the electric light control is set to on position (up) to lock the TTR range circuits.

h. Computer Settings. When the MISSION switch is set to SS, the computer is automatically conditioned for a surface-to-surface engagement. However, the height displacement and final dive time must be manually set into the computer. The height displacement is the altitude of the displaced aiming point, and the final dive time is the predetermined time on the missile trajectory when the missile will start its final dive toward the target. The procedure for setting the computer for the height displacement and the final dive time is given in (1) and (2) below.

(1) The HT DISPLACE knob on the servo computer assembly is turned until the specified altitude of the displaced aiming point for the engagement is indicated on the HT DISPLACE dial.

(2) The FINAL DIVE TIME knob on the servo computer assembly is turned until the specified final dive time for the engagement is indicated on the FINAL DIVE TIME dial.

i. Identification and Designation of Targets. The interrogation and identification of targets as friend or foe by the SIF/IFF system or FUIF system and designation of targets for the target tracking radar system are not re-

quired for surface-to-surface operation since MISSION instructions for the surface target to be engaged are supplied by the AADCP. However, the FOE switch on the IFF control-indicator must be depressed and the DESIGNATE–ABANDON switch on the target designate control-indicator must be set to DESIGNATE before the missile firing circuit can be completed. The events given in (1) and (2) below occur when these switches are operated.

(1) When the FOE switch is depressed, the ivory TARGET—FOE indicator light on the battery signal panel-indicator extinguishes and the green TARGET—FOE indicator light illuminates.

(2) When the DESIGNATE–ABANDON switch is set to DESIGNATE, the ivory TARGET–DESIGNATED indicator light on the battery signal panel-indicator extinguishes and the green TARGET–DESIGNATED indicator light illuminates. The ivory DESIGNATE indicator light on the target track indicator assembly extinguishes and the green DESIGNATE indicator light illuminates.

(3) The ACQUIRE switch need not be used since the target coordinates are present; however, the TRACKED switch must be operated to energize associated circuits in the computer.

j. Missile Acquisition. The procedure for missile acquisition by MTR is the same for surface-to-surface and surface-to-air missions. This procedure is given in paragraph 149*l*.

k. Red Alert. After a surface-to-surface mission has been assigned to an Improved NIKE–HERCULES System and the MTR, TTR, and computer have been conditioned for the engagement, the system is placed in red alert status using the procedures given in paragraph 149*e*.

l. Ready to Fire. The Improved NIKE–HERCULES System is ready to fire a surface-to-surface mission when the TTR is locked on the displaced aiming point, the MTR antenna is set for the proper guidance cutoff angle, the missile is tracked, the computer is programmed for height displacement and final dive time, and the computer has stabilized. When these conditions have been met, the ivory READY TO FIRE indicator light on the battery signal panel-indicator extinguishes and the green READY TO FIRE indicator light illuminates.

m. Launching. After the green READY TO FIRE indicator light illuminates, the missile can be fired. The time of firing is determined by the scheduled time on target for the missile and the predicted time of flight. The launching sequence is given in paragraph 149*n*.

n. Guidance Cutoff. After launching, the missile is automatically guided toward the target until the guidance cutoff point is reached. When this point is reached, a burst command is issued to the missile by the computer, and the events given in (1) through (4) below occur.

(1) The barometric fuze in the missile is armed and guidance commands to the missile are terminated.

(2) The ivory BURST indicator light on the battery signal panel-indicator extinguishes and the green BURST indicator light illuminates.

(3) The ivory BURST indicator light on the target track indicator group extinguishes and the green BURST indicator light illuminates.

(4) The ivory BURST indicator light on the missile control-indicator group extinguishes and the green BURST indicator light illuminates.

(5) The TARGET MISSILE switch on the computer control-panel is set to IND ERROR AT BURST YDS/10 and the missile position error at burst command in X, Y, and H coordinates is read on the ACCELERATION, VELOCITY AND POSITION DIFFERENCE—X, G_Y meter, ACCELERATION, VELOCITY AND POSITION DIFFERENCE—Y, G_P meter, and ACCELERATION, VELOCITY AND POSITION DIFFERENCE—H, G_T meter. The meter readings are used to determine the effectiveness of the engagement.

(6) The meter readings obtained in (5) above are compared with established standards which correlate the amount of target damage expected when the

missile receives a burst command at various distances from the programmed guidance cutoff point. When the amount of target damage has been estimated, the results are reported to the AADCP.

o. Missile Burst. After guidance cutoff, the missile falls freely toward the target until it reaches the predetermined detonation altitude. When this altitude is reached, the missile warhead is automatically exploded by the barometric fuze.

p. Post Missile Burst. After missile burst, the Improved NIKE–HERCULES System is prepared for another engagement. The sequence of events following missile burst is given in (1) through (7) below.

(1) The MTR automatically slews to the flight simulator in the launching area.

(2) The green BURST indicator light, LAUNCH indicator light, FIRE indicator light, READY TO FIRE indicator light, and MISSILE—TRACKED indicator light on the battery signal panel-indicator are extinguished and the ivory BURST indicator light, LAUNCH indicator light, FIRE indicator light, READY TO FIRE indicator light, and MISSILE—TRACKED indicator light are illuminated.

(3) The green BURST indicator light, LAUNCH indicator light, and FIRE indicator light on the target track indicator assembly are extinguished and the ivory BURST indicator light, LAUNCH indicator light, and FREE indicator light are illuminated.

(4) The green BURST indicator light, LAUNCH indicator light, FIRE indicator light, and TRACK indicator light on the missile control-indicator group are extinguished and the ivory BURST indicator light, LAUNCH indicator light, and FIRE indicator light, and TRACK indicator light are illuminated.

(5) The DESIGNATE–ABANDON switch on the target designate control-indicator is operated to ABANDON. Operation of the switch causes the green TARGET—TRACKED indicator light, TARGET—CONFIRMED indicator light, TARGET—DESIGNATED indicator light, and TARGET—FOE indicator light on the battery signal panel-indicator to extinguish and the ivory TARGET—TRACKED indicator light, TARGET—CONFIRMED indicator light, TARGET—DESIGNATED indicator light, and TARGET—FOE indicator light to illuminate. The green TRACK indicator light, CONFIRM indicator light, and DESIGNATE indicator light on the target track indicator group extinguish and the ivory TRACK indicator light, CONFIRM indicator light, and DESIGNATE indicator light illuminate. Illumination of the ivory indicator lights indicates that the TTR has been cleared for designation of a new target.

(6) The COORDINATE LOCK—ELEV switch, COORDINATE LOCK—AZ switch, and COORDINATE LOCK—RANGE switch on the electric light control are set to off position (down) to unlock the TTR elevation, azimuth, and range circuits.

(7) When the events described in (1) through (6) above have occurred, the surface-to-surface engagement cycle has been completed and the Improved NIKE–HERCULES System is ready for another engagement.

151 (U). Firing Data

Firing data to be used in a surface-to-surface mission are presented in Department of the Army Firing Table HERCULES A–1 and within this technical manual.

152 (U). Computer Input Data Nomogram

a. The results of NIKE–HERCULES simulated surface-to-surface trajectories were used to derive gravity corrections, height displacements (H_D), maximum guidance cutoff angles (MAX ϕ_L), and final dive times (FDT) (fig. 123).

b. Data presented in the nomogram was derived assuming the parallax between the

launcher and the radars to be zero. Also, the launcher, radars, and target were considered as being at sea level.

c. Gravity corrections under 10 yards may be neglected; therefore, the R_L scale on the right reflects only ranges where gravity correction values may be significant. Nomogram scales do not reveal system limitations.

d. Gravity correction may be read by laying a straightedge from the ϕ_L scale to the R_L scale on the right through to the gravity correction scale, as indicated by the dashed line.

e. Height displacement (H_D), maximum guidance cutoff angle (MAX ϕ_L), and final dive time (FDT) corresponding to specific R_L values are read from scales adjacent and corresponding to the R_L scale on the left.

153 (U). Altitude Correction Nomogram

a. Altitude correction nomogram (fig. 124) prescribes the correction to the surface-to-surface firing range based on true ground distance (R_s) and average target tracking radar/target altitude. See TM 5–241–2 for detailed discussion and need for this correction.

b. The altitude correction nomogram may be read by laying a straightedge from the R_s scale to the average TTR/target altitude scale through to the altitude correction scale.

Note. No correction is required for values of average TTR/target altitude or values of R_s less than those reflected in the nomogram.

154 (C). Minimum Guidance Cutoff Set

a. Minimum guidance cutoff set, table 86, prescribes the minimum allowable GCO settings

Table 86 (C). Minimum Guidance Cutoff Set[1] (U)

True ground distance TTR-to-target (Rs) (yards)	Minimum guidance cutoff set (GCO SET) (mils)	True ground distance TTR-to-target (Rs) (yards)	Minimum guidance cutoff set (GCO SET) (mils)
33,000	59	68,000	29
34,000	57	69,000	28
35,000	55	70,000	28
36,000	53	71,000	28
37,000	51	72,000	27
38,000	50	73,000	27
39,000	48	74,000	27
40,000	47	75,000	26
41,000	46	76,000	26
42,000	45	77,000	26
43,000	44	78,000	25
44,000	43	79,000	25
45,000	42	80,000	25
46,000	41	81,000	25
47,000	40	82,000	24
48,000	39	83,000	24
49,000	38	84,000	24
50,000	38	85,000	24
51,000	37	86,000	23
52,000	36	87,000	23
53,000	36	88,000	23
54,000	35	89,000	23
55,000	34	90,000	22
56,000	34	91,000	22
57,000	33	92,000	22
58,000	33	93,000	22
59,000	32	94,000	21
60,000	32	95,000	21
61,000	31	96,000	21
62,000	31	97,000	21
63,000	30	98,000	21
64,000	30	99,000	21
65,000	30	100,000	20
66,000	29		
67,000	29		

[1] Minimum GCO SET for all ranges greater than 100,000 yards is 20 mils.

that may be set in at the missile tracking radar. This is required to allow final arming of the warhead from guidance cutoff to burst.

b. Minimum guidance cutoff set for all ranges greater than 100,000 yards is 20 angular mils.

155 (C). Altitude of Burst Correction

A dynamic lag in the barometric fuze line requires that a correction be made to the equivalent altitude of burst. The value of this correction is minus 373 feet.

156 (C). Symbology and Data Utilization

a. H_D (height displacement) is utilized as prescribed in paragraph 150*h*.

b. At least 10 seconds of final guidance must be obtained before the guidance cutoff point is reached. Therefore, a maximum guidance cutoff angle that may be set in at the missile tracking radar is prescribed. MAX ϕ_L is the symbol for this quantity. This is utilized as prescribed in FM 44–95.

c. FDT (final dive time) is utilized as prescribed in paragraph 150*h*.

d. R_L (launcher-to-target radar plane range) is used as an argument in computer input data nomogram (fig. 123). It is calculated and further utilized as prescribed in FM 44–95.

e. ϕ_L (launcher cutoff angle) equals guidance cutoff angle (GCO) in the simulations per assumptions outlined in paragraph 152. For field use, however, launcher cutoff angle is defined by the equation

$$\phi_L = (GCO - Si)\frac{R_s}{R_L}$$

where GCO = radar mask + 5 angular mils

(angle of site) $Si = \frac{H_t - H_{tt}}{R_g/1000}$ angular mils

Launcher cutoff angle is calculated as prescribed in FM 44–95. It is used as an argument in computer input data nomogram (fig. 123).

f. The additional distance which must be considered in calculating the actual firing range to prevent the missile from impacting short of the target due to gravity effects is called gravity correction. This quantity is utilized as prescribed in FM 44–95.

g. R_s (true ground distance TTR-to-target) is used as an argument in altitude correction nomogram (fig. 124). It is calculated and further utilized as prescribed in FM 44–95.

h. The additional distance which must be considered in calculating the actual firing range due to the difference between map derived range and the actual TTR-to-target range at different altitudes is called altitude correction. This quantity is utilized as prescribed in FM 44–95.

i. Minimum guidance cutoff set (par. 154) is utilized as prescribed in FM 44–95.

j. Actual firing range incorporating gravity and altitude corrections is calculated as prescribed in FM 44–95 and is utilized as prescribed in paragraph 150*g*.

k. Altitude of burst correction (par. 155) is added algebraically to the equivalent altitude of burst in feet for determination of BARO FUZE SET.

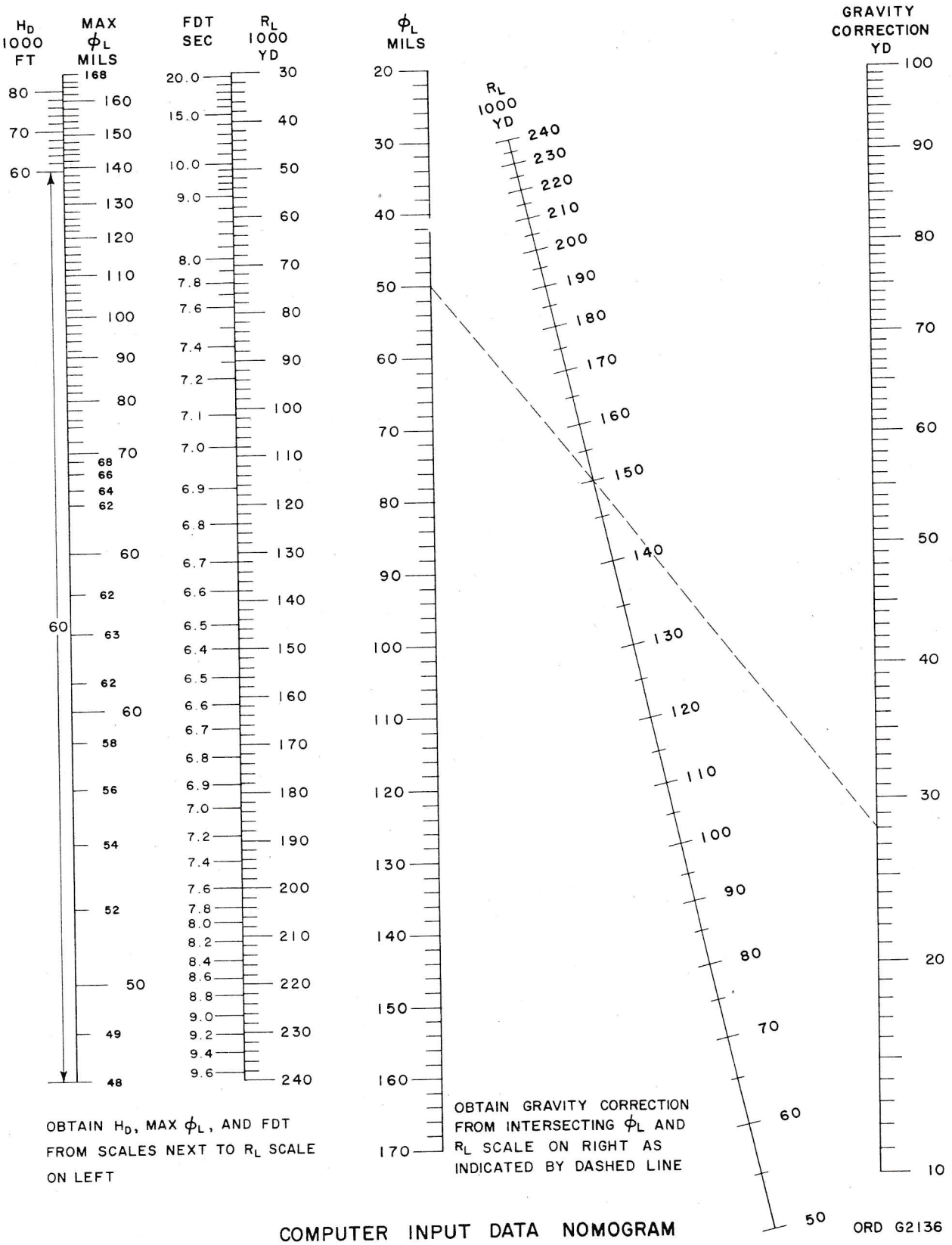

Figure 123 (U). Computer input data nomogram (U).

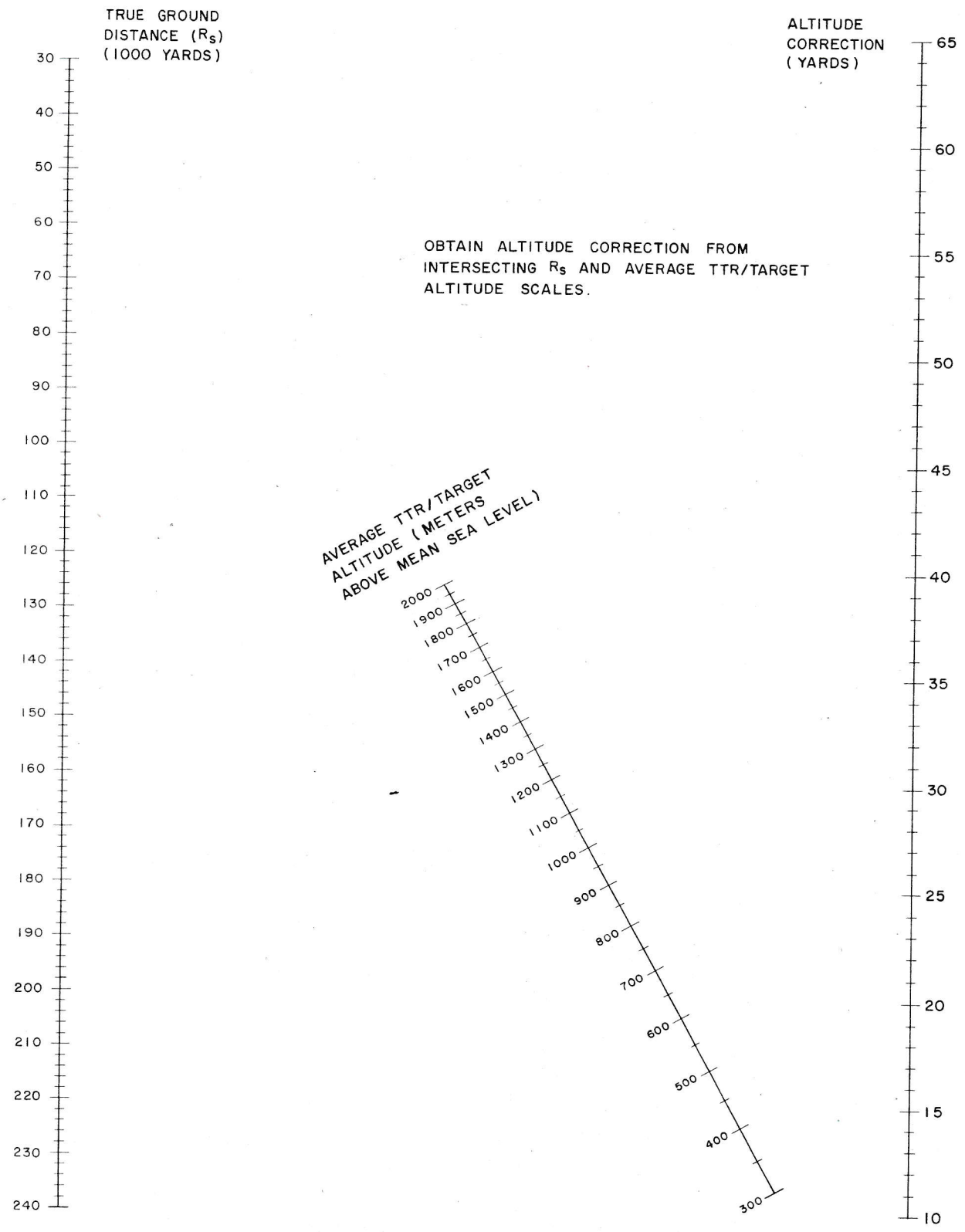

Figure 124 (U). Altitude correction nomogram (U).