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FM 44-1A

DEPARTMENT OF THE ARMY FIELD MANUAL

U.S. ARMY AIR DEFENSE EMPLOYMENT (U)

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HEADQUARTERS, DEPARTMENT OF THE ARMY
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h. Engagement Effectiveness (EE). Based on the number of attempted missile launches per target, EE reflects the increase in kill probability resulting from multiple missile launches against a threat. See table II.

Table II (C). Hawk Engagement Effectiveness in Percent (U)

m=	1	2	3	4	5	6
EE=	53	78	90	95	98	99

i. Time-Along-Trajectory. Figure 11 is used during construction of missile trajectory scales as described in paragraph 16, appendix II, FM 44-1. Figure 11 plots missile time of flight versus altitude and ground range, with all data measured from the launcher position.

j. Dead Zones. Hawk dead zones vary from engagement to engagement, as shown in the effectiveness templates (figs. 1-10).

k. Miscellaneous Planning Data.

Maximum rate of fire per section: 1 round/6 seconds.

Sustained rate of fire per section: 3 rounds/minute.

Maximum target radial speed: 1,620 kmph.

Minimum target radial speed: 162 kmph.

Maximum effective engagement altitude: 45,000 feet (13,700 meters).

Battery emplacement time: 1 hour, using well-trained crew.

Battery march order time: 30 minutes, using well-trained crew.

4. (S) Nike Hercules Weapon System Characteristics

a. Effective Radar Range. The presentation system limit of the Nike Hercules acquisition radar (designated LOPAR in the Improved Nike Hercules system) is 250,000 yards (229 kilometers). The target tracking and target ranging radar presentation limits are 200,000 yards (183 kilometers). The theoretical radar effective range is a function of target size, and is determined from table III. Table III assumes no limiting effects due to terrain.

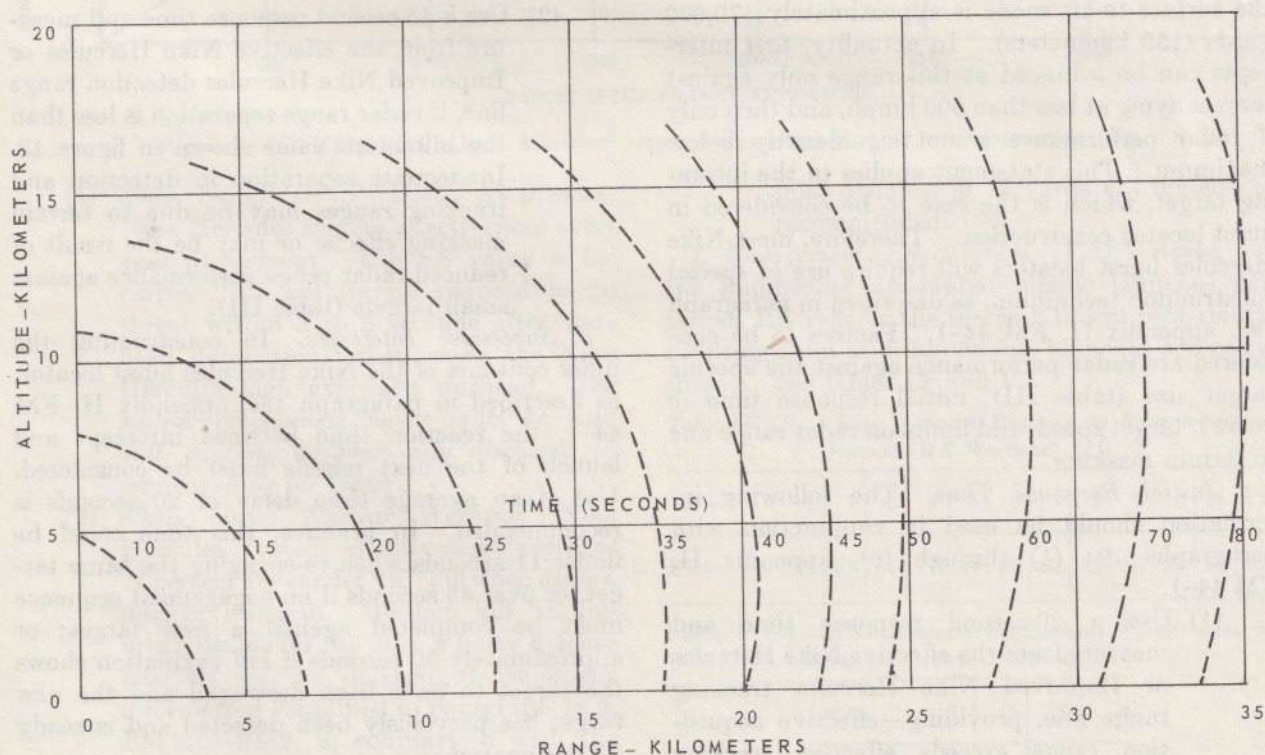


Figure 11 (CONFIDENTIAL). HAWK time-along-trajectory graph (U).

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Table III (C). Nike Radar Range Performance (U)

	Nike Hercules		Improved Nike Hercules w/HIPAR			
	Acquisition radar	Target tracking radar	HIPAR (electronic frequency shift)	HIPAR (electronic frequency shift/ATBM**)	Target tracking radar (long pulse)	Target ranging radar (long pulse)
≥30m ² (B52, Bull, Badger)-----	*230	*185	*320	*320	*185	*185
25m ² -----	210	*185	*320	*320	*185	*185
20m ² -----	195	*185	*320	*320	*185	*185
15m ² (B47, B58)-----	185	175	*320	*320	*185	*185
10m ² -----	160	150	*320	*320	*185	*185
4m ² (Typical fighter-interceptor)-----	130	125	*320	300	*185	*185
3m ² (Small fighter)-----	120	115	*320	280	*185	*185
1m ² (Light plane)-----	90	85	*320	210	150	150
0.6m ² (Typical air-to-surface missile)-----	80	75	*320	185	130	130

*Presentation system limits.

**Estimated.

Note 1. Ranges are expressed in kilometers, to the nearest multiple of five.

Note 2. At the ranges given, the probability of reliable detection or tracking is not less than 50%.

Note 3. The Nike Hercules acquisition radar is designated "LOPAR" when used in the Improved Nike Hercules system.

b. *First Intercept Range.* The maximum effective missile range of the Nike Hercules missile in the surface-to-air mode is approximately 170,000 yards (155 kilometers). In actuality, first intercepts can be achieved at this range only against targets flying at less than 600 kmph, and then only if radar performance is not significantly below maximum. This statement applies to the incoming target, which is the case to be considered in burst locator construction. Therefore, most Nike Hercules burst locators will require use of special construction techniques, as described in paragraph 19a, appendix II, FM 44-1. Factors to be considered are radar performance against the specific target size (table III), initial response time (c below), target speed, and limits on radar range due to terrain masking.

c. *Initial Response Time.* The following information should be used in conjunction with paragraphs 19a (1) through (6), appendix II, FM 44-1.

- (1) Use a 20-second response time and measure from the effective Nike Hercules or Improved Nike Hercules tracking range line, providing—effective acquisition range exceeds effective tracking range by at least the amount shown in

figure 12, for the target speed being considered.

- (2) Use a 45-second response time and measure from the effective Nike Hercules or Improved Nike Hercules detection range line, if radar range separation is less than the minimum value shown in figure 12. Inadequate separation in detection and tracking ranges may be due to terrain masking effects, or may be the result of reduced radar range performance against small targets (table III).

d. *Successive Intercepts.* In constructing the inner contours of the Nike Hercules burst locator, as described in paragraph 18c, appendix II, FM 44-1, the reaction time between intercept and launch of the next missile must be considered. Use of an average time delay of 20 seconds is recommended. In practice, this time could be under 11 seconds when re-engaging the same target, or over 45 seconds if an engagement sequence must be completed against a new target; or approximately 30 seconds if kill evaluation shows the target to have been destroyed and the new target has previously been detected and is ready for designation.

e. *System Effectiveness (SE).*

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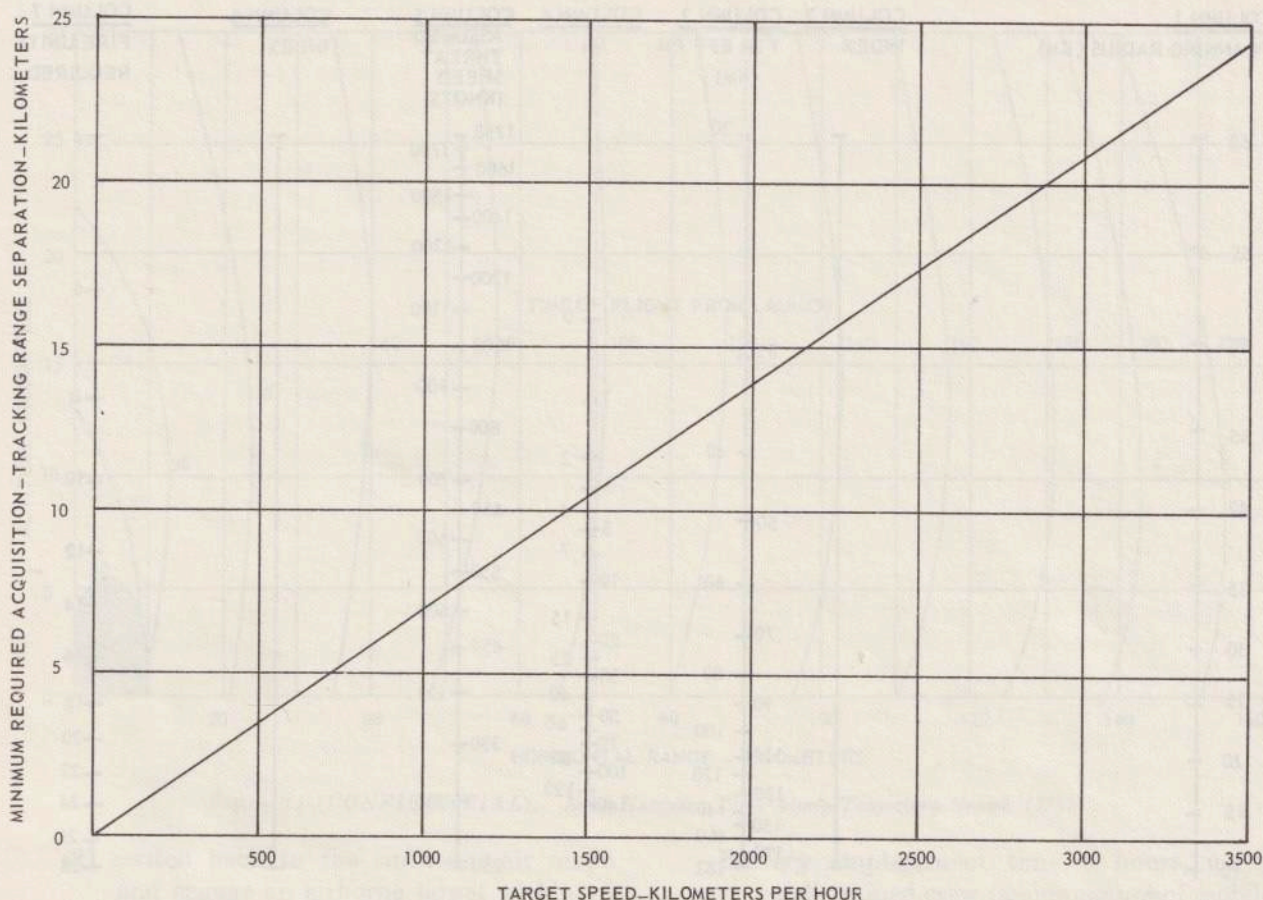


Figure 12 (CONFIDENTIAL). Minimum required acquisition-tracking range separation (U).

- (1) *When Using HE Warhead.* At present, Nike Hercules system effectiveness averages 31 percent. The SE value is for carrier "K" kill (target reduced to no threat within 3 to 5 seconds after warhead detonation) when using the Nike Hercules high explosive warhead. *The system effectiveness figure must be used with caution, as previously discussed in paragraph 3g for Hawk.*
- (2) *When Using Nuclear Warhead.* Nike Hercules system effectiveness averages 74 percent for carrier "K" kill when using a nuclear warhead. Weapon kill SE figures suitable for use during hasty defense analysis can be determined using the information contained in paragraph 18.2, FM 101-31-2, in conjunction with the value of average Nike Hercules radial miss distance. Use of an average radial

miss distance of 25 yards (23 meters) is recommended.

f. Engagement Effectiveness (EE). Based on the number of attempted missile launches per target, EE reflects the increase in kill probability resulting from multiple missile launches against a threat. See tables IV and V.

Table IV (S). Nike Hercules Engagement Effectiveness in Percent (HE Warhead) (U)

m=	1	2	3	4	5	6	7	8	9	10	11	12
EE=	31	52	67	77	84	89	92	95	96	97	98	99

Table V (S). Nike Hercules Engagement Effectiveness in Percent (Nuclear Warhead) (U)

m=	1	2	3	4
EE=	74	93	98	99

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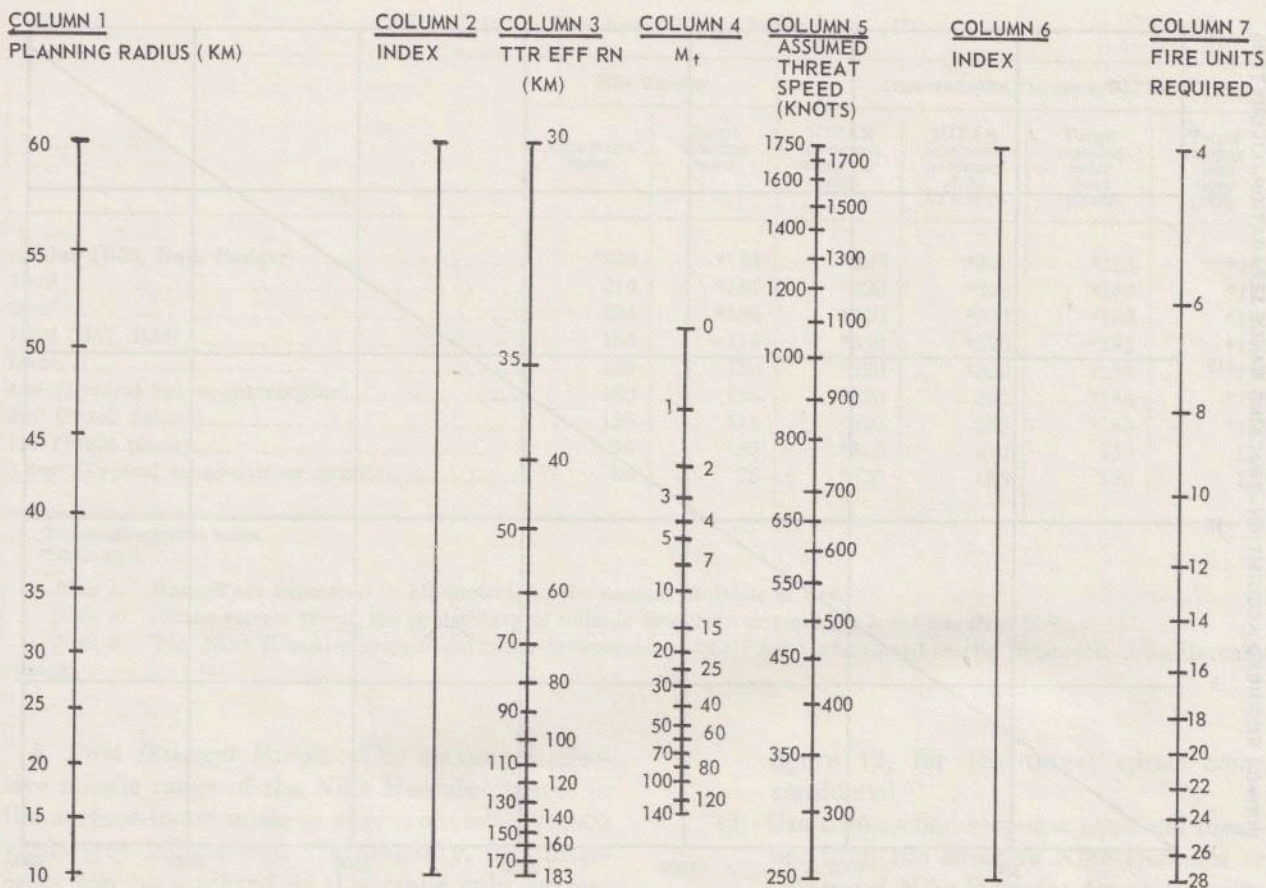


Figure 13 (SECRET). Nike Hercules Planning Nomograph (U).

g. Planning Nomograph. Figure 13 is used in the planning and designing of certain types of Nike Hercules defenses, as described in paragraph 5, appendix II, FM 44-1.

h. Time-Along-Trajectory. Figure 14 is used to construct missile trajectory scales, as described in paragraph 16, appendix II, FM 44-1. Figure 14 plots missile time of flight versus altitude and ground range, with all data measured from the launcher position.

i. Dead Zone. The dead zone indicated in figure 14 is considered when constructing the burst locator, as described in paragraph 19b, appendix II, FM 44-1.

j. Rocket Motor Cluster Impact Area. Figure 15 depicts the rocket motor cluster impact area which, as stated in paragraph 7, appendix II, FM 44-1, should be considered during defense design. Figure 15 shows that all expended rocket motor clusters fall within a 2,190-meter radius

circle which is centered 1,930 meters from the launching section and in the direction of launcher orientation.

k. Reaction Times. (This is para 12b(1), FM 44-1.) The fast reaction time of the Nike Hercules system permits it to switch rapidly between targets in either the surface-to-air or the surface-to-surface mode of operation. Having fired on a surface target at maximum range, and assuming missiles prepared for the appropriate mission are available, a Nike Hercules battery can—

- (1) Fire a designated second missile at the same target within 15 seconds after guidance cutoff. The 15 seconds reaction time consists of a maximum of 11 seconds required for the missile-tracking radar to slew from the first missile to acquire the next designated missile on the launcher, and 4 seconds for the computer to settle.

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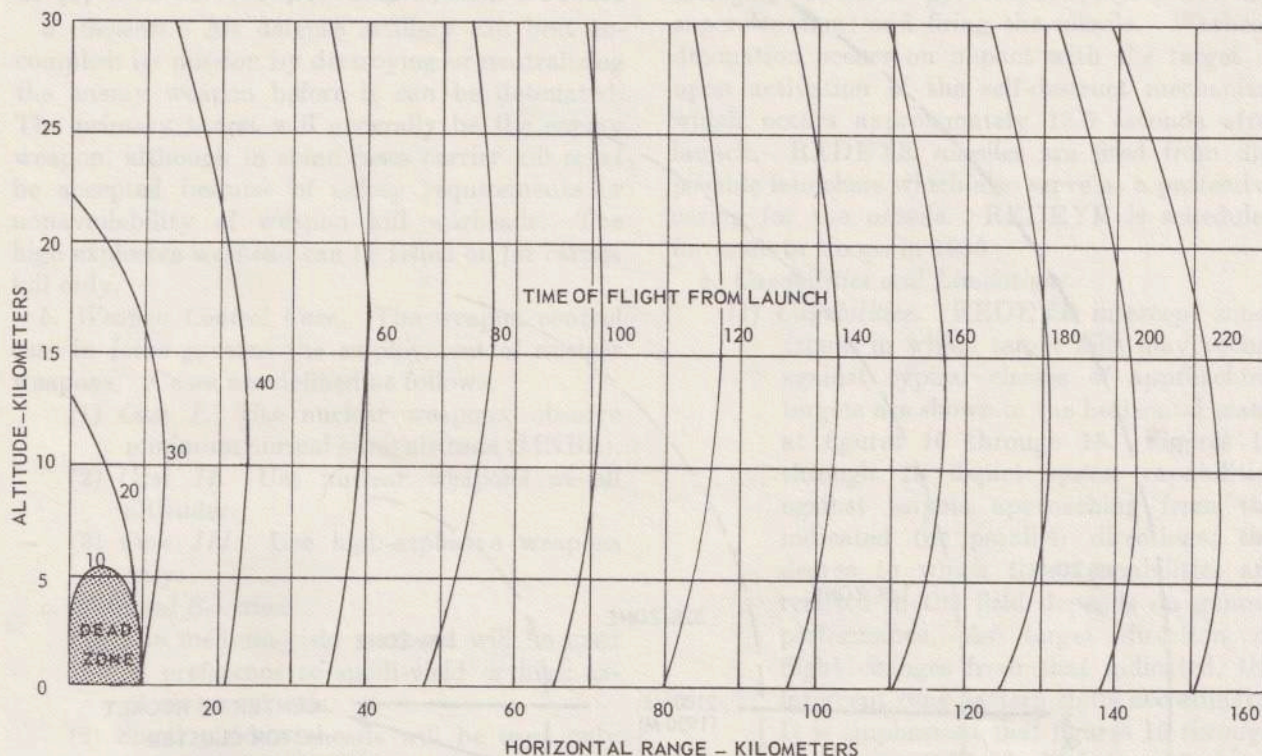


Figure 14 (CONFIDENTIAL). Nike Hercules Time-Along-Trajectory Graph (U).

- (2) Switch back to the surface-to-air mode and engage an airborne target within 15 seconds after completion of firing on a surface target, providing the acquisition radar operator is able to designate the airborne target to the target-tracking radar at nearly the instant the surface-to-surface firing is completed.
- (3) Engage a new surface target within 3 minutes, assuming the firing data for the new target has been precomputed and is available at the battery.

l. Miscellaneous Planning Data.

Battery average rate of fire: 1 round/2 minutes.
 Maximum target speed: 1,982 knots (3,673 kmph).
 Effective altitude limit: 100,000 feet (30,400 meters).
 Maximum effective range (SS): 200,000 yards (183,000 meters).
 Minimum effective range (SS): 33,500 yards (30,600 meters).

Battery emplacement time: 3 hours, using well-trained crew (assuming use of mobility equipment).

Battery march order time: 2 hours, using well-trained crew (assuming use of mobility equipment).

5. (C) Improved Nike Hercules Weapon System Characteristics

a. Effective ranges are determined as described in paragraphs 4 *a* and *b*.

b. The information presented in paragraph 4 *c* through *l* is also valid for Improved Nike Hercules, with the following exceptions:

- (1) Maximum target speed: 2,300 knots (4,280 kmph).
- (2) Maximum acquisition presentation range (with alternate battery acquisition radar or HIPAR): 350,000 yards (320 kilometers).
- (3) Emplacement and march order times exclude the alternate battery acquisition radar or HIPAR.

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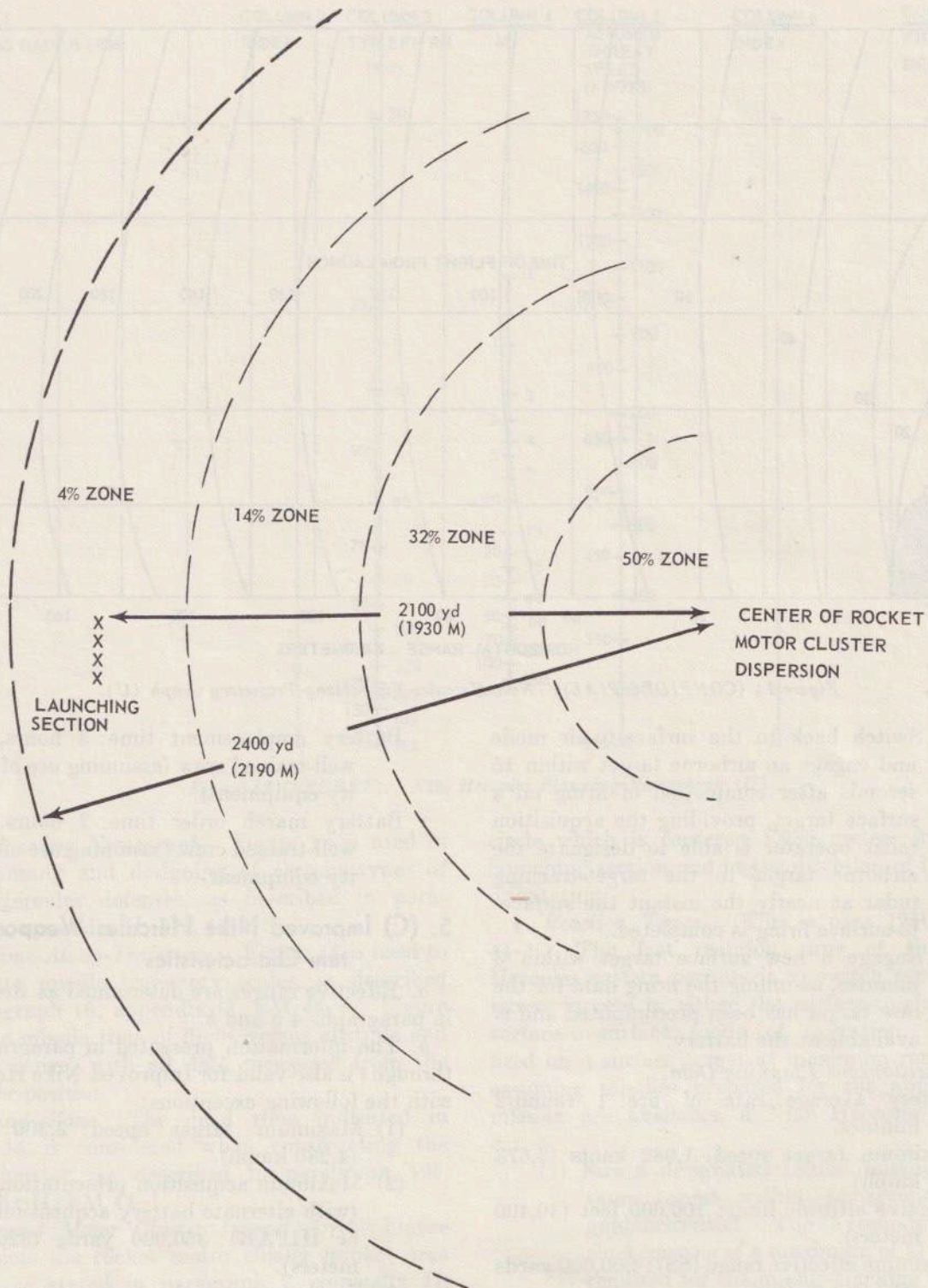


Figure 15 (CONFIDENTIAL—Modified Handling Authorized). Nike Hercules rocket motor cluster impact area (U).

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