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REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER: TOP 3-2-813	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): US ARMY TEST AND EVALUATION COMMAND TEST OPERATIONS PROCEDURE "FIELD OF FIRE"	5. TYPE OF REPORT & PERIOD COVERED: Final
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US ARMY COMBAT SYSTEMS TEST ACTIVITY (STECS-AD-A) ABERDEEN PROVING GROUND, MARYLAND 21005-5059	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: AMC-R 310-6
11. CONTROLLING OFFICE NAME AND ADDRESS: US ARMY TEST AND EVALUATION COMMAND (AMSTE-AD-M) ABERDEEN PROVING GROUND, MARYLAND 21005-5055	12. REPORT DATE: 22 March 1985
	13. NUMBER OF PAGES: 9
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report): Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Field of Fire
Maximum Angles of Depression & Elevation
Maximum Traverse Angles
Primary Armament
Secondary Armament
Vehicle-mounted weapons

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Provides procedures for determining the field of fire for vehicle-mounted primary and secondary armament (e.g., tank guns, armored personnel carriers).

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US ARMY TEST AND EVALUATION COMMAND
TEST OPERATIONS PROCEDURE

AMSTE-RP-702-102
*Test Operations Procedure 3-2-813 22 March 1985
AD No.

FIELD OF FIRE

1. SCOPE. This ~~TOP~~ test provides procedures for determining the field of fire (the area which a weapon or group of weapons can cover effectively with fire from a given position) for vehicle-mounted primary and secondary armament. This includes maximum elevation and depression angles at all traverse positions; maximum traverse angles or provisions for continuous traverse; and minimum range of anti-personnel fire at all positions of traverse.

Field of fire is an important factor in determining the effectiveness of combat vehicles. Field of fire is restricted by such factors as mechanical interference and limits of gun movement; limitations of physical movement of the operator in using available field of fire; zones of firing interference where line of fire intersects the vehicle; and suitability of limit switches, firing interrupters, and automatic devices to divert the gun from interference areas.

2. FACILITIES AND INSTRUMENTATION.

2.1 Facilities.

ITEM	REQUIREMENT
Turning circle	Large diameter with 10° intervals on circular periphery)
Feed chutes	
Ammunition boxes	
Dummy ammunition	
Ejection heads and chutes	
Spent cartridge and link containers	
Sights and mounts	
Antenna masts	
Canvas mantlet covers	

*This TOP supersedes MTP 3-2-813 dated 20 April 1966.

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2.2 Instrumentation.

ITEM	MAXIMUM PERMISSIBLE ERROR OF MEASUREMENT*
Gunner's quadrant Azimuth indicator Boresight kits	±0.4 mil

3. REQUIRED TEST CONDITIONS.

a. Using a level test area such as a large diameter concrete turning circle, mark radial lines from a center point to markers spaced at 10° intervals on the circular periphery.

b. Mount all primary and secondary armament together with dummy ammunition, ammunition boxes, feed chutes, ejection heads and chutes, spent cartridge and link containers, sights and sight mounts. Secure any stowage items on the exterior of the vehicle that might interfere with gun movement, the operator, or the line of fire. Mount antenna masts and canvas mantlet covers (dust shields).

c. Place the vehicle with the gun's traverse center of rotation over the center of the turning circle so that the gun is at a 0° reference azimuth and points directly at a 0° reference marker on the turning circle. Lock the pintle of ring mounts so that the center of the ring becomes the center of rotation.

d. Ensure that manual and power gun control systems operate properly and that limit switches are properly adjusted.

e. Remove the firing mechanism from the main gun to permit sighting through the firing pin hole. Define the bore centerline at the muzzle by taping two intersecting threads across the boresight witness marks. For machine guns, either use a boresight kit or remove the backplate and bolt in order to sight the barrel.

4. TEST PROCEDURES.

4.1 Gun Traverse Test. Determine gun traverse angles at full elevation and depression for weapons 20 mm and larger by the following procedures:

a. Place the gun at maximum allowable elevation by manual control. Measure the angle with a gunner's quadrant. Record items that prevent further elevation. If the item involved is a mechanical elevation stop, determine the additional elevation angle that can be obtained by its removal. When the limiting factor is mechanical interference, determine if a mechanical stop is required to protect the interfering component of the gun.

b. Traverse the gun through 360° or the maximum possible angle. Record any change in the maximum elevation, identify the points of mechanical elevation interference, and the traverse angles through which interference occurs. Record the location, elevation, and traverse angles through which interference with the

*Values can be assumed to represent ±2SD; thus, the stated tolerances should not be exceeded in more than 1 measurement of 20.

line of sight occurs and the vehicle components that would be struck by projectiles and the reduction of available angles caused by restraint of body movement of the crew. Observe limitations upon loading the weapon when it is at maximum elevation (see Figure 1).

c. Depress the gun and note any tendency to stick or bind as it departs from maximum elevation.

d. Place the gun at maximum allowable depression by manual control. Measure the angle with a gunner's quadrant. Record items that prevent further depression. If the item involved is a mechanical depression stop, determine the additional depression angle that can be obtained by its removal. When the limiting factor is mechanical interference, determine if a mechanical stop is required to protect the interfering component of the gun.

e. Traverse the gun through 360° or the maximum possible angle. Record any change in the maximum depression, identify the points of mechanical depression interference, and the traverse angles through which interference occurs. Record the location, depression, and traverse angles through which interference with the line of sight occurs and the vehicle components that would be struck by projectiles and the reduction of available angles caused by restraint of body movement of the crew. Observe limitations upon loading the weapon when it is at maximum depression (see Figure 1).

f. Elevate the gun and note any tendency to stick or bind as it departs from maximum depression.

g. Observe whether electrical or hydraulic connections limit the ability of the gun to traverse 360°.

h. Conduct procedures a through f above for guns with limited traverse. Record the maximum traverse available. Angles of traverse shall be measured by using the radial reference markers on the turning circle. An azimuth indicator can be used to determine traverse angles for rotating turrets.

i. Place the gun at full elevation by power control. Measure the elevation angle.

j. Place the gun at full depression by power control. Measure the depression angle.

k. Determine the adequacy and performance of limit switches, when applicable, to prevent driving the gun to its mechanical limit by the following method:

(1) Drive the gun from a depressed position at maximum power elevation rate into its maximum elevation position.

(2) Drive the gun from an elevated position at maximum power depression rate into its maximum depression position.

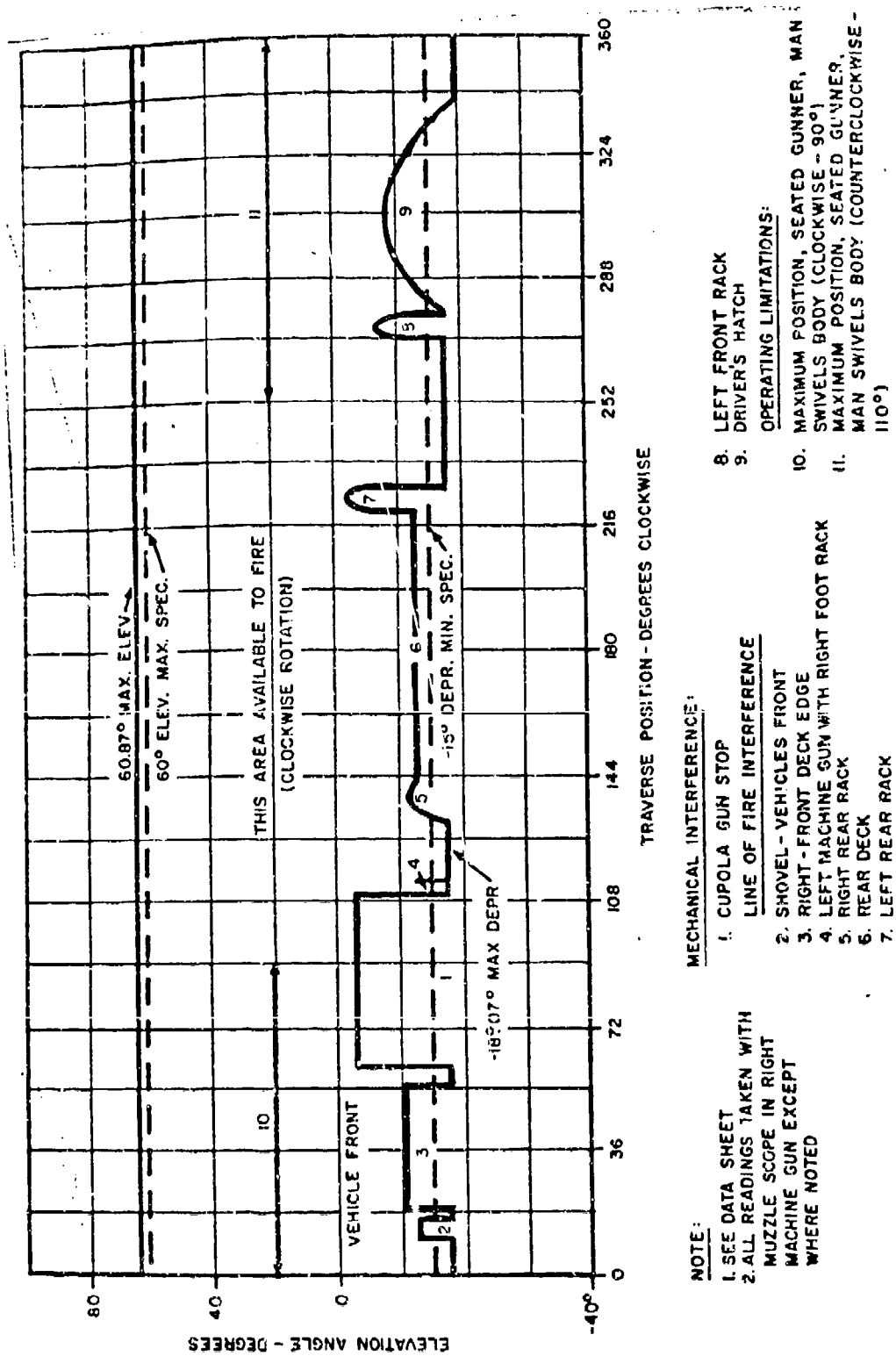

Figure 1. Field of fire, two machine guns, 7.62-mm, M73 for XM30 cupola.

4.2 Minimum Ranges of Fire. Determine these for weapons usually less than 20 mm by the following procedures:

a. Place the gun at full depression, aimed over the bow of the vehicle at the same reference 0° traverse.

b. Sight through the gun bore while an assistant outside the vehicle marks with chalk the point where the projected bore centerline intersects the surface of the turning circle.

c. Traverse the gun through 360°. The projected bore will define a circular path concentric with the turning circle except when interference with gun movement or obstructions in the line of fire occur. When possible, elevate the gun to clear an interference.

d. Define the appropriate projected points of interference with chalk marks on the turning circle. When the gun elevation causes its projection to be too far from the center of the turning circle for convenient measurement, measure and record the gun angle with a gunner's quadrant. The interference zone projections usually result in radial lines and arc of concentric circles. NOTE: The chalk marks on the turning circle and, when required, the gunner's quadrant measurements form polar coordinates of the minimum ranges of fire.

e. Transfer the interference points to polar graph paper by measuring the horizontal distance of each point from the center of the turning circle, and by measuring the azimuth of each point to the nearest degree.

f. Reposition the vehicle for each gun with gun's center of traverse placed over the center of the turning circle. Typical results are shown in Figures 2 and 3. NOTE: The vehicle selected to demonstrate typical results was chosen because of its varied assortment of vehicle obstructions. Most direct-fire weapon systems are equipped with either electrical or mechanical gun stops that ensure the weapon's clearing all vehicle obstructions. Under these conditions, limit switches and stops shall be checked for compatibility with the particular vehicle.

5. DATA REQUIRED.

5.1 Gun Traverse Test.

5.1.1 Elevation check. Record the following:

a. Maximum elevation angle

b. Items that prevent further elevation

c. Maximum elevation angle obtainable with mechanical stop removed, when applicable

d. Requirement of mechanical stop

e. Changes in maximum allowable elevation angle for continuous or limited traverse guns, and traverse angle location

f. Location, elevation, and traverse angles in which:

(1) Interference with line of sight and the vehicle components that would be struck by projectiles

(2) Reduction of available angles caused by crew movement restraints

g. Loading limitations with weapon at maximum elevation

h. Tendency of gun to stick or bind when depressed

5.1.2 Depression check. Record the following:

a. Maximum depression angle

b. Items that prevent further depression

c. Maximum depression angle obtainable with mechanical stop removed, when applicable

d. Requirement of mechanical stop

e. Changes in maximum allowable depression angle for continuous or limited traverse guns, and traverse angle location

f. Location, depression, and traverse angles in which:

(1) Interference with line of sight and the vehicle components that would be struck by projectiles

(2) Reduction of available angles caused by crew movement restraints

g. Loading limitations with weapon at maximum depression

h. Tendency of gun to stick or bind when elevated

5.1.3 Power Elevation/Depression Check. Record the following:

a. Maximum elevation angle

b. Maximum depression angle

c. Adequacy and performance of limit switches

5.1.4 Record electrical or hydraulic connection interference.

5.2 Minimum Ranges of Fire. Record, when applicable, the gunner's quadrant readings. Record turning circle chalk marks and, when applicable, the gunner's quadrant readings on polar coordinate paper.

6. DATA PRESENTATION. Plot suitable representation of the complete field of fire for each gun, and note thereon all limitations of the possible firing areas, as suggested by Figures 1 through 3. In reporting results, qualify all limitations and interference zones as to necessity for redesigning vehicle

components or requirement for safety devices. Compare the results with known military characteristics of the weapon being tested.

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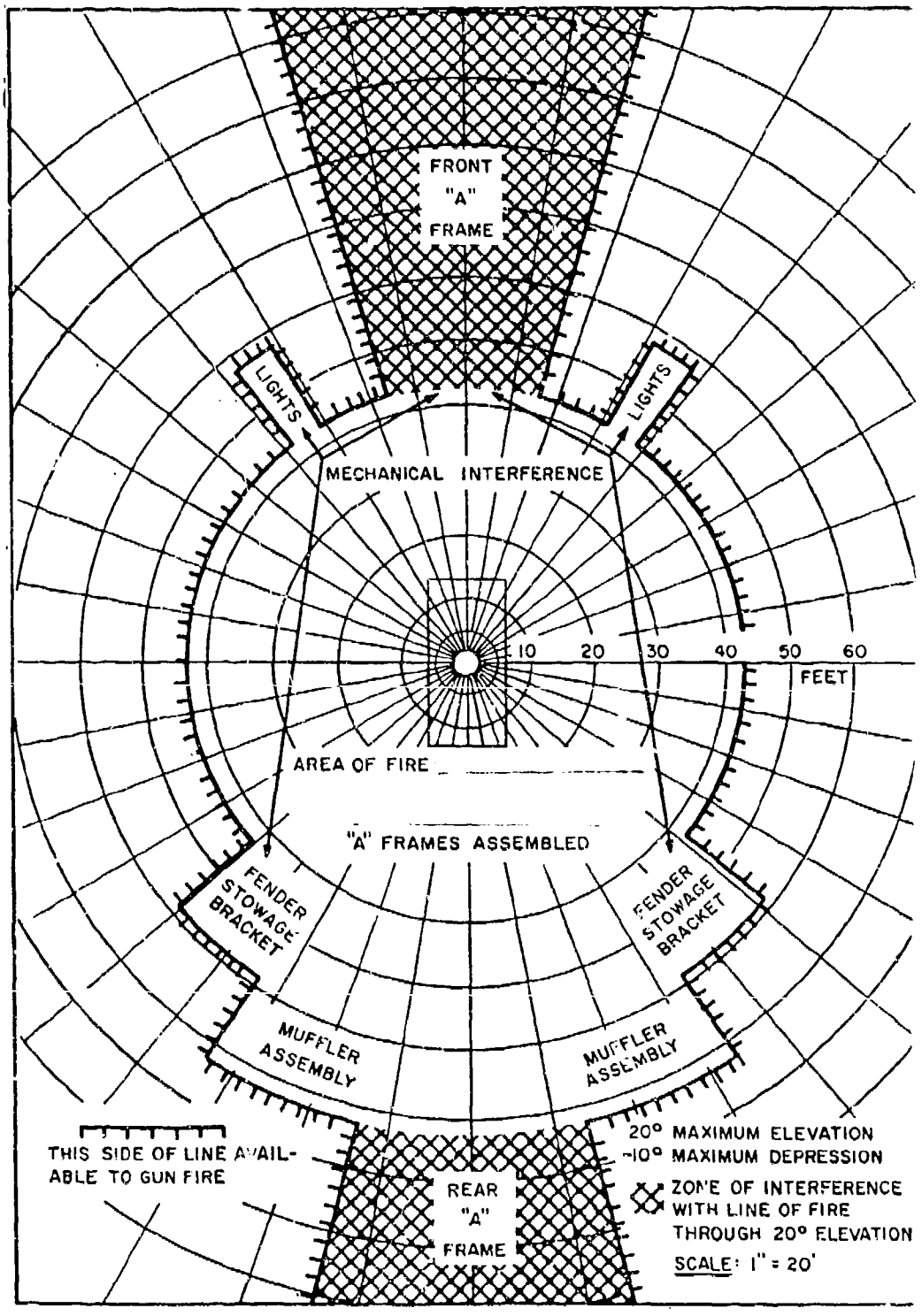

Figure 2. Plot of minimum ranges of fire for primary weapon.

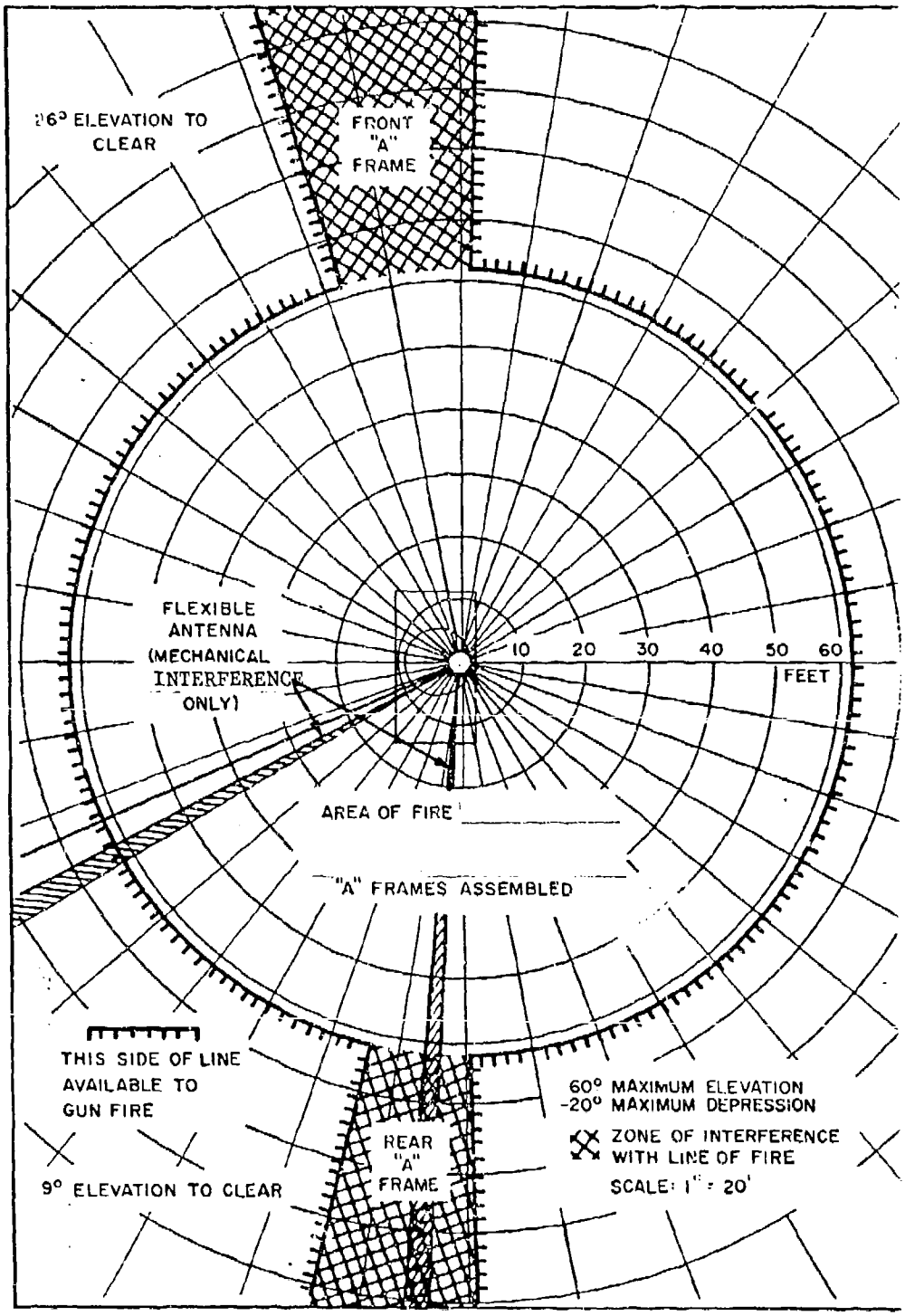

Figure 3. Plot of minimum ranges of fire for secondary weapon.