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TACTICAL DATA
FOR
TORPEDOES MARK XIV & XIV-1
HIGH POWER
LOW POWER

MC 12/4/41
Officer in Charge

[Signature] 12/3/41
Officer of Section

HLB 11/13/41
Head Engineer *actg*

Stockard 10/14/41
Senior Engineer

WBE
Engineer

NAVY DEPARTMENT,
BUREAU OF ORDNANCE,
WASHINGTON, D.C.

Dec. 4, 1941

[Signature]
Chief of Bureau

[illegible]

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OD 2158 (Rev. 1)	CHANGE 1
OD 2557 (Rev. 4)	CHANGE 1
OD 3089 (Rev. B)	CHANGE 1
OD 3379	CHANGE 1
OD 3699	CHANGE 1
OD 3731	CHANGE 1
OD 3823 (Rev. B)	CHANGE 1
OD 4398 (Rev. A)	CHANGE 1
OD 4455	CHANGE 1
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Approved by The Chief of The Bureau of Ordnance

9 July 1945

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	OD 1880 (Rev. 3)	GUN DIRECTOR MK 27 AND GUN DIRECTOR MK 27 MOD 1
	OD 2158 (Rev. 1)	MULTIPLE TURRET TRAIN INDICATOR MK 8 (FOR CAs 33 AND 35)
	OD 2557 (Rev. 4)	GUN DIRECTOR MK 32 AND MK 32 MOD 1, 2, 3 AND 4.
	OD 3089 (Rev. B)	CONTROL UNIT, RELAY BOX AND MOTOR FOR GYRO SETTING MECHANISMS MKS 11, 13, 14 AND MODS
	OD 3379	TEST OF GYRO SETTING MECHANISMS FOR SS 170 to 175
	OD 3699	TACTICAL DATA FOR TORPEDOES MK 14 AND MK 14 MOD 1 (HIGH POWER, LOW POWER)
	OD 3731	MIRROR TILTING DEVICE (FOR B.S.)
	OD 3823 (Rev. B)	TORPEDOES, WARHEAD CHARACTERISTICS
	OD 4398 (Rev. A)	TABLE OF ESTIMATED LIVES OF U.S. NAVAL GUNS
	OD 4455	TELESCOPE FOR 8.8-cm DECK GUN (GERMAN TYPE) - DESCRIPTION
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TACTICAL DATA FOR TORPEDOES MARK XIV & XIV-1

HIGH & LOW POWER

INTRODUCTION

1. The data supplied in this publication were compiled from records of extensive submarine firings and the records of proof firing of all of the subject torpedoes which have been assigned to date for submarine use. No appreciable differences between the performance characteristics of the Mark XIV and Mark XIV-1 torpedoes have been observed.

2. These data apply only to the submarine firing of the subject torpedoes. Torpedo run time is measured from the instant of closing of the firing key. Torpedo run, advance and transfer are measured from the tube muzzle.

3. The torpedo ejection velocities and the ejection times, upon which these data are based are given by figures (A) and (B). These data are representative of average performance of the torpedo tubes and firing systems of submarines SS170 to 197, inclusive, and of the design of tubes and firing systems now in use on or projected for submarines SS198 to 284, inclusive.

TORPEDO RUN EQUATION

4. The subject torpedoes are regulated to run at constant speed after the initial acceleration period is complete. Torpedo run on a straight or curved path may be expressed by the general equation:

$$U = .563 T'a(Sz + Sy) - Uy$$

in which:

U = TORPEDO RUN, the distance in yards the actual torpedo runs from the muzzle of the tube to the point of intercept.

.563 = Constant for the conversion from knots to yards per second.

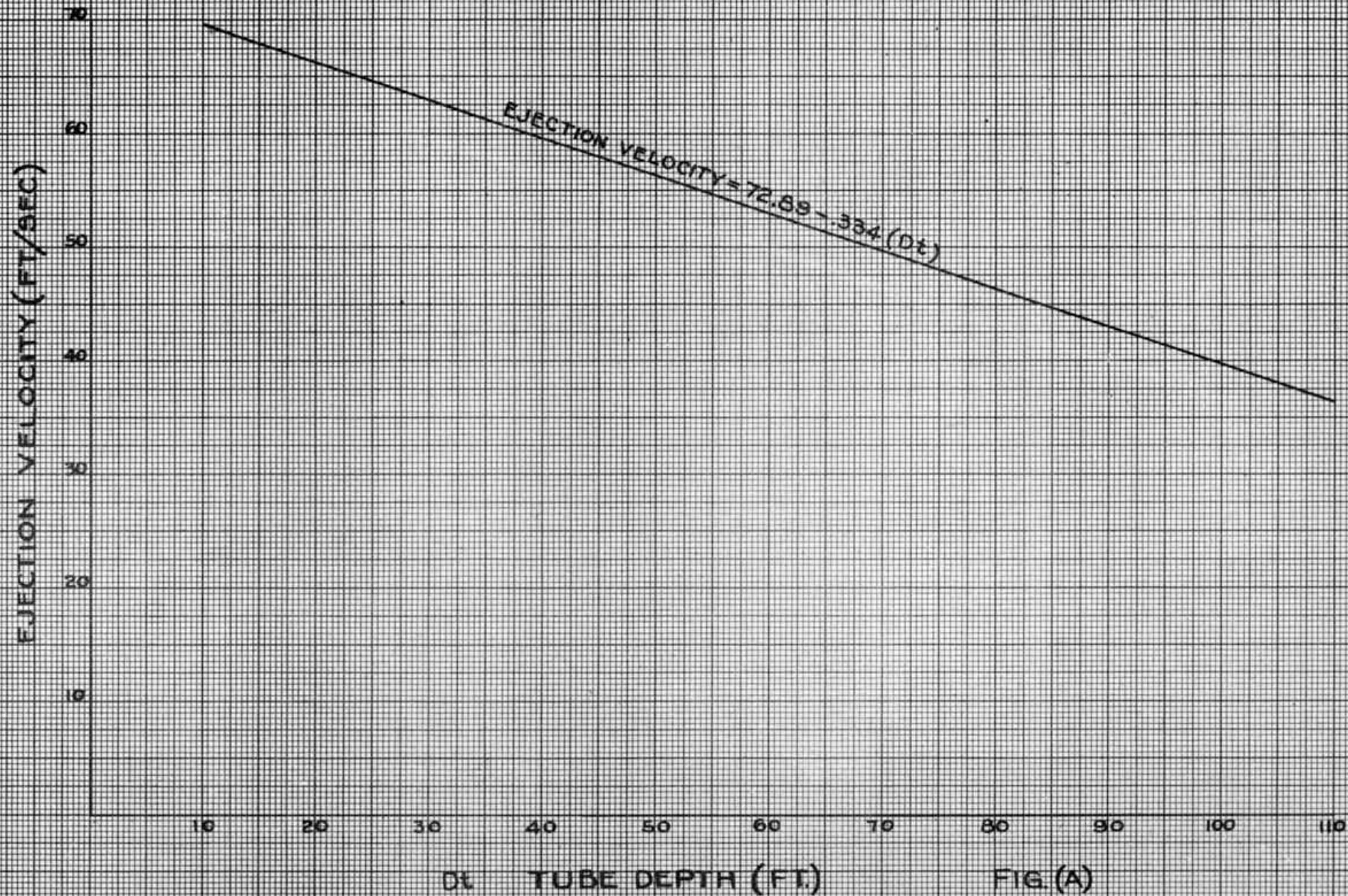


FIG. (A)

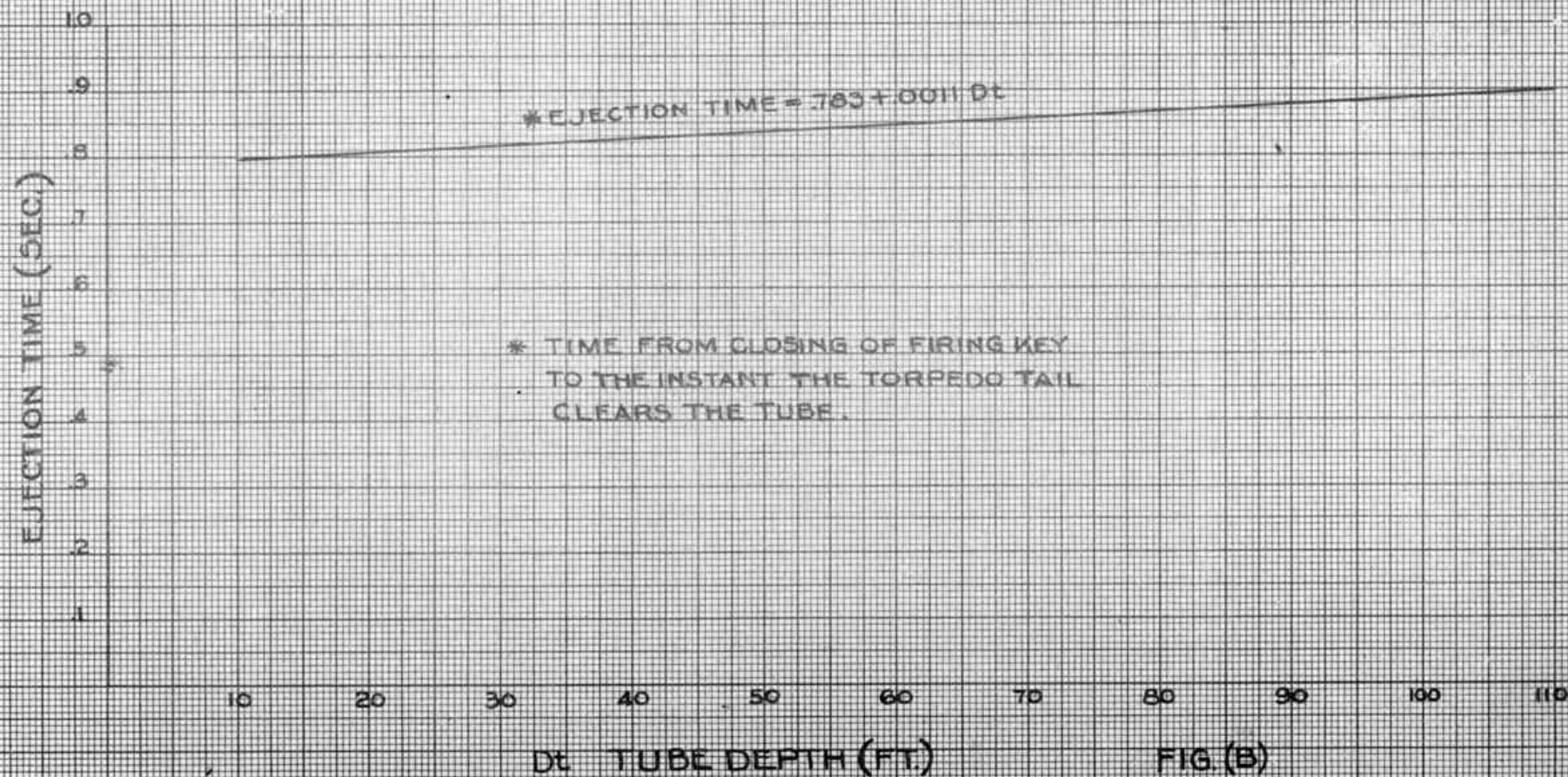


FIG. (B)

- Sz = TORPEDO RUNNING SPEED, the uniform running speed in knots at proof depth after the initial acceleration period is complete.
- Sy = DEPTH RUNNING SPEED CORRECTION, the correction in torpedo running speed in knots due to running at depths other than that at which it was proved.
- T'a = CORRECTED TIME OF TORPEDO RUN, the time between the instant of firing of the torpedo and the instant it crosses the target track.
- Uy = TORPEDO RUN DIFFERENCE, the difference in yards between the actual torpedo run for a given time and the distance it would have travelled in the same time at final running speed.

The values of Sz, Sy and Uy are given by figures (D) and (E) for high power and figures (M) and (N) for low power.

ANGLE FIRE PERFORMANCE

5. The subject torpedoes, when angle fired, start on a straight path, the length of which is designated as "Reach" and identified by the Letter M, and then describe a circular path of radius Z until the final course is reached. Figure (C) is a plot of the path of a typical curved shot. Reach, M, varies as a linear function of tube depth as shown by figures (F) and (O). The radii of curvature are constant at the values given by figures (F) and (O).

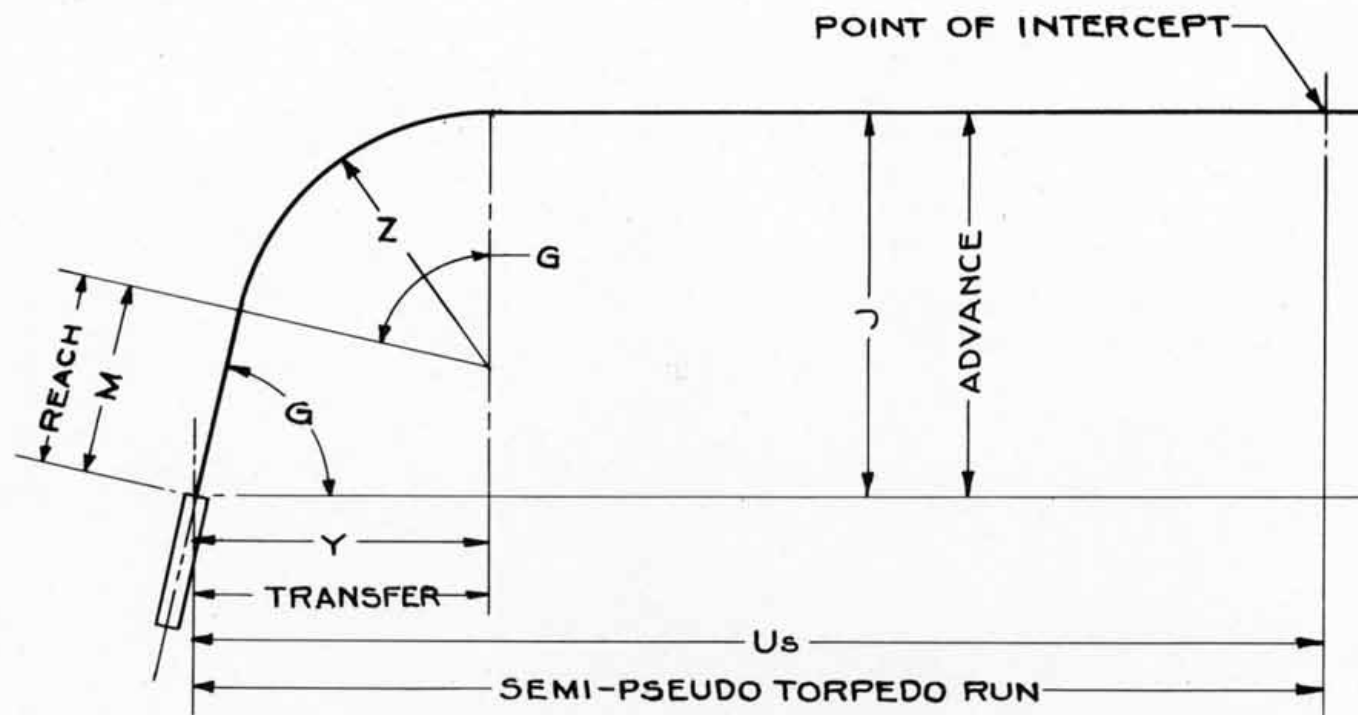


FIGURE (C)

6. The following equations may be set up directly from figure (C):

$$J = M \sin G + Z - Z \cos G \quad (1)$$

$$= M \sin G + Z(1 - \cos G) \quad (2)$$

$$Y = M \cos G + Z \sin G \quad (3)$$

$$U = U_s + U_g \quad (4)$$

$$U_g = M + \frac{\pi G Z}{180} - Y \quad (5)$$

$$= M + \frac{\pi G Z}{180} - M \cos G - Z \sin G$$

$$= M(1 - \cos G) + \frac{\pi G Z}{180} - Z \sin G \quad (5)$$

in which:

U_s = SEMI-PSEUDO TORPEDO RUN, the distance in yards measured from the tube muzzle, parallel to the final course of the torpedo to a point abreast of the point of intercept of the torpedo with the target.

U_g = TORPEDO ANGLE DIFFERENCE, the difference in yards between the length of the actual path of the torpedo from the tube muzzle to the point at which the curved path ends and the distance measured from the tube muzzle parallel to the final course of the torpedo to a point abreast of the end of the curved path.

G = GYRO ANGLE, the angle between the axis of the torpedo tube and the final track of the actual torpedo measured clockwise from 0° to 360° . (See note under "Computation Methods").

Y = TRANSFER, the distance in yards measured from the tube muzzle parallel to the final course of the torpedo to a point abreast of the end of the curved path.

J = TORPEDO ADVANCE, the perpendicular distance in yards between the track of the Actual Torpedo on its final course and the line from the tube muzzle parallel to the final course.

U_y (YDS.)

$$U_y = 86.71 + .26 Dt$$

TORPEDOES MK. XIV & XIV - 1
HIGH POWER

Dt TUBE DEPTH (FT.)

FIG. (D)

TORPEDOES MK XIV & XIV-1

HIGH POWER

S_z RUNNING SPEED AT PROOF DEPTH
OF 15 FEET, = 47.288 KNOTS

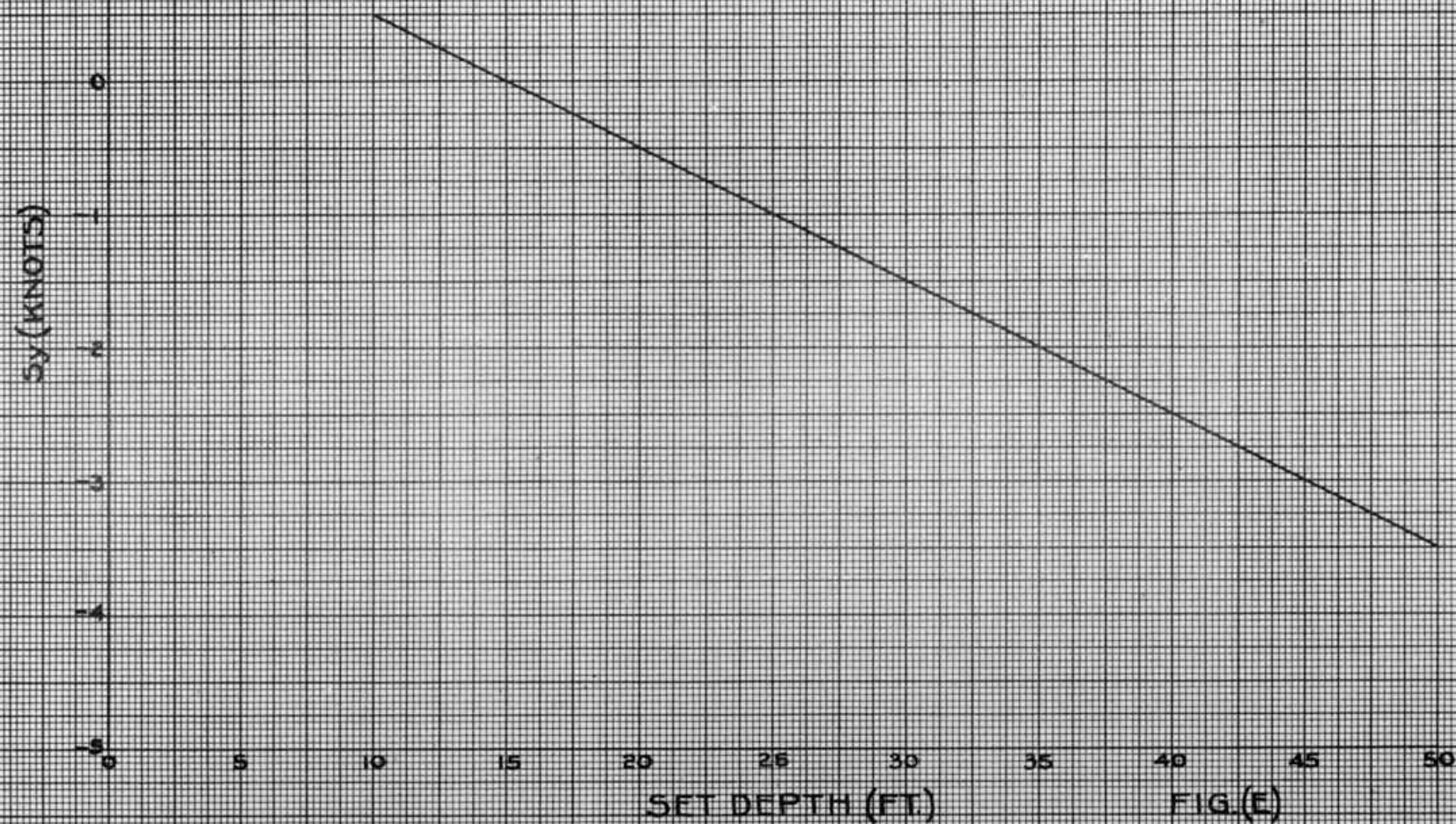


FIG (E)

(M) REACH(YDS.)

TORPEDOES MK. XIV & XIV-1
HIGH POWER

(HIGH POWER FOR G=0 TO 150)
Z=215 YDS.

REACH=M=93.30-.655 Dt

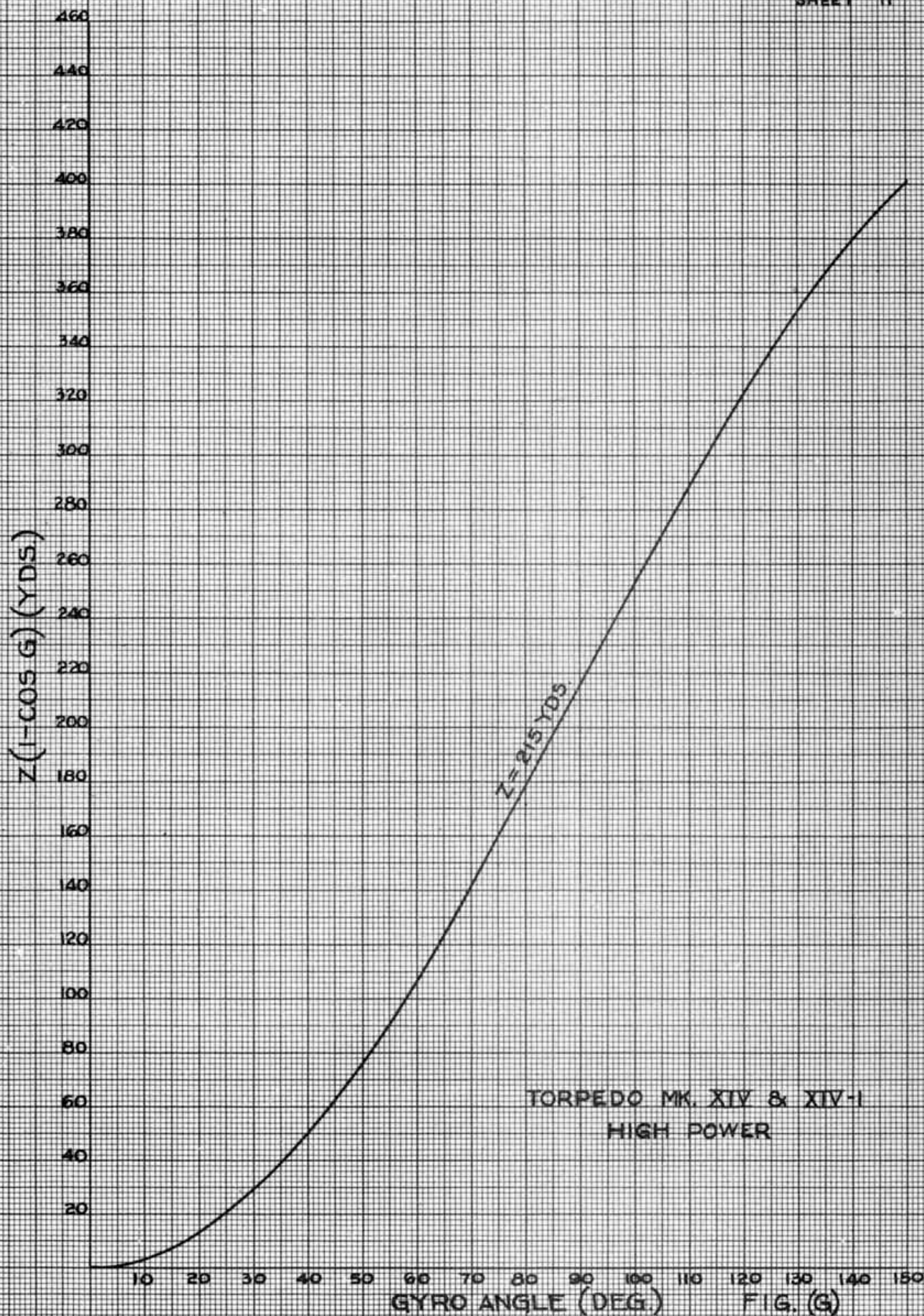
(HIGH POWER FOR G=210 TO 360)
Z=206 YDS.

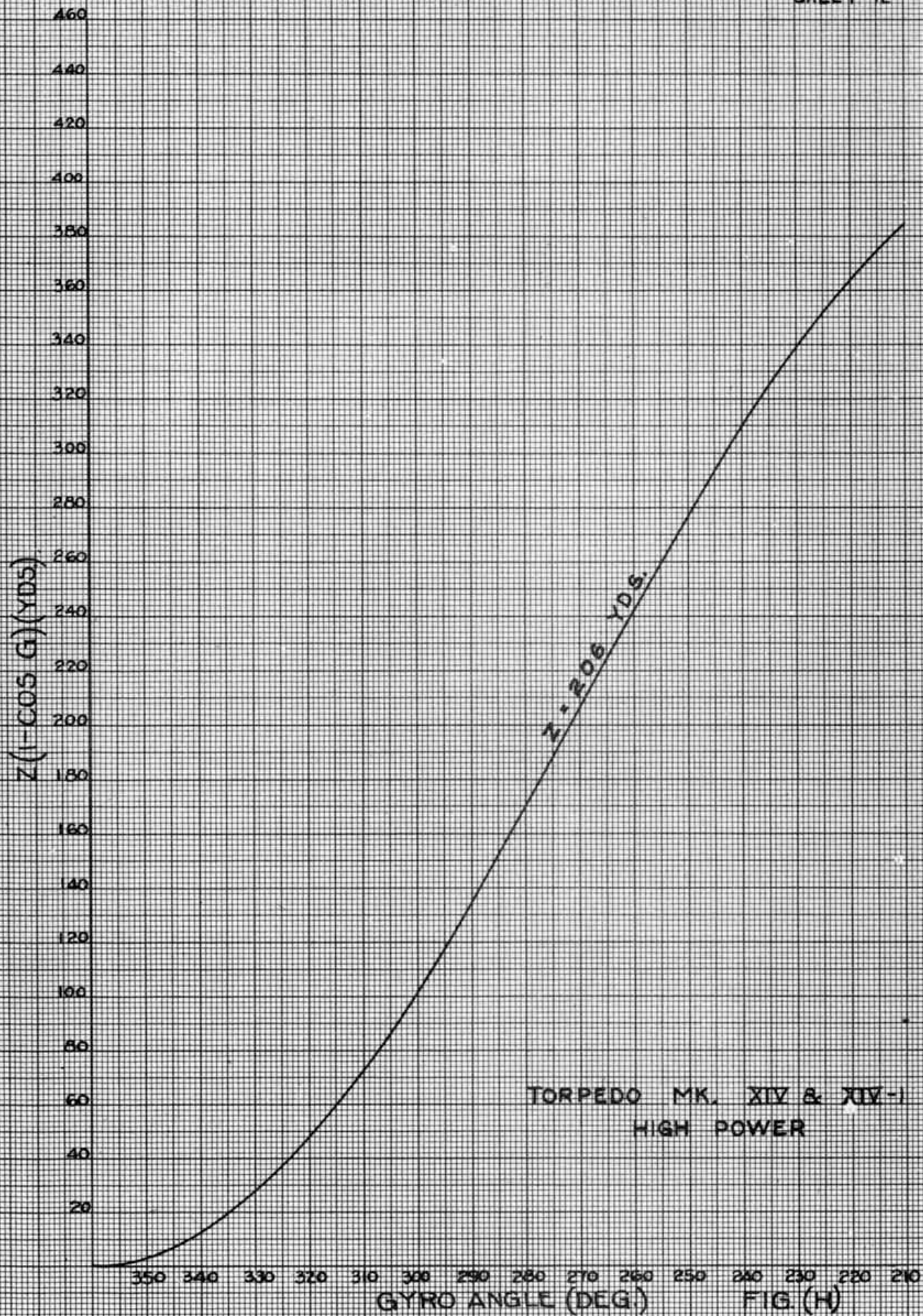
REACH=M=67.83-.655 Dt

10 20 30 40 50 60 70 80 90 100 110

Dt TUBE DEPTH (FT.)

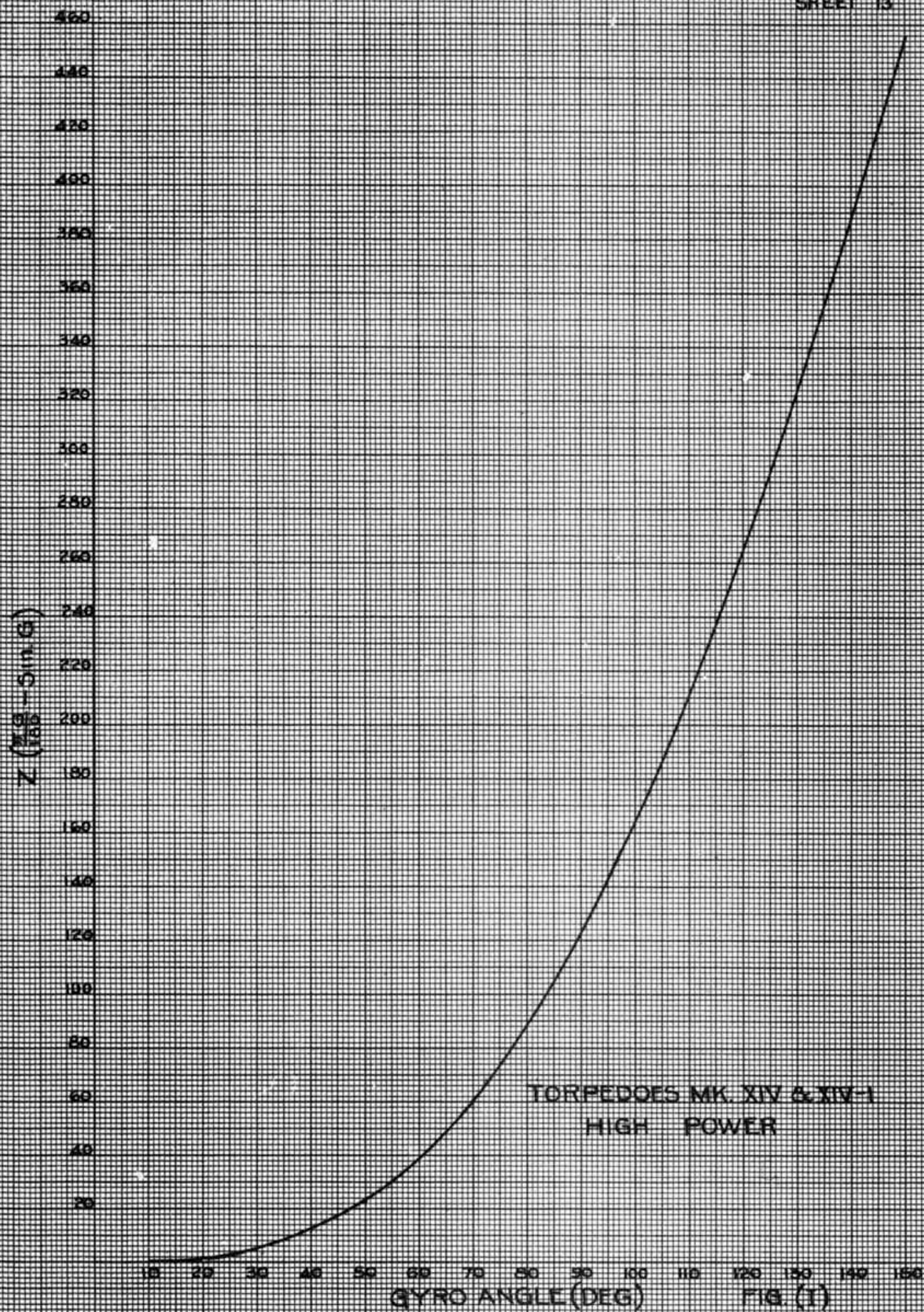
FIG.(F)

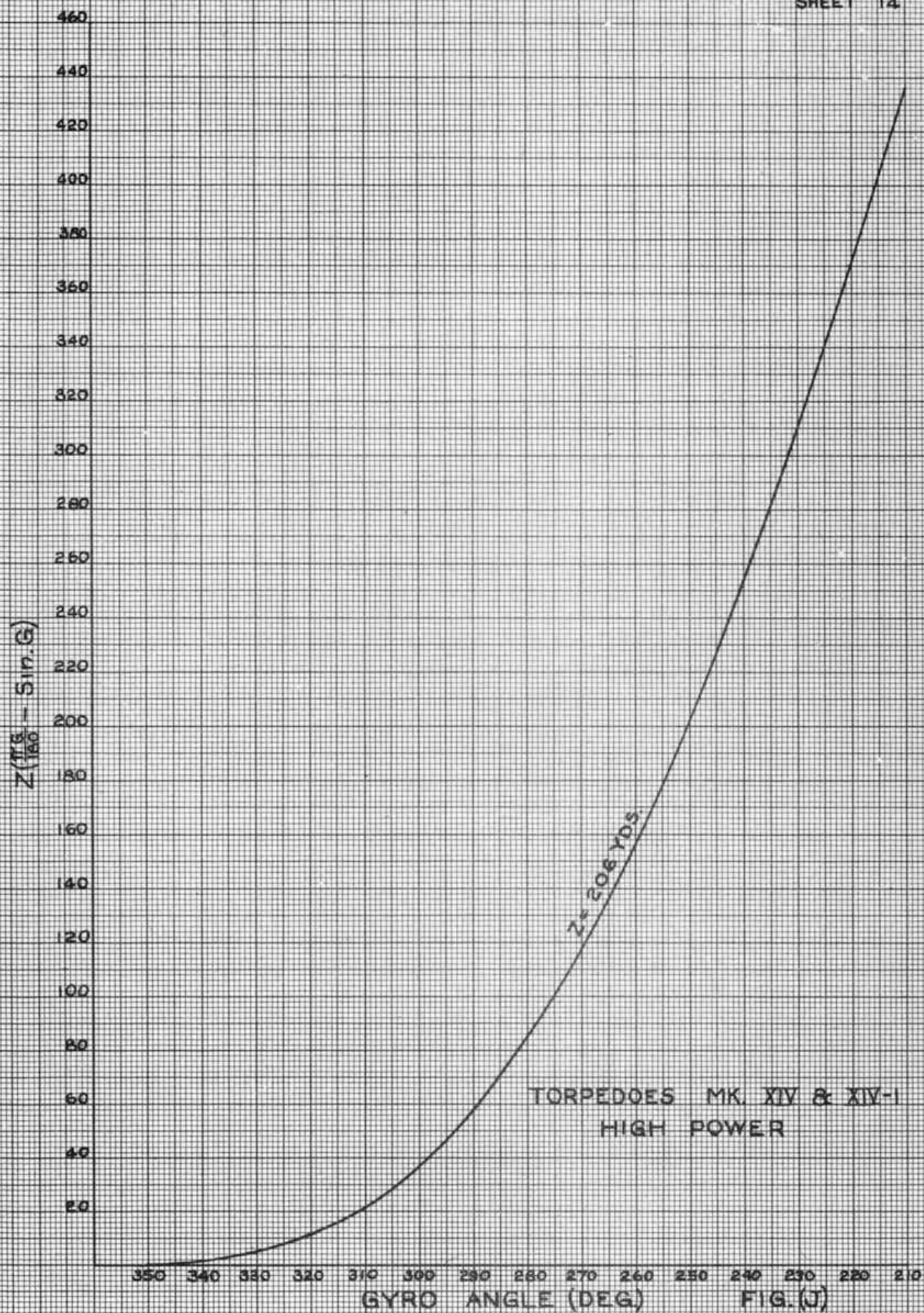


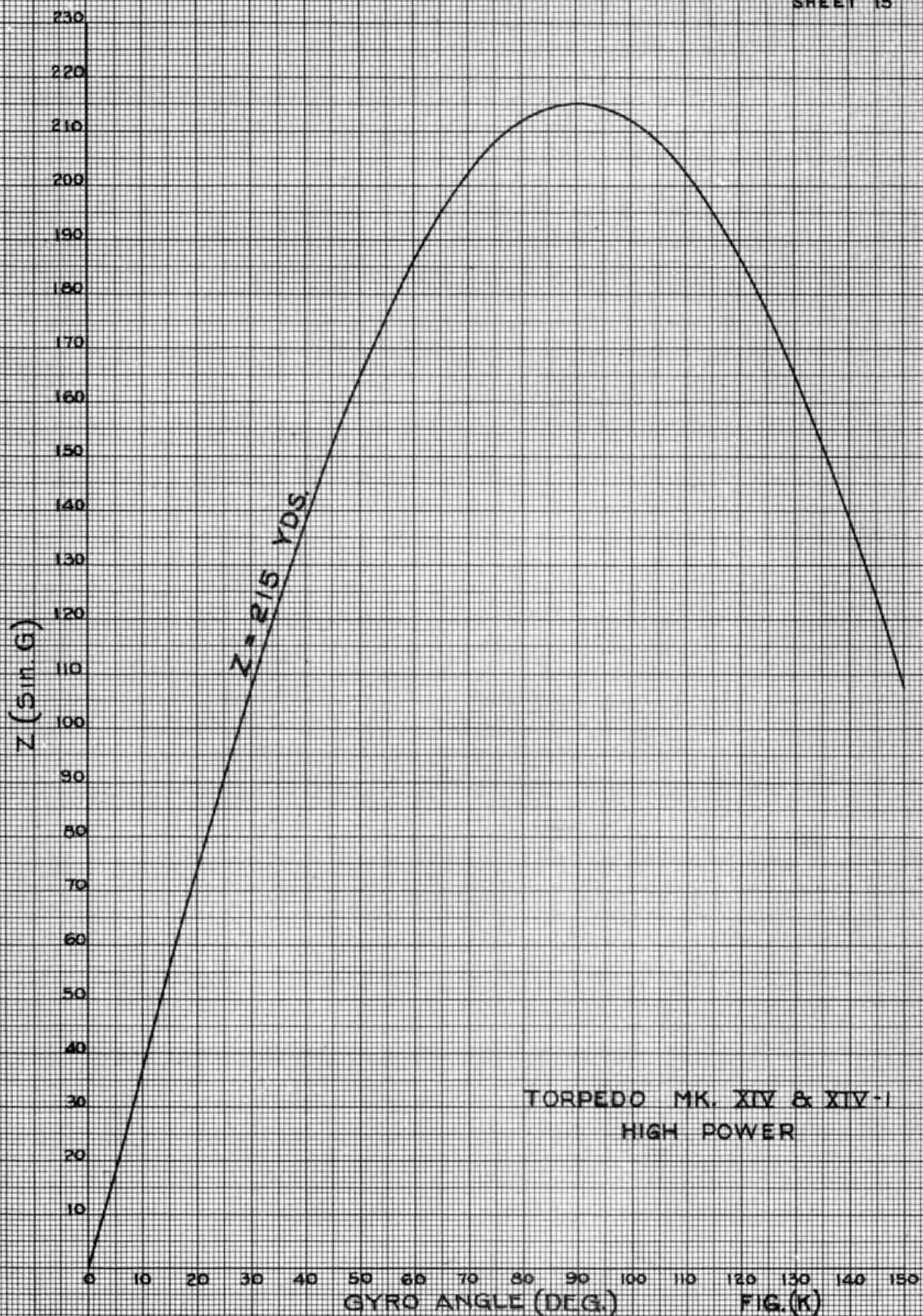


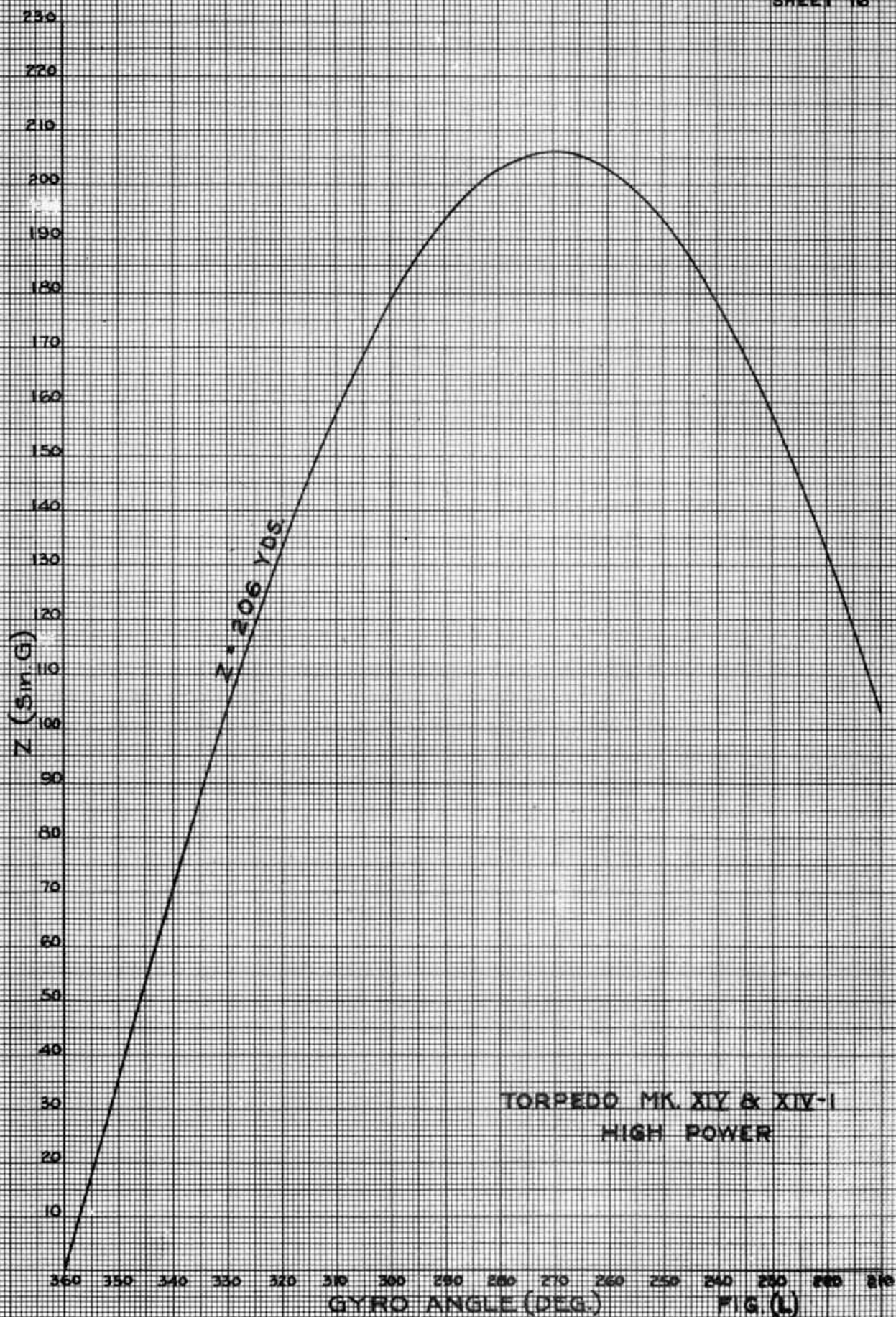
TORPEDO MK. XIV & XIV-1
HIGH POWER

FIG. (H)



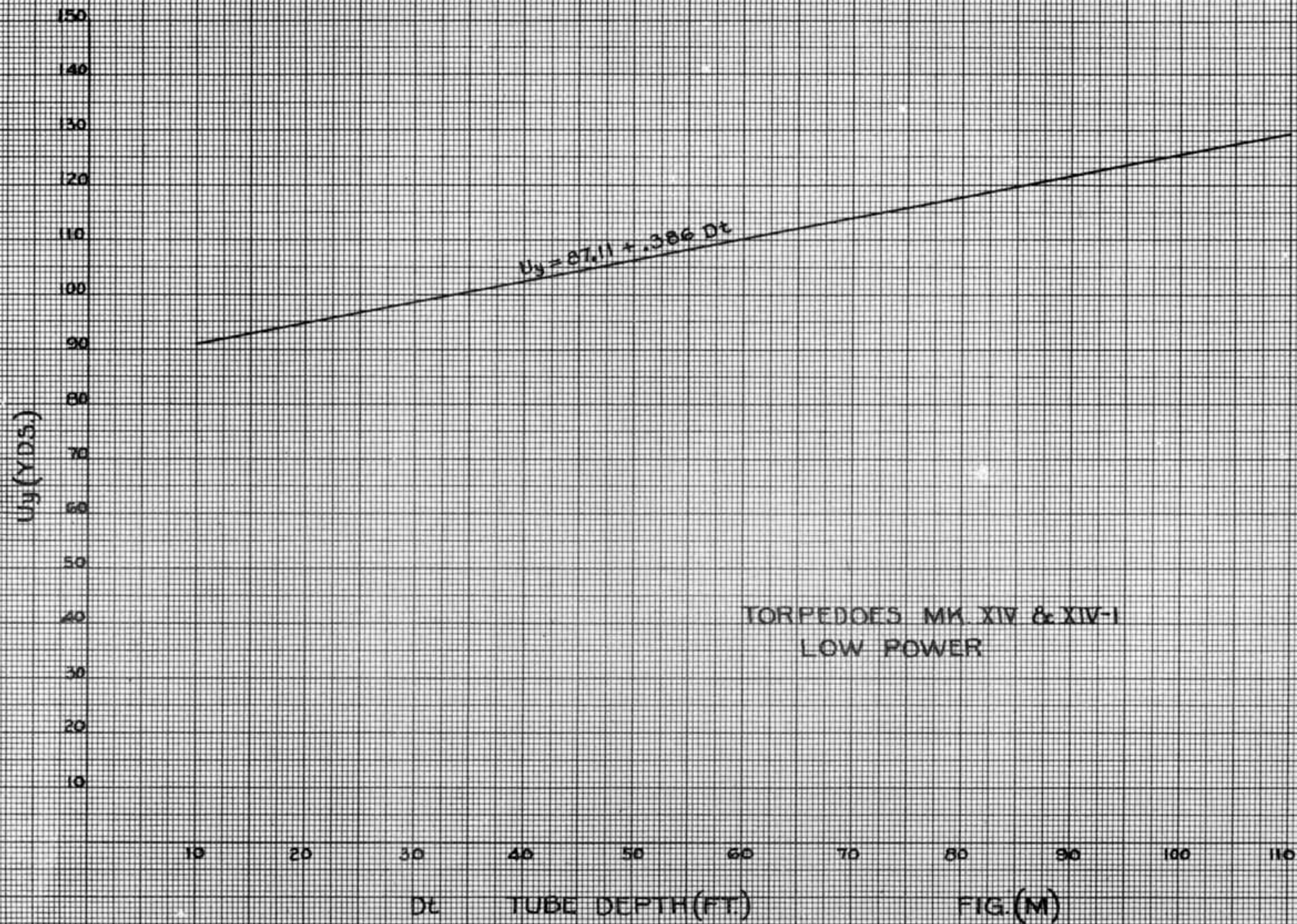






TORPEDO MK. XIV & XIV-1
HIGH POWER

FIG (L)



TORPEDOES MK XIV & XIV-1
LOW POWER

5z, RUNNING SPEED AT PROOF DEPTH
OF 15 FEET, = 31.827 KNOTS

5y (KNOTS)

SET DEPTH (FT.)

FIG. (N)

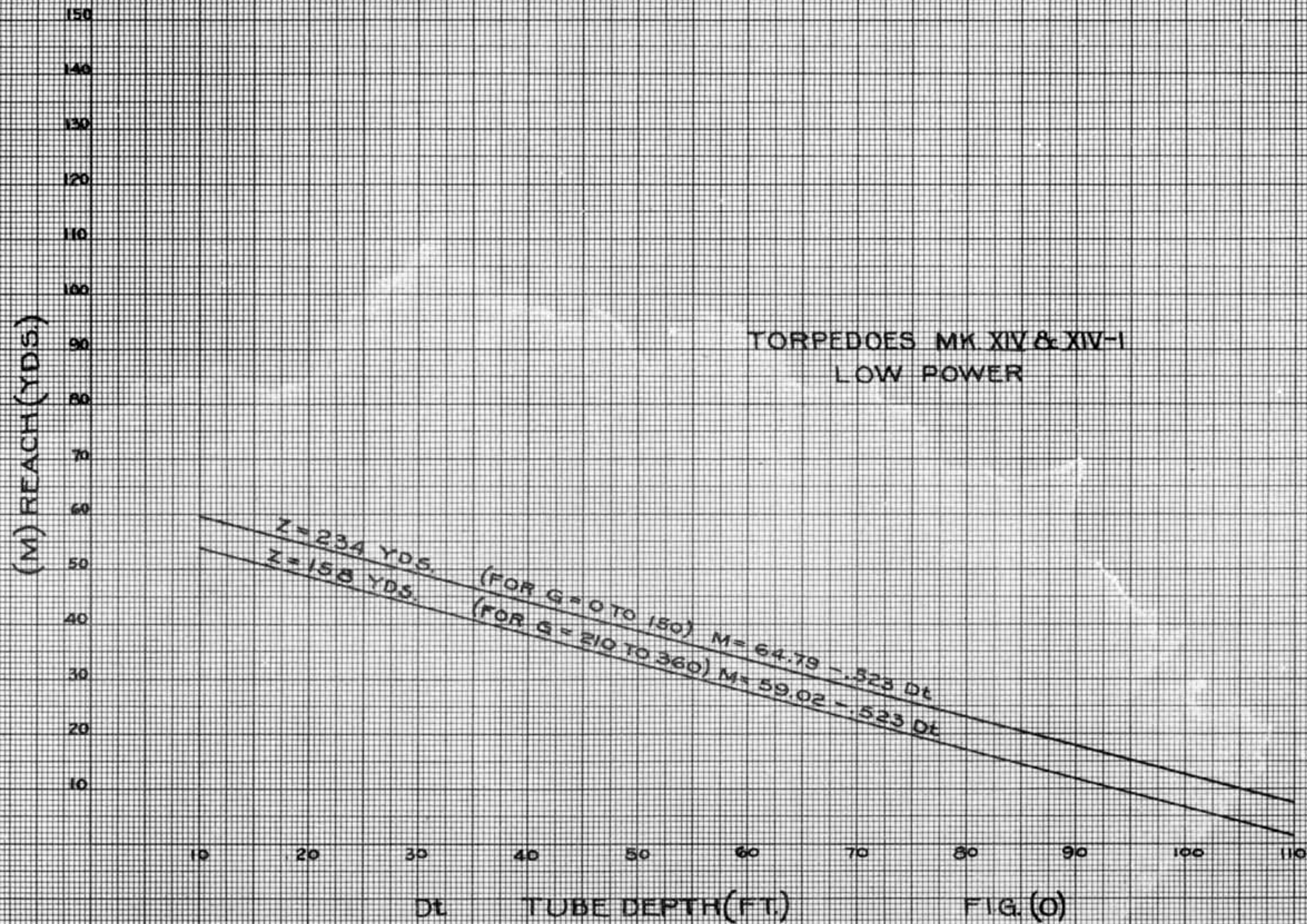
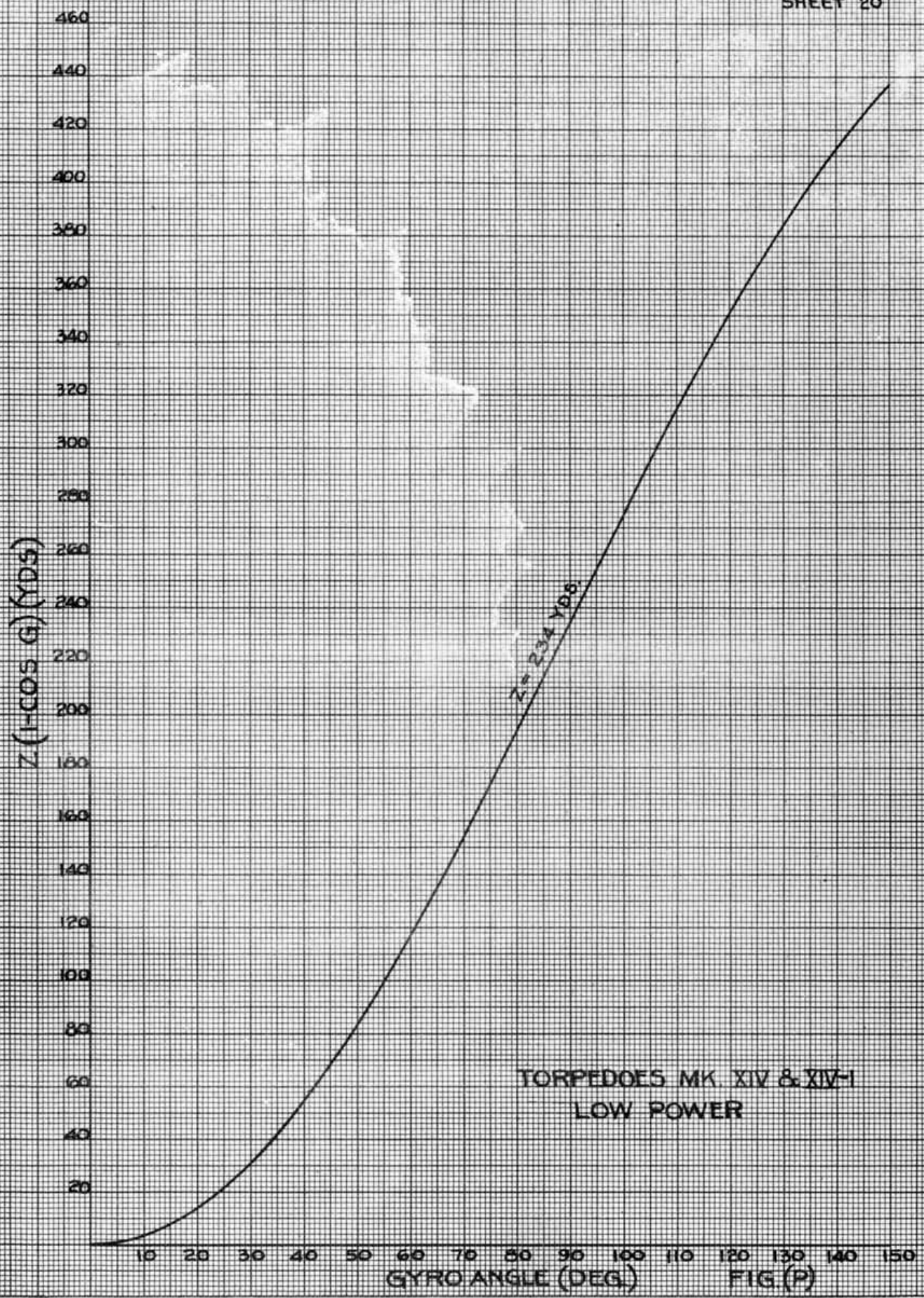


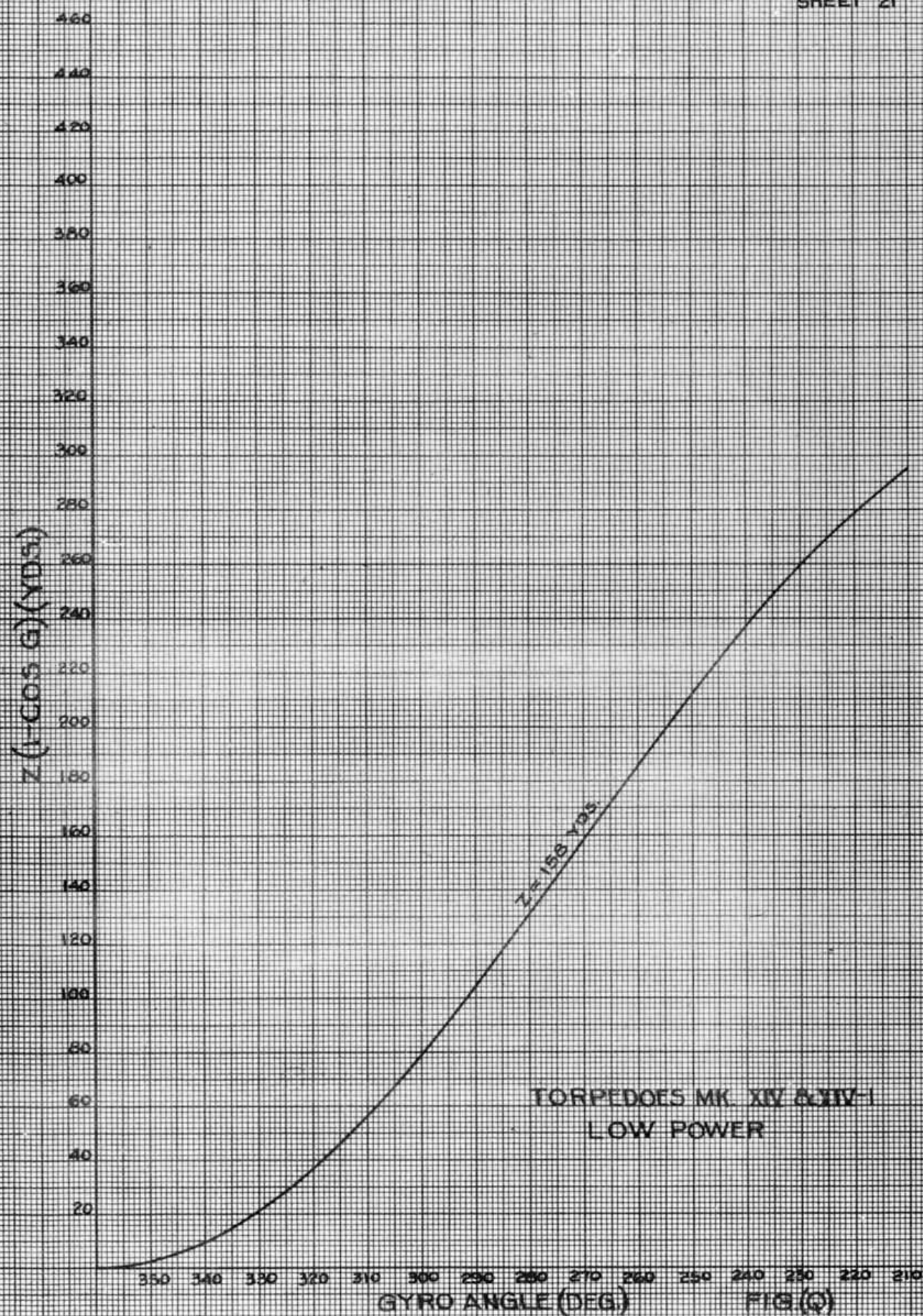
FIG. (O)

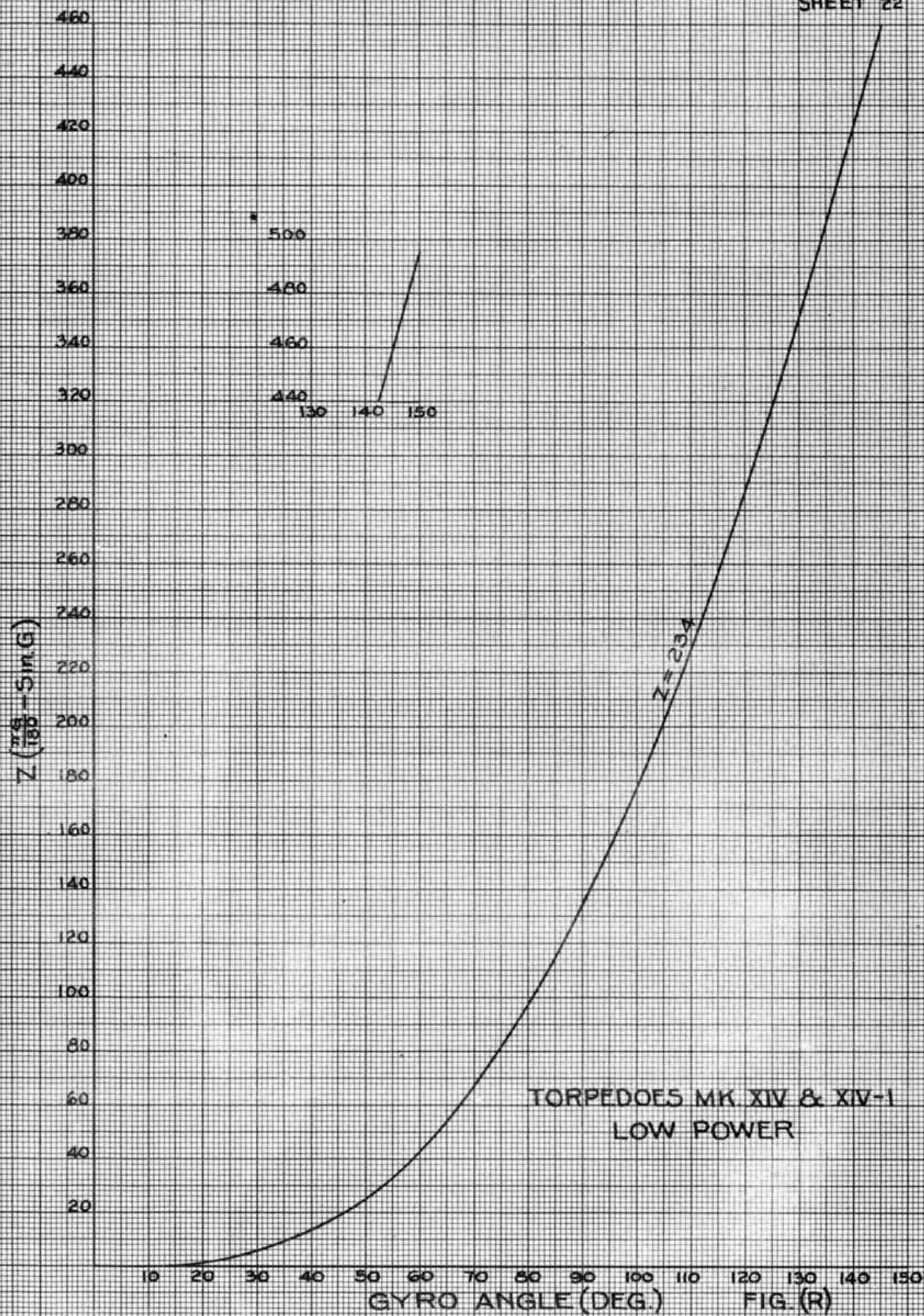


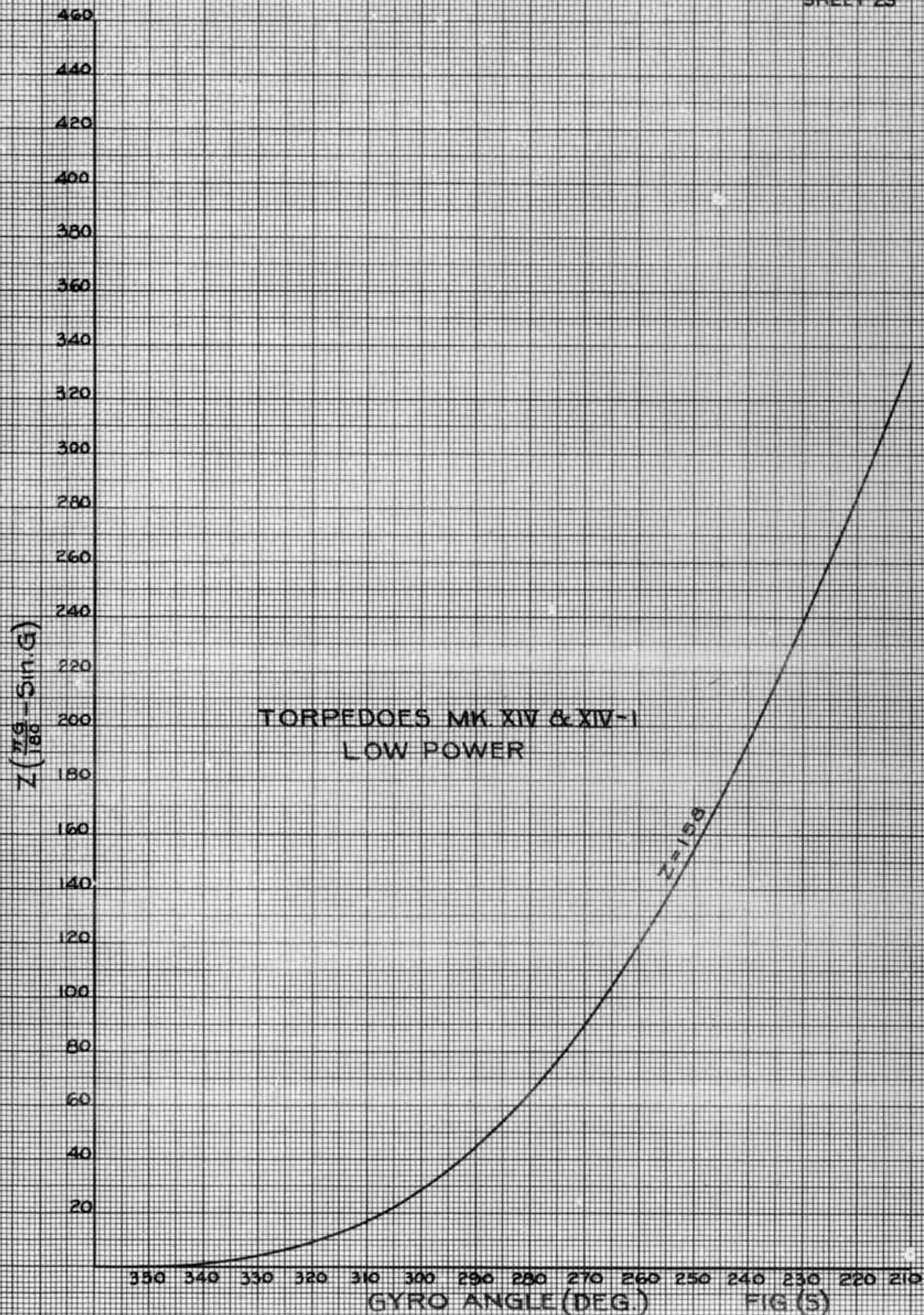
TORPEDOES MK XIV & XIV-1
LOW POWER

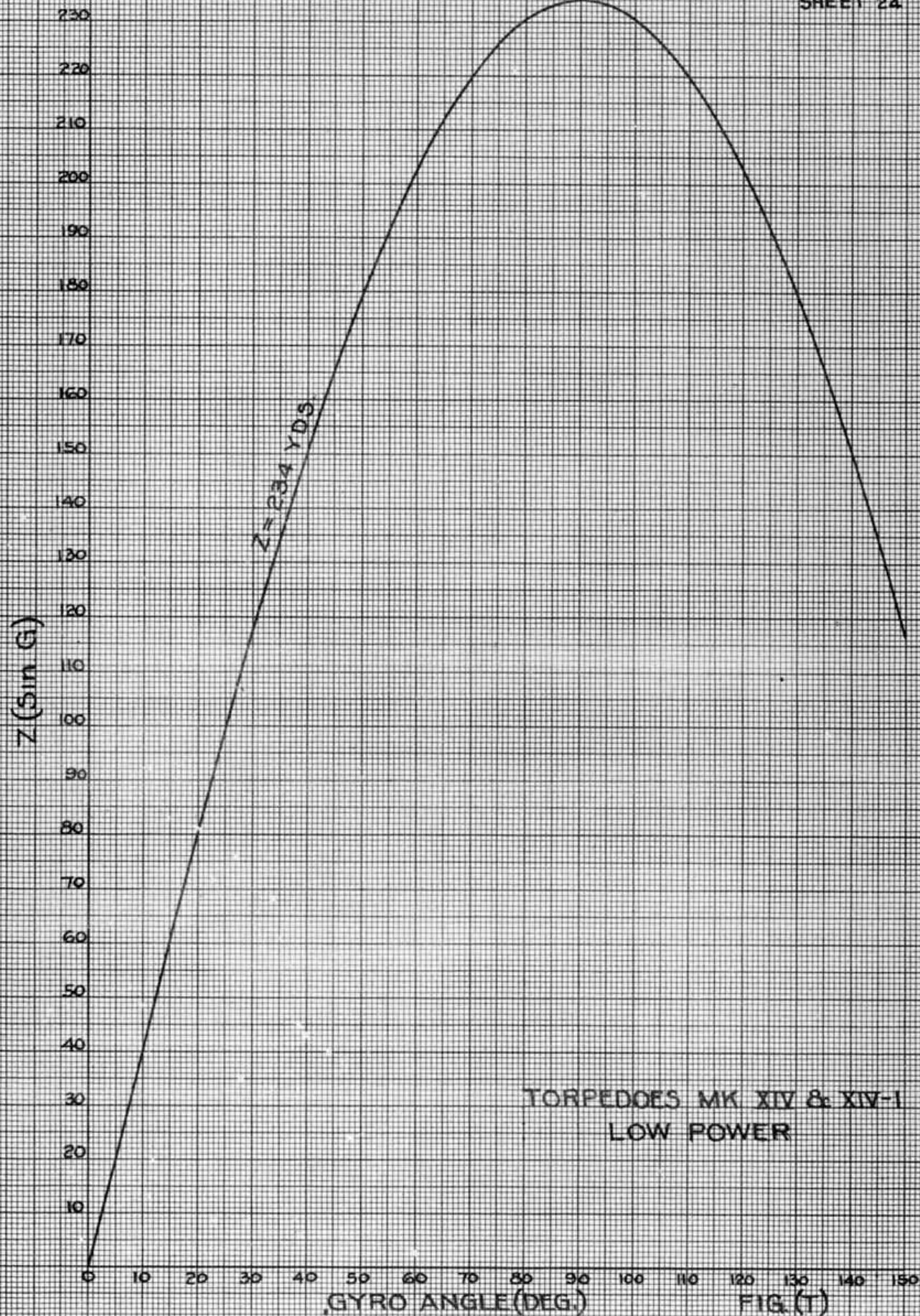
GYRO ANGLE (DEG.)

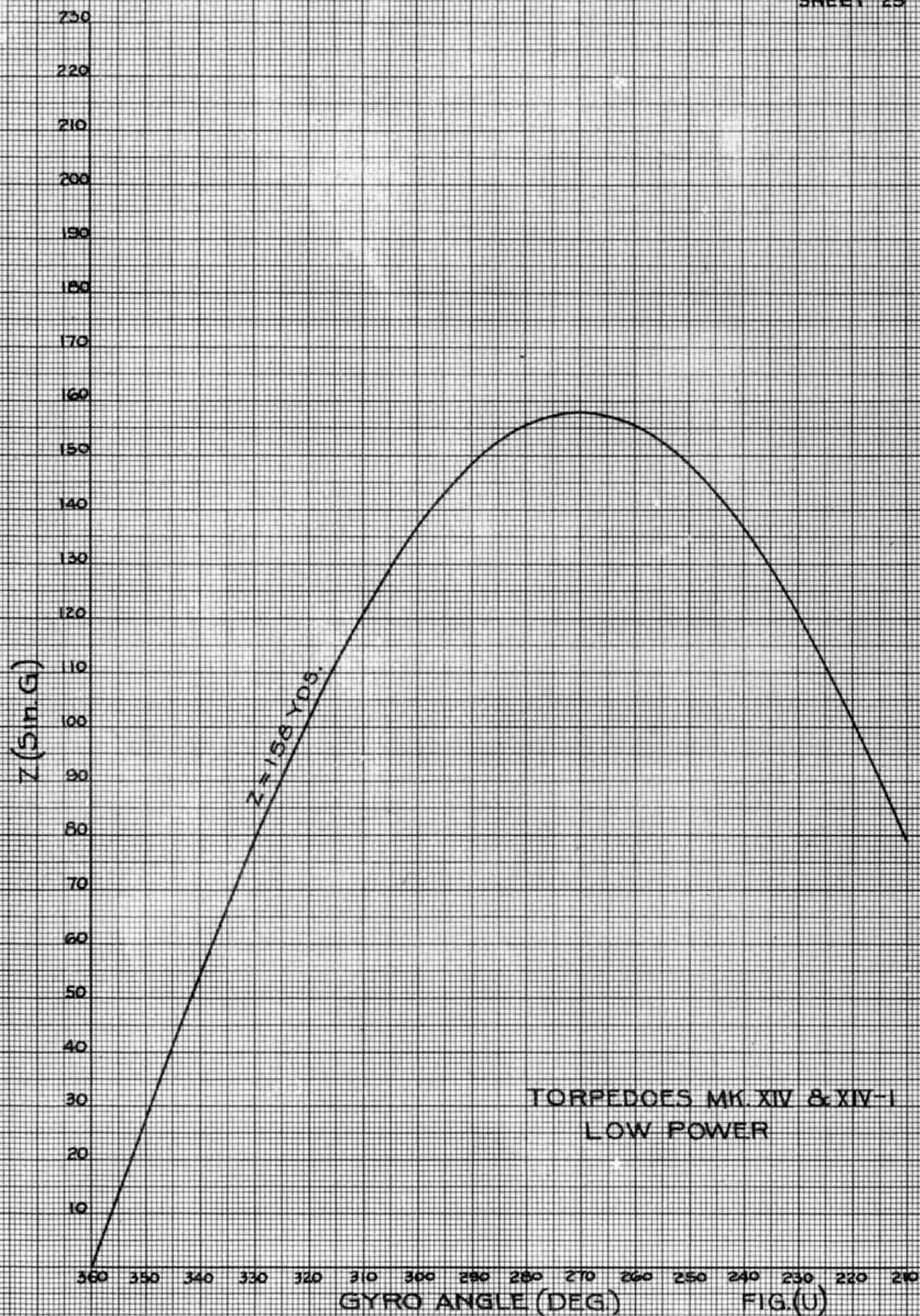
FIG (P)











COMPUTATION METHODS

NOTE:

In problems where gyro angles between 210 and 360 degrees are encountered, use trigonometric functions for the corresponding left gyro angles. For example, use functions for 150 degrees left when 210 degrees occurs.

7. To compute advance, J, for given values of gyro angle and tube depth, substitute values of M and $Z(1 - \cos G)$ from figures (F), (G) and (H) for high power and figures (O), (P) and (Q) for low power in equation (1) which is:

$$J = M \sin G + Z(1 - \cos G)$$

8. To compute transfer, Y, for given values of gyro angle and tube depth, substitute values of M and $Z \sin G$ from figures (F), (K) and (L) for high power and (O), (T) and (U) for low power in equation (2) which is:

$$Y = M \cos G + Z \sin G$$

9. To compute U_g for given values of gyro angle and tube depth, substitute values of M and $Z(\pi G/180 - \sin G)$ from figures (F), (I) and (J) for high power and figures (O), (R) and (S) for low power in equation (5) which is:

$$U_g = M(1 - \cos G) + \frac{Z(\pi G}{180} - \sin G)$$

10. To compute torpedo run, U, From given values of U_s , gyro angle and tube depth, add U_g as determined in paragraph 9 above to the value of U_s .

11. To compute corrected time of torpedo run, $T'a$, substitute values of U as determined in paragraph 10 above and values of U_y , S_z and S_y from figures (D) and (E) for high power and figures (M) and (N) for low power in the equation:

$$U = .563 T'a(S_z + S_y) - U_y \quad \text{or}$$

$$T'a = \frac{U + U_y}{.563(S_z + S_y)}$$

DEPTH PERFORMANCE

12. For high power operation with tube depths of 40 feet or more, the subject torpedoes run an average of 440 yards before reaching a running depth of 15 feet. This value of run is not appreciably affected by tube depth. No data are available for the shallower depths.

13. For low power operation, the run required to reach a 15 foot depth setting averages 401 yards for a tube depth of 100 feet and 356 yards for a tube depth of 50 feet.

14. The values of run given above should decrease rapidly with increase of set depth. Data on this phase of torpedo performance are not available. It is estimated that an increase from a depth set of 15 feet to 25 feet would decrease the run to set depth by nearly one hundred yards.

15. It is considered that the reason that torpedo run to set depth does not increase with tube depth at high power as it does at low power, is that the torpedo has sufficient propeller torque at shallow depths and high power to produce the acceleration that is required to cause the depth gear to produce a dive, while at low power the torpedo decelerates after it clears the tube and causes the depth gear to produce upward movement. The dive at high power appears to offset the increase in run time to set depth that would be expected to result from an increase in tube depth.