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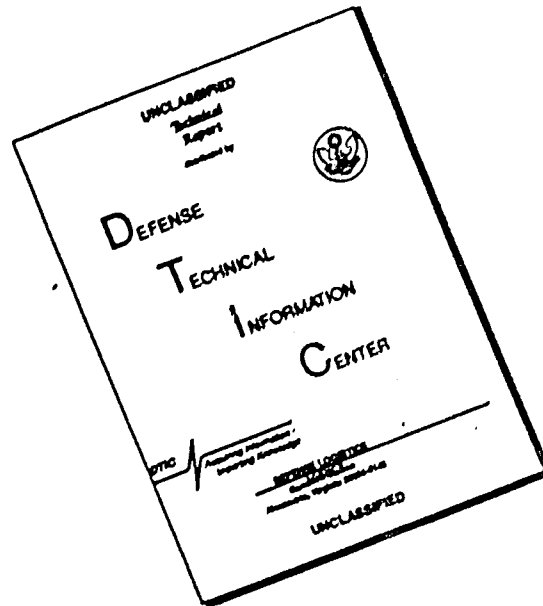
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~~RESTRICTED~~
HANDBOOK OF

**BALLISTIC AND ENGINEERING DATA
FOR AMMUNITION**



FC
~~RESTRICTED~~

VOLUME IV
T-1-1 to T-1-5 incl.

JULY 1950

Classification cancelled in accordance with
Executive Order 10501 issued 5 November 1953

J. Beel
7/1/54

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BALLISTIC RESEARCH LABORATORIES

ABERDEEN PROVING GROUND, MD.
~~RESTRICTED~~

TABLE OF CONTENTS

VOLUME IV - T-1-1 TO T-1-8 INCL.

	BRLH No.	Paragraph Nos.
For Projectile Type 1.....	T-1-1	1-5
For Projectile Type 2.....	T-1-2	1-6
For Projectile Type 5.....	T-1-5	1-6
For Projectile Type 6.....	T-1-6	1-6
For Projectile Type 7.....	T-1-7	1-4
For Projectile Type 8.....	T-1-8	1-4

Ballistic Research Laboratories
 Handbook of Ballistic and
 Engineering Data for Ammunition,
 No. T-1-1

Ballistic Research Lab.,
 Aberdeen Proving Ground,
 Maryland.
 24 March 1949

BALLISTIC AND ENGINEERING DATA
 for
 Projectile Type I

<u>Section</u>	<u>Paragraph</u>
I General -----	1
II Description -----	2- 3
III Exterior ballistic data -----	4 - 5

**SECTION I
 GENERAL**

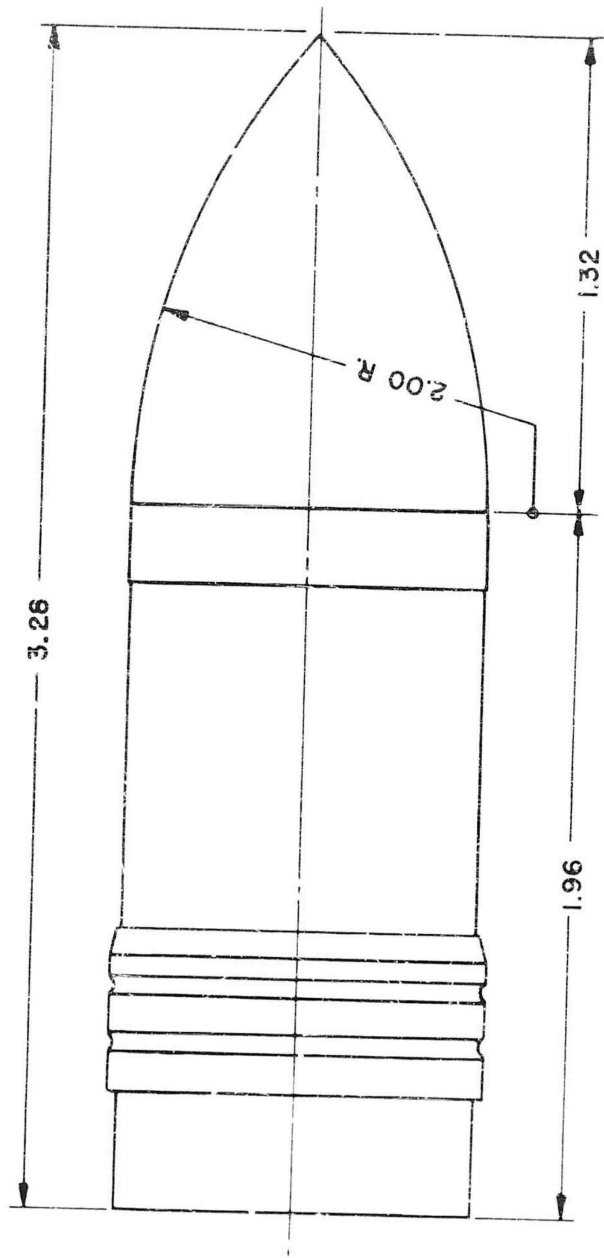
	<u>Paragraph</u>
Purpose - - - - -	1

1. Purpose. The purpose of this number of the handbook is to furnish a concise collection of information regarding the shape, dynamics and ballistics of Projectile Type I. This is an ideal projectile with a square base and a two-caliber-radius ogival head. The G[^]vre Commission of France corrected the empirical drag coefficients of various projectiles of this general form to determine a single drag coefficient - velocity law pertaining to this ideal shape. The information herein is collected from the reports and ballistic tables pertaining to this law and the corresponding drag function.

**SECTION II
 DESCRIPTION**

	<u>Paragraph</u>
Drawing - - - - -	2
Dimensions - - - - -	3

ALL DIMENSIONS IN CALIBERS



PROJECTILE TYPE I

3. Dimensions.

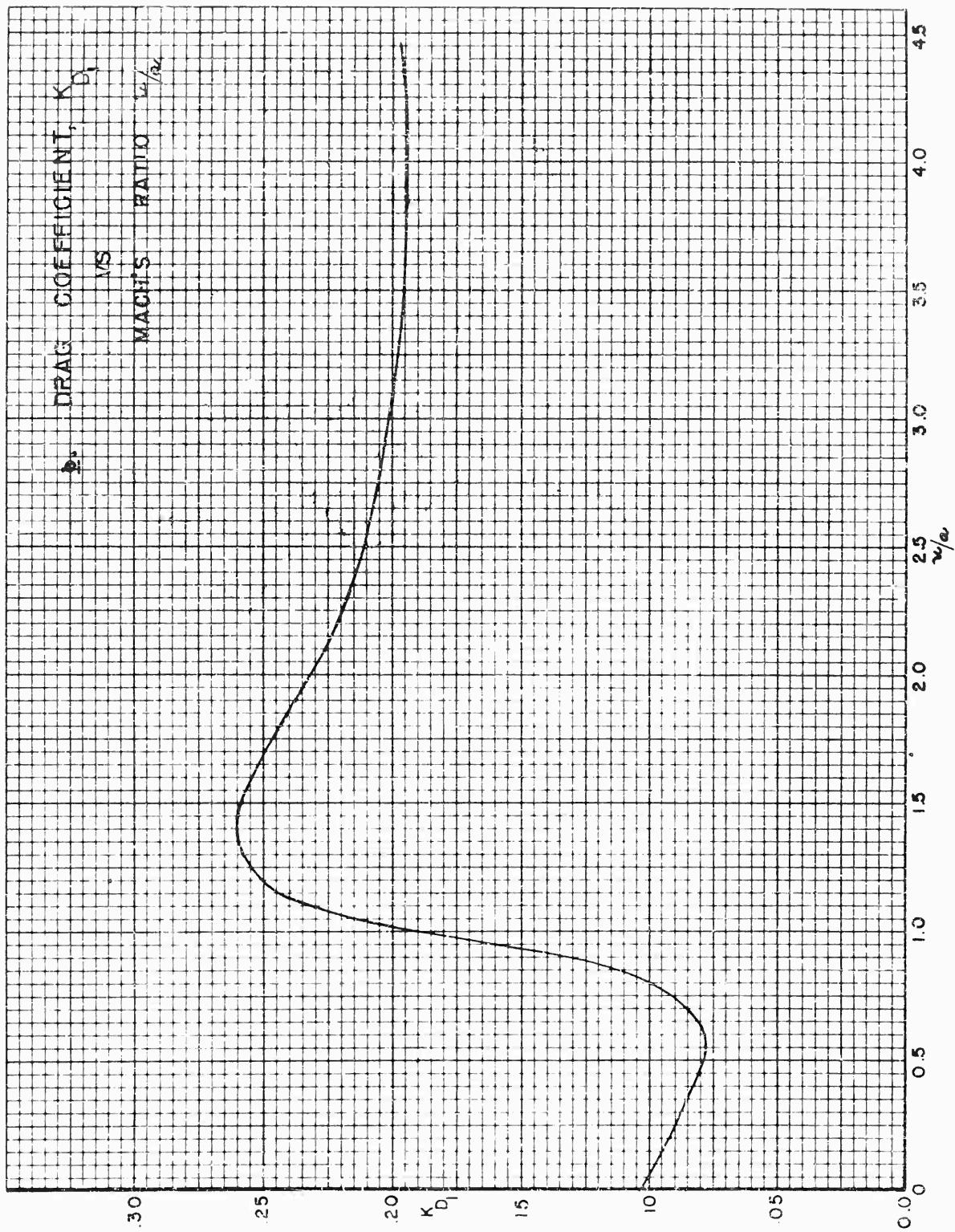
Cylindrical body: Length (assumed)	1.96 cal.
Ogive: Length	1.32 cal.
Radius of arc	2.00 cal.
Shell: Length	3.28 cal.

SECTION III
EXTERIOR BALLISTIC DATA

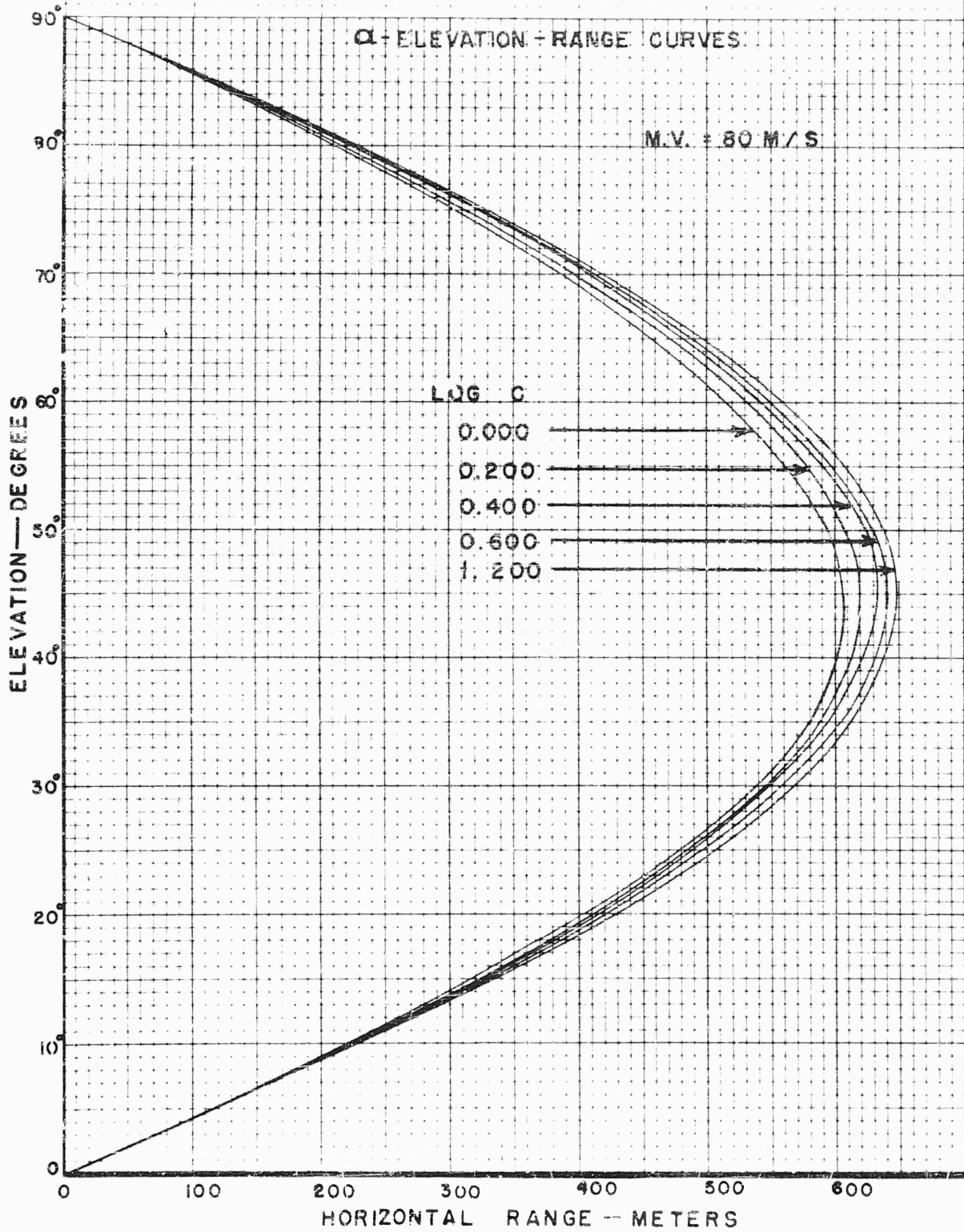
	<u>Paragraph</u>
Aerodynamic data - - - - -	4
Ballistic table data - - - - -	5

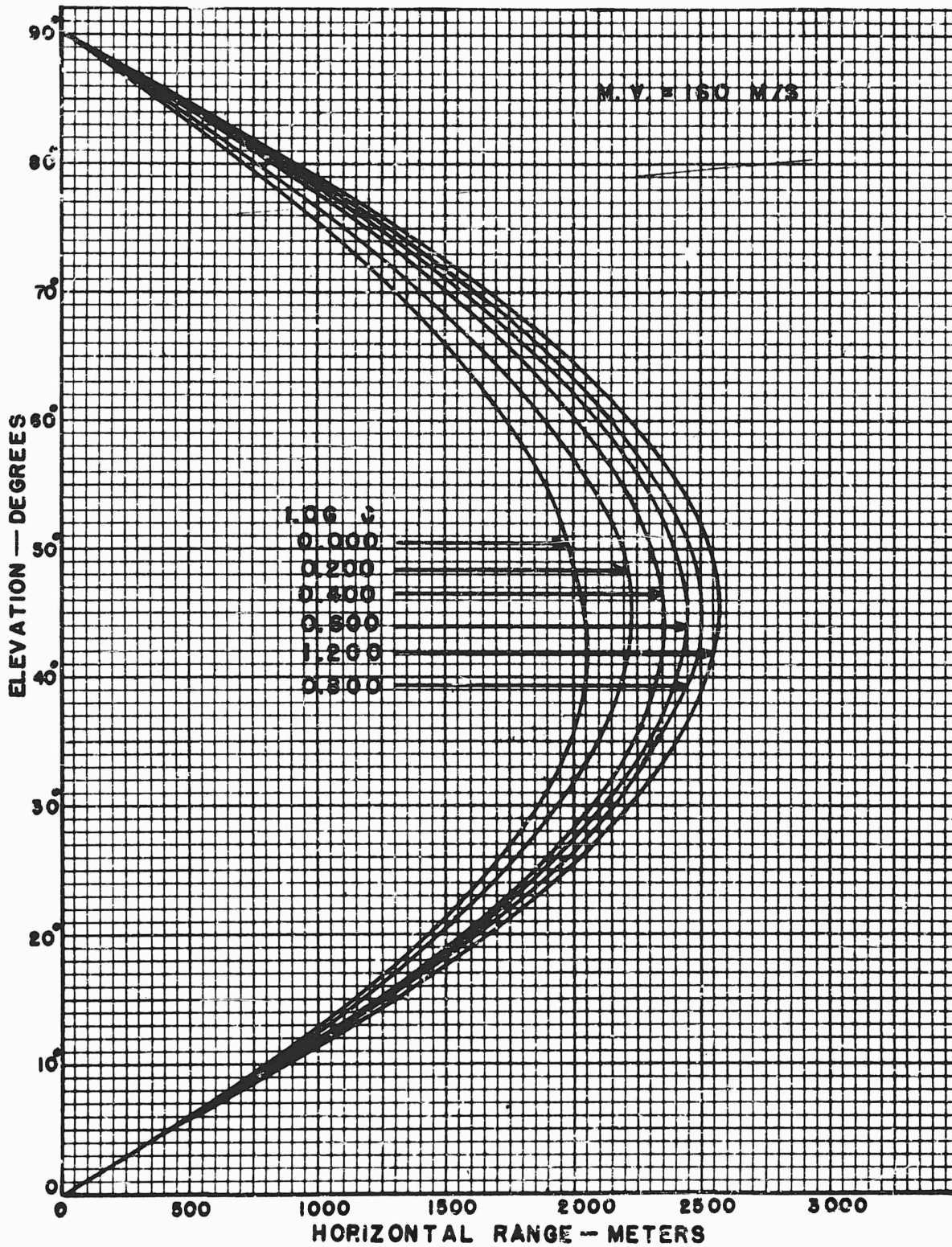
4. Aerodynamic data.

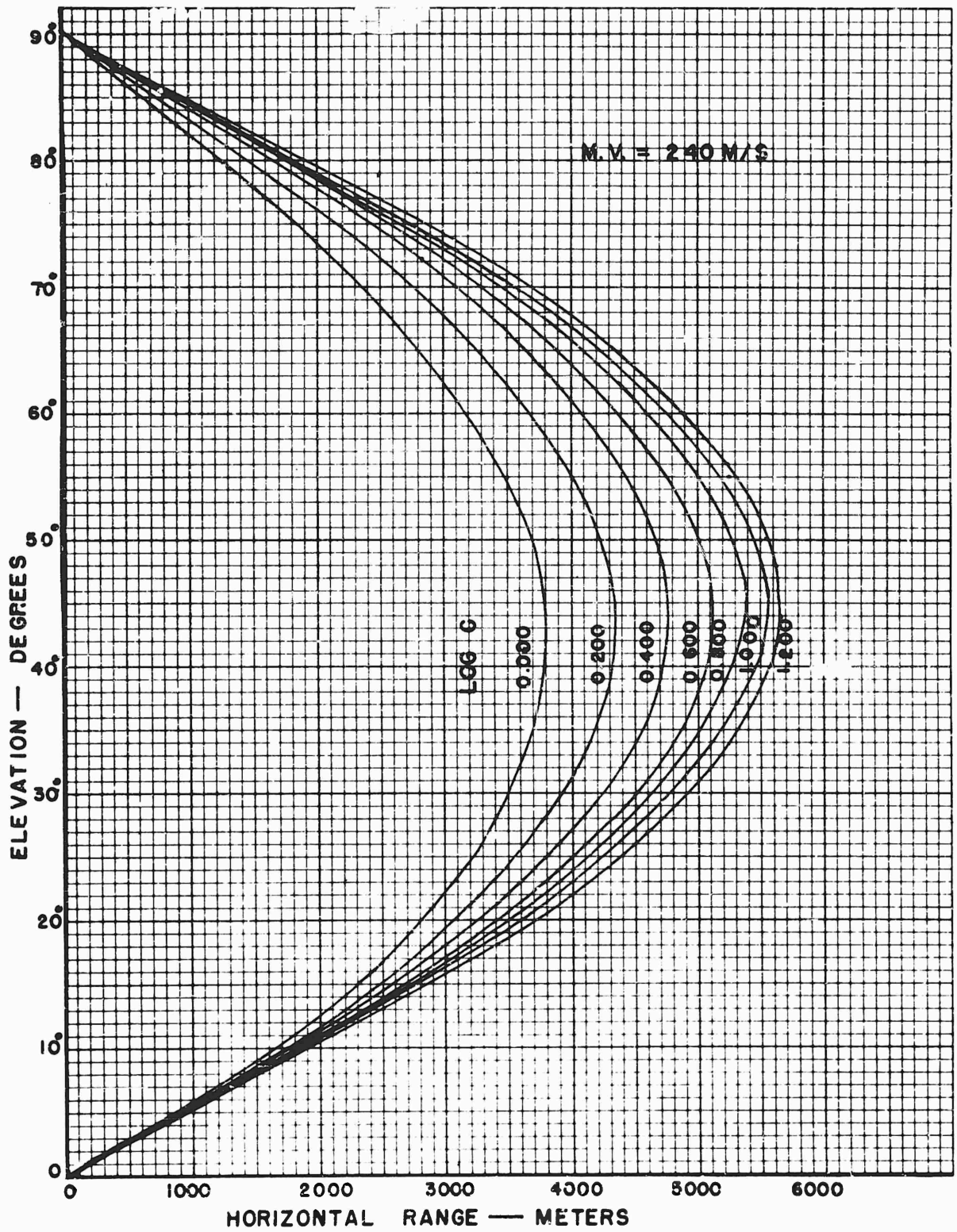
a. **Drag function:** G_1 . The values tabulated by the Ordnance Department of the United States Army were calculated from the Gâvre drag coefficient, except that slight revisions were made at velocities above 600 m/sec.

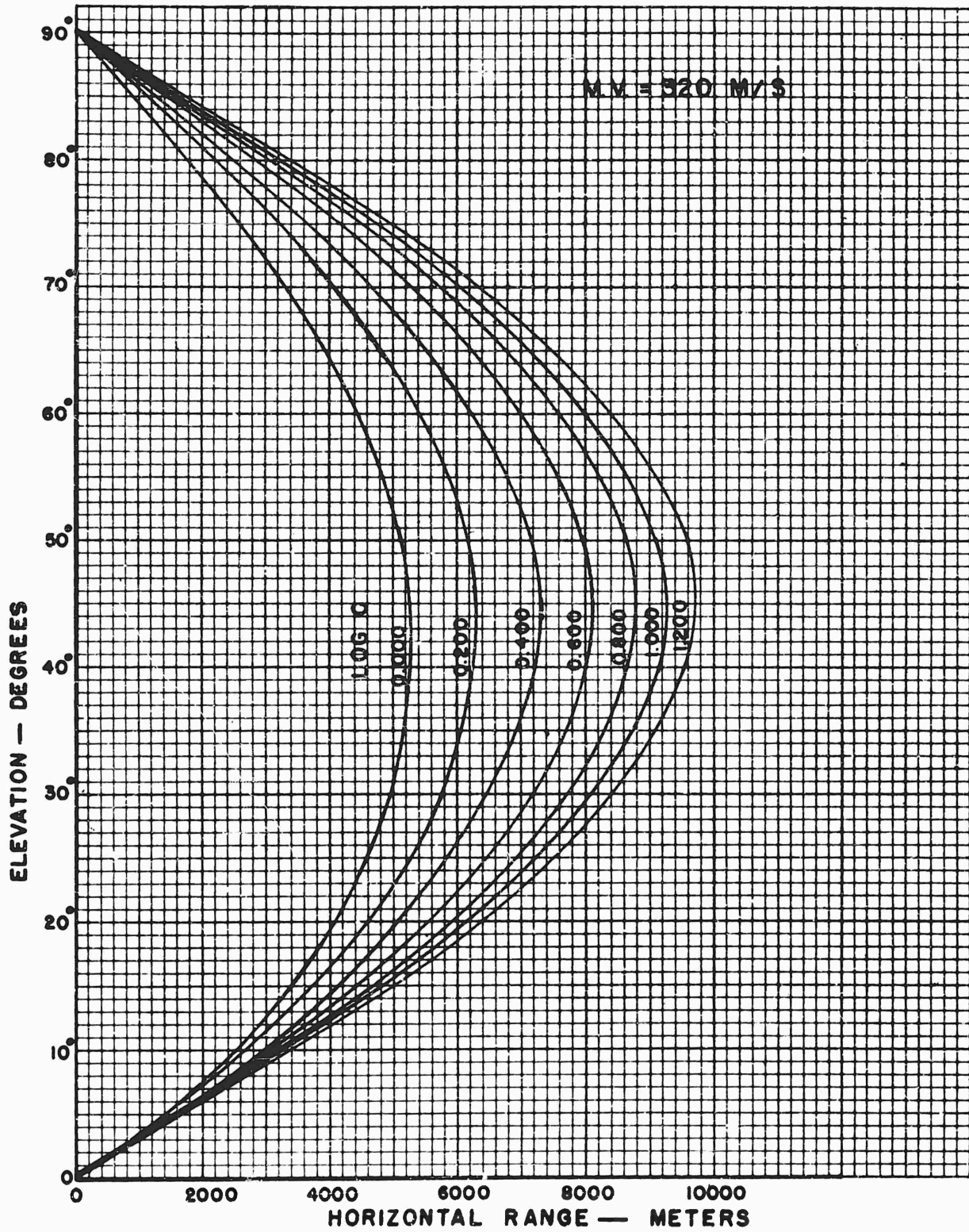


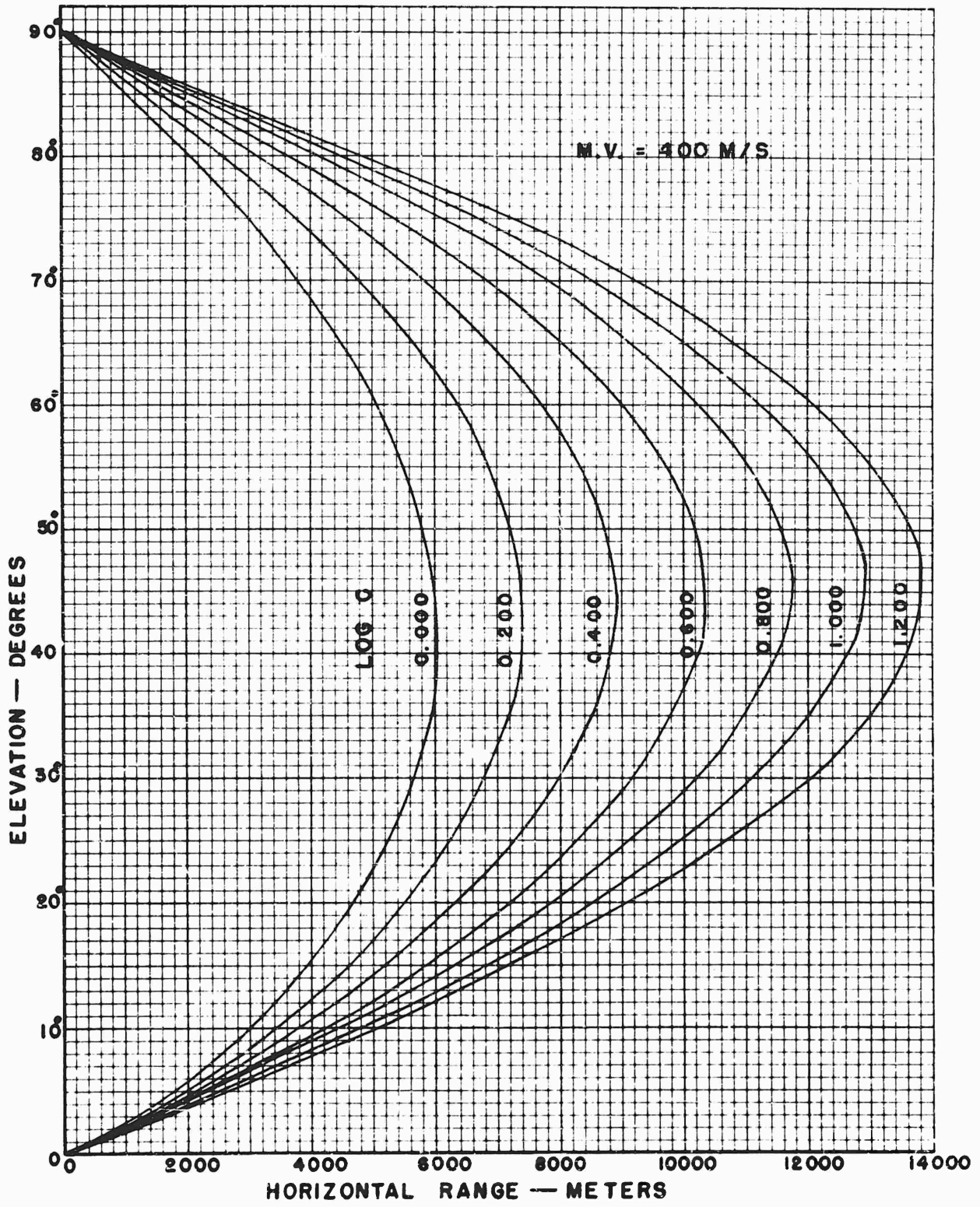
5. BALLISTIC TABLE DATA. EXTERIOR BALLISTIC TABLES BASED ON NUMERICAL INTEGRATION. VOL. III

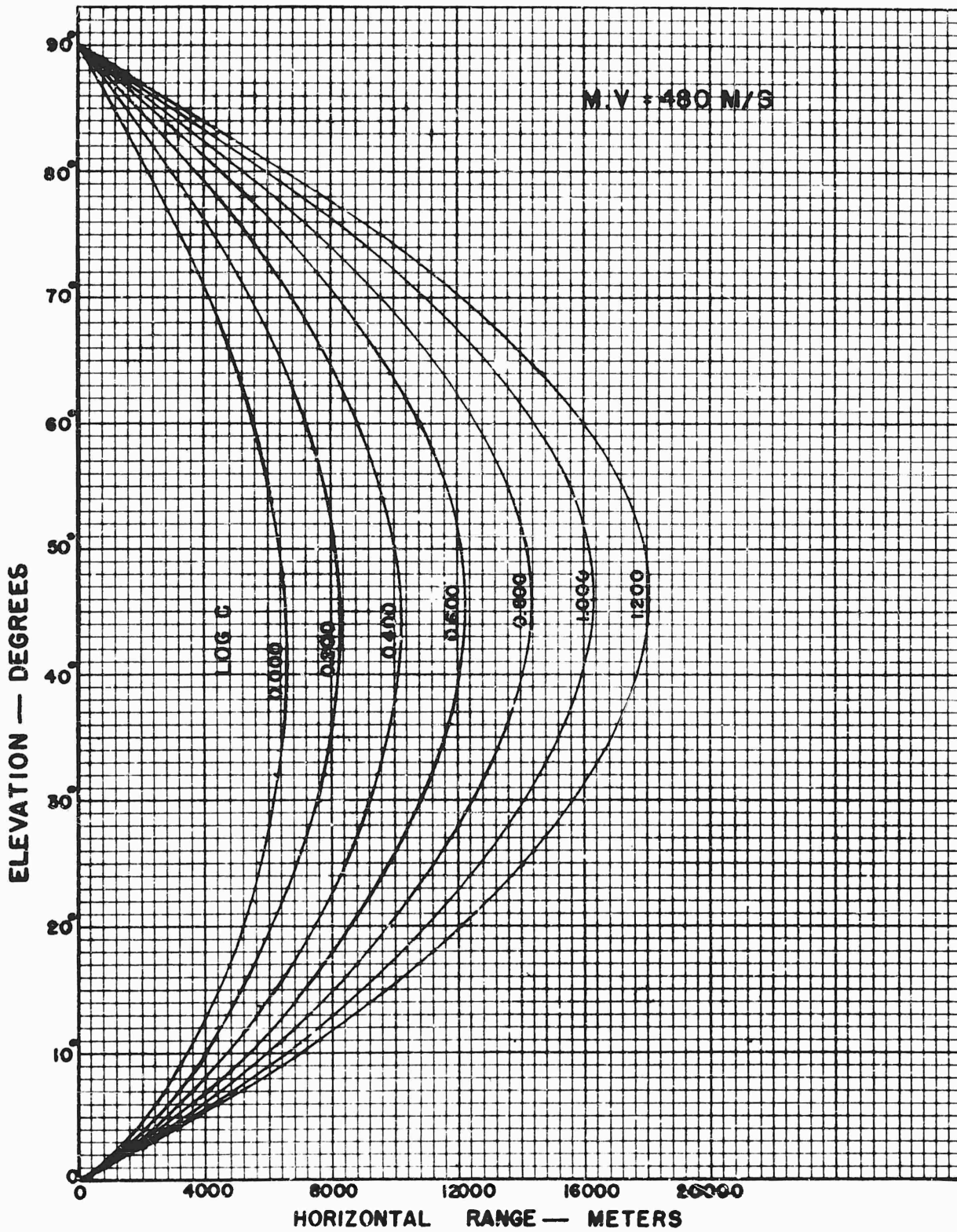


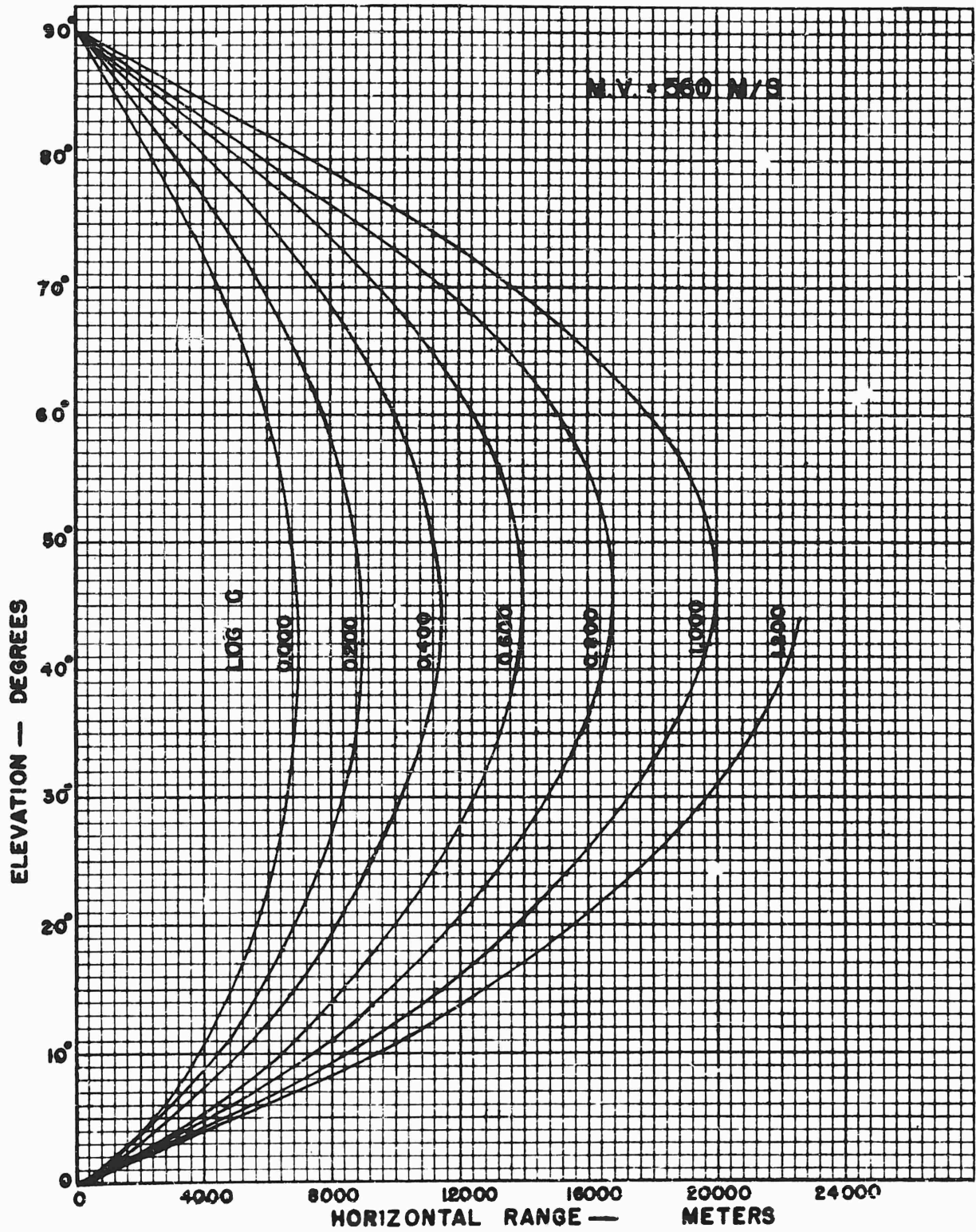


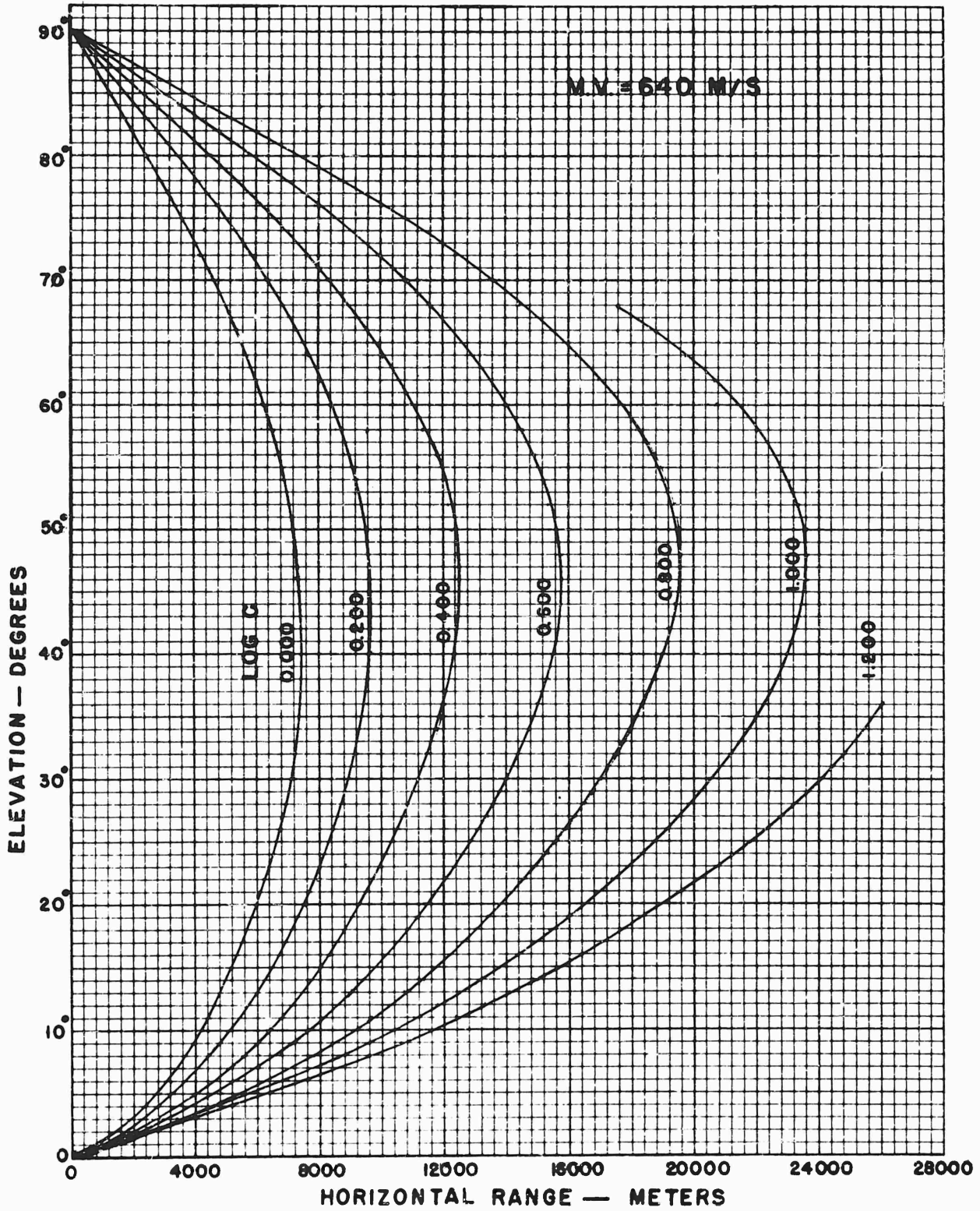


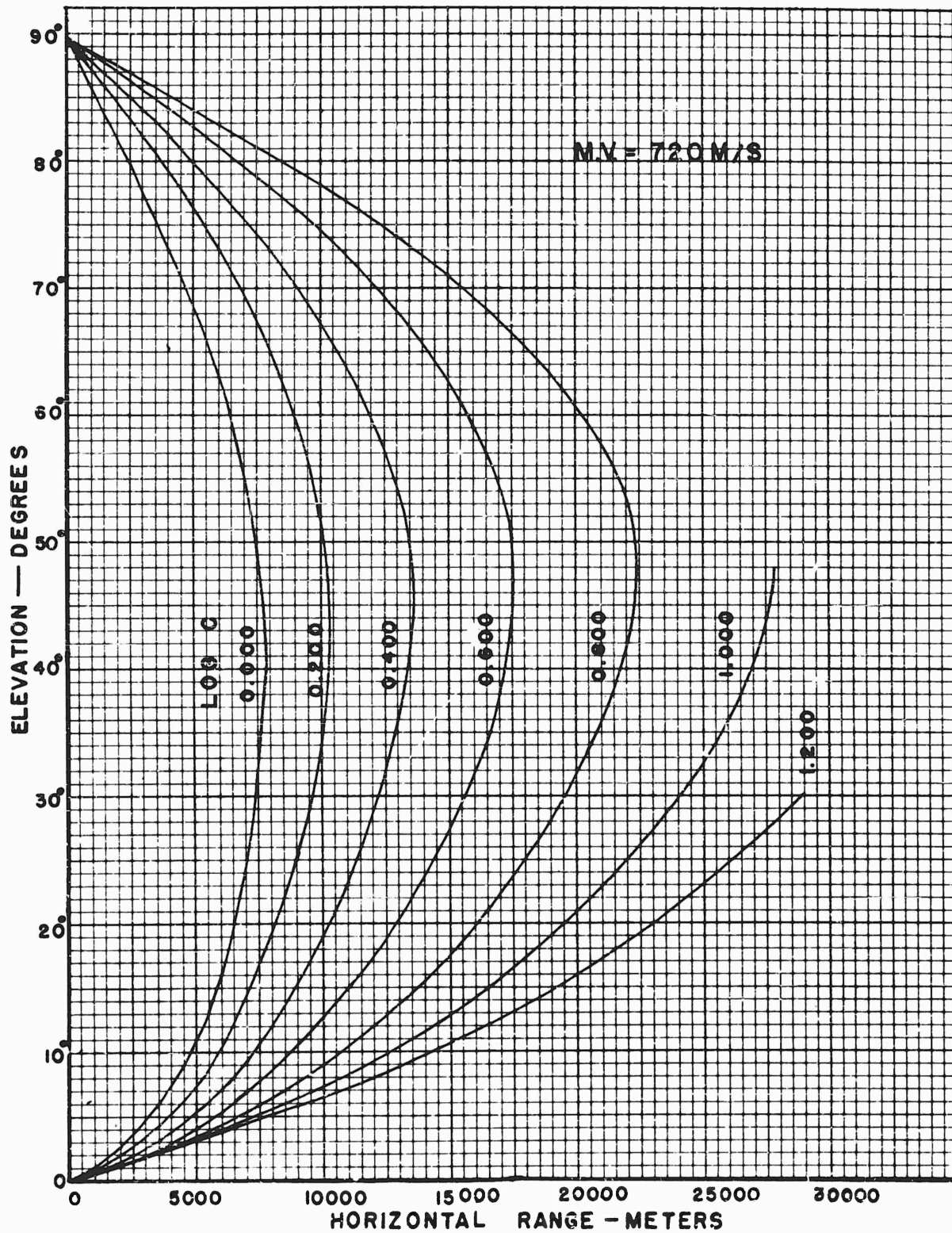


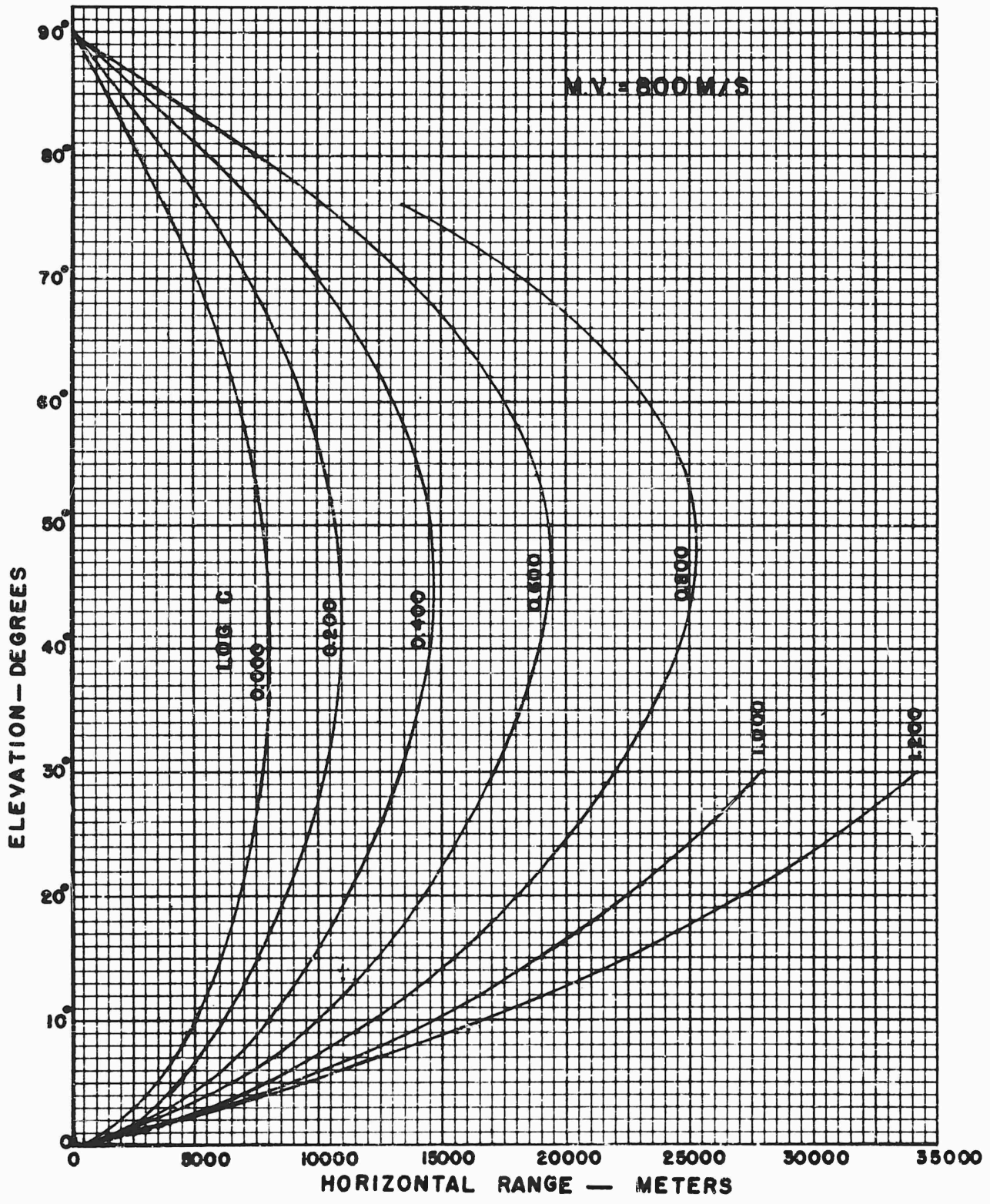


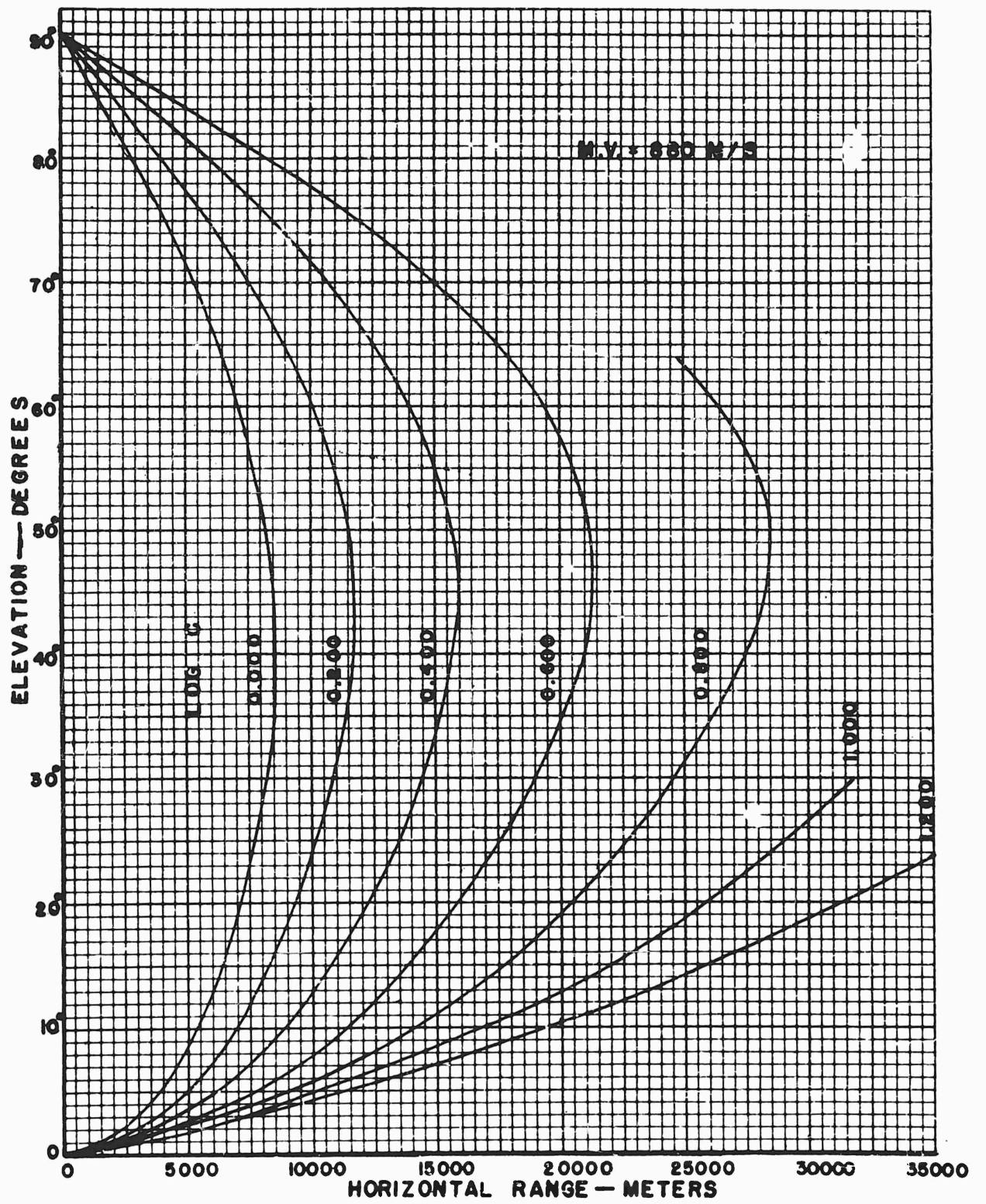


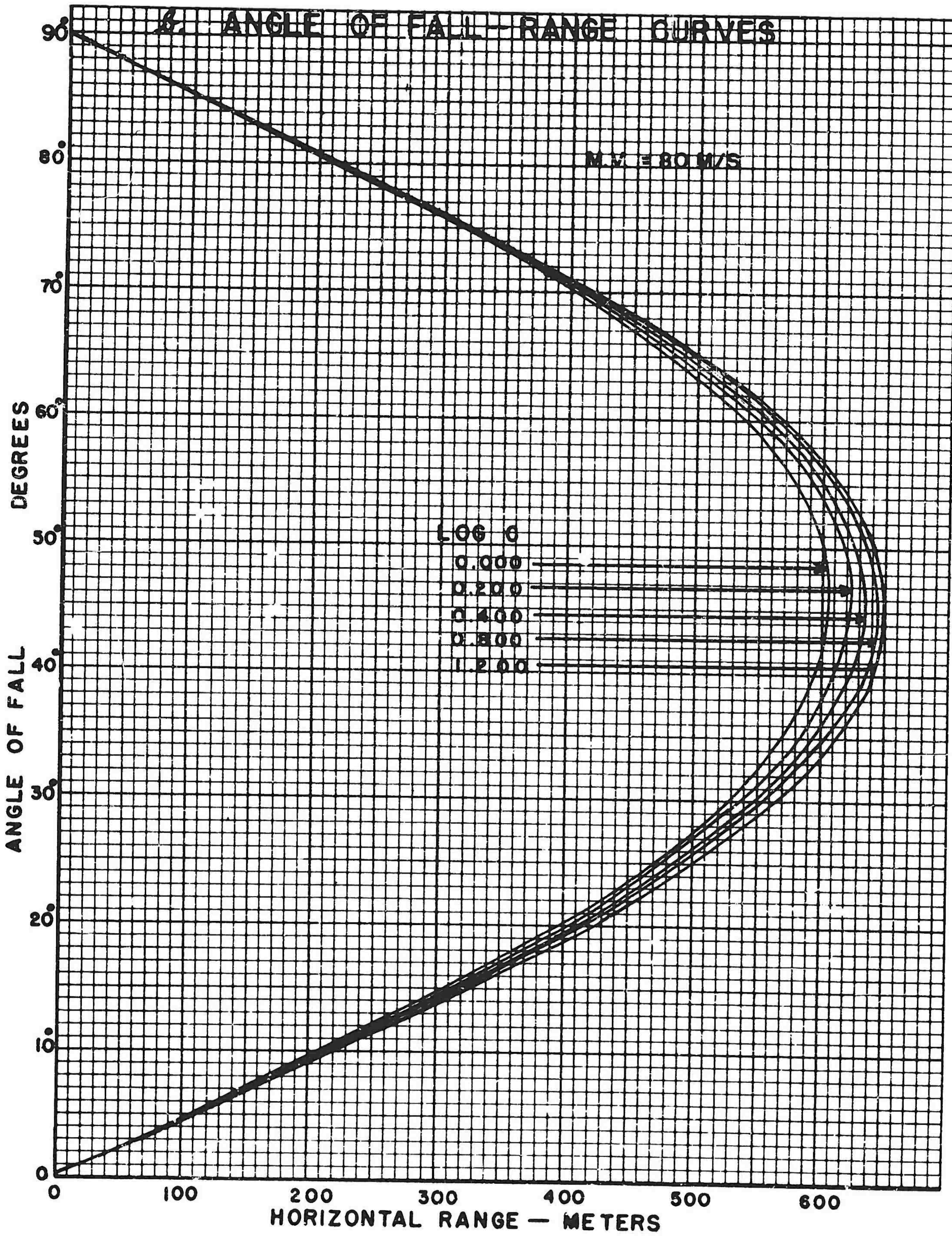


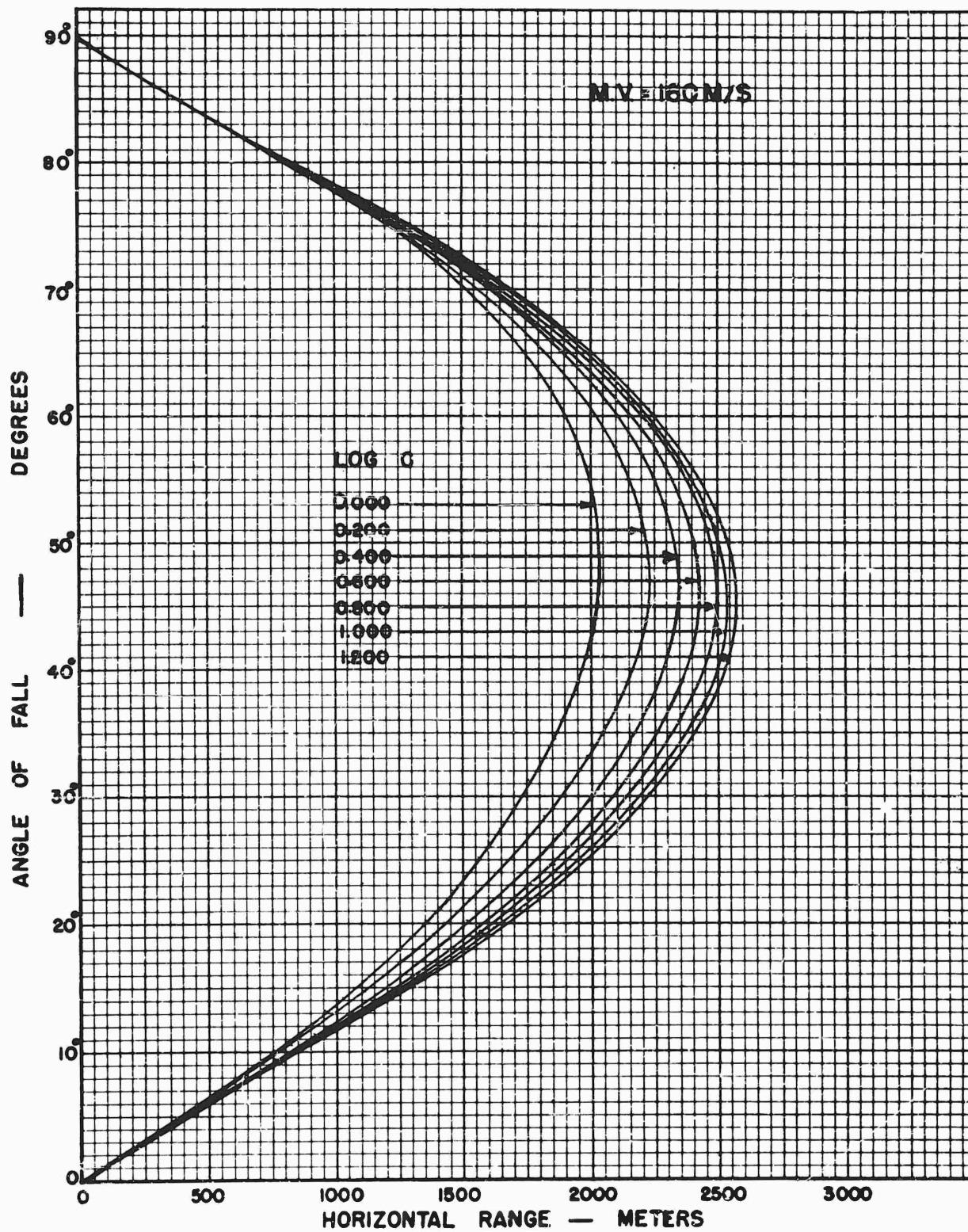


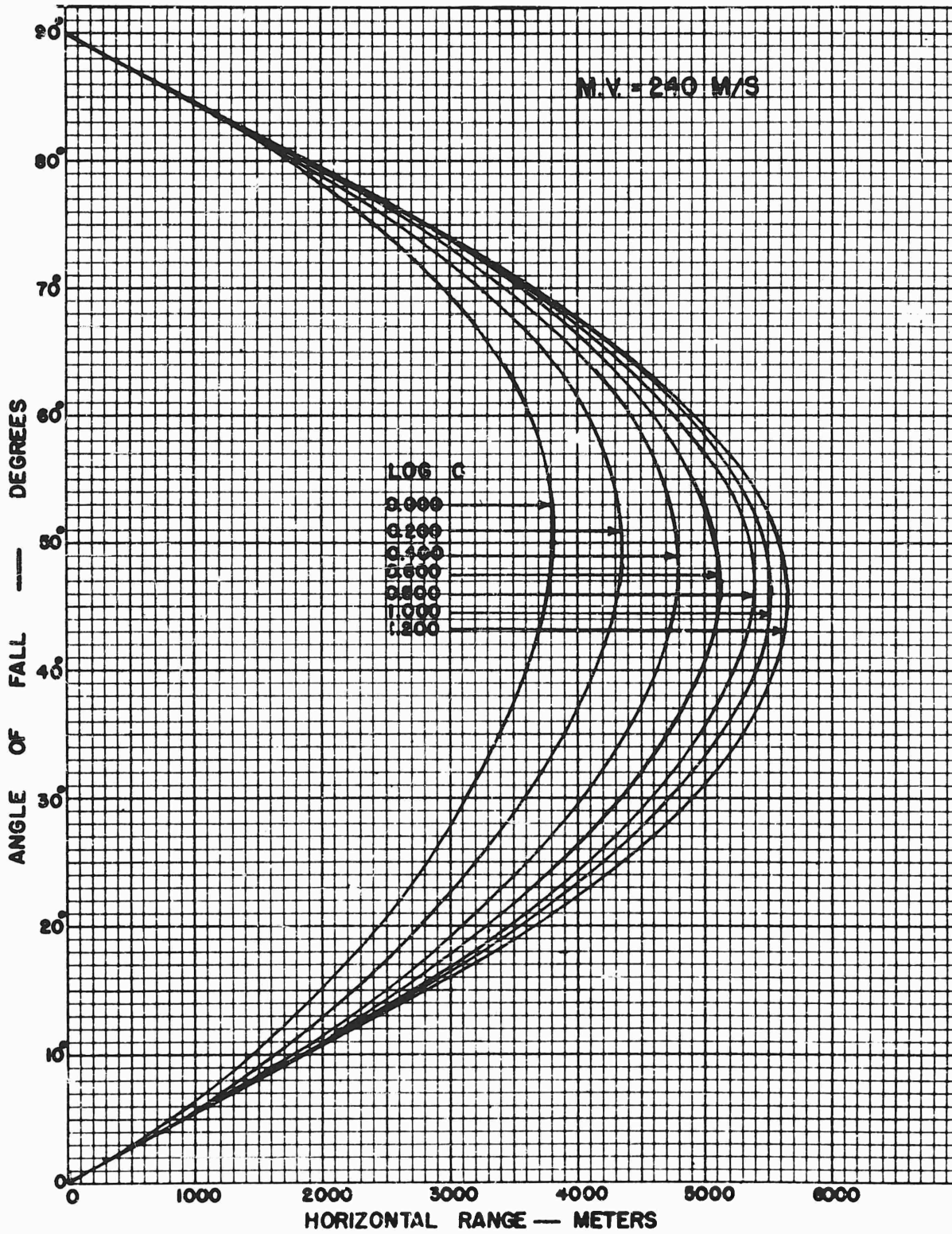


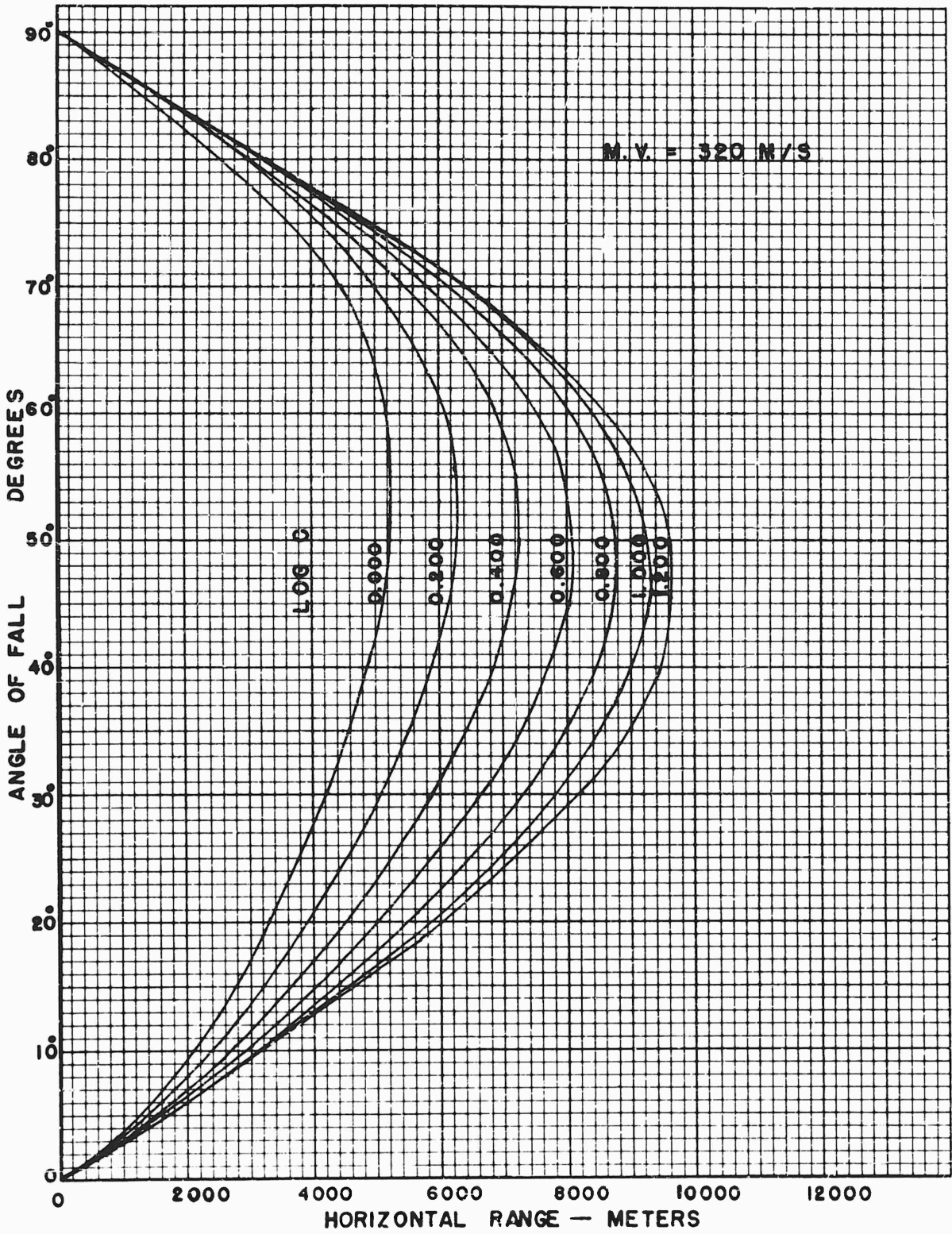


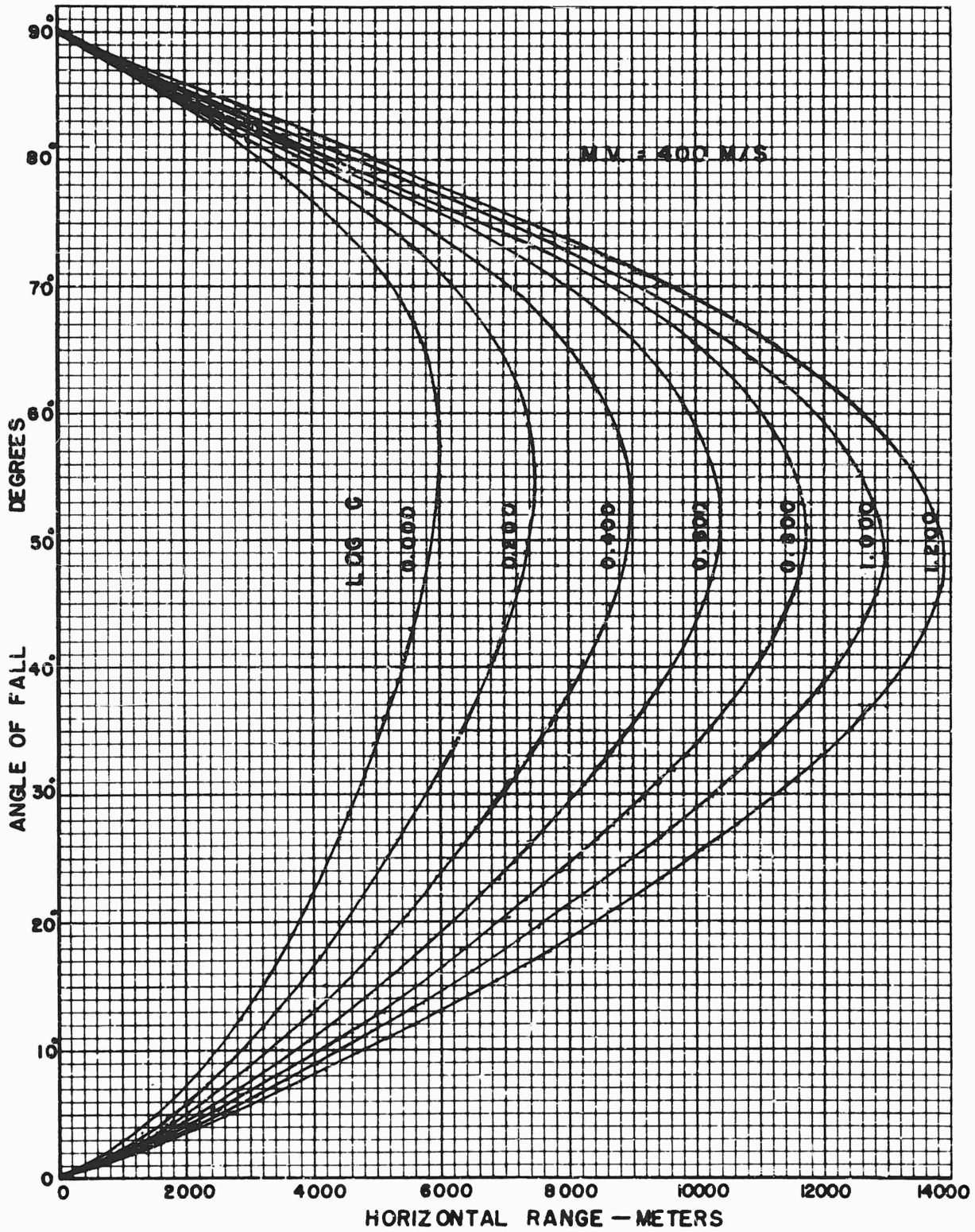


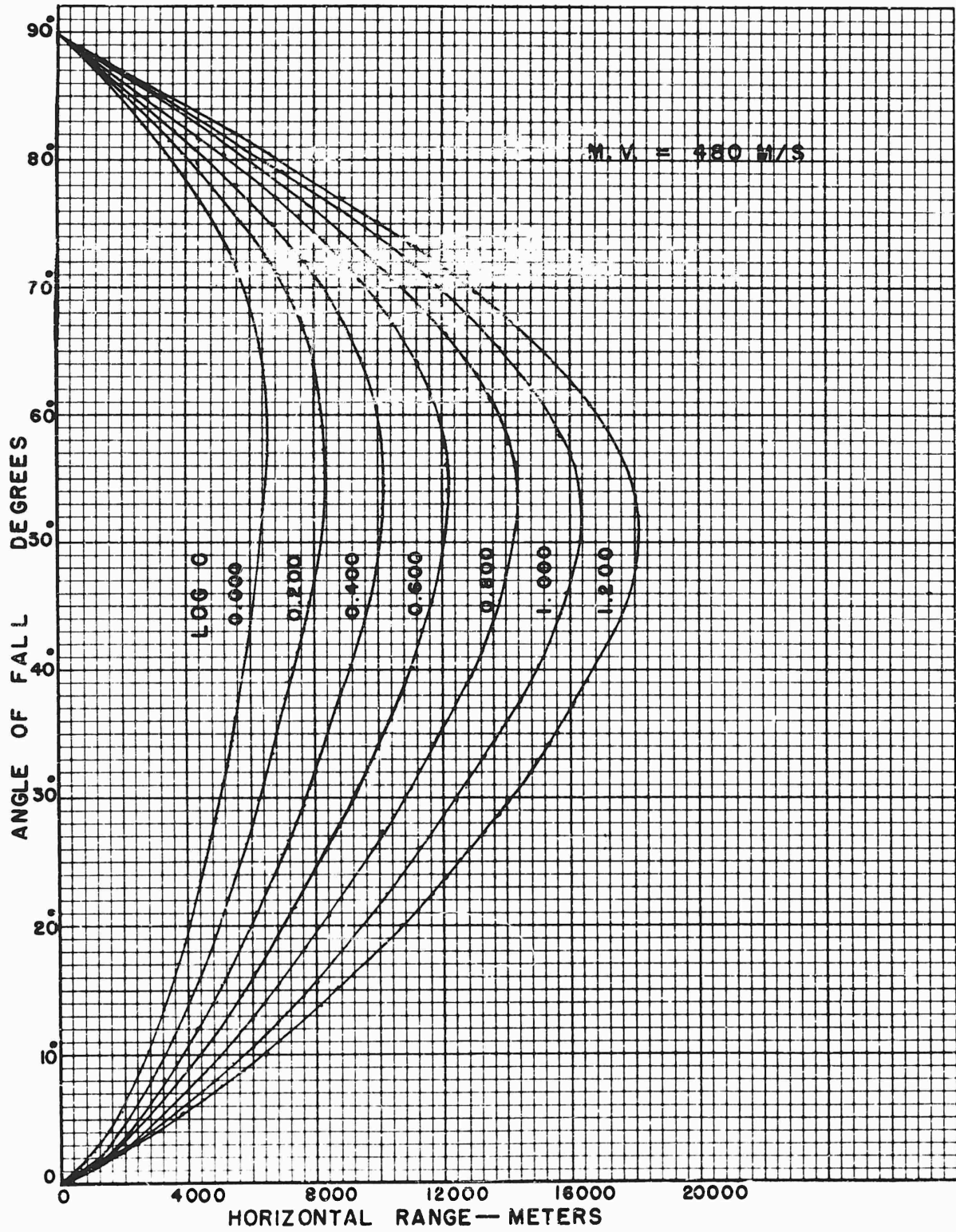


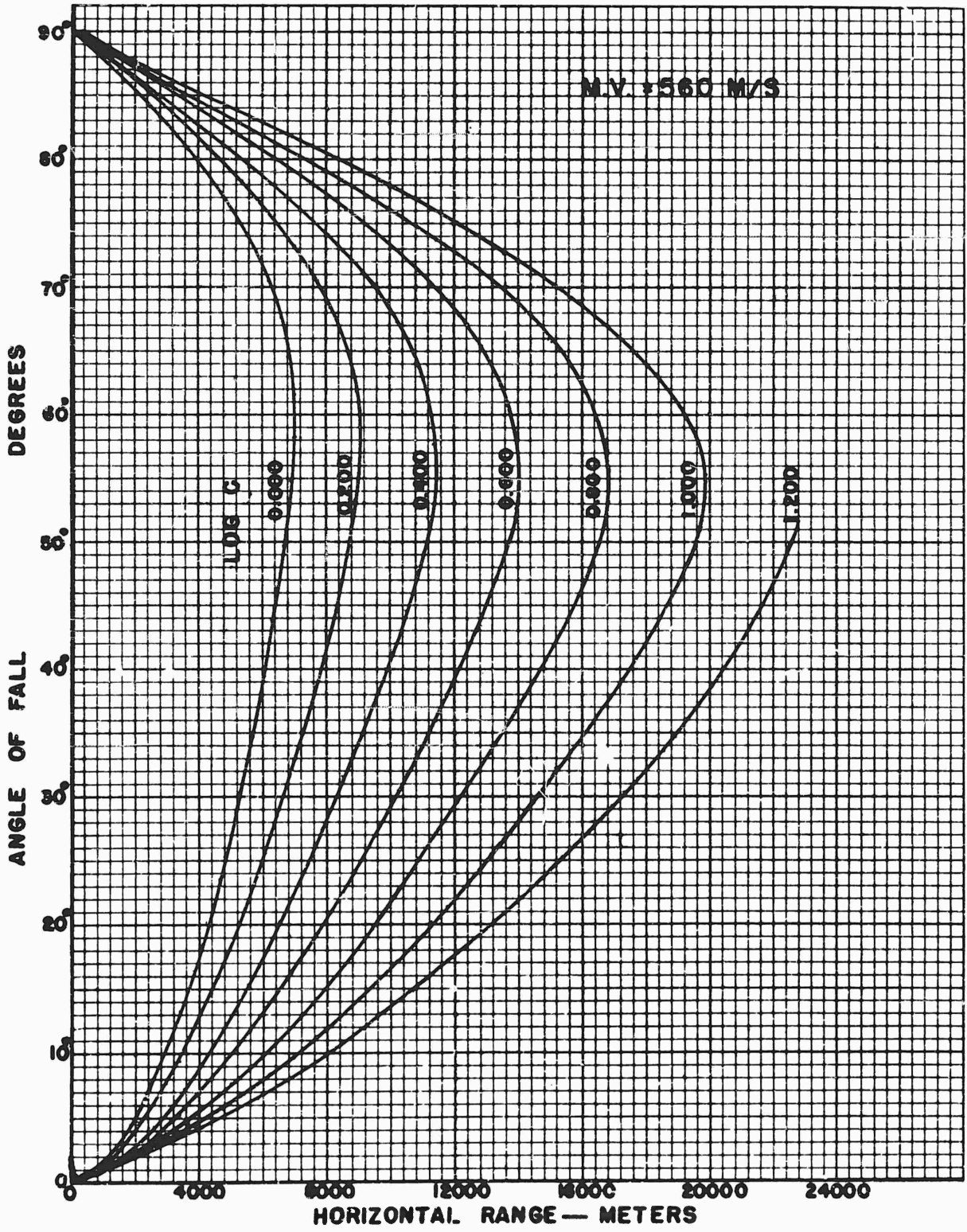


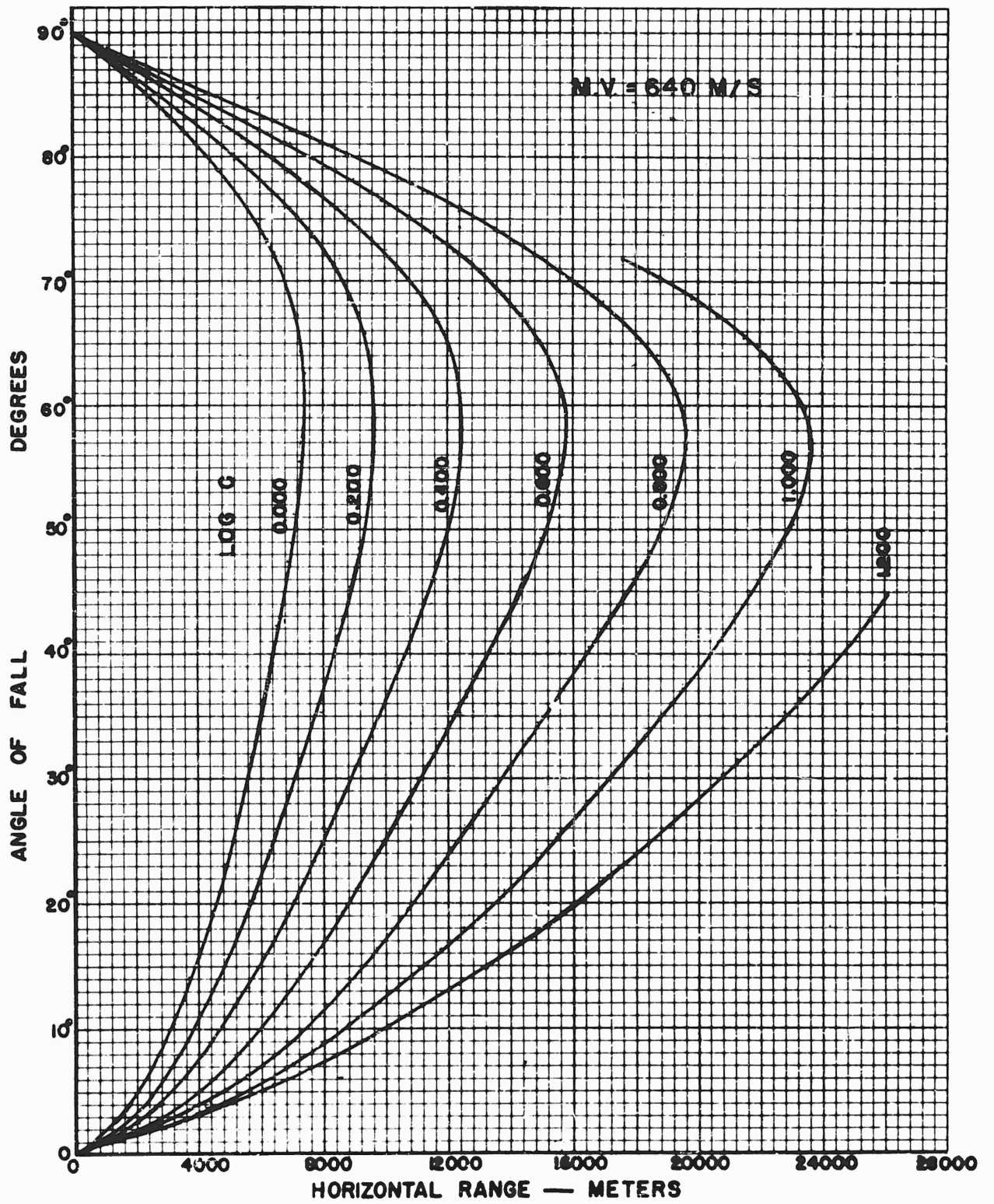


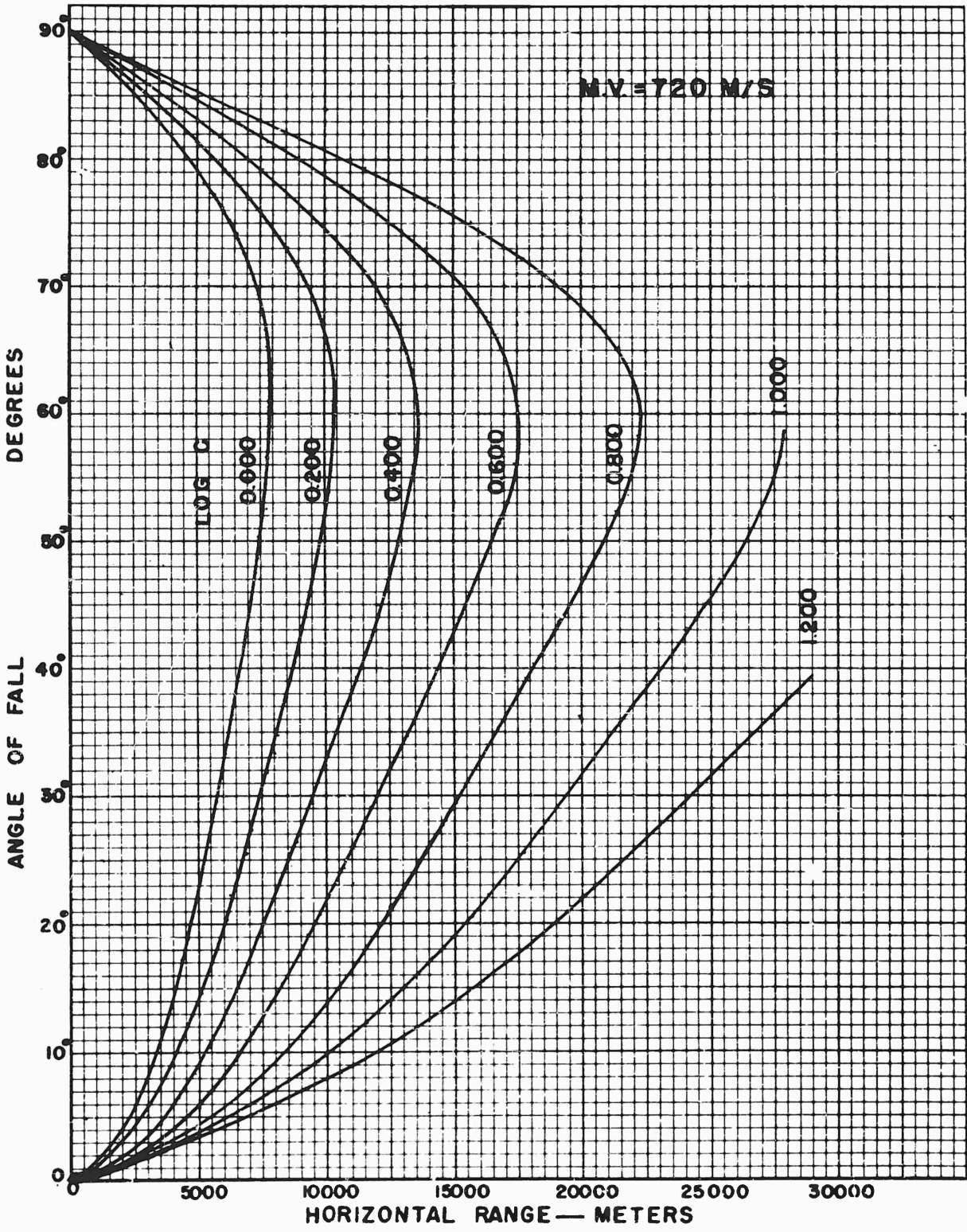


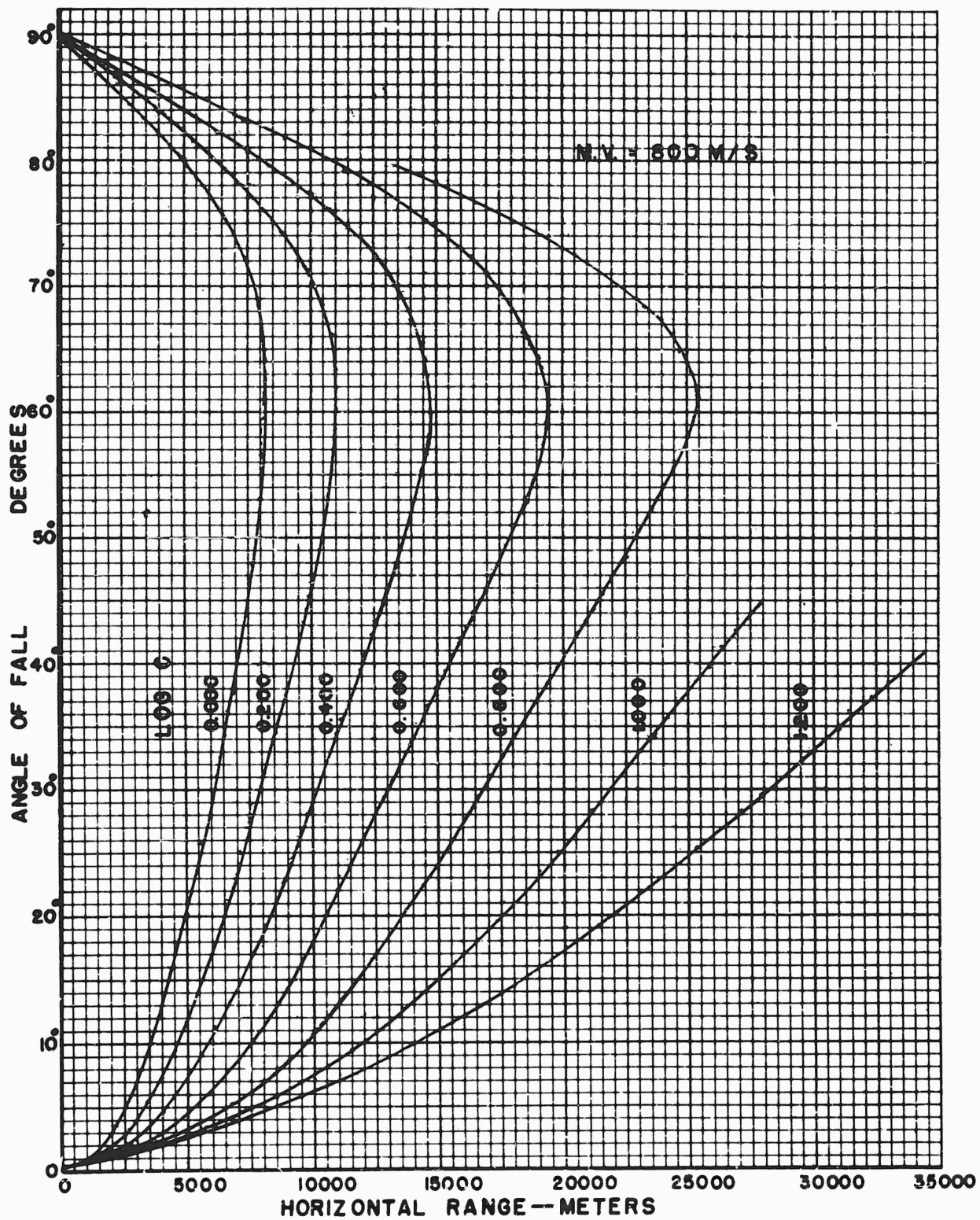


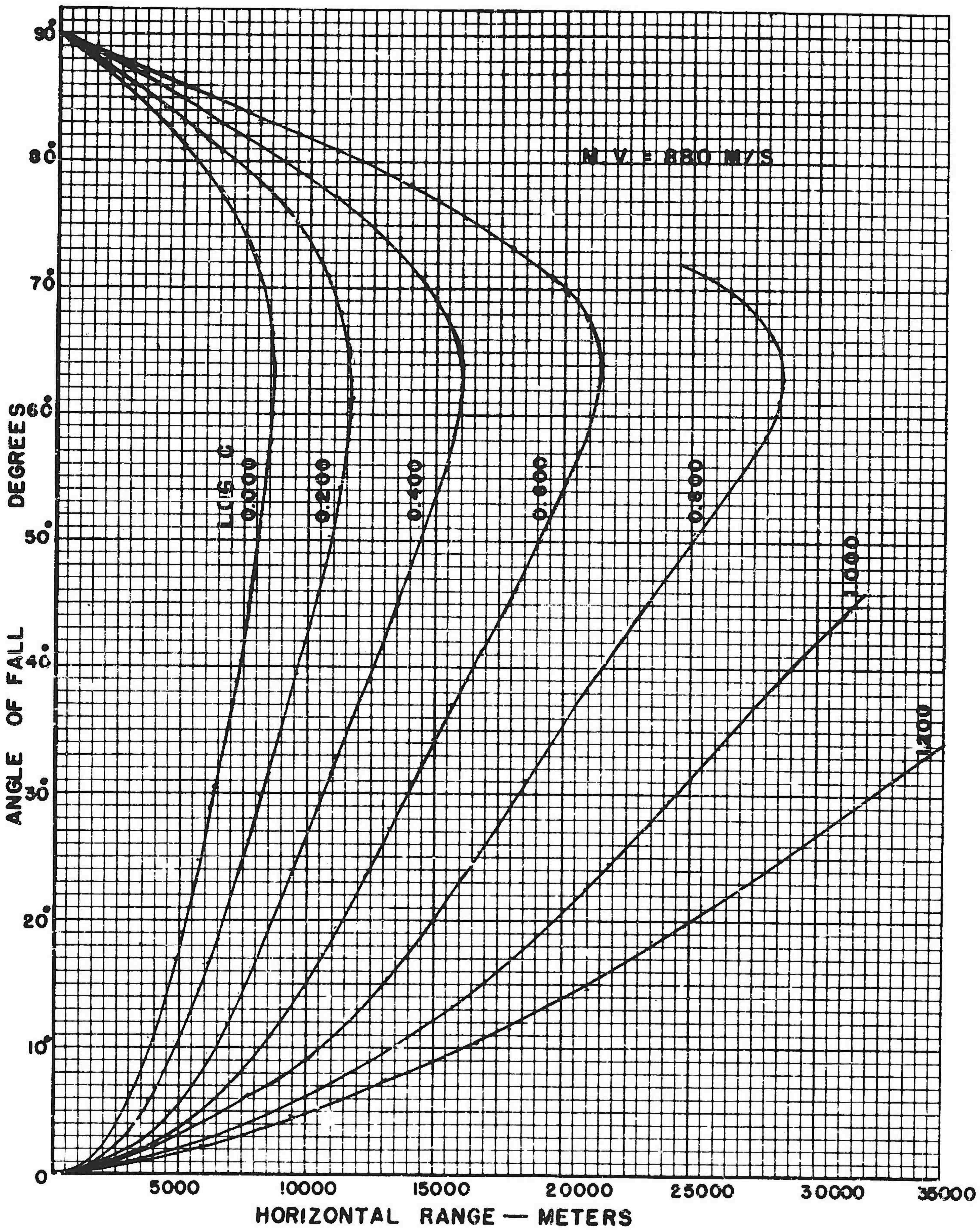


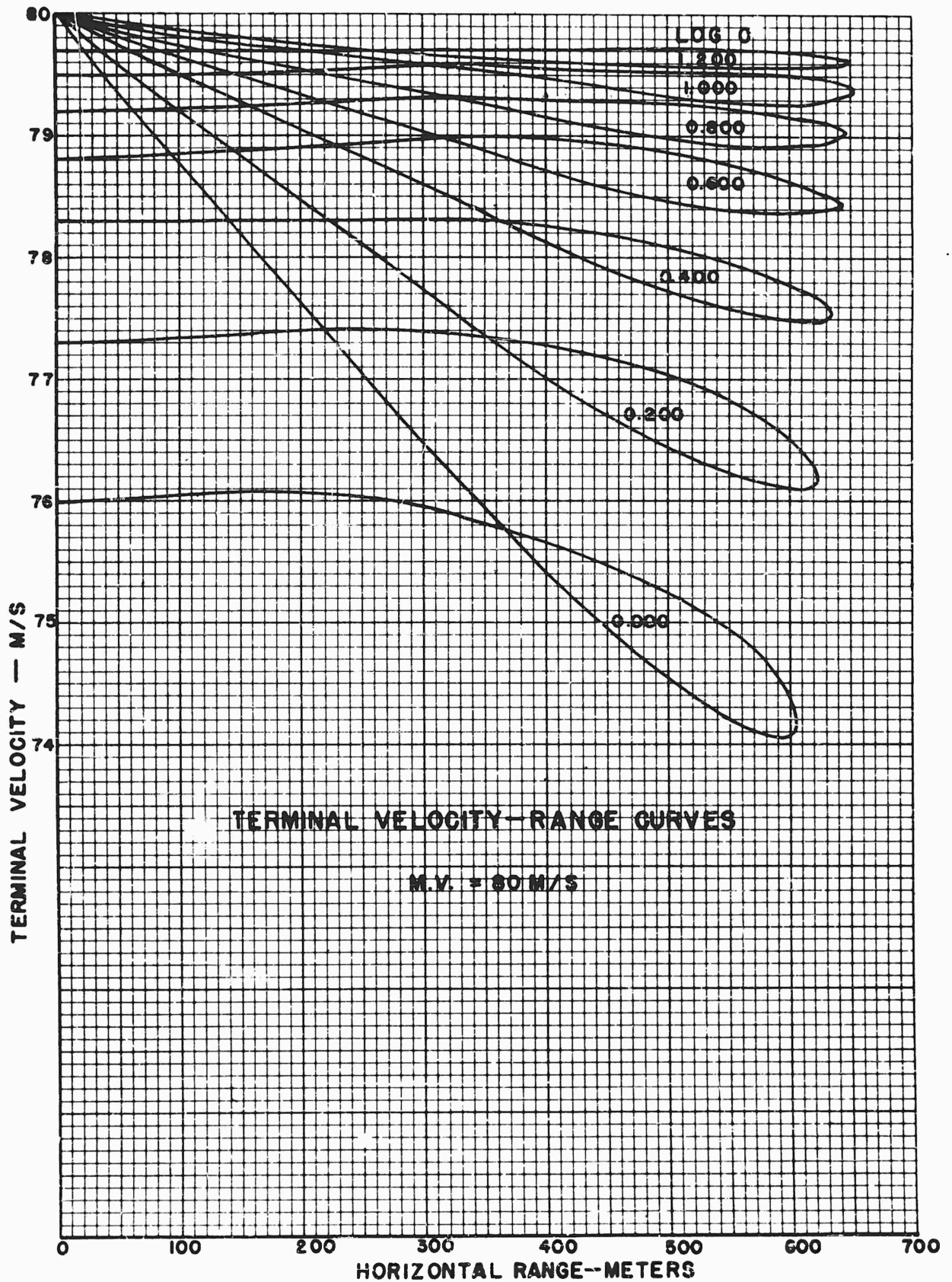


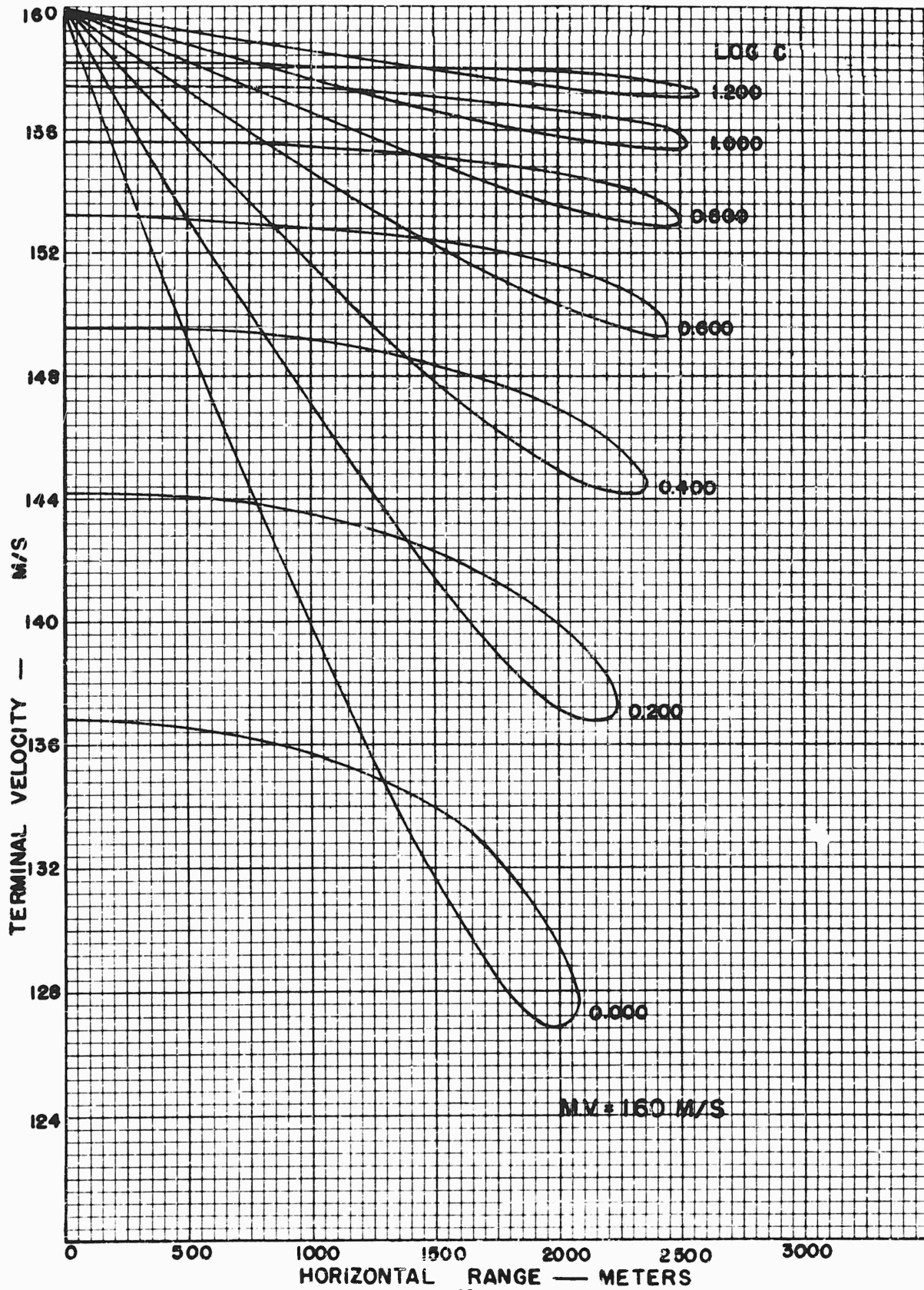


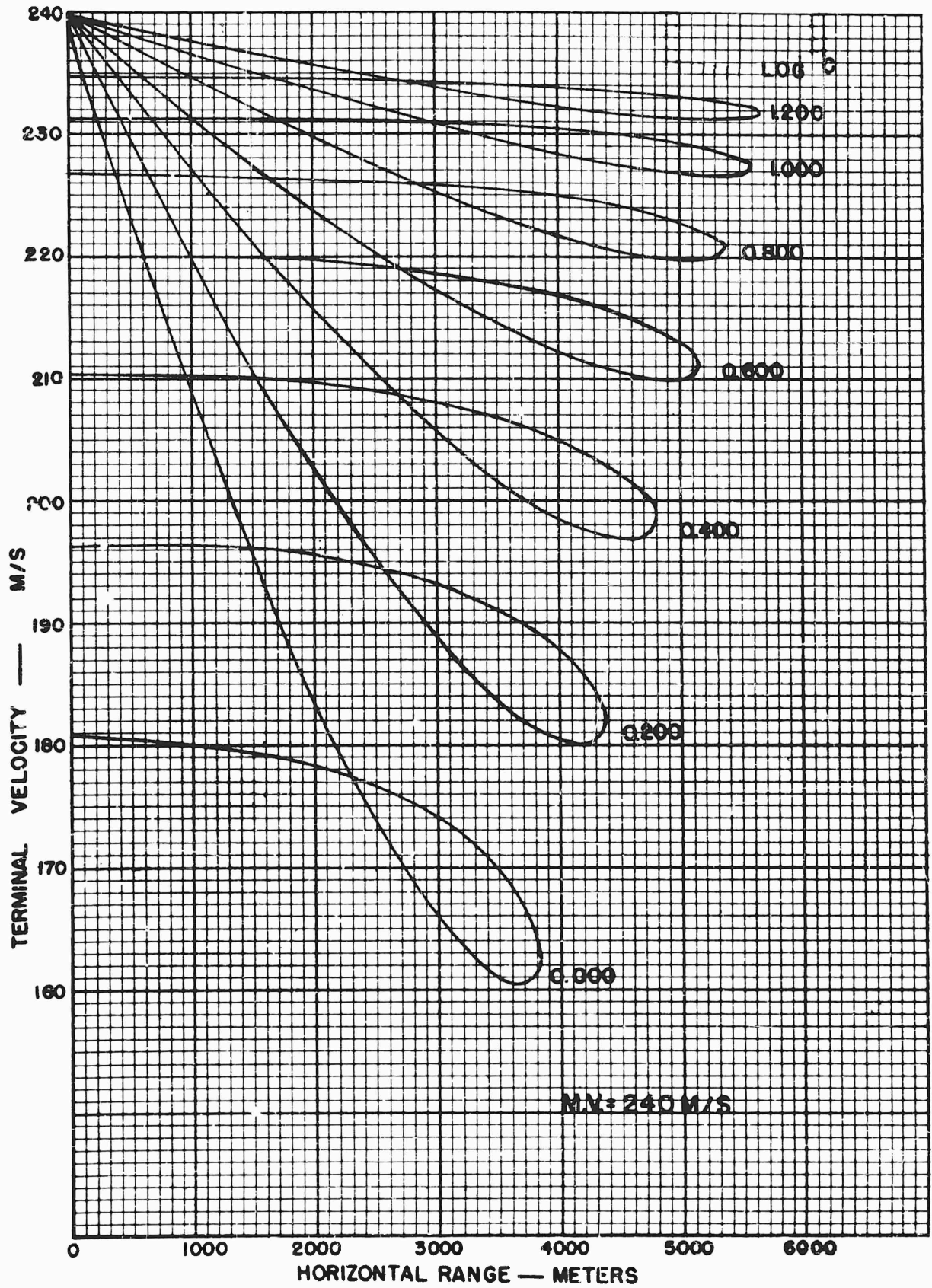


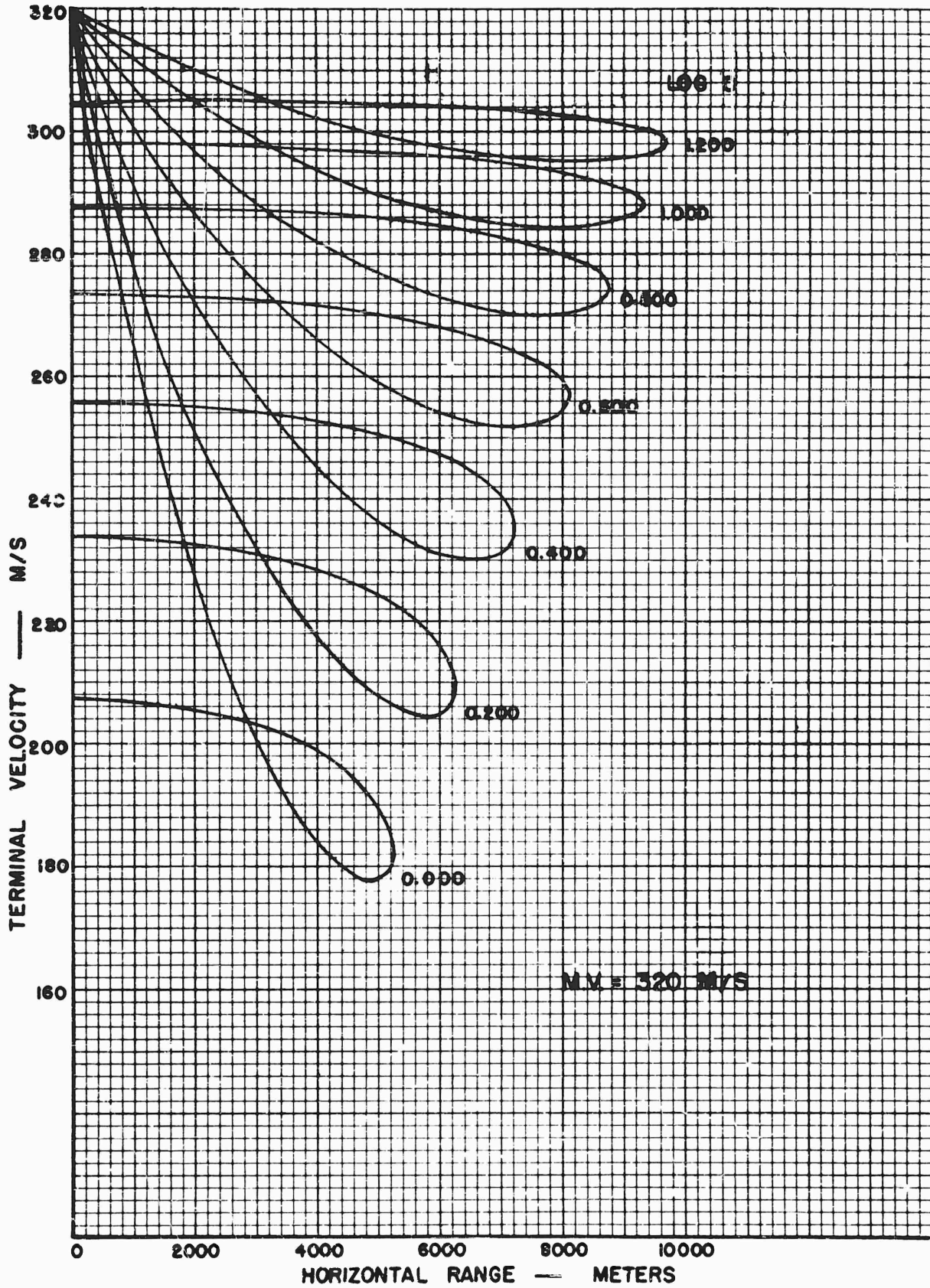


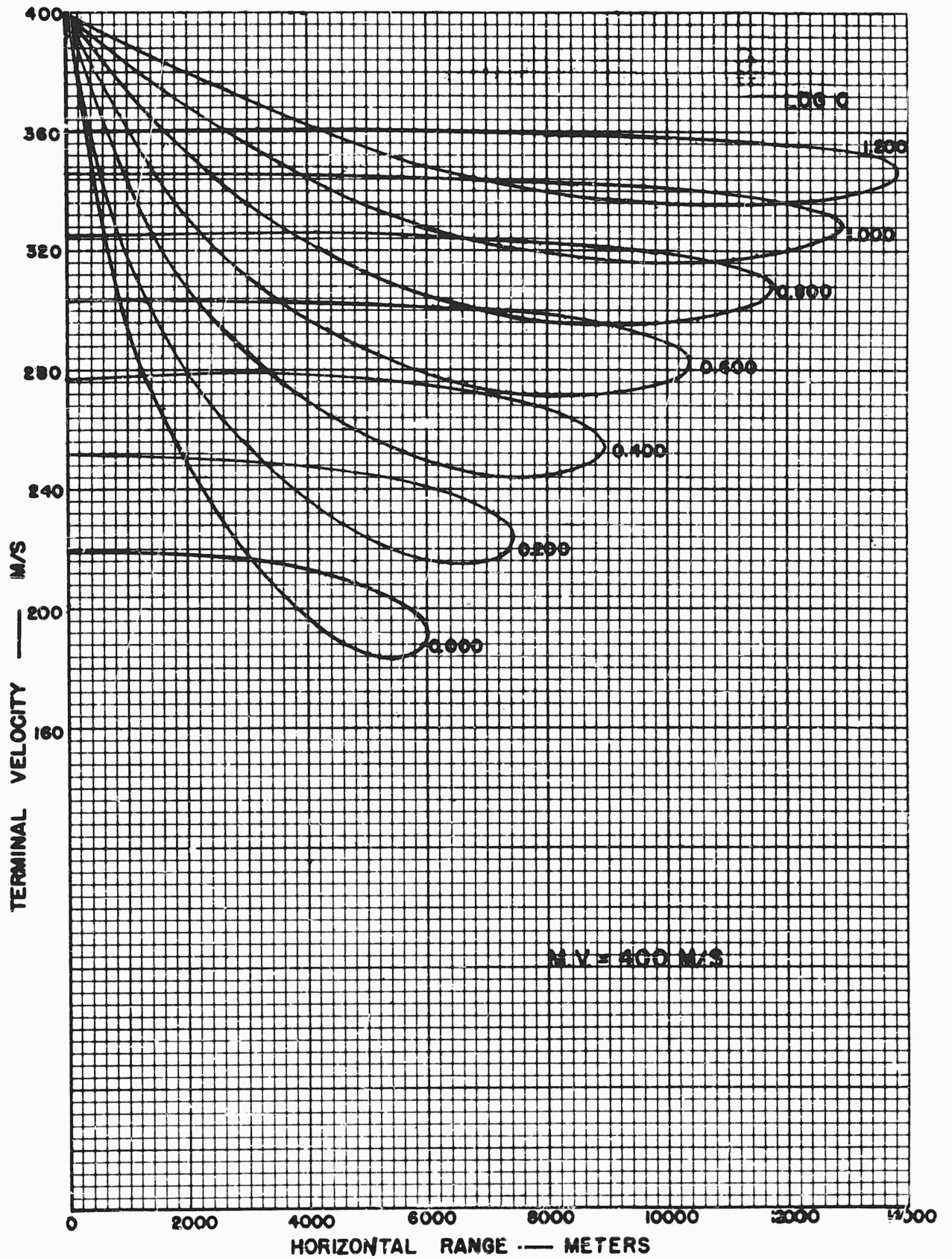


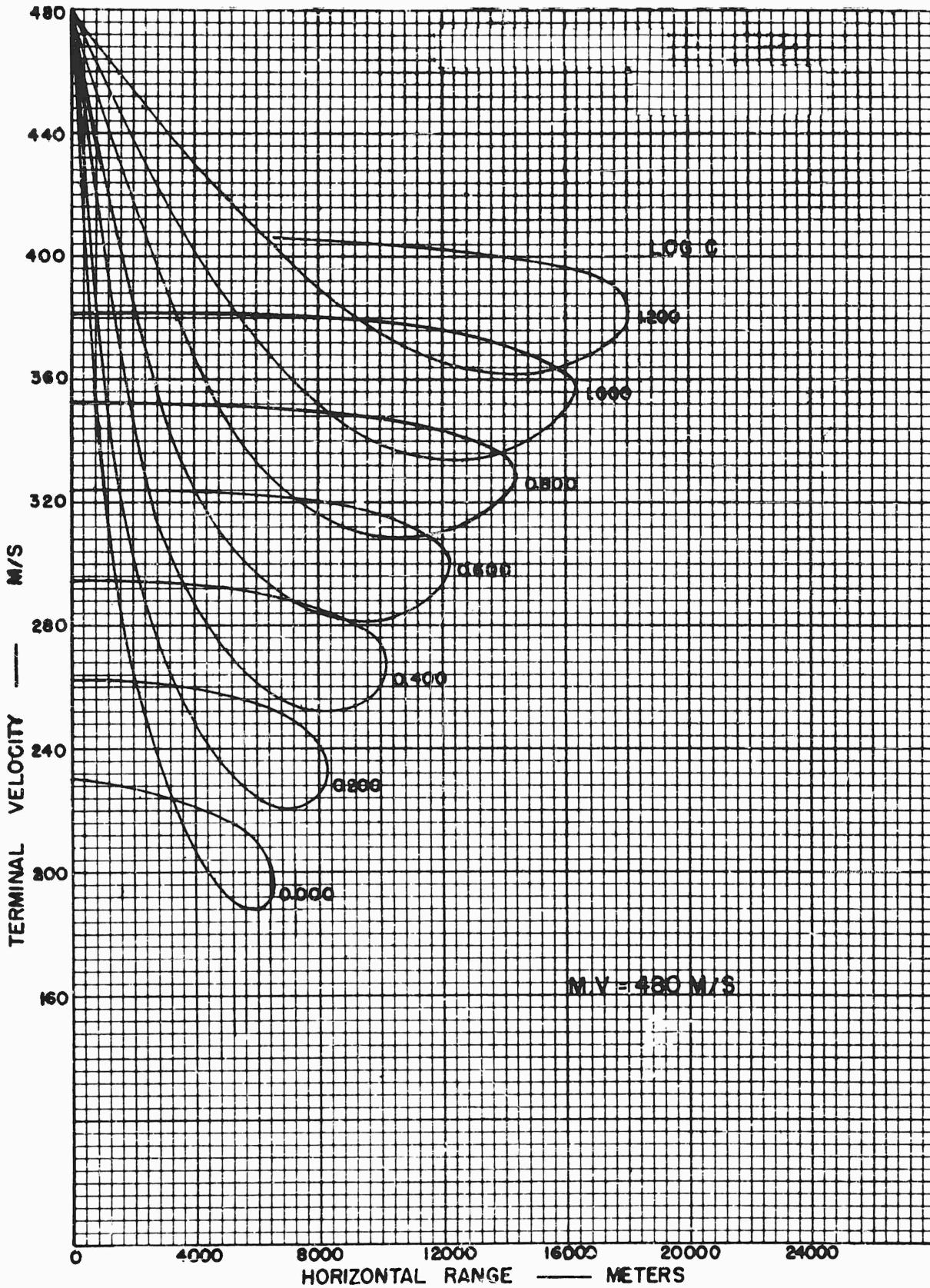


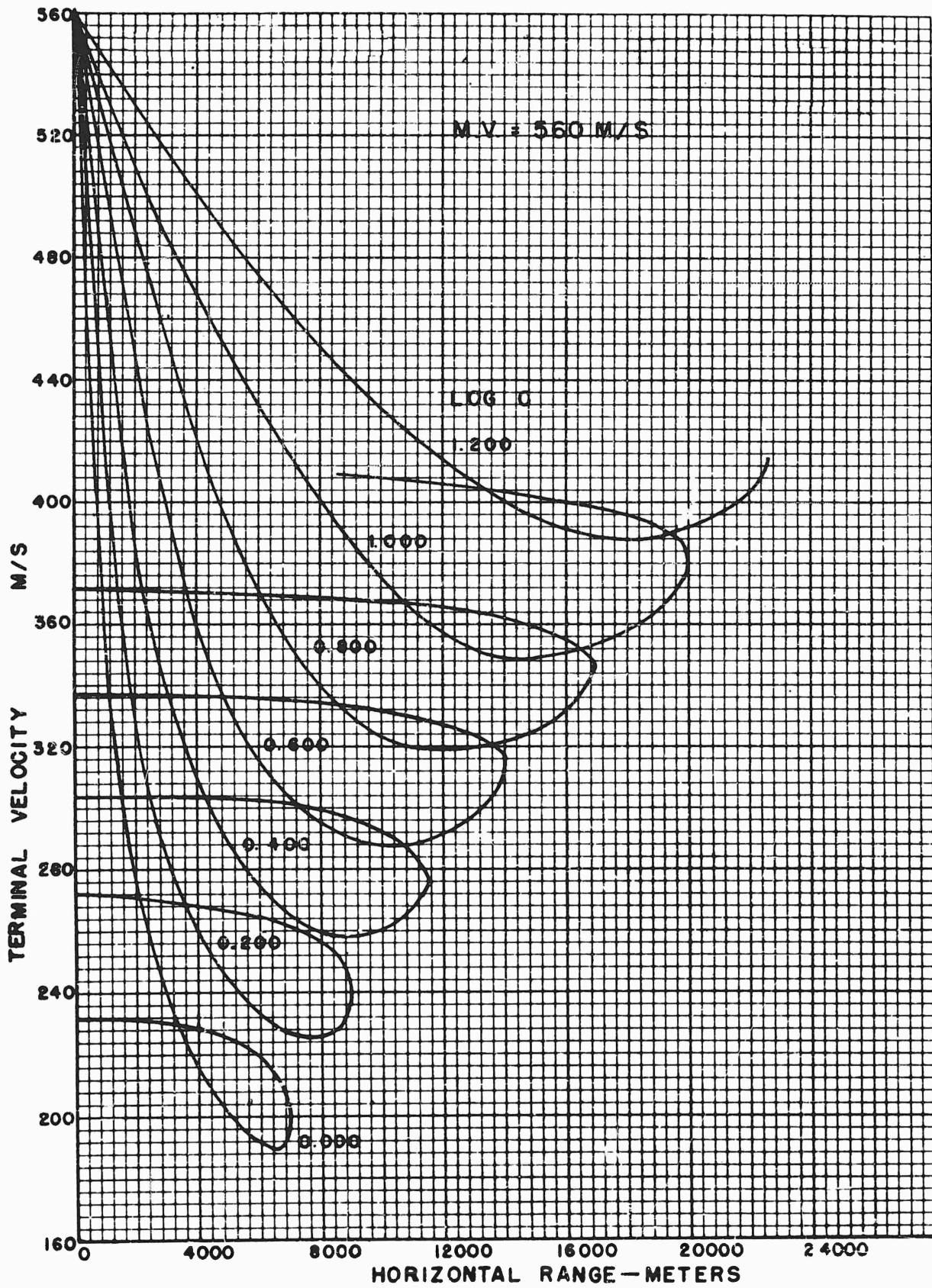


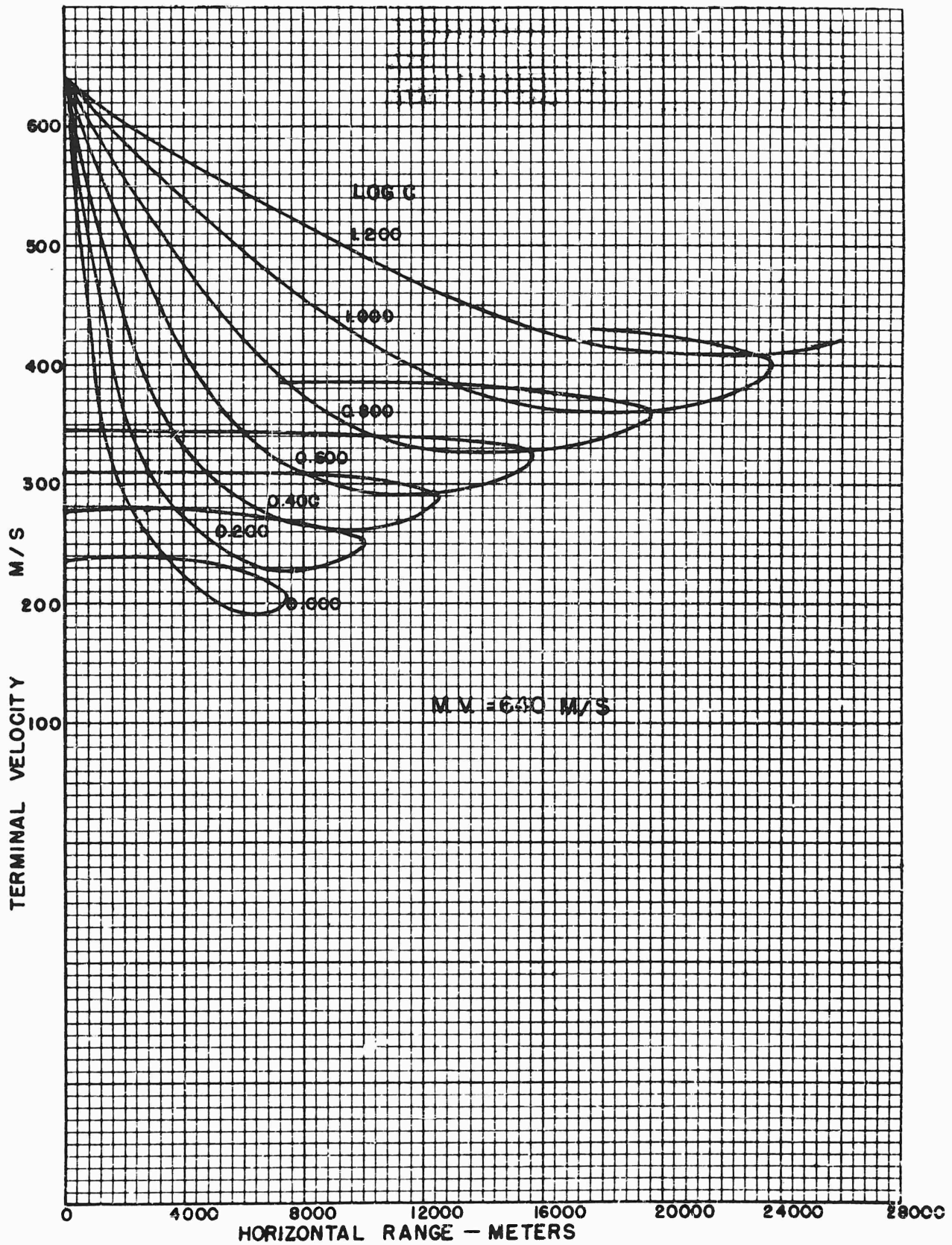


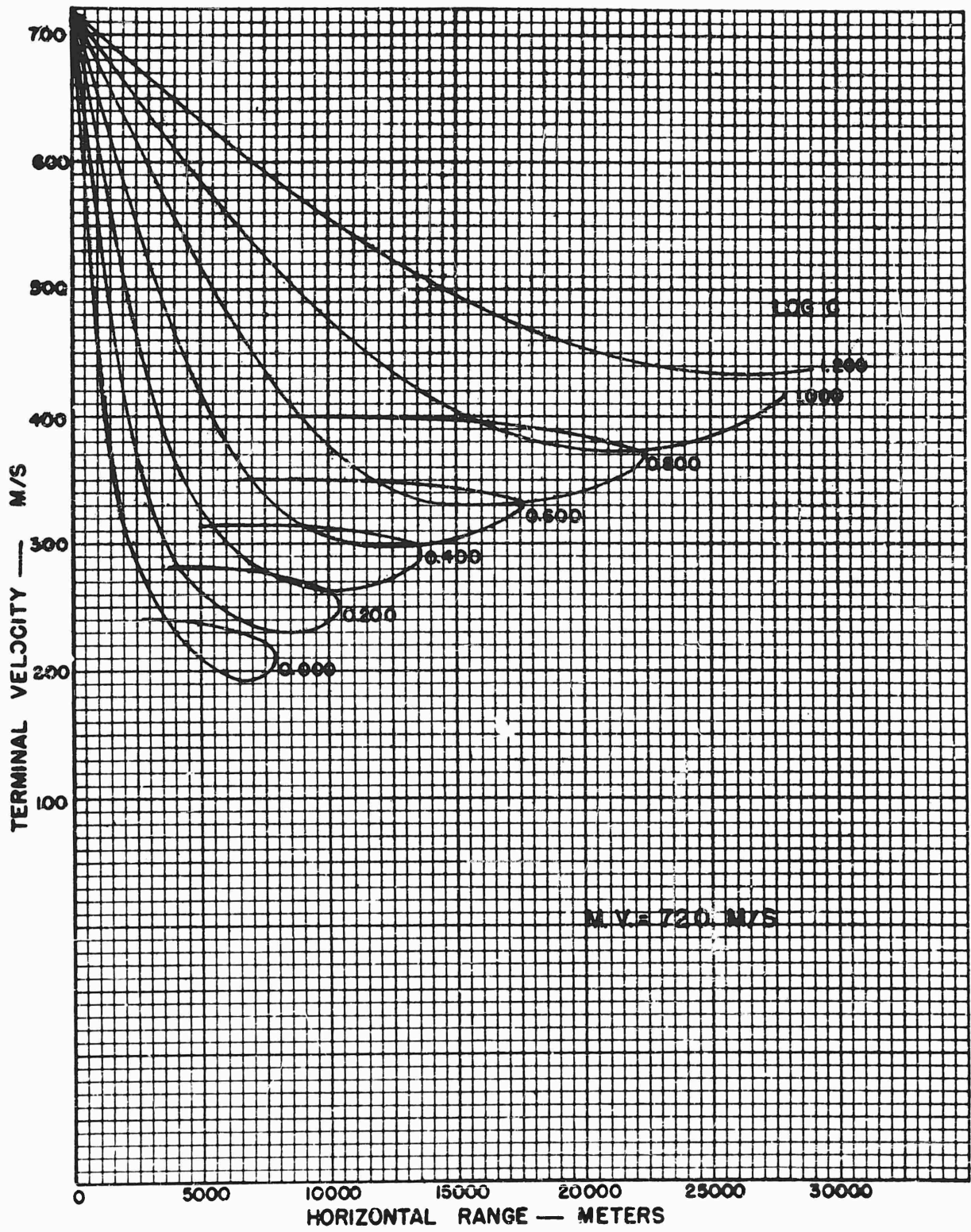


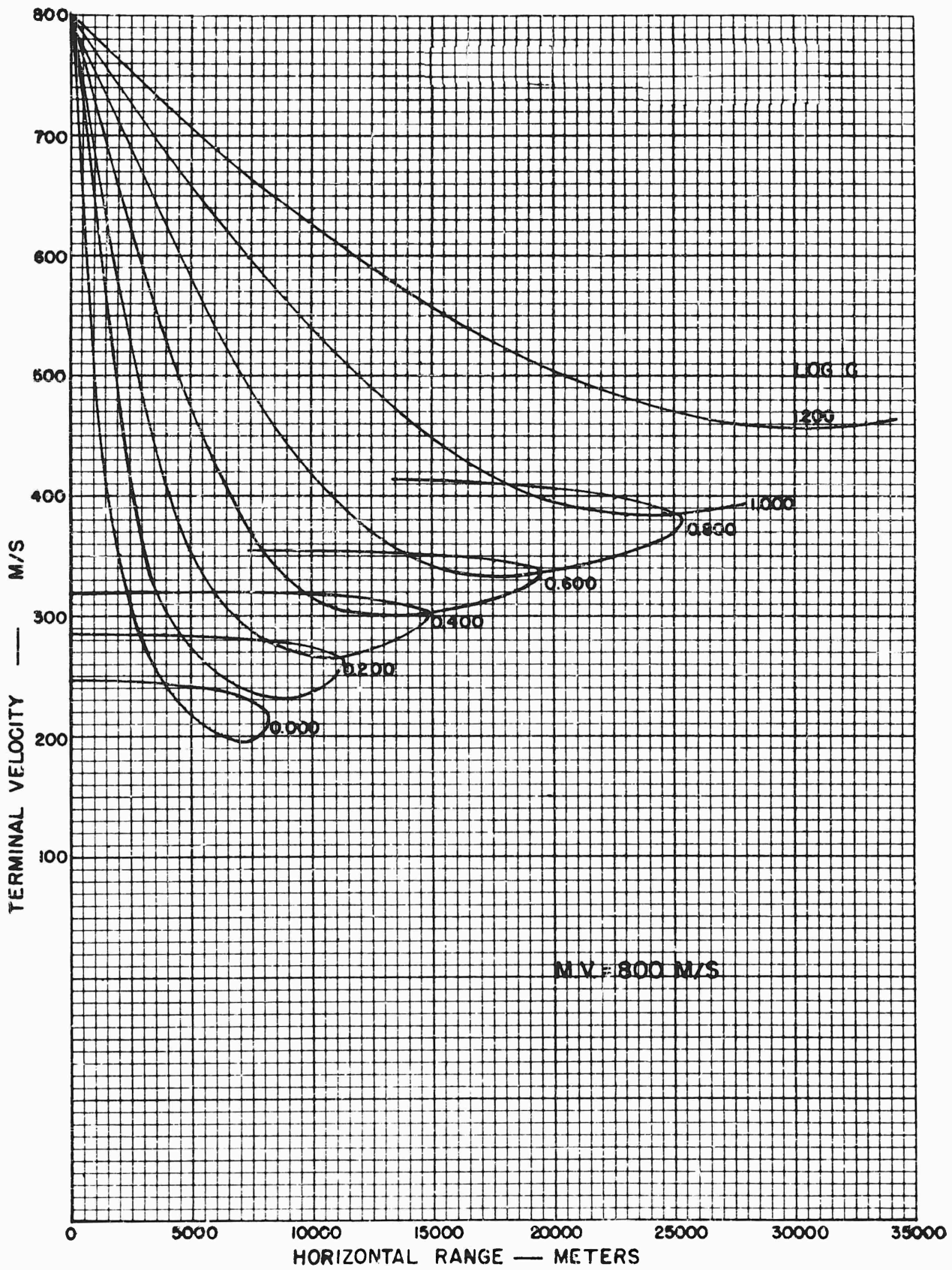


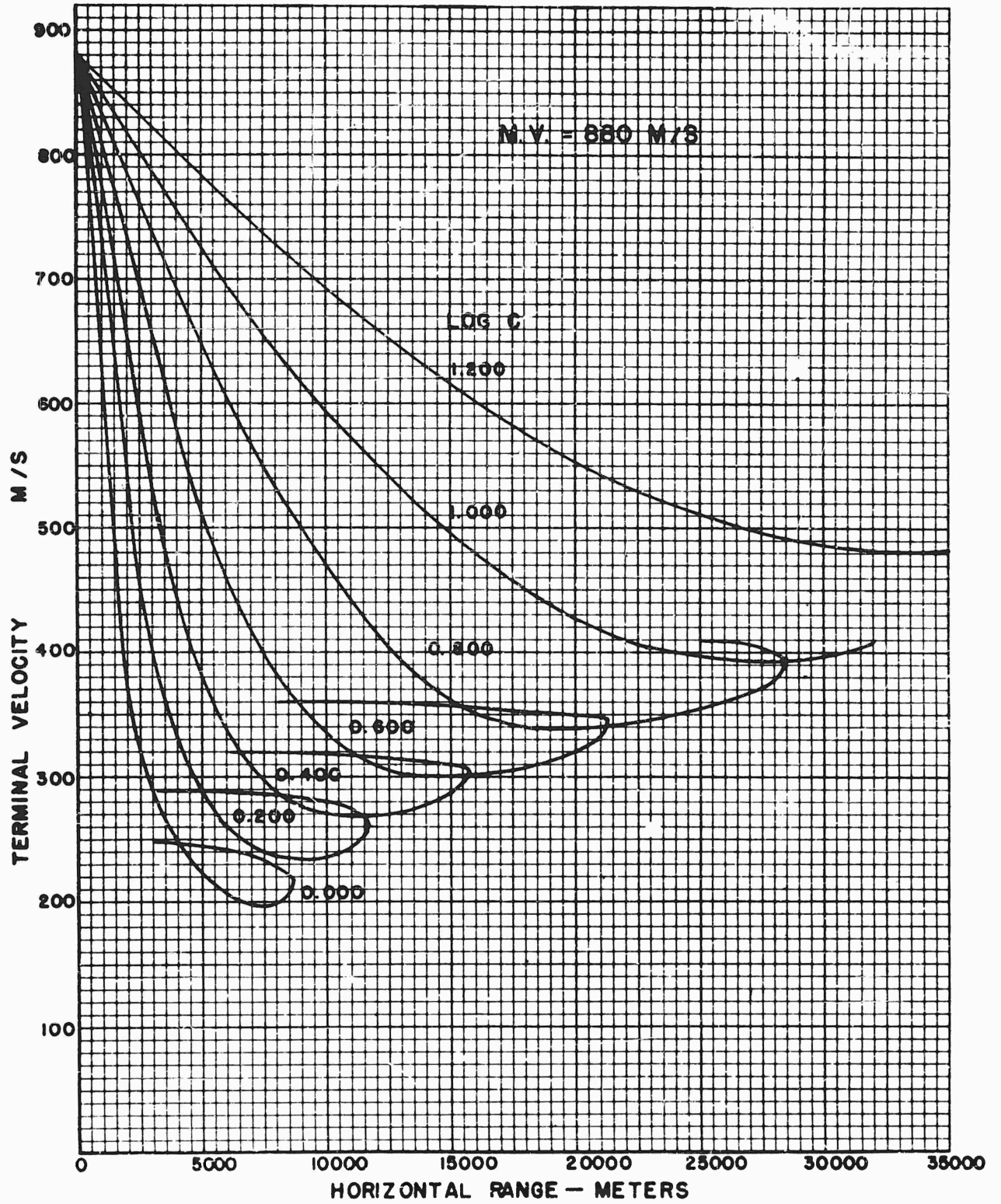


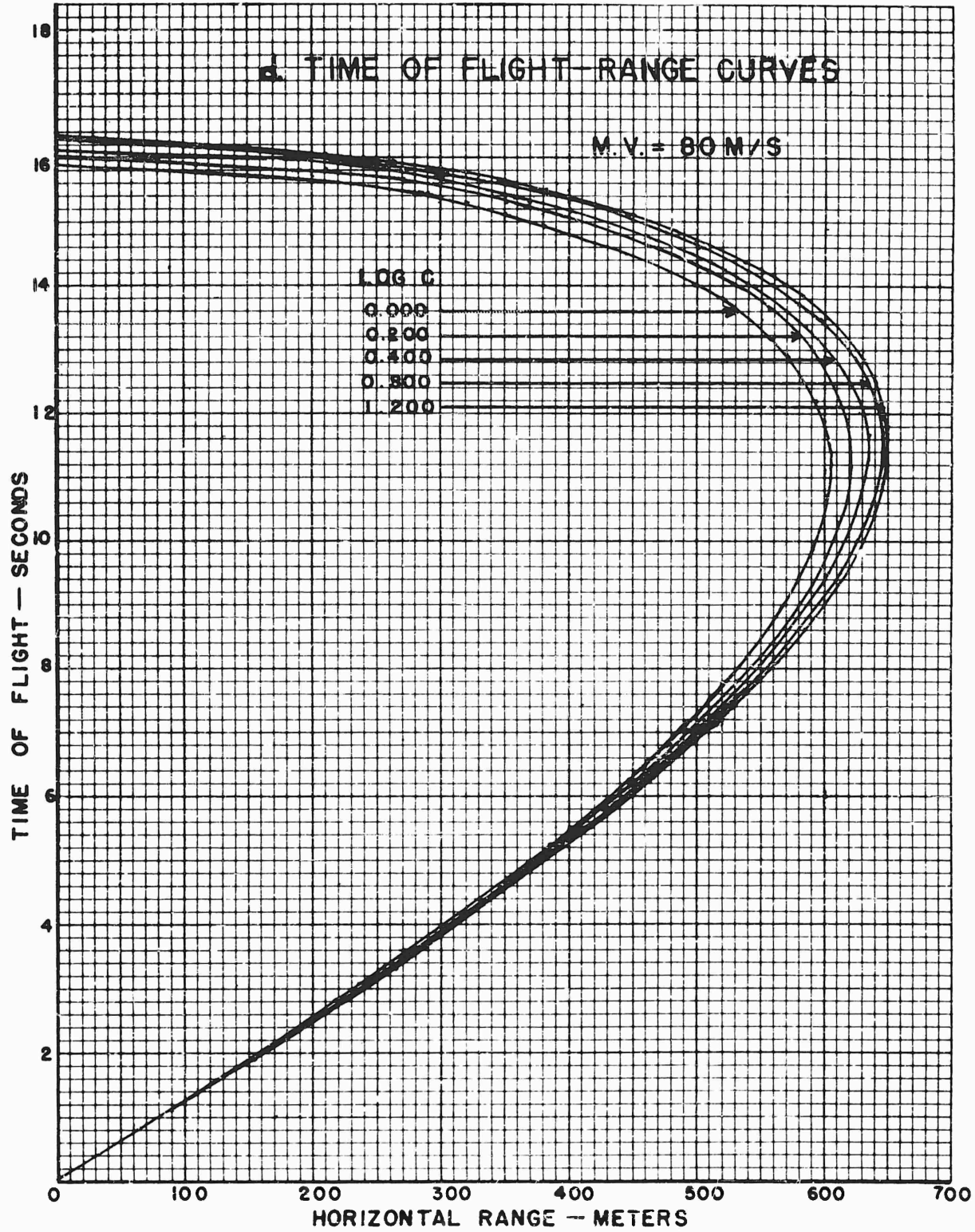


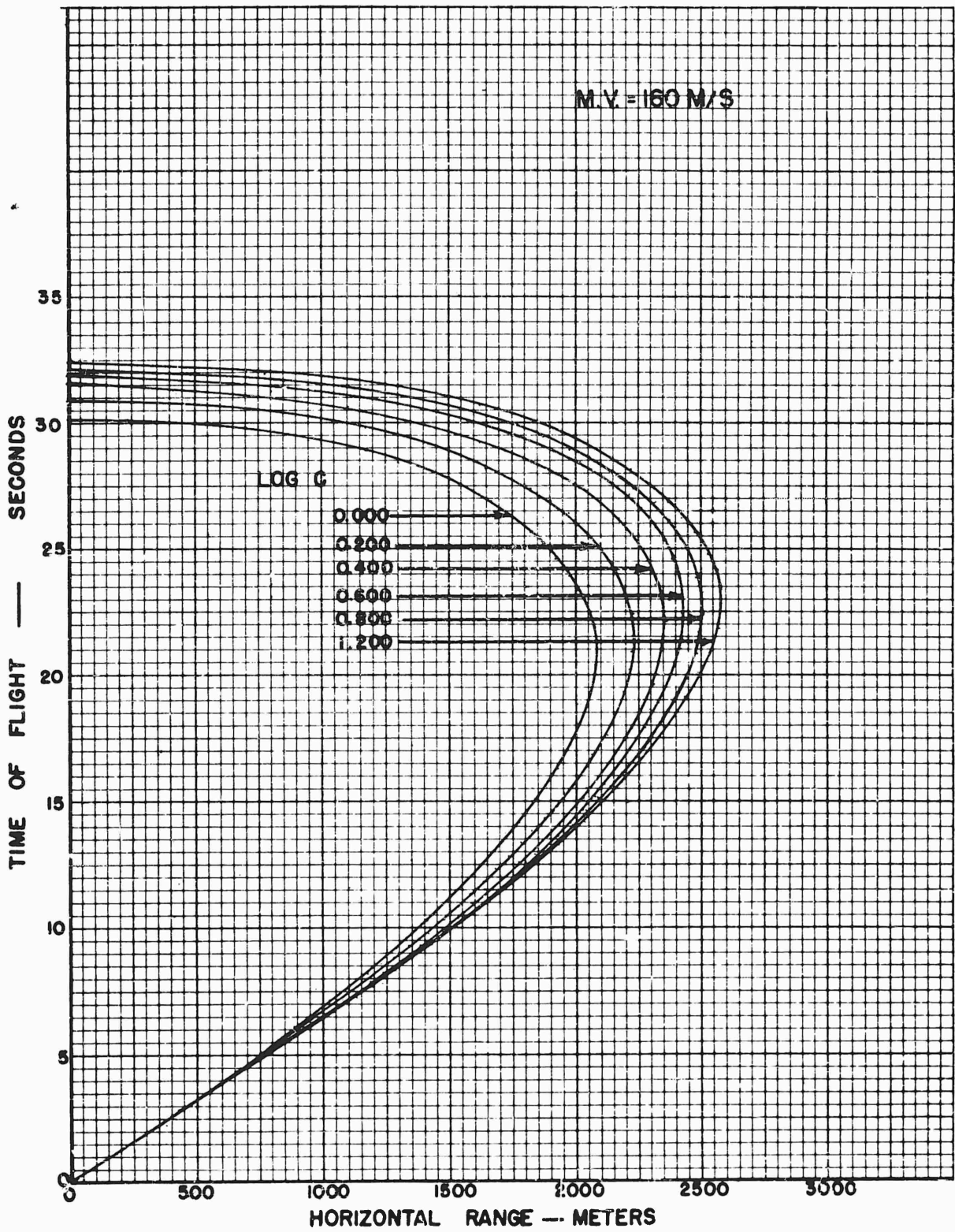


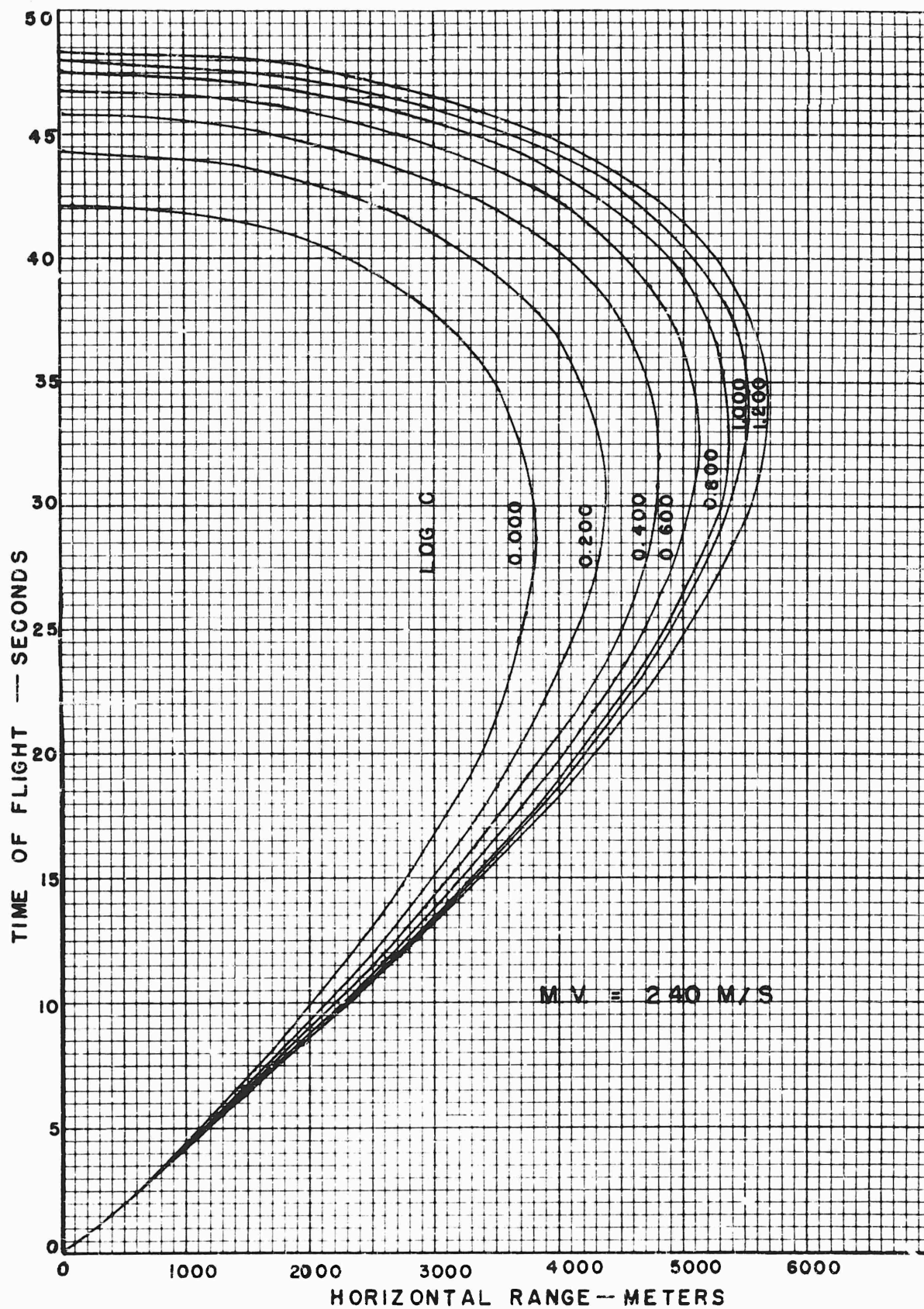


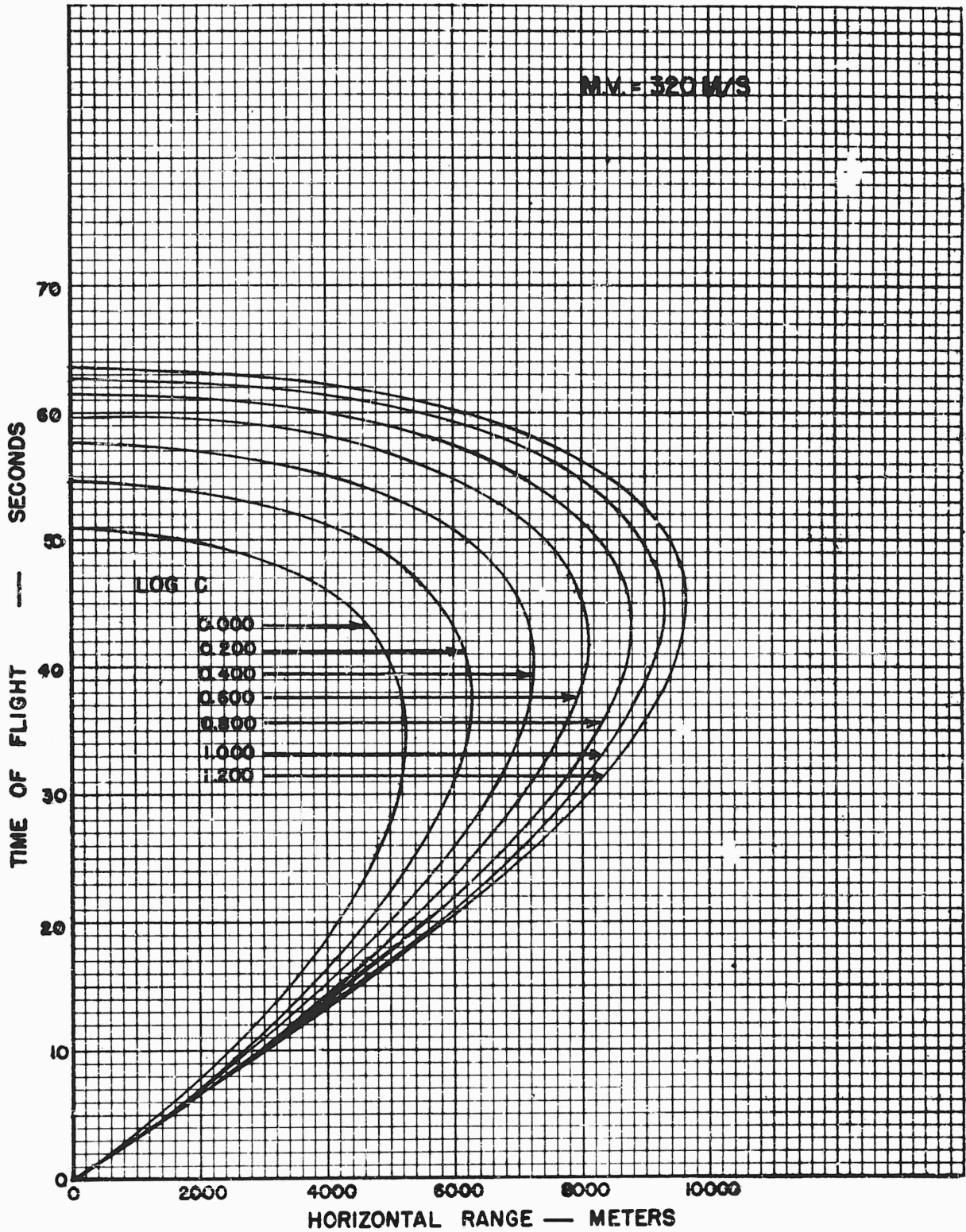


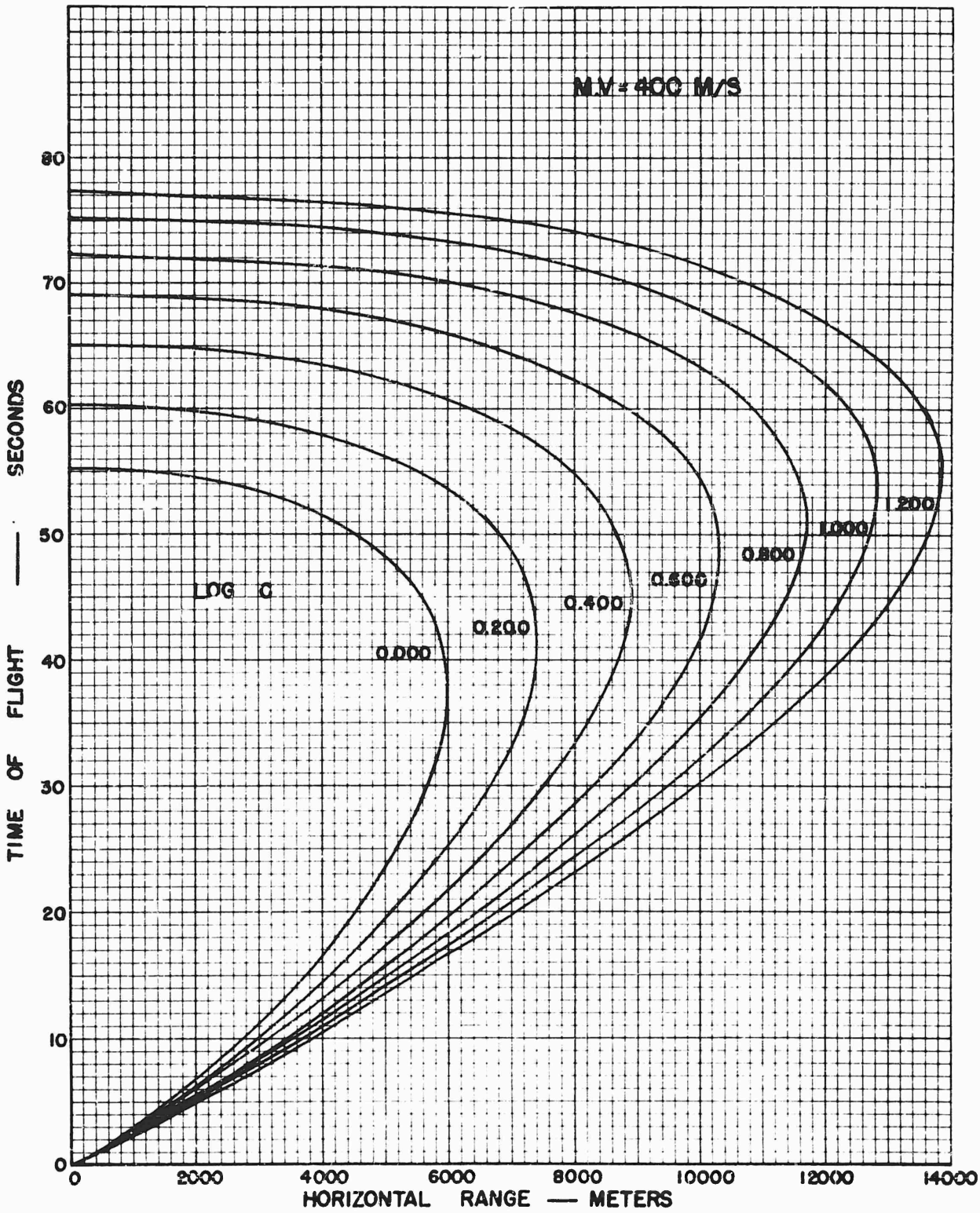


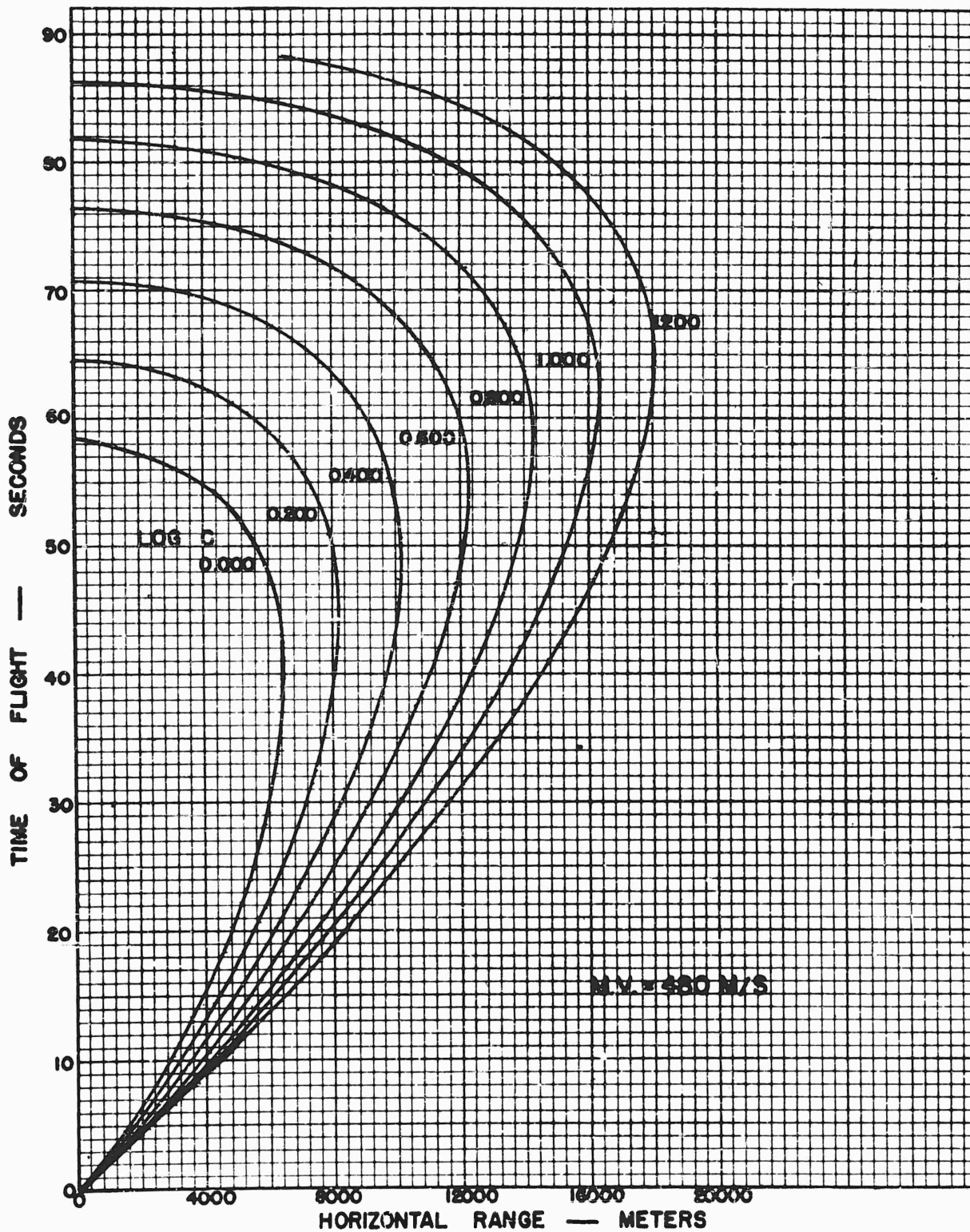


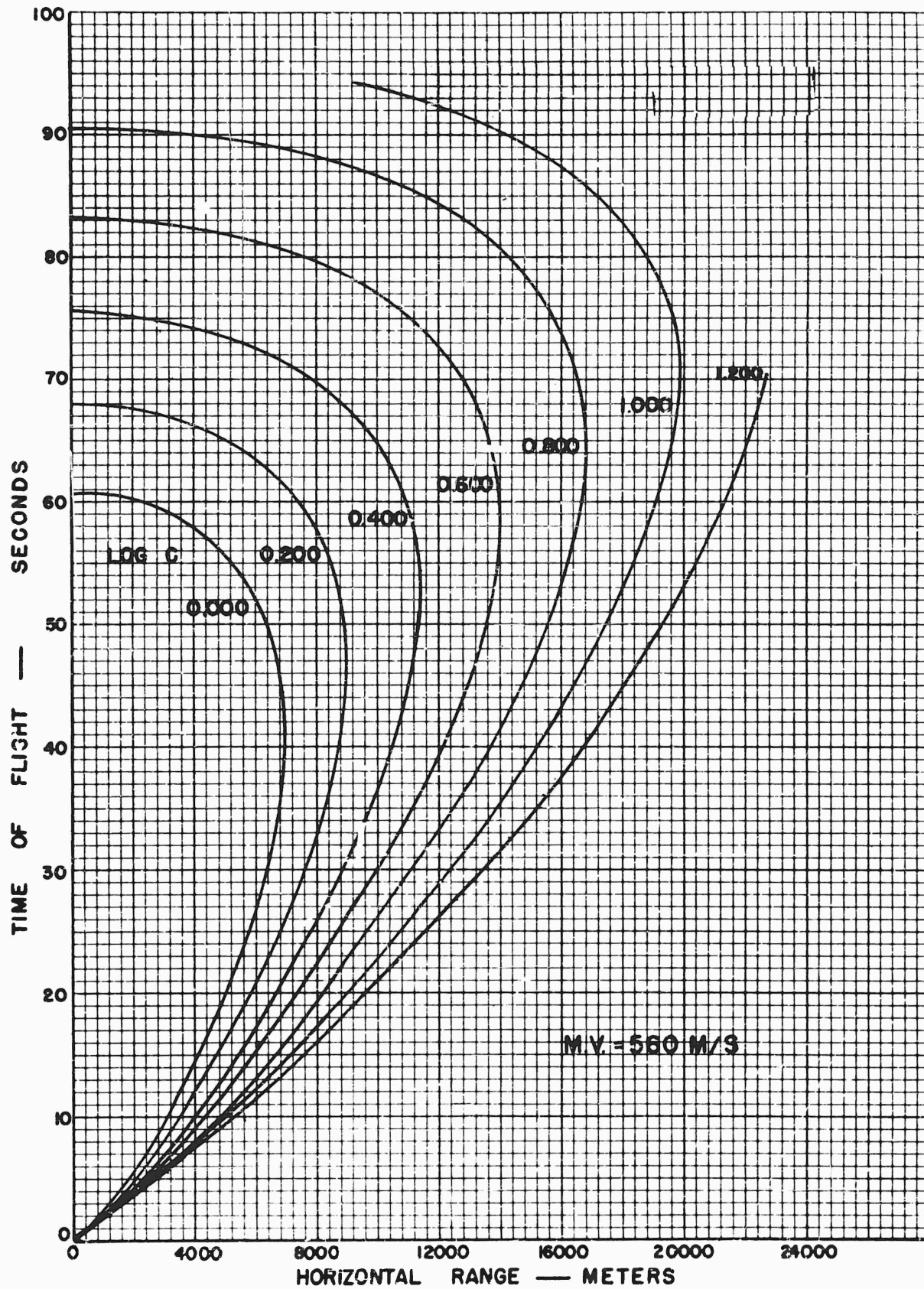


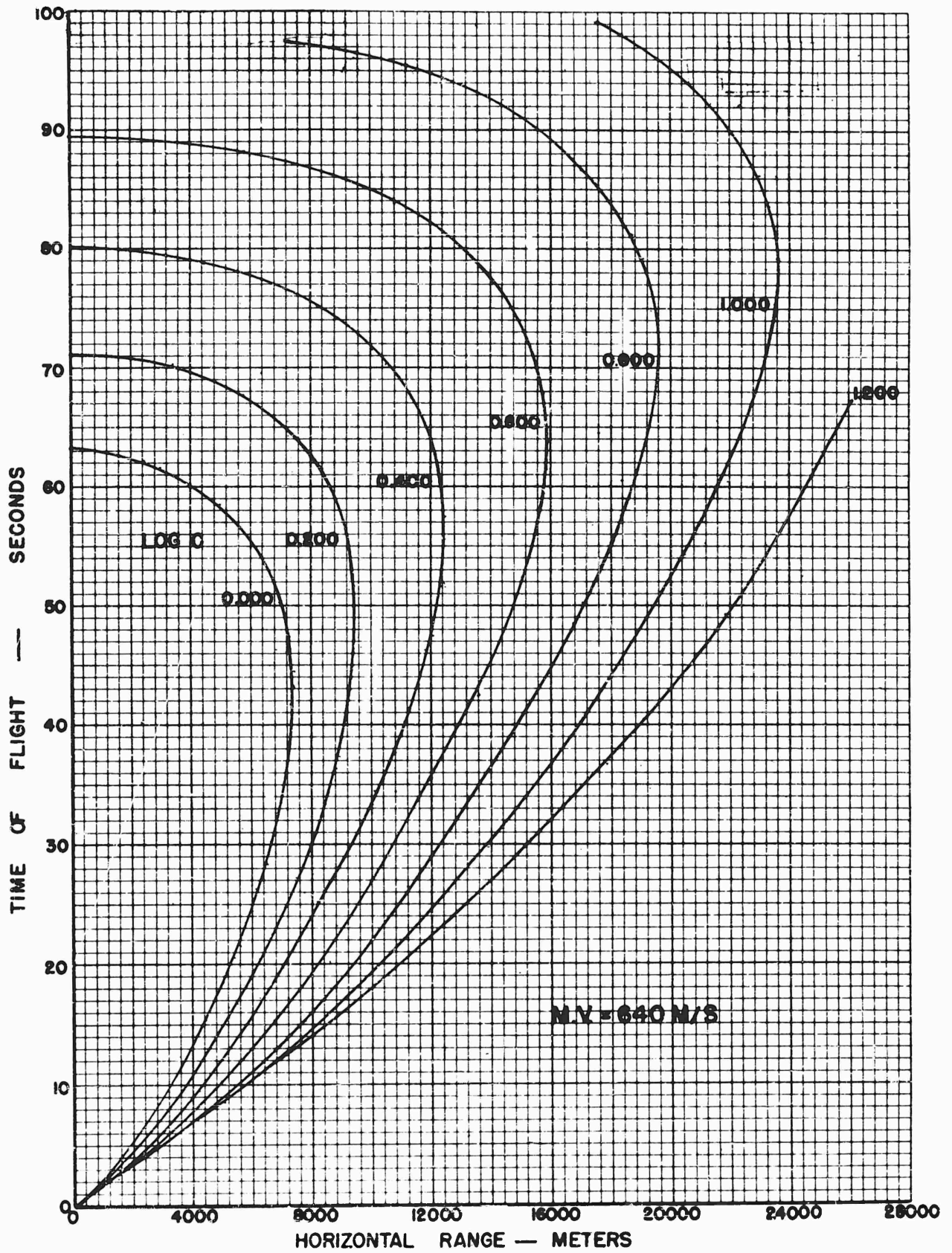


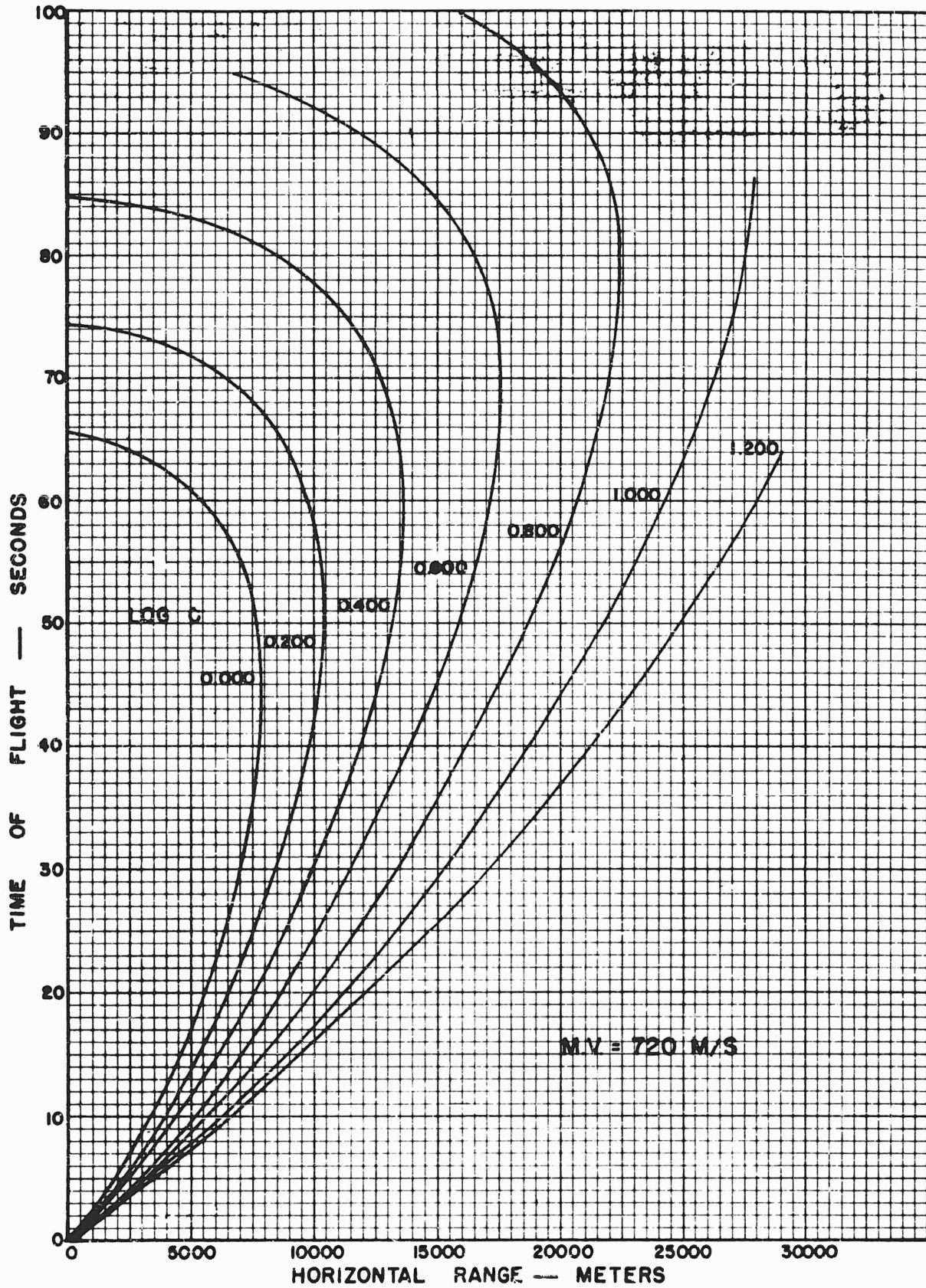


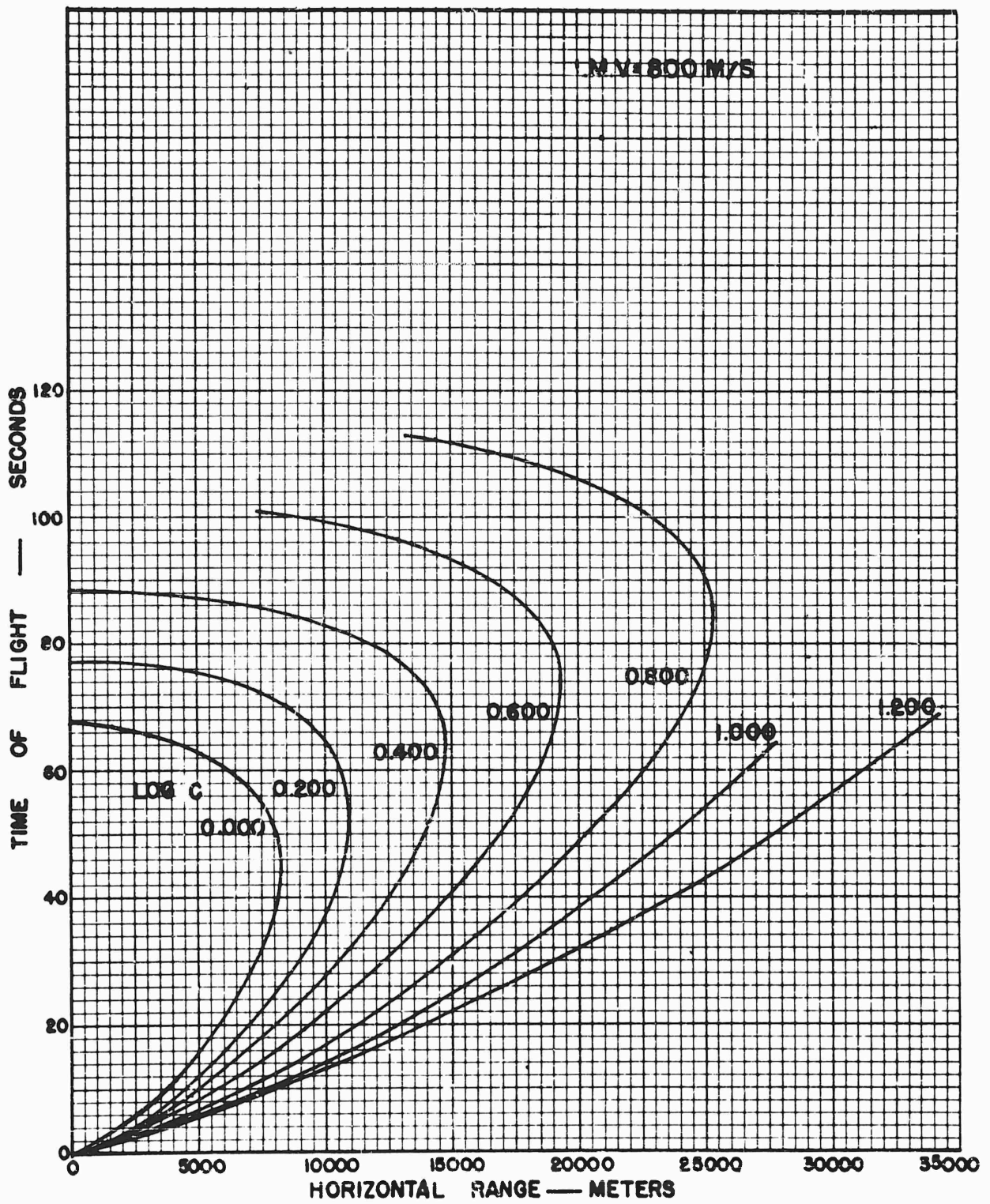




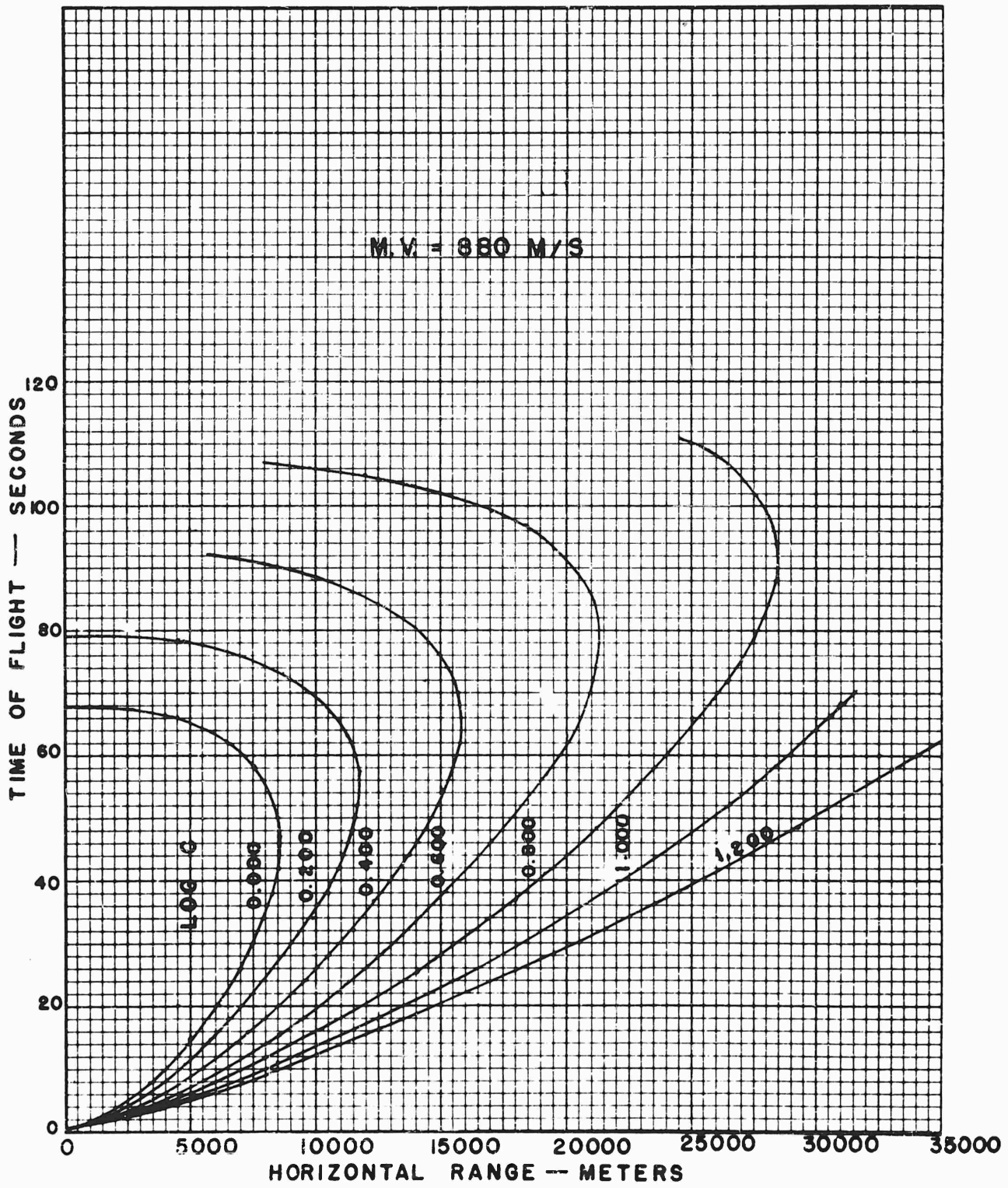








BALLISTIC AND ENGINEERING DATA



Ballistic Research Laboratories
 Handbook of Ballistic and
 Engineering Data for Ammunition,
 No. T-1-2

Ballistic Research Lab.,
 Aberdeen Proving Ground,
 Maryland
 24 March 1949

BALLISTIC AND ENGINEERING DATA
 for
 Projectile Type 2

<u>Section</u>	<u>Paragraphs</u>
I General -----	1
II Description -----	2 - 4
III Exterior ballistic data -----	5 - 6

**SECTION I
 GENERAL**

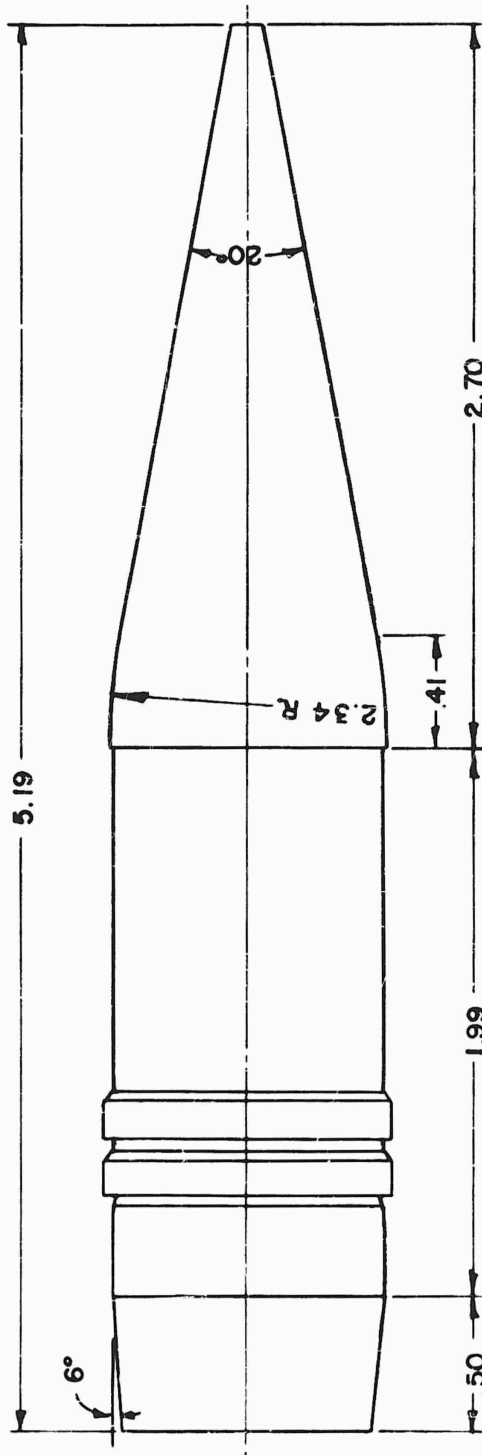
	<u>Paragraph</u>
Purpose -----	1

1. Purpose. The purpose of this number of the handbook is to furnish a concise collection of information regarding the shape, dynamics and ballistics of Projectile Type 2. The prototype of this shape is the experimental 4.7-inch High Explosive Shell Model E1. The dynamic data were obtained with experimental 3.3-inch Shell Types 155 and 159. The information herein is collected from the drawings, reports and ballistic tables pertaining to these projectiles.

**SECTION II
 DESCRIPTION**

	<u>Paragraph</u>
Drawings -----	2
Dimensions -----	3
Physical characteristics -----	4

ALL DIMENSIONS IN CALIBERS



PROJECTILE TYPE 2

2. Drawings.

- a. Shell, Experimental
4.7-inch, E1 75E-2-225
- b. Shell, Experimental,
3.3-inch, Type 155:
Base 75E-2-201D
Body GA 340B
Ogive GA 494A
Assembly 75E-2-204
Force Diagram 2258-A*
- c. Shell, Experimental,
3.3-inch, Type 159:
Base 75E-2-201E
Body GA 340B
Ogive GA 494A
Assembly 75E-2-204
Force Diagram 2258-B*
- d. Projectile Type 2. (See page 2)

* Aberdeen Proving Ground, Design and Development Section.

3. Dimensions.

Boattail: Angle (Type 155, 5° Type 159, 7°)	6°
Length	0.50 cal
Cylindrical body: Length	1.99 cal
Ogive: Length	2.70 cal
Length of ogival portion	0.41 cal
Radius of ogival arc	2.34 cal
Vertical angle of conical portion	20°
Shell: Length	5.19 cal

4. Physical characteristics. The following values pertain to the 4.7-inch experimental shell E1.

Weight	50 lb
Base to center of gravity	1.686 cal
Axial moment of inertia	1.125 lb. ft ²
Transverse moment of inertia	9.614 lb. ft ²

SECTION III
EXTERIOR BALLISTIC DATA

	Paragraph
Aerodynamic data -----	5
Ballistic table data -----	6

5. Aerodynamic data.

a. Drag function: G_2 . For velocities below 1000 m/sec, the tabulated values were calculated from the average drag coefficients obtained from observations with the 3.3-inch Shell Types 155 and 159. For velocities from 1000 to 3000 m/sec, the tabulated values are proportional to the theoretical values for a shell with a conical ogive four calibers high and a 5° boattail 0.75 caliber long.

In September 1946, the drag coefficient for Projectiles Type 2 was revised: this being the second revision, it was called $K_{D2.2}$. At Mach numbers less than 1.86 (635 m/sec velocity) $K_{D2.2}$ is the same as K_{D2} ; at higher Mach numbers,

$$K_{D2.2} = 0.987 (K_{DB} + K_{DF} + K_{DH})$$

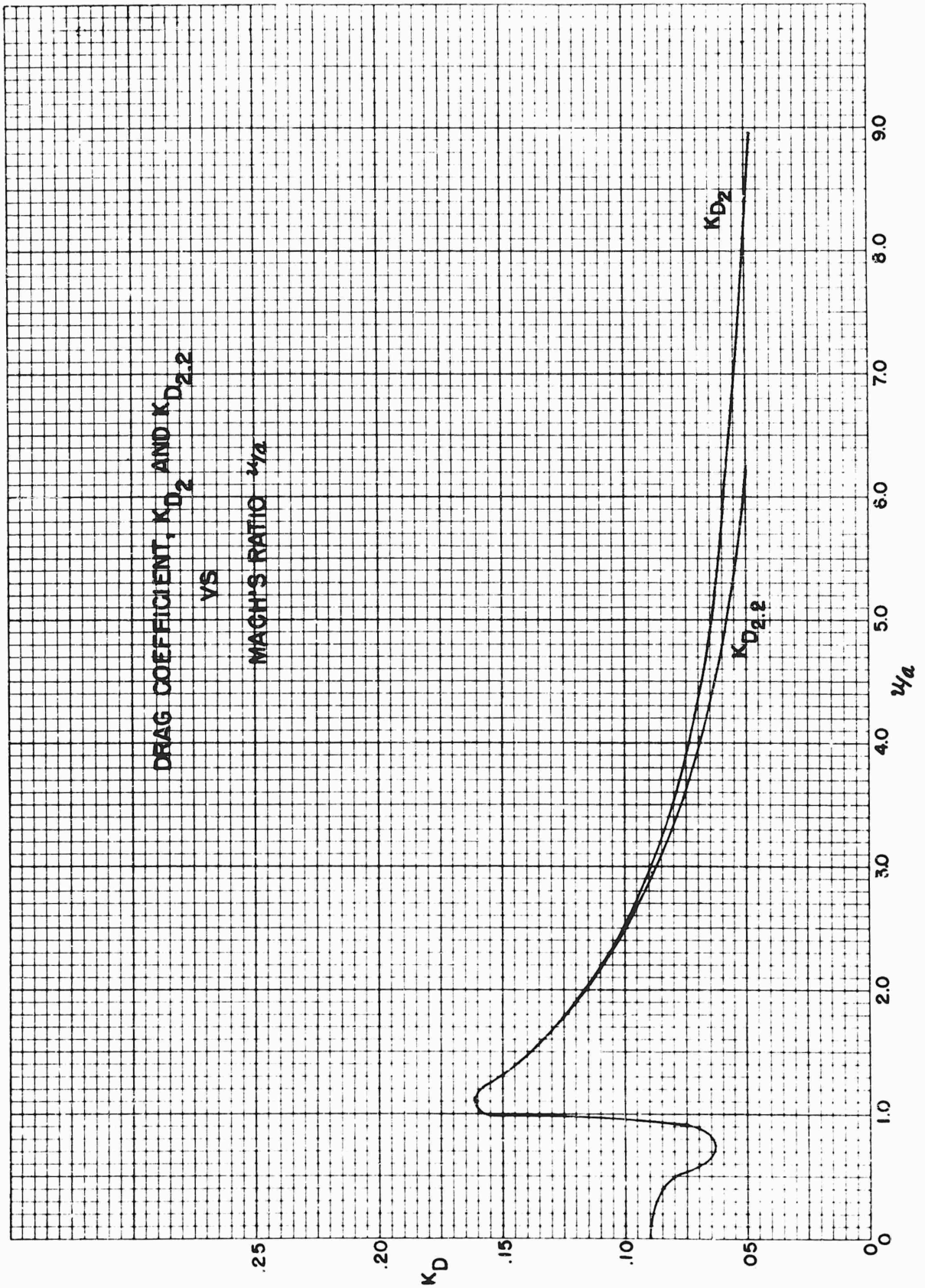
where

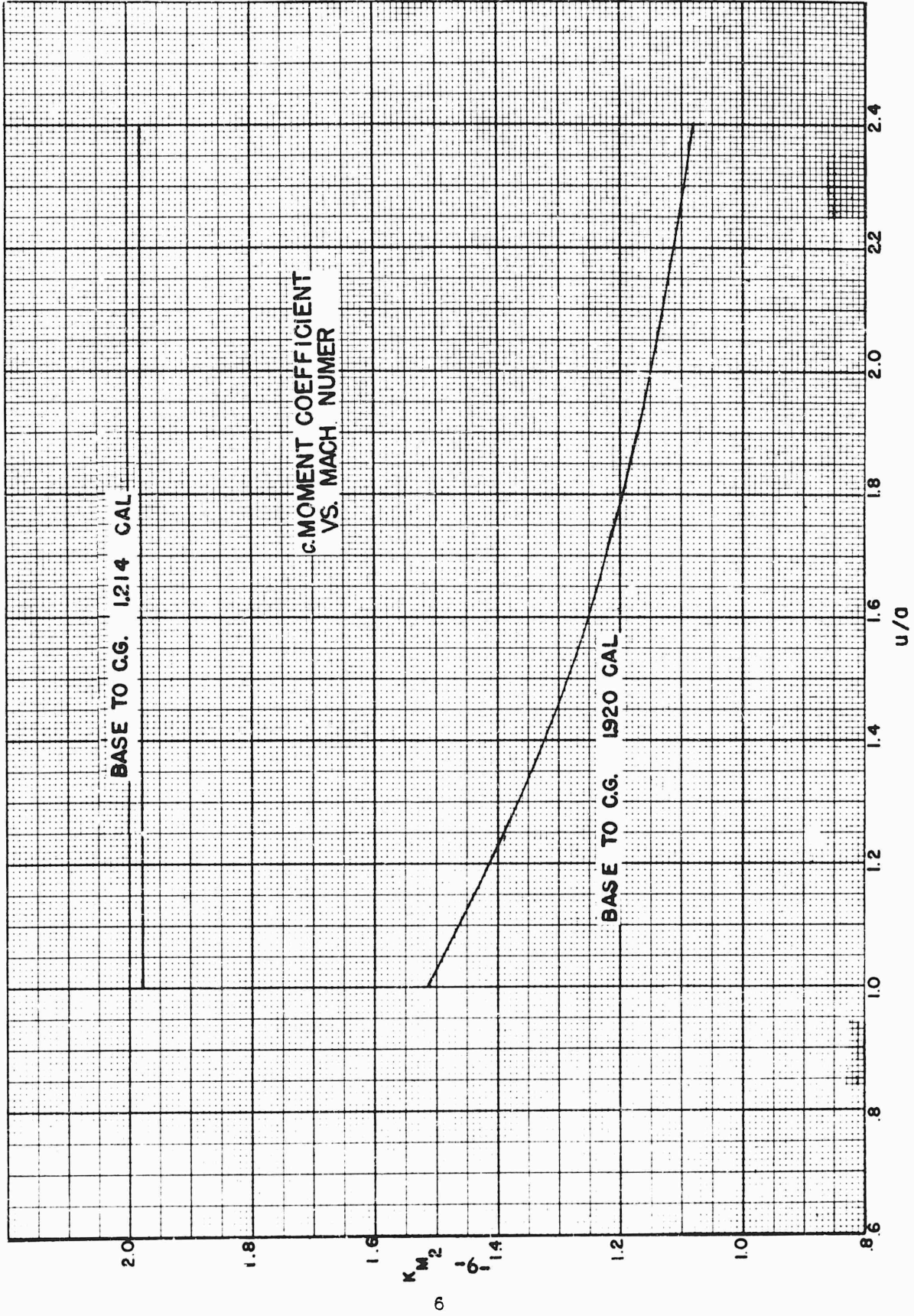
K_{DB} is a base drag coefficient computed from empirical data on the base pressure of a 20-mm model projectile,

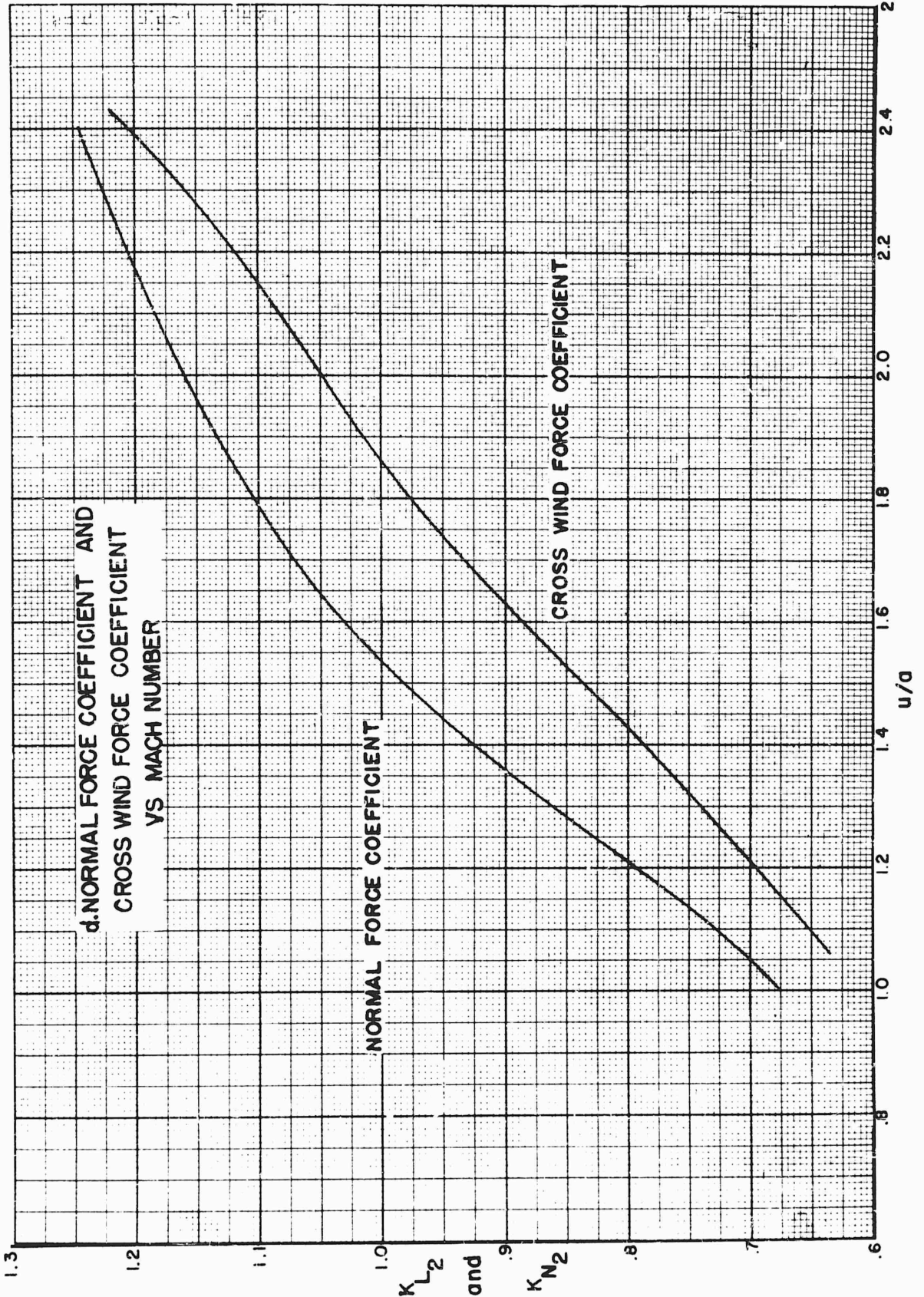
K_{DF} is a skin friction drag coefficient determined by a modification of John K. Vennard's flat plate formula for turbulent flow,

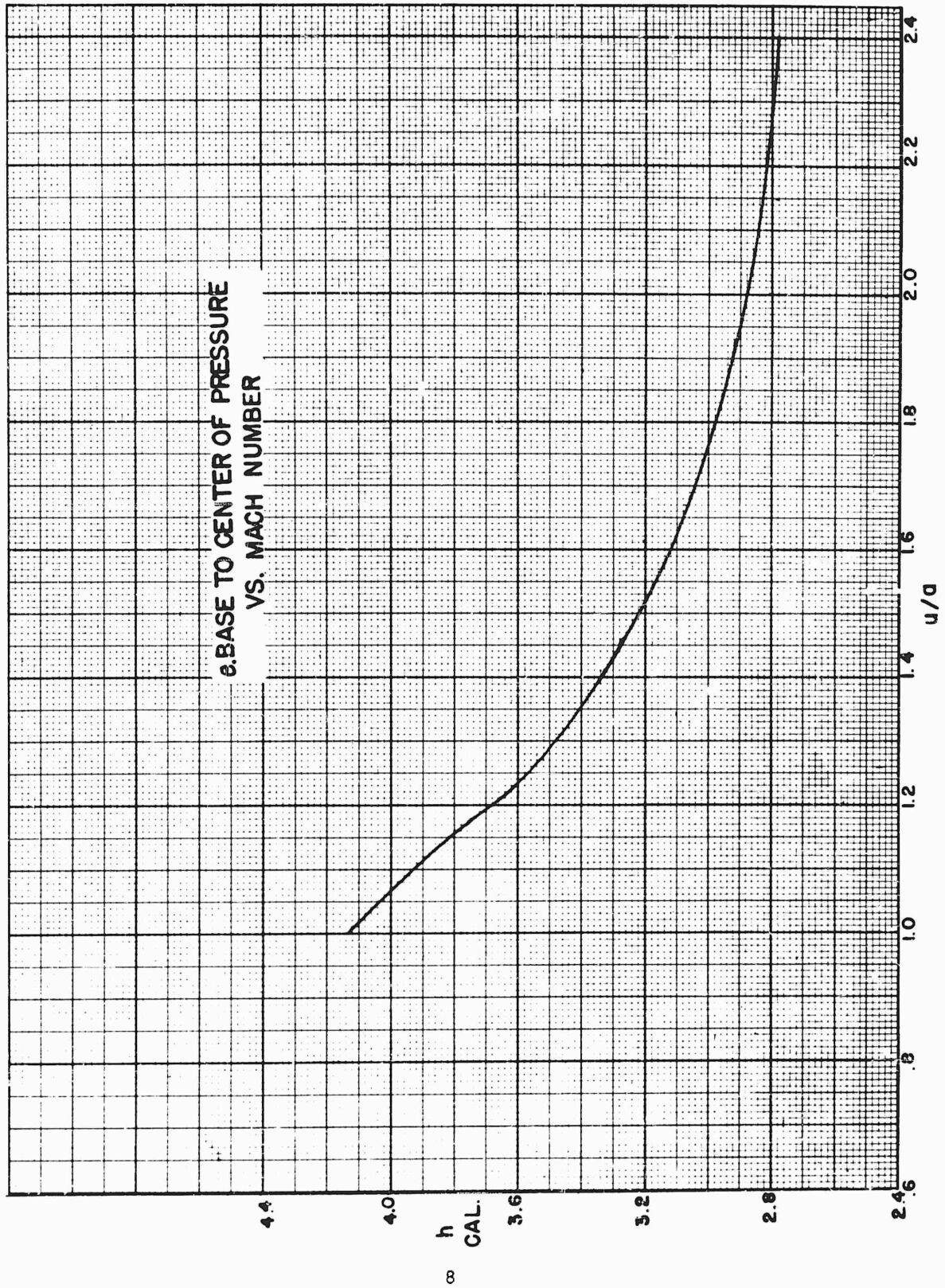
K_{DH} is a head drag coefficient computed by Taylor and Maccoll's theory for an infinite cone with a semi-apex angle of 10.5° (the same as a finite cone 2.7 calibers high)

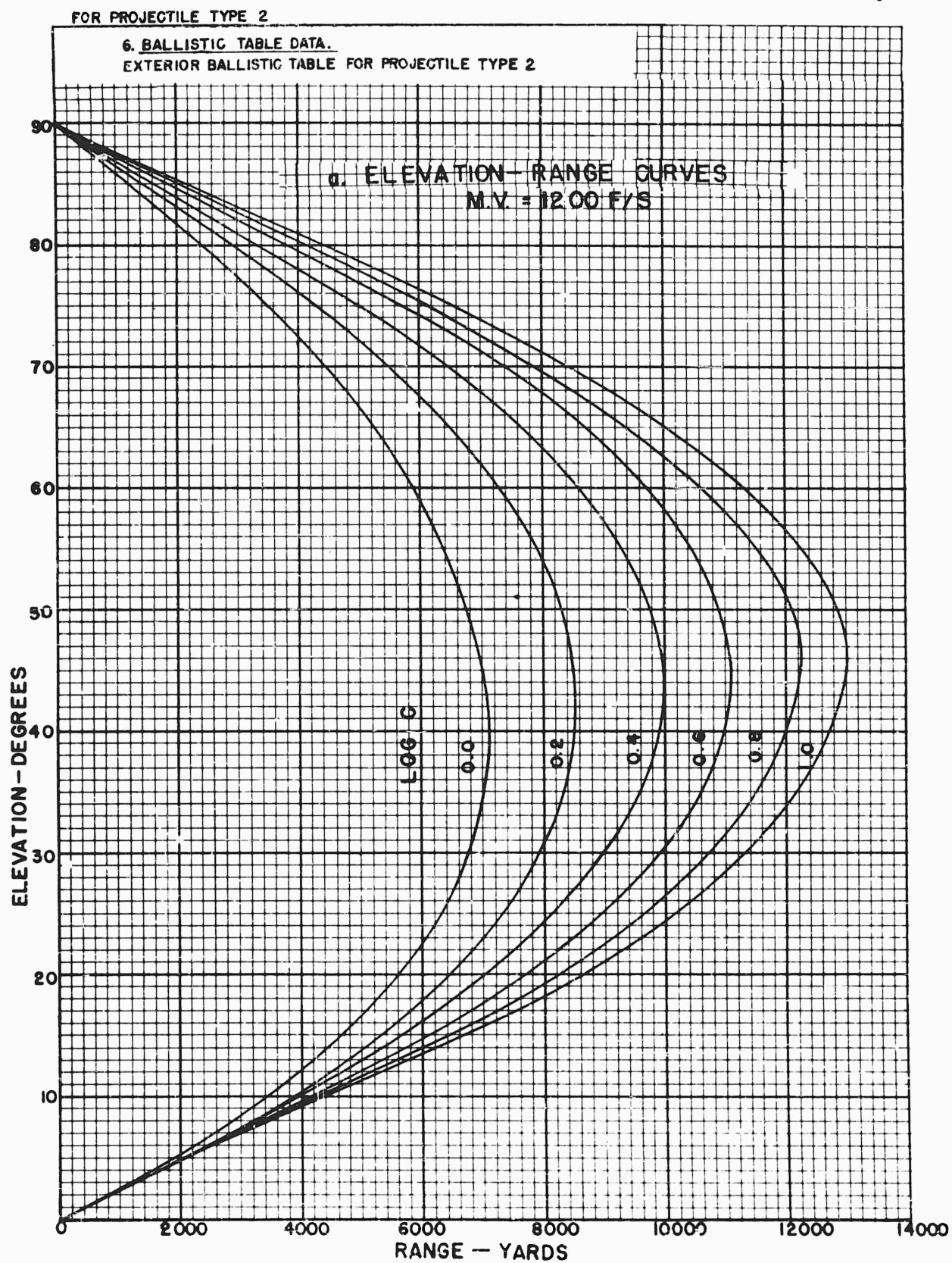
and the factor 0.987 was chosen to make the two branches of the curve meet tangentially (see p. 5)

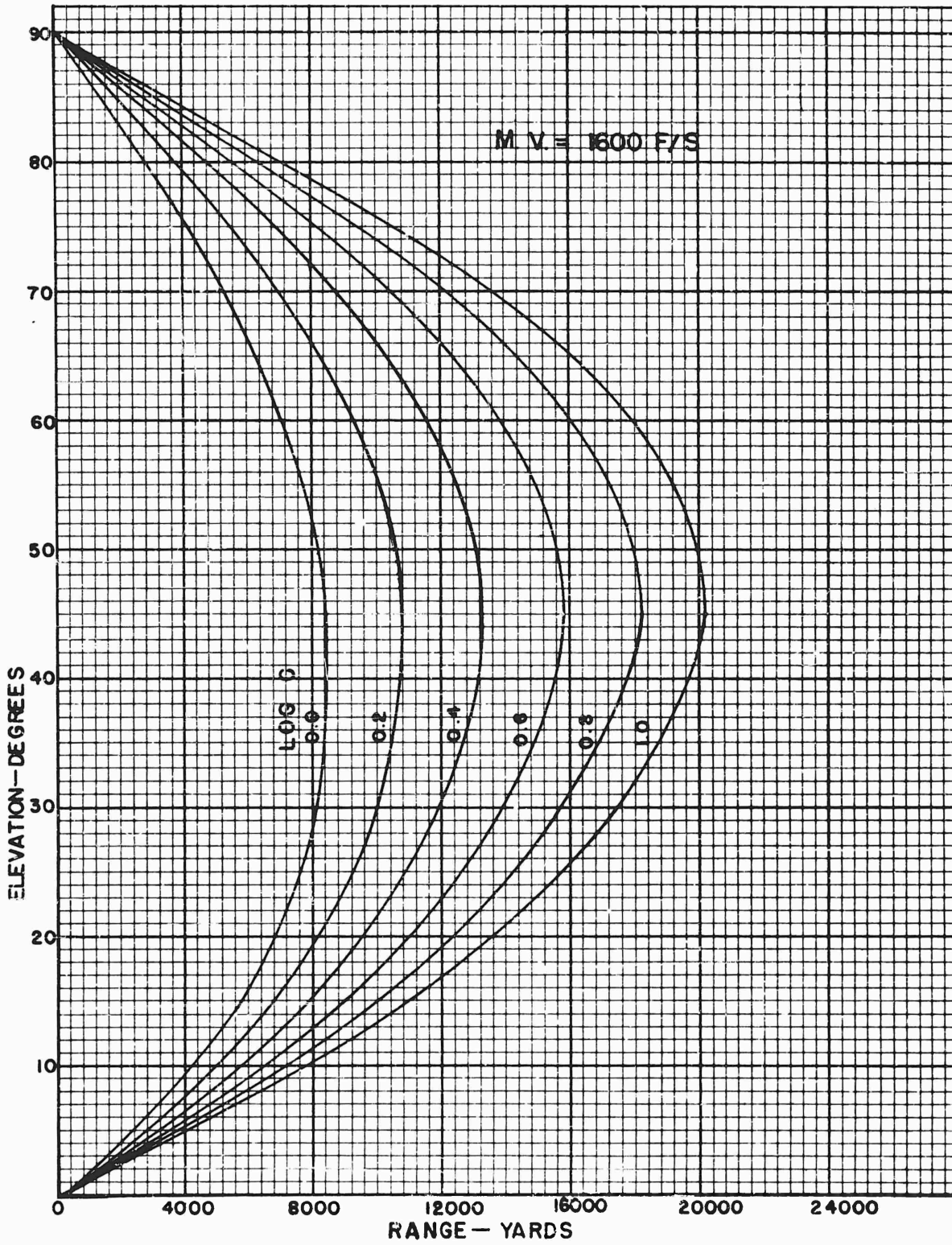


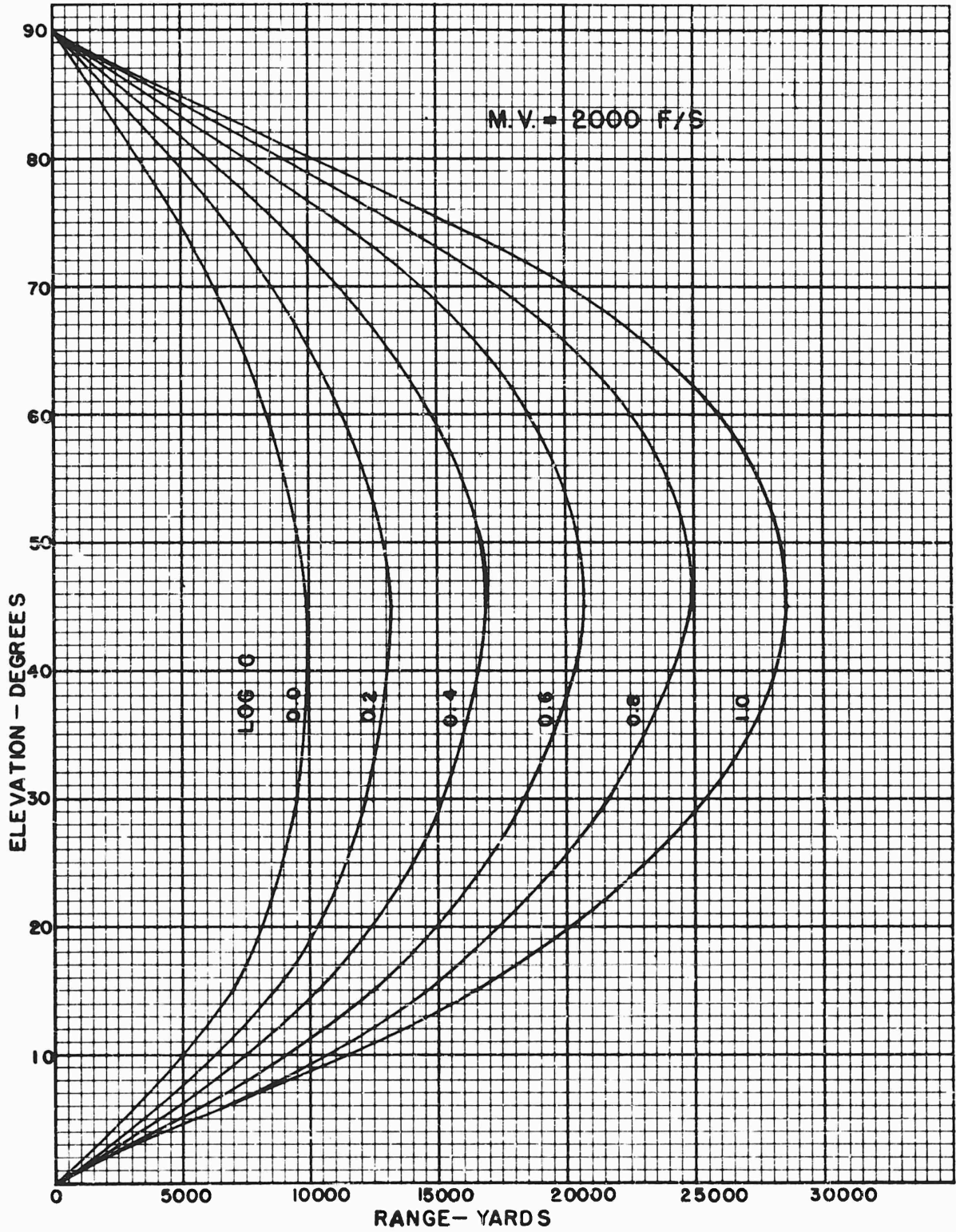


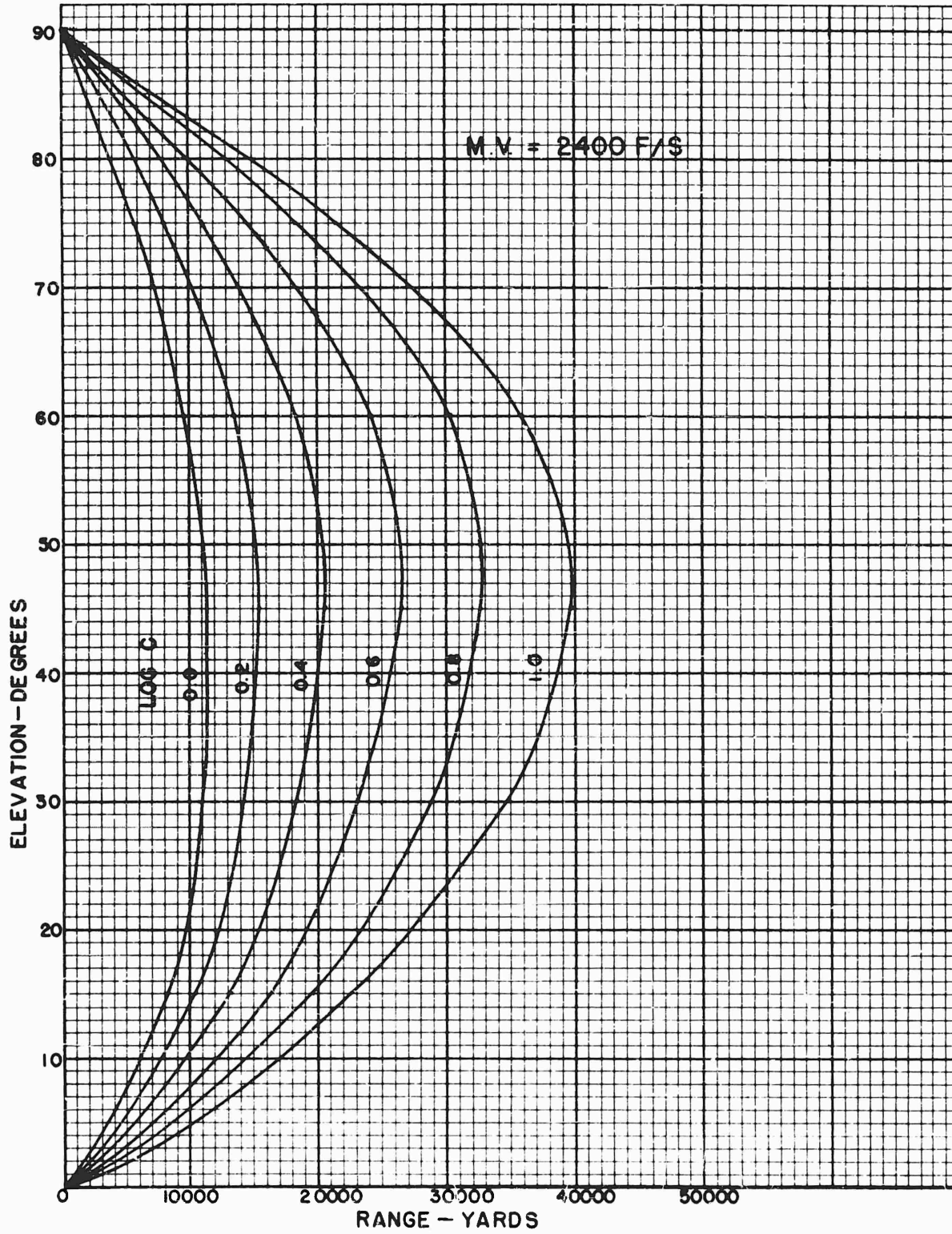


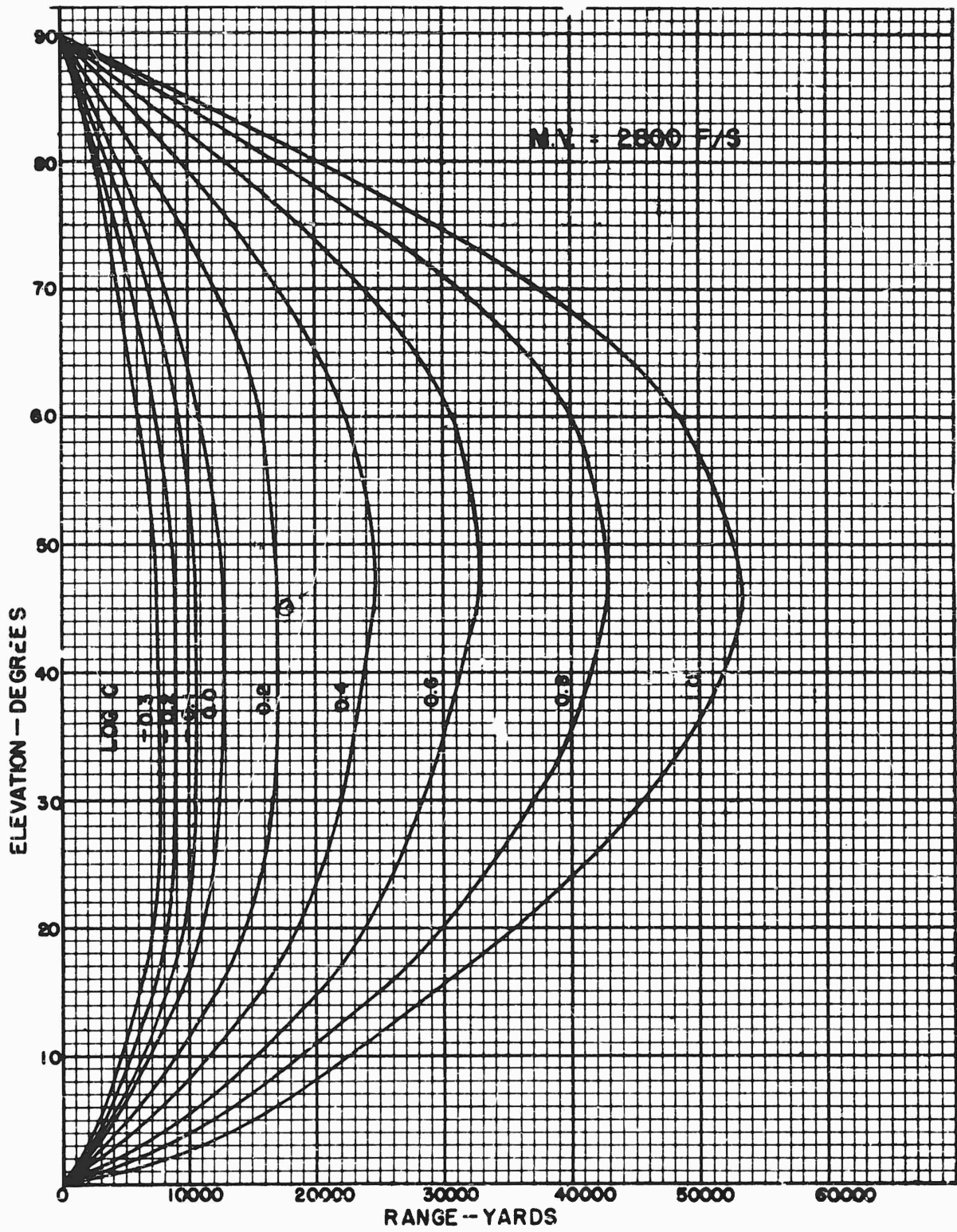


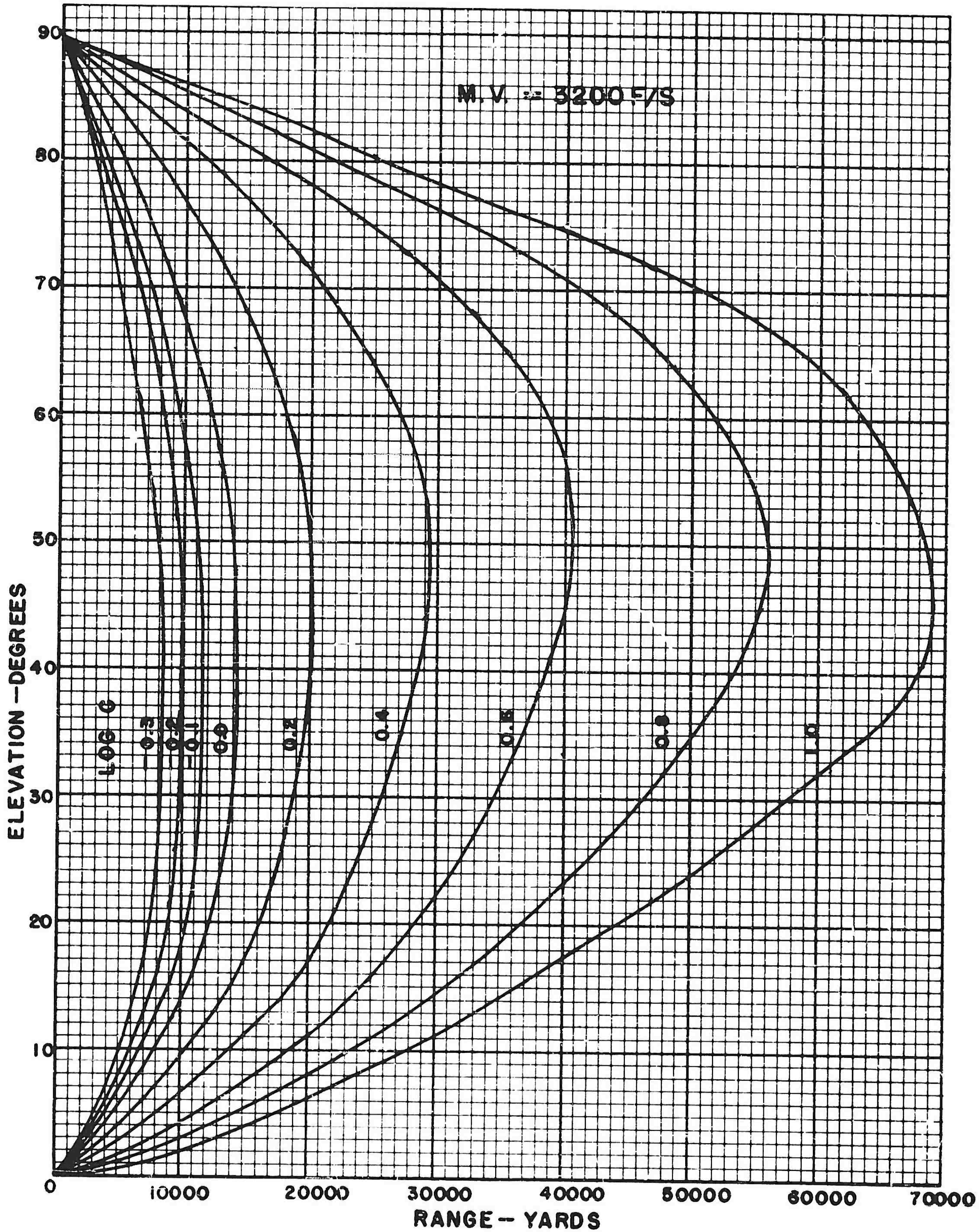


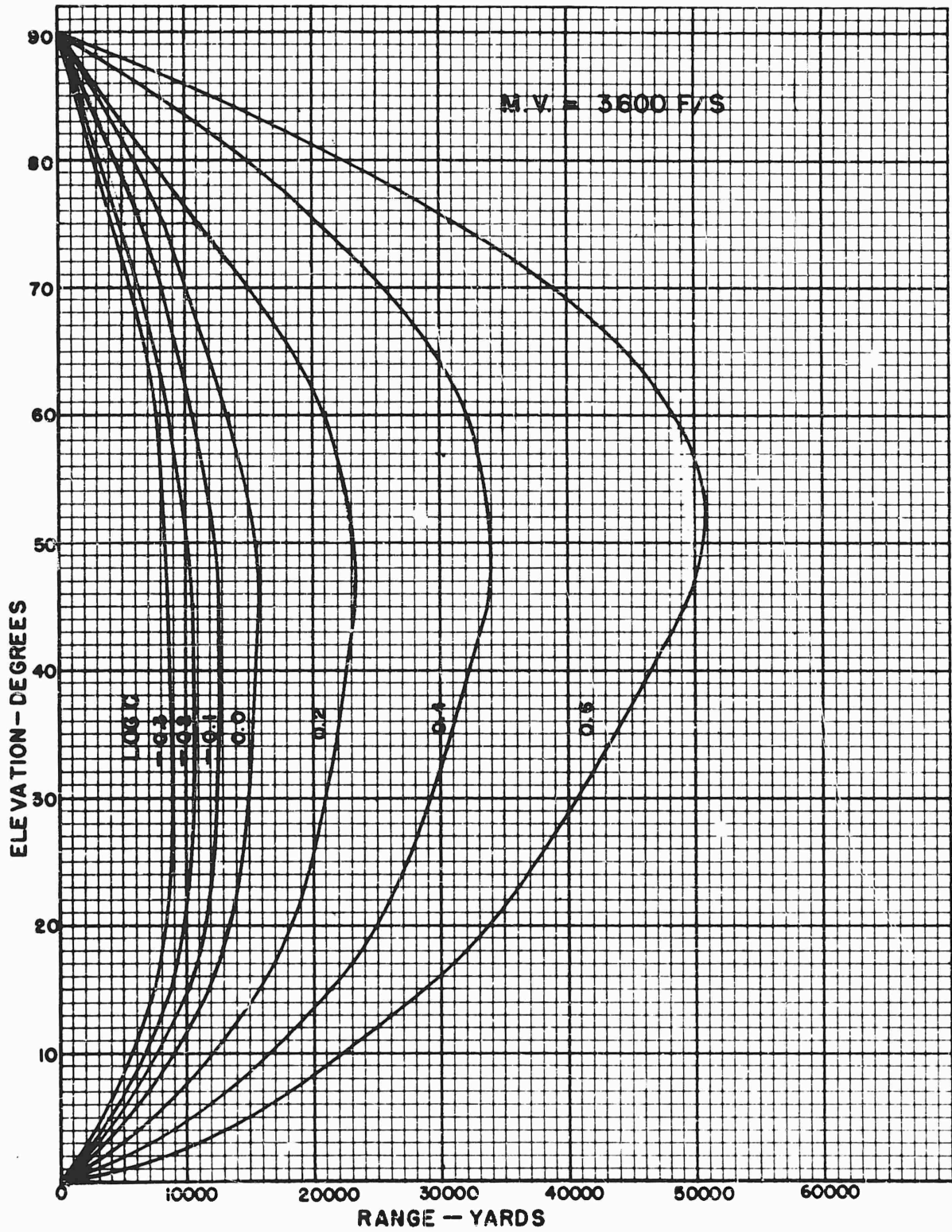


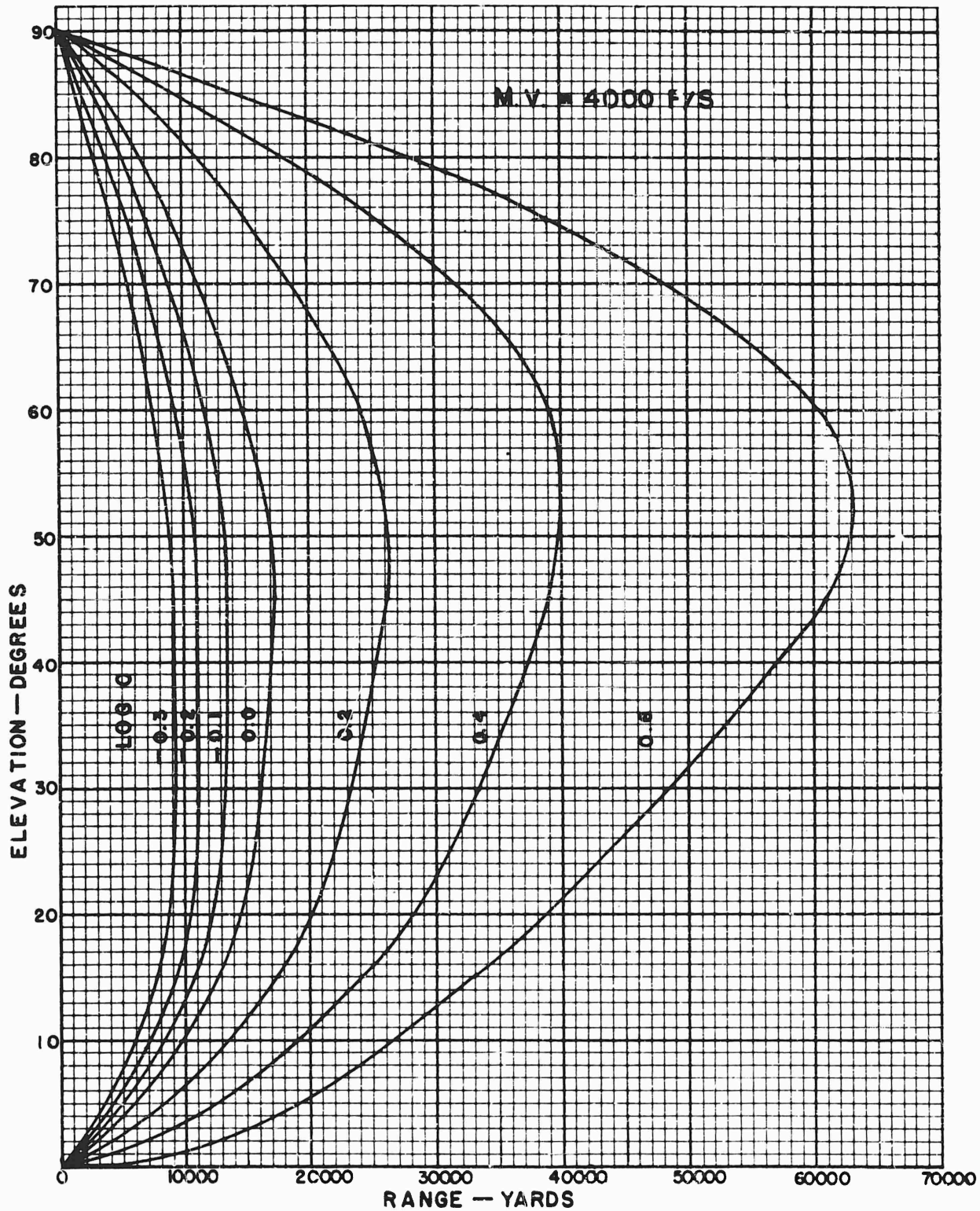


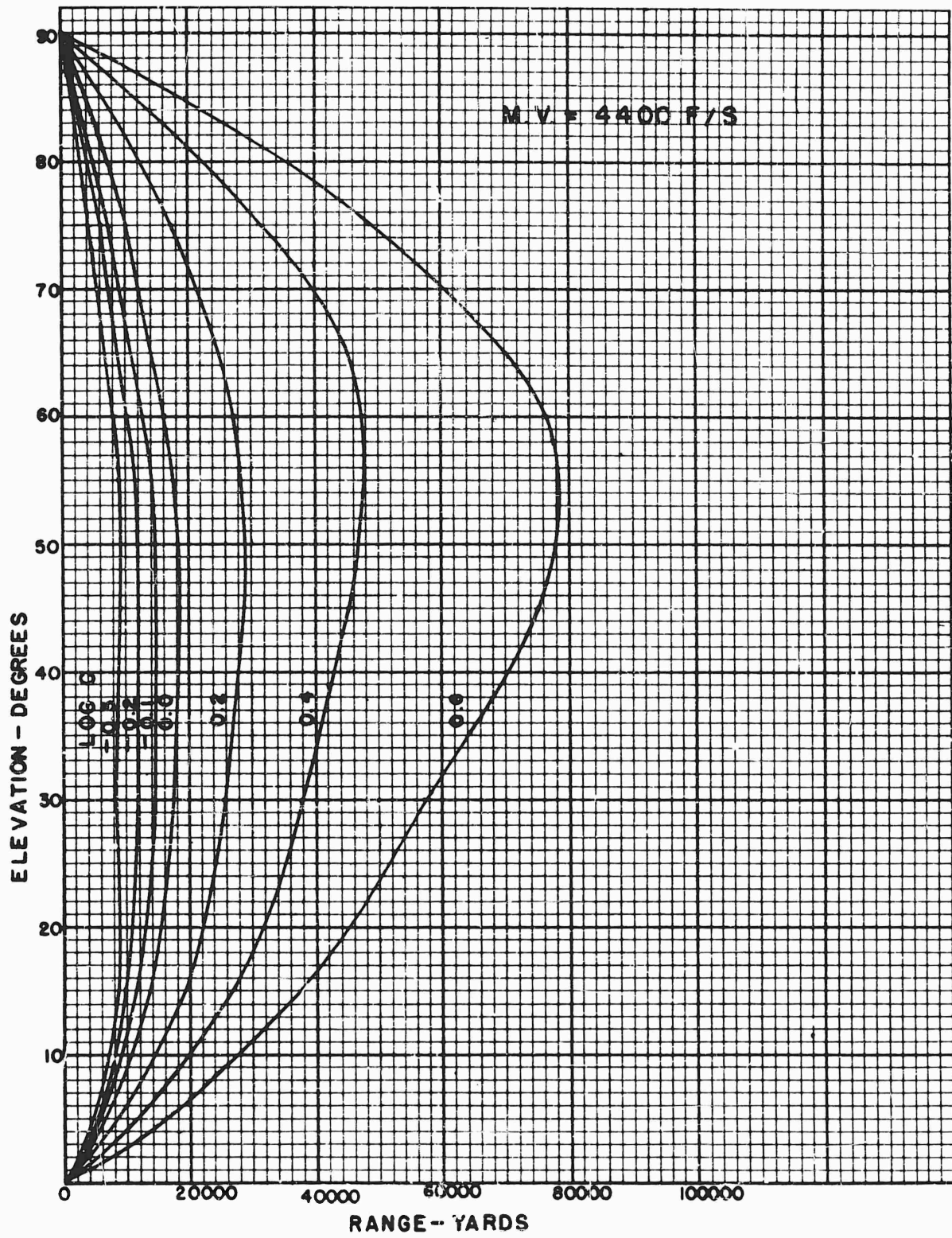


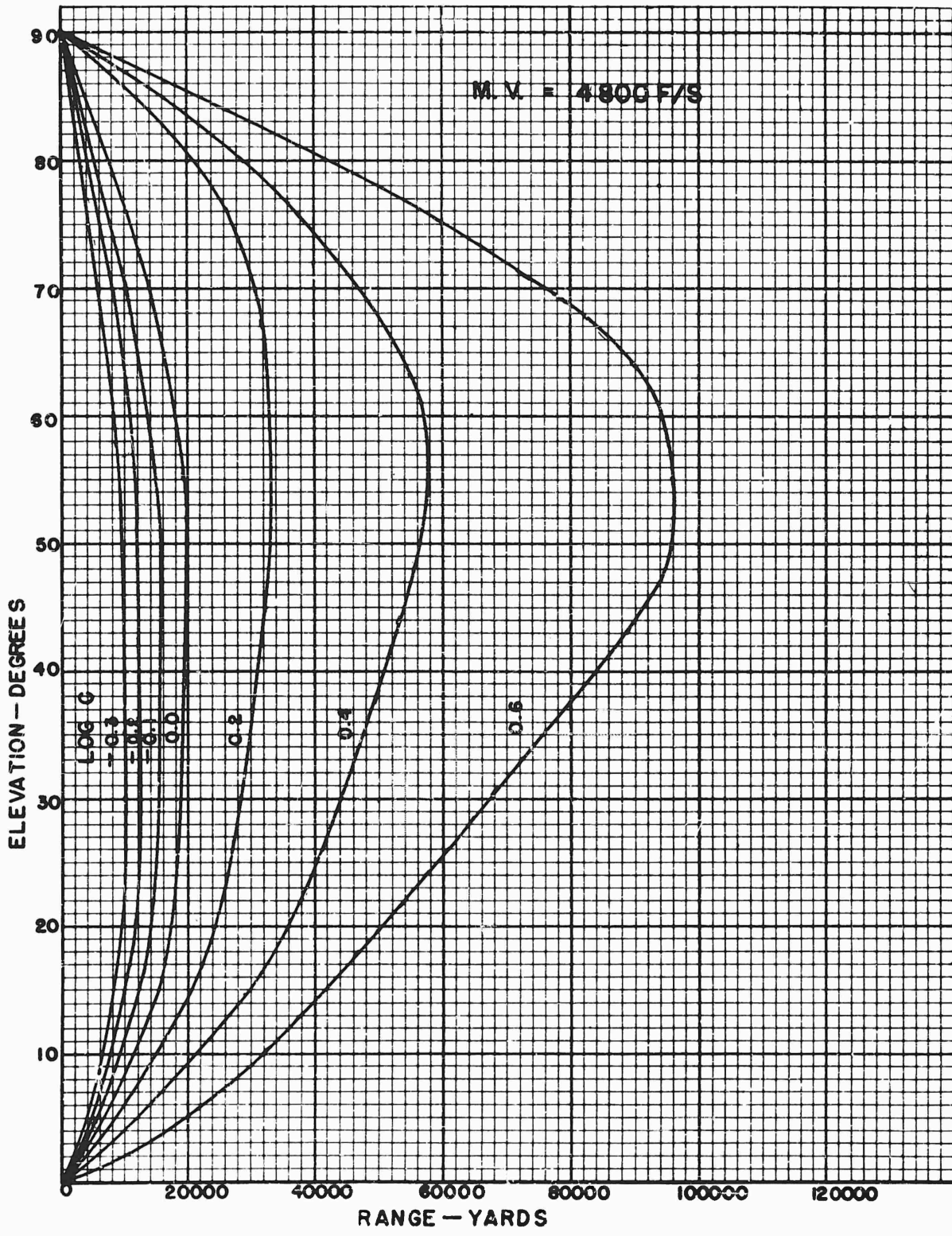


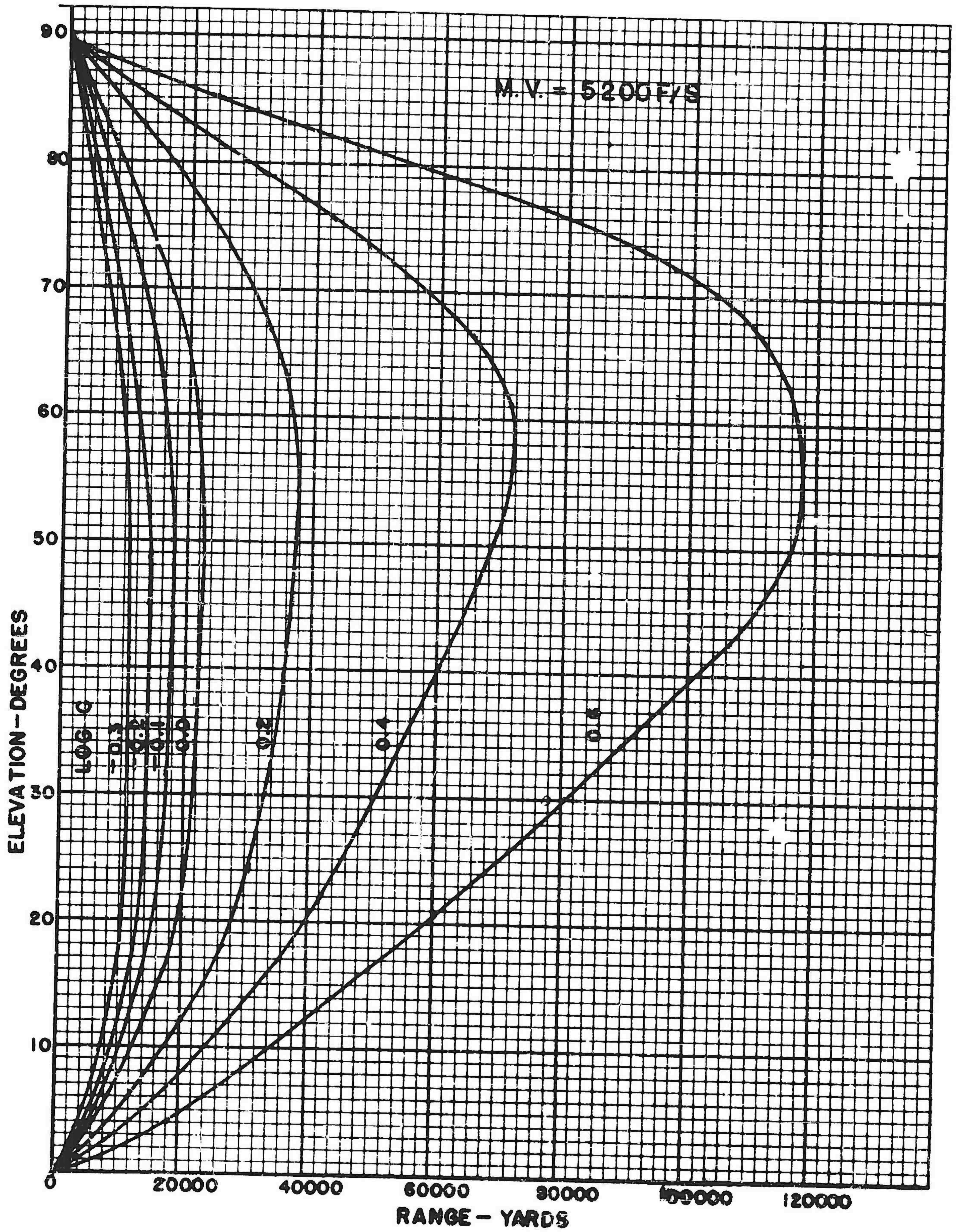


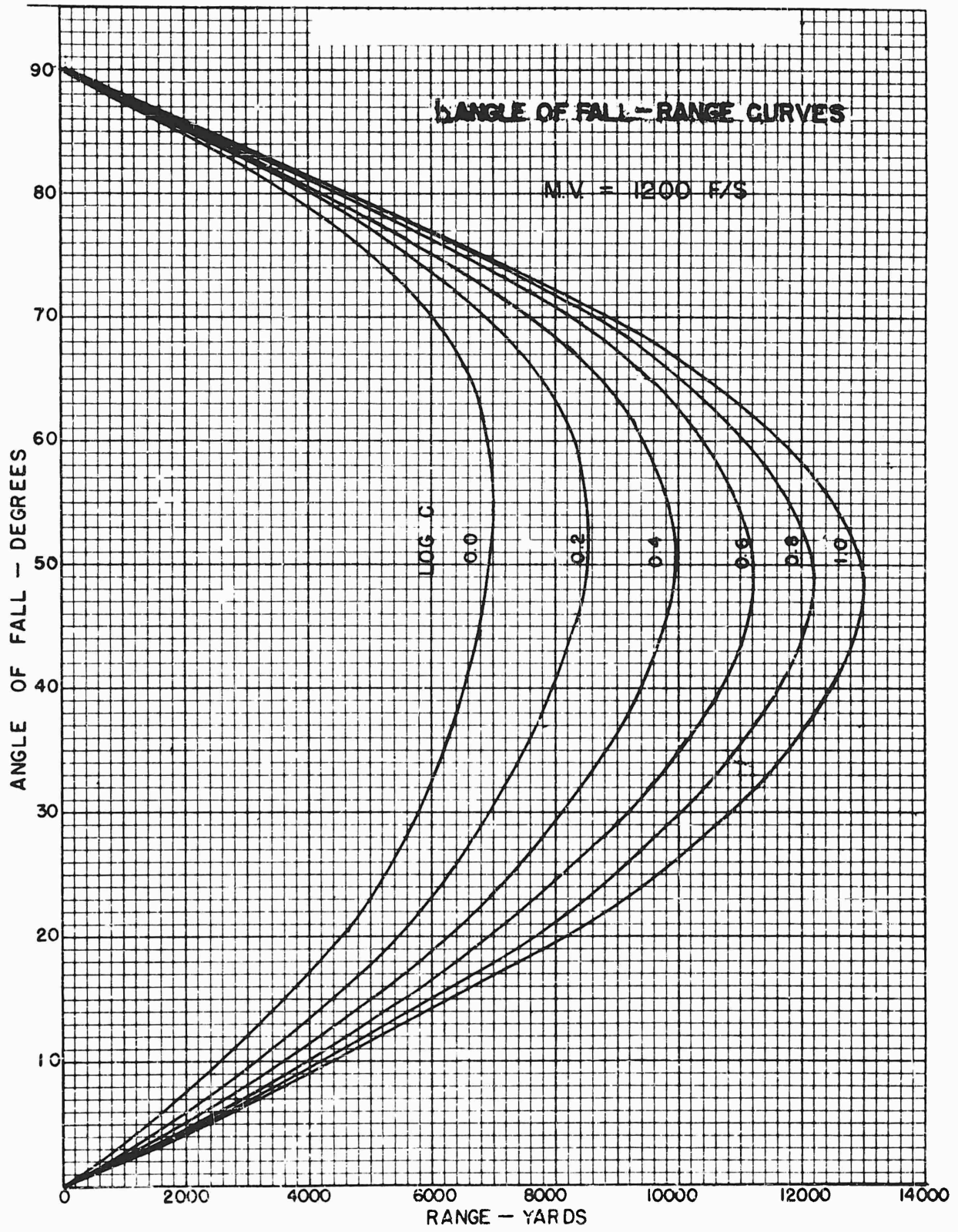


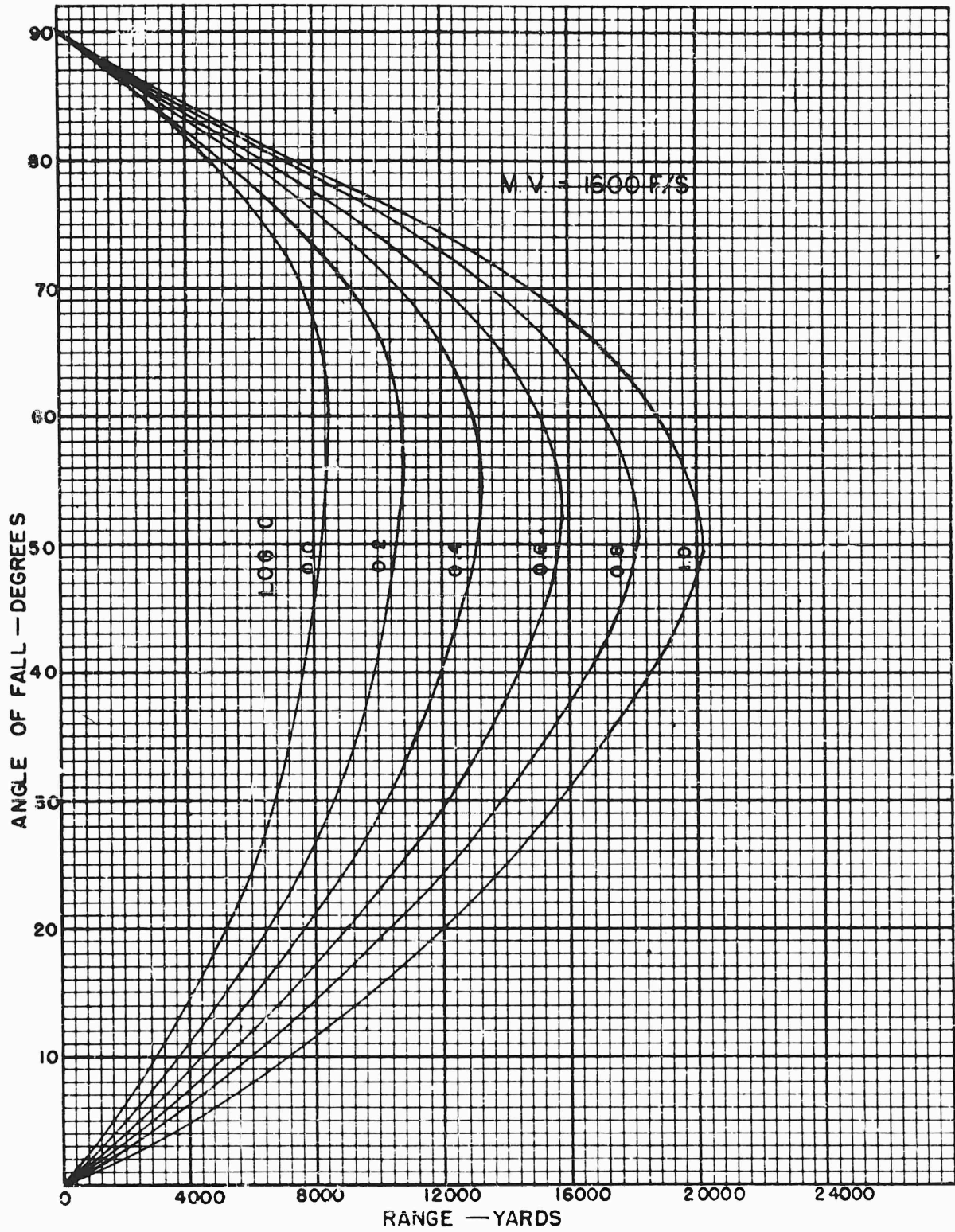


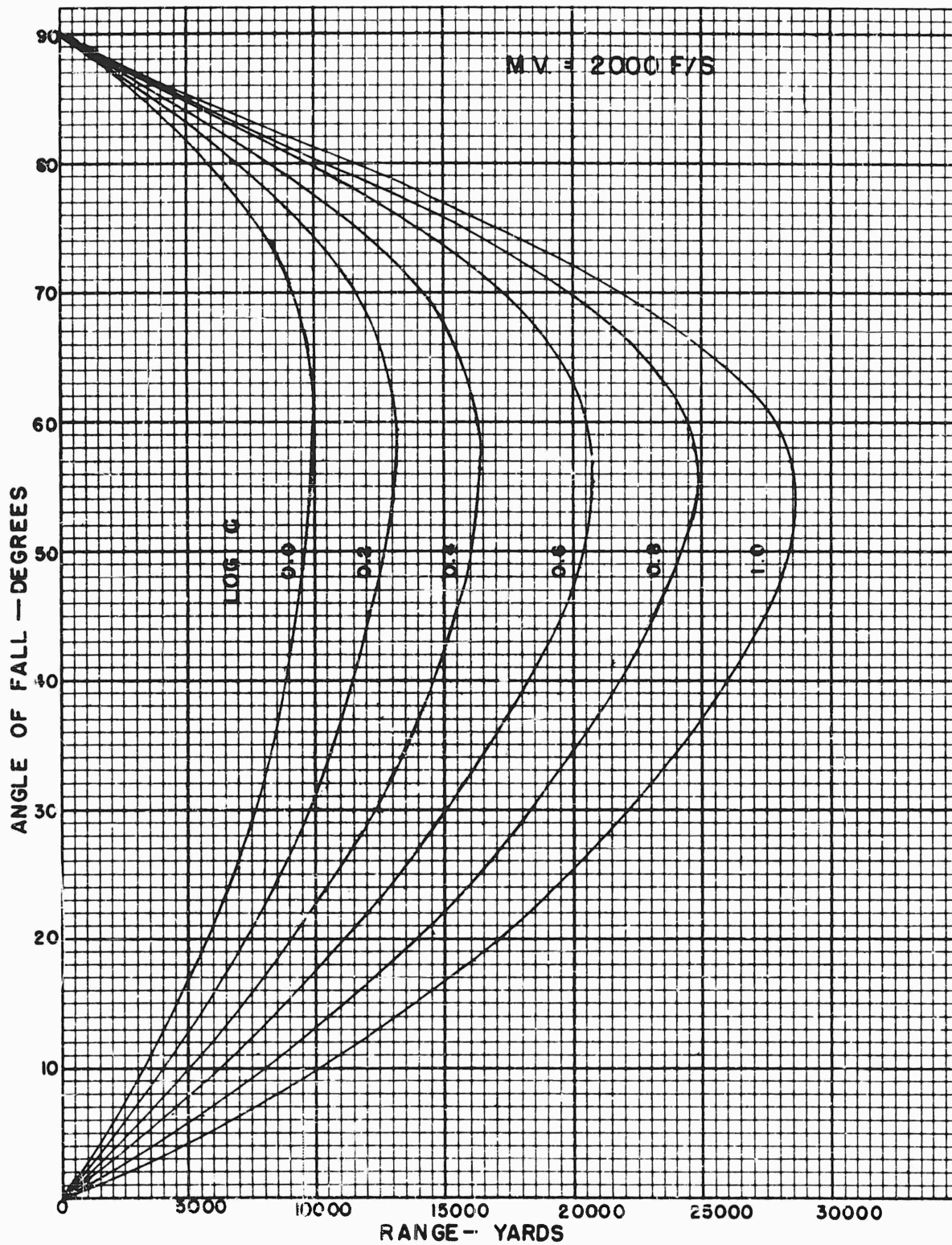


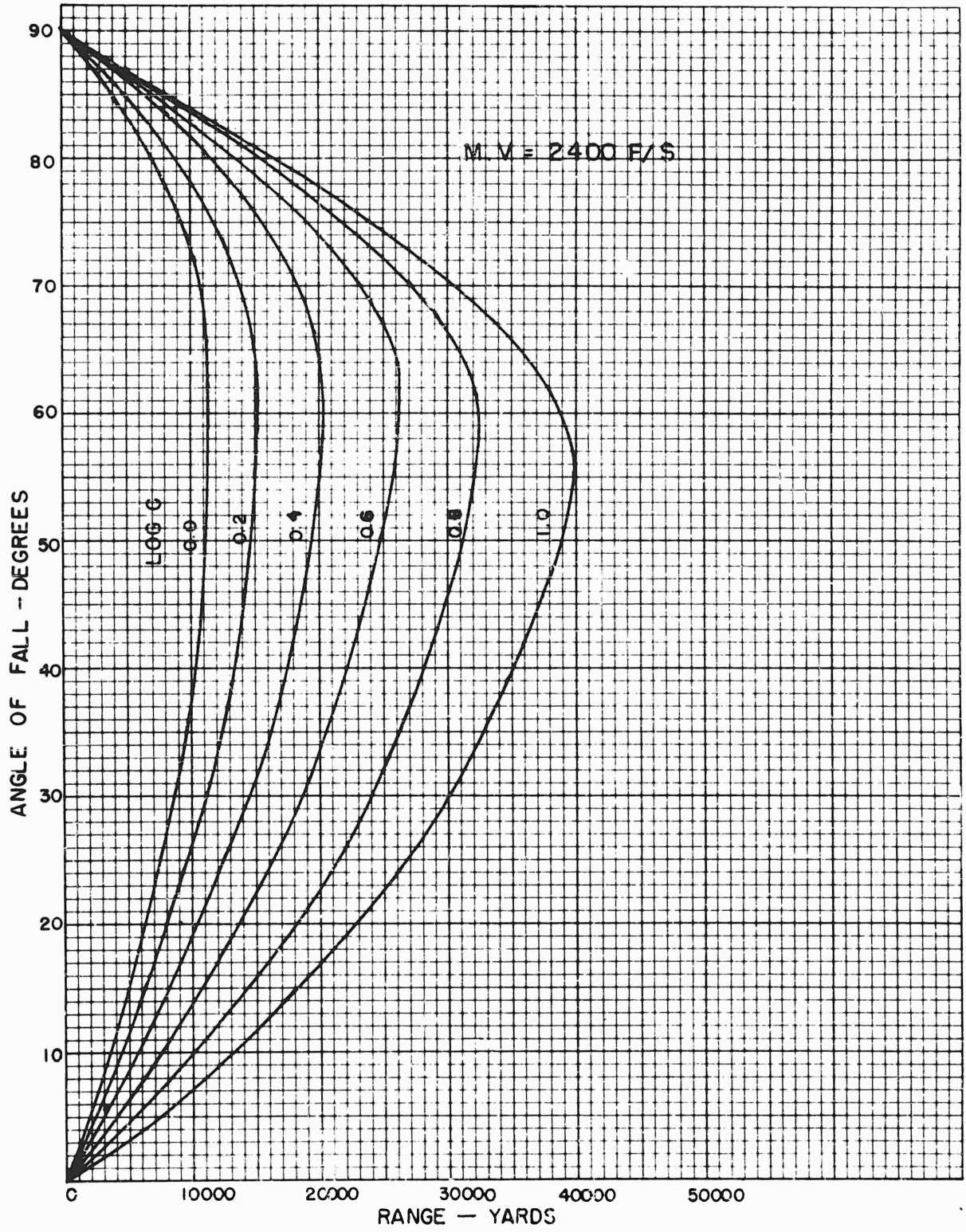


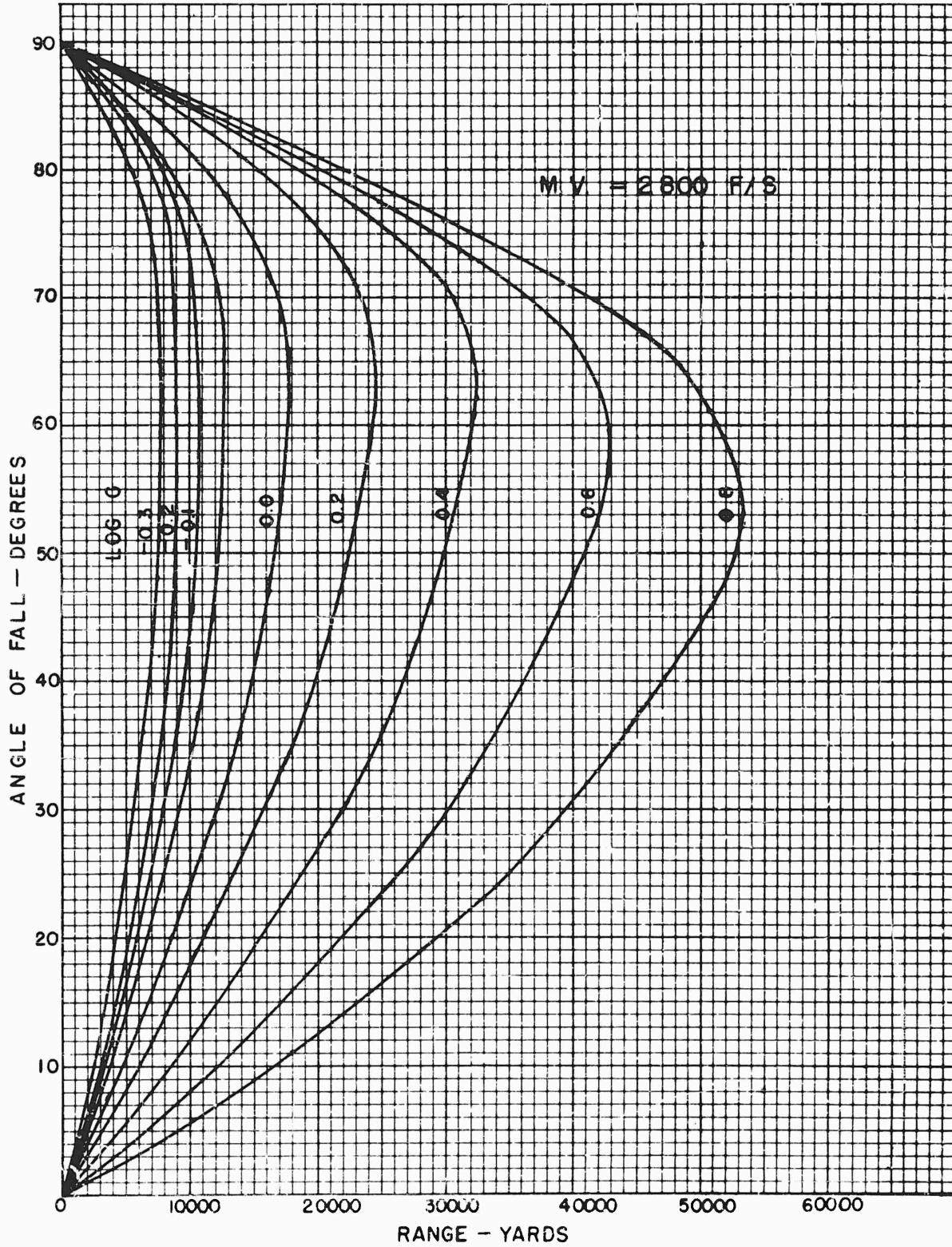


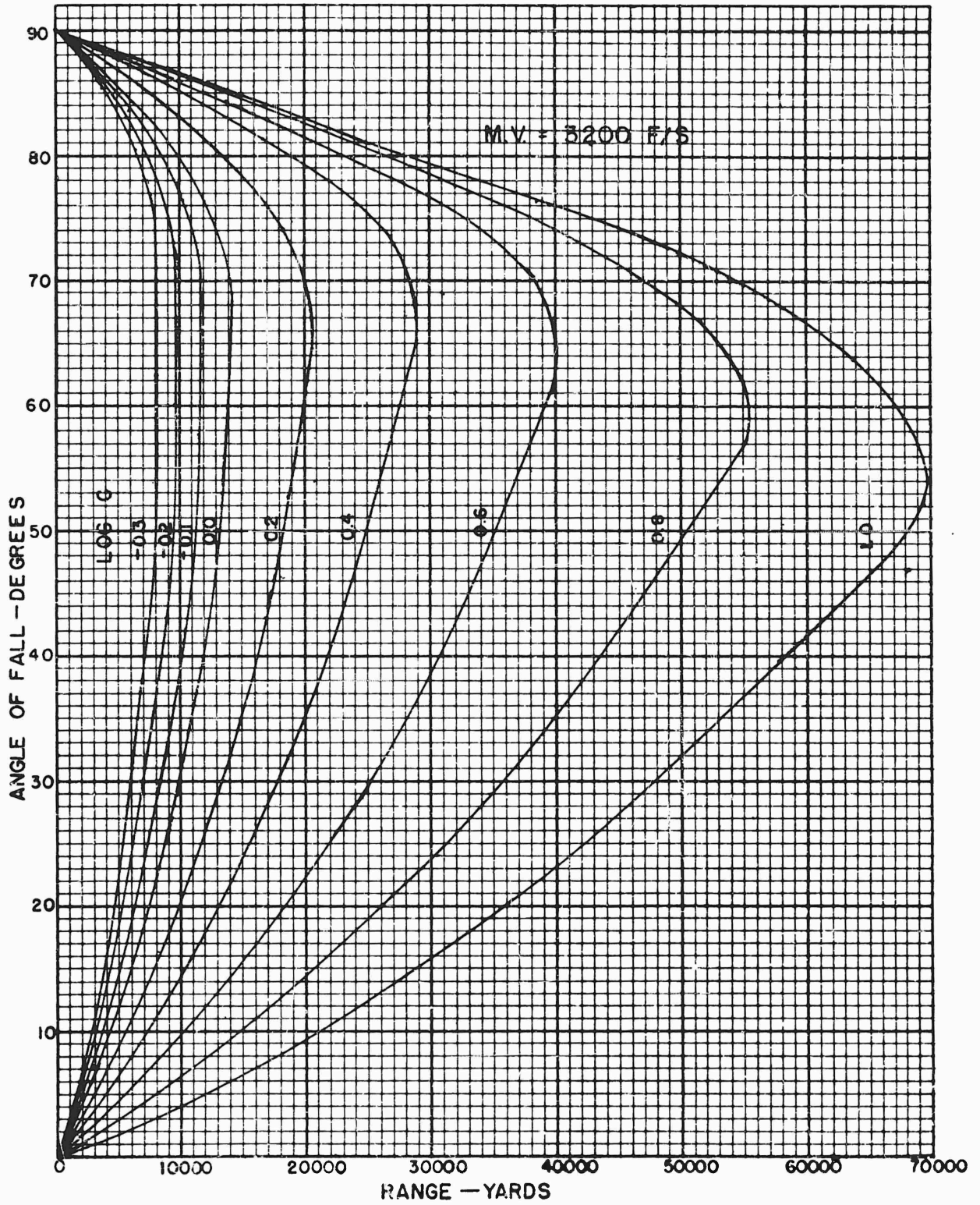


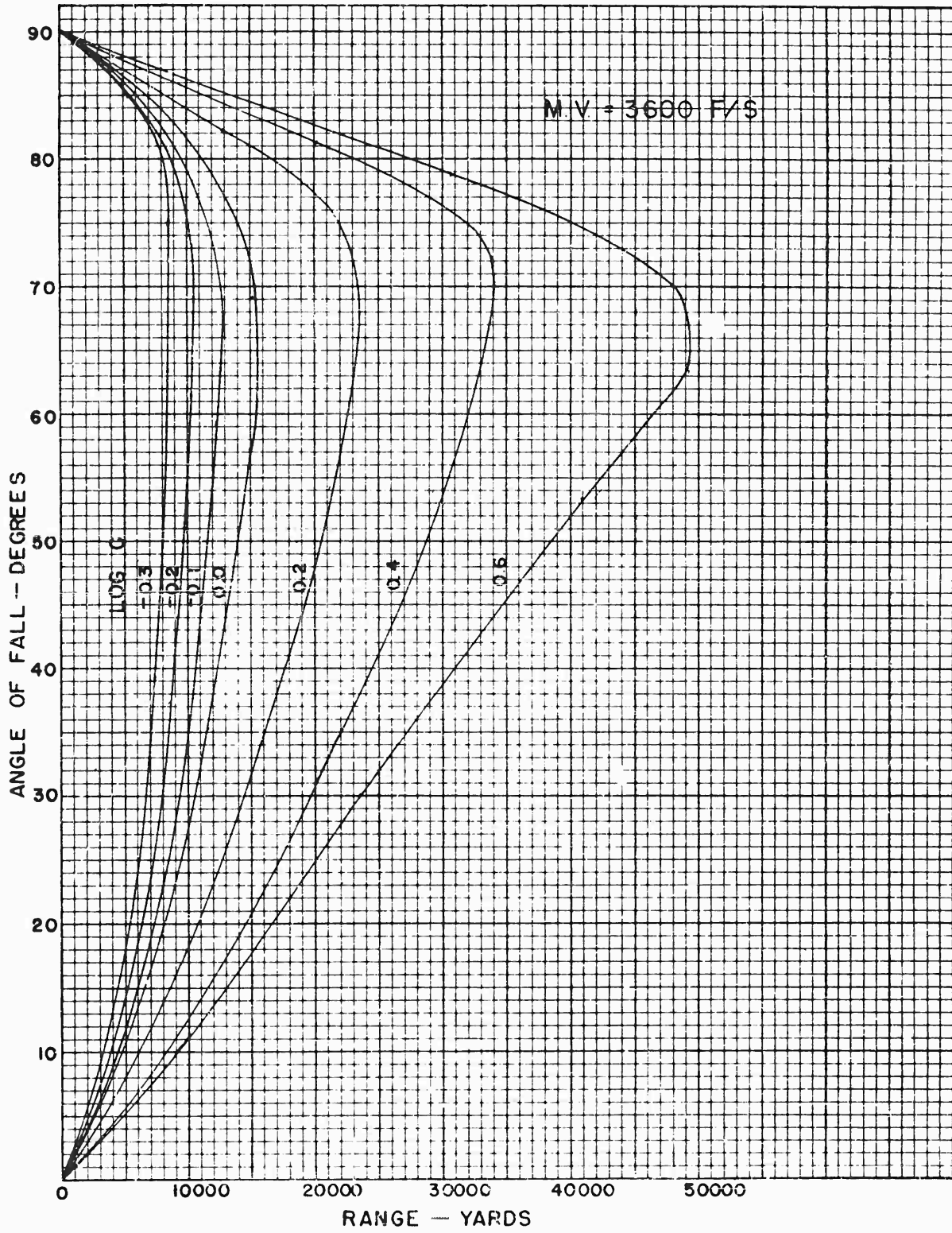


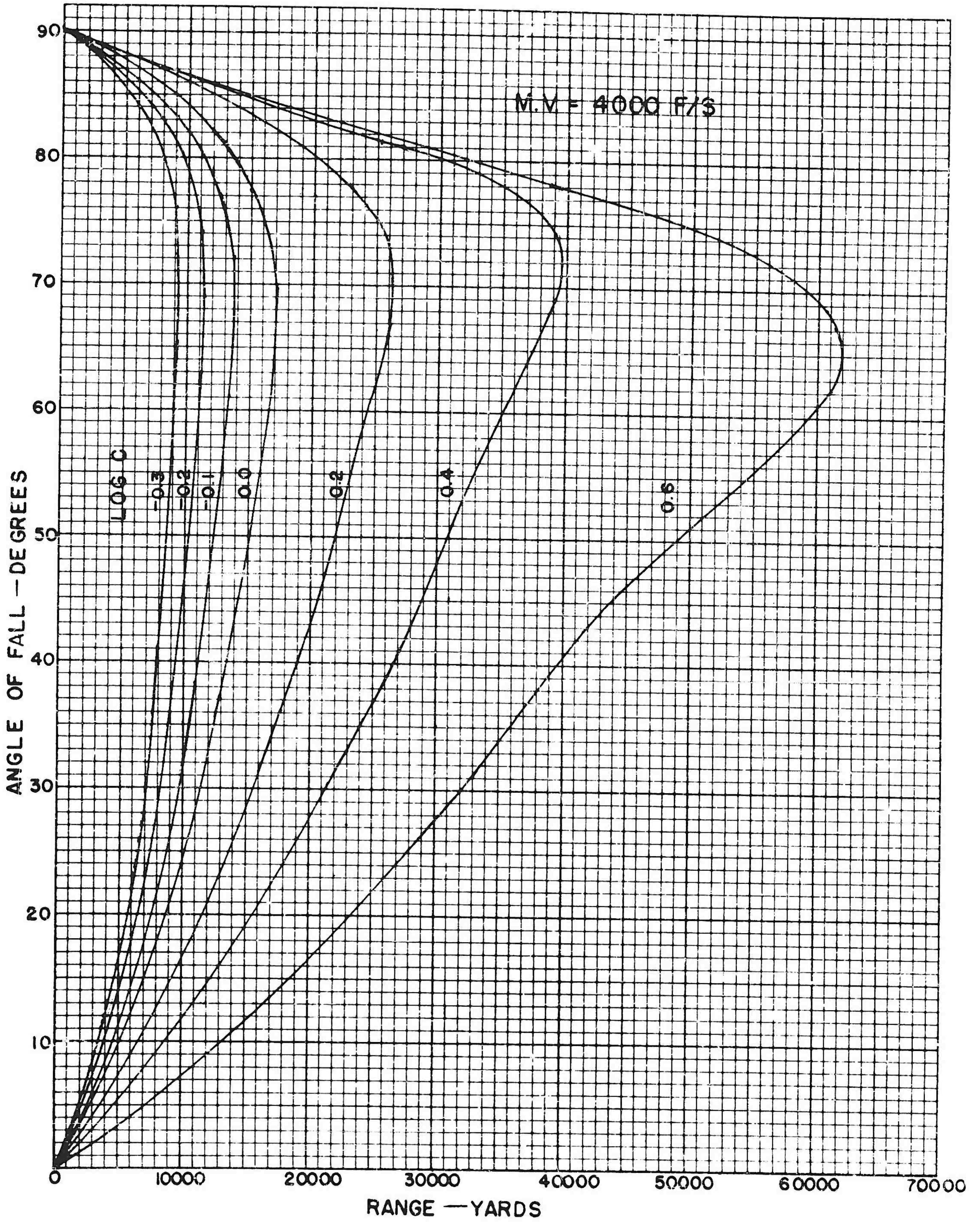


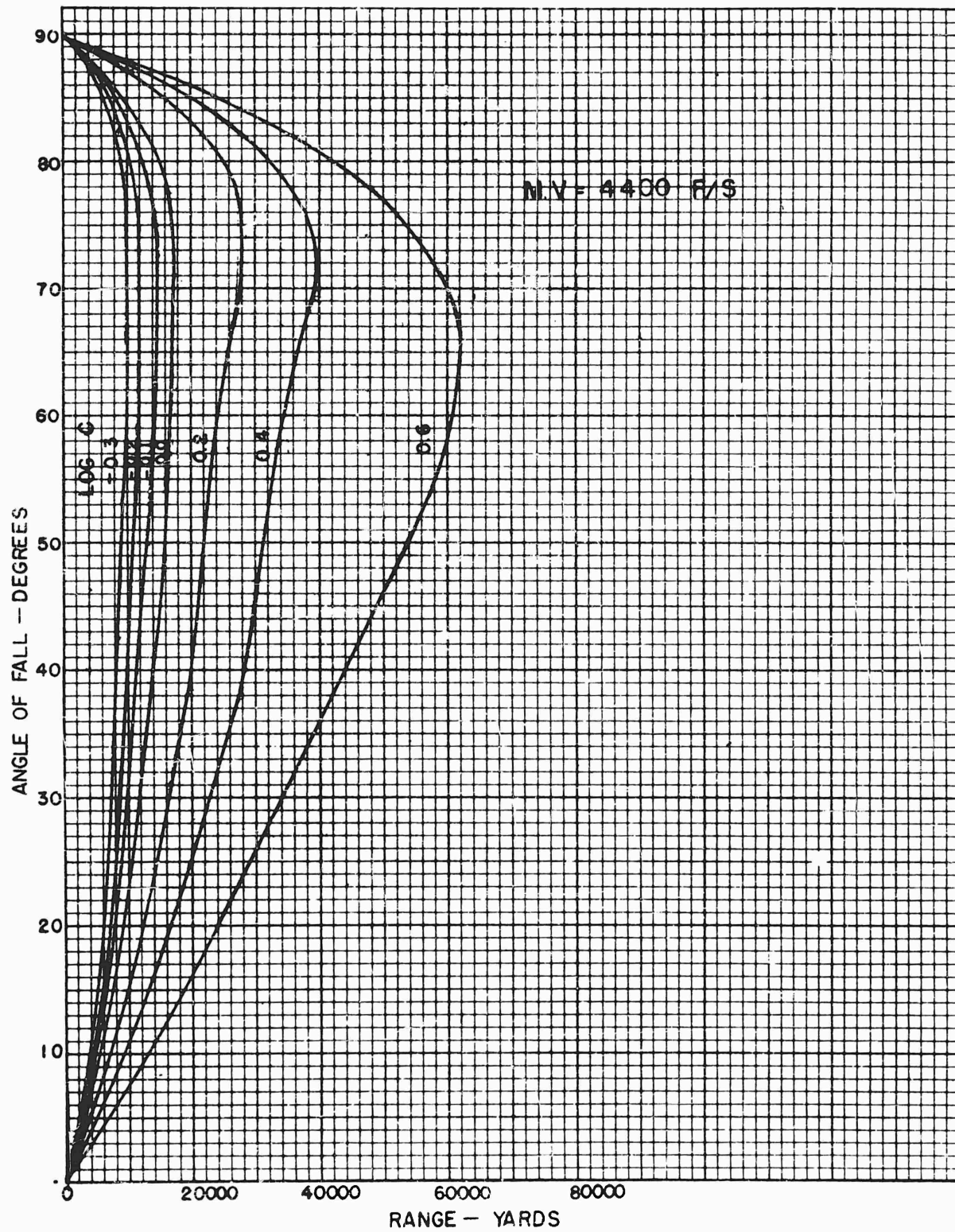


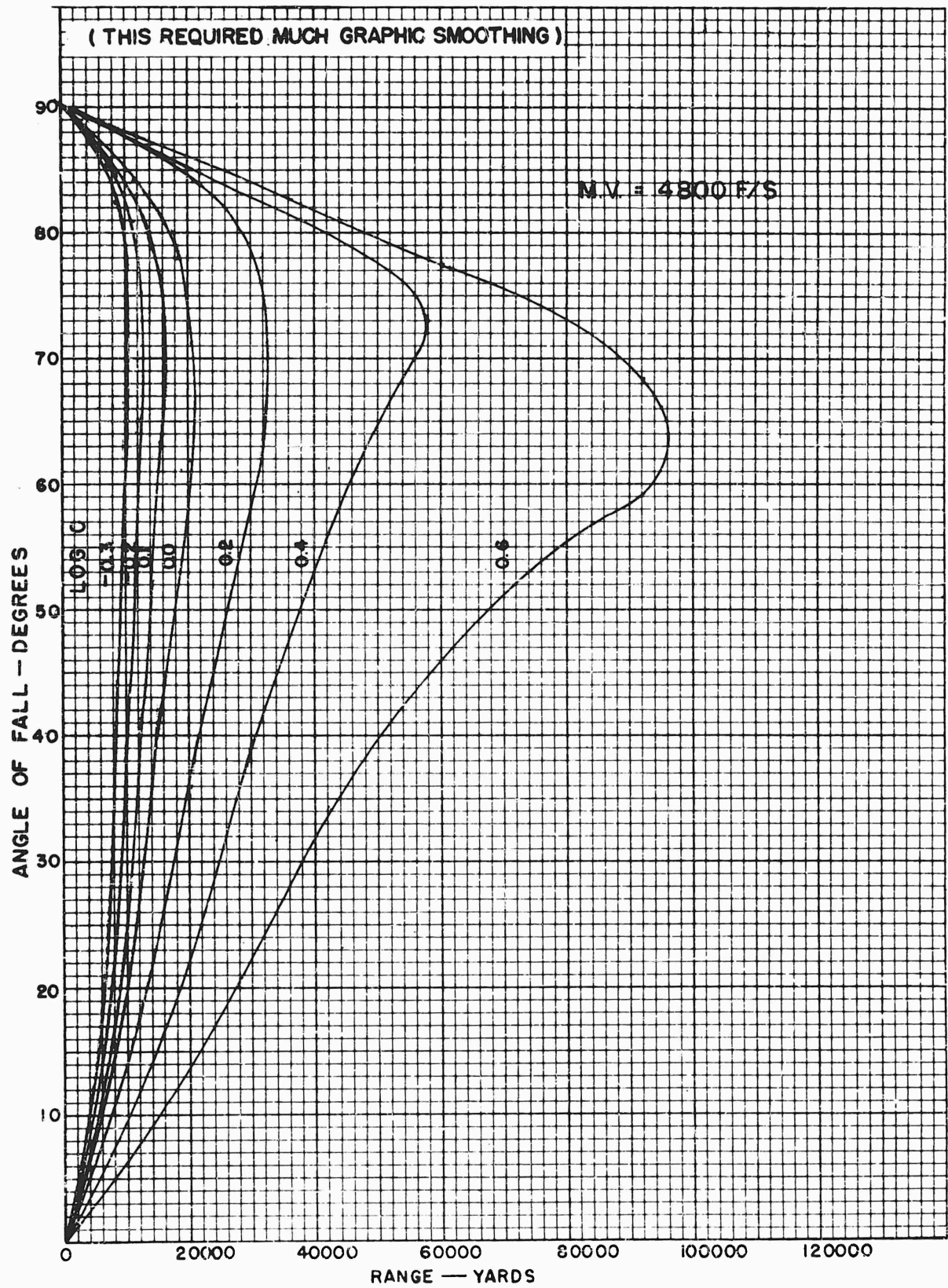


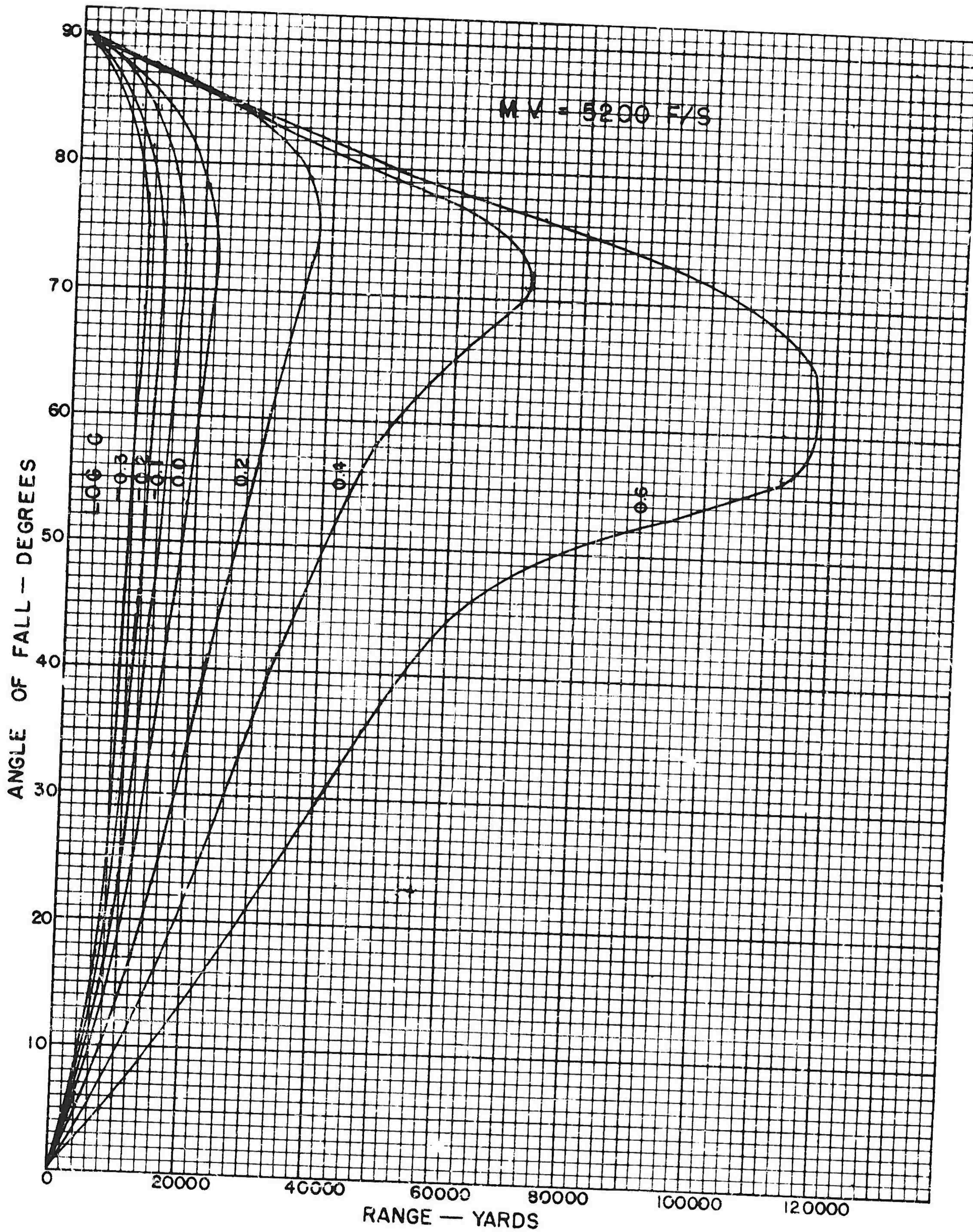


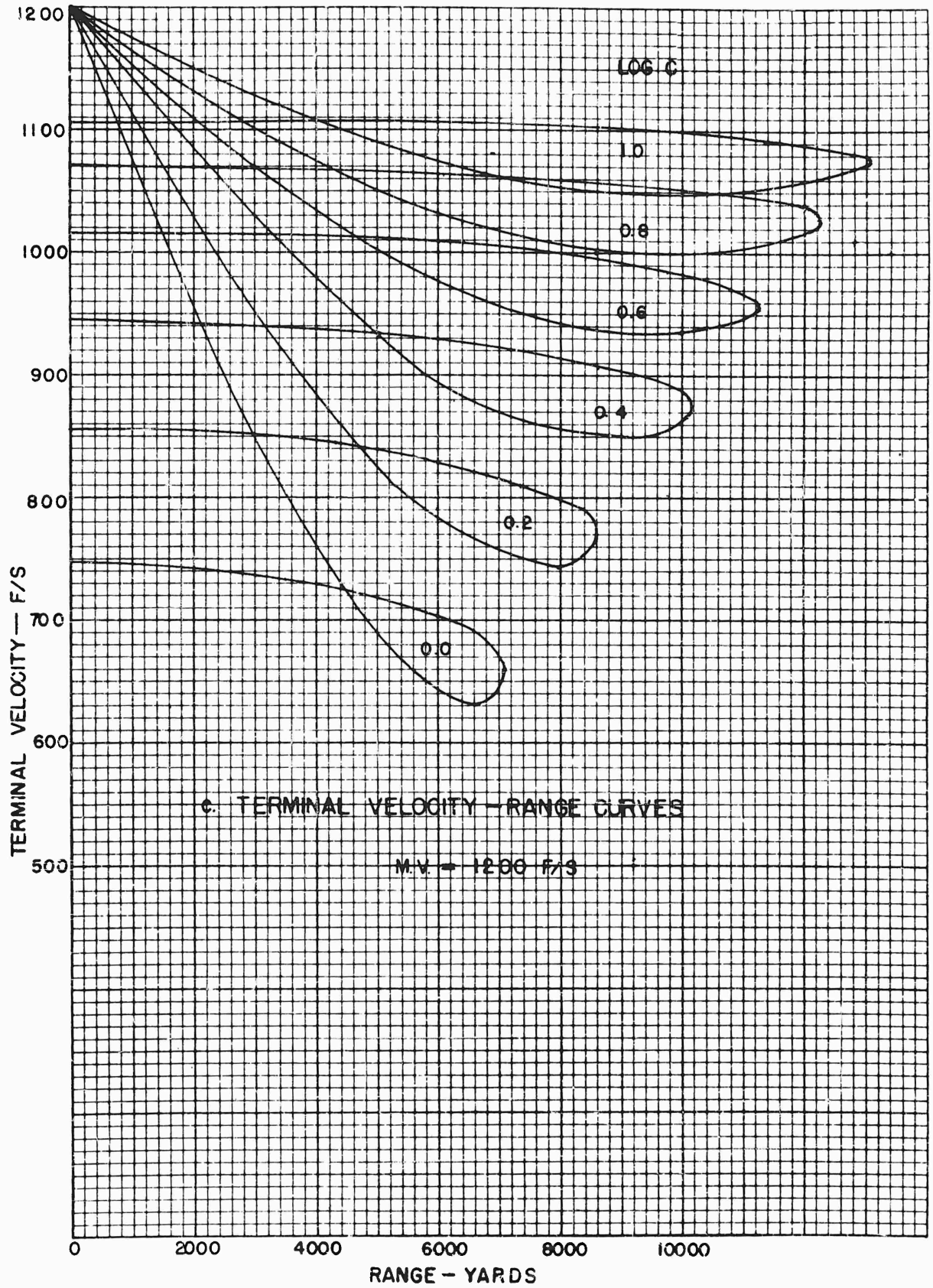


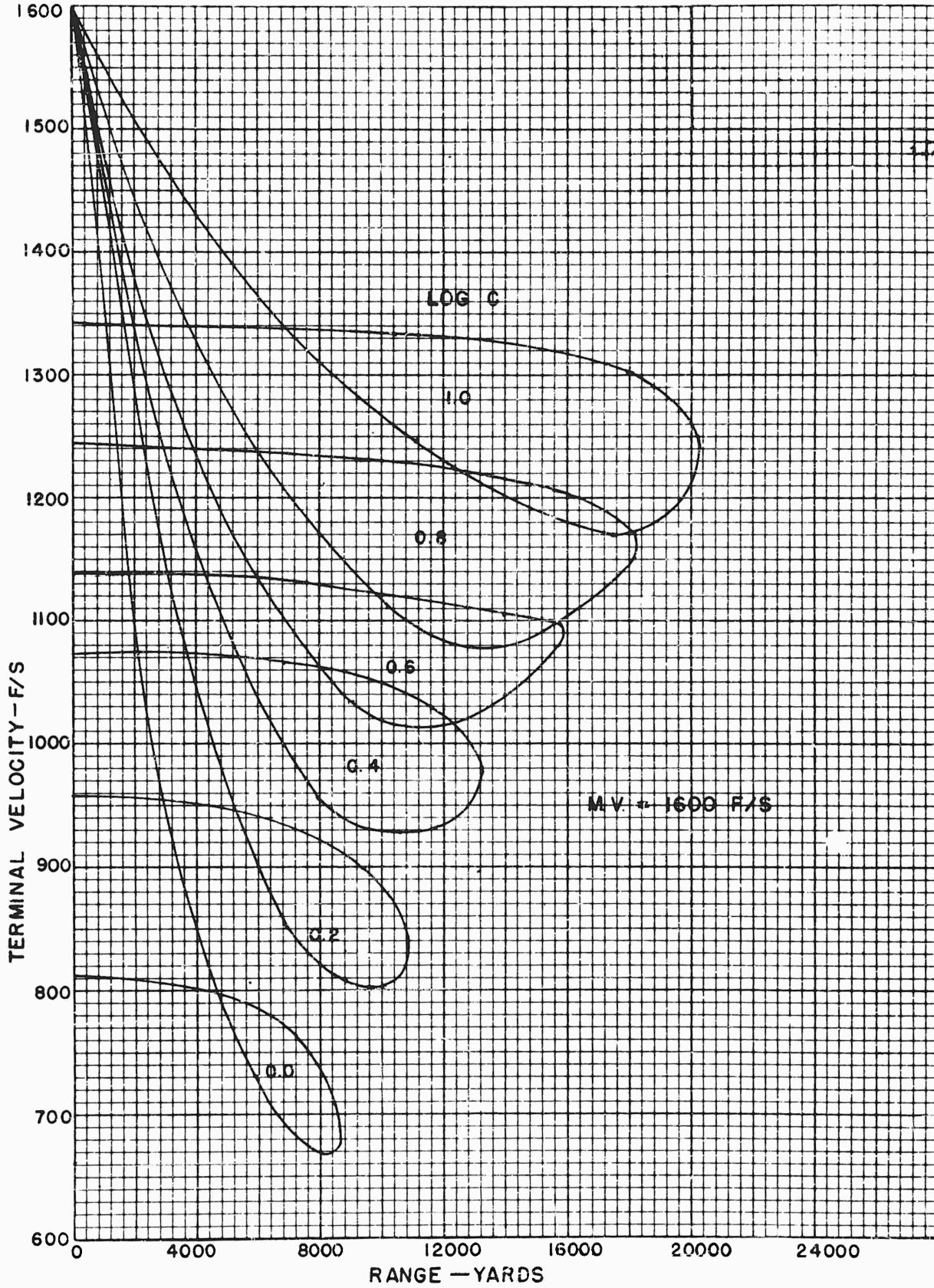


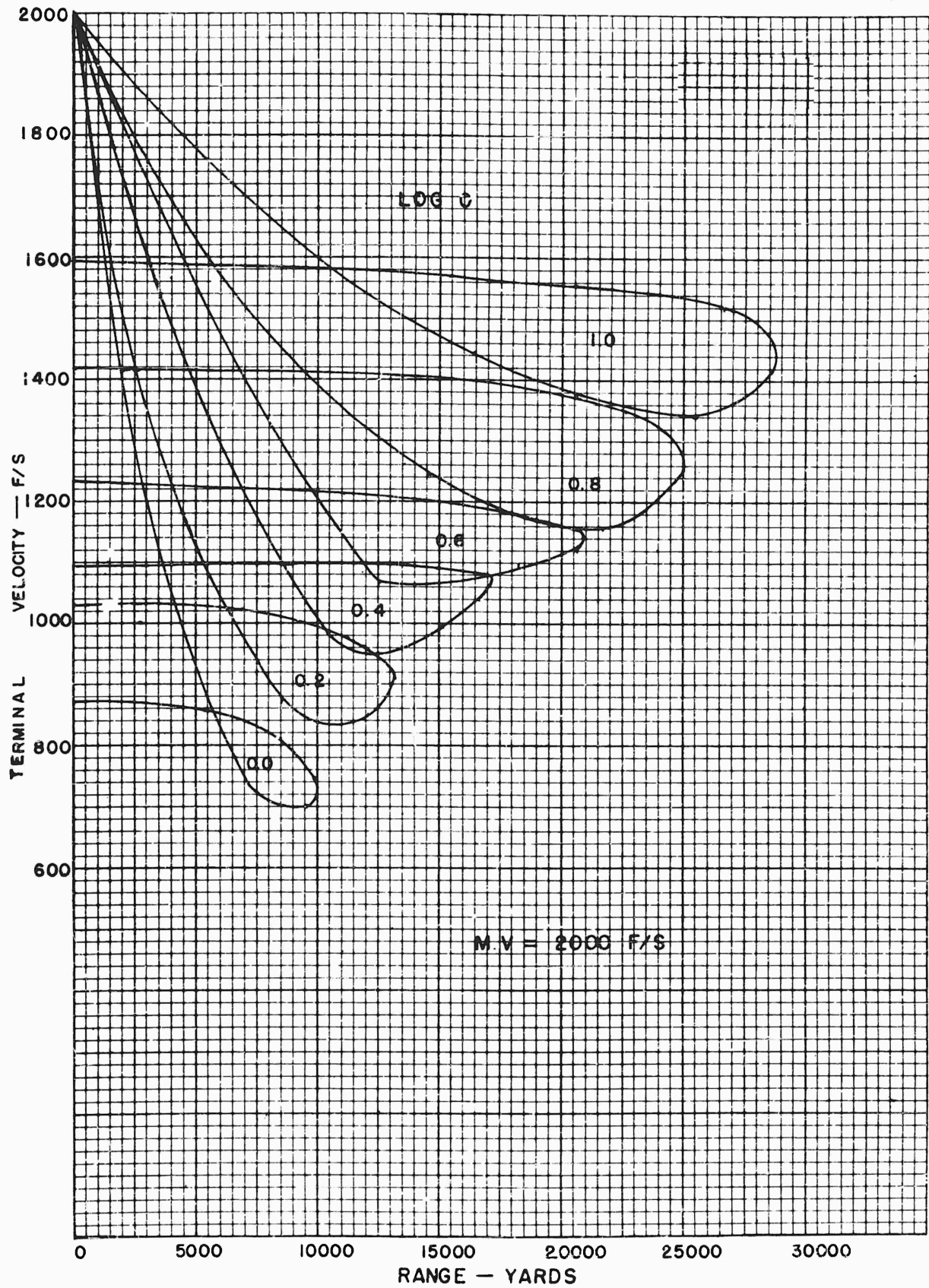


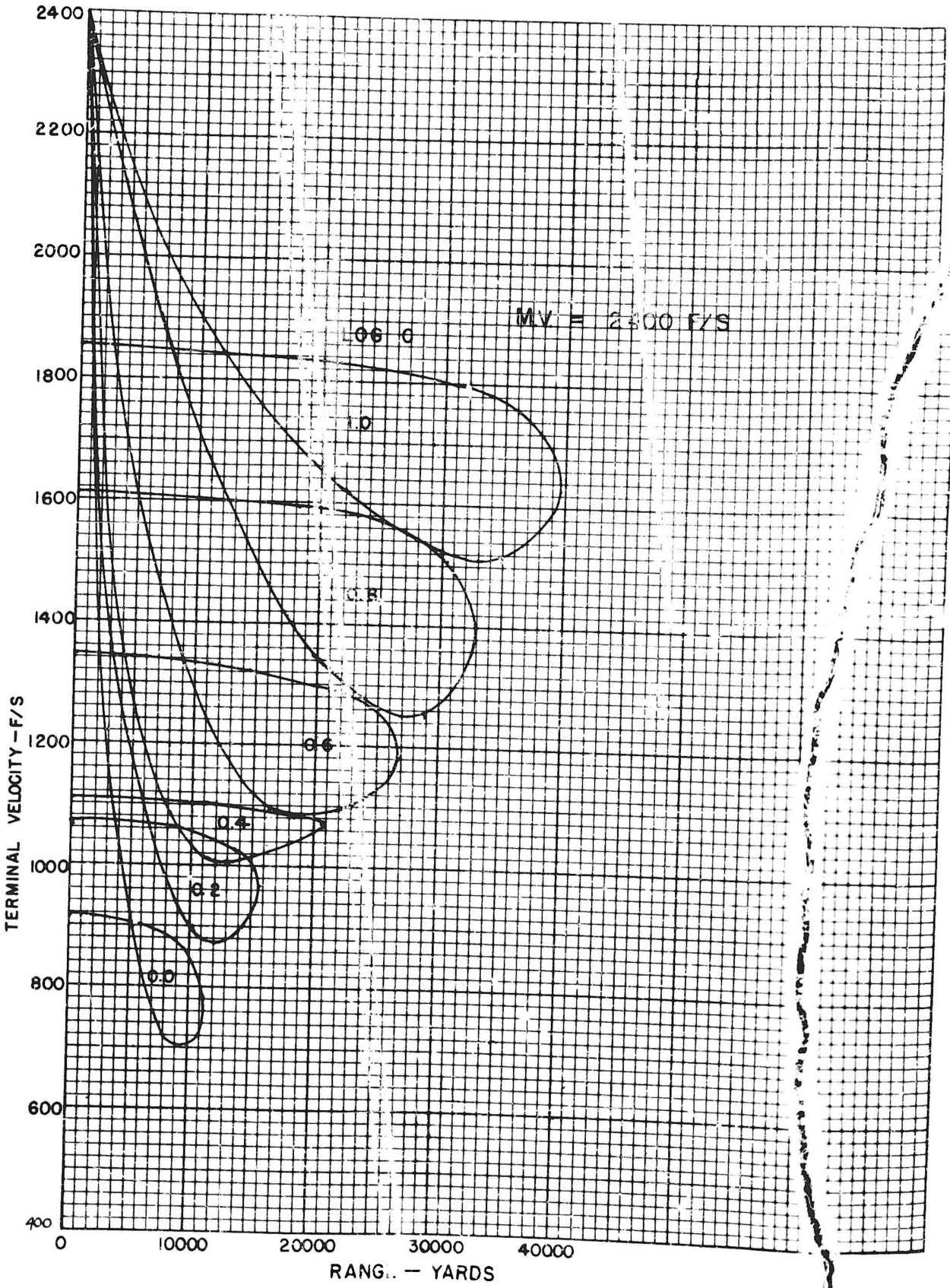


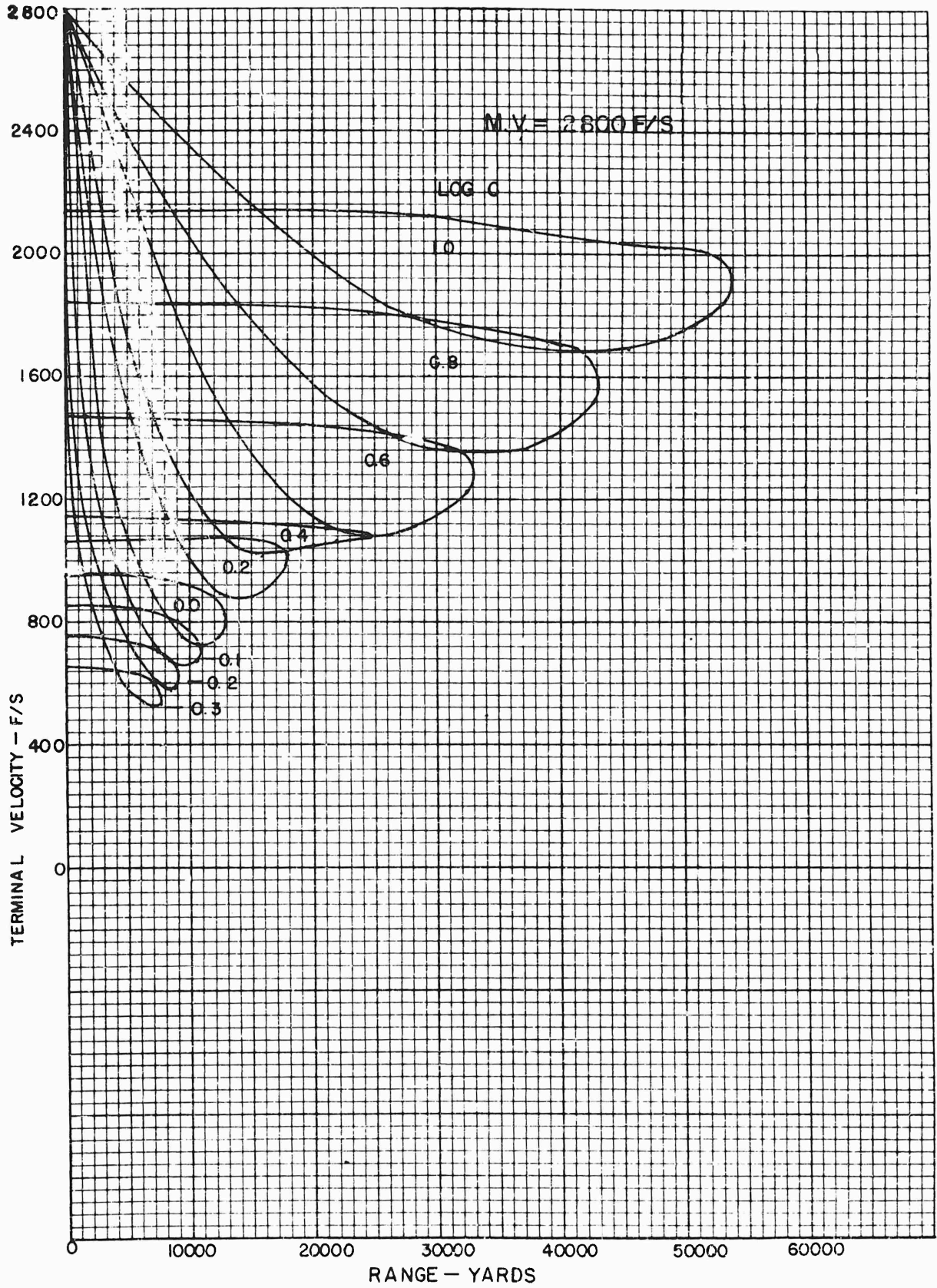


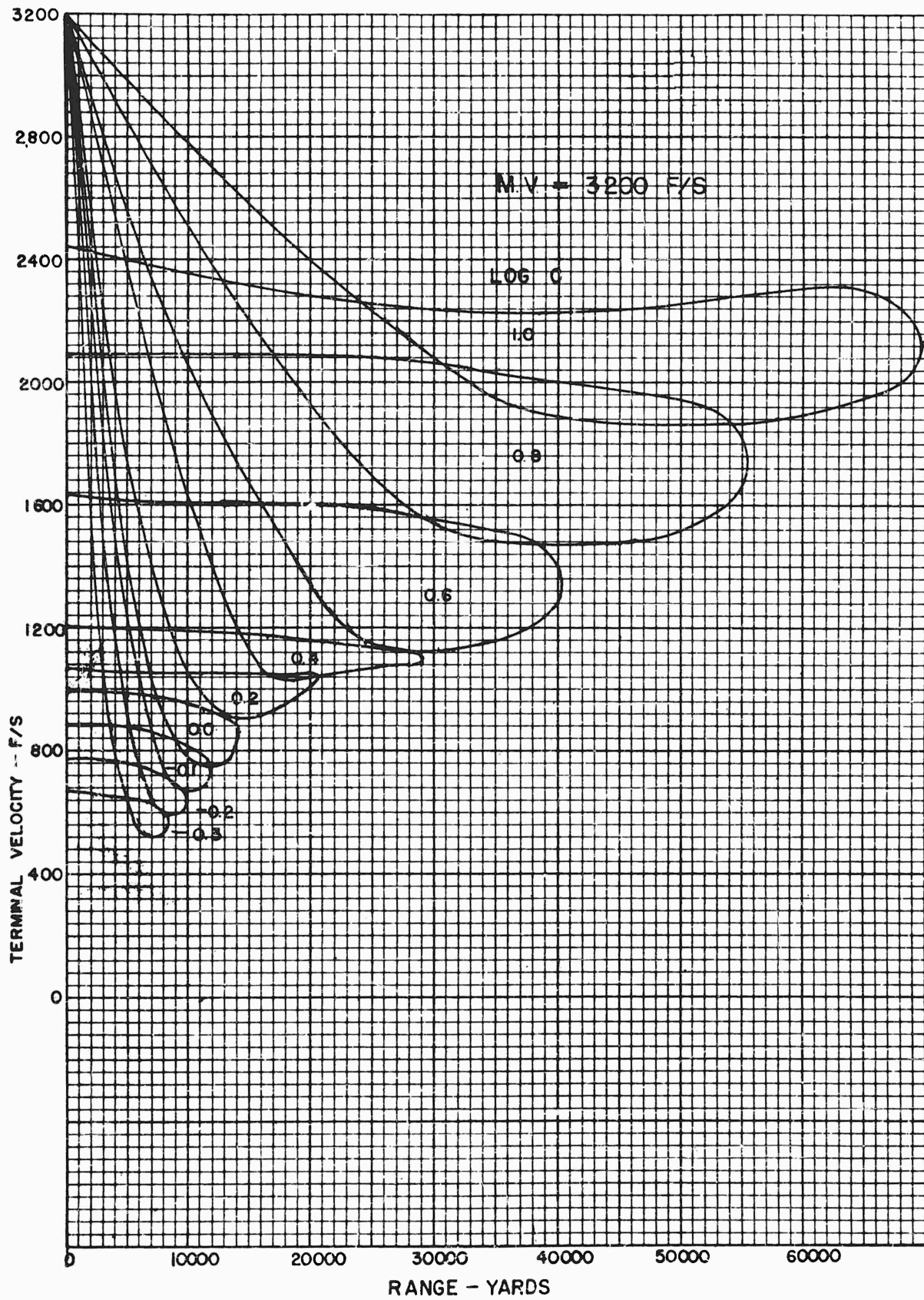


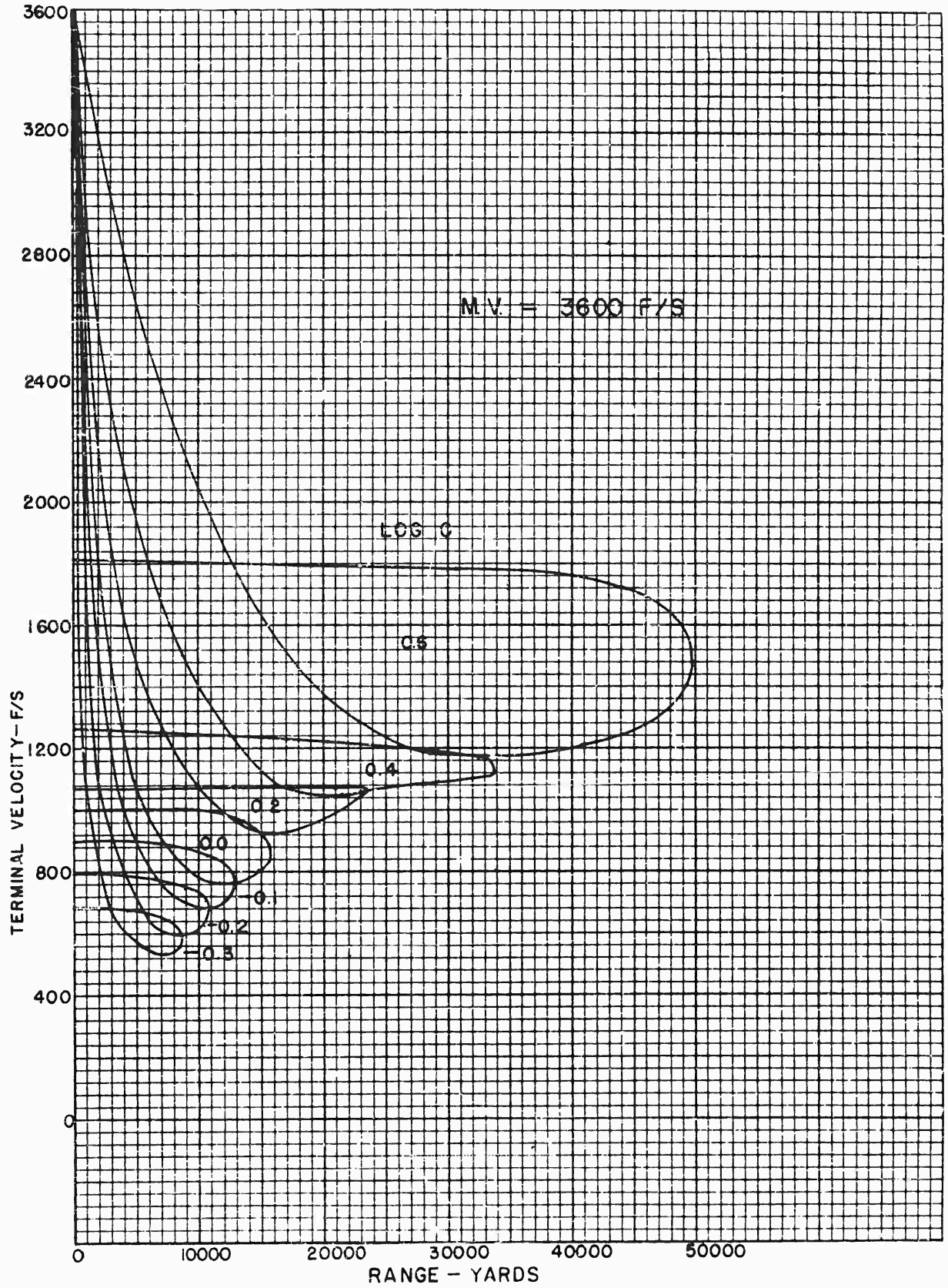


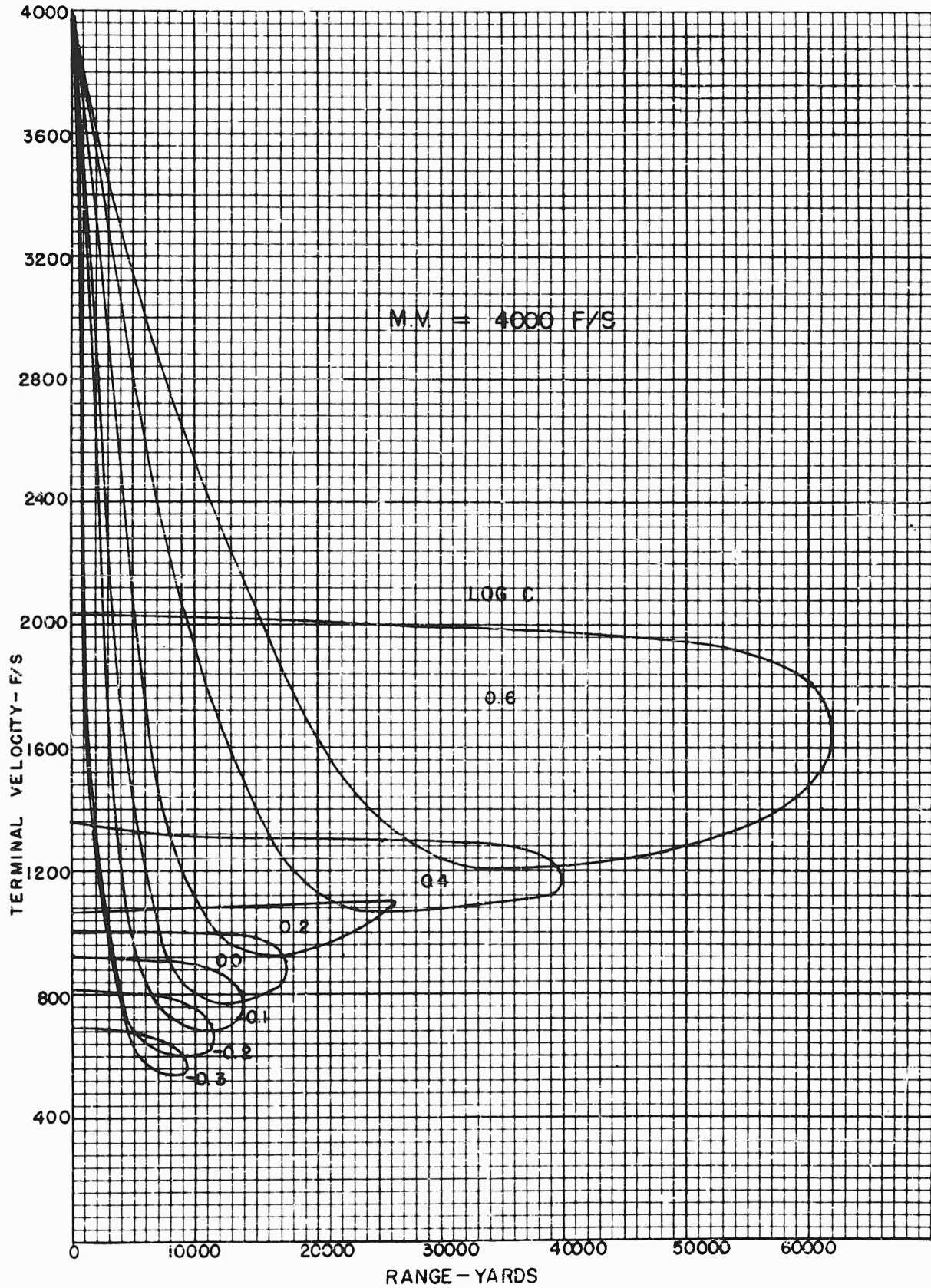


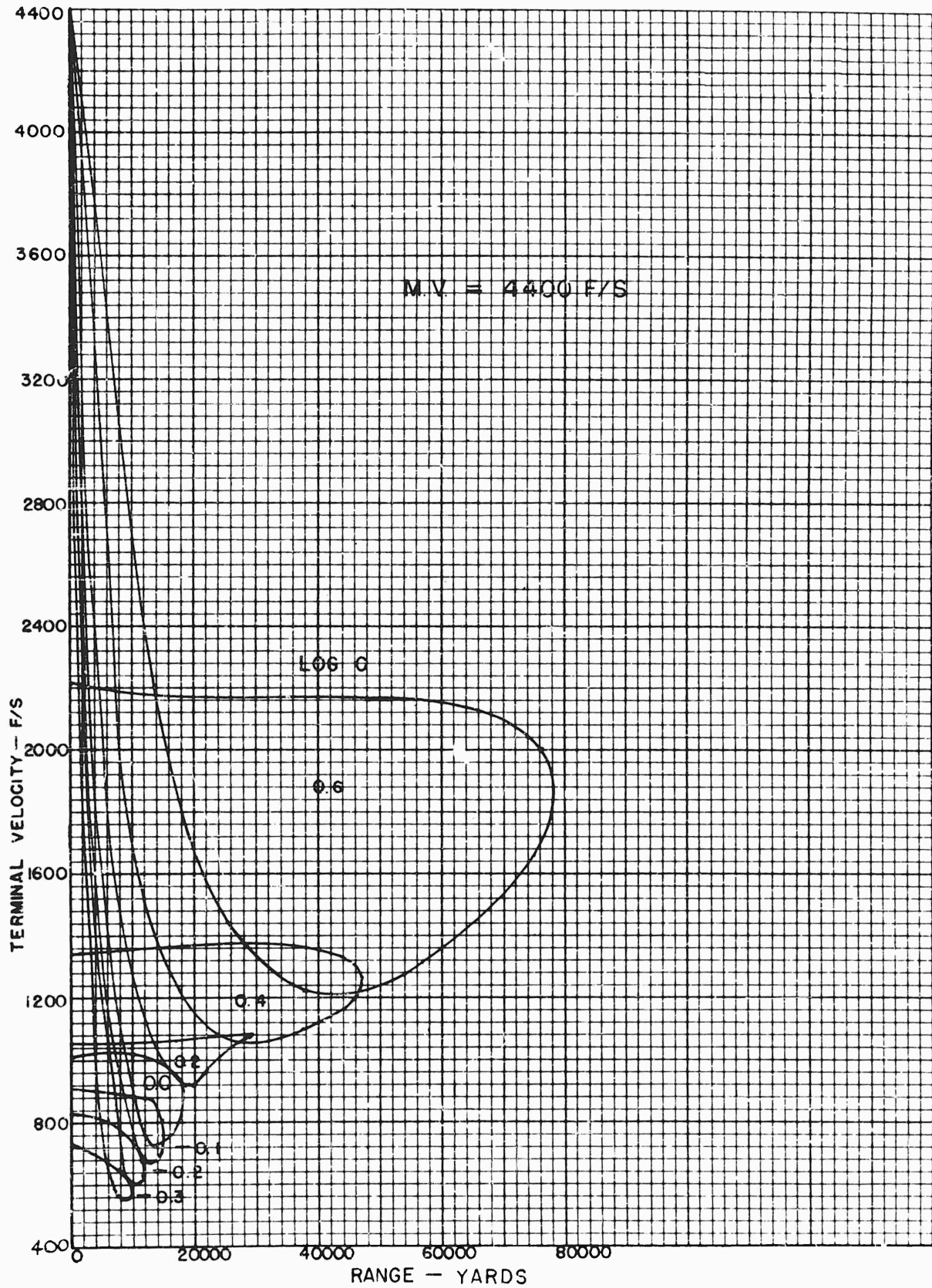


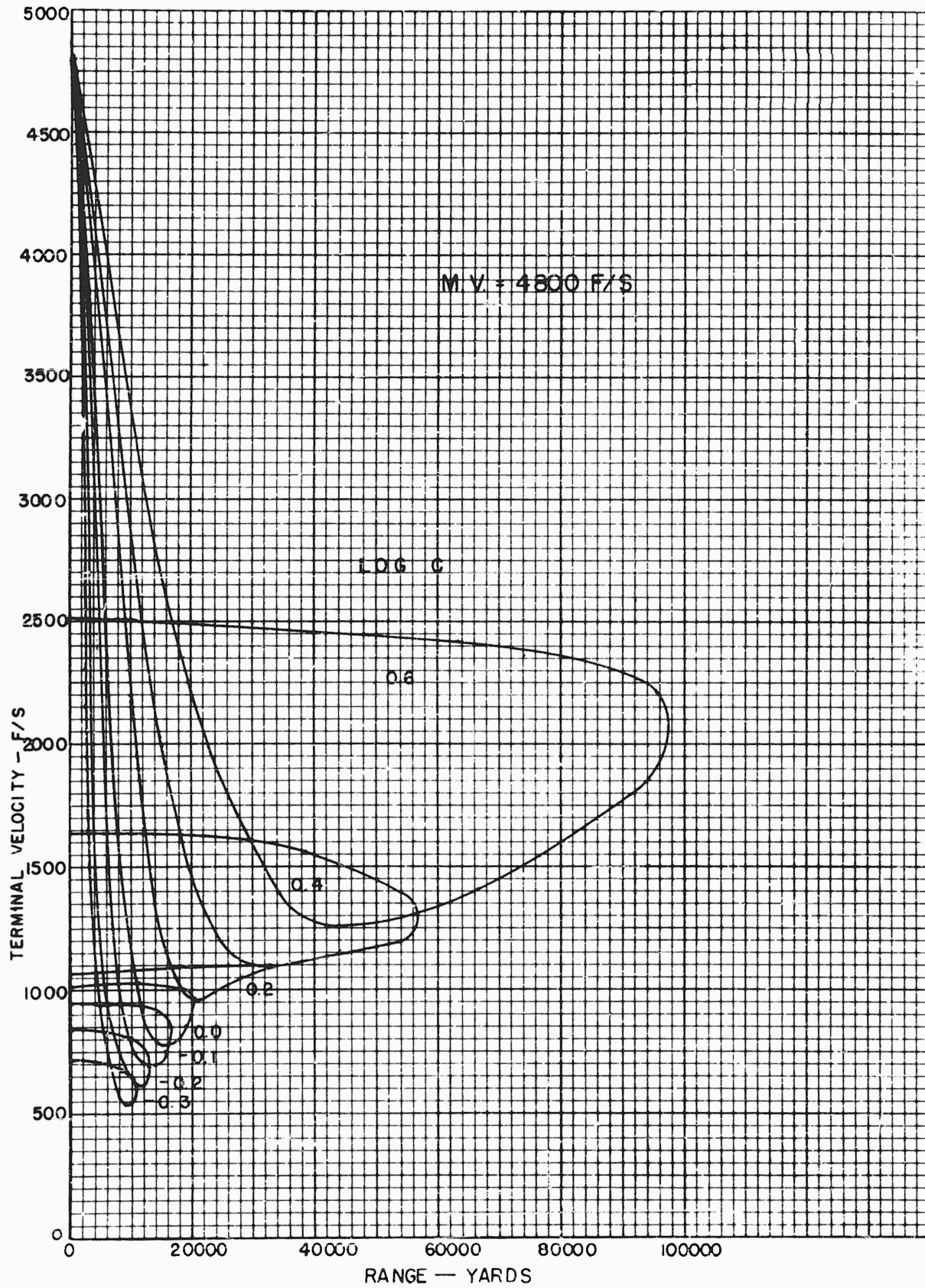


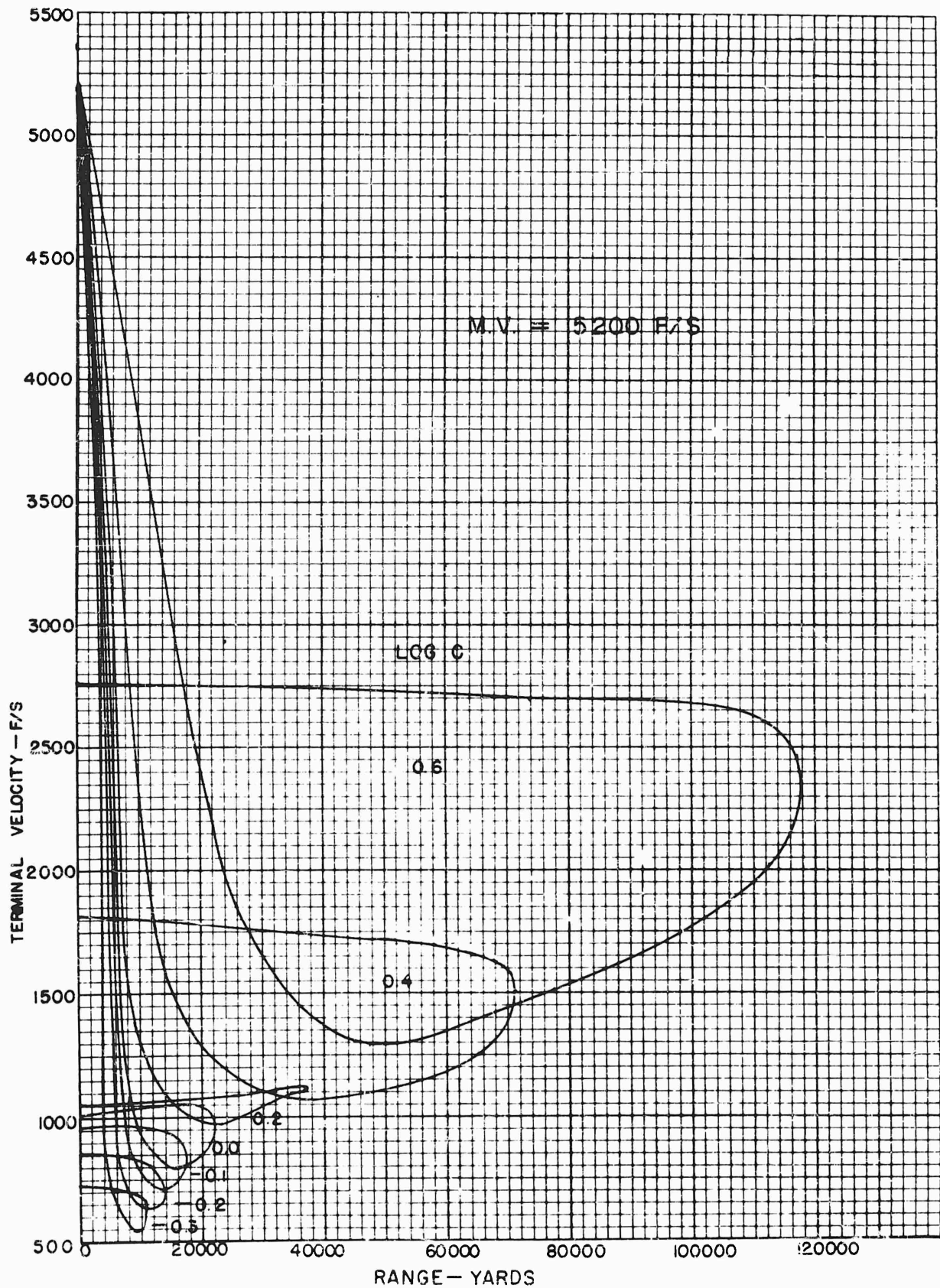


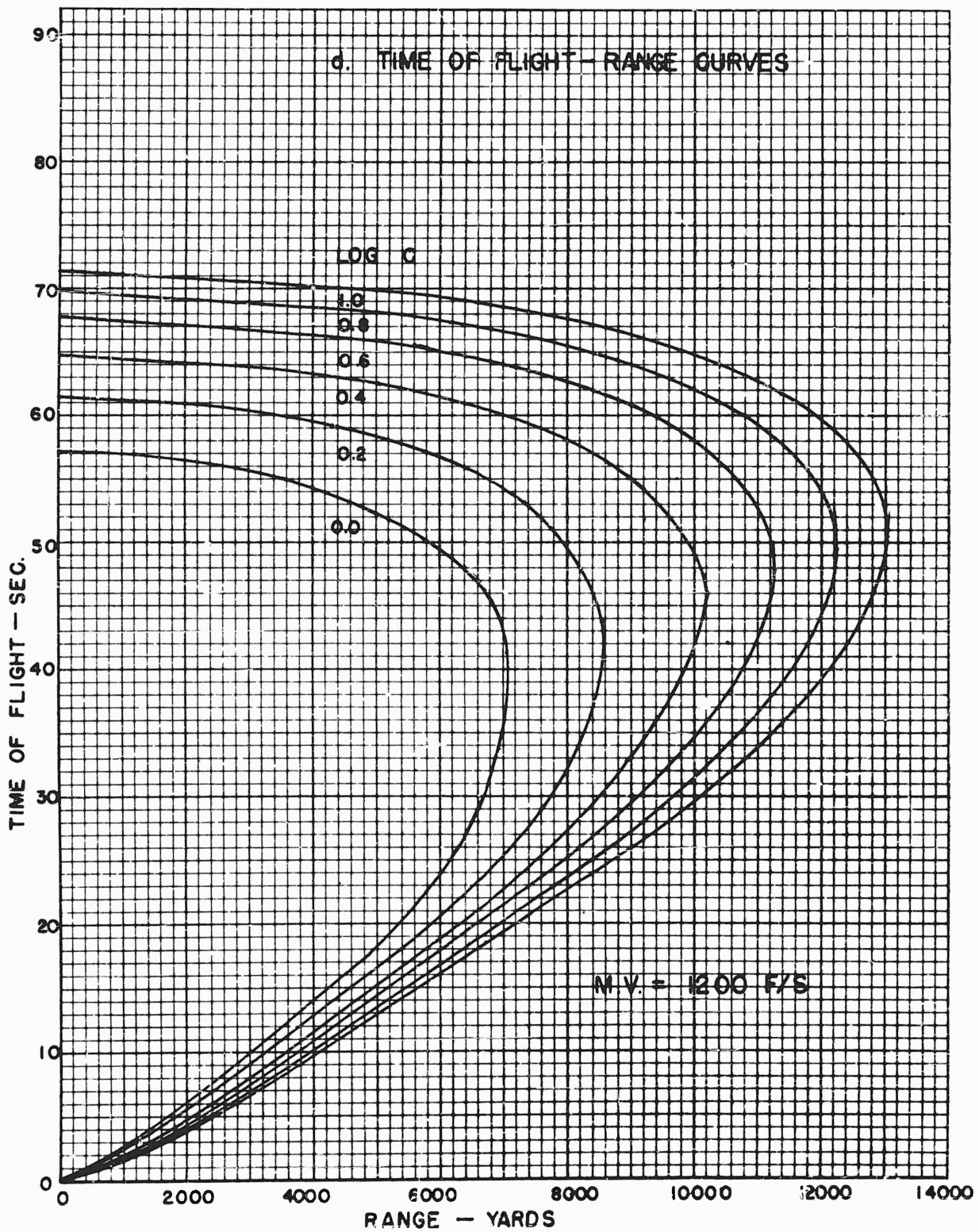


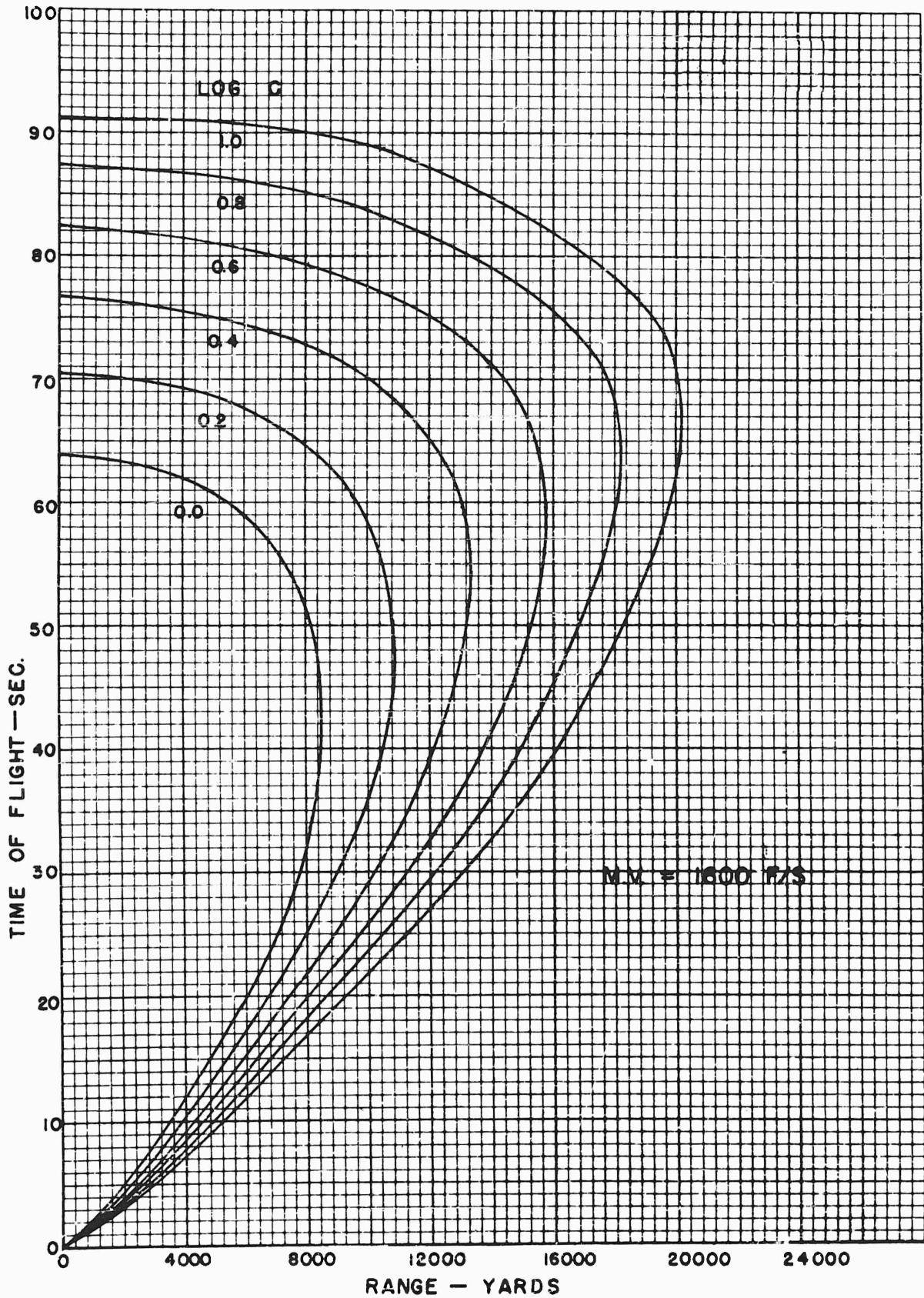


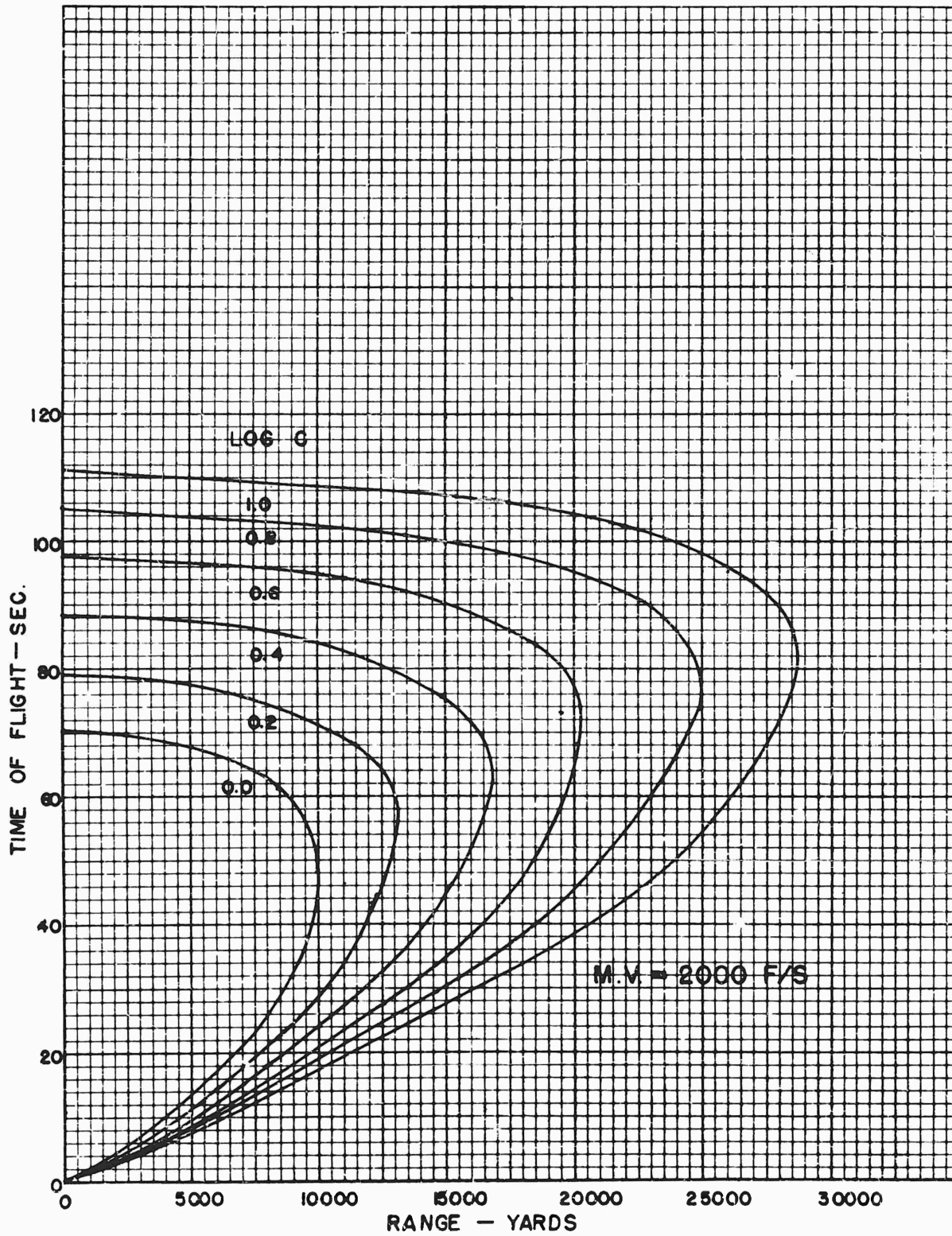


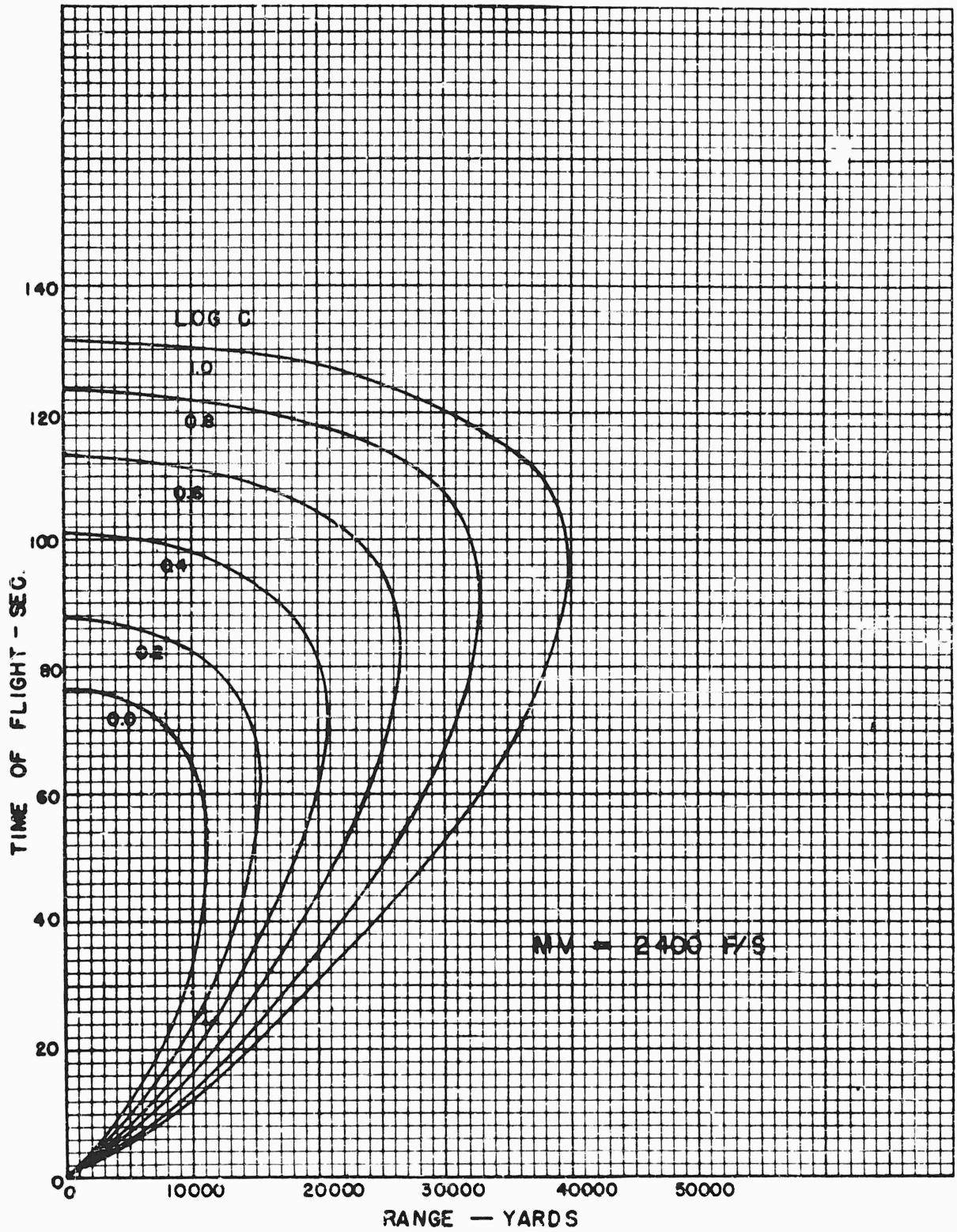


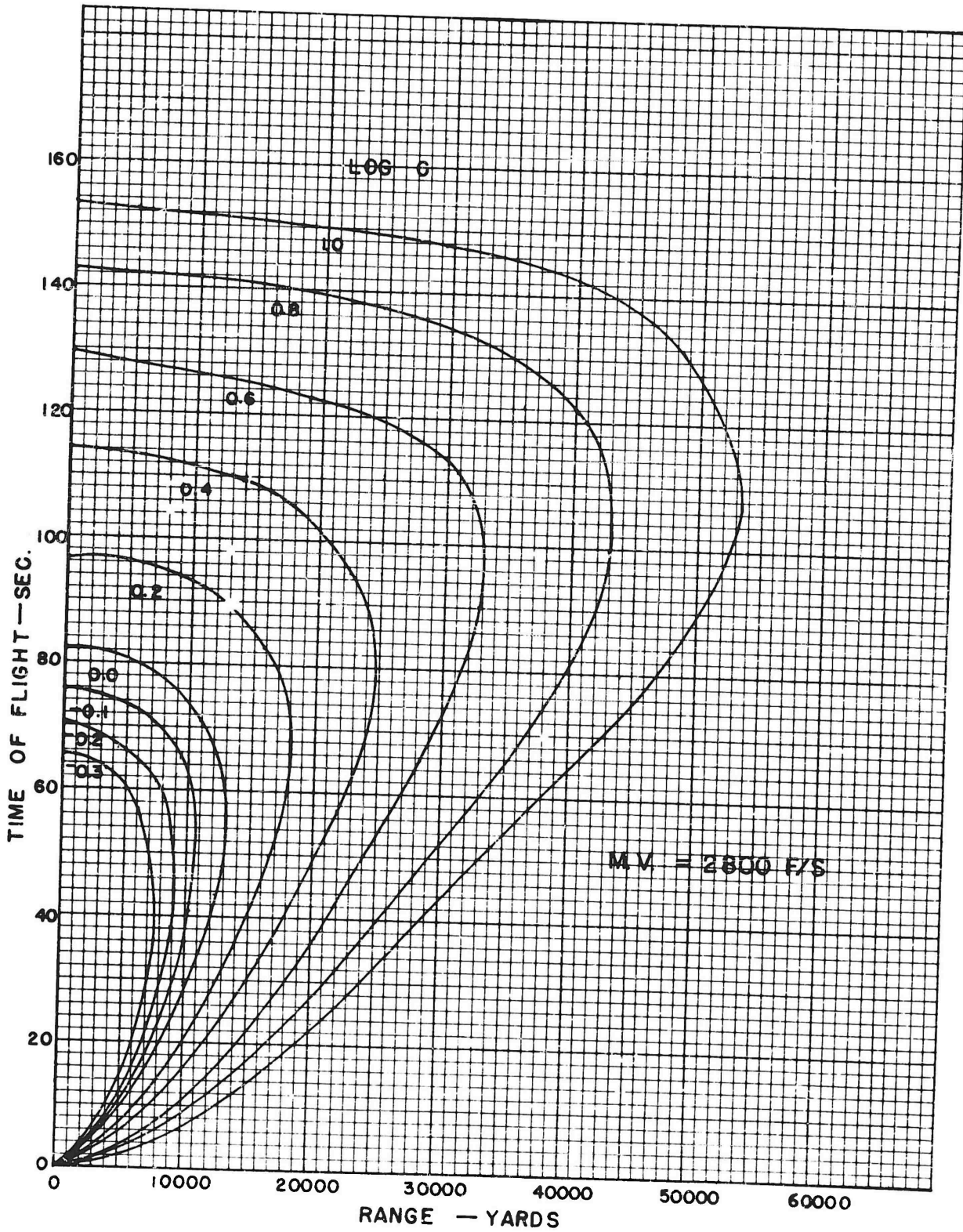


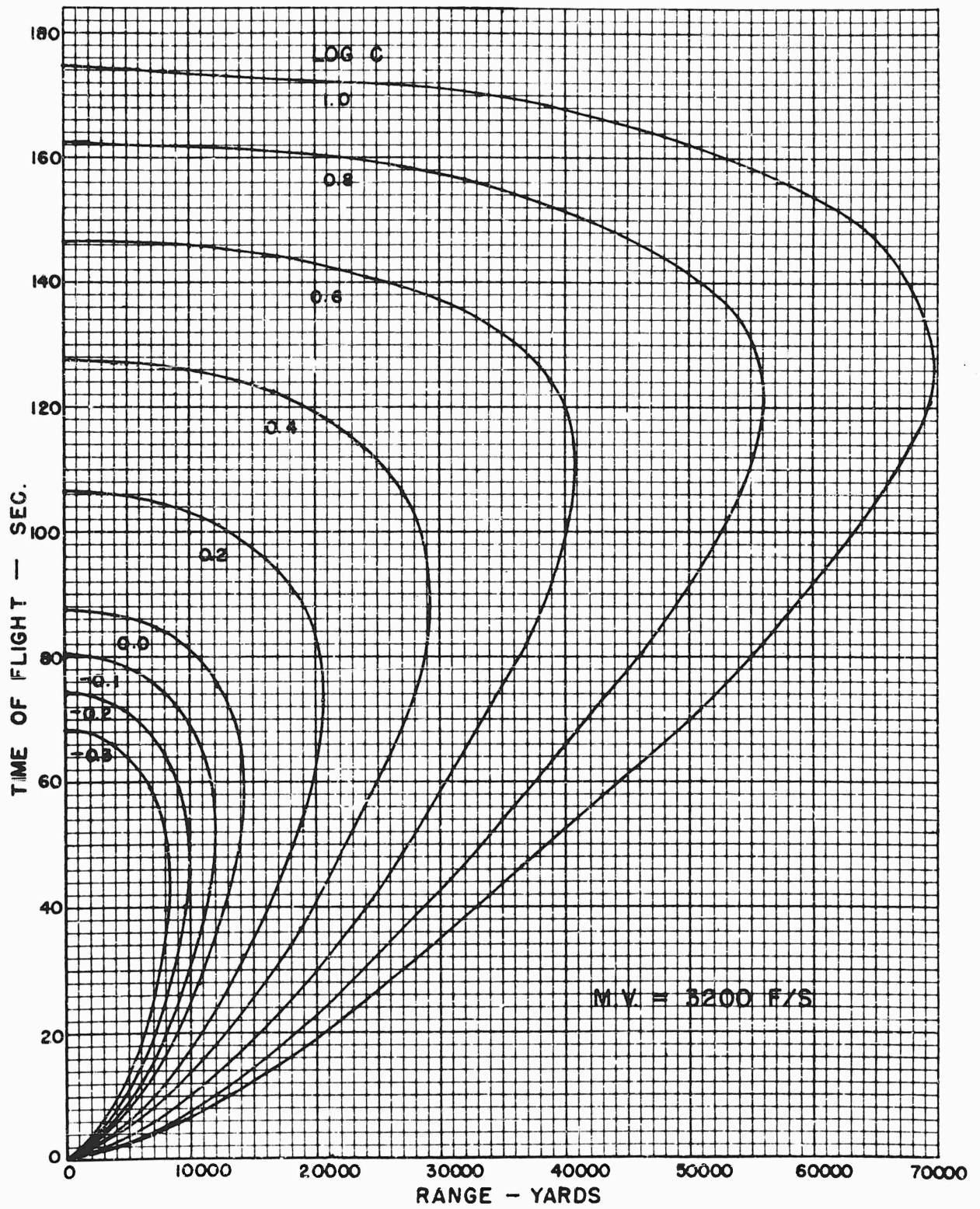


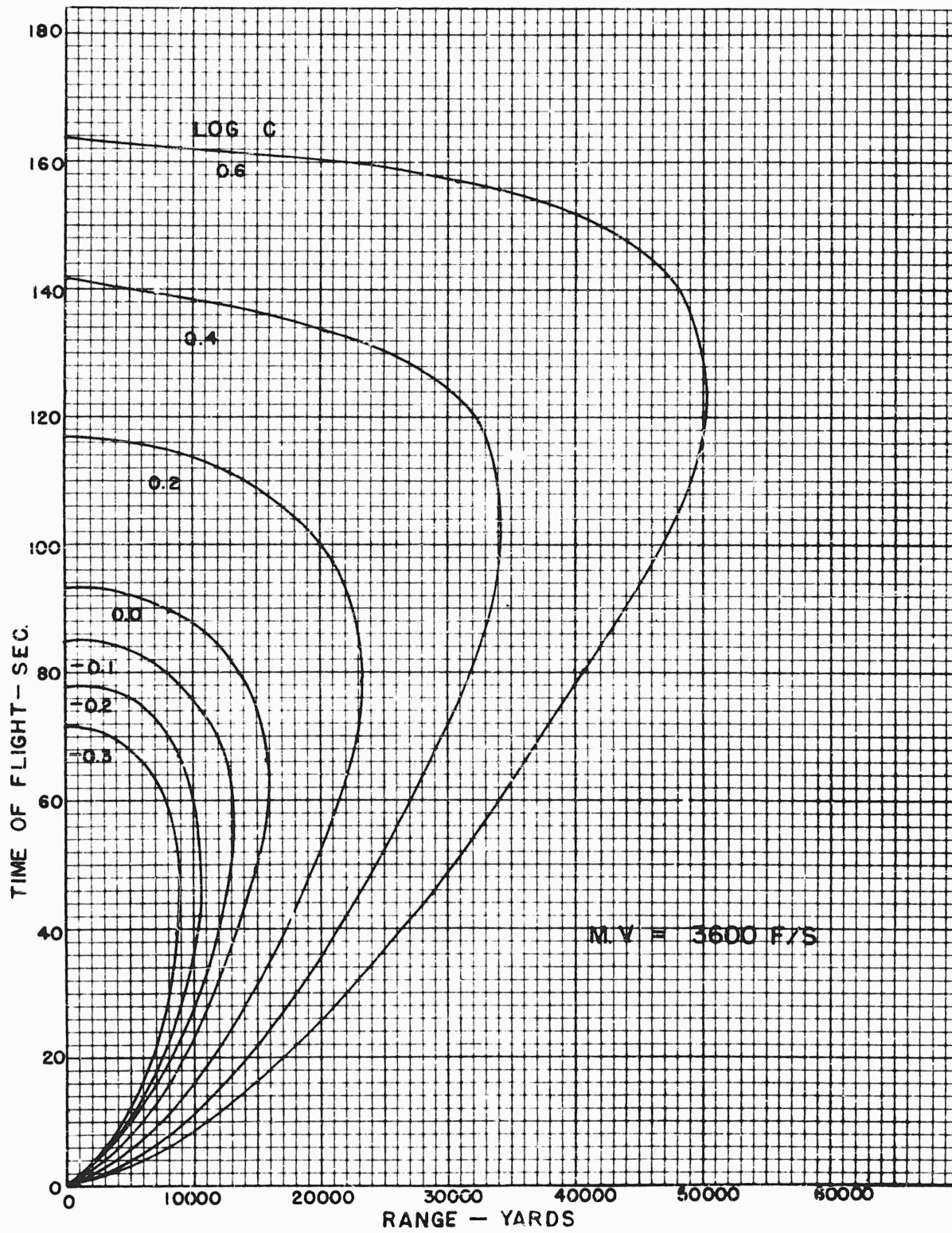


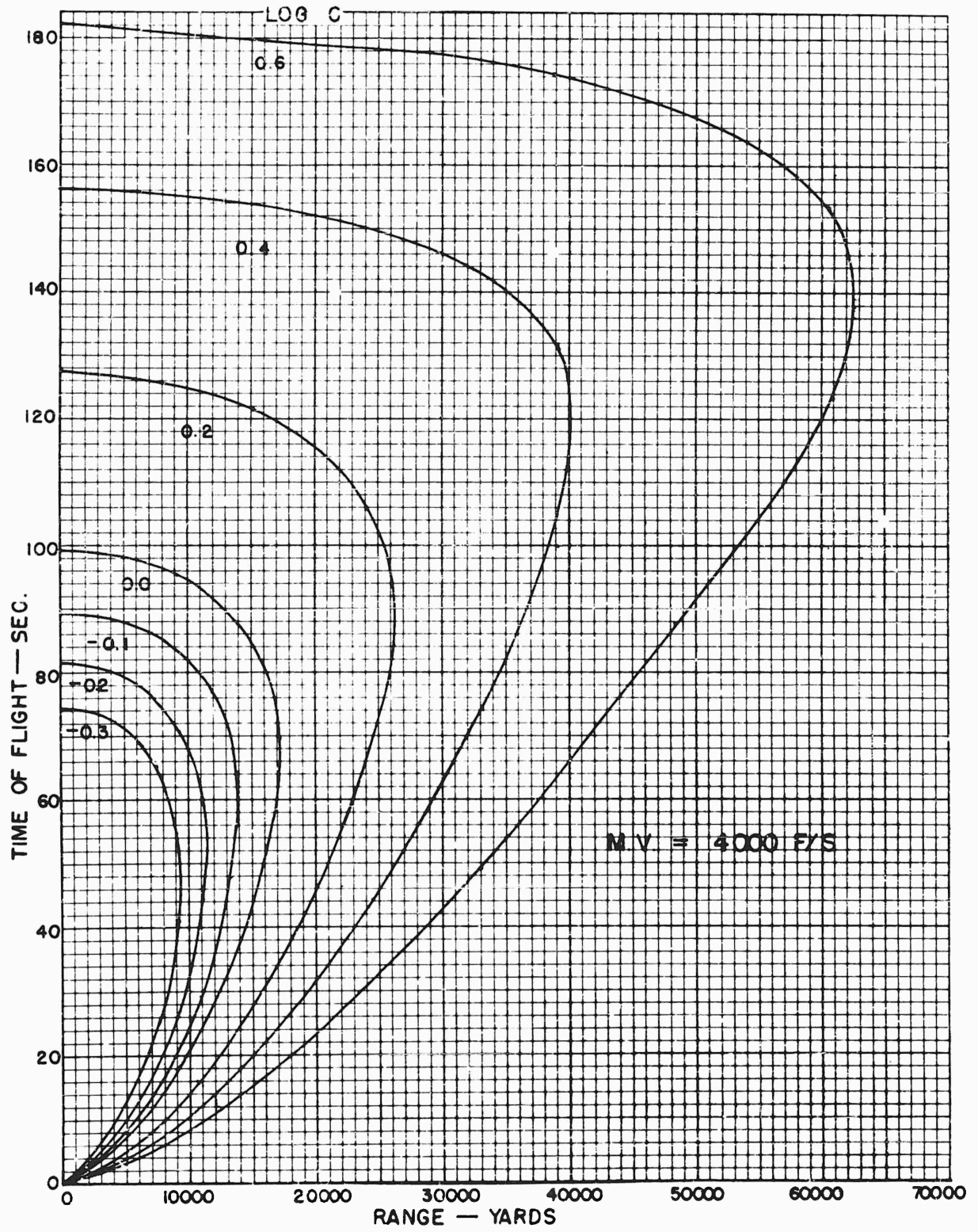


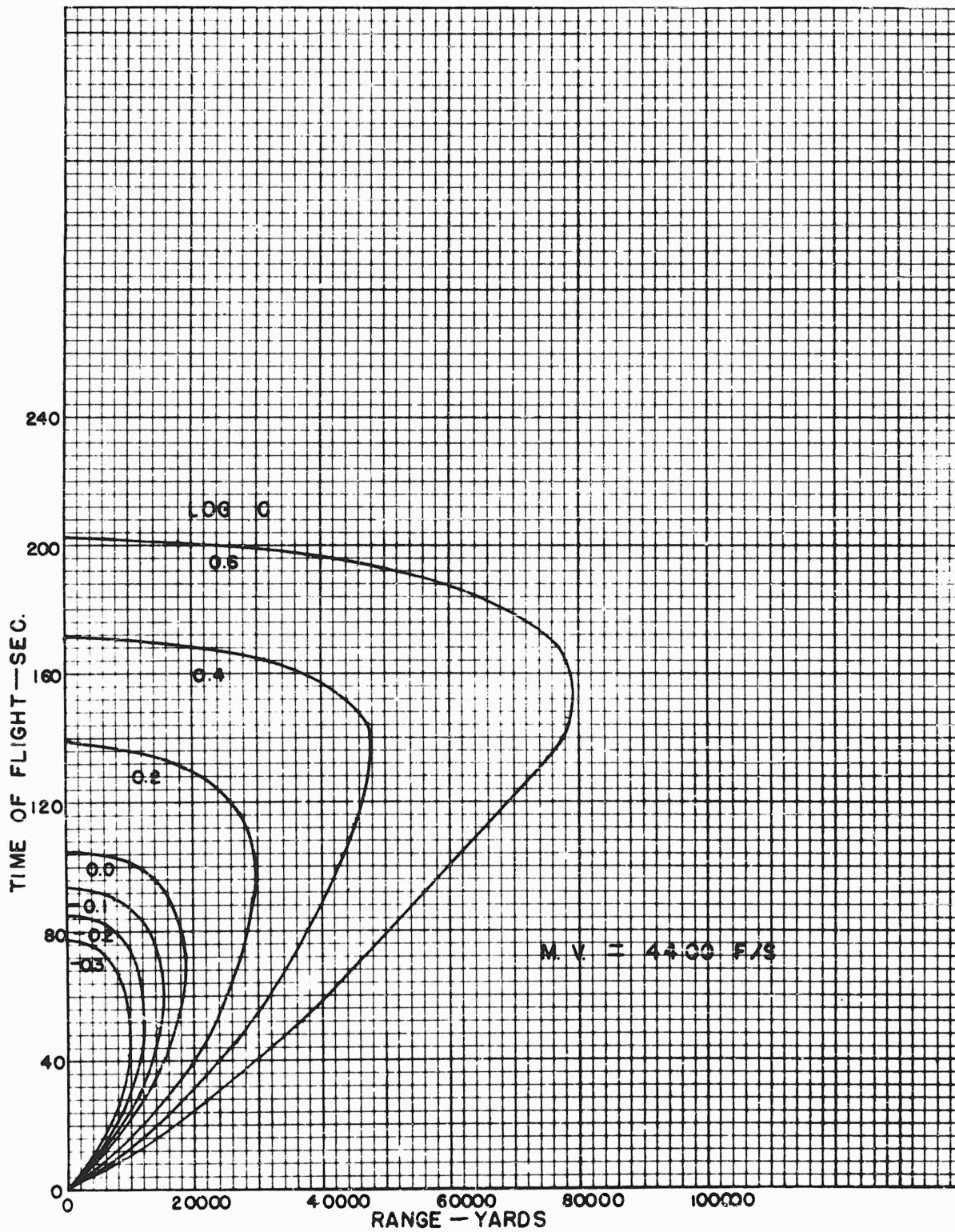


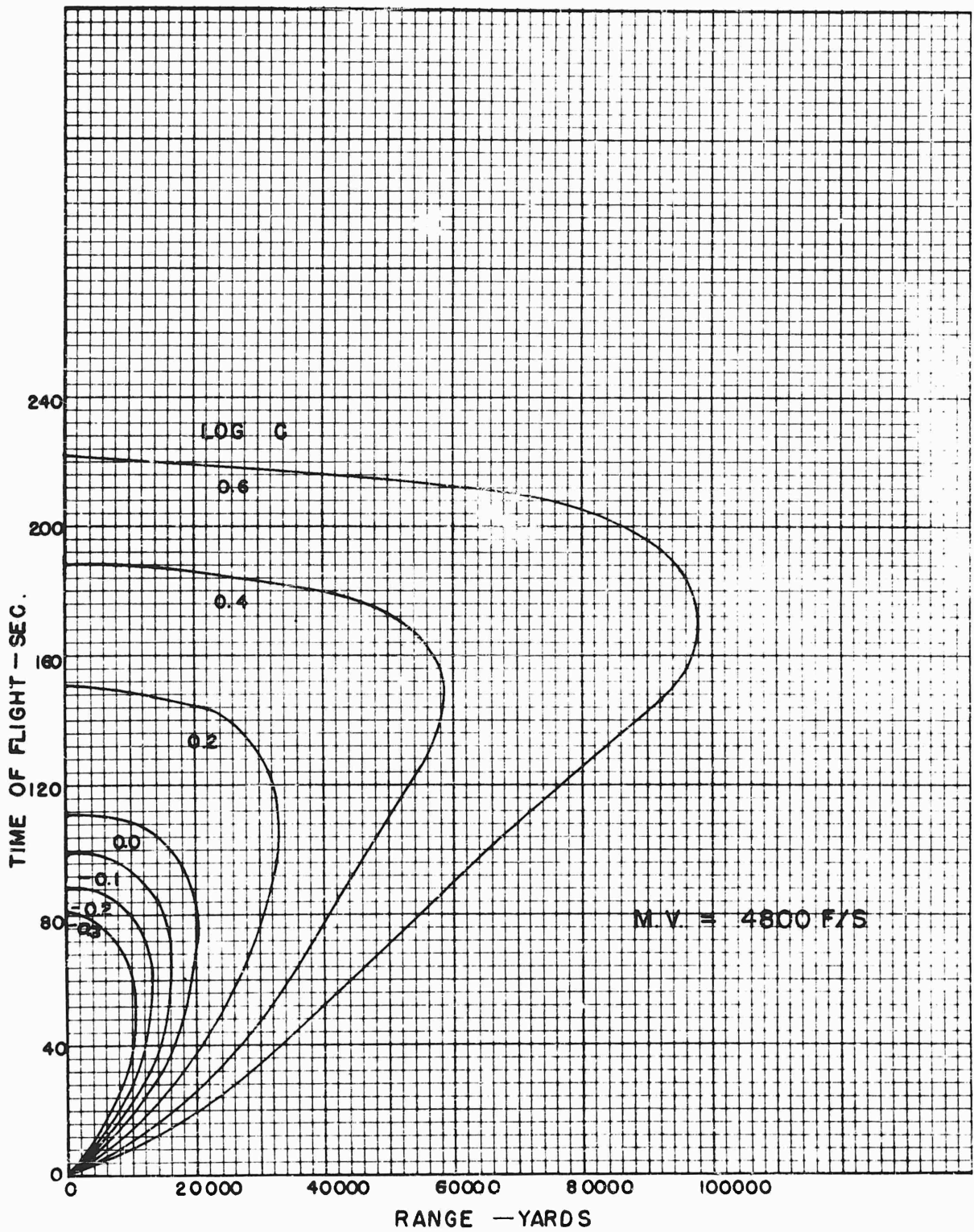


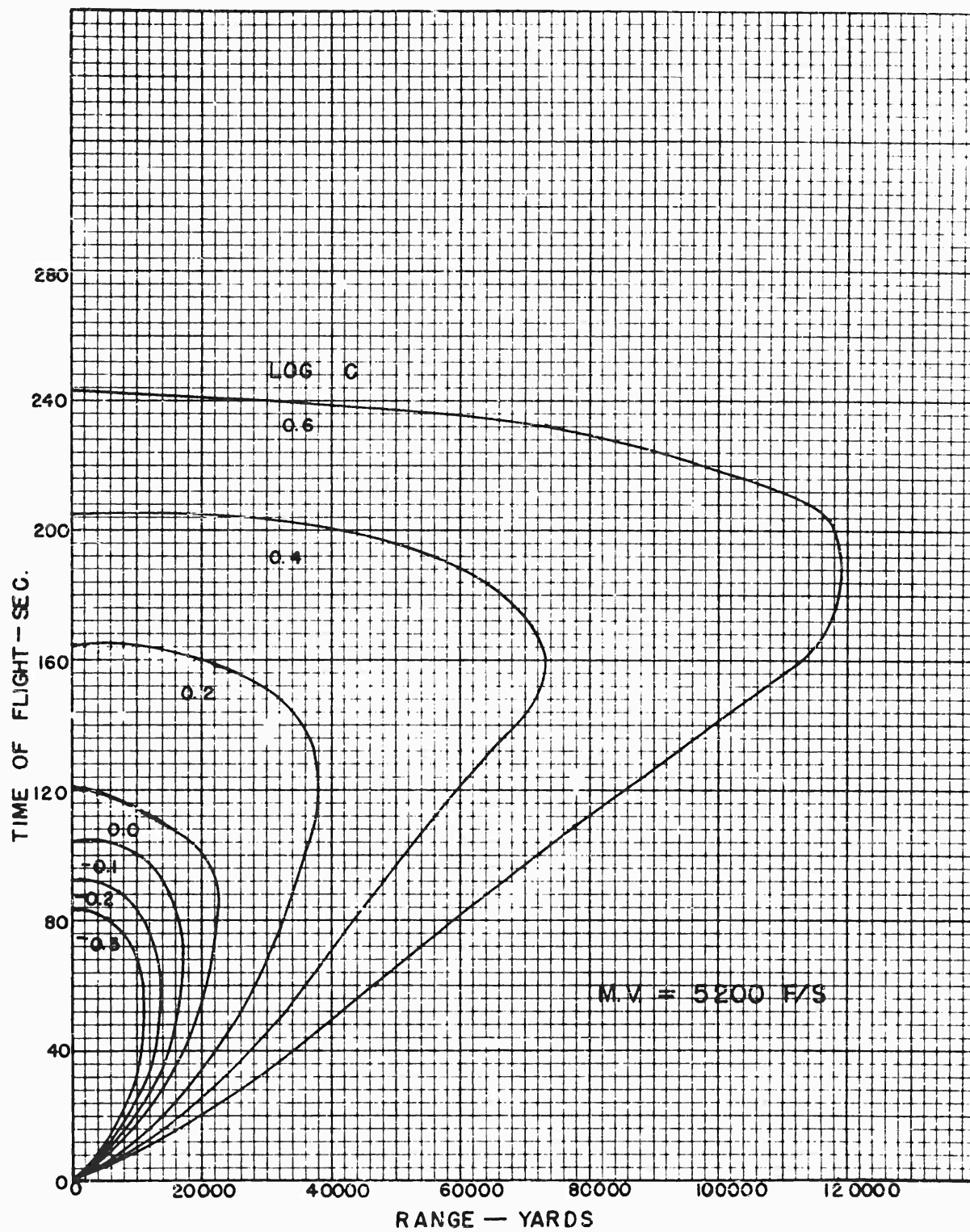












Ballistic Research Laboratories
 Handbook of Ballistic and
 Engineering Data for Ammunition,
 No. T-1-5

Ballistic Research Lab.,
 Aberdeen Proving Ground,
 Maryland.
 7 March 1949

BALLISTIC AND ENGINEERING DATA
 for
 Projectile, Type 5

<u>Section</u>	<u>Paragraphs</u>
I General - - - - -	1
II Description - - - - -	2 - 4
III Exterior ballistic data - - - - -	5 - 6

**SECTION I
 GENERAL**

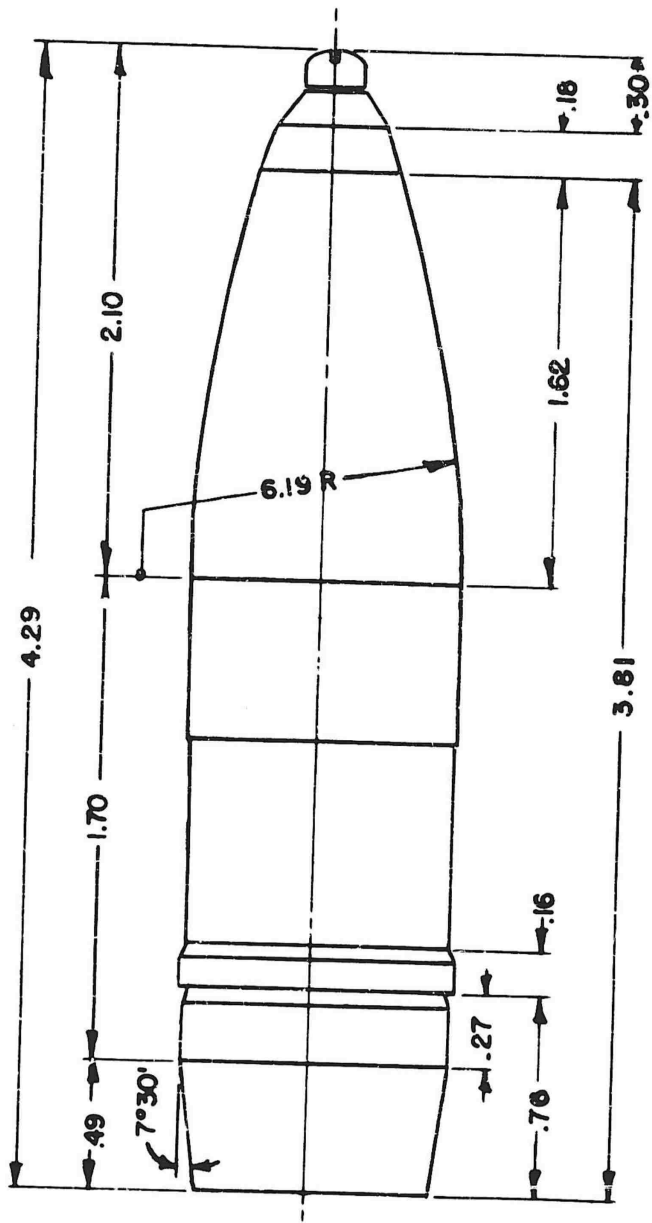
	<u>Paragraph</u>
Purpose - - - - -	1

1. Purpose. The purpose of this number of the handbook is to furnish a concise collection of information regarding the shape, dynamics and ballistics of Projectile Type 5. The prototype of this shape is the 75-mm High Explosive Shell Mark IV with the short Point Detonating Fuze Mark V. The information herein is collected from the drawings, reports and firing tables pertaining to this ammunition.

**SECTION II
 DESCRIPTION**

	<u>Paragraph</u>
Drawings - - - - -	2
Dimensions - - - - -	3
Physical characteristics - - - - -	4

ALL DIMENSIONS IN CALIBERS



PROJECTILE TYPE 5

2. Drawings.

Shell, HE, 75-mm, Mark IV	75-2-180
Adapter and Booster Casing	73-1-55
Fuze, Point Detonating, Mark V	73-1-82
Shell, Experimental, 3.3-inch, Mark II	75-2-194
Force Diagram of 3.3-inch Shell, Mark II with Mark V Fuze	1969-B*
Force Diagram of 75-mm Shell Mark IV with Mark V Fuze	1969-D*

*Aberdeen Proving Ground: Design and Development Section.

3. Dimensions.

Boattail: Angle	7°30'
Length	0.49 cal
Band: Width	0.16 cal
Distance from boattail	0.27 cal
Distance from base	0.76 cal
Cylindrical body: Length	1.70 cal
Ogive: Length	1.62 cal
Radius of arc	6.19 cal
Adapter: Outside length	0.18 cal
Fuze: Outside length	0.30 cal
Length: Shell	3.81 cal
Shell, adapter and fuze	4.29 cal
Ogive, adapter and fuze	2.10 cal

4. Physical characteristics. The following values pertain to the 75-mm Shell Mark IV with Fuze Mark V.

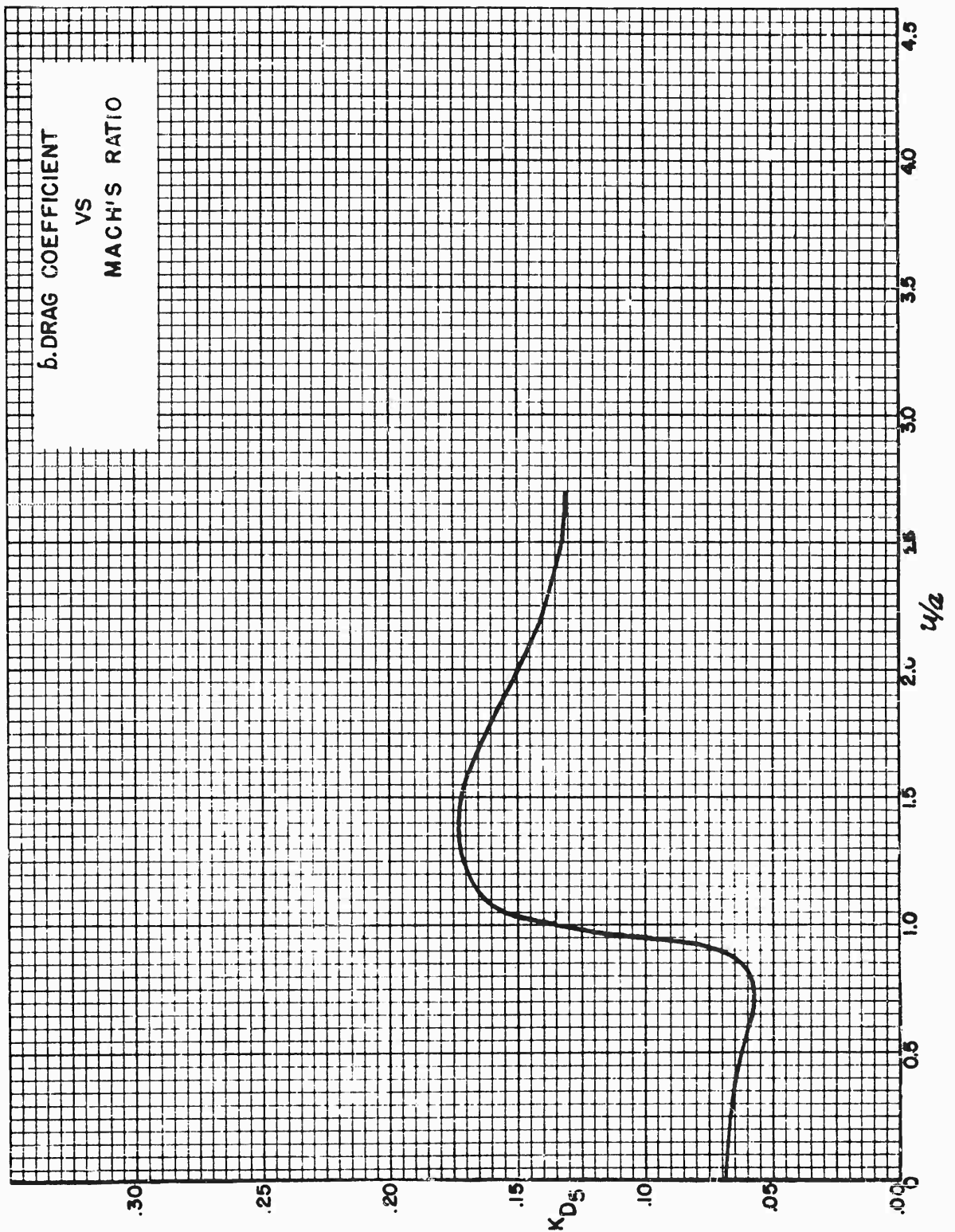
Loading	Weight lb.	Base to C. G. cal	Moments of inertia lb.ft ²	
			Axial	Transverse
High Explosive	13.50 Std	----	----	----
Empty	11.90	1.717	.1096	0.965
Sand and rosin	13.31	1.716	.1178	1.026
Lead (1/3 full)	15.94	1.558	.1201	1.091

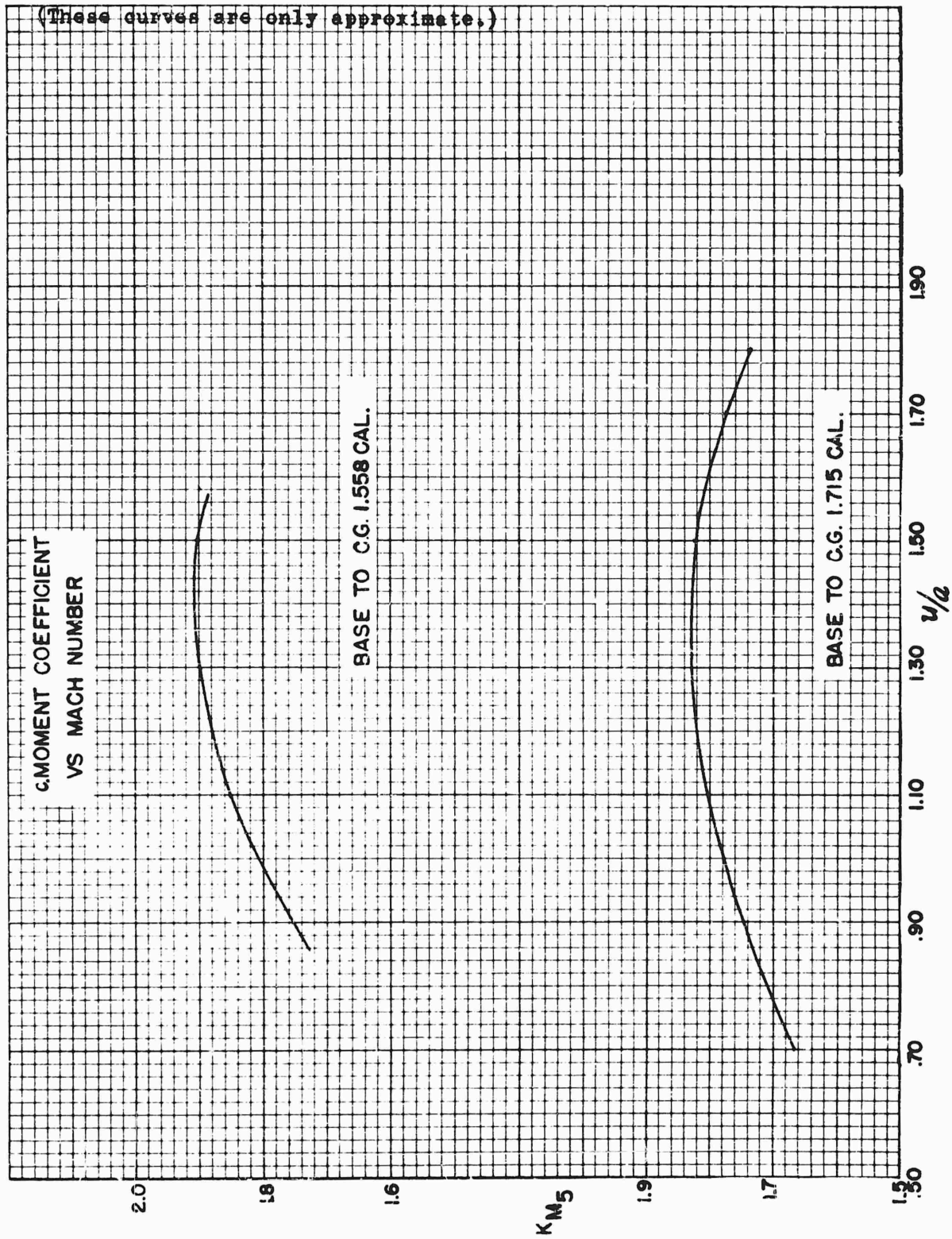
SECTION III
EXTERIOR BALLISTIC DATA

	<u>Paragraph</u>
Aerodynamic data - - - - -	5
Firing table data - - - - -	6

5. Aerodynamic data.

a. **Drag function: G_5 .** The 75-mm Shell Mark IV was fired for resistance at velocities from 600 to 2225 fps. The 3.3-inch Shell Mark II was fired for resistance at velocities from 1735 to 3021 fps. The rotating band of the 3.3-inch shell is different from that of the 75-mm Shell and its larger diameter makes the dimensions of the fuze, expressed in calibers, slightly different; otherwise, the contours of the two projectiles are practically similar. The tabulated drag function fits the observations obtained with the 75-mm Shell, but is lower than the values obtained with the 3.3-inch Shell at all velocities.





6. FIRING TABLE DATA. GUN, 75MM, M1897

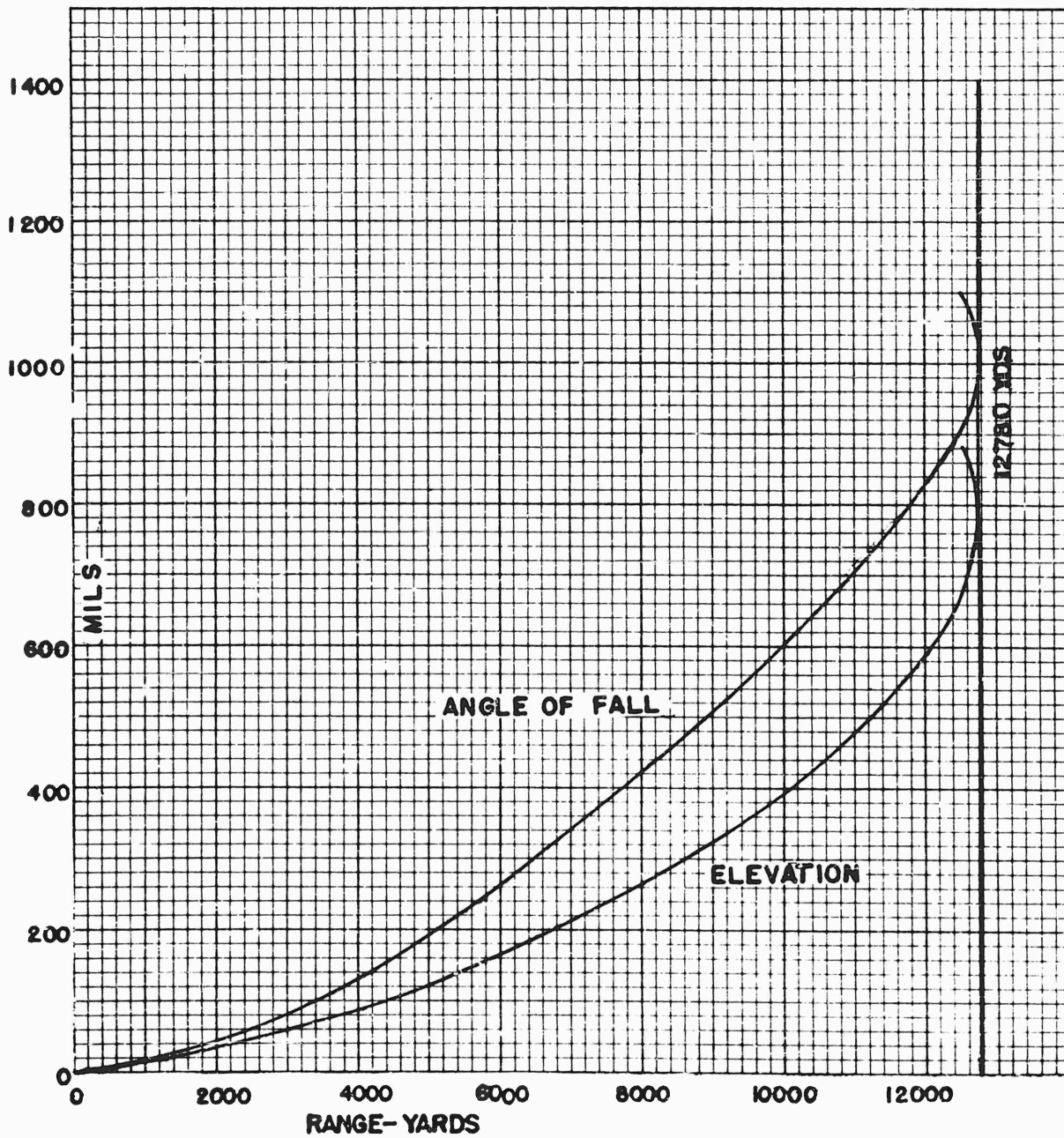
MUZZLE VELOCITY: 1955 FPS

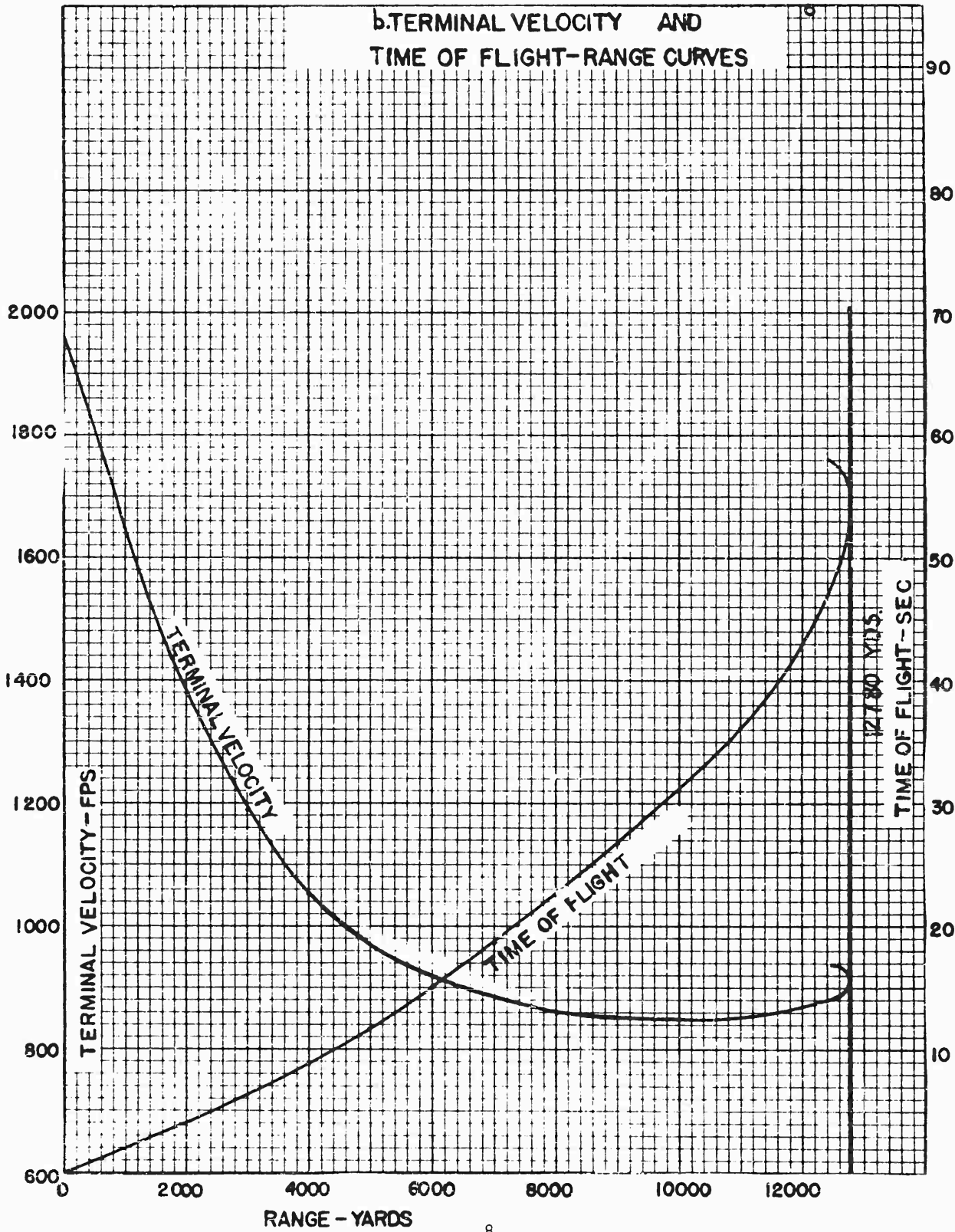
TWIST OF RIFLING: 1/25.596

FT 75-B-2

(THESE DATA WERE BASED ON RANGE FIRINGS AND CALCULATED WITH THE G_1 DRAG FUNCTION.)

a. ELEVATION - RANGE AND ANGLE OF FALL - RANGE CURVES





Ballistic Research Laboratories
Handbook of Ballistic and
Engineering Data for Ammunition,
No. T-1-6

Ballistic Research Lab.
Aberdeen Proving Ground,
Maryland.
8 March 1949

BALLISTIC AND ENGINEERING DATA
for
Projectile Type 6

<u>Section</u>	<u>Paragraphs</u>
I General-----	1
II Description -----	2 - 4
III Exterior ballistic data -----	5 - 6

**SECTION I
GENERAL**

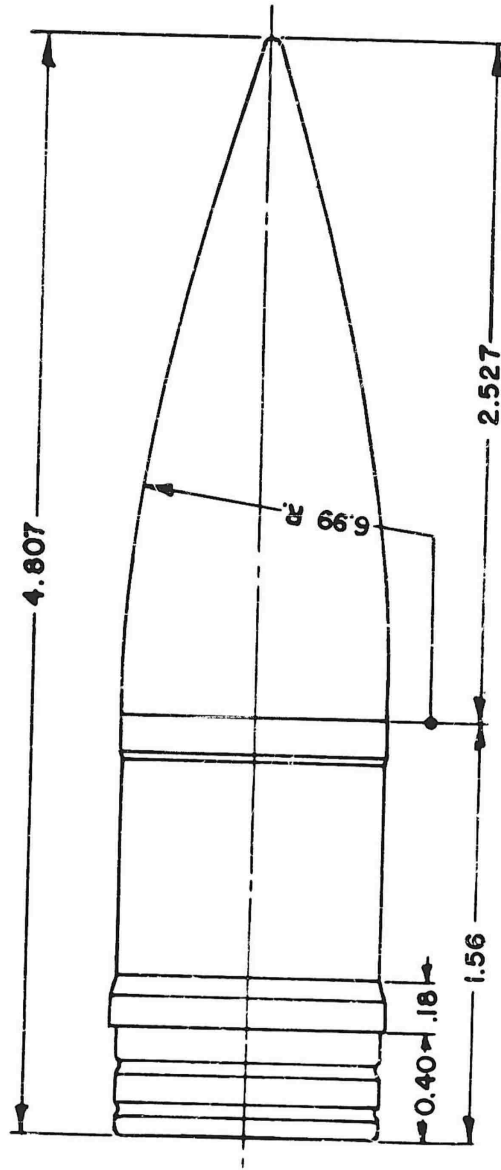
	<u>Paragraph</u>
Purpose - - - - -	1

1. Purpose. The purpose of this number of the handbook is to furnish a concise collection of information regarding the shape, dynamics and ballistics of Projectile Type 6. The prototype of this shape is the 15-pound 3-inch High Explosive Shell M1915. The information herein is collected from the drawings, reports and firing tables pertaining to this ammunition.

**SECTION II
DESCRIPTION**

	<u>Paragraph</u>
Drawings - - - - -	2
Dimensions - - - - -	3
Physical characteristics - - - - -	4

ALL DIMENSIONS IN CALBERS



PROJECTILE TYPE 6

2. Drawings.

Shell, HE, 3-inch, M1915 75-5-48
Fuze, BD, Mark V 73-2-62

3. Dimensions.

Band: Distance from base 0.40 cal
Width 0.18 cal

Cylindrical body: Length 1.56 cal

Ogive: Length 2.527 cal
Radius of arc 6.99 cal

Shell: Length 4.087 cal

4. Physical characteristics. The following values pertain to the 3-inch HE Shell M1915.

Fuze	Weight lb	Base to C.G. cal	Moments of inertia lb.ft ²	
			Axial	Transverse
BD Fuze Mark V	15.00 Std	----	----	---
Fuze hole plug	14.80	1.619	.1130	.988
Fuze hole plug*	13.59	1.658	.1180	.941

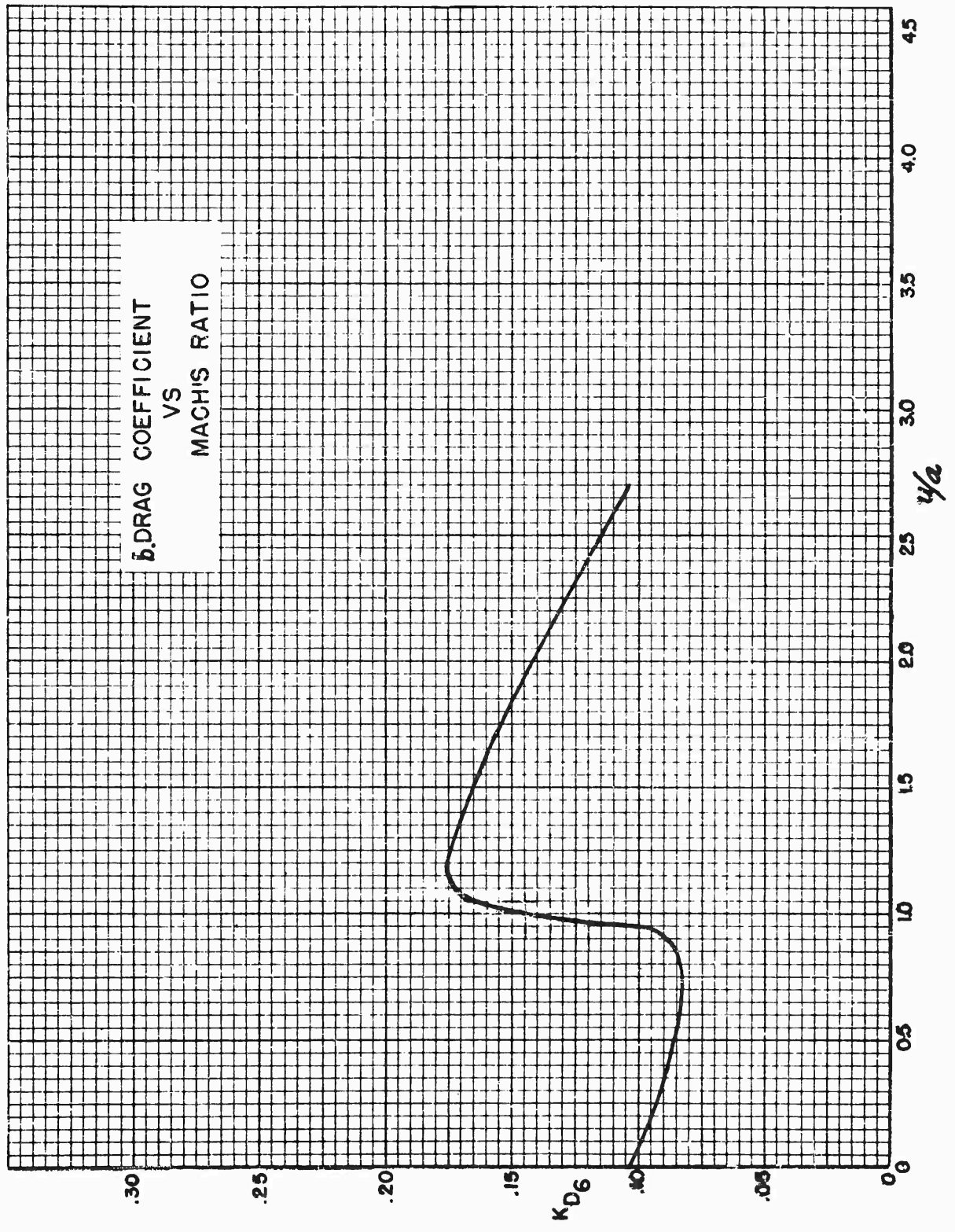
*Plug sawed off flush with base; shell empty.

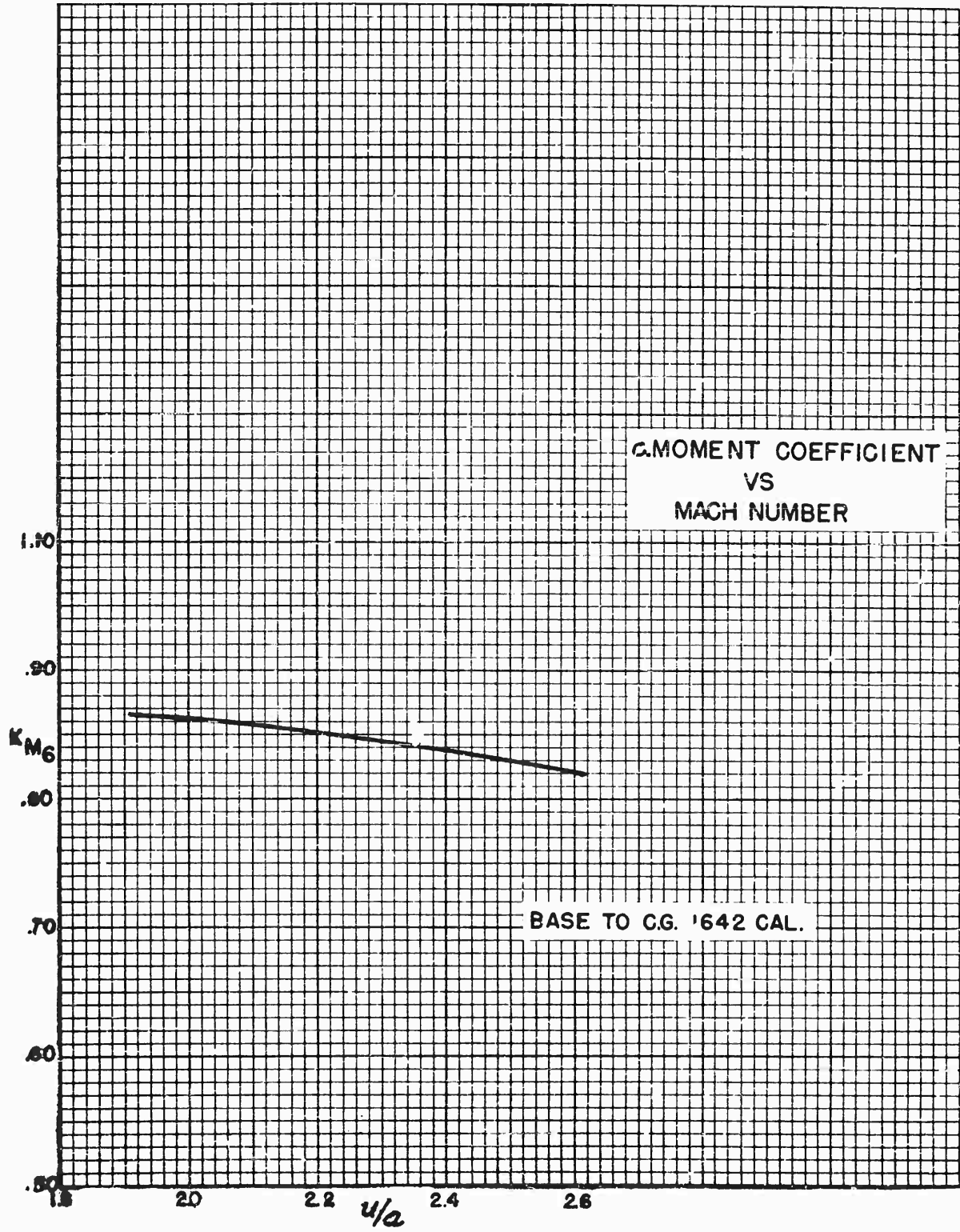
SECTION III
EXTERIOR BALLISTIC DATA

	<u>Paragraph</u>
Aerodynamic data - - - - -	5
Firing table data - - - - -	6

5. Aerodynamic data.

a. **Drag function: G_0 .** The 3-inch Shell M1915 with the fuze hole plug was fired for resistance at velocities from 600 to 3000 ft/sec. The tabulated drag function fits the observations.



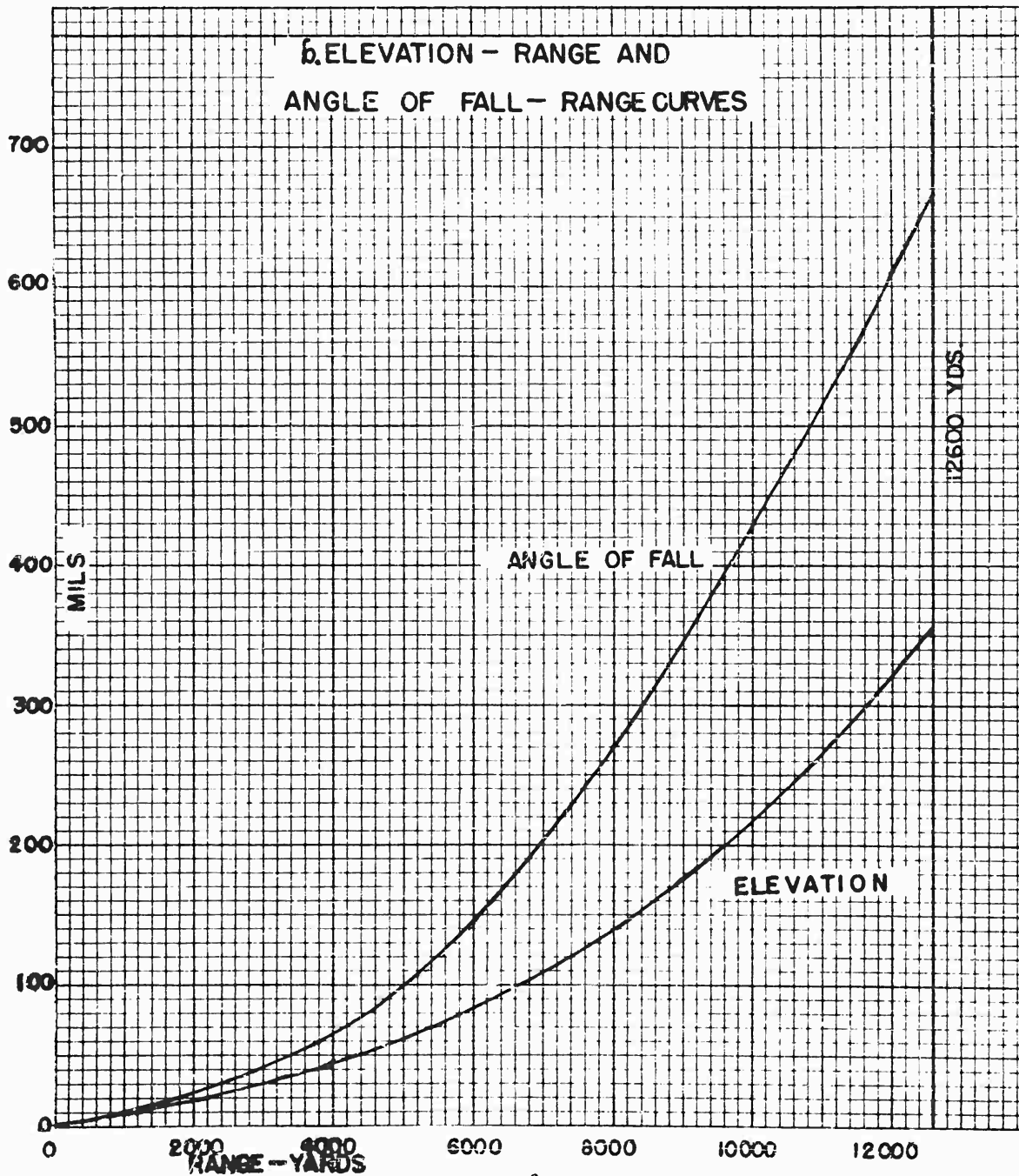


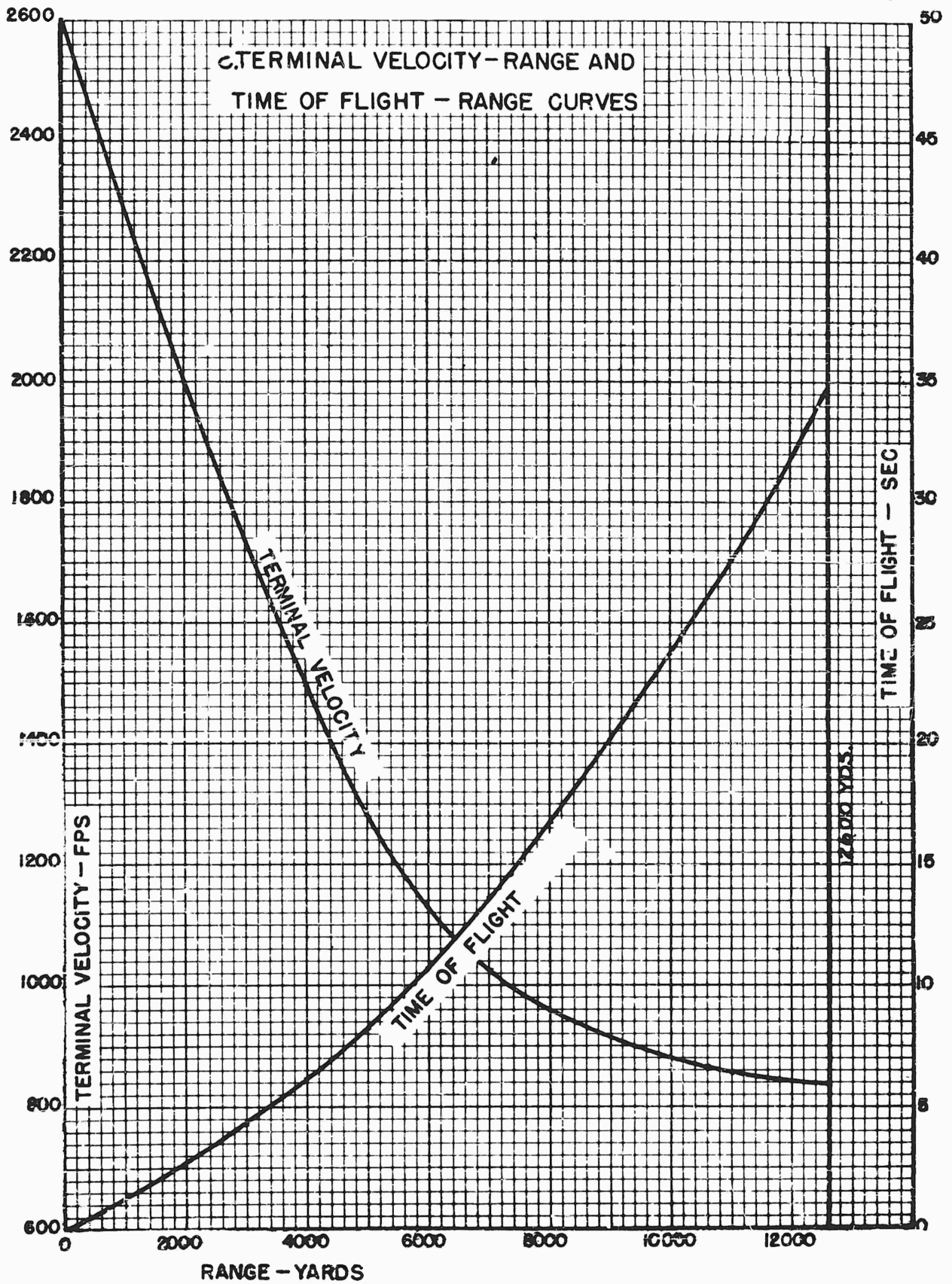
6. FIRING TABLE DATA, GUN, 3-INCH, M1902 AND M1903.

MUZZLE VELOCITY: 2600 FPS
TWIST OF RIFLING: INCREASING TO 1/25
FT 3-M-2.

(THESE DATA WERE BASED ON RANGE FIRINGS AND CALCULATED WITH THE G_6 DRAG FUNCTION.)

a. BALLISTIC COEFFICIENT AND FORM FACTOR: THE BALLISTIC COEFFICIENT C_B VARIES FROM 1.69 AT ELEVATIONS BELOW 160 MILS TO 1.71 AT ELEVATIONS ABOVE 275 MILS. THE CORRESPONDING VALUES OF THE FORM FACTOR I ARE 0.986 AND 0.975 RESPECTIVELY.





Ballistic Research Laboratories
Handbook of Ballistic and
Engineering Data for Ammunition,
No. T-1-7

Ballistic Research Lab.,
Aberdeen Proving Ground,
Maryland.
8 March 1949

BALLISTIC AND ENGINEERING DATA
for
Projectile Type 7

<u>Section</u>		<u>Paragraphs</u>
I	General - - - - -	1
II	Description - - - - -	2 - 3
III	Exterior ballistic data - - - - -	4

**SECTION I
GENERAL**

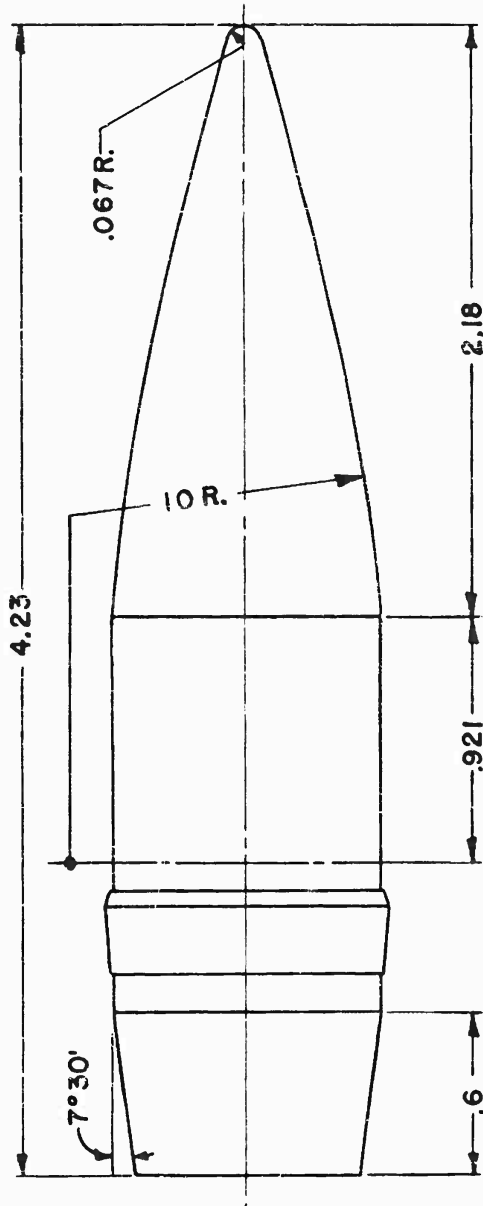
	<u>Paragraphs</u>
Purpose - - - - -	1

1. Purpose. The purpose of this number of the handbook is to furnish a concise collection of information regarding the shape, dynamics and ballistics of Projectile Type 7, which is the British Standard Streamline Projectile. This information is collected from the drawings and charts pertaining to this ammunition.

**SECTION II
DESCRIPTION**

	<u>Paragraph</u>
Drawing - - - - -	2
Dimensions - - - - -	3

ALL DIMENSIONS IN CALIBERS



PROJECTILE TYPE 7

3. Dimensions.

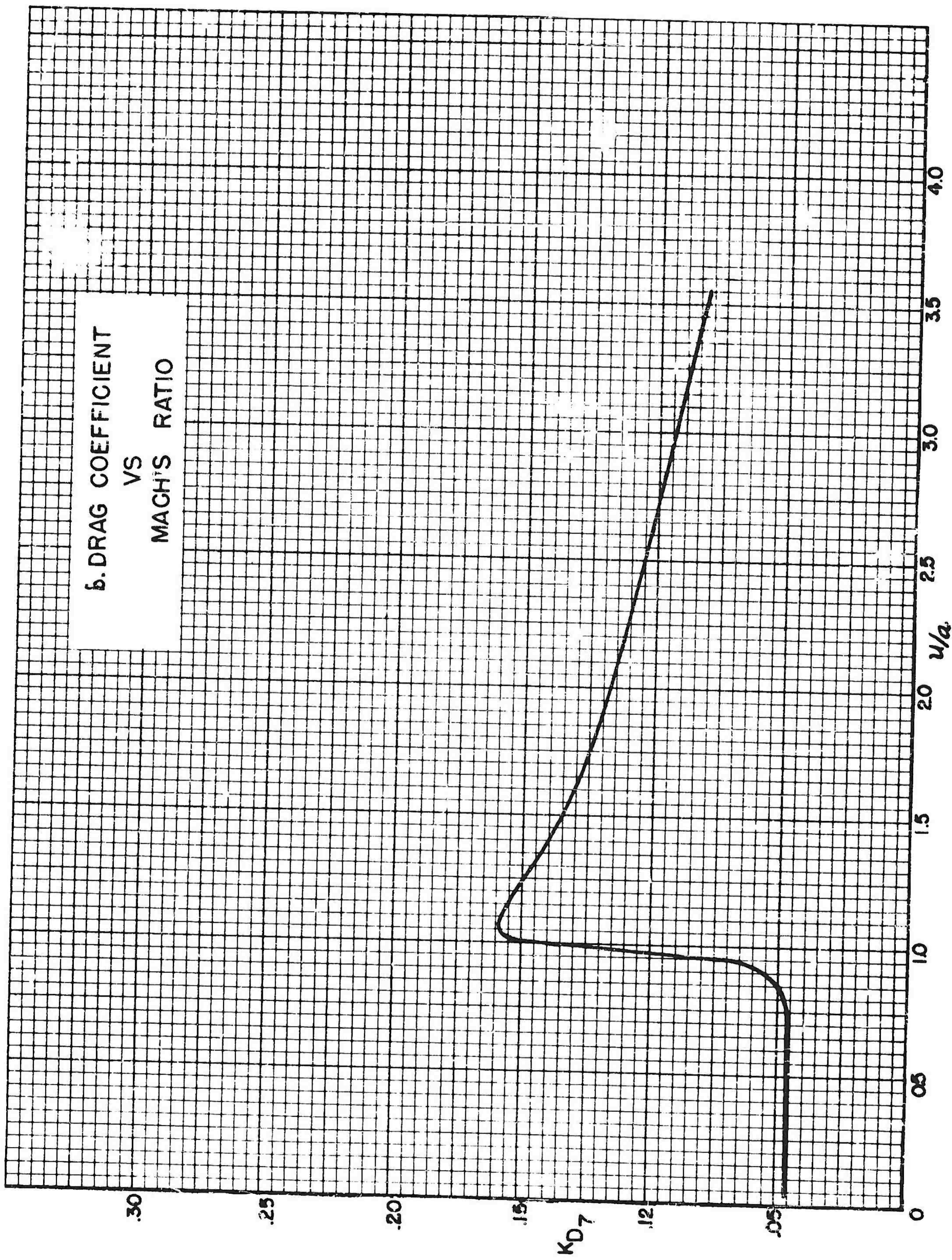
Boattail: Angle	7°30'
Length	0.60 cal
Cylindrical body: Length	1.45 cal
Ogive: Length (same as complete 5-cal-radius ogive)	2.18 cal
Radius of arc	10.00 cal
Shell: Length	4.23 cal

**SECTION III
EXTERIOR BALLISTIC DATA**

	<u>Paragraph</u>
Aerodynamic data. - - - - -	4

4. Aerodynamic data.

a. **Drag function: G_7 .** The tabulated drag function was calculated from values of the drag coefficient read from a large scale curve that was obtained from the British External Ballistic Department.



Ballistic Research Laboratories
Handbook of Ballistic and
Engineering Data for Ammunition,
No. T-1-8

Ballistic Research Lab.,
Aberdeen Proving Ground,
Maryland.
8 March 1949

BALLISTIC AND ENGINEERING DATA
for
Projectile Type 8

<u>Section</u>		<u>Paragraphs</u>
I	General - - - - -	1
II	Description - - - - -	2 - 3
III	Exterior ballistic data - - - - -	4

**SECTION I
GENERAL**

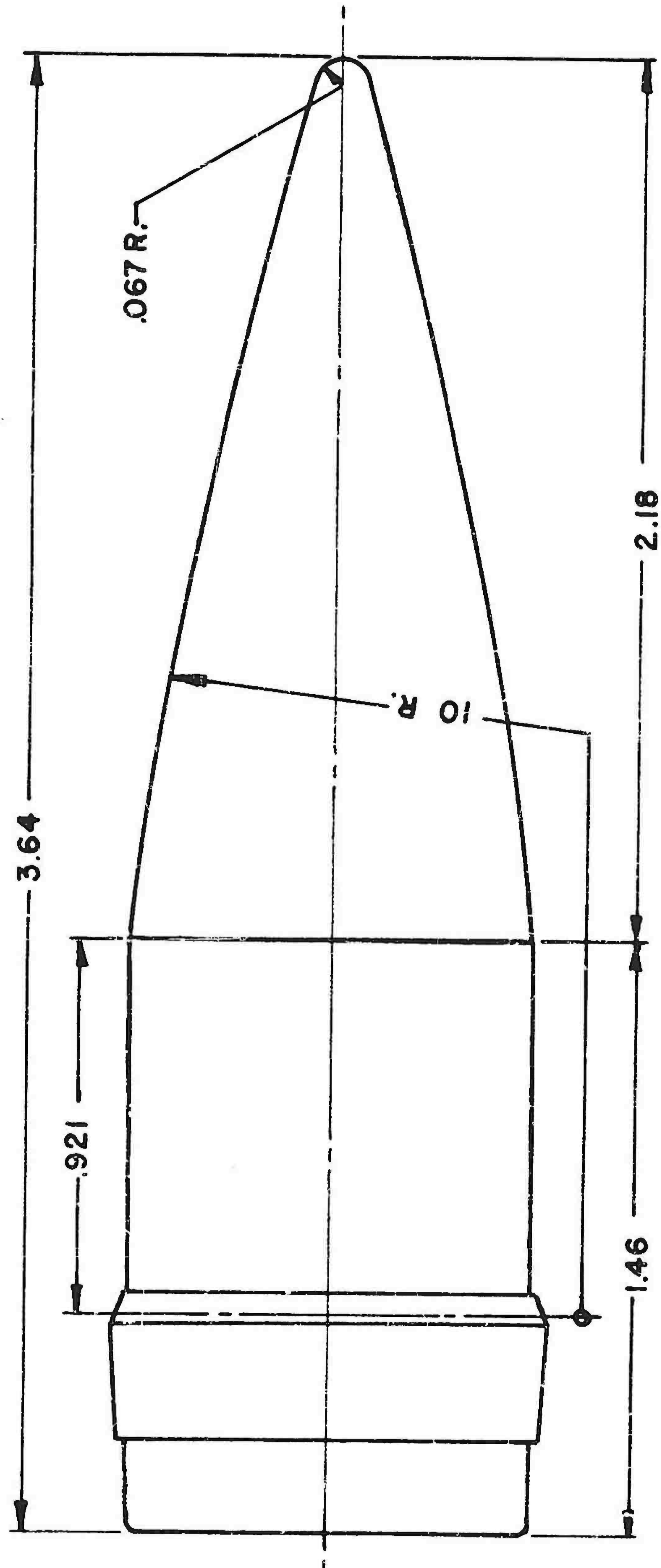
	<u>Paragraph</u>
Purpose - - - - -	1

1. Purpose. The purpose of this number of the handbook is to furnish a concise collection of information regarding the shape, dynamics and ballistics of Projectile Type 8, which is the British Streamline Projectile with cylindrical base. This information is collected from the drawings and charts pertaining to this ammunition.

**SECTION II
DESCRIPTION**

	<u>Paragraph</u>
Drawing - - - - -	2
Dimensions - - - - -	3

ALL DIMENSIONS IN CALIBERS



PROJECTILE TYPE 8

3. Dimensions.

Cylindrical body: Length	1.46 cal
Ogive: Length (same as complete 5-cal-radius ogive)	2.18 cal
Radius of arc	10.00 cal
Shell: Length	3.64 cal

**SECTION III
EXTERIOR BALLISTIC DATA**

	<u>Paragraph</u>
Aerodynamic data- - - - -	4

4. Aerodynamic data.

a. **Drag function: G_8 .** The tabulated drag function was calculated from values of the drag coefficient read from a large scale curve that was obtained from the British External Ballistic Department.

