

~~SECRET~~
UNCLASSIFIED

TABLE OF CONTENTS

VOLUME II - 76-1-42 TO 105-1-314 INCL.

	BRLH No.	Paragraph Nos.
Shell, HE, 76-mm, M42A1	76-1-42	1-12
Projectile, APC, 76-mm (3-inch), M62A1	76-1-62	1- 8
Shot, AP, 76-mm (3-inch), M79	76-1-79	1- 8
Shot, HVAP, 76-mm, M93	76-1-93	1- 8
Shell, HE, 81-mm, M43 and M43A1	81-1-43	1- 7
Shell, HE, 81-mm, M56	81-1-56	1- 9
Shell, Smoke, 81-mm, M57	81-1-57	1- 8
Shot, AP, 90-mm, T33	90-1-T33	1- 8
Shell, HE, 90-mm, M58 and M58B1	90-1-58	1- 8
Shell, HE, 90-mm, M71	90-1-71	1-13
Shot, AP, 90-mm, M77	90-1-77	1- 8
Projectile, APC, 90-mm, M82	90-1-82	1- 8
Shot, HVAP, 90-mm, M304	90-1-304	1- 8
Shell, HE, 105-mm, M1	105-1-1	1-12
Shell, HE, 105-mm, T12	105-1-T12	1- 6
Shell, HEAT, 105-mm, M67	105-1-67	1- 9
Shell, Illuminating, 105-mm, M314	105-1-314	1- 8

DEM

dimensional

Accession For	
NTIS CRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By _____	
Distribution/ _____	
Availability Codes	
Dist	Avail and/or Special
A-1	



UNCLASSIFIED

UNANNOUNCED

Ballistic Research Laboratories
Handbook of Ballistic and
Engineering Data for Ammunition,
No. 76-1-42

Ballistic Research Lab.
Aberdeen Proving Ground,
Maryland.
2 February 1949

BALLISTIC AND ENGINEERING DATA

for

Shell, HE, 76-mm, M42A1

with

Fuzes, PD, M48, M48A1, M48A2 and M51A4; TSQ,
M54 and M55A3; MT, M43A5; and CP, M78

<u>Section</u>		<u>Paragraphs</u>
I	General -----	1
II	Description -----	2 - 4
III	Interior ballistic data -----	5 - 6
IV	Exterior ballistic data -----	7 - 8
V	Effect data -----	9 - 12

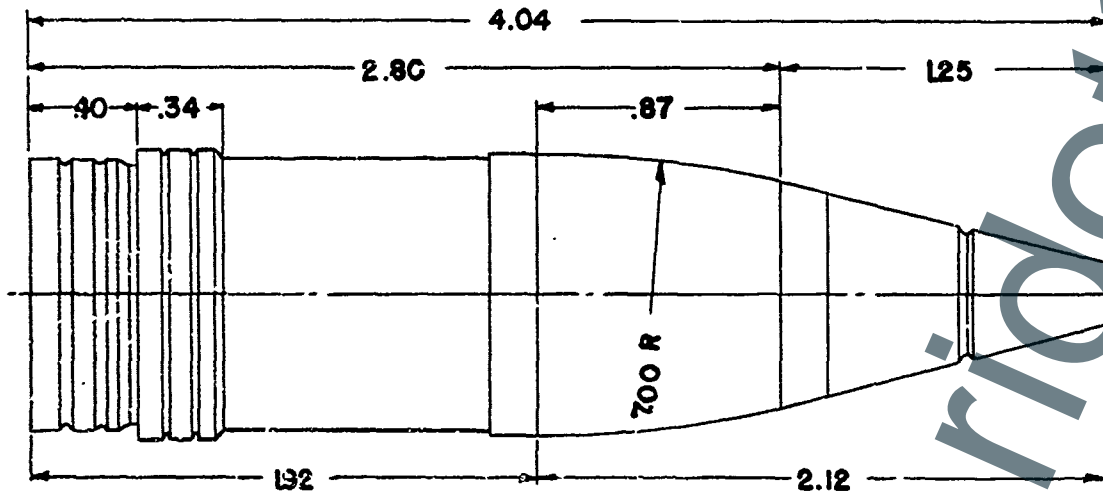
SECTION I

GENERAL

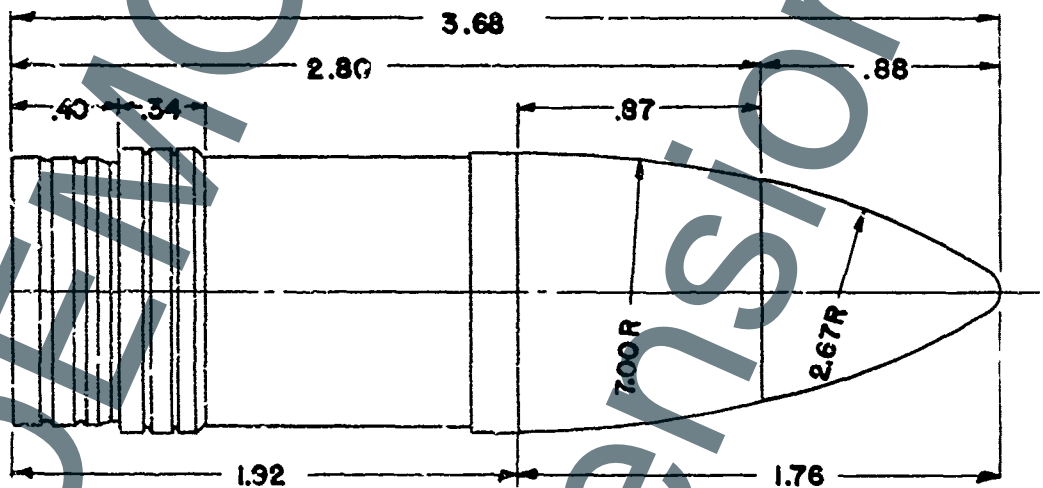
	<u>Paragraph</u>
Purpose -----	1

1. **Purpose.** The purpose of this number of the handbook is to furnish a concise collection of information regarding the shape, dynamics, ballistics and effects of the 76-mm High Explosive Shell M42A1 with the Point Detonating Fuzes M48, M48A1, M48A2 and M51A4; the Time and Superquick Fuze M54; the Mechanical Time Fuze M43A5; and the Concrete Piercing Fuze M78. This information is collected from the drawings, reports, firing tables, and technical manuals pertaining to this ammunition.

DIMENSIONS IN CALIBERS
1 CAL = 3.000"



SHELL, HE, 76-MM, M42A1
FUZE, PD, M48, M48A1, M48A2 OR M51A4;
T SQ, M54; OR MT, M43A5



SHELL, HE, 76-MM, M42A1
FUZE, CP, M78

SECTION II
DESCRIPTION

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

2. Drawings.

Shell, M42A1: Metal parts assembly and details	75-18-33
Shell, M42B1: Metal parts assembly and details	75-18-37
Shell, M42B2: Metal parts assembly and details	75-18-38
Booster, M20A1: Assembly and details	73-2-112
Booster, M21A4: Assembly	73-2-154
Fuze, PD, M48, M48A1 and M48A2: Assembly	73-2-140
Fuze, PD, M51A4: Assembly	73-2-145
Fuze, TSQ, M54: Assembly	73-3-154
Fuze, MT, M43A5: Assembly and details	73-7-29
Fuze, CP, M78: Assembly and details	73-2-214

Note: The MT, PD, and TSQ Fuzes require one of the boosters; but the CP Fuze contains their working parts. The TSQ Fuze M54 and the Booster M21A4 are components of the TSQ Fuze M55A3, dwg 73-3-155.

3. Dimensions.

Band: Width	0.34 cal
Distance from base	0.40 cal
Cylindrical body: Length	1.92 cal
Ogive: Length	0.87 cal
Radius of arc	7.00 cal
Shell, unfuzed: Length	2.80 cal
Fuze, PD, TSQ or MT:	
Outside length	1.25 cal
Shell and fuze	4.04 cal
Ogive and fuze	2.12 cal
Fuze, CP: Outside length	0.88 cal
Radius of ogival arc	2.67 cal
Shell and fuze	3.68 cal
Ogive and fuze	1.76 cal

4. **Physical characteristics.** The weight, location of center of gravity, and moments of inertia of the HE Shell M42A1 with any of the PD, TSCQ or MT Fuzes are approximately the same as those of the HE Shell M42 with the MT Fuze M43A2. The physical characteristics of the HE Shell M42A1 with the CP Fuze is approximately the same as those of the HE Shell M42B2 with the inert Fuze T105 Type 6.

Shell Fuze		M42 M43A2	M42B2 T105 Type 6	
Mean weight:	Marking (Standard)	lb	12.80	13.14
	Marking	lb	13.00	13.34
	Marking	lb	13.20	13.54
Base to center of gravity	cal	2	1.540	1.546
Axial moment of inertia	lb.ft ²		0.1105	0.1096
Transverse moment of inertia	lb.ft ²		0.8092	0.8106

SECTION III
INTERIOR BALLISTIC DATA

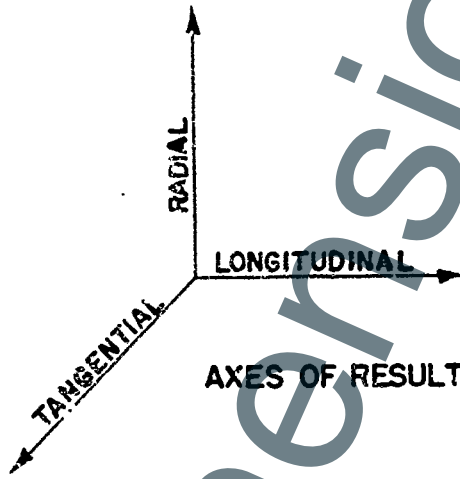
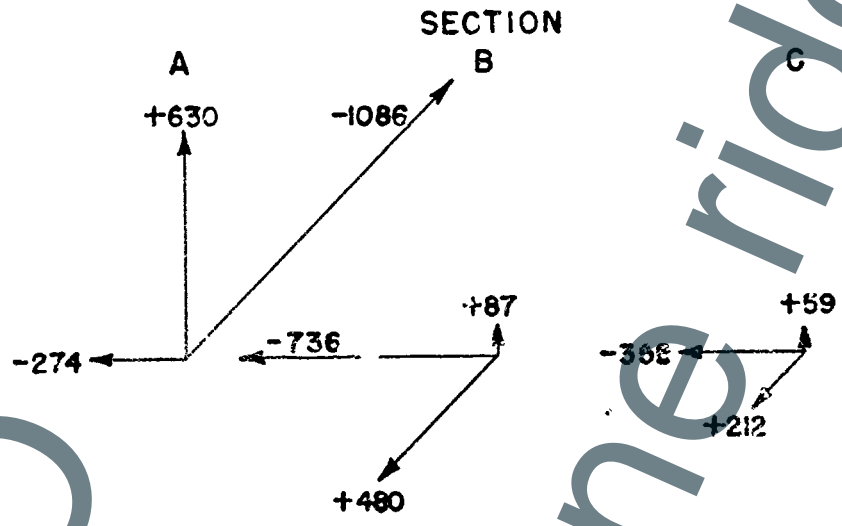
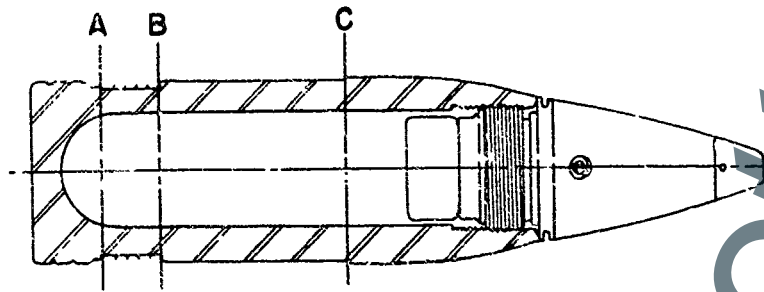
	Paragraph
Stresses - - - - -	5
Theoretical yaw in bore - - - - -	6

5. **Stresses.** The following table and the graphical representation on page 5 show the longitudinal, radial and tangential resultant stresses at each of three sections: (A) the rear corner of the band seat, (B) the front of the band seat, and (C) immediately behind the bourrelet.

Gun	76-mm M1A2
Twist of rifling	1/32
Cross-sectional area of bore	7.2776 sq in.
Rated maximum pressure	43,000 psi
Total weight of projectile	12.80 lb
Muzzle Velocity	2,700 fps
Density of filler (TNT)	0.057 lb per cu in.

Resultant Stress*	Section		
	A	B	C
100 psi			
Longitudinal	- 274	-736	-355
Radial	+ 630	+ 87	+ 59
Tangential	-1086	+480	+212

* + denotes tension, - denotes compression



AXES OF RESULTANT STRESS

DIAGRAM OF RESULTANT STRESSES

DEMO

dimensione ridotta

6. Theoretical yaw in bore.

Minimum	7 min
Maximum	12 min

**SECTION IV
EXTERIOR BALLISTIC DATA**

Aerodynamic data - - - - -	Paragraph 7
Firing table data - - - - -	8

7. Aerodynamic data. The aerodynamic data obtained with any of the PD, TSQ and MT Fuzes are applicable to all of them. The aerodynamic data obtained with the inert Fuze T105 Type 6 are applicable to the CP Fuze M78. The form factor given in this paragraph for the PD Fuze M48 was determined from resistance and range firings of the HE Shell M42 with the PD Fuze M48 and the MT Fuze M43A2. BRL Report No. 30, "Stability Factors of Projectiles" (Rev. Sep 1940) gives the stability factors and moment coefficients that were determined for the HE Shell M42 with the MT Fuze M43. BRL Report No. 298, "Stability and Resistance of 3-inch HE Shell M42A1 with PD Fuze T105 Type 6", gives the form factor and stability factor that were obtained in developing the CP Fuze. BRL Report No. 403, "Loss of Spin and Skin Friction Drag of Projectiles", gives the axial couple coefficient obtained from firings of the HE Shell M42 with a radio spin sonde in a dummy fuze having the same shape as the MT Fuze M43A2.

a. Drag.

Shell	M42	M42A1
Fuze	M48	T105 Type 6
Drag function	G_3	G_6
Muzzle Velocity	3,700	2,680
Form factor	1.04	1.37
Ballistic coefficient	1.368	1.068
Drag coefficient, K_D	0.123	0.163

b. Stability.

Shell	M42	M42A1
Fuze	M43	T105 Type 6
Muzzle Velocity	2800	2600
Mach number	2.50	2.39
Moment coefficient, K_M	0.991	0.794
Twist of rifling	1/32 1/40	1/32 1/40
Stability factor	2.03 1.30	2.45 1.57

c. Axial couple.

Shell	M42
Fuze	Radio sonde
Average velocity	1800 fps
Reynolds' number (based on avg vel. and caliber)	2.75×10^6
Axial couple coefficient, K_A	0.00585
Surface (without base)	96.5 sq in
Skin friction drag coefficient, C_{DF}	0.00218

8. Firing table data. FT 76-C-1

FT 76-A-6 (Range-elevation tables and Aiming Data charts).

Gun, 76-mm, M1A2 on Medium Tank M4 or Gun Motor Carriage M18.

Twist of rifling: 1/32.

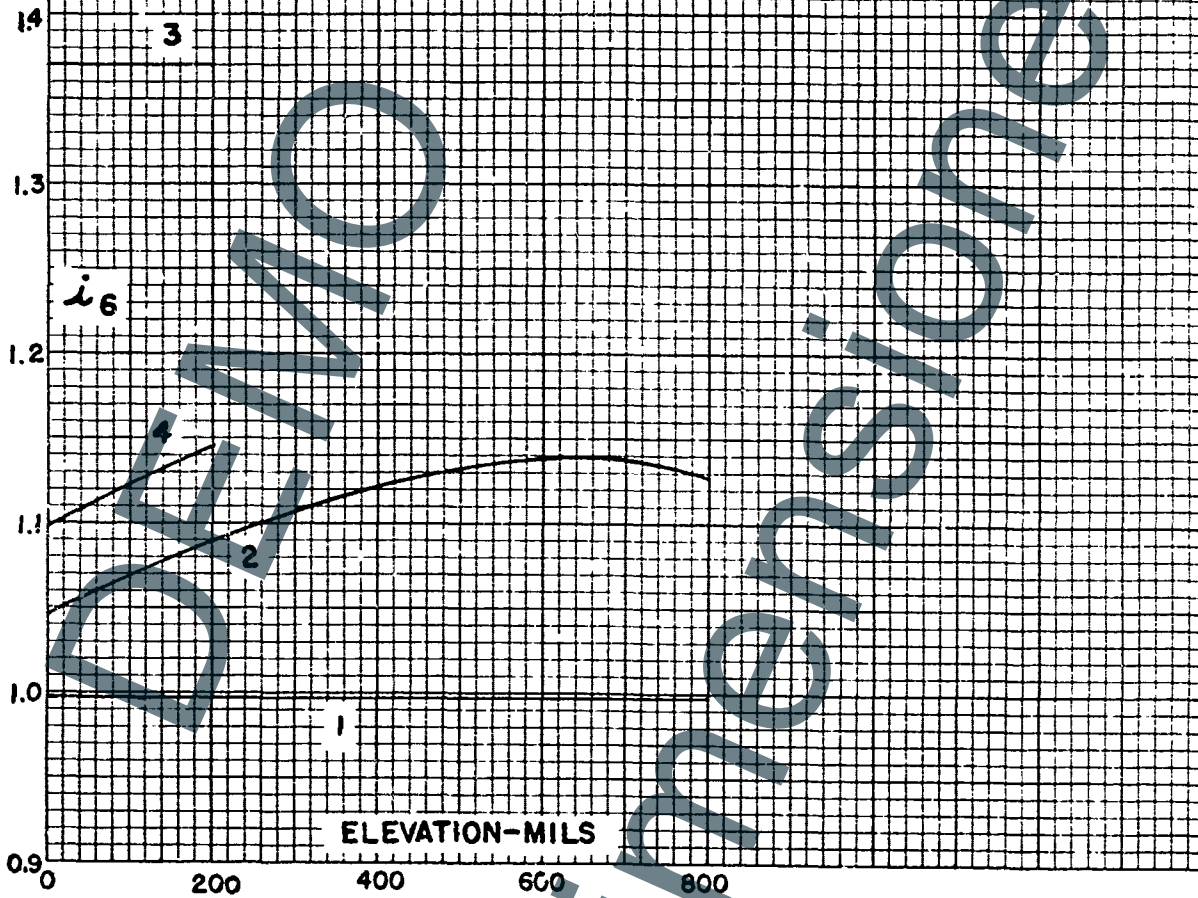
OCM item 18656 standardized the HE Shell M42A1 for the 76-mm Gun M1. OCM item 25455 authorized the use of a reduced charge to give a muzzle velocity of approximately 1550 fps; the normal charge gives about 2700 fps. The 76-mm Guns M1 and M1A1, whose twist of rifling is 1/40, are now obsolete. FT 3-W-1 gives data for the 3-inch Gun M5, whose twist of rifling is 1/40, firing the HE Shell M42A1 at muzzle velocities of 1550 and 2800 fps.

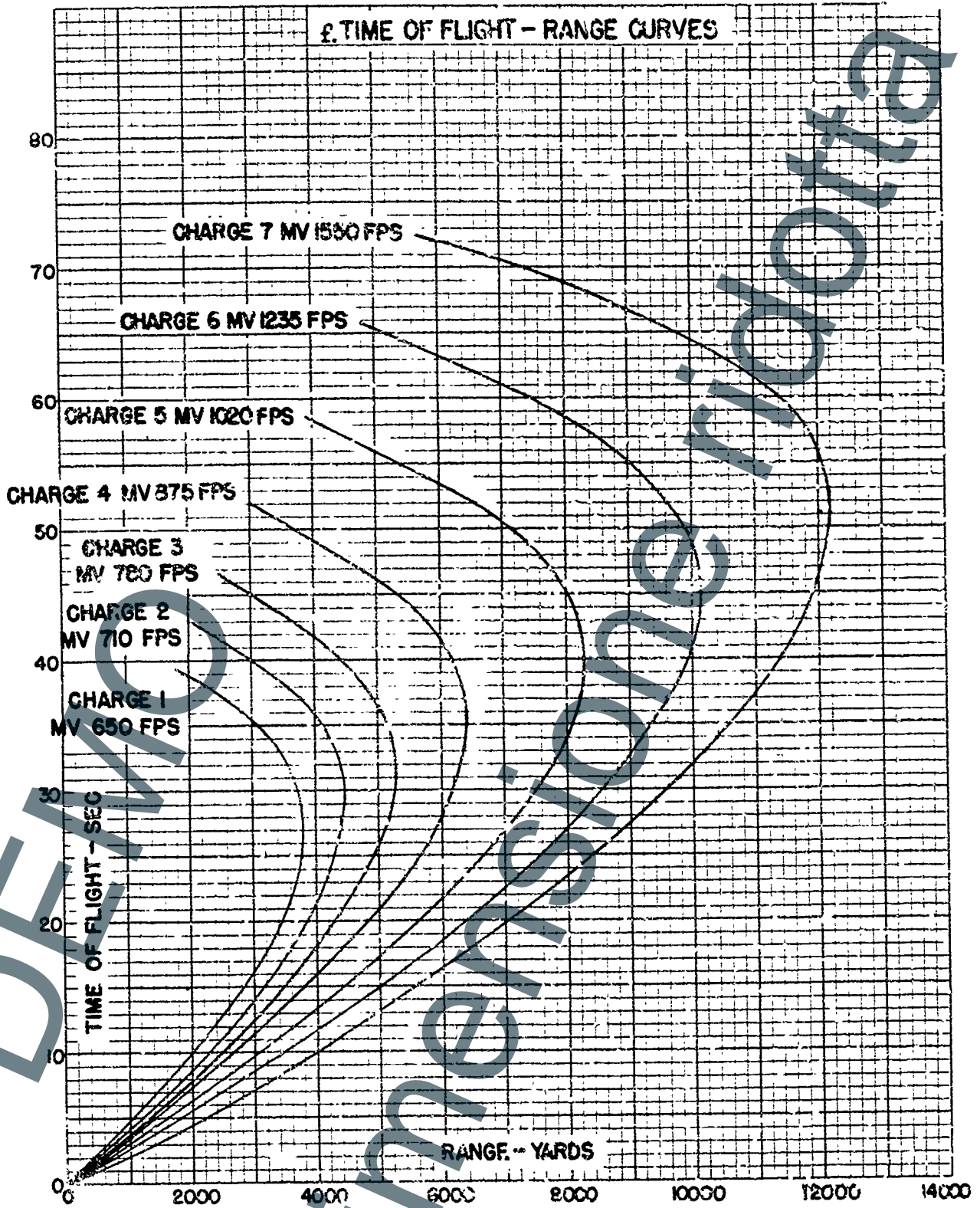
DENMO

dimensione
ridotta

aFORM - FACTOR - ELEVATION CURVES
(PROJ TYPE 6)

<u>FUZE</u>	<u>CHARGE</u>	<u>MV-FPS</u>	<u>CURVE</u>
PD OR T. SQ	NORMAL	2700	1
	REDUCED	1550	2
CP	NORMAL	2680	3
	REDUCED	1539	4





Ballistic Research Laboratories
Handbook of Ballistic and
Engineering Data for Ammunition,
No. 105-1-314

Ballistic Research Lab.
Aberdeen Proving Ground,
Maryland.
15 February 1949

BALLISTIC AND ENGINEERING DATA
for
Shell, Illuminating, 105-mm, M314
with
Fuze, TSQ, M54

<u>Section</u>	<u>Paragraphs</u>
I General -----	1
II Description -----	2 - 4
III Interior ballistic data -----	5
IV Exterior ballistic data -----	6 - 7
V Effect data -----	8

**SECTION I
GENERAL**

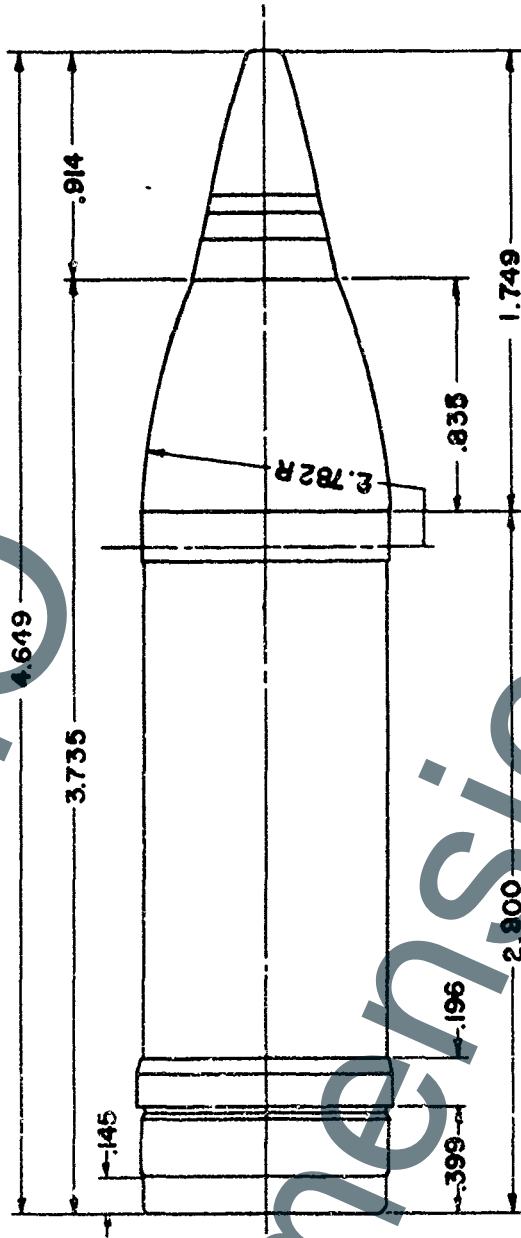
	<u>Paragraphs</u>
Purpose -----	1

1. Purpose. The purpose of this number of the handbook is to furnish a concise collection of information regarding the shape, dynamics, ballistics and effects of the 105-mm Illuminating Shell M314 with the Time and Superquick Fuze M54. This information is collected from the drawings, reports, firing tables and firing records pertaining to this ammunition.

**SECTION II
DESCRIPTION**

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

ALL DIMENSIONS IN CALIBERS
CAL = 4.134"



SHELL, ILLUMINATING, 105-MM, M314
FUZE, T SQ, M54

DEMO
dimensione ridotta

2. Drawings.

Shell: Metal parts assembly	75-4-128
Details	75-4-129
Fuze: Assembly	73-3-154

3. Dimensions.

Band: Width	0.196 cal
Distance from base	0.399 cal
Body: Length of base piece	0.145 cal
Length of cylindrical part	2.900 cal
Length of ogival part	0.835 cal
Radius of ogival arc	2.782 cal
Length of shell	3.735 cal
Fuze: Length (outside)	0.914 cal
Length of shell and fuze	4.649 cal
Length of ogive and fuze	1.749 cal

4. Physical characteristics.

Weight (standard)	38.60 lb
Base to center of gravity	1.180 cal
Axial moment of inertia	0.286 lb.ft ²
Transverse moment of inertia	1.416 lb.ft ²

**SECTION II
INTERIOR BALLISTIC DATA**

Theoretical yaw in bore - - - - - Paragraph
5

5. Theoretical yaw in bore.

Minimum	8 min
Maximum	15 min

SECTION IV
EXTERIOR BALLISTIC DATA

	<u>Paragraph</u>
Aerodynamic data - - - - -	6
Firing table data - - - - -	7

6. Aerodynamic data.

a. Drag. The following drag coefficients were computed from the ballistic coefficients tabulated in paragraph 6, which were determined by range firings.

<u>Velocity</u> <u>fps</u>	<u>K_D</u>
620	.0881
674	.0881
738	.0885
825	.0899
958	.0950
1158	.1829
1453	.1892

b. Stability.

Muzzle Velocity	1228 fps
Moment coefficient, K_M	1.37
Twist of rifling	1/20
Stability factor	3.60

7. Firing table data. FT 105-H-3 (C-11)

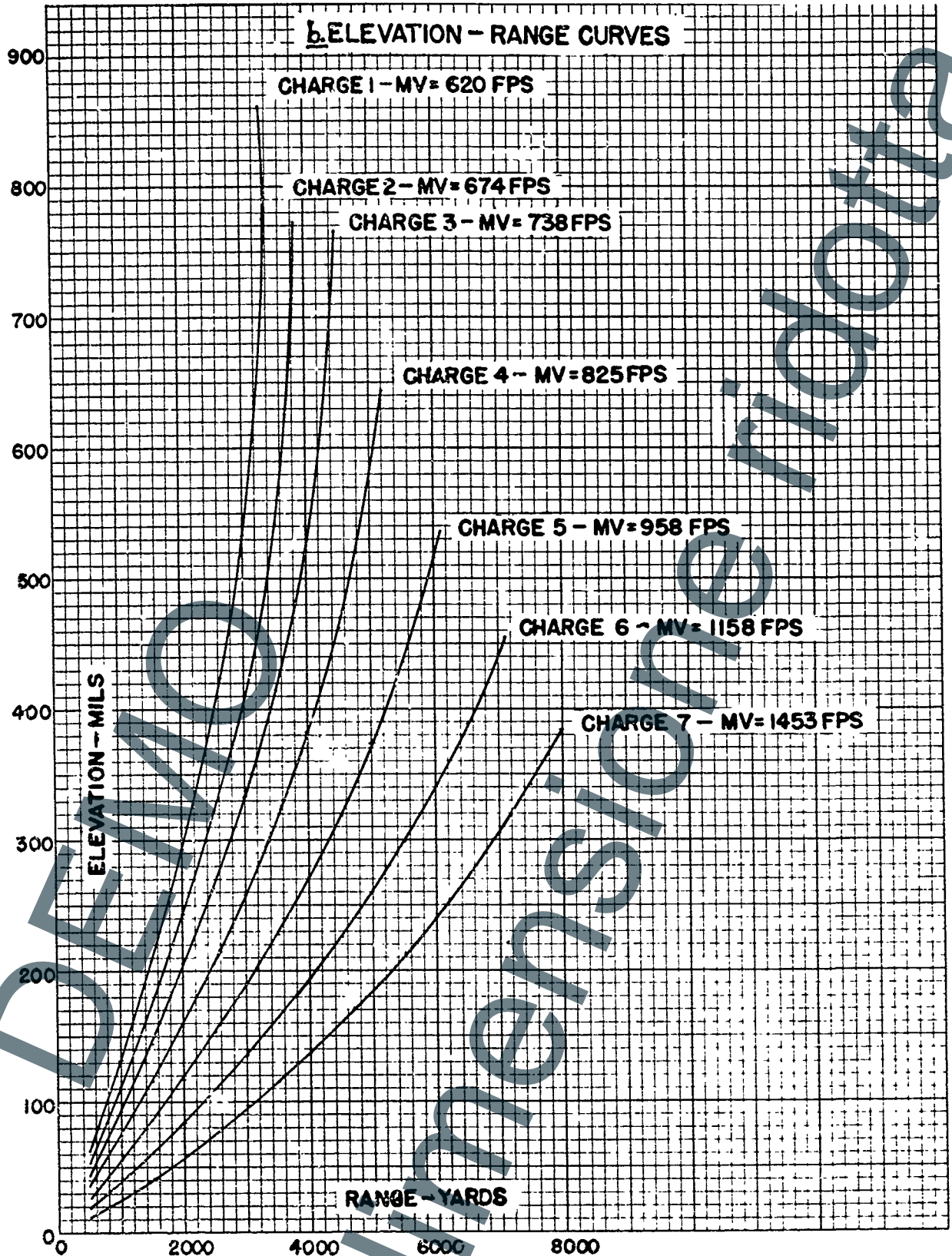
105-mm Howitzer M2A1 and M4. Twist of rifling: 1/20.

OCM items 28809 and 29657 recommended and approved standardization of the Illuminating Shell M314.

a. Form Factor and Ballistic Coefficient.

The following form factors and ballistic coefficients on the drag function $G_{6.1}$ were determined by range firings and are independent of elevation.

<u>Charge</u> <u>No.</u>	<u>MV</u> <u>fps</u>	<u>Form</u> <u>Factor</u>	<u>Ballistic</u> <u>Coefficient</u>
1	620	1.050	2.007
2	674	1.055	1.996
3	738	1.063	1.981
4	825	1.075	1.959
5	958	1.101	1.914
6	1158	1.135	1.856
7	1453	1.097	1.920



SECTION V
EFFECT DATA

Illumination - - - - - Paragraph
8

8. **Illumination.** When the fuze functions, the candle and parachute are released. A few seconds later, the parachute opens and slowly lowers the candle to the ground. In the functioning tests of this ammunition, the candles burned from 38 to 57 seconds.

DEMO

dimensione ridotta