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# BRL

MEMORANDUM REPORT No. 564

## Table Of Form Factors Of Projectiles

H. P. HITCHCOCK

ORDNANCE RESEARCH AND DEVELOPMENT PROJECT No. TB3-0430AD

BALLISTIC RESEARCH LABORATORIES



ABERDEEN PROVING GROUND, MARYLAND

BALLISTIC RESEARCH LABORATORIES

MEMORANDUM REPORT NO. 564

October 1951

TABLE OF FORM FACTORS OF PROJECTILES

H. P. Hitchcock

Project No. TB3-0430AD of the Research  
and Development Division, Ordnance Corps

ABERDEEN PROVING GROUND, MARYLAND

BRL MR 564

Tables of Form Factors of Projectiles

Supplement 1 June 1952

Gun	Projectile	Fuze	Weight lb	Velocity fps	Ball. Coef.	Form Factor	Proj. Type	
75mm How M3 76mm Gun M1A2 90mm Gun M3	HEP T150E11	ED M91	8.76	1760	1.04	0.97	1	
	HEP T170E3	ED M91	9.93	2506	1.15	0.96	1	
	HEP T142E3	ED M91	15.8	2426	1.16	1.08	1	
	HEP T142E5	ED M91	17.2	2434	1.40	0.98	1	
	AP T33E5	Tracer	23.7	3178	1.59	1.19	6	
	AP T33E7	Tracer	24.1	3050	1.61	1.19e	6	
	HEAT T108E15	PI T209	14.5	2324	1.85	0.625	1	
	HEAT T108E45	PI T209	14.5	2689	1.96	0.59	1	
	90mm Gun T119	HEP T142E3	ED M91	15.9	2582	1.34	0.94	
		HEAT T108E15	PI T209	14.5	3173	1.78	1.65	
HVAP T137			9.9	4103	3.52	0.50a	1	
105mm Rifle M27	HE T268	PD M503	16.9	1700	2.55	1.60e	2	
	WP T269	PD M503	16.9	1700	2.55	1.60e	2	
	HEAT T184E3	ED M91	16.8	1688	1.29	0.76	1	
	HEAT T138E57A	ED M91	17.4	1646	0.54	1.90	8	
	HEAT T171 MD11	ED M91	17.5	1675	0.81	1.26	1	
105mm How M4	HEP T81E28	ED M91	23.5	2066	1.42	0.97	1	
	AP T147E1 b		50.0	5518	2.08	1.09	8	
120mm Gun T123	AP T147E1 c		49.6	3307	1.69	1.33	8	
	HE T45E3	PD M51A4	95	2800	2.507	1.02	2	
155mm Gun M2E1	HE T45E4, E5	PD M51A4	95	2800	2.60	0.98	2	

a Diameter of Shot in Flight 2.36 in. (60mm)

b Windshield welded to shot

c Windshield welded to adaptor

e Estimated.

BALLISTIC RESEARCH LABORATORIES

MEMORANDUM REPORT NO. 564

HPHitchcock/lbe  
Aberdeen Proving Ground, Md.  
25 October 1951

TABLE OF FORM FACTORS OF PROJECTILES

ABSTRACT

This is a revision of Table VII, Ballistic Research Laboratories Report No. 284, "Form Factors of Projectiles" (1942), and supplements thereof. The values in the present revision supersede those in the earlier editions with which they conflict. Some form factors with respect to specific projectiles are tabulated: in order to obtain the form factor with respect to a typical projectile, multiply these by the form factor of the specific projectile which is plotted as a function of velocity. Graphs of the form factors of beveled slugs and a sphere are also included.

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Form Factors of Projectiles

Gun	Projectile	Weight gr.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type	
.30" (7.62mm) BMG. M1917A1 BMG M1919A4 BMG M1919A5 BMG M2 BAR M1918A2 USR M1903 USR M1903A1 USR M1917 USR M1	Ball M1906	150	2700	.400	.60	1	
	Ball M2 (Std. & Alt.)	150	2740a	.21	1.13	6	
	AP M2	164	2730b	.283	.92	5	
	Tracer M1 (Std.)	150	2700a	.355	.67	5	
	Tracer M1 (Alt.)	142	2700a	.301	.75	5	
	Tracer M25 (Night)	150	2650	.294	.81	5	
	Incendiary M1	137	2950a	.181	1.20	6	
	Frangible M22 (T44)	108.5	1360	.155	1.11	M22	
	Sub-caliber Rifle M1903A2, Sub-caliber BMG M1917A1	Sub-caliber M1925	172	2025	.317	.86	5
	Carbine M2, Carbine M3	Carbine, Ball M1 (gilding metal jacket)	110	1860a	.179	.975	1
(g.m. clad steel jacket)		107	1860a	.174	.975	1	
Carbine, AP		84		.137	.975e	1	
Carbine, Tracer, M27		110	1800b	.179	.975e	1	
.45" (11.4mm) Thompson Sub-machine Gun M1928A1, Gun M1, M1A1 Pistol M1911 Pistol M1911A1 Revolver M1917 Sub-machine Gun M3	Ball M1911	230	800c	.112	1.45*	1	
	Tracer M26	210	850c	.102	1.45e	1	

a Standard instrumental velocity at 78 ft.

b Standard instrumental velocity at 53 ft.

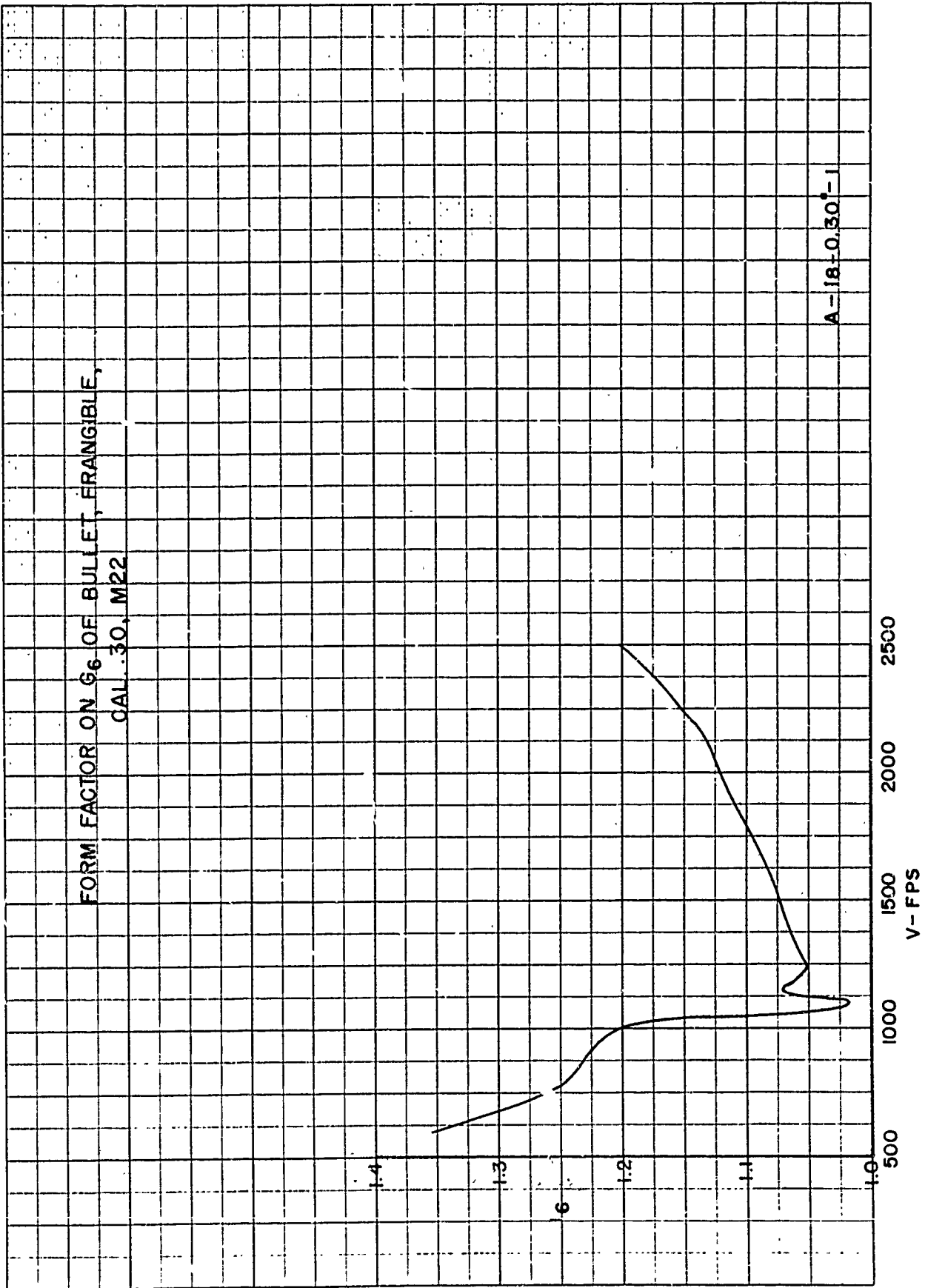
c Standard instrumental velocity at 25 ft.

e Estimated

\* Determined by resistance firings.



FORM FACTOR ON G<sub>6</sub> OF BULLET, FRANGIBLE,  
CAL. 30, M22



A-18-0.30-1

Form Factors of Projectiles

Gun	Projectile	Weight gr.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type
.50" (12.7mm) BMG M2 BMG M2A1 BMG M3	Ball M1923	802	2525	.612	.75	5
	Ball M1	750	2800d	.542	.79	5
	Ball M2 (Std.)	703	2900f	.461	.87	5
	Ball M2 (Alt.)	698	2900f	.458	.87	5
	Ball M33	650	2910h	.359	1.03e	API M8
	AP M1	750	2800d	.542	.79	5
	AP M2 (Std.)	710	2900f	.4715	.86	5
	AP M2 (Alt.)	698	2900f	.458	.87	5
	API M8	650	2910h	.359	1.03	API M8
	API T49	501	3460	.223	1.29	7
	APIIT M20	614	2900	.437	.80	5
	Tracer M1 (Std.)	674	2800d	.467	.825	5
	Tracer M1 (Alt.)	635	2800d	.446	.81	5
	Tracer M10	640	2860h	.450	.81	5
	Headlight Tracer M21	696	2762j	.574	.69	5
	Incendiary M1	625	2950h	.387	.92	6
	Incendiary M23	512	3400j	.232	1.26	7
.60" (15.2mm) Gun	Ball T32	1200	3550	.382	1.25	7
	Ball T32E2	1140	3600	.368	1.23	7
	Ball T77	1140	3550	.356	1.265	8
	AP BC-3	1180	3584	.373	1.255	7
	Tracer BC-3	1100	3579	.361	1.21	7
	API T39	1140	3550	.360	1.25	8
	APIIT T60	1050	3570	.358	1.16	7
	Incendiary T31	1200	3590	.404	1.18	7
	Incendiary T36	1140	3550	.351	1.29	7
	Incendiary T36E2	1140	3550	.354	1.28	8
	APIIT T76	1050	3570	.366	1.14	8

d Standard muzzle velocity with 45" barrel

e Estimated

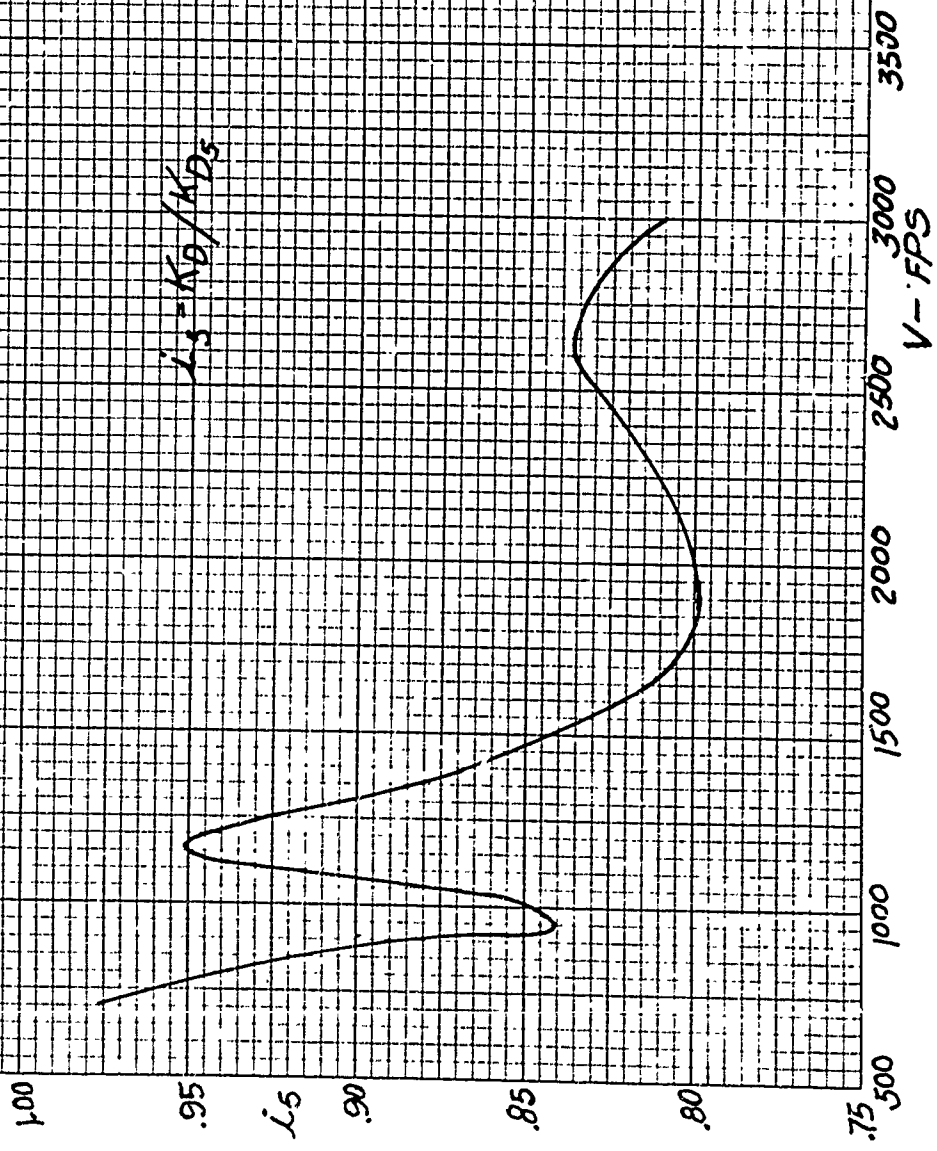
f Standard instrumental velocity at 78 ft.: 2900 fps with 45" barrel

g Standard instrumental velocity at 78 ft.: 2810 fps with 36" barrel

h Standard instrumental velocity at 78 ft. with 36" barrel

j Standard instrumental velocity at 78 ft.

FORM FACTOR ON  $G_s$  OF BULLET, API, CAL 0.50, MB

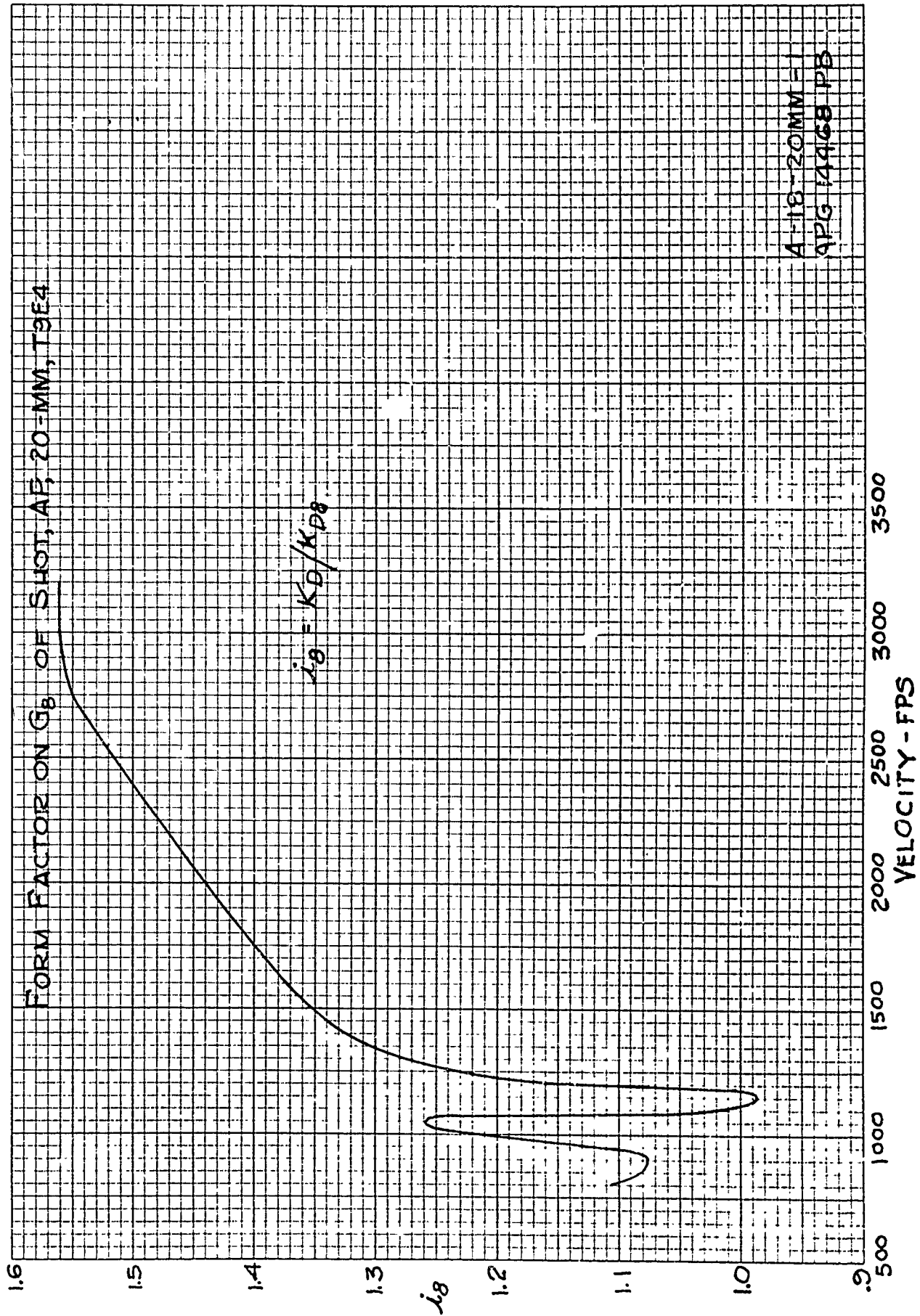


A = 18 - 50 = 1  
APG 14469 PD

Form Factors of Projectiles

Gun	Projectile	Fuze	Weight gr.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type
20mm (.787") Aircraft Automatic Gun AN-M2	Ball Projectile		2000	2850	.472	.98*	1
	Ball Projectile T4		2542	2530	.612	.96	1
	AP Shot M75		2548	2550	.298	1.98	6
	AP Shot T9E4		2000	{ 890 to } 3070	.462	1.00*	AP T9E4
	AP Shot M95		2000	3000	.413	1.12	5
	AP Shot M95		2000	3000	.401	1.15	5
	API Shot T21		1980	2700	.384	1.19	5
	API Shot T21E1		2000	2700	.488	0.945	AP T9E4
	API Shot T69		1600	3110	.427	0.87	AP T9E4
	HE Shell (Dwg. TAN292)		1565	3500	.272	1.33e	7
AA MG Mark IV	HEI Shell Mk I		2030	2800	.459	1.02	1
	HEI Shell T16		1900	2800	.403	1.09	5
	HEI Shell M97		2039	2800	.520	0.90	AP T9E4
	HEI Shell T39		1500	3270	.269	1.24	8
	HEI Shell T9E2		1700	3045	.320	1.22	8
	HEI Shell T68		1600	3080	.4155	0.82	AP T9E4
	Inc. Shell M96		1920	2800	.383	1.16	5
	Inc. Shell T28		1500	{ 2700 } { 3200 }	.270	1.28	8
	Inc. Shell T35		1200	{ 2620 } { 3650 }	.220	1.26	8
	Practice Proj. M99		2000	2800	.506	0.91	AP T9E4
Gun T118 (Navy)	Practice Proj. T61E1		1600	3135	.307	1.20	8
	API Shot T90E1 (T133)		1700	3300	.339	1.16	8
	HE Shell T124 (T215)	{ Dummy } { T201E1 }	1615	2936	.284	1.31	8
	Practice Proj. T114 (T130)		1700	3340	.306	1.28	8

\* Determined by resistance firings  
e Estimated



Form Factors of Projectiles

Gun	Projectile	Fuze	Weight lb.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type
37mm (1.457") Gun M1916 and sub-caliber Guns and Tubes	HE Shell Mark 2	BD M38	1.25	1259b 1530 1926	.66 .64 .65	.89* .92* .91*	1 1 1
	Practice Shell M94 Practice Shell M92	Base plug PD M74	1.05 1.25	1276b	.56 .48	.89e 1.22e	1 1
	HE Shell M54	PD M56	1.34	1300 to 2550b	.631	1.00*	HE M54
Automatic (antiaircraft) Gun M1A2	Plug 75-14-309A	Plug 75-14-309A	1.34	1900 to 2600		a e	1
	Practice Shell M55A1	Dummy M5C Plug 75-14-309A	1.34 1.34	1900 to 2600	.631	1.00e a *	HE M54 1
Tank Gun M6	HE Shell M63	BD M58	1.61	2600b	.87	.87	6
	AP Shot M80	Tracer	1.66	1230 to 2780b	.78	1.00*	AP M80
Gun M1916 M1A2 M6	APC Suct M59	Tracer	1.91	1380 to 3070b	.900	1.00*	APC M59
	APC Shot M51B1 & B2	Tracer	1.92	2900b	.984	.92	6
	TP Shot M51A2	Tfacer	1.92	2900b	.984	.92	6
	TP Shot M51A1	Tracer	1.92	2900b	.476	1.90e	1

a  $i = 0.722 + 0.00056 v$  (fps)

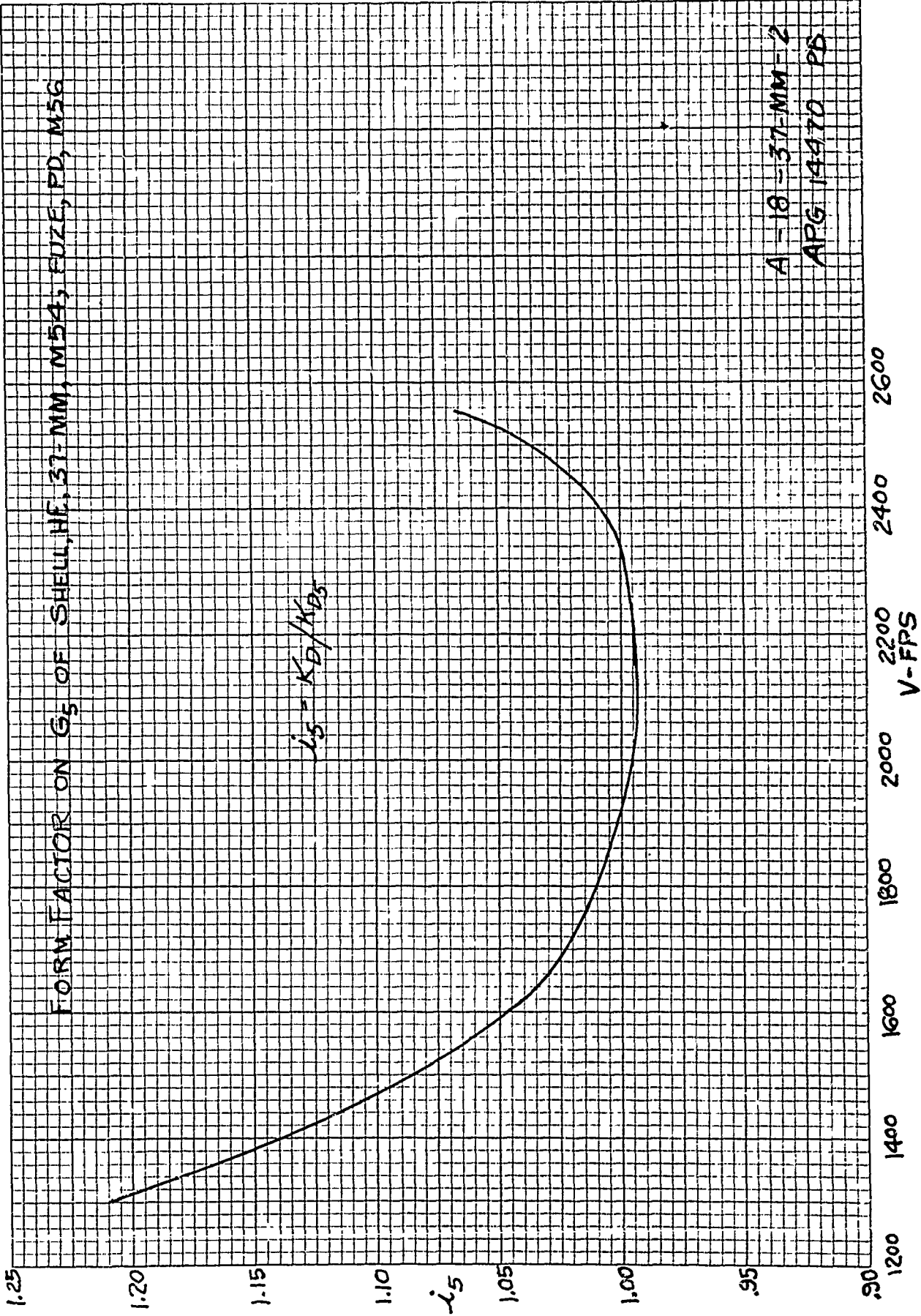
b Standard muzzle Velocities:

e Estimated

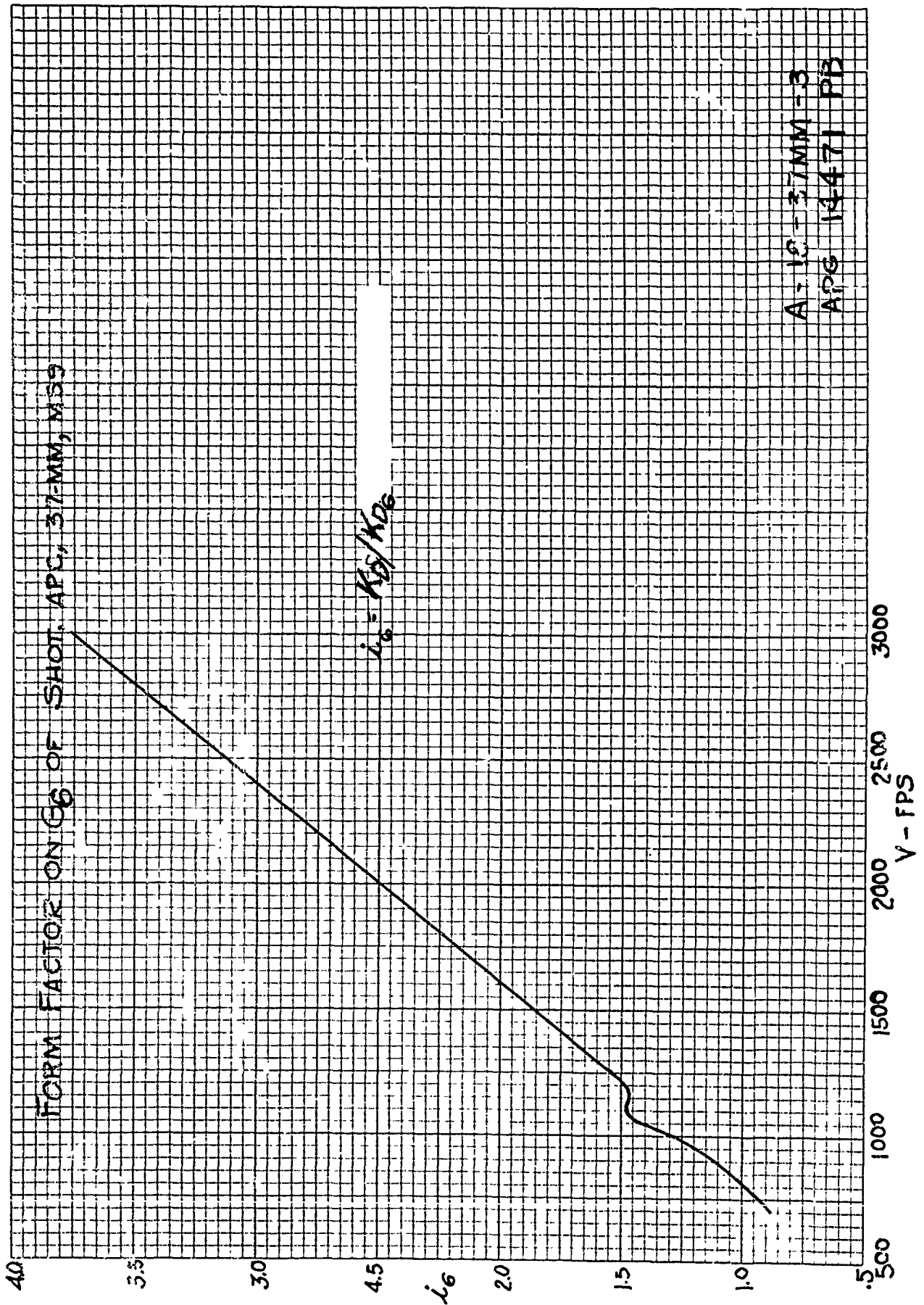
\* Determined by resistance firings

Gun	Projectile	M63	M59	M51
M1916 M1A2 M6	Mk 2 M54 M 92 M55A1			
	1276	2600	2050	2900

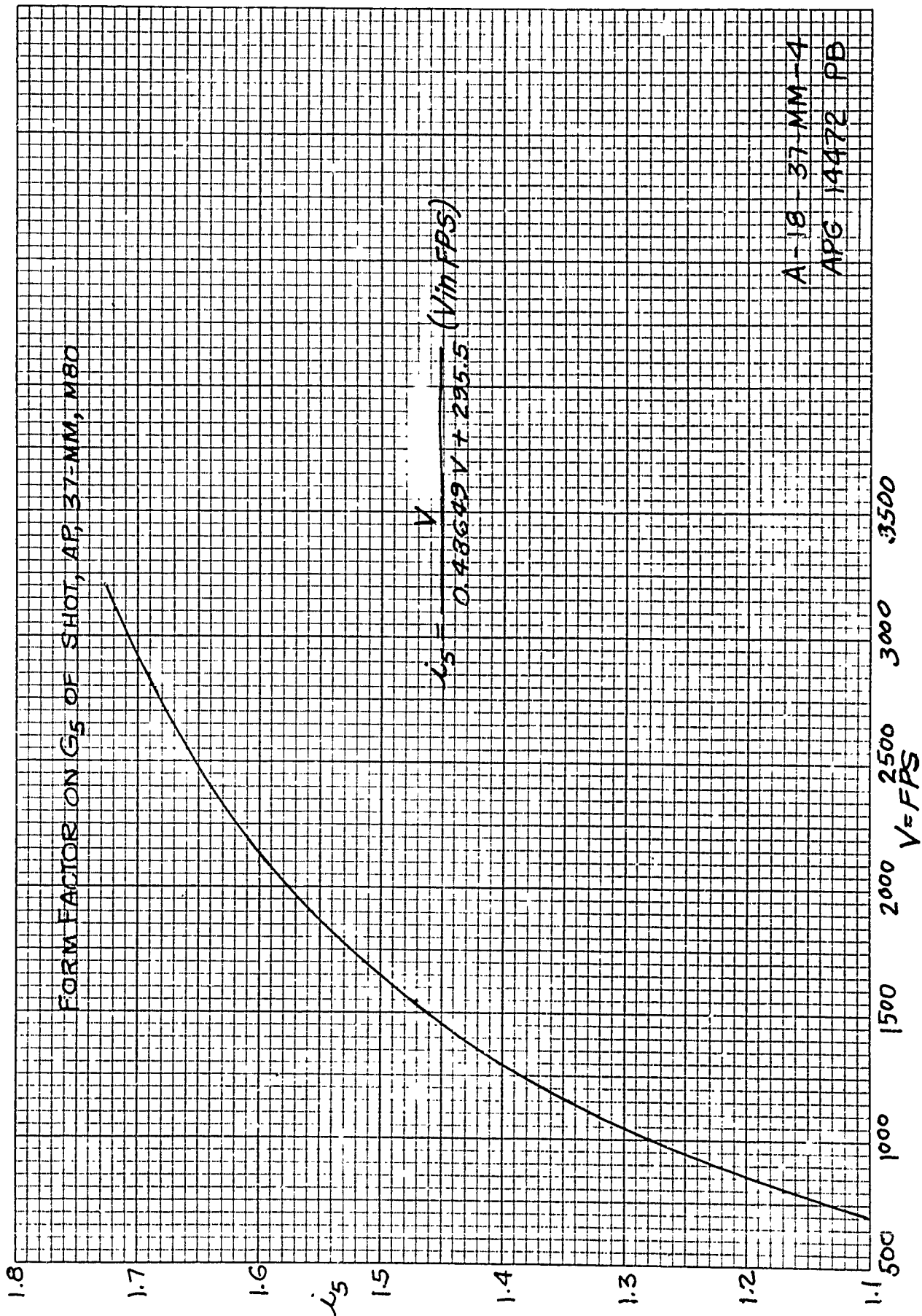
FORM FACTOR ON  $G_5$  OF SHELL, HE. 37-MM, M54, FUZE, PD, M56



A-18-37-MM-2  
APG 14470 PD







A-18 37-MM-4  
APG 14472 PB

Form Factors of Projectiles

Gun	Projectile	Fuze	Weight lb.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type
40mm (1.575") Automatic (Antiaircraft) Gun M1	AF Shot M81	Tracer	1.96	2870	.615	1.285	6
	Same w/o cap or windshield					1.10e	1
	APC Shot T4E10	Tracer	1.975	2709	.664	1.20*	6
	HE Shell Mk 2	FD M64A1	1.954	2867	.828	.952	5
		Det. Mk 27	1.954	2896	.850	.927	5
	Same w/o Tracer	Dummy Mk 27		1120 to 2800		1.00*	HE Mk2
	HE Shell T7	Det. Mk 27	1.96	2870	.670	1.18	5
	Practice Shell M91	Dummy T34	1.96	2870	.739	1.07*	5
		Plug 75-14-309B	1.96	2870	.395	2.0e	1
	57mm (2.244") Rifle M18	HE Shell M306A1	FD M89, M503	2.75	1200	.608	.90
WP Smoke Shell M308A1		FD M89, M503	2.75	1200	.608	.90	1
HEAT Shell M307		PI M90	2.75	1200	.52	1.05	1
Test Projectile T36			3.50		.56	1.24e	2

e Estimated

\* Determined by resistance firings

Form Factors of Projectiles

Gun	Projectile	Fuze	Weight lb.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type	
60mm (2.362") Mortars M2 and M19	HE Shell M49A2 Practice Shell M50A2	PD M52	2.96	189	.850	.62	1	
				292	.730	.73	1	
				377	.680	.78	1	
				449	.658	.81	1	
				518	.650	.82	1	
			Hex plug	2.96		.265	2.00e	1
		WP Smoke Shell M302	PD M82	3.98	156	.788	.905	1
				244	.788	.905	1	
				316	.788	.905	1	
				360	.788	.905	1	
				439	.788	.905	1	
		Illuminating Shell M83A1	Time M65	3.70	315	.343	2.01	1
				377	.327	2.11	1	
				430	.326	2.12	1	
		Training Shell M69		4.40	152.5	.39	2.00e	1
	Proof Proj. T1		2.51		.187	2.40e	1	

e Estimated

Form Factors of Projectiles

Gun.	Projectile	Fuze	Weight lb.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type
75mm (2.953") Tank Guns M3, M6 and M17	AP Shot. M72	Tracer	13.94	2030	1.13	1.41*	5
	AP Shot TL48		13.36	2120	1.40	1.09	2
	APC Proj. M61A1	BD M66A1	14.90	2030	1.735	.985*	6
	HVAP Shot TL5	Tracer	8.31	2940	.87	1.10*	6
	HE Shell Mk 1	PD M46	12.24	1135	1.69	.83	1
				1814	1.53	.92	1
			{ PD M48A2, A3 PD M51A1, A5 PD M81, M81A1 TSQ M54, M55A3 M500, M501 CP M78, M78A1 }	{ 960 1520 1980 }	{ 1.630 1.705 1.612 }	{ 1.03 .99 1.05 }	{ 2 2 2 }
	HE Shell M48		14.70				
				1855	1.28	1.39*	2
	WP Smoke Shell. M64	PD M57		15.25		Same as HE Shell M48.	
	SE HC Smoke Shell M89			6.61	850	.323	2.35
	HEAT Shell. TL7E1, 2, 3	PI TL68E1				1.18e	2
	HEP Shell TL65E1	BD M62A1, M91		7.74	1773	.726	1
	HEP Shell TL65E2	BD M62A1, M91		9.07	1850	1.134	1
	HEP Shell TL65E6	BD M62A1, M91		8.1	1856	.999	1
HEP Shell TL65E10	BD M62A1, M91		8.8	1770	.691	1	
HEP Shell TL65E11	BD M62A1, M91				.92e	1	
HEP Shell TL65E12	BD M62A1, M91		8.8	1790	1.012	1	
HEP Shell TL65E14	BD M62A1, M91		10.5	1812	1.179	1	
HE Shell M48	{ TSQ M54 M500, M501 BD M66A1 Tracer }		14.70	1850	1.56	1.08	2
APC Proj. M61A1			14.90	1920	1.735	.985*	6
AP Shot M72			13.94	1930	1.13	1.41*	5

e Estimated  
\* Determined by resistance firings

Form Factors of Projectiles

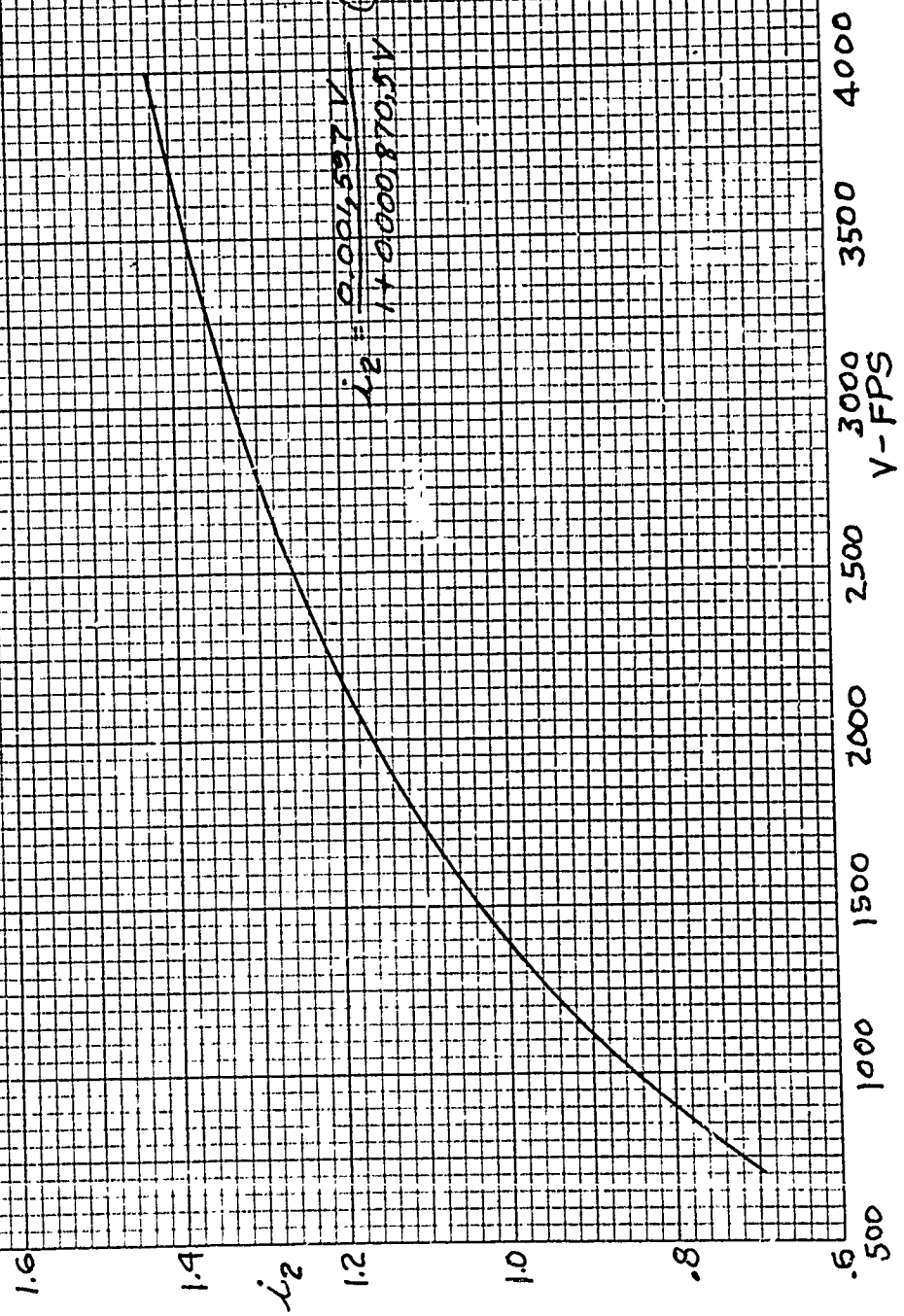
Gun	Projectile	Fuze	Weight lb.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type
75mm (2.953") AA Gun T22	HE Shell M48E2	VT T73	14.95	2300	1.715	1.00	HE M48E2
	HE Shell T50	MTSQ M502	12.15	2825	1.255	1.11	HE M48E2
Sub-caliber Guns M7, M8 M9, M12 and M25	HE Shell M48	{ PD M48A2, A3 PD M81, M81A1 TSQ M54, M55A3 MTSQ, M500, M501 }	14.70	1170	1.76	.96	2
			13.90	705 820 965 1270	1.964 1.886 1.830 1.714	.81 .85 .87 .93	2 2 2 2
Howitzer M3	HE Shell M41A1	{ PD M48A2, A3 PD M81, M81A1 }	14.70	700 810 950 1250	1.927 1.883 1.888 1.869	.875 .895 .89 .90	2 2 2 2
			{ 14.94 HS 15.25 WP 15.41 FS }				Same as HE Shell M48
Gas and Smoke Shell M64	HEAT Shell M66 HEP Shell TL50E1 HEP Shell TL50E2 HEP Shell TL50E16	Plug 75-14-309F BD M62A1, M91 BD M62A1, M91 BD M62A1, M91 BD M62A1, M91	13.17	1000	1.54	.98*	2
			7.22	1000	0.484	1.71	1
			7.6	1040	1.029	.85	1
			8.85	1013	1.273	.80	1

e Estimated  
\* Determined by resistance firings

Form Factors of Projectiles

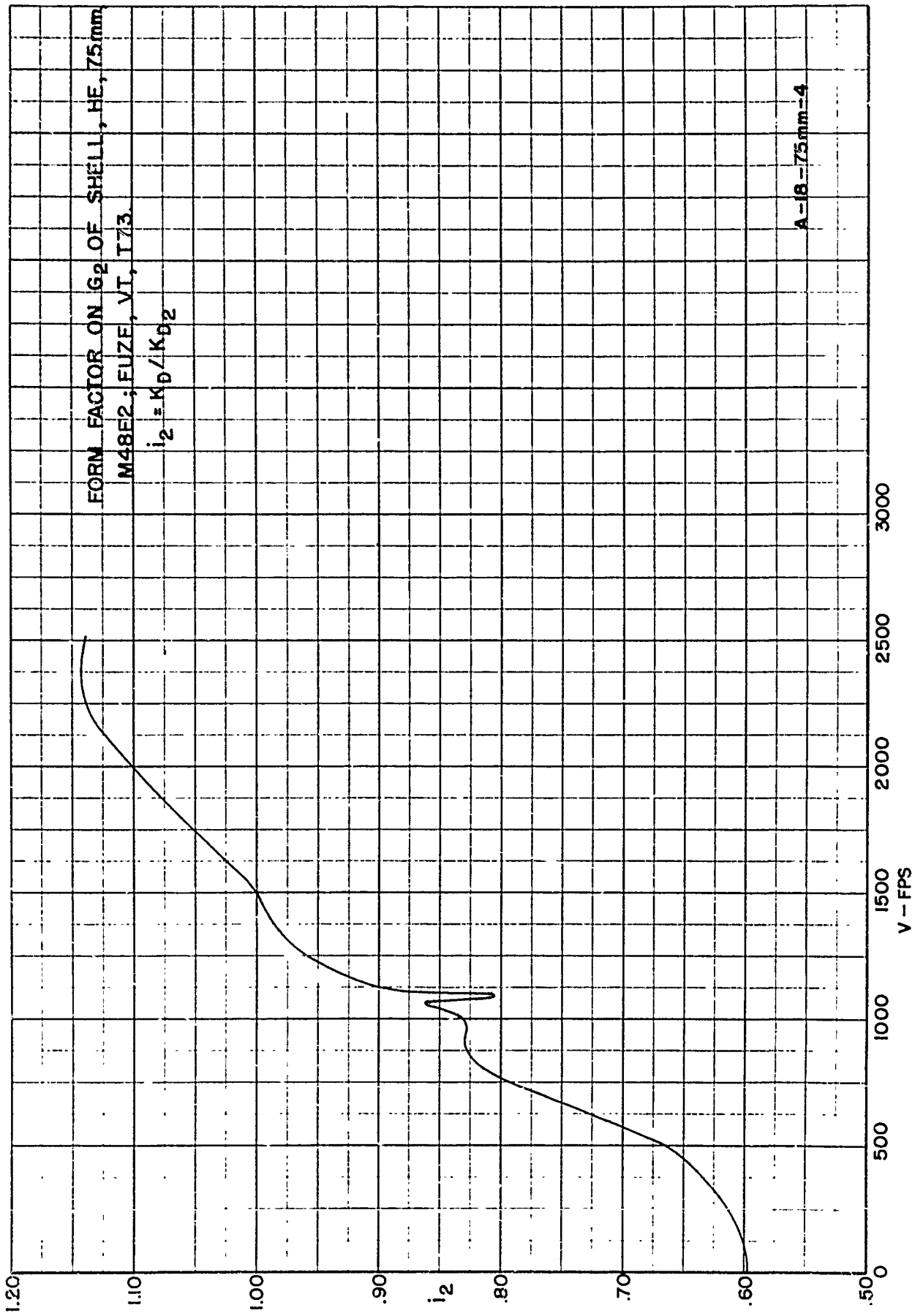
Gun	Projectile	Fuze	Weight lb.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type		
75mm (2.953") Rifle M20	HE Shell M309, M309AL	{ PD M48A2, A3 PD M81, M81AL PD M51A4, A5 MTSQ M500, M501 }	14.40	990	1.473	1.12	2		
			13.10	1000	1.781	.84	6		
			14.82	990	1.516	1.12	2		
	HEAT Shell M310, M301AL	{ PD M81A2, A3 PD M81, M81AL PD M51A4, A5 }	15.10	990	1.545	1.12	2		
			6.8	1137	.566	1.38	1		
	WT Smoke Shell M311, M311AL	{ PD M81A2, A3 PD M81, M81AL PD M51A4, A5 }	8.04	1050	1.302	.71	1		
			8.347	1058	1.308	.73	1		
			8.50	1026	1.343	.73	1		
			8.478	1390	1.092	.89	1		
			8.66	1064	1.268	.78	1		
			8.64	1064	1.300	.76	1		
			HEP Shell T151E1	ED M62AL, M91	6.8	1137	.566	1.38	1
			HEP Shell T151E4	ED M62AL, M91	8.04	1050	1.302	.71	1
			HEP Shell T151E4A	ED M62AL, M91	8.347	1058	1.308	.73	1
HEP Shell T151E11	ED M62AL, M91	8.50	1026	1.343	.73	1			
HEP Shell T151E11D	ED M62AL, M91	8.478	1390	1.092	.89	1			
HEP Shell T151E16	ED M62AL, M91	8.66	1064	1.268	.78	1			
HEP Shell T151E17	ED M62AL, M91	8.64	1064	1.300	.76	1			

FORM FACTOR ON  $G_2$  OF SHELL, HE, 75-MM, M48; FUZE, PD, M57



$$G_2 = \frac{0.004597 V}{140000.870.5 V} \quad (V \text{ in FPS})$$

A = 18 = 75-MM = 3  
 AFG 1447.3 FB





Form Factors of Projectiles

Gun	Projectile	Fuze	Weight Velocity lb. fps	Balli. Coef.	Form Factor	Proj. Type	
76mm (3.000") Tank Guns M1A2 T91 T12L4	AP Shot M79	Tracer	15.00	1.59	1.05*	1	
	AP Shot T128E6		14.58	1.392	1.16	8	
	APC Proj. M62A1	BD M66A1	15.40	1.714	1.00	6	
	HVAP Shot M93	Tracer	8.31	0.888	1.165	8	
	HVAP Shot M321 (T29E15)		6.90	0.576	1.33	8	
	HVAP (DS) Shot M331 (T145)		6.16	1.582	.93a	8	
	HVAP Shot T66		7.00	0.625	1.24	8	
	HVAP Shot T66E1		6.83	0.598	1.27	8	
	HVTF Shot M315 (T24E1)	Tracer	9.31	0.903	1.145	8	
	HVTF Shot T73	Tracer	6.67	0.652	1.14	8	
			6.66	0.646	1.15	6	
			7.00	0.625	1.24e	8	
				2700	1.226	1.16	2
				1550	1.357	1.95	6
				13.14	1.294	1.10	6
				2680	1.066	1.37*	6
				15	1.755	.95e	6
			14.7	1.60	1.34e	8	
			2400	1.02	.95e	6	
			2430	1.355	1.02	2	
			12.95	1.02	1.20	2	
					Same as HE Shell M12A1		
			7.60	0.485	1.74e	1	
			7.74	0.703	1.22	1	
			9.36	1.022	1.02	1	
			13.00	1.378	1.05	6	
			1200	1.726	1.0726	1	
			1600	1.795	1.795	1	
			2000	1.865	1.865	1	
			2400	1.934	1.934	1	
			2800	2.004	2.004	1	
			3200	2.053	2.053	1	

PD M18A2, A3  
 PD M51A1, A5  
 PD M81, M81A1  
 TSQ M54, M55A3  
 MTSQ M500, M501  
 CF M78, M78A1

Dummy T144  
 Dummy M73  
 Dummy T144  
 Dummy M73  
 Dummy M73  
 PD M57

BD M62A1, M91  
 BD M62A1, M91  
 TSQ M54

a The diameter of the shot is 2.047 in. (52mm)

e Estimated

\* Determined by resistance firings

Form Factors of Projectiles

Gun	Projectile	Fuze	Weight lb.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type	
3mm (3.189") Mortars M1, M2, M19, M21 and M29	HE Shell M43A1 Practice Shell M43A1 Practice Shell M44	PD M52, M52A1	6.87	235	1.236	.55	1	
				532	.984	.69	1	
				419	.861	.78	1	
				499	.944	.72	1	
				572	.906	.75	1	
				638	.881	.77	1	
				700	.802	.84	1	
		HE Shell M56	TSQ M77	7.96	320	1.173	.67	1
				403	1.019	.77	1	
				476	1.062	.74	1	
				542	1.065	.73	1	
				603	1.033	.76	1	
				660	.985	.79	1	
	HE Shell T28M6	TSQ M77	10.62	306	.947	1.10	1	
			412	.916	1.14	1		
			502	.900	1.16	1		
			583	.850	1.23	1		
			11.62	300	1.036	1.10	1	
				399	1.005	1.14	1	
				482	.987	1.16	1	
				557	.946	1.21	1	
				755		.84a	1	

a Approximate

Form Factors of Projectiles

Gun	Projectile	Fuze	Weight lbs.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type	
81mm (3.189") Mortars M1, M2, M19, M21 and M29	Smoke Shell M57 (WP)	PD M52, M52A1	11.36	297	1.012	1.10	1	
				399	.986	1.13	1	
				484	.965	1.16	1	
				560	.955	1.17	1	
			TSQ M77	12.45	284	1.101	1.11	1
					381	1.078	1.14	1
					462	1.056	1.16	1
					535	1.042	1.17	1
		Smoke Shell M57 (FS)	PD M52 M52A1	11.86	291	1.144	1.02	1
					390	1.131	1.03	1
					472	1.083	1.08	1
					544	1.010	1.15	1
		Illuminating Shell M301	Time M84	10.49	423	1.124	.92	1
					516	1.055	.98	1
				597	.995	1.04	1	
	Training Shell M68		10.75	172.8	.53	2.00e	1	
	Proof Proj. T5		5.97		.245	2.46e	1	

e Estimated

Form Factors of Projectiles

Gun	Projectile	Fuze	Weight lbs.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type	
90mm (3.543") Guns M1, M1A1, M1A2, M1A3, M2, M2A1, M2A2, M3, M3A1, M3A2, M26, T8, T119, T125, and T139	AP Shot M77	Tracer	23.40	2700	1.564	1.19*	1	
	AP Shot M318	Tracer	24.06	2666	1.90	1.01*	6	
	AP Shot T54	Tracer				1.01e	6	
	APC Proj. M62	BD M68		2670	2.134	.90*	6	
				2800	2.163	.89	6	
	APC Proj. T50E1	BD M68				.90e	6	
	HVAP Shot M304	Tracer		3350	1.15	1.16*	8	
	HVAP Shot M332 (T67E7)	Tracer		3900	.810	1.20	8	
	HVAP Shot M332BI (T67E6)			4100	.826			
	HVAP Shot M333 (T83)							
	HVAP Shot M317 (T45)			16.80	3257	1.155	1.16*	8
	HVAP Shot T65E4			10.0	3529	2.117	.89a	1
	HVAP Shot T65E9			10.4	3518	2.608	.75a	1
	HE Shell M58 and M58BI.		Tracer	21.00	2800	1.66	1.01	2
HE Shell M71		MT M13A5 } MTSQ M502 } Plug 75-14-309E }	23.40	2628	.79	2.35*	5	
		MT M13A5, M67A3 } MTSQ M502 } VT M92, M93 } PD M18A2, A3 } PD M51A1, A5 } PD M81, M81A1 } TSQ M54, M55A3 } MTSQ M500, M501 } VT M97A1 }	23.40	2700	1.864	1.00	HE M71	
		CP M78, M78A1 } Plug 75-14-309E }	23.40	2700b	1.79	1.04	2	
WP Smoke Shell M313		PD M57	23.74	2673	1.596	1.89	2	
			23.40		.79	2.35e	5	
			23.40	2700	1.79	1.04	2	

a The diameter of the shot is 2.3 in.

b For the T119 Gun, the MV is 2765 fps

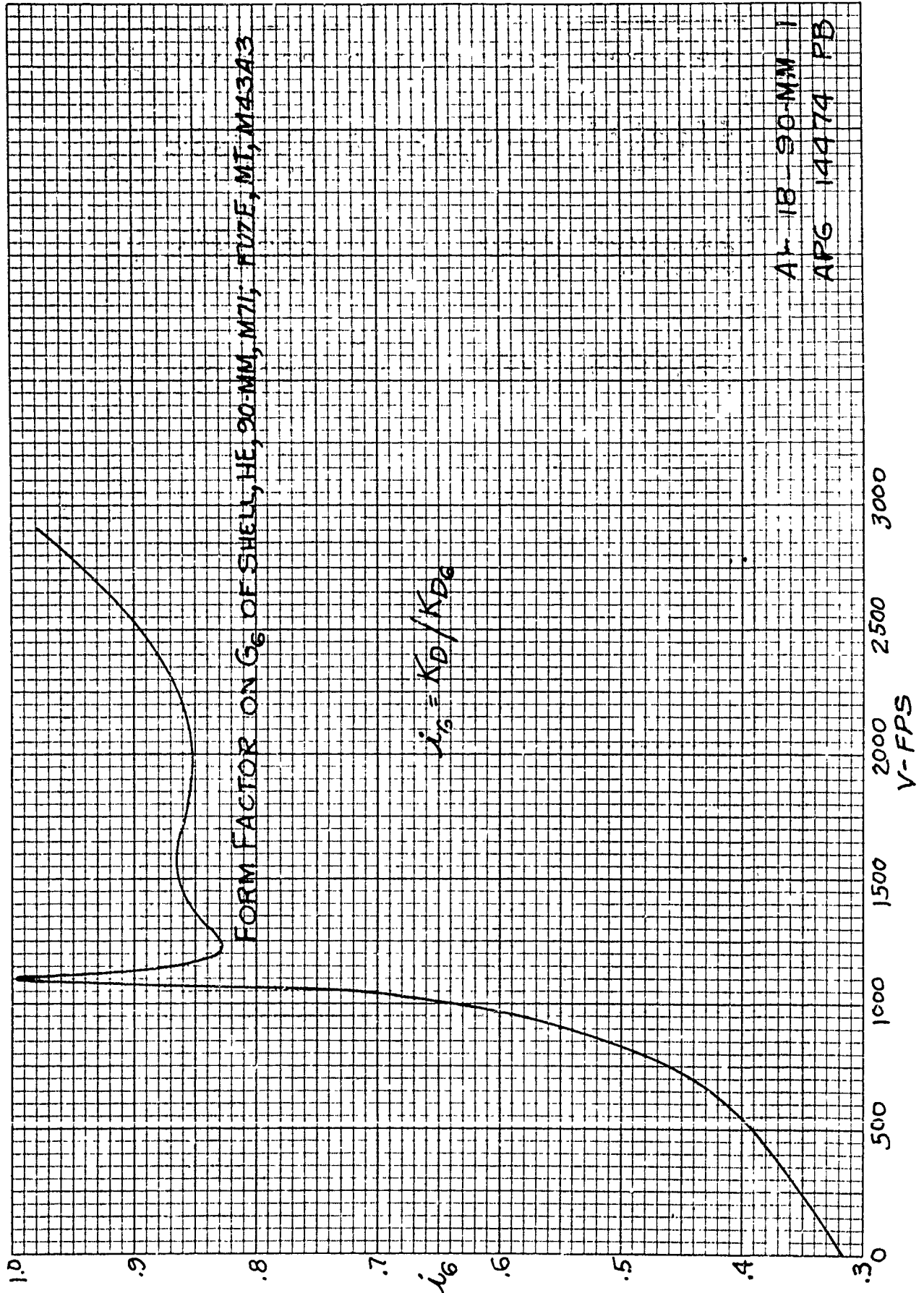
e Estimated

\* Determined by resistance firings

Form Factors of Projectiles

Gun	Projectile	Fuze	Weight lb.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type	
90mm (3.543") Guns M1, M1A1, M1A2, M1A3, M2, M2A1, M2A2, M3, M3A1, M3A2, M26, T8, T119, T125, and T139	HE Shell T91 WP Smoke Shell T92	PD M48A2, A3	18.00	2100 to 2400b	1.43	1.00e	2	
			11.5	2000 3000 4000 5000	3.31 3.05 2.79 2.45	1.40ae 1.52ae 1.66ae 1.89ae	2 2 2 2	
	HE (DS) Shell T82E1, E2, E5 and E10	PD T194	16.25	2000 3000 4000	2.67 2.28 2.20	2.45ae 2.87ae 2.98ae	1 1 1	
			14.3 14.2 14.2	2446 2400 2400to 2800	.550 1.79 1.79	2.07 0.63 0.63e	2 1 1	
	HEAT Shell T108E1 HEAT Shell T108E3 HEAT Shell T108E11 E15, E19 and E20	PI T209 PI T209 PI T209	17.7 16.8	1950 1950	.943 1.580	1.495 .85	1 1	
			24.06 24.11 16.62	3029 3017 3316 3671 3700	1.81 1.83 1.08 1.03 1.016	1.06* 1.05* 1.23* 1.28* 1.32* 1.32e	7 7 7 7 8 8	
	Tank Guns T15, T15E1, T15E2 and T15E3	AP Shot M318	Tracer					
		APC Proj. M82	BD M68					
		HVAP Shot T30E15	Tracer					
		HVAP Shot T14	Tracer					
	HVAP Shot T14E2	Tracer						

a The diameter of the shot is 1.575 in. (40mm)  
 b The T91 and T92 Shell must be fired from only the T119 Gun  
 c Estimated  
 \* Determined from resistance firings



AT-18-90-MM-1  
APG 14474 PB

Form Factors of Projectiles

Gun	Projectile	Fuze	Weight lb.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type
105mm (4.134") Rifle M27	HE Shell M323 (T42)	{ PD M51A4, A5 PD M81, M81A1 MTSQ M500, M501 BD M91 PD M51A4, A5 PD M81, M81A1 MTSQ M500, M501 BD M91	32.4	1120	2.23	.85	2
	HEAT Shell 324 (T43)		29.3	1250	1.34	1.28	2
	WP Smoke Shell M325 (T44)		34.6	1120	2.38	.85	2
	HEP Shell M326 (T139E2)		24.8	1328 1768	1.74 1.65	.835 .88	1 1
Aircraft Gun T7	HE Shell M1	PD M48	33.0	425 to 3000	1.931	1.00	HE M1
Tank Guns T5E1 and T5E2	AFC Shot T32E1, E2 HVAP Shot T29E4	Tracer  { PD M51A4, A5 PD M81, M81A1 MTSQ M500, M501 CP M78, M78A1	39.0	2641	2.22	1.03	8
			24.6	3358	1.29	1.12	8
	HE Shell T30E1		33.5	2266 2930	2.00 1.88	.98 1.04	8 8
			34.22	2252	1.83	1.095	8

Form Factors of Projectiles

Gun	Projectile	Fuze	Weight lb.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type
105mm (4.134") Howitzers M2A1 and M4	Illuminating Shell M314	TS4 M54 MFS4 M501 }	36.60	620	2.007	1.05	6
				674	1.996	1.055	6
			738	1.981	1.06	1.06	6
			825	1.959	1.075	1.075	6
			958	1.914	1.10	1.10	6
			1158	1.856	1.13	1.13	6
			1453	1.920	1.10	1.10	6
			900 to 10500			.83e	1
		HEP Shell T81E1	BD M62A1, M91				
		HEP Shell T81E2, E3	BD M62A1, M91			1.71e	1
		HEP Shell T81E4	BD M62A1, M91			1.39e	1
		HEP Shell T81E5, P6	BD M62A1, M91			1.07e	1
		HEP Shell T81E8, E9	BD M62A1, M91			1.07e	1
		HEP Shell T81E10	BD M62A1, M91	25.6	1760	1.253	1.24
	HEP Shell T81E17	BD M62A1, M91	25.3	1768	1.68	.88	1
	HEP Shell T81E18B	BD M62A1, M91		1250	1.76	.84	1
	HEP Shell T81E18D	BD M62A1, M91	23.17	2037	1.45	.94	1
	Model Shell T124		43.5	784	2.52	1.01*	6
				896	2.50	1.02*	6
				1008	2.52	1.01*	6
				1120	2.57	.99*	6
				1232	2.83	.90*	6
				1344	2.86	.89*	6
				1456	2.80	.91*	6

e Estimated  
\* Determined by resistance firings

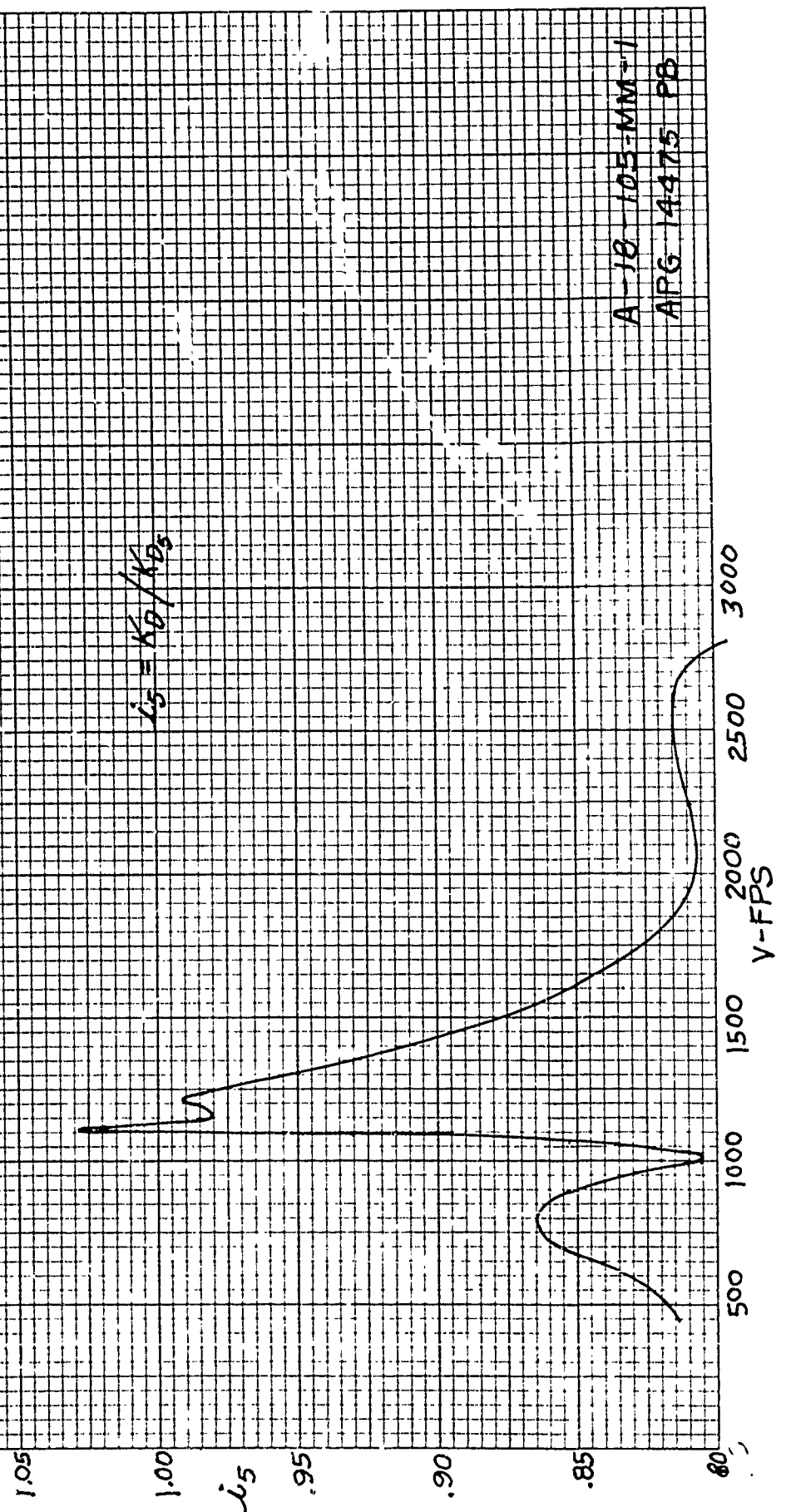


Form Factors of Projectiles

Gun	Projectile	Fuze	Weight lb.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type							
105mm (4.234") Howitzers M2A1 and M4	HE Shell M1	PD M18A2, A3 PD M51A4, A5 PD M81, M81A1 TSQ M54, M55A3 MTSQ M500, M501 VT M97A1 CP M78, M78A1 Plug 75-14-309E PD M57 PD M51A5 TSQ M54 MTSQ M500 MTSQ M501	33.00	{ 650 710 780 875 1020 1235 1550 1519 }	{ 2.572 2.489 2.392 2.260 2.311 2.230 1.994 2.12 1.76 }	{ .75 .78 .81 .85 .84 .87 .97 .93* 1.10e }	{ 2 2 2 2 2 2 2 5 5 }							
								Smoke Shell M60	{ 33.38 HS 34.31 WP 34.82 FS }	{ Same as HE Shell M1 with PD Fuze }				
											BE Smoke Shell M84	{ 32.87 HC 30.50 Green 30.50 Violet 30.70 Red 30.30 Yellow }	{ Same as HE Shell M1 with TSQ Fuze }	
														HEAT Shell M67
								TP Shell M67	{ BD M62 BD M91 Dummy TL21 PI T209 PI T209 PI T209 PD TL55 Mod. Dummy TL44E1 }	{ 29.23 29.00 16.8 25.11 23.03 29.4 }	{ 1250 1250 1674 1729 1549 1940 1680 }	{ 1.62 1.62 1.64 1.62 1.26 1.40 1.98 1.80 2.13 }	{ 1.06* 1.06* 1.04* 1.05* .78 .70 .74 .75 .81 }	{ 2 2 2 2 1 1 1 1 2 }

e Estimated  
\* Determined by resistance firing

FORM FACTOR ON  $G_5$  OF SHELL, HE, 105-MM, MI; FOZE, PD, M40



A-18-105-MM-1  
APG 14475 PB

Form Factors of Projectiles

Gun	Projectile	Fuze	Weight lb.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type	
4.2" (106.7mm) Chemical Mortars M2 and M3C	HE Shell M3	{ PD M3, M4 PD M9 PD M2, M8 }	24.25	239	1.216	1.13	1	
				360	1.205	1.14	1	
				459	1.187	1.16	1	
	Gas and Smoke Shell M2 (CG, H, HD, CNR, CK, HT, PWF)			546	1.158	1.19	1	
				625	1.115	1.23	1	
				694	1.065	1.29	1	
				757	1.009	1.36	1	
	Gas and Smoke Shell M2 (TS, WP, FM, ONS)		PD M2, M8	814	0.952	1.44	1	
				841	0.922	1.49	1	
				219	1.216	1.19	1	
Recoilless Chemical Mortar M4	HE Shell M6	PD E48R1 PD M2, M3, M4 PD M5, M6, b	24.25	343	1.205	1.20	1	
				446	1.187	1.22	1	
				533	1.158	1.25	1	
	Smoke Shell E77 (PWF, CG, H) c			25.25	613	1.115	1.30	1
					682	1.065	1.36	1
					743	1.009	1.43	1
					796	0.952	1.52	1
					820	0.922	1.57	1
					715	1.035	1.33	1
					730a			
				715	1.035	1.38	1	
				730a				

a MW is 715 fps with Rocket Driver M1, 730 fps without it  
 b Fuzes M2, M3, M4, and M5 may be used without Rocket Driver  
 c CG and H are used without Rocket Driver

Form Factors of Projectiles

Gun	Projectile	Fuze	Weight lb.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type
120mm (4.700") Antiaircraft Gun M1, M1A1, M1A2	HE Shell M73	MT M61, M61A1	50	3100	2.535	.89	2
		VT M50h, M50hA1	49.79	3000	1.288	1.75e	5
		PD M18 series				1.18*	1
		Fuzg 75-11-509E					
Gun T53, M123	HE Shell T11 HE Shell T12 HE Shell T15 WF Smoke Shell T16 AP Shot T16 Same w/o windshield APC Shot, T14E3 Same w/o windshield Same w/o esp or windshield HVAP Shot T17E1 Mod. 0	MT T14	55	3000	3.025	.82	2
		MT T14	51.37	3000	2.637	.88	2
		PD M57A5	50	2500	2.76	.82	8
		Tracer	50	3150	2.050	1.10	8
		Tracer	50	3150	2.31	1.19e	1
		Tracer				.98e	6
		Tracer				1.84e	1
		Tracer	28	4150	2.04	1.40e	1
		Tracer				.62	1

e Estimated

\* Determined by resistance firings

Form Factors of Projectiles

Gun	Projectile	Fuze	Weight lb.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type	
155mm (6.102") Howitzer M1	HE Shell M107	PD M51A4, A5 PD M81, M81A1 TSQ M54, M55A3 MTSQ M500, M501 VT M96	95	680	3.315	.77	2	
				770	3.178	.80	2	
				880	3.010	.85	2	
				1020	2.790	.91	2	
				1220	2.952	.86	2	
		1520	2.837	.90	2			
		1850	2.710	.94	2			
				1% higher than with PD Fuze				
				95	2.41	1.06e	5	
						1.12e	5	
		Gas or Smoke Shell M110	PD M51A4, A5 PD M61, M81A1 Plug 75-14-309E Circular Plug	94.20 HS			Same as HE Shell M107	5
	98.10 WP							
	99.40 FS							
				95	2.41	1.06e	5	
		Gas or Smoke Shell T77	PD M51A4, A5 PD M81, M81A1 Plug 75-14-309E	96			Same as HE Shell M107	
	BE Smoke Shell M116, M116B1 Illuminating Shell M118, M118B1	TSQ M54 MTSQ M501 TSQ M54 MTSQ M501	95.10 HC, Red Yellow, Green, Violet			Same as HE Shell M107		
			103.06	650	2.545	1.09	6	
				735	2.572	1.08	6	
			840	2.575	1.075	6		
			970	2.534	1.09	6		
			1160	2.385	1.16	6		
	AP Proj. M112B2	ED M60	100	1815	3.035	.885*	6	

e Estimated  
\* Determined by resistance firings

Form Factors of Projectiles

Gun	Projectile	Fuze	Weight lb.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type				
155mm (6.102") Guns M1, M1-c, M1A1, M2, M3 and M4	HE Shell M101	PD M51A1, A5 PD M81, M81A1 TSQ M54, M55A3 MTSQ M500, M501 CP M78, M78A1 Plug 75-114-309E	95	2100	3.19	.80*	5				
			2800	3.07	.83*	5					
			95.34	2800	2.91	.87e	5				
			95	2.41	1.06e	5					
			95	2.84	.90e	2					
			Gas or Smoke Shell M1C4	PD M51A1, A5 PD M81, M81A1 MT M67A3	93.45 HS	2100	3.14	.80	5		
					2800	2.99	.84	5			
					98.37 WF	2100	3.30	.80	5		
					2800	3.15	.84	5			
					98.63 FS	2100	3.31	.80	5		
					2800	3.15	.84	5			
					98	2.48	1.06e	5			
					BE Smoke Shell M1I7	TSQ M54 MTSQ M501	94.73 HC	2100	3.22	.79	5
							2800	3.10	.82e	5	
Illuminating Shell M1I8, M1I8B1	TSQ M54 MTSQ M501	103.06			2000	2.337	1.185	6			
		100	2341	2.95	.91*	6					
AP Proj. M1I2 M1I2B2	BD M60	2745	2745	3.000	.895	6					
		98	2.83	Same as M1I2	6						
Gun M2E1	HE Shell T45E1 HE Shell T45E3, E4, E5	Same w/o windshield	2800	2.507	1.02	2					
			2800	2.507	1.02e	2					

e Estimated  
 \* Determined by resistance firings

Form Factors of Projectiles

Gun	Projectile	Fuze	Weight lb.	Velocity fps	Ball. Coef.	Form Factors	Proj. Type
3" (203.2mm) Hewitzer M2	HE Shell M106	PD M51A4, A5 PD M81, M81A1 MT M67A3 TSQ M54, M55A3 MTSQ M500, M501 VT M96 Plug 75-14-399E	200	820	3.50	.89	5
				900	3.44	.91	5
				1000	3.39	.92	5
				1150	3.36	.93	5
				1380	3.34	.94	5
				1640	3.53	.89	5
				1950	3.79	.82	5
				2.84	1.10e	5	
				795	2.920	1.07	6
				873	2.920	1.07	6
				970	2.920	1.07	6
				1115	2.950	1.06	6
				1339	2.907	1.075	6
				1590	2.860	1.09	6
				1880	2.805	1.11	6
Gun M1	Proof Proj. T9  HE Shell M103  Common Proj. Mk 14 Common Proj. Mk 17	Circular plug  PD M51A4 Mod. 3 PD M51A5 Mod. 3 MT M67A3 MTSQ M500, M501 CP M78, M78A1 BD Mk 11 BD Mk 12	200	820	5.90	.53*	1
				1020	5.90	.53e	1
				1380	7.57	.43*	1
			240	2100	4.25	.88	2
				2600	4.21	.89	2
				2840	4.21	.89	2
			260	2750	4.76	.85	6

e Estimated

\* Determined by resistance firings

Form Factors of Projectiles

Gun	Projectile	Fuze	Weight lb.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type
240mm (9.449") Howitzer M1	HE Shell M114	PD M51A4, A5 PD M81, M81A1 MT M67A3 MTSQ M500, M501 VT M96 CP M78, M78A1 Plug 75-14-309E	360	1500	4.31	.94	2
			360	1740	4.16	.97	2
				2020	4.07	.99	2
				2300	4.11	.98	2
				2300	3.88	1.03e	2
Gun T1	HE Shell T10	PD M51A4, A5 PD M81, M81A1 MT M67A3 MTSQ M500, M501	400	2704	4.67	.96	2
				2798	4.72	.95	2
				3136	4.77	.94	2
250mm (10") Mortar T5E2	Shell T158		380		4.58	.93e	6
	HE Shell T3	FD T164E2	250		3.73	.67	1

e Estimated



Form Factors of Projectiles

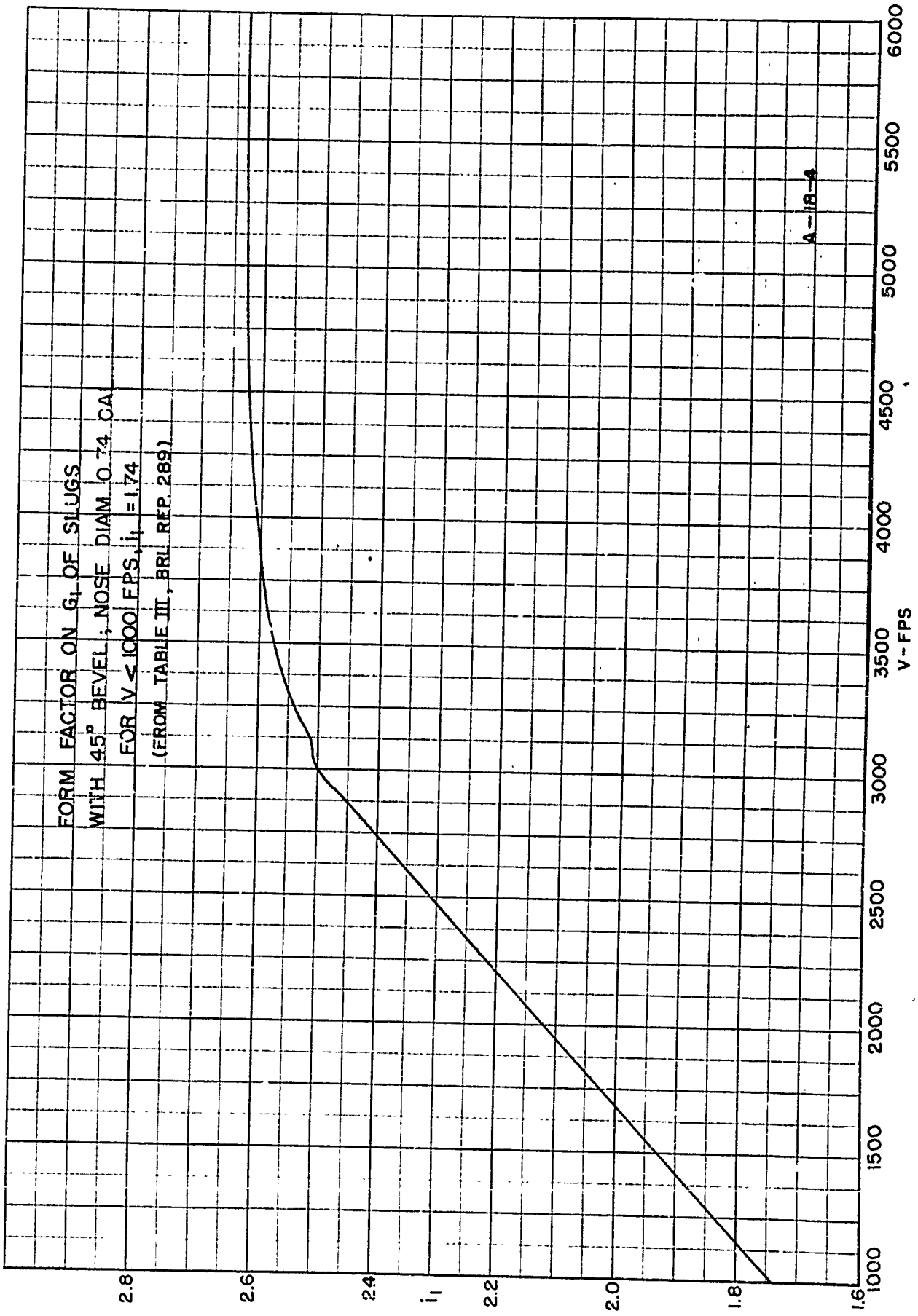
Gun	Projectile	Fuze	Weight lb.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type
12" Gun M1888, I M1888MI, M12 M1888MII	AP Shell Mk 1	BD Mk X	900	2250	7.90	.80	6
	AP Shot Mk 16	BD Mk X	975	2260	7.38	.91	6
	AP Shot M1912A	BD Mk X	1070	2235	8.10	.92	6
	AP Shot M1913	BD Mk X	1070	2235	8.10	.92	6
Gun M1900	AP Shot Mk 16	BD Mk X	975	2275	7.38	.91	6
	AP Shot M1912A	BD Mk X	1070	2250	8.10	.92	6
	AP Shot M1913	BD Mk X	1070	2250	8.10	.92	6
	TP Proj. M1911		1070	2250	8.10	.92	6
14" Guns M1909 M1910	AP Shot Mk 6	BD Mk X	1560	2350	9.50	.84	6
	TP Proj. Mk 10		1560	2350	9.50	.84	6
	AP Shot Mk 8 M9A1	BD Mk X	1400	2400	6.11	1.17	6
	AP Shot M1909	BD Mk X	1660	2350	7.80	1.09	6
Gun M1920MI M1920MII	AP Shot Mk 6	BD Mk X	1560	2650	8.55	.93	6
	TP Proj. Mk 10		1560	2650	8.55	.93	6
	AP Shot Mk 8 M9A1	BD Mk X	1400	2700	6.17	1.15	6
	HE Shell Mk 11 M2A1	BD Mk V	1215	3000	6.90	.90	6

Form Factors of Projectiles

Gun	Projectile	Fuze	Weight lb.	Velocity fps	Ball. Coef.	Form Factor	Proj. Type
16" Gun Mk III Mod. I (Heavy)	AP Shot Mk 2	BD Mk I	2100	1950	8.06	1.03	6
	TP Proj. M100			2750	7.83	1.05	6
Gun M1919M1, M1919M1A, M1919M1B	TP Proj. M100		2270		8.84	.99	6
	AP Shot Mk 2	BD Mk K	2100	2210	8.12	1.00	6
	TP Proj. M100			2470	8.10	1.01	6
	AP Shot Mk 5	BD Mk I	2340	2750	7.83	1.05	6
	AP Shot Mk 9	BP Mk K		2190	9.74	.94	6
	TP Proj. Mk 7			2440	9.85	.93	6
Howitzer M1920	AP Shot Mk 2	BD Mk X	2100	1350	7.63	1.07	6
	TP Proj. M100			1550	7.60	1.08	6
				1750	7.82	1.05	6
				1950	8.06	1.03	6

e Estimated

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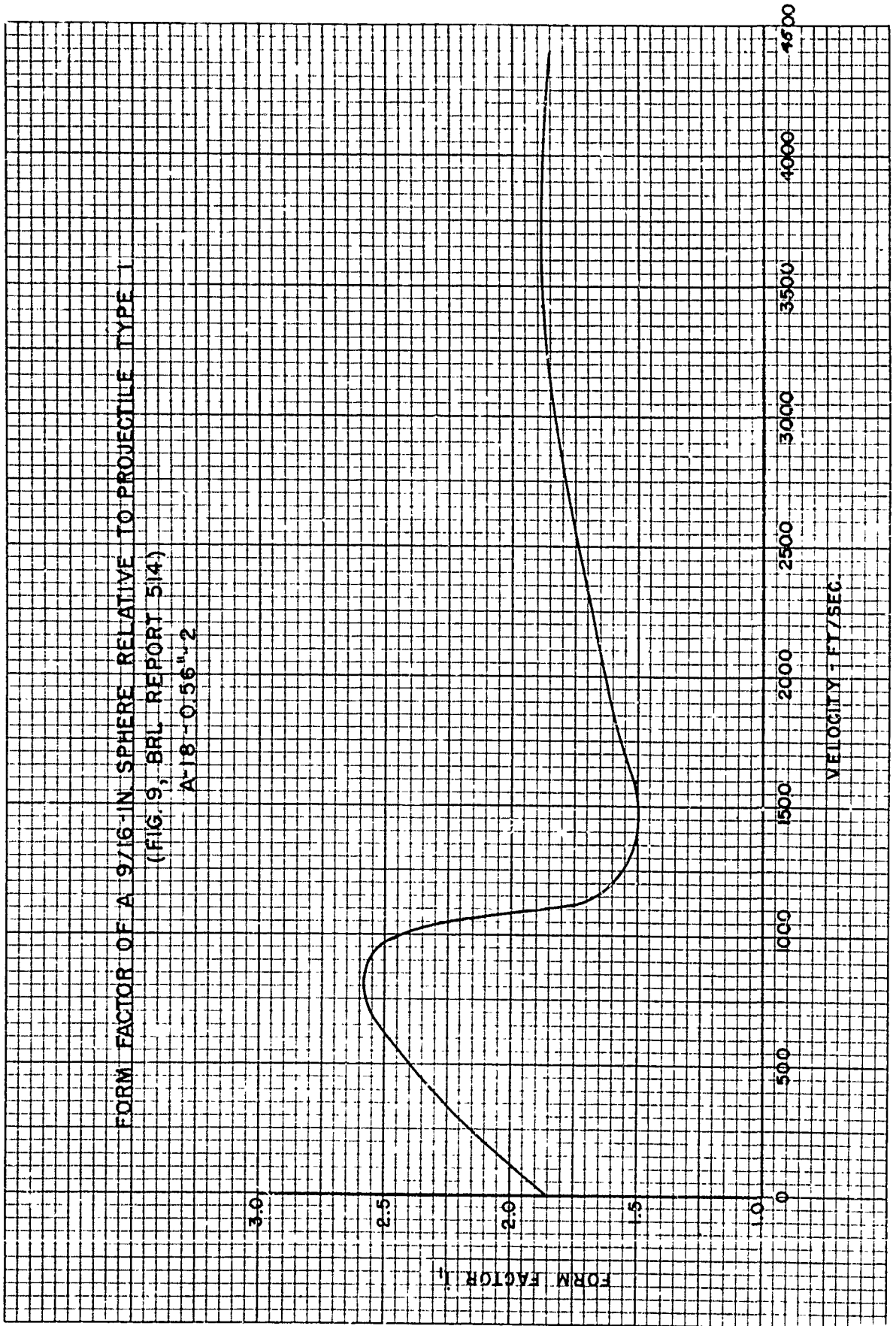


A-18-A

FORM FACTOR OF A 9/16-IN SPHERE RELATIVE TO PROJECTILE TYPE 1

(FIG. 9, BRL REPORT 514)

A-18-0.56<sup>1.2</sup>



FORM FACTOR

VELOCITY - FT/SEC