U·S·NAVAL·TECHNICAL·MISSION·IN·EUROPE

~~CONFIDENTIAL~~

AMERICAN

TECHNICAL REPORT No. 485-45

UNCLASSIFIED

GERMAN POWDER COMPOSITION AND INTERNAL BALLISTICS FOR GUNS

Jira 9-11-3122

October 1945

U·S·NAVAL·TECHNICAL·MISSION·IN·EUROP

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

U. S. NAVAL TECHNICAL MISSION IN EUROPE
c/o Fleet Post Office
New York, N.Y.

File: A9-16(3)(40/Hn)

Serial: 01353 26 October 1945

~~CONFIDENTIAL~~

From: Chief, U.S. Naval Technical Mission in Europe.
To : Chief of Naval Operations (OP-16-PT).

Subject: U.S. Naval Technical Mission in Europe Technical Report No. 485-45, German Powder Composition and Internal Ballistics for Guns - Forwarding of.

Enclosures: (A) (HV) Four (4) complete copies of subject report as listed in distribution.
(B) (HV) One (1) set of negatives of photographs in subject report with copy No. 5 as listed in distribution.

1. Enclosures (A) and (B) are forwarded herewith.

2. CNO (OP-16-PT) is requested to make complete additional copies of this report for forwarding to such other agencies as may be interested.

L.V. HONSINGER
Captain, U.S.N.
Acting

DISTRIBUTION To:

CNO (OP-16-PT)	Copy Nos.	1 - 4
CNO (OP-16-PT) w/Enclosure B	Copy No.	5
FIAT	Copy No.	6
Office of Research and Inventions	Copy No.	7
ComNavEu	Copy No.	8
ComNavEu for Admiralty	Copy No.	9
BuOrd (Re)	Copy No.	10
BuOrd (Re 2)	Copy No.	11
BuOrd (Re 2a)	Copy No.	12
BuOrd (Pr 6)	Copy No.	13
BuOrd (Pr 6a)	Copy No.	14
NavTechMisEu (Main Files)	Copy No.	15
OSRD, Washington, D.C.	Copy No.	16

~~CONFIDENTIAL~~

TECHNICAL REPORT No. 485-45

GERMAN POWDER COMPOSITION AND INTERNAL BALLISTICS FOR GUNS

SUMMARY

This report gives a list of propellant powder compositions for German guns from 20 mm upwards together with the internal ballistics produced in each gun. A short statement on methods of internal ballistic calculation and also on closed bomb determination of ballistic constants is included.

October 1945

U.S. NAVAL TECHNICAL MISSION IN EUROPE

TABLE OF CONTENTS

Closed Bomb Work and Internal Ballistics Calculations (B)(Cont'd).

work was done in the Deutsche Waffen Munition-Fabrik research laboratory at Lübeck.

2. Apparatus Closed bombs of various capacities up to three and one-half liters were used. They were constructed with a liner and shrunk-on jacket and were tested at 30 tons/sq.in. The chamber length was usually five or more diameters. The cooling water was pumped through a water jacket from a thermostat.

The charges were loaded in much the same way as in the gun and with a similar ignition system, i.e.: gun powder with or without NC igniters. The breech end was closed by a steel cartridge case containing a percussion primer. This case was reformed after each round and had a life of about 30 rounds. (It is said that some used a mushroom head with rubber gasket).

Zeiss-Ikon piezo-electric recording sets were available at Lübeck, Düneberg and Essen. That a Lübeck was used for closed bombs, rockets and guns. Calibration was by the simple press supplied by Zeiss-Ikon and of the approximate accuracy of 2%. The set at Düneberg was similar but seldom used as a mechanical gauge was preferred. At Essen both piezo-electric and mechanical gauges were used and both considered accurate, but a special unit was made to calibrate either type of gauge in position in the closed bomb. Krupps also used a piezo-electric gauge for gun measurements both in the chamber and on the base of the projectile.

The mechanical guage used at Düneberg was quite accurate utilizing a one piece beam of flexible steel with a mirror mounted on each end and the piston from the bomb working against the center of the beam. A beam of light passed over first one mirror and then the other and thence to the sensitive paper thus giving double optical deflection. The gauge was calibrated in position by a dead weight testing machine. Waterproof recording paper was used to minimize shrinkage in processing and this error was allowed for by printing two accurate centimeter scales over the record.

All the gauges used the same piston for transmitting thrust from the gases. This protruded into a recess inside the vessel and was protected by a thimble filled with grease which formed the obturation. Its cross sectional area was 0.250 sq.cms.

P6.3

Closed Bomb Work and Internal Ballistics Calculations (B)(Cont'd).

In the piezo-electric sets the time-scale was provided by a flashing tube controlled by a 1000 cps tuning fork. For the mechanical gauge the time scale was provided by accurate control of the angular velocity of the drum.

By means of the thermostat the closed bomb could be fired either at normal or high temperatures but no provision was made for low temperatures.

(C) Method of Analysis of Records. Powders were almost invariably fired in the form of tube, strip or flake, all assumed to have constant burning surface.

For any given size of a given powder composition, measurements of force and covolume were made by firing one round at each of five or more densities of loading. Then if P Max/Δ were plotted as a function of P max $>$1500 atm. would lie on a straight line. The intercept of this line on the zero pressure line gave the force constant, F, and the slope gave the co-volume N. Since no heat loss correction was applied, the values of F and N depended on the web size of the powder, F diminishing N increasing with increase in web size.

Two methods of determining the relative quickness of the powder were used, depending on the use to which the results were to be put.

The simple method assumed a linear rate of burning law and no co-volume correction. Under such circumstances the pressure must be an exponential function of the time. Times were measured at which the pressure reaches P, and Pie, where P, is some arbitrary pressure, about 1/3 of P max and e = 2.718. If T is the time interval from P, to Pie, then TP max = Y equals D/B the reciprocal of the relative quickness. The beginning and end of the pressure curve are not used because they depart from the ideal exponential curve, mainly owing to irregularities in ignition. The relative quickness obtained by this method is almost independent of the density of loading for deglycol powders. For gudol powders, however, the relative quickness diminishes at higher densities of loading and the figure used is that for which P max equals the maximum pressure to be expected in the gun.

At Essen a more elaborate analysis was used, the appropriate force and co-volume constants being used to calculate Z, the fraction of the charge burnt, at each of some 20 constants of time for which the pressure was read off the curve. Then S Pdt was plotted as a function of Z

Closed Bomb Work and Internal Ballistics Calculations (B)(Cont'd).

and the slope of the middle part of this curve, which was nearly linear, gave Y. Results varied slightly for different densities of loading and a mean value was taken.

For experimental powders log P was plotted against time, using logarithmatic graph paper, and the curvature of the line showed whether the powder were progressive or degressive.

(D) Application to Gun Calculations. For most purposes a very simple method of gun calculation was used, similar to the old ADD method. The closed bomb figures for F and N are estimated for about the right web size. The powder was assumed to be all burnt before the shot started to move, giving a pressure

$$Po = F/1/\Delta - N$$

The gas was then assumed to expand adiabatically, using a value of 2 given by:

$$F = 1 + \frac{F}{(J \times \text{cal. cal.})} \sim 1.2$$

where HJ is the mechanical equivalent of heat in the appropriate units. This adiabatic curve was then intersected by a constant pressure line P = P max (crusher) and this line together with the adiabatic line to the muzzle gave the pressure-space curve used for design purposes. A factor of 0.96 was then used to allow for rounding off the corners of the diagram in calculating the muzzle energy $(W + C/3)\ VO^2$. A further 3% or 5% was substracted from the muzzle energy to allow for the frictional losses with one or three driving bands respectively. This method did not involve propellant size or the position of all burnt, but gave reasonably accurate results in experienced hands.

A more elaborate method was used by Krupps in detailed design of new weapons. This used closed bomb data for force, co-volume and relative quickness and started from a shot start pressure. The co-volume correction was applied in a step by step integration.

In choosing a given solution for use it was considered that the velocity at burnt should never exceed 90% of the muzzle velocity in order to obtain reasonable regularity. This gave a minimum value for the relative

Application to Gun Calculations (D)(Cont'd).

quickness of the powder. For low performance weapons, of course, V burnt would be about 20% less than Vo.

(E) Special Closed Bomb Investigations. Three special closed bomb investigations deserve mentioning. In the first place a study of the effect of moderation on the burning properties of small arms powders was made both in the closed bomb and in the gun, at Lübeck. For chopped NC tube moderated with about 4% methyl centralite or camphor the progressiveness due to the moderation counterbalanced the degressiveness due to the shortness of the tubes, giving an effectively constant burning surface.

Secondly at Düneberg a long and detailed study was made of the effect of varying the ratio of external to hole diameter, and of tube length to hole diameter, on the burning properties of powder at various temperatures. The general conclusions reached were as follows:

(a) The mean rate of burning increased and became more irregular when the stick length exceeded thirty times the hole diameter. The temperature coefficient also increased in the same way.

(b) The mean rate if burning became irregular if the ratio of external to hole diameter exceeded 2.5 for powders with cal. vol 800 or 2.0 for powders with lower cal. vols. Since different factories produced powders with different ballistic properties it was necessary to lay down tolerances for hole size as well as annulus and tube length in order to obtain both the required relative quickness and temperature coefficient. This work was carried out in conjunction with gun firings.

A third investigation was the effect of atmospheric humidity on moisture content and so on ballistics, but this was done mainly by gun firings.

Other investigations included the taking of gas samples from guns or closed bombs by means of a small evacuated closed vessel placed in the chamber or screwed into the wall. This small vessel was sealed by a disc, which ruptured at a suitable high pressure and admitted the gas sample. Experiments with this apparatus showed that for Ngl, and Digl. powders the gases had approximately the calculated composition but that for gudol powders the water gas equilibrium constant was well below the theoretical value. This was believed to be due to the shortage of oxygen in such powders. The continued pressure rise in closed bombs firing Gudol powders after the

Special Closed Bomb Investigations (E)(Cont'd).

charge should be all burnt was believed to be due to completion of some gas reaction which could only proceed slowly with such powders.

A somewhat similar apparatus, in which the gases produced in a small closed bomb ruptured a disk and expanded into a larger closed bomb was used for measuring the smoke produced by various powders. In this case the large vessel was fitted with a light source and photocell.

Notes and Abbreviations to Tables.

1. Theoretical cal. vol. in Table I have been calculated by personnel of Armament Research Department, Woolwich, England.

2. Units of Force in Table I and II are tons/sq. in. per gram centimeter.

3. Additional German values not given in the British translation of these tables are included in Appendix to Tables.

4. Abbreviations:

NC	Nitrocellulose
% N	Nitrogen content of NC by weight.
NG	Nitroglycerine
DGN	Diethylene glycoldinitrate
Trigl	Triethyleneglycoldinitrate
Ptc	Nitroguanadine
Akar	Akardite
Centra	Centralite I
MgO	Magnesium Oxide
Graph	Graphite
Na	Nitronaphthalene
Hydr.	Hydrocellulose
DNT	Dinitrotoluene
MJ	Mineral Jelly
Phth	Diamylphthalate
Ephu	Ethylphenylurethane
Dphu	Diphenylurethane

APPENDIX TO TABLES

Supplementary Data on German Powder Compositions

Powder No.	Description	German Theor. Cal.Val. Cal/gm	Specific Gas. Vol. $CM^3/kg.$
1	Ngl. Pl. P-12.5	1198	814
2	Ngl. Bl P-12.5	1144	829
3	Ngl Blp - 11.5	1023	869
4	Ngl. RP - 9.5	832	943
5	Ngl RP - 8	725	981
6	RP 32	719	988
7	Digl. BIP - 10.5	925	953
8	Digl. BIP - 10.5	916	957
9	Digl. RP - 9.5	841	970
10	Digl. RP - -0.3	740	994
11	Digl. RP - 8.2	717	1005
12	RP - 38	686	1019
13	RP - 38N	695	1010
14	RP - E	579	1066
15	Digl. RP - KO	571	1088
16	Digl. RP - KN	559	1055
17	Digl. RP - KOD	575	1052
18	Digl. RP - GO	503	1123
19	Digl. RP - GO.5	497	1108
20	RP 40	540	1078
21	RP 40N	577	1063
22	Digl. RP-Gl.5	498	1920
23	Digl. RP - G 2.5	509	1069
24	Digl. RP - G.5	...	1035
25	LgP 40N	-	---
25a	Lgp 40	---	---
26	Gup - AO to al.3	830	993
27	GuRP - 39	713	1023
28	GuRP - 7.5	537	1100
29	GuRP - 8	736	1007

Appendix to Tables (Cont'd).

Powder No.	Description	German Theor. Cal.Val. Cal/gm	Specific Gas. Vol. CM^3/kg
30	GuRP - KN	518	1074
31	GuRP - G0	531	1102
32	GuRP - G5	476	1051

Prepared by:

C. H. BROOKS,
Lt.Comdr., USNR.

G. H. NEFF
Lt., USNR

T. L. MILLER
Lt., USNR

J. B. CASTNER,
Technician

GERMAN GUN PROPELLANTS

Powder No.	Type	User	Composition in % by weight												Cal. Val. cal/gm	Force British Units	T_o °K	Theor. Cal.Val. cal/gm
			1. Nitroglycerine Powders															
			N.C.	%N	N.G.	Akar	Centr	MgO	Graph									
1.	Ngl.Pl.P-12,5 -	Army	54.40	12.90	44.20	0.30	1.00	0.05	0.05						1290	79.4	4065	1297
2.	Ngl.Bl.P-12,5 -	Army	59.31	12.75	39.54	0.25	0.75	0.05	0.10						1255	77.8	3910	1256
3.	Ngl.Bl.P-11,5 -	Army	57.75	12.75	38.50	-	3.60	0.05	0.10						1150	74.1	3550	1159
4.	(Ngl.R.P.- 9,5 - (R.P.12 or RPC/12	Army) Navy)	64.13	11.90	29.77	-	5.75	0.25	0.10						950	67.3	2975	938
5.	Ngl.R.P. - 8 -	Army	67.07	11.40	26.08	-	6.50	0.25	0.10						840	62.5	2650	827
6.	R.P.32 or RPC/32	Navy	66.60	11.50	25.90	-	7.25	0.15	0.10						830	62.4	2630	816
			2. D. E. G. D. N. Powders															
			N.C.	%N	D.G.N.	Akar	Centr	MgO	Graph	α Kn	M.J.	Phth.	K_2SO_4	KNO_3				
7.	Digl.Bl.P.-10,5 - (Howitzers)	Army	33.62	13.00	35.78	0.25	0.85	0.05	0.05						1020	72.1	3150	1005
8.	Digl.Bl.P.-10,5 - (Primary charge)	Army	54.72	13.00	44.78	0.25	0.25	-	-						1020	72.0	3130	1012
9.	Digl.R.P. - 9,5 -	Army	61.80	12.60	36.45	-	1.50	0.15	0.10						950	68.4	2940	933
10.	Digl.R.P.-8-0.3 (3.7-cm. Flak)	Flak	68.30	11.90	29.25	-	2.20	0.15	0.10					0.30	870	63.2	2850	840
11.	(Digl.R.P. - 8,2 - (Digl.R.P. - 8 -	Flak Army	67.70	11.90	29.05	-	3.00	0.15	0.10						820	62.2	2570	809
12.	R.P.38 or RPC/38	Navy	69.45	12.20	25.30	-	5.00	0.15	0.10						810	61.0	2495	785
13.	R.P. 38 N	Navy	68.72	12.20	25.03	-	1.50	0.15	0.10	4.50					810	61.7	2545	774
14.	R.P.-8. -	ALL	60.55	12.00	25.95	-	3.75	0.15	0.10	2.50	(4.00	D.N.T.	3.00	Hydr.)	730	55.3	2175	638
15.	Digl.R.P.-K.O. - or -K.I.-	Flak	64.15	12.00	27.50	-	5.35	0.15	0.10		1.85	0.90	0 or 1.00		725	55.5	2125	634 or 633
16.	Digl.R.P.-K.N. -	Flak	61.08	12.00	26.17	-	7.00	0.15	0.10		1.25	0.25		4.00	730	53.8	2125	665

Powder No.	Type	User	Composition in % by weight												Cal. Val. cal/gm	Force British Units	T_o °K	Theor. Cal. Val. cal/gm
			N.C.	NG	D.G.N.	Ahar	Centr	Mg_2O	Graph	Al_2O_3	N.J.	Ftsh.	K_2SO_4	FeO_3				
			a. D.B.G.D.N. Powders (contd.)															
17.	Digl.R.P.-E0-D-	Flak	68.88	18.00	14.63		3.00	0.15	0.10	2.00	(10.00 D.N.T.)				730	55.3	2190	844
18.	Digl.R.P.-00 -	Army	62.40	18.00	26.75		8.00	0.15	0.10		1.80	0.80			700	51.5	1910	55[illegible]
19.	(Digl.R.P.-00,5- (or -01 -	Army	61.88	18.00	26.58		7.75	0.15	0.10		1.80	0.80		0.50 or 1.00	700	50.6	1905	55[illegible] or 56[illegible]
22.	(Digl.R.P.-01,5- (or -02 -	Army	61.80	18.00	26.40	-	7.90	0.15	0.10		1.80	0.85		1.50 or 2.00	700	50.4	1920	8[illegible] or 6[illegible]
23.	(Digl.R.P.-02,5- (or -03 -	Army	61.48	18.00	26.33	-	7.00	0.15	0.10		1.90	0.90		2.50 or 3.00	700	50.4	1985	6[illegible] or 6[illegible]
24.	Digl.R.P.-03-	Army	60.73	18.00	26.02		8.50	0.15	0.10		1.85	0.85		5.00	700	50.2	2020	852
20.	R.P. 40	Navy	67.55	11.45	24.80		7.50	0.25	0.20						720	52.9	2040	81
21.	R.P. 40 N	Navy	64.87	18.20	23.65	0.30		0.15	0.10	7.00	(2.75 Dphm., 2.00 Dphm.)				730	55.6	2185	83[illegible]
25.	Lg. P. 40 N	Navy	67.72	11.50	-		4.80	0.15	0.10	5.25	(28.88 Trigl.) 4.00				650	(45.6)	(1755)	5[illegible]
25a.	Lg. P. 40	"	67.92	11.50			5.00	0.15	0.10		(28.46 ")				650			
			b. Miscellaneous Powders															
			N.C.	NG	D.G.N.	Ahar	Flour	Mg_2O	Graph		Dphm.	Dphm.	K_2SO_4	FeO_3				
26.	(Gu. P. - A0 - (to- A1,2-	Army	30.17	13.00	31.83	0.50	30.00		0.10				0 to 1.80		950	68.7	2880	90 to 91[illegible]
27.	Gu. R.P. 39	Navy	35.49	12.20	21.78	0.50	40.00	0.25	0.10		0.70	0.70	0.50		830	62.7	2550	7[illegible]
28.	(Gu. R.P.-7,5- (	Army Flak	42.70	12.00	18.30		30.00	0.15	0.10		3.75	5.00			750	53.5	2020	58
29.	Gu. R.P. -8-	Army	48.13	12.00	20.62		30.00	0.15	0.10		1.00				810	63.8	2630	82
30.	Gu. R.P. -EX-	Flak	39.95	12.00	16.95		30.00	0.15	0.10		5.00	4.25		4.00	730	51.4	1995	60
31.	(Gu. R.P. -00- to G1 (	Army	42.70	12.00	18.30	0.50	30.00	0.15	0.10		3.75	4.50	0 to 1.00		730	53.1	2005	59 to 50[illegible]
32.	Gu. R.P. - 05-	Army	42.50	12.00	18.25		25.00	0.15	0.20		4.50	4.50	5.00		730	54.6	1890	56[illegible]

GERMAN INTERNAL BALLISTIC DATA

Sheet 1

Powder No.	Gun	Calibre mm.	Powder Type	Powder Size mm.	Charge wt. kgs.	Shot wt. kgs.	Chamber length mm.	Chamber cap. litres	Shot travel mm.	Total cap. litres	Pressure Working kg/sq.cm.	Pressure Design kg/sq.cm.	M.V. m/s	Projectile
–	2 cm. Flak 30	20	No. R.P.	3 x 3/0.5	.058	.134	110.5	.048	1178.5	.434	3200	3500	835	H.E. tracer
			"	2.5 x 2.5/0.5	.040	.115	"	"					900	H.E. tracer
–	3 cm. Flak M.44	30.9	"		.170	.330	200	.230	2000	1.490	2800	3300	1070	H.C.H.E. 44
			"	3 x 2.8/0.8	.150	.455	app.	"	app.				900	A.P.H.E. 44
12.	3.7 cm. S.K. C/30	37	R.P. 38	325 x 2.6/0.8	.345	.745	357	.50	2473	3.27	2850	3450	1000	H.E. tracer 41
13.	3.7 cm. Flak M.42	37	R.P.38H	180 x 1.8/0.8	.180	.635		.270	–	–	–	–	885	H.E. 18
			"	175 x 1.8/0.65	.195	.585		"	–	–	2800	3350	985	H.C.H.E. 18
13.	3.7 cm. S.K. C/36	37	R.P.38H	180 x 1.8/0.8	.180	.635	216	.270	1895	2.09	2800	3200	840	H.E. 18
			"	175 x 1.8/0.65	.195	.585							"	H.C.H.E. 18
18.	3.7 cm. Flak 18	37	Dig1. R.P. -8-	201 x 2.8/0.85	.180	.625	215	.275	1876.2	2.35	2575	2900	840	H.E. 18
				188 x 2.8/0.85	.182	.685	"	"	"	"	"	"	"	A.P. 18
11.	3.7 cm. FuK M(L/65)	37	Dig1.R.R-8.2-	310 x 3/1	.320	.685	340	.49	1970	2.73	2800	3030	885	A.P.
24.	1 FuK 41	48/27	Gu.R.R -A 0.5-	315 x 2.3/1	.480	.360			–	–	–	–	–	A.P.
18.	(Model 2472		or Dig1.R.R-G 1-	310 x 1.8/1	.304	.330								"
18.			or Dig1.Str.P-G1-	310 x 6 x 0.5	.387	"								"
	Gerat 50	55	Not in Service			1.8	510.5	2.63	5538	–	3000	3800	1880	
	Gerat 58	55	Not in Service			1.8	420.7	1.41	3795.5	–	3000	3800	1070	
19.	5 cm. FuK 38 (L/50)	50	Dig1.R.R- G 0.5	300 x 2.4/1	.755	2.1	335	1.1	1973.5	5.3	2800	3300	930	A.P.
					"	1.86		"	"					H.E.
18	5 cm. FuK 38 (L/60)	50	Dig1.R.R.-G 0.6-	310 x 3/1	.900	2.06	377	1.21	2473.5	6.3	2800	3300	835	A.P.
24			Gu.R.P.-A 0 -	4 x 4 x 0.6	.836	1.86	"	"	"	"			550	H.E.
7.			Dig1.R.P.-10.5-	345 x 14/18 (1 tube)										
10.			Dig1.R.P.-8.2-	288 x 2.8/ 0.85	.709	0.90	"	"	"	"			1190	A.P. 40

Sheet 3

Powder No.	Gun	Calibre mm.	Powder Type	Powder Size mm.	Charge wt. kgs.	Shot wt. kgs.	Chamber Length mm.	Chamber Cap. litres	Shot travel mm.	Total cap. litres	Pressure Working kg/sq.cm.	Pressure Design kg/sq.cm.	M.V. m/s	Projectile
11.	5 cm. PaK. (K.h.T.) (Casemate & tower)	50	Digl.R.R-8.2-	310 x 4.4/2	.770	2.06	335	1.1	2973	7.3	2300	3300	870	nose A.P.
7.			Digl.R.R-10.5-	3 x 3 x 0.8	.216	1.82							575	fuze H.E.
7.			Digl.R.P.-10.5-	285 x 7⅝ (1 tube)										
	5 cm. PaK. (K.h.T.) (Casemate & tower)	50	As first two charges of PaK 38 (L/60)			2.06 1.82	389.3	1.23	2973.5	7.19	2600	3500	870 575	A.P. H.E.
12.	5 cm. PaK automatic	50	Digl.R.R-G 1-	835 x 2.5/1	.655	2.06 2.195	292.3	.823	3038	7.48	2900	3500	850 860	A.P. H.E.
15.	Gerat 58	50	Digl.R.P.-RD.5-	370 x 3.6/1.5	1.02	2.0	388	1.41	3880	9.05	3000	3700	1020	A.P. 5-3 cals.
18.	7.5 cm. KwK.40 & 7.5 cm. Stu.K.40 (Tank and S.P.)	75	Digl.R.R-GO.5-	420 x 3.8/1.5 370	-	6.8 4.10 9.74 6.2 4.57 4.4 5.0	537.6	3.17	-	-	-	3600	790 980 585 555 485 485 465	A.P.38 A.P.40 H.E.38 H.E.(many bond H.E.38 H.E.38 H.E.38
31. 18. 19.	7.5 cm. Kw K.42	75	Gu. R.P.-G 1- or Digl.R.P.-G 1- Digl.R.P.-GO.6-	560 x 4.1/1.5 560 x 5/2 530 x 6/4	4.12 4.12 2.3	6.8 " 5.74	609.2 578.2	5.1 4.9	4416 4447	25.1	3000 1300	3600 "	955 " 700	A.P.38/42 " H.E.42
- 4. 13.	7.5 cm. S.K. C/34 (L/33)	75	Nz. R.P. or Ngl. R.P. or R.P. 38N	300 x 6.5/1.8 290 x 4.2/2.6 290 x 3.9/2.6	0.93 1.00 0.90	5.85	325.5	1.45	2179.5	11.34	2400	2900	620	H.E.
1.	1. I G 18 (L/11.8) (For infantry)	75	1. Ngl.Pl.P-12.5-	50 x 0.2	.0155	5.45	60.6	0.24	721.2	3.58	1400	1800	95	H.E.
			2. Ngl.Pl.P-12.5-	73.5 x 0.8	.0220								113	"
			3. "	"	.0310								134	"
			4. "	"	.0475								172.5	"
			5. "	"	.0715								231	"
			Wt. of Ch. 1 is included in Ch. 2 to 5 to give total wt. of the composite charge.											
			1. "	50 x 0.2	as	6.00							92	H.E.
			2. "	73.5 x 0.8	above								109.5	"
			3. "	"									131.5	"
			4. "	"									157	"
			5. "	"									211.5	"

Sheet 3

Powder No.	Gun	Calibre mm.	Powder Type	Powder Size mm.	Charge wt. kgs.	Shot wt. kgs.	Chamber Length mm.	Chamber Cap. litres	Shot travel mm.	Total cap. litres	Pressure Working kg/sq.cm.	Pressure Design kg/sq.cm.	M.V. m/s	Projectile
1.	7.5 cm. Kw.K & Stu. G. (Tank & S.P.)	75	Ngl.Bl.P.-12.5- plus Ng.R.P.	50 x 0.2 / 135 x 5.5/2	.040 / .370	5.74	183.7	0.8	1363.5	7.2	2400	2800	420	H.E. 34
						6.80							385	H.E.
			Total ch. wt. .410 kgs.			4.40							450	H.E. 38
						6.80							420	Amt. iron band
						6.80							450	soft.
7.	Geb. Gesch. 36 (Mountain Gun)	75	1. Digl.R.P.-10.5	8 x 8/1	.125	5.74	186	0.9	1054	5.75	2800	3100	200	H.E. 34
			2. "	"	.158								240	
			3. "	"	.203								285	
			4. "	"	.273								354	
9.			5. Digl.R.P.-9.5-	130 x 2.5/1	.530								475	
			Ch. is all one size, not composite.											
8.			1. All charges as above.			5.83							200	H.E. (Aluminium fume)
			2.										238	
			3.										280	
			4.										358	
9.			5.										475	
2.	Geb. K.15 (Mountain gun)	75	1. (Ngl.Bl.P.-	10 x 10 x 1.5	.147	5.74	160.4	0.7	829.6	4.5	2100		255	)
			2. (12.5-		.182	"							283	) H.E. 15 [illegible]
			3. ((inc. 60 gms. 4 x 4 x 1)		.232	4.56							304	)
1.			4. Ngl.R.P.-9.5-	12.5 x 3/1.8	.330	"							328	) H.E. 15
4.			(inc. 10 gms. Ngl.Bl.P.-12.5- 50 x 0.2)											
			Ch. 4 does not contain any Ngl. Bl.P. from the other charges.											
7.	l. F.K. 18 (light field gun)	75	1. Digl.Bl.P.-10.5	50 x 0.15	.074	5.83	248.5	1.25	1680.7	8.05	2500	2800	185	) H.E. [illegible]
			2. Digl.R.P.-G 0.5-	170 x 2/1	.344	"							370	)
12.			3. "	"	.509	"							500	)
			Wt. of ch. 2 and 3 is total wt. of composite charge											
1.	s. Gr. W. 34 (Heavy mortar)	80	1. Ngl.Bl.P.-12.5-	1 x 1 x 0.2	.010	3.5	–	–		–	400	850	75	) Wgr. [illegible]
			2. Ngl.Rg.P.-12.5-	0.4 x 60/30	.019	"							105	) (Mortar
			3. "	"	.057	"							150	) bomb)
			4. "	"	.024	"							150	)
			Ch. 1 is the primary and its wt. is included in other charges.											

Sheet 4

Powder No.	Gun	Calibre mms.	Powder Type	Powder Size	Charge wt. kgs.	Shot wt. kgs.	Chamber Length mms.	Chamber Cap. litres	Shot travel mms.	Total cap. litres	Pressure Working kg/sq.cm.	Pressure Design kg/sq.cm.	M.V. m/s	Projectile
4.	8.8 cm. S.K. C/35, C/31 or L/7.5	88	R.P.C/32	800 x 8.75/4	4.55	9.0	838.5	6.35	5501.5	41.43	3100	3900	1080	H.E. L/4.4
6.			or R.P.C/32	800 x 5.5/2	4.68	"							"	nose fuze
12.			or R.P.C/38	800 x 5.5/1.9	4.50	"							"	
			R.P.C/32	800 x 7/5.85	2.70	"							825	ditto
			or R.P.C/38	800 x 7/4.9	2.70	"							"	H.E. or
20.			or R.P.40	785 x 4.3/3.0	2.80	"							"	practice.
+			R.P. for Lg-4.75-	785 x 5/4	2.10	9.4							650	Star L/4.5
25a.			or Lg P.40	785 x 4.5/3.5	2.05	"							"	
4.	8.8 cm. Pbts. K. L/45 (Torpedoboat gun)	88	(Ngl. R.P.	290 x 4.5/2)	1.420	9.75	321	2.33	3410	23.82	2600	2900	650	H.E. L/3.9
6.			("	290 x 4.5/2.5)									"	or L/3.8, both
12.			or R.P.C/38	290 x 4.0/1.8	1.48	"							"	nose fuse.
25a.			Lg. P.40	255 x 4.2/3.2	0.85	8.0							450	Star L/3.5.
6.	8.8 cm. S.K.C/30	88	R.P.C/32	495 x 5/2.75	2.38	9.0	530.7	3.67	3175.3	23.58	2750	3100	795	H.E. L/4.5
12.			or C/32, or C/38	495 x 5.5/2.75	2.53	"							"	nose fuse.
20.			or R.P.40	490 x 4.3/1.7	2.90	"							"	
25a.			Lg.P.40.	480 x 4/2.4	2.15	9.4							650	Star L/4.4
6.	8.8 cm. S.K.C/32	88	R.P.C/32	495 x 4.75/1.5	3.02	9.0	530.7	3.67	5809.8	36.50	3150	3600	950	As
12.			or R.P.C/38	495 x 4.5/1.5	"	"							"	above
25a.			Lg.P.40	480 x 3.0/2.8	1.70	9.4							650	
6.	8.8 cm. S.K.C/35	88	R.P.C/32	320 x 4.2/3	1.75	9.0	348.7	2.49	-	23.40	2500	3000	700	As
12.			or R.P.C/38.	320 x 4.2/2	1.78	"							"	above
21.			or R.P.40N	300 x 3.6/1	2.10	"							"	
25.			Lg.P.40N.	305 x 2.5/1	1.60	9.4							800	
11.	8.8 cm. Flak 18 and 36	88	Dig.R.P.-K1-	500 x 4.5/1.8	2.85	9.0	530	3.67	4159.3	29.61	2800	3350	840	H.E. L/4.5
15.			Dig.2.P.-8.2-	495/x 5.5/2.75	2.55	"							"	nose fuse.
24.			do.	460 x 5.5/2.75	2.55	9.5							830	A.P.
30.	8.8 cm. Flak 41	88	Gu.R.P.-K N-	740 x 4.2/1.5	5.5	9.4	980	6.80	5510	40.3	3000	3800	1000	H.E. L/4.7
28.			Gu.R.P.- 7.5-	740 x 4.7/1.5	5.5	10.2							880	A.P. 39

Sheet 5

Powder No.	Gun	Calibre mms.	Powder Type	Powder Size	Charge wt. kgs.	Shot Wt. kgs.	Chamber Length mms.	Chamber Cap. litres	Shot travel mms.	Total cap. litres	Pressure Working kg/sq.cm.	Pressure Design kg/sq.cm.	M.V. m/s.	Projectiles
31.	8.8 cm. Kw.K.43 and PaK 43	88	Gu.R.P.-G 0 -	$\frac{700}{650}$ x 8/6	3.4	9.4	746	8.8	6010	41.82	--	-	750	H.E. 43
19.		or	Digl.R.P.-G 1 -	$\frac{700}{650}$ x 6/4.5	"	"	"	"					"	"
31.			Gu.R.P.-G 0 -	$\frac{735}{650}$ x 5.1/2	6.8	10.16	781	9.0			2900	3800	1000	A.P. 39/43
18.		or	Digl.R.P.-G 0 -	$\frac{735}{650}$ x 6.1/2.5	7.0	"	"	"					"	"
	The double numbers under sizes mean two lengths of tube.													
12.	10.5 cm. S.K. C/28	105	R.P. 38	780 x 6.8/3.2	5.65	14.7	813.9	8.36	4616.8	49.46	2700	3900	925	H.E. L/4.1
25a.			Lg.P.40	780 x 4.5/3.5	2.80	14.6					2300		650	Star L/4.2
6.	10.5 cm. S.K. C/32	105	R.P. 38	550 x 6/3.5	4.05	15.1	586.5	5.38	3813.5	39.25	2850	3200	785	H.E. L/4.4
12.		or	R.P. 38	550 x 6/3	4.10	"							"	"
21.		or	R.P.40N	540 x 4.4/1.7	4.90	"							"	"
25a.			Lg.P.40	544 x 4.2/2.6	3.15	14.7							650	Star L/4.1
6.	10.5 cm. S.K. C/33	105	R.P.38	665 x 6.25/3	5.02	15.1	698	7.31	5650	58.15	2850	3600	907	
21.		or	R.P.40N	665 x 5.6/2.2	5.80	"							"	As
25a.			Lg.P.40	665 x 4.2/3.2	2.85	14.7							650	above
25.		or	Lg.P.40N	665 x 3.7/2.5	"	"							"	
11.	10.5 cm. Flak 38	105	Digl.R.P.-8.2-	665 x 6.25/3	5.00	15.1	698	7.31	5650	58.15	2850	3400	900	H.E. L/4.4
16.		or	Digl.R.P.-K 2-	665 x 5.2/1.5	6.00	"							"	"
11.			Digl.R.P.- 8 -	665 x 6.25/3	5.00	15.56							880	A.P.

Powder No.	Gun	Calibre mms.	Powder Type	Powder Size	Charge wt. kgs.	Shot wt. kgs.	Chamber Length mms.	Chamber Cap. litres	Shot travel mms.	Total cap. litres	Pressure Working kg/sq.cm.	Pressure Design kg/sq.cm.	M.V. m/s	Projectile
7.	1. F.H. 18 (light howitzer) or 1. F.H. 18 M (with muzzle brake)	105	1. Digl.Bl.P.-10.5	3 x 3 x 0.8	.245	14.81	211.7	2.3	2493.3	24.4	2500	2650	208	H.E.
			2. "	"	.308	"							240	"
			3. "	"	.378	"							272	"
			4. "	"	.498	"							326	"
			5. "	"	.685	"							401	"
			6.("	"	.222)	"	Total ch.wt. 1.022 kg.						460	"
			(plus "	4 x 4 x 1.2	.800)	"							)	
8.			Alternative charges giving the same velocities are as follows.											
24.			1. Digl.Bl.P.-10.5	10x10x0.2	.190									
			2. Gu. Bl.P.-A 0 -	4 x 4 x 0.6	.262									
			3. "	"	.342									
			4. "	"	.479									
			5. "	"	.695									
			6.("	"	.260)		Total ch.wt. 1.080 kg.							
			(plus "	8 x 8 x 0.9	.820)									
8.			1. Digl.Bl.P.-10.5	10x10x0.2	.190									"
—			2. Nz.Bl.P.	6 x 6 x 1	.254									"
			3. "	"	.328									"
			4. "	"	.470									"
			5. "	"	.692									"
—			6. Nz.R.P.	175 x 5.5/2	1.060									"
			Wts. of ch. 2 to 5 include ch. 1 in the composite charges. Ch. 6 does not include ch. 1.											
18.	n. 10 cm. K (M.T.) (casemate & tower)	105	Digl. R.P.-G 0.5-	345 x 3/1.2	2.65	14.95	385	3.64	2565	26.85	2800	3150	630	H.E. 34
			Nz.R.P.	345 x 5.9/1.3	2.20	14.00							640	"
19.	n. 10 cm. K.12 (heavy gun)	105	Digl.R.P.- G 0.5-	450 x 3.1/1.5	2.40	15.14	791.5	7.80	4300.5	47.40	2700	3150	550	H.E. 19
			"	"	3.40	"							690	"
22.			Digl.R.P.-G 2 -	750 x 5.9/3.0	5.75	"							655	"

Powder No.	Gun	Calibre mm.	Powder Type	Powder Size	Charge wt. kgs.	Shot wt. kgs.	Chamber length mms.	Chamber Cap. litres	Shot travel mms.	Total cap. litres	Pressure Working kg/sq.cm.	Pressure Design kg/sq.cm.	M.V. m/s	Projectile
12	s. 10 cm. K 18/40	105	Dgl.R.P.-G 0.5-	600 x 3.1/1.5	2.94	15.14	1034.5	10.18	5010	54.28	2800	3260	550	H.E. [illegible]
			"	"	3.95	"							690	
22.			Dgl. R. P. - G 2-	350 x 5.5/2.5	6.80	"							915	"
8.	10 cm. Geb. Hach. (Mountain How.)	105	1. Dgl.Bl.P.-10.5-	10 x 10 x 0.2	.242	14.81	158	1.9	1417	14.49	2600	3000	216	H.E. as for
			2. "	"	.277								237	I.P.S. 16.
26.			3. Gu.Bl.P.- A 0-	4 x 4 x 0.6	.332								262	"
			4. "	"	.457								299	"
			5. "	"	.577								352	"
			6. "	"	.837								438	"
			7. ("	"	.100)								566	"
			(plus Gu.Rg.P.-A 0.25- 1.9 x 154		1.170) total ch. wt. 1.270 kg.									
			Ch. 5 to 6 include wt. of ch. 2 in the composite charge.											
			Alternative charges to give the same velocities.											
7.			1. Dgl.Bl.R-10.5-	3 x 3 x 0.8	.275									"
			2. "	"	.325									"
			3. "	"	.380									"
			4. "	"	.482									"
			5. "	"	.615									"
			6. "	"	.875									"
			7. DglRg.P-10.5	1.9 x 15/4	1.800									"
			8. Dgl.R.P.-G 0.5-	280 x 2.9/1.5	2.140									"
26.	L.F. [illegible] recoilless)	105	(Gu.R.P.-A 1-	280 x 2.6/1.0	2.630)	14.81	481	5.4	899	13.5	2150	2500	350	H.E. as for
			plus "	60 x 2.6/1.0	0.430)									I.P.S. 18.
6.	[illegible] cm. G.K. 6/34	128	R.P. 38	690 x 8/4.25	8.50	28.0	619	12.10	4011	75.9	2900	3500	630	H.E. [illegible]
12.			or R.P.38	690 x 6.4/2.1	"	"							"	"
18.			or R.P.38H	690 x 3.5/4.1	"	"							"	"
24.			Lg. P.40	690 x 6.5/4.5	5.75	37.4					2000		650	Star [illegible]
25.			or Lg. P.40H	690 x 5.6/3.8	5.60	"							"	"

Sheet 3

Powder No.	Gun	Calibre mm.	Powder Type	Powder Size	Charge wt. kgs.	Shot wt. kgs.	Chamber Length mms.	Chamber Cap. litres	Shot travel mms.	Total cap. litres	Pressure Working kg/sq.cm.	Pressure Design kg/sq.cm.	M.V. m/s	Projectile
16.	12.8 cm. Flak 40	128	Digl.R.P.-K N-	850 x 5.4/2.0	9.50	26.0	906	14.37	6584	100.94	2850	3400	900	H.E. L/4.5
17.			or Digl.R.P.-KHD-	815 x 6.1/2.5		"							"	"
18.			Digl.R.P.- 8 -	880 x 7.25/3.8	8.25	28.0							880	A.P.
21.	12.8 cm. Flak 40N	128	R.P. 40N	850 x 6.5/2.5	10.0	28.0	------	As for Flak 40		------	2950	3300	900	A.P.
14.			or R.P.-E-	815 x 6.1/1.8	10.0	"								
+	12.8 cm. Flak 40 (increased velo'y	128	Gu.R.P.-E 2-	950 x . . .	14.0	28.0	1231	19.1	8259		2850	3400	880	H.E. L/5
34.	12.8 cm. Pak 44 (Tank destroyer)	128	Gu.R.P.-G 0.5-	880 x 5.8/2.5	15.1	28.3	961	20.4	5829	95.4	3000	3700	940	A.P. 43
			"	"	12.0	28.0							770	H.E. L/5
6.	15 cm. S.K. L/40 (40 calibre)	149.1	R.P. 38	550 x 8/2.5	10.34	40.0	731	14.2		100.2	3100	3600	800	A.P. L/2.9
						"							"	or H.E. L/3.2
						"							"	or H.E. L/3
26a.			Lg.P. 40	550 x 5/2.3	8.50	37.0							500	Star L/3.6
6.	15 cm. Utw K L/45 (U boat gun)	149.1	R.P. 38	550 x 8/2.5	8.84	45.3	749	14.08	5592	114.1	2100	2700	680	H.E. L/4.1
12.			or R.P.38	535 x 6.5/2.8	8.50	"							"	"
15.			or R.P.38N	535 x 7/3.1	8.30	"							"	"
26a.			Lg.P.40	550 x 4.5/2.0	7.95	41.0							650	Star L/4.3
6.	15 cm. S.K. L/45	149.1	R.P. 38	825 x 8/3.5	14.25	45.3	1150	21.6	5176	114.4	2950	3400	835	H.E. L/4.6
12.			or R.P.38	825 x 7.5/3	"	"							"	or L/4.5
26a.			Lg.P.40	825 x 5.5/3.5	9.50	41.0							650	Star L/4.3
6	15 cm. S.K. C/28	149.1	R.P.38	825 x 8/3.5	14.25	45.3	1151	21.7	6065	141.3	2900	4000	875	as above.
12.			or R.P.38.	825 x 7.5/3	"	"							"	
26a.			Lg.P.40	825 x 6.3/4.6	9.20	41.0							650	
	15 cm. S.K. L/55	149.1	as above	as above	as above	as above	1151	21.7	6065	141.1	2800	3600	875	as above.
													"	
													850	

Chart 9

Powder No.	Gun	Calibre mm.	Powder Type	Powder Size	Charge wt. kgs.	Shot wt. kgs.	Chamber Length mm.	Chamber Cap. litres	Shot travel mm.	Total cap. litres	Pressure Working kg/sq.cm.	Pressure Design kg/sq.cm.	M.V. m/s	Projectile
12 6 26a	15 cm. S.K. C/25	149.1	R.P. 38 or R.P. 38 Lg.P.40	1150 x 10/4.4 1150 x 11/5.75 1150 x 8/6.4	10.1 " 9.2	45.5 " 41.0	1398	27.7	7174	158.3	3000	3750	980 " 650	(H.E. L/4.4 (or L/4.5 Star L/4.3.
6 12 26a	15 cm. Tbts K/36 (torpedoboat gun)	149.1	R.P. 38 or R.P. 38 Lg.P.40	825 x 8/4.8 825 x 7.5/3 825 x 5.5/3.5	14.0 " 9.5	45.3 " 41.0	1150	21.7	5885	123.2	3000	3500	875 " 650	H.E. L/4.6 " Star L/4.3
1. 7.	s.I.G. 33 (heavy infantry gun)	150	1. Digl.Bl.P.-10.5- 2. " 3. " 4. " 5. " 6. "	3 x 3 x 0.8 " " " " "	.172 .275 .390 .485 .578 .618	38.0 " " " " "	80	1.7	1385	-	1810	2250	129 157 190 216 237 247	H.E. 33 or 36 " " " "
	All above ch. wts. include .150 kgs. of Ngl. Bl.P.-12.5 - 40 x 40 x 0.2													
26.	Alternative charges for same velocities 1. Gu.Bl.P.-A 0- 2. " 3. " 4. " 5. " 6. "			4 x 4 x 0.8 " " " " "	.194 .305 .439 .545 .633 .677									
	All those alternative ch. wts. include .150 kgs. Digl. Bl.P.-10.5- 10 x 10 x 0.2													
7.	s.F.H. 18 (heavy howitzer)	150	1. DigLBl.B-10.5- 2. " 3. " 4. " 5. " 6. "	4 x 4 x 1.2 " " " " "	.615 .740 .870 1.085 1.395 1.870	43.5	364	7.22	3781	75	2500	2920	216 237 258 288 330 388	H.E. 19 or 19 Eo (anti-concrete)
7.			7. Digl.Bg.P.-10.5- 8. "	1.9 x 15/4 "	2.910 3.665								448 525	
	All charges are composite, wts. of Ch. 1 to 6 include .550 kgs. Ngl.Bl.P.-12.5- 40 x 40 x 0.2, and wts. of chs. 7 and 8 include .440 kgs. Digl.Bl.P.-10.5- 3 x 3 x 0.8.													

Powder No.	Gun	Calibre mms.	Powder Type	Powder Size	Charge wt. kgs.	Shot wt. kgs.	Chamber Length mms.	Chamber Cap. litres	Shot travel mms.	Total cap. litres	Pressure Working kg/sq.cm.	Pressure Design kg/sq.cm.	M.V. m/s	Projectile
	s.F.H. 18	150	Alternative charges for the same velocities.											
8.	(Heavy Howitzer)		1. Digl.Bl.P.10.5-	10x10x0.2	.710	including .010 kgs. N.P.								
26.			2. Gu.Bl.P.-A 0-	8 x 8 x 0.9	.840									
	(contd.)		3. "	"	.985	including ch. 1.								
			4. "	"	1.222									
			5. "	"	1.535									
			6. "	"	1.985									
18.			7. Digl.R.P.-G 0-	280 x 5/1.2	3.855	including .075 kgs. N.P.								
			8. "	"	4.805									
			Special ch. for rocket shell.											
19.			Digl.R.P.-G 1-	380 x 3.8/1.3	5.800								535	R. Shell 19
18.	15 cm. K. 18 and	150	Digl.R.P.-G 1-	530 x 3.8/1.3	8.0	43.0	1270	24.0	6584	144	3000	3600	638	H.E. 18
22.	15 cm. (Kh T)		Digl.R.P.-G 2-	455 x 7.5/3.4	16.8								805	"
	(casemate & tour)		"	"	18.3								880	"
7.	s.H.T. (Heavy howitzer for fortifications)		1. Dig.Bl.P.-10.5-	4 x 4 x 1.2	.95	43.5	505.5	10.1	4354.5	89.1	2700	3150	235	H.E. 19
			2. "	"	1.08								250	"
			3. "	"	1.19								270	"
			4. "	"	1.37	including .40 kgs. Ngl.Bl.P.-12.5- 40 x 40 x 0.2							296	"
			5. "	"	1.59								336	"
			6. "	"	2.13								388	"
—			7. Digl.R.P.-G 1-	460 x 5.6/3	5.985								490	"
			8. "	"	7.575	including .075 kgs. Nz. Man. N.P. 1.5 x 1.5.							632	"
			Alternative charges for the same velocities.											
7.			1. Digl.Bl.P.-10.5-	10 x 10 x 0.2	.87	including .10 kgs. N.P.								
26.			2. Gu.Bl.P.-A 0-	8 x 8 x 0.9	.96									
			3. "	"	1.11									
			4. "	"	1.30	including ch. 1.								
			5. "	"	1.535									
			6. "	"	2.075									

Powder No.	Gun	Calibre mms.	Powder Type	Powder Size	Charge wt. kgs.	Shot wt. kgs.	Chamber Length mms.	Chamber Cap. litres	Shot travel mms.	Total Cap. litres	Pressure Working kg/sq.cms.	Pressure Design kg/sq.cms.	M.V. m/s	Projectile
-	17 cm. K. L/50		Ns.M.P.	1.5 x 1.5	.08		1852.4	42.0	6448	196.6	3200	3750		H.E. 39 wt. 68 kgs.
29.			Digl.R.P.-G 2.5-	660 x 34.6/30	.25	Main charge, total wt. 19.08 kgs.							635	
			"	660 x 7.6/3	18.75									
-			Ns. Man. M.P.	1.5 x 1.5	.04	Fore charge 3, total wt. 9.70 kgs., fired with								
29.			Digl.R.P.-G 2.5-	660 x 29.6/25	.54	main charge to give ch. wt. 28.78 kgs. and velocity							755	
			"	760 x 7.6/3	9.12									
			Digl.R.P.-G 2.5-	660 x 7.6/3	1.75	Fore charge 4, put in central tube of fore charge 3 to increase velocity in worn gun.								
			Ns. Man. M.P.	1.5 x 1.5	.10	Special charge 1, total wt. 15.5 kgs., fired with main								
22.			Digl.R.P.-G 2-	980 x 7/4.2	15.40	charge to give ch. wt. 34.58 kgs. and velocity							875	
			Digl.R.P.-G 2-	980 x 7/4.2	4.4	Special charge 2 wrapped round special charge 1 to give total charge wt. 38.98 kgs. and velocity							940	H.E. 38 wt. 62.8 kgs.
6.	17 cm. S.K. L/40	172.6	R.P. C/32	1040 x 10/4.8	22.5	64.0	1304	32.5	5087.5	152.5	2930	3800	850	A.P. L/3 or H.E. L/3 or L/3.3 (both base fuse.)
18.			R.P. C/38	1040 x 9.5/3.8	23.5	62.8								
20.			Lg.P.40	1048 x 7.5/5.2	14.15	58.7							875	H.E. L/4.7
													650	Star L/3.7
6.	20.3 cm. C/34a	203	R.P.C/32	835 x 12/5	43.55	122	1882	70.3	9645	390.8	3200	3700	925	-
			or R.P.38		45.0									
25a			Lg.P.40	835 x 5/2	27.0								700	
These charges contain small amounts of other stick lengths which are included in the ch. wt.														
4.	21 cm. S.K.L/45	209.3	R.P.C/12	845 x 12/5		108	1302	48.9	7524	313.7	3400	3800	900	A.P. L/2.9 or practice L/2.9 or H.E. L/4.3 of wt. 113.5 kgs.
6.			or R.P.C/32	845 x 9/3.75		Or with small Service charge velocity							800	
12.			or R.P.C/38	845 x 9/3.0										
There are also reduced charges for velocity 800 m/s.														

Powder No.	Gun	Calibre mms.	Powder Type	Powder Size	Charge wt. kgs.	Shot wt. kgs.	Chamber Length mms.	Chamber cap. litres	Shot travel mms.	Total cap. litres	Pressure Working kg/sq.cm.	Pressure Design kg/sq.cm.	M.V. m/s	Projectile
7.	21 cm. Mrs. 18 (Mortar)	210	1. Digl.Rg.P.-10.5-	1.9 x 15/4	2.48	113	643.5	24.5	5436.5	219	2550	2970	232	H.E. 18 or
			2. "	"	3.01								263	H.E. 18 Re
			3. "	"	3.72	These wts. include 1.00 kgs. Digl.Bl.P.-10.5-							299	of wt.
			4. "	"	5.21	3 x 3 x 0.8 plus .05 kgs. Nz. Man. K.P. 1.5 x 1.5							366	121.4 kgs.
18.			5. "	"	7.35								453	(Re means
			6. Digl.R.P.-6 1-	500 x 5.4/3	15.80	including .10 kgs. Nz. Man. K.P. 1.5 x 1.5							582	anti-concrete
26.			Alternative charges for the same velocities.											
			1. Gu.Rg.P.-A 1.2-	1.8 x 15/4	2.67									
			2. "	"	3.29									
			3. "	"	4.03	These wts. include 1.00 kgs. Gu.Bl.P.-A 0-								
			4. "	"	5.02	4 x 4 x 0.6 plus 0.5 kgs. Nz.Man.K.P. 1.5 x 1.5.								
			5. "	"	7.05									
32.	K.12 (120 km. range)	211	Gu.R.P.-C 4-	805/700 x 14/4	75	107.5	4518	343	27805	1337	4125	4800	1500	H.E.
						total 241 kgs. (main plus 1st and 2nd fore charges)								
			plus . . .	1800 x 14/4	188									
			Gu.R.P.-C 4-	865 x 14/4	23	Third fore charge to increase velocity to							1625	"
6.	24 cm. S.K.L/40 or Theodor K(E) (Railway mounting)	238	R.P. 38	1040/346 x 12/6.6	44.5	140	1503.5	73.8	7362	405.8	2700	3550	835	A.P. L/2.6
						151								
12.			or R.P.38	1040/346 x 12.2/6.6	43.0	148.5							810	H.E. L/4.1
													810	H.E. L/4.2
						There are also small Service charges of 37.6 and 35.0 kgs. respectively to give velocities of							(710	as above.
													(690	
													(690	
12.	24 cm. S.K.L/50	-	R.P. 38	1040/346 x 12/4	65.0	(148.5	1830	90.0	9288	513.4	2810	3200	900	H.E. L/4.2
						(140							925	A.P. L/2.6
23.	K. 3 (30 km. range)	240	Digl.R.P.-C 3-	1330/600 x 10/4	78.0	153.3	2006	110	10459	589	3100	3600	970	H.E. 35
			"	"	66.0	"							880	"
6.	28 cm. S.K.C/34	283	R.P. 32	1230/1040 x 10/7	110.8	330	2619	180	11686	948.2	3200	3700	890	
12.			or R.P.38	1230/1040 x 15/4.9	114.9									

Powder No.	Gun	Calibre mms.	Powder Type	Powder Size	Charge wt. kgs.	Shot wt. kgs.	Chamber Length mms.	Chamber Cap. litres	Shot travel mms.	Total cap. litres	Pressure Working kg/sq.cm.	Pressure Design kg/sq.cm.	M.V m/s	Projectile
6.	28 cm. S.K. L/50 or long Bruno K (E) (Railway mounting)	283	R.P. 32	$\frac{1230}{820}$ x 16/6.7	104.5	302	2192	150	11229	874.2	3100	4100	845	A.P. L/3.2 (or H.E. L/3.6
12.			or R.P. 38	$\frac{1230}{830}$ x 16/6	105.5									
13.			or R.P. 38M	$\frac{1190}{820}$ x 14.8/4.9	111.0	284 Each charge may be fired with any projectile.							860	H.E. L/4.4
6.	28 cm. S.K. C/28	283	R.P. 32	$\frac{1230}{870}$ x 15.5/6.9	100.6	300	2333	160	11572	907.9	3300	3700	910	H.E. L/4.2 (or A.P. L/3.7
12.			or R.P. 38	$\frac{1230}{870}$ x 16/7.2	105.2									
4.	28 cm. S.K. C/40	283	R.P. 32	1230 x 10/4.7	65	240	1842	122.8	8559	670.8	3100	3300	820	A.P. L/2.6
12.	or short Bruno K (E) (Railway mounting)		or R.P. 38	1230 x 11/5.1	67									or H.E. L/4.3 or H.E. L/4.1
24.	K.5 (50 Km. range)	280	Digl. R.P.-C 5 -	820 x 12.7/5.6	165	255	2943	240.0	17607	1371.6	3200	3750	990	H.E. 35
			or plus "	300 x 12.7/5.6	21	"							1150	
	This gun also fires a rocket shell with M.V. of 1120 m/s but a range of 85 Km.													
24.	Bruno M.K.	280	Digl. R.P.-C 5 -	$\frac{770}{810}$ x 13/5.2	186	285	2766	229.7	12600 approx	1040.9	3200	3700	960	H.E. L/4.4
6.	30.5 cm. S.K. L/50	305	R.P. 32	$\frac{1230}{1240}$ x 16/6.7	122.4	405	2528	199.3	11933	1093.8	3000	3900	855	H.E. L/3.8 or A.P.
					142.4	250	2493	197.5	11968	"	3350	"	1120	H.E. L/3.6
12.			or R.P. 38	$\frac{1230}{1240}$ x 18/8	123	405	2528	199.3	11933	"	3000	"	855	H.E. or A.P. L/3.4
					143	250	2493	197.5	11968	"	3350	"	1120	H.E. L/3.6

Sheet 14

Powder No.	Gun	Calibre mms.	Powder Type	Powder Size	Charge wt. kgs.	Shot wt. kgs.	Chamber Length mms.	Chamber Cap. litres	Shot travel mms.	Total cap. litres	Pressure Working kg/sq.cm.	Pressure Design kg/sq.cm.	M.V. m/s	Projectile
22.	M. 1	350	1. Digl.R.P.-G 2-	800 x 5/3	33.4	575	1603	168.5	7997	939	2500	3000	340	Anti-con-
			2. "	"	43.4								402	[illegible]
			3. "	"	60.4	All ch. wts. include .4 kgs. N.P. 1.5 x 1.5.							480	
23.			4. Digl.R.P.-G2.5-	1000 x 9.6/5	95.4								582	
6.	38 cm. S.K. C/34	380	R.P. 38	850 x 16.6/6.8	200	800	2230	319	16175	2204	3200	3700	820	
12.			or R.P. 38	850 x 17/7	208									
32.	Siegfried K. (Coast defence)	380	Gu. R.P.-G 5-	820/1300 x 10.5/3.5	300	495	2479	361.7	15926	22.7	3200	3700	1050	Light proj.
					253	495	"	"	"	"	"	"	[illegible]	-
					261	800	2464	360	15941	"	3000	"	820	Heavy proj.
32.	Adolf K. (Coast defence)	406.4	Gu. R.P.-G 5-	1290/865 x 10/3	350	600	2676	460	17074	2732	3200	3650	1050	Light proj.
					307	1030				"	3100	"	810	Heavy proj.
9.	Gamma Mrs (Heavy mortar)	420	1. Digl.R.P.-9.5-	550 x 13/5	58.3	1020	909	135	5431	911	2800	3050	348	[illegible]
			2. "	"	58.3								365	[illegible]
			3. "	"	65.8	All ch. wts. include .3 kgs. N.P. 1.5 x 1.5.							412	
			4. "	"	77.8								465	
	Gerät 36	533.4	Gu. R.P.	-	800	2200	4368	1250	21674	6211	3000	3420	820	
32.	s. Gustav	800	Gu. R.P.-G 5-	1510/1280 x 25/12	1500	7000	4748	3400	27352		-	3000	[illegible]	anti-concrete
					1650	"	"	"	"		-	"	650	
					1800	"	"	"	"		2500	"	710	
					2000	4750	"	"	"		2600	"	850	[illegible]