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PICATINNY ARSENAL
TECHNICAL DIVISION

FRAGMENTATION TEST

RECORD NO. 285

DATE 17 May 1954

SUBJECT: SHELL, HE, 105 MM, T178 (SERIES), METAL
PARTS ASSEMBLY

54AA

45775

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COPY NO. 42

E X C L U D E

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IN ACCORDANCE WITH
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DATED - JULY 1972

**DDG 5000.1R & EXECUTIVE ORDER 11652
(EXECUTIVE ORDER 10501 AMENDED)**

BY

**Defense Documentation Center
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DEC 1972

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**PICATINNY ARSENAL
FRAGMENTATION TEST**

Date: 17 May 1954
Test Record No. 285
Sheet: 1 of 3

REFERENCE

Project No. TA1-1546D, OO 471.381/12(C),
ORDBB 471.14/950-130

**DESCRIPTION OF
AMMUNITION**

Shell, HE, 105 mm, T178 (Series), Metal Parts
Assembly

T178E1 - Class 30 Cast Iron (QQ-I-652)

T178E2 - Class 50 Cast Iron (QQ-I-652)

T178E3 - Class A Malleable Iron (QQ-I-666)

T178E4 - Cast Steel (MIL-S-20556)

(Loaded with 70/30 Baratol, Cast TNT or Comp B)

DWG NO (METAL PARTS)

P-82283, rev 6/28/52

DWG NO (SHELL LDG)

None

QUANTITY IN LOT

2 in each lot

QUANTITY FRAGMENTED

24

METHOD OF FUNCTIONING

Fuze, M54, Mod, (modified for static firing)
Dwg PX-97-287

**FRAGMENTATION
PROCEDURE**

Shell fragmented at ambient temperature.
Shell assembly equipped with electric ignition,
placed in a pine box, with $\frac{1}{2}$ " thick wall. The
overall dimensions of the box were 10" x 10" x 20".
The box was placed on end over 6' of sawdust in
a 14' - 9" deep fragmentation tub, 15' - 5" in
diameter at top and tapering to 13" diameter at
bottom. Box covered with 5 feet of sawdust.

**FRAGMENTATION
RECOVERY AND
CLASSIFICATION**

Fragments were recovered from tub by sifting
the sawdust on a mechanically-operated screen
of No. 4 mesh (.170" opening, .08" wire diameter),
using a magnetic separator.

The fragments were classified by weighing and
grouping according to the following weight zones:

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- Group 0 - 0 to $\frac{1}{2}$ grain
1 - $\frac{1}{2}$ to 2 grains
2 - 2 to 5 grains
3 - 5 to 10 grains
4 - 10 to 25 grains
5 - 25 to 50 grains
6 - 50 to 75 grains
7 - 75 to 150 grains
8 - 150 to 750 grains
9 - 750 to 2,500 grains
10 - Over 2,500 grains

MISCELLANEOUS DATA

The 105 mm, T178 (Series) Shell which were fragmented during the course of this test, were manufactured by the Lehigh Foundries of Easton, Pa. The subject shell were of two-piece silver-soldered base plug construction, as shown on Drawing P-82283, rev 6/28/52. The 105 mm, T178E1 Shell were cast from Class 30, cast iron (QQ-I-652). The 105 mm, T178E2 Shell were cast from Class 50, cast iron (QQ-I-652). The 105 mm, T178E3 Shell were cast from Class A Malleable Iron (QQ-I-666). The 105 mm, T178E4 Shell were cast from Cast Steel (MIL-S-20556).

DISCUSSION:

In analyzing the data, the following curves were employed:

Percent Average Cumulative Weight versus Group Number, for each pair of shell from each type of metal parts and each type of loading.

Twelve curves are inclosed, each of which gives a representation of the data shown on each of the inclosed Fragmentation Test Data Sheets. The "Percent Average Cumulative Weight" is based on the average weight of fragments (vs group no) of each pair of projectiles on the inclosed twelve data sheets.

By definition, the average cumulative weight of fragments equals the average weight of fragments in a group, plus the average weight of fragments of all preceding groups. The percent average cumulative weight of fragments is defined as the ratio of the average cumulative weight to the average weight of the empty shell.

According to information furnished in the 1st Ind, 3/2/54, Watertown Arsenal to PA, ORDBE-L 471.2/1824, ORDBB 471.14/10-122, subject: "Fragmentation Characteristics of Shell and Test Cylinders of Cast and Forged Steels (Project TAL-1546D)", shell fragments in the weight range of 10 - 50 grains constitute the most efficient casualty-producing size of fragment.

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Using this Criterion for evaluating the relative efficiency of the various Shell Material - Explosive Filler combinations, the following table lists the combinations in descending order of lethality:

No.	Explosive Filler	Shell Metal Parts Material	Total wt of frags 10 to 50 grs (avg) X 100 Weight of Empty Shell Metal Parts (avg)
1	Baratol	Class 50 Cast Iron	45.0%
2	Baratol	Class 30 Cast Iron	39.0%
3	TNT	Class 50 Cast Iron	34.0%
4	TNT	Class 30 Cast Iron	27.5%
5	Comp B	Class 50 Cast Iron	27.0%
6	Comp B	Class A Malleable Iron	27.0%
7	Comp B	Cast Steel	27.0%
8	TNT	Class A Malleable Iron	26.0%
9	Comp B	Class 30 Cast Iron	23.0%
10	TNT	Cast Steel	17.0%
11	Baratol	Class A Malleable Iron	17.0%
12	Baratol	Cast Steel	11.0%

A Bar Graph (Curve No. 13) shows, in descending order, the average total number of fragments occurring above 10 grains for each combination of shell metal parts - Explosive Filler fragmented.

The conclusion that Class 50 Cast Iron with Baratol filler is the most desirable is based entirely on the criterion established by Watertown Arsenal as given in correspondence referred to previously.

However, if the assumptions relative to the nature of terrain, effect of fragment velocities, and wound ballistics contained in various Ballistic Research Laboratories Reports, by T. Sterne, et al, are followed, the conclusions probably would be changed and the shell and explosive combinations giving fine degrees of fragmentation might be moved up into higher categories of preference. This involves decisions to be made only after consideration by higher echelons, such as Service Boards, ORO, and WSEG, and probably would require acquiring information on fragmentation velocity and distribution patterns which is presently not available.

G. FLARTEY

George Flartey
S.S., P.S./9.D., *[Signature]*

[Signature]
JOHN D. ARMITAGE
Col, Ord Corps
Director, R & D Div
[Signature]

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ARMY-P. A. DOVER, N. J.

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CATINNY ARSENAL FRAGMENTATION TEST

Projectile: 105mm, HE, T178EL, Cast from Class 30 Test Record No: 6155

Cast Iron (QQ-1-652)

Explosive Filler: TNT Cast

Sheet 1 of 12

Type Fuze: M54 PD Modified for static firing

Date: 30 Sept 52

Dwg. PX-97-287

Size of Box: 10" x 10" x 20", 1/2" Pine

Recovery Medium: Sawdust No. 4 Mesh Screen & Magnetic Separator

		PROJECTILE NO.			
Requested by Mr. P. Sadlon		1		2	
Wt. Empty Lbs.		17.09		17.45	
Wt. Loaded Lbs.		19.92		20.20	
Number and Weight of Recovered Fragments	No. 0 Group Not 0 to 1/2 Grs. Counted	Through a 10 Mesh Screen (U. S. Std Sieve Series) Wt. Lbs.	2.93	2.31	
	No. 1 Group 1/2 to 2 Grs.	No. Wt. Lbs.	15678 2.21	18239 2.51	
	No. 2 Group 2 to 5 Grs.	No. Wt. Lbs.	5746 2.59	5703 2.65	
	No. 3 Group 5 to 10 Grs.	No. Wt. Lbs.	2633 2.62	2704 2.80	
	No. 4 Group 10 to 25 Grs.	No. Wt. Lbs.	1453 3.08	1470 3.27	
	No. 5 Group 25 to 50 Grs.	No. Wt. Lbs.	312 1.50	332 1.58	
	No. 6 Group 50 to 75 Grs.	No. Wt. Lbs.	71 .60	57 .49	
	No. 7 Group 75 to 150 Grs.	No. Wt. Lbs.	27 .40	33 .48	
	No. 8 Group 150 to 750 Grs.	No. Wt. Lbs.	8 .26	5 .12	
	No. 9 Group 750 to 2500 Grs.	No. Wt. Lbs.			
	No. 10 Group 2500 and Larger	No. Wt. Lbs.			
	Total No.		25928	28543	
	Total Wt. Lbs.		16.19	16.21	
	% of Fragments Recovered		94.7	92.8	
	Photo No.		M41485	None	CONFIDENTIAL
			CONFIDENTIAL		

ARMY-P. A. DOVER, N. J.

Projectile: 105mm, HE, T178E2 Cast from Class 50 Test Record No: 6155
Cast Iron (QQ-1-652)
Explosive Filler: TNT Cast Sheet 2 of 12
Type Fuze: M54 PD Modified for static firing Date:
Dwg. PX-97-287
Size of Box: 10" x 10" x 20", 1/2" Pine
Recovery Medium: Sawdust No. 4 Mesh Screen & Magnetic Separator

			PROJECTILE NO.			
Requested by Mr. P. Sadlon			3		4	
Wt. Empty Lbs.			17.51		17.55	
Wt. Loaded Lbs.			20.60		20.68	
Number and Weight of Recovered Fragments	No. 0 Group	Not Through a 10 Mesh Screen (U. S. Std Sieve Series)				
	0 to ¼ Grs.	Counted Wt. Lbs.	1.55		1.97	
	No. 1 Group	No.	13104		11351	
	¼ to 2 Grs.	Wt. Lbs.	1.89		1.62	
	No. 2 Group	No.	5340		6413	
	2 to 5 Grs.	Wt. Lbs.	2.61		2.60	
	No. 3 Group	No.	2541		3219	
	5 to 10 Grs.	Wt. Lbs.	2.55		3.02	
	No. 4 Group	No.	1790		1802	
	10 to 25 Grs.	Wt. Lbs.	3.84		3.92	
	No. 5 Group	No.	418		465	
	25 to 50 Grs.	Wt. Lbs.	2.01		2.25	
	No. 6 Group	No.	105		90	
	50 to 75 Grs.	Wt. Lbs.	.91		.77	
	No. 7 Group	No.	72		44	
	75 to 150 Grs.	Wt. Lbs.	1.02		.60	
	No. 8 Group	No.	22		9	
	150 to 750 Grs.	Wt. Lbs.	.75		.24	
	No. 9 Group	No.				
	750 to 2500 Grs.	Wt. Lbs.				
No. 10 Group	No.					
2500 and Larger	Wt. Lbs.					
Total No.			23392		23393	
Total Wt. Lbs.			17.13		16.99	
% of Fragments Recovered			97.8		96.8	
Photo No.			M41487		None	CONFIDENTIAL
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ARMY-P. A. DOVER, N. J.

CONFIDENTIAL ICATINNY ARSENAL FRAGMENTATION TEST

Projectile: 105mm HE, T178E3, Cast from Class A Malleable (QQ-1-666) Test Record No: 6155

Explosive Filler: TNT Cast Sheet 3 of 12

Type Fuze: M54 PD Modified for static firing Date:

Size of Box: ^{Dwg. PX-97-287} 10" x 10" x 20", 1/2" Pine

Recovery Medium: Sawdust No. 4 Mesh Screen & Magnetic Separator

			PROJECTILE NO.			
Requested by Mr. P. Sadlon			5		6	
Wt. Empty Lbs.			17.76		17.06	
Wt. Loaded Lbs.			20.83		20.44	
Number and Weight of Recovered Fragments	No. 0 Group Not 0 to 1/2 Grs. Counted	Through a 10 Mesh Screen (U. S. Std Sieve Series) Wt. Lbs.	.26		.15	
	No. 1 Group 1/2 to 2 Grs.	No. Wt. Lbs.	1914 .28		2361 .33	
	No. 2 Group 2 to 5 Grs.	No. Wt. Lbs.	866 .38		1150 .53	
	No. 3 Group 5 to 10 Grs.	No. Wt. Lbs.	730 .69		641 .67	
	No. 4 Group 10 to 25 Grs.	No. Wt. Lbs.	772 1.70		719 1.67	
	No. 5 Group 25 to 50 Grs.	No. Wt. Lbs.	589 2.88		526 2.58	
	No. 6 Group 50 to 75 Grs.	No. Wt. Lbs.	261 2.20		248 2.19	
	No. 7 Group 75 to 150 Grs.	No. Wt. Lbs.	285 4.29		281 4.14	
	No. 8 Group 150 to 750 Grs.	No. Wt. Lbs.	147 4.86		130 4.56	
	No. 9 Group 750 to 2500 Grs.	No. Wt. Lbs.			1 .12	
	No. 10 Group 2500 and Larger	No. Wt. Lbs.				
	Total No.		5564		6057	
	Total Wt. Lbs.		17.54		17.04	
	% of Fragments Recovered		98.8		99.8	
	Photo No.		M41489		None	CONFIDENTIAL
	CONFIDENTIAL					

ARMY-P. A. DOVER, N. J.

CONFIDENTIAL ICATINNY ARSENAL FRAGMENTATION TEST

Projectile: 105mm, HE, T178E4 Cast from Cast Steel Test Record No: 6155

Explosive Filler: (M11-S-20556)
TNT Cast

Sheet 4 of 12

Type Fuze: M54 PD Modified for static firing
Dwg. PX-97-287

Date:

Size of Box: 10" x 10" x 20", 1/2" Pine

Recovery Medium: Sawdust No. 4 Mesh Screen & Magnetic Separator

		PROJECTILE NO.			
		7		8	
Requested by Mr. P. Sadlon					
Wt. Empty Lbs.		18.40		18.15	
Wt. Loaded Lbs.		21.37		20.78	
Number and Weight of Recovered Fragments	No. 0 Group Not 0 to 1/4 Grs. Counted	Through a 10 Mesh Screen (U. S. Std Sieve Series)			
		Wt. Lbs.	.21	.21	
	No. 1 Group 1/4 to 2 Grs.	No.	1921	2007	
		Wt. Lbs.	.28	.29	
	No. 2 Group 2 to 5 Grs.	No.	929	1016	
		Wt. Lbs.	.42	.46	
	No. 3 Group 5 to 10 Grs.	No.	538	542	
		Wt. Lbs.	.54	.56	
	No. 4 Group 10 to 25 Grs.	No.	632	612	
		Wt. Lbs.	1.42	1.42	
	No. 5 Group 25 to 50 Grs.	No.	333	344	
		Wt. Lbs.	1.72	1.72	
	No. 6 Group 50 to 75 Grs.	No.	186	175	
		Wt. Lbs.	1.63	1.54	
	No. 7 Group 75 to 150 Grs.	No.	260	279	
		Wt. Lbs.	4.00	4.18	
	No. 8 Group 150 to 750 Grs.	No.	199	204	
		Wt. Lbs.	7.26	7.04	
	No. 9 Group 750 to 2500 Grs.	No.	5	5	
		Wt. Lbs.	.65	.62	
	No. 10 Group 2500 and Larger	No.			
		Wt. Lbs.			
Total No.		5003		5184	
Total Wt. Lbs.		18.13		18.04	
% of Fragments Recovered		98.5		99.4	
Photo No.		M-41491		None	CONFIDENTIAL
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ARMY-P. A. DOVER, N. J.

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Projectile: 105mm, HE, T178E1, Cast from Class 30 Test Record No: 6155
 Cast Iron (QQ-1-652)
 Explosive Filler: Comp B Sheet 5 of 12

Type Fuze: M54 PD Modified for static firing Date:
 Dwg. PX-97-287

Size of Box: 10" x 10" x 20", 1/2" pine

Recovery Medium: Sawdust No. 4 Mesh Screen & Magnetic Separator

			PROJECTILE NO.			
Requested by Mr. P. Sadlon			9		10	
Wt. Empty Lbs.			16.89		17.45	
Wt. Loaded Lbs.			19.87		20.70	
Number and Weight of Recovered Fragments	No. 0 Group Not 0 to 1/2 Grs. Counted	Through a 10 Mesh Screen (U. S. Std Sieve Series) Wt. Lbs.	3.97		2.60	
	No. 1 Group 1/2 to 2 Grs.	No. Wt. Lbs.	18372 2.56		18540 2.74	
	No. 2 Group 2 to 5 Grs.	No. Wt. Lbs.	5636 2.50		6766 3.04	
	No. 3 Group 5 to 10 Grs.	No. Wt. Lbs.	2129 2.11		2657 2.77	
	No. 4 Group 10 to 25 Grs.	No. Wt. Lbs.	1090 2.30		1325 2.91	
	No. 5 Group 25 to 50 Grs.	No. Wt. Lbs.	255 1.22		333 1.59	
	No. 6 Group 50 to 75 Grs.	No. Wt. Lbs.	61 .53		60 .53	
	No. 7 Group 75 to 150 Grs.	No. Wt. Lbs.	37 .51		44 .63	
	No. 8 Group 150 to 750 Grs.	No. Wt. Lbs.	1 .02		10 .27	
	No. 9 Group 750 to 2500 Grs.	No. Wt. Lbs.				
	No. 10 Group 2500 and Larger	No. Wt. Lbs.				
	Total No.		27581		29735	
	Total Wt. Lbs.		15.72		17.08	
	% of Fragments Recovered		93.1		97.9	
	Photo No.		M-42034		None	CONFIDENTIAL
	CONFIDENTIAL					

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CATINNY ARSENAL FRAGMENTATION TEST

Projectile: 105mm, HE, T178E2 Cast from Class 50 Test Record No: 6155
 Cast Iron. (QQ-1-652)

Explosive Filler: Comp B

Sheet 6 of 12

Type Fuze: M54 PD Modified for static firing

Date:

Dwg. PX-97-287

Size of Box: 10" x 10" x 20", 1/2" Pine

Recovery Medium: Sawdust No. 4 Mesh Screen & Magnetic Separator

			PROJECTILE NO.			
Requested by Mr. P. Sadlon			11		12	
Wt. Empty Lbs.			17.71		17.58	
Wt. Loaded Lbs.			21.02		20.56	
Number and Weight of Recovered Fragments	No. 0 Group Not 0 to 1/2 Grs. Counted	Through a 10 Mesh Screen (U. S. Std Sieve Series)				
		Wt. Lbs.	3.45		2.56	
	No. 1 Group 1/2 to 2 Grs.	No.	17872		22993	
		Wt. Lbs.	2.67		1.64	
	No. 2 Group 2 to 5 Grs.	No.	6535		6591	
		Wt. Lbs.	2.88		3.06	
	No. 3 Group 5 to 10 Grs.	No.	2760		2904	
		Wt. Lbs.	2.74		2.94	
	No. 4 Group 10 to 25 Grs.	No.	1491		1530	
		Wt. Lbs.	3.15		3.68	
	No. 5 Group 25 to 50 Grs.	No.	282		258	
		Wt. Lbs.	1.34		1.24	
	No. 6 Group 50 to 75 Grs.	No.	46		34	
		Wt. Lbs.	.39		.29	
	No. 7 Group 75 to 150 Grs.	No.	31		28	
		Wt. Lbs.	.46		.38	
	No. 8 Group 150 to 750 Grs.	No.	4		8	
		Wt. Lbs.	.10		.23	
	No. 9 Group 750 to 2500 Grs.	No.				
		Wt. Lbs.				
	No. 10 Group 2500 and Larger	No.				
		Wt. Lbs.				
Total No.			29021		34346	
Total Wt. Lbs.			17.18		16.02	
% of Fragments Recovered			97.0		91.1	
Photo No.			M42036		None	CONFIDENTIAL
			CONFIDENTIAL			

CONFIDENTIAL CATINNY ARSENAL FRAGMENTATION TEST

Projectile: 105mm HE, T178E3 Cast from Class A
Malleable (QQ-1-666)

Test Record No: 6155

Explosive Filler: Comp B

Sheet 7 of 12

Type Fuze: M54 PD Modified for static firing

Date:

Size of Box: 10" x 10" x 20", 1/2" Pine

Recovery Medium: Sawdust No. 4 Mesh Screen & Magnetic Separator

Requested by Mr. P. Sadlon			PROJECTILE NO.			
			13		14	
Wt. Empty Lbs.			18.25		17.40	
Wt. Loaded Lbs.			20.08		20.69	
Number and Weight of Recovered Fragments	No. 0 Group Not 0 to 1/2 Grs. Counted	Through a 10 Mesh Screen (U. S. Std Sieve Series)				
		Wt. Lbs.	.81		.23	
	No. 1 Group 1/2 to 2 Grs.	No.	5403		2561	
		Wt. Lbs.	.80		.37	
	No. 2 Group 2 to 5 Grs.	No.	2495		1613	
		Wt. Lbs.	1.14		.67	
	No. 3 Group 5 to 10 Grs.	No.	1391		524	
		Wt. Lbs.	1.42		.53	
	No. 4 Group 10 to 25 Grs.	No.	1476		528	
		Wt. Lbs.	3.33		1.21	
	No. 5 Group 25 to 50 Grs.	No.	699		307	
		Wt. Lbs.	3.51		1.58	
	No. 6 Group 50 to 75 Grs.	No.	216		189	
		Wt. Lbs.	1.85		1.73	
	No. 7 Group 75 to 150 Grs.	No.	134		240	
		Wt. Lbs.	1.89		3.68	
	No. 8 Group 150 to 750 Grs.	No.	52		193	
		Wt. Lbs.	1.76		6.93	
	No. 9 Group 750 to 2500 Grs.	No.			1	
		Wt. Lbs.			.12	
	No. 10 Group 2500 and Larger	No.				
		Wt. Lbs.				
Total No.			11866		6156	
Total Wt. Lbs.			16.51		17.05	
% of Fragments Recovered			90.5		98	
Photo No.			M42038		None	CONFIDENTIAL
			CONFIDENTIAL			

CONFIDENTIAL MICATINNY ARSENAL FRAGMENTATION TEST

Projectile: 105mm HE, T178E4 Cast from Cast Steel Test Record No: 6155
(Mil-S-20556)

Explosive Filler: Comp B

Sheet 8 of 12

Type Fuze: M54 PD Modified for static firing Date:

Size of Box: 10" x 10" x 20", 1/2" Pine

Recovery Medium: Sawdust No. 4 Mesh Screen & Magnetic Separator

Requested by Mr. P. Sadlon

PROJECTILE NO.

Wt. Empty Lbs.

15

16

17.97

17.94

Wt. Loaded Lbs.

20.62

21.06

No. 0 Group Not

Through a 10 Mesh Screen (U. S. Std Sieve Series)

0 to 1/2 Grs. Counted

Wt. Lbs.

.22

.28

No. 1 Group

No.

3278

2127

1/2 to 2 Grs.

Wt. Lbs.

.48

.32

No. 2 Group

No.

1560

1111

2 to 5 Grs.

Wt. Lbs.

.71

.54

No. 3 Group

No.

802

568

5 to 10 Grs.

Wt. Lbs.

.81

.60

No. 4 Group

No.

1092

690

10 to 25 Grs.

Wt. Lbs.

2.48

1.61

No. 5 Group

No.

645

439

25 to 50 Grs.

Wt. Lbs.

3.24

2.28

No. 6 Group

No.

284

231

50 to 75 Grs.

Wt. Lbs.

2.45

2.17

No. 7 Group

No.

282

212

75 to 150 Grs.

Wt. Lbs.

4.14

3.37

No. 8 Group

No.

103

164

150 to 750 Grs.

Wt. Lbs.

3.30

6.13

No. 9 Group

No.

1

4

750 to 2500 Grs.

Wt. Lbs.

.11

.52

No. 10 Group

No.

2500 and Larger

Wt. Lbs.

Total No.

8047

5546

Total Wt. Lbs.

17.94

17.82

% of Fragments Recovered

99.8

99.3

Photo No.

M42040

None

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Reviewed by L. D. Bercow
Chief, Proof Testing Unit
Approved by L. F. Page
Chief, Testing Section
Prepared by G. Smalinski

CONFIDENTIAL RICATINNY ARSENAL FRAGMENTATION TEST

Projectile: 105mm, HE. 1178E1, cast from Class 30 Test Record No: 6155

Explosive Filler: cast iron (QQ-1-652)

Sheet 9 of 12

Type Fuze: M54 PD. Modified for static firing, Date: 15 June 1953

Size of Box: 10" x 10" x 20", 1/2" Pine

Recovery Medium: Sawdust, No. 4 Mesh Screen and Magnetic Separator
Requested by Mr. F. Sadlon

			PROJECTILE NO.			
			17	18		
Wt. Empty Lbs.			17.51	17.28		
Wt. Loaded Lbs.			22.02	22.10		
Number and Weight of Recovered Fragments	No. 0 Group	Through a 10 Mesh Screen (U. S. Std Sieve Series)				
	0 to 1/2 Grs.	Wt. Lbs.	2.28	1.07		
	No. 1 Group	No.	10600	10159		
	1/2 to 2 Grs.	Wt. Lbs.	1.56	1.33		
	No. 2 Group	No.	4938	4540		
	2 to 5 Grs.	Wt. Lbs.	2.25	2.02		
	No. 3 Group	No.	2486	2319		
	5 to 10 Grs.	Wt. Lbs.	2.52	2.37		
	No. 4 Group	No.	1693	2060		
	10 to 25 Grs.	Wt. Lbs.	3.66	4.60		
	No. 5 Group	No.	430	618		
	25 to 50 Grs.	Wt. Lbs.	2.08	2.95		
	No. 6 Group	No.	115	81		
	50 to 75 Grs.	Wt. Lbs.	1.00	.68		
	No. 7 Group	No.	67	55		
	75 to 150 Grs.	Wt. Lbs.	.86	.73		
	No. 8 Group	No.	19	17		
	150 to 750 Grs.	Wt. Lbs.	.52	.55		
	No. 9 Group	No.				
	750 to 2500 Grs.	Wt. Lbs.				
	No. 10 Group	No.				
	2500 and Larger	Wt. Lbs.				
Total No.			20348	19849		
Total Wt. Lbs.			16.83	16.35		
% of Fragments Recovered			96.1	94.6		
Photo No.			M-42865	M42866		CONFIDENTIAL
			CONFIDENTIAL			

CONFIDENTIAL

CONFIDENTIAL CATINNY ARSENAL FRAGML. TATION TEST

Projectile: 105mm, VE. T173E2, Cast from Class 50

Test Record No: 6155

Explosive Filler: Baratol

Sheet 10 of 12

Type Fuze: M54 PD Modified for static firing

Date:

Size of Box: 10" x 10" x 20", 1/2" Pine

Recovery Medium: Sawdust, No. 4 Mesh Screen & Magnetic Separator

Requested by Mr. P. Sadlon

			PROJECTILE NO.			
			19	20		
Wt. Empty Lbs.			17.58	17.43		
Wt. Loaded Lbs.			22.41	22.41		
Number and Weight of Recovered Fragments	No. 0 Group	Through a 10 Mesh Screen (U.S. Std Sieve Series)				
	0 to 1/2 Grs.	Wt. Lbs.	1.31	1.15		
	No. 1 Group	No.	9845	8202		
	1/2 to 2 Grs.	Wt. Lbs.	1.45	1.24		
	No. 2 Group	No.	3755	3324		
	2 to 5 Grs.	Wt. Lbs.	1.80	1.50		
	No. 3 Group	No.	1977	2215		
	5 to 10 Grs.	Wt. Lbs.	2.03	2.20		
	No. 4 Group	No.	1912	1871		
	10 to 25 Grs.	Wt. Lbs.	4.37	4.26		
	No. 5 Group	No.	740	806		
	25 to 50 Grs.	Wt. Lbs.	3.65	3.42		
	No. 6 Group	No.	152	175		
	50 to 75 Grs.	Wt. Lbs.	1.31	1.49		
	No. 7 Group	No.	58	99		
	75 to 150 Grs.	Wt. Lbs.	.87	1.34		
	No. 8 Group	No.	18	20		
	150 to 750 Grs.	Wt. Lbs.	.73	.81		
	No. 9 Group	No.				
	750 to 2500 Grs.	Wt. Lbs.				
	No. 10 Group	No.				
	2500 and Larger	Wt. Lbs.				
Total No.			18457	16712		
Total Wt. Lbs.			17.52	17.41		
% of Fragments Recovered			99.6	99.9		
Photo No.			M-42867	M-42868		
CONFIDENTIAL						

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CONFIDENTIAL PICATINNY ARSENAL FRAGMENTATION TEST

Projectile: 105mm, HE, T178E3, Cast from Class A

Test Record No: 0155

Explosive Filler: Malleable (QQ-I-666)

Sheet 11 of 12

Type Fuze: M54 PD Modified for static firing

Date: 15 June 53

Size of Box: 10" x 10" x 20", 1/2" Pine

Recovery Medium: Sawdust, No. 4 Mesh Screen & Magnetic Separator

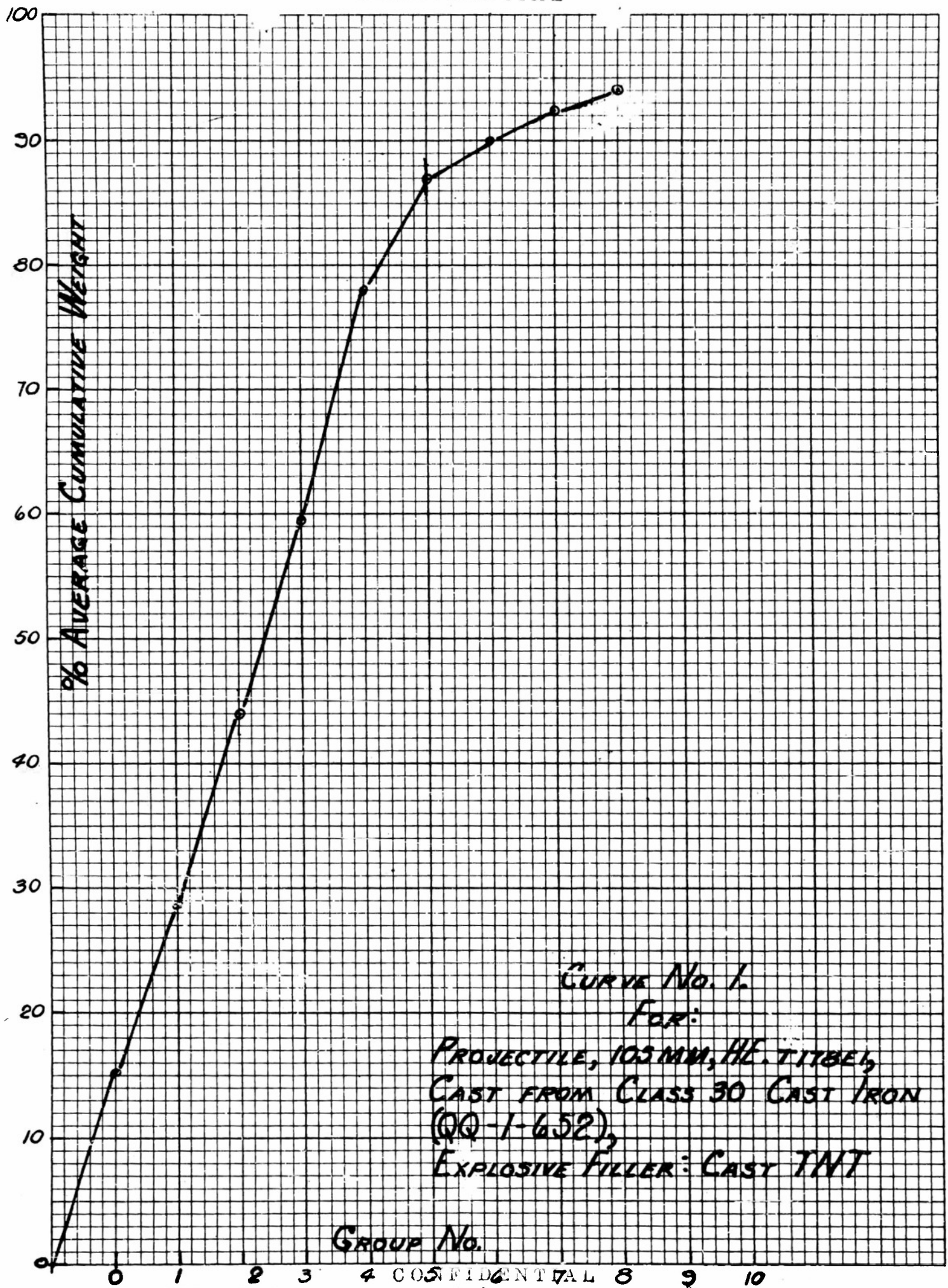
Requested by Mr. P. Sadlon

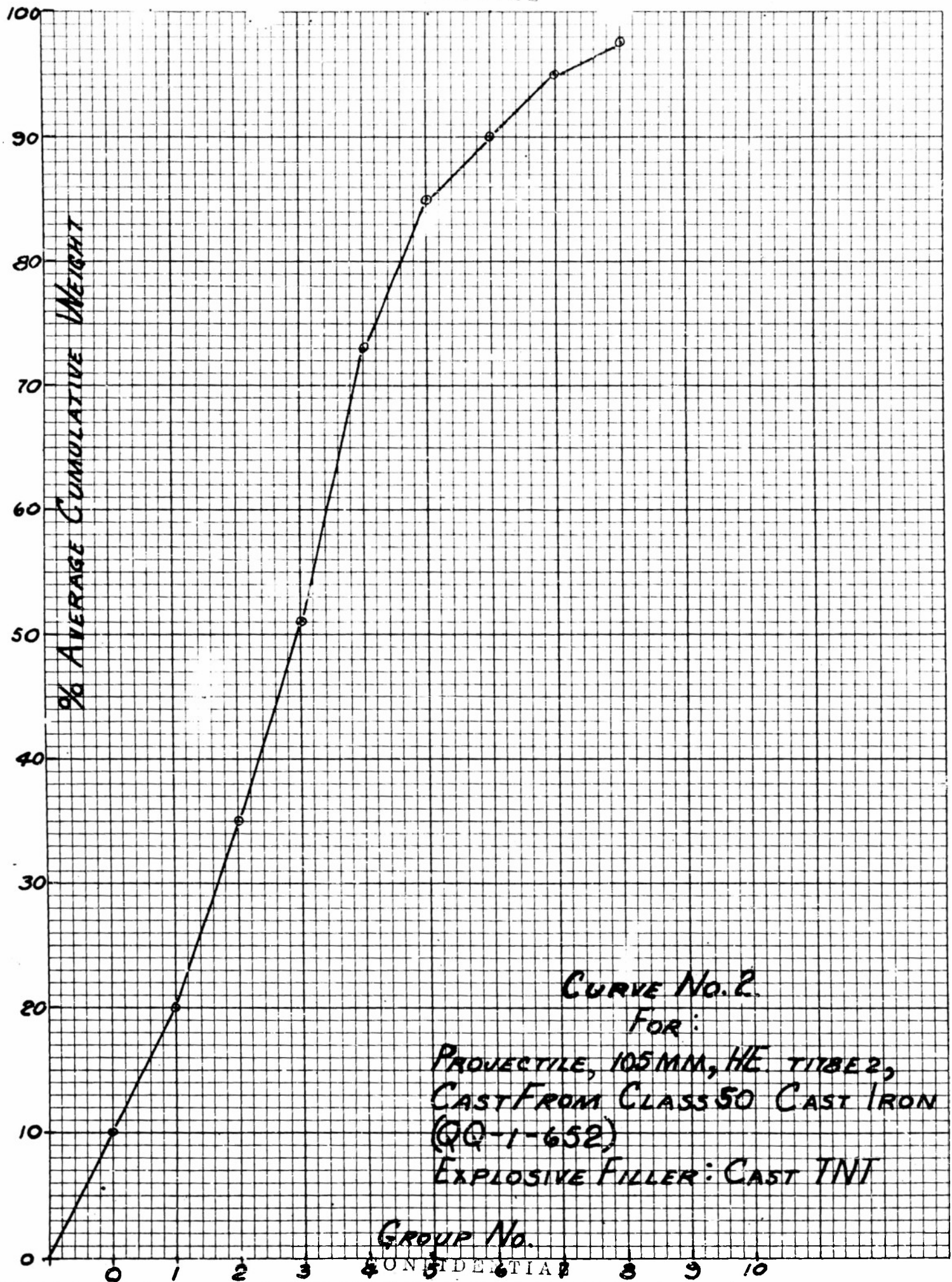
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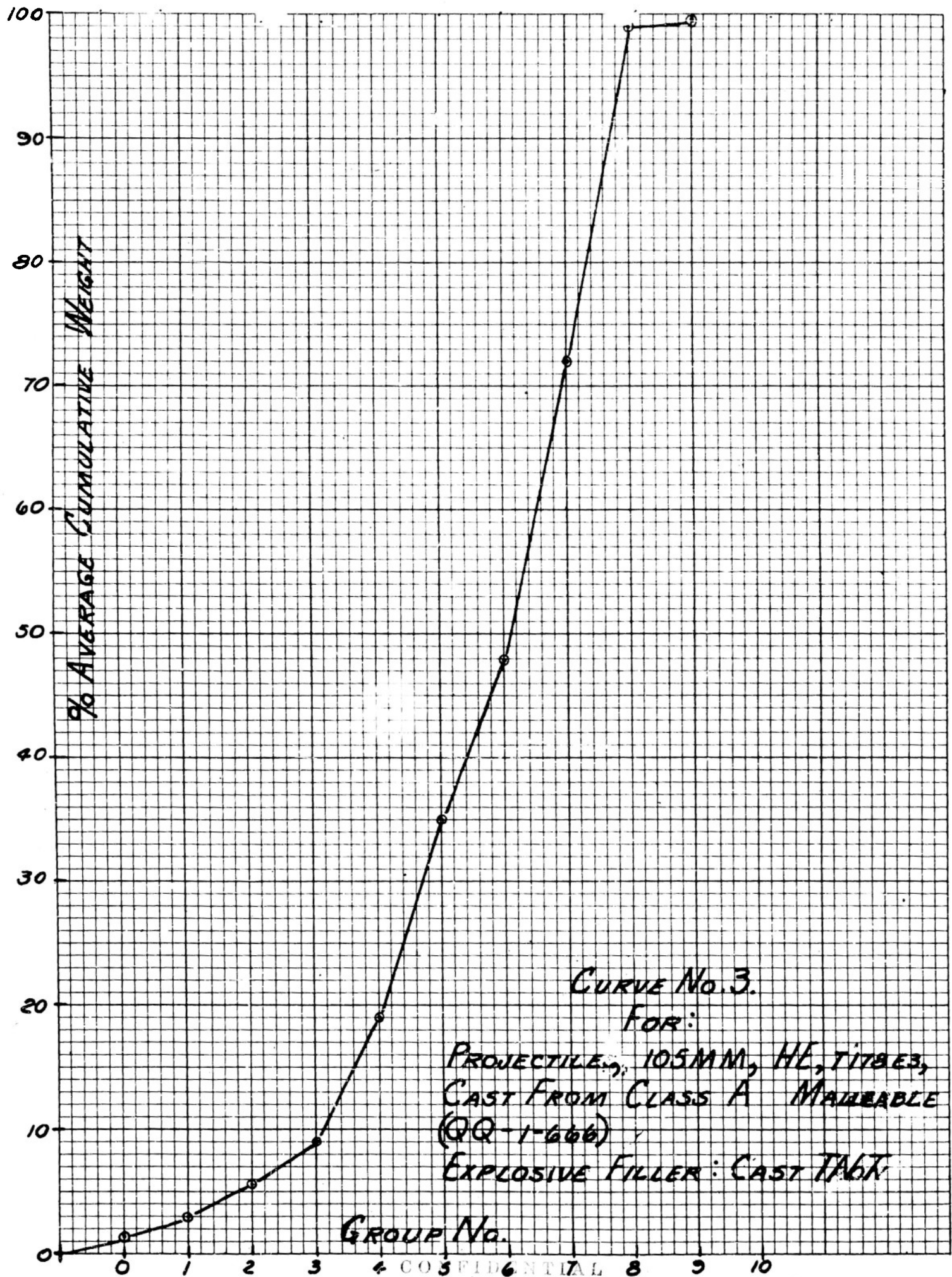
			21	22		
Wt. Empty Lbs.			17.52	17.56		
Wt. Loaded Lbs.			22.32	22.31		
Number and Weight of Recovered Fragments	No. 0 Group	Through a 10 Mesh Screen (U.S. Std Sieve Series)				
	0 to 1/2 Grs.	Wt. Lbs.	.43	.28		
	No. 1 Group	No.	2166	1236		
	1/2 to 2 Grs.	Wt. Lbs.	.32	.17		
	No. 2 Group	No.	1226	639		
	2 to 5 Grs.	Wt. Lbs.	.51	.28		
	No. 3 Group	No.	733	159		
	5 to 10 Grs.	Wt. Lbs.	.35	.13		
	No. 4 Group	No.	737	426		
	10 to 25 Grs.	Wt. Lbs.	1.62	1.01		
	No. 5 Group	No.	425	251		
	25 to 50 Grs.	Wt. Lbs.	2.05	1.26		
	No. 6 Group	No.	228	178		
	50 to 75 Grs.	Wt. Lbs.	2.02	1.53		
	No. 7 Group	No.	288	231		
	75 to 150 Grs.	Wt. Lbs.	4.27	3.48		
	No. 8 Group	No.	141	123		
	150 to 750 Grs.	Wt. Lbs.	5.10	3.64		
	No. 9 Group	No.	4	5		
	750 to 2500 Grs.	Wt. Lbs.	.52	.70		
	No. 10 Group	No.				
	2500 and Larger	Wt. Lbs.				
Total No.			5948	3243		
Total Wt. Lbs.			17.49	17.51		
% of Fragments Recovered			99.8	99.7		
Photo No.			M-42869	M-42870		CONFIDENTIAL
			CONFIDENTIAL			

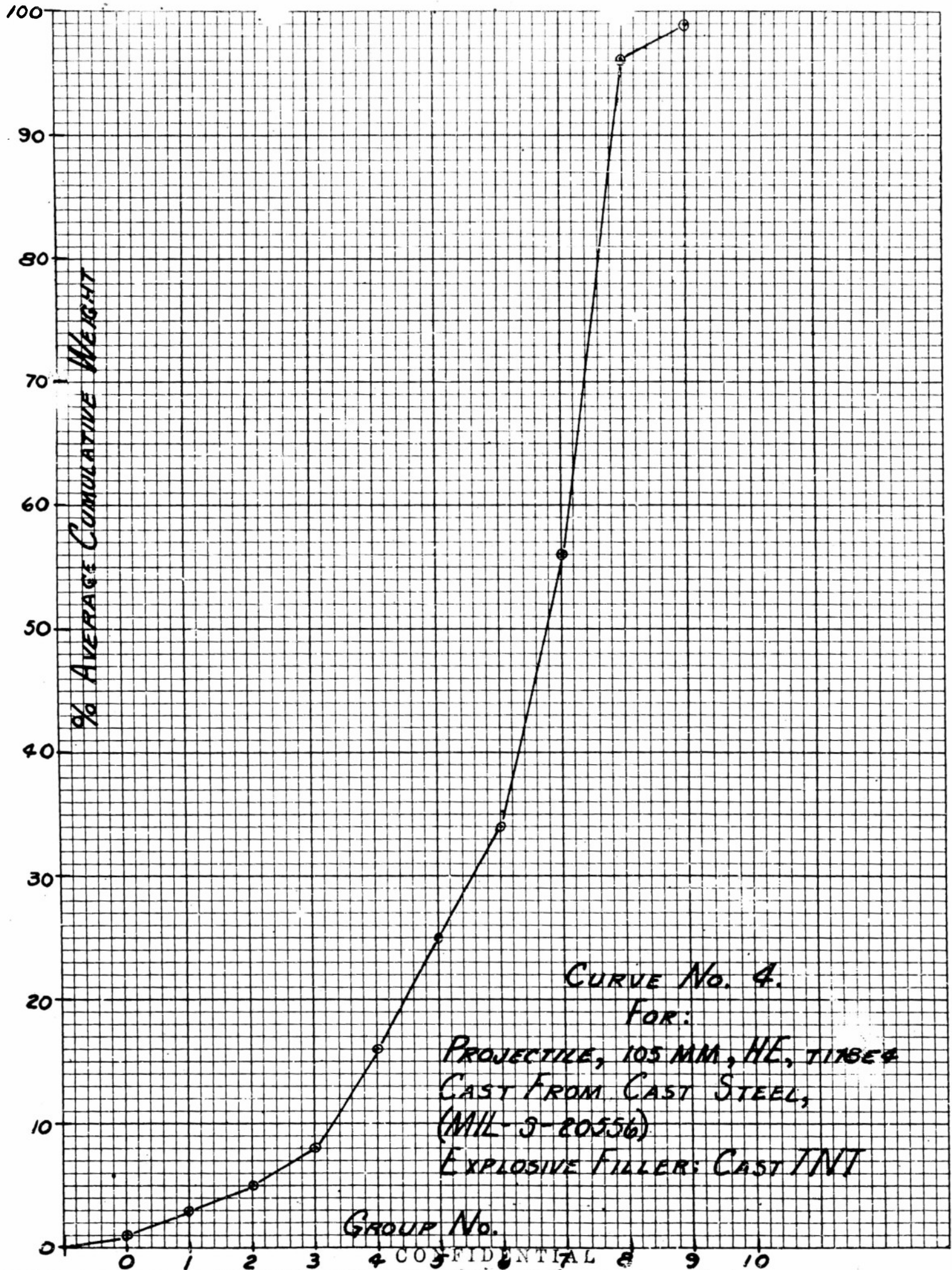
Projectile: 105mm, HE, T178E4, Cast from Cast Steel Test Record No: 6155
 (Mil-S-20556)
 Explosive Filler: Baratol Sheet 12 of 12
 Type Fuze: M54 PD Modified for static firing Date:
 Dwg. PX-97-287
 Size of Box: 10" x 10" x 20" Pine
 Recovery Medium: Sawdust, No. 4 Mesh Screen & Magnetic Separator

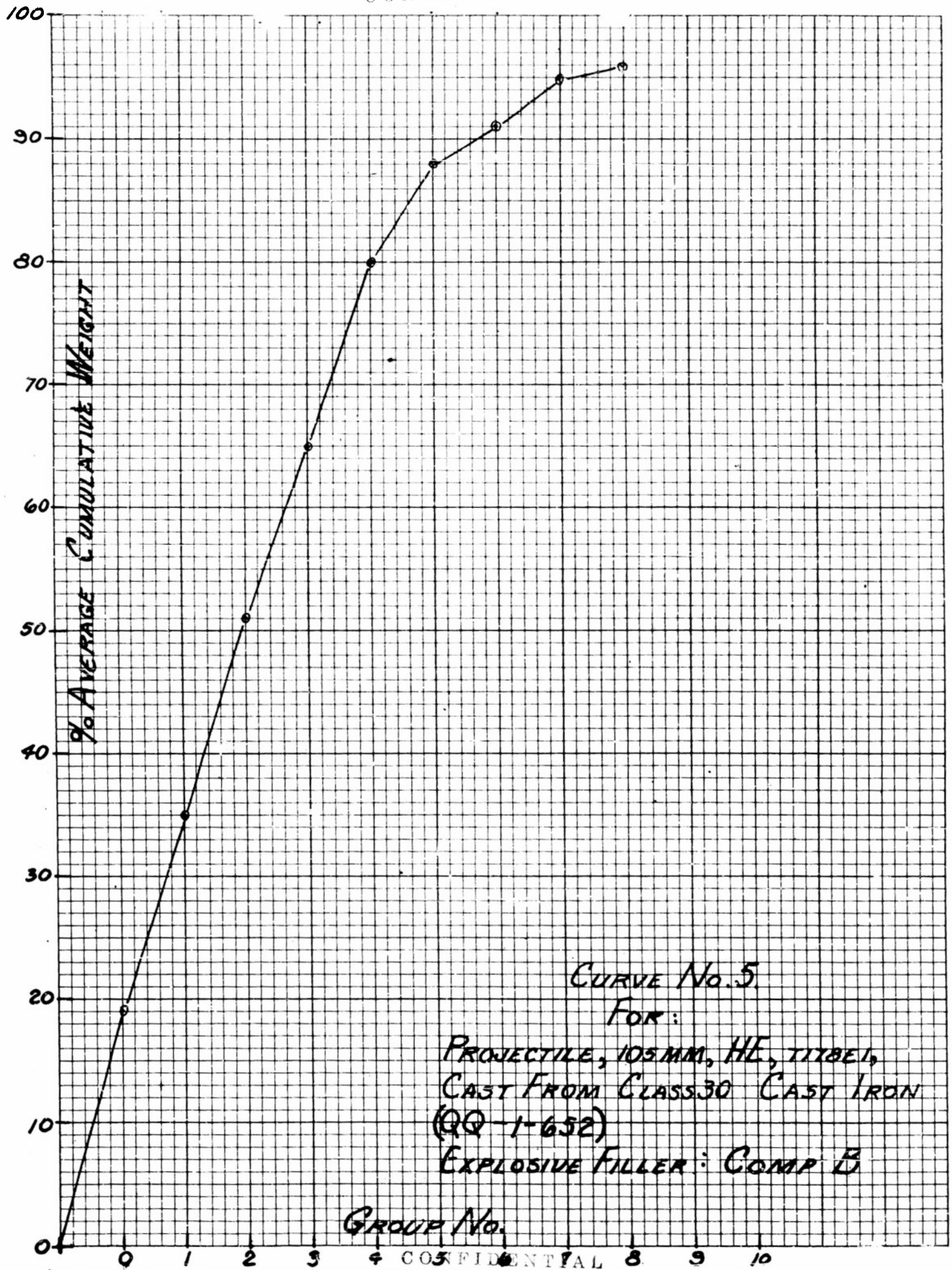
Requested by Mr. P. Sadlon			PROJECTILE NO.				
			23	24			
Wt. Empty Lbs.			18.46	18.11			
Wt. Loaded Lbs.			23.03	22.70			
Number and Weight of Recovered Fragments	No. 0 Group 0 to ½ Grs.	Through a 10 Mesh Screen (U. S. Std Sieve Series)					
		Wt. Lbs.	.18	.19			
	No. 1 Group ½ to 2 Grs.	No.	1151	1217			
		Wt. Lbs.	.15	.18			
	No. 2 Group 2 to 5 Grs.	No.	551	624			
		Wt. Lbs.	.25	.29			
	No. 3 Group 5 to 10 Grs.	No.	365	584			
		Wt. Lbs.	.37	.40			
	No. 4 Group 10 to 25 Grs.	No.	445	399			
		Wt. Lbs.	1.02	.92			
	No. 5 Group 25 to 50 Grs.	No.	221	214			
		Wt. Lbs.	1.10	1.05			
	No. 6 Group 50 to 75 Grs.	No.	105	108			
		Wt. Lbs.	.90	.96			
	No. 7 Group 75 to 150 Grs.	No.	158	132			
		Wt. Lbs.	2.46	2.07			
	No. 8 Group 150 to 750 Grs.	No.	219	226			
		Wt. Lbs.	10.01	10.17			
	No. 9 Group 750 to 2500 Grs.	No.	16	13			
		Wt. Lbs.	2.00	1.86			
No. 10 Group 2500 and Larger	No.						
	Wt. Lbs.						
Total No.			3231	3317			
Total Wt. Lbs.			18.44	18.09			
% of Fragments Recovered			~~99.9~~ 99.8	~~99.9~~ 99.8			
Photo No.			M-42871	M-42872		CONFIDENTIAL	
CONFIDENTIAL							

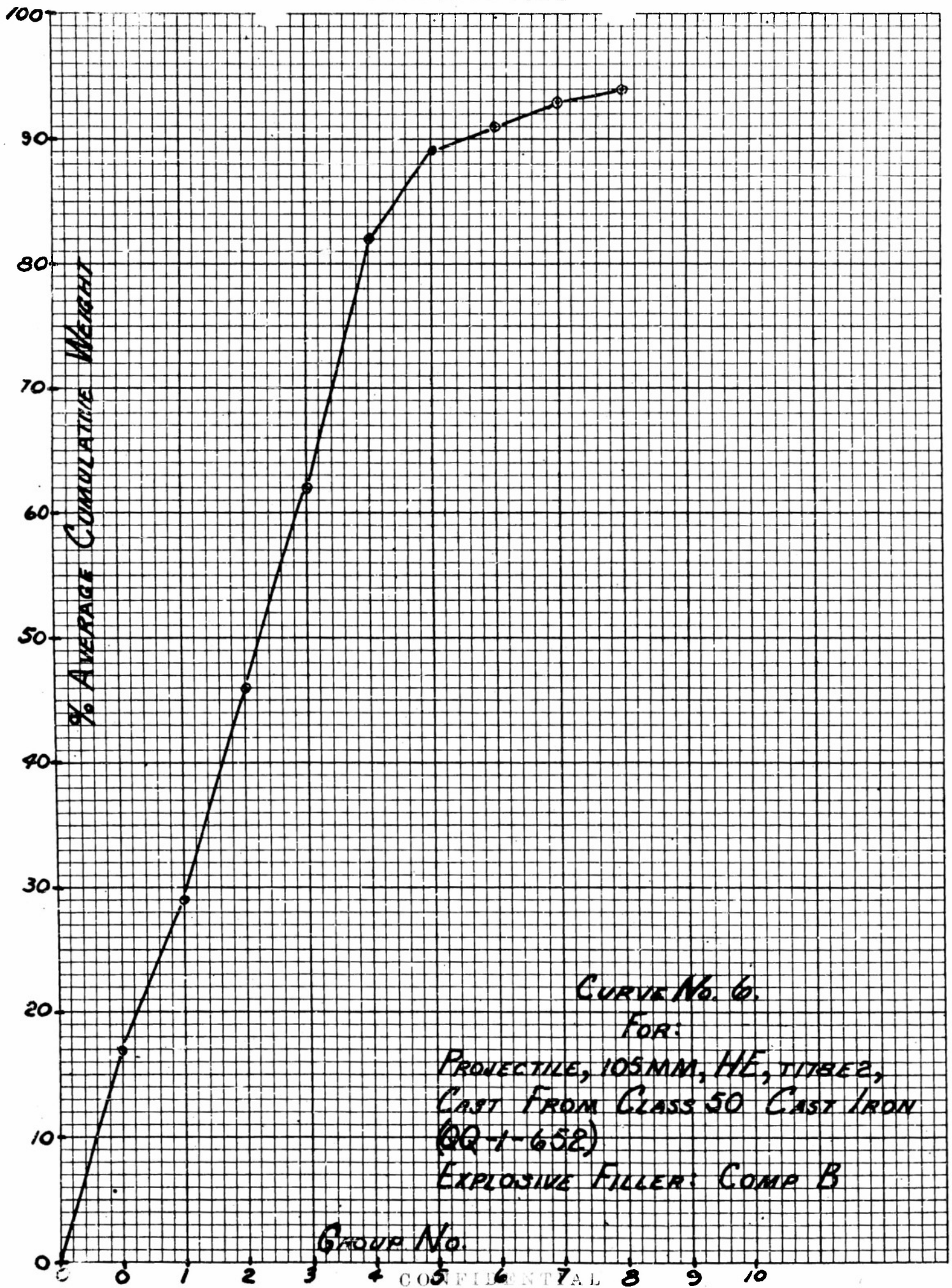


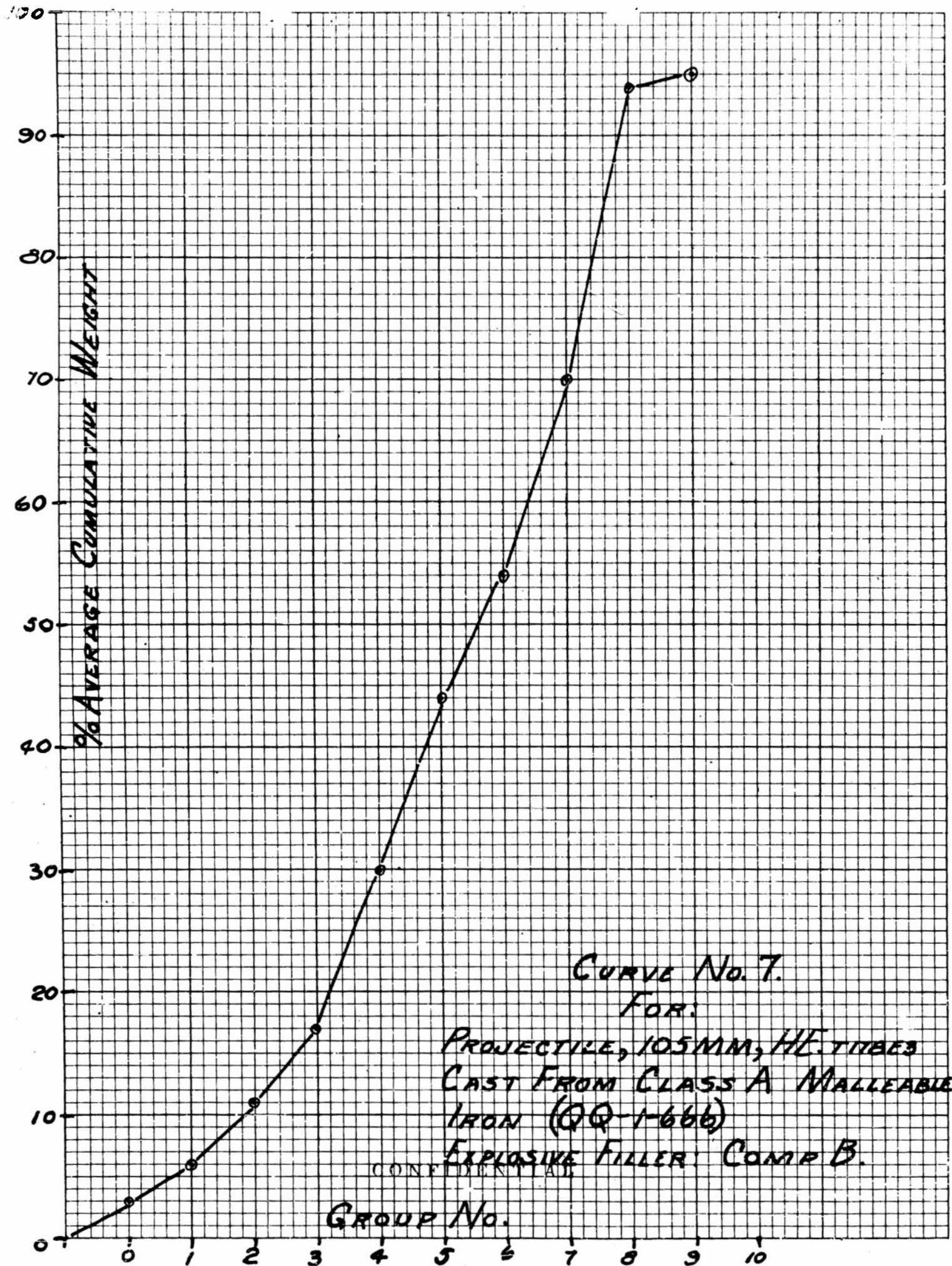


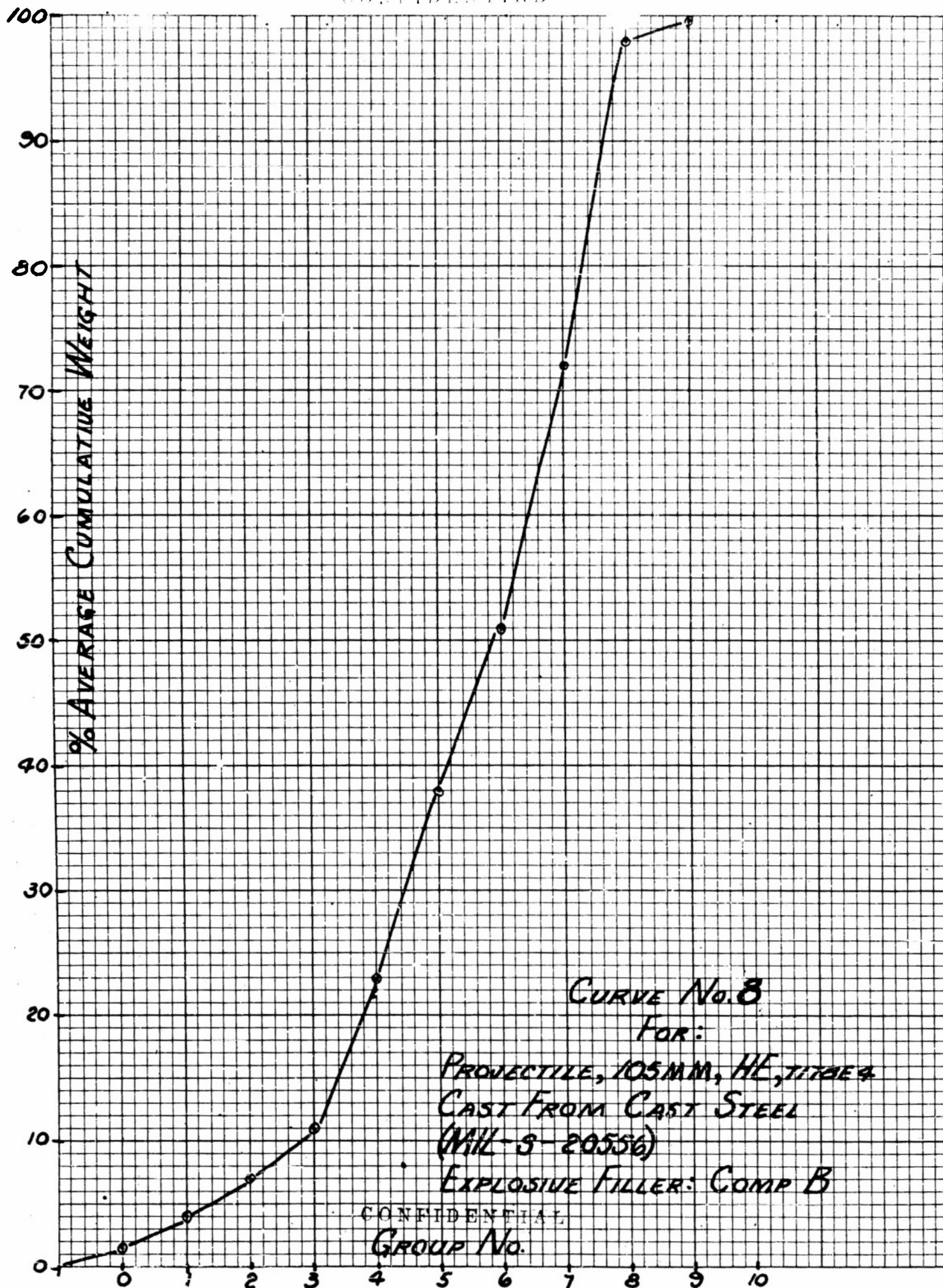


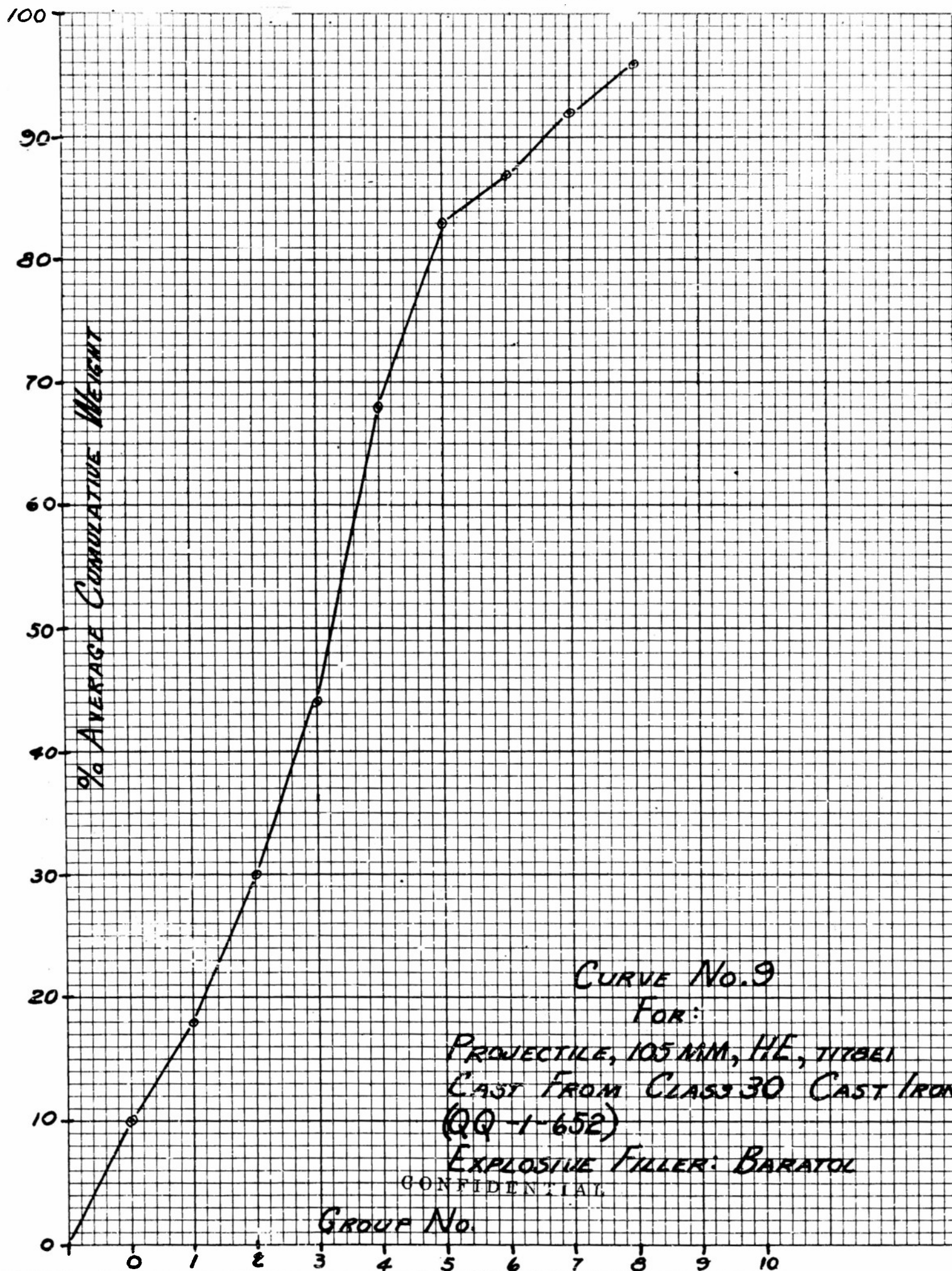






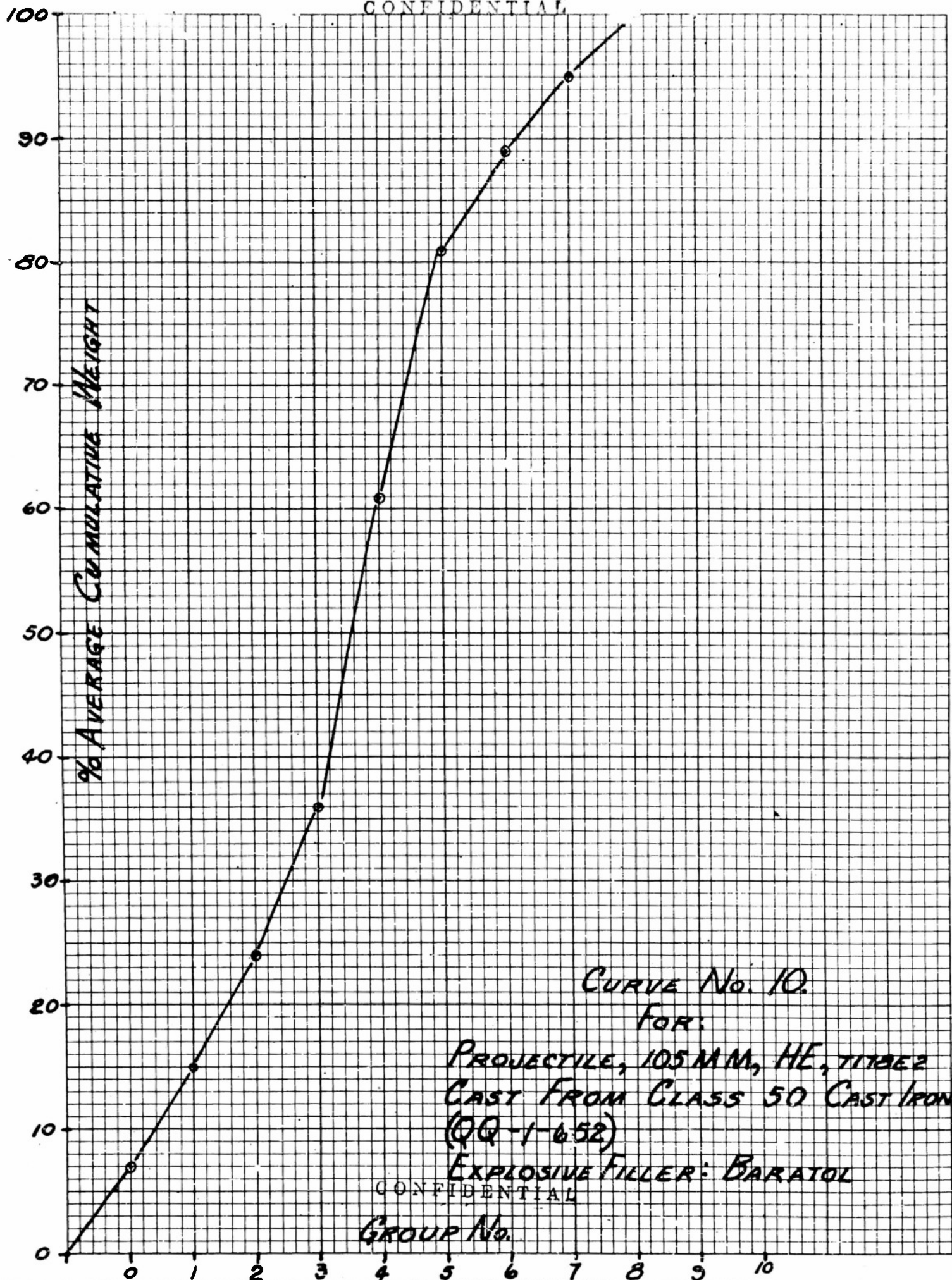




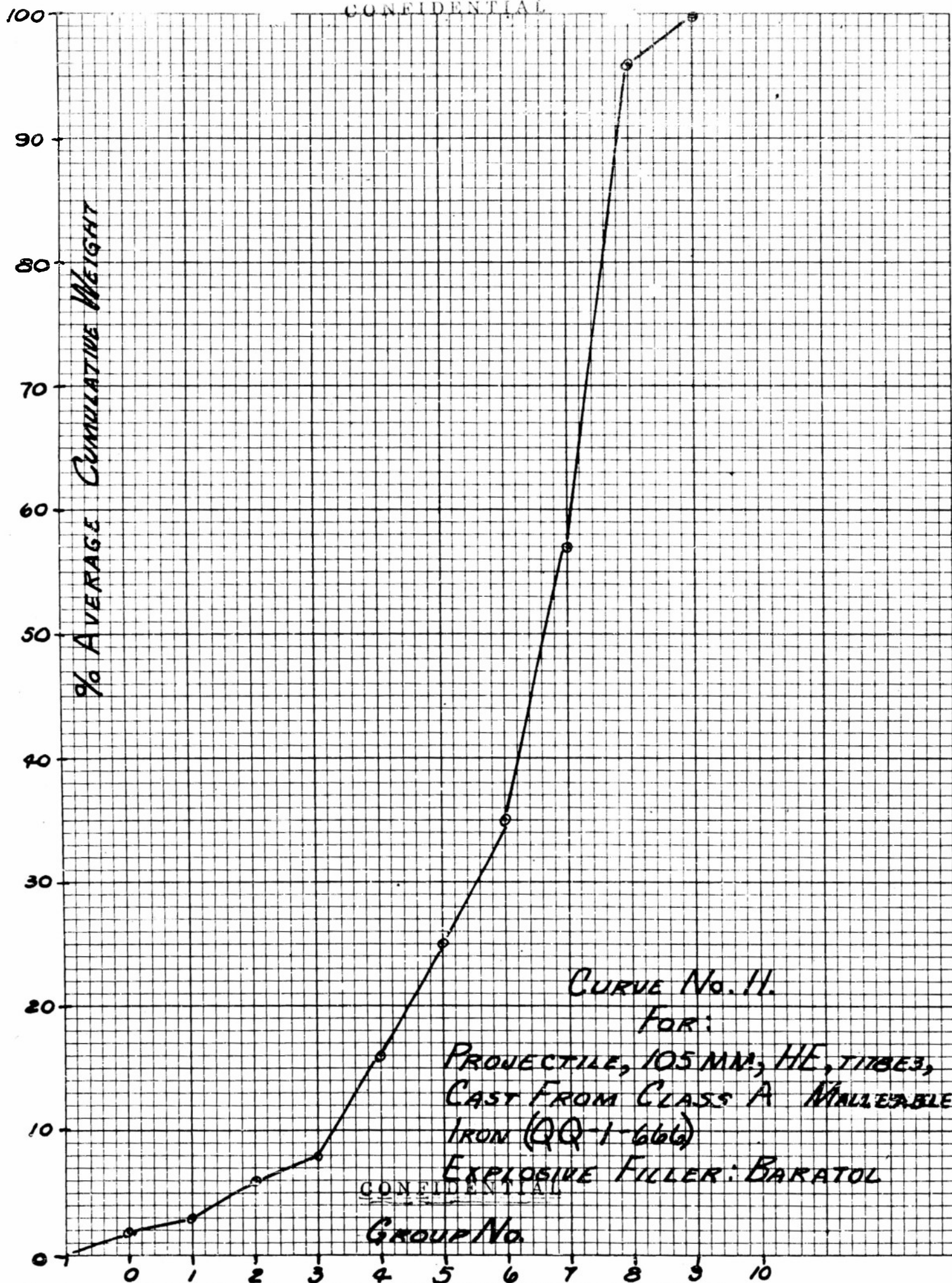


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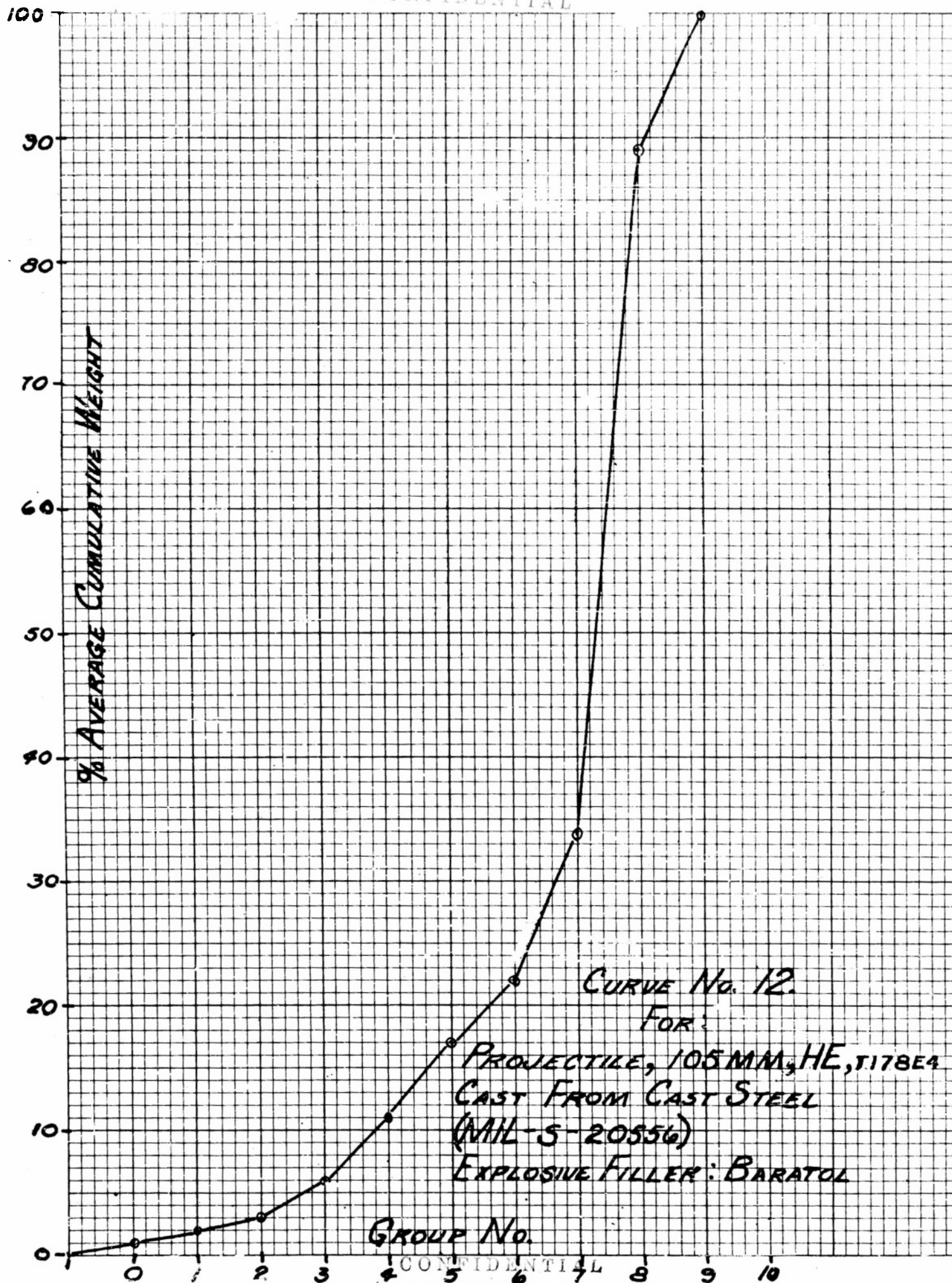
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GROUP No.

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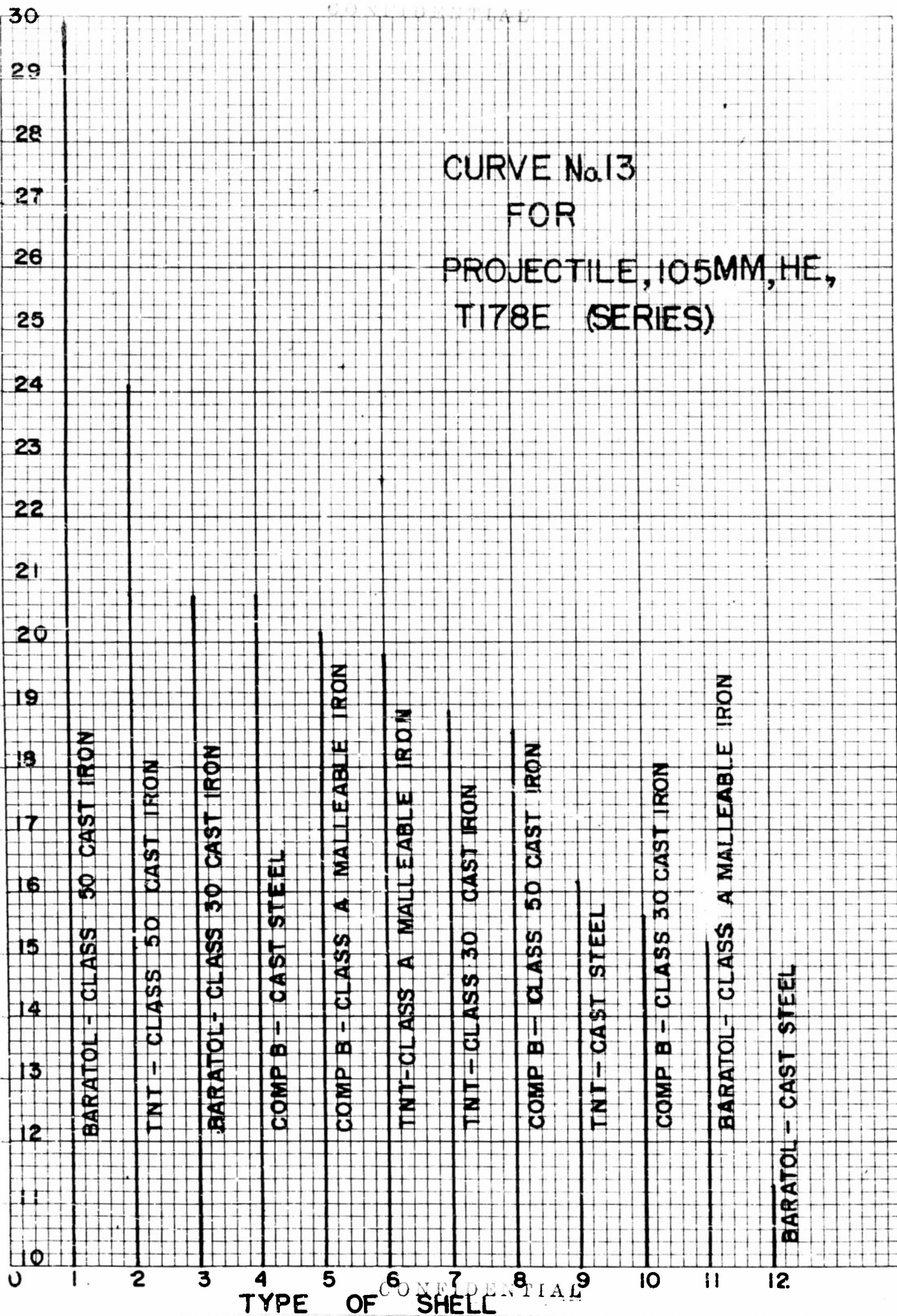
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AVERAGE TOTAL NUMBER OF FRAGMENTS OCCURRING ABOVE 10 GRAINS $\times 10^2$

CURVE No. 13

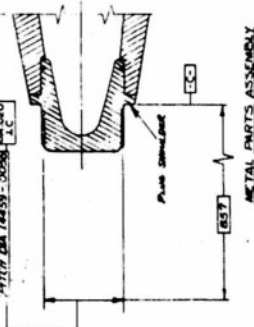
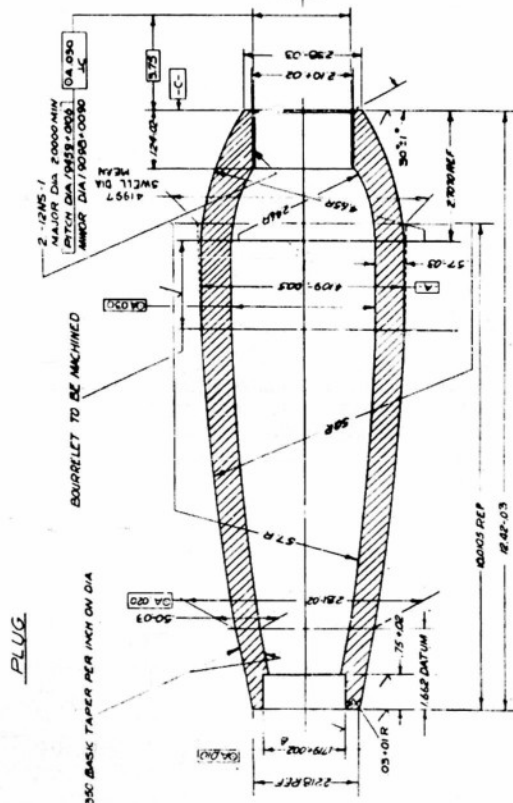
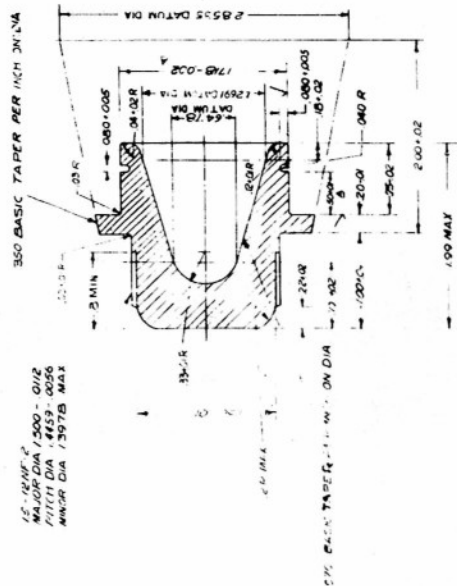
FOR

PROJECTILE, 105MM, HE,
T178E (SERIES)

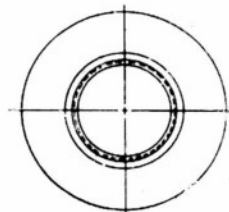


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LINE NO	NAME OF PART	PART NUMBER	PIECE MARK	SIZE OR FORM	MATERIAL	GRADE	SPEC NUMBER	REV'D	DATE	APPROVED	REMARKS
1	SHELL BODY (71718 E)					CLASS 30	GG-1452	14.91			
2	SHELL BODY (71718 E)			CAST	CAST IRON	CLASS 50	GG-1454	14.91			
3	SHELL BODY (71718 E)			CAST	MALLEABLE IRON	CLASS A	GG-1454	14.91			
4	SHELL BODY (71718 E)			CAST	STEEL		ML-5 JUNE	14.91			
5	SHELL BODY (71718 E)			CAST	DUCTILE IRON	CLASS F	ML-5 JUNE	14.91			
6	SHELL BODY (71718 E)			CAST	DUCTILE IRON	CLASS 4	ML-5 JUNE	14.91			
7	FLUG			CAST	SAVE MATERIAL AS SMALL BODY						
8					BRASS		GG-5 JUNE				
9					STEEL		ML-5 JUNE				
10					FLUG		ML-5 JUNE				
11					FLUG		ML-5 JUNE				
12					FLUG		ML-5 JUNE				
13					FLUG		ML-5 JUNE				
14					FLUG		ML-5 JUNE				
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METAL PARTS ASSEMBLY



BODY, SHELL, T178C ET AL

SURFACE MARKED / TO HAVE 125/

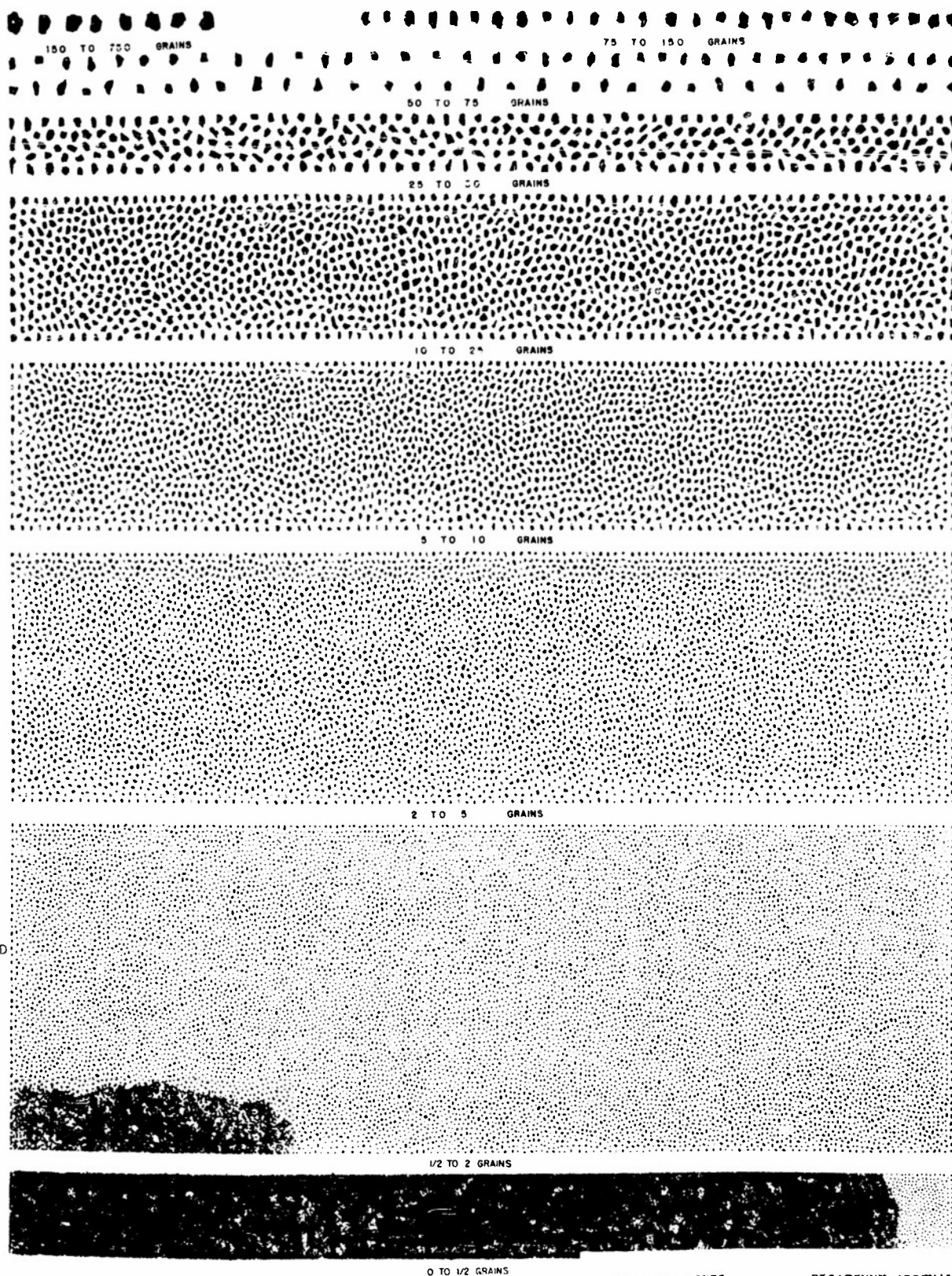
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U.F. FRAGMENTED SHELL

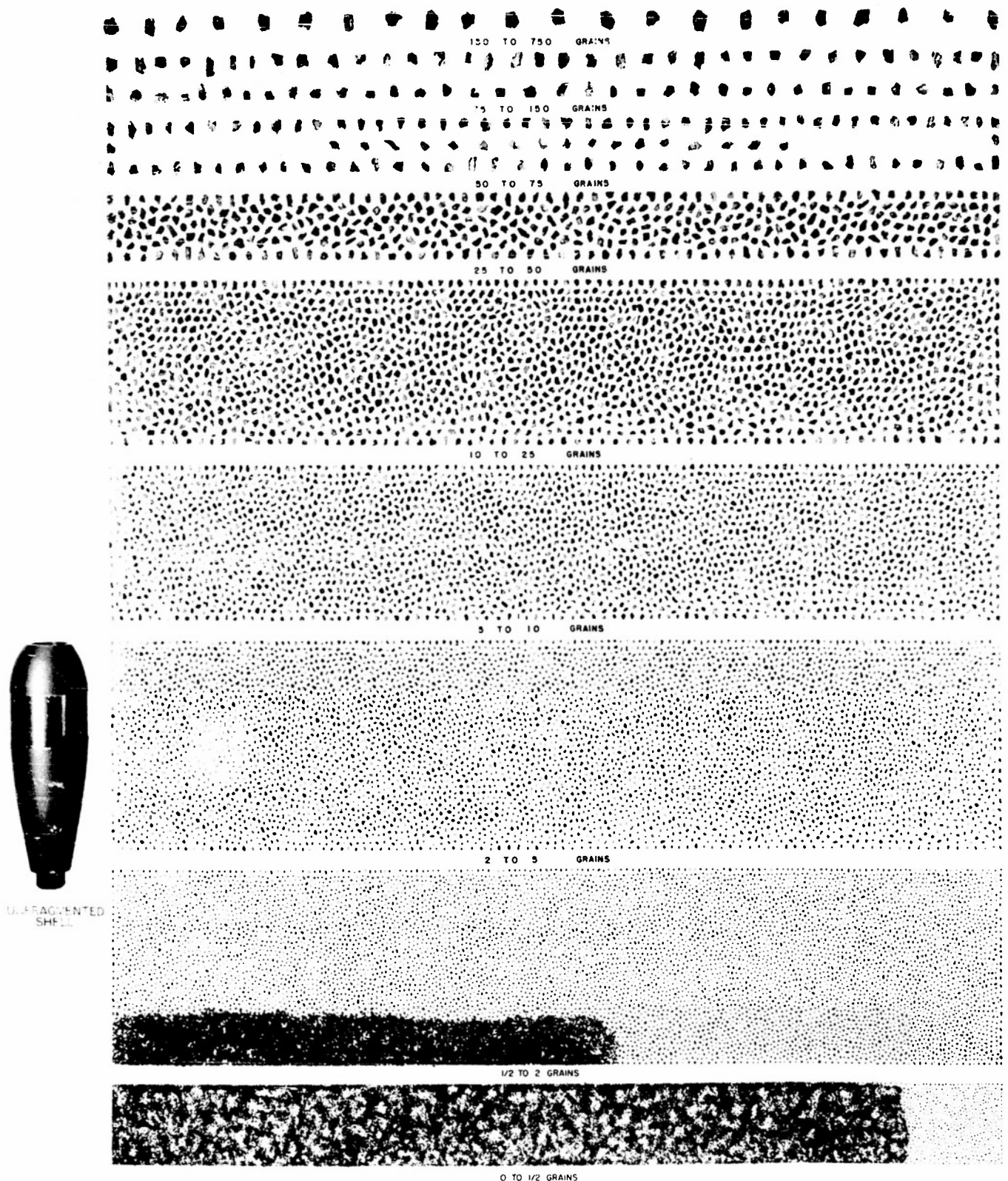


ORDNANCE CORPS
SHELL, HE, 105MM, T178E1
TNT LOADED QC-1-652
MFGD. BY LEHIGH FOUNDRIES, INC. EASTON, PA
SHELL NO. 1 MARCH 1954

PICATINNY ARSENAL
CLASS 30 CAST IRON
M-41485

CONFIDENTIAL

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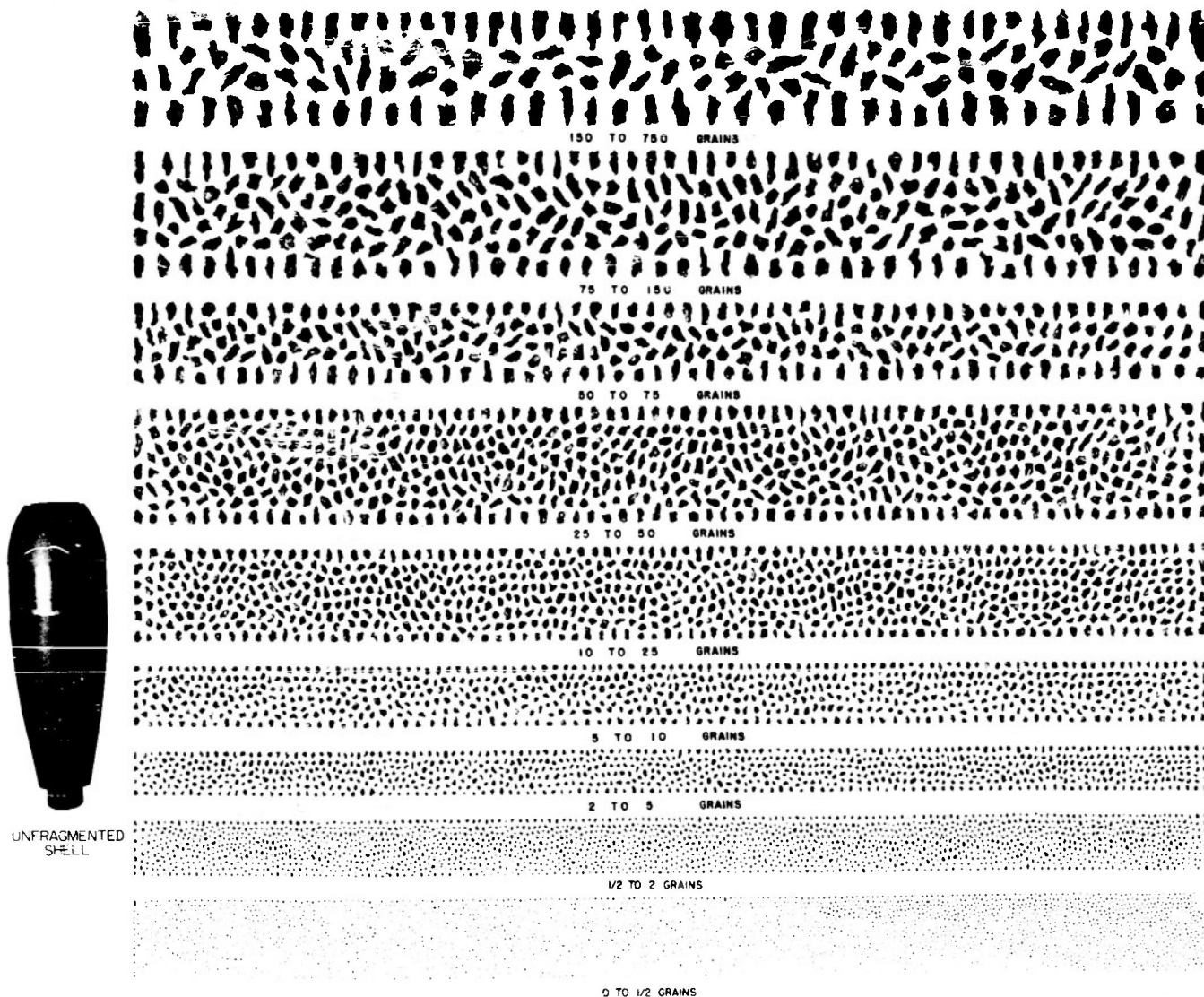


ORDNANCE CORPS
SHELL, HF, 105MM, T178F2
TNT LOADED
MFGD. BY LEHIGH FOUNDRIES, INC. EASTON, PA
SHELL NO. 3 MARCH 1954

PICATINNY ARSENAL
CLASS 50 CAST IRON
CQ-1-652
M-41487

CONFIDENTIAL

CONFIDENTIAL

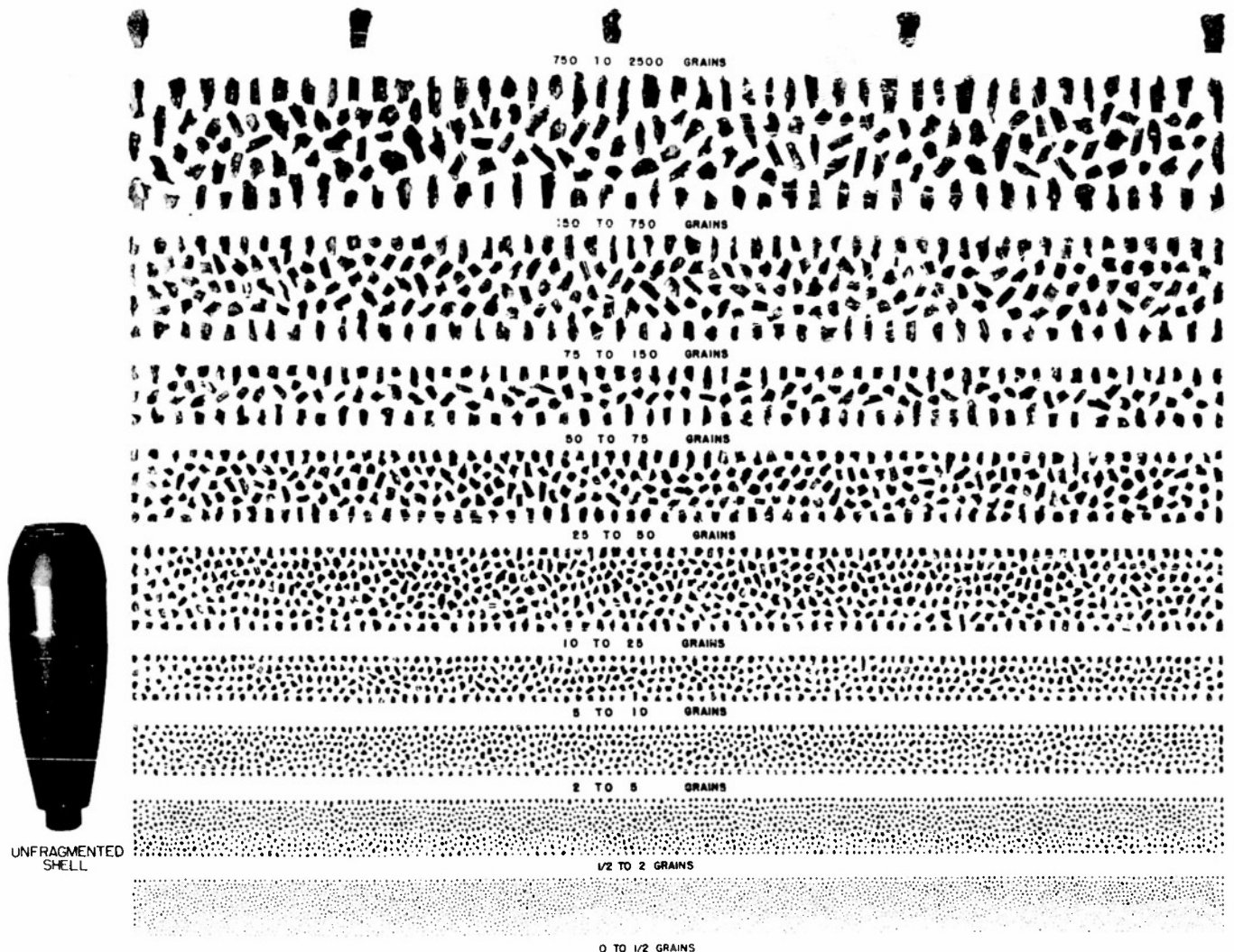


ORDNANCE CORPS
SHELL, HE, 105MM, T178E3
TNT*LOADED CQ-I-666
MFGD. BY LEHIGH FOUNDRIES, INC. EASTON, PA
SHELL NO.5 DECEMBER 1953

PICATINNY ARSENAL
CLASS A MALLEABLE IRON
M-41489

CONFIDENTIAL

CONFIDENTIAL

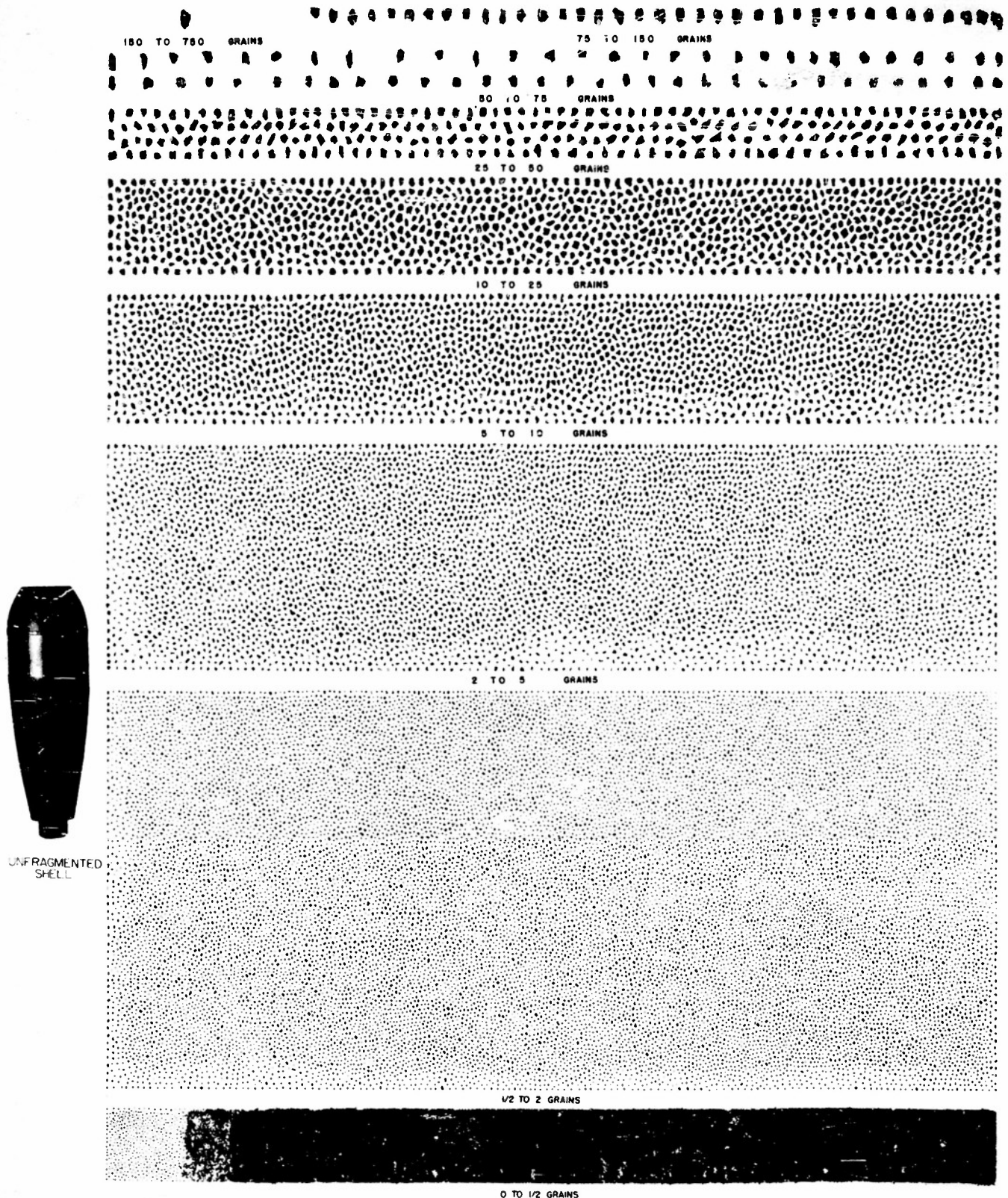


ORDNANCE CORPS
SHELL, HE, 105MM, T17624
TNT LOADED MIL-S-20556
MFGD. BY LEHIGH FOUNDRIES, INC. EASTON, PA
SHELL NO. 7 DECEMBER 1953 M-41491

PICATINNY ARSENAL
CAST STEEL

CONFIDENTIAL

CONFIDENTIAL



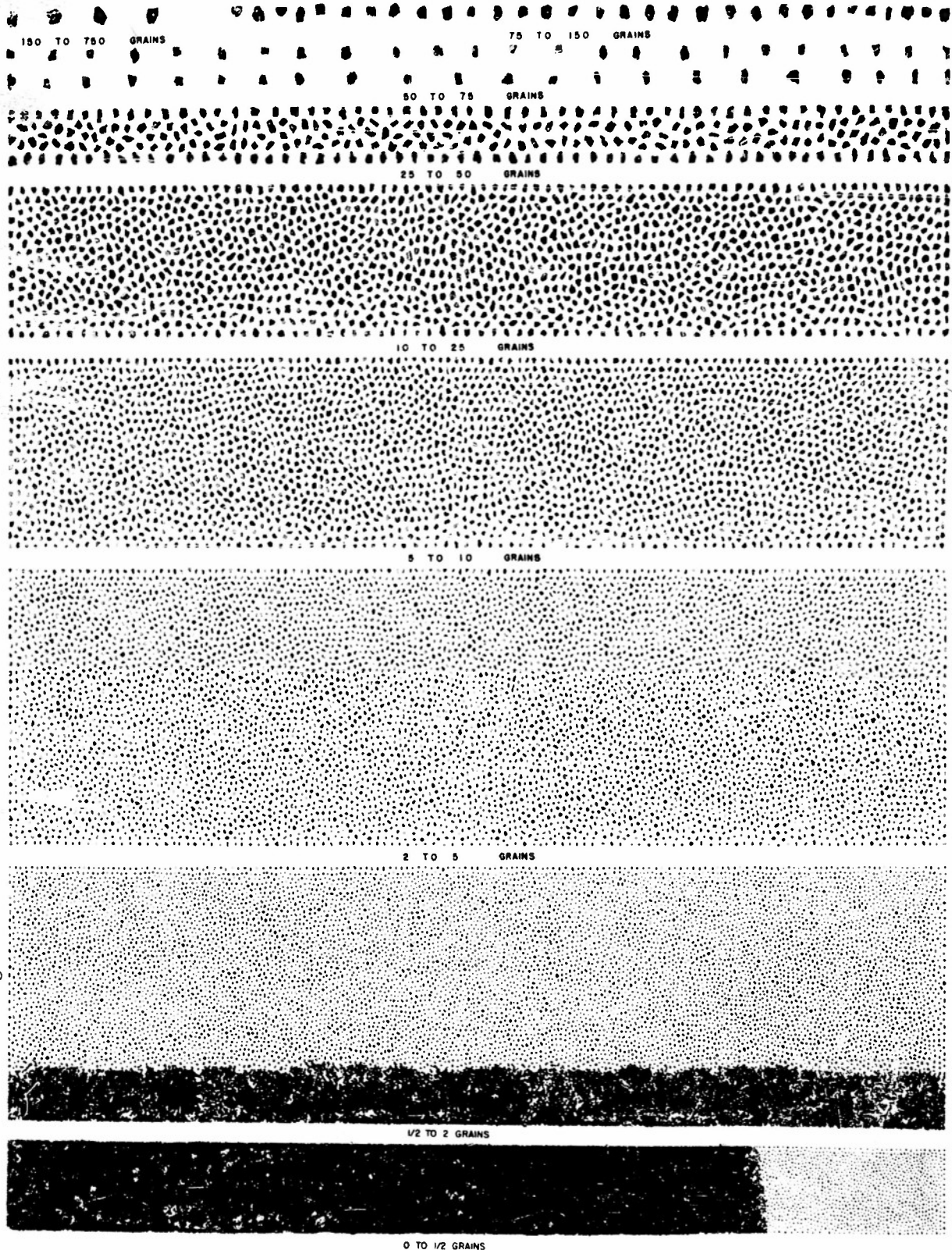
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ORDNANCE CORPS
SHELL, HE, 105MM, T178E1
COMP. B LOADED
MFGD. BY LEHIGH FOUNDRIES, INC. EASTON, PA
SHELL NO. 9 DECEMBER 1953

PICATINNY ARSENAL
CLASS 30 CAST IRON
QQ-I-652
M-42034

CONFIDENTIAL

CONFIDENTIAL

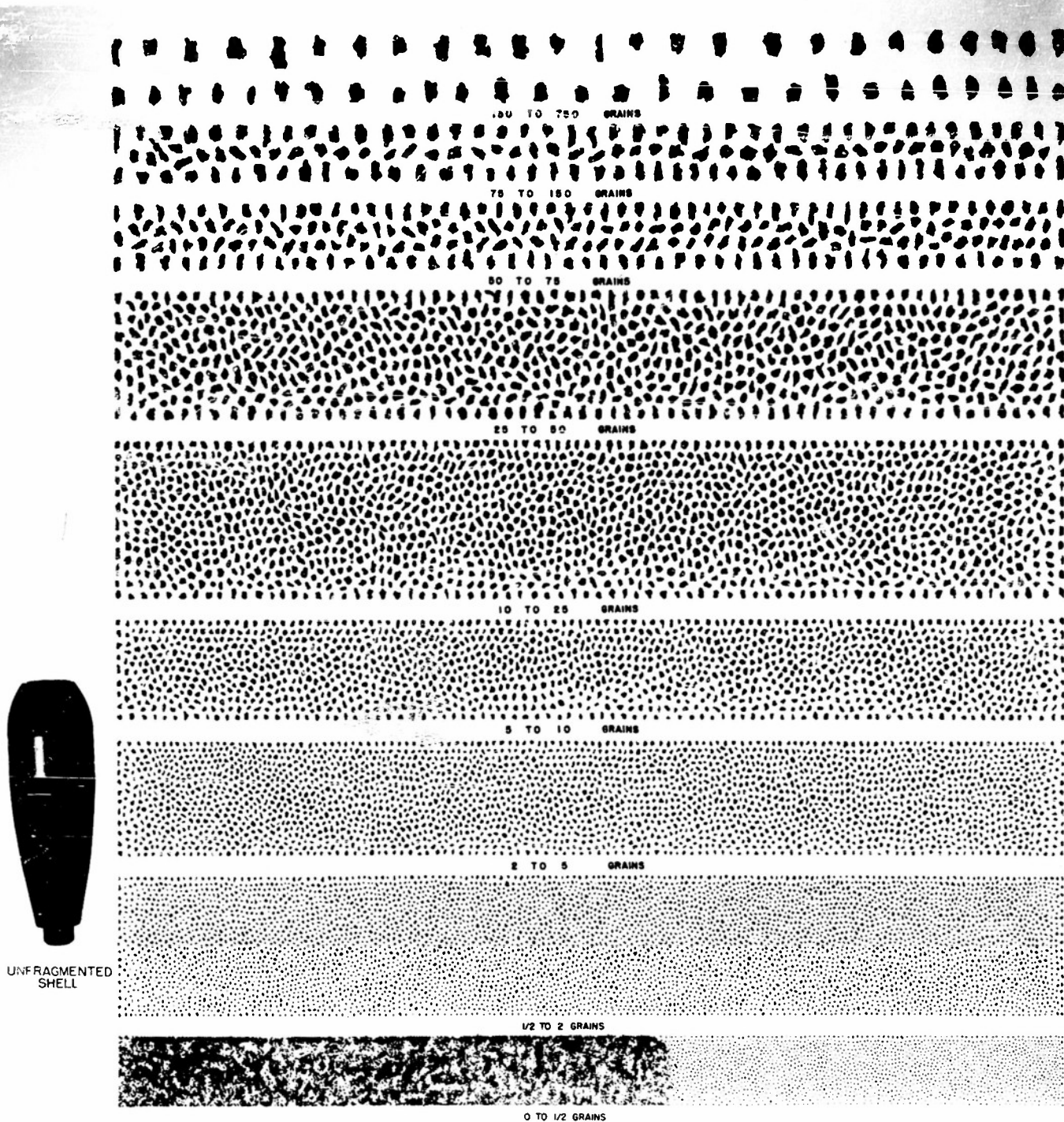


FRAGMENTED SHELL

ORDNANCE CORPS
SHELL, HE, 105MM, T178E2 CLASS 50 CAST IRON
COMP. B LOADED QQ-1-652
MFGD. BY LEHIGH FOUNDRIES, INC. EASTON, PA
SHELL NO. 11 MARCH 1954 M-42036

CONFIDENTIAL

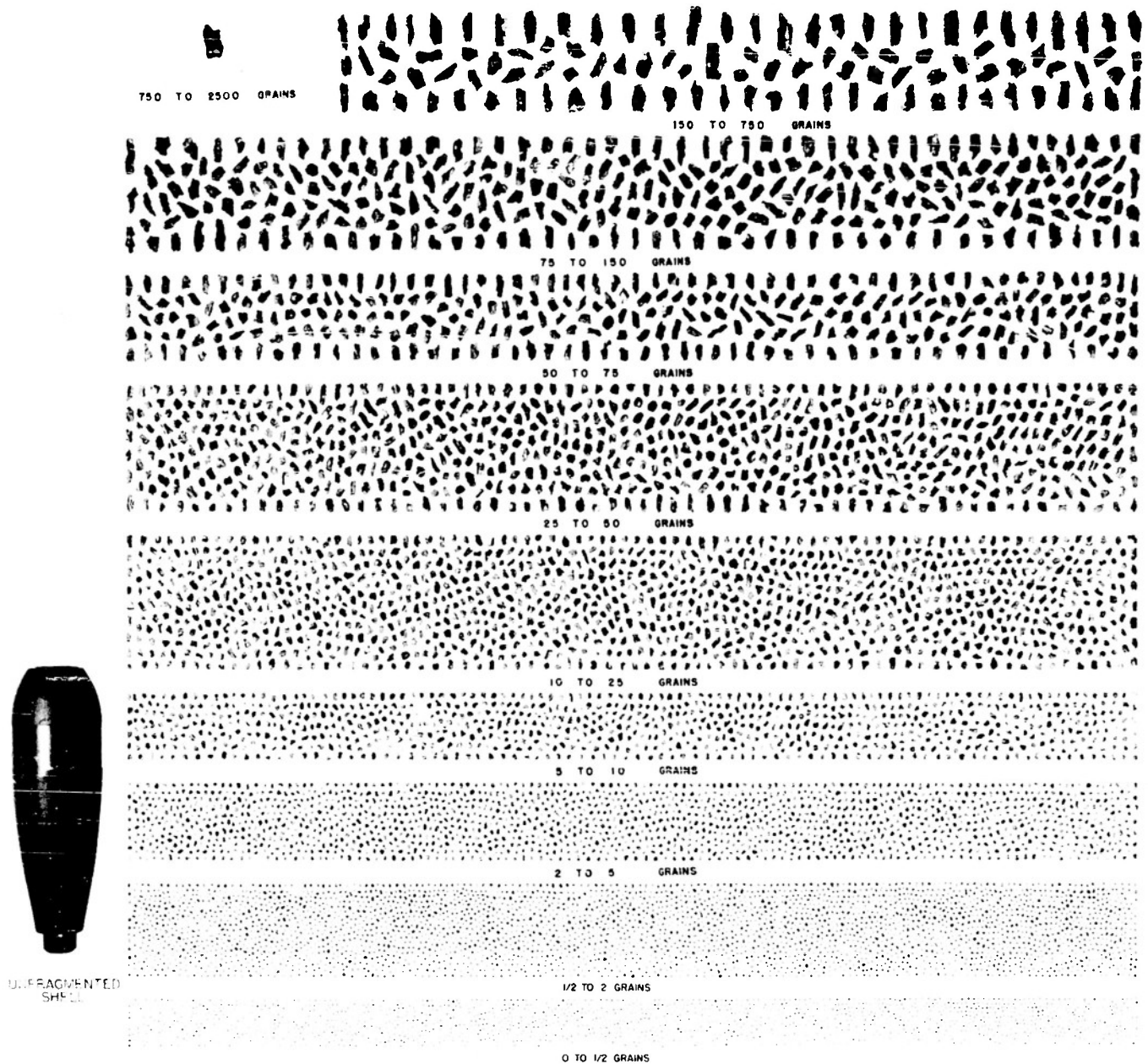
CONFIDENTIAL



ORDNANCE CORPS
SHELL, HE, 105MM, T178E3 CLASS A MALLEABLE IRON
COMP. B LOADED QC-I-666
MFGD. BY LEHIGH FOUNDRIES, INC. EASTON, PA
SHELL NO. 13 MARCH 1954 M-42038

CONFIDENTIAL

CONFIDENTIAL

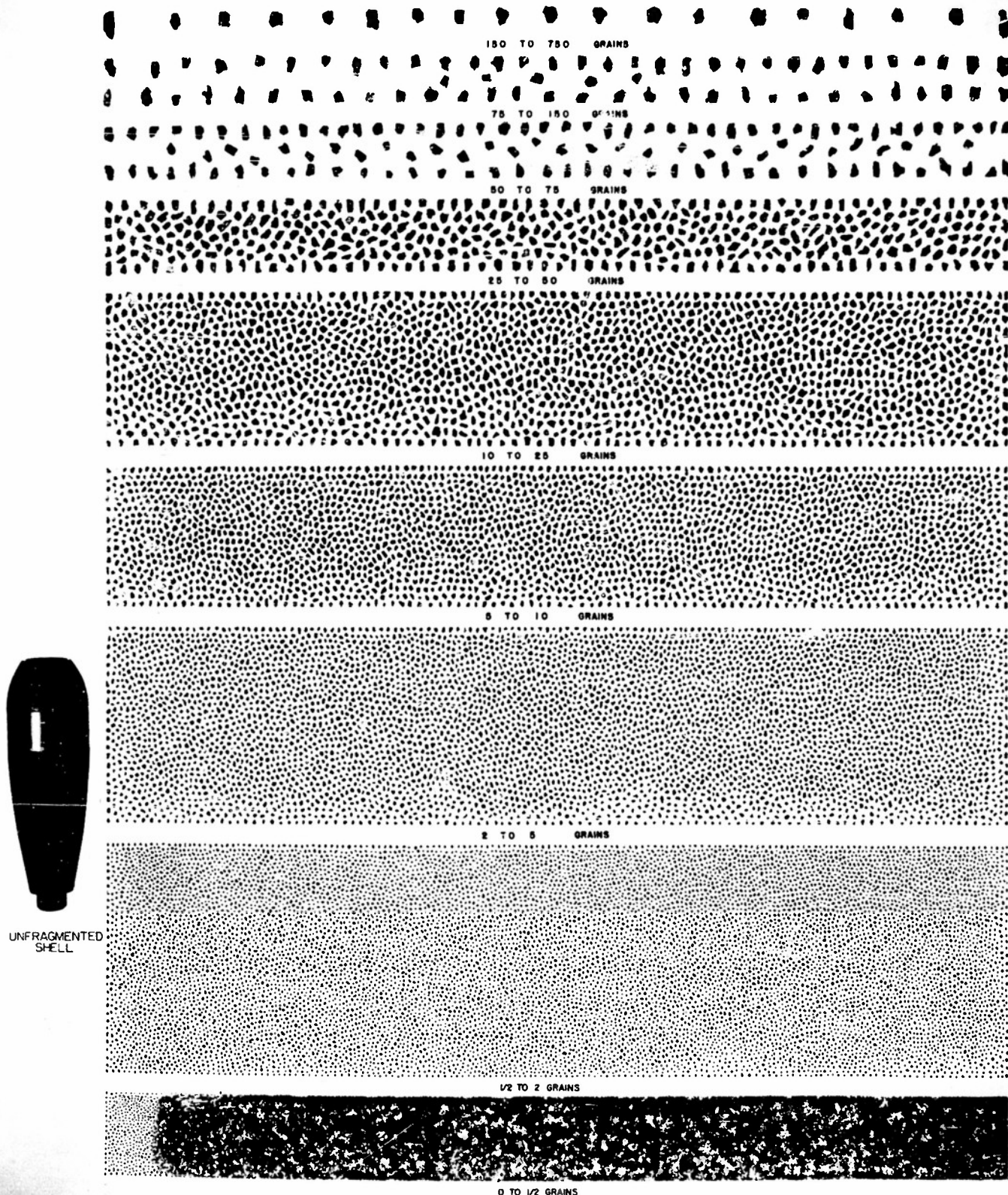


ORDNANCE CORPS
SHELL, HE, 105MM, T178E4
COMP. B LOADED
MFGD. BY LEHIGH FOUNDRIES, INC. EASTON, PA
SHELL NO. 15 MARCH 1954

PICATINNY ARSENAL
CAST STEEL
MIL-S-20556
M-42040

CONFIDENTIAL

CONFIDENTIAL



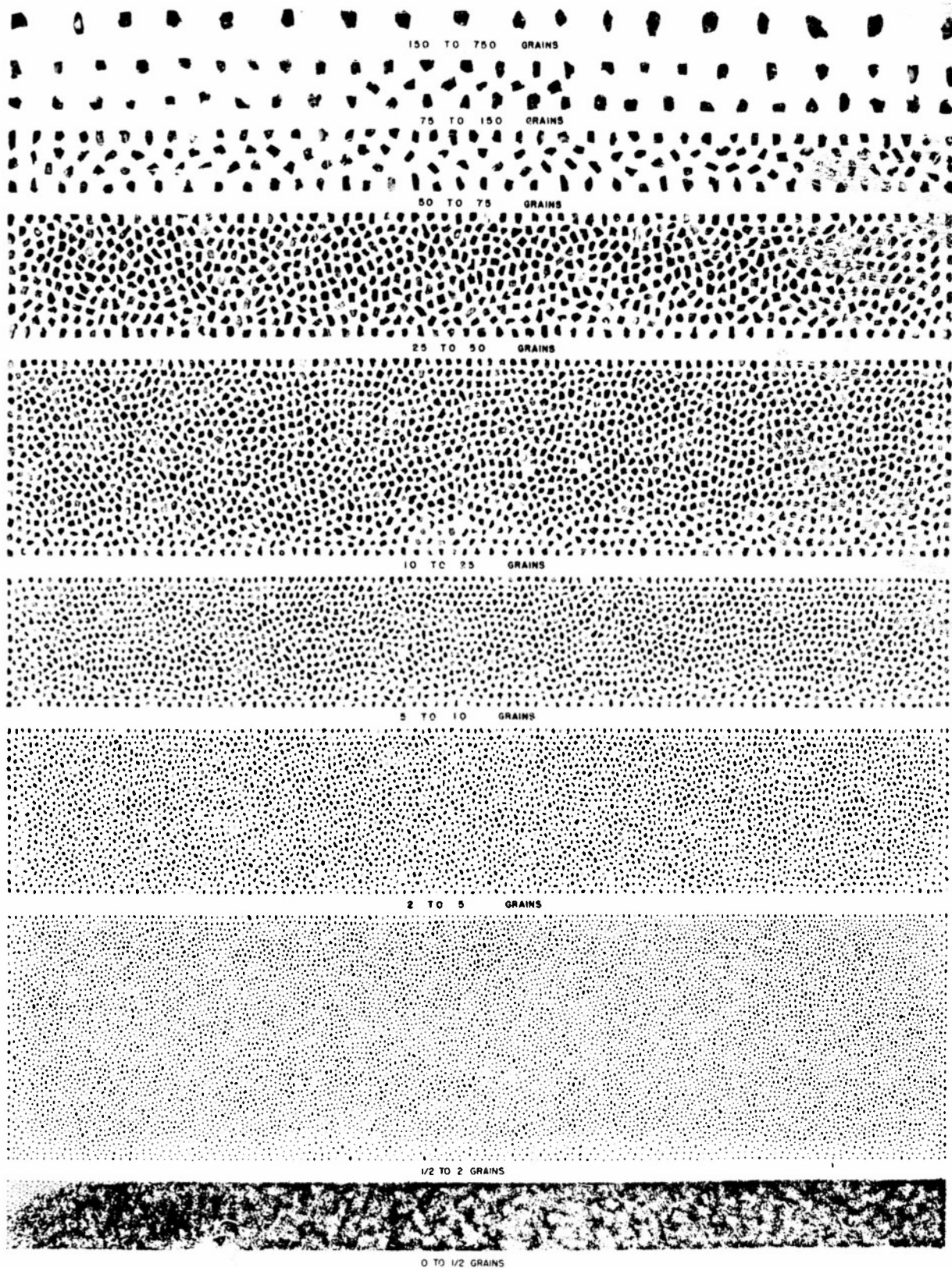
ORDNANCE CORPS PISCATINNY ARSENAL
SHELL, HE. 105MM, T178E1 CLASS 30 CAST IRON
70/30 BARATOL LOADED QQ-I-652
MFGD. BY LEHIGH FOUNDRIES, INC. EASTON, PA
SHELL NO. 17 NOVEMBER, 1953 M-42865

CONFIDENTIAL

CONFIDENTIAL



FRAGMENTED SHELL

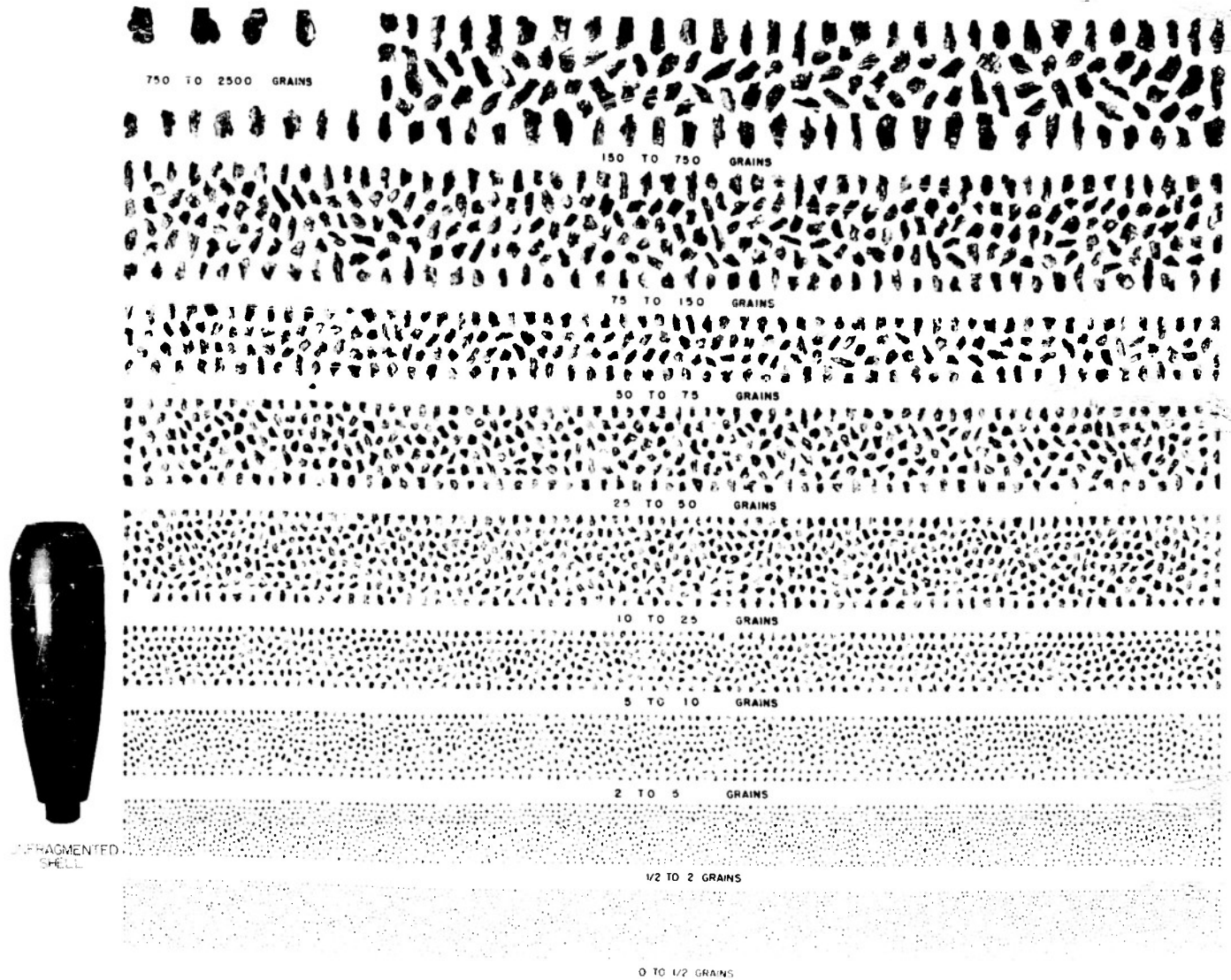


ORDNANCE CORPS
SHELL, HE, 105MM, T17AE2
70/30 BARATOL LOADED
MFGD BY LEHIGH FOUNDRIES, INC. EASTON, PA
SHELL NO. 19 NOVEMBER, 1953

PICATINNY ARSENAL
CLASS 50 CAST IRON
QC-1-652
M-42867

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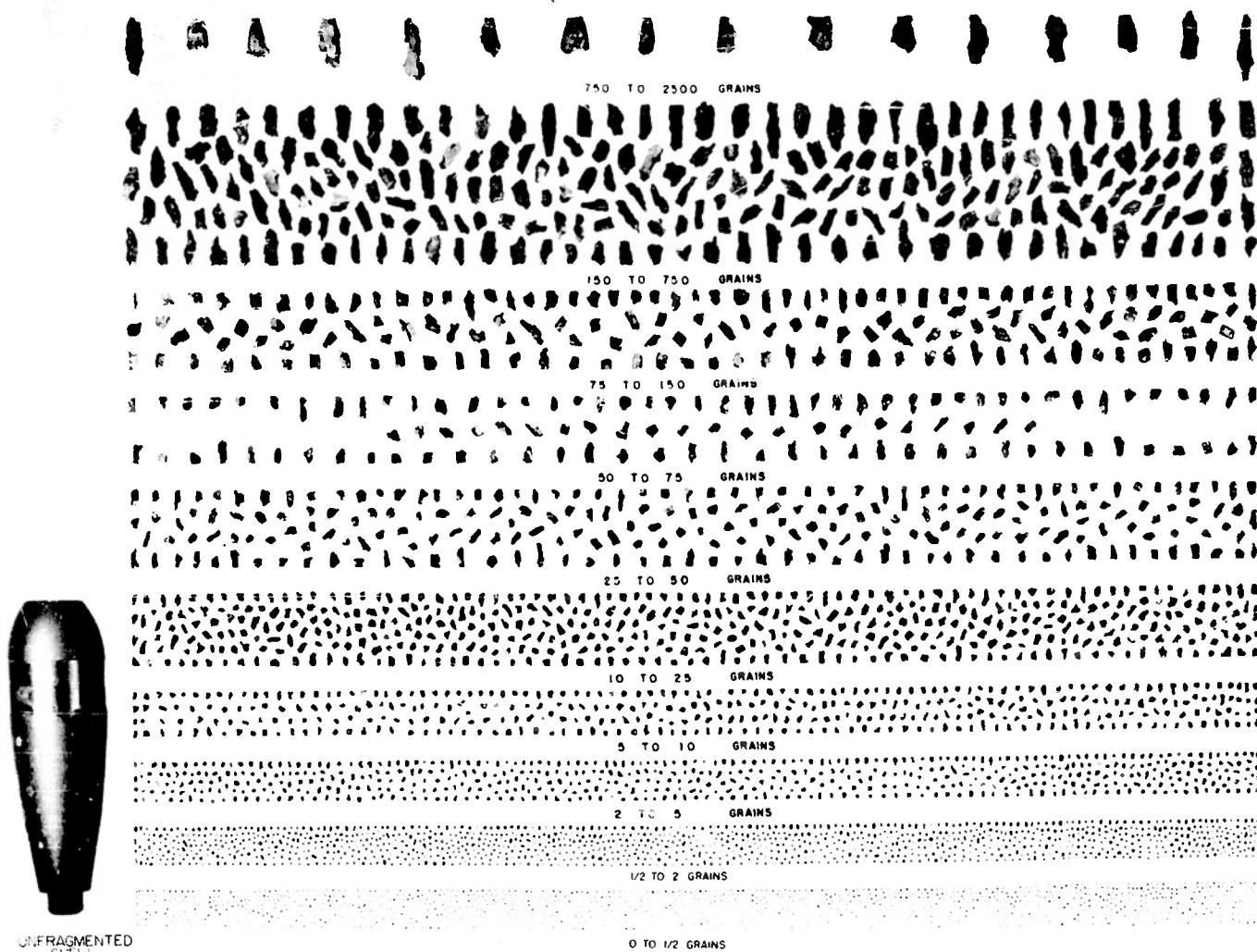
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ORDNANCE CORPS
SHELL, HE, 105MM, T178E3 CLASS A MALLEABLE IRON
70/30 BARATOL LOADED QQ-I-666
MFGD. BY LEHIGH FOUNDRIES, INC. EASTON, PA
SHELL NO. 21 OCTOBER, 1953 M-42869

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ORDNANCE CORPS PICATINNY ARSENAL
SHELL, HE, 105MM, T178E4 CAST STEEL
70/30 BARATOL LOADED MIL-S-20556
MFGD. BY LEHIGH FOUNDRIES INC.,
EASTON, PA
SHELL NO. 23 OCTOBER 1953 M-42871

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