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U S NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

REPORT NO 867

TASK ASSIGNMENT NPG-14-Re5a-21-1

TEST FIRING OF 3"/70 CALIBER GUN BARRELS

37th Partial Report

RAPID-FIRE TESTS OF 3"/70 CALIBER BARREL TYPE C MOD 3 SERIAL NO 24479-L

FINAL Report

Task Assignment NPG-14-Re5a-21-1

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NPG REPORT NO. 867

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

Thirty-Seventh Partial Report

on

Task Assignment NPG-14-Re5a-21-1

Test Firing of 3"/70 Caliber Gun Barrels

- -

Final Report

on

Rapid-Fire Tests of 3"/70 Caliber

Barrel Type C Mod 3 Serial No. 24479-L

Project No.: NPG-14-Re5a-21-1
Copy No.: 2
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Date: OCT 27 1951

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NPG REPORT NO. 867

Rapid-Fire Tests of 3"/70 Caliber
Barrel Type C Mod 3 Serial No. 24479-L

TABLE I

PROOF SEQUENCE DATA

Gun No. 24479-L
Case EX Lot 3

Elevation 9°40'
Lead Foil 45 gms.

Round	Powder Index	Charge Wt. Lbs.	Max. Recoil Inches	Max. Chamber Pressure tsi	Muzzle Velocity ft/sec	Proj.
1	SPDN 10114	7.00	13.1	16.9	3070	EX 24
2	"	8.00	14.25	24.3	3420	"
3	"	8.20	14.4	26.8	3501	"
4	"	7.00	13.7	18.2	Missed	"

[redacted]

APPENDIX A

Rapid-Fire Tests of 3"/70 Caliber
Barrel Type C Mod 3 Serial No. 24479-L

TABLE II

COLD GUN EROSION CHECKS

Charge Wt. 8.75 lbs. Case EX Lot 3 Gun No. 24479-L
Powder SPDN 3531 Primer XCM3B Elevation 9°40'

Erosion Check No.	ESR	Max. Recoil Inches	Max. Chamber Pressure tsi	Muzzle Velocity ft/sec.	Proj.	Range Yards	D/R %
1	74.98	14.5	20.8	3397	Mod. EX 11	Missed	
	75.98	14.6	21.5	3407	"	Missed	
	76.98	14.6	20.9	3404	"	7208	
	77.98	14.6	21.2	3410	"	6907	
	78.98	14.5	21.3	3394	"	7598	4.10
	79.98	14.6	21.0	3388	"	8075	
	80.98	14.7	21.5	3414	"	7138	
	81.98	14.7	22.1	3417	"	7035	
	82.98	14.7	21.5	3401	"	7388	
2	161.98	14.4	19.4	3394	Mod. EX 11	9150	
	162.98	14.4	20.0	3391	"	9505	
	163.98	14.4	19.9	3385	"	8976	
	164.98	14.4	19.6	3356	"	9281	
	165.98	14.5	19.4	3359	"	9210	1.86
	166.98	14.5	18.9	3362	"	Missed	
	167.98	14.5	19.7	3362	"	9012	
	168.98	14.5	19.7	3362	"	9474	
	169.98	14.5	19.4	3347	"	9464	
3	230.98	14.4	20.5	3391	Mod. EX 11	7677	
	231.98	14.4	20.2	3397	"	7706	
	232.98	14.5	20.2	3372	"	8812	
	233.98	14.5	20.5	3388	"	8290	
	234.98	14.5	19.9	3378	"	8440	3.29
	235.98	14.5	19.6	3375	"	8423	
	236.98	14.5	20.7	3397	"	8231	
	237.98	14.5	20.2	3388	"	8440	
	238.98	14.5	20.4	3388	"	8501	

Rapid-Fire Tests of 3"/70 Caliber
Barrel Type C Mod 3 Serial No. 2479-L

TABLE II (Continued)

Erosion Check No.	ESR	Max. Recoil Inches	Max. Chamber Pressure tsi	Muzzle Velocity ft/sec.	Proj.	Range Yards	D/R %
4	315.98	14.4	20.4	3365	Mod. EX 11	6822	
	316.98	14.5	20.4	3365	"	6442	
	317.98	14.5	20.0	3394	"	6425	
	318.98	14.5	20.4	3394	"	6541	
	319.98	14.5	20.4	3362	"	7205	6.65
	320.98	14.5	20.5	3322	"	6571	
	321.98	14.5	20.1	3369	"	7984	
	322.98	14.5	19.8	3350	"	6209	
	323.98	14.5	20.2	3294	"	6145	
*5	325.98	14.6	20.7	3310	EX 24-4	5204	
	326.98	14.6	20.6	Missed	"	6189	
	327.98	14.6	20.8	3362	"	5495	
	328.98	14.6	20.0	3404	"	5109	
	329.98	14.6	20.4	3385	"	5194	4.18
	330.98	14.7	Missed	3375	"	5154	
	331.98	14.7	20.0	3404	"	5154	
	332.98	14.7	19.6	3300	"	5298	
	333.98	14.7	20.4	3385	"	5255	
6	409.98	14.7	19.2	3243	Mod. EX 11	5847	
	410.98	14.7	19.8	3310	"	5548	
	411.98	14.7	19.8	3319	"	5744	
	412.98	14.8	19.3	3313	"	5784	
	413.98	14.8	19.2	3356	"	6088	4.55
	414.98	14.8	19.2	3334	"	6803	
	415.98	14.8	19.6	3337	"	6117	
	416.98	14.8	19.5	3264	"	5644	
	417.98	14.8	19.6	3343	"	5809	
7	501.98	14.6	17.9	3277	Mod. EX 11	Missed	
	502.98	14.6	18.3	Missed	"	"	
	503.98	14.7	18.2	"	"	5201	
	504.98	14.7	18.5	3289	"	5460	
	505.98	14.7	18.4	3283	"	5340	3.75
	506.98	14.7	18.0	3298	"	5709	
	507.98	14.8	17.8	3298	"	5784	
	508.98	14.8	18.5	3274	"	5326	
	509.98	14.8	18.2	3304	"	5772	

* This is an extra erosion check to determine the effect of using the Ex 24 Mod 4 projectile.

Rapid-Fire Tests of 3"/70 Caliber
Barrel Type C Mod 3 Serial No. 24479-L

TABLE III

CARTRIDGE CASE TEST DATA

3"/70 Cases EX 3 (Steel) and EX 4 (Brass)

Test	Rounds	Case	Coating	Case Ejection Velocities Feet Per Second		
				Maximum	Minimum	Average
A	1 and 2	EX 3	Bare	64	63	63.5
A	Odd rounds 3 thru 15	EX 4	Bare	83	71	76
A	Even rounds 4 thru 16	EX 3	Bare	83	63	73
	Remaining 55	EX 3	Bare	78	45	71
B	2	EX 3	Bare	76	-	76
B	Odd rounds 3 thru 15	EX 4	Ceresin Wax	89	76	83
B	Even rounds 4 thru 16	EX 3	Ceresin Wax	85	81	84
	Remaining 60	EX 3	Ceresin Wax	91	73	83
C	1 and 2	EX 3	Bare	67	63	65
C	Odd rounds 3 thru 15	EX 4	Petrolatum Grease	75	72	73
C	Even rounds 4 thru 16	EX 3	Petrolatum Grease	75	67	72
	Remaining 53	EX 3	Petrolatum Grease	80	63	70

NPG. 45194

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3"/70 AUTOMATIC PILOT MT. MK. 35, GUN NO. 24479L
75 ROUNDS RAPID FIRE

CURVE I - - Temperature of Recoil Liquid
CURVE II - Temperature of Inlet Water
CURVE III - Temperature of Outlet Water
RATE OF WATER FLOW: 58 gals. per minute.

U.S. NAVAL PROVING GROUND

17 January 1951

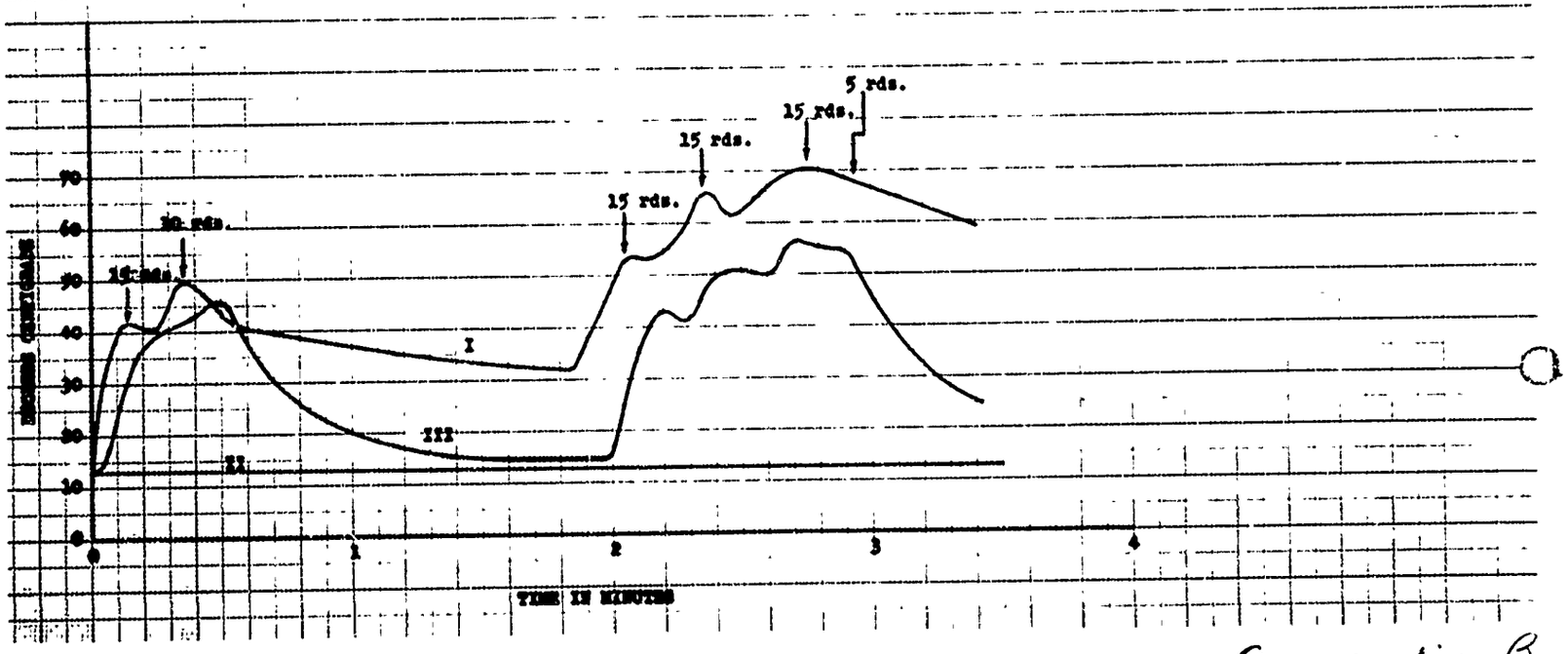

Figure 1

Appendix B

NRL-45195

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3"/70 AUTOMATIC PILOT MT. MK. 35, GUN NO. 24479L
31 ROUNDS RAPID FIRE

CURVE I - Temperature of Recoil Liquid
CURVE II - Temperature of Inlet Water
CURVE III - Temperature of Outlet Water

RATE OF WATER FLOW: 58 gals. per minute.

U.S. NAVAL PROVING GROUND

5 April 1951

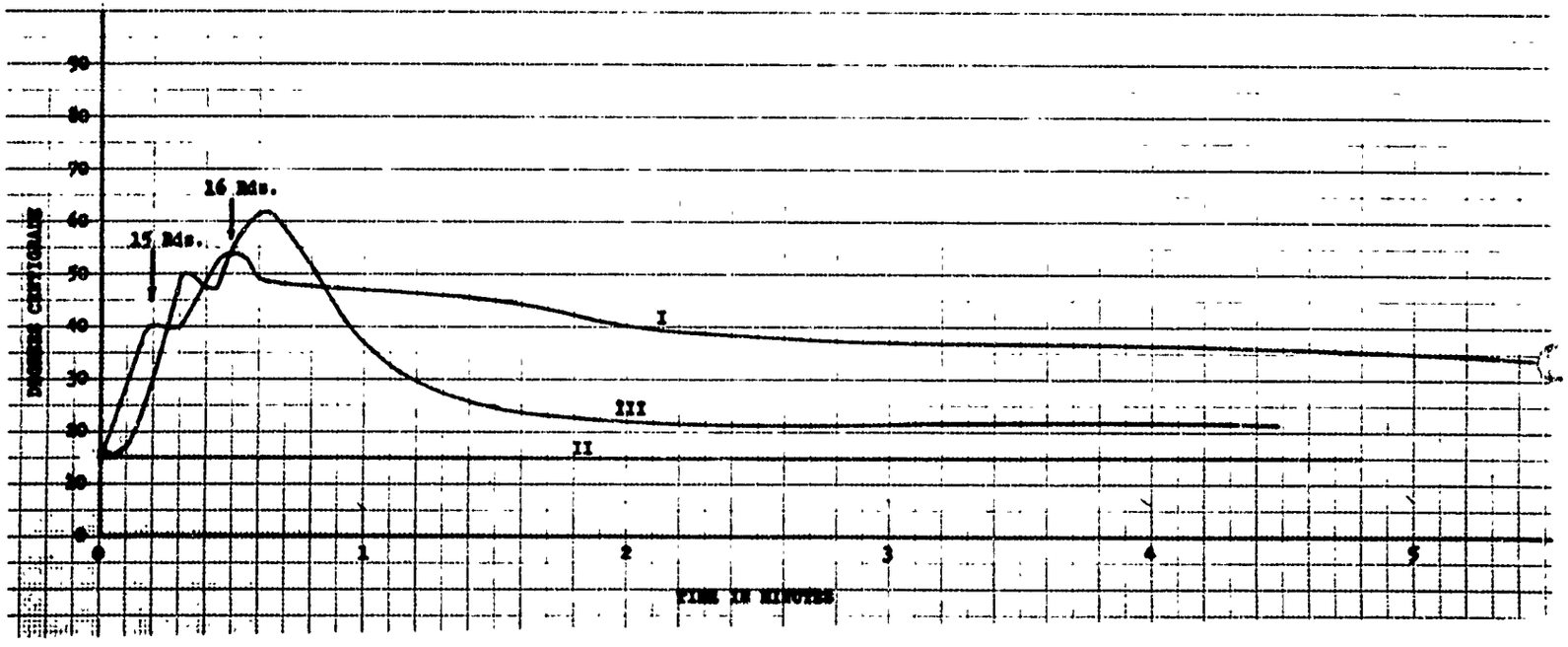


Figure 2

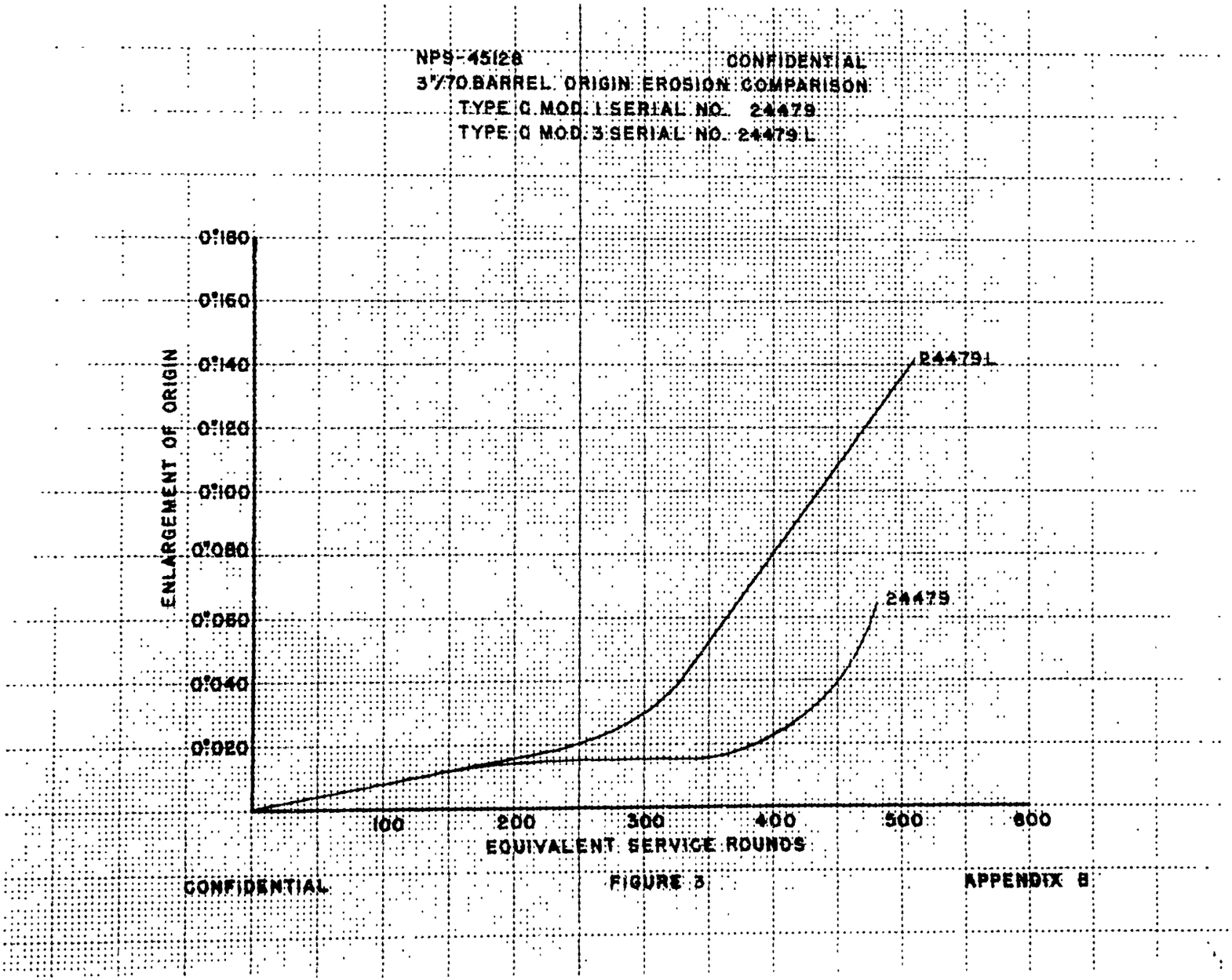
Appendix C

NPS-45128 CONFIDENTIAL

3"/70 BARREL ORIGIN EROSION COMPARISON

TYPE C MOD. 1 SERIAL NO. 24479

TYPE C MOD. 3 SERIAL NO. 24479 L



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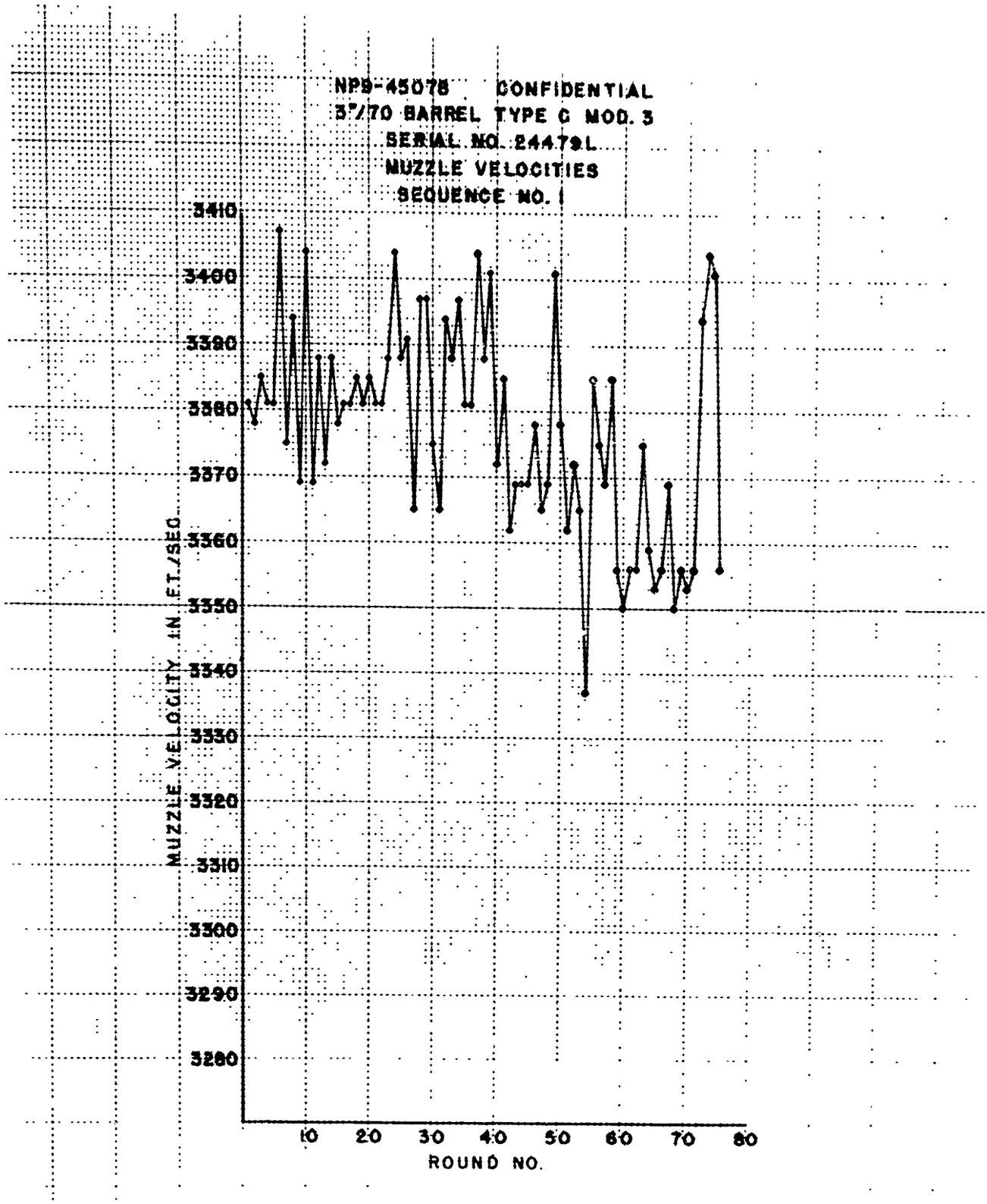

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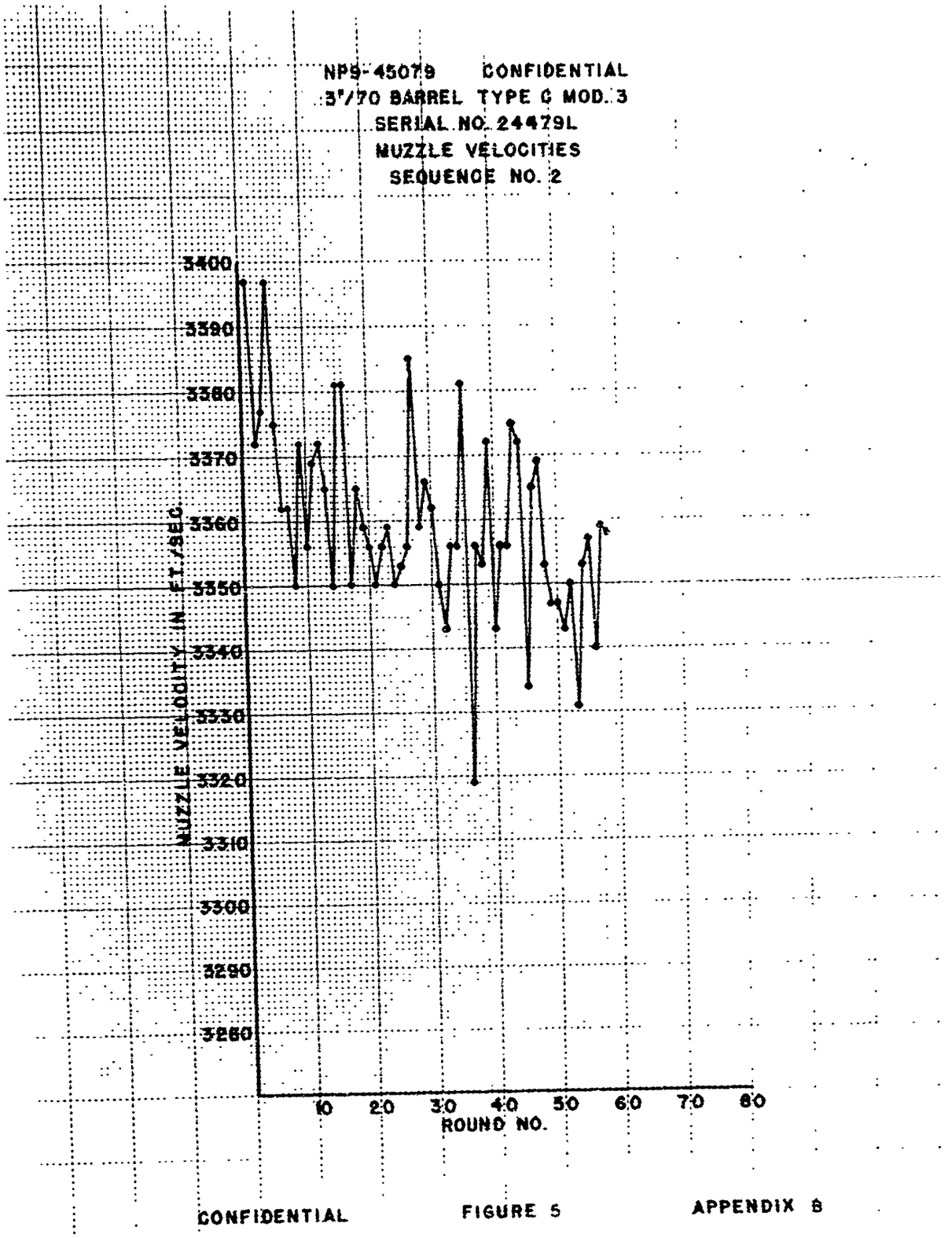

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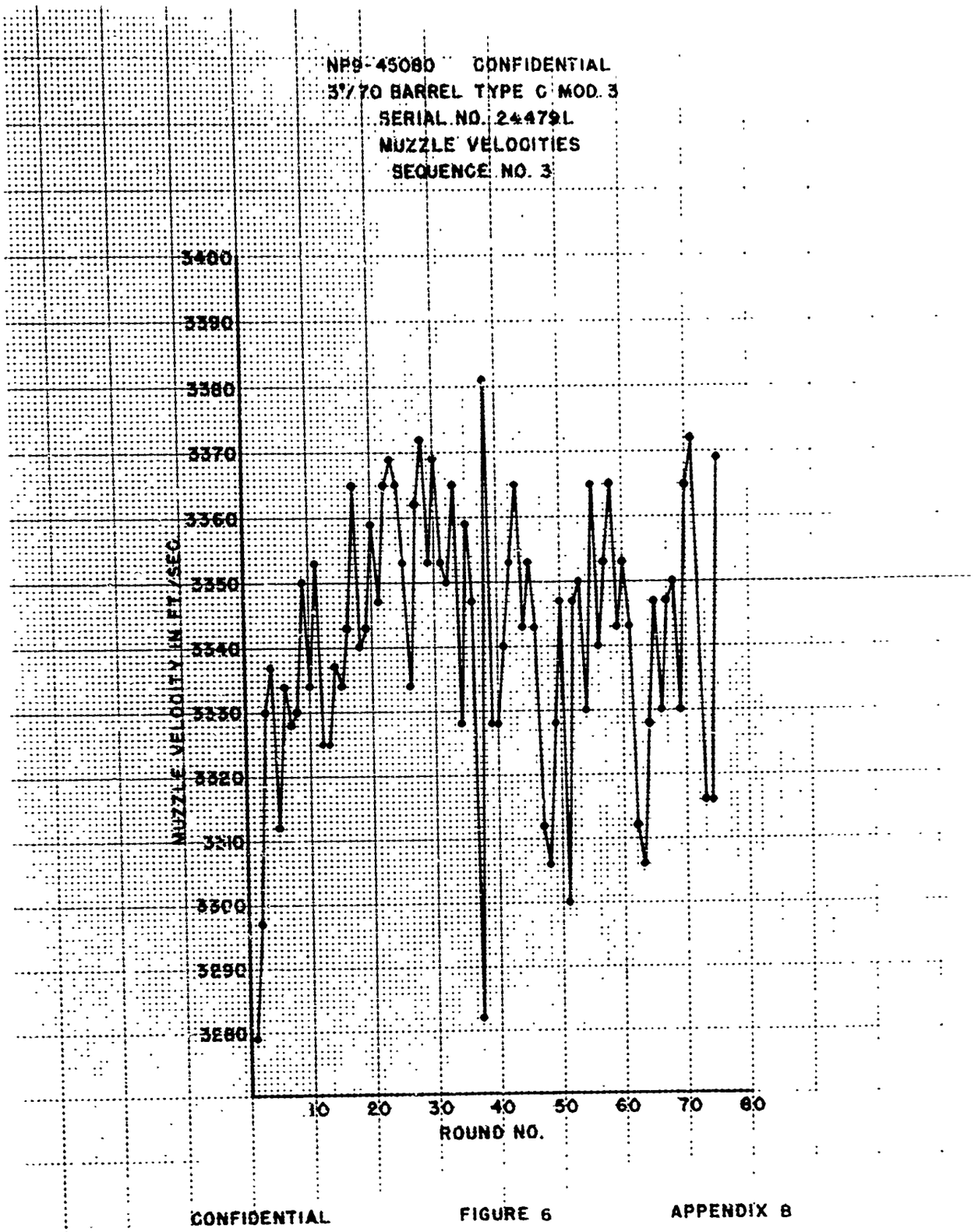

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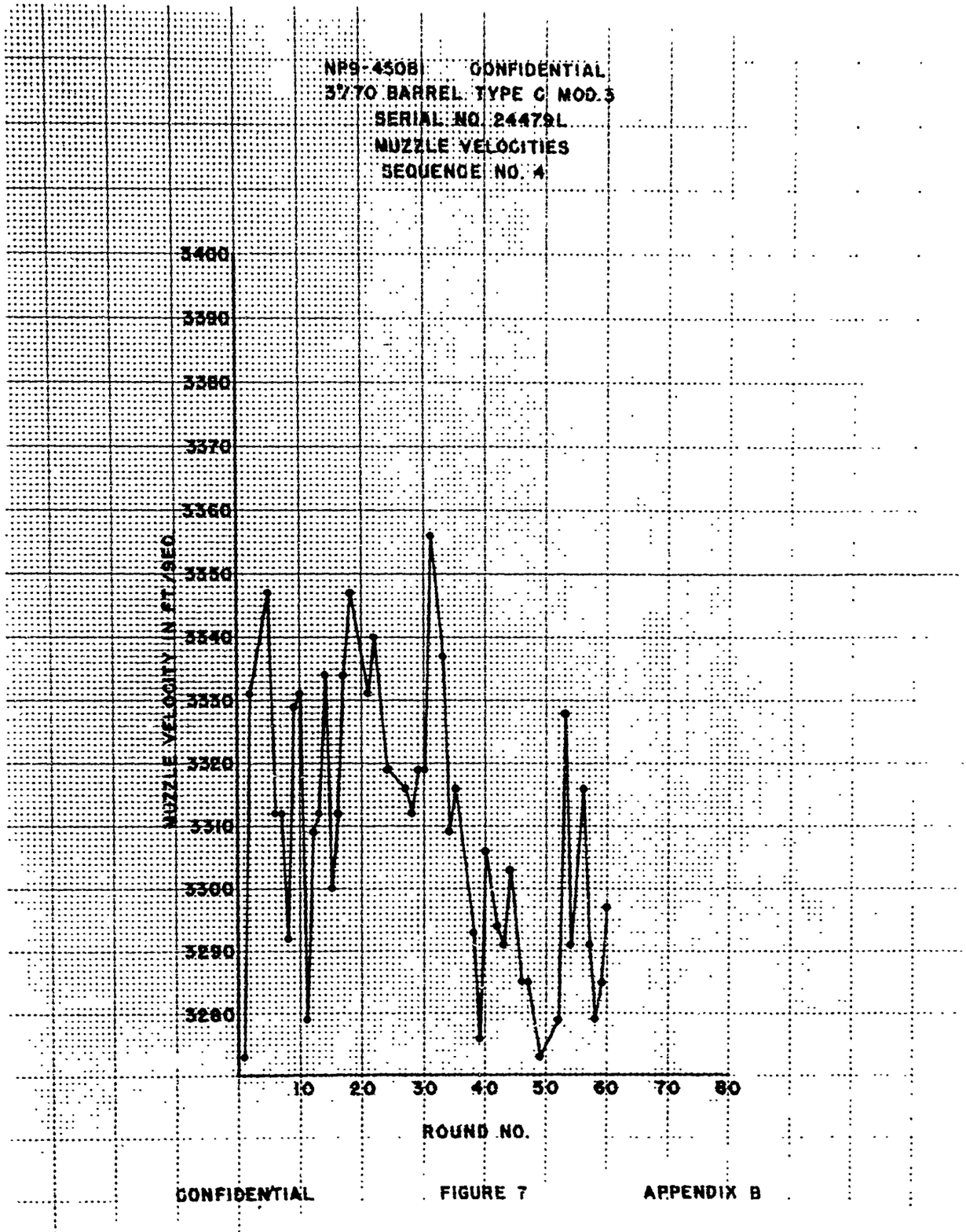

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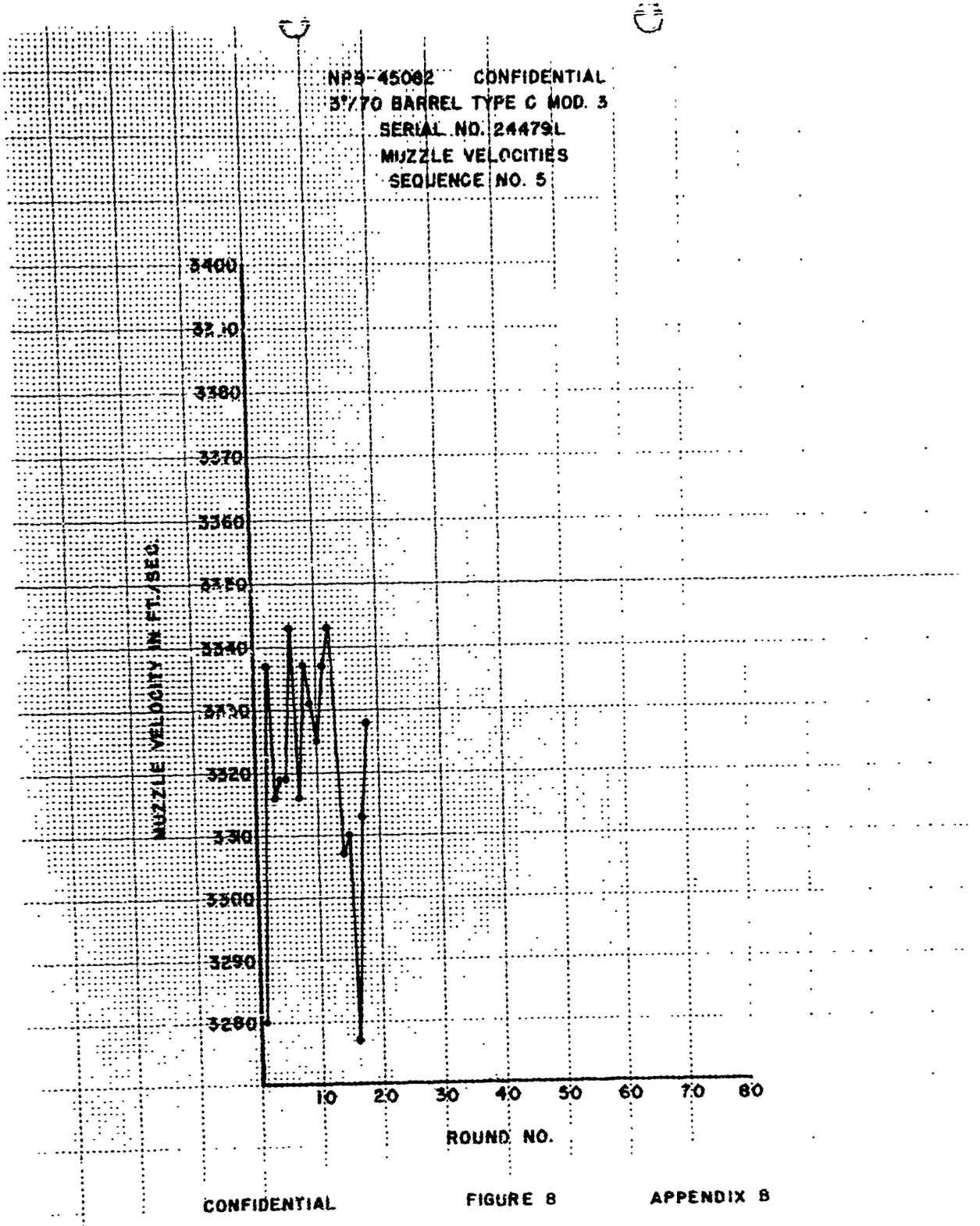

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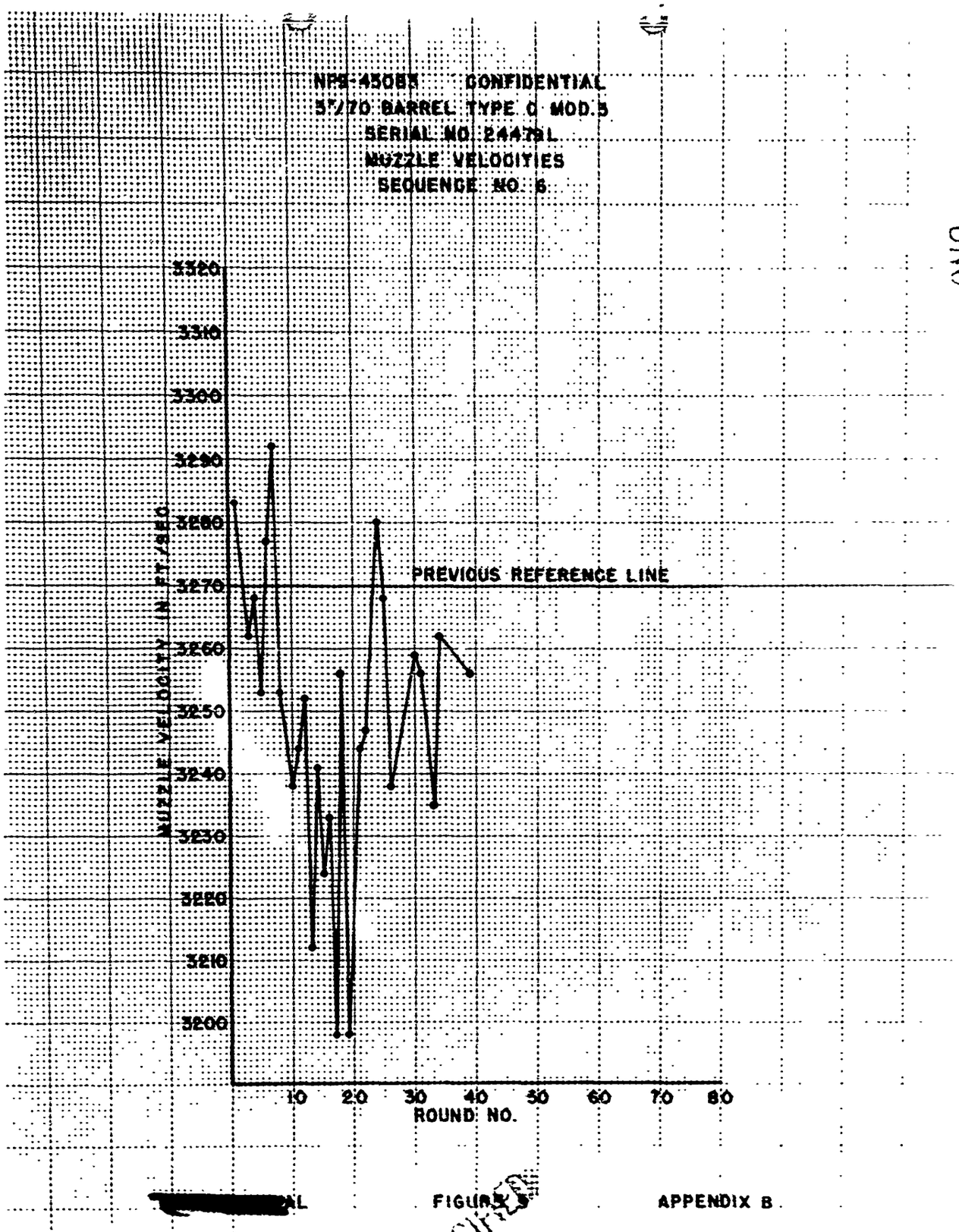

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Rapid-Fire Tests of 3"/70 Caliber
Barrel Type C Mod 3 Serial No. 24479-L

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Rapid-Fire Tests of 3"/70 Caliber Barrel Type C Mod 3 Serial No. 24479-L

PART A

SYNOPSIS

1. This is the thirty seventh partial report on Task Assignment NPG-14-Re5a-21-1: Test Firing of 3"/70 Caliber Gun Barrels.

2. This report covers the rapid-fire life tests conducted with 3"/70 Caliber Barrel Type C Mod 3 Serial No. 24479-L. This barrel is an interface-cooled barrel similar to the Type C Mod 1 barrel except that it has had a new liner inserted, the rifling of which has increasing twist from zero to one turn in 25 calibers, increasing land width from zero at the origin to 0.231 at the muzzle, and a shorter run-up.

3. The tests reported herein were conducted for the following purposes:

a. To fire the subject barrel to end of life.

b. To obtain information relative to the wear (gun life) characteristics of this type barrel under rapid-fire conditions.

c. To obtain information relative to the cooling characteristics of this type barrel under rapid-fire conditions.

d. To obtain information relative to cook-off temperatures following rapid-fire bursts.

e. To determine the effects of using ceresin wax or petrolatum grease as a coating on cartridge cases to facilitate case extraction and ejection.

4. The tests were conducted by subjecting the barrel to a series of rapid-fire programs during which cooling, erosion, and temperature data were obtained.

5. As a result of these tests, it is concluded that:

a. The modifications introduced in the Type C Mod 3 barrel did not result in increased barrel life.

b. Projectiles fired from the Type C Mod 3 barrel have unpredictable flight characteristics resulting in entirely unacceptable deviations in range. This is apparently due to malfunctioning of the projectile rotating bands.

c. Following an extended burst, cook-off temperatures, provided the coolant system is in operation, are so low as to be considered negligible.

d. The use of ceresin wax as a coating on cartridge cases is an effective method of achieving more efficient case ejection.

e. The use of steel cases requires ejection chutes considerably stronger than those used with brass cases only.

Rapid-Fire Tests of 3"/70 Caliber
Barrel Type C Mod 3 Serial No. 24479-L

TABLE OF CONTENTS

Rapid-Fire Tests of 3"/70 Caliber
Barrel Type C Mod 3 Serial No. 24479-L

PART B

INTRODUCTION

1. AUTHORITY:

Reference (a), later superseded by reference (b), authorized the tests reported herein.

2. REFERENCES:

a. BUORD ltr S74-1(3")(Re5a)PJO:cmj Serial 5899 of 13 Feb 1950
b. BUORD ltr S74-1(3")(Re5a)RMS:cmj Serial 10647 of 8 Aug 1951
c. NPG Report No. 414 of 8 Nov 1949
d. NPG Report No. 365 of 9 Sep 1949
e. NPG Report No. 626 of 18 Aug 1950

3. BACKGROUND:

a. Rapid-fire tests have, in recent years, been conducted on a 3"/70 caliber automatic gun mount using a barrel cooled by water pumped through a water jacket. Reference (d) reported failure of the water jacket due to water hammer and shock, and an early end of barrel life due, in part, to poor heat transfer between barrel and water.

b. In an effort to reduce or eliminate this type of failure of the cooling system, and in order to bring the cooling water closer to the inner surface of the barrel, thereby permitting the heat to reach the water and be carried off sooner, the 3"/70 caliber barrel Type C Mod 1 serial No. 24479 was designed and constructed. This was an interface-cooled barrel in which water was pumped through grooves machined along the inner surface of the gun tube so that the water contacts the external surface of the liner itself. This barrel was proof and life tested at the Naval Proving Ground during the interval 17 December 1948 to 21 July 1949. Reference (c) reports that test.

c. At the conclusion of the life test, the 3"/70 Caliber Barrel Type C Mod 1 Serial No. 24479 was returned to the Naval Gun Factory where the worn out liner was removed. A new liner, of markedly different design was installed, and the barrel redesignated as 3"/70 Caliber Barrel Type C Mod 3 Serial No. 24479-L. By references (a) and (b) the Bureau of Ordnance authorized a rapid-fire life test to be conducted on this barrel.

4. OBJECT OF TEST:

a. To fire the subject barrel to end of life.

b. To obtain information relative to the wear (gun life) characteristics of this type barrel under rapid-fire conditions.

c. To obtain information relative to the cooling characteristics of this type barrel under rapid-fire conditions.

d. To obtain information relative to cook-off temperatures following rapid-fire bursts.

e. To determine the effects of using ceresin wax or petrolatum grease as a coating on cartridge cases to facilitate case extraction and ejection.

5. PERIOD OF TEST:

a.	Date Project Letter	13 February 1950
b.	Date Barrel Received	1 February 1950
c.	Date Commenced Test	21 February 1950
d.	Date Test Completed	25 April 1951

6. REPRESENTATIVE PRESENT:

Mr. R. C. Persinger Bureau of Ordnance (Re5d)

Rapid-Fire Tests of 3"/70 Caliber
Barrel Type C Mod 3 Serial No. 24479-L

PART C

DETAILS OF TEST

7. DESCRIPTION OF ITEM UNDER TEST:

a. The 3"/70 Caliber Barrel Type C Mod 3 Serial No. 24479-L is an experimental "interface-cooled" barrel consisting of a tube and liner. In order to eliminate the need of an external water jacket for cooling purposes, and to bring the cooling water closer to the inner surface of the barrel, twelve (12) longitudinal grooves were machined into the inner surface of the gun tube. These grooves, equally spaced around the inner circumference of the tube, are semi-circular in cross section and have a radius of one quarter (0".25) inch. The liner was then inserted and the grooves became tubes for the passage of water. Water collector rings, one at each end of the tube connected to inlet and outlet manifolds, permit water at 100 lbs. per square inch pressure to be pumped through the cooling tubes at the flow rate of approximately 58 gallons per minute.

b. The rifling of this barrel has twist increasing from zero at the breech end to one turn in twenty-five (25) calibers at nine (9) inches from the muzzle. It remains uniform at one in twenty-five the last nine inches to the muzzle. The land width increases from zero at the origin to 0".231 at the muzzle. Width of the grooves at the muzzle is 0".161. The groove depth is constant at 0".035. The external surface of the liner is copper-plated 0".001 for better heat transfer.

c. Rapid-fire tests were conducted with the subject barrel mounted in the 3"/70 Caliber Mount Mark 35 Mod 0 Automatic Pilot Gun, a rapid-fire mount capable of firing at a cyclic rate of ninety (90) rounds per minute. A detailed description of this mount may be found in reference (d).

8. DESCRIPTION OF TEST EQUIPMENT:

a. Maximum Chamber Pressure:

The maximum chamber pressures of the proof sequence and erosion check rounds were obtained by the use of standard copper-crusher type gauges.

b. Projectile Muzzle Velocity:

Muzzle velocities of projectiles were obtained by placing a magnetizing coil around the forward end of the barrel. Projectiles passing through the barrel became magnetized and triggered electronic time counting devices by traveling through solenoids placed in their trajectory as close to the muzzle as practicable.

c. Cooling Water:

Water for the cooling system was stored in an open tank containing approximately 2000 gallons. As a rust inhibitor 0.67 oz. of neutral sodium chromate per gallon of water was added. The water was supplied to the gun by a centrifugal pump which, at 100 psi, pumped 58 gallons per minute through the system.

d. Cooling Water, Recoil Fluid, and Cook-Off Temperatures:

Temperature data were obtained by the use of Iron-Constantan Thermocouples and were recorded by a "Brown" recording potentiometer.

9. PROCEDURE:

a. A proof sequence of four (4) hand rammed rounds was fired.

b. Fifty four (54) hand rammed rounds were fired for a special test of projectiles. This was not part of the barrel life test firing, but was reported in reference (e).

Rapid-Fire Tests of 3"/70 Caliber
Barrel Type C Mod 3 Serial No. 24479-L

c. Thirty-two (32) hand rammed rounds were fired to determine the powder charge to be used for the rapid-fire tests. Subsequent tests were fired with rounds assembled by the Naval Proving Ground using the following components:

Propellant	SPDN 3531
Charge Weight	8.75 lbs.
PPD	1:9
Projectile (inert)	EX 11 (modified by having the forward rotating band ground off flush with the body of the projectile)
Primer	XCM3B
Lead Foil	65 grams
Case	EX 3 (Steel)
Crimp	Standard rubber crimp
Dummy Nose Plug	Dwg. No. 593006

d. It was desired to conduct the rapid-fire tests by firing a series of 75-round sequences. Each sequence was to consist of five (5) 15-round bursts with a five second interval between bursts, all bursts to be fired at the cyclic rate of 90 rounds per minute.

e. Due to unexpected stoppages of the automatic loader the majority of the sequences were either cut short or interrupted. The sequences of 15 rounds or more actually fired were as follows:

Sequence No. 1	75 rounds (15-12-15-15-18)
Sequence No. 2	58 rounds (4-15-15-1-15-2-6)
Sequence No. 3	75 rounds (15-15-10-15-15-5)
Sequence No. 4	60 rounds (15-15-15-15)
Sequence No. 5	17 rounds (15-2)
Sequence No. 6	31 rounds (15-14-2)

f. During all firing, cooling water was pumped through the cooling system at the rate of 58 gallons per minute. Temperatures of the ingoing and outgoing water and of the recoil fluid were recorded simultaneously.

g. Immediately after the conclusion of sequences 1, 3 and 4 a specially prepared cook-off test round was inserted in the chamber in order to get information on the temperature rises in the round.

h. Following each rapid-fire sequence the subject barrel was shipped to the Naval Gun Factory for star gauging, bore photographing, and detailed examinations. Where time permitted, the barrel was also star gauged at the Naval Proving Ground in order to obtain a curve of origin enlargement versus rounds fired.

i. A 10-round cold gun erosion check, during which muzzle velocities, maximum chamber pressures, and ranges were recorded, was fired between all sequences.

j. Rapid-fire tests were conducted until the barrel liner was worn and had deteriorated to the extent that further firing was deemed hazardous.

k. In conjunction with the above mentioned firings, tests were conducted to ascertain the operational characteristics of brass (EX 4) and Steel (EX 3) cases with various types of surface coatings. The tests were as follows:

Test	Sequence	Rounds	Case	Coating
A	1	1 and 2	EX 3	Bare
A	1	Odd rounds 3 thru 15	EX 4	Bare
A	1	Even rounds 4 thru 16	EX 3	Bare
		Remaining 55	EX 3	Bare
B	3	2	EX 3	Bare
B	3	Odd rounds 3 thru 15	EX 4	Ceresin Wax
B	3	Even rounds 4 thru 16	EX 3	Ceresin Wax
		Remaining 60	EX 3	Ceresin Wax
C	4	1 and 2	EX 3	Bare
C	4	Odd rounds 3 thru 15	EX 4	Petrolatum Grease
C	4	Even rounds 4 thru 16	EX 3	Petrolatum Grease
		Remaining 53	EX 3	

l. The first 16 cases in each test were numbered by stamps for recognition and inspection after firing.

m. At the conclusion of all rapid-fire tests the barrel was fired a final 10 round erosion check.

10. RESULTS AND DISCUSSION:

a. The subject barrel was fired a total of 509.98 equivalent service rounds or 527 actual rounds. Of the actual rounds, 167 were fired single-fire and the remaining 360 were fired in automatic rapid-fire.

b. The data obtained during proof of the barrel are included in Table I Appendix (A) of this report.

c. Table II Appendix (A) contains the data obtained during the firing of the cold gun erosion checks. It is noted that from the start the D/R was excessively large. Furthermore, the D/R does not appear to have any particular relationship to barrel age. This is unusual, for past 3"/70 barrel rapid-fire tests have shown the D/R to start at less than one half of one percent and to increase with barrel age. Table II also shows the range to be far short of that reached by other 3"/70 barrels fired in the same mount at the same elevation. The usual range for this elevation is approximately 12,000 yards throughout the greater part of barrel life. The subject barrel, however, showed ranges varying from 10,000 yards down to 7000 yards early in barrel life. These deficiencies can be attributed largely to the poor flight characteristics of the projectiles fired from this barrel. All the projectiles used in the life test were EX 11 projectiles modified by having the forward rotating bands cut down to bourrelet diameter. This was necessary due to the fact that the subject barrel has a short run-up and because of the increasing twist rifling. The flight of each projectile fired from this barrel was noticeably vibratory. Reference (e) reports that even when the subject barrel was nearly new (38 rds.) projectiles fired at service pressure from it had the engraving in their bands almost completely obliterated, and attained, on the average, only 67% nominal spin. At reduced pressures, band engraving and spin were normal. It is suggested that this might be caused by the extreme narrowness of the grooves near the muzzle, and might perhaps, be corrected by reducing the number of lands. It is noted, further, that unmodified EX 11 projectiles, when fired at 15° elevation in Types A Mod 1 and B Mod 1 barrels, had satisfactory dispersion in range.

Rapid-Fire Tests of 3"/70 Caliber
Barrel Type C Mod 3 Serial No. 24479-L

d. Figures 1 and 2 Appendix (B) are temperature vs. time curves of the inlet and outlet cooling water temperatures obtained for sequences Nos. 3 and 6. These figures also include curves of the recoil fluid temperatures. The total temperature rise of the cooling water is shown in the following table:

Sequence No.	Rounds	Inlet Temp. Deg. C	Outlet Temp. Deg. C	Temp. Rise Deg. C
3	75	13	56	43
6	31	15	54	39

Factors which prevented the recording of satisfactory water temperature data for all sequences were as follows:

(1) Stoppages occurring to the automatic loader, preventing the firing of sufficiently long sequences.

(2) Breakages of the water hose connections to the barrel.

(3) Malfunction of the "Brown" recording potentiometer. The outlet water pressure was determined to be seven pounds per square inch.

e. Of the three attempts to get cook-off temperature data (Sequences Nos. 1, 3, and 4) only one was successful. On Sequences Nos. 1 and 4 the "Brown" recording potentiometer did not function properly. Data were obtained for Sequence No. 3, but the temperature rises were so small that the drawing of time-temperature curves was considered impracticable. The data obtained were as follows:

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Rounds fired	75 (a 1' 34" delay after Rd. 25)
Powder	SPDN 3531
Cook-off Projectile	EX 17
Cook-off Projectile in gun	30 sec. after firing ended
Temp. rise of squib	0°
Temp. rise of booster in Aux. Det.	3°C
Temp. rise of Proj. wall under forward rotating band	5°C
Temp. rise of Proj. wall under rear rotating band	3°C
Temp. rise of Case wall 19" from base	2°C
Temp. rise of Primer	0°

f. Star gauge data and bore photographs obtained at the Naval Gun Factory were periodically forwarded direct to the Bureau of Ordnance by the Naval Gun Factory, and are therefore not included as part of this report.

g. Figure 3 Appendix (B) is a set of curves showing a comparison of origin enlargement versus equivalent service rounds between the subject barrel and barrel Type C Mod 1 Serial No. 24479, also an interface - cooled barrel. It is observed that after the chromium plate had ceased to protect the origin of bore, the wear rates of the Type C Mods 1 and 3 barrels appear to be approximately equal, but that the chromium failed at the origin approximately 100 rounds earlier in the subject barrel. This might be attributed to the extreme narrowness of the lands at the origin of bore, which was apparently not fully compensated for by the beneficial effect of reduced band pressure resulting from the narrow lands.

h. Figures 4 thru 9 Appendix (B) are charts showing the projectile muzzle velocities for each round fired in Sequences 1 thru 6. These charts will also give an indication of barrel wear in progressive sequences. It can be seen that the velocity grouping lowers for each sequence fired. The velocity difference (loss) between the Sequence No. 1 group and the Sequence No. 6 group is approximately 130 feet per second.

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i. Table III Appendix (A) contains a summary of the cartridge case test data, namely the case ejection velocities attained with the EX 3 and EX 4 cases either bare or coated with ceresin wax or petrolatum grease. The figures in Table III indicate that the most satisfactory case ejection was achieved through coating the cases with ceresin wax. It does not appear to make any appreciable difference whether the cases were EX 3 or EX 4. The minimum case velocities reached with bare cases (45 ft/sec) or cases coated with petrolatum grease (43 ft/sec) were sufficiently low to make a stoppage of the automatic loader due to a case ejection fault quite probable. The velocities of the cases coated with ceresin wax were all satisfactorily high (over 70 ft/sec). Neither the ceresin wax nor the petrolatum grease caused any detrimental coating effects on the chamber after extended burst firing.

j. Deformation of the EX 3 (steel) cases due to ejection was negligible. However cases lying in front of the mount suffered severe deformations when struck by following ejected cases. During early firings it was noted that ejected cases were riding down the upper edges of ejection chute sides rather than in the chute itself. This resulted in the chute sides being bent outward and cases striking the brackets holding the chute to the mount. This difficulty was overcome by straightening the chute sides and increasing the height of the sides by welding on additional sides so that the cases are directed downward and through the chute.

PART D

CONCLUSIONS

11. As a result of the tests reported herein it is concluded that:

a. The modifications introduced in the Type C Mod 3 barrel did not result in increased barrel life.

b. Projectiles fired from the Type C Mod 3 barrel have unpredictable flight characteristics resulting in entirely unacceptable deviations in range. This is apparently due to malfunctioning of the projectile rotating bands.

c. Following an extended burst, cook-off temperatures, provided the coolant system is in operation, are so low as to be considered negligible.

d. The use of ceresin wax as a coating on cartridge cases is an effective method of achieving more efficient case ejection.

e. The use of steel cases requires ejection chutes considerably stronger than those used with brass cases only.

PART E

DISPOSITION OF MATERIAL

12. The subject barrel was returned to the Naval Gun Factory for detailed post firing examination and bore photographing.

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