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AUTHORITY

31 Oct 1965, DoDD 5200.10; USNSWC ltr, 21 Jun 1976

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NPG REPORT NO. 1187

U. S. NAVAL PROVING GROUND  
DAHLGREN, VIRGINIA

Sixth Partial Report

on

Firing and Operational Tests of

5" Prototype Mount Mark 42

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Final Report

on

5"/54 Caliber Mount Mark 39 - Gun Mark 16

Pressure Recoil Curves at Increased Powder Pressures

Project No.: NPG-Re5b-43-1-53

Date:

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SECURITY INFORMATION

5"/54 Caliber Mount Mark 39 - Gun Mark 16  
Pressure Recoil Curves at Increased Powder Pressures

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PART B

INTRODUCTION

1. AUTHORITY:

The tests described herein were conducted by authority of the Bureau of Ordnance as defined in references (a) and (b).

2. REFERENCES:

- a. BUORD Conf ltr Re5c-HAA:jpb S74-2(5") Ser 53348 of 11 Mar 1953
- b. BUORD Rest ltr Re5b-HCF:mm1 S74-2(5") Ser 16609 of 4 Aug 1952

3. BACKGROUND:

a. It was explained in reference (a) that it is proposed to increase the pressure limits of the 5"/54 Caliber Gun Mark 16 from 17.0-18.5 t.s.i. to 18.5-20.5 t.s.i. with a proof pressure of 23.5 t.s.i. using a 70.00 pound projectile, and also, that there was a possible eventuality of using 60.00 pound projectiles in the Mount Mark 39 at gun pressures of 22-24 t.s.i. and a proof pressure of 27.5 t.s.i.

b. In view of the above the Bureau, in reference (a), requested that the Naval Proving Ground obtain pressure-recoil curves for the proposed service and proof pressures using the corresponding projectile weights. This information is required in order to ascertain whether modifications to the recoil cylinder grooves will be required.

4. OBJECT OF TEST:

The object of the test was to obtain pressure-recoil data on the recoil mechanism of the 5-inch Mark 39 mount at proposed new service conditions in order to ascertain whether redesign of the recoil cylinder grooves will be required.

5. PERIOD OF TEST:

- |                        |               |
|------------------------|---------------|
| a. Date Project Letter | 11 March 1953 |
| b. Date Commenced Test | 23 April 1953 |
| c. Test Completed      | 28 April 1953 |

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PART C

DETAILS OF TEST

6. DESCRIPTION OF ITEM UNDER TEST:

a. The recoil brake of the 5-inch Mark 39 mount is an equalized (cross connected), dual cylinder, hydraulic type. It comprises twin cylinders, pistons, and rods mounted in parallel bores in the bottom of the housing. Each piston rod forward end is separately connected to the front plate of the slide weldment. The system and mechanism when filled with hydraulic fluid constitutes a variable flow, fixed stroke, recoil brake. Braking action is obtained by hydraulic displacement past the pistons through rifled grooves of two cylinder liners. These give a variable throttling of the liquid. A transverse bore between the cylinders provides a pressure equalizing cross connection for the fluid. The maximum recoil is 19.0 inches.

7. DESCRIPTION OF TEST EQUIPMENT:

a. Guns: 5"/54 Cal. Mk 18 Mod 0 Serial Nos. 16092 and 16098. These were new barrels for proof.

b. Housing: Mk 4 Mod 0 Serial 3098.

c. Slide: Mk 28 Mod 2 Serial 15127.

d. Carriage: Mk 32 Mod 0 Serial 13233.

e. Stand: Mk 16 Mod 2 Serial 13226.

f. A Tabor engine indicator was attached to the filling hole of the recoil system to record recoil cylinder pressure versus gun displacement.

g. Attached to the same fitting as the engine indicator was an elastic tube, strain type pressure gage the output of which was displayed on a cathode ray oscilloscope and recorded with a drum camera.

h. Projectiles: Mk 41 Mod 0, BLP, 70.00 pounds. Mk 41 Mod 0, empty and plugged, 60.00 pounds.

i. Charges: Powder Indexes IHBF-3 and IHBF-7. Charge weights as required to produce the desired pressures.

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## 8. PROCEDURE:

a. The test which simulated the proposed new pressure limits with the 70.00 pound projectile was conducted on 23 and 24 April 1953. This test was combined with the proof of a new Mark 18 Mod 0 Barrel Serial 16098. A total of 11 rounds was fired which, in addition to the proof of barrel series, included two rounds at approximately 20 t.s.i. pressure fired at zero degrees gun elevation, two rounds at approximately 20 t.s.i. pressure fired at 60 degrees gun elevation, one round at 23.6 t.s.i. fired at 60 degrees gun elevation, and one round at 24.6 t.s.i. fired at zero degrees gun elevation. Tabor engine indicator records of recoil cylinder pressure versus gun displacement, elastic tube pressure gage records of recoil cylinder pressure versus time, maximum gun chamber pressures (by copper crusher gage), and maximum recoil displacement were recorded on all rounds including the proof of barrel series.

b. The test which simulated the contemplated pressure limits with the 60.00 pound projectile was conducted on 28 April 1953. This test was combined with the proof of Mark 18 Mod 0 Barrel No. 16092. A total of nine rounds was fired which included two rounds at a pressure of approximately 23 t.s.i. fired at 60 degrees gun elevation, two rounds at a pressure of approximately 23 t.s.i. fired at zero degrees gun elevation, one round at 26.8 t.s.i. fired at 60 degrees gun elevation, and one round at 27.8 t.s.i. fired at zero degrees gun elevation. Data as described above were recorded on all rounds.

## 9. RESULTS AND DISCUSSION:

a. Table I, Appendix (A), is a tabulation of the conditions and results of the tests. The maximum pressures attained in the recoil system are included. These pressures were read from the elastic tube gage records. The high frequency pressure peaks at the beginning of recoil were ignored in reading these maximum pressures. The maximum recoil cylinder pressures along with the maximum measured recoils are excerpted from Table I and reproduced below for the conditions requested by reference (a):

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<u>Condition</u>	<u>Gun Elevation</u>	<u>Maximum Recoil Cylinder Pressure (p.s.i.)</u>	<u>Maximum Recoil (inches)</u>
(1) Contemplated service charge with 70.00 pound projectile (18.5-20.5 t.s.i.)	0°	2870	17.7
	60°	2970	18.6
(2) Near proof round corresponding with above service condition (item (1))	60°	3280	18.7
(3) Proof round corresponding with above service condition (item (1))	0°	3260	18.0
(4) Contemplated service charge with 60.00 pound projectile (22-24 t.s.i.)	0°	3015	17.9
	60°	2995	18.5
(5) Near proof round corresponding with 60.00 pound projectile service condition (item (4))	60°	3430	18.7
(6) Proof round corresponding with 60.00 pound projectile service condition (item (4))	0°	3530	18.3

The design maximum recoil of the Mark 28 Mod 2 Slide is 19.0 inches. The recoil cylinders are designed to work at a maximum pressure in excess of 4350 p.s.i. None of the conditions fired in this test, including the proof of barrel series, produced excessive recoil or pressure. (There was one exception to this statement. On the sixth round of the test of 28 April (a near proof round at 60 degrees gun elevation) two pressure peaks occurred at the beginning of recoil which were of approximately 7000 p.s.i. magnitude; however, both were less than 0.2 millisecond duration and hence of little significance.) The most severe condition was the near proof round of the proof of barrel series fired on Barrel No. 16098 (round 2, 24 April 1953). This round produced a maximum chamber pressure of 27.0 t.s.i. and was fired at a gun elevation of 60 degrees. The resulting recoil was 18.8 inches and the maximum recoil cylinder pressure was 3720 p.s.i.

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b. Appendix (B) comprises the pressure-recoil records of the recoil cylinders as recorded by the Tabor engine indicator.

c. Appendix (C) comprises the drum camera recordings of recoil cylinder pressure versus time as indicated by the elastic tube gage.

PART D

CONCLUSIONS

10. It is concluded that the contemplated new service charges can be safely fired in the 5"/54 Mark 39 Mod O Mount without modification to the recoil cylinder throttling grooves.

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The tests upon which this report is based were conducted by:

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Main Battery Division  
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Commander, Naval Proving Ground



E. A. RUCKNER  
Captain, USN  
Ordnance Officer  
By direction

TABLE I

CONDITIONS AND RESULTS OF TESTS

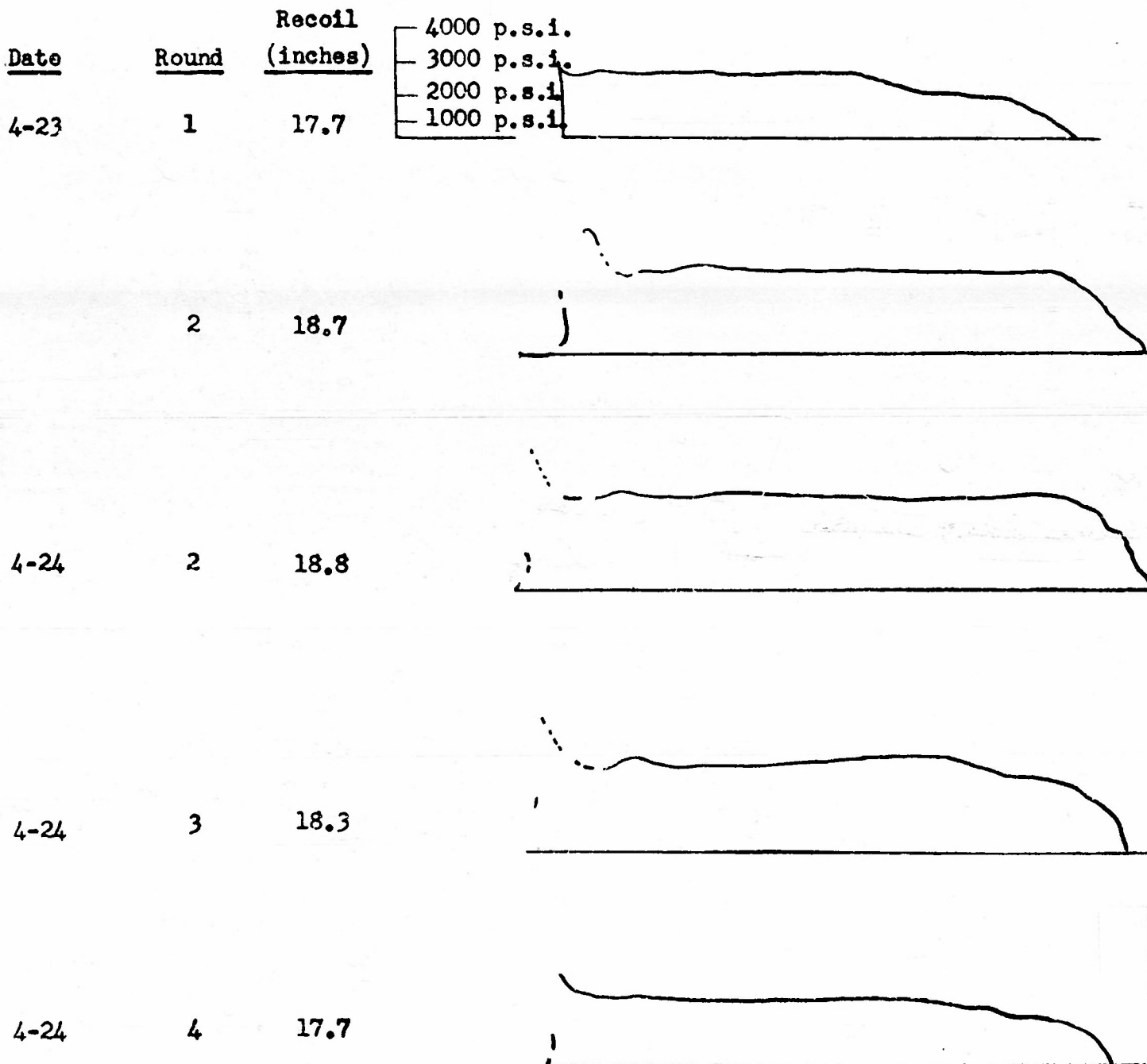
Date	1953	Rd.	Gun Ele- vation (deg.)	Projectile		Charge Weight (lbs.)	Charge Powder Index	Maximum Chamber Pressure (t.s.i.)	Maximum Recoil Cylinder Pressure (p.s.i.)	Maximum Recoil (inches)	Remarks
				Mk - Mod	Weight (lbs.)						
23 Apr		1	8	41-0	70.00	17.70	IHEF-7	18.9	2750	17.7	See Notes 1, 4, 5
"		2	60	(BLP)	"	19.30	"	24.6	3300	18.7	
24 Apr		1	"	"	"	"	"	23.4	3360	18.7	See Notes 2, 4, 5
"		2	"	"	"	20.40	"	27.0	3720	18.8	
"		3	0.5	"	"	20.70	"	27.9	3750	18.3	
"		4	"	"	"	18.00	"	20.0	2850	17.7	
"		5	"	"	"	"	"	20.1	2890	17.7	
"		6	60	"	"	"	"	20.6	2940	18.6	
"		7	"	"	"	"	"	19.9	3000	18.5	
"		8	"	"	"	19.00	"	23.6	3280	18.7	
"		9	0.5	"	"	19.50	"	24.6	3260	18.0	
28 Apr		1	"	41-0	60.00	17.60	IHEF-3	16.3	2250	16.9	See Notes 3, 4, 5
"		2	"	(Empty)	"	20.00	"	23.2	2990	17.8	
"		3	"	"	"	"	"	23.4	3040	17.9	
"		4	60	"	"	"	"	22.9	2990	18.4	
"		5	"	"	"	"	"	23.0	3000	18.5	
"		6	"	"	"	21.30	"	26.8	3430	18.7	
"		7	0.5	"	"	21.60	"	26.7	3480	18.0	
"		8	"	"	"	21.90	"	27.8	3530	18.3	
"		9	"	"	"	20.00	"	21.8	2930	17.6	

NOTES: 1. Ambient temperature on 23 April was 67°F.  
 2. Ambient temperature on 24 April was 66°F.  
 3. Ambient temperature on 28 April was 61°F.  
 4. Counterrecoil air pressure was 1500 p.s.i. throughout the tests.  
 5. New Mk 18 Mod O Barrel 16098 was used on 23 and 24 April; new Mk 18 Mod O Barrel 16092 was used on 28 April.

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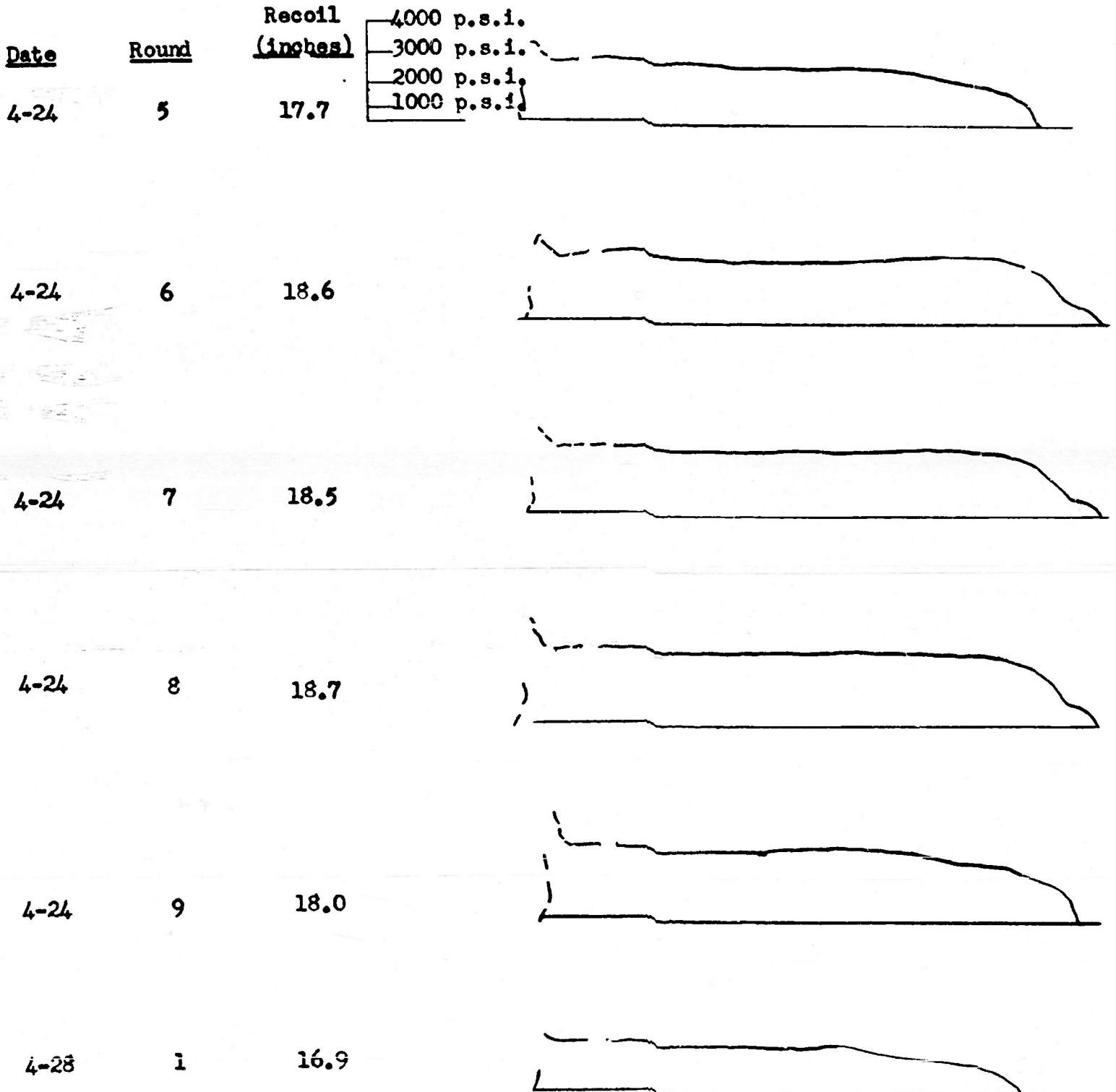
PRESSURE-RECOIL CURVES  
(engine indicator records)



5<sup>n</sup>/54 Caliber Mount Mark 39 - 0 Gun Mark 16  
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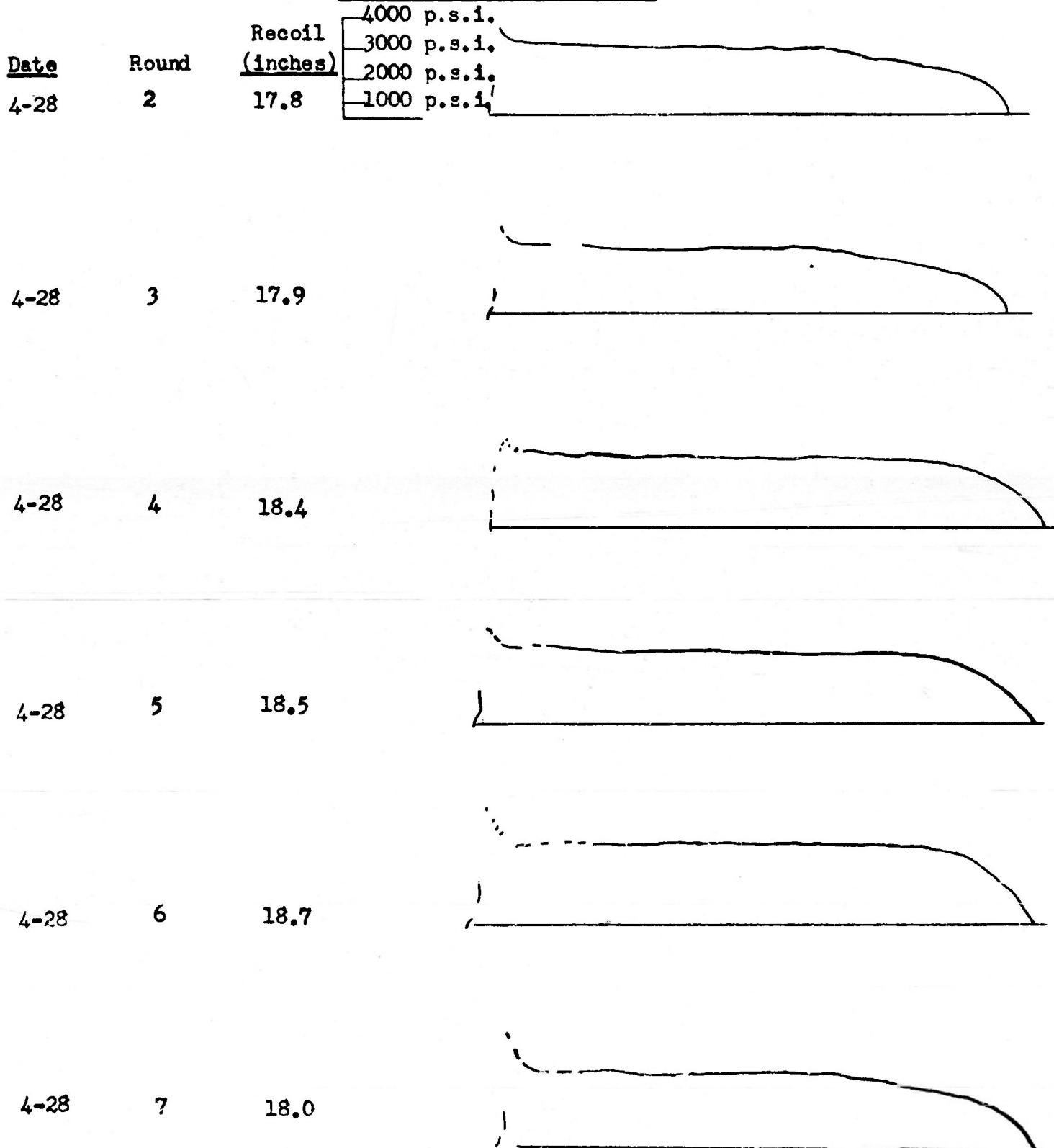
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PRESSURE-RECOIL CURVES  
(engine indicator records)



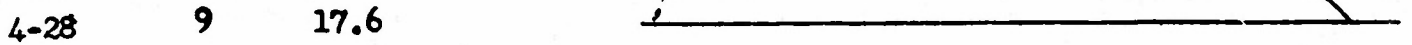
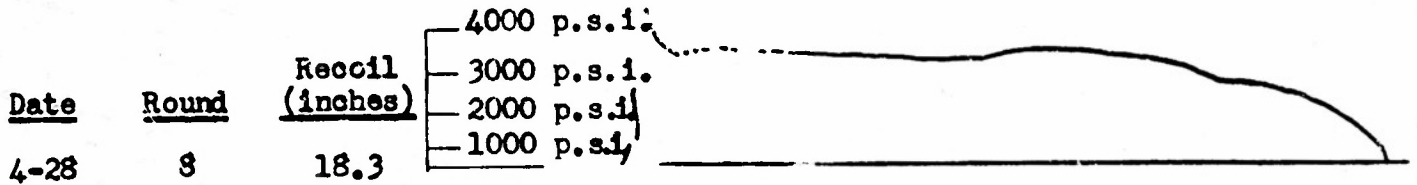
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PRESSURE-RECOIL CURVES  
(engine indicator records)



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PRESSURE-RECOIL CURVES  
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PRESSURE-TIME CURVES

(FORWARDED UNDER SEPARATE COVER TO BUORD (Re5c))