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AUTHORITY

Feb 1965, DoDD 5200.10, 26 July 1962;  
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U. S. NAVAL PROVING GROUND  
DAHLGREN, VIRGINIA

REPORT NO. 1088

TEST FIRINGS OF 3"/70 GUN BARRELS

56th Partial Report

-----  
STRAIN GAGE MEASUREMENTS; 3"/70 AND 5"/54 GUNS

FINAL Report

Copy No. 6

Task

Assignment NPG-Re5a-21-1-53

Classification CONFIDENTIAL

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Strain Gage Measurements; 3"/70 and 5"/54 Guns

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PART A

SYNOPSIS

1. This report describes the experimental measurement of strains on the breech face of 3"/70 and 5"/54 caliber guns.
2. Breech face strains were investigated by means of wire resistance strain gages located on the breech face, as near the outside diameter as possible.
3. The maximum tangential breech face strain recorded on the 3"/70 caliber gun was 740 micro-inches per inch with a charge weight of 10.50 lbs. and a copper crusher pressure of 23.4 TSI.
4. The maximum tangential breech face strain recorded on the 5"/54 caliber gun was 895 micro-inches per inch with a charge weight of 21.4 lbs. and a copper crusher pressure of 25.7 TSI.
5. It was observed that the tangential strains on both the 3"/70 and 5"/54 caliber guns were slightly greater on the right of the centerline. It is believed that these differences are due to the unsymmetrical structure of the slide and housing and the unsymmetrical location of the interrupted threads in the housing, with respect to the strain gages.

Strain Gage Measurements; 3"/70 and 5"/54 Guns  
-----TABLE OF CONTENTS

|                                                                   | <u>Page</u> |
|-------------------------------------------------------------------|-------------|
| SYNOPSIS . . . . .                                                | 1           |
| TABLE OF CONTENTS. . . . .                                        | 2           |
| AUTHORITY. . . . .                                                | 3           |
| REFERENCES . . . . .                                              | 3           |
| BACKGROUND . . . . .                                              | 3           |
| OBJECT OF TEST . . . . .                                          | 4           |
| PERIOD OF TEST . . . . .                                          | 4           |
| DESCRIPTION OF ITEM UNDER TEST . . . . .                          | 4           |
| DESCRIPTION OF TEST EQUIPMENT. . . . .                            | 5           |
| PROCEDURE. . . . .                                                | 5           |
| RESULTS AND DISCUSSION . . . . .                                  | 5           |
| APPENDIX A - SKETCHES OF GAGE LOCATIONS. . . . FIGURES 1-2 (Incl) |             |
| APPENDIX B - SUMMARY OF TABULATED DATA . . . . TABLES I-II (Incl) |             |
| APPENDIX C - NPG PHOTOGRAPHS . . . . . FIGURES 3-9 (Incl)         |             |
| APPENDIX D - DISTRIBUTION. . . . .                                | 1 (Only)    |

Strain Gage Measurements; 3"/70 and 5"/54 Guns

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PART B

INTRODUCTION

1. AUTHORITY:

The work reported herein was conducted under Task Assignment No. NPG-Re5a-21-1-53, reference (a). Specific authority for the tests is contained in references (b) and (c).

2. REFERENCES:

- a. BUORD NP9 Re5a-FBW:fl of 3 July 1952
- b. Fonecon of 3 November 1952 between Mr. Stengard, BUORD and Mr. Overman, NAVPROV
- c. BUORD ltr Re5a-EOS:11h S74-1(3") of 5 November 1952
- d. BUORD ltr NP9(11132) - Re5a-JHM:CMJ S74-1(3") of 18 April 1951
- e. NPG Report No. 871 of 20 October 1951

3. BACKGROUND:

a. By reference (d) the Naval Proving Ground was requested to conduct a series of experiments to determine the strains induced in the breech faces of 3"/70 and 5"/54 caliber guns by firings conducted at various pressures between service and proof pressure. The purpose of these tests was to collect information to be used in the future design of cartridge cases that will be subjected to high pressures. Results of these tests were reported in reference (e).

b. The strains observed in the early experiments were measured as close to the chamber as possible without the cartridge cases interfering with the gages. They were not as high as expected, presumably because of the effect of the extractor pockets on the axial symmetry of the strain distribution.

c. In order to investigate breech face strains with a minimum extractor pocket effect, a new series of experiments was undertaken in November 1952. This series differed from the first only in the location of the strain gages, which were moved outward as near as possible to the outside diameter of the gun at the breech.

Strain Gage Measurements; 3"/70 and 5"/54 Guns

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## 4. OBJECT OF TEST:

a. The immediate object of the tests was to determine the magnitude of tangential strains, due to firing, on the breech face of a 5"/54 caliber gun at service pressure and at copper crusher pressures of 24 and 26 TSI respectively, and on the breech face of a 3"/70 caliber Type G gun at service pressure and near proof pressure.

b. A further object was to measure the radial strains near the tangential gages on both guns, since these measurements would provide, at slight extra cost, information of interest in studying the distribution of the surface strains and stresses.

## 5. PERIOD OF TEST:

|                               |                  |
|-------------------------------|------------------|
| a. Date of Project Letter     | 3 November 1952  |
| b. Date of Specific Directive | 5 November 1952  |
| c. Date Commenced Test        | 14 November 1952 |
| d. Test Completed             | 17 November 1952 |

PART C

DETAILS OF TEST

## 6. DESCRIPTION OF ITEM UNDER TEST:

a. Strains were measured on a 3"/70 Type G Mod 7 Gun No. 24579, fired in a 5"/38 Mount with a Mk 24 Mod 5 slide using Mk 10 cases and Ex-24 Mod 2 projectiles. A total of six (6) rounds were fired, three (3) service and three (3) near proof, using HKPC-1 powder.

b. Strains were also measured on a 5"/54 Type G Mod 0, Gun No. 16070, fired in a Mk 28 Mod 2 slide using Mk 7 cases and Mk 41 Mod 0 (70 lb.) projectiles. Ten (10) rounds were fired, four (4) service, three (3) near proof and three (3) proof, using IHBF-3 powder.

Strain Gage Measurements; 3"/70 and 5"/54 Guns  
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## 7. DESCRIPTION OF TEST EQUIPMENT:

The strain recordings were taken on a four-channel cathode ray oscilloscope and a high speed rotating drum recorded with auxiliary equipment consisting of power supplies, wheatstone bridge, calibrating switch and d. c. amplifiers.

## 8. PROCEDURE:

a. Both guns were fired with two (2) identical sets of type C-3 strain gages cemented to the right and left of the centerline on the breech faces, as near the outside diameter as possible, and oriented so as to measure the maximum tangential and radial strains. Appendix (A), Figures 1 and 2, shows the locations and orientations of the gages.

b. The resistance of the gages was 505 ohms. The gage factor was 3.43, and calibrations were in increments of one-half (1/2) ohm.

## 9. RESULTS AND DISCUSSION:

a. Tabulated results of strains for the 3"/70 and 5"/54 caliber guns are contained in Appendix (B), Tables I and II. Reproductions of the original recordings of the firings are contained in Appendix (C), Figures 3 through 7.

b. Graphical comparisons of strains with copper crusher pressures were made both for the current firings and those reported in Naval Proving Ground Report No. C71. Those graphs are reproduced in Appendix (C), Figures 8 and 9.

c. The maximum tangential breech face strain recorded on the 3"/70 caliber gun was 740 micro-inches per inch with a charge weight of 10.50 lbs. and a copper crusher pressure of 23.4 TSI.

d. The maximum tangential breech face strain recorded on the 5"/54 caliber gun was 895 micro-inches per inch with a charge weight of 21.4 lbs. and a copper crusher pressure of 25.7 TSI.

e. It is noted that the tangential strains on both the 3"/70 and 5"/54 caliber guns are slightly greater on the right of the centerline. It is believed that these differences may be attributed to the unsymmetrical structure of the slide and housing and the locations of the gages with respect to the threads on the breech end.



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NPG REPORT NO. 1088

Strain Gage Measurements; 3"/70 and 5"/54 Guns  
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Ordnance Officer  
By direction

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NPG REPORT NO. 1088

U. S. NAVAL PROVING GROUND  
DAHLGREN, VIRGINIA

Fifty-Sixth Partial Report  
on  
Test Firings of 3"/70 Gun Barrels

-----  
Final Report  
on  
Strain Gage Measurements; 3"/70 and 5"/54 Guns

Project No.: NPG-Re5a-21-1-53  
Copy No.: 6  
No. of Pages: 6

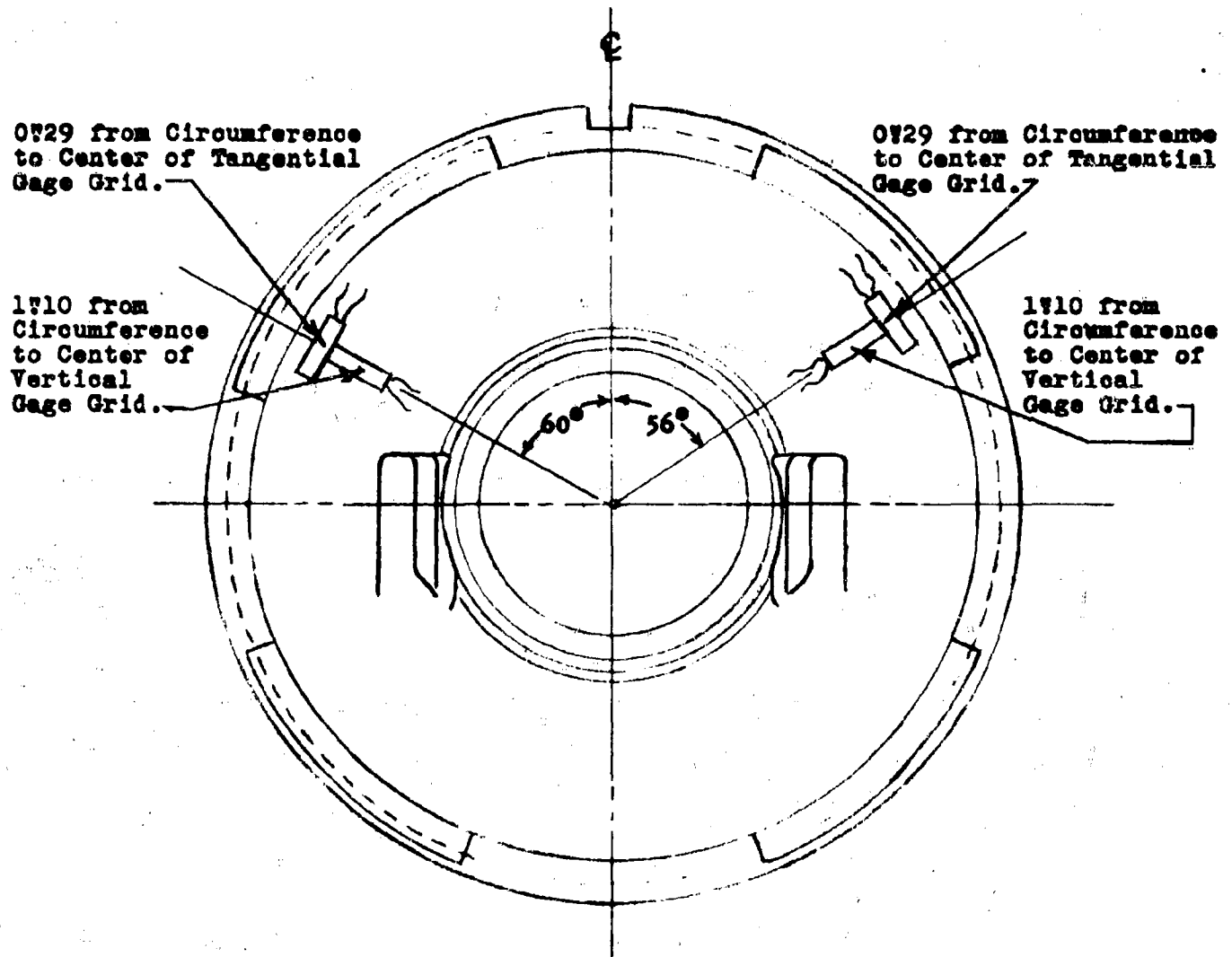
Date: FEB 12 1953

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NP9-51727

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3"/70 TYPE G, MOD. 7, GUN NO. 24579  
LOCATIONS OF STRAIN GAGES ON GUN BREACH FACE

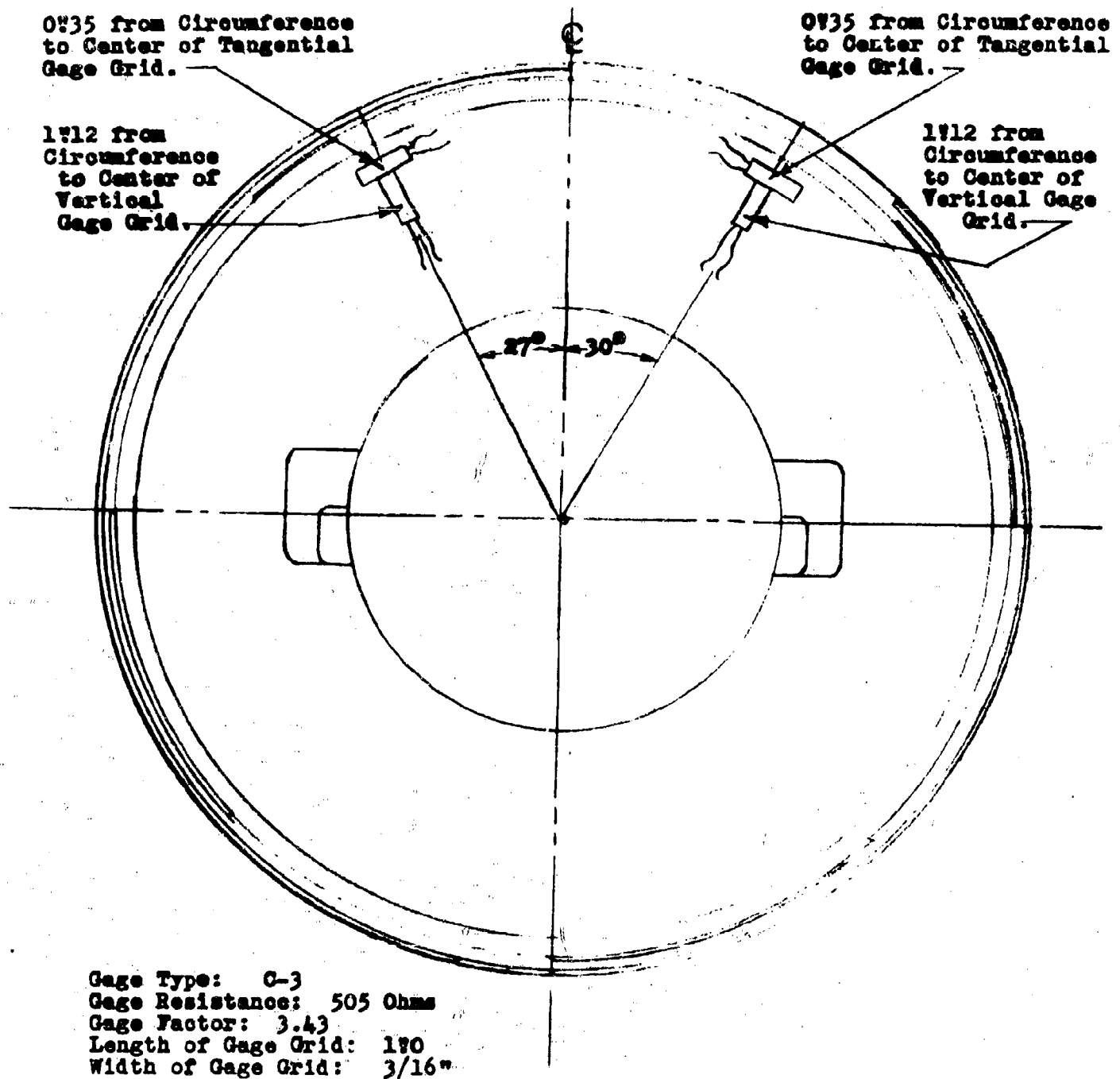


Gage Type: C-3  
Gage Resistance: 505 Ohms  
Gage Factor: 3.43  
Length of Gage Grid: 1V0  
Width of Gage Grid: 3/16"

U.S. NAVAL PROVING GROUND

14 November 1952

FIGURE 1

5"/54 TYPE G, MOD. O, GUN NO. 16070  
LOCATIONS OF STRAIN GAGES ON GUN BREACH FACE

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17 November 1952

FIGURE 2

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Strain Gage Measurements; 3"/70 and 5"/54 Guns

TABLE I

3"/70 TYPE G, MOD O, GUN NO. 24579  
STRAINS ON GUN BREECH FACE  
(O#29 from circumference to center of Tangential Gage)

14 November 1952

| <u>Round</u> | <u>STRAINS IN MICRO-INCHES PER INCH</u>      |                                               |                                                         | <u>Copper<br/>Crusher<br/>Pressure<br/>(TSI)</u> | <u>Powder<br/>Index</u> | <u>Charge<br/>Weight<br/>(lbs.)</u> |
|--------------|----------------------------------------------|-----------------------------------------------|---------------------------------------------------------|--------------------------------------------------|-------------------------|-------------------------------------|
|              | <u>Tangential<br/>Left of<br/>Centerline</u> | <u>Tangential<br/>Right of<br/>Centerline</u> | <u>Vertical<br/>(Radial)<br/>Left of<br/>Centerline</u> |                                                  |                         |                                     |
| 1            | 695                                          | 655                                           | -260                                                    | 22.5                                             | HKPC-1                  | 10.11                               |
| 2            | 690                                          | 655                                           | -280                                                    | 22.4                                             | "                       | "                                   |
| 3            | 665                                          | 610                                           | -255                                                    | 21.5                                             | "                       | "                                   |
| 4            | 735                                          | 665                                           | -275                                                    | 23.0                                             | "                       | 10.50                               |
| 5            | 720                                          | 695                                           | -300                                                    | 23.3                                             | "                       | "                                   |
| 6            | 740                                          | 695                                           | -300                                                    | 23.4                                             | "                       | "                                   |

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APPENDIX B

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NPG REPORT NO. 1088

Strain Gage Measurements; 3"/70 and 5"/54 Guns

TABLE II

5"/54 TYPE G, MOD O, GUN NO. 16070  
 STRAINS ON GUN BREECH FACE  
(0.35 from circumference to center of Tangential Gage)

17 November 1952

| Round | STRAINS IN MICRO-INCHES PER INCH    |                                      |                                                | Copper<br>Crusher<br>Pressure<br>(TSI) | Powder<br>Index | Charge<br>Weight<br>(lbs.) |
|-------|-------------------------------------|--------------------------------------|------------------------------------------------|----------------------------------------|-----------------|----------------------------|
|       | Tangential<br>Left of<br>Centerling | Tangential<br>Right of<br>Centerling | Vertical<br>(Radial)<br>Right of<br>Centerline |                                        |                 |                            |
| 1     | 595                                 | 525                                  | -290                                           | 18.0                                   | IHBF-3          | 18.0                       |
| 2     | 635                                 | 565                                  | -325                                           | 18.6                                   | "               | "                          |
| 3     | 595                                 | 540                                  | -280                                           | 17.8                                   | "               | "                          |
| 4     | 840                                 | 735                                  | -495                                           | 22.5                                   | "               | 20.7                       |
| 5     | 830                                 | 710                                  | -495                                           | 23.1                                   | "               | "                          |
| 6     | 810                                 | 725                                  | -490                                           | 23.4                                   | "               | "                          |
| 8     | 395                                 | 800                                  | -570                                           | 25.7                                   | "               | 21.4                       |
| 9     | 895                                 | 795                                  | -565                                           | 24.4                                   | "               | "                          |
| 10    | 605                                 | 545                                  | -260                                           | 17.1                                   | "               | 18.0                       |

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APPENDIX B

NP9-51664

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3"/70 Type G, Mod. 7, Gun No. 24579

Strains On Gun Breech Face

Timing Pips Are At One Millisecond Intervals

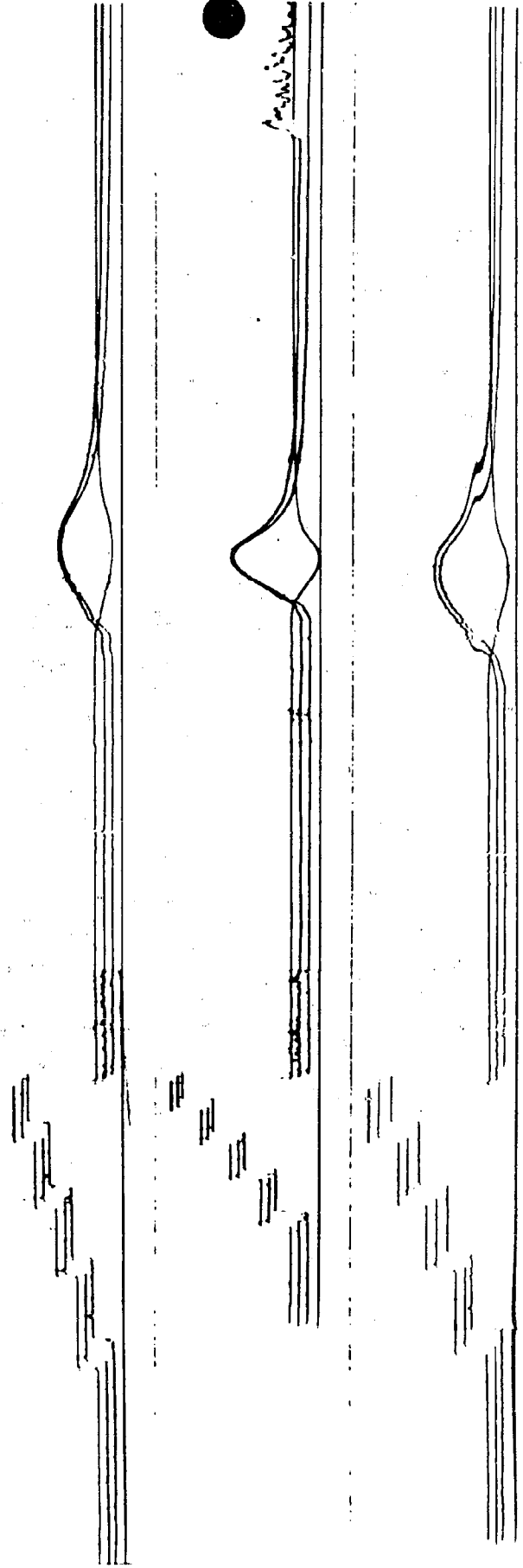
Reading From Top To Bottom:

Strains in Micro-inches  
per Inch:

| Rd. | Tangential |                        |                       | Copper<br>Crusher<br>Pressure<br>(TSI) | Powder<br>Index | Projectile |
|-----|------------|------------------------|-----------------------|----------------------------------------|-----------------|------------|
|     | Vertical   | Right of<br>Centerline | Left of<br>Centerline |                                        |                 |            |
| 1   | -260       | 655                    | 695                   | 22.5                                   | HIPC-1          | KX24-2     |
| 2   | -280       | 655                    | 690                   | 22.4                                   | HIPC-1          | KX24-2     |
| 3   | -255       | 610                    | 665                   | 21.5                                   | HIPC-1          | KX24-2     |

U.S. Naval Proving Ground

14 November 1952



NP9-51665

3"/70 Type G, Mod. 7, Gun No. 24579  
Strains On Gun Breech Face

Timing Pips Are At One Millisecond Intervals

Reading From Top To Bottom:

Strains in Micro-inches  
per Inch:

| Rd. | Vertical | Tangential             |                       |
|-----|----------|------------------------|-----------------------|
|     |          | Right of<br>Centerline | Left of<br>Centerline |
| 4   | -275     | 665                    | 735                   |
| 5   | -300     | 695                    | 720                   |
| 6   | -300     | 695                    | 740                   |

Copper  
Crusher  
Pressure  
(TSI)

Powder  
Index

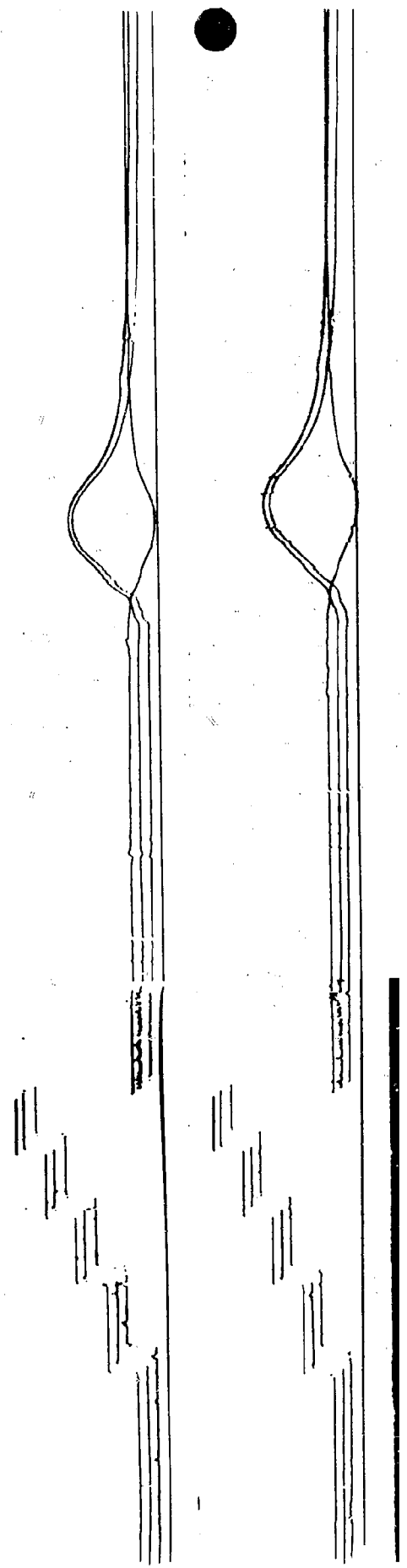
Projectile

HKPC-1  
HKPC-1  
HKPC-1

23.0  
23.3  
23.4

U.S. Naval Proving Ground

14 November 1952





## 5"/54 Type G, Mod. O, Gun No. 16070

## Strains On Gun Breech Face

## Timing Pips Are At One Millisecond Intervals

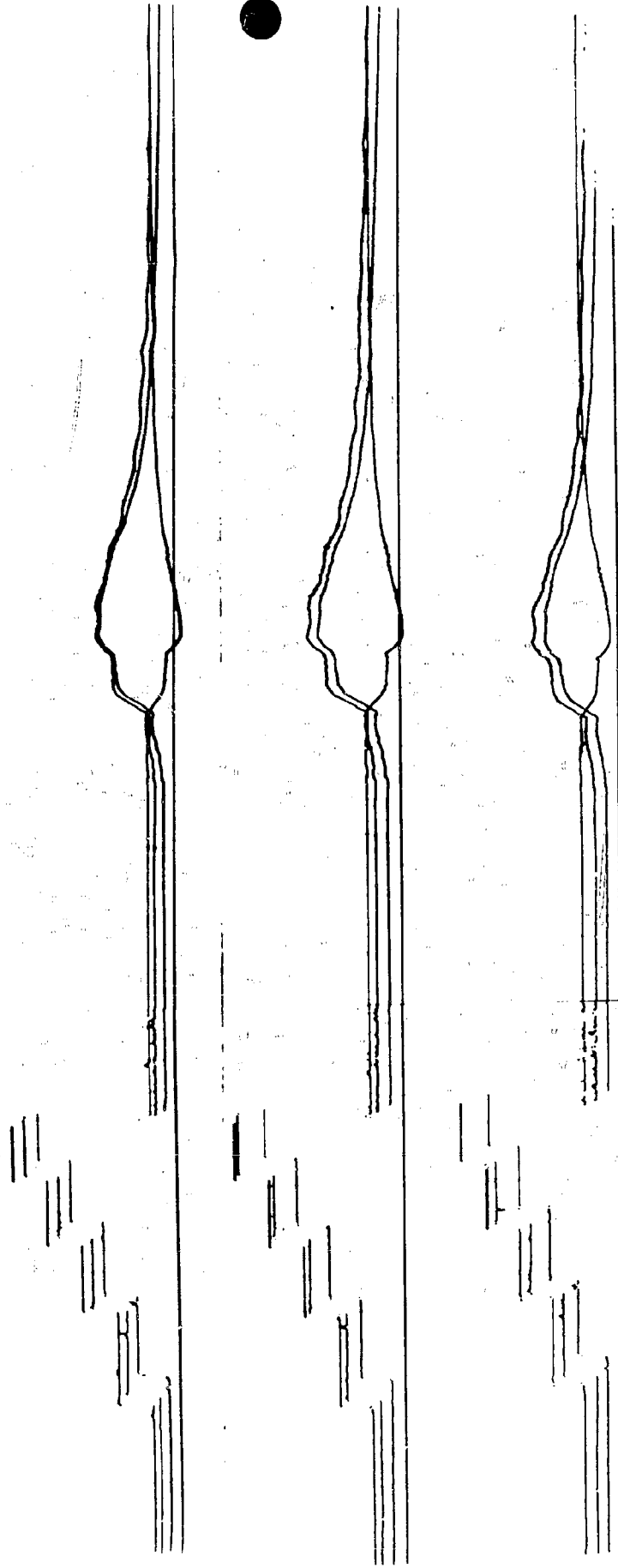
## Reading From Top To Bottom:

Strains in Micro-inches  
per Inch:

| Rd. | Copper                               |                                     | Powder<br>Index | Projectile |
|-----|--------------------------------------|-------------------------------------|-----------------|------------|
|     | Tangential<br>Right of<br>Centerline | Tangential<br>Left of<br>Centerline |                 |            |
| 1   | -290                                 | 525                                 | 18.0            | Mk. 41-0   |
| 2   | -325                                 | 565                                 | 18.6            | Mk. 41-0   |
| 3   | -280                                 | 540                                 | 17.8            | Mk. 41-0   |

U.S. Naval Proving Ground

17 November 1952



NP9-51667

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5"/54 Type G, Mod. O, Gun No. 16070

Strains On Gun Breech Face

Timing Pips Are At One Millisecond Intervals

Reading From Top To Bottom:

Strains in Micro-inches  
per Inch:

| Rd. | Tangential |            | Copper     |         | Powder | Projectile |
|-----|------------|------------|------------|---------|--------|------------|
|     | Vertical   | Tangential | Right of   | Crusher |        |            |
|     | Centerline | Centerline | Left of    | (TSI)   | Index  |            |
|     |            |            | Centerline |         |        |            |
| 4   | -495       | 735        | 840        | 22.5    | IHBP-3 | Mk. 41-0   |
| 5   | -495       | 710        | 830        | 23.1    | IHBP-3 | Mk. 41-0   |
| 6   | -490       | 725        | 810        | 23.4    | IHBP-3 | Mk. 41-0   |

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17 November 1952

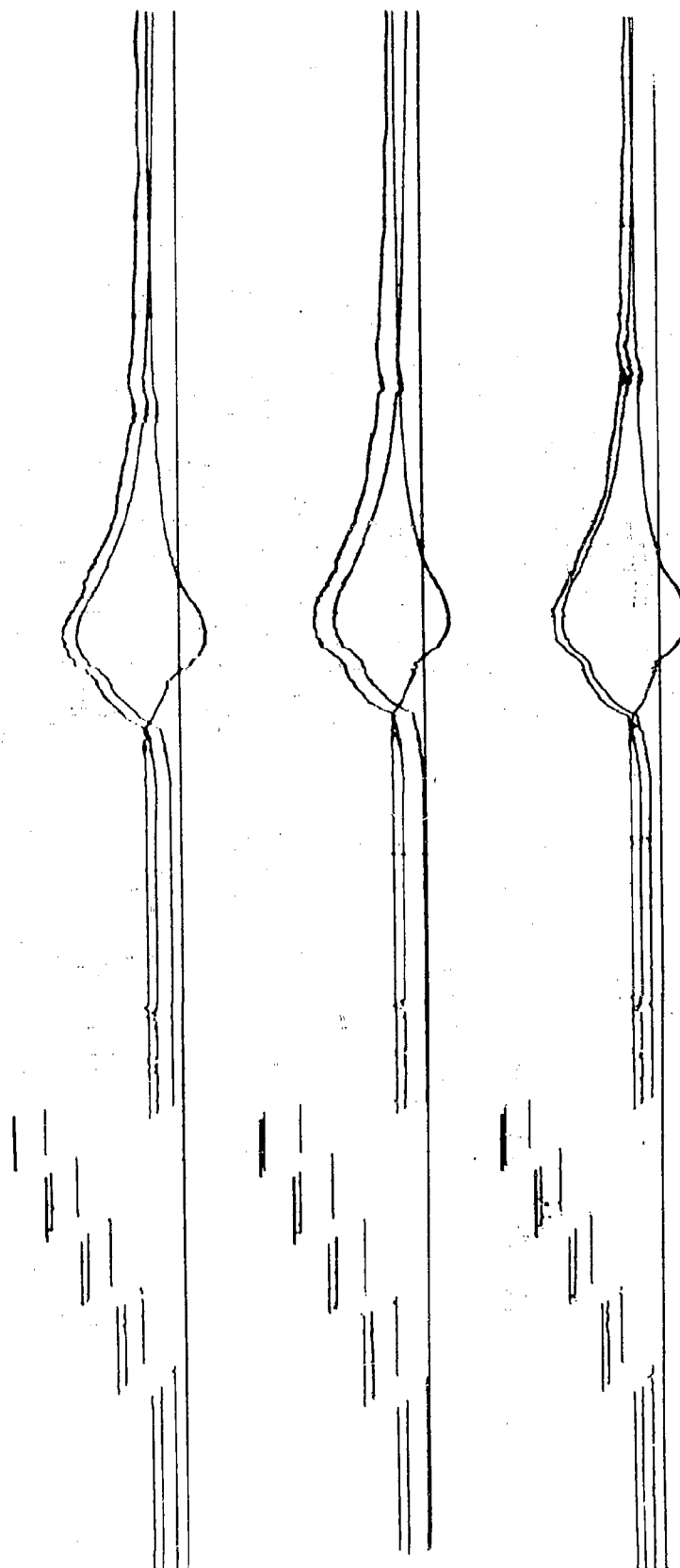


FIG 6

NP9-51668

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5"/54 Type G, Mod. O, Gun No. 16070

Strains On Gun Breech Face

Timing Pips Are At One Millisecond Intervals

Reading From Top To Bottom:

Strains in Micro-inches  
per Inch:

| Rd. | Strains in Micro-inches<br>per Inch: |            | Copper<br>Crusher<br>Pressure<br>(TSI) |                                     | Powder<br>Index | Projectile |
|-----|--------------------------------------|------------|----------------------------------------|-------------------------------------|-----------------|------------|
|     | Vertical                             | Tangential | Right of<br>Centerline                 | Tangential<br>Left of<br>Centerline |                 |            |
| 8   | -570                                 | 800        | 895                                    | 895                                 | IHBP-3          | Mk. 41-0   |
| 9   | -565                                 | 795        | 895                                    | 895                                 | IHBP-3          | Mk. 41-0   |
| 10  | -260                                 | 545        | 605                                    | 605                                 | IHBP-3          | Mk. 41-0   |

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17 November 1952

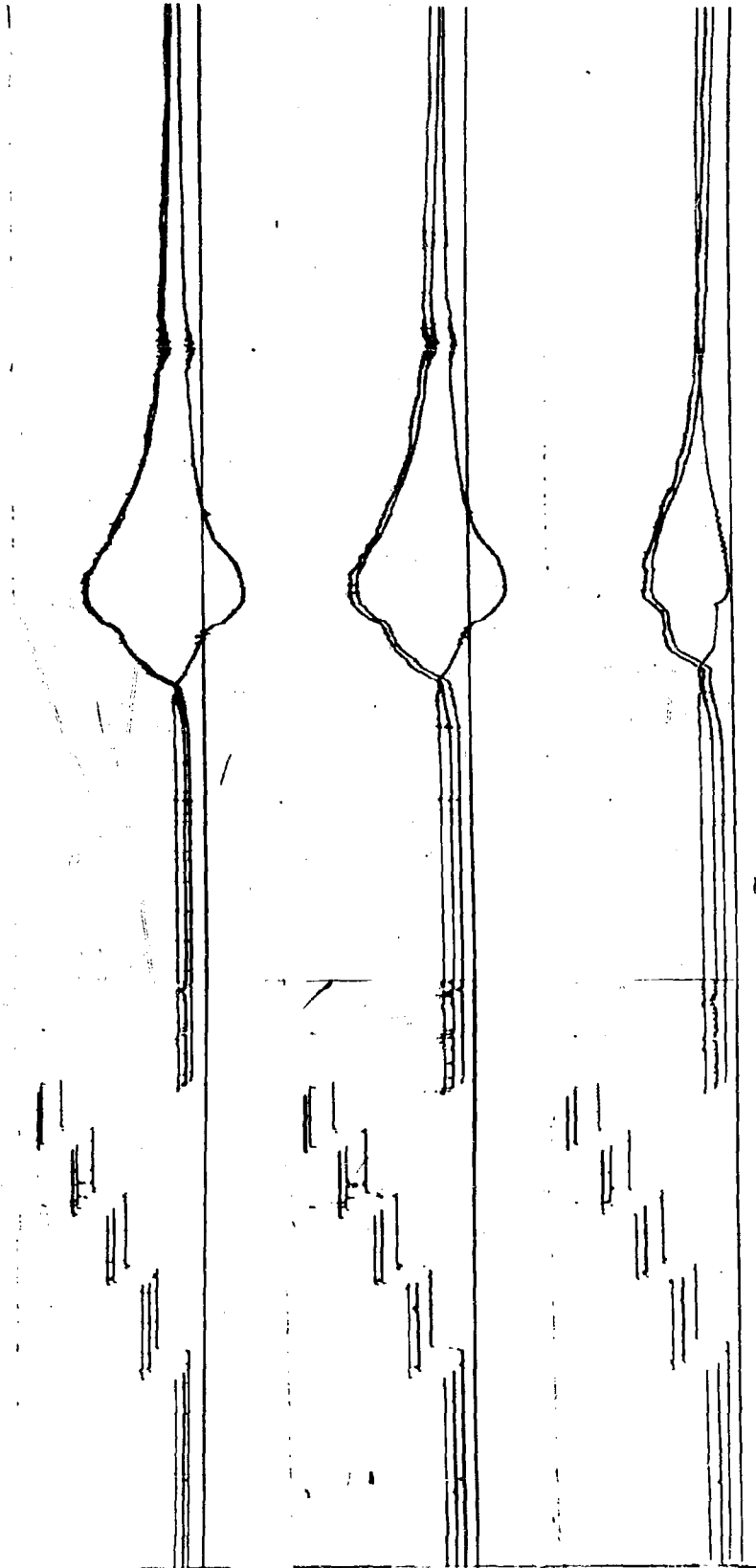


FIG 7

NP7-31690

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1400

1200

1000

800

600

400

200

0

STRAIN IN MICRO-INCHES PER INCH ON GUN FLAT

III

I

II

35/70 TIPS & GUNS  
STRAIN vs PRESSURE

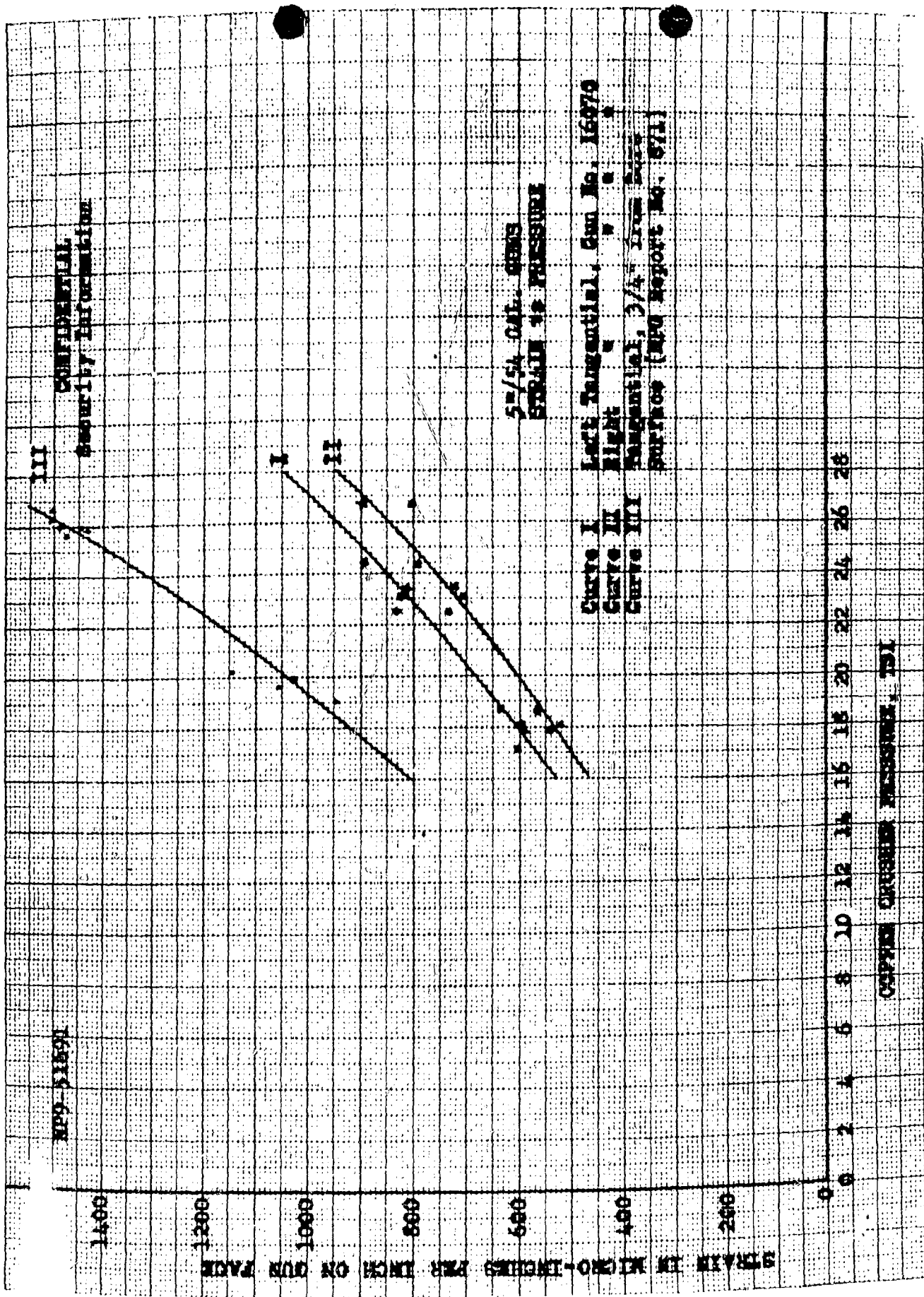
Curve I Left Tangential, Gun No. 26579  
Curve II Right " " " "  
Curve III Tangential, 7/8" from Bore  
Surface (NPG Report No. 871)

0 2 4 6 8 10 12 14 16 18 20 22 24 26 28

COPPER CRUSHER PRESSURE, PSI

THE UNIVERSITY OF CHICAGO

附錄一：「中國」與「中國人」

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# Strain Gage Measurements; 3"/70 and 5"/54 Guns

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