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# PRE-FLIGHT ACTUAL WEIGHT AND BALANCE REPORT

# BOILERPLATE STACK NO. 22

# HIGH ALTITUDE ABORT TEST

# CONTRACT NAS 9-150

(U)

ISSUED 28 APRIL 1965

CLASSIFICATION CHANGE

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NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

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# TECHNICAL REPORT INDEX/ABSTRACT

C65-8058

| ACCESSION NUMBER | | | | | | DOCUMENT SECURITY CLASSIFICATION Confidential | |
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TITLE OF DOCUMENT

Pre-Flight Actual Weight and Balance Report
Boilerplate Stack No. 22
High Altitude Abort

LIBRARY USE ONLY

AUTHOR(S)

J. F. Kessler

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| | NAA - S&ID | SID 63-143-14W |

| PUBLICATION DATE | CONTRACT NUMBER |
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| 28 April 1965 | NAS9-150 |

DESCRIPTIVE TERMS

ABSTRACT


The actual weight and balance report is a contractural requirement for the Boilerplate and Airframe Stacks. The data contained in this report is to present the pre-flight configuration of Boilerplate Stack No. 22, derived from the actual weight and balance and thrust vector alignment determinations conducted at White Sands Missile Range.

The Launch Escape System is ballasted to obtain a desired longitudinal center of gravity for the Launch Escape Vehicle (L.E.S. and CM combination) at burnout. The Launch Escape System configuration includes the Boost Protective Cover and the Canard.

The Command Module is ballasted to a predicted weight and center of gravity and presents the configuration with the actual Earth Landing System installed at the time of the actual weight and balance determination.

The Service Module data presents the results from the Downey actual weight and balance determination and the changes that have occurred since the Downey weighing.


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# SECTION I

# INTRODUCTION

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# ACTUAL WEIGHT AND BALANCE REPORT

## BOILERPLATE STACK NO. 22

## HIGH ALTITUDE ABORT TEST

## INTRODUCTION

This report presents the pre-flight mass data of Boilerplate Stack No. 22, derived from the actual weight and balance determinations of the individual module weighings conducted at White Sands Missile Range, in the Vehicle Assembly Building between 29 March 1965 and 8 April 1965. The weighings were accomplished by the use of the A14-154 Quotentiometer with the H14-040 and H14-041 Revere load cells. The load cells were calibrated by the Army Standards Lab at WSMR into the A14-154 direct millivolt/volt reading instrument. The millivolt/volt reading is converted to true pounds mass on the individual calculation sheets as well as corrections for air buoyancy. No gravity corrections are required to these readings since the dead weights used for calibrating were trimmed to the local gravity force at WSMR.

Attitudes of the module weighings along with the centers of gravity derived from each weighing are listed below.

| ASSEMBLY | CENTER OF GRAVITY |
|---|---|
| Launch Escape Tower (Horizontal) | X |
| Launch Escape System (Horizontal) | X |
| Command Module (Horizontal) | X |
| Command Module (Vertical) | Y and Z |
| Command Module Apex Cover (Single Cell) | Weight (Only) |
| LES and Command Module (Vertical) | Y and Z |

Due to the Service Module weight and balance fixtures not being provisioned for use at WSMR, the Service Module weight and center of gravity was monitored for changes since the Downey weighing (refer to SID 63-143-14, issued 16 March 1965). These changes are noted and incorporated on page 40.

Following each assembly weighing, up to the date of this report, all weight and/or center of gravity changes were monitored, plus future known changes, and are employed in the determination of the mass properties for the subject boilerplate at launch.

These corrections are summarized on page 31 for the Launch Escape System pages 34 and 37 for the Command Module and page 45 for the Launch Escape System and Command Module combination. The Command Module corrections for the horizontal and vertical weighings differ due to the fact that the main parachutes were changed and the mission sequencer was installed between the two weighings.

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Included in this report are the actual weighing data for the Launch Escape Tower and the Command Module Apex Cover. The weights presented for the Boost Protective Cover are also based on actual weighings.

A summary of the weight, center of gravity and inertia for Boilerplate Stack No. 22 from total launch payload to Command Module at touchdown is presented on pages 3 and 4. The mass properties for the Launch Escape Vehicle (LES and CM) have been computed for 0.5 second intervals of escape motor burning to burnout and also include the pitch motor burning within the cycle. The mass properties summary reflects the rotated LES, as derived from the thrust vector alignment determination.

The thrust vector alignment determinations (Pre-TVA and Post-TVA) are presented on pages 42 and 44. The corrections to these weighings are indicated on page 45.

The Launch Escape System is ballasted to meet a required longitudinal (Xa) center of gravity (Xa = 1125.0 $\pm$0.5 inches) for the combined LES and CM at burnout. The mass properties for the LES jettison phase are presented on page 5 and are based on the jettison motor burning at 0.2 seconds intervals.

All inertia data presented in the summary are calculated values. All weighings entailed three consecutive determinations to establish repeatability and the results were averaged to derive the mass properties.

Curves presented depict weight versus center of gravity and inertia, plus the individual modules gross weight distribution.

The weight breakdown summaries present the functional groupings of structure and system weights of the various components. A manufacturing variation is shown to indicate the difference of the actual weight from the calculated weight.

The dimensional diagram, page 49, shows the relationship of the Apollo Spacecraft Xa stations, which has an origin 998.7 inches below the tangency of the Command Module structure mold line.

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# SECTION II

# MASS DATA

# BOILERPLATE STACK NO. 22

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## WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY
## HIGH ALTITUDE ABORT TEST
## BOILERPLATE STACK NO. 22
## LAUNCH AND ABORT PHASE

| ITEM | WEIGHT | CENTER OF GRAVITY* | | | MOMENT OF INERTIA (SLUG-FT.$^2$) | | |
|---|---|---|---|---|---|---|---|
| | | Xa | Ya | Za | ROLL (Ixx) | PITCH (Iyy) | YAW (Izz) |
| LAUNCH ESCAPE SYSTEM (INITIAL) | 8191 | 1292.9 | -0.5 | 1.4 | 611 | 21133 | 21128 |
| COMMAND MODULE | 10013 | 1042.0 | 0.6 | 5.7 | 5677 | 4858 | 4772 |
| SERVICE MODULE | 9618 | 936.4 | -0.1 | -7.9 | 11334 | 10955 | 10232 |
| TOTAL LAUNCH PAYLOAD | 27822 | 1079.4 | 0.0 | -0.3 | 17825 | 163198 | 162183 |
| LESS: SERVICE MODULE | -9597 | 936.6 | -0.1 | -7.9 | 11320 | 10922 | 10199 |
| TOTAL LEV (INITIAL) | 18204 | 1154.9 | 0.1 | 3.8 | 6306 | 87233 | 87127 |
| LEV (t = +0.5 Sec.) | 17828 | 1151.9 | 0.1 | 3.8 | 6301 | 85346 | 85240 |
| LEV (t = +1.0 Sec.) | 17443 | 1148.7 | 0.2 | 3.9 | 6295 | 83435 | 83330 |
| LEV (t = +1.5 Sec.) | 17028 | 1145.1 | 0.2 | 3.9 | 6287 | 81286 | 81181 |
| LEV (t = +2.0 Sec.) | 16633 | 1141.5 | 0.2 | 4.0 | 6278 | 79147 | 79043 |
| LEV (t = +2.5 Sec.) | 16258 | 1137.9 | 0.2 | 4.0 | 6269 | 77027 | 76923 |
| LEV (t = +3.0 Sec.) | 15918 | 1134.6 | 0.2 | 4.1 | 6259 | 75024 | 74921 |
| LEV (t = +3.5 Sec.) | 15603 | 1131.3 | 0.2 | 4.2 | 6249 | 73096 | 72992 |
| LEV (t = +4.0 Sec.) | 15408 | 1129.2 | 0.2 | 4.2 | 6243 | 71865 | 71762 |
| LEV (t = +4.5 Sec.) | 15268 | 1127.7 | 0.2 | 4.2 | 6238 | 70962 | 70860 |
| LEV (t = +5.0 Sec.) | 15193 | 1126.9 | 0.2 | 4.2 | 6236 | 70473 | 70370 |
| LEV (t = +5.5 Sec.) | 15133 | 1126.2 | 0.2 | 4.2 | 6234 | 70078 | 69975 |
| LEV (t = +6.0 Sec.) | 15098 | 1125.8 | 0.2 | 4.2 | 6232 | 69846 | 69743 |
| LEV (t = +6.5 Sec.) | 15073 | 1125.5 | 0.2 | 4.2 | 6231 | 69679 | 69577 |
| LEV (t = +7.0 Sec.) | 15048 | 1125.3 | 0.2 | 4.2 | 6230 | 69513 | 69411 |
| LEV (t = +7.5 Sec.) | 15028 | 1125.0 | 0.2 | 4.3 | 6230 | 69379 | 69277 |
| LEV (t = +8.0 Sec.) | 15013 | 1124.9 | 0.2 | 4.3 | 6229 | 69278 | 69176 |
| LEV (t = +9.0 Sec.) | 15003 | 1124.7 | 0.2 | 4.3 | 6229 | 69211 | 69109 |

*Centers of gravity are in the NASA reference system except that the longitudinal (Xa) has an origin 998.7 inches below the tangency of the Command Module structure mold line.

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## WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

## HIGH ALTITUDE ABORT TEST

## BOILERPLATE STACK NO. 22

## COMMAND MODULE DESCENT PHASE

| ITEM | WEIGHT | CENTER OF GRAVITY* | | | MOMENT OF INERTIA (SLUG-FT.$^2$) | | |
|---|---|---|---|---|---|---|---|
| | | Xa | Ya | Za | ROLL (Ixx) | PITCH (Iyy) | YAW (Izz) |
| LEV (t = +9.0 Sec. - BURNOUT) | 15003 | 1124.7 | 0.2 | 4.3 | 6229 | 69211 | 69109 |
| LESS: L.E.S. (BURNOUT) | -4990 | 1290.8 | -0.5 | 0.6 | 549 | 19854 | 19860 |
| LESS: CM APEX COVER | -429 | 1098.5 | 0.0 | 1.3 | 65 | 49 | 42 |
| TOTAL CM PRIOR TO DROGUE DEPLOYMENT | 9584 | 1039.5 | 0.6 | 5.9 | 5610 | 4498 | 4422 |
| LESS: DUAL DROGUE CHUTES | -51 | 1090.8 | 0.0 | -21.8 | 1 | - | 1 |
| TOTAL CM PRIOR TO DROGUE DISCONNECT | 9533 | 1039.2 | 0.6 | 6.0 | 5600 | 4461 | 4392 |
| LESS: DROGUE DISCONNECT (PARTIAL) | -6 | 1098.3 | 0.0 | -20.5 | - | - | - |
| TOTAL CM PRIOR TO PILOT & MAIN CHUTE DEPLOYMENT | 9527 | 1039.2 | 0.6 | 6.1 | 5599 | 4455 | 4387 |
| LESS: PILOT AND MAIN CHUTES | -407 | 1091.4 | -1.1 | 7.4 | 54 | 20 | 43 |
| TOTAL CM AT TOUCHDOWN | 9120 | 1036.9 | 0.7 | 6.0 | 5545 | 4184 | 4094 |

NOTE: *Centers of gravity are in the NASA reference system except that the longitudinal (Xa) has an origin 998.7 inches below the tangency of the Command Module structure mold line.

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## WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

## HIGH ALTITUDE ABORT TEST

## BOILERPLATE STACK NO. 22

## L.E.S. JETTISON PHASE

| ITEM | WEIGHT | CENTER OF GRAVITY* | | | MOMENT OF INERTIA (SLUG-FT.$^2$) | | |
|---|---|---|---|---|---|---|---|
| | | Xa | Ya | Za | ROLL (Ixx) | PITCH (Iyy) | YAW Izz) |
| L.E.S. JETTISON (t = +0.0 Sec.)** | 4990 | 1290.8 | -0.5 | 0.6 | 549 | 19854 | 19860 |
| L.E.S. JETTISON (t = +0.2 Sec.) | 4968 | 1290.3 | -0.5 | 0.6 | 548 | 19786 | 19793 |
| L.E.S. JETTISON (t = +0.4 Sec.) | 4935 | 1289.5 | -0.5 | 0.6 | 547 | 19685 | 19692 |
| L.E.S. JETTISON (t = +0.6 Sec.) | 4898 | 1288.6 | -0.5 | 0.6 | 546 | 19571 | 19578 |
| L.E.S. JETTISON (t = +0.8 Sec.) | 4862 | 1287.7 | -0.5 | 0.6 | 545 | 19456 | 19462 |
| L.E.S. JETTISON (t = +1.0 Sec.) | 4828 | 1286.9 | -0.5 | 0.6 | 544 | 19346 | 19353 |
| L.E.S. JETTISON (t = +1.2 Sec.) | 4796 | 1286.0 | -0.5 | 0.6 | 543 | 19242 | 19249 |
| L.E.S. JETTISON (t = +1.4 Sec.) | 4784 | 1285.8 | -0.5 | 0.6 | 542 | 19205 | 19212 |

NOTE: *Centers of gravity are in the NASA reference system except that the longitudinal (Xa) has an origin 998.7 inches below the tangency of the Command Module structure mold line.

**After escape motor and pitch control motor burnout.

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# SECTION III

# CURVES

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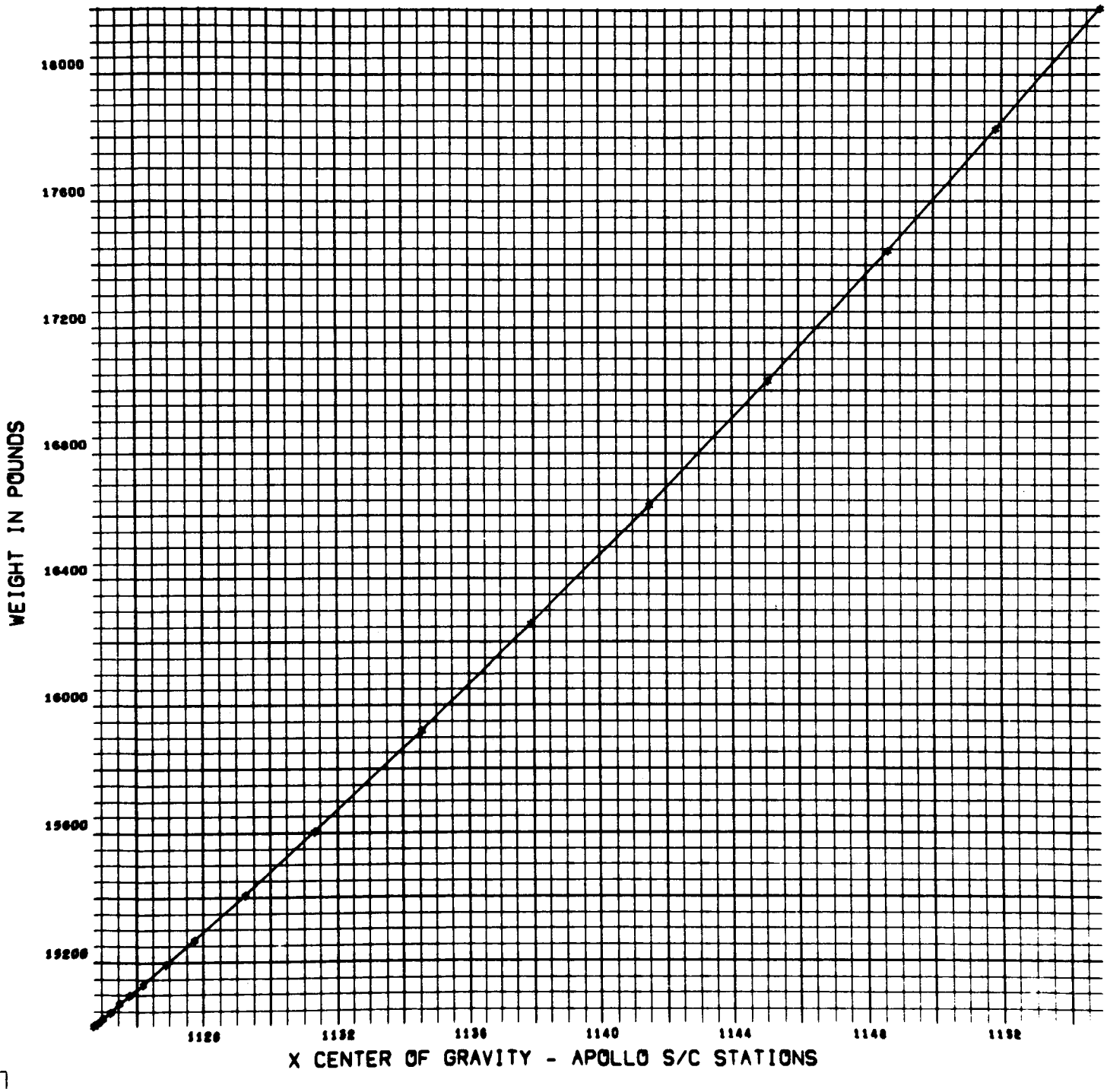


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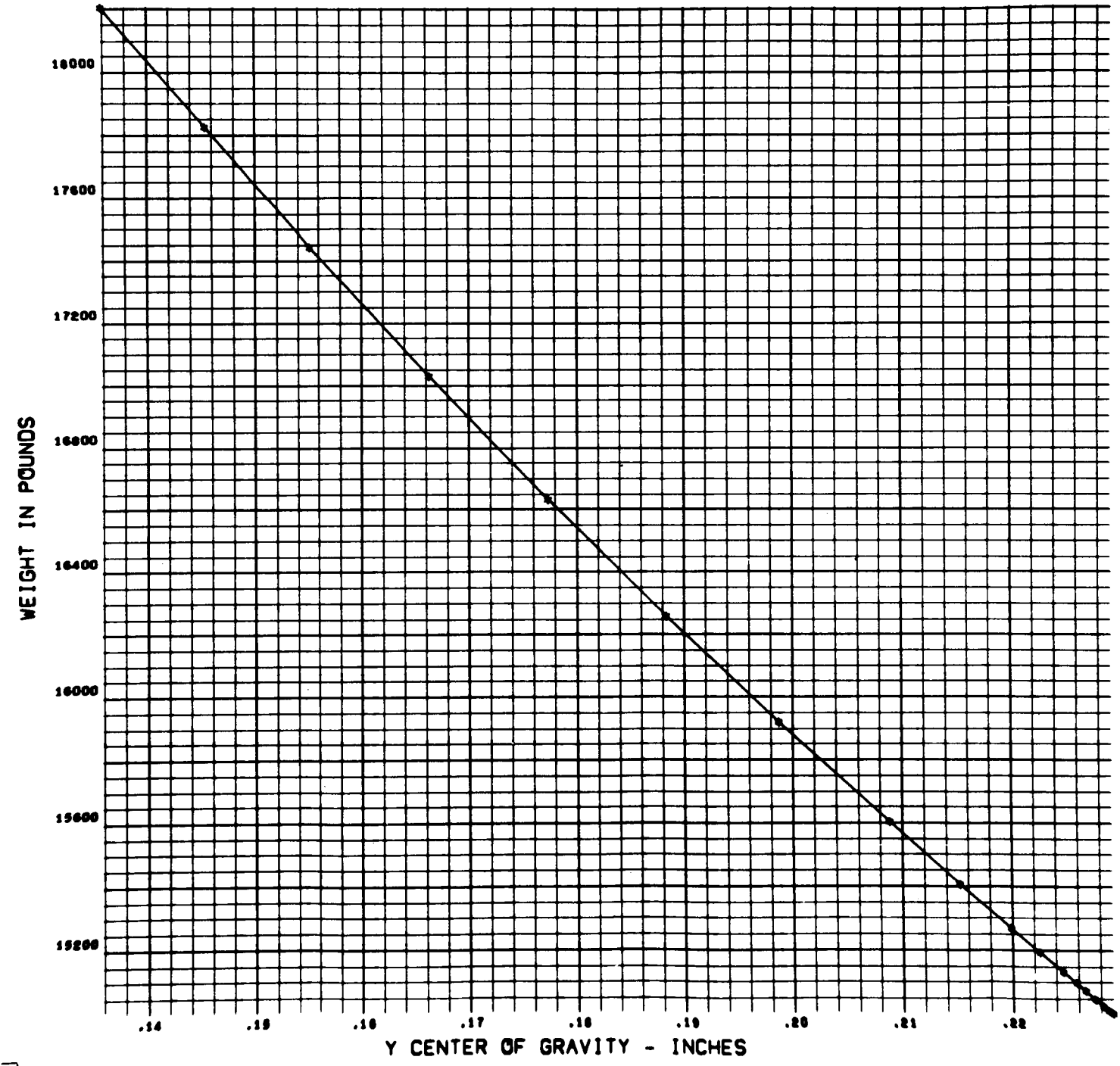


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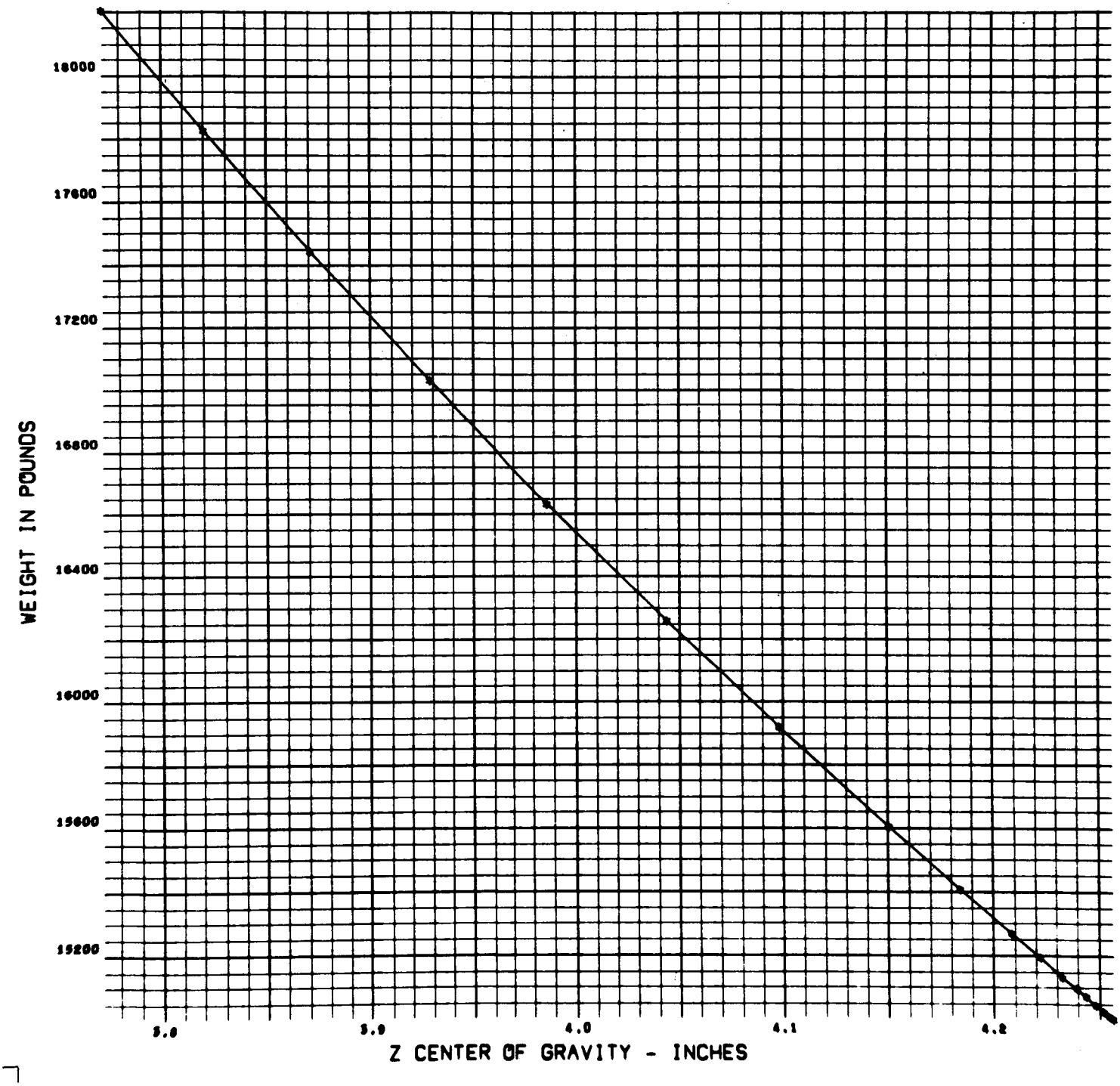

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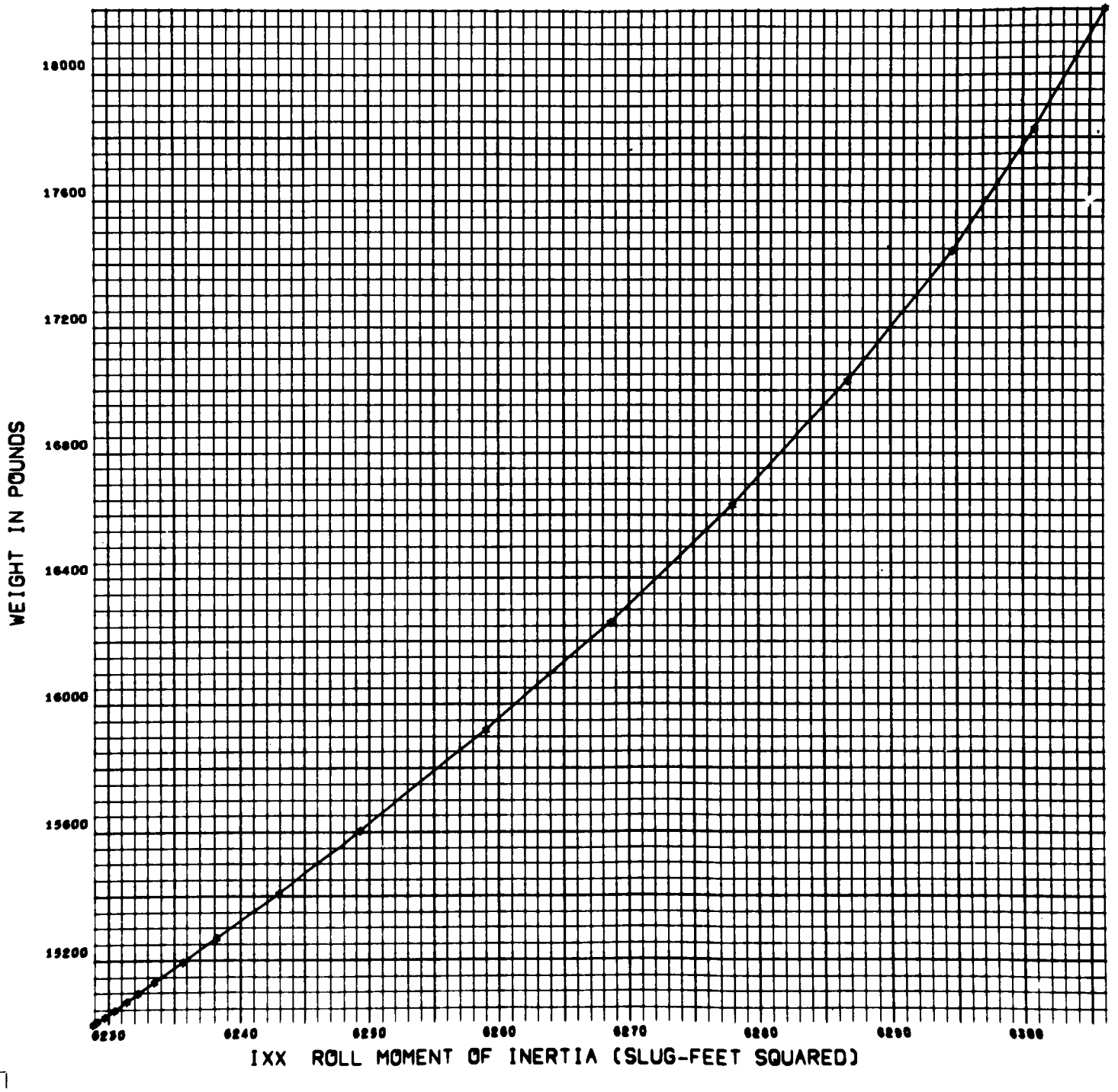


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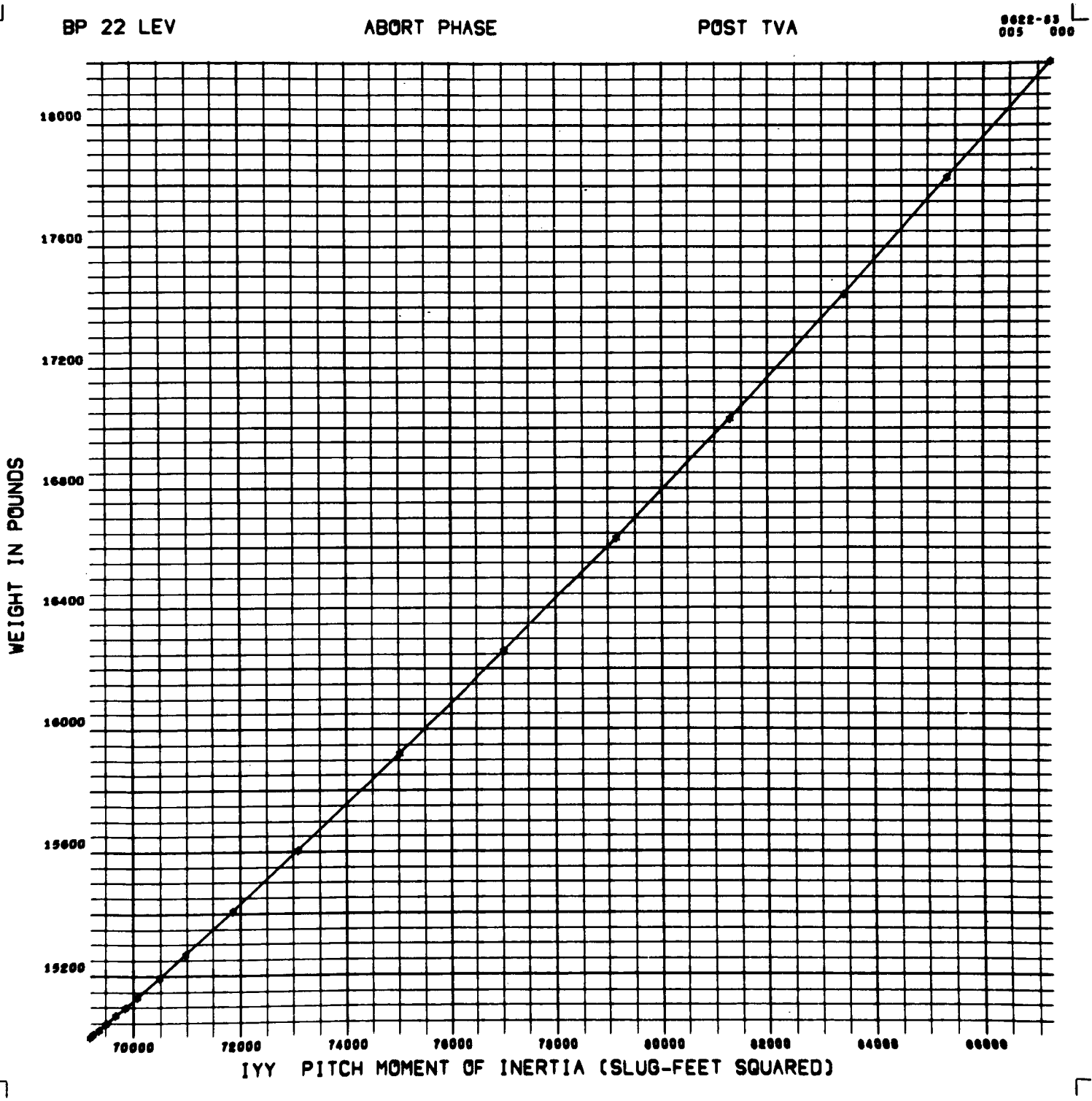


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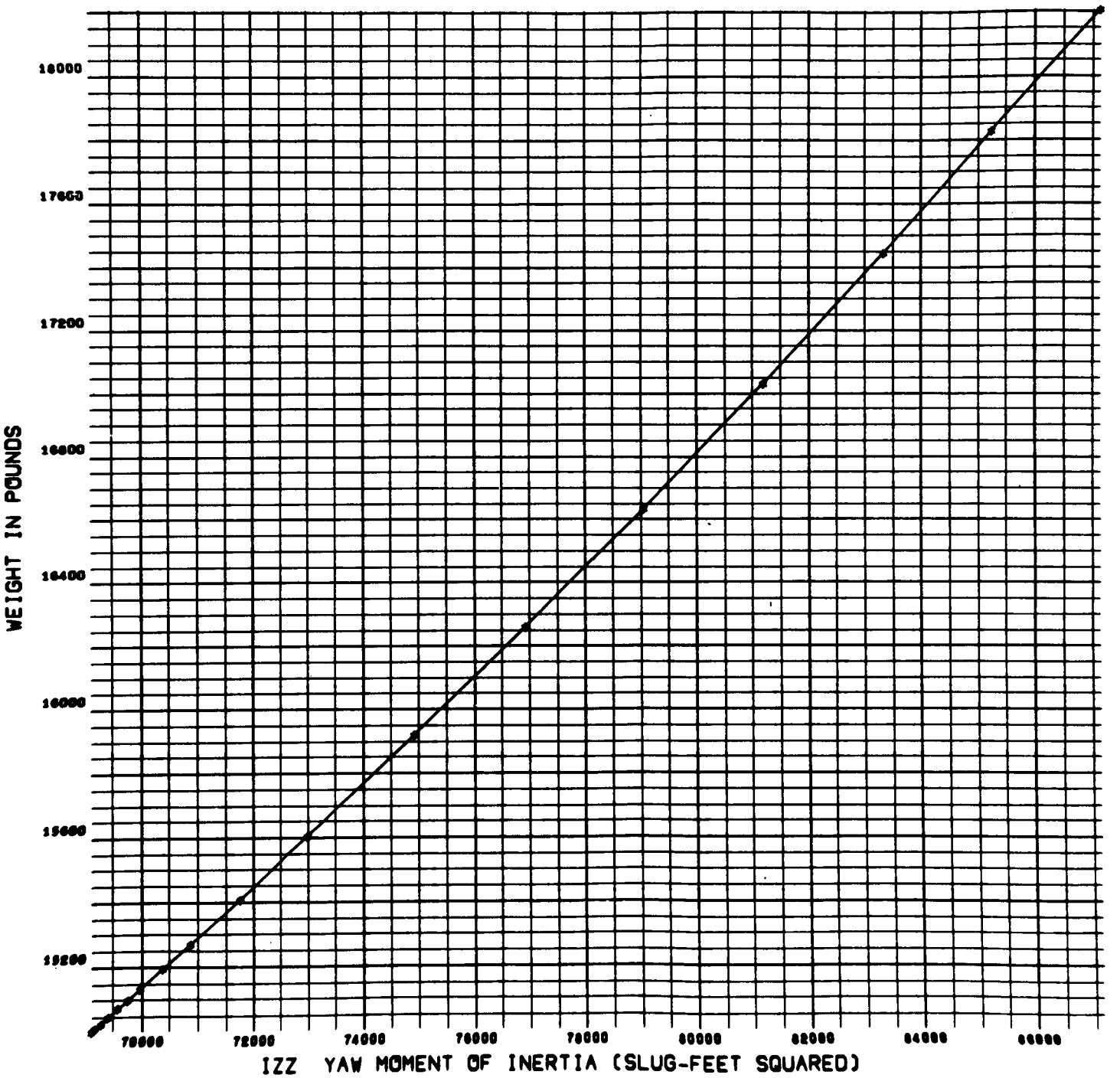


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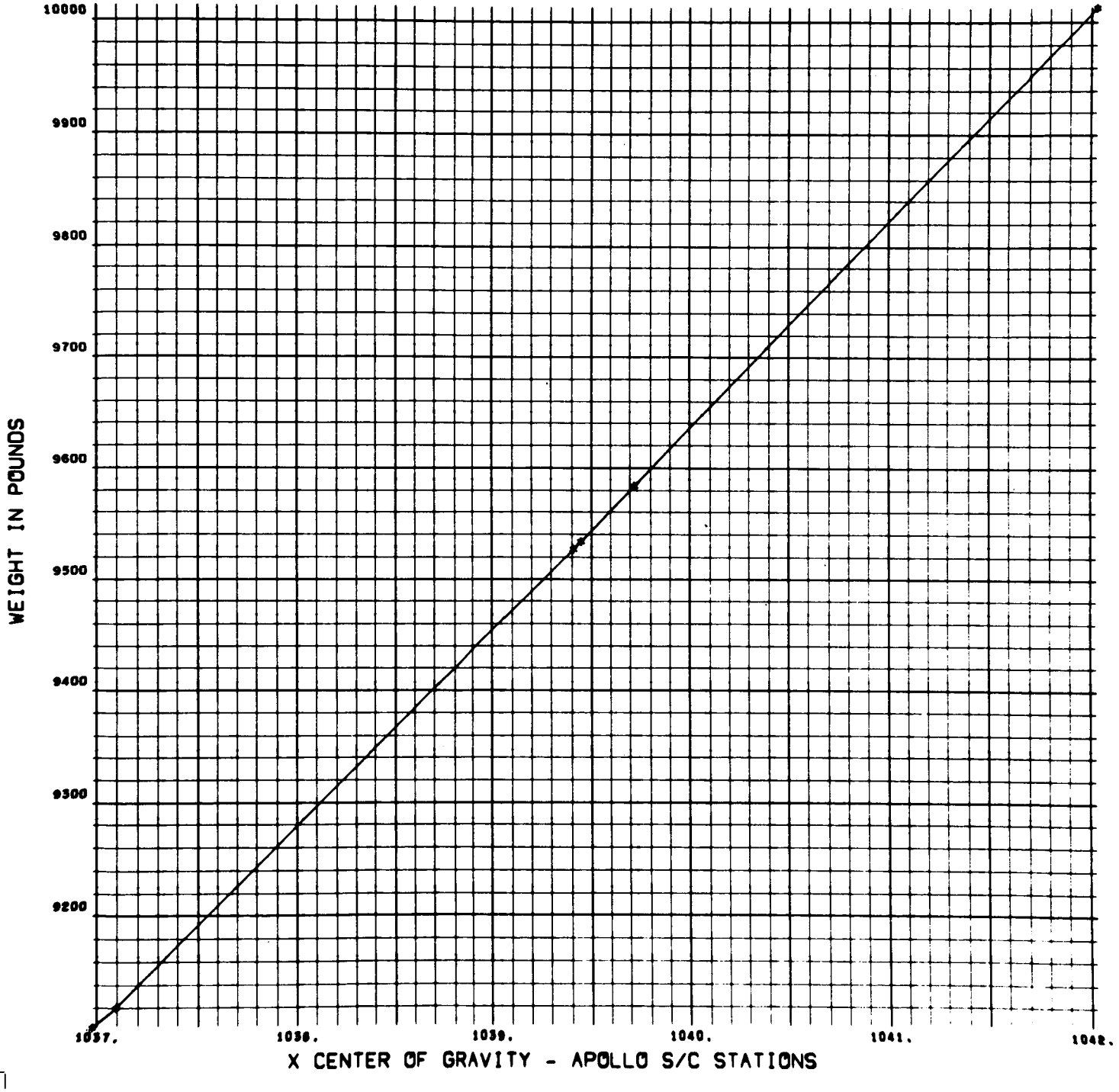


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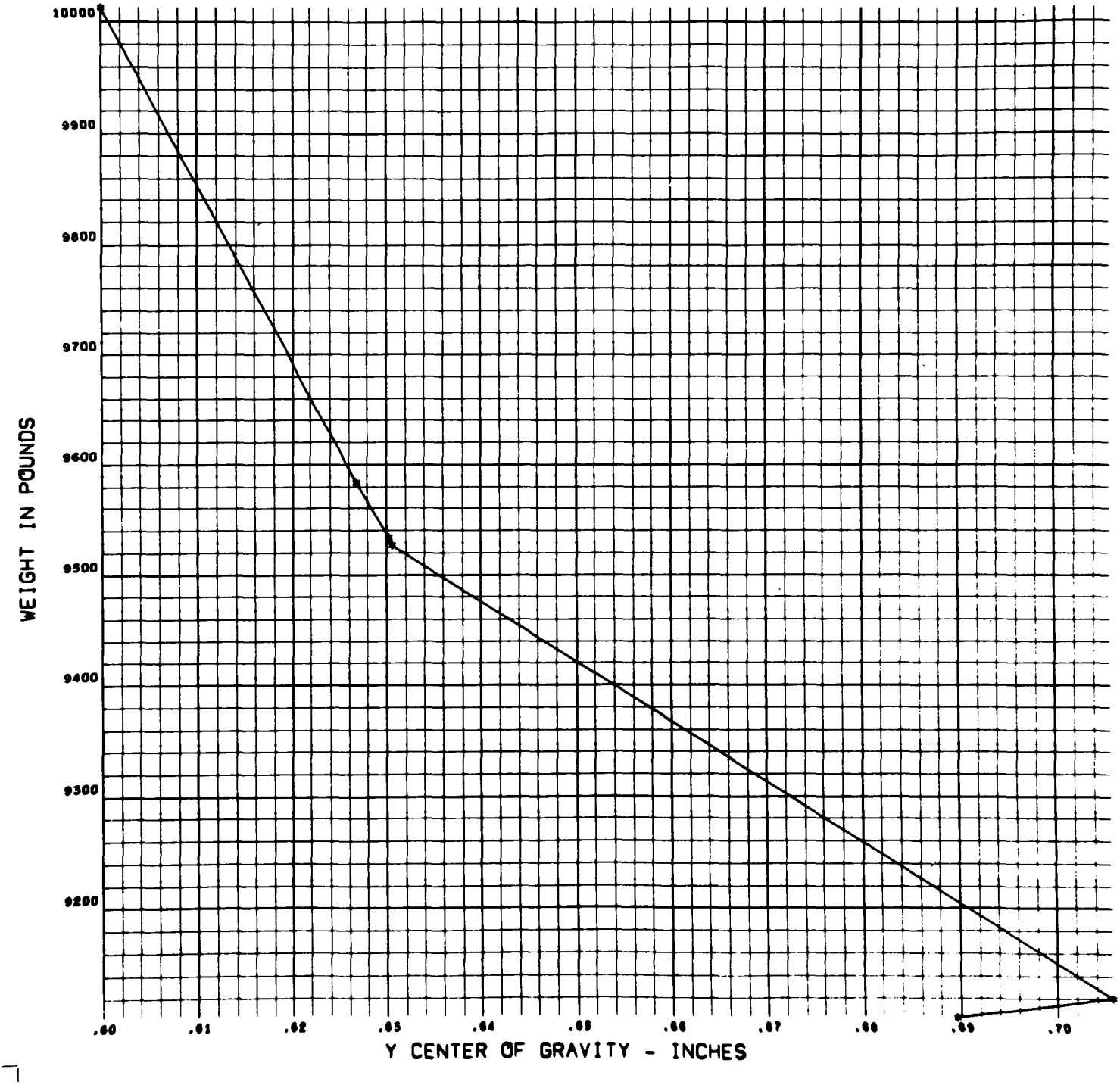


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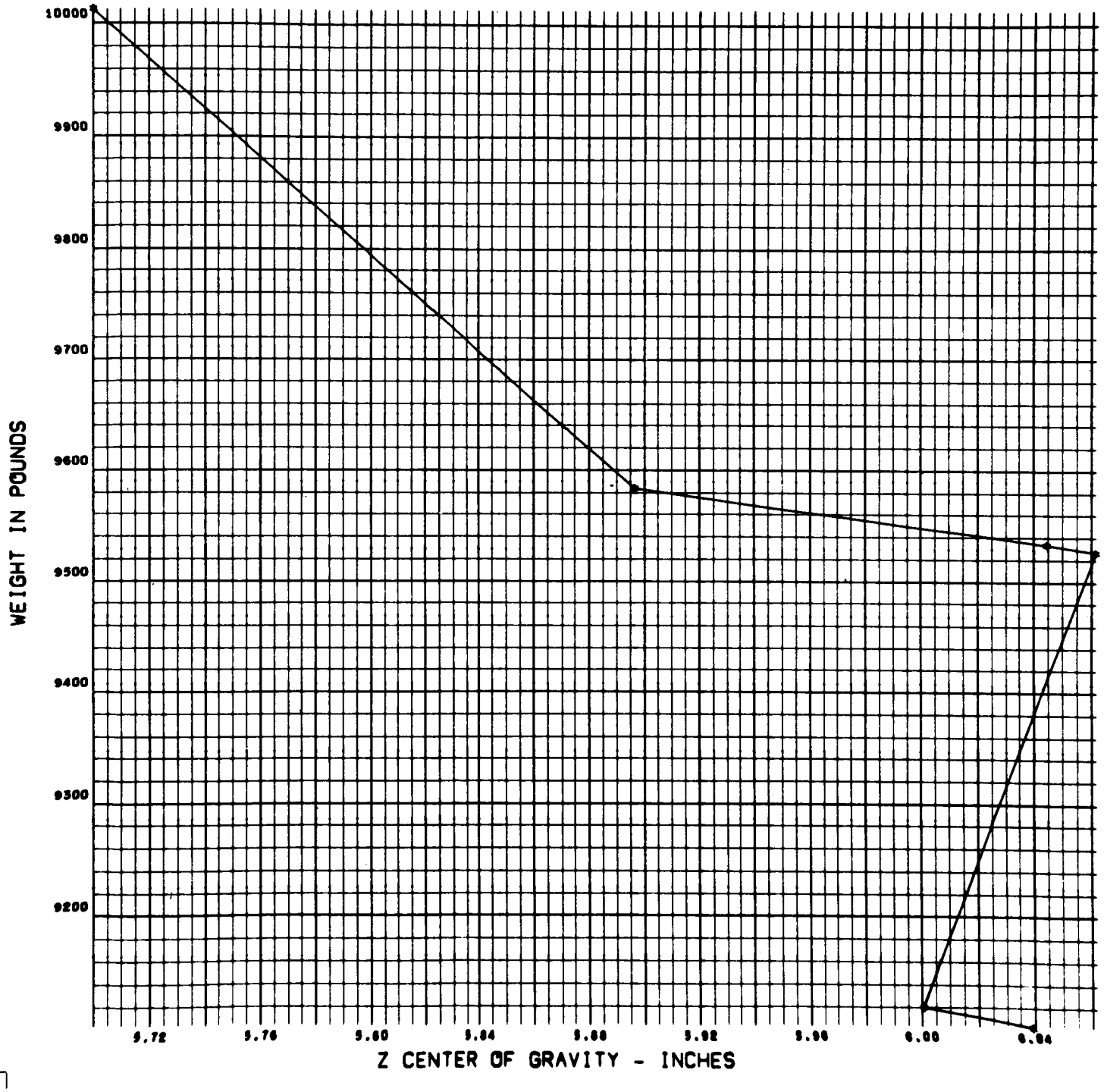


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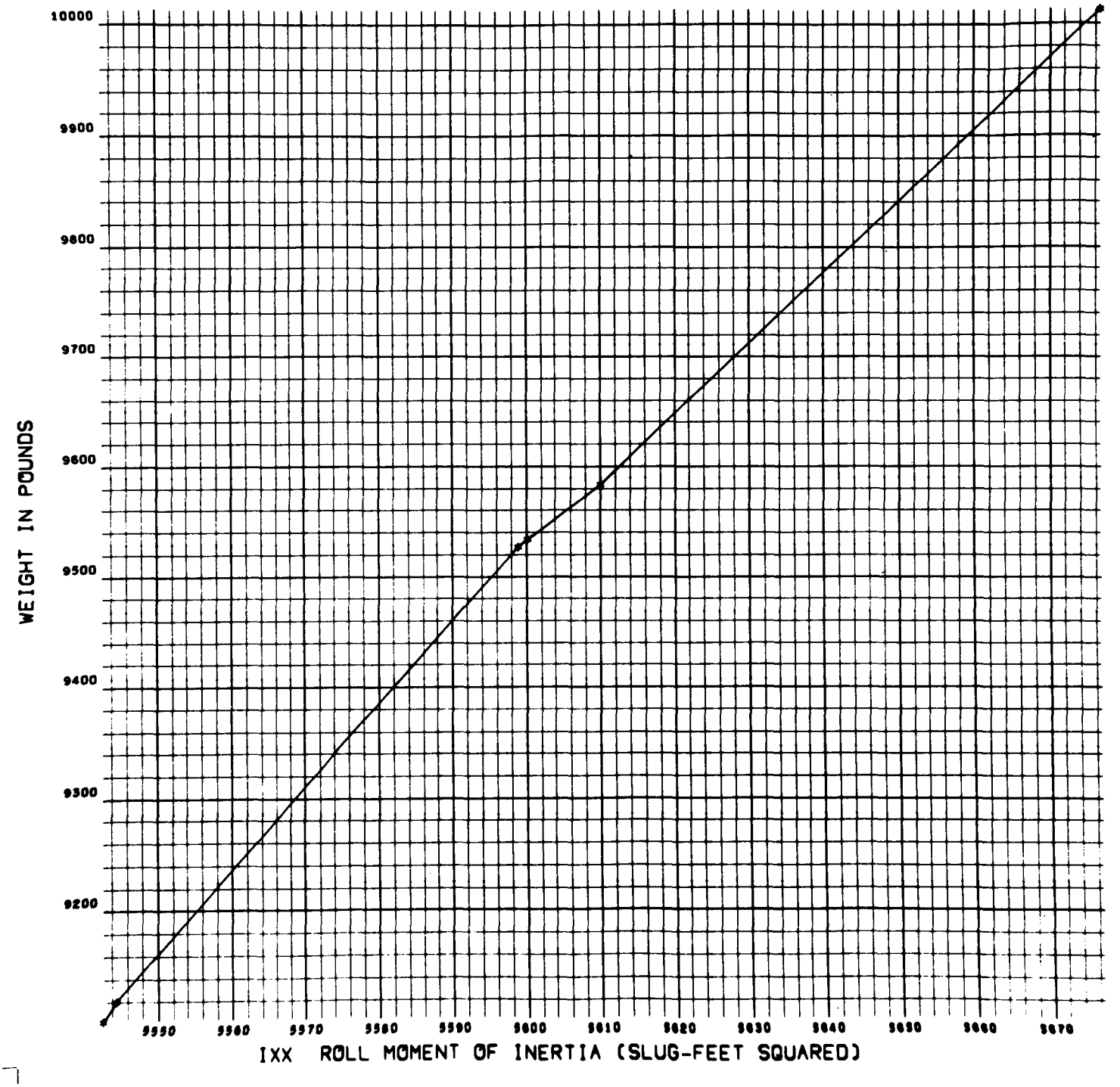


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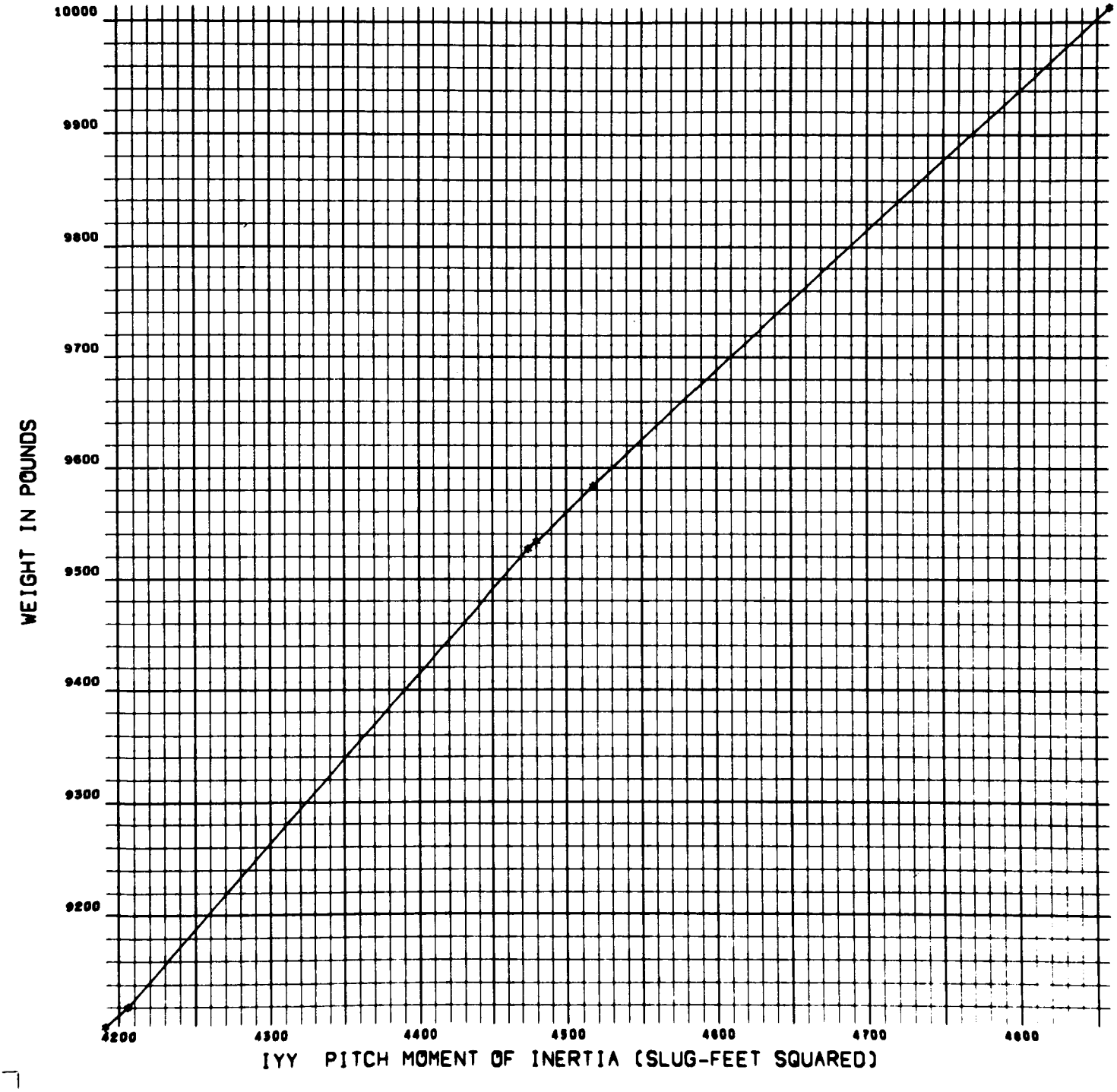


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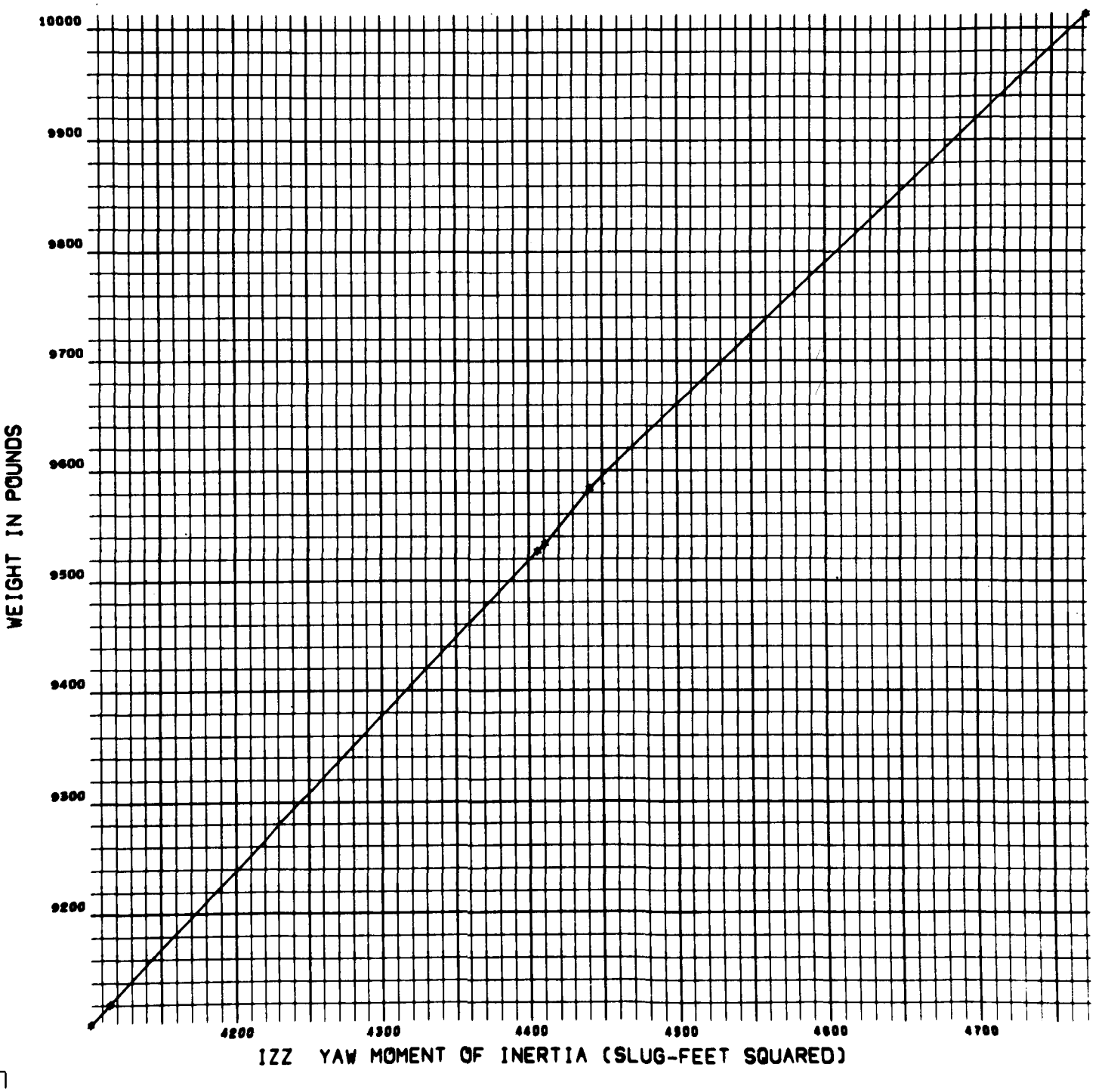


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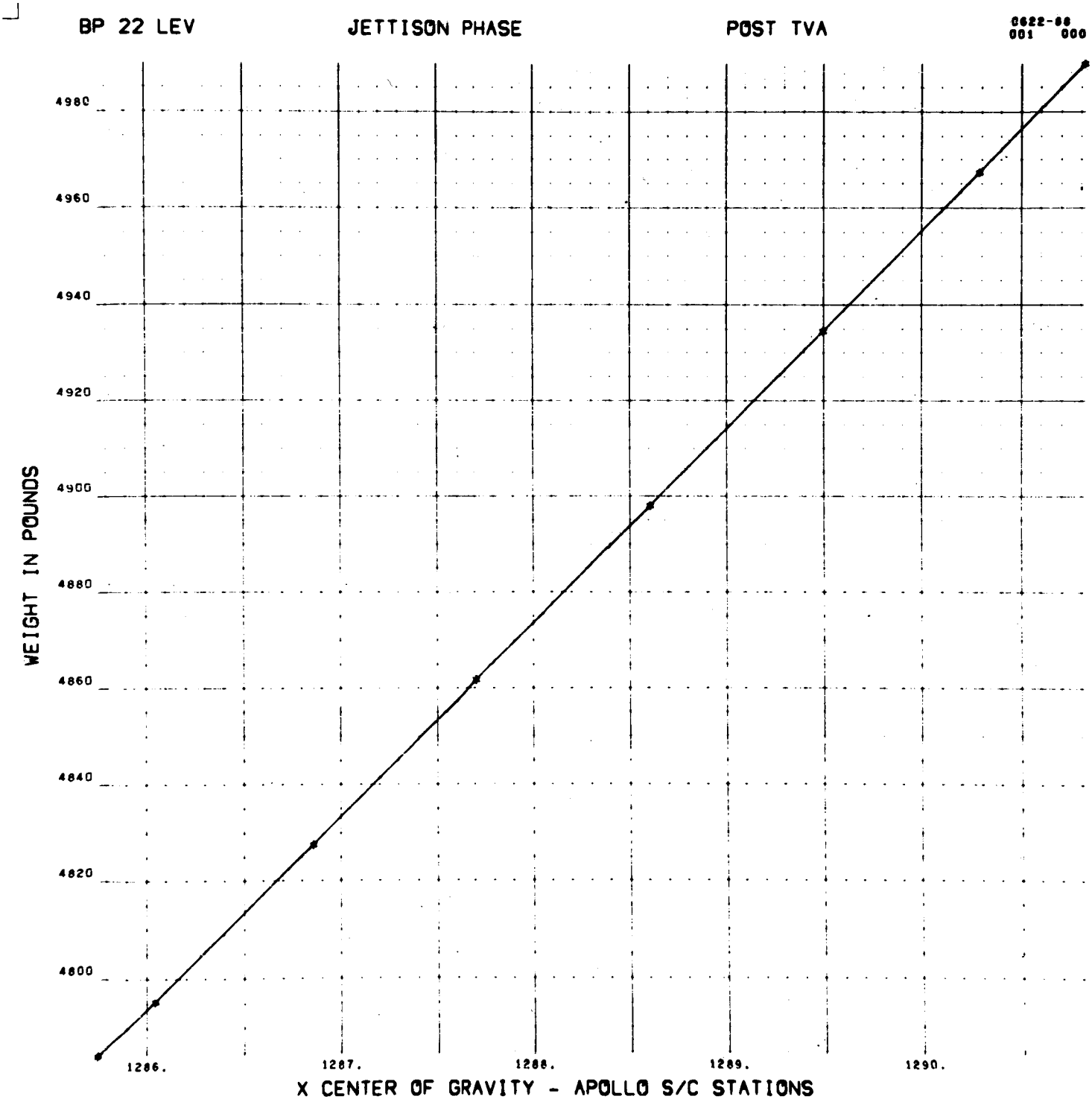


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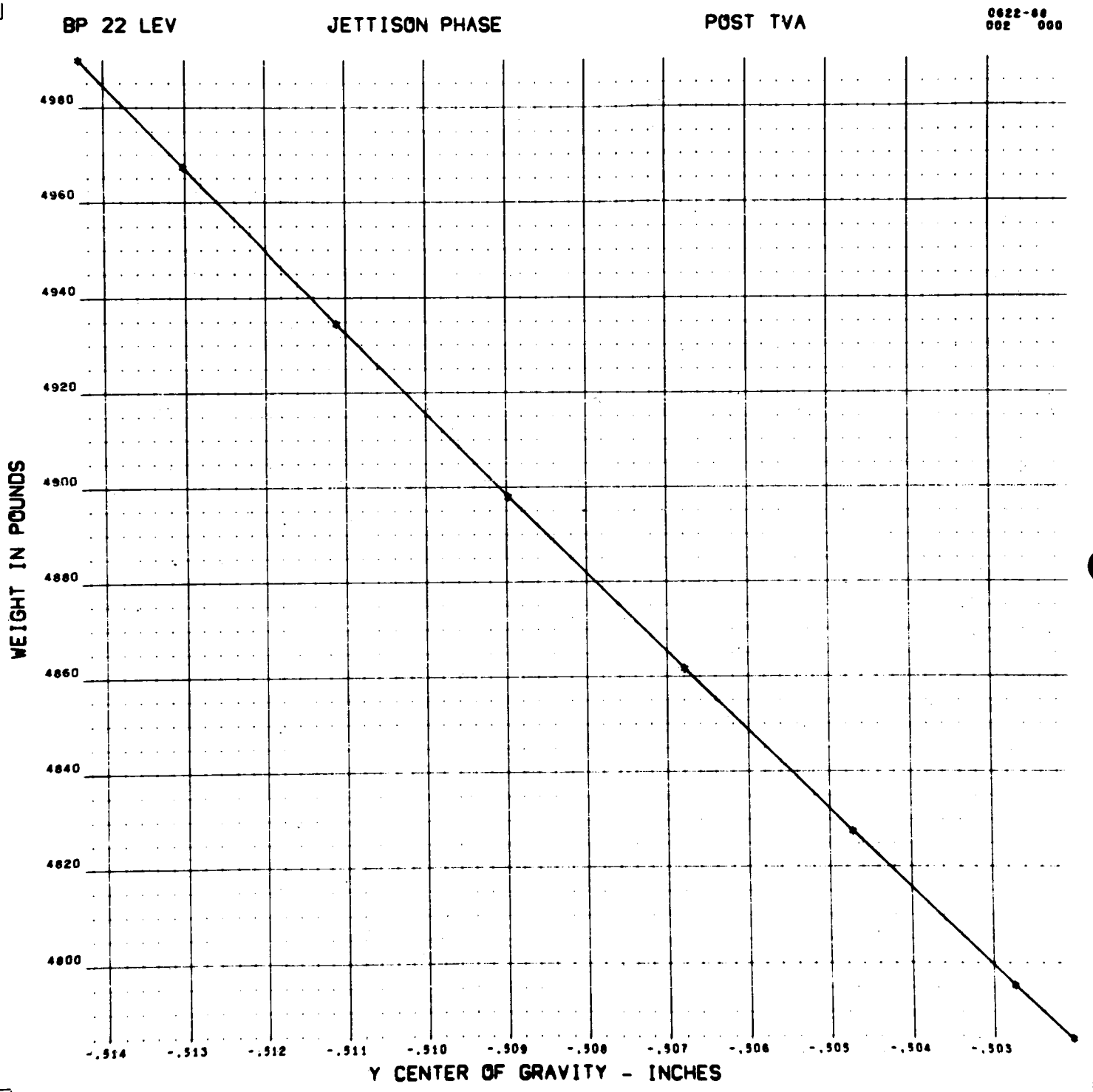
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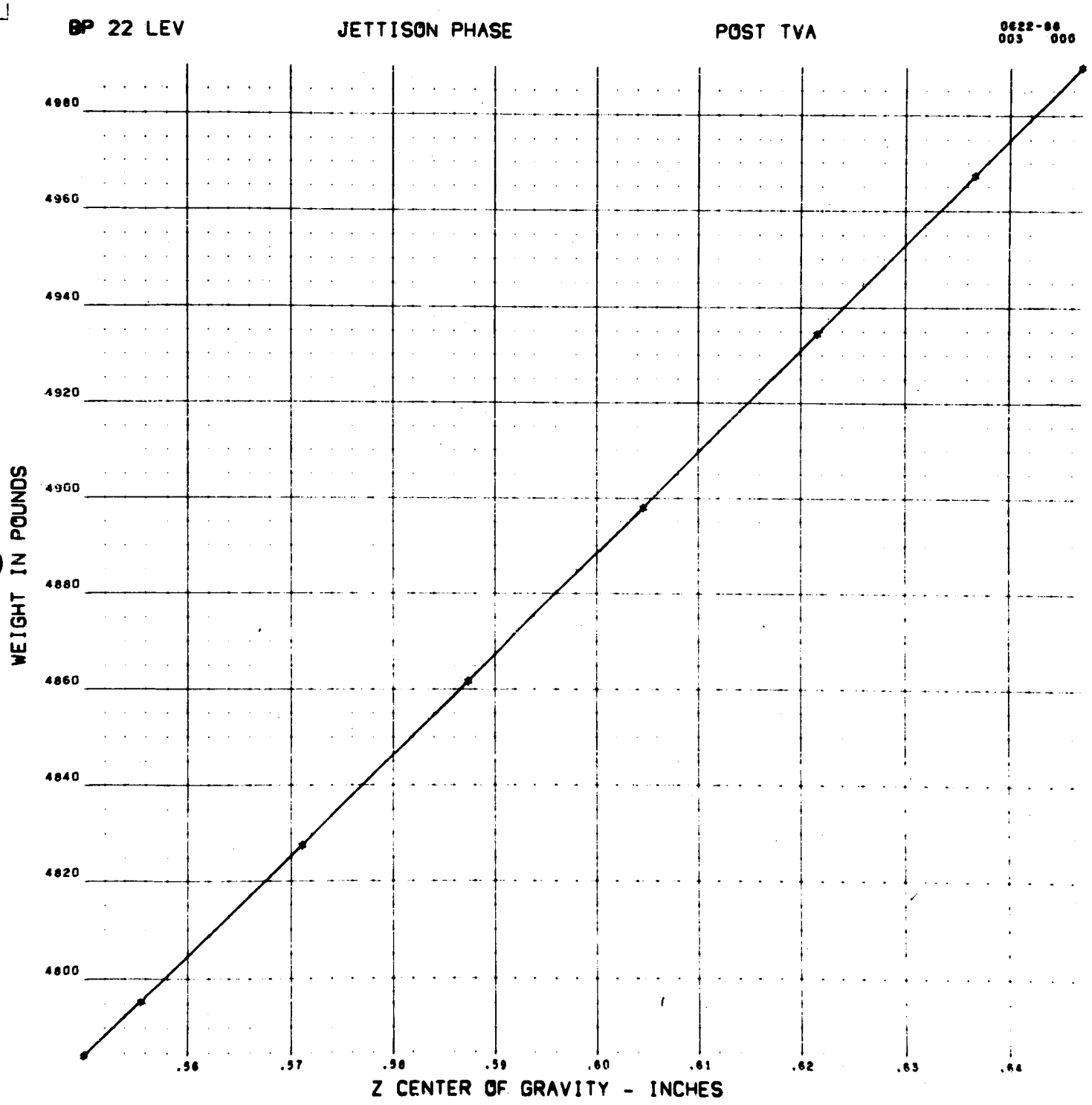


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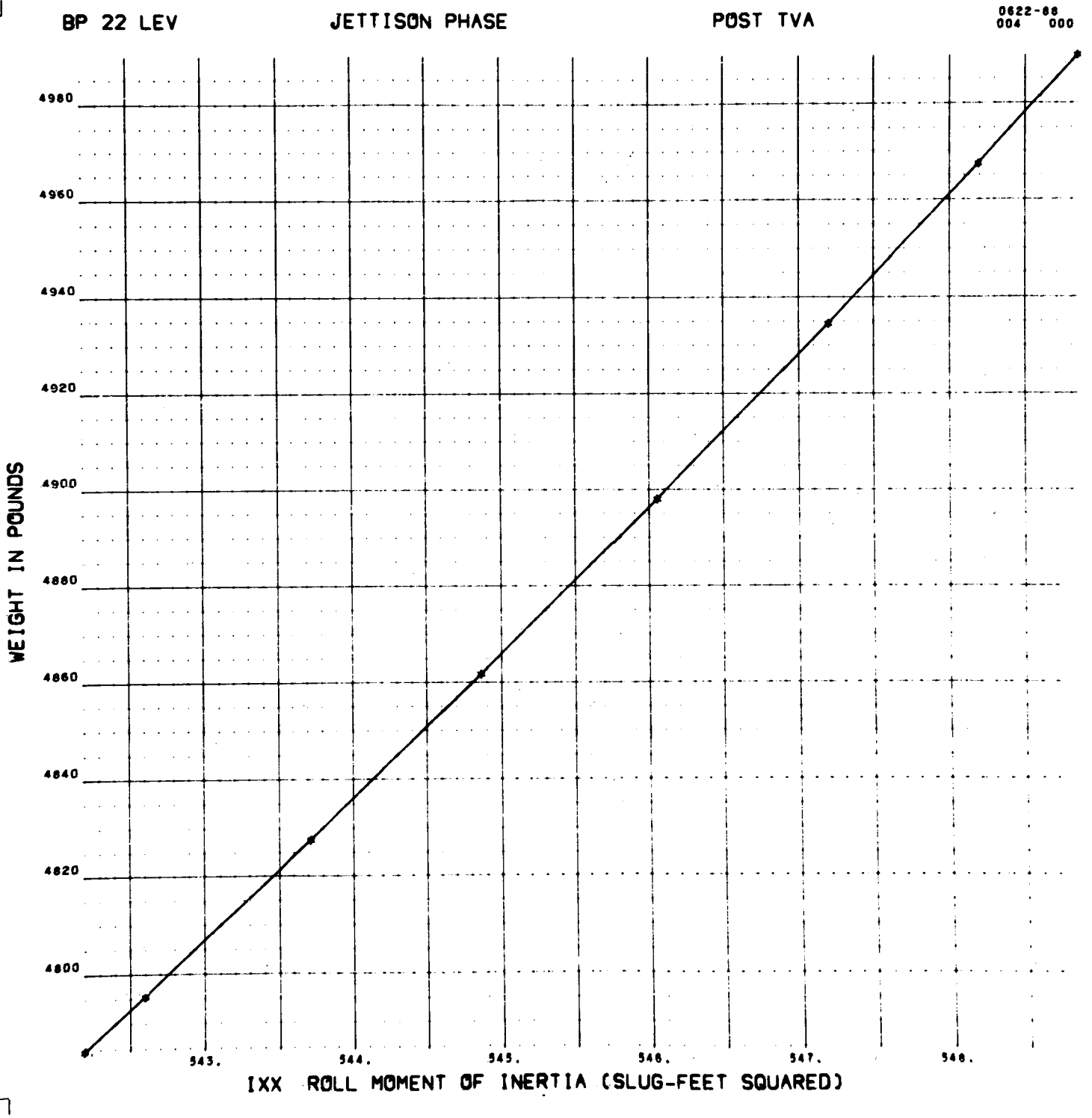


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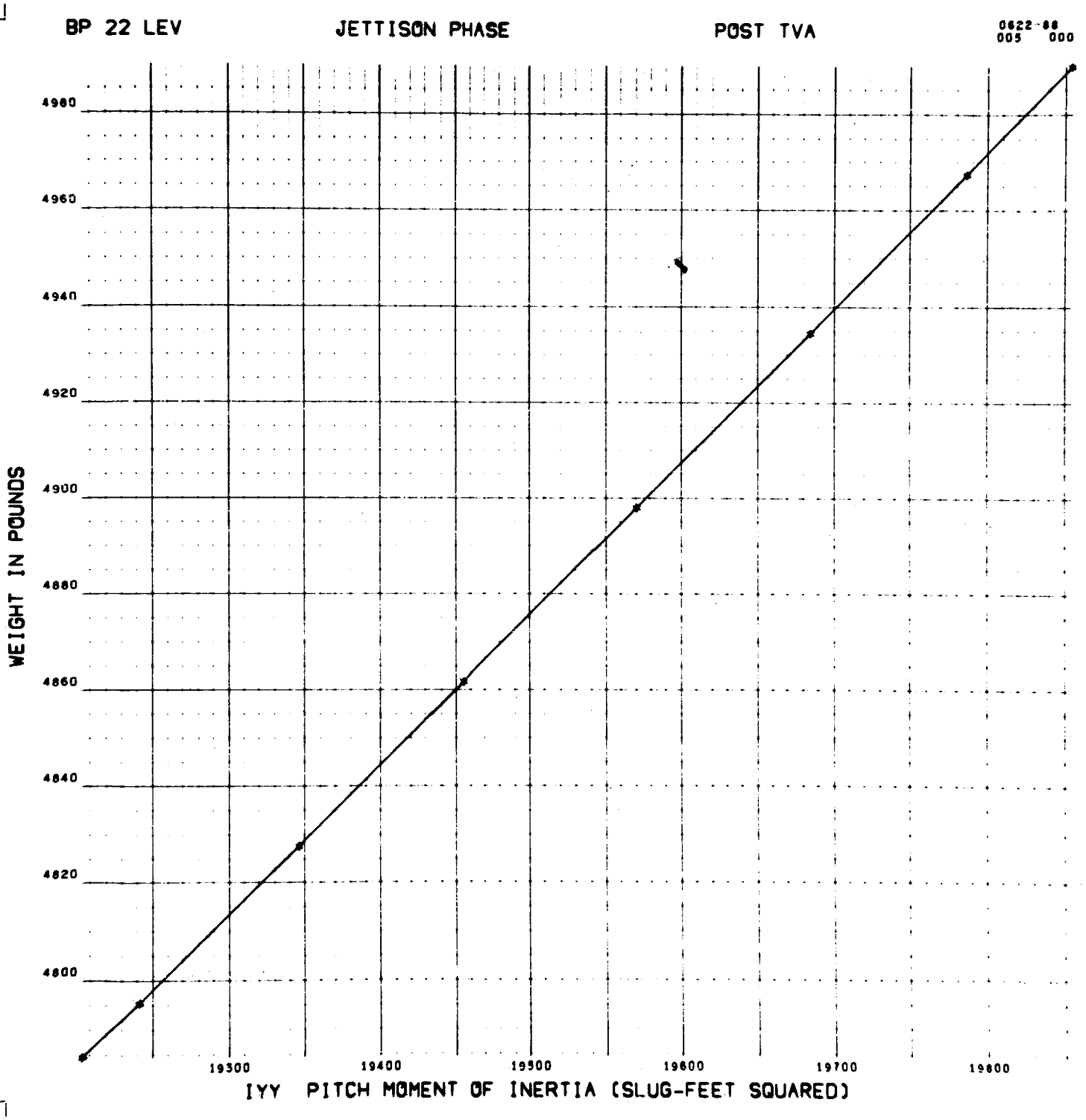


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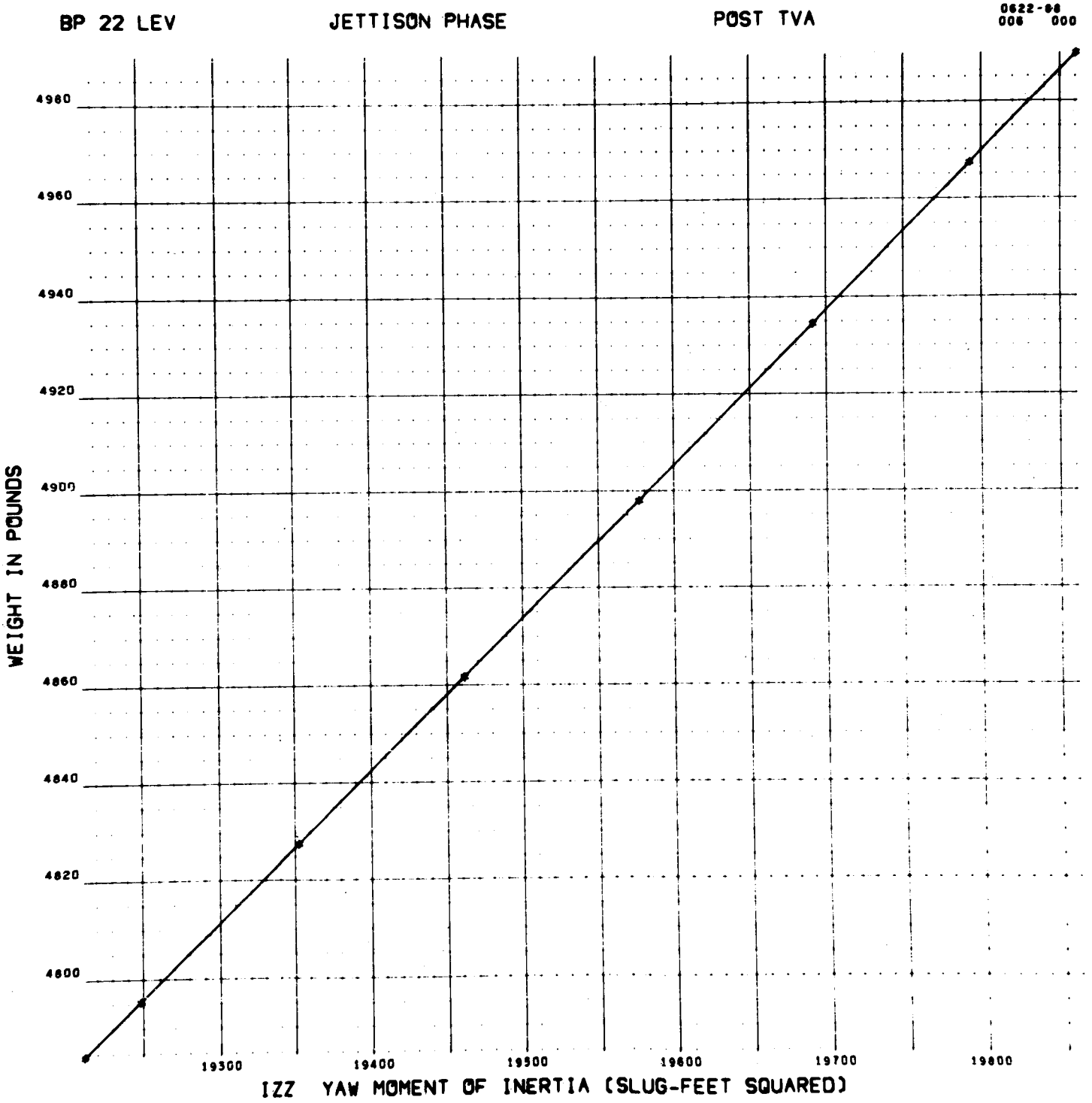


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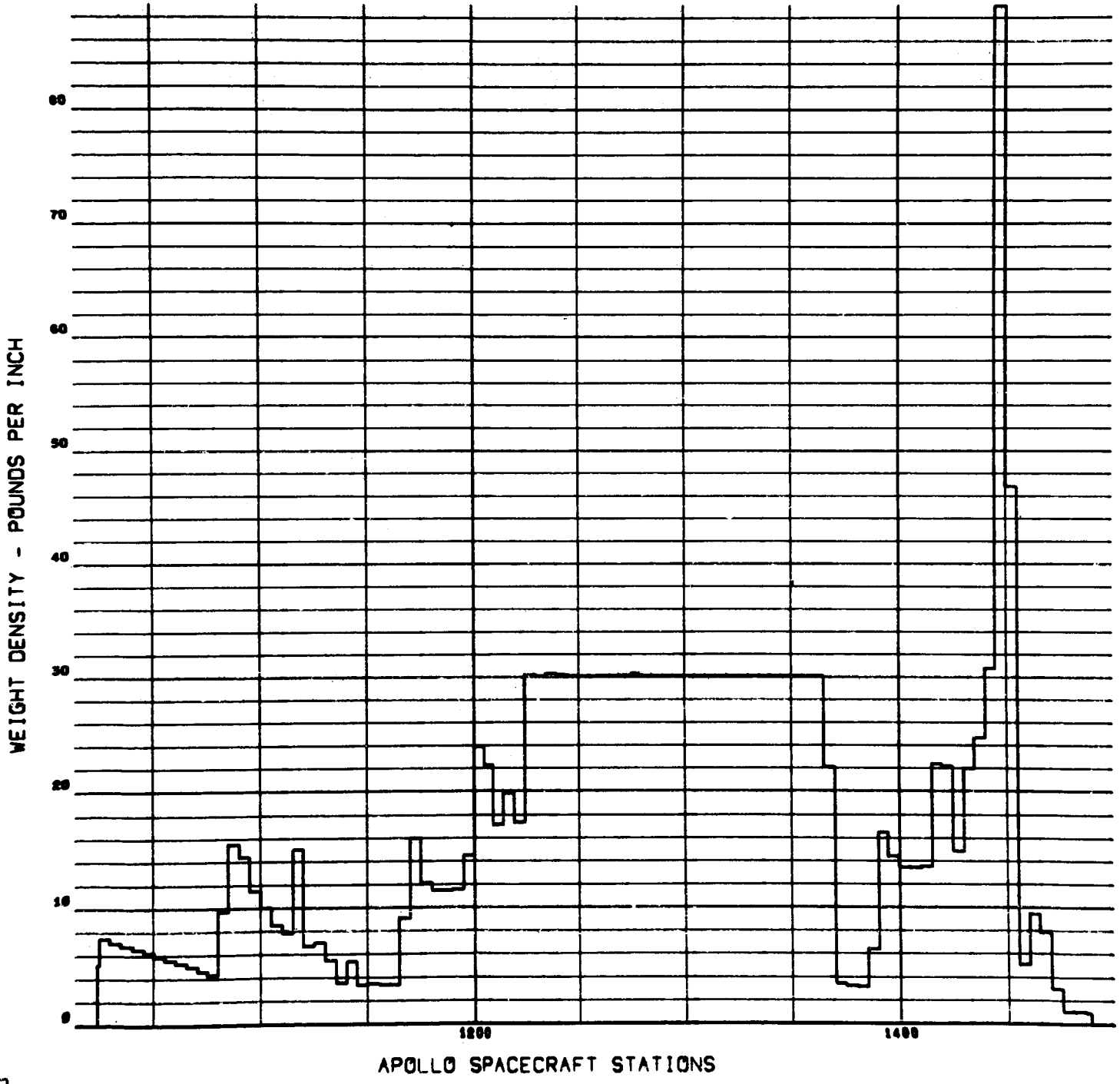
LAUNCH ESCAPE SYSTEM GROSS WEIGHT V15 2 11 21 APR 65 2464-06 001 .000



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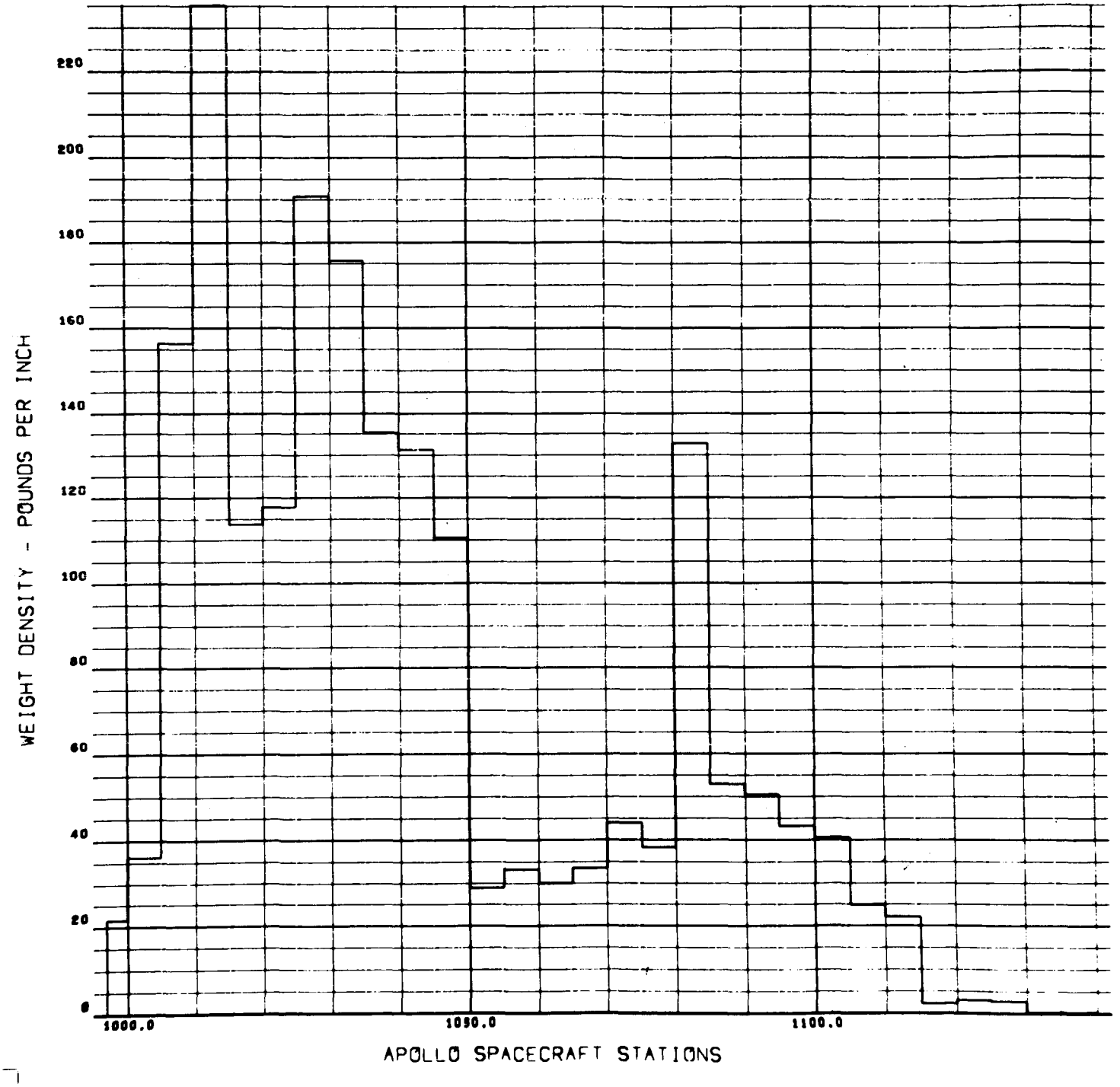
COMMAND MODULE GROSS WEIGHT V16 2 16 15 APR 65 0622-50 001 000

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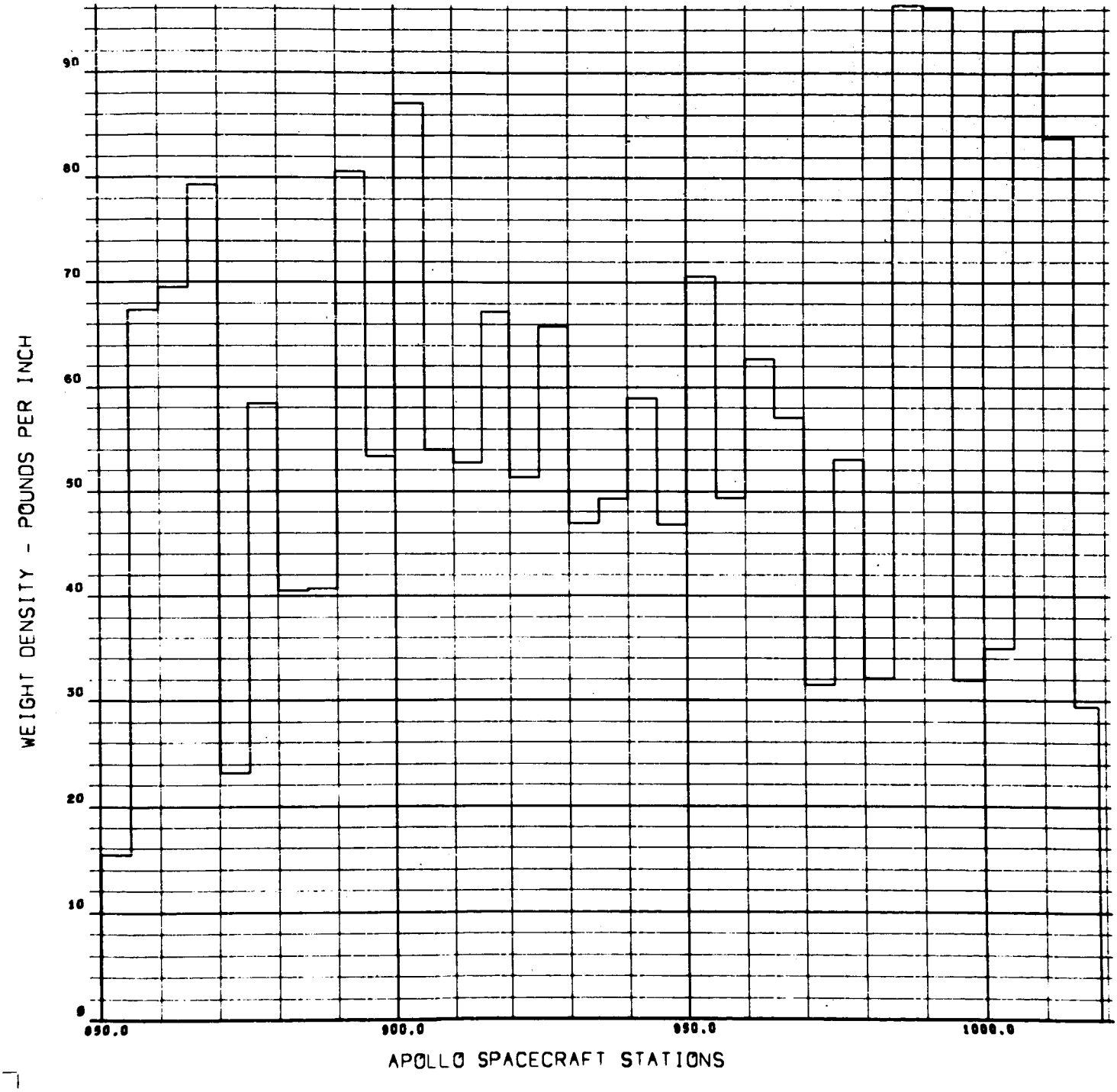
SERVICE MODULE GROSS WEIGHT V17 2 10 15 APR 65 0622-50 002 00

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# SECTION IV

# ACTUAL WEIGHT AND BALANCE

WEIGHT AND BALANCE DATA SHEET

LAUNCH ESCAPE SYSTEM - TOWER ASSEMBLY

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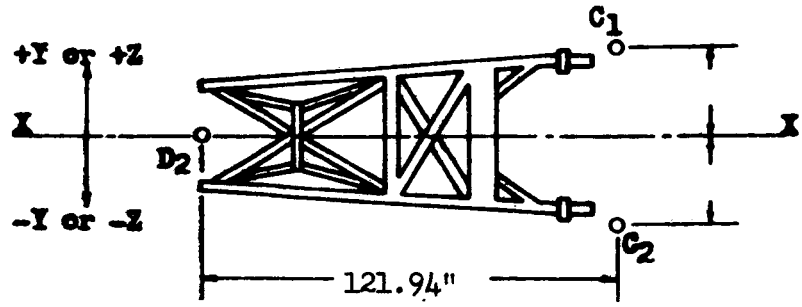


$X_a$ = 1205.15 **PLAN VIEW** $X_a$ = 1083.21

**Vehicle No.** BP 22 **Recorded By** K. L. Beets

**Location** VAB - WSMR **Date Performed** 3-24-65

**REACTION POINT** $C_1$ (COMPRESSION)

| DETERMINATION NUMBER | LOAD CELL | GROSS READING | ZERO READING | CORRECTED READING | AVERAGE READING |
|---|---|---|---|---|---|
| 1 | Red | 11997.0 | -490 | 11507.0 | |
| 2 | S/N 20336 | 11988.5 | -500 | 11488.5 | |
| 3 | | 11988.0 | -501 | 11487.0 | |
| | | | | | 11494.2 |
| | | | | | |

**REACTION POINT** $C_2$ (COMPRESSION)

| DETERMINATION NUMBER | LOAD CELL | GROSS READING | ZERO READING | CORRECTED READING | AVERAGE READING |
|---|---|---|---|---|---|
| 1 | Yellow | 12630.0 | -491 | 12139.0 | |
| 2 | S/N 20338 | 12660.0 | -498 | 12162.0 | |
| 3 | | 12658.5 | -499 | 12159.5 | |
| | | | | | 12153.5 |
| | | | | | |

**REACTION POINT** $D_2$ (COMPRESSION)

| DETERMINATION NUMBER | LOAD CELL | GROSS READING | ZERO READING | CORRECTED READING | AVERAGE READING |
|---|---|---|---|---|---|
| 1 | Blue | 9946.0 | -494 | 9452.0 | |
| 2 | S/N 20341 | 9950.0 | -500 | 9450.0 | |
| 3 | | 9952.0 | -501 | 9451.0 | |
| | | | | | 9451.0 |
| | | | | | |

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SID 63-143-14W

MX9970-10[illegible]2

WEIGHT AND BALANCE CALCULATION SHEET

LAUNCH ESCAPE SYSTEM - TOWER ASSEMBLY

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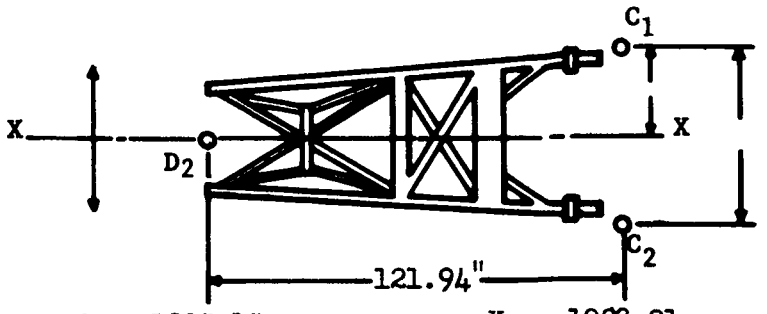


$X_a$ = 1205.15 PLAN VIEW $X_a$ = 1083.21

Vehicle No. BP 22 Recorded By K. L. Beets

Location VAB - WSMR Date Performed 3-24-65

| WEIGHT DERIVATION | | | | | | |
|---|---|---|---|---|---|---|
| REACT POINT | LOAD CELL | AVERAGE READING | INDICATED WEIGHT | BUOYANCY CORRECTION | GRAVITY CORRECTION | WEIGHT |
| $C_1$ | Red | 11494.2 | 286.52 | -0.04 | - | 286.48 |
| $C_2$ | Yellow | 12153.5 | 302.75 | -0.05 | - | 302.70 |
| $D_2$ | Blue | 9451.0 | 239.01 | -0.04 | - | 238.97 |

| WEIGHT AND X - Y CENTER OF GRAVITY | | | | | | |
|---|---|---|---|---|---|---|
| DESCRIPTION | REACT POINT | WEIGHT | X STA | X MOMENT | STA | MOMENT |
| Cell Location | $C_1$ | 286.5 | 1083.21 | 310340 | - | - |
| Cell Location | $C_2$ | 302.7 | 1083.21 | 327888 | - | - |
| Cell Location | $D_2$ | 239.0 | 1205.15 | 288031 | - | - |
| GROSS (as weighed) | | 828.2 | 1118.40 | 926259 | | |
| Less: Aft. Frame | | -321.4 | 1083.19 | -348137 | - | - |
| Fwd. Frame | | -7.4 | 1205.15 | -8918 | - | - |
| | | | | | | |
| NET (as weighed) | | 499.4 | 1139.78 | 569204 | - | - |
| Less: Dual Mode Twr. Feet | | -30.2 | 1088.60 | -32876 | - | - |
| Plus: Single Mode Twr. Feet | | +33.5 | 1088.60 | 36468 | - | - |
| Camera Shortage | | +16.3 | 1176.09 | 19170 | - | - |
| Explosive Bolts (Partial) | | +4.9 | 1085.30 | 5318 | - | - |
| | | | | | | |
| CORRECTED WEIGHT AND CG (X-Y) | | 523.9 | 1140.07 | 597284 | - | - |



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LAUNCH ESCAPE SYSTEM

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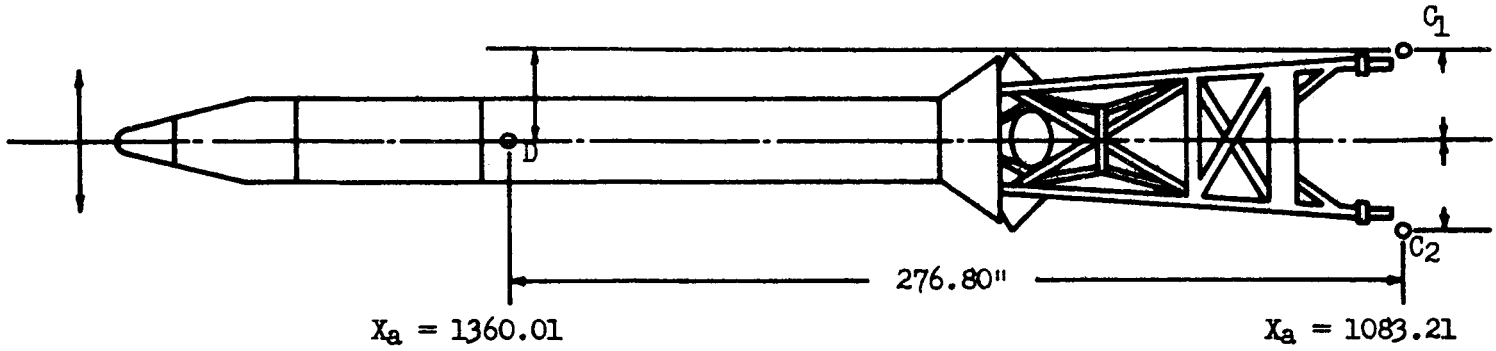


**Vehicle No.** BP 22 **Recorded By** K. L. Beets

**Location** VAB - WSMR **Date Performed** 3-29-65

**REACTION POINT** D (COMPRESSION)

| DETERMINATION NUMBER | LOAD CELL | GROSS READING | ZERO READING | CORRECTED READING | AVERAGE READING |
|---|---|---|---|---|---|
| 1 | Red | 25253 | -503 | 24750 | |
| 2 | 10,000# Cap. | 25256 | -497 | 24759 | |
| 3 | S/N 34215 | 25264 | -497 | 24767 | |
| | | | | | 24758.7 |
| | | | | | |

**REACTION POINT** $C_1$ (COMPRESSION)

| DETERMINATION NUMBER | LOAD CELL | GROSS READING | ZERO READING | CORRECTED READING | AVERAGE READING |
|---|---|---|---|---|---|
| 1 | Yellow | 33683 | -499 | 33184 | |
| 2 | 1,000 # Cap. | 33707 | -498 | 33209 | |
| 3 | S/N 20338 | 33423 | -494 | 32929 | |
| | | | | | 33107.3 |
| | | | | | |

**REACTION POINT** $C_2$ (COMPRESSION)

| DETERMINATION NUMBER | LOAD CELL | GROSS READING | ZERO READING | CORRECTED READING | AVERAGE READING |
|---|---|---|---|---|---|
| 1 | Blue | 33119 | -494 | 32625 | |
| 2 | 1,000 # Cap. | 33083 | -498 | 32585 | |
| 3 | S/N 20341 | 33278 | -498 | 32780 | |
| | | | | | 32663.3 |
| | | | | | |

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WEIGHT AND BALANCE CALCULATION SHEET

LAUNCH ESCAPE SYSTEM

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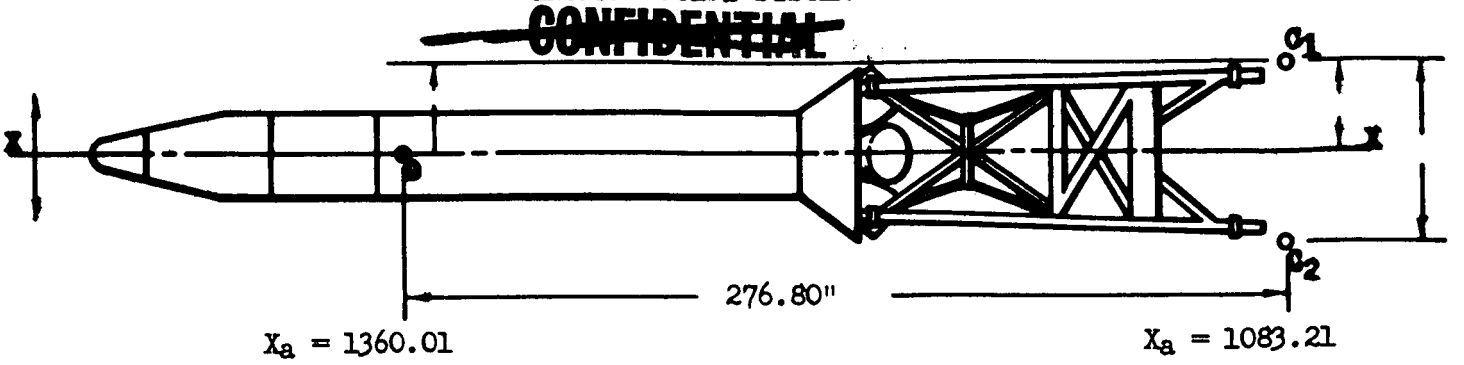


PLAN VIEW

**Vehicle No.** BP 22 **Recorded By** K. L. Beets

**Location** VAB - WSMR **Date Performed** 3-29-65

| WEIGHT DERIVATION | | | | | | |
|---|---|---|---|---|---|---|
| REACT POINT | LOAD CELL | AVERAGE READING | INDICATED WEIGHT | BUOYANCY CORRECTION | GRAVITY CORRECTION | WEIGHT |
| $C_1$ | Yellow | 33107.3 | 823.27 | -0.12 | - | 823.15 |
| $C_2$ | Blue | 32663.3 | 823.19 | -0.12 | - | 823.07 |
| D | Red | 24758.7 | 6261.77 | -0.94 | - | 6260.83 |

| WEIGHT AND X CENTER OF GRAVITY | | | | |
|---|---|---|---|---|
| DESCRIPTION | REACT POINT | WEIGHT | X STA | X MOMENT |
| Cell Location | $C_1$ | 823.2 | 1083.21 | 891698 |
| Cell Location | $C_2$ | 823.1 | 1083.21 | 891590 |
| Cell Location | D | 6260.8 | 1360.01 | 8514751 |
| **GROSS (as weighed)** | | 7907.1 | 1302.38 | 10298039 |
| Less: Aft Frame | | -321.4 | 1083.19 | -348137 |
| Fwd. Saddle | | -83.3 | 1360.10 | -113296 |
| (4) Nozzle Covers | | -3.8 | 1198.00 | -4552 |
| Ground Clamp | | -2.0 | 1209.00 | -2418 |
| Plus: Air Buoyancy Correction | | +3.5 | 1317.80 | 4612 |
| | | | | |
| NET (as weighed) | | 7500.1 | 1311.22 | 9834248 |
| | | | | |
| Plus: Shortages (Page 31) | | +690.5 | 1094.10 | 755476 |
| **CORRECTED WEIGHT AND CG (X)** | | 8190.6 | 1292.91 | 10589724 |

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## CORRECTIONS TO ACTUAL WEIGHT AND BALANCE

## LAUNCH ESCAPE SYSTEM

## BOILERPLATE NO. 22

| ITEM | ± | WEIGHT | CENTER OF GRAVITY | | |
|---|---|---|---|---|---|
| | | | Xa | Ya* | Za* |
| Camera Installation (Calc.) | + | 26.9 | 1187.1 | - | - |
| Tower Explosive Bolts-Partial (Act.) | + | 4.9 | 1085.3 | - | - |
| Ordnance Installation (Calc.) | + | 0.6 | 1396.7 | - | - |
| (1) Pressure Transducer (Calc.) | + | 0.5 | 1205.5 | - | - |
| Camera Support (Act.) | + | 6.5 | 1173.0 | - | - |
| Canard Ordnance Installation (Calc.) | + | 1.5 | 1436.0 | - | - |
| Dual Mode Tower Feet (Act.) | - | 30.2 | 1088.6 | - | - |
| Single Mode Tower Feet (Act.) | + | 33.5 | 1088.6 | - | - |
| Fwd. Boost Cover - "Soft" (Act.) | + | 270.1 | 1102.1 | - | - |
| Aft Boost Cover - "Hard" (Act.) | + | 350.8 | 1051.8 | - | - |
| (1) V15-300421-15 Ballast (Act.) | + | 24.7 | 1454.2 | - | - |
| (2) V15-300221-11 Brackets (Act.) | + | 0.7 | 1206.5 | - | - |
| TOTAL LES CORRECTIONS | + | 690.5 | 1094.1 | - | - |

NOTE: *The Ya and Za centers of gravity are omitted for the LES since these centers of gravity were not obtained on the LES weighing. The LES Ya and Za centers of gravity are derived from the post thrust vector alignment weighing.

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WEIGHT AND BALANCE DATA SHEET

COMMAND MODULE - HORIZONTAL

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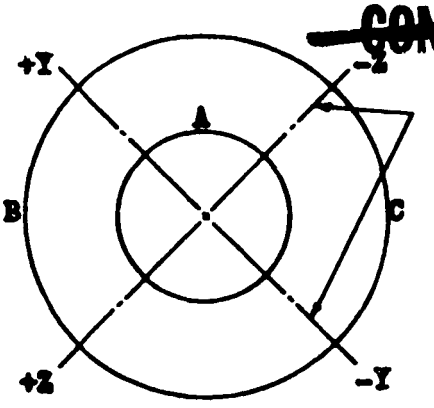


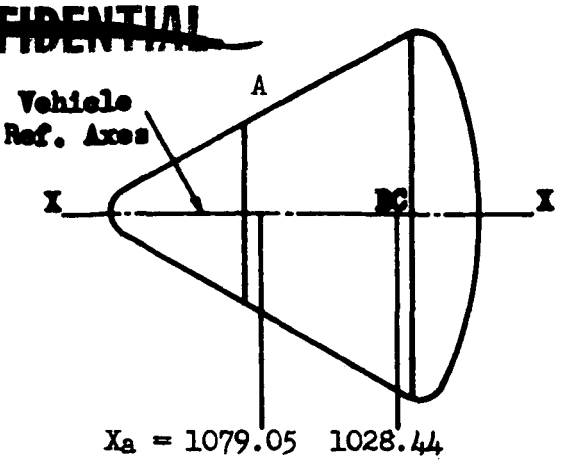


$X_a$ = 1079.05 1028.44

Vehicle No. BP 22

Recorded By J. F. Kessler/K. L. Beets

Location VAB - WSMR

Date Performed 3-31-65

REACTION POINT A (TENSION)

| DETERMINATION NUMBER | LOAD CELL | GROSS READING | ZERO READING | CORRECTED READING | AVERAGE READING |
|---|---|---|---|---|---|
| 1 | Red | 12146 | -493 | 11653 | |
| 2 | S/N 34215 | 12159 | -498 | 11661 | |
| 3 | | 12153 | -488 | 11665 | |
| | | | | | 11659.7 |
| | | | | | |

REACTION POINT B (COMPRESSION)

| DETERMINATION NUMBER | LOAD CELL | GROSS READING | ZERO READING | CORRECTED READING | AVERAGE READING |
|---|---|---|---|---|---|
| 1 | Yellow | 16065 | -501 | 15564 | |
| 2 | S/N 34210 | 16061 | -500 | 15561 | |
| 3 | | 16058 | -499 | 15559 | |
| | | | | | 15561.3 |
| | | | | | |

REACTION POINT C (COMPRESSION)

| DETERMINATION NUMBER | LOAD CELL | GROSS READING | ZERO READING | CORRECTED READING | AVERAGE READING |
|---|---|---|---|---|---|
| 1 | Blue | 13963 | -498 | 13465 | |
| 2 | S/N 34214 | 13946 | -501 | 13445 | |
| 3 | | 13954 | -499 | 13455 | |
| | | | | | 13455.0 |
| | | | | | |

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SID 63-143-14W

WEIGHT AND BALANCE CALCULATION SHEET

COMMAND MODULE - HORIZONTAL

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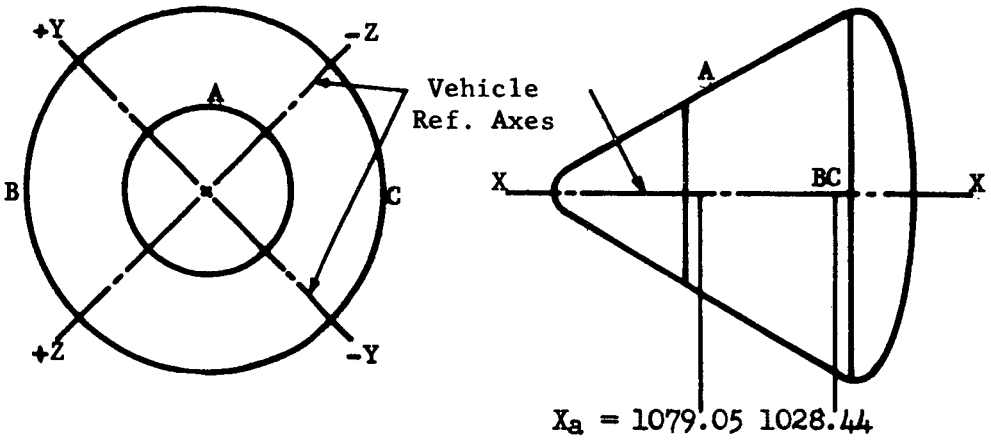


Vehicle No. BP 22

Recorded By J. F. Kessler

Location VAB - WSMR

Date Performed 3-31-65

| WEIGHT DERIVATION | | | | | | |
|---|---|---|---|---|---|---|
| REACT POINT | LOAD CELL | AVERAGE READING | INDICATED WEIGHT | BUOYANCY CORRECTION | GRAVITY CORRECTION | WEIGHT |
| A | Red | 11659.7 | 2930.6 | -0.5 | - | 2930.1 |
| B | Yellow | 15561.3 | 3930.8 | -0.6 | - | 3930.2 |
| C | Blue | 13455.0 | 3397.2 | -0.5 | - | 3396.7 |

| WEIGHT AND X CENTER OF GRAVITY | | | | |
|---|---|---|---|---|
| DESCRIPTION | REACT POINT | WEIGHT | X STA | X MOMENT |
| Cell Location | A | 2930.1 | 1079.05 | 3161724 |
| Cell Location | B | 3930.2 | 1028.44 | 4041975 |
| Cell Location | C | 3396.7 | 1028.44 | 3493302 |
| GROSS (as weighed) | | 10257.0 | 1042.90 | 10697001 |
| Less: H14-9006 Sling & Trunnions | | -296.8 | 1079.05 | -320262 |
| (3) Aft Jack Pads | | -37.9 | 1028.44 | -38978 |
| (4) Apex Cover Hold Down | | | | |
| Bolts | | -5.5 | 1081.10 | -5946 |
| (43) Press. Xducer Covers | | -2.5 | 1054.40 | -2636 |
| Plus: Air Buoyancy Correction | | +6.7 | 1039.35 | 6964 |
| NET (as weighed) | | 9921.0 | 1041.84 | 10336143 |
| | | | | |
| Plus: Shortages (Page 34) | | +89.7 | 1060.50 | 95127 |
| CORRECTED WEIGHT AND CG (X) | | 10010.7 | 1042.01 | 10431270 |

[redacted]



MX9970-101-1

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CORRECTIONS TO ACTUAL WEIGHT AND BALANCE

COMMAND MODULE - HORIZONTAL

BOILERPLATE NO. 22

| ITEM | ± | WEIGHT | CENTER OF GRAVITY Xa |
|---|---|---|---|
| Main Battery Electrolite (1) | + | 7.9 | 1023.0 |
| Pyro Battery Electrolite (2) | + | 1.7 | 1039.4 |
| Apex Cover Thruster Cartridges | + | 1.5 | 1105.3 |
| Apex Cover Thruster Att. Ftg's | + | 0.8 | 1108.5 |
| Camera, Lens & Mount | + | 15.0 | 1124.0 |
| Camera Control Box | + | 6.2 | 1040.1 |
| Camera Generator | + | 2.3 | 1040.1 |
| Apex Cover Nose Probe (Act.) | + | 1.9 | 1132.0 |
| Mission Sequencer (Act.) | + | 35.8 | 1042.2 |
| CM/LES Explosive Bolts - Partial | + | 3.4 | 1080.9 |
| Jack Pad Plugs & Patching | + | 5.3 | 1061.0 |
| Gyro "J" Box (Act.) | + | 4.8 | 1039.1 |
| Camera Cables (3) (Act.) | + | 2.7 | 1073.1 |
| Breakwire Adapter Box (Act.) | + | 0.9 | 1039.0 |
| *Main Chutes Change (Horiz./Vert.) | - | 0.5 | 1091.8 |
| TOTAL HORIZONTAL CORRECTIONS | + | 89.7 | 1060.5 |

NOTE: *The main chutes installed for the horizontal weight and balance were 0.5 pounds heavier than the actual flight chutes installed for the vertical weight and balance.

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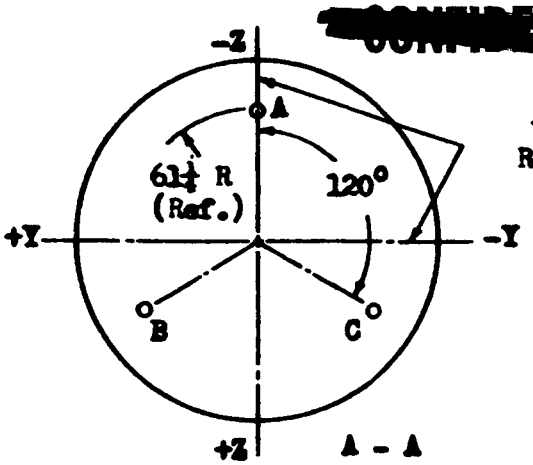
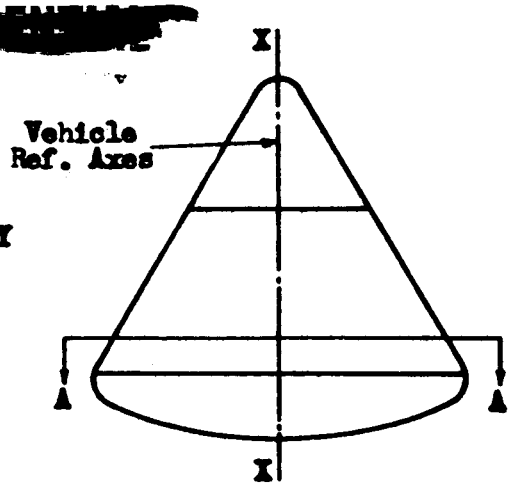
WEIGHT AND BALANCE DATA SHEET

COMMAND MODULE - VERTICAL

[redacted]




Vehicle No. BP 22

Recorded By J. F. Kessler/K. L. Beets

Location VAB - WSMR

Date Performed 4-6-65

REACTION POINT A (COMPRESSION)

| DETERMINATION NUMBER | LOAD CELL | GROSS READING | ZERO READING | CORRECTED READING | AVERAGE READING |
|---|---|---|---|---|---|
| 1 | Red | 11822 | -496 | 11326 | |
| 2 | S/N 34215 | 11819 | -499 | 11320 | |
| 3 | | 11829 | -497 | 11332 | |
| | | | | | 11326.0 |
| | | | | | |

REACTION POINT B (COMPRESSION)

| DETERMINATION NUMBER | LOAD CELL | GROSS READING | ZERO READING | CORRECTED READING | AVERAGE READING |
|---|---|---|---|---|---|
| 1 | Yellow | 15711 | -497 | 15214 | |
| 2 | S/N 34210 | 15720 | -500 | 15220 | |
| 3 | | 15718 | -497 | 15221 | |
| | | | | | 15218.3 |
| | | | | | |

REACTION POINT C (COMPRESSION)

| DETERMINATION NUMBER | LOAD CELL | GROSS READING | ZERO READING | CORRECTED READING | AVERAGE READING |
|---|---|---|---|---|---|
| 1 | Blue | 15271 | -498 | 14773 | |
| 2 | S/N 34214 | 15272 | -499 | 14773 | |
| 3 | | 15266 | -497 | 14769 | |
| | | | | | 14771.7 |
| | | | | | |

VERIFIED BY: [redacted]

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WEIGHT AND BALANCE CALCULATION SHEET

COMMAND MODULE - VERTICAL

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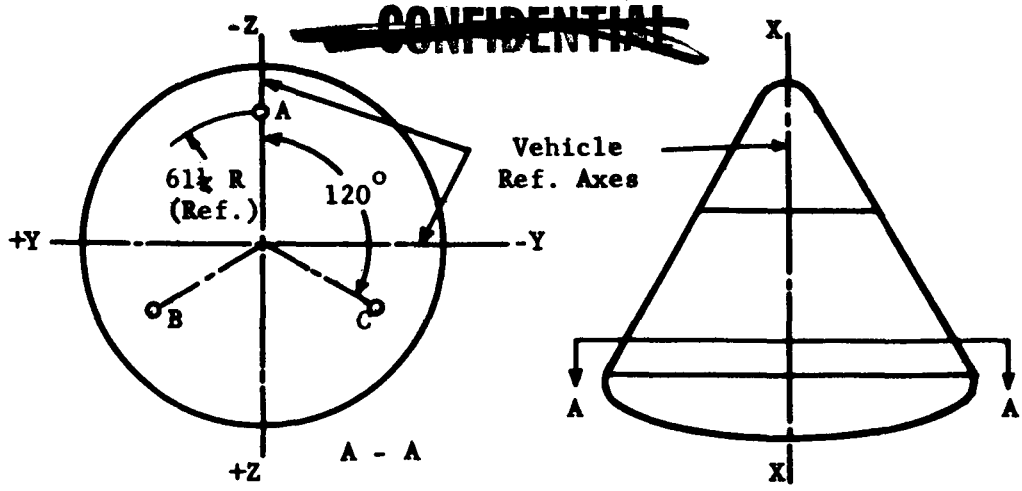


Vehicle No. BP 22 Recorded By J. F. Kessler

Location VAB - WSMR Date Performed 4-6-65

| WEIGHT DERIVATION | | | | | | |
|---|---|---|---|---|---|---|
| REACT POINT | LOAD CELL | AVERAGE READING | INDICATED WEIGHT | BUOYANCY CORRECTION | GRAVITY CORRECTION | WEIGHT |
| A | Red | 11326.0 | 2858.25 | -0.43 | - | 2857.82 |
| B | Yellow | 15218.3 | 3844.13 | -0.58 | - | 3843.55 |
| C | Blue | 14771.7 | 3730.02 | -0.56 | - | 3729.46 |

| WEIGHT AND Y - Z CENTER OF GRAVITY | | | | | | |
|---|---|---|---|---|---|---|
| DESCRIPTION | REACT POINT | WEIGHT | Y STA | Y MOMENT | Z STA | Z MOMENT |
| Cell Location | A | 2857.8 | 0.0 | - | -61.22 | -174955 |
| Cell Location | B | 3843.6 | 53.02 | 203788 | 30.66 | 117845 |
| Cell Location | C | 3729.5 | -53.00 | -197664 | 30.62 | 114197 |
| GROSS (as weighed) | | 10430.9 | 0.59 | 6124 | 5.47 | 57087 |
| Less: H14-017 Ring | | -470.4 | 0.62 | -292 | -0.50 | 235 |
| (43) Press. Xducer Covers | | -2.5 | 0.0 | - | 0.0 | - |
| Plus: Air Buoyancy Correction | | +6.7 | 0.59 | 4 | 5.47 | 37 |
| NET (as weighed) | | 9964.7 | 0.59 | 5836 | 5.76 | 57359 |
| | | | | | | |
| Plus: Shortages (Page 37) | | +50.2 | -0.26 | -13 | -7.32 | -367 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| CORRECTED WEIGHT AND CG (Y-Z) | | 10014.9 | 0.58 | 5823 | 5.69 | 56992 |

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CORRECTIONS TO ACTUAL WEIGHT AND BALANCE

COMMAND MODULE - VERTICAL

BOILERPLATE NO. 22

| ITEM | ± | WEIGHT | CENTER OF GRAVITY | |
|---|---|---|---|---|
| | | | Ya | Za |
| Main Battery Electrolite (1) | + | 7.9 | 40.6 | -13.4 |
| Pyro Battery Electrolite (2) | + | 1.7 | 46.2 | -9.3 |
| Camera, Lens & Mount | + | 15.0 | -0.8 | 0.0 |
| Camera Control Box | + | 6.2 | -27.1 | -30.3 |
| Camera Generator | + | 2.3 | -32.1 | -20.3 |
| Apex Cover Nose Probe (Act.) | + | 1.9 | 0.0 | 0.0 |
| CM/LES Explosive Bolts (Partial) | + | 3.4 | 0.0 | 0.0 |
| Jack Pad Plugs & Patching | + | 5.3 | 0.0 | 0.0 |
| Apex Cover Thruster Att. Ftg's | + | 0.8 | 0.0 | 0.0 |
| System #2 Recorder Tape (Act.) | + | 3.0 | -39.0 | 16.0 |
| Camera Cables (Act.) | + | 2.7 | -15.5 | -21.4 |
| TOTAL VERTICAL CORRECTIONS | + | 50.2 | -0.26 | -7.32 |

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**WEIGHT AND BALANCE DATA SHEET**

COMMAND MODULE APEX COVER

SINGLE CELL - TENSION

~~CONFIDENTIAL~~

**Vehicle No.** BP 22 **Recorded By** K. L. Beets

**Location** VAB - WSMR **Date Performed** 3-24-65

| DETERMINATION NUMBER | LOAD CELL | GROSS READING | ZERO READING | CORRECTED READING |
|---|---|---|---|---|
| 1 | Red | 17937 | -196.0 | 17741.0 |
| 2 | S/N 20336 | 17938 | -197.5 | 17740.5 |
| 3 | | 17938 | -199.0 | 17739.0 |
| | | | | |
| | | | | |

| | |
|---|---|
| **AVERAGE READING** | 17740.2 |
| **INDICATED WEIGHT** | 443.53 |
| **BUOYANCY CORRECTION** | - |
| **GRAVITY CORRECTION** | - |
| **GROSS WEIGHT (as weighed)** | 443.53 |
| Less: H14-057 Sling | -21.45 |
| | |
| **NET WEIGHT (as weighed)** | 422.08 |
| | |
| Plus: Nose Probe | +1.90 |
| | |
| CORRECTED WEIGHT | 423.98 |
| Plus: Thruster Rods | +5.00 |
| **JETTISONED WEIGHT** | 428.98 |

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WEIGHT AND CENTER OF GRAVITY SUMMARY

COMMAND MODULE

BOILERPLATE NO. 22

| ITEM | WEIGHT | CENTER OF GRAVITY | | |
|---|---|---|---|---|
| | | Xa | Ya | Za |
| Horizontal Weighing (Page 33) | 10010.7 | 1042.01 | - | - |
| Vertical Weighing (Page 36) | 10014.9 | - | 0.58 | 5.69 |
| COMMAND MODULE (Average) | 10012.8 | 1042.0 | 0.6 | 5.7 |

[redacted]

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WEIGHT AND BALANCE SUMMARY

SERVICE MODULE

BOILERPLATE NO. 22

| ITEM | ± | WEIGHT | CENTER OF GRAVITY | | |
|---|---|---|---|---|---|
| | | | Xa | Ya | Za |
| S/M (Actual Weight & Balance Report SID 63-143-14)* | | 9612.0 | 936.5 | -0.1 | -7.9 |
| Plus: Calc. Shockwave Barrier Removal | + | 318.5 | 867.0 | 0.0 | 0.0 |
| Less: Act. Shockwave Barrier Removal | - | 308.0 | 867.0 | 0.0 | 0.0 |
| Less: (1) Camera Battery | - | 7.9 | 929.8 | 62.1 | -41.5 |
| Plus: (3) Camera Cables | + | 3.0 | 914.1 | 26.1 | -12.6 |
| SERVICE MODULE CORRECTED WT. & C.G. | | 9617.6 | 936.4 | -0.1 | -7.9 |

NOTE: *Service Module total indicated is as referenced in the Downey Actual Weight and Balance Report, SID 63-143-14, dated 16 March 1965.

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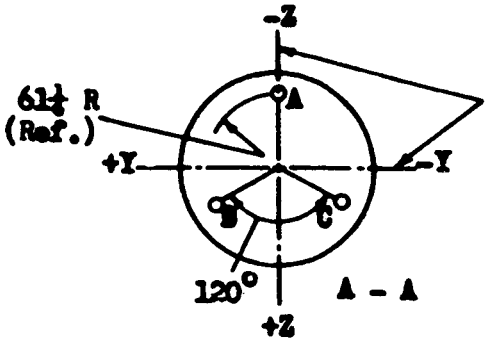
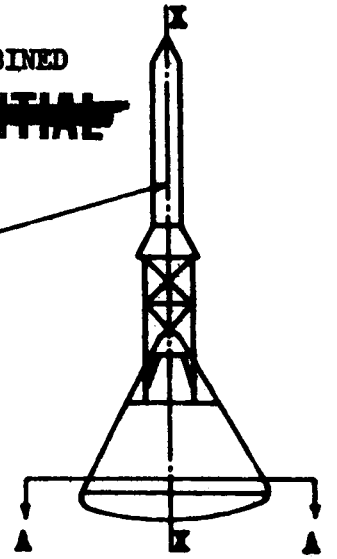
WEIGHT AND BALANCE DATA SHEET

LAUNCH ESCAPE SYSTEM-COMMAND MODULE COMBINED

PRE-TVA ~~CONFIDENTIAL~~




Vehicle No. BP 22

Recorded By J. F. Kessler/K. L. Beets

Location VAB - WSMR

Date Performed 4-7-65

REACTION POINT A (COMPRESSION)

| DETERMINATION NUMBER | LOAD CELL | GROSS READING | ZERO READING | CORRECTED READING | AVERAGE READING |
|---|---|---|---|---|---|
| 1 | Red | 22051 | -493 | 21558 | |
| 2 | S/N 34215 | 22054 | -498 | 21556 | |
| 3 | | 22054 | -499 | 21555 | |
| | | | | | 21556.3 |
| | | | | | |

REACTION POINT B (COMPRESSION)

| DETERMINATION NUMBER | LOAD CELL | GROSS READING | ZERO READING | CORRECTED READING | AVERAGE READING |
|---|---|---|---|---|---|
| 1 | Yellow | 26004 | -498 | 25506 | |
| 2 | S/N 34210 | 25999 | -498 | 25501 | |
| 3 | | 26000 | -499 | 25501 | |
| | | | | | 25502.7 |
| | | | | | |

REACTION POINT C (COMPRESSION)

| DETERMINATION NUMBER | LOAD CELL | GROSS READING | ZERO READING | CORRECTED READING | AVERAGE READING |
|---|---|---|---|---|---|
| 1 | Blue | 25495 | -501 | 24994 | |
| 2 | S/N 34214 | 25504 | -500 | 25004 | |
| 3 | | 25500 | -500 | 25000 | |
| | | | | | 24999.3 |
| | | | | | |

VERIFIED BY: Shiller NASA

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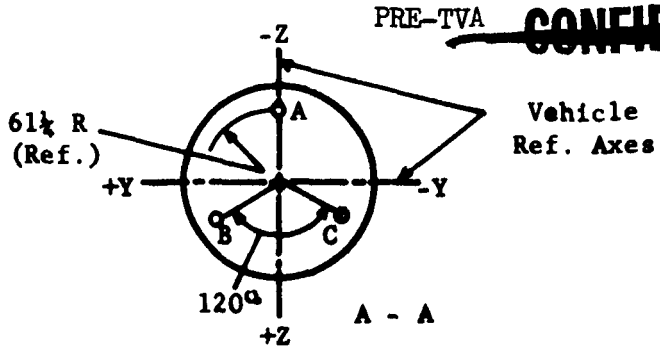
SID 63-143-14W

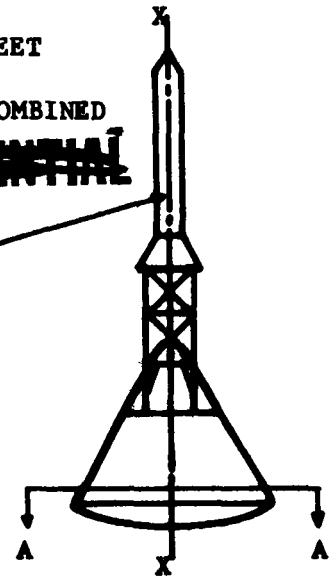
MX9970-10-12

WEIGHT AND BALANCE CALCULATION SHEET

LAUNCH ESCAPE SYSTEM-COMMAND MODULE COMBINED

PRE-TVA ~~CONFIDENTIAL~~




Vehicle No. BP 22 Recorded By J. F. Kessler

Location VAB - WSMR Date Performed 4-7-65

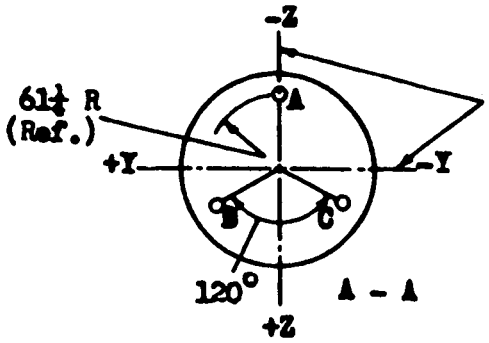
| WEIGHT DERIVATION | | | | | | |
|---|---|---|---|---|---|---|
| REACT POINT | LOAD CELL | AVERAGE READING | INDICATED WEIGHT | BUOYANCY CORRECTION | GRAVITY CORRECTION | WEIGHT |
| A | Red | 21556.3 | 5449.3 | -0.82 | - | 5448.48 |
| B | Yellow | 25502.7 | 6450.9 | -0.97 | - | 6449.93 |
| C | Blue | 24999.3 | 6321.6 | -0.95 | - | 6320.65 |

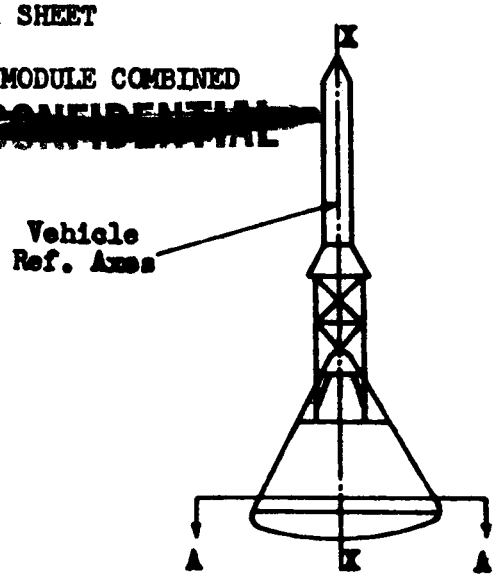
| WEIGHT AND Y - Z CENTER OF GRAVITY | | | | | | |
|---|---|---|---|---|---|---|
| DESCRIPTION | REACT POINT | WEIGHT | Y STA | Y MOMENT | Z STA | Z MOMENT |
| Cell Location | A | 5448.5 | 0.0 | - | -61.22 | -333557 |
| Cell Location | B | 6449.9 | 53.02 | 341974 | 30.66 | 197754 |
| Cell Location | C | 6320.7 | -53.00 | -334997 | 30.62 | 193540 |
| GROSS (as weighed) | | 18219.1 | 0.38 | 6977 | 3.17 | 57737 |
| Less: H14-017 Ring | | -470.4 | 0.62 | -292 | -0.50 | 235 |
| (4) Nozzle Covers | | -3.8 | 0.0 | - | 0.0 | - |
| (43) Press. Xducer Covers & | | | | | | |
| Ground Clamp | | -3.0 | 0.0 | - | 0.0 | - |
| "Q" Ball Cover | | -0.3 | 0.0 | - | 0.0 | - |
| Plus: Air Buoyancy Correction | | +10.2 | 0.39 | 4 | 3.62 | 37 |
| | | | | | | |
| NET (as weighed) | | 17751.8 | 0.38 | 6689 | 3.27 | 58009 |
| Plus: Shortages (Page 45) | | +449.1 | -1.66 | -746 | -3.93 | -1765 |
| CORRECTED WEIGHT AND CG (Y-Z) | | 18200.9 | 0.33 | 5943 | 3.09 | 56244 |

WEIGHT AND BALANCE DATA SHEET

LAUNCH ESCAPE SYSTEM-COMMAND MODULE COMBINED

POST-TVA [redacted]




Vehicle No. BP 22 Recorded By J. F. Kessler/K. L. Beets

Location VAB - WSMR Date Performed 4-7-65

REACTION POINT A (COMPRESSION)

| DETERMINATION NUMBER | LOAD CELL | GROSS READING | ZERO READING | CORRECTED READING | AVERAGE READING |
|---|---|---|---|---|---|
| 1 | Red | 21609 | -498 | 21111 | |
| 2 | S/N 34215 | 21601 | -496 | 21105 | |
| 3 | | 21586 | -498 | 21088 | |
| | | | | | 21101.3 |
| | | | | | |

REACTION POINT B (COMPRESSION)

| DETERMINATION NUMBER | LOAD CELL | GROSS READING | ZERO READING | CORRECTED READING | AVERAGE READING |
|---|---|---|---|---|---|
| 1 | Yellow | 26180 | -500 | 25680 | |
| 2 | S/N 34210 | 26203 | -500 | 25703 | |
| 3 | | 26193 | -497 | 25696 | |
| | | | | | 25693.0 |
| | | | | | |

REACTION POINT C (COMPRESSION)

| DETERMINATION NUMBER | LOAD CELL | GROSS READING | ZERO READING | CORRECTED READING | AVERAGE READING |
|---|---|---|---|---|---|
| 1 | Blue | 25946 | -499 | 25447 | |
| 2 | S/N 34214 | 25934 | -499 | 25435 | |
| 3 | | 25951 | -498 | 25453 | |
| | | | | | 25445.0 |
| | | | | | |

VERIFIED BY: Hmiller NASA [redacted]



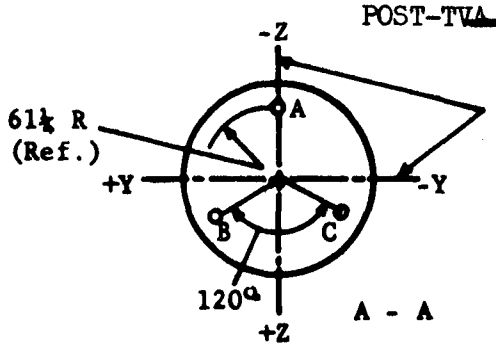
SID 63-143-14W

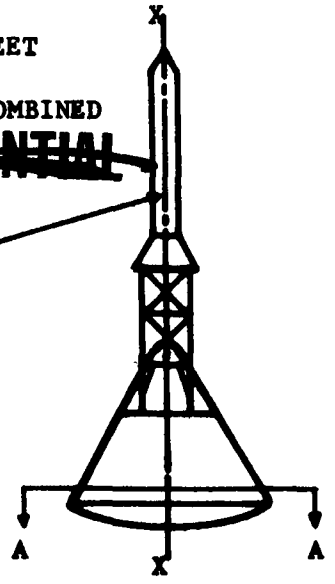
MX9970-1[illegible]-12

WEIGHT AND BALANCE CALCULATION SHEET

LAUNCH ESCAPE SYSTEM-COMMAND MODULE COMBINED

POST-TVA ~~CONFIDENTIAL~~




Vehicle No. BP 22 Recorded By J. F. Kessler

Location VAB - WSMR Date Performed 4-8-65

| WEIGHT DERIVATION | | | | | | |
|---|---|---|---|---|---|---|
| REACT POINT | LOAD CELL | AVERAGE READING | INDICATED WEIGHT | BUOYANCY CORRECTION | GRAVITY CORRECTION | WEIGHT |
| A | Red | 21101.3 | 5333.9 | -0.80 | - | 5333.10 |
| B | Yellow | 25693.0 | 6499.2 | -0.97 | - | 6498.23 |
| C | Blue | 25445.0 | 6434.6 | -0.97 | - | 6433.63 |

| WEIGHT AND Y - Z CENTER OF GRAVITY | | | | | | |
|---|---|---|---|---|---|---|
| DESCRIPTION | REACT POINT | WEIGHT | Y STA | Y MOMENT | Z STA | Z MOMENT |
| Cell Location | A | 5333.1 | 0.0 | - | -61.22 | -326492 |
| Cell Location | B | 6498.2 | 53.02 | 344535 | 30.66 | 199235 |
| Cell Location | C | 6433.6 | -53.00 | -340981 | 30.62 | 196997 |
| GROSS (as weighed) | | 18264.9 | 0.19 | 3554 | 3.82 | 69740 |
| Less: H14-017 Ring | | -470.4 | 0.62 | -292 | -0.50 | 235 |
| (4) Nozzle Covers | | -3.8 | 0.0 | - | 0.0 | - |
| (43) Press. Xducer Covers & Ground Clamps | | -3.0 | 0.0 | - | 0.0 | - |
| A14-007 Alignment Grid | | -23.3 | 0.0 | - | 3.00 | -70 |
| A14-007 Projector & Mount | | -25.2 | 0.0 | - | 0.90 | -23 |
| "Q" Ball Cover | | -0.3 | 0.0 | - | 0.0 | - |
| Plus: Air Buoyancy Correction | | +10.2 | 0.39 | 4 | 3.62 | 37 |
| NET (as weighed) | | 17749.1 | 0.18 | 3266 | 3.94 | 69919 |
| Plus: Shortages (Page 45) | | +449.1 | -1.66 | -746 | -3.93 | -1765 |
| CORRECTED WEIGHT AND CG (Y-Z) | | 18198.2 | 0.14 | 2520 | 3.75 | 68154 |



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CORRECTIONS TO ACTUAL WEIGHT AND BALANCE

THRUST VECTOR ALIGNMENT

LAUNCH ESCAPE SYSTEM - COMMAND MODULE

BOILERPLATE NO. 22

| ITEM | ± | WEIGHT | CENTER OF GRAVITY | |
|---|---|---|---|---|
| | | | Ya | Za |
| LES - Camera Installation | + | 26.9 | -3.7 | 6.7 |
| LES - Camera Support | + | 6.5 | 0.0 | 0.4 |
| LES - Ordnance Installation | + | 0.6 | 0.0 | -1.9 |
| LES - Pressure Transducer | + | 0.5 | 0.0 | 0.0 |
| LES - Canard Ordnance Installation | + | 1.5 | 0.0 | 0.8 |
| LES - Aft Boost Cover - "Soft" | + | 350.8 | -1.8 | -4.5 |
| LES - Fwd Boost Cover Doors - "Hard" | + | 15.5 | 0.0 | 0.0 |
| CM - Main Battery Electrolite | + | 7.9 | 40.6 | -13.4 |
| CM - Pyro Battery Electrolite | + | 1.7 | 46.2 | -9.3 |
| CM - Camera, Lens & Mount | + | 15.0 | -0.8 | 0.0 |
| CM - Camera Generator | + | 2.3 | -32.1 | -20.3 |
| CM - Camera Control Box | + | 6.2 | -27.1 | -30.3 |
| CM - Camera Cables | + | 2.7 | -15.5 | -21.4 |
| CM - Apex Cover Nose Probe | + | 1.9 | 0.0 | 0.0 |
| CM - Jack Pad Plugs & Patching | + | 5.3 | 0.0 | 0.0 |
| CM - Apex Cover Thruster Att. Ftg's. | + | 0.8 | 0.0 | 0.0 |
| CM - System #2 Recorder Tape | + | 3.0 | -39.0 | 16.0 |
| TOTAL TVA CORRECTIONS | + | 449.1 | -1.66 | -3.93 |

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# SECTION V

# WEIGHT BREAKDOWN SUMMARY

[redacted]

## WEIGHT BREAKDOWN SUMMARY
## LAUNCH ESCAPE SYSTEM
## BOILERPLATE NO. 22

| ITEM | WEIGHT |
|---|---|
| BASIC STRUCTURE | (1594) |
| Tower Assy. (Less Insulation) | 301 |
| Escape Motor Skirt | 209 |
| Canard | 875 |
| Tower Insulation | 192 |
| Attaching Parts | 17 |
| EXPLOSIVE BOLTS | (5) |
| PROPULSION | (5366) |
| Escape Motor (Live) | 4787 |
| Pitch Control Motor (Live) | 49 |
| Jettison Motor & Interstage (Live) | 530 |
| ELECTRICAL | (93) |
| INSTRUMENTATION | (85) |
| BALLAST INSTALLATION | (454) |
| Ballast Plates | 425 |
| Ballast Studs & Nuts | 26 |
| Ballast Retaining Plate | 3 |
| BOOST COVER | (621) |
| Forward Section - "Hard" (Including Instrumentation) | 270 |
| Aft Section - "Soft" | 351 |
| MANUFACTURING VARIATION | (-27) |
| TOTAL LAUNCH ESCAPE SYSTEM | 8191 |

[redacted]

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## WEIGHT BREAKDOWN SUMMARY

## COMMAND MODULE

## BOILERPLATE NO. 22

| ITEM | WEIGHT |
|---|---|
| BASIC STRUCTURE | (5378) |
| Structure - Less Ablator | 5147 |
| Ablator | 231 |
| SECONDARY STRUCTURE | (2711) |
| Internal Ballast | 1652 |
| Apex Cover Ballast | 62 |
| Aft Heat Shield Ballast | 577 |
| Equipment Racks and Supports | 312 |
| Coldplates | 88 |
| Tension Ties (Partial) | 20 |
| STABILIZATION AND CONTROL | (60) |
| ENVIRONMENTAL CONTROL | (103) |
| EARTH LANDING SYSTEM | (657) |
| INSTRUMENTATION | (331) |
| ELECTRICAL POWER SYSTEM | (435) |
| COMMUNICATIONS | (322) |
| MANUFACTURING VARIATION | (16) |
| TOTAL COMMAND MODULE | 10013 |

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WEIGHT BREAKDOWN SUMMARY

SERVICE MODULE

BOILERPLATE NO. 22

| ITEM | WEIGHT |
|---|---|
| BASIC STRUCTURE | (7952) |
| SECONDARY STRUCTURE | (1121) |
| Internal Ballast | 1110 |
| Tension Ties (Partial) | 11 |
| INSTRUMENTATION | (318) |
| ELECTRICAL POWER SUPPLY | (19) |
| REACTION CONTROL (DUMMY) | (242) |
| MANUFACTURING VARIATION | (-34) |
| TOTAL SERVICE MODULE | 9618 |

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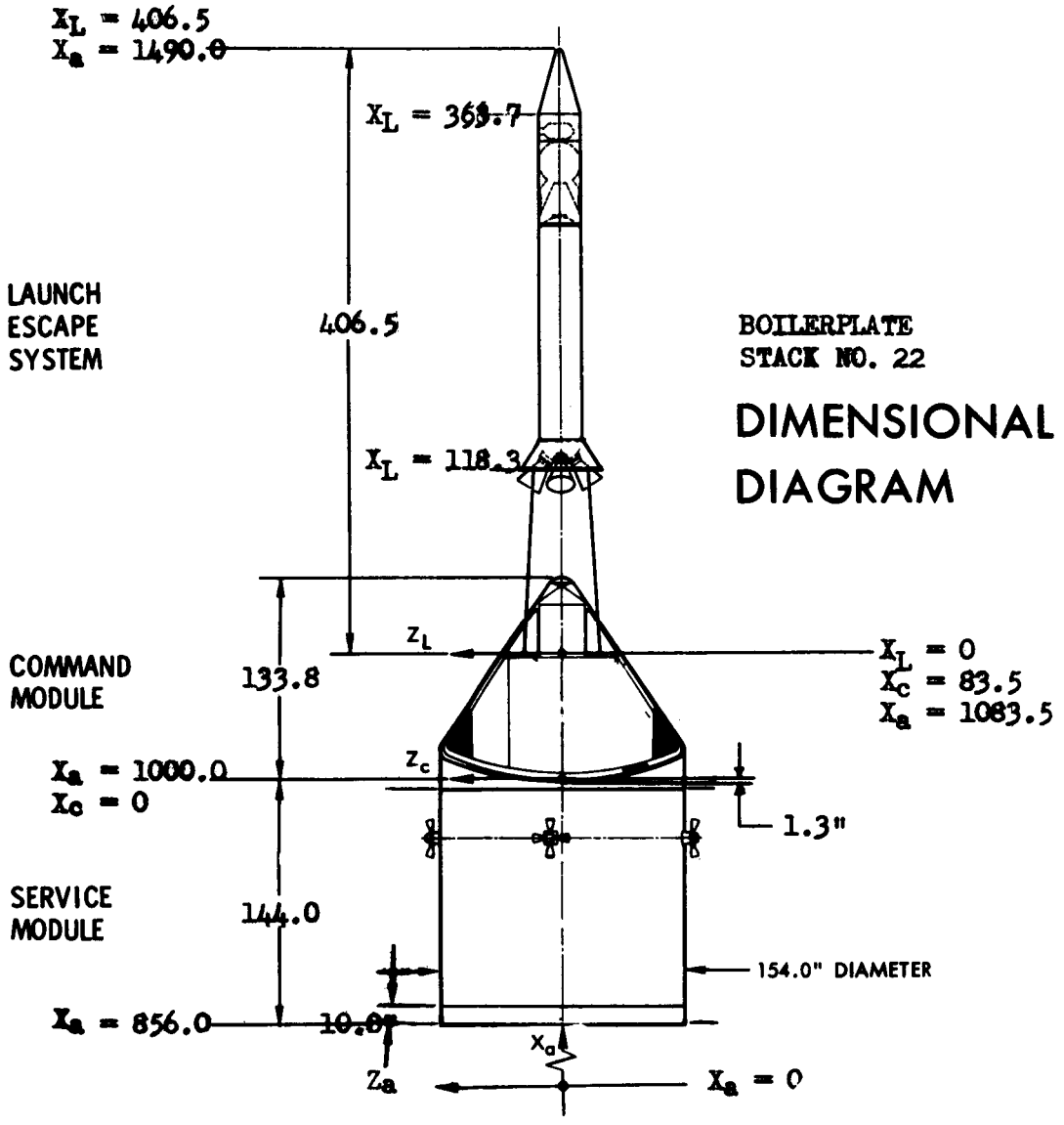
# SECTION VI

# DIMENSIONAL DIAGRAM

[redacted]




BOILERPLATE STACK NO. 22

# DIMENSIONAL DIAGRAM



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