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MASS PROPERTIES DATA - BLOCK II CONTROL WEIGHTS FOR THE APOLLO SPACECRAFT

CONTRACT NAS 9-150

(U)

15 FEBRUARY 1965

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Prepared by:

WEIGHT CONTROL

GROUP 4 Downgraded at 3 year intervals; declassified after 12 years

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TECHNICAL REPORT INDEX ABSTRACT

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DESCRIPTIVE TERMS

*Mass Properties Data, *Control Weights, *Apollo Spacecraft

ABSTRACT

The weights, centers of gravity, moments, products of inertia and weight distributions for various modules and spacecraft configuration are included.

[redacted]

FORM 131-V REV. 6-64

TABLE OF CONTENTS

		PAGE
SECTION I	INTRODUCTION	
	TABLE OF CONTENTS	1
	INTRODUCTION	3
SECTION II	WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARIES	
	MODULE MASS PROPERTIES SUMMARY	4
	MAXIMUM WEIGHT	
	SPACECRAFT LAUNCH CONDITION	5
	SPACECRAFT FLIGHT CONDITION	6
	SATURN IB CAPABILITY - EARTH ORBIT	
	SPACECRAFT LAUNCH CONDITION	7
	SPACECRAFT FLIGHT CONDITION	8
	SATURN V CAPABILITY - LUNAR LANDING	9
	LAUNCH ESCAPE VEHICLE	10
	LOW ALTITUDE ABORT CONFIGURATION	11
	ENTRY CONFIGURATION - LUNAR MISSION	12
	SATURN LEM ADAPTER PANEL DEPLOYMENT	13
SECTION III	SPACECRAFT SUMMARY WEIGHT STATEMENTS	
	LAUNCH ESCAPE SYSTEM	14
	COMMAND MODULE	15
	SERVICE MODULE	16
	ADAPTER	17
	GOVERNMENT FURNISHED EQUIPMENT	18
	LUNAR EXCURSION MODULE	19
SECTION IV	SPACECRAFT WEIGHT DISTRIBUTION	
	LAUNCH ESCAPE SYSTEM	20
	COMMAND MODULE	21
	SERVICE MODULE	22
	SERVICE MODULE PROPELLANT - 41210 POUNDS	23
	SERVICE MODULE PROPELLANT - 20655 POUNDS	24
	ADAPTER - SATURN LEM	25
SECTION V	MISSION TIME MASS PROPERTIES	
	SPACECRAFT	26

		PAGE
SECTION VI	SPACECRAFT WEIGHT VERSUS CENTER OF GRAVITY AND INERTIA	
	A. CSM - MAXIMUM SPS PROPELLANT (INCLUDES ENGINE GIMBAL ANGLES)	27-38
	B. LAUNCH ESCAPE VEHICLE	39-48
	C. LES - TOWER JETTISON	49-58
SECTION VII	ALTERNATE DESIGN CONFIGURATIONS	
	A. COMMAND MODULE - RECOVERY	59-60
	B. COMMAND MODULE - FLOTATION	61-62
	C. CSM WITH DOCKED LEM - TRANSLUNAR AND RENDEZVOUS	63-64
	D. S-IVB, LEM AND ADAPTER AT TRANSPOSITION DOCKING	65

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INTRODUCTION

The mass properties data presented in this report are for the Block II control weights as defined in SID 64-1344 Master Performance Specification.

The Control weights are:

Launch Escape System	8200 pounds
Command Module	11000 pounds
Service Module	10200 pounds
Saturn LEM Adapter	3800 pounds

The inflight separation of the CSM from the adapter leaves the attaching ring on the base of the Service Module. This 75 pound increase to the burnout weight has been included in the Spacecraft Mass Properties Summaries titled flight conditions and the docking summaries. The ring is shown on the adapter weight distribution.

The Mass Properties Summary for the Saturn IB reports an adapter 100 pounds heavier than the control weight, this increase provides for the stabilization provisions.

The Lunar Excursion Module for transposition and rendezvous docking configuration does not include the anticipated roll maneuver necessary to provide visual clearance. This data will be incorporated when the degree of roll is finalized.

The data in this report will be revised when changes occur to the individual module control weights.

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BLOCK II

MODULE MASS PROPERTIES SUMMARY

ITEM	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**			PRODUCTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
LAUNCH ESCAPE SYSTEM	8200	1300.5	0.0	0.0	528.6	21137.9	21138.6	17.9	69.5	-0.2
COMMAND MODULE	11000	1043.3	-0.2	6.3	4949.9	4364.8	4057.6	15.2	-278.7	30.5
SERVICE MODULE	10200	915.4	-4.3	7.5	7103.9	10850.9	10814.5	-421.7	387.7	-633.9
S/M PROPELLANT (MAXIMUM)	41210	906.0	0.1	0.0	21516.0	21036.0	28486.5	255.4	-111.8	3987.9
ADAPTER RING	75	837.1	0.0	-1.8	93.3	47.6	45.7	0.0	0.2	0.0
ADAPTER AFT SECTION	1320	544.0	0.0	-1.3	4288.5	2445.0	2404.8	0.3	-3.9	-0.9
ADAPTER FWD SECTION	2405	697.9	1.1	-3.0	5048.6	5762.6	5505.5	-25.5	-21.9	-9.3
SATURN/LEM ADAPTER	3800	647.2	0.7	-2.4	9431.2	13209.3	12909.8	3.9	-72.5	-10.6
LUNAR EXCURSION MODULE	29500	588.5	0.0	0.0	19409.0	21485.0	21219.0	0.0	0.0	0.0

NOTE: *Centers of gravity are given in the Apollo Vehicle Reference System as defined by MD-V14-14-10.

**Moments and products of inertia units are slug feet squared about the centers of gravity.

BLOCK II

SPACECRAFT MASS PROPERTIES SUMMARY

MAXIMUM WEIGHT LAUNCH CONDITION

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENT OF INERTIA**			PRODUCTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
COMMAND MODULE	11000	1043.3	-0.2	6.3	4949.9	4364.8	4057.6	15.2	-278.7	30.5
SERVICE MODULE	10200	915.4	-4.3	7.5	7103.9	10850.9	10814.5	-421.7	387.7	-633.9
TOTAL	21200	981.8	-2.2	6.9	12074.7	33904.3	33578.6	192.5	-66.3	-609.0
S/M PROPELLANT (MAX)	41210	906.0	0.1	0.0	21516.0	21036.0	28486.5	255.4	-111.8	3987.9
TOTAL	62410	931.7	-0.7	2.3	33749.3	72426.8	79424.8	-72.3	1396.2	3331.7
SATURN/LEM ADAPTER	3800	647.2	0.7	-2.4	9431.2	13209.3	12909.8	3.9	-72.5	-10.6
TOTAL	66210	915.4	-0.6	2.1	43199.1	148246.2	154929.3	-370.2	2365.6	3316.0
LUNAR EXCURSION MODULE	29500	588.5	0.0	0.0	19409.0	21485.0	21219.0	0.0	0.0	0.0
TOTAL - INJECTED	95710	814.6	-0.4	1.4	62628.4	640478.4	646878.4	-1224.5	5338.2	3310.6
LAUNCH ESCAPE SYSTEM	8200	1300.5	0.0	0.0	528.6	21137.9	21138.6	17.9	69.5	-0.2
TOTAL - LAUNCH	103910	853.0	-0.4	1.3	63161.0	1046444.9	1052842.8	-881.5	4276.5	3309.5

NOTE: *Centers of gravity are given in the Apollo Vehicle Reference System as defined by MD-V14-14-10.

**Moments and products of inertia units are slug feet squared about the centers of gravity.

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BLOCK II

SPACECRAFT MASS PROPERTIES SUMMARY

MAXIMUM WEIGHT FLIGHT CONDITION

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENT OF INERTIA**			PRODUCTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
COMMAND MODULE	11000	1043.3	-0.2	6.3	4949.9	4364.8	4057.6	15.2	-278.7	30.5
SERVICE MODULE	10200	915.4	-4.3	7.5	7103.9	10850.9	10814.5	-421.7	387.7	-633.9
ADAPTER RING	75	837.1	0.0	-1.8	93.3	47.6	45.7	0.0	0.2	0.0
TOTAL	21275	981.3	-2.2	6.8	12169.3	34290.7	33962.0	187.5	-45.9	-609.3
S/M PROPELLANT (MAX)	41210	906.0	0.1	0.0	21516.0	21036.0	28486.5	255.4	-111.8	3987.9
TOTAL	62485	931.6	-0.7	2.3	33842.8	72619.5	79615.3	-73.3	1402.8	3331.6
LEM DOCKED	29500	1232.5	0.0	0.0	19409.0	21485.0	21219.0	0.0	0.0	0.0
TOTAL S/C - FLIGHT	91985	1028.1	-0.5	1.6	53277.3	485687.9	492396.3	800.1	-1631.1	3324.8

NOTE: *Centers of gravity are given in the Apollo Vehicle Reference System as defined by MD-V14-14-10.

**Moments and products of inertia units are slug feet squared about the centers of gravity.

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BLOCK II

SPACECRAFT MASS PROPERTIES SUMMARY

SATURN IB CAPABILITY - EARTH ORBIT

LAUNCH CONDITION

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENT OF INERTIA**			PRODUCTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
COMMAND MODULE	11000	1043.3	-0.2	6.3	4949.9	4364.8	4057.6	15.2	-278.7	30.5
SERVICE MODULE	10200	915.4	-4.3	7.5	7103.9	10850.9	10814.5	-421.7	387.7	-633.9
TOTAL	21200	981.8	-2.2	6.9	12074.7	33904.3	33578.6	192.5	-66.3	-609.0
S/M PROPELLANT (SIB)	7400	865.1	27.3	-11.5	2463.6	1584.5	1947.2	6.1	5.3	1218.4
TOTAL	28600	951.6	5.5	2.1	15966.6	52002.8	52668.4	-3872.3	2477.4	-31.9
SATURN/LEM ADAPTER	3900	645.4	0.7	-2.4	9565.1	13376.9	13077.8	4.9	-76.0	-10.6
TOTAL - INJECTED***	32500	914.8	4.9	1.6	25563.3	134826.3	135195.0	-2785.3	3413.0	-26.8
LAUNCH ESCAPE SYSTEM	8200	1300.5	0.0	0.0	528.6	21137.9	21138.6	17.9	69.5	-0.2
TOTAL - LAUNCH	40700	992.5	3.9	1.3	26129.5	366176.7	366576.5	-5427.7	2617.5	-16.0

NOTES: *Centers of gravity are given in the Apollo Vehicle Reference System as defined by MD-V14-14-10.

**Moments and products of inertia units are slug feet squared about the centers of gravity.

***The weight injected is based on a 32500 pound in orbit payload capability.

BLOCK II

SPACECRAFT MASS PROPERTIES SUMMARY

SATURN IB CAPABILITY - EARTH ORBIT

FLIGHT CONDITION

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**			PRODUCTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
COMMAND MODULE	11000	1043.3	-0.2	6.3	4949.9	4364.8	4057.6	15.2	-278.7	30.5
SERVICE MODULE	10200	915.4	-4.3	7.5	7103.9	10850.9	10814.5	-421.7	387.7	-633.9
ADAPTER RING	75	837.1	0.0	-1.8	93.3	47.6	45.7	0.0	0.2	0.0
TOTAL	21275	981.3	-2.2	6.8	12169.3	34290.7	33962.0	187.5	-45.9	-609.3
S/M PROPELLANT (SIB)	7400	865.1	27.3	-11.5	2463.6	1584.5	1947.2	6.1	5.3	1218.4
TOTAL S/C - FLIGHT	28675	951.3	5.4	2.1	16060.7	52262.2	52926.2	-3862.2	2484.8	-31.5

NOTE: *Centers of gravity are given in the Apollo Vehicle Reference System as defined by MD-V14-14-10.

**Moments and products of inertia units are slug feet squared about the centers of gravity.

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BLOCK II

SPACECRAFT MASS PROPERTIES SUMMARY

SATURN V CAPABILITY - LUNAR LANDING SA506 AND SUBS

LAUNCH CONDITION

(REF: R-P & VE-VAW-64-139 DATED 27 NOV. 1964)

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENT OF INERTIA**			PRODUCTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
COMMAND MODULE	11000	1043.3	-0.2	6.3	4949.9	4364.8	4057.6	15.2	-278.7	30.5
SERVICE MODULE	10200	915.4	-4.3	7.5	7103.9	10850.9	10814.5	-421.7	387.7	-633.9
TOTAL	21200	981.8	-2.2	6.9	12074.7	33904.3	33578.6	192.5	-66.3	-609.0
S/M PROPELLANT	39500	903.5	1.3	-0.5	20607.3	19362.9	26493.1	860.2	-382.6	3828.1
TOTAL	60700	930.8	0.1	2.1	32879.7	71668.2	78346.4	243.4	1270.3	3142.8
SATURN/LEM ADAPTER	3800	647.2	0.7	-2.4	9431.2	13209.3	12909.8	3.9	-72.5	-10.6
TOTAL	64500	914.1	0.1	1.8	42329.5	146989.2	153353.2	113.2	2177.9	3130.1
LUNAR EXCURSION MODULE	29500	588.5	0.0	0.0	19409.0	21485.0	21219.0	0.0	0.0	0.0
TOTAL - INJECTED	94000	811.9	0.1	1.2	61749.9	631747.7	637831.4	288.5	4757.0	3131.1
LAUNCH ESCAPE SYSTEM	8200	1300.5	0.0	0.0	528.6	21137.9	21138.6	17.9	69.5	-0.2
TOTAL - LAUNCH	102200	851.1	0.1	1.1	62281.4	1041464.3	1047546.5	239.2	3837.2	3131.0

NOTES: *Centers of gravity are given in the Apollo Vehicle Reference System as defined by MD-V14-14-10.

**Moments and products of inertia units are slug feet squared about the centers of gravity.

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BLOCK II

SPACECRAFT MASS PROPERTIES SUMMARY

LAUNCH ESCAPE VEHICLE

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENT OF INERTIA**			PRODUCTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
COMMAND MODULE	11000	1043.3	-0.2	6.3	4949.9	4364.8	4057.6	15.2	-278.7	30.5
LAUNCH ESCAPE SYSTEM	8200	1300.5	0.0	0.0	528.6	21137.9	21138.6	17.9	69.5	-0.2
TOTAL - LAUNCH ABORT	19200	1153.1	-0.1	3.6	5519.2	92621.8	92275.4	85.3	-1852.3	29.0
LESS: MAIN & PITCH MOTOR PROPELLANT	-3198	1294.3	0.0	0.0	-71.4	-1284.8	-1284.8	0.0	0.0	0.0
TOTAL - LES BURNOUT	16002	1124.9	-0.1	4.3	5579.4	77394.2	77058.6	71.9	-1430.3	29.4

NOTES: *Centers of gravity are given in the Apollo Vehicle Reference System as defined by MD-V14-14-10.

**Moments and products of inertia units are slug feet squared about the centers of gravity.

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BLOCK II

COMMAND MODULE MASS PROPERTIES SUMMARY

LOW ALTITUDE ABORT CONFIGURATION

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**			PRODUCTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
COMMAND MODULE - LAUNCH	11000.0	1043.3	-0.2	6.3	4949.9	4364.8	4057.6	15.2	-278.7	30.5
Less: RCS Oxidizer	-190.0	1022.6	14.5	62.7						
Forward Heat Shield	-305.8	1090.0	0.0	1.0						
Docking	-150.0	1110.0	0.0	0.0						
Drogue Chutes	-56.2	1089.1	0.0	-21.0						
C/M - PRIOR TO MAIN CHUTE DEPLOYMENT	10308.0	1041.1	-0.5	5.7	4736.6	3847.7	3660.9	24.5	-191.2	-0.4
Less: RCS Fuel	-90.0	1022.6	-45.8	45.8						
Main Chutes (3)	-435.0	1090.4	-1.2	7.5						
C/M - LANDING	9783.0	1039.0	0.0	5.3	4609.9	3550.0	3334.9	13.6	-187.0	34.4

NOTES: *Centers of gravity are given in the Apollo Vehicle Reference System as defined by MD-V14-14-10.

**Moments and products of inertia units are slug feet squared about the centers of gravity.

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BLOCK II

COMMAND MODULE MASS PROPERTIES SUMMARY

ENTRY CONFIGURATION - LUNAR MISSION

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**			PRODUCTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
COMMAND MODULE - LAUNCH	11000.0	1043.3	-0.2	6.3	4949.9	4364.8	4057.6	15.2	-278.7	30.5
Less: Boost & Mission										
Water	-8.0	1022.6	-63.4	-16.4						
Food	-41.9	1049.8	-4.9	40.0						
Docking	-150.0	1110.0	0.0	0.0						
Add: Waste Fecal	13.6	1039.0	47.0	12.0						
CO_2 Absorbed	39.1	1016.6	-4.2	27.5						
Potable Water	30.0	1022.6	-63.4	-16.4						
Waste Water	56.0	1022.5	-21.1	61.8						
C/M - PRIOR TO ENTRY	10938.8	1042.1	-0.4	6.6	5005.4	4258.8	3946.5	25.8	-283.0	25.3
Less: RCS Propellant	-135.0	1022.6	-5.6	57.0						
Ablator Burnoff	-365.0	1016.2	-0.4	15.7						
Entry Coolant	-6.0	1022.6	-63.4	-16.4						
Forward Heat Shield	-305.8	1090.0	0.0	1.0						
Drogue Chutes	-56.2	1089.1	0.0	-21.0						
C/M - PRIOR TO MAIN CHUTE DEPLOYMENT	10070.8	1041.6	-0.3	5.9	4571.0	3687.3	3447.7	19.9	-203.6	31.5
Less: Main Chutes (3)	-435.0	1090.4	-1.2	7.5						
RCS Propellant	-135.0	1022.6	-5.6	57.0						
C/M - LANDING	9500.8	1039.6	-0.2	5.1	4412.4	3344.6	3139.0	21.6	-185.8	39.8

NOTES: *Centers of gravity are given in the Apollo Vehicle Reference System as defined by MD-V14-14-10.

**Moments and products of inertia units are slug feet squared about the centers of gravity.

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BLOCK II

SUMMARY

SATURN LEM ADAPTER

PANEL DEPLOYMENT

ITEM	WEIGHT	CENTERS OF GRAVITY**			MOMENTS OF INERTIA***			PRODUCTS OF INERTIA***		
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
ADAPTER PANEL - OPEN	658.7	471.3	-2.6	-148.7	302.2	884.1	1114.2	5.6	34.0	6.6
ADAPTER PANEL - OPEN	590.4	474.4	2.5	149.2	295.4	778.6	1007.7	-3.7	-31.3	6.2
ADAPTER PANEL - OPEN	588.4	470.9	150.6	-3.7	300.4	1048.8	809.0	-27.2	-7.3	-5.3
ADAPTER PANEL - OPEN	555.5	469.5	-150.6	2.6	293.0	972.2	739.9	25.6	-2.5	-5.7
TOTAL ADAPTER PANELS*	2393.0	471.5	2.0	-4.4	12761.6	9657.3	9271.0	25.9	52.0	-8.9
ADAPTER AFT SECTION	1320.0	544.0	0.0	-1.3	4288.5	2445.0	2404.8	0.3	-3.9	-0.9
TOTAL LEM ADAPTER WITH DEPLOYED PANELS	3713.0	497.3	1.3	-3.3	17052.6	13068.0	12640.4	-0.1	89.7	-10.9

NOTES: *Adapter panels are opened to a position 170 degrees from the X axis.

**Centers of gravity are given in the Apollo vehicle reference system as defined by MD-V14-14-10.

***Moments and products of inertia units are slug feet squared about the centers of gravity.

CONTROL WEIGHT STATEMENT

LAUNCH ESCAPE SYSTEM

SUMMARY

	BLOCK II
LAUNCH ESCAPE SYSTEM	
Structure	(1537)
Tower	295
Escape Motor Skirt	208
Canard	871
Attaching Parts	17
Tower Insulation	111
Skirt Insulation	10
Q-Ball - GFE	25
Separation Provisions	(16)
Ballast Provisions	(690)
Ballast Plates	661
Ballast Instl. Prov.	29
Propulsion	(5369)
Escape Motor	4794
Jettison Motor	434
Jettison Motor Skirt	92
Pitch Control Motor	49
Electrical Power	(53)
C/M Boost Protection Cover	(535)
TOTAL LAUNCH ESCAPE SYSTEM	8200

CONTROL WEIGHT STATEMENT

COMMAND MODULE

SUMMARY

		BLOCK II
WEIGHT EMPTY (SUBSYSTEMS)		(9578)
Structure		5369
Structure & Mechanical	3945	
Heat Shield Ablator	1177	
Earth Impact & Flotation	247	
Stabilization & Control		156
Guidance & Navigation (GFE)		400
Crew Equipment		333
Environmental Control		386
Earth Recovery		671
Instrumentation - Operational		115
Electrical Power		1218
Wiring & Connectors	572	
Electrical Power Equipment	499	
Automated Sequencer Control	147	
Reaction Control		341
Communications		305
Displays & Controls		284
USEFUL LOAD		(1422)
Scientific Equipment		80
Crew & Equipment (Includes 899 lbs GFE)		960
Reaction Control Propellant		270
Environmental Control (Includes 13.5 lbs. cooling water)		112
TOTAL COMMAND MODULE		11000

CONTROL WEIGHT STATEMENT

SERVICE MODULE

SUMMARY

		BLOCK II
WEIGHT EMPTY (SUBSYSTEMS)		(8104)
Structure		2514
Environmental Control		133
Instrumentation		38
Electrical Power		1674
Electrical Power Equipment	1370	
Wiring & Connectors	271	
Automated Sequence Control	33	
Service Propulsion		2930
Reaction Control		588
Communications & Rendezvous Radar		227
USEFUL LOAD		(2096)
Reaction Control Propellants		838
Electrical Power Reactants		503
Environmental Control Oxygen		150
Service Propulsion Residuals		605
TOTAL SERVICE MODULE		10200

CONTROL WEIGHT STATEMENT

ADAPTER

SUMMARY

	BLOCK II
ADAPTER	
Structure	(3165)
Basic Body Structure	
Honeycomb Panels	2495
Longerons	60
Frames & Rings	340
Access Doors	50
Fittings & Attaching Parts	80
Secondary Structure	
LEM Supports	50
SLA-LEM Umbilical	10
Miscellaneous	80
Insulation	(20)
Separation Provisions & Attach	(330)
Electrical Provisions	(70)
Growth Allowance	(215)
TOTAL ADAPTER	3800

The Control Weight for the SLA Adapter is 3800 pounds. The Adapter requires the addition of 100 pounds of stabilizing provision when the LEM is not included.

CONTROL WEIGHT STATEMENT

GOVERNMENT FURNISHED EQUIPMENT

SUMMARY

	BLOCK II
GFE Total	(31018.8)
Lunar Excursion Module	29500.0
Guidance and Navigation	400.0
Crew (50-70-90)	528.0
Crew Equipment	371.0
Spacesuits (3) (Incl. Suit Mtd Comm.)	
Constant Wear Garments (7)	
External Thermal Garments (1)	
Liquid Cooled Garments (2)	
Portable Life Support System (2)	
Emergency Oxygen (2)	
Spare Parts and Repair Kit (1)	
Biomedical Instrumentation	
Radiation Dosimeters	
Medical Kit	
Instrument Set - Physiological Monitoring	
Food Set for 8.3 Day Mission	
Water Delivery Probe	
Survival Equipment Kit	
Television Camera	8.8
Scientific Equipment	80.0
Rendezvous Radar	106.0
"Q" Ball (LES)	25.0

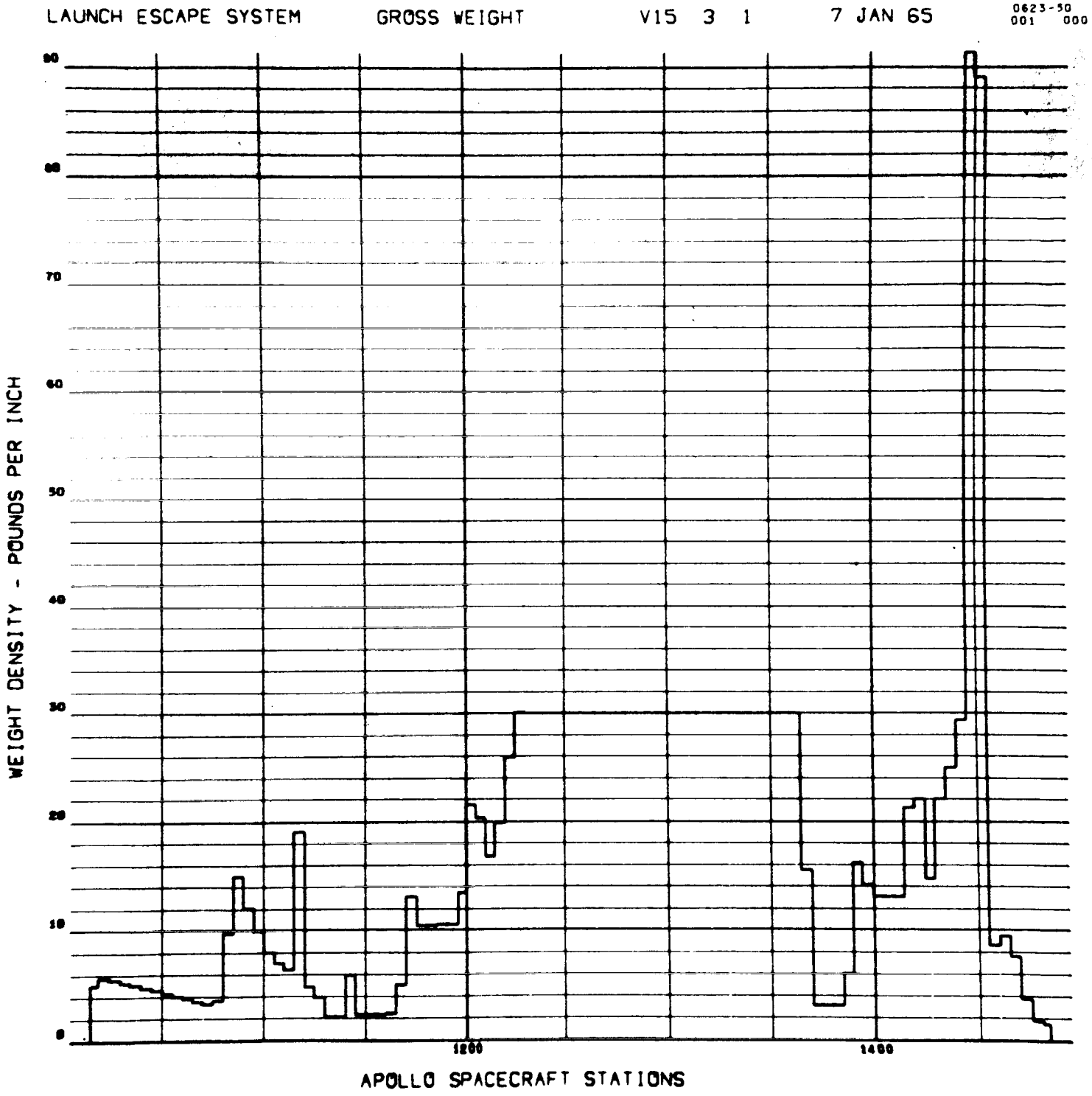
CONTROL WEIGHT STATEMENT

LUNAR EXCURSION MODULE

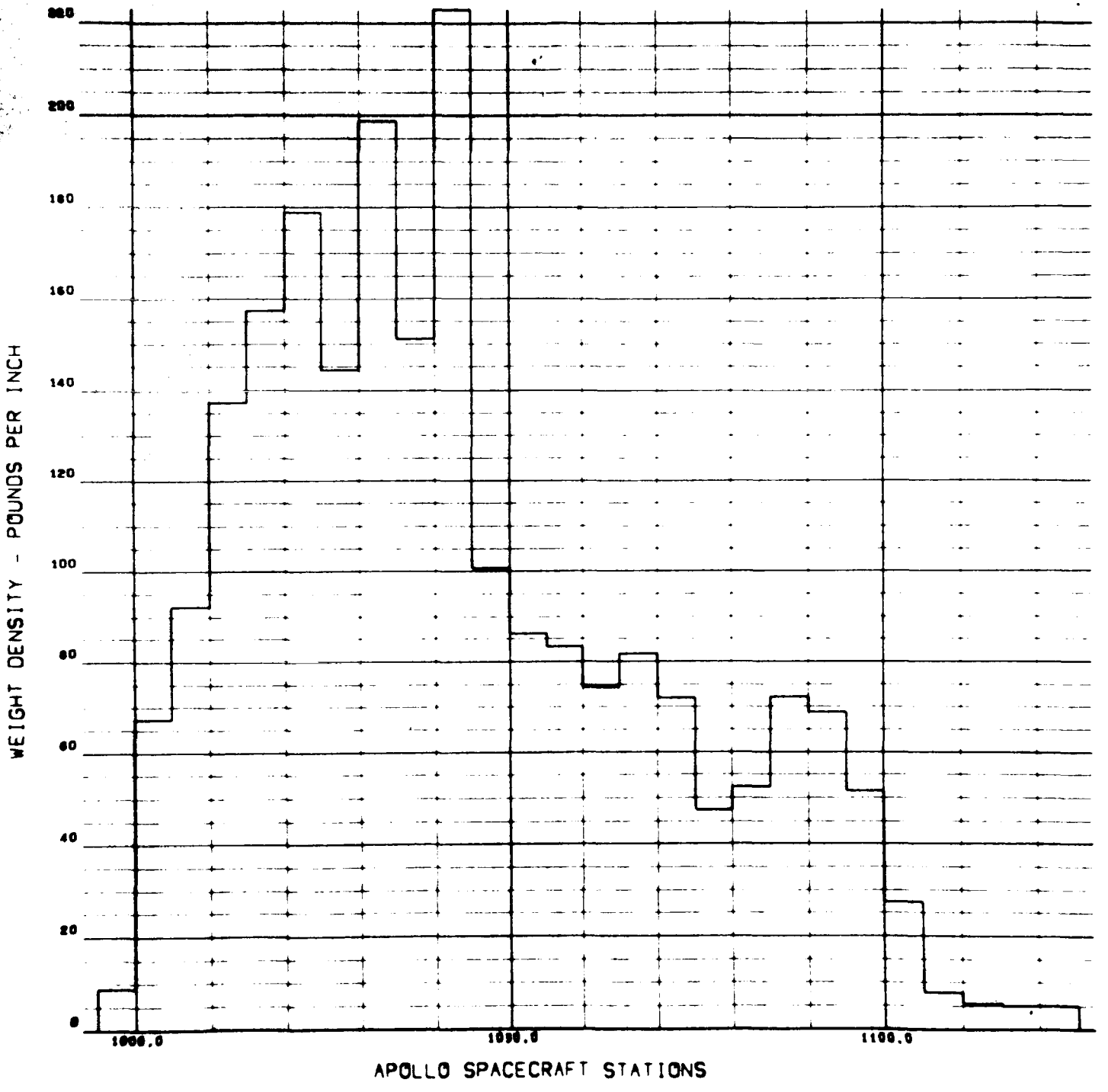
SUMMARY

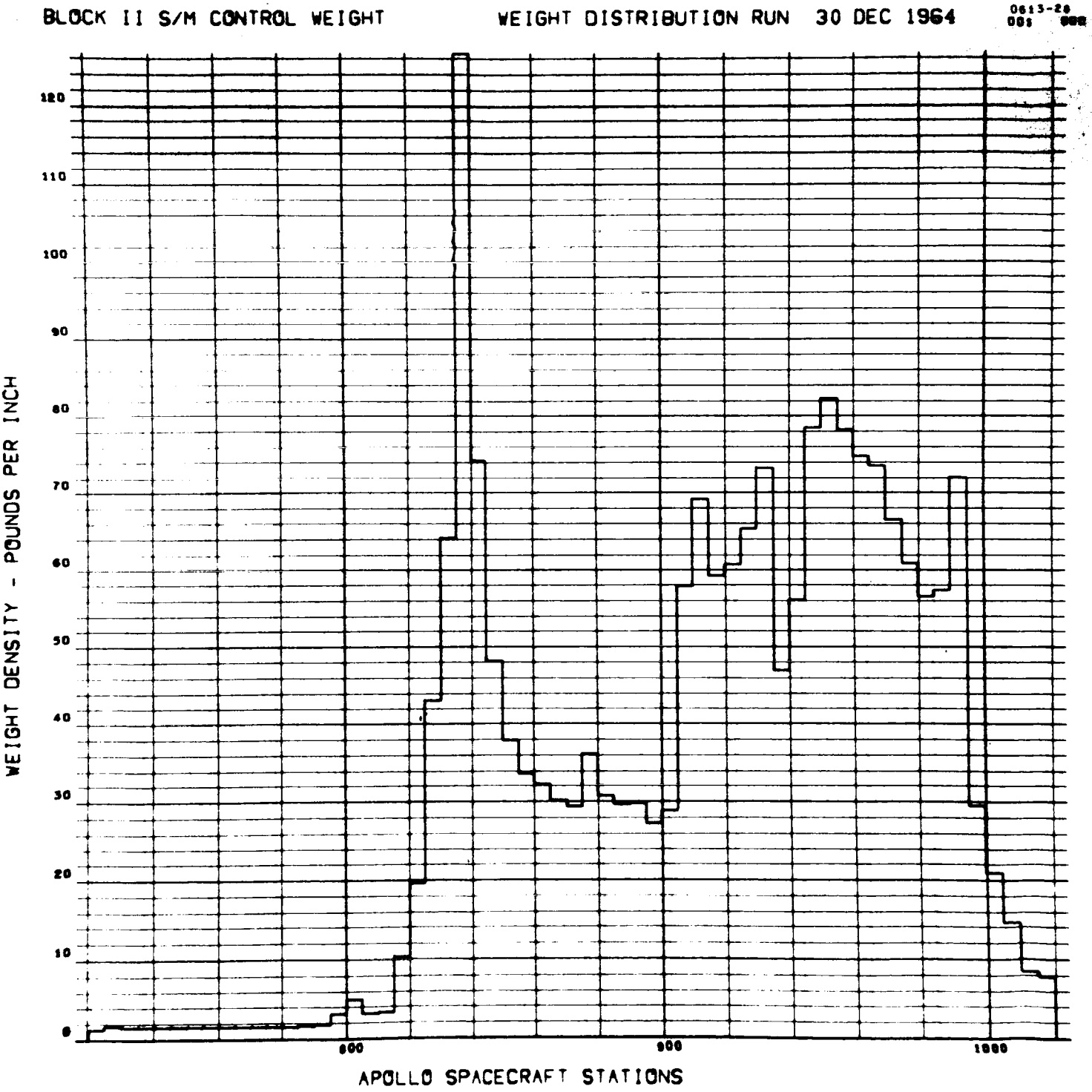
(Reference GAEC Memo LMO-490-109A-13 Nov. 1964)

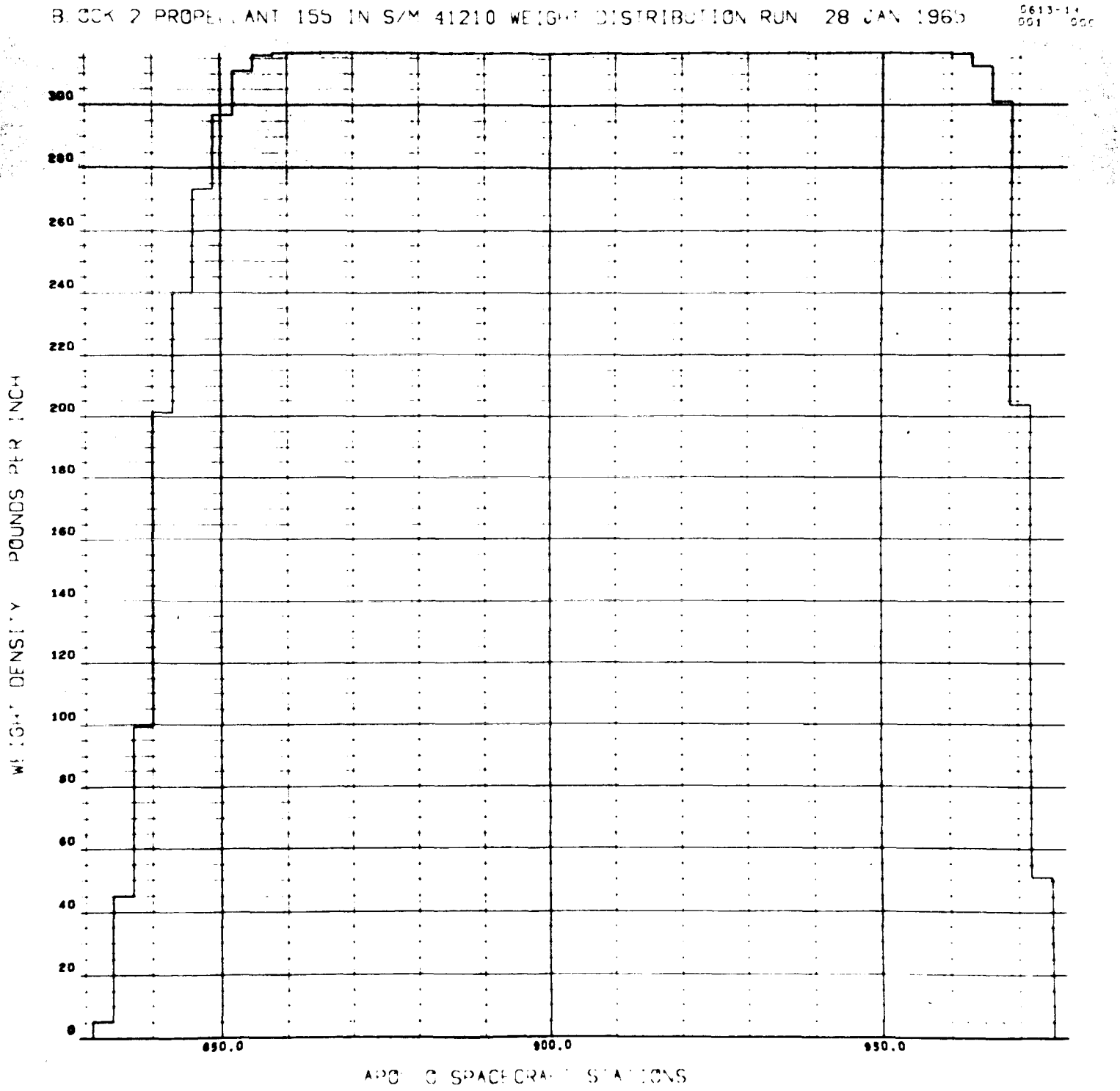
	POUNDS
ASCENT STAGE (Less Crew & Equipment	
Wet	10200
Dry	5000
DESCENT STAGE	
Wet	19300
Dry	3400
TOTAL LEM Wet	29500
TOTAL LEM Dry	8400


LAUNCH ESCAPE SYSTEM
GROSS WEIGHT
V15 3 1
7 JAN 65
0623-50
001 000
WEIGHT DENSITY - POUNDS PER INCH
90
80
70
60
50
40
30
20
10
0
1200
1400
APOLLO SPACECRAFT STATIONS

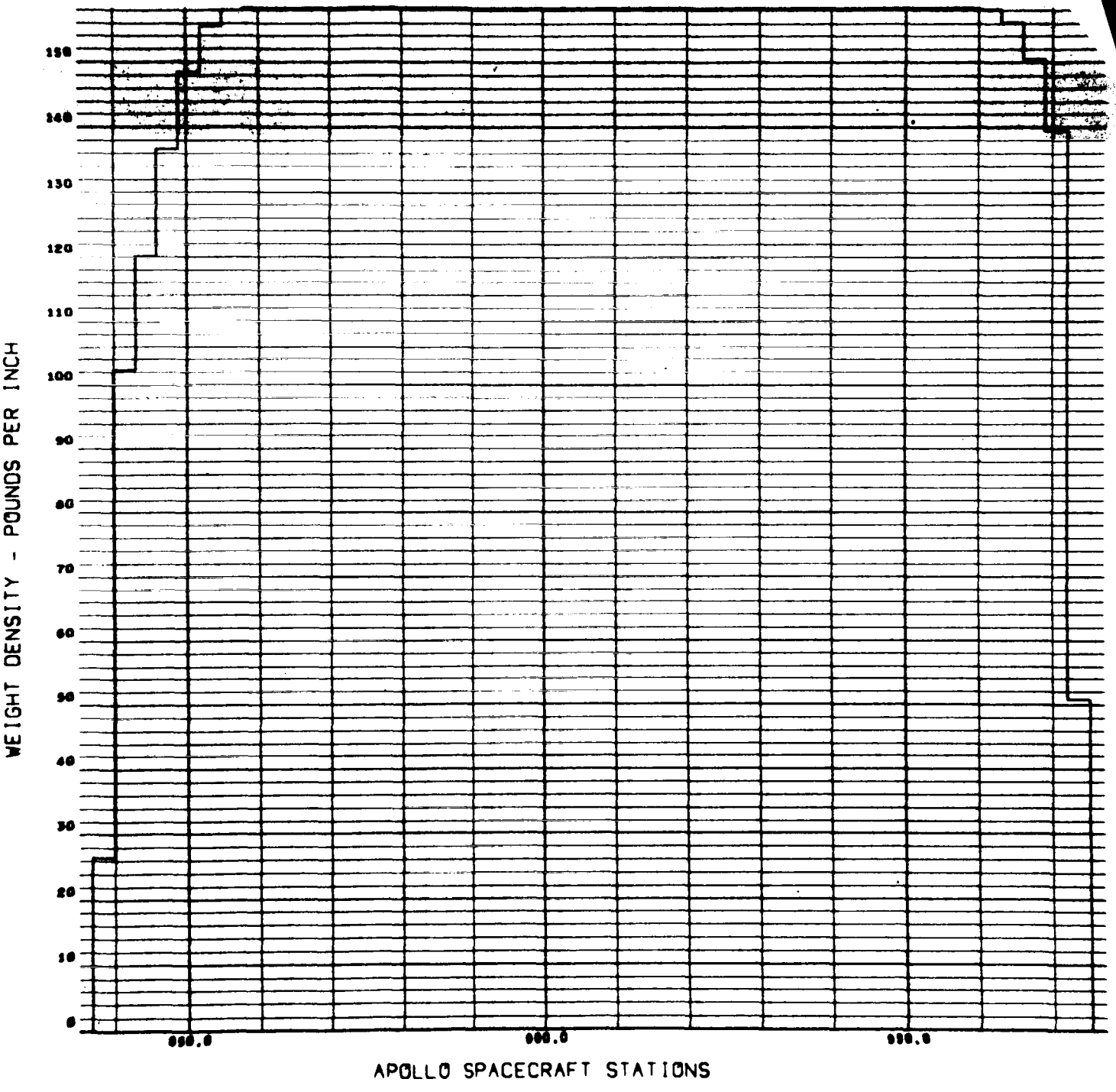
CM BLOCK II CONTROL WT JANUARY 1965 WEIGHT DISTRIBUTION RUN 14 JAN 1965 0613-65 001 000

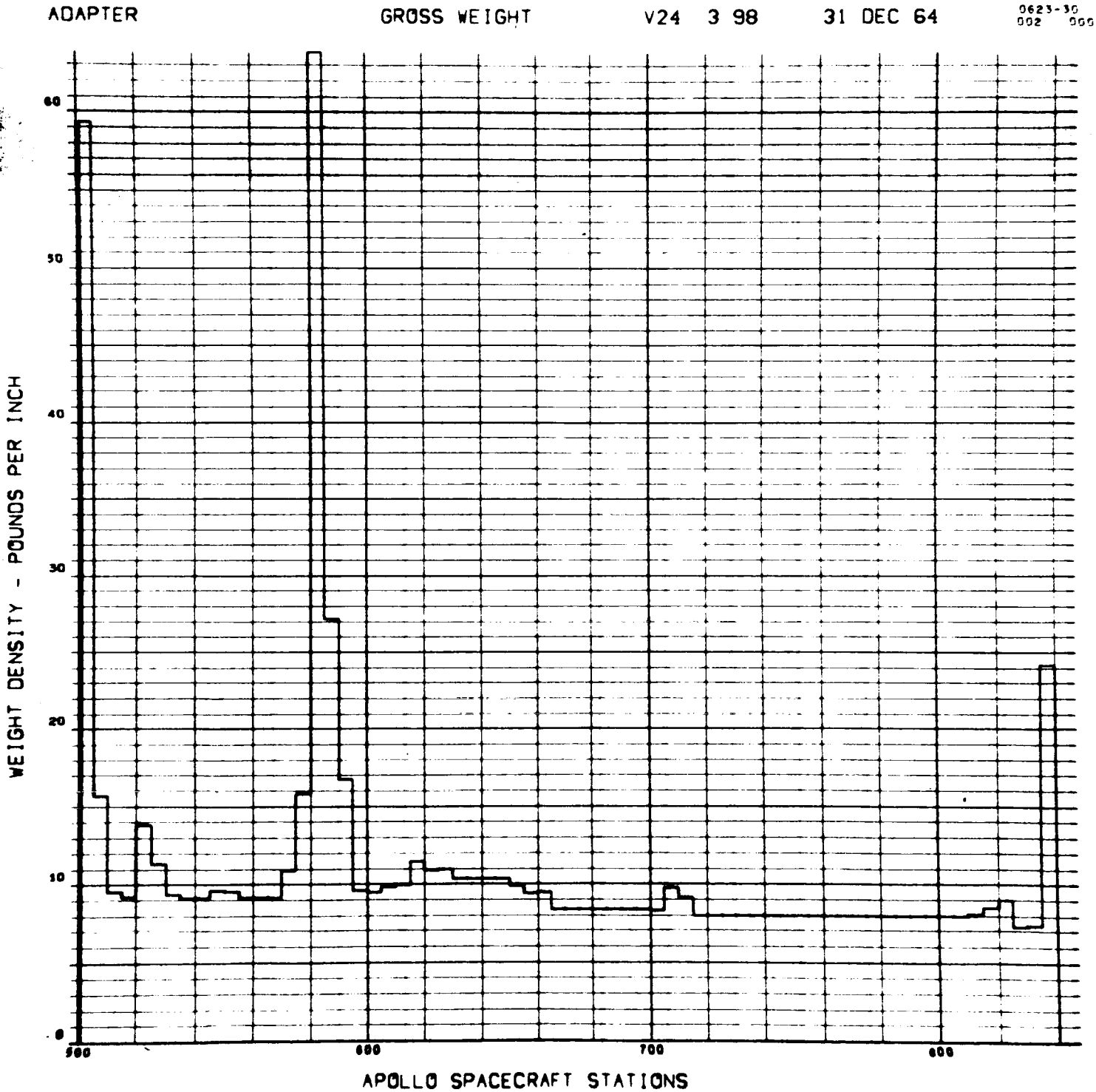



BLOCK II S/M CONTROL WEIGHT
WEIGHT DISTRIBUTION RUN 30 DEC 1964
0613-26
001 000
WEIGHT DENSITY - POUNDS PER INCH
120
110
100
90
80
70
60
50
40
30
20
10
0
800
900
1000
APOLLO SPACECRAFT STATIONS


B. CCK 2 PROPELLANT 155 IN S/M 41210 WEIGHT DISTRIBUTION RUN 28 JAN 1965
0613-14
001 000
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
WEIGHT DENSITY POUNDS PER INCH
850.0
900.0
950.0
APOLLO SPACECRAFT STATIONS

SERVICE MODULE PROPELLANT 20655 LBS WEIGHT DISTRIBUTION RUN 3 FEB 1965

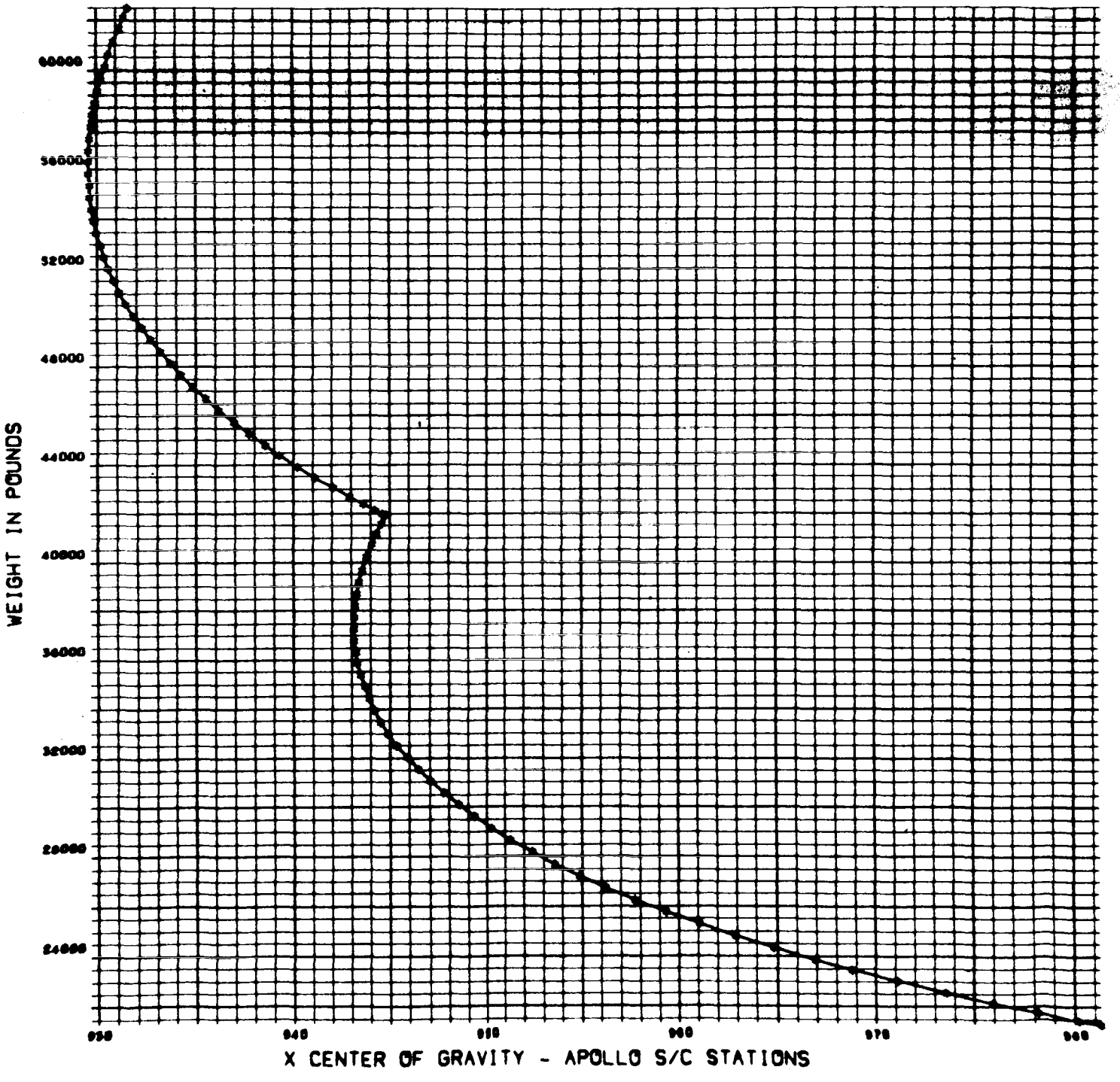



ADAPTER
GROSS WEIGHT
V24 3 98
31 DEC 64
0623-30
002 000
60
50
40
30
20
10
0
500
600
700
800
WEIGHT DENSITY - POUNDS PER INCH
APOLLO SPACECRAFT STATIONS

This data to be included at a later date.

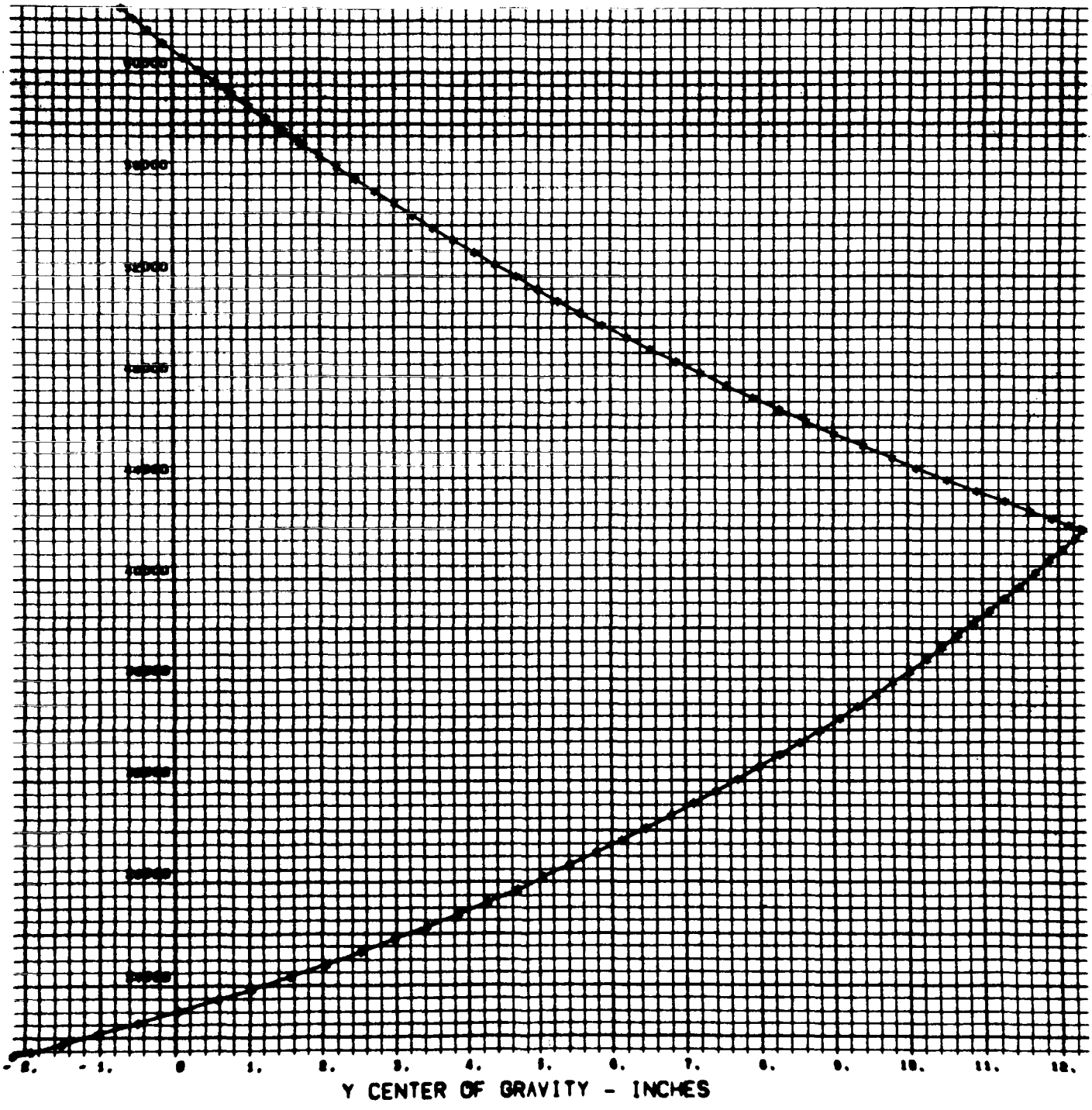
CONT WT CSM WITH SLA RING VS SPS PROPELLANT BLOCK II JAN 1965

0613-2# 001 000



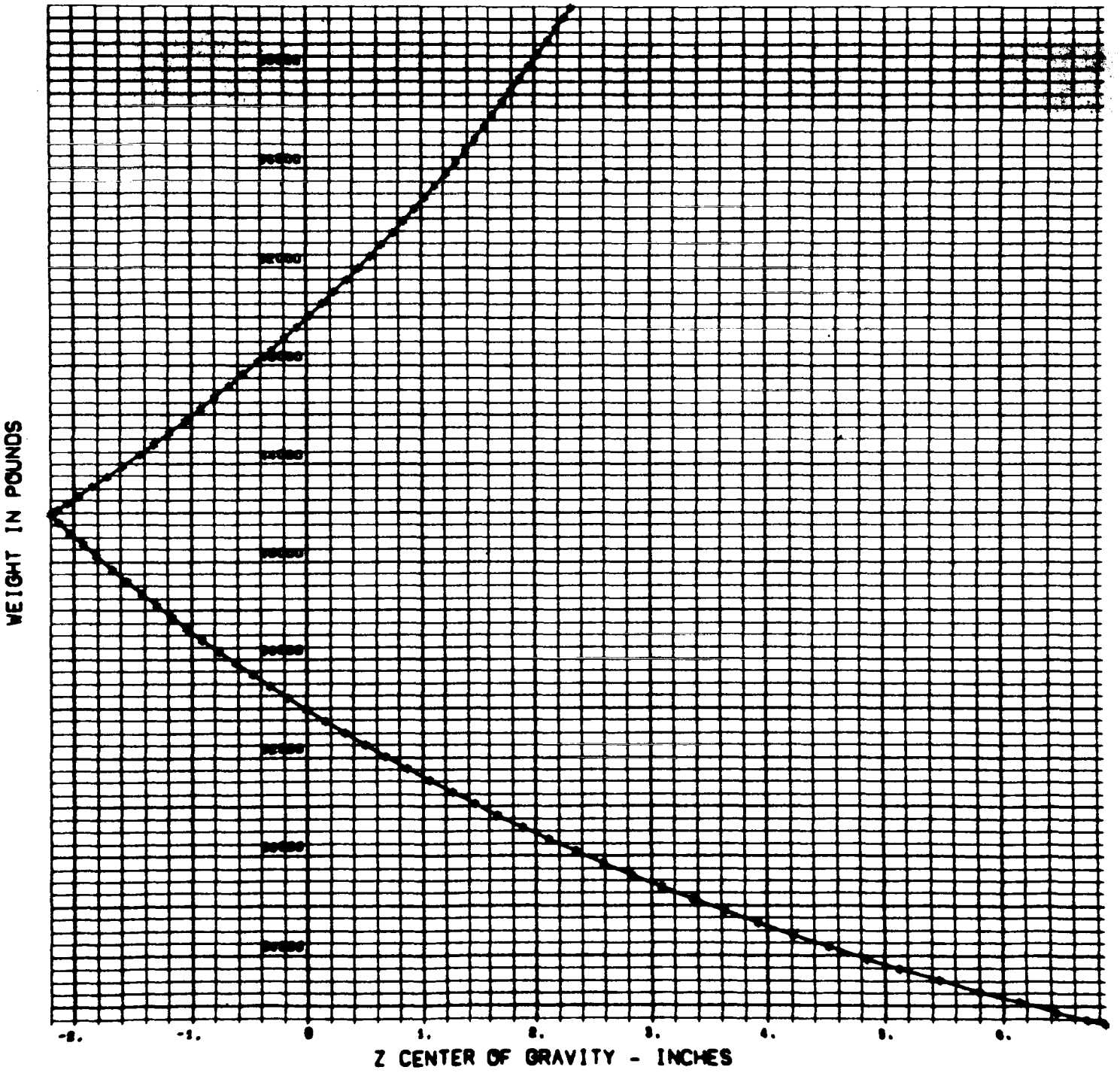
CONT WT CSM WITH SLA RING VS SPS PROPELLANT BLOCK II JAN 1965

0613-2R
002 000



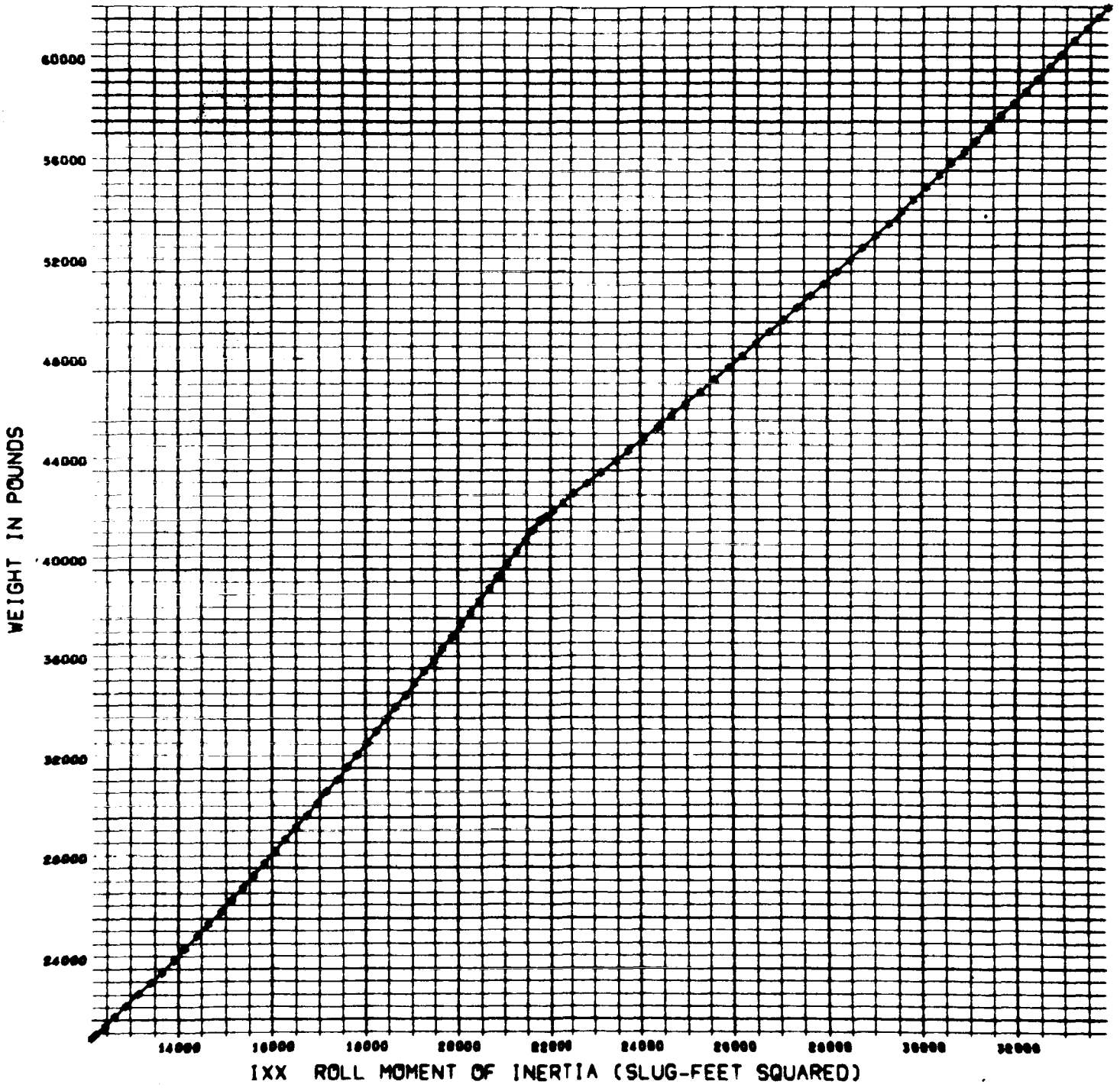
CONT WT CSM WITH SLA RING VS SPS PROPELLANT BLOCK II JAN 1965

0613-2F
003 000



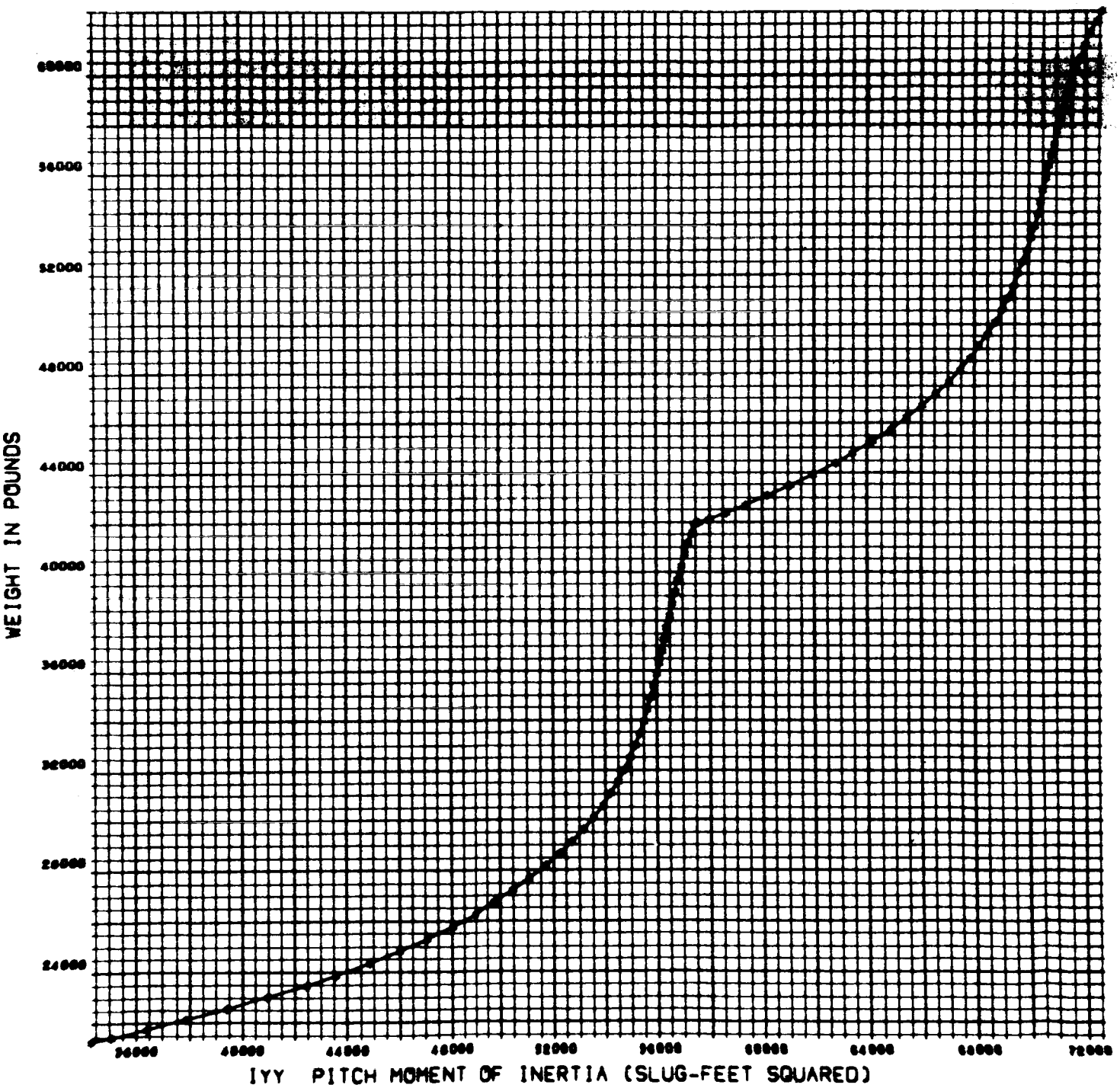
CONT WT CSM WITH SLA RING VS SPS PROPELLANT BLOCK II JAN 1965

0613-2# 004 000



CONT WT CSM WITH SLA RING VS SPS PROPELLANT BLOCK II JAN 1965

0613-27
005 000



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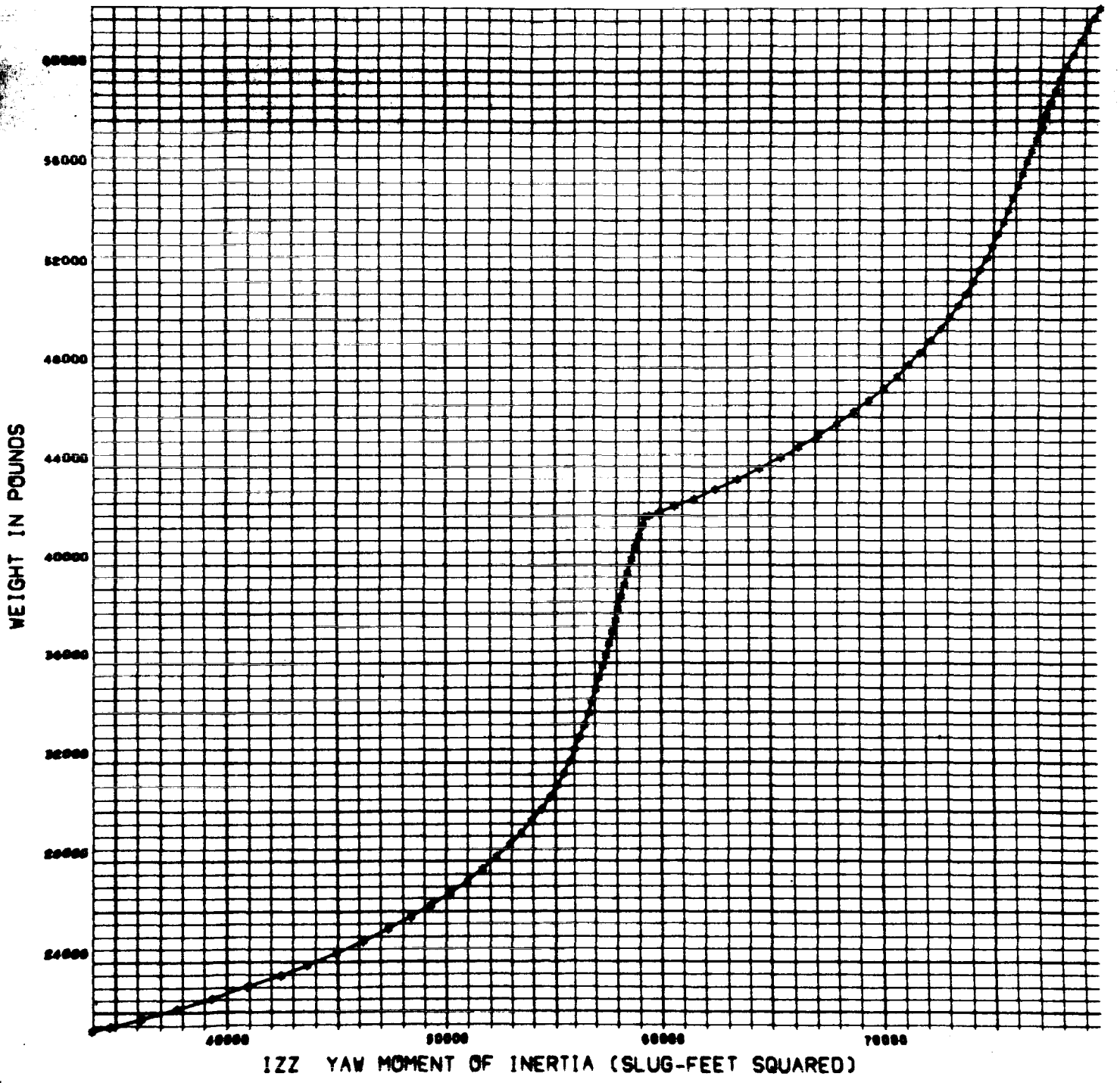
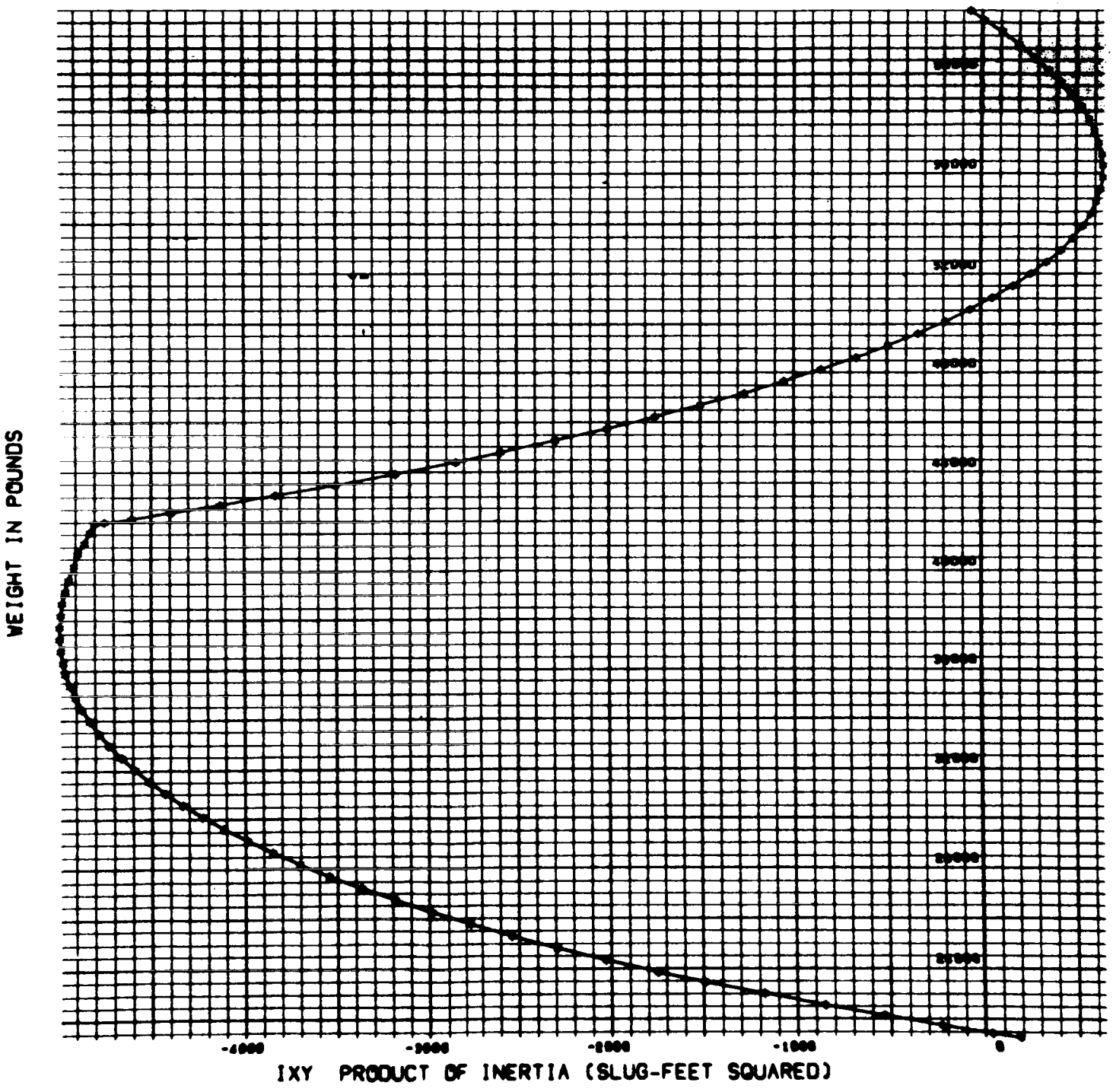
0613-27
006 000



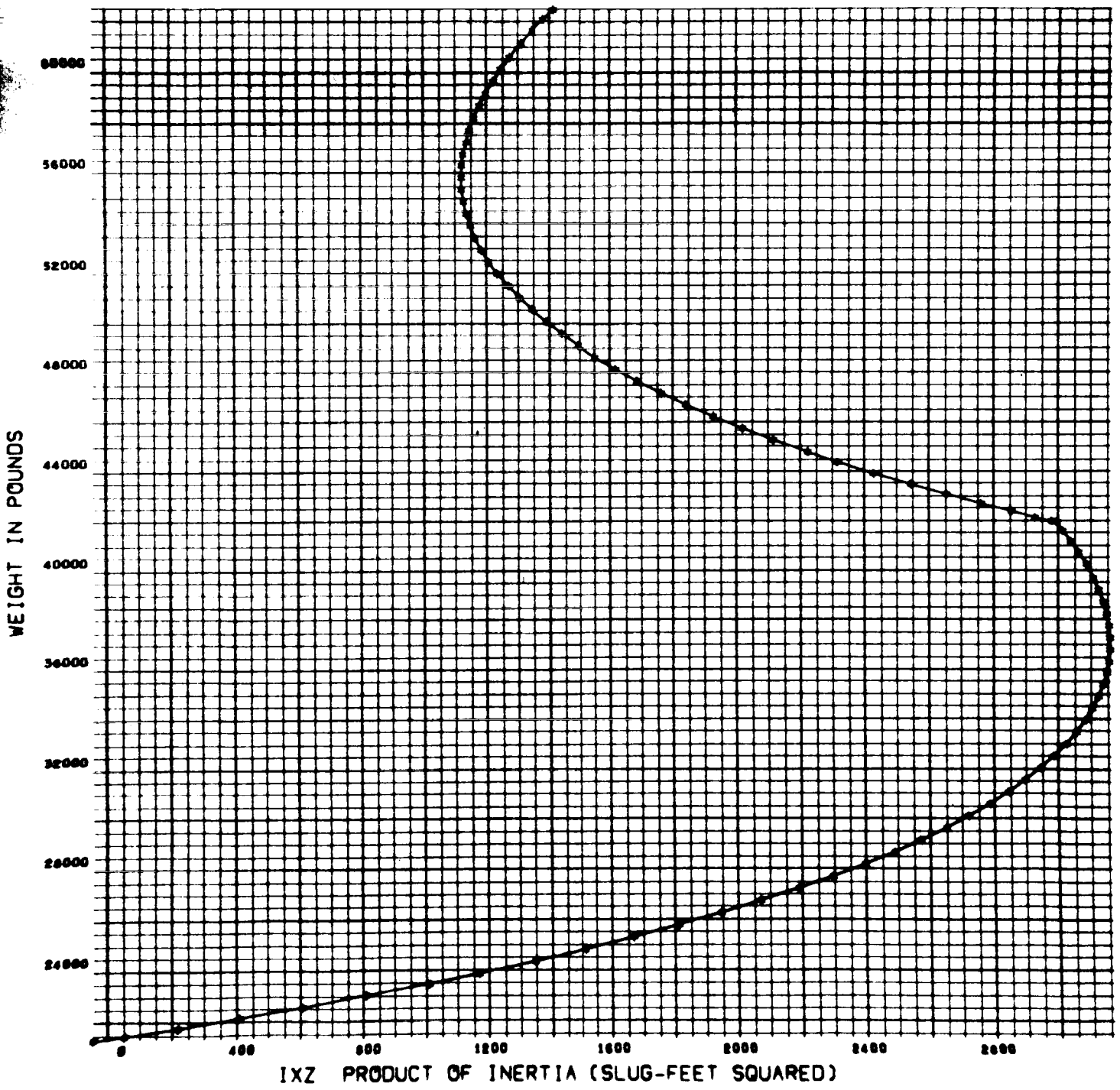
CONT WT CSM WITH SLA RING VS SPS PROPELLANT BLOCK II JAN 1965

0613-2# 007 00



CONT WT CSM WITH SLA RING VS SPS PROPELLANT BLOCK II JAN 1965

0613-27
008 000



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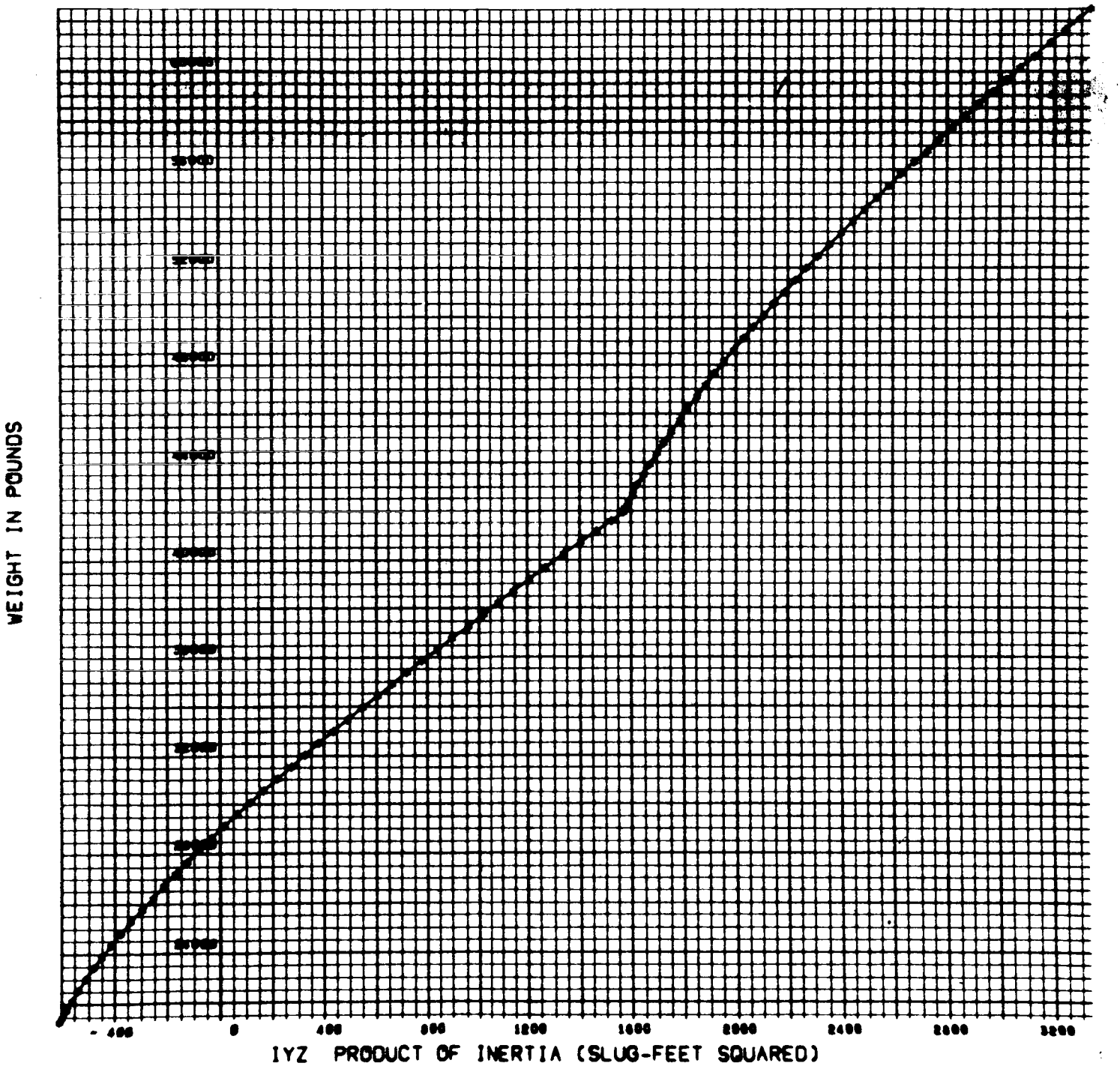
0613-2F
009 000



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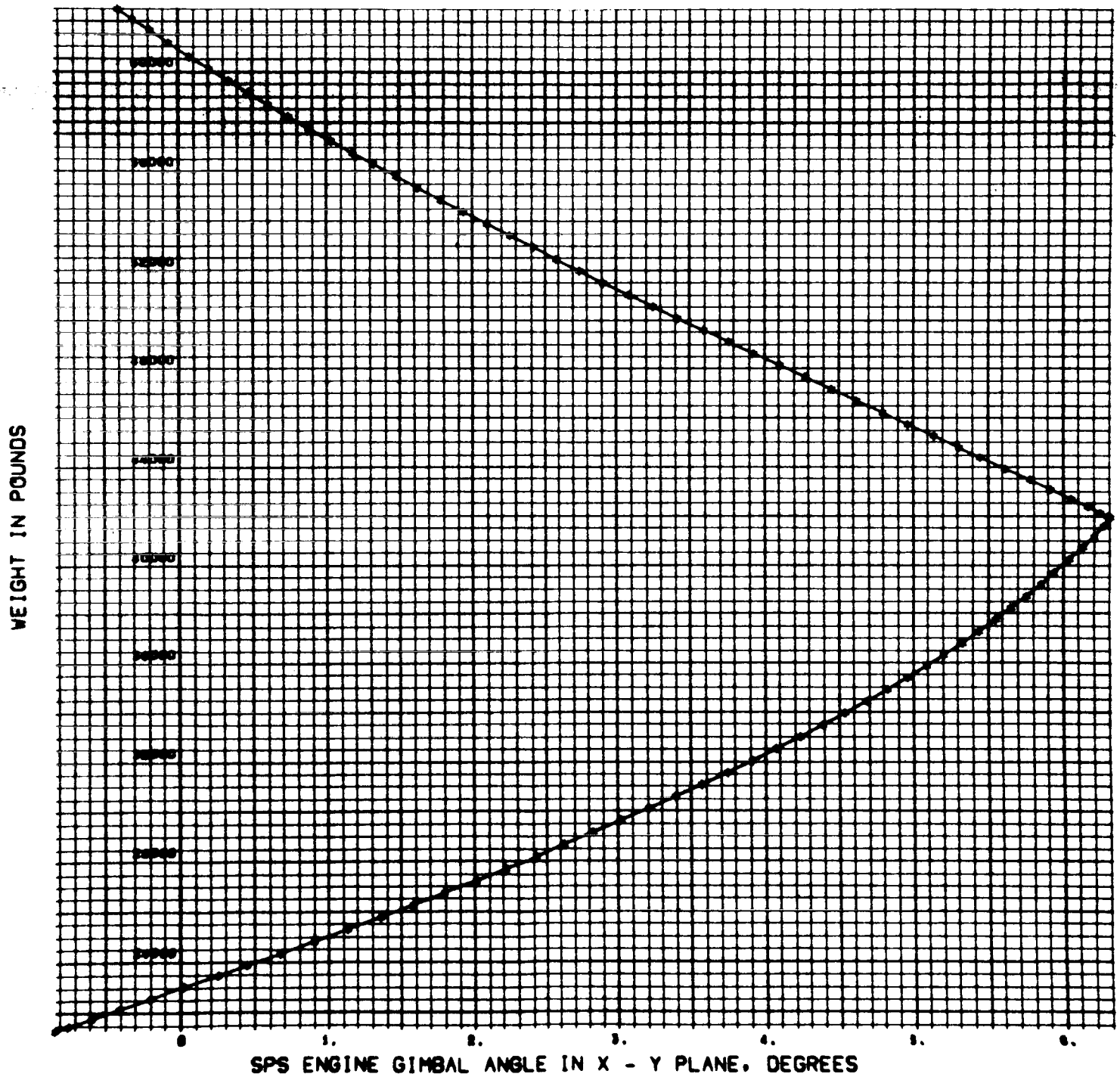
010 000



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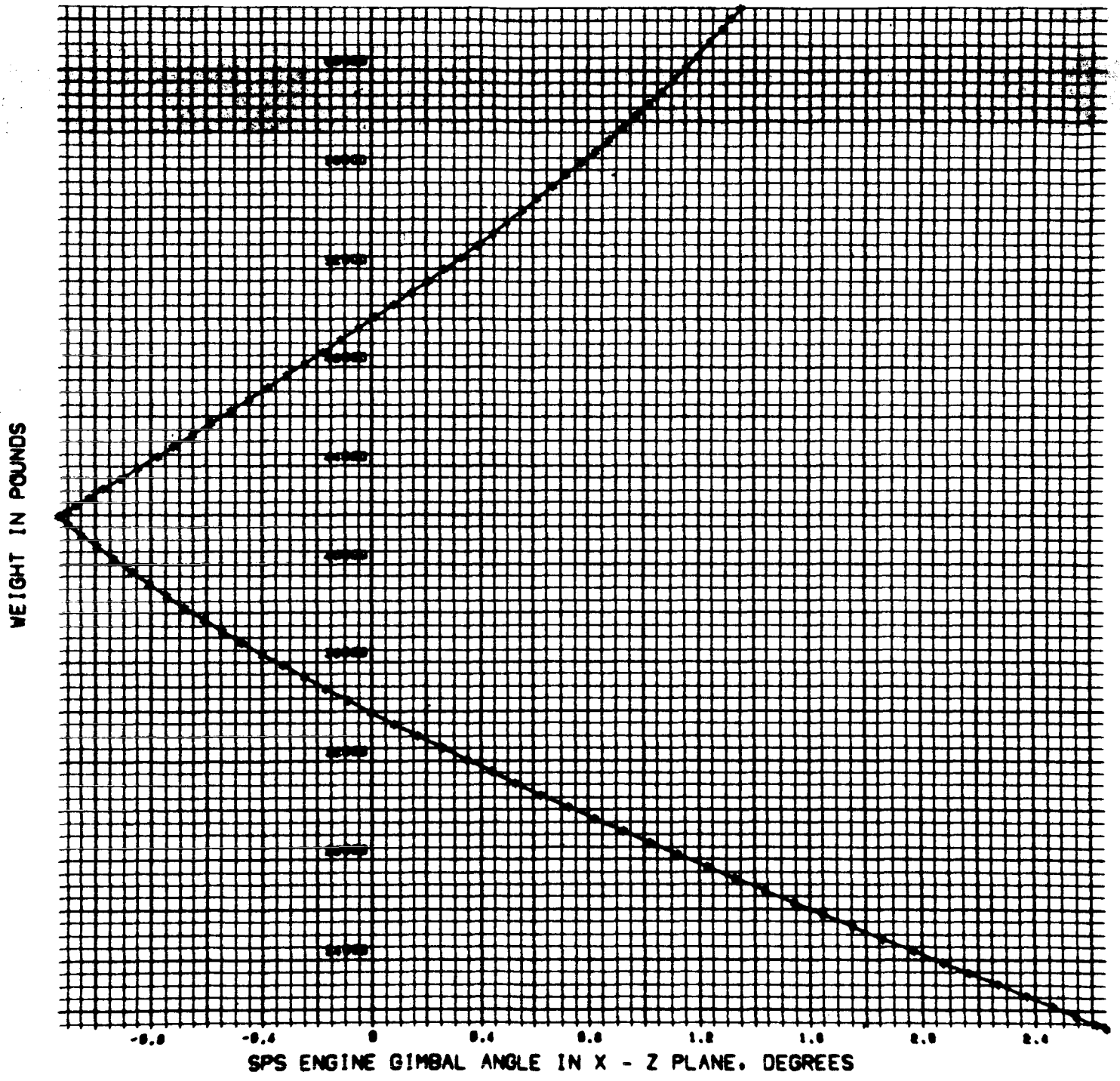

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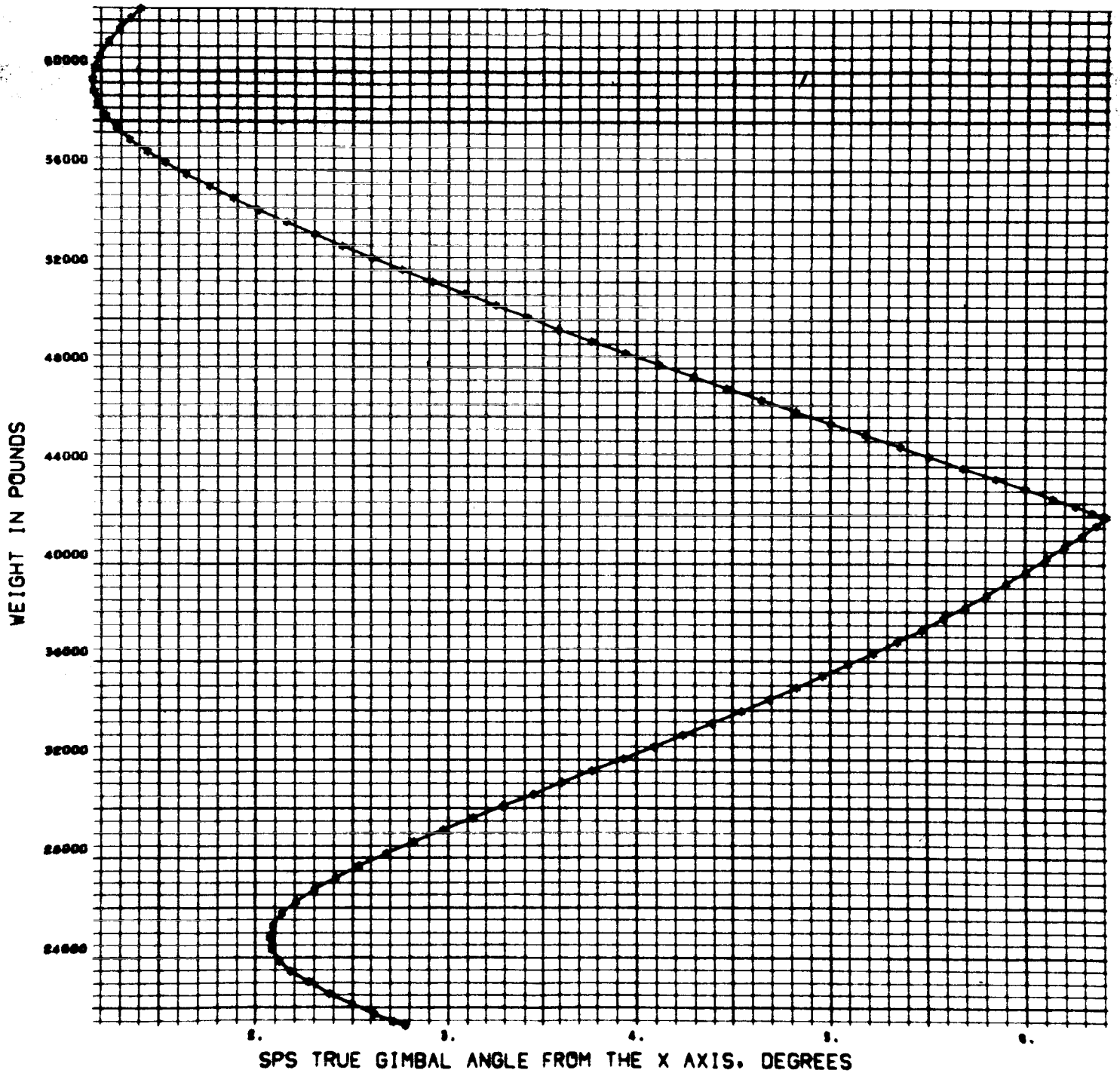
0613-27
012 000



CONFIDENTIAL

BLOCK II

LAUNCH ESCAPE VEHICLE ABORT PHASE

TIME SECONDS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**			PRODUCTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
0.0	19200.0	1153.2	-0.1	3.6	5520.8	92628.7	92281.1	69.2	-1869.1	29.5
0.5	18814.1	1150.2	-0.1	3.7	5514.7	90696.4	90350.0	67.4	-1824.0	29.5
1.0	18412.1	1147.1	-0.1	3.7	5507.6	88707.3	88362.1	65.6	-1777.4	29.5
1.5	18009.1	1143.8	-0.1	3.8	5499.1	86630.4	86286.4	63.7	-1728.6	29.6
2.0	17612.1	1140.4	-0.2	3.9	5489.5	84498.1	84155.4	61.7	-1678.4	29.6
2.5	17236.1	1137.0	-0.2	4.0	5479.3	82394.0	82052.6	59.8	-1628.7	29.7
3.0	16895.1	1133.9	-0.2	4.1	5469.0	80410.0	80069.8	57.9	-1581.6	29.7
3.5	16596.1	1131.0	-0.2	4.1	5459.2	78607.6	78268.5	56.2	-1538.8	29.8
4.0	16385.1	1128.9	-0.2	4.2	5451.9	77298.5	76960.1	55.0	-1507.7	29.8
4.5	16271.1	1127.7	-0.2	4.2	5447.7	76577.9	76240.0	54.3	-1490.5	29.8
5.0	16182.1	1126.8	-0.2	4.3	5444.4	76008.7	75671.2	53.8	-1476.9	29.8
5.5	16128.1	1126.3	-0.2	4.3	5442.4	75660.5	75323.1	53.5	-1468.6	29.9
6.0	16088.1	1125.9	-0.2	4.3	5440.9	75401.1	75063.9	53.2	-1462.4	29.9
6.5	16062.1	1125.6	-0.2	4.3	5439.9	75231.9	74894.8	53.1	-1458.4	29.9
7.0	16035.8	1125.3	-0.2	4.3	5438.9	75060.1	74723.1	52.9	-1454.3	29.9
7.5	16018.8	1125.1	-0.2	4.3	5438.2	74948.8	74611.9	52.8	-1451.6	29.9
8.0	16001.8	1124.9	-0.2	4.3	5437.6	74837.3	74500.5	52.7	-1449.0	29.9

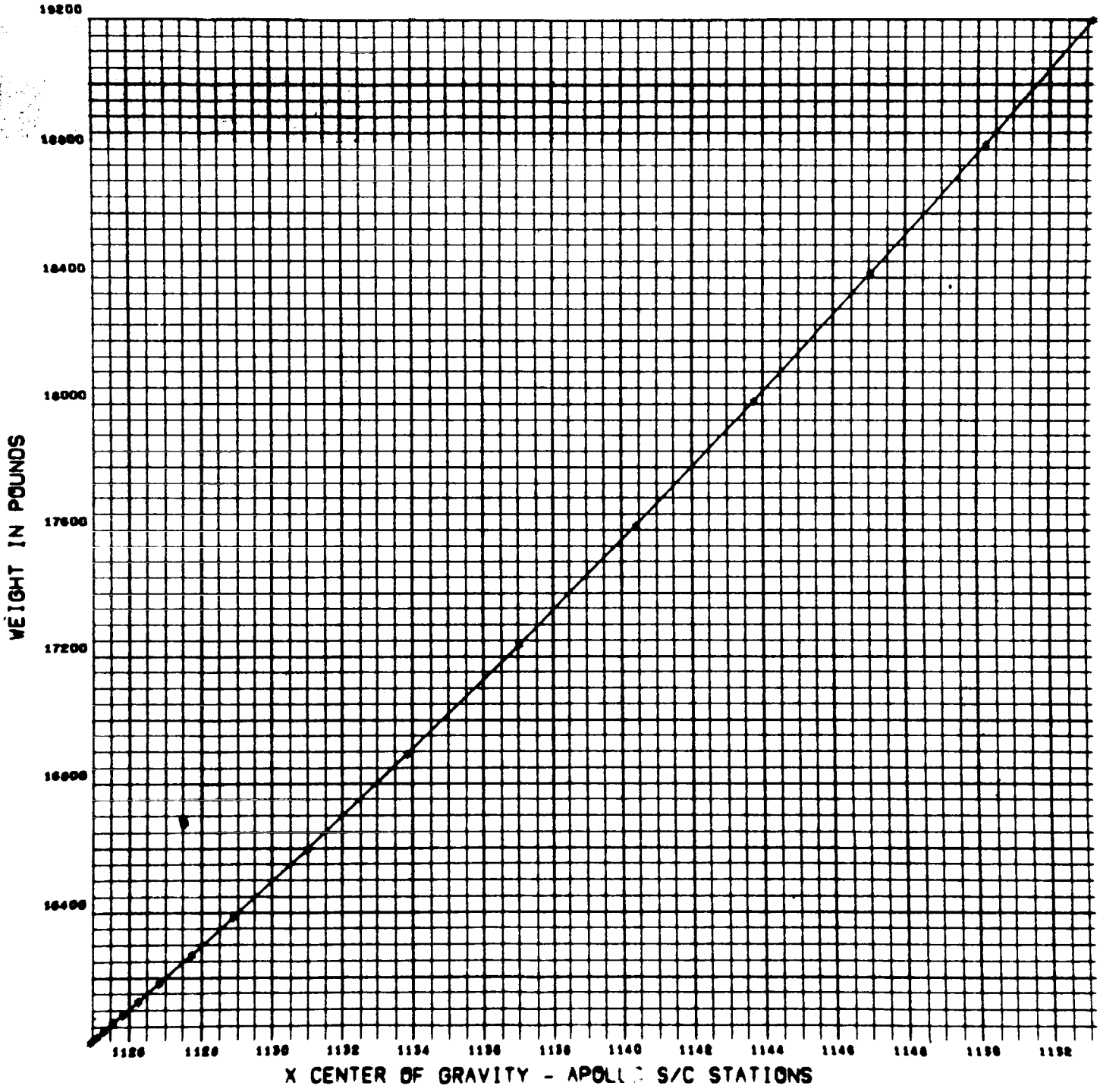
NOTE: *Centers of gravity are given in the Apollo Vehicle Reference System as defined by MD-V14-14-10.

**Moments and products of inertia units are slug feet squared about the centers of gravity.

CONFIDENTIAL

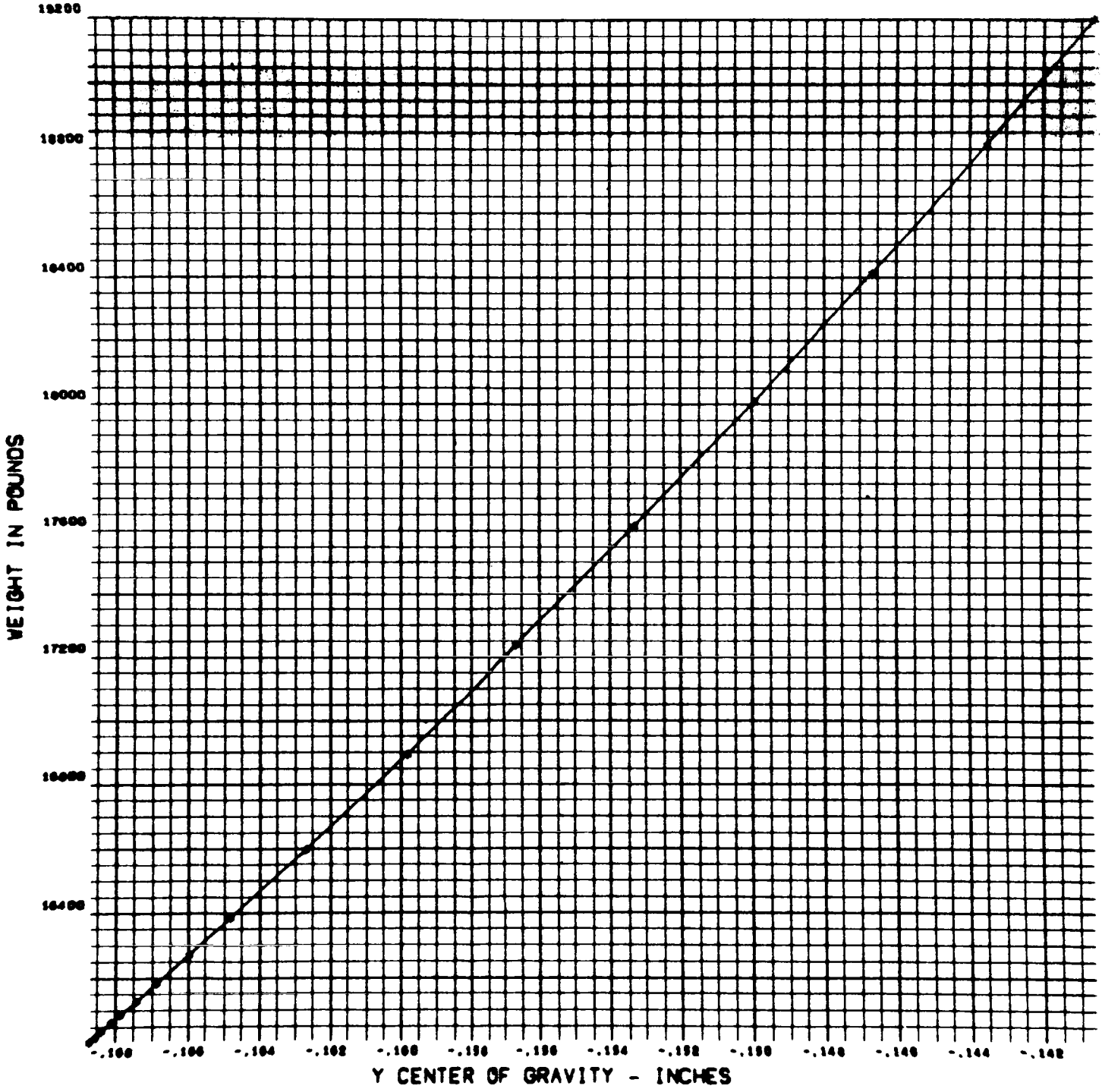
BLOCK II LAUNCH ESCAPE VEHICLE ABORT PHASE CONTROL WEIGHT

0613-36
001 000



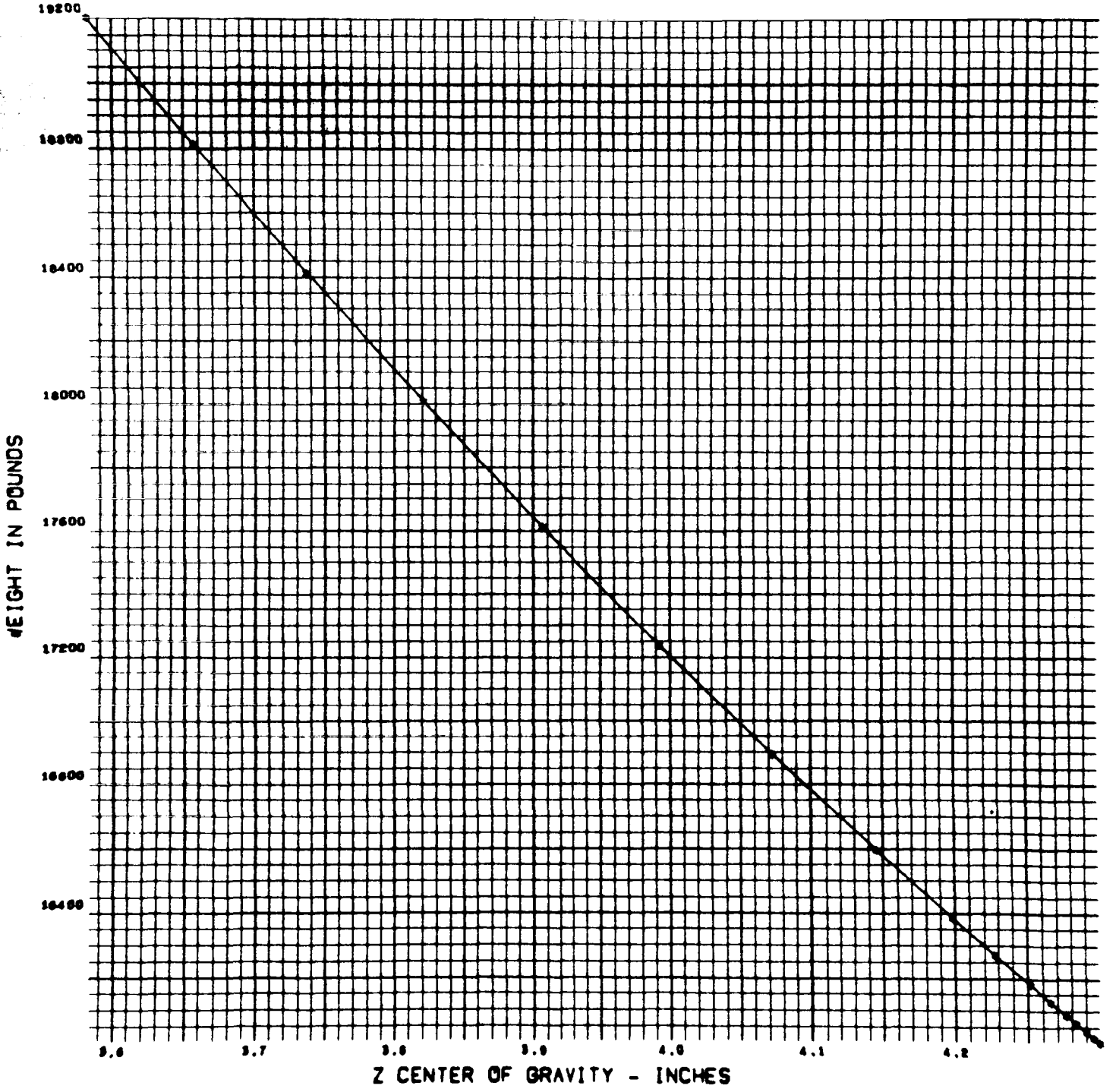
BLOCK II LAUNCH ESCAPE VEHICLE ABORT PHASE CONTROL WEIGHT

0613-38
002 000



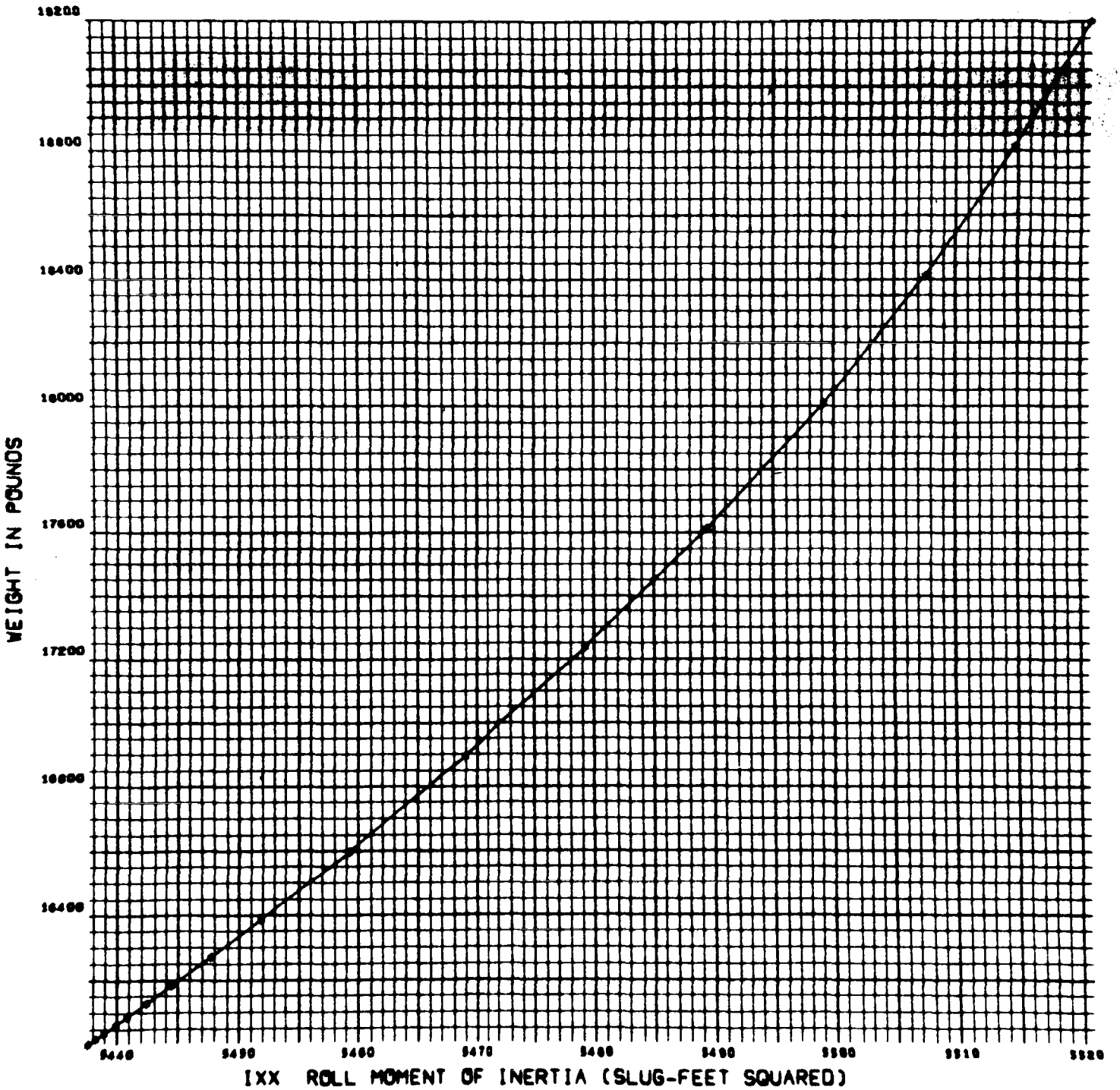
BLOCK II LAUNCH ESCAPE VEHICLE ABORT PHASE CONTROL WEIGHT

0613-36
003 000



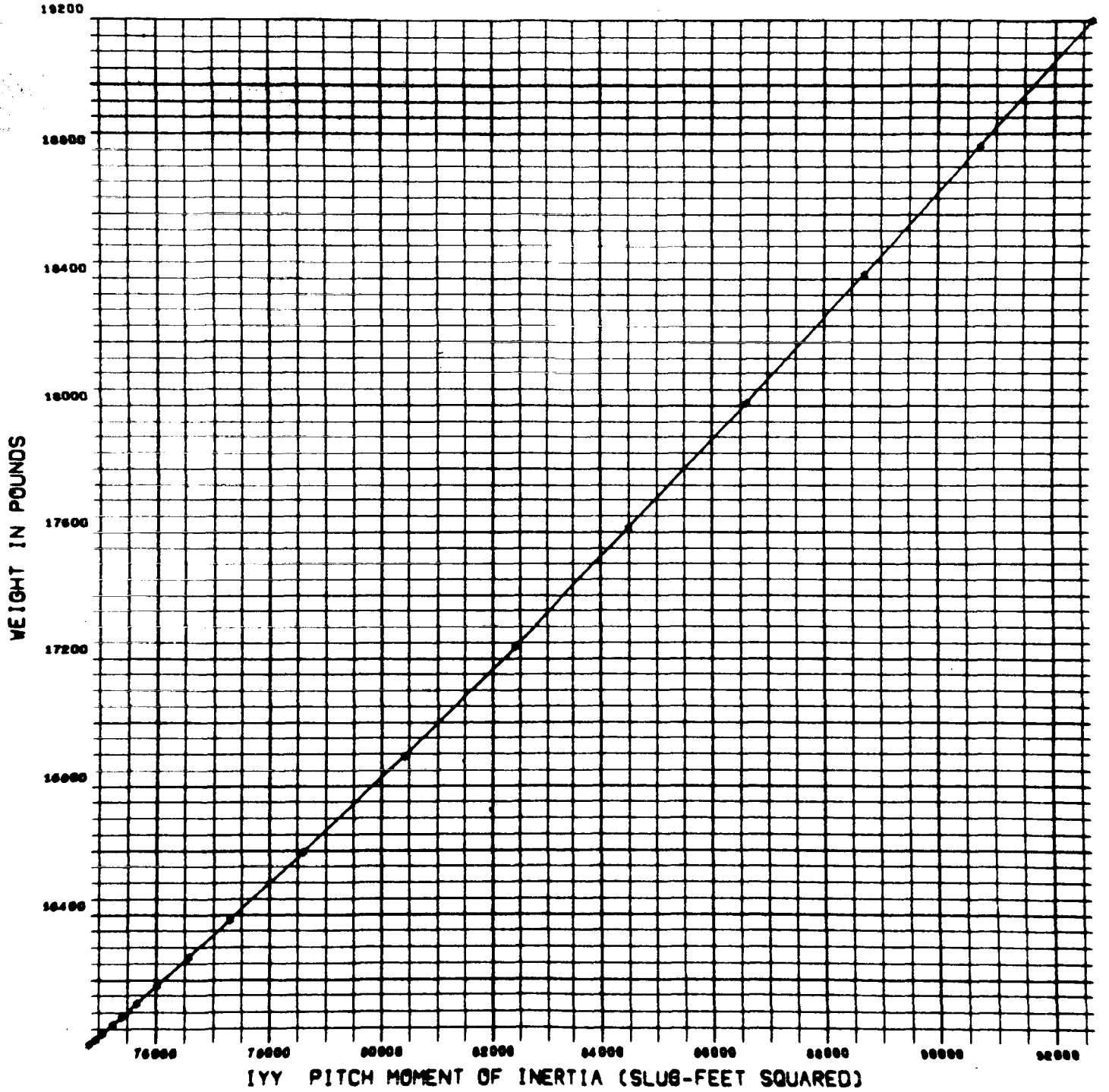
BLOCK II LAUNCH ESCAPE VEHICLE ABORT PHASE CONTROL WEIGHT

0613-38
004 000



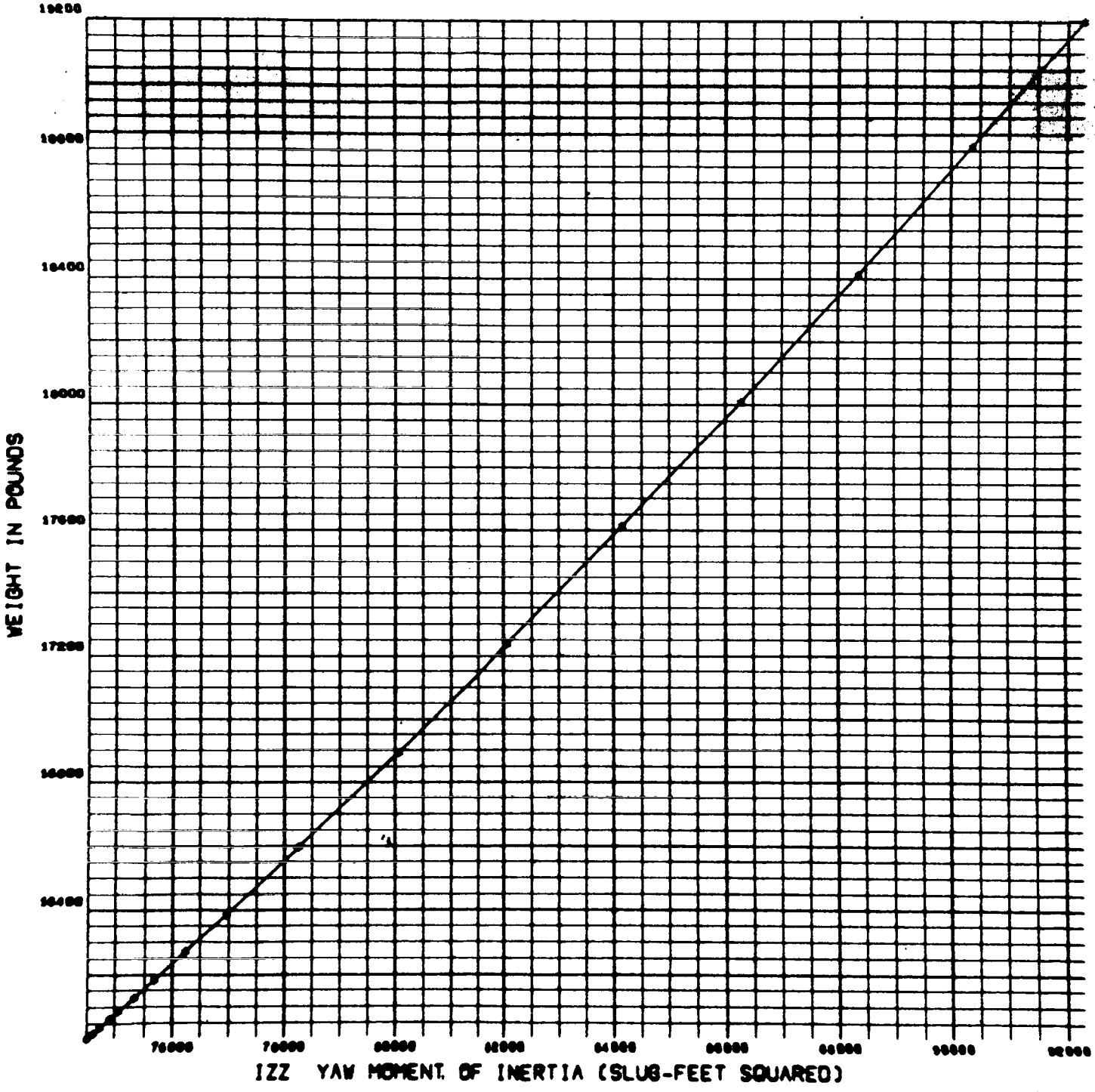
BLOCK II LAUNCH ESCAPE VEHICLE ABORT PHASE CONTROL WEIGHT

D613-30
005 000



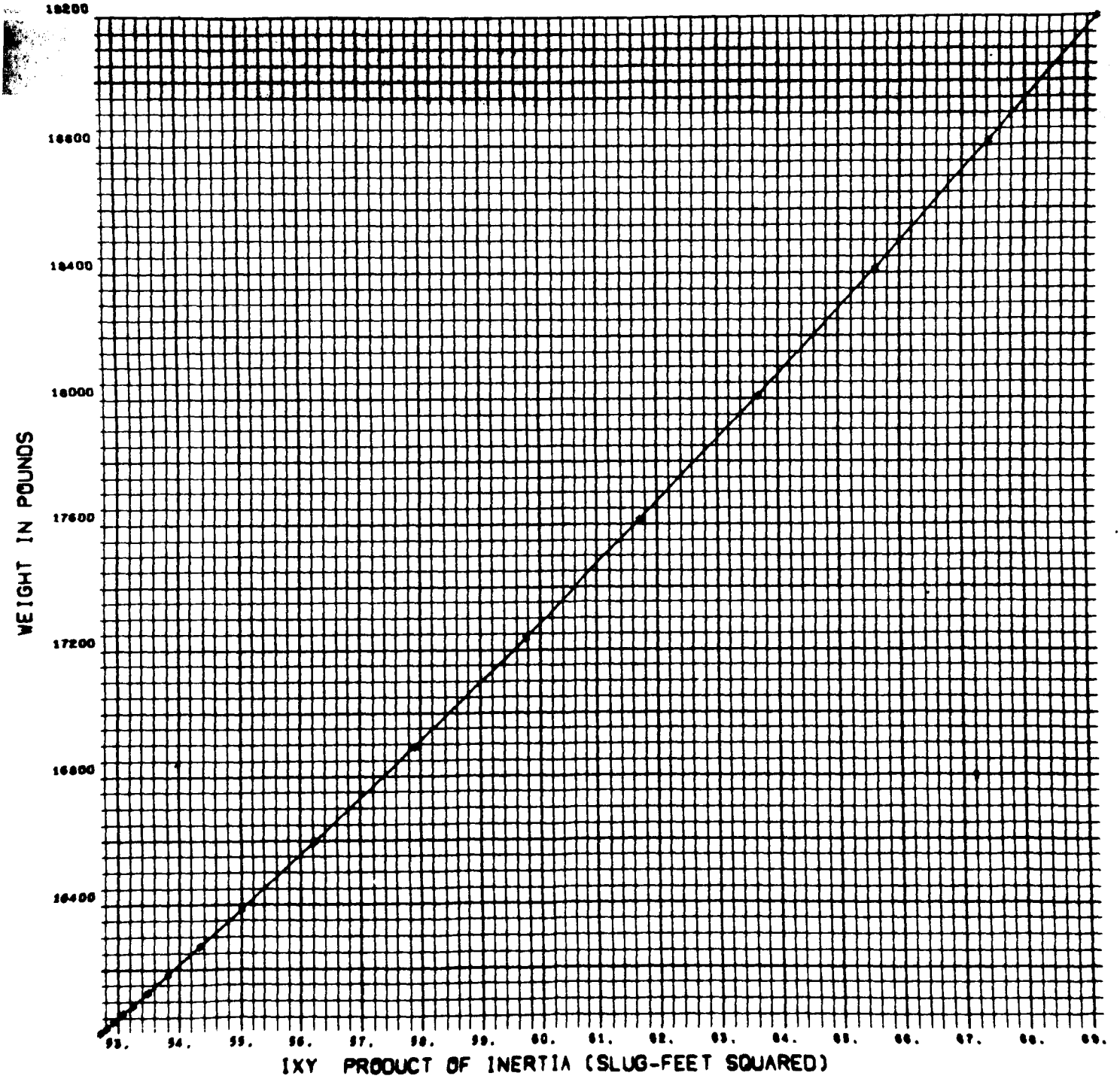
BLOCK II LAUNCH ESCAPE VEHICLE ABORT PHASE CONTROL WEIGHT

0613-38
006 000



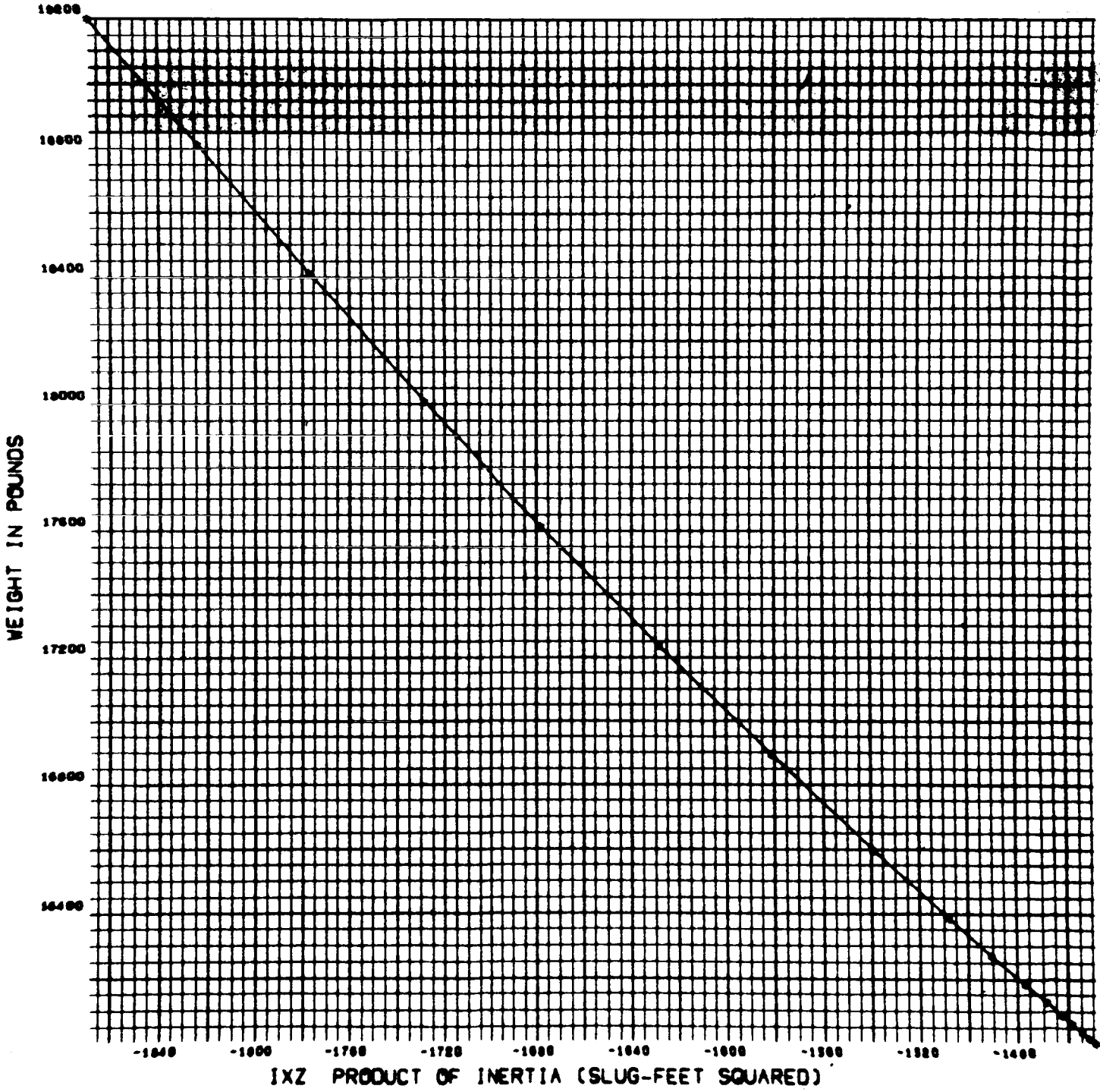
BLOCK II LAUNCH ESCAPE VEHICLE ABORT PHASE CONTROL WEIGHT

0613-38
007 000



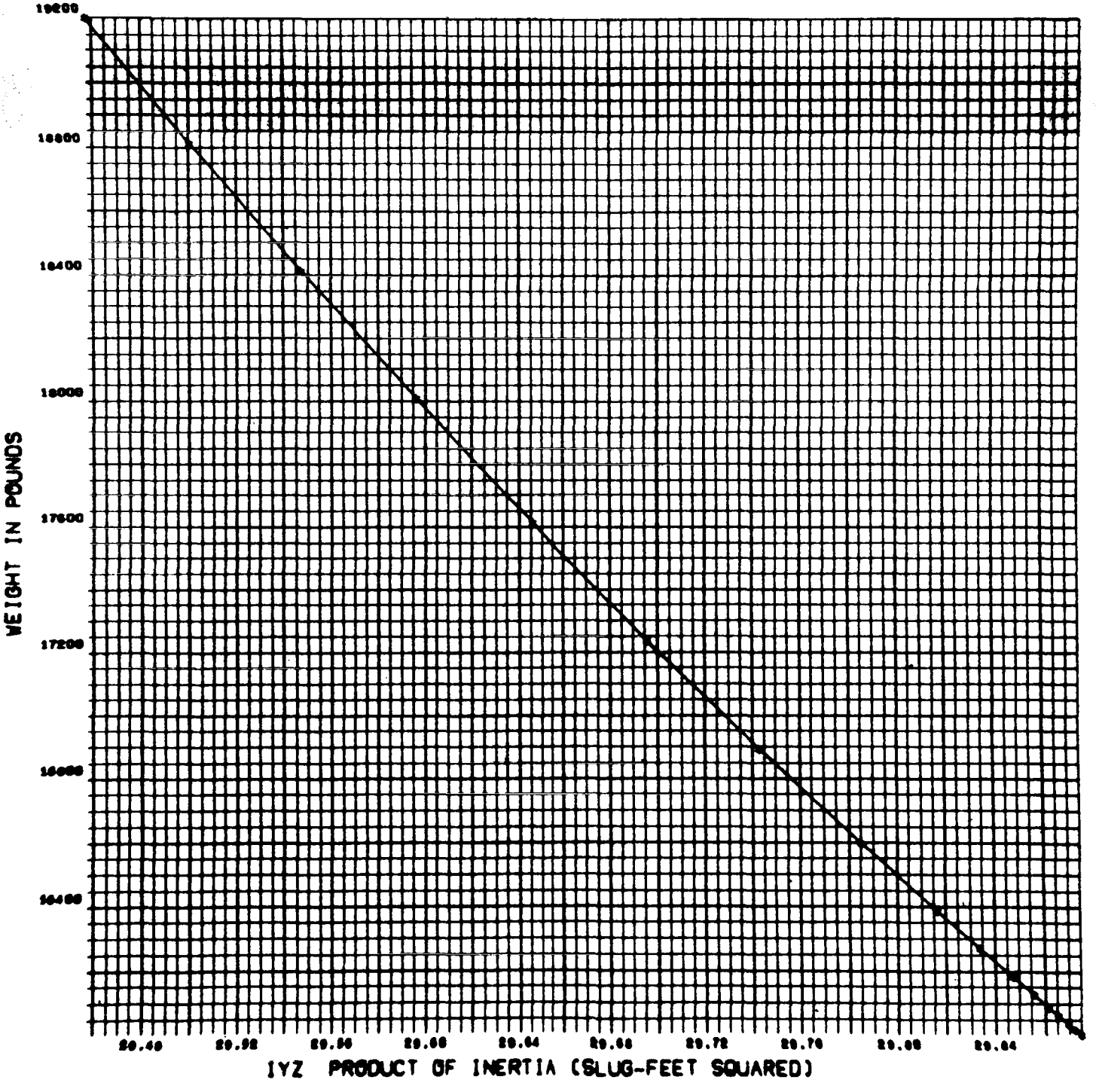
BLOCK II LAUNCH ESCAPE VEHICLE ABORT PHASE CONTROL WEIGHT

0613-38
008 000



BLOCK II LAUNCH ESCAPE VEHICLE ABORT PHASE CONTROL WEIGHT

0613-38
009 000



[redacted]

BLOCK II

LAUNCH ESCAPE VEHICLE JETTISON PHASE

CANARDS DEPLOYED

TIME SECONDS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**			PRODUCTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
0.0	4998.4	1304.7	-0.1	-0.8	470.6	19781.4	19789.3	18.1	-38.0	-0.2
0.5	4921.1	1303.0	-0.1	-0.8	468.9	19597.2	19605.1	18.0	-39.4	-0.2
1.0	4830.6	1301.1	-0.1	-0.8	466.6	19373.8	19381.8	17.8	-41.1	-0.2
1.4	4793.1	1300.2	-0.1	-0.8	465.5	19278.7	19286.7	17.7	-41.8	-0.2

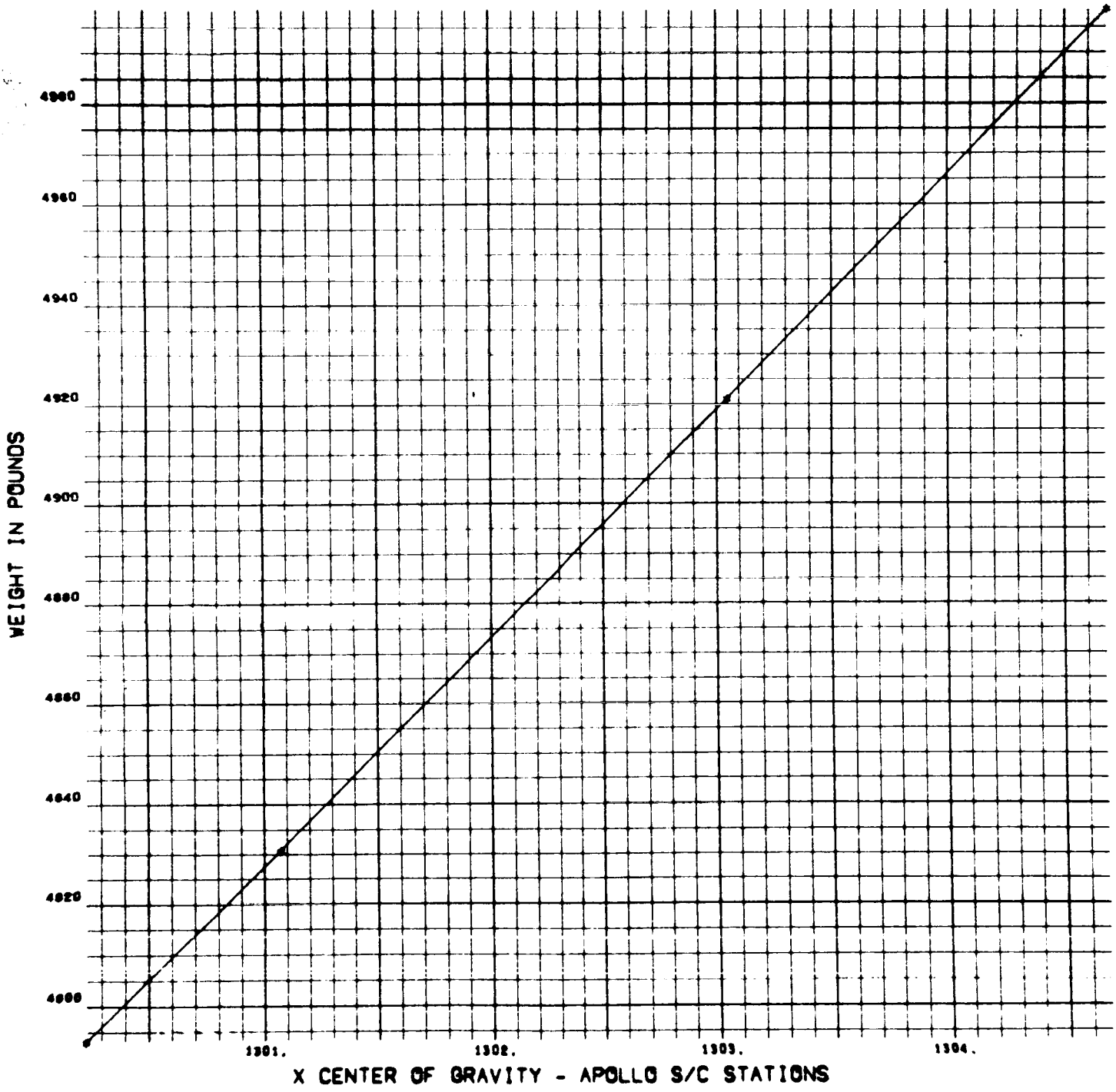
NOTE: *Centers of gravity are given in the Apollo Vehicle Reference System as defined by MD-V14-14-10.

**Moments and products of inertia units are slug feet squared about the centers of gravity.

[redacted]

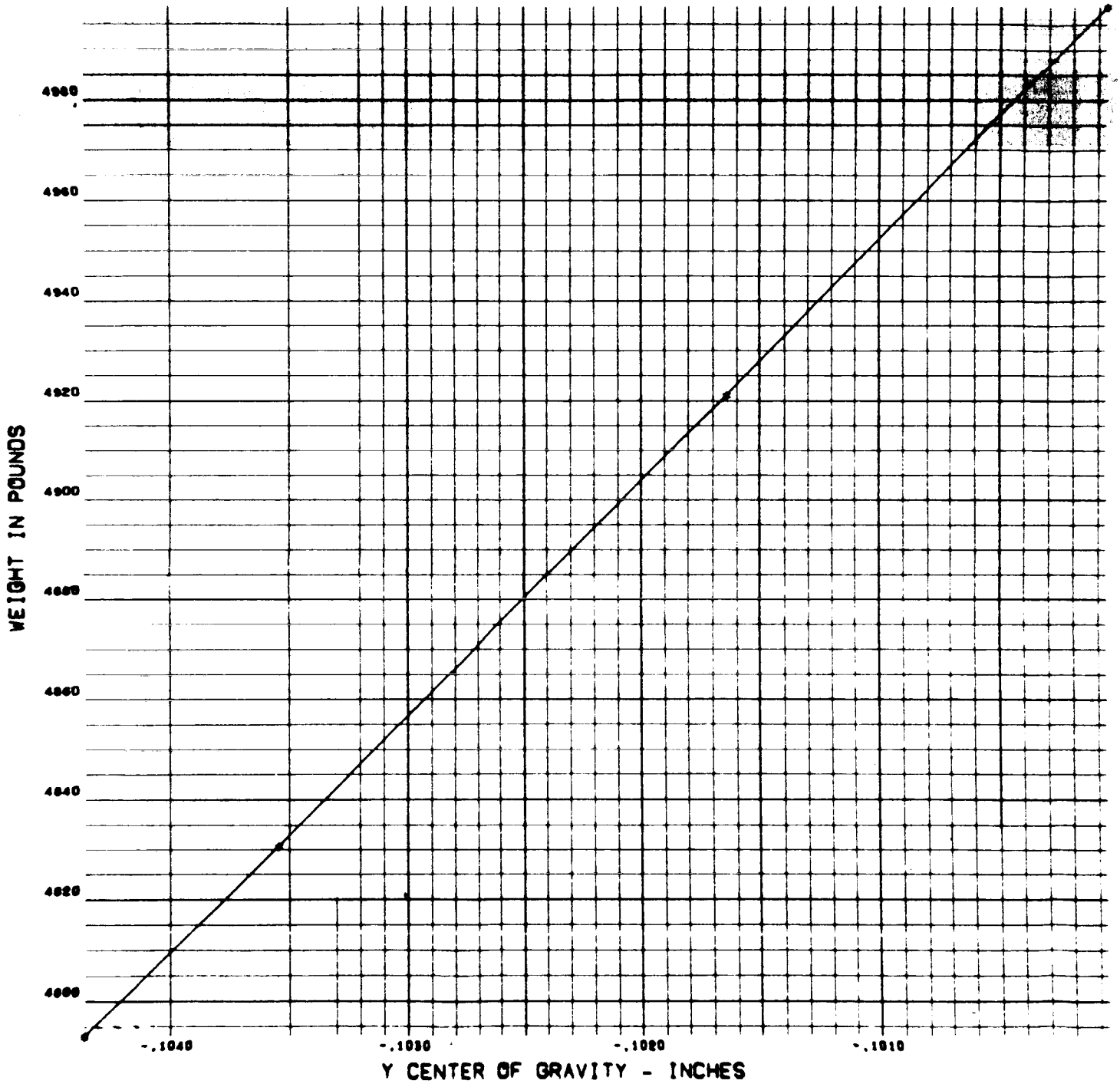
BLOCK II LES JETTISON PHASE CANARDS DEPLOYED CONTROL WT

0613-73
001 000



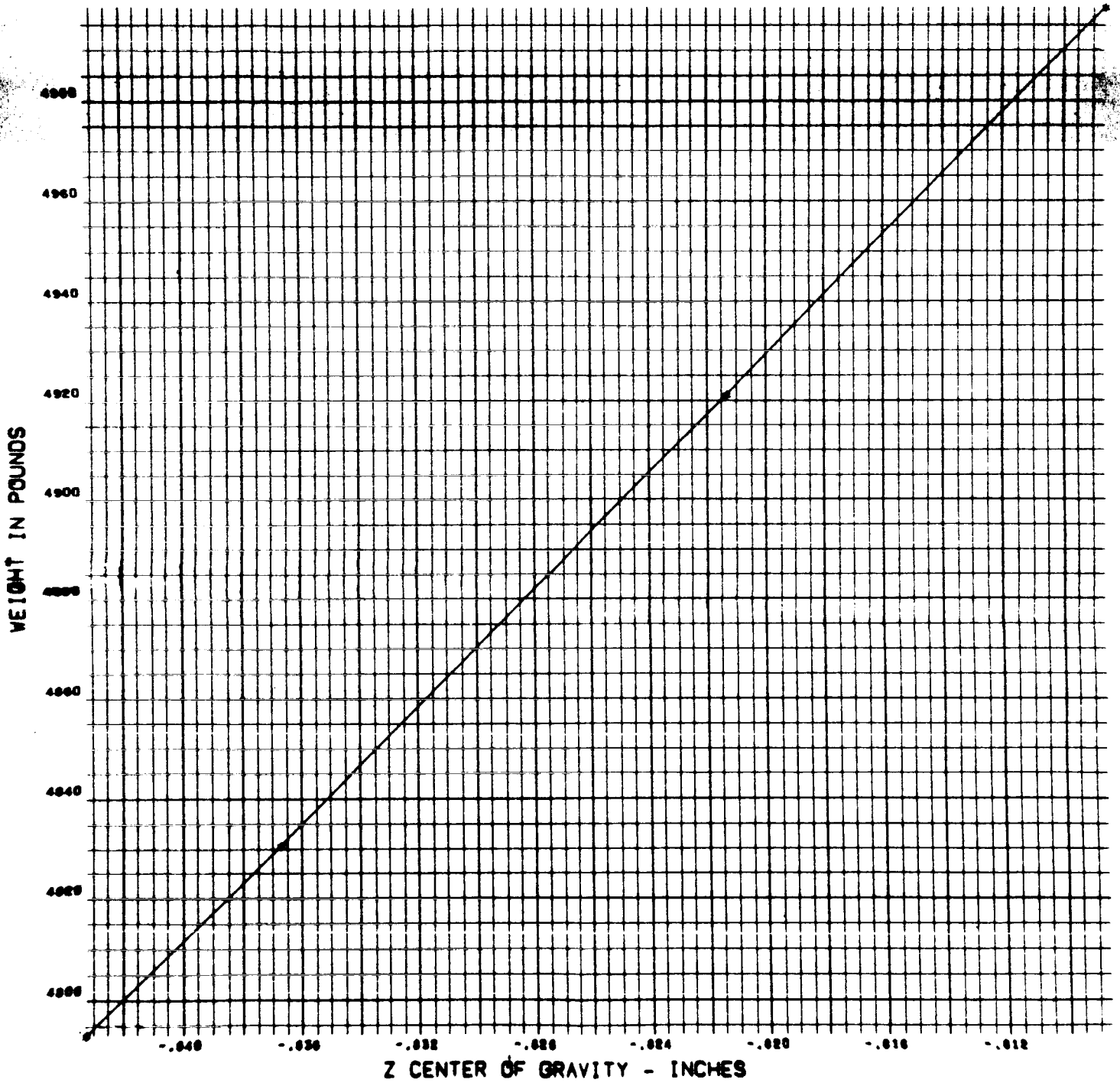
BLOCK II LES JETTISON PHASE CANARDS DEPLOYED CONTROL WT

0613-71
002 000



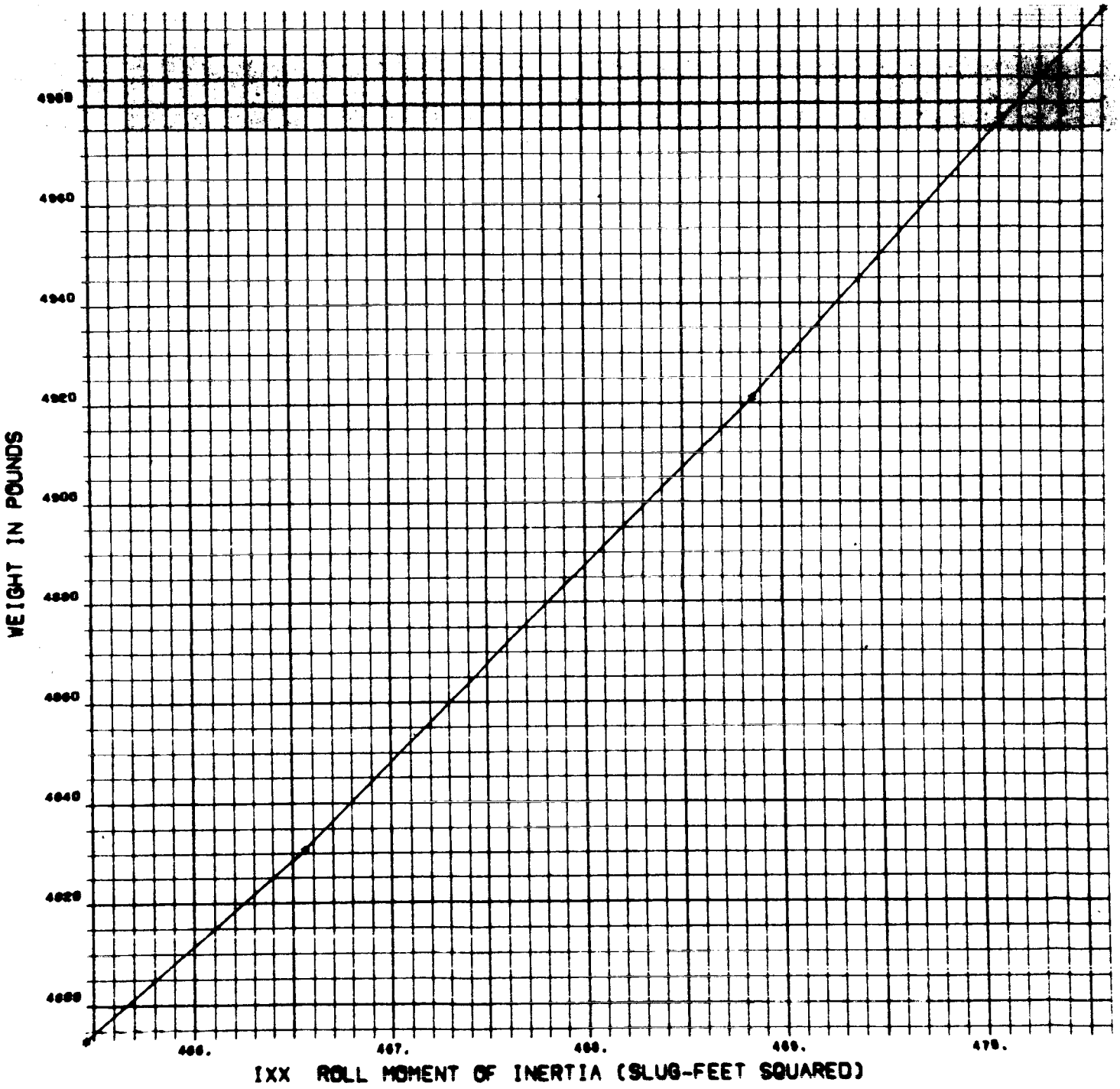
BLOCK II LES JETTISON PHASE CANARDS DEPLOYED CONTROL WT

0613-71
003 000



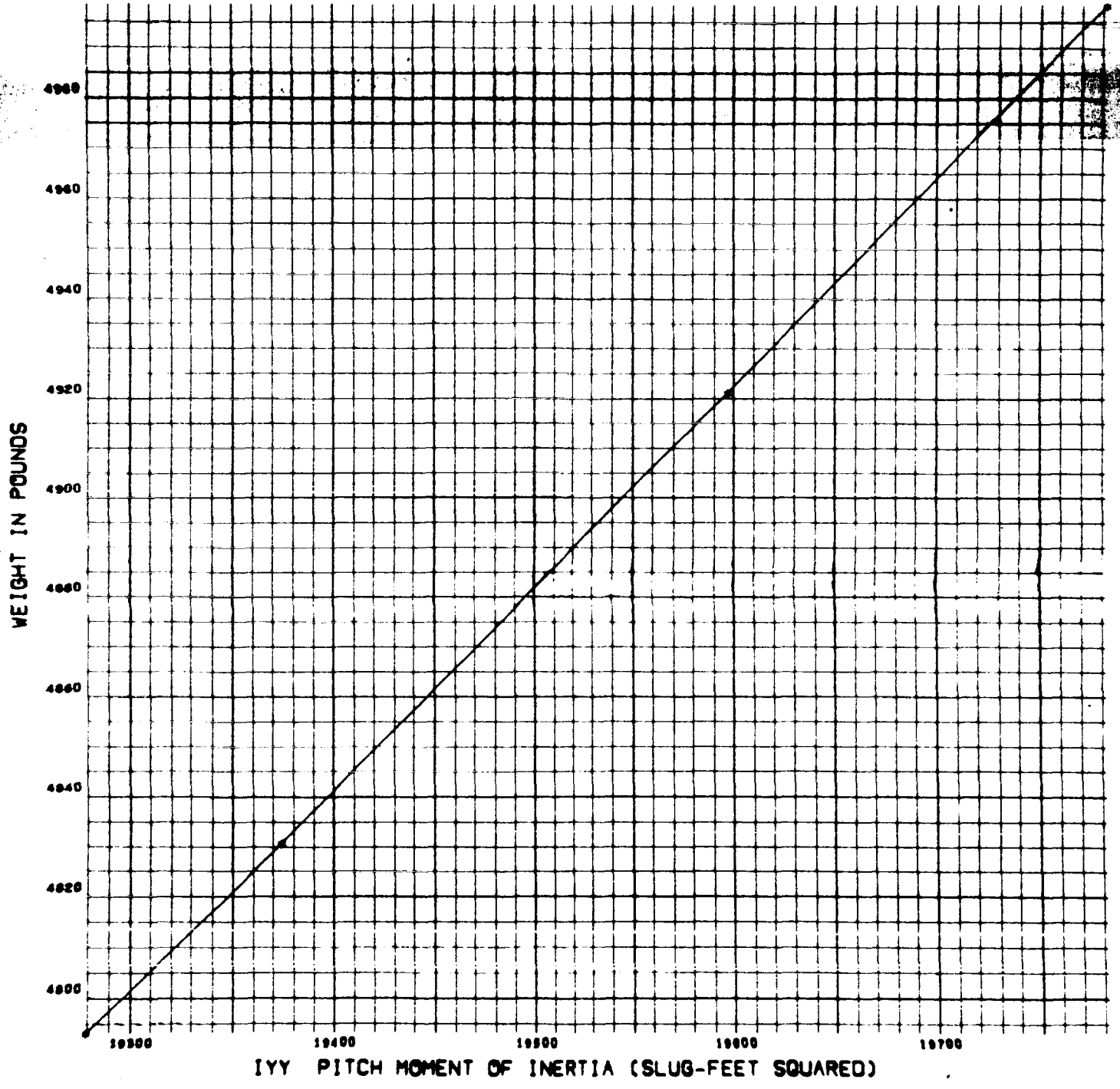
BLOCK II LES JETTISON PHASE CANARDS DEPLOYED CONTROL WT

0613-71
004 000



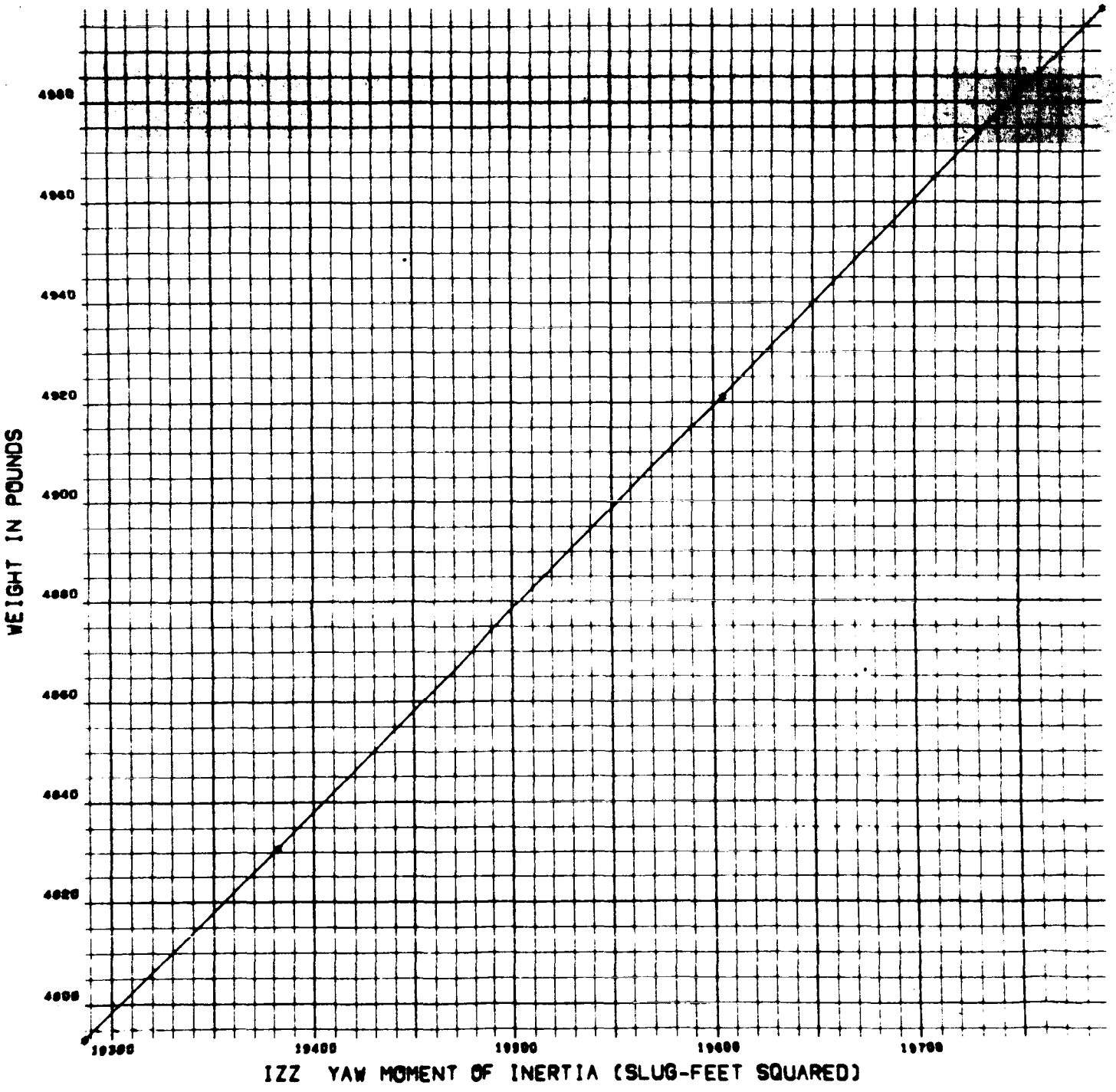
BLOCK II LES JETTISON PHASE CANARDS DEPLOYED CONTROL WT

0613-71
005 000



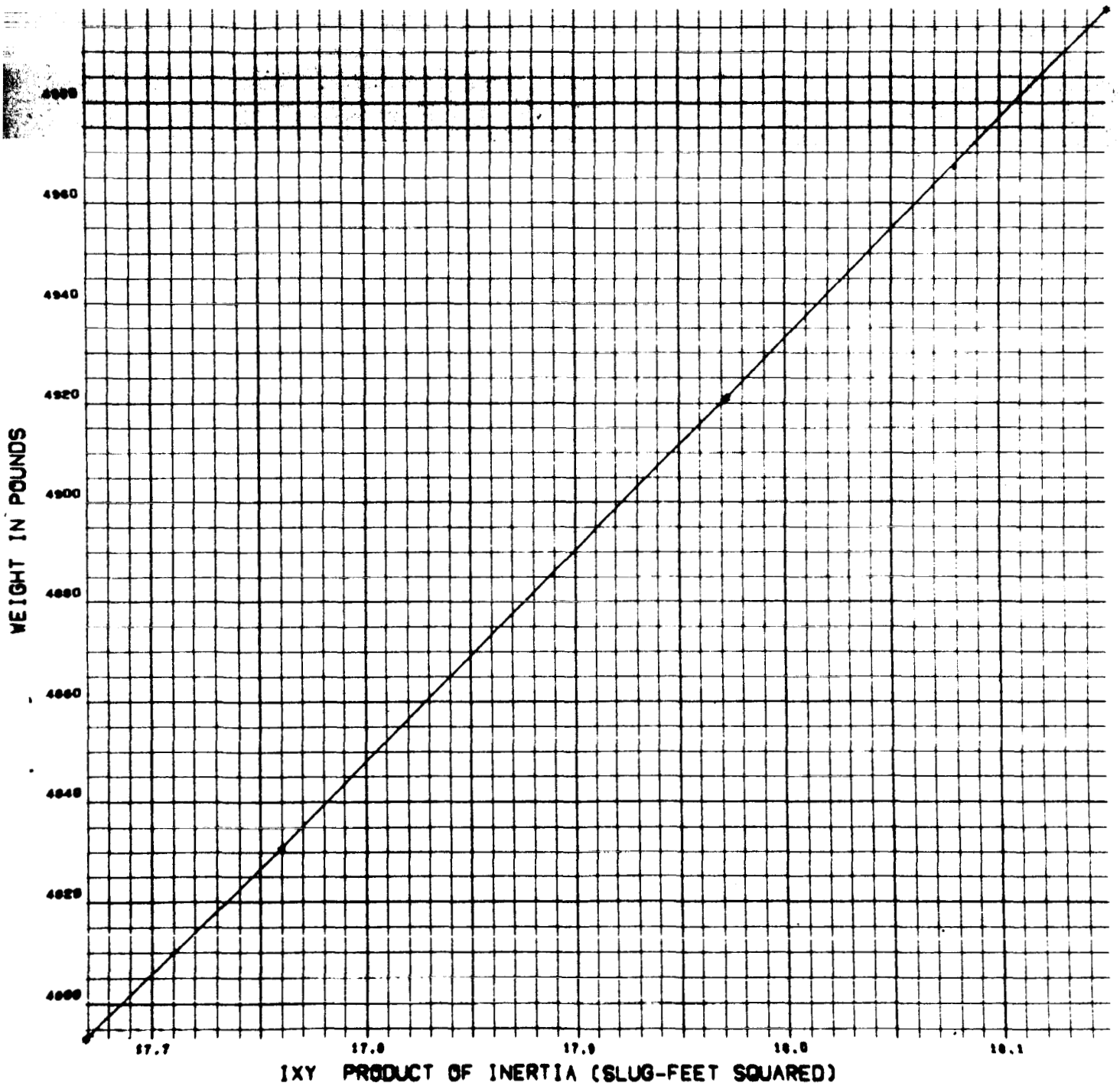
BLOCK II LES JETTISON PHASE CANARDS DEPLOYED CONTROL WT

0613-73
006 000



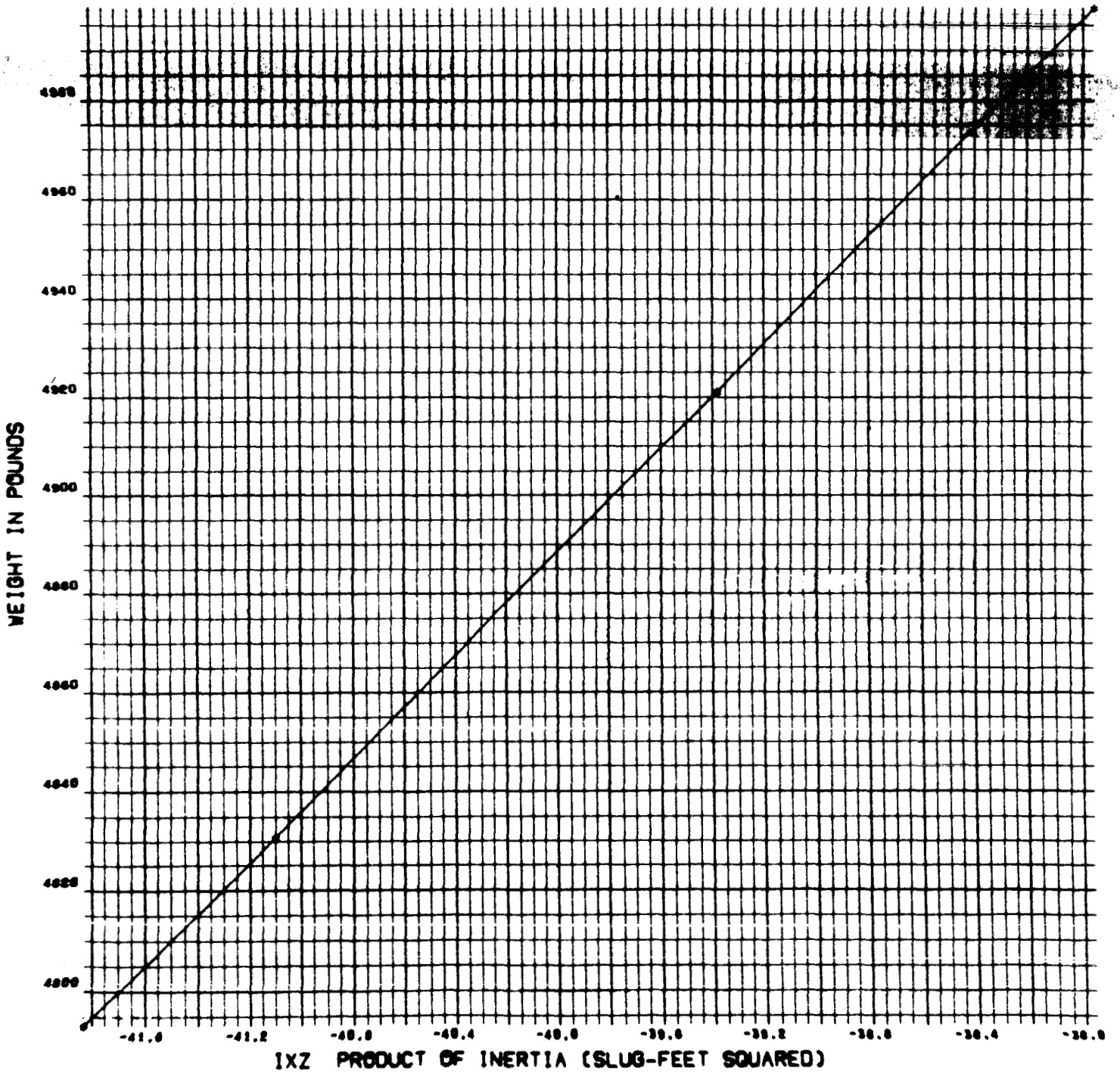
BLOCK II LES JETTISON PHASE CANARDS DEPLOYED CONTROL WT

0613-71
007 000



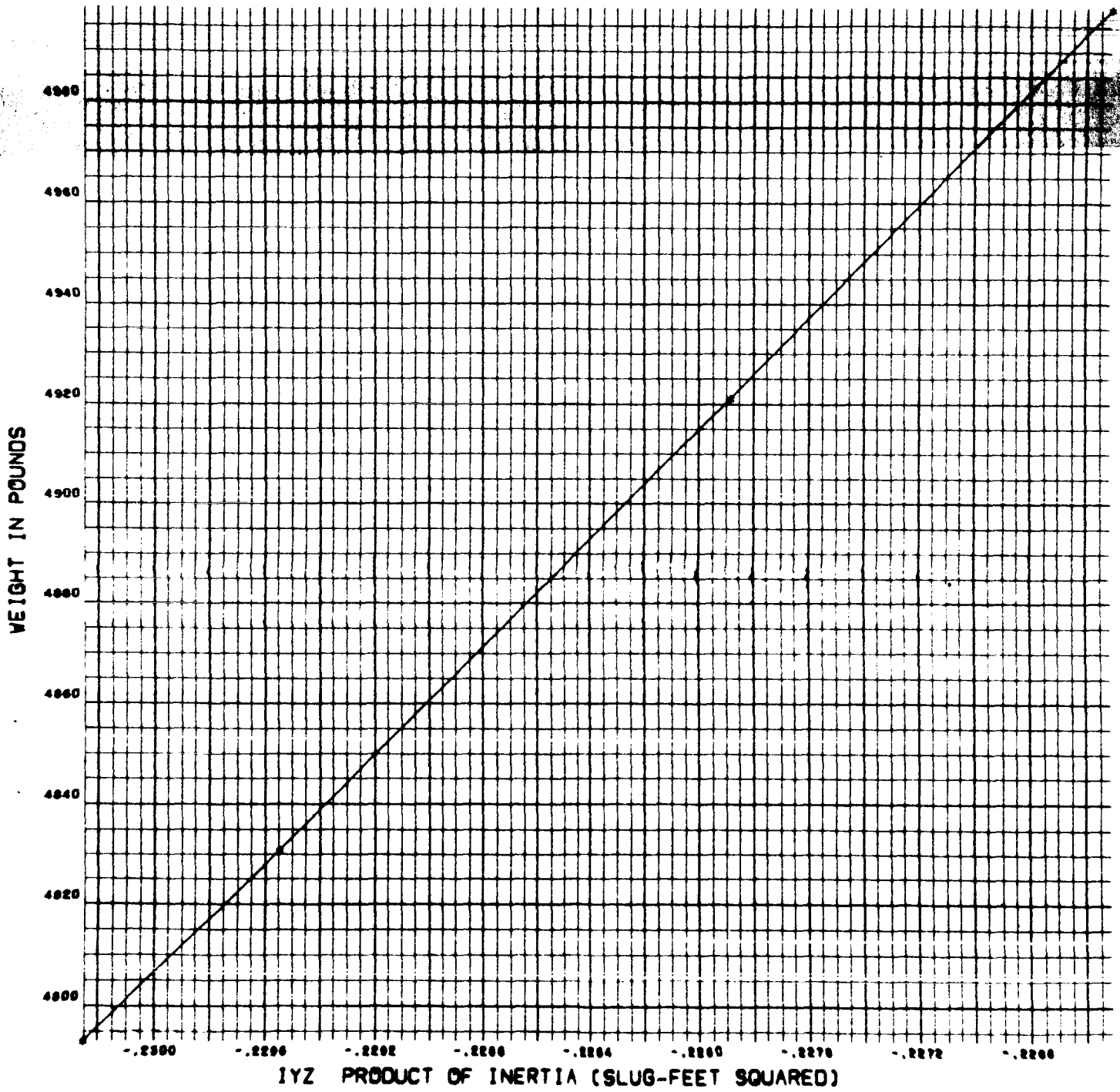
BLOCK II LES JETTISON PHASE CANARDS DEPLOYED CONTROL WT

0613-71
008 000



BLOCK II LES JETTISON PHASE CANARDS DEPLOYED CONTROL WT

0513-71
009 000



RECOVERY CONFIGURATION DEFINITION

1. GENERAL

The recovery, descending, or "Hung" weight definition falls into two categories as follows:

A. Abort Condition

Launch weight minus items expended, deployed, jettisoned or ejected during the abort phase prior to main chute deployment.

Variation: Retention of specific items (normally not on board at this phase) to establish critical conditions for design criteria is the prerogative of the design groups and are to be considered as special loadings. Weight Group analysis are based on the mass characteristics of the vehicle at or during a specific series of events.

B. Normal Mission

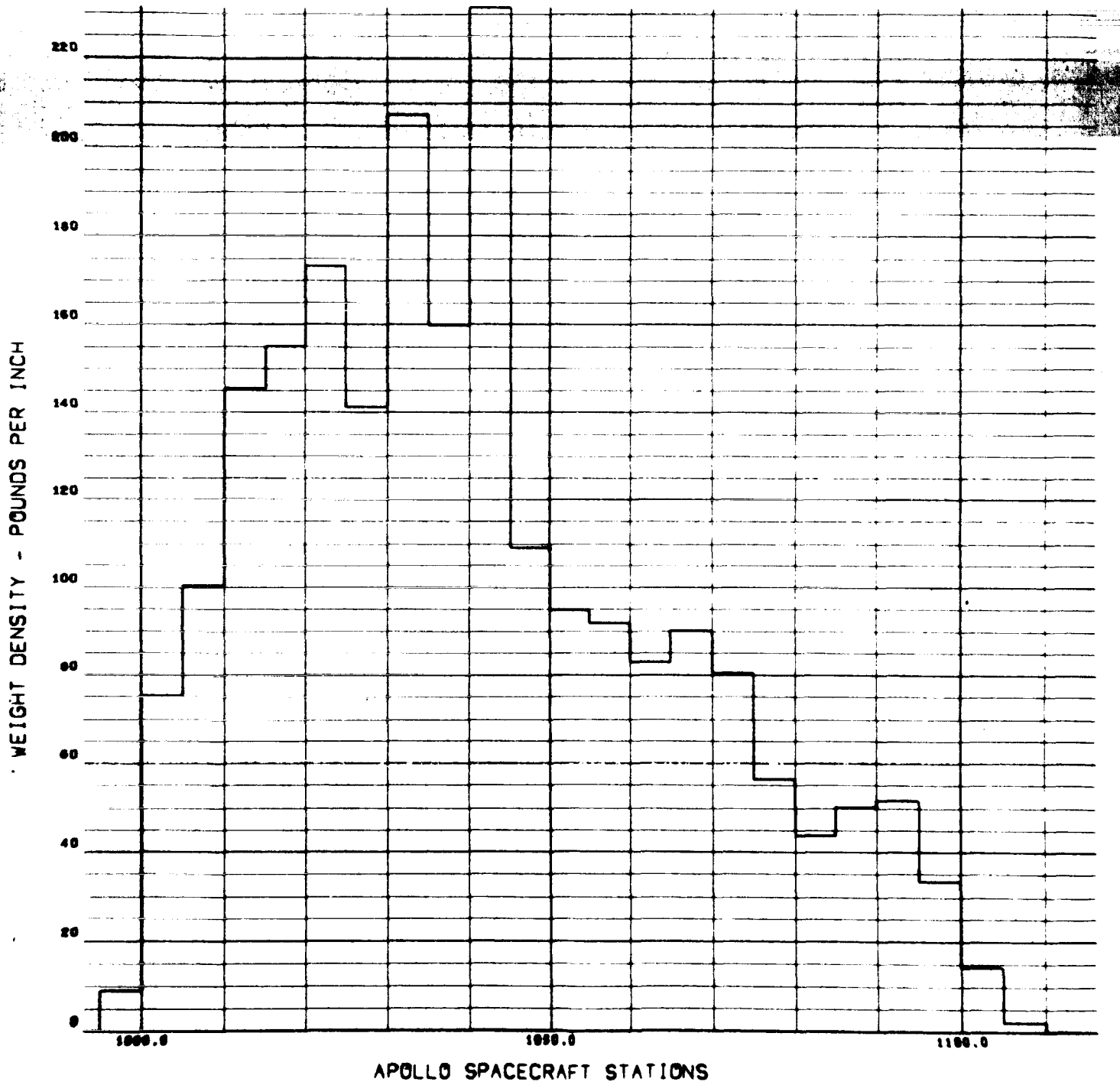
Launch weight plus or minus items accumulated, expended, deployed, jettisoned or ejected during the normal mission phase prior to main chute deployment.

Variation: See item A variation

2. RECOVERY WEIGHT ANALYSIS

The mission analyzed herein is the abort condition. The recovery weight is derived from the 11,000 pound Command Module Control Weight (Launch) minus oxidizer, forward heat shield, drogue chutes and LEM docking provisions. Design contingencies were then added to arrive at the 11,000 pound recovery weight.

CM BLOCK II RECOVERY WT JAN 1965 WEIGHT DISTRIBUTION RUN 13 JAN 1965 G613-58 001 000



FLOTATION CONFIGURATION DEFINITION

1. GENERAL

The Impact or Flotation Weight definition falls into two categories as follows:

A. Abort Condition

Launch weight minus items expended, deployed, jettisoned or ejected during the abort phase prior to impact.

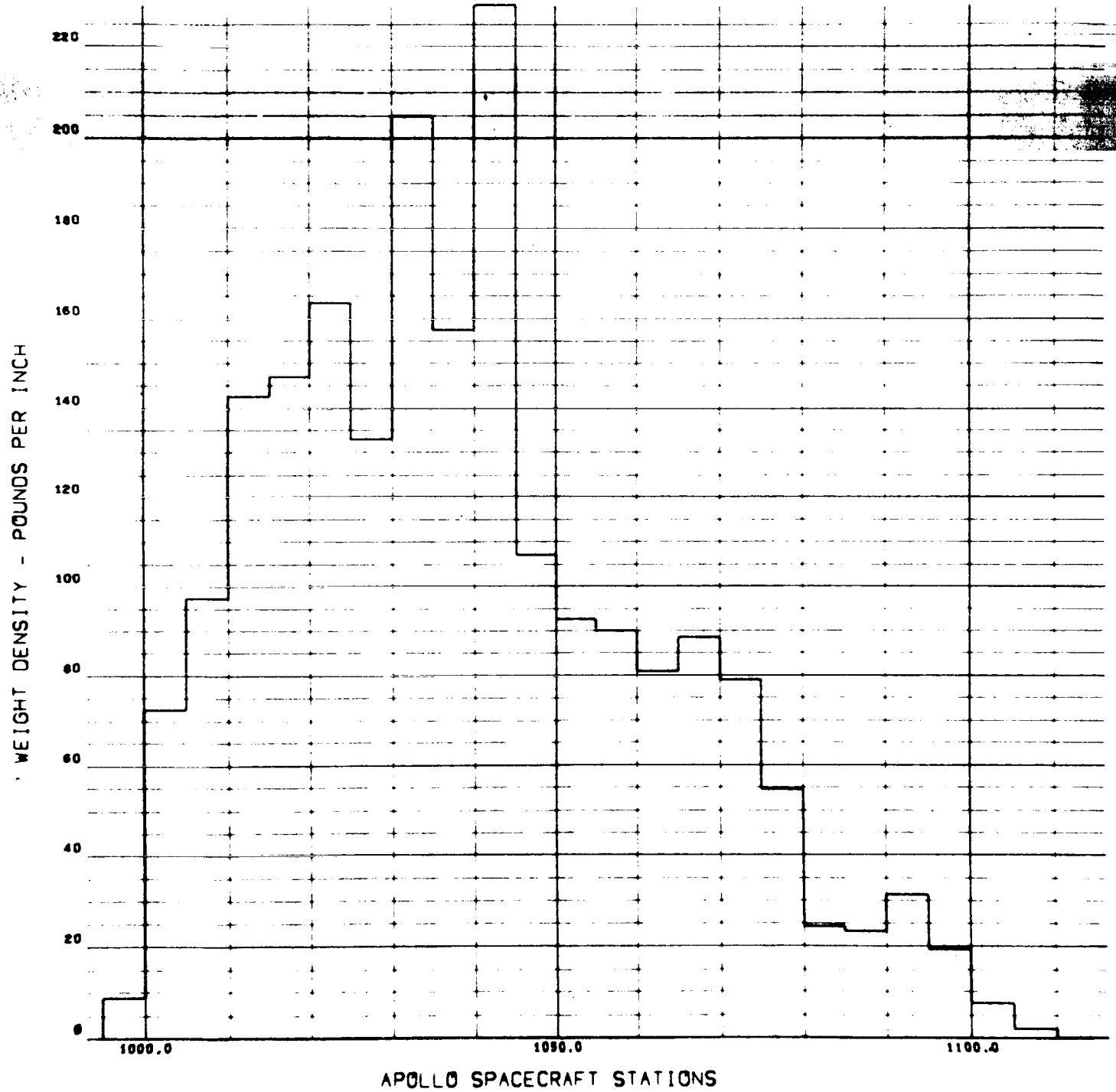
B. Normal Mission

Launch weight plus or minus items accumulated, expended, deployed jettisoned or ejected during the normal mission phase prior to impact.

2. FLOTATION WEIGHT ANALYSIS

The mission analyzed herein is the abort condition. The impact/flotation weight is derived from the 11,000 pound Command Module control weight (launch), adjusted by the addition of 500 pounds of design contingencies (simulating an 11,500 pound Command Module at launch). The propellant, forward heat shield, drogue chutes, main chutes and LEM docking provisions are then removed to establish the impact/flotation weight.

CM BLOCK II FLOTATION WT JAN 1965 WEIGHT DISTRIBUTION RUN 13 JAN 1965 0613-61 001 006



BLOCK II

SPACECRAFT MASS PROPERTIES SUMMARY

TRANSLUNAR FLIGHT CONDITION

(LEM COMPLETE DOCKED - LESS CREW)

ITEM	WEIGHT	CENTERS OF GRAVITY*			MOMENT OF INERTIA**			PRODUCTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
COMMAND MODULE	11000	1043.3	-0.2	6.3	4949.9	4364.8	4057.6	15.2	-278.7	30.5
SERVICE MODULE	10200	915.4	-4.3	7.5	7103.9	10850.9	10814.5	-421.7	387.7	-633.9
ADAPTER RING	75	837.1	0.0	-1.8	93.3	47.6	45.7	0.0	0.2	0.0
TOTAL	21275	981.3	-2.2	6.8	12169.3	34290.7	33962.0	187.5	-45.9	-609.3
S/M PROPELLANT (MAX)	41210	906.0	0.1	0.0	21516.0	21036.0	28486.5	255.4	-111.8	3987.9
TOTAL	62485	931.6	-0.7	2.3	33842.8	72619.5	79615.3	-73.3	1402.8	3331.6
LEM DOCKED	29500	1232.5	0.0	0.0	19409.0	21485.0	21219.0	0.0	0.0	0.0
TOTAL S/C - FLIGHT	91985	1028.1	-0.5	1.6	53277.3	485687.9	492396.3	800.1	-1631.1	3324.8

NOTE: *Centers of gravity are given in the Apollo Vehicle Reference System as defined by MD-V14-14-10.

**Moments and products of inertia units are slug feet squared about the centers of gravity.

BLOCK II

SPACECRAFT MASS PROPERTIES SUMMARY

RENDEZVOUS FLIGHT CONDITION

(LEM ASCENT STAGE DOCKED - LESS CREW)

ITEM	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**			PRODUCTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
COMMAND MODULE	11000	1043.3	-0.2	6.3	4949.9	4364.8	4057.6	15.2	-278.7	30.5
SERVICE MODULE	10200	915.4	-4.3	7.5	7103.9	10850.9	10814.5	-421.7	387.7	-633.9
ADAPTER RING	75	837.1	0.0	-1.8	93.3	47.6	45.7	0.0	0.2	0.0
TOTAL	21275	981.3	-2.2	6.8	12169.3	34290.7	33962.0	187.5	-45.9	-609.3
S/M PROPELLANT	11100	876.7	27.3	-11.5	3693.0	2936.7	3480.6	-0.4	1826.3	-0.4
TOTAL	32375	945.4	7.9	0.6	17759.2	54967.9	56020.1	-4663.2	4800.5	-1460.8
LEM ASCENT DRY	5000	1166.0	0.0	0.0	2700.0	2500.0	1500.0	0.0	0.0	0.0
TOTAL S/C - FLIGHT	37375	974.9	6.9	0.5	20518.4	102958.8	103069.6	-6300.0	4685.7	-1456.7

NOTE: *Centers of gravity are given the Apollo Vehicle Reference System as defined by MD-V14-14-10.

**Moments and products of inertia units are slug feet squared about the centers of gravity.

BLOCK II

SPACECRAFT MASS PROPERTIES SUMMARY

S-IVB, LEM AND ADAPTER AT TRANSPOSITION DOCKING

ITEM	WEIGHT	CENTERS OF GRAVITY*			MOMENT OF INERTIA**			PRODUCTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
S-IVB STAGE	34360	87.6	4.3	-2.2	67610.0	71660.0	71650.0	0.0	0.0	0.0
I.U. PACKAGE	4150	487.0	-6.1	-9.8	13569.0	7219.0	6582.0	0.0	0.0	0.0
TOTAL	38510	130.6	3.2	-3.0	81311.6	406416.7	405810.0	-3325.8	-2426.0	63.2
LEM ADAPTER - OPEN	3713	497.3	1.3	-3.3	17053.0	13068.0	12640.0	-0.1	89.7	-10.9
TOTAL	42223	162.9	3.0	-3.0	98367.2	517752.7	516720.5	-3823.5	-2411.6	52.7
LUNAR EXCURSION MODULE	29500	588.5	0.0	0.0	19409.0	21485.0	21219.0	0.0	0.0	0.0
TOTAL SPACECRAFT	71723	337.9	1.8	-1.8	117845.0	1218297.4	1216998.5	-8632.0	2444.3	18.3

NOTE: *Centers of gravity are given in the Apollo Vehicle Reference System as defined by MD-V14-14-10.

**Moments and products of inertia units are slug feet squared about the centers of gravity.