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SID 65-68

DESIGN WEIGHTS - GROUND SUPPORT EQUIPMENT (GSE) FOR BLOCK I AND BLOCK II APOLLO SPACECRAFT

(U)

26 JANUARY 1965

Exhibit I, Paragraph 8.10

N79-76238

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TECHNICAL REPORT INDEX/ABSTRACT

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ABSTRACT

This report contains weight, center of gravity and moment of inertia data for the design of Ground Support Equipment. These data are based on the control weights of the Block I and Block II Apollo Spacecraft.

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FORM 131-V REV. 6-64

SECTION I

INTRODUCTION

The mass properties data presented in this report are for the design of Ground Support Equipment only.

Three configurations are included: Block I Spacecraft, Block II Spacecraft with Service Module Sector 1 empty and Block II Spacecraft with Service Module Sector 1 containing a GFE Package as defined by IL 693-400-040-64-II-02-038 from A. B. Kehlat, subject: Request for Immediate Block II Support, dated 17 September 1964. Enclosure (1) Block II Bulletin VS-22. The configuration data including this GFE package are for information only.

The three configurations are further defined as to the GSE functions of weight and balance, handling and transportation.

The Block I data are based on the control weights of SID 64-1700, Mass Properties Data - Block I Control Weights for the Apollo Spacecraft, dated 16 October 1965.

The weight data for Block II are preliminary and will be revised, where necessary, with the publication of SID 64-2142, Mass Properties Data - Block II Control Weights for the Apollo Spacecraft in January 1965.

The reported Design Weights are maximum for the vehicle configuration which are to be handled by the ground support equipment, no additional growth has been included.

Centers of gravity and moment of inertia data are included for the individual modules and various combination of modules and propellants.

The Launch Escape System is reported with maximum ballast installed. The Boost Cover is shown separated from the LES tower and motors in the Individual Mass Properties presentations, in the Summary pages the system is presented with the Boost Cover joined to the tower and motor portions.

The Lunar Excursion Module weight data are included in the Maximum Weight and Special Configuration items of the Block I and II sections. The LEM data is contained in or extrapolated from Grumman Aircraft Engineering Corporation, LEM Engineering Memorandum LMO-490-109A, dated 13 November 1964. The LEM weight will be increased to 32,000 pounds in the near future.

The weight of the LEM presented for SA501 and SA502 missions, in the Maximum Weights of Block I is contained in MSFC Memo R-P&VE-RAW-64-139, subject: Saturn V Preliminary Mass Characteristics Based on Control Weights, dated 27 November 1964.

The control weight of the Saturn LEM Adapter is 3800 pounds. In missions where the LEM is not carried, the adapter weight is 3900 pounds. The increased weight is for supports in the lower portion of the SLA.

The adapter in the Individual Mass Properties pages, is separated into upper and lower sections.

NOTE: The weight data of this report have been prepared for the express use in the design of ground support equipment and is not to be incorporated in the spacecraft design. For further information please contact Mr. H. M. Dunn, Apollo Engineering Weight Control Group.

GSE FUNCTIONAL DEFINITIONS

WEIGHT AND BALANCE

The weights presented in these sections are those for the handling and support of the various spacecraft modules during all weight and balance operations.

The Command Module will not have the Automatic Checkout Equipment (ACE) on board during weight and balance operations at any facility.

The module weights quoted are for wet configurations, including all fluids and gases except usable SPS Propellants, to account for the possibility of the ballasting of the modules to simulate design and/or control weights.

Additional growth or design margins have not been added to the reported weights.

HANDLING AND TRANSPORTATION

The weight configurations for the design of the Handling and Transporting GSE are maximum, and include the ACE on board the Command Module.

During the handling and transportation functions, supports and protective covers will be utilized, these additional weights have not been included in this report.

Additional growth or design margins have not been added to the reported weights.

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SECTION II

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GSE DESIGN WEIGHTS

BLOCK I - WEIGHT AND BALANCE

INDIVIDUAL MODULE MASS PROPERTIES

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
LAUNCH ESCAPE SYSTEM	(8500)	(1306.1)	(0.0)	(0.0)	(531)	(22770)	(22770)
LES AND TOWER	8220	1315.1	0.0	0.0	306	18333	18333
BOOST COVER (SOFT)	280	1044.1	-1.2	-1.2	225	131	131
COMMAND MODULE	11500	1043.1	0.1	5.2	5250	4579	4122
SERVICE MODULE	10200	909.6	0.8	-1.3	6618	10619	10377
SATURN LEM ADAPTER	(3900)	(643.4)	(0.0)	(0.0)	(9660)	(13289)	(13171)
UPPER SECTION	2507	697.8	0.0	0.0	5324	6331	6316
LOWER SECTION	1393	545.4	0.0	0.0	4336	2475	2372

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

** Moment of inertia units are slug feet squared about the centers of gravity.

[redacted]

GSE DESIGN WEIGHTS

BLOCK I - WEIGHT AND BALANCE

SUMMARY

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
COMMAND MODULE	11500	1043.1	0.1	5.2	5250	4579	4122
SERVICE MODULE	10200	909.6	0.8	-1.3	6618	10619	10377
TOTAL	21700	980.3	0.4	2.1	11918	36042	35294
SATURN LEM ADAPTER	3900	643.4	0.0	0.0	9660	13289	13171
TOTAL	25600	929.0	0.4	1.8	21581	130346	129477
LAUNCH ESCAPE SYSTEM	8500	1306.1	0.0	0.0	531	22770	22770
TOTAL	34100	1023.0	0.3	1.4	22117	349019	348147

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

** Moment of inertia units are slug feet squared about the centers of gravity.

[redacted]

GSE DESIGN WEIGHTS

BLOCK I - WEIGHT AND BALANCE

COMMAND MODULE AND LAUNCH ESCAPE SYSTEM

SUMMARY

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
COMMAND MODULE	11500	1043.1	0.1	5.2	5250	4579	4122
LAUNCH ESCAPE SYSTEM	8500	1306.1	0.0	0.0	531	22770	22770
TOTAL	20000	1154.9	0.1	3.0	5809	100361	99877

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

** Moment of inertia units are slug feet squared about the centers of gravity.

[redacted]

GSE DESIGN WEIGHTS

BLOCK I - HANDLING AND TRANSPORTATION

INDIVIDUAL MODULE MASS PROPERTIES

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
LAUNCH ESCAPE SYSTEM	(8500)	(1306.1)	(0.0)	(0.0)	(531)	(22770)	(22770)
LES AND TOWER	8220	1315.1	0.0	0.0	306	18333	18333
BOOST COVER (SOFT)	280	1044 1	-1.2	-1.2	225	131	131
COMMAND MODULE AND ACE	12700	1040.9	1.5	4.4	5498	4821	4422
SERVICE MODULE	10200	909.6	0.8	-1.3	6618	10619	10377
SATURN LEM ADAPTER	(3900)	(643.4)	(0.0)	(0.0)	(9660)	(13289)	(13171)
UPPER SECTION	2507	697.8	0.0	0.0	5324	6331	6316
LOWER SECTION	1393	545.4	0.0	0.0	4336	2475	2772

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

** Moment of inertia units are slug feet squared about the centers of gravity.

[redacted]

GSE DESIGN WEIGHTS

BLOCK I - HANDLING AND TRANSPORTATION

SUMMARY

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
COMMAND MODULE AND ACE	12700	1040.9	1.5	4.4	5498	4821	4422
SERVICE MODULE	10200	909.6	0.8	-1.3	6618	10619	10377
TOTAL	22900	982.4	1.2	1.9	12156	36527	35847
SATURN LEM ADAPTER	3900	643.4	0.0	0.0	9660	13289	13171
TOTAL	26800	933.1	1.0	1.6	21819	132487	131687
LAUNCH ESCAPE SYSTEM	8500	1306.1	0.0	0.0	531	22770	22770
TOTAL	35300	1022.9	0.8	1.2	22355	349124	348323

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

** Moment of inertia units are slug feet squared about the centers of gravity.

[redacted]

GSE DESIGN WEIGHTS

BLOCK I - HANDLING AND TRANSPORTATION

COMMAND MODULE AND LAUNCH ESCAPE SYSTEM

SUMMARY

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
COMMAND MODULE WITH ACE LAUNCH ESCAPE SYSTEM	12700 8500	1040.9 1306.1	1.5 0.0	4.4 0.0	5498 531	4821 22770	4422 22770
TOTAL	21200	1147.2	0.9	2.6	6052	104930	104513

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

** Moment of inertia units are slug feet squared about the centers of gravity.

[redacted]

GSE DESIGN WEIGHTS

BLOCK I

MAXIMUM WEIGHT CONDITION

SUMMARY

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
COMMAND MODULE WITH ACE	12700	1040.9	1.5	4.4	5498	4821	4422
SERVICE MODULE	10200	909.6	0.8	-1.3	6618	10619	10377
TOTAL	22900	982.4	1.2	1.9	12156	36527	35847
SPS PROPELLANT MAXIMUM CAPACITY	45000	911.9	0.0	0.0	23495	25616	33752
TOTAL	67900	935.7	0.4	0.6	35667	78443	85891
SATURN LEM ADAPTER	3800	646.9	0.7	-2.4	9556	13124	13006
TOTAL	71700	920.4	0.4	0.5	45230	156349	163673
LUNAR EXCURSION MODULE FOR SA 501 & 502	21500	588.5	0.0	0.0	14293	16209	16318
TOTAL	93200	843.8	0.3	0.4	59524	565776	573209
LAUNCH ESCAPE SYSTEM	8500	1306.1	0.0	0.0	531	22770	22770
TOTAL	101700	882.5	0.3	0.3	60056	947971	955405

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

** Moment of inertia units are slug feet squared about the centers of gravity.

[redacted]

GSE DESIGN WEIGHTS

SPECIAL CONFIGURATIONS

BLOCK I - SERVICE MODULE WITH FULL SPS PROPELLANT

SUMMARY

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
SERVICE MODULE	10200	909.6	0.8	-1.3	6618	10619	10377
SPS PROPELLANT MAXIMUM CAPACITY	45000	911.9	0.0	0.0	23495	25616	33752
TOTAL	55200	911.5	0.1	-0.2	30117	36248	44140

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

**Moment of inertia units are slug feet squared about the centers of gravity.

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GSE DESIGN WEIGHTS

SPECIAL CONFIGURATIONS

BLOCK I - WEIGHT SUMMARY FOR

MASS PROPERTIES CURVES

	POUNDS
COMMAND MODULE	11500
AUTOMATIC CHECKOUT EQUIPMENT	1200
SERVICE MODULE	10200
SPS PROPELLANT	45000

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BLOCK I GSE DESIGN WEIGHTS CSM SPS PROPELLANT 16 DEC 1964

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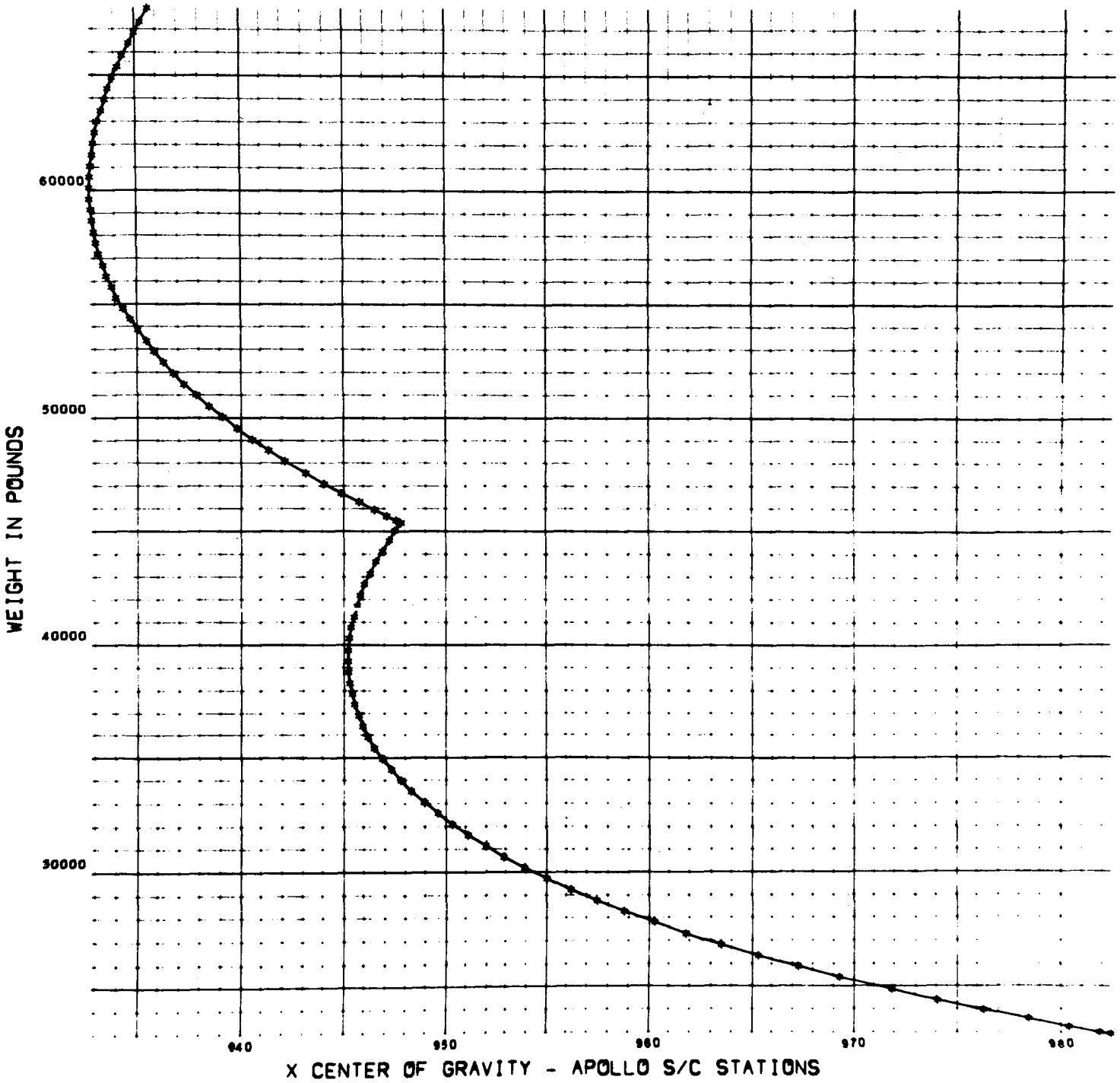

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BLOCK I GSE DESIGN WEIGHTS CSM SPS PROPELLANT 16 DEC 1964

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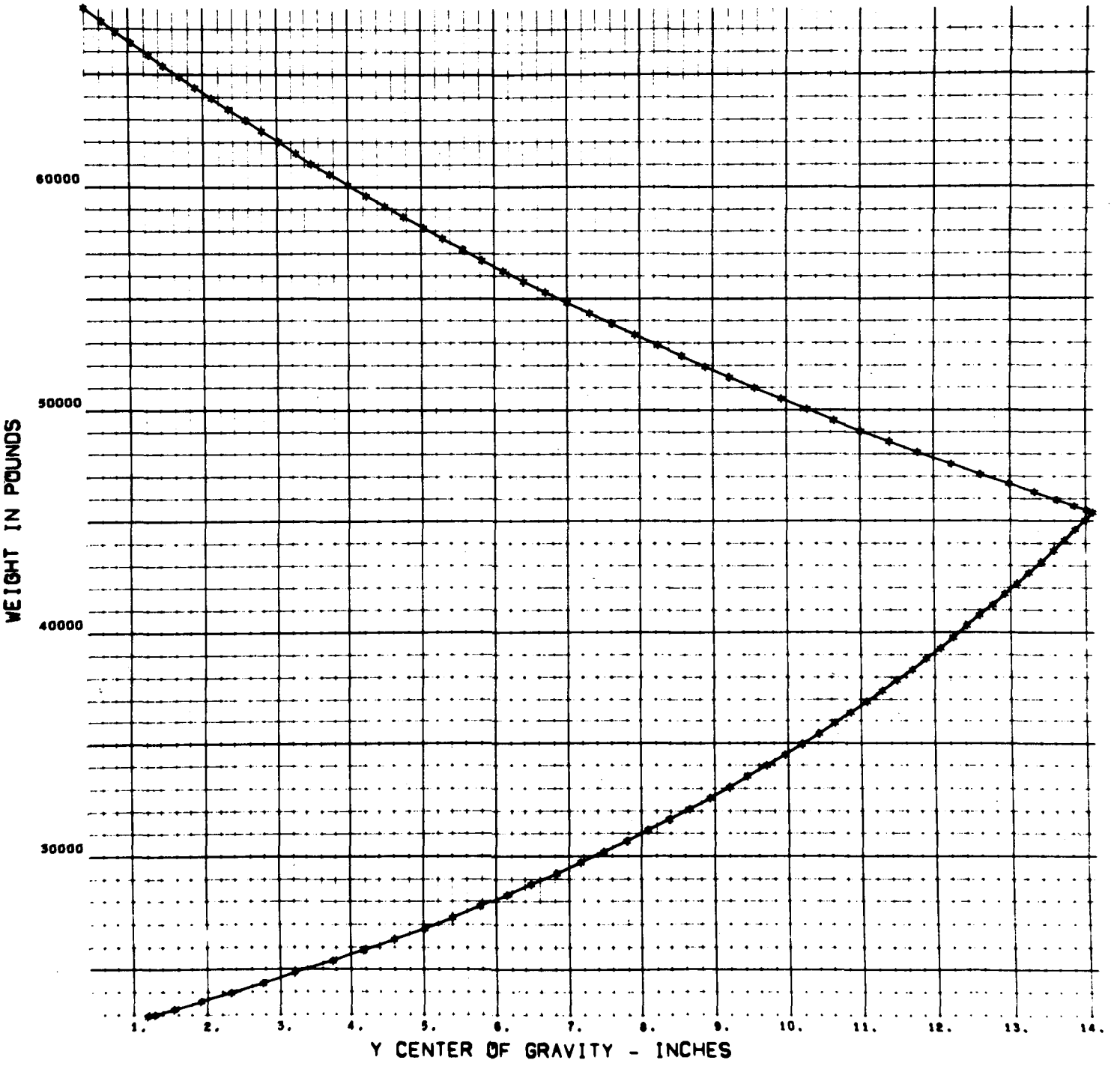

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BLOCK I GSE DESIGN WEIGHTS CSM SPS PROPELLANT 16 DEC 1964

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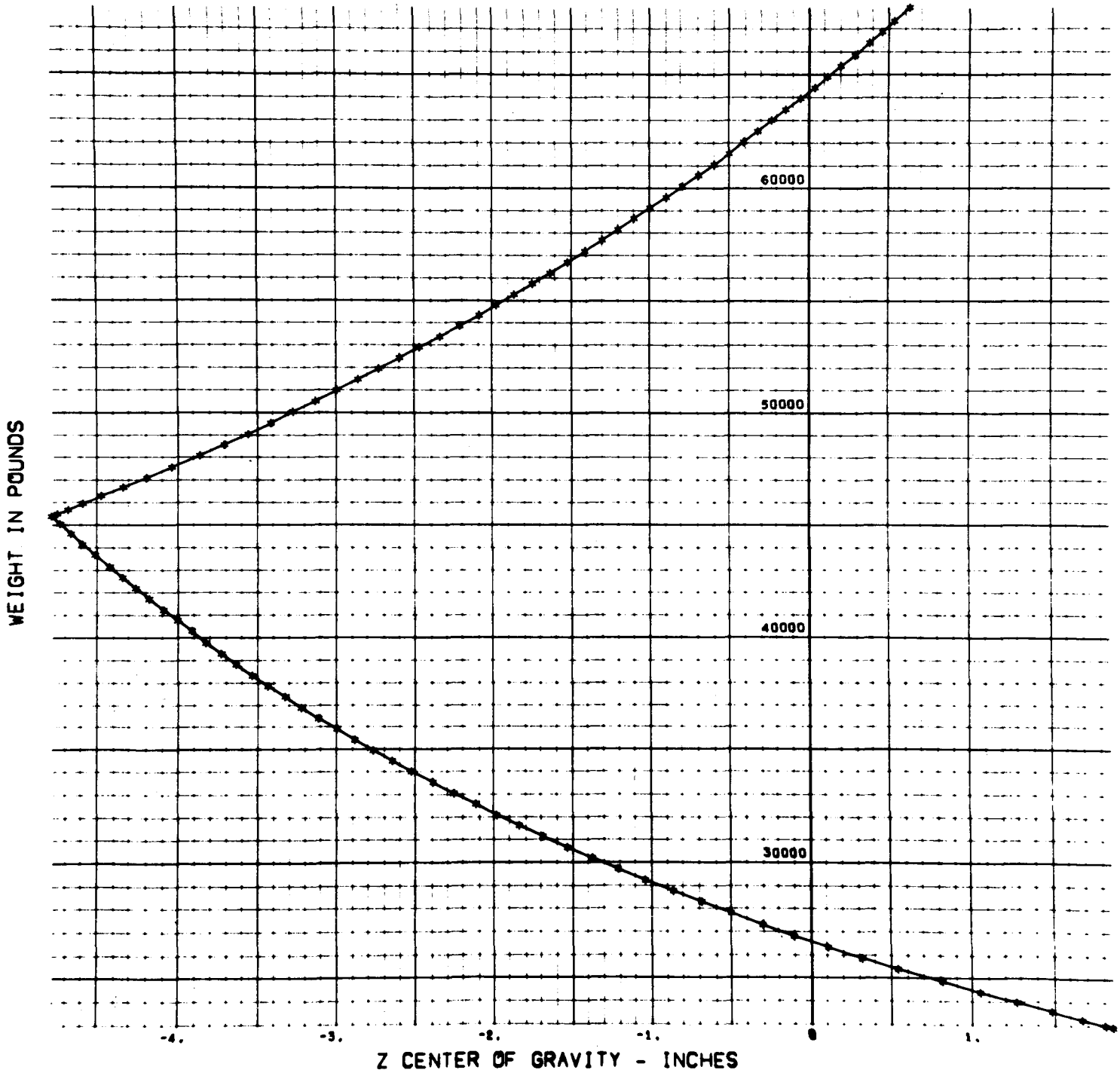

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BLOCK I GSE DESIGN WEIGHTS CSM SPS PROPELLANT 16 DEC 1964

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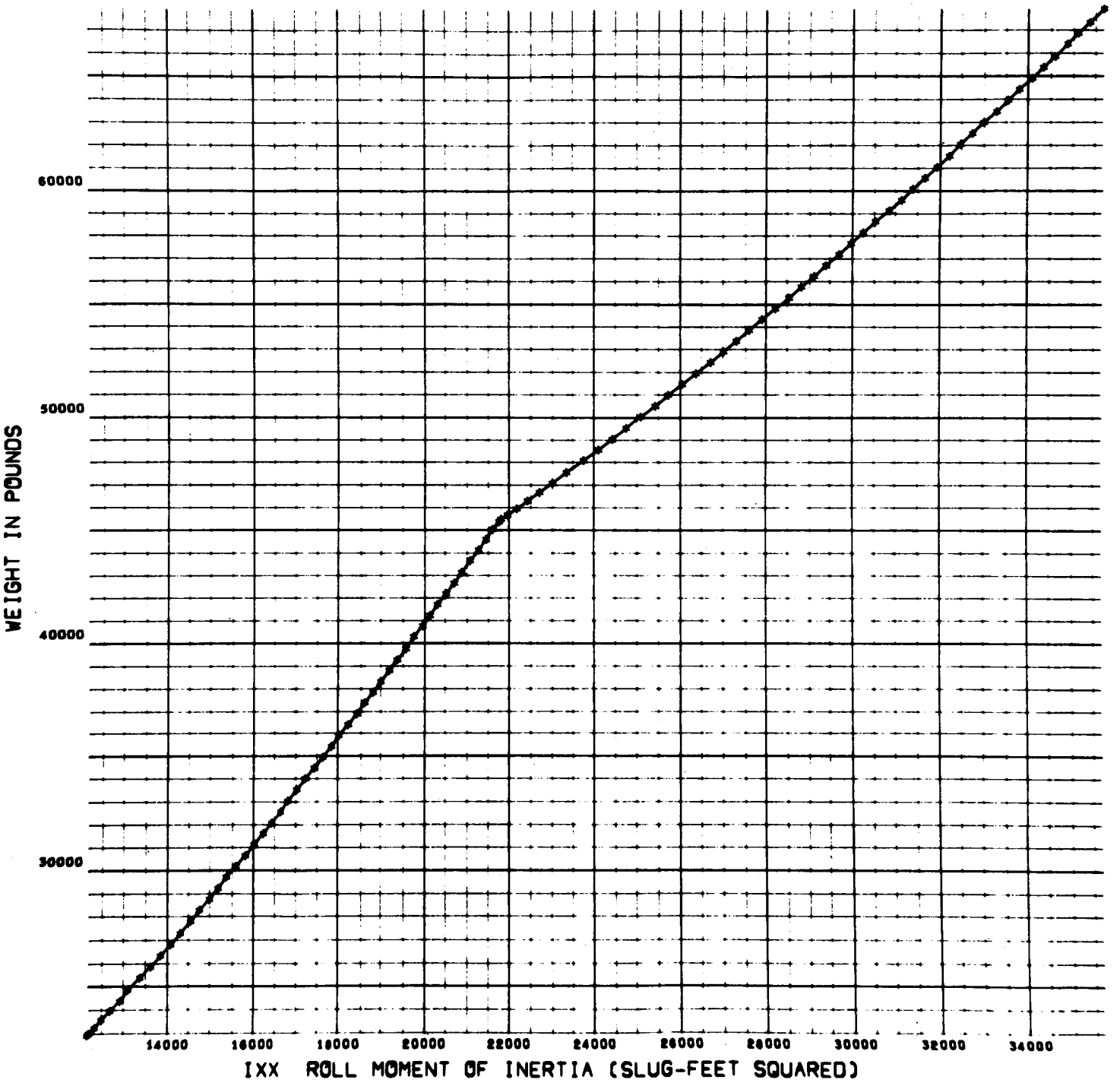

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BLOCK I GSE DESIGN WEIGHTS CSM SPS PROPELLANT 16 DEC 1964

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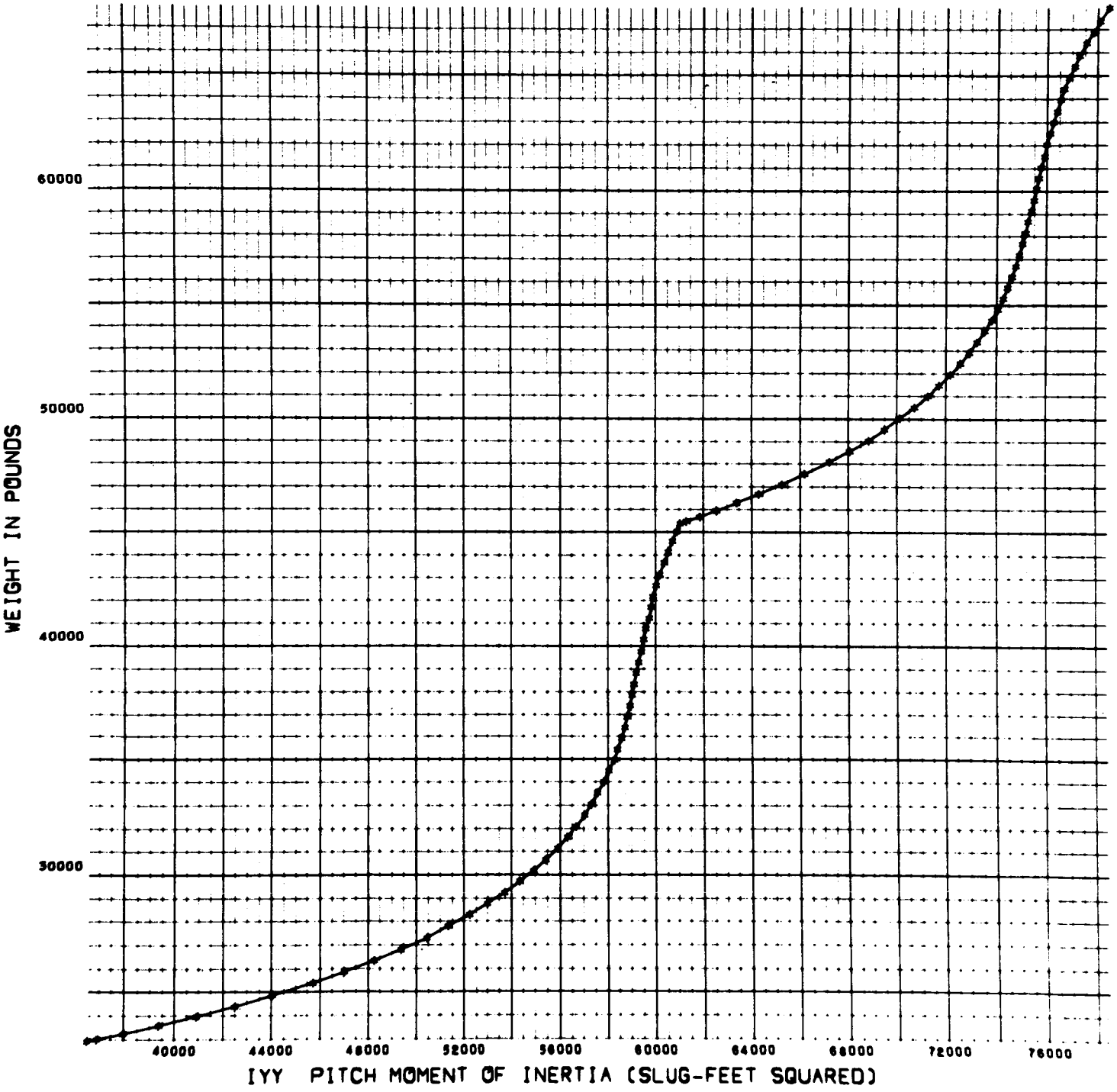

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BLOCK I GSE DESIGN WEIGHTS CSM SPS PROPELLANT 16 DEC 1964

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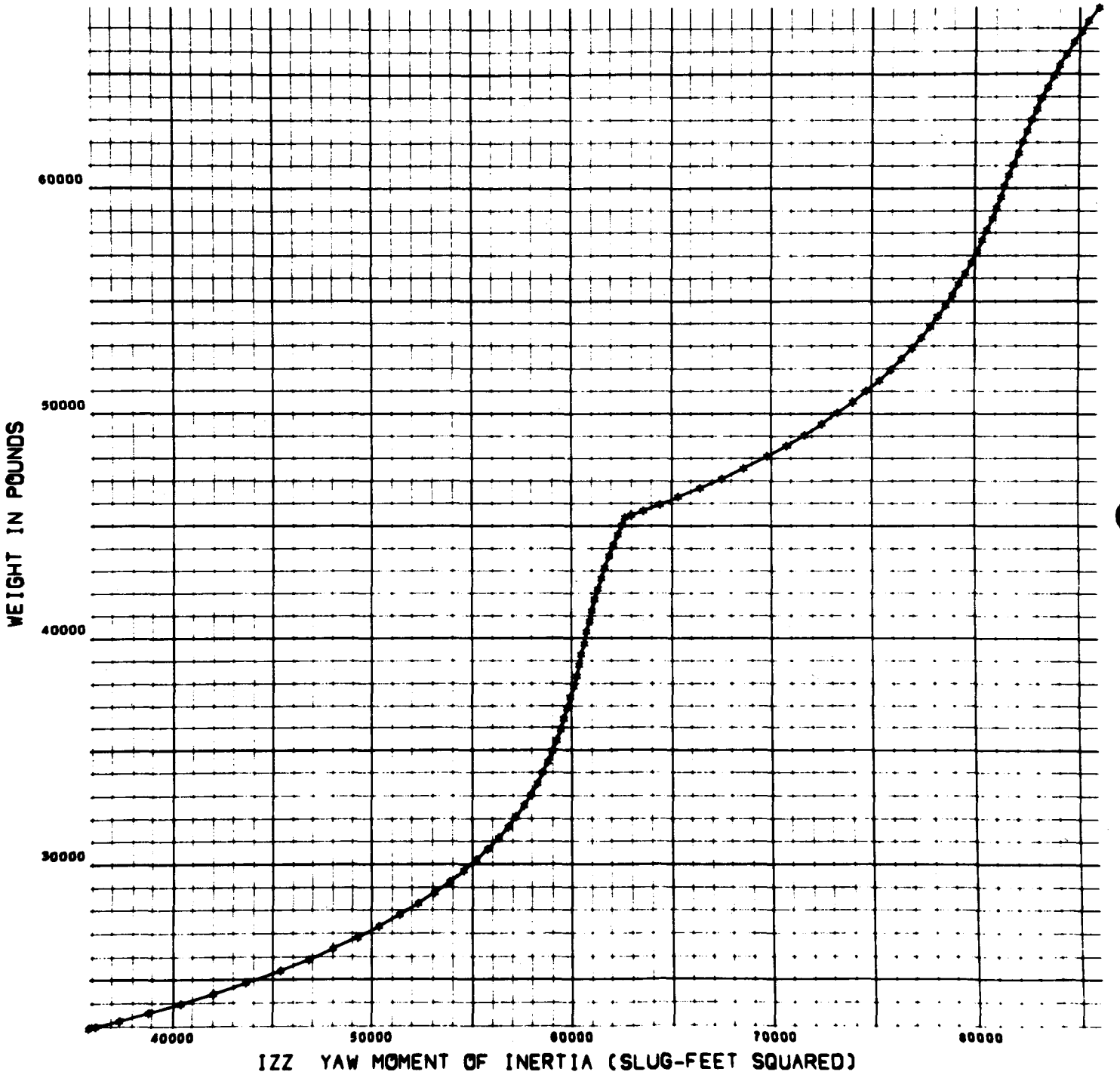

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GSE DESIGN WEIGHTS

SPECIAL CONFIGURATIONS

BLOCK I - SLA LOWER SECTION AND LEM FOR SA501 & SA502

SUMMARY

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
LOWER SECTION OF BLOCK I							
SATURN LEM ADAPTER	1240	540.3	0.5	-0.2	4184	2368	2265
LUNAR EXCURSION MODULE	21500	588.5	0.0	0.0	14293	16209	16318
TOTAL	22740	585.9	0.0	0.0	18477	19165	19171

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

** Moment of inertia units are slug feet squared about the centers of gravity.

GSE DESIGN WEIGHTS

BLOCK II - SERVICE MODULE SECTOR I EMPTY

WEIGHT AND BALANCE

INDIVIDUAL MODULE MASS PROPERTIES

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
LAUNCH ESCAPE SYSTEM	(8500)	(1306.1)	(0.0)	(0.0)	(531)	(22770)	(22770)
LES AND TOWER	8220	1315.1	0.0	0.0	306	18333	18333
BOOST COVER (SOFT)	280	1044.1	-1.2	-1.2	225	131	131
COMMAND MODULE	11500	1043.3	-0.2	6.3	5171	4560	4242
SERVICE MODULE	10200	915.3	-4.3	7.7	7102	10879	10849
SATURN LEM ADAPTER	(3800)	(646.9)	(0.7)	(-2.4)	(9556)	(13124)	(13006)
UPPER SECTION	2480	701.7	1.1	-3.0	5267	6056	5979
LOWER SECTION	1320	544.0	0.0	-1.3	4289	2445	2405

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

** Moment of inertia units are slug feet squared about the centers of gravity.

GSE DESIGN WEIGHTS

BLOCK II - SERVICE MODULE SECTOR I EMPTY

WEIGHT AND BALANCE

SUMMARY

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
COMMAND MODULE	11500	1043.3	-0.2	6.3	5171	4560	4242
SERVICE MODULE	10200	915.3	-4.3	7.7	7102	10879	10849
TOTAL	21700	983.1	-2.1	7.0	12295	34557	34226
SATURN LEM ADAPTER	3800	646.9	0.7	-2.4	9556	13124	13006
TOTAL	25500	933.0	-1.7	5.6	21918	126651	126146
LAUNCH ESCAPE SYSTEM	8500	1306.1	0.0	0.0	531	22770	22770
TOTAL	34000	1026.3	-1.3	4.2	22495	341028	340487

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

** Moment of inertia units are slug feet squared about the centers of gravity.

[redacted]

GSE DESIGN WEIGHTS

BLOCK II - WEIGHT AND BALANCE

COMMAND MODULE AND LAUNCH ESCAPE SYSTEM

SUMMARY

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
COMMAND MODULE	11500	1043.3	-0.2	6.3	5171	4560	4242
LAUNCH ESCAPE SYSTEM	8500	1306.1	0.0	0.0	531	22770	22770
TOTAL	20000	1155.0	-0.1	3.6	5744	100244	99885

[redacted]

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

**Moment of inertia units are slug feet squared about the centers of gravity.

[redacted]

[redacted]

GSE DESIGN WEIGHTS

BLOCK II - SERVICE MODULE SECTOR I EMPTY

HANDLING AND TRANSPORTATION

INDIVIDUAL MODULE MASS PROPERTIES

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
LAUNCH ESCAPE SYSTEM	(8500)	(1306.1)	(0.0)	(0.0)	(531)	(22770)	(22770)
LES AND TOWER	8220	1315.1	0.0	0.0	306	18333	18333
BOOST COVER (SOFT)	280	1044.1	-1.2	-1.2	225	131	131
COMMAND MODULE WITH ACE	12700	1041.1	1.6	5.4	5420	4808	4540
SERVICE MODULE	10200	915.3	-4.3	7.7	7102	10879	10849
SATURN LEM ADAPTER	(3800)	(646.9)	(0.7)	(-2.4)	(9556)	(13124)	(13006)
UPPER SECTION	2480	701.7	1.1	-3.0	5267	6056	5979
LOWER SECTION	1320	544.0	0.0	-1.3	4289	2445	2405
LUNAR EXCURSION MODULE EMPTY	(7430)	(603.3)	(0.0)	(0.0)	(5506)	(6762)	(5852)
ASCENT STAGE-EMPTY	4550	635.5	0.0	0.0	2457	2275	1365
DESCENT STAGE-EMPTY	2880	552.5	0.0	0.0	3049	1864	1864

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

**Moment of inertia units are slug feet squared about the centers of gravity.

[redacted]

GSE DESIGN WEIGHTS

BLOCK II - SERVICE MODULE SECTOR I EMPTY

HANDLING AND TRANSPORTATION

SUMMARY

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
COMMAND MODULE WITH ACE	12700	1041.1	1.6	5.4	5420	4808	4540
SERVICE MODULE	10200	915.3	-4.3	7.7	7102	10879	10849
TOTAL	22900	985.1	-1.0	6.4	12572	35008	34747
SATURN LEM ADAPTER	3800	646.9	0.7	-2.4	9556	13124	13006
TOTAL	26700	936.9	-0.8	5.2	22185	128628	128196
LUNAR EXCURSION MODULE-EMPTY	7430	603.3	0.0	0.0	5506	6762	5852
TOTAL	34130	864.3	-0.6	4.0	27725	275044	273669
LAUNCH ESCAPE SYSTEM	8500	1306.1	0.0	0.0	531	22770	22770
TOTAL	42630	952.4	-0.5	3.2	28280	584615	583218

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

**Moment of inertia units are slug feet squared about the centers of gravity.

GSE DESIGN WEIGHTS

BLOCK II - HANDLING AND TRANSPORTATION

COMMAND MODULE AND LAUNCH ESCAPE SYSTEM

SUMMARY

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
COMMAND MODULE WITH ACE	12700	1041.1	1.6	5.4	5420	4808	4540
LAUNCH ESCAPE SYSTEM	8500	1306.1	0.0	0.0	531	22770	22770
TOTAL	21200	1147.4	1.0	3.2	5986	104822	104576

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

** Moment of inertia units are slug feet squared about the centers of gravity.

GSE DESIGN WEIGHTS

BLOCK II - SERVICE MODULE SECTOR I EMPTY

MAXIMUM WEIGHT CONDITION

SUMMARY

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
COMMAND MODULE WITH ACE	12700	1041.1	1.6	5.4	5420	4808	4540
SERVICE MODULE	10200	915.3	-4.3	7.7	7102	10879	10849
TOTAL	22900	985.1	-1.0	6.4	12572	35008	34747
SPS PROPELLANT MAXIMUM CAPACITY	41310	906.2	0.0	0.0	21568	21146	28614
TOTAL	64210	934.3	-0.4	2.3	34274	76059	83137
SATURN LEM ADAPTER	3800	646.9	0.7	-2.4	9556	13124	13006
TOTAL	68010	918.3	-0.3	2.0	43848	153172	160117
LUNAR EXCURSION MODULE	29500	588.5	0.0	0.0	19409	21485	21219
TOTAL	97510	818.5	-0.2	1.4	63276	657609	664269
LAUNCH ESCAPE SYSTEM	8500	1306.1	0.0	0.0	531	22770	22770
TOTAL	106010	857.6	-0.2	1.3	63810	1081737	1088396

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

** Moment of inertia units are slug feet squared about the centers of gravity.

GSE DESIGN WEIGHTS

SPECIAL CONFIGURATIONS

BLOCK II - SERVICE MODULE SECTORS I EMPTY WITH FULL

SPS PROPELLANT

SUMMARY

ITEMS	WEIGHTS	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
SERVICE MODULE	10200	915.3	-4.3	7.7	7102	10879	10849
SPS PROPELLANT MAXIMUM CAPACITY	41310	906.2	0.0	0.0	21568	21146	28614
TOTAL	51510	908.0	-0.9	1.5	28807	32276	39642

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

** Moment of inertia units are slug feet squared about the centers of gravity.

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GSE DESIGN WEIGHTS

BLOCK II - WEIGHT SUMMARY FOR

MASS PROPERTIES CURVES

	POUNDS
COMMAND MODULE	11500
AUTOMATIC CHECKOUT EQUIPMENT	1200
SERVICE MODULE	10200
SPS PROPELLANT	41310

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BLOCK II GSE DESIGN WEIGHTS CSM SECT 1 EMPTY SPS PROPELLANT 16 DEC 64

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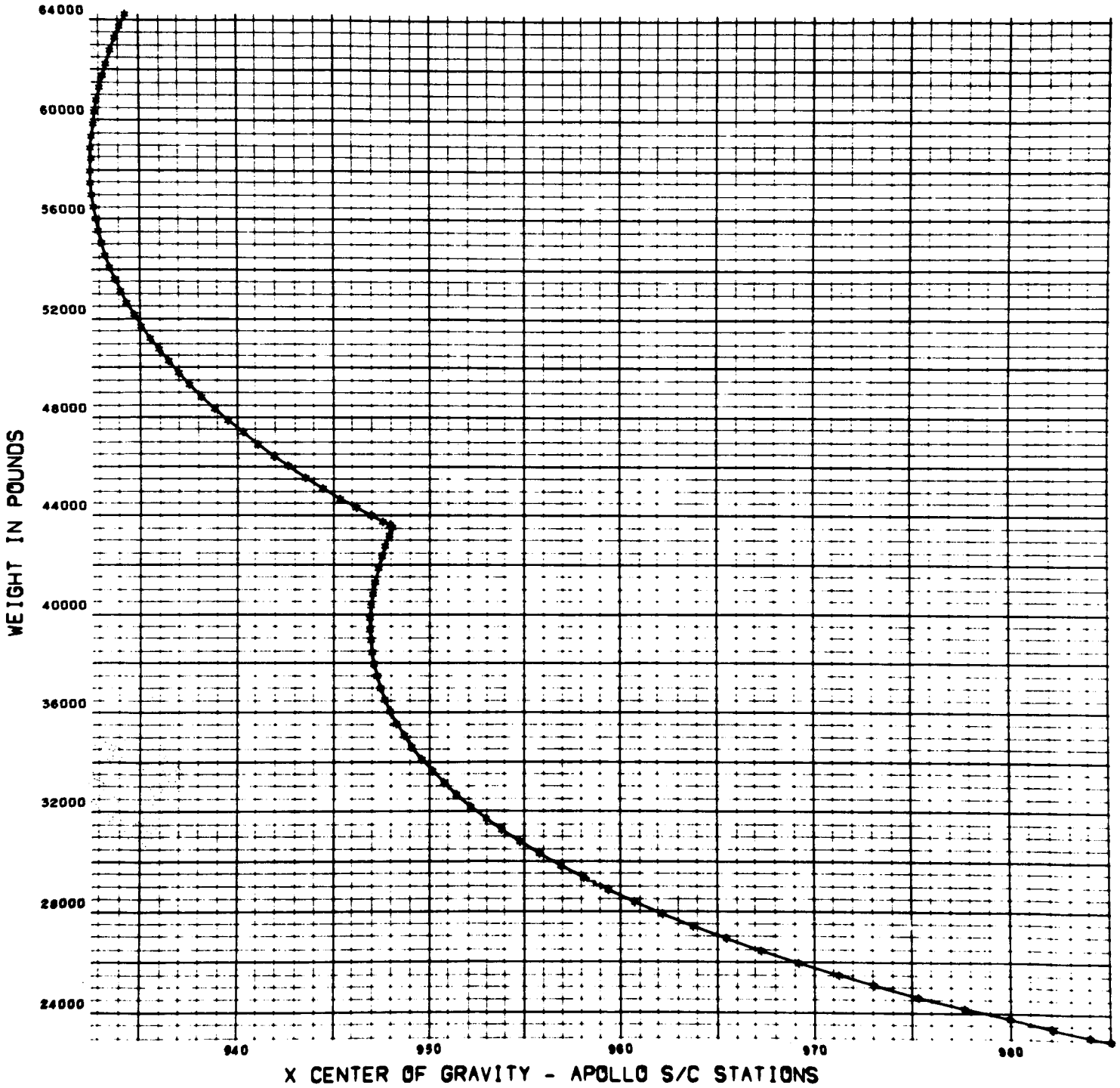

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BLOCK II GSE DESIGN WEIGHTS CSM SECT 1 EMPTY SPS PROPELLANT 16 DEC 64

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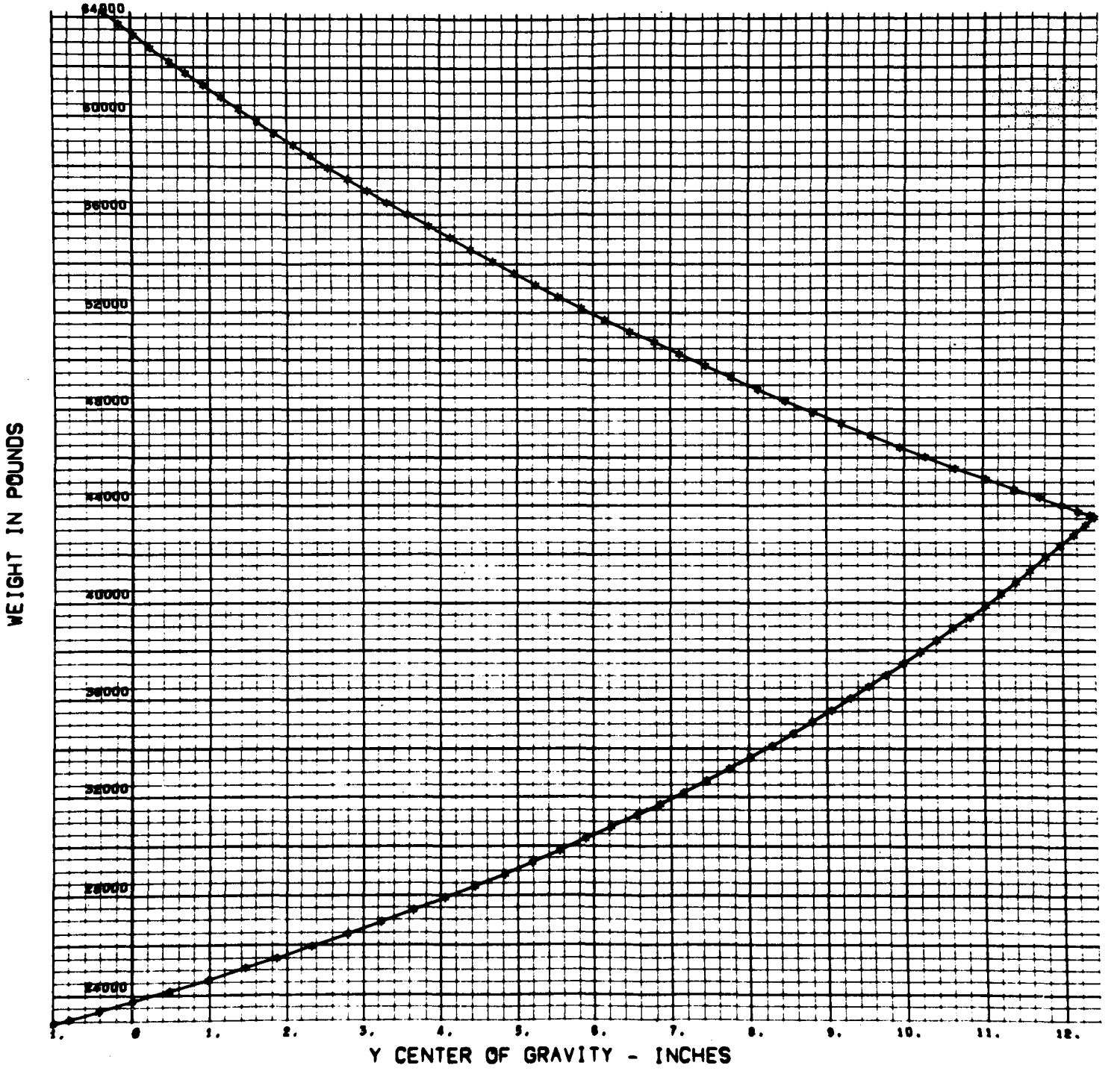

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BLOCK II GSE DESIGN WEIGHTS CSM SECT 1 EMPTY SPS PROPELLANT 16 DEC 64

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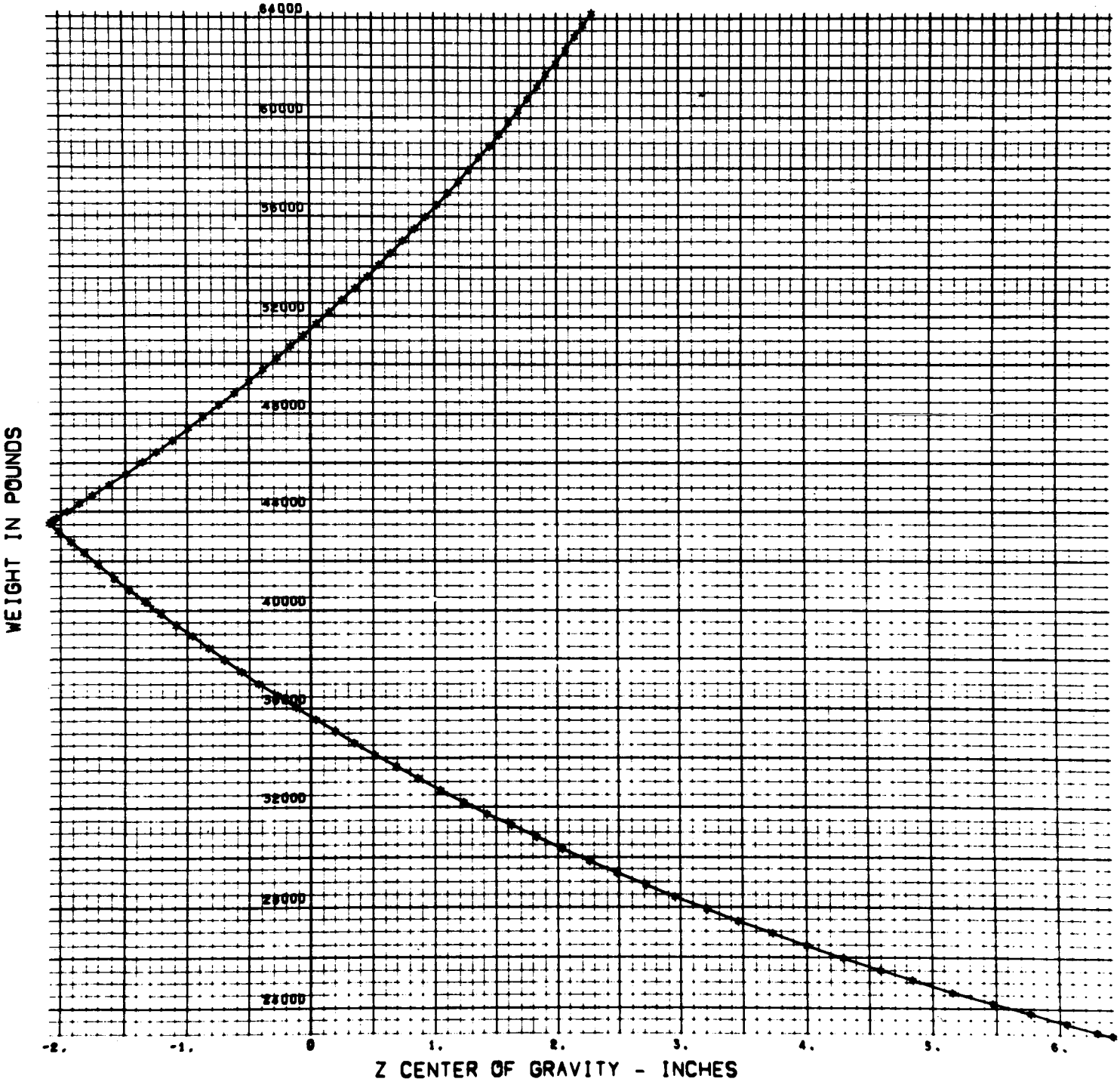

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BLOCK II GSE DESIGN WEIGHTS CSM SECT 1 EMPTY SPS PROPELLANT 16 DEC 64

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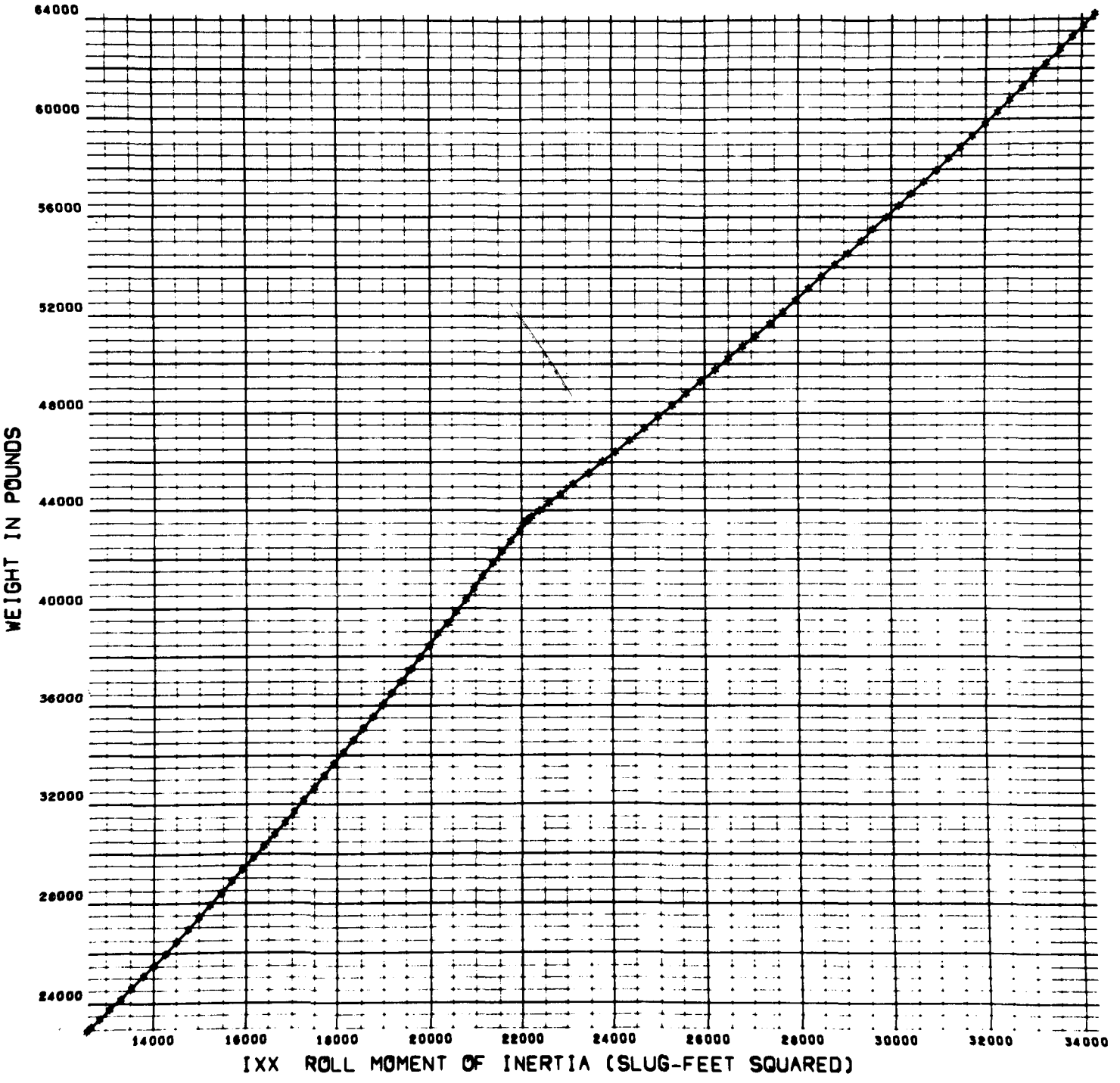

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BLOCK II GSE DESIGN WEIGHTS CSM SECT 1 EMPTY SPS PROPELLANT 16 DEC 64

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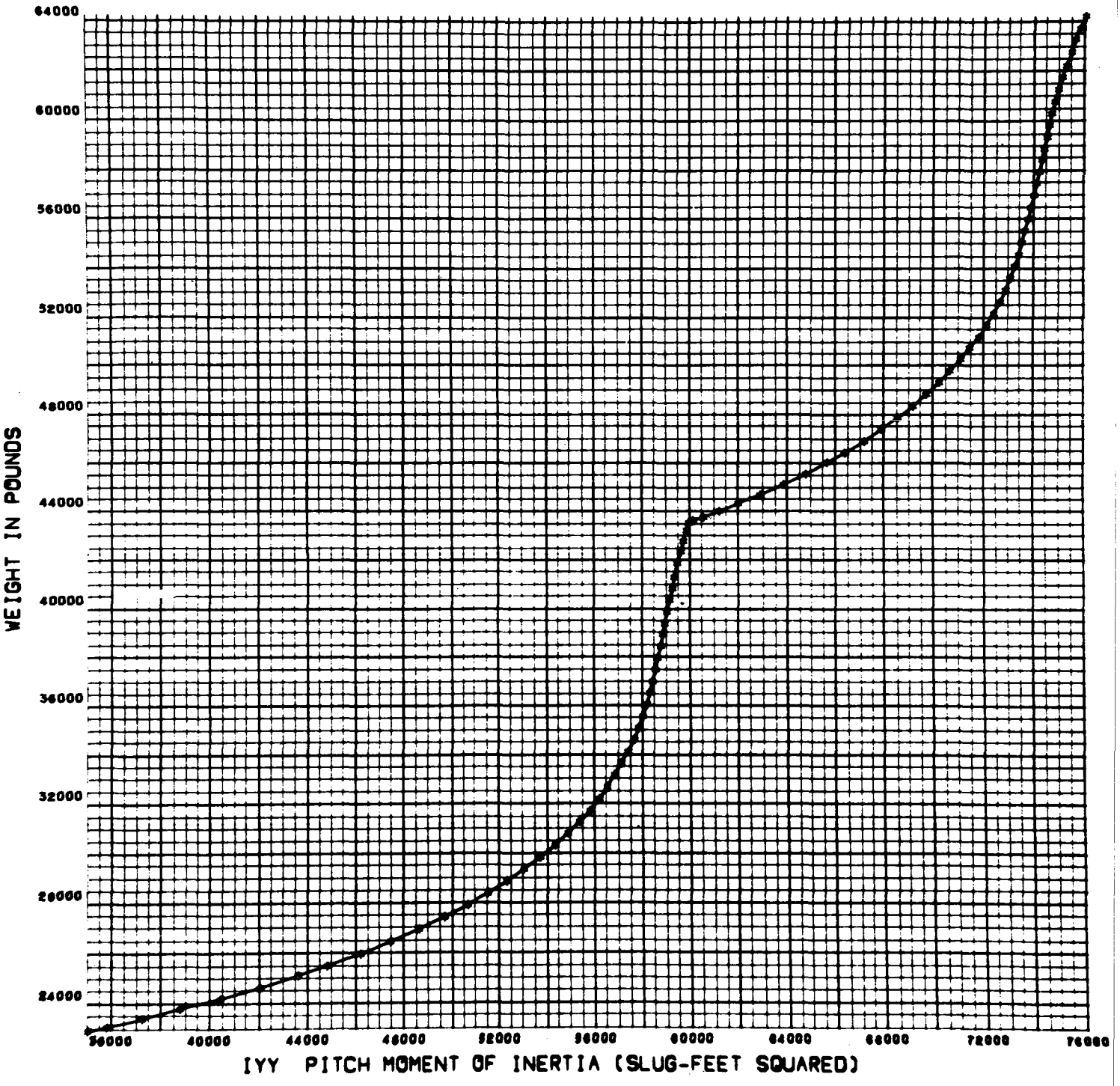

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BLOCK II GSE DESIGN WEIGHTS CSM SECT 1 EMPTY SPS PROPELLANT 16 DEC 64

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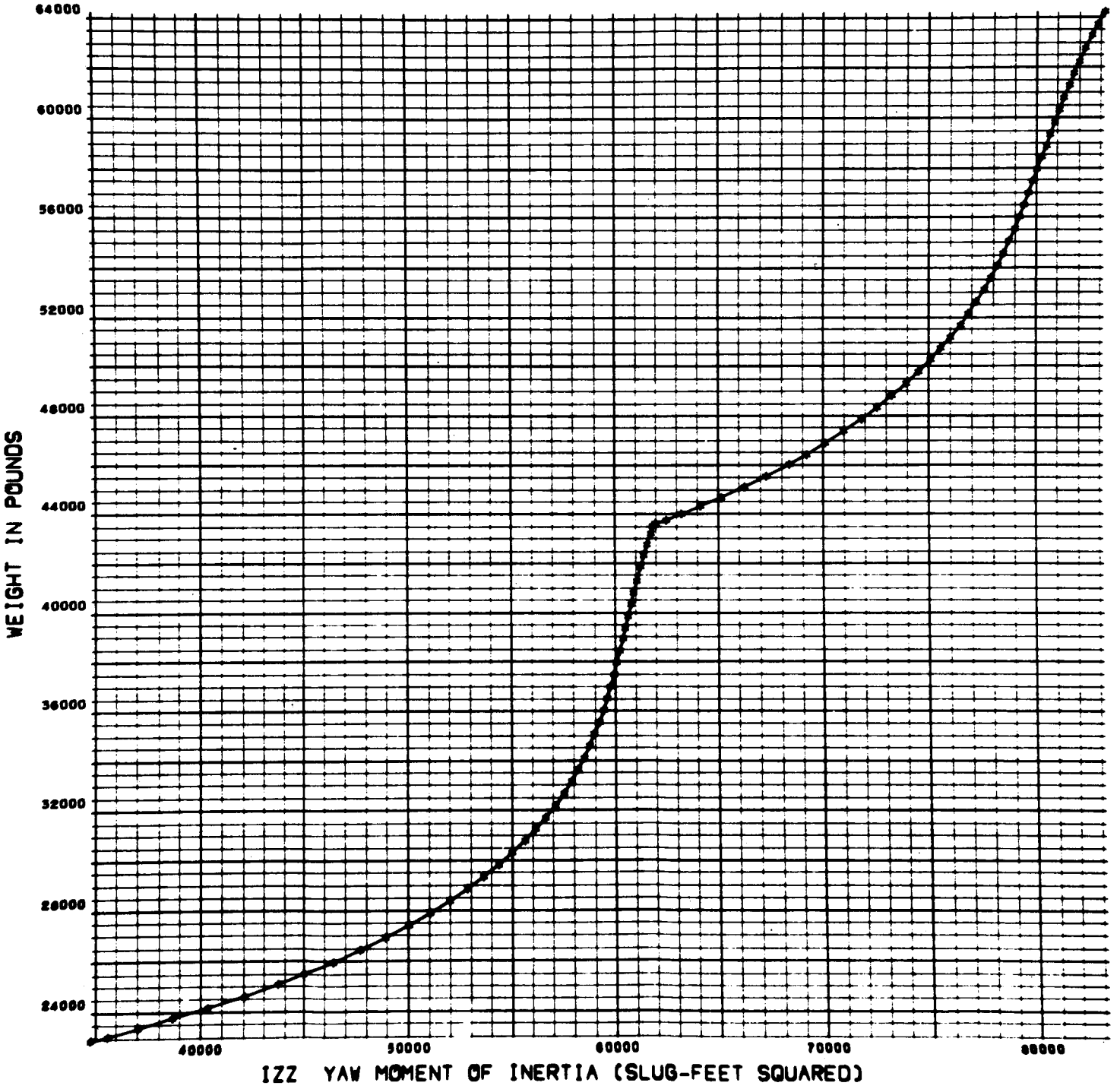

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GSE DESIGN WEIGHTS

SPECIAL CONFIGURATIONS

BLOCK II SLA LOWER SECTION AND CONTROL WEIGHT LEM

SUMMARY

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
LOWER SECTION OF BLOCK II SATURN LEM ADAPTER	1320	544.0	0.0	-1.3	4289	2445	2405
LUNAR EXCURSION MODULE	29500	588.5	0.0	0.0	19409	21485	21219
TOTAL	30820	586.6	0.0	-0.1	23698	24471	24164

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

**Moment of inertia units are slug feet squared about the centers of gravity.

SECTION IV

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GSE DESIGN WEIGHTS

BLOCK II - SERVICE MODULE SECTOR I WITH GFE

WEIGHT AND BALANCE

INDIVIDUAL MODULE MASS PROPERTIES

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
LAUNCH ESCAPE SYSTEM	(8500)	(1306.1)	(0.0)	(0.0)	(531)	(22770)	(22770)
LES AND TOWER	8220	1315.1	0.0	0.0	306	18333	18333
BOOST COVER (SOFT)	280	1044.1	-1.2	-1.2	225	131	131
COMMAND MODULE	11500	1043.3	-0.2	6.3	5171	4560	4242
SERVICE MODULE with GFE	11600	915.4	0.3	1.3	8356	12141	11801
SATURN LEM ADAPTER	(3800)	(646.9)	(0.7)	(-2.4)	(9556)	(13124)	(13006)
UPPER SECTION	2480	701.7	1.1	-3.0	5267	6056	5979
LOWER SECTION	1320	544.0	0.0	-1.3	4289	2445	2405

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

**Moment of inertia units are slug feet squared about the centers of gravity.

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GSE DESIGN WEIGHTS

BLOCK II - SERVICE MODULE SECTOR I WITH GFE

WEIGHT AND BALANCE

SUMMARY

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
COMMAND MODULE	11500	1043.3	-0.2	6.3	5171	4560	4242
SERVICE MODULE WITH GFE	11600	915.4	0.3	1.3	8356	12141	11801
TOTAL	23100	979.1	0.1	3.8	13558	37115	36426
SATURN LEM ADAPTER	3800	646.9	0.7	-2.4	9556	13124	13006
TOTAL	26900	932.2	0.2	2.9	23141	127987	127153
LAUNCH ESCAPE SYSTEM	8500	1306.1	0.0	0.0	531	22770	22770
TOTAL	35400	1022.0	0.1	2.2	23684	345767	344923

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

** Moment of inertia units are slug feet squared about the centers of gravity.

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GSE DESIGN WEIGHTS

BLOCK II - SERVICE MODULE SECTOR I WITH GFE

HANDLING AND TRANSPORTATION

INDIVIDUAL MODULE MASS PROPERTIES

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
LAUNCH ESCAPE SYSTEM	(8500)	(1306.1)	(0.0)	(0.0)	(531)	(22770)	(22770)
LES AND TOWER	8220	1315.1	0.0	0.0	306	18333	18333
BOOST COVER SOFT	280	1044.1	-1.2	-1.2	225	131	131
COMMAND MODULE WITH ACE	12700	1041.1	1.6	5.4	5420	4808	4540
SERVICE MODULE WITH GFE	11600	915.4	0.3	1.3	8356	12141	11801
SATURN LEM ADAPTER	(3800)	(646.9)	(0.7)	(-2.4)	(9556)	(13124)	(13006)
UPPER SECTION	2480	701.7	1.1	-3.0	5267	6056	5979
LOWER SECTION	1320	544.0	0.0	-1.3	4289	2445	2405
LUNAR EXCURSION MODULE EMPTY	(7430)	(603.3)	(0.0)	(0.0)	(5506)	(6762)	(5852)
ASCENT STAGE EMPTY	4550	635.5	0.0	0.0	2457	2275	1365
DESCENT STAGE EMPTY	2880	552.5	0.0	0.0	3049	1864	1864

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

** Moment of inertia units are slug feet squared about the centers of gravity.

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GSE DESIGN WEIGHTS

BLOCK II - SERVICE MODULE SECTOR I WITH GFE

HANDLING AND TRANSPORTATION

SUMMARY

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
COMMAND MODULE WITH ACE	12700	1041.1	1.6	5.4	5420	4808	4540
SERVICE MODULE WITH GFE	11600	915.4	0.3	1.3	8356	12141	11801
TOTAL	24300	981.1	1.0	3.5	13800	37632	37004
SATURN LEM ADAPTER	3800	646.9	0.7	-2.4	9556	13124	13006
TOTAL	28100	935.9	1.0	2.7	23380	129996	129226
LUNAR EXCURSION MODULE EMPTY	7430	603.3	0.0	0.0	5506	6762	5852
TOTAL	35530	866.4	0.8	2.1	28897	277050	275363
LAUNCH ESCAPE SYSTEM	8500	1306.1	0.0	0.0	531	22770	22770
TOTAL	44030	951.3	0.6	1.7	29435	586201	584509

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

** Moment of inertia units are slug feet squared about the centers of gravity.

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GSE DESIGN WEIGHTS

BLOCK II - SERVICE MODULE SECTOR I WITH GFE

MAXIMUM WEIGHT CONDITION

SUMMARY

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
COMMAND MODULE With ACE	12700	1041.1	1.6	5.4	5420	4808	4540
SERVICE MODULE With GFE	11600	915.4	0.3	1.3	8356	12141	11801
TOTAL	24300	981.1	1.0	3.5	13800	37632	37004
SPS PROPELLANT Maximum Capacity	41310	906.2	0.0	0.0	21568	21146	28614
TOTAL	65610	933.9	0.4	1.3	35411	77340	84144
SATURN LEM ADAPTER	3800	646.9	0.7	-2.4	9556	13124	13006
TOTAL	69410	918.2	0.4	1.1	44978	154352	161028
LUNAR EXCURSION MODULE	29500	588.5	0.0	0.0	19409	21485	21219
TOTAL	98910	819.9	0.3	0.8	64392	661624	668029
LAUNCH ESCAPE SYSTEM	8500	1306.1	0.0	0.0	531	22770	22770
TOTAL	107410	858.4	0.3	0.7	64925	1083928	1090334

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

**Moment of inertia units are slug feet squared about the centers of gravity.

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GSE DESIGN WEIGHTS

SPECIAL CONFIGURATIONS

BLOCK II - SERVICE MODULE SECTOR I WITH GFE

AND FULL SPS PROPELLANT

SUMMARY

ITEMS	WEIGHT	CENTERS OF GRAVITY*			MOMENTS OF INERTIA**		
		X	Y	Z	Ixx	Iyy	Izz
SERVICE MODULE With GFE	11600	915.4	1.6	5.4	5420	4808	4540
SPS PROPELLANT Maximum Capacity	41310	906.2	0.0	0.0	21568	21146	28614
TOTAL	52910	908.2	0.1	0.3	29928	33457	40581

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

**Moment of inertia units are slug feet squared about the centers of gravity.

[redacted]

GSE DESIGN WEIGHTS

BLOCK II - WEIGHT SUMMARY FOR

MASS PROPERTIES CURVES

	POUNDS
COMMAND MODULE	11500
AUTOMATIC CHECKOUT EQUIPMENT	1200
SERVICE MODULE	10200
GFE PACKAGE	1400
SPS PROPELLANT	41310

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BLOCK II GSE DESIGN WEIGHTS CSM SECT 1 W/ GFE SPS PROPELLANT 16 DEC 64

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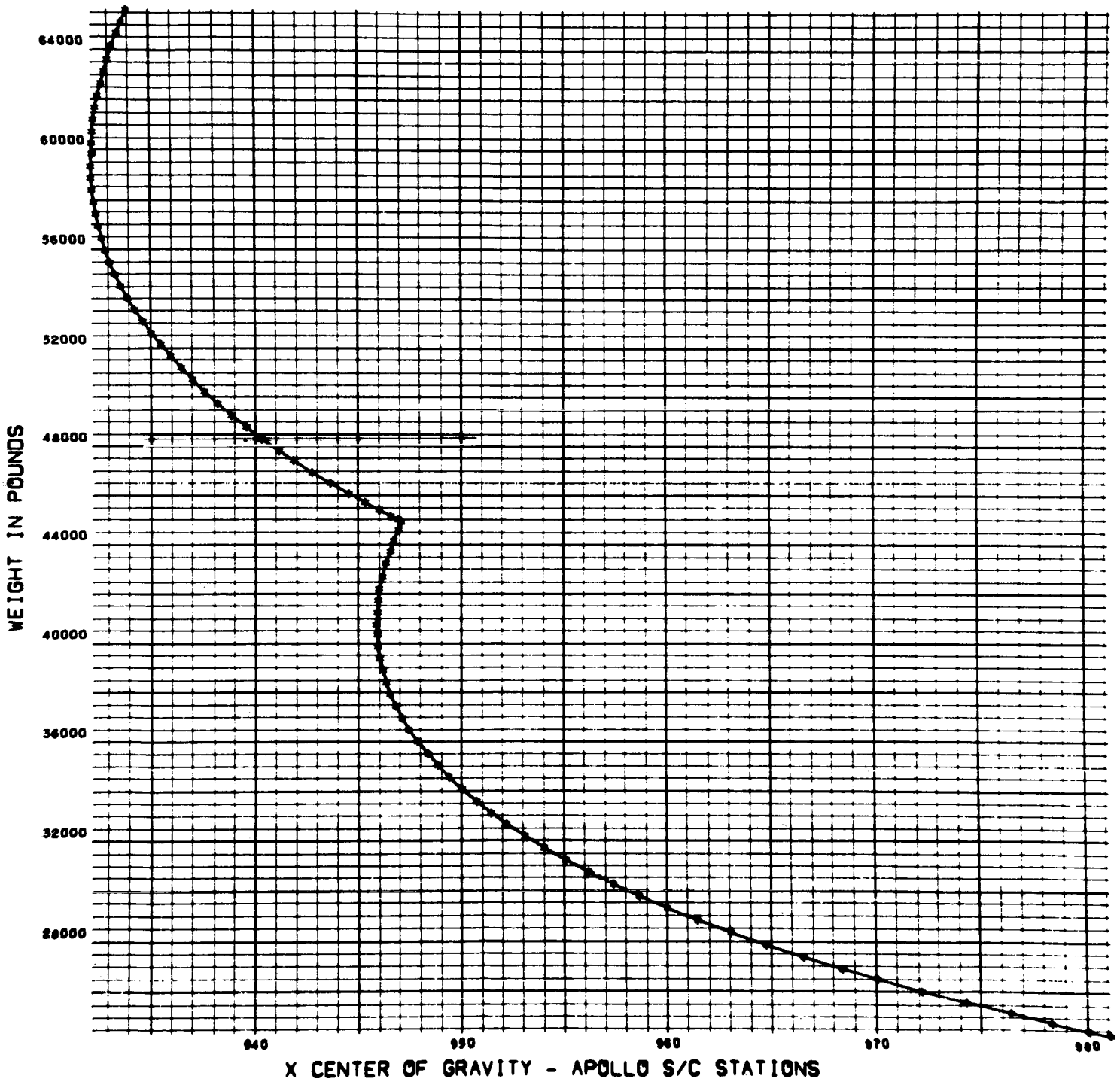

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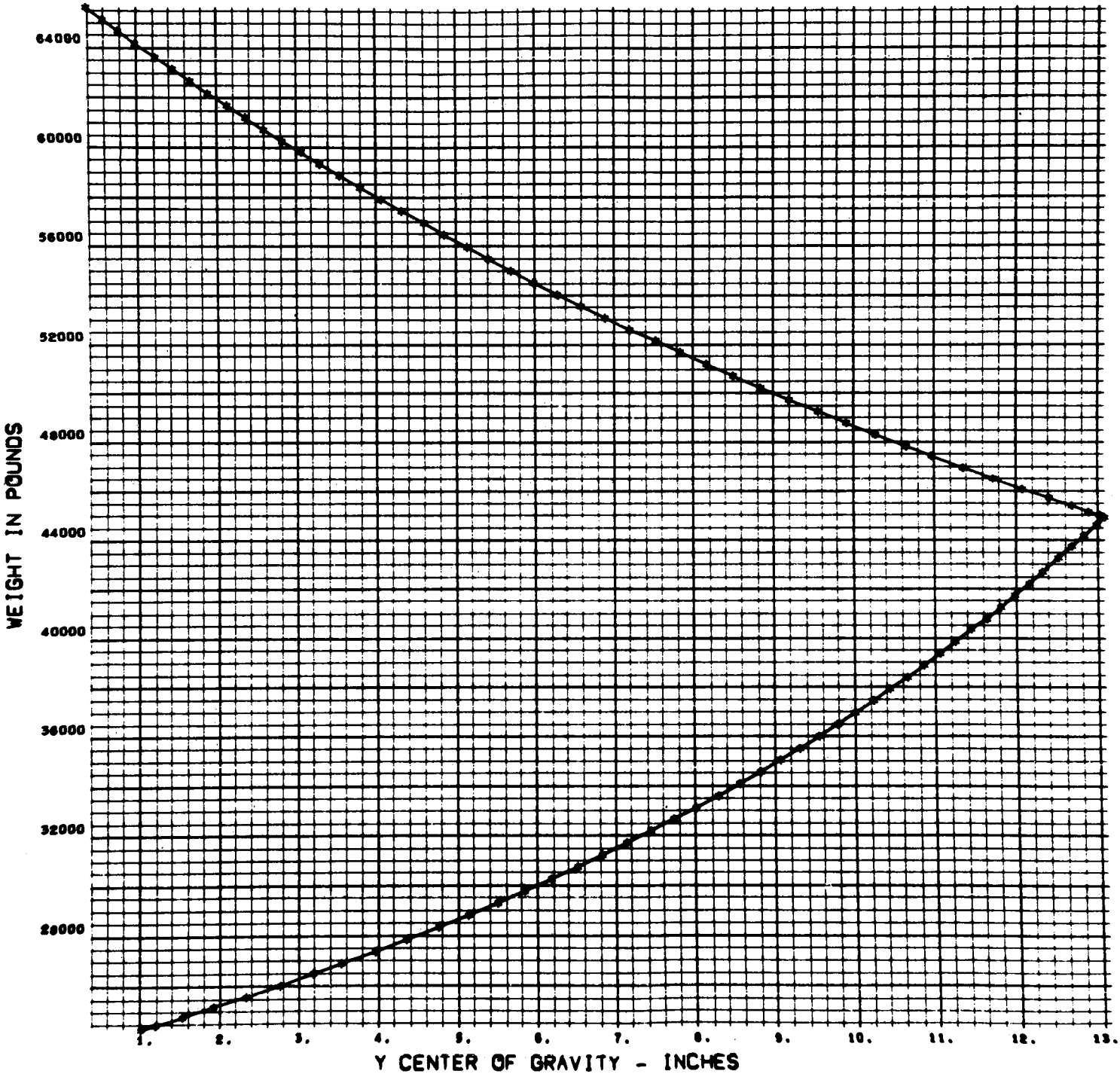
BLOCK II GSE DESIGN WEIGHTS CSM SECT 1 W/ GFE SPS PROPELLANT 16 DEC 64 0613-13 002 000



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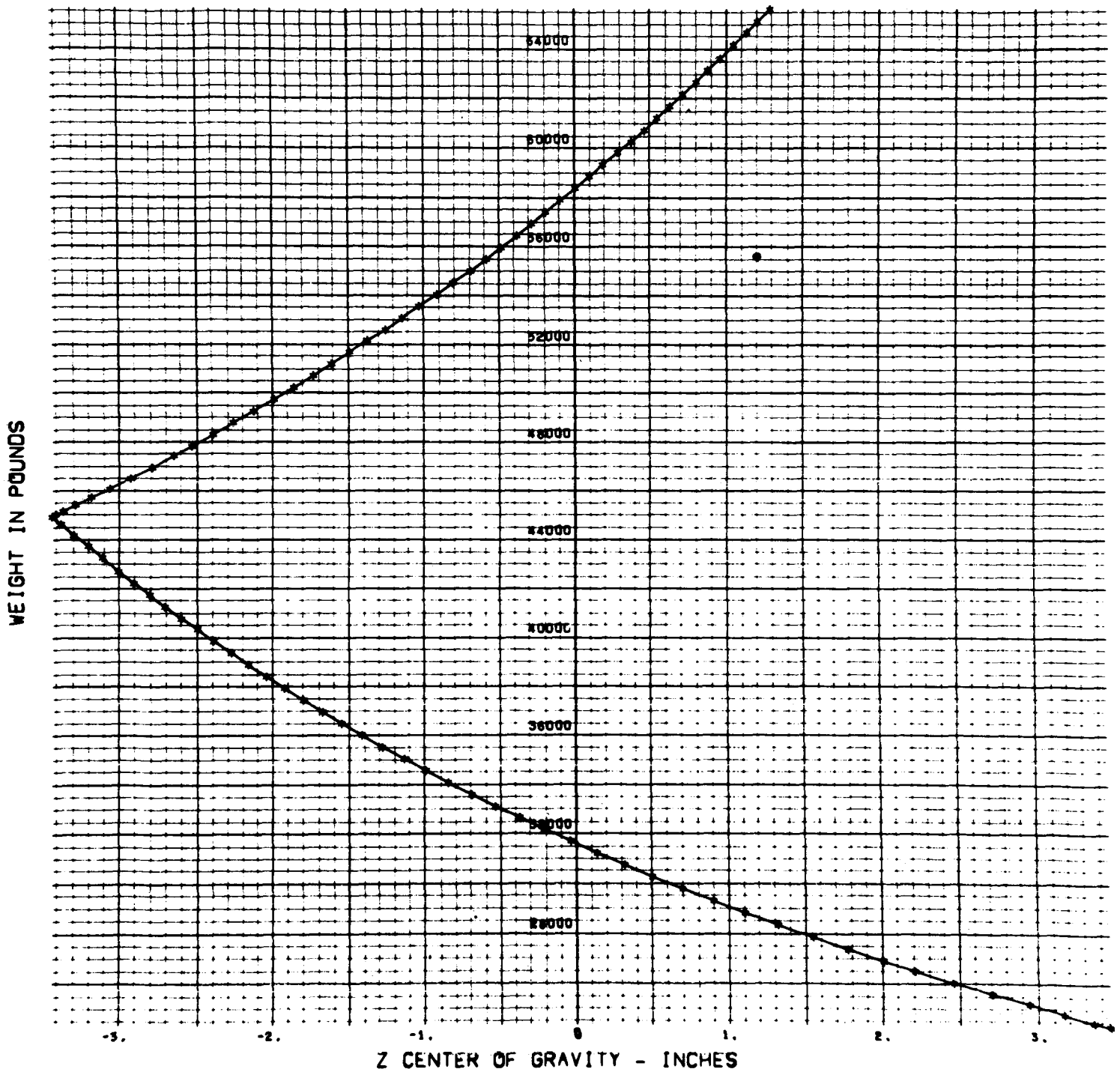

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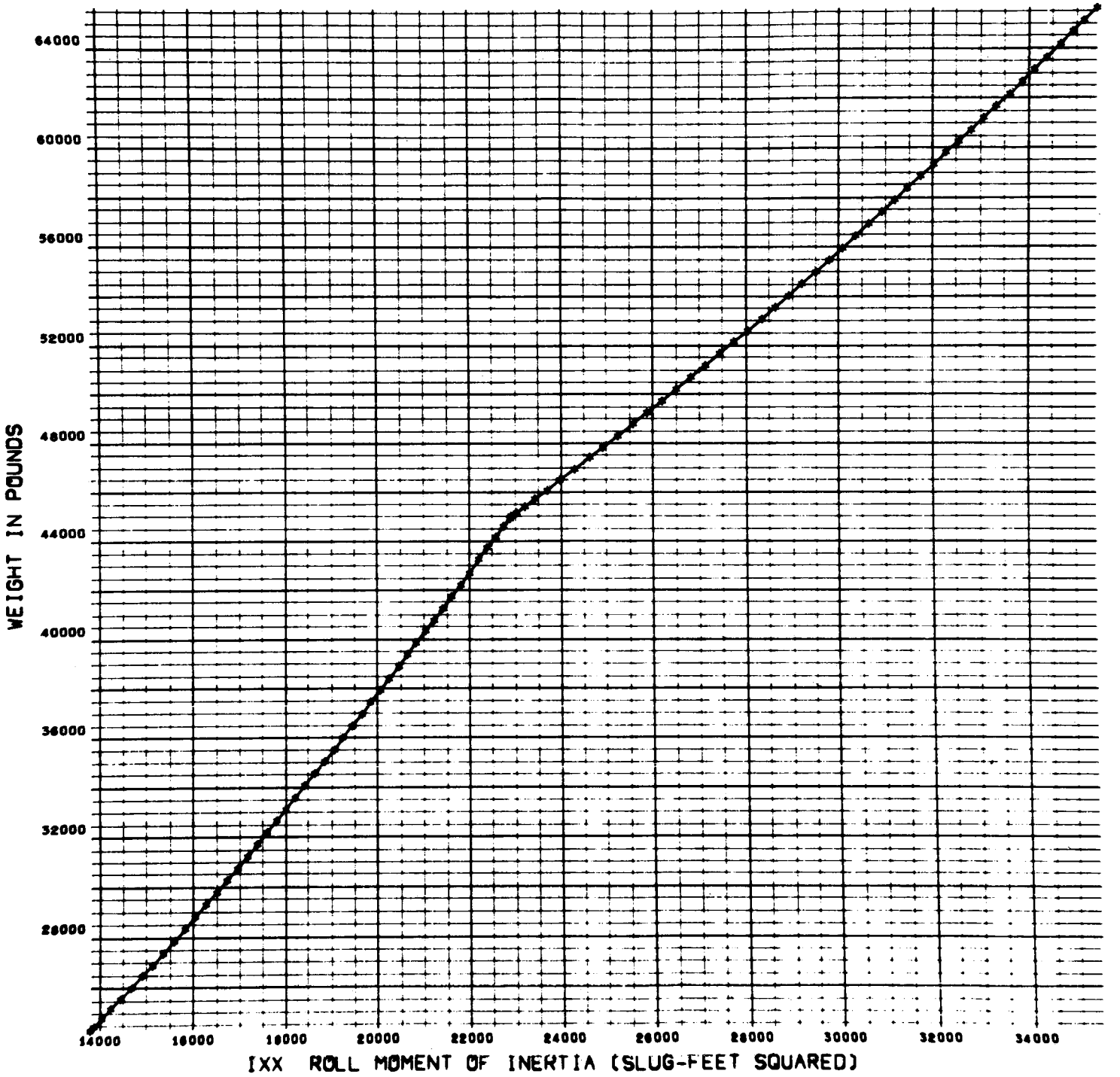

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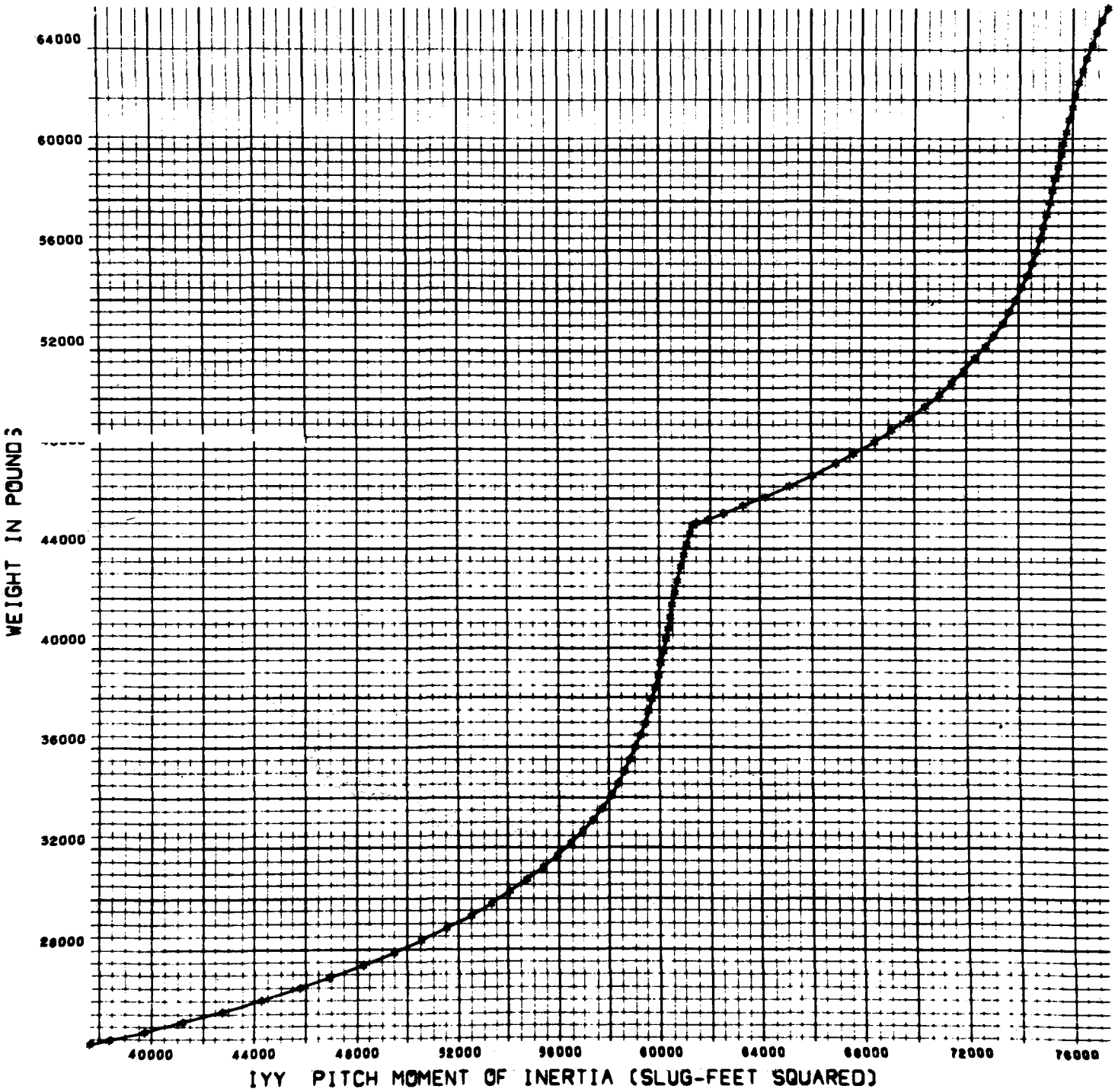

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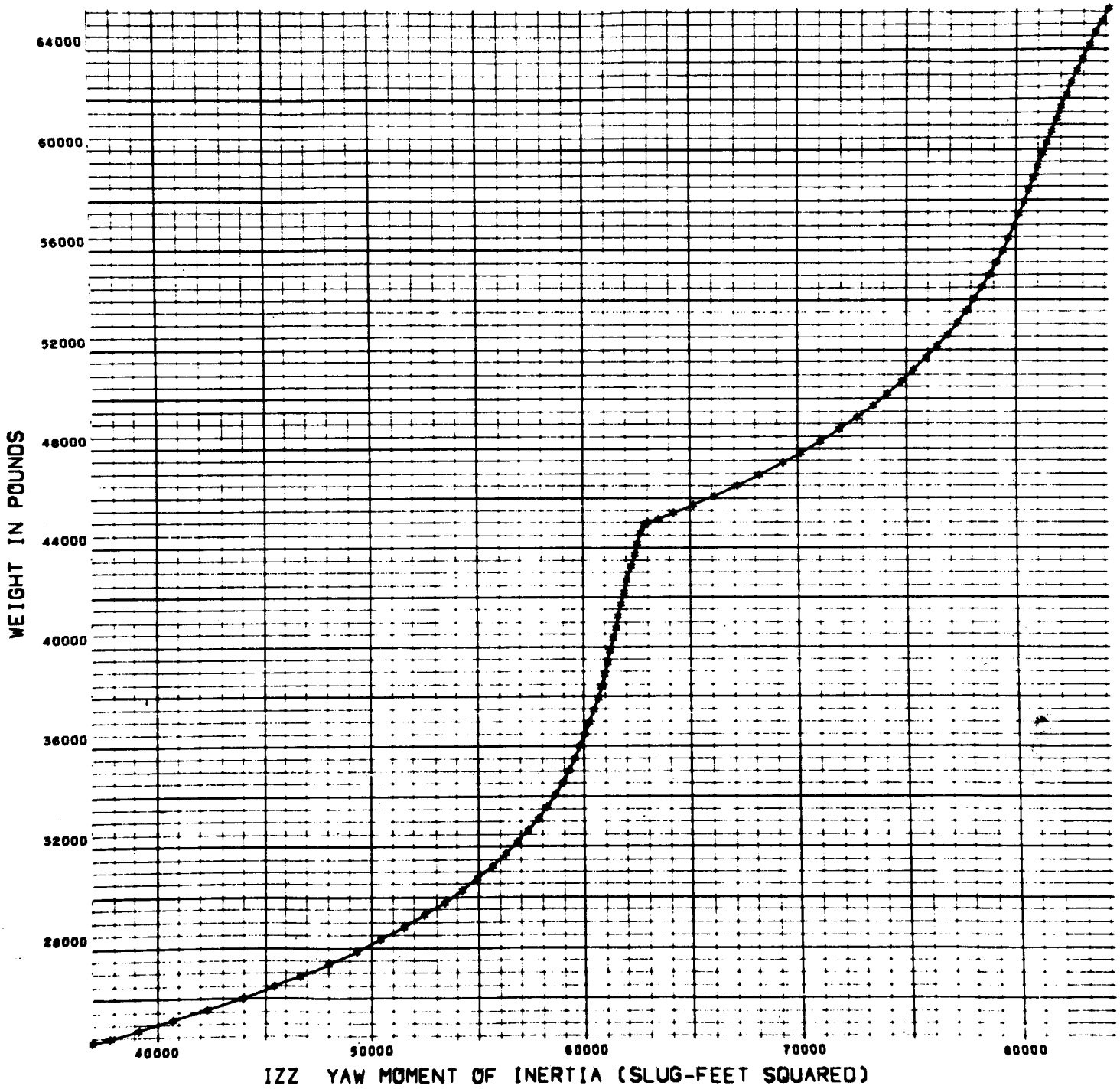

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