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DEPARTMENT OF DEFENSE HANDBOOK

CATAPULTING AND ARRESTING GEAR FORCING FUNCTIONS FOR AIRCRAFT STRUCTURAL DESIGN

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NAVAL AIR SYSTEMS COMMAND
DEPARTMENT OF THE NAVY

CATAPULTING AND ARRESTING GEAR FORCING FUNCTIONS FOR AIRCRAFT STRUCTURAL DESIGN

MIL-STD-2066(AS)

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FOREWORD

This document summarizes loads, accelerations, velocities, and other parameters statistically analyzed and extracted from test data representative of the various shipboard and shore based launching and recovery equipment employed by the U.S. Navy. In determining the volume of information to be presented, every effort has been made to condense the data and yet present it, as much as possible, in a form that requires the least amount of additional calculations by the user. The data shown herein may be used to derive time histories of loads and accelerations for the design conditions of MIL-A-8863 "Airplane Strength and Rigidity, Ground Loads for Navy Procured Airplanes" and MIL-A-8866 "Airplane Strength and Rigidity, Reliability Requirements, Repeated Loads, and Fatigue."

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1. SCOPE

1.1 General. The information contained herein presents loading characteristics, associated parameters, and methods to be used in calculating the catapulting and arresting loads of MIL-A-8863 and MIL-A-8866 for the design of U.S. Navy airplanes operating from shipboard and shorebased launching and recovery gears. A listing of such gears for which data is contained herein is given in Table 1.

2. REFERENCED DOCUMENTS

2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of this standard to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-A-8863	Airplane Strength and Rigidity - Ground Loads for Navy Procured Airplanes
MIL-A-8866	Airplane Strength and Rigidity - Reliability Requirements, Repeated Loads, and Fatigue
MIL-A-8868	Airplane Strength and Rigidity - Data and Reports

(Copies of specificaitons, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publicaitons. A listing of Navy publications which include loading and performance behavior of equipment contained herein is presented, for reference only, in Table 2.

3. DEFINITIONS

Not applicable

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TABLE 1. Launching and Recovery Gear

Location	Type	Equipment Description	Carriers Installed On
Shipboard	Catapults	C7 (metering rod) 550 psi variable pressure	CVA 60(2), CVA 61(2), CVA 62(2)
		C7 Constant pressure	CVA 59(2), CVA 61(2) CVA 62(2)
		C11-1 (full expansion) 550 psi variable pressure	AVT 16(2)
		C11-1 (metering rod) 550 psi variable pressure	CVA 59(2), CVA 60(2)
		C11-1 Wet Accum. (metering rod) 550 psi variable	CVA 43(3)
		C13 1,000 psi variable pressure	CVA 63(4), CVAN 65(4)
		C13 900 psi variable pressure	CVA 64(4), CVA 66(3)
		C13 Wet Accum. 800 psi constant pressure	CVA 67(3)
		C13 Wet Accum. 520 psi constant pressure	CVA 41(2)
		C13-1 Wet Accum. 800 psi constant pressure	CVA 67(1)
		C13-1 900 psi variable pressure	CVA 66(1)
		C13-1 Wet Accum. 520 psi constant pressure	CVAN 68(4)
	Arresting Gear	MK7-1 Arresting Gear without sheave dampers	AVT 16
		MK7-2 Arresting Gear with sheave dampers	CVA 43, CVA 59, CVA 60, CVA 61, CVA 62, CVA 63, CVA 64, CVA 65, CVA 66
		MK7-3 Arresting Gear with sheave dampers	CVA 41, CVA 67, CVAN 68, CVAN 69
Shorebased	Catapult	CE1-3	Various shore stations
	Arresting Gear	M-21	Various shore stations
		E-15 Emergency Gear	Various shore stations

Note: Number of each catapult type shown in parentheses.

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TABLE 2. Related Navy Perfomace Charts and Bulletins

Operation	Equipment	Chart or Bulletin	Revision	Date[2]	Title
Launching	All Shipboard Catapults	NAEC 06900		6-1-74	Aircraft Carrier Reference Data Manual
	All Shipboard Catapults	NAEC Misc 08627	B	11-3-75	Shipboard Catapult Minimum Performance and Load Factors for Aircraft Design
	C11-1	NAEC Misc 06585	B	11-19-59	Minimum Performance for CVT-16 Catapults
		NAEC Misc 08486	C	5-25-66	Minimum Performance for CV-42, -59 Catapults
		NAEC Misc 08485		5-18-66	Minimum Performance for CV-34 Catapults
		NAEC Misc 09727		7-11-74	Minimum Performance for CV-60 Catapults
	C11-1 (Wet Accum.)	NAEC Misc 09333		6-14-72	Minimum Performance for CV-43 Catapults
	C7	NAEC Misc 08546	B	2-4-69	Minimum Performance for CV-59, -60, -61, -62 Catapults
	C13	NAEC Misc 07819		12-15-61	Minimum Performance for CV-63 (1,000 psi variable pressure) Catapults
		NAEC Misc 07810		11-9-61	Minimum Performance for CVN-65 (1,000 psi variable pressure) Catapult
		NAEC Misc 08272	B	3-12-70	Minimum Performance for CV-64 and 66 (900 psi variable pressure) Catapults
		NAEC Misc 08747		8-26-68	Minimum Performance for CV-67 (800 psi Wet Accumulator) Constant Pressure Catapults
		NAEC Misc 08970		3-12-70	Minimum Performance for CV-41 (500 psi Wet Accumulator) Constant Pressure Catapults
	C13-1	NAEC Misc 08260	B	3-12-70	Minimum Performance for CV-66 (900 psi variable pressure) Catapult
		NAEC Misc 08754		9-9-68	Minimum Performance for CV-67 (800 psi Wet Accumulator) Constant Pressure Catapult
		NAEC Misc 09698		8-5-75	Minimum Performance for CVN-68 (520 psi Wet Accumulator) Constant Pressure Catapults
	CE1-3	SATS Aircraft Launching Bulletin No. 104B	B	7-1-68	Launching Aircraft from the CE1-3 Catapult; Parameters and General Data Concerning
Recovery	All Shipboard Arresting Gear	NAEC 06900	-	6-1-74	Aircraft Carrier Reference Data Manual
	All Shipboard Arresting Gear	NAEC Misc 08626	A	3-13-69	Shipboard Arresting Gear Capacity for Aircraft Design
	MK7-1	NAEC Misc 08749	-	8-26-68	Performance Chart for Mk 7 Mod 1 Arresting Gear with Sheave Dampers
	MK7-2	NAEC Misc 08750	-	8-23-68	Performance Chart for Mk 7 Mod 2 Arresting Gear with Sheave Dampers
	MK7-3	NAEC Misc 08744		8-6-68	Performance Chart for Mk 7 Mod 3 Arresting Gear with Sheave Dampers
	E-15	NAEC Misc 08574	B	12-19-73	Performance Chart for E15 (200 ft. span) Emergency Arresting Gear
		NAEC Misc 08375	B	12-20-73	Performance Chart for E15 (300 ft. span) Emergency Arresting Gear
	M-21	Aircraft Recovery Bulletin 45-12E	E	7-9-74	Land-based Arresting Gear Bulletin

[1] The methodology used in deriving the curves of MIL-STD-2066(AS) reflect structural requirements. NAEC performance charts are based on different methodology; therefore, some differences exist.

[2] Charts are applicable per dates given; NAEC should be consulted for most recent bulletins.

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4. GENERAL REQUIREMENTS

4.1 Description of forcing functions. The forcing functions are presented as load versus stroke data. The form of presentation is adjusted to provide condensed and yet readily usable data. This necessitated presentation of data in basically three different forms. For catapulting, the data are presented in a tabular form, nondimensional for the shorebased catapults and dimensional for the" shipboard catapults. For arresting, they are presented in a graphical nondimensional form. The equation for the data that are presented in a nondimensional form is:

$$L = \frac{F\ R}{C\ M\ V^2}$$

where: L = nondimensional load

F = catapult tow force or arresting force parallel to the deck or ground, pounds

C = correction factor; for catapulting C = 1

R = total stroke for catapulting or total runout for arresting, feet

M = airplane mass, slugs

V = catapult end speed (including effects of rolling friction and aerodynamic drag, but not thrust) or engaging speed, feet per second

W = airplane weight, pounds

The nondimensional stroke is defined as $\frac{X}{R}$, where X is the value of stroke or runout in feet.

4.2 Tolerance limits of forcing functions. The catapulting and arresting forcing functions presented herein have been derived from empirical analyses of data obtained from a large number of both deadload and airplane tests. In general, the test results include the effects or perturbations in loading behavior due to wear, temperature, manufacturing tolerances on component parts of the gear, installation tolerances (from ship to ship and from one location to the other on a given ship), etc. These effects are presented in the form of mean values and tolerance limits. Such limits were determined by statistical analyses of the large number of records of time histories of loads, accelerations, velocities, stroke, etc. The upper and lower limits about the mean are stated as 90-90 probability limits. This means that there is 90 percent confidence that 90 percent of the data as obtained in practice will fall within these limits at each stroke position. In the discussion and the examples that follow, the force and the nondimensional load shall have the following notations:

F_U = force at upper 90-90 probability limit or upper boundary, pounds

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L_u = nondimensional load at upper 90-90 probability limit or upper boundary

F_M = mean force, pounds

L_M = mean nondimensional load

F_L = force at lower 90-90 probability limit or lower boundary, pounds

L_L = nondimensional load at lower 90-90 probability limit or lower boundary

4.3 Nondimensional load-stroke diagrams - derivation of. The nondimensional load-stroke diagram is a plot presenting the nondimensional load L as ordinate versus the nondimensional stroke X/R as abscissa. Such a presentation permits derivation of numerous dimensioned diagrams from a single diagram. The diagram is derived from a statistical analysis of a substantial number of catapult launch and arrestment records which are first normalized to the same base and then nondimensionalized. Slices are made at frequent intervals of stroke to obtain load variation and thus establish the upper and lower 90-90 probability envelopes. Within the boundaries of these envelopes, a multitude of diagrams can be drawn. These diagrams, however, muse satisfy the constant area requirements under the nondimensional load-stroke diagram of paragraph 4.4. For simplicity and standardization, however, a 90-90 probability diagram is formed following the envelope upper boundary during the early portion of the stroke but crossing over and picking up the envelope lower boundary during the later portion of the stroke to satisfy the constant area requirement. The other 90-90 probability diagram is defined as the reverse of this. The mean load lies midway between the two extremes of the envelope boundaries. The maximum load is defined as the highest value of nondimensional load occurring on either diagram or on a connecting line. Connecting lines are used to completely describe the 90-90 probability envelope boundaries. Figure 1 shows the upper 90-90 peak load occurring on a connecting line for this particular case. For other cases it may occur during the early or the later portion of the stroke. Figure 1 also gives typical nomenclature for all nondimensional arresting load-stroke diagrams. The catapult load-stroke diagrams are derived similarly but are presented in a tabular form and are dimensioned for the shipboard catapults. This was done because such a presentation permitted retention of the general applicability without increasing the number of tables required. The nomenclature of the catapult load data is the same as that shown in Figure 1 except for the absence of the oscillatory loads.

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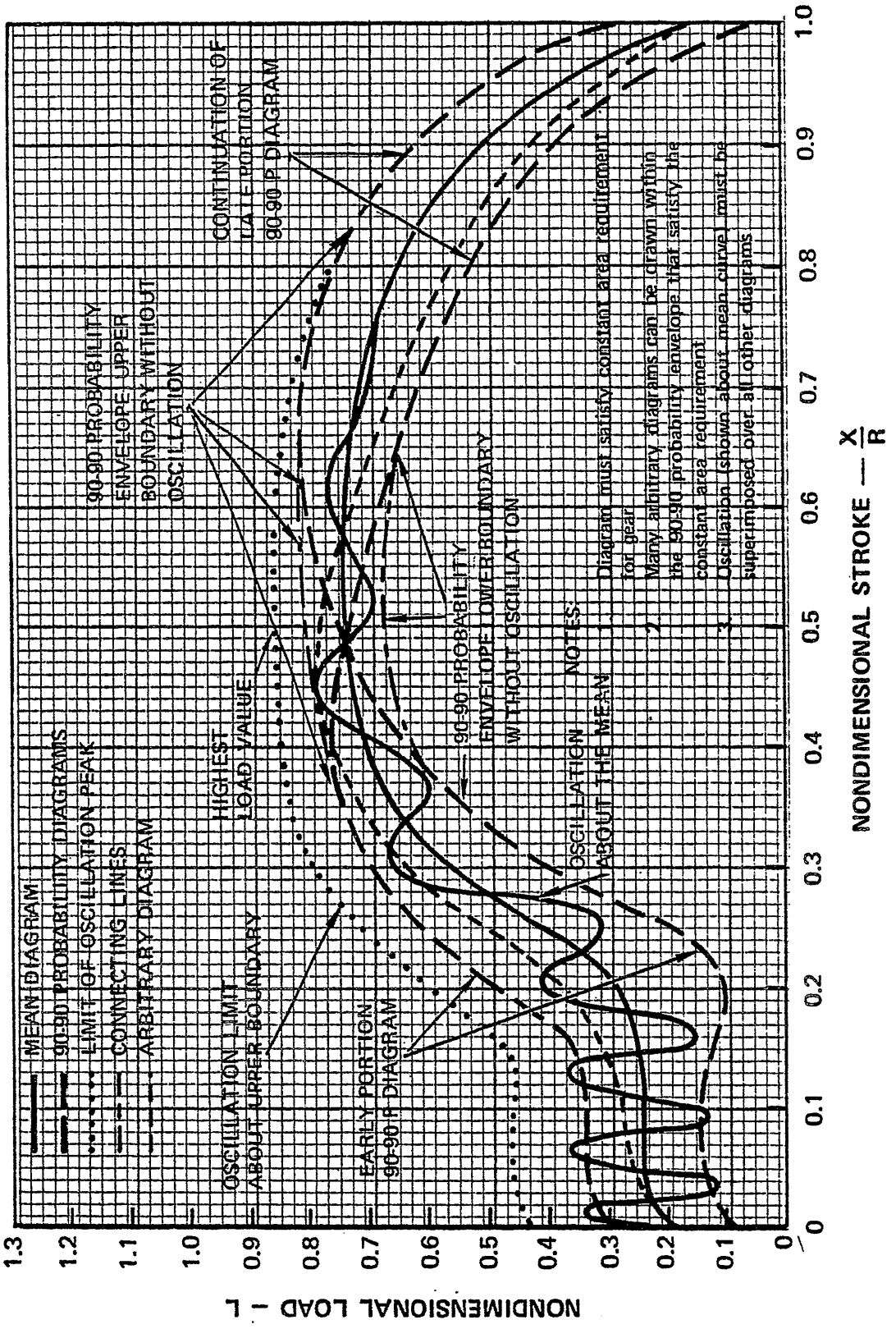

FIGURE 1. Load versus Stroke - Nondimensional Diagram Nomenclature for Arresting

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4.4 Area under the nondimensional load-stroke diagrams. To determine the area constraint for catapulting, consider the energy balance equation:

$$\frac{1}{2} MV^2 = \int_0^R [F - F_F - F_D]\, dX$$

where: F_F = force of friction

F_D = force of aerodynamic drag

or

$$\frac{R}{MV^2} \int_0^1 F dX/R = .5 + \frac{1}{MV^2}\left[\int_0^R F_F dX + \int_0^R F_D dX\right]$$

The left hand term is the area under the nondimensional load-stroke diagram. The second term of the right-hand side of the above equation has been evaluated for different catapults, extreme ranges of endspeeds, and gross weights using the equations of 5.2.6.1.1 for friction and drag, and has been found to be nearly equal to .01. Therefore the area under the nondimensional load for catapulting shown herein and the area that has been used for the derivation of the numerical load-stroke tabulations are based on an area under the nondimensional load-stroke diagram equal to .51.

To determine the area constraint for arresting, the following energy equation applies:

$$\frac{1}{2} MV^2 = \int_0^R [F + F_F + F_D - T]\, dX$$

where: T = airplane thrust

or

$$\frac{R}{MV^2} \int_0^1 F dX/R = .5 + \frac{1}{MV^2}\left[\int_0^R T dX - \int_0^R F_F dX - \int_0^R F_D dX\right]$$

For the purpose of making the load-stroke diagrams presented herein as general as possible, a constant value of thrust = .4W (base thrust) was used throughout the stroke. A constant value of engaging speed (base engaging speed) for each gear was also used (see Section 5 for corrections required for other values of thrusts and engaging speeds). The sum of the integrals on the right-hand side of the equation above has been evaluated for all gross weights using again for friction and drag the equation of 5.2.6.1.1. This sum has been found to vary very little for each gear. The corresponding areas are .50 for the E-15, .54 for the MK 7-1, .55 for the MK 7-2 and MK 7-3, and .57 for the M-21 gear.

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5. DETAIL REQUIREMENTS

5.1 Launching gear (catapult loads).

5.1.1 Types of catapults. The data presented herein apply to the C7, C11-1, C13, and C13-1 shipboard catapults and the CE1-3 shorebased catapulta

5.1.2 Catapult tow force load-stroke tables. Data for catapult load-stroke curves are given in a tabular form. Each table has been arranged to show for a specific catapult the upper, mean, and lower boundary value of the horizontal tow force versus stroke; in dimensional form for shipboard catapults and in nondimensional form for the shorebased catapult.

5.1.2.1 Shipboard load-stroke tables. For shipboard catapults numerical load versus numerical stroke data are shown in Tables 3 through 32 for specific airplane weights and catapult energy levels. The peak load attained during a launch is underlined for each weight. Catapult energy level is expressed as accumulator pressure setting for the variable pressure C7, Cll, and C13 catapults, and as control selector valve (CSV) setting for the constant pressure C13 catapults.

5.1.2.2 Shorebased load-stroke tables. Due to the variable total stroke R of the shorebased catapult, the load-stroke data is given in Table 33 in nondimensional form to minimize the number of tables required.

5.1.3 Catapult stroke.

5.1.3.1 Shipboard catapult total stroke values. The following values of the total stroke, R, are used for each catapult:

Catapult	Total Stroke, R, feet
C7	247
C11-1	205
C13	243
C13-1	302

5.1.3.2 Shorebased catapult total stroke values. To change the nondimensional load-stroke data of Table 33 to dimensioned load and stroke values, two values of total stroke, R, must be used as follows:

(a) Airplane total stroke values. The curve of Figure 2 represents the total stroke due to all forces acting during the launch. This curve is used to dimension the nondimensional stroke value.

(b) Interim total stroke values. The curve of Figure 3 represents the total stroke due to tow force only. It is used to dimension the nondimensional value of the catapult tow force, F, from the nondimensional load, L, given in Table 33.

5.1.4 Catapult energy level. To determine the accumulator pressure or CSV setting for shipboard catapults the minimum catapult end speed, $V_{cat\ rein}$, must be found. This is found by subtracting from the minimum airplane launch

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speed, V_{min}, the minimum wind over deck WOD_{min}, and the end speed increment due to engine thrust, V_{ET} is determined by airplane performance while WOD_{min} and the criteria for determining V_{min} are defined in the detail specification. Having thus determined V_{cat} min, the accumulator pressure is found from Figure 4.1, 5.1, 6.1, 7.1, 8.1, 6.1, 10.1, 11.1, 12.1, and 13.1 as a function of airplane weight and V_{cat} min.

5.1.5 Shorebased catapult end speed. To change the nondimensional load data presented in Table 33 to dimensional load values, the value of the end speed must be determined. This is the airplane ground speed at the instant of tow force cutoff.

5.1.6 Peak catapult force. The peak catapult force attained during a shipboard launch as a function of weight and catapult energy level is shown in Figures 4.2, 4.3, 5.2, 5.3, 6.2, 6.3, 7.2, 7.3, 8.2, 8.3, 9.2, 9.3, 10.2, 10.3, 11.2, 11.3, 12.2, 12.3, 13.2 and 13.3. Separate families of curves are given for the upper or maximum and mean values of the peak load. The minimum values of peak load are not shown in this fern but may be obtained from the load-stroke tables. For obtaining the peak loads for intermediate values of airplane weights and catapult energy levels linear interpolation may be used. for shorebased catapults the peak catapult force must be computed.

5.1.7 Catapult primary loading rate. The catapult primary loading rates expressed in g's per second, is imposed on the airplane during the initial stages of the catapult operation. The values of the primary loading rate as a function of weight and accumulator pressure are given in Figures 4.4, 4.5, 5.4, 5.5, 6.4, 6.5, 7.4, 7.5, 8.4, 8.5, 9.4, 9.5, 10.4, 10.5, 11.4, 11.5, 12.4, 12.5, 13.4, 13.5. Separate families of curves are given for the upper or maximum and mean values of the primary loading rate. The lower or minimum value of primary loading rate can readily be obtained since it is the same amount below the mean as the upper is above the mean. For obtaining the primary loading rates for intermediate values of airplane weights and accumulator pressures linear interpolation must be used.

5.1.8 Sample of calculations.

5.1.8.1 Sample of calculations for shipboard catapults.

Given data:
Airplane launch weight - 45,000 pounds
C7 catapult, total stroke, R - 247 feet
Airplane minimum launch speed, V_{min} - 148 knots
Minimum wind over deck, WOD_{min} - 15 knots
End speed increment due to engine thrust, VET - 6 knots

Data to be determined:

(a) Accumulator pressure

(b) Catapult primary loading rate

(c) Catapult peak tow forces for each of the following conditions:

(1) Upper boundary

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(2) Mean

(3) Lower boundary

(d) Load-stroke for the upper boundary

Solution: (a) Accumulator pressure -

$$V_{cat_{min}} = V_{min} - WOD_{min} - V_{ET}$$

$$= 148 - 15 - 6$$

$$V_{cat_{min}} = 127 \text{ knots}$$

From Figure 4.1, for 127 knot end speed and launch weight of 45,000 pounds, an accumulator pressure of 450 psi is obtained.

(b) Catapult primary loading rate - From Figures 4.4 and 4.5, upper boundary and mean catapult loading rate values are 10.15 and 8.25 g's per second, respectively. The lower boundary value is obtained as 8.25 - (10.15 - 8.25) = 6.35 g's per second.

(c) Catapult peak tow forces -

(1) Upper boundary - Interpolation is required using Table 3, as follows:

F_U for 40,000 lb airplane at 49 ft and at 450 psi = 164.9 kips

F_U for 50,000 lb airplane at 49 ft and at 450 psi = 176.5 kips

delta weight tabulation = 10,000 lbs;
corresponding delta load = 11.6 kips
delta weight this case = 5,000 lb over 40,000 lb

F_U for 45,000 lb airplane =

$$\left(\frac{5,000}{10,000} \times 11.6\right) + 164.9 = 170.7 \text{ kips or } 170,700 \text{ lbs}$$

The peak tow force can be also obtained by using Figure 4.2.

(2) Mean - By interpolation using Table 4, or using Figure 43 F_M = 157,600 lbs

(3) Lower boundary - By interpolation using Table 5, F_L = 144,500 lbs

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(d) Load-stroke data for the upper boundary - In the dynamic analysis requirement of MIL-A-8863 it is necessary to have data for the relationship between the actual catapult stroke, X, and the catapult tow force, F, which acts on the airplane. This is obtained either directly or by straight line interpolation using the tabulated numerical load-stroke diagram. Using Table 3 and interpolation., the upper boundary diagram is formed as shown in Table 34.

TABLE 34. C7 Catapult Tow Force vs Stroke for a 45,000 Pound Airplane

Stroke (feet)	F_U (lbs)	Stroke (feet)	F_U (lbs)
0	54,800	86	160,000
.2	76,150	99	155,050
1.2	123,750	111	150,550
2	135,500	124	145,650
6	157,100	136	139,600
12	163,700	148	133,250
19	166,550	161	128,350
25	167,350	173	123,750
31	168,450	185	119,300
37	169,650	198	114,200
49	170,700	222	105,250
62	167,450	247	96,100
74	164,600		

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5.1.8.2 Sample of calculations for shorebased catapults.

Given data: Airplane launch weight - 37,685 pounds
Type catapult - CE1-3
End speed requirement - 150 knots
Airplane thrust - 13,200 pounds (.35W)

Data to be determined: Load-stroke for the upper boundary

Solution: Load-stroke - To obtain the relationship between the catapult stroke, X, and the catapult tow force, F, the following operations are performed:

(a) From Table 33 interpolate between 30,000 and 40,000 lbs, to get the desired nondimensional load values of L for the given airplane weight. These values are shown in the second column of Table 35 at different X/R values.

(b) From Figure 2, using the given data, solve for the airplane total stroke, R, hence R = 1,010 feet.

(c) The catapult stroke, X, may be found by multiplying the non-dimensional stroke, X/R, value by the R value of 1,010 feet. The values of stroke are shown in the last column of Table 35.

(d) To calculate the tow force, F, 'the value of the interim total stroke must be used. This value, obtained from Figure 3, is 1,320 feet.

Hence $$F_U = \frac{LUMV^2}{R}$$

$$F_U = \frac{LU \frac{37,685}{32.2} \times (150 \times 1.689)^2}{1,320}$$

or $$F_U = 56,908.9 \times L$$

and F is determined by substituting the values of L, shown in Table 35, as a function of X/R.

(e) Tabulation of the tow force for the upper boundary is shown in the third column of Table 35.

TABLE 35. Calculation of the CE1-3 Catapult Tow Force vs Stroke for a 37,685 Pound Airplane

Nondimensional Values From Table 33		Dimensional	
$\frac{X}{R}$	L_U	F_U (lbs)	X (feet)
1	2	3	4
		56,908.9 x 2	1010 x 1
0	.470	26,747	0
.025	.567	32,267	25.25
.050	.618	35,170	50.50
.075	.626	35,625	75.75
.100	.621	35,340	101.00
.125	.618	35,170	126.25
.150	.618	35,170	151.50
.200	.623	35,454	202.00
.250	.628	35,739	252.50
.300	.625	35,568	303.00
.350	.619	35,227	353.50
.400	.603	34,316	404.00
.450	.583	33,178	454.50
.500	.558	31,755	505.00
.550	.530	30,162	555.50
.600	.503	28,625	606.00
.650	.488	27,772	656.50
.700	.467	26,576	707.00
.750	.443	25,211	757.50
.800	.412	23,446	808.00
.850	.366	20,829	858.50
.900	.289	16,447	909.00
.950	.159	9,048	959.50
1.000	0	0	1010.00

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5.2 Recovery gear (arresting loads).

5.2.1 Arresting gears. The data herein are presented for two types of arrestments, i.e., routine and emergency. The gears used for routine or normal arrestments are the shipboard arresting gears, MK7-1, MK7-2, and MK7-3 and the shorebased M-21 gear. There are many emergency arresting gears in use but data for only the E-15 gear are shown.

5.2.2 Nondimensional load-stroke diagrams. Diagrams of nondimensional load versus nondimensional stroke are presented for specific airplane gross weights in the figures shown in Table 36. Each figure shows, for each gross weight, three smooth curves and an oscillatory curve. The three curves are the upper, the lower 90-90 probability diagrams, and the mean. The oscillatory curve will be discussed in paragraph 5.2.3. For weights not shown in Table 36 interpolation must be used to obtain the nondimensional load.

TABLE 36. List of Figures Showing Nondimensional Load vs Stroke Curves for Specific Airplane Weights and Arresting Gears

Aircraft Weight (lbs)	Arresting Gears				
	MK7-1	MK7-2	MK7-3	M-21	E-15
10,000	Fig. 14.1	Fig. 16.1	Fig. 18.1	Fig. 20.1	Fig. 22.1
15,000	Fig. 14.2	Fig. 16.2	Fig. 18.2	Fig. 20.2	Fig. 22.2
20,000	Fig. 14.3	Fig. 16.3	Fig. 18.3	Fig. 20.3	Fig. 22.3
30,000	Fig. 14.4	Fig. 16.4	Fig. 18.4	Fig. 20.4	Fig. 22.4
40,000	Fig. 14.5	Fig. 16.5	Fig. 18.5	Fig. 20.5	Fig. 22.5
50,000	Fig. 14.6	Fig. 16.6	Fig. 18.6	Fig. 20.6	Fig. 22.6
60,000	Fig. 14.7	Fig. 16.7	Fig. 18.7	Fig. 20.7	Fig. 22.7

5.2.3 Oscillatory nondimensional load-stroke curves. Because of cable dynamics there is an oscillatory force during each arrestment. For each nondimensional load-stroke curve shown herein, the oscillatory nondimensional load is shown superimposed on the mean load-stroke curve. Actually, the oscillatory load must be also superimposed on the upper as well as the lower 90-90 probabiliuty load curves. The dotted line on each diagram represents the upper limit of the oscillatory load about the upper 90-90 envelope boundary and therefore contains the highest value of peak load during an arrestment. It should be noted that the amplitude-and the frequency of the oscillatory curves are average values and that frequency can vary as much as one half cycle in either direction from that shown. Therefore, in extracting the maximum nondimensional load from the curves listed in Table 36, allowance must be made

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for the frequency variation so that the peaks of the oscillatory and the smooth curves coincide. The average half amplitudes and average frequencies for each arresting gear and specific weight of Table 36 are shown in Figures 15.3, 17.3, 19.3, 21.3 and 23.3 as a function of nondimensional stroke. To obtain average half amplitudes and frequencies for intermediate airplane weights, linear interpolation must be used.

5.2.4 Runout. The values of runout vary for each arresting gear. The runout value must be used in obtaining dimensional values from the nondimensional load-stroke curves.

5.2.4.1 Runout for shipboard arrestments. The runouts for the MK7-1, MK7-2, and MK7-3 gears are 230, 310, and 340 feet respectively.

5.2.4.2 Runout for shorebased arrestments. The runout is variable and can be obrtained from Figure 21.6, and Figure 23.1 as a function of airplane weight and/or engaging speed. For calculating loads, the mean value of the runout must be used for emergency arrestments. For routine shorebased arrestments, runouts associated with the mean and upper 90-90 loads are to be used.

5.2.5 Engaging speeds. Engaging speeds along with airplane weights and runout must be used for dimensioning the nondimensional load-stroke curves.

5.2.5.1 Engaging speeds for normal arrestments. Engaging speeds up to the limit engaging speeds shown in Figures 15.1, 17.1, 19.1 and 21.1 for the MK7-1, MK7-2, MK7-3, and M-21 gears may be used.

5.2.5.2 Engaging speeds for emergency arrestments. Engaging speeds up to 160 knots may be used.

5.2.6 Corrections to the nondimensional diagrams. It was pointed out in Section 4 that the nondimensional diagrams are correct for only certain base conditions. Therefore some corrections are required to make the diagrams applicable to the general case.

5.2.6.1 Corrections for routine arrestments.

5.2.6.1.1 Corrections for thrust and engaging speed. In Section 4 it was stated that the area of the nondimensional diagrams is nearly constant for the base thrust and engaging speed for each arresting gear. The base thrust is a constant 0.4W during the runout for the shipboard gears and is as shown in Figure 24 for the M-21 gear. The base engaging speeds are 130 knots, 135 knots, 145 knots and 160 knots for the MK7-1, MK7-2, MK7-3, and M-21 gears, respectively. To make the diagrams applicable to the general case the-area and the nondimensional load (including the oscillatory load) have to be multiplied by a correction factor. This factor is the ratio of the area of the nondimensional diagram for any engaging speed and thrust to the area of the nondimensional diagram corresponding to the base thrust and engaging speed. The correction factor is given by the following equation:

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$$C = \frac{\left[.5\ MV^2 + TR - k_1WR - k_2 \int_0^R V_i^{\ 2} dX \right] V_B^2}{\left[.5\ MV_B^2 + T_BR - k_1WR - k_2 \int_0^R V_{i_B}^2\ dX \right] V^2}$$

where: k_1 = .017, coefficient of rolling friction,

k_2 = (.011 + 2.2 x 10-6 W) aerodynamic drag coefficient, lbs $\frac{sec^2}{f\ t^2}$

V_i = instantaneous velocity, ft/sec,

and the subscript B for V and T refers to the base cases for which the nondimensional diagrams are presented.

Plots of correction factors for selected values of thrust are shown in Figures 15.2, 17.2, 19.2, and 21.2 as a function of engaging speeds. If, for a particular airplane, the values of the coefficients and thrust are different than those appearing here, the applicable parameters can be substituted into the numerator above to obtain a more accurate correction factor.

5.2.6.1.2 Correction for wet tape. When the M-21 arresting gear tape is wet oscillatory loads increase. Figure 21.7 gives the correction factor for this situation.

5.2.6.2 Correction for emergency engagements. The correction factor for the E-15 gear is 1.0 since it is assumed that the thrust is always equal to drag during the arrestment. Figure 23.2 gives the correction factor for converting 300 foot span to 200 foot span.

5.2.7 Diagram dimensional load scale. For each nondimensional diagram a base dimensional load scale is given. To obtain a dimensional value for other than base conditions corrections as shown at the bottom of each diagram must be made.

5.2.8 Peak arresting force. The peak arresting force can be obtained from the nondimensional load stroke diagrams. For easy reference the maximum and mean peak arresting forces have been plotted as a function of engaging speed for different values of weights. These are shown in Figures 15.4, 15.5, 17.4, 17.5, 19.4, 19.5, 21.4, 21.5, 21.8, 23.4 and 23.5. Peak values for intermediate weights can be approximated by visual interpolation.

5.2.9 Sample of calculations.

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5.2.9.1 Sample of calculations for normal arrestments.

Given data:
Airplane weight - 17,500 pounds
Airplane thrust - 7,500 pounds (.43W)
MK7-1 arresting gear
Engaging speed - 100 knots

Data to be determined:

(a) Peak arresting force for the upper 90-90 probability with and without the oscillatory force; also, corresponding forces at the same stroke for the mean and lower 90-90 probability.

(b) Load-stroke curves for the upper 90-90 probability including the oscillatory force.

Solution:

(a) By inspecting Figure 14.2 for 15,000 pounds weight, and Figure 14.3 for 20,000 pounds it appears that the peak force 17,500 pounds will occur at X/R = .23. (In cases where this is not immediately apparent a trial and error method may be used.) Calculation of the nondimensional load is shown in Table 37, where the values of the first two rows of nondimensional load without the oscillatory for weight of 15,000 pounds and 20,000 pounds are obtained from Figures 14.2 and 14.3. The nondimensional component of the oscillatory load for 15,000 and 20,000 at X/R = .23 is obtained from Figure 15.3. The values of the second through the fifth column of the third row for 17,500 pounds weight are found by interpolation. The values of the last three columns of the third row are the values of the nondimensional load including the oscillatory component.

Substituting in the formula of 4.1 the values of L from Table 37, 17,500/32.2 slugs for M, 100 x 1.69 ft/sec for V, 230 ft for R, 1.09 for C (see Figure 15.2) and solving for F, the following peak arresting forces are obtained.

$$F_M = .625 \times 1.09 \left(\frac{17,500}{32.2}\right) \frac{(100 \times 1.69)^2}{230} = 45,900 \text{ lbs}$$

$$F_{M+osc} = .833 \times 1.09 \left(\frac{17,500}{32.2}\right) \frac{(100 \times 1.69)^2}{230} = 61,200 \text{ lbs}$$

$$F_U = .762 \times 1.09 \left(\frac{17,500}{32.2}\right) \frac{(100 \times 1.69)^2}{230} = 56,000 \text{ lbs}$$

$$F_{U+osc} = .970 \times 1.09 \left(\frac{17,500}{32.2}\right) \frac{(100 \times 1.69)^2}{230} = 71,300 \text{ lbs}$$

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$$= .488 \times 1.09 \left(\frac{17,500}{32.2}\right) \frac{(100 \times 1.69)^2}{230} = 35,900 \text{ lbs}$$

$$= .696 \times 1.09 \left(\frac{17,500}{32.2}\right) \frac{(100 \times 1.69)^2}{230} = 51,100 \text{ lbs}$$

TABLE 37. Calculation of Peak Nondimensional Load for a 17,500 Pound Airplane

Airplane Weight, lbs. ①	L_M ②	L_U ③	L_L ④	L_{OSC} ⑤	L_{M+OSC} ⑥=②+⑤	L_{U+OSC} ⑦=③+⑤	L_{L+OSC} ⑧=④+⑤
15,000	.675	.822	.527	.227			
20,000	.575	.701	.450	.189			
17,500	.625	.762	.488	.208	.833	.970	.696

(b) To obtain the load-stroke curve for the upper 90-90 probability including the oscillatory force the following step-by-step procedure is used:

(1) obtain the upper 90-90 probability nondimensional load-stroke curve for a gross weight of 17,500 pounds without the oscillatory. This can be readily done by reading at various values of stroke the corresponding values of the nondimensional load without the oscillatory for weights of 15,000 and 20,000 pounds from Figure 14.2 and 14.3, and then interpolating to obtain the upper 90-90 probability nondimensional load for 17,500 pounds. The results of this interpolation are shown in column 5 of Table 38.

(2) Superimpose on the values of column 5, Table 38, the envelope of the peaks and bottom of the troughs of the oscillatory nondimensional load. This can be done by reading the values of the half amplitudes of the oscillatory nondimensional load for weights of 15,000 and 20,000 pounds from Figure 15.3 at various values of the nondimensional stroke and then interpolating for 17,500 pounds. Results of this interpolation are shown in column 8 of Table 38. Then by adding to and alternately subtracting column 8 from column 5, superimposition is completed and the results are shown in columns 9 and 10 of Table 38.

TABLE 38. Load-Stroke Values for a 17,500 Pound Airplane

$\frac{X}{R}$ (1)	STROKE feet (2) = 230 x (1)	L_U For 15,000 Lbs. (3)	L_U For 20,000 Lbs. (4)	L_U For 17,500 Lbs. (5) = $\frac{(3)+(4)}{2}$	L_{OSC} For 15,000 Lbs. (6)	L_{OSC} For 20,000 Lbs. (7)	L_{OSC} For 17,500 Lbs. (8) = $\frac{(6)+(7)}{2}$	L_{U+OSC} For 17,500 Lbs. (9) = (5) + (8)	L_{U-OSC} For 17,500 Lbs. (10) = (5) - (8)	F_{U+OSC} Lbs. (11) = 73,475 x (9)	F_{U-OSC} Lbs. (12) = 73,475 x (10)	F_U Lbs. (13) = 73,475 x (5)
.025	5.75	.310	.268	.289	.138	.118	.128	.417	.161	30,600	11,800	21,200
.050	11.5	.390	.336	.363	.162	.134	.148	.511	.215	37,500	16,000	26,700
.075	17.25	.470	.408	.439	.178	.146	.162	.601	.277	44,200	20,400	32,300
.10	23.0	.558	.476	.517	.193	.161	.177	.694	.340	51,000	25,000	38,000
.15	34.5	.726	.598	.662	.217	.181	.199	.861	.463	63,300	34,000	48,600
.20	46.0	.819	.678	.749	.227	.189	.208	.957	.541	70,300	39,700	55,000
.23	52.9	.822	.702	.762	.227	.189	.208	.970	.554	71,300	40,700	56,000
.30	69.0	.752	.690	.721	.214	.178	.196	.917	.525	67,400	38,600	53,000
.35	80.5	.722	.722	.722	.198	.164	.181	.903	.541	66,300	39,700	53,000
.40	92.0	.722	.738	.730	.178	.148	.163	.893	.567	65,600	41,700	53,600
.45	103.5	.715	.719	.717	.160	.132	.146	.863	.571	63,400	42,000	52,700
.50	115.0	.628	.640	.634	.142	.114	.128	.762	.506	56,000	37,200	46,600
.55	126.5	.528	.580	.554	.123	.097	.110	.664	.444	48,800	32,600	40,700
.60	138.0	.496	.540	.518	.103	.083	.093	.611	.425	44,900	31,200	38,100
.65	149.5	.485	.536	.511	.084	.066	.075	.586	.436	43,100	32,000	37,500
.70	161.0	.476	.524	.500	.066	.052	.059	.559	.441	41,100	32,400	36,700
.75	172.5	.465	.513	.489	.048	.036	.042	.531	.447	39,000	32,800	36,000
.80	184.0	.446	.490	.468	.030	.024	.027	.495	.441	36,400	32,400	34,400
.85	195.5	.428	.464	.446	.015	.011	.013	.459	.433	33,700	31,800	32,800
.90	207.0	.396	.440	.418	0	0	0	.418	.418	30,700	30,700	30,700
.95	218.5	.330	.400	.365	0	0	0	.365	.365	26,800	26,800	26,800
1.00	230.0	.040	.090	.065	0	0	0	.065	.065	4,800	4,800	4,800

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(3) Dimensionalize the nondimensional loads of (1) and (2). This is simply done by multiplying columns 5, 9, and 10 by 1.09 (17,500/32.2) X (100 X 1.69)^2/230 = 73,475 pounds, as explained in part (a) of this example. The dimensional loads are shown in columns 11, 12, and 13 of Table 38 and are also plotted in Figure 25.

(4) Locate points of tangency and intersection of the upper 90-90 load (including oscillatory loads) with each of the three curves of Figure 25. Since as it was pointed out in 5.2.3 the frequency of the oscillatory component of the load is a variable, an infinite number of points canbelocated. For this example the frequency of ,the oscillatory component of the load will be adjusted so that the upper 90-90 probability load plus its oscillatory component will be maximum. From inspection of Figure 25 this maximum occurs at a stroke of 52.9 feet. To determine the points of tangency and intersection, Table 39 is constructed. Derivation of the first six columns is self explanatory. The seventh column is obtained by adjusting the number of cycles of column 6 so that the upper 90-90 probability load plus its oscillatory component will be maximum with the least amount of frequency adjustment. From column 6 it is noted that at a stroke of 52.9 feet the number of average cumulative cycles. is 2.939. This number has to be adjusted to 3.25 cvcles so that the Desk of the oscillatory component will occur at a stroke of 52.9 feet. Therefore, the cycles of column 6 are multiplied by the ratio of 3.25/2.939, as shown in column 7. Column 8 shows the adjusted number of cycles per interval and it is obtained as the difference of two successive cumulative cycles of column 7. To obtain the To obtain the points of tangency and intersection of the oscillatory with each of the three curves of Figure 25, the following observations are made:

1. Intersection with the middle curve will occur when the number of cycles is equal to zero and each half cycle thereafter.

2. Tangency with the upper or the lower curve will occur when the number of cycles is equal to .25 and each half cycle thereafter.

To obtain any intersection or tangency point, say for instance a point for 6 cycles (intersection), it is noted from Table 39 (column 7) that this point will correspond to a stroke greater than 92 feet and that another .752 of a cycle (6-5*248) is required to complete the 6th cycle. Therefore, the corresponding value of the stroke will be:

$$92 + \frac{.752 \text{ x interval}}{\text{adjusted cycles per interval}} = 92 + \frac{.752 \text{ x } 23}{1.073} = 108.1 \text{ feet}$$

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TABLE 39. Adjustment of Cycles per Interval

STROKE feet (1)	INTERVAL feet (2)	AVERAGE NONDIMENSIONAL FREQUENCY Ref. Fig. 15.3 (3)	AVERAGE INTERVAL FREQUENCY (4)	AVERAGE CYCLES PER INTERVAL $\frac{(2) \times (4)}{230}$ (5)	AVERAGE CUMULATIVE CYCLES Σ (5) (6)	ADJUSTED CUMULATIVE CYCLES (6) $\times \frac{3.25}{2.939}$ (7)	ADJUSTED CYCLES PER INTERVAL (8)
0		11.3			0	0	
	11.5		12.0	.600			.663
11.5		12.7			.600	.663	
	11.5		13.0	.650			.719
23.0		13.3			1.250	1.382	
	11.5		13.3	.665			.736
34.5		13.3			1.915	2.118	
	11.5		13.0	.650			.718
46.0		12.7			2.565	2.836	
	6.9		12.45	.374			.414
52.9		12.2			2.939	3.250	
	4.6		11.95	.239			.264
57.5		11.7			3.178	3.514	
	11.5		11.15	.558			.617
69.0		10.6			3.736	4.131	
	11.5		10.3	.515			.570
80.5		10.0			4.251	4.701	
	11.5		9.9	.495			.547
92.0		9.8			4.746	5.248	
	23.0		9.7	.970			1.073
115.0		9.6			5.716	6.321	
	23.0		9.45	.945			1.045
138.0		9.3			6.661	7.366	
	23.0		9.15	.915			1.012
161.0		9.0			7.576	8.378	
	23.0		8.85	.885			.978
184.0		8.7			8.461	9.356	
	23.0		8.55	.855			.946
207.0		8.4			9.316	10.302	

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By the same method the remainder of the intersection points and all the tangency points are found and are shown as small circles on Figure 25. An alternate graphical method of plotting Table 39 column 1 versus column 7 and then reading the quarter cycle intersections directly will expedite the solution. By drawing on Figure 25 a smooth curve tangent to the upper and lower curve at the small circles and intersecting the middle line at the small circles, the load-stroke curve for the upper 90-90 probability, including its oscillatory component, is determined.

5.2.9.2 Sample of calculations for emergency arrestments.

Given data: Airplane weight - 45,000 pounds
E-15 arresting gear (300 foot span)
Engaging speed 155 knots

Data to be determined: Peak arresting force for the upper 90-90 probability with and without its oscillatory component

Solution: By inspecting Figures 22.5 and 22.6, it appears that at X/R = .53 the peak arresting force will develop. The values of L_U of Table 40 are obtained from Figures 22.2 and 22.6. The value of L_{osc} is obtained from Figure 23.3 and the third row for 45,000 pounds is obtained by interpolation.

Additionally, from Figure 23.1, the value of the runout R, of 1,020 feet for 155 knots is obtained. Substituting in the formula of 4.1 the values of L from Table 40, 45,000/32.2 slugs for M, 155 x 1.69 ft./see for V, 1,020 feet for R and solving for F the following is obtained:

$$F_U = .798 \times \left(\frac{45,000}{32.2}\right) \times \frac{(155 \times 1.69)^2}{1,020} = 74,900 \text{ lbs}$$

$$F_{U+osc} = .844 \times \left(\frac{45,000}{32.2}\right) \times \frac{(155 \times 1.69)^2}{1,020} = 79,250 \text{ lbs}$$

The above calculated load (including oscillation) can be read directly using Figures 23.4 and 23.5 The load-stroke curve may be obtained using the same procedure as in the previous example.

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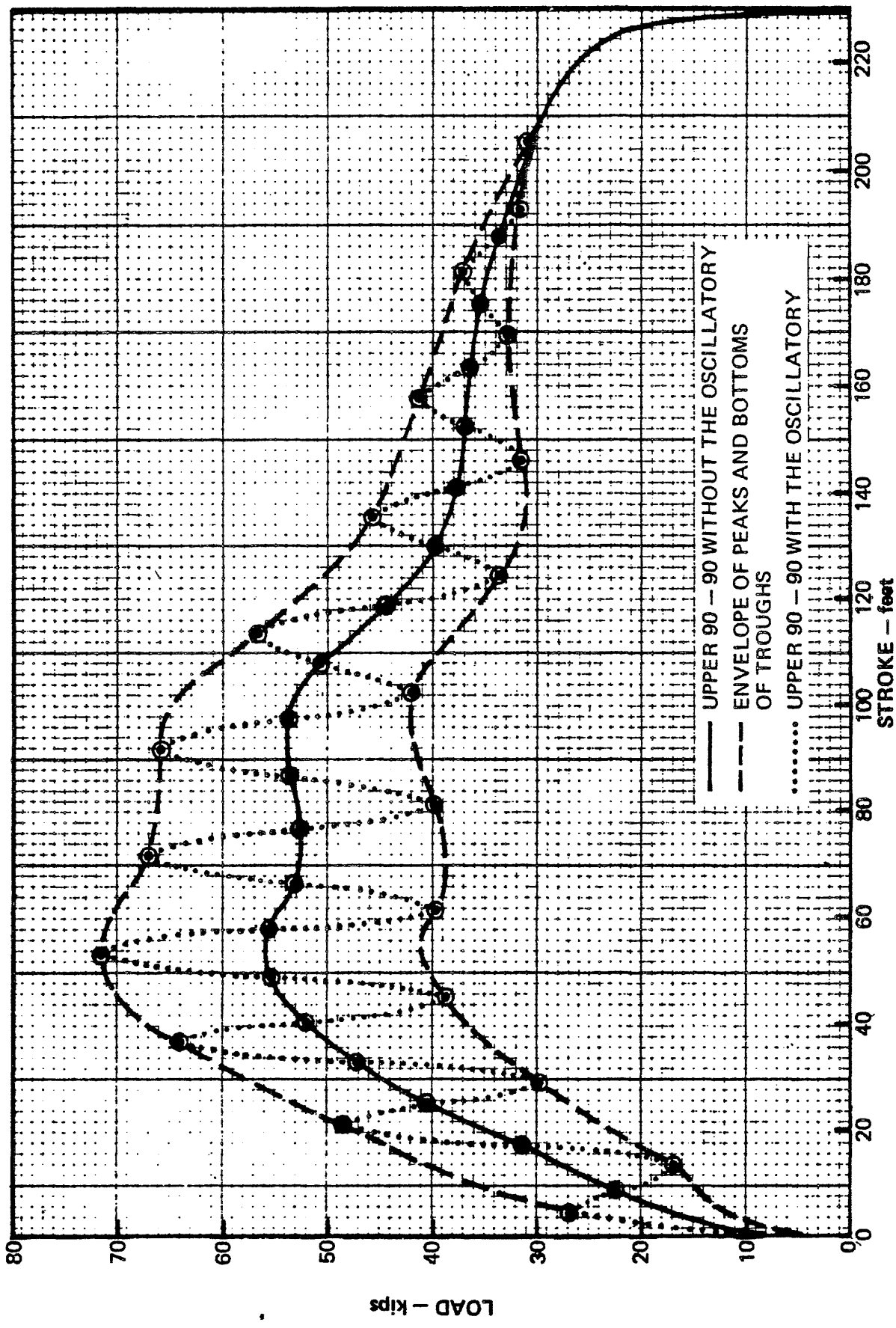

FIGURE 25. Load Stroke Curve for a 17,500 Lb Airplane

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TABLE 40. Calculation of Peak Nondimensional Load for a 45,000 Pound Airplane

Weight Pounds (1)	L_U (2)	L_{OSC} (3)	L_{U+OSC} (4) = (2) + (3)
40,000	.814		
50,000	.782		
45,000	.798	.046	.844

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TABLE 3. C7 Catapult (with metering rod), Upper Boundary, load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) — NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND ACCUMULATOR PRESSURE

Pressure (PSI)	Stroke / Weight (LBS)	0	0.2	1.2	2	6	12	19	25	31	37	49	62	74	86	99	111	124	136	148	161	173	185	198	222	247
	10,000	9.7	16.0	35.1	37.0	39.3	38.9	39.1	39.0	39.1	39.2	39.5	39.1	38.6	36.2	33.6	31.8	30.0	28.6	27.1	26.0	25.1	24.0	23.0	21.7	20.4
	20,000	18.9	29.4	53.7	55.0	56.5	57.0	57.3	57.5	57.3	57.2	57.2	54.4	51.7	49.1	46.5	44.2	41.9	40.2	38.5	37.1	35.9	34.7	33.4	31.6	29.6
150	30,000	27.4	41.5	61.6	62.9	65.0	65.1	65.4	65.5	64.8	64.3	63.2	60.6	58.2	55.5	52.7	50.4	47.8	45.8	43.7	42.0	40.4	38.8	37.2	35.3	33.5
	40,000	34.1	51.3	64.9	66.2	68.9	68.7	68.6	68.7	67.6	66.5	64.2	62.2	60.4	57.9	55.1	52.8	50.3	48.0	45.7	43.8	41.9	40.1	38.1	36.6	35.0
	50,000	42.4	56.0	65.3	66.0	69.0	69.0	71.4	69.5	67.8	66.5	64.5	62.2	60.2	58.0	55.7	53.3	50.7	48.8	47.0	44.8	42.9	40.9	38.8	36.9	34.9
	10,000	11.4	17.9	37.2	41.2	45.9	46.2	46.4	46.4	46.5	46.7	47.0	46.6	46.3	44.3	42.1	40.3	38.2	36.6	35.0	33.7	32.5	31.3	29.9	28.0	26.1
	20,000	22.3	33.3	60.5	64.3	68.7	69.6	70.0	70.2	70.2	70.3	70.5	67.7	65.1	62.5	59.7	57.2	54.4	52.1	49.8	48.0	46.5	44.9	43.1	40.3	37.5
	30,000	32.1	46.8	71.5	75.0	79.6	80.2	80.7	80.9	80.4	80.0	78.7	76.0	73.3	70.5	67.6	64.8	61.9	59.1	56.4	54.3	52.3	50.4	48.4	45.5	42.4
200	40,000	40.8	59.3	78.8	81.3	85.6	86.0	86.6	86.9	85.7	84.7	81.9	79.3	76.8	74.1	71.1	68.4	65.6	62.4	59.4	57.1	54.9	52.7	50.4	47.5	44.6
	50,000	48.9	70.2	82.8	84.4	88.8	89.6	90.1	89.7	88.5	87.2	84.7	81.8	79.2	76.6	73.9	70.8	67.7	64.9	62.1	59.5	57.2	54.9	52.3	49.1	45.8
	60,000	56.8	71.4	84.4	85.7	90.5	91.8	92.8	91.2	89.7	88.3	86.0	83.0	80.3	78.0	75.3	72.2	68.8	66.3	63.8	61.1	58.5	56.1	53.4	49.8	46.3
	70,000	65.5	74.1	87.5	88.6	92.9	94.0	93.6	92.6	91.3	89.9	87.9	84.7	81.8	79.3	76.6	73.7	70.6	68.2	65.7	63.0	60.4	57.9	55.0	51.3	47.5
	10,000	12.4	19.0	38.4	44.1	51.3	52.6	53.0	53.0	53.1	53.3	53.5	53.3	53.1	52.0	50.7	48.7	46.6	45.0	43.4	41.7	40.3	38.8	37.2	34.7	31.9
	20,000	24.1	35.1	63.6	71.2	79.9	80.8	81.5	81.8	82.2	82.5	83.0	80.7	78.3	76.0	73.3	70.6	67.6	64.6	61.6	59.4	57.4	55.5	53.3	49.4	45.5
	30,000	35.3	50.2	80.8	86.6	94.3	95.7	96.5	97.0	96.8	96.5	95.2	92.3	89.5	86.8	83.8	80.7	77.4	74.0	74.6	67.9	65.7	63.5	60.9	56.5	52.0
250	40,000	44.4	63.1	91.7	95.0	100.8	102.0	103.4	104.5	103.4	102.3	98.9	95.6	92.5	89.7	86.8	83.7	80.3	76.7	73.2	70.6	68.1	65.8	63.1	58.6	53.9
	50,000	52.5	74.5	99.4	101.5	107.2	108.6	109.6	109.5	108.4	107.4	104.3	100.9	97.8	95.0	91.9	88.3	84.6	80.8	77.2	74.3	71.7	69.0	66.2	61.4	56.5
	60,000	61.8	83.7	101.9	104.0	109.9	111.8	112.7	111.3	110.1	108.8	106.3	102.8	99.7	97.0	93.9	90.2	86.2	82.4	78.5	75.6	72.7	70.0	67.0	62.1	57.1
	70,000	70.4	94.3	107.5	108.8	113.3	115.7	114.6	113.4	111.8	110.5	107.7	104.6	101.6	98.9	95.9	92.1	88.2	84.4	80.7	77.5	74.7	71.8	68.8	63.7	58.5
	80,000	79.5	100.1	110.9	112.1	115.4	117.0	115.7	114.2	112.4	110.7	108.1	105.1	102.5	99.7	96.8	93.2	89.2	85.6	81.9	78.7	75.9	72.9	69.9	64.5	59.1
	10,000	12.9	19.6	39.1	45.8	55.3	57.8	58.3	58.4	58.6	58.8	58.9	58.9	59.0	59.0	59.0	57.1	55.0	53.4	51.8	49.9	48.2	46.5	44.7	41.3	37.8
	20,000	25.6	36.8	70.3	78.2	89.1	88.1	91.4	91.7	92.5	93.3	94.0	92.5	90.9	89.0	86.7	83.8	80.7	77.0	73.3	70.6	68.4	66.0	63.3	58.4	53.2
	30,000	37.2	52.4	89.5	96.0	105.7	108.0	109.5	110.1	110.3	110.5	109.1	106.3	103.5	101.3	98.8	95.5	91.9	87.7	83.7	80.8	78.2	75.6	72.8	66.9	60.5
300	40,000	46.8	65.7	102.7	107.4	115.1	117.5	120.1	121.0	120.4	119.9	116.0	111.9	108.2	105.6	103.0	99.7	95.9	91.7	87.4	84.6	82.0	79.5	76.7	70.0	63.3
	50,000	55.5	77.9	112.0	116.8	123.3	125.9	127.4	127.6	126.8	126.2	122.7	118.9	115.2	112.3	109.3	105.4	101.2	96.3	91.5	88.5	85.8	82.9	79.9	73.3	66.4
	60,000	64.9	90.4	118.8	121.7	128.8	131.2	131.5	130.9	130.1	129.3	126.5	122.8	119.4	116.2	112.7	108.5	103.9	98.5	93.1	90.0	87.0	84.2	81.0	74.6	67.9
	70,000	73.5	101.8	124.6	127.3	132.4	134.9	134.3	132.9	131.5	130.1	126.8	123.9	121.0	118.2	115.1	110.6	105.5	100.2	94.9	91.6	88.7	85.6	82.5	75.8	68.8
	80,000	83.0	107.0	131.8	133.8	135.4	137.8	136.5	134.2	132.0	129.9	126.2	123.9	122.0	119.6	116.6	111.7	106.3	101.2	96.0	92.6	89.7	86.7	83.3	76.5	69.4
	20,000	26.3	37.7	71.4	76.9	96.2	100.2	101.3	101.6	102.3	103.2	103.5	102.8	102.1	99.9	97.7	95.0	92.1	88.0	83.9	81.2	78.8	76.2	73.6	68.2	62.6
	30,000	38.4	53.7	94.3	102.7	116.7	120.4	122.1	122.6	123.0	123.4	123.2	120.9	118.8	115.8	112.8	109.6	106.1	101.3	96.4	93.1	90.2	87.2	84.2	77.6	70.8
	40,000	48.5	67.5	110.7	118.0	129.8	133.6	135.5	136.3	136.3	136.5	135.1	131.2	127.4	124.0	120.1	116.7	112.9	107.6	102.3	98.8	95.4	92.2	88.7	81.5	74.0
350	50,000	57.4	79.9	122.0	128.2	138.9	142.3	144.1	144.6	144.5	144.3	141.9	137.6	133.6	130.0	125.9	122.3	118.3	112.5	107.0	102.8	99.2	95.7	91.8	84.4	76.8
	60,000	67.1	92.8	130.7	135.5	145.0	148.4	149.6	150.0	149.6	149.3	145.5	141.0	136.9	133.2	129.2	125.3	121.0	115.1	109.1	104.8	100.9	97.0	93.1	85.7	78.1
	70,000	76.1	104.5	138.8	142.8	151.1	153.0	155.0	154.5	153.1	151.6	147.4	143.5	139.8	136.2	132.4	127.9	123.0	117.6	112.2	107.8	104.0	100.3	96.2	88.2	79.8
	80,000	85.6	116.5	145.1	148.6	155.9	159.0	158.8	157.3	154.9	152.5	147.9	144.5	141.4	138.3	134.6	129.5	124.1	119.0	114.0	110.1	106.2	102.6	98.7	89.8	80.8
	20,000	26.8	38.6	72.3	83.0	103.0	108.4	110.5	110.9	111.3	111.6	112.0	112.4	113.0	110.6	108.1	106.0	103.5	98.9	94.4	91.7	89.2	86.6	83.9	78.2	72.5
	30,000	38.9	55.5	96.9	107.2	125.9	131.4	133.1	133.6	134.2	134.9	136.5	134.6	133.3	129.8	126.0	123.1	120.1	114.6	108.8	105.2	101.9	98.6	95.0	88.1	81.0
	40,000	49.5	68.7	114.1	124.4	140.6	145.4	146.7	147.2	148.2	149.1	151.0	147.3	143.8	139.1	134.2	130.9	127.5	121.1	114.7	110.4	106.6	102.6	98.2	90.7	82.8
400	50,000	58.7	81.4	127.9	137.3	152.2	157.0	158.9	159.9	160.4	161.1	159.6	155.1	150.9	146.4	141.5	138.3	134.6	128.1	121.6	116.7	112.2	107.7	102.8	94.8	86.5
	60,000	68.4	94.2	137.7	146.2	159.1	163.5	166.0	167.4	167.7	168.0	162.9	157.6	152.7	148.6	143.9	140.9	137.1	130.8	124.4	119.1	114.2	109.1	103.8	95.7	87.4
	70,000	77.3	105.6	146.7	153.9	167.2	171.2	173.1	173.8	172.5	171.4	166.1	161.0	156.5	152.3	147.9	143.7	139.1	133.8	128.2	123.1	118.6	113.8	108.9	99.4	89.5
	80,000	86.7	117.3	153.4	160.3	174.4	177.8	179.1	179.0	176.2	173.5	168.1	163.4	159.0	155.0	150.6	145.7	140.1	135.8	131.2	126.5	122.2	117.8	113.1	102.2	91.2
	30,000	39.4	55.4	99.9	111.7	135.2	141.9	144.6	145.1	145.8	146.8	148.0	147.3	146.3	143.4	140.0	136.8	133.0	127.4	121.8	117.8	114.1	110.2	106.3	98.5	90.6
	40,000	50.1	69.9	116.6	128.5	150.7	157.3	159.9	160.4	161.5	162.8	164.9	162.8	160.7	156.2	151.4	146.9	142.0	136.0	129.7	125.1	120.6	116.4	111.6	102.9	93.9
450	50,000	59.5	82.4	130.9	142.5	163.5	170.1	173.2	174.3	175.4	176.5	176.5	172.1	168.5	163.8	158.7	154.2	149.3	143.2	136.8	131.6	126.9	122.2	116.8	107.6	98.3
	60,000	68.9	96.0	140.9	152.2	171.4	177.9	181.3	183.2	184.1	185.0	181.8	176.3	171.2	166.4	160.8	156.5	152.1	145.8	139.6	134.0	128.8	123.7	118.2	109.0	99.2
	70,000	77.9	106.3	153.6	164.2	182.7	188.5	191.3	192.4	192.1	191.5	186.8	181.3	176.0	171.2	166.1	161.0	155.8	149.9	144.3	139.1	134.1	129.3	124.1	113.2	102.0
	80,000	87.4	118.5	166.7	174.6	190.4	195.0	197.5	198.0	196.2	194.4	188.0	182.1	177.0	172.4	167.5	162.1	155.9	151.1	145.9	141.0	136.8	132.3	127.3	115.2	102.9
	30,000	39.6	56.0	100.9	114.6	143.1	151.3	154.8	155.3	156.1	156.7	158.0	158.8	158.0	156.2	153.9	149.9	145.5	140.2	134.9	130.3	126.0	121.8	117.1	108.6	99.8
	40,000	50.4	70.5	119.7	132.1	159.9	169.1	173.0	173.6	175.0	176.5	178.8	178.6	178.0	174.0	169.8	163.7	156.8	151.3	145.8	140.4	135.8	131.1	126.1	116.2	105.9
500	50,000	60.0	83.3	134.2	146.1	172.6	181.8	185.9	187.4	189.0	190.5	191.4	188.6	185.8	181.0	175.6	169.8	163.5	157.7	151.9	146.3	141.4	136.2	130.9	120.5	109.7
	60,000	69.6	95.7	145.7	156.9	181.9	190.7	194.6	197.4	199.0	200.9	199.6	194.3	189.0	183.3	177.2	171.9	166.1	160.2	154.5	148.8	143.4	138.1	132.7	122.0	110.9
	70,000	78.4	107.5	160.5	172.1	194.5	201.9	205.8	208.0	208.3	209.0	205.1	198.8	193.0	187.4	181.8	175.9	169.9	164.1	158.3	153.0	148.1	143.2	137.9	125.9	113.3
	80,000	87.7	119.2	175.5	186.8	205.8	211.5	215.1	216.6	215.9	214.9	208.0	201.1	194.4	189.4	184.0	178.3	171.8	166.2	160.5	155.8	151.1	146.8	141.7	128.4	114.5
	30,000	39.7	56.4	104.3	116.8	148.8	158.6	162.9	163.5	164.4	164.9	166.3	167.9	169.0	167.6	166.0	161.6	156.5	151.7	146.6	141.6	137.1	132.2	127.3	117.9	108.1
	40,000	50.5	70.7	118.0	130.3	164.0	175.3	186.6	181.4	183.0	184.8	187.3	189.0	190.9	187.5	183.8	178.0	167.7	163.0	158.1	152.7	147.7	142.7	137.3	126.5	115.1
550	50,000	60.5	84.0	131.1	145.5	179.9	191.4	196.7	198.7	201.0	202.9	205.3	203.6	202.0	197.0	191.6	184.3	176.5	171.6	166.3	160.6	155.6	150.3	144.5	133.0	120.9
	60,000	69.7	96.6	143.2	157.3	189.9	201.3	206.4	209.7	212.1	214.8	216.5	210.9	205.8	199.3	192.4	185.9	179.0	173.9	168.5	162.9	157.5	152.4	146.5	134.6	122.3
	70,000	78.8	108.6	161.4	176.7	205.1	214.6	219.7	222.5	224.2	225.6	222.8	216.1	209.4	203.7	197.2	190.5	183.7	178.0	172.4	167.0	162.1	157.2	151.8	138.4	124.8
	80,000	87.8	119.7	181.7	196.2	218.2	225.5	230.6	233.0	233.4	234.1	226.2	218.0	210.4	205.0	199.1	192.9	185.9	179.8	173.6	168.9	164.6	159.9	155.1	140.6	125.6
	Stroke	0	0.2	1.2	2	6	12	19	25	31	37	49	62	74	86	99	111	124	136	148	161	173	185	198	222	247

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TABLE 4. C7 Catapult (with metering rod), Mean, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) – NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND ACCUMULATOR PRESSURE

Pressure (PSI)	Stroke / Weight (LBS)	0	0.2	1.2	2	6	12	19	25	31	37	49	62	74	86	99	111	124	136	148	161	173	185	198	222	247
	10,000	9.1	14.7	29.8	31.5	34.5	34.1	34.2	34.2	34.3	34.3	35.0	34.5	34.1	32.6	30.9	29.7	28.5	27.6	26.8	26.1	25.6	25.0	24.4	23.8	23.1
	20,000	17.7	26.5	45.4	47.9	50.4	50.9	51.1	51.5	51.4	51.4	51.3	49.6	47.9	46.1	44.2	42.7	41.2	40.1	39.0	37.9	36.9	35.9	35.0	34.0	32.9
150	30,000	25.6	36.9	53.2	55.5	58.8	58.8	58.9	59.0	58.6	58.2	57.5	55.7	54.0	52.3	50.3	48.7	46.9	45.7	44.6	43.3	42.1	40.9	39.6	38.2	36.6
	40,000	31.9	45.3	55.9	58.1	61.9	61.5	61.4	61.2	60.5	59.6	58.4	56.7	55.1	53.5	51.9	50.2	48.4	47.3	46.2	44.7	43.4	42.0	40.7	38.7	36.7
	50,000	39.6	54.6	58.9	48.7	63.8	64.0	64.0	63.6	62.7	61.8	60.5	58.6	56.9	55.3	53.7	52.0	50.2	49.1	48.0	46.5	45.1	43.7	42.2	40.1	38.0
	10,000	10.7	16.4	31.3	35.0	40.2	40.5	40.6	40.6	40.7	40.9	41.5	41.3	41.2	39.9	38.6	37.5	36.2	35.3	34.3	33.5	32.8	32.0	31.2	30.1	29.0
	20,000	20.8	29.9	54.1	57.1	61.7	62.7	62.9	63.3	63.5	63.7	64.0	62.3	60.7	58.9	57.0	55.3	53.6	52.3	50.8	49.4	48.2	46.9	45.5	43.8	42.0
	30,000	30.0	41.8	64.2	67.4	72.7	73.3	73.6	73.9	73.7	73.4	72.8	70.8	69.0	67.1	65.1	63.2	61.3	59.6	58.0	56.4	54.9	53.4	51.8	49.4	47.0
200	40,000	38.1	52.8	70.1	73.3	78.6	78.9	79.3	79.5	78.7	78.0	76.2	74.1	72.2	70.4	68.5	66.5	64.3	62.7	60.9	59.1	57.5	55.8	54.1	51.3	48.4
	50,000	45.7	62.5	74.0	76.2	81.0	81.7	81.9	81.8	80.9	80.0	78.1	76.0	74.0	72.2	70.2	68.1	66.0	64.2	62.5	60.7	59.0	57.2	55.4	52.5	49.4
	60,000	53.1	72.0	77.0	78.3	82.5	83.6	83.9	83.2	82.1	81.2	79.2	77.1	75.1	73.3	71.3	69.2	66.9	65.2	63.5	61.6	59.8	58.1	56.1	53.1	50.1
	70,000	61.2	77.6	78.9	80.8	84.7	85.5	85.1	84.4	83.6	82.8	80.8	78.6	76.6	74.8	72.8	70.7	68.4	66.6	64.9	62.8	60.9	59.1	57.2	54.1	51.0
	10,000	11.6	17.3	32.2	37.2	44.6	45.9	46.1	46.2	46.3	46.5	47.1	47.3	47.5	48.9	46.0	45.1	44.1	43.1	42.1	41.1	40.1	39.1	38.1	36.4	34.8
	20,000	22.5	31.7	56.5	62.3	71.3	72.8	73.2	73.6	74.1	74.7	75.5	74.2	72.8	71.2	69.5	67.9	66.0	64.3	62.5	60.9	59.4	57.9	56.2	53.5	50.0
	30,000	33.0	45.3	72.4	77.3	85.6	87.1	87.8	88.4	88.4	88.5	87.8	85.9	84.0	82.3	80.4	78.3	76.1	74.0	71.8	69.9	68.2	66.4	64.5	61.1	57.6
250	40,000	41.5	56.4	79.9	84.5	88.6	92.8	94.1	94.9	94.3	93.7	91.4	89.1	86.8	85.0	83.0	80.9	78.6	76.3	73.8	71.8	70.0	68.2	66.2	62.4	58.6
	50,000	49.1	66.2	86.8	90.7	97.7	99.1	99.8	99.9	99.3	98.6	96.1	93.8	91.7	89.6	87.5	85.1	82.5	80.1	77.6	75.5	73.4	71.5	69.4	65.4	61.4
	60,000	57.8	77.6	91.7	94.6	101.0	102.4	102.5	102.0	101.2	100.4	97.8	95.7	93.7	91.6	89.3	86.8	84.0	81.5	79.1	76.8	74.7	72.5	70.4	66.3	62.2
	70,000	65.8	87.7	96.8	98.8	103.6	104.9	104.4	103.8	102.8	101.8	99.3	97.3	95.4	93.3	90.9	88.3	85.4	82.9	80.4	78.0	75.9	73.7	71.4	67.2	63.0
	80,000	74.3	93.8	101.1	102.4	105.8	106.9	105.9	105.0	103.8	102.7	100.5	98.4	96.6	94.6	92.2	89.5	86.4	84.0	81.5	78.9	76.7	74.4	72.0	68.0	63.6
	10,000	12.1	18.0	32.8	38.4	47.6	50.1	50.4	50.5	50.7	50.9	51.4	52.1	52.8	52.9	53.0	52.3	51.5	50.6	49.6	48.3	47.2	46.0	44.7	42.4	40.1
	20,000	23.9	33.2	57.9	66.0	79.5	81.6	82.1	82.4	83.4	84.5	85.9	85.0	84.2	83.0	81.7	80.1	78.3	76.3	74.2	72.3	70.6	68.7	66.7	62.8	58.8
	30,000	34.8	47.3	77.4	84.0	95.6	101.6	99.6	100.4	100.9	101.4	100.9	99.1	97.4	95.9	94.2	92.3	90.1	87.4	84.8	82.6	80.5	78.5	76.4	71.8	67.2
300	40,000	43.7	58.9	88.9	95.2	104.3	107.2	109.4	110.9	110.5	110.4	107.5	104.7	102.4	100.6	98.6	96.3	93.9	90.9	87.6	85.5	83.5	81.3	79.2	74.5	69.6
	50,000	51.9	69.6	99.1	104.1	112.9	115.2	116.4	117.1	116.7	116.3	113.1	110.8	108.7	106.6	104.3	101.9	99.0	95.5	92.3	89.8	87.6	85.5	83.0	78.1	72.9
	60,000	60.7	81.0	105.2	109.8	118.7	120.2	120.4	120.0	119.6	119.2	115.8	113.8	112.2	109.9	107.4	104.4	101.3	97.8	94.2	91.7	89.4	87.0	84.5	79.4	74.2
	70,000	68.7	91.2	112.6	116.4	122.3	124.0	123.8	123.0	121.8	120.6	117.6	116.0	114.5	112.1	109.5	106.5	103.0	99.7	96.1	93.5	91.1	88.5	85.9	80.7	75.1
	80,000	77.6	102.7	120.0	122.5	125.0	126.8	126.2	124.9	122.9	120.9	118.7	117.1	115.9	113.5	110.9	107.4	103.9	100.5	97.1	94.4	91.8	89.4	86.6	81.1	75.7
	20,000	24.6	34.1	59.1	68.3	86.3	90.4	91.4	91.7	92.6	93.4	94.7	95.0	95.0	94.3	93.4	92.0	90.6	88.2	86.0	84.0	82.2	80.4	78.3	74.0	69.5
	30,000	35.9	48.5	75.6	86.8	105.3	109.3	110.7	111.5	112.1	112.7	113.5	112.3	111.1	109.5	107.8	106.3	104.3	101.2	98.1	95.7	93.4	91.3	88.9	83.9	78.6
	40,000	45.3	60.8	89.9	101.7	118.6	122.1	123.9	125.1	125.3	125.5	125.5	122.7	120.1	117.6	115.1	113.2	111.3	107.6	103.6	100.8	98.3	95.8	93.3	87.6	81.9
350	50,000	53.6	71.5	102.7	112.2	127.5	130.6	132.2	133.0	133.0	133.0	131.0	128.4	126.0	123.6	120.7	118.8	116.3	112.4	108.4	105.5	102.7	100.0	97.2	91.2	85.0
	60,000	62.7	83.1	112.0	120.0	134.0	136.5	137.5	138.0	138.0	137.7	133.7	131.4	129.4	126.7	123.6	121.5	119.0	115.0	110.9	107.7	104.8	101.9	98.9	92.6	86.0
	70,000	71.1	93.7	121.7	128.0	138.9	141.5	142.4	142.1	141.2	140.3	136.8	134.5	132.2	129.4	126.4	123.6	120.6	116.9	113.4	110.2	107.2	104.2	100.9	94.4	87.5
	80,000	80.0	104.9	131.1	135.4	142.9	145.7	146.1	145.2	143.4	141.5	138.9	136.3	134.0	131.2	128.1	124.8	121.3	118.2	114.9	111.6	108.5	105.5	102.4	95.6	88.5
	20,000	25.0	33.9	59.9	68.8	90.6	97.0	98.7	99.1	99.4	100.0	101.3	102.7	103.5	103.3	103.0	102.5	101.4	98.8	96.4	94.4	92.7	90.9	88.8	84.2	79.6
	30,000	36.4	49.2	79.9	90.4	113.4	119.1	120.7	121.2	121.8	122.5	124.9	124.5	124.1	122.6	120.7	119.8	118.5	114.8	111.3	108.7	106.3	103.9	101.3	95.7	90.0
	40,000	46.3	62.1	97.9	107.6	128.0	132.1	133.5	134.2	134.9	135.8	139.3	136.5	134.0	130.9	127.7	126.6	125.4	120.8	116.3	113.3	110.3	107.5	104.2	98.2	91.7
400	50,000	54.9	73.1	110.5	120.6	140.7	144.5	146.3	147.3	148.0	148.5	148.3	145.4	142.7	139.7	136.3	135.0	133.8	129.1	124.6	120.8	117.6	114.4	110.8	103.9	96.6
	60,000	63.9	84.5	120.3	129.3	147.3	150.9	153.0	154.2	154.4	155.0	150.4	147.6	145.1	141.8	138.5	137.2	136.0	131.4	126.9	123.0	119.7	116.2	112.3	104.7	97.0
	70,000	72.2	94.8	129.6	138.1	154.4	158.0	160.2	160.6	160.1	159.6	155.7	152.2	149.1	145.9	142.5	140.4	138.1	134.4	130.7	127.0	123.4	120.0	116.0	108.1	99.6
	80,000	81.0	106.2	137.0	145.0	159.3	163.2	165.0	164.9	163.3	161.7	158.5	154.8	151.0	147.8	144.6	141.4	138.2	135.5	132.6	128.9	125.4	121.6	117.8	109.6	100.9
	30,000	36.8	50.2	81.9	93.8	121.4	129.4	131.9	132.4	133.1	133.8	135.7	136.1	136.1	135.1	134.1	132.8	131.7	128.3	124.7	121.8	119.2	116.5	113.6	107.3	100.8
	40,000	46.8	62.9	98.8	110.7	137.1	143.8	146.3	147.1	148.2	149.2	152.3	151.1	150.0	147.2	144.4	142.3	140.2	136.1	131.9	128.3	125.2	122.1	118.7	111.7	104.4
450	50,000	55.6	74.3	111.9	124.0	149.8	156.4	159.1	160.4	161.5	162.4	162.9	160.6	158.4	155.4	151.9	149.9	147.7	143.3	139.2	135.3	132.0	128.4	124.8	116.8	108.8
	60,000	64.4	85.4	122.0	133.9	158.1	164.2	167.2	168.9	169.7	170.9	168.3	165.0	161.9	158.2	154.3	152.6	150.3	146.1	141.9	137.9	134.2	130.5	126.6	118.4	109.3
	70,000	72.8	96.0	134.2	145.6	167.6	173.4	176.2	177.6	177.6	176.4	174.7	171.2	166.8	163.0	159.2	156.6	153.7	149.8	146.3	142.2	138.4	134.9	130.7	122.0	113.1
	80,000	81.7	107.1	144.2	155.0	174.2	179.5	182.0	182.8	181.9	181.0	177.4	174.1	168.5	164.9	160.7	157.4	153.9	150.9	147.6	143.7	140.2	136.3	132.4	123.4	113.8
	30,000	37.0	50.8	80.6	94.6	128.0	138.4	141.4	142.2	142.7	143.5	145.1	146.3	147.1	146.8	146.2	145.2	144.0	140.8	137.6	134.5	131.4	128.5	125.3	118.2	111.1
	40,000	47.1	63.5	96.8	111.2	144.0	154.1	157.5	158.2	159.6	161.1	163.6	164.3	164.9	162.6	160.1	157.3	153.9	150.5	146.8	143.0	139.6	136.2	132.5	124.8	116.5
500	50,000	56.1	75.0	111.8	125.7	157.6	167.2	170.9	172.5	174.0	175.5	177.0	175.5	173.9	170.6	167.4	164.3	161.3	157.4	153.8	149.9	146.3	142.6	138.7	130.2	121.1
	60,000	65.0	86.2	124.5	137.4	167.2	176.4	180.3	182.7	183.9	185.5	186.1	181.9	177.9	173.8	169.8	167.0	163.9	160.2	156.5	152.5	148.7	145.0	141.0	132.0	122.6
	70,000	73.3	97.1	138.7	151.4	178.4	186.5	190.1	192.3	192.9	193.6	192.0	187.2	182.7	178.5	174.0	170.8	167.7	164.1	160.3	156.4	152.6	148.7	144.5	135.2	125.5
	80,000	82.0	107.7	153.0	164.7	188.0	195.2	198.8	200.3	200.3	200.0	196.4	190.8	185.8	181.6	176.9	173.3	169.7	166.1	162.8	158.6	155.0	151.0	147.0	137.2	127.2
	30,000	37.1	51.3	82.1	95.2	132.1	145.0	149.2	149.8	150.6	151.2	152.3	154.1	155.8	156.4	156.9	155.8	154.5	151.7	148.9	145.6	142.5	139.1	135.7	128.1	120.2
	40,000	47.2	63.8	95.3	109.1	146.8	160.1	164.6	165.6	167.1	168.9	170.7	173.7	176.4	174.6	172.9	168.7	164.4	161.7	158.9	155.0	151.7	148.0	144.0	135.2	126.3
550	50,000	56.5	76.0	110.2	125.0	163.2	176.4	181.3	183.3	185.2	187.2	189.8	189.2	188.2	185.3	182.1	178.2	173.6	170.7	168.1	163.9	160.3	156.4	152.4	143.0	133.1
	60,000	65.1	87.0	121.8	136.2	172.2	184.5	189.5	192.4	194.4	196.7	200.4	195.6	191.0	186.7	182.0	178.3	174.4	171.4	168.4	164.5	160.8	156.8	152.8	143.2	133.5
	70,000	73.6	97.9	138.5	154.0	187.5	198.1	202.8	205.9	207.3	209.0	209.0	203.6	198.0	193.5	188.2	184.7	180.6	177.5	174.0	169.9	166.1	162.2	158.4	148.3	137.8
	80,000	82.1	108.2	155.4	170.4	199.1	208.0	212.4	215.1	215.8	216.9	213.0	206.5	200.8	195.9	190.5	186.9	183.1	179.5	175.6	171.8	167.8	164.3	160.0	149.7	139.0
	Stroke	0	0.2	1.2	2	6	12	19	25	31	37	49	62	74	86	99	111	124	136	148	161	173	185	198	222	247

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TABLE 5. C7 Catapult (with metering rod), Lower Boundary, Load vsStroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) – NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND ACCUMULATOR PRESSURE

Pressure (PSI)	Stroke / Weight (LBS)	0	0.2	1.2	2	6	12	19	25	31	37	49	62	74	86	99	111	124	136	148	161	173	185	198	222	247
	10,000	8.6	13.3	24.2	25.8	29.4	29.0	29.0	29.0	29.1	29.1	30.0	29.6	29.1	28.4	27.8	27.1	26.4	26.1	25.7	25.5	25.3	25.1	25.0	24.9	24.8
	20,000	16.5	23.4	37.4	41.0	44.3	44.9	44.8	45.4	45.5	45.6	45.4	44.7	43.9	42.9	41.7	40.9	40.1	39.6	39.1	38.3	37.6	36.8	36.1	35.9	35.8
150	30,000	23.8	32.1	44.8	48.2	52.3	52.4	52.3	52.3	52.2	52.0	51.7	50.6	49.6	48.7	47.6	46.6	45.6	45.3	45.0	44.1	43.3	42.5	41.5	40.3	39.1
	40,000	30.0	39.7	47.0	50.1	54.9	54.2	54.1	53.6	53.1	52.7	52.3	51.0	49.6	48.9	48.3	47.2	46.0	46.0	46.0	45.1	44.3	43.4	42.5	40.2	37.8
	50,000	37.2	48.3	50.9	53.2	56.9	57.0	57.0	56.5	56.0	55.4	54.8	53.3	52.0	51.1	50.1	49.1	48.1	47.7	47.4	46.5	45.8	44.3	44.0	41.9	39.9
	10,000	10.1	15.0	25.6	28.9	34.5	34.8	34.9	34.9	34.9	35.1	36.0	35.9	35.9	35.4	34.8	34.4	34.0	33.6	33.2	32.8	32.5	32.1	31.8	31.4	30.7
	20,000	19.3	26.6	47.7	49.8	54.7	55.8	55.8	56.4	56.7	57.1	57.5	56.7	56.1	55.1	54.0	53.2	52.5	52.0	51.3	50.4	49.4	48.4	47.5	46.6	45.9
	30,000	27.9	37.0	56.9	60.0	65.8	66.5	66.7	67.0	67.0	67.0	66.9	65.8	64.7	63.8	62.6	61.5	60.5	60.0	59.4	58.2	57.2	56.1	55.0	53.2	52.0
200	40,000	35.8	46.7	61.4	65.2	71.5	71.7	71.9	72.0	71.5	71.1	70.4	68.8	67.3	66.5	65.7	64.4	63.0	62.5	62.0	60.8	59.7	58.6	57.4	54.7	51.2
	50,000	43.0	55.6	65.2	68.0	73.1	73.7	73.9	73.7	73.2	72.7	71.5	70.0	68.7	67.6	66.4	65.3	64.1	63.3	62.6	61.4	60.4	59.2	58.0	55.4	52.6
	60,000	50.0	64.4	69.9	71.3	74.9	75.8	76.0	75.5	74.9	74.4	72.7	71.3	70.2	68.8	67.4	66.2	65.1	64.2	63.2	62.1	60.9	59.9	58.7	56.1	53.6
	70,000	57.5	73.0	74.1	75.6	76.4	76.9	76.4	76.0	75.8	75.5	73.6	72.3	71.1	69.8	68.6	67.2	65.6	64.5	63.4	62.0	61.0	59.7	58.5	56.2	53.7
	10,000	10.9	15.7	26.1	30.4	37.8	39.0	39.2	39.2	39.3	39.5	40.3	40.9	41.5	41.2	41.0	40.9	40.8	40.4	40.1	39.5	38.9	38.5	37.9	37.2	36.4
	20,000	20.9	28.3	49.6	53.6	62.9	64.5	64.8	65.3	66.0	66.7	67.9	67.5	66.9	66.1	65.3	64.7	63.9	63.5	62.9	61.7	60.7	59.6	58.4	56.7	55.0
	30,000	30.7	40.1	63.6	67.6	76.2	78.1	78.5	79.3	79.6	79.9	80.0	79.0	78.0	77.1	76.1	75.2	74.1	73.1	72.3	70.9	69.8	68.5	67.1	64.7	62.3
250	40,000	39.0	50.1	68.6	74.4	82.7	84.3	85.1	86.0	85.9	85.6	84.2	82.8	81.6	80.4	79.4	78.1	76.8	75.6	74.4	73.0	71.9	70.2	69.0	66.2	63.1
	50,000	46.2	59.0	74.3	80.2	88.5	89.6	90.2	90.5	90.2	89.8	87.8	86.6	85.5	84.3	82.9	81.7	80.2	78.9	77.7	76.2	74.8	73.4	72.0	68.9	65.7
	60,000	53.8	68.4	81.5	85.2	92.0	92.9	93.0	92.7	92.4	91.9	89.2	88.3	87.5	86.1	84.5	83.1	81.7	80.3	79.0	77.5	76.1	74.6	73.1	69.9	65.8
	70,000	61.9	75.4	86.4	89.0	94.3	95.0	94.7	94.3	93.9	93.2	91.0	90.0	89.2	87.6	85.9	84.3	82.6	81.3	79.8	78.1	76.6	75.0	73.5	70.4	67.2
	80,000	69.8	88.2	91.3	92.7	96.3	96.9	96.1	95.9	95.1	94.3	92.7	91.6	90.6	89.0	87.2	85.4	83.3	81.9	80.4	78.7	77.0	75.4	73.6	70.6	67.5
	10,000	11.4	16.4	26.3	30.9	39.5	41.9	42.1	42.2	42.4	42.6	43.3	44.6	45.9	46.1	46.3	46.6	47.0	46.6	46.3	45.5	44.8	44.1	43.2	42.0	40.9
	20,000	22.5	29.9	46.1	54.2	70.2	72.5	73.0	73.3	74.6	75.8	78.0	77.7	77.5	77.0	76.7	76.3	75.8	75.3	74.8	73.5	72.3	71.1	69.7	66.8	63.9
	30,000	32.7	42.3	65.4	72.1	85.4	88.5	89.4	90.7	91.4	92.2	92.6	91.9	91.0	90.4	89.5	88.8	87.9	86.6	85.2	83.8	82.3	81.0	79.3	76.3	73.1
300	40,000	41.1	52.5	75.5	83.3	93.8	97.2	98.8	101.0	101.0	101.0	99.0	97.7	96.6	95.4	94.2	93.0	91.8	89.7	87.6	86.1	84.5	83.1	81.4	78.4	75.5
	50,000	48.8	62.1	86.4	92.4	102.4	104.5	105.5	106.5	106.5	106.5	103.4	102.7	102.2	100.9	99.3	98.0	96.4	94.5	92.5	90.7	89.0	87.4	85.6	82.2	78.6
	60,000	57.1	72.0	92.1	98.2	108.8	109.4	109.6	109.4	109.4	109.4	105.2	105.1	105.1	103.6	102.0	100.3	98.4	96.7	95.0	93.2	91.3	89.6	87.5	83.7	79.8
	70,000	64.6	81.3	100.6	105.4	112.0	112.9	112.9	112.7	111.9	111.0	108.5	108.0	107.6	105.9	103.8	102.0	100.2	98.4	96.7	94.6	92.7	90.7	88.8	84.8	80.7
	80,000	72.9	91.9	108.5	112.1	114.7	115.9	115.9	115.6	113.7	111.9	111.1	110.3	109.7	107.3	105.0	103.2	101.3	99.6	97.8	95.7	93.7	91.5	89.4	85.5	81.4
	20,000	23.1	30.6	45.8	54.3	74.0	78.6	79.3	79.7	80.6	81.6	83.8	84.7	85.4	86.0	86.5	86.5	86.4	85.9	85.2	84.0	82.9	81.6	80.4	77.2	73.9
	30,000	33.7	43.9	57.1	71.1	93.6	97.7	99.0	100.1	100.7	101.5	103.4	103.0	102.8	102.7	102.3	102.1	101.8	100.5	99.0	97.3	95.8	94.3	92.8	89.0	85.2
	40,000	42.6	54.8	68.8	84.6	106.0	109.5	111.1	112.8	113.0	113.4	114.9	113.0	111.6	110.2	108.8	108.6	108.3	105.9	103.4	101.6	99.8	98.2	96.4	92.5	88.5
350	50,000	50.4	63.5	83.6	96.5	116.1	118.7	120.1	121.1	121.3	121.5	120.2	119.3	118.4	116.9	115.1	114.7	114.1	112.0	109.4	107.5	105.5	103.8	101.7	97.2	92.5
	60,000	58.9	74.1	93.3	104.4	122.7	124.3	125.1	125.5	125.7	126.0	121.8	121.4	121.4	119.7	117.6	117.1	116.4	114.2	111.9	109.8	107.8	105.8	103.9	98.6	93.1
	70,000	66.8	83.8	105.0	113.7	126.9	128.9	129.0	130.1	129.4	129.0	126.3	125.5	124.6	122.5	120.3	119.2	118.0	116.2	114.3	111.9	109.7	107.6	105.2	100.0	94.8
	80,000	75.2	94.2	116.8	122.0	129.3	131.9	133.0	132.7	131.6	130.2	129.3	127.6	125.7	123.7	121.2	119.6	117.9	116.5	114.9	112.5	110.0	107.7	105.2	100.2	95.2
	20,000	23.5	31.6	46.4	53.2	75.9	83.0	84.3	84.7	85.2	85.7	87.8	89.9	92.0	93.6	95.5	95.6	96.0	95.4	94.9	93.8	92.7	91.5	90.3	86.8	83.4
	30,000	34.2	44.4	61.6	75.0	98.6	104.2	105.6	106.2	106.9	107.5	111.1	111.6	112.0	112.2	112.7	113.3	113.9	112.2	110.8	109.2	107.5	106.0	104.4	100.2	95.9
	40,000	43.5	55.5	82.0	91.3	115.5	118.9	120.5	121.4	122.1	122.8	127.8	126.0	124.2	122.6	121.2	122.1	123.1	120.4	117.7	115.7	113.9	111.8	116.0	105.1	100.3
400	50,000	51.6	65.4	92.4	103.2	128.0	131.3	133.0	134.0	134.5	135.2	136.0	134.7	133.7	131.8	130.0	130.9	131.8	129.2	126.2	124.1	121.9	119.9	117.8	111.9	105.8
	60,000	60.1	76.1	103.0	112.5	135.4	138.2	139.9	140.9	141.4	141.9	137.9	137.5	137.3	135.0	132.9	133.7	134.6	131.8	129.1	126.9	124.9	122.6	120.4	113.4	106.3
	70,000	67.9	85.5	112.1	121.7	140.8	144.5	146.5	147.0	147.0	147.0	144.5	142.7	141.2	139.1	136.6	136.6	136.3	134.5	132.4	129.9	127.3	125.0	122.4	115.7	108.9
	80,000	76.1	95.9	120.7	129.7	144.3	148.6	151.0	150.9	150.4	149.9	148.8	145.8	142.9	140.8	138.5	137.2	136.0	134.7	133.7	130.8	127.9	125.3	122.2	116.1	110.1
	30,000	34.2	44.8	61.7	73.0	103.6	112.1	114.2	114.9	115.6	116.3	119.0	120.1	121.0	121.9	122.9	123.8	124.9	123.6	122.4	120.7	119.1	117.5	115.7	110.9	106.2
	40,000	44.0	56.6	81.3	93.2	123.5	130.4	132.6	133.7	134.7	135.7	139.7	139.7	139.4	138.1	137.0	137.6	138.3	136.0	133.7	131.4	129.4	127.3	125.1	119.7	114.2
450	50,000	51.7	65.2	92.9	105.5	135.8	142.2	144.8	145.9	147.0	147.8	149.3	148.6	147.8	146.2	144.5	144.7	145.2	143.0	140.6	138.2	136.1	134.2	131.8	125.3	118.8
	60,000	59.9	76.9	103.7	116.2	145.3	151.0	153.7	155.3	156.2	157.0	155.6	154.1	152.7	150.5	148.1	148.6	148.8	146.6	144.4	141.9	139.7	137.5	135.0	128.0	120.4
	70,000	68.4	86.4	114.4	126.5	151.6	157.8	160.6	161.7	162.1	162.6	161.4	159.0	156.7	154.1	151.3	151.0	150.7	148.7	146.9	144.1	141.6	139.3	136.4	129.5	122.7
	80,000	76.8	95.5	122.3	136.0	159.4	164.4	167.1	168.0	168.0	168.0	167.1	163.7	160.1	157.5	154.3	153.2	151.9	150.7	149.5	146.4	143.3	122.7	137.3	131.1	124.7
	30,000	34.8	45.8	57.9	71.7	107.8	119.8	122.6	123.3	124.0	124.8	126.5	128.1	129.6	131.1	132.7	134.5	136.0	135.0	134.0	132.4	130.6	128.9	127.0	122.0	116.6
	40,000	44.3	57.2	74.2	90.2	127.6	138.3	141.3	142.4	143.5	144.9	147.7	149.5	150.9	150.3	149.7	149.7	149.7	148.3	146.6	144.2	142.0	140.1	137.7	131.6	125.5
500	50,000	52.2	67.1	89.5	105.2	141.9	152.5	155.9	157.4	158.5	160.0	162.6	161.9	161.6	160.1	158.5	158.5	158.4	156.7	155.2	152.6	150.2	148.2	145.6	139.0	131.9
	60,000	60.5	77.1	102.7	117.0	151.2	160.7	164.5	166.3	167.8	169.0	170.8	168.0	165.6	163.2	160.9	160.6	160.2	158.7	156.8	154.5	152.1	150.0	147.6	140.3	132.7
	70,000	68.2	86.3	116.4	129.9	160.9	169.7	173.2	175.4	176.3	177.2	177.9	174.6	171.5	168.3	165.3	164.6	163.9	162.3	160.8	158.1	155.6	152.7	150.0	143.0	135.8
	80,000	77.1	97.0	130.2	142.8	170.1	178.3	181.5	183.4	184.1	184.4	184.1	180.0	176.4	172.6	168.7	167.8	166.7	165.1	163.8	160.7	157.8	154.5	151.4	144.9	138.5
	30,000	34.9	46.3	57.5	70.2	110.1	125.2	128.8	129.6	130.4	130.9	131.7	133.9	135.8	138.1	140.7	142.8	145.0	144.4	143.9	142.2	140.4	138.8	136.8	131.2	125.5
	40,000	44.4	57.6	73.2	88.4	129.8	145.0	148.6	149.8	151.3	153.1	154.3	158.1	162.0	162.0	162.0	161.4	160.7	159.9	159.3	156.7	154.6	152.6	150.0	143.4	136.6
550	50,000	52.5	67.7	89.5	104.8	146.4	161.0	165.3	167.2	169.1	170.7	174.3	174.4	174.4	173.1	172.0	171.1	170.4	169.4	168.8	166.4	164.1	161.5	159.1	152.0	144.6
	60,000	60.5	77.6	100.9	115.6	154.5	167.7	172.6	175.2	176.8	178.7	184.2	180.0	176.1	173.8	171.4	170.4	167.4	168.4	167.7	165.3	163.0	160.8	158.3	151.1	143.7
	70,000	68.4	87.1	114.2	129.7	167.4	179.2	183.6	186.2	187.9	189.2	192.3	188.1	183.7	180.3	176.7	176.1	175.0	173.9	172.6	170.0	167.3	164.6	161.7	154.9	147.9
	80,000	77.2	97.4	129.9	145.3	180.5	190.9	194.6	197.7	198.7	200.1	200.1	195.7	191.5	187.0	182.1	181.1	180.3	178.9	177.5	174.1	171.3	168.2	164.7	158.5	151.9
	Stroke	0	0.2	1.2	2	6	12	19	25	31	37	49	62	74	86	99	111	124	136	148	161	173	185	198	222	247

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TABLE 6. C11-1 (DRY) Cataput, Upper Boundary, Load vs Stroke, Numetical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) — NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND ACCUMULATOR PRESSURE

Pressure (PSI)	Stroke / Weight (LBS)	0	2	5	10	15	21	26	31	41	51	62	72	82	92	103	113	123	133	143	154	164	184	205
	10,000	9.8	32.3	37.9	39.8	40.8	41.6	41.8	42.0	40.9	39.4	37.8	35.9	34.0	32.3	30.4	29.3	28.2	27.4	26.7	25.9	25.2	23.7	22.1
150	20,000	17.3	43.4	50.2	52.7	53.9	54.8	54.9	54.9	53.3	51.5	49.4	47.0	44.8	42.6	40.2	38.6	37.0	35.8	34.6	33.4	32.2	29.7	27.0
	30,000	24.9	52.6	59.6	62.7	64.1	65.0	64.8	64.7	62.7	60.6	58.1	55.5	52.9	50.4	47.8	45.7	43.7	42.1	40.5	38.6	37.0	33.3	29.6
	40,000	32.6	58.6	65.4	68.8	70.3	71.0	70.7	70.4	68.1	65.6	63.0	60.4	57.7	55.1	52.4	50.0	47.7	45.7	43.6	41.3	39.2	34.7	29.8
	10,000	11.3	39.7	47.8	51.1	52.7	53.7	53.8	54.0	52.6	50.8	48.9	46.7	44.4	42.3	40.0	38.4	36.8	35.7	34.6	33.4	32.3	30.3	28.2
	20,000	20.7	54.8	64.5	68.7	70.8	71.9	72.0	72.0	70.0	67.6	65.0	62.2	59.4	56.5	53.6	51.4	49.1	47.4	45.8	43.9	42.1	38.9	35.3
200	30,000	29.7	64.1	74.0	78.6	80.8	82.0	81.8	81.7	79.2	76.6	73.5	70.4	67.4	64.3	61.0	58.5	55.8	53.6	51.4	49.0	46.8	42.3	37.7
	40,000	38.3	71.4	80.8	85.8	88.0	89.0	88.7	88.2	85.5	82.6	79.3	76.1	72.9	69.8	66.2	63.4	60.5	57.8	55.2	52.2	49.6	43.9	38.1
	50,000	46.8	76.2	84.8	90.1	92.0	92.9	92.2	91.6	88.7	85.5	82.1	79.0	75.9	72.7	69.2	65.9	62.9	59.8	56.7	53.3	50.2	43.8	36.9
	10,000	12.5	45.9	56.5	61.3	63.8	64.9	65.0	64.9	63.4	61.3	59.2	56.7	54.2	51.8	49.2	47.0	44.9	43.4	41.9	40.2	38.7	36.3	33.8
	20,000	22.9	63.6	76.4	82.6	85.6	87.0	86.9	86.7	84.5	81.8	78.8	75.6	72.4	69.2	65.6	62.8	60.0	57.8	55.5	53.1	50.8	46.9	42.7
250	30,000	32.1	74.8	87.8	94.6	97.5	99.0	98.7	98.5	95.8	92.6	89.1	85.6	81.9	78.5	74.6	71.4	68.1	65.4	62.6	59.4	56.7	51.3	45.8
	40,000	41.6	81.8	94.1	100.7	103.6	106.0	104.6	104.2	101.2	97.6	93.8	90.3	86.6	83.0	78.9	75.6	72.1	68.9	65.7	62.0	58.8	52.4	45.7
	50,000	50.9	88.0	99.4	105.8	108.5	109.8	109.3	108.7	105.3	101.5	97.5	93.9	90.3	86.5	82.5	78.8	75.2	71.6	67.9	63.9	60.3	52.7	44.7
	60,000	59.2	93.0	103.1	109.5	111.9	113.0	112.4	111.6	108.2	104.3	100.1	96.5	92.8	89.6	86.0	81.6	77.3	73.3	69.2	64.8	60.8	52.2	43.4
	10,000	13.1	51.4	64.6	71.4	74.7	76.0	75.8	75.7	74.0	71.8	69.4	66.7	64.0	61.4	58.5	55.8	53.1	51.2	49.2	47.0	45.0	42.1	39.2
	20,000	23.8	70.2	86.1	94.4	98.4	100.0	99.7	99.5	97.0	94.0	90.7	87.2	83.8	80.4	76.6	73.1	69.8	66.9	64.1	61.1	58.2	53.7	49.1
	30,000	33.9	83.2	99.4	108.3	112.3	113.9	113.6	113.4	110.4	106.8	102.8	99.0	95.2	91.2	86.9	83.1	79.3	76.0	72.5	68.7	65.3	59.3	53.1
300	40,000	43.9	92.9	108.7	117.3	121.2	122.9	122.6	122.1	118.6	114.7	110.2	106.1	102.1	98.0	93.3	89.3	85.4	81.5	77.6	73.3	69.4	62.1	54.3
	50,000	53.6	99.4	113.6	121.8	125.3	126.9	126.5	125.9	122.2	117.8	113.2	109.0	105.0	100.7	96.0	91.8	87.8	83.6	79.5	74.7	70.5	62.1	53.1
	60,000	62.1	105.2	118.5	126.1	129.5	131.0	130.4	129.8	126.1	121.6	116.9	112.6	108.5	105.7	102.4	96.5	90.5	85.8	81.2	76.2	71.6	62.2	52.4
	70,000	69.6	127.7	122.3	128.3	131.5	132.9	132.3	131.5	127.9	123.4	118.5	114.3	110.0	108.9	107.3	99.4	91.5	86.6	81.7	76.4	71.7	61.3	50.7
	10,000	13.2	55.5	71.4	80.3	84.5	85.9	85.7	85.3	83.4	81.1	78.5	75.8	73.0	70.2	67.1	63.9	60.7	58.3	55.7	53.0	50.4	47.3	43.9
	20,000	24.3	76.3	95.4	106.3	111.2	113.0	112.7	112.3	109.6	106.4	102.8	99.3	95.6	91.8	87.7	83.7	79.7	76.3	72.9	69.0	65.6	60.6	55.4
	30,000	35.1	90.2	109.7	120.8	125.9	127.9	127.5	127.1	124.0	120.0	115.7	111.7	107.7	103.3	98.7	94.3	89.9	85.9	81.9	77.4	73.4	66.8	60.1
350	40,000	45.4	101.6	120.3	131.0	135.9	138.0	137.6	137.1	133.6	129.0	124.2	119.9	115.6	110.8	105.8	101.3	96.7	92.2	87.8	82.9	78.3	70.4	61.9
	50,000	55.4	110.7	128.4	138.6	142.9	144.9	144.6	144.1	140.2	135.2	130.0	125.4	120.8	115.8	110.6	106.0	101.4	96.6	91.7	86.4	81.4	72.0	62.2
	60,000	63.8	117.0	133.9	143.0	147.1	149.1	148.7	148.4	144.6	139.7	134.3	129.4	124.5	122.4	119.7	111.9	104.0	98.9	93.8	88.2	83.1	72.9	62.1
	70,000	72.4	122.4	138.0	146.2	150.1	152.1	151.7	151.2	147.7	142.8	137.3	132.3	127.2	128.0	128.4	117.1	105.9	100.5	95.1	89.2	83.8	72.8	61.5
	80,000	79.7	126.1	140.4	147.5	151.3	153.1	152.6	151.9	148.9	143.9	138.9	133.5	128.1	132.0	135.1	120.7	106.2	100.6	95.0	89.0	83.4	72.0	60.0
	20,000	24.6	81.1	103.5	116.3	122.5	124.9	124.4	124.0	121.1	117.6	113.8	110.1	106.3	102.4	98.0	93.4	88.9	85.0	81.1	76.8	73.0	67.7	62.0
	30,000	35.7	96.7	120.6	133.8	140.3	143.0	142.6	142.2	138.7	134.4	129.8	125.3	121.0	116.5	111.3	106.4	101.5	97.0	92.5	87.3	82.8	75.8	68.5
	40,000	46.2	109.0	132.7	145.9	152.0	154.9	154.5	154.2	150.2	145.3	140.1	135.2	130.3	125.2	119.8	114.7	109.5	104.4	99.5	93.9	89.0	80.5	71.4
400	50,000	56.5	119.4	142.2	154.4	160.1	162.1	161.9	161.5	158.1	152.7	147.0	141.6	136.4	131.0	125.3	120.1	114.9	109.5	104.1	98.4	93.0	82.9	72.5
	60,000	65.4	126.2	148.0	159.3	164.8	167.9	167.4	167.1	163.3	157.7	151.9	146.3	140.8	138.6	135.9	127.0	118.1	112.5	106.7	100.6	95.1	84.3	73.1
	70,000	74.0	132.6	153.4	163.3	168.9	171.8	171.3	171.0	167.3	161.9	156.0	150.1	144.2	145.4	146.1	133.3	120.5	114.6	108.7	102.3	96.4	85.1	73.2
	80,000	81.9	139.2	158.9	167.7	172.9	175.8	175.3	174.7	171.7	166.2	160.1	154.1	147.9	152.6	156.5	139.8	122.8	116.8	110.8	104.2	97.9	85.9	73.3
	20,000	25.1	85.6	111.6	125.8	133.3	136.9	136.5	136.0	132.8	129.0	124.8	120.8	116.8	112.8	108.4	103.2	98.2	94.0	89.8	85.2	81.2	75.6	69.7
	30,000	36.2	102.0	130.8	146.0	154.0	158.0	157.6	157.3	153.3	148.7	143.9	139.0	134.2	129.3	124.2	118.4	112.9	108.0	103.2	97.8	93.0	85.6	78.1
	40,000	46.8	113.7	143.6	158.5	166.8	171.0	170.5	170.2	165.9	160.9	155.1	149.6	144.4	139.2	133.3	127.4	121.6	116.4	110.9	105.1	99.9	91.1	81.9
450	50,000	57.6	123.6	153.5	167.8	175.7	180.1	179.8	179.4	175.0	169.2	163.1	157.0	151.0	145.5	139.4	133.3	127.5	122.0	116.2	110.1	104.3	94.3	83.8
	60,000	66.9	132.1	161.1	175.0	182.6	187.0	186.5	186.2	181.8	176.1	169.8	163.5	157.0	153.7	149.6	140.9	132.2	126.2	120.2	113.6	107.6	96.8	85.3
	70,000	75.4	140.3	168.1	181.0	188.7	193.0	192.4	191.8	187.9	182.0	175.5	168.8	162.1	161.3	159.5	147.8	136.0	129.9	123.5	116.7	110.6	99.4	86.5
	80,000	83.6	146.2	172.6	184.4	191.7	195.9	195.3	194.4	190.8	184.8	178.3	171.5	164.7	166.4	167.1	152.5	137.8	131.3	125.1	117.9	111.4	99.0	86.0
	20,000	25.3	86.8	116.2	131.2	140.2	145.0	144.6	144.3	140.6	136.7	132.6	128.3	124.2	120.3	116.1	110.5	104.8	100.5	96.2	91.6	87.3	81.7	75.7
	30,000	36.4	103.6	137.2	153.8	163.7	169.0	168.8	168.2	164.2	159.4	154.4	149.1	143.8	139.2	134.2	127.9	121.6	116.5	111.5	106.0	100.9	93.9	86.2
	40,000	47.4	115.1	151.1	168.1	178.3	184.0	183.7	183.4	179.0	173.5	167.8	161.8	155.8	150.6	144.8	138.2	131.7	126.2	120.7	114.7	109.3	100.8	91.6
500	50,000	58.3	124.6	162.0	179.0	189.2	194.9	194.6	194.2	189.6	183.8	177.7	170.8	164.2	158.4	152.0	145.4	138.7	133.0	127.2	120.8	115.1	105.0	94.7
	60,000	67.8	133.5	170.0	186.4	196.5	203.4	202.8	201.4	196.9	191.0	184.4	177.2	170.3	165.6	160.2	152.1	143.7	137.8	131.5	124.9	118.7	107.9	96.6
	70,000	76.5	142.8	178.3	194.2	204.3	210.1	209.4	208.7	204.1	198.0	191.1	184.0	176.6	172.9	168.9	159.0	149.1	142.7	136.2	129.1	122.6	110.9	98.6
	80,000	84.7	151.0	184.7	199.9	209.6	215.7	214.8	213.8	209.4	202.8	195.8	188.6	181.3	178.8	175.6	164.2	152.6	146.0	139.1	131.8	124.9	112.6	99.7
	20,000	25.1	86.5	118.8	134.7	144.9	151.0	150.8	150.5	146.5	142.6	138.3	134.1	129.7	126.3	122.1	116.1	110.1	105.7	101.5	96.7	92.3	86.8	81.0
	30,000	36.7	104.3	143.1	161.3	173.1	180.1	179.8	179.4	175.1	170.1	165.0	159.5	153.7	149.4	144.1	137.3	130.5	125.3	120.3	114.6	109.4	102.3	94.8
	40,000	47.5	115.1	158.2	177.1	189.6	196.9	196.6	196.2	191.8	186.4	180.5	173.9	167.4	162.0	156.3	148.9	141.8	136.1	130.7	124.5	118.9	110.6	101.8
550	50,000	58.3	123.6	169.4	188.8	201.7	209.0	208.7	208.3	203.9	197.9	191.6	184.1	176.6	170.9	164.3	157.1	149.6	143.6	137.9	131.4	125.4	116.0	106.1
	60,000	67.2	133.5	178.4	197.8	210.5	218.1	217.4	217.0	212.1	205.9	199.4	191.5	184.1	177.5	170.7	163.2	156.0	149.8	143.3	136.5	130.3	119.8	109.2
	70,000	77.3	142.6	186.2	205.4	218.0	225.8	224.7	223.7	219.0	212.3	205.2	197.5	189.8	183.1	175.6	168.3	160.9	154.5	147.8	140.8	134.1	123.0	111.0
	80,000	85.6	151.0	192.8	211.6	223.9	231.7	230.4	229.3	224.1	217.3	210.3	202.2	194.6	187.4	179.5	172.3	165.1	158.2	151.4	143.9	137.0	125.0	112.4
	Stroke	0	2	5	10	15	21	26	31	41	51	62	72	82	92	103	113	123	133	143	154	164	184	205

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TABLE 7. C11-1 (DRY) Catapult, Mean, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) — NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND ACCUMULATOR PRESSURE

Pressure (PSI)	Stroke / Weight (LBS)	0	2	5	10	15	21	26	31	41	51	62	72	82	92	103	113	123	133	143	154	164	184	205
	10,000	9.2	27.2	32.7	35.1	36.2	36.8	36.9	37.0	36.4	35.4	34.3	32.8	31.4	30.6	29.6	28.7	27.9	27.1	26.4	25.6	24.9	23.4	21.8
150	20,000	16.2	36.4	42.8	45.7	47.0	47.8	47.9	47.9	47.0	45.7	44.3	42.6	40.9	39.7	38.5	37.3	36.2	35.1	34.1	33.0	32.0	29.8	27.6
	30,000	23.3	43.1	49.4	52.7	54.2	55.0	55.0	55.0	53.8	52.3	50.6	48.9	47.2	45.8	44.2	42.9	41.6	40.3	39.0	37.6	36.4	33.6	30.7
	40,000	30.5	48.2	54.1	57.5	59.1	59.9	59.8	59.7	58.2	56.6	54.8	53.2	51.4	49.9	48.2	46.7	45.3	43.7	42.2	40.6	39.1	35.9	32.5
	10,000	10.6	32.9	40.4	44.1	45.8	46.6	46.8	47.0	46.1	44.9	43.7	42.0	40.4	39.2	38.0	36.9	35.7	34.8	33.9	32.9	32.0	30.1	28.1
	20,000	19.3	45.8	54.9	59.5	61.7	62.8	62.9	63.0	61.7	60.1	58.4	56.3	54.2	52.7	51.0	49.5	48.0	46.7	45.3	43.8	42.5	39.7	36.8
200	30,000	27.8	54.3	63.4	68.4	70.7	71.9	71.9	72.0	70.4	68.6	66.4	64.3	62.1	60.2	58.2	56.5	54.8	53.1	51.5	49.6	48.0	44.6	41.0
	40,000	35.8	60.0	68.6	73.8	75.8	77.1	76.9	76.8	75.0	73.0	70.8	68.6	66.4	64.4	62.1	60.3	58.4	56.6	54.7	52.5	50.7	46.7	42.7
	50,000	43.7	64.9	72.6	77.5	79.7	81.0	80.7	80.4	78.3	76.3	73.9	71.8	69.7	67.5	65.1	63.2	61.2	59.0	56.9	54.7	52.5	48.1	43.5
	10,000	11.7	38.0	47.7	53.0	55.5	56.6	56.9	57.0	55.9	54.6	53.1	51.4	49.6	48.1	46.7	45.3	43.9	42.8	41.7	40.4	39.3	37.0	34.6
	20,000	21.4	53.7	65.5	72.2	75.3	76.8	76.9	77.0	75.6	73.7	71.7	69.4	67.0	65.1	62.8	61.0	59.2	57.6	56.0	54.1	52.5	49.2	45.8
250	30,000	30.0	62.4	74.2	81.2	84.2	85.8	85.8	85.9	84.0	82.0	79.6	77.2	74.7	72.4	69.9	67.9	65.8	63.9	61.9	59.8	57.9	54.0	49.9
	40,000	38.9	70.1	81.6	88.3	91.4	93.0	93.0	92.8	90.8	88.4	85.8	83.2	80.7	78.1	75.4	73.1	70.9	68.7	66.5	64.1	61.9	57.4	52.6
	50,000	47.6	76.2	86.8	93.4	96.3	97.9	97.6	97.4	95.1	92.5	89.8	87.2	84.6	81.9	78.7	76.4	74.2	71.7	69.3	66.6	64.0	59.1	53.9
	60,000	55.3	80.4	89.8	96.9	98.6	100.0	99.7	99.4	96.9	94.3	91.4	88.9	86.4	83.8	81.0	78.3	75.6	73.0	70.4	67.5	64.9	59.4	53.8
	10,000	12.2	41.8	53.7	60.8	64.1	65.6	65.8	65.9	64.8	63.3	61.8	59.9	58.2	56.5	54.7	53.1	51.5	50.2	48.8	47.3	46.0	43.4	40.6
	20,000	22.2	59.9	74.7	83.6	87.7	89.6	89.7	90.0	88.3	86.1	83.9	81.5	79.0	76.7	74.0	71.9	69.8	67.8	66.0	63.8	61.9	58.3	54.2
	30,000	31.7	71.0	86.5	95.6	99.8	101.8	101.9	101.9	99.8	97.4	94.9	92.0	89.3	86.4	83.4	81.0	78.6	76.3	74.1	71.6	69.4	64.9	60.2
300	40,000	41.0	79.8	94.9	103.8	107.8	109.9	109.9	109.7	107.4	104.8	101.8	98.9	95.8	92.7	89.3	86.7	84.1	81.5	79.1	76.3	73.7	68.7	63.4
	50,000	50.1	87.0	101.0	109.3	113.1	115.0	114.9	114.6	112.1	109.2	105.9	102.8	99.8	96.4	92.6	90.0	87.3	84.6	81.9	78.9	76.0	70.6	64.8
	60,000	58.0	92.0	105.2	112.9	116.2	118.1	117.7	117.5	114.7	111.8	108.4	105.5	102.3	99.8	96.9	93.2	89.6	86.6	83.5	80.3	77.4	71.3	65.2
	70,000	65.0	95.4	107.2	114.1	117.0	118.9	118.3	117.9	115.1	112.0	108.8	105.9	102.9	101.1	99.1	94.6	90.0	86.9	83.7	80.3	77.0	70.8	64.1
	10,000	12.3	45.0	59.3	68.4	72.7	74.6	74.8	75.0	73.6	72.2	70.5	68.7	66.9	64.9	62.9	61.1	59.2	57.7	56.1	54.4	52.8	50.0	46.9
	20,000	22.7	64.7	82.7	94.1	99.4	101.8	101.9	102.0	100.1	98.0	95.5	93.1	90.6	87.8	84.7	82.3	79.9	77.8	75.6	73.3	71.0	66.8	62.6
	30,000	32.8	77.4	96.4	108.1	113.3	115.8	115.9	115.9	113.7	111.1	108.3	105.2	102.3	99.0	95.5	92.7	90.0	87.4	84.9	82.3	79.7	74.8	69.8
350	40,000	42.4	88.3	107.3	118.5	123.5	126.1	126.1	125.9	123.5	120.5	117.2	113.9	110.5	106.7	102.8	99.9	96.9	94.1	91.4	88.3	85.4	80.0	74.4
	50,000	51.8	96.7	114.7	125.1	129.7	131.9	131.7	131.7	129.0	125.7	122.0	118.5	114.8	110.9	106.4	103.5	100.4	97.3	94.4	91.2	88.1	82.3	76.0
	60,000	59.6	102.2	119.4	128.5	132.8	135.0	134.8	134.5	131.8	128.4	124.7	121.1	117.5	115.0	112.1	107.5	102.9	99.5	96.3	92.9	89.5	83.2	76.6
	70,000	67.7	107.6	124.0	132.2	136.1	138.1	137.9	137.4	134.6	131.2	127.4	123.8	120.1	119.3	116.1	111.8	105.4	101.8	98.3	94.6	90.9	84.1	76.9
	80,000	74.5	111.4	126.8	134.0	137.2	139.1	138.7	138.2	135.4	132.0	128.2	124.5	121.1	121.9	122.2	114.3	106.3	102.5	98.8	94.8	90.9	83.6	76.0
	20,000	23.0	67.7	89.4	102.8	109.2	112.4	112.6	112.9	110.8	108.6	106.1	103.4	100.7	97.7	94.6	91.7	89.0	86.6	84.2	81.5	79.0	74.7	70.1
	30,000	33.4	82.3	105.5	119.5	126.4	129.8	129.9	130.0	127.7	124.9	121.7	118.6	115.3	111.7	107.8	104.8	101.5	98.6	95.9	92.8	89.9	84.8	79.2
	40,000	43.2	93.8	117.4	131.0	137.6	141.0	141.0	141.0	138.5	135.4	131.7	127.9	124.2	120.2	115.8	112.5	109.1	106.0	102.9	99.5	96.4	90.6	84.5
400	50,000	52.8	104.1	127.0	139.8	146.0	149.1	149.1	149.0	146.5	142.7	138.6	134.6	130.4	125.9	121.0	117.5	114.0	110.7	107.4	103.8	100.5	94.2	87.5
	60,000	61.1	110.7	133.2	144.9	150.7	153.9	153.6	153.6	150.9	147.1	142.8	138.7	134.4	131.7	128.7	123.4	117.8	114.2	110.6	106.6	103.0	96.3	89.9
	70,000	69.2	116.8	138.8	149.5	154.7	157.8	157.6	157.3	154.6	150.6	146.3	142.1	137.9	137.0	135.8	128.4	121.0	117.1	113.2	108.8	105.2	97.5	89.5
	80,000	76.5	123.2	144.3	154.0	159.0	161.9	161.4	161.1	158.1	154.3	149.9	145.6	141.4	142.4	143.2	133.7	124.4	120.1	115.8	111.4	107.1	99.1	90.4
	20,000	23.5	69.6	95.7	110.7	116.8	123.2	123.6	123.9	121.8	119.4	116.7	113.8	110.8	107.9	104.6	101.4	98.1	95.5	92.7	89.7	87.1	82.6	77.6
	30,000	33.8	84.9	113.8	129.8	138.7	143.5	143.8	143.9	142.3	138.7	135.3	131.7	128.0	124.3	120.5	116.9	113.2	110.0	106.8	103.3	100.1	94.6	88.8
	40,000	43.7	96.5	125.7	141.9	150.7	155.7	155.9	155.8	153.4	149.9	146.1	141.9	137.7	133.7	129.1	125.1	121.4	118.0	114.3	110.4	107.0	100.8	94.3
450	50,000	53.8	107.5	136.8	152.4	161.1	166.0	166.0	166.0	163.4	159.4	155.0	150.3	145.9	141.1	136.2	132.0	128.1	124.4	120.5	116.4	112.8	105.7	98.5
	60,000	62.5	115.4	144.3	159.6	168.1	172.9	172.9	172.5	169.8	165.7	161.2	156.3	151.4	148.1	144.4	138.7	133.3	129.2	125.1	120.6	116.6	108.9	101.2
	70,000	70.5	122.3	150.6	165.3	173.5	178.1	178.0	177.7	174.6	170.4	165.8	160.8	155.8	153.8	151.4	144.2	137.2	132.7	128.5	123.7	119.5	111.1	102.6
	80,000	78.1	128.6	155.5	169.6	177.3	181.8	181.3	180.9	177.5	173.6	168.9	163.8	158.7	158.1	157.1	148.3	139.8	135.3	130.8	125.8	121.0	112.2	103.0
	20,000	23.6	68.8	99.4	115.9	125.2	131.3	131.6	131.9	130.0	127.7	124.8	121.6	118.4	94.3	112.4	108.7	105.1	102.1	99.3	96.1	93.1	88.4	83.7
	30,000	34.0	84.1	118.1	136.2	146.7	153.3	153.6	154.0	151.8	148.6	145.2	141.3	137.3	133.9	129.8	125.8	121.6	118.2	114.7	110.9	107.4	101.8	95.8
	40,000	44.3	96.6	132.0	150.7	161.6	168.5	168.8	169.0	166.5	162.7	158.8	154.2	149.7	145.6	141.1	136.8	132.5	128.5	124.7	120.5	116.7	110.0	103.2
500	50,000	54.5	107.2	142.8	161.6	172.8	179.5	179.8	180.0	177.1	173.1	168.4	163.5	158.4	153.8	148.8	144.2	139.7	135.7	131.4	127.0	122.7	115.5	108.0
	60,000	63.4	116.3	151.9	171.0	182.1	189.0	189.0	189.0	186.0	181.8	176.8	171.4	166.4	162.2	157.5	152.1	146.8	142.3	137.8	132.9	128.4	120.3	111.8
	70,000	71.5	124.2	159.0	177.9	189.0	195.8	195.5	195.1	192.1	187.4	182.6	177.1	171.6	168.2	164.0	157.8	151.4	146.8	141.8	136.7	132.1	123.2	114.2
	80,000	79.2	131.6	165.7	184.3	195.1	202.0	201.4	201.0	197.2	192.8	187.9	182.2	176.5	173.4	170.0	162.8	155.5	150.5	145.7	140.2	135.5	126.0	116.1
	20,000	23.5	66.9	101.8	119.5	130.3	138.1	138.5	138.9	137.1	134.6	131.8	128.4	125.0	122.3	119.2	115.3	111.3	108.1	104.9	101.4	98.5	93.7	88.9
	30,000	34.3	82.9	122.7	142.9	155.6	164.2	164.5	165.0	162.8	159.6	156.0	151.7	147.5	144.3	140.4	135.8	131.0	127.3	123.5	119.4	115.7	109.8	103.6
	40,000	44.4	95.3	137.3	158.5	172.3	181.2	181.7	181.9	179.3	175.8	171.6	166.6	161.6	157.8	153.3	148.6	143.6	139.2	135.1	130.3	126.2	119.5	112.4
550	50,000	54.5	105.5	148.3	170.1	184.3	193.3	193.6	193.9	191.1	186.8	182.3	176.7	171.1	166.8	162.0	157.0	151.8	147.2	142.8	137.7	133.1	125.4	117.6
	60,000	62.8	113.8	155.9	178.7	192.9	201.9	201.9	201.8	198.9	194.4	189.7	184.0	178.2	173.4	168.1	162.9	157.5	153.0	148.2	142.9	138.1	129.7	121.0
	70,000	72.2	122.4	164.3	187.6	202.0	210.9	210.8	210.4	207.1	202.4	197.6	191.3	185.3	179.9	174.4	169.1	163.8	158.8	153.8	148.3	143.3	134.3	124.5
	80,000	80.0	129.1	169.4	193.2	207.3	215.9	215.5	214.8	211.0	206.6	201.4	195.3	188.8	183.4	177.5	172.0	166.6	161.5	156.5	150.9	145.8	136.0	125.7
	Stroke	0	2	5	10	15	21	26	31	41	51	62	72	82	92	103	113	123	133	143	154	164	184	205

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TABLE 8. C11-1 (DRY) Catapult, Lower Boundary, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) – NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND ACCUMULATOR PRESSURE

Pressure (PSI)	Stroke / Weight (LBS)	0	2	5	10	15	21	26	31	41	51	62	72	82	92	103	113	123	133	143	154	164	184	205
	10,000	8.6	23.1	28.4	31.3	32.4	32.8	32.9	33.0	32.7	32.1	31.5	30.4	29.3	29.2	29.0	28.4	27.7	27.0	26.3	25.5	24.8	23.3	21.7
150	20,000	15.1	31.2	37.3	40.7	42.1	42.8	42.9	43.0	42.5	41.8	40.9	39.6	38.4	38.1	37.7	37.0	36.2	35.3	34.4	33.4	32.5	30.5	28.6
	30,000	21.7	35.4	41.0	44.5	46.1	46.8	47.0	47.0	46.3	45.5	44.6	43.4	42.3	41.8	41.3	40.5	39.7	38.7	37.7	36.7	35.7	33.7	31.6
	40,000	28.4	38.1	43.0	46.3	47.8	48.8	48.9	49.0	48.1	47.2	46.2	45.2	44.3	43.7	43.0	42.2	41.5	40.4	39.5	38.3	37.2	35.3	33.2
	10,000	9.9	27.8	34.9	39.4	40.9	41.6	41.8	42.0	41.6	41.0	40.2	39.0	37.8	37.5	37.1	35.4	35.7	34.9	34.2	33.3	32.5	30.6	28.7
	20,000	17.9	38.7	47.1	52.3	54.5	55.5	55.7	56.0	55.3	54.4	53.3	51.9	50.5	49.9	49.3	48.5	47.5	46.5	45.4	44.3	43.3	40.9	38.4
200	30,000	25.9	45.3	53.7	59.0	61.4	62.7	62.9	63.0	62.1	61.0	59.8	58.5	57.0	56.2	55.3	54.4	53.4	52.2	51.1	49.8	48.6	46.2	43.5
	40,000	33.3	49.4	57.0	61.9	64.3	65.7	65.8	66.0	64.9	63.8	62.5	61.2	59.9	58.8	57.7	56.8	55.8	54.6	53.4	52.1	50.9	48.5	45.9
	50,000	40.6	53.6	60.3	65.0	67.2	68.7	68.9	68.9	67.6	66.4	65.1	63.9	62.7	61.4	60.1	59.1	58.2	56.9	55.7	54.4	53.1	50.8	48.3
	10,000	10.9	32.4	41.6	47.5	50.1	51.3	51.7	52.0	51.4	50.7	49.8	48.6	47.4	46.8	46.2	45.5	44.8	43.9	43.1	42.2	41.4	39.2	36.7
	20,000	19.9	45.1	56.3	63.5	66.7	68.3	68.6	68.9	68.1	67.1	65.9	64.4	62.8	61.9	61.0	60.0	59.1	57.9	56.9	55.7	54.5	51.9	49.0
250	30,000	27.9	52.8	64.1	71.4	74.6	76.3	76.7	76.9	75.9	74.7	73.4	71.8	70.1	69.0	67.5	66.5	65.4	64.3	63.1	61.8	60.6	57.8	54.9
	40,000	36.2	59.6	70.6	77.5	80.7	82.6	82.9	83.0	81.7	80.4	79.0	77.3	75.7	74.1	72.4	71.3	70.2	68.9	67.6	66.3	65.0	62.3	59.4
	50,000	44.3	64.7	74.6	81.0	84.1	85.8	86.0	86.1	84.8	83.3	81.7	80.1	78.5	76.7	74.7	73.5	72.4	71.1	69.8	68.3	67.0	64.5	61.8
	60,000	51.4	67.9	76.6	82.4	85.2	87.0	87.0	87.0	85.4	83.9	82.3	81.0	79.5	77.6	75.4	74.3	73.2	71.9	70.4	68.9	67.5	65.1	62.6
	10,000	11.3	34.9	46.1	53.8	57.2	59.1	59.5	60.0	59.3	58.6	57.7	56.5	55.4	54.5	53.6	53.0	52.4	51.6	50.8	49.9	49.1	46.6	44.0
	20,000	20.6	50.6	64.9	74.4	78.8	81.0	81.5	81.9	80.9	79.8	78.7	77.0	75.5	74.2	72.7	71.8	70.8	69.7	68.7	67.5	66.5	63.4	60.2
	30,000	29.5	60.8	75.7	85.4	89.9	92.3	92.7	93.0	91.9	90.6	89.2	87.3	85.5	83.8	81.9	80.7	79.6	78.4	77.2	75.8	74.7	71.7	68.3
300	40,000	38.1	68.2	82.7	91.9	96.2	98.4	98.8	98.9	97.7	96.2	94.7	92.6	90.6	88.6	86.4	85.0	83.8	82.5	81.3	80.0	78.6	75.7	72.7
	50,000	46.6	74.7	88.6	96.9	100.8	102.9	103.1	103.0	101.8	100.2	98.5	96.3	94.2	91.8	89.1	87.7	86.3	85.1	83.8	82.5	81.2	78.6	76.0
	60,000	53.9	78.3	91.0	98.5	101.9	104.1	104.1	104.0	102.3	100.7	98.7	97.0	95.0	92.7	90.2	88.8	87.4	86.0	84.5	83.0	81.6	79.1	76.3
	70,000	60.5	80.8	92.4	98.9	101.9	104.2	103.8	103.7	101.8	100.0	98.1	96.5	94.9	92.6	90.1	88.7	87.5	85.9	84.3	82.7	81.2	78.5	75.7
	10,000	11.4	36.7	50.0	59.6	64.2	66.6	67.3	68.0	66.9	66.2	65.4	64.4	63.5	62.3	61.1	60.6	60.1	59.4	58.7	57.9	57.2	54.4	51.5
	20,000	21.1	53.9	71.0	83.0	88.6	91.5	92.2	92.9	91.6	90.5	89.4	87.8	86.3	84.6	82.7	81.9	80.9	79.9	79.1	78.1	77.1	73.9	70.3
	30,000	30.5	65.6	83.9	96.2	101.8	104.9	105.5	106.0	104.7	103.4	101.8	99.9	97.9	95.7	93.2	92.1	91.0	89.9	88.9	87.7	86.6	83.5	80.1
350	40,000	39.4	75.7	94.4	106.1	111.5	114.4	114.6	114.9	113.8	112.2	110.4	108.0	105.8	103.0	100.1	98.7	97.3	96.1	95.1	93.8	92.8	89.8	86.9
	50,000	48.2	83.6	102.1	112.6	117.4	119.9	120.1	120.1	119.1	117.2	115.1	112.6	109.9	106.8	103.3	101.6	100.0	98.9	97.9	96.5	95.5	93.0	90.6
	60,000	55.4	88.2	106.0	115.5	119.8	122.2	122.0	122.0	120.5	118.6	116.3	114.0	111.7	108.7	105.8	104.1	102.4	101.2	99.7	98.1	96.8	94.1	91.2
	70,000	63.0	92.7	109.8	118.2	121.8	124.0	123.8	123.5	121.6	119.5	117.4	115.2	113.1	110.6	107.8	106.1	104.6	102.9	101.2	99.6	97.9	94.7	91.6
	80,000	69.3	95.9	112.1	119.2	122.1	124.1	123.8	123.5	121.0	118.9	116.6	114.7	113.0	110.7	108.4	106.9	105.2	103.5	101.6	99.5	97.6	94.2	90.6
	20,000	21.4	55.0	76.1	90.4	97.2	101.3	102.2	103.0	101.7	100.7	99.5	97.8	96.4	94.3	92.1	91.1	90.2	89.1	88.2	87.0	86.1	82.7	79.1
	30,000	31.1	68.9	92.1	107.0	114.5	118.5	119.3	119.9	118.8	117.4	115.7	113.7	111.6	108.9	106.0	104.7	103.5	102.2	101.2	99.8	98.8	95.2	91.7
	40,000	40.2	80.0	103.6	118.0	125.2	129.2	129.6	130.0	128.9	127.3	125.3	122.8	120.1	117.0	113.6	112.0	110.4	109.1	107.9	106.5	105.3	102.2	98.9
400	50,000	49.1	89.0	112.2	125.4	132.0	136.6	135.7	135.9	134.9	132.8	130.7	127.6	124.6	121.1	117.3	115.4	113.5	112.1	110.9	109.4	108.2	105.6	102.7
	60,000	56.8	95.5	118.8	131.4	137.5	140.9	140.9	140.6	139.2	137.0	134.8	131.9	129.0	125.8	122.4	120.2	118.3	116.8	115.2	113.5	111.8	108.7	105.4
	70,000	64.4	100.3	123.0	134.5	139.7	142.9	142.8	142.6	140.6	138.4	135.7	133.0	130.6	127.6	124.7	122.7	120.8	118.8	116.8	114.9	113.0	109.3	105.4
	80,000	71.1	105.6	128.1	138.5	143.1	145.9	145.6	145.3	142.6	140.4	137.6	135.1	132.7	130.4	128.0	126.0	124.0	121.7	119.5	117.0	114.8	110.6	106.1
	20,000	21.9	54.9	81.6	97.9	106.4	112.1	113.0	114.0	113.2	112.2	110.8	108.8	107.1	104.9	102.7	101.3	99.9	98.5	97.3	95.8	94.6	90.8	87.1
	30,000	31.4	70.4	99.8	117.5	127.1	133.4	134.3	134.9	134.0	132.6	130.8	128.4	125.8	123.3	120.2	118.6	116.7	115.1	113.7	111.9	110.2	106.2	102.3
	40,000	40.6	81.9	111.6	129.2	138.9	144.9	145.6	146.1	145.3	143.3	141.0	138.3	135.2	132.2	128.9	126.9	124.6	122.9	121.1	119.4	117.6	113.6	109.6
450	50,000	50.0	92.1	121.0	138.0	147.3	153.2	153.5	153.9	152.9	150.5	148.1	144.7	141.5	137.8	134.1	131.7	129.6	127.8	125.7	123.6	121.8	118.1	114.2
	60,000	58.1	99.2	128.3	145.0	154.2	159.6	159.9	160.1	158.5	156.0	153.5	150.2	147.0	143.4	139.8	137.4	135.2	133.0	130.8	128.4	126.2	121.8	117.5
	70,000	65.6	105.2	133.6	150.4	158.9	164.1	164.1	164.1	161.8	159.6	156.6	153.5	153.5	147.1	143.6	141.1	138.6	136.4	133.9	131.4	128.9	124.1	119.1
	80,000	72.6	109.7	137.4	153.4	161.1	166.0	166.0	165.6	163.1	160.6	157.8	154.4	151.3	148.5	145.4	142.9	140.3	137.8	135.3	132.2	129.7	124.3	118.7
	20,000	21.9	52.6	85.3	103.3	113.3	121.0	122.1	123.1	122.9	121.6	120.3	118.0	115.8	113.7	111.5	109.6	107.9	106.2	104.7	102.8	101.1	97.4	93.6
	30,000	31.6	68.3	103.9	124.0	135.8	144.0	145.0	145.9	145.4	143.9	142.2	139.1	136.4	133.8	131.1	128.8	126.8	124.7	122.5	120.2	118.2	113.9	109.4
	40,000	41.2	80.5	116.0	136.8	149.0	157.5	158.3	159.1	158.3	156.1	153.9	150.6	147.6	144.6	141.3	138.9	136.4	134.2	131.8	129.4	126.9	122.3	117.7
500	50,000	50.7	91.8	126.6	147.0	159.7	167.8	168.4	168.9	167.7	165.4	162.5	159.1	155.6	152.4	148.7	146.1	143.5	140.9	138.3	135.5	132.9	128.3	123.1
	60,000	59.0	98.9	133.3	154.6	167.0	175.0	175.6	175.8	174.3	171.6	168.9	165.1	161.5	158.2	154.6	151.6	148.9	146.2	143.3	140.3	137.6	132.2	126.6
	70,000	66.5	105.4	139.8	161.7	173.8	181.3	181.6	181.9	179.7	177.3	174.2	170.5	166.5	163.1	159.4	156.4	153.6	150.5	147.7	144.4	141.6	135.8	129.7
	80,000	73.7	111.1	144.7	166.9	178.7	185.9	185.9	185.6	183.0	180.5	177.7	173.6	169.3	166.1	162.7	159.6	156.5	153.3	150.2	147.1	144.0	137.4	130.9
	20,000	21.9	48.2	86.1	105.6	117.2	126.4	127.5	128.6	129.1	128.0	126.6	123.9	121.5	119.4	117.4	115.2	112.9	110.9	109.1	106.9	104.9	101.1	97.3
	30,000	31.9	64.5	106.6	129.3	143.2	153.7	155.1	156.1	156.1	154.5	152.6	149.4	146.4	144.0	141.3	138.6	135.9	133.4	130.8	128.1	125.4	120.8	116.0
	40,000	41.3	78.2	120.7	144.8	160.0	171.0	171.9	173.0	172.4	170.3	167.7	164.4	160.8	158.2	154.9	152.3	149.3	146.4	143.4	140.1	137.2	131.6	125.9
550	50,000	50.7	89.5	130.1	154.6	170.5	181.3	182.2	183.1	181.9	179.1	176.3	172.6	169.1	166.0	162.6	159.5	156.7	153.3	150.2	146.5	143.1	137.2	131.0
	60,000	58.4	96.3	137.1	163.0	179.3	189.8	190.4	191.0	189.4	186.8	183.9	179.7	176.9	172.3	168.8	165.5	162.3	159.1	155.6	152.0	148.5	142.0	135.3
	70,000	67.1	102.6	142.2	170.0	185.8	196.1	196.4	197.0	195.0	192.4	189.4	184.8	180.1	176.8	172.9	169.6	166.0	162.7	159.4	155.4	152.1	145.2	137.6
	80,000	74.4	108.3	147.3	176.3	192.1	201.5	201.9	202.1	199.8	197.1	194.4	189.3	184.3	180.5	176.5	172.8	169.1	165.7	162.3	158.6	155.3	147.5	139.7
	Stroke	0	2	5	10	15	21	26	31	41	51	62	72	82	92	103	113	123	133	143	154	164	184	205

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TABLE 9. C11-1 (DRY) Catapult (with metering rod), Upper Boundary, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) – NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND ACCUMULATOR PRESSURE

Pressure (PSI)	Stroke / Weight (LBS)	0	0.2	1	2	5	10	15	21	26	31	41	51	62	72	82	92	103	113	123	133	143	154	164	184	205
	10,000	10.6	17.8	40.5	43.6	44.6	46.9	46.6	45.9	45.5	45.1	44.1	42.7	41.1	39.5	38.0	36.3	34.4	33.1	31.6	30.4	29.1	27.6	26.3	23.8	21.2
150	20,000	18.1	29.6	53.5	55.9	57.0	59.0	58.3	57.4	56.8	56.1	54.8	52.9	50.9	48.9	47.1	45.0	42.7	41.0	39.3	37.7	36.1	34.3	32.7	29.7	26.4
	30,000	26.1	39.7	60.7	62.7	63.7	64.9	64.0	62.9	62.1	61.2	59.5	57.4	55.1	53.0	51.0	48.8	46.4	44.5	42.6	40.9	39.2	37.3	35.7	32.4	28.9
	40,000	32.0	49.7	66.0	67.7	68.7	68.9	67.7	66.4	65.5	64.4	62.3	60.1	57.7	55.6	53.3	51.1	48.6	46.6	44.7	42.9	41.1	39.2	37.4	34.1	30.4
	10,000	12.1	19.0	43.5	49.9	52.8	55.3	55.1	54.5	54.2	53.8	53.0	51.7	50.2	48.5	46.8	44.9	42.8	41.2	39.4	37.9	36.4	34.7	33.1	30.1	27.1
	20,000	21.6	32.7	60.7	67.3	70.5	72.9	72.3	71.5	70.8	70.2	68.8	66.8	64.8	62.6	60.4	57.9	55.2	53.0	50.9	48.9	47.0	44.8	42.8	38.9	35.0
200	30,000	30.4	44.6	71.9	77.3	80.2	81.9	81.0	79.8	78.9	77.9	76.0	73.8	71.3	68.8	66.4	63.6	60.6	58.4	56.0	53.8	51.7	49.3	47.2	42.9	38.5
	40,000	38.8	56.2	79.2	83.4	85.8	86.4	85.1	83.8	82.6	81.5	79.2	76.5	73.8	71.1	68.5	65.7	62.7	60.3	57.8	55.7	53.4	51.0	48.7	44.4	40.0
	50,000	45.8	65.7	84.2	88.1	90.0	89.5	88.0	86.4	85.0	83.6	80.8	78.0	74.9	72.3	69.5	66.7	63.6	61.2	58.7	56.5	54.2	51.9	49.6	45.1	40.6
	10,000	13.3	20.0	45.7	54.7	60.1	62.8	62.6	62.3	62.1	61.8	61.2	60.2	59.0	57.3	55.6	53.5	51.2	49.2	47.3	45.6	43.8	42.0	40.2	36.8	33.3
	20,000	24.1	34.7	68.5	76.3	82.0	84.9	84.4	83.7	83.1	82.5	81.3	79.8	77.7	75.4	73.1	70.2	67.2	64.7	62.1	59.8	57.6	55.0	52.8	48.2	43.6
	30,000	34.0	48.2	83.0	89.0	94.2	96.3	95.5	94.4	93.6	92.7	90.8	88.5	86.1	83.3	80.5	77.4	74.1	71.3	68.6	66.0	63.5	60.7	58.2	53.2	48.0
250	40,000	43.2	60.6	92.6	98.4	102.6	103.9	102.7	101.2	100.0	98.7	96.3	93.6	90.4	87.3	84.3	81.1	77.6	74.7	71.8	69.2	66.4	63.6	60.8	55.6	50.2
	50,000	51.8	72.7	101.0	106.3	109.3	109.6	108.0	106.2	104.7	103.2	100.1	96.8	93.1	89.8	86.5	83.2	79.6	76.7	73.7	70.9	68.2	65.2	62.4	57.0	51.4
	60,000	60.5	83.2	104.9	109.7	112.5	112.0	110.1	108.0	106.2	104.6	101.1	97.8	94.2	90.9	87.7	84.2	80.5	77.4	74.4	71.7	68.8	65.8	62.9	57.3	51.6
	70,000	68.7	94.0	110.7	113.0	115.4	113.9	112.0	109.6	107.5	105.6	101.9	98.6	95.1	91.7	88.5	84.9	81.2	78.1	75.0	72.1	69.2	66.2	63.3	57.6	51.5
	10,000	13.7	20.3	48.9	57.7	66.0	68.9	68.9	68.8	68.8	68.6	68.3	67.9	67.2	65.5	63.9	61.8	59.3	57.2	55.0	53.1	51.2	49.1	47.3	43.4	39.5
	20,000	25.5	36.2	73.0	83.3	92.7	95.9	95.6	95.2	94.7	94.3	93.3	92.0	90.6	88.1	85.7	82.8	79.4	76.5	73.6	71.1	68.5	65.6	63.2	58.0	52.7
	30,000	36.2	50.2	91.3	99.9	108.1	110.9	110.2	109.4	108.5	107.8	105.9	103.9	101.6	98.6	95.6	92.1	88.5	85.3	82.2	79.3	76.4	73.2	70.3	64.4	58.5
300	40,000	46.2	63.3	103.6	112.2	118.8	121.3	120.0	118.5	117.4	116.2	113.6	110.7	107.5	104.0	100.6	96.9	93.1	89.7	86.4	83.3	80.2	76.8	73.8	67.6	61.3
	50,000	55.4	75.6	114.7	121.7	126.0	127.5	126.1	124.1	122.7	121.2	117.6	114.1	110.0	106.3	102.3	98.6	94.7	91.4	88.0	84.7	81.5	78.0	74.8	68.5	61.9
	60,000	65.1	87.9	122.4	128.2	132.0	132.4	130.6	128.3	126.5	124.6	121.0	117.3	113.1	109.3	105.4	101.4	97.2	93.7	90.3	86.8	83.6	79.8	76.5	70.0	63.1
	70,000	73.5	99.0	126.0	131.2	134.8	133.8	131.9	129.3	127.2	125.1	121.1	117.6	113.6	109.5	105.7	101.6	97.4	93.7	90.3	86.8	83.5	79.7	76.4	69.7	62.6
	80,000	81.3	109.3	130.8	134.3	137.2	135.0	132.9	130.2	128.2	125.3	121.3	117.6	113.7	109.9	106.0	101.9	97.3	93.6	90.1	86.7	83.2	79.6	76.1	69.1	62.0
	10,000	14.2	20.8	47.7	58.7	70.4	73.2	73.5	73.9	73.9	74.0	74.2	74.4	74.4	72.9	71.4	69.3	66.8	64.5	62.1	60.1	58.0	55.8	53.8	49.8	45.5
	20,000	26.6	37.4	74.7	88.3	101.7	105.3	105.3	105.3	105.1	104.7	104.4	103.7	102.8	100.4	98.1	95.0	91.5	88.4	85.1	82.3	79.5	76.2	73.5	67.9	62.0
	30,000	37.1	51.0	94.5	108.3	120.3	123.8	123.4	122.9	122.1	121.5	120.1	118.4	116.3	113.2	110.2	106.7	102.8	99.2	95.5	92.3	89.0	85.5	82.1	75.8	69.2
350	40,000	47.4	64.7	111.8	123.2	132.6	135.8	135.0	134.1	132.7	131.6	129.1	126.2	123.1	119.4	115.6	111.7	107.6	104.0	100.3	96.7	93.2	89.3	85.9	79.0	71.8
	50,000	57.8	78.0	126.2	135.4	141.3	144.3	143.0	141.0	139.5	138.2	134.5	130.7	126.2	121.9	117.7	113.6	109.4	105.7	101.9	98.3	94.6	90.6	87.0	79.9	72.5
	60,000	67.8	90.9	136.0	143.6	148.9	150.0	148.9	146.5	144.5	142.7	139.0	135.0	130.6	126.2	121.7	117.3	112.7	108.7	105.0	101.2	97.2	93.1	89.3	81.8	74.1
	70,000	76.3	102.0	141.1	148.2	151.6	153.5	151.1	148.7	146.5	144.5	140.5	136.4	132.0	127.5	123.2	118.5	113.6	109.6	105.6	101.8	98.0	93.5	89.7	82.1	74.1
	80,000	83.8	112.2	145.8	152.9	156.8	154.7	152.7	150.2	147.5	145.1	141.0	137.2	132.7	128.2	123.9	119.2	114.0	109.7	105.7	101.6	97.8	93.4	89.5	81.7	73.4
	20,000	27.1	37.9	73.7	95.0	109.6	113.2	113.5	114.1	114.1	114.1	114.3	114.3	114.4	112.1	109.9	106.8	103.3	99.8	96.3	91.4	90.2	87.0	83.9	77.8	71.5
	30,000	38.1	52.3	98.5	116.2	131.5	135.8	137.3	135.5	135.3	134.9	134.0	132.6	131.3	127.7	124.8	121.2	117.1	113.3	109.2	105.7	102.1	98.1	94.6	87.6	80.1
	40,000	48.9	66.3	119.7	133.3	145.9	150.3	150.0	148.9	148.0	147.3	144.9	142.3	139.1	135.1	131.3	127.3	122.9	118.9	114.9	110.8	107.1	102.7	98.9	91.3	83.4
400	50,000	59.4	80.7	134.1	148.0	156.1	160.6	159.9	157.8	156.6	155.3	151.7	147.6	142.8	138.2	133.3	129.2	124.5	120.6	116.5	112.4	108.3	103.7	99.6	91.7	83.5
	60,000	69.6	92.9	146.5	157.3	164.5	166.9	165.9	163.8	162.1	160.8	156.8	152.3	147.6	142.8	137.8	133.3	128.1	123.9	119.6	115.4	111.1	106.5	102.2	94.0	85.3
	70,000	78.0	103.9	153.8	165.0	171.1	171.6	170.2	167.8	165.7	163.7	159.9	155.5	150.7	145.9	140.8	135.9	130.3	126.0	121.4	117.1	112.7	107.9	103.4	94.9	85.8
	80,000	81.4	108.7	161.7	169.2	175.1	173.3	171.5	169.3	166.7	164.2	160.6	156.3	151.4	146.6	141.4	136.3	130.4	125.8	121.2	116.8	112.5	107.4	103.1	94.3	85.2
	20,000	27.3	38.2	72.0	92.9	113.5	119.5	120.5	121.1	121.5	120.8	120.8	120.6	120.5	118.8	117.4	115.1	112.4	108.7	105.1	102.0	98.8	95.4	92.2	85.9	79.3
	30,000	38.3	52.6	98.1	119.3	139.4	145.7	141.8	146.2	146.0	145.5	145.0	143.5	139.5	139.2	136.5	133.0	129.5	125.3	121.2	117.2	113.6	109.3	105.6	98.3	90.6
	40,000	49.4	67.0	122.6	140.4	157.6	163.4	163.9	162.8	162.3	161.5	160.4	157.5	154.3	150.1	146.1	141.9	137.5	133.0	128.6	124.6	120.4	115.8	111.6	103.6	95.1
450	50,000	60.3	81.0	140.8	163.1	171.2	176.3	176.1	174.5	173.4	172.3	170.4	166.1	161.2	156.0	150.8	145.9	140.3	135.9	131.5	127.2	122.8	118.0	113.3	104.9	96.3
	60,000	70.5	94.1	155.6	168.7	180.2	183.9	183.3	181.3	179.9	178.5	175.7	171.2	165.9	160.6	155.0	149.6	143.8	139.3	134.5	130.0	125.3	120.3	115.5	106.8	97.7
	70,000	79.1	105.5	164.3	177.4	187.4	189.4	188.4	186.4	184.4	182.4	178.0	174.1	169.0	163.3	157.6	151.9	145.6	140.8	135.9	131.1	126.5	121.1	116.3	107.1	97.5
	80,000	86.3	116.3	173.3	185.4	193.4	194.0	192.1	190.0	187.4	185.1	181.0	176.1	170.7	164.9	159.1	153.1	146.5	141.3	136.1	131.5	126.6	121.2	116.3	107.0	97.0
	20,000	27.4	38.2	71.4	92.7	115.5	124.0	125.8	125.9	125.7	125.7	125.5	124.8	124.3	123.7	123.2	121.7	120.1	116.1	103.3	109.1	106.0	102.5	99.2	93.0	86.5
	30,000	38.5	52.9	98.7	121.6	145.3	153.7	155.3	155.1	154.9	154.6	154.4	152.8	151.0	148.6	146.5	143.9	140.6	136.4	131.9	128.0	124.0	119.7	115.7	108.3	100.3
	40,000	50.0	67.9	125.8	146.2	168.4	176.1	177.0	176.4	175.8	175.5	175.5	172.6	169.1	165.0	161.2	156.9	152.1	147.4	142.7	138.4	134.0	129.2	124.9	116.4	107.6
500	50,000	61.0	82.0	145.7	165.7	185.6	191.4	192.0	190.7	190.1	189.5	189.8	185.2	180.4	174.4	168.6	163.1	156.7	151.9	147.3	142.4	137.8	132.5	127.9	118.7	109.5
	60,000	70.6	94.6	160.7	178.0	195.9	201.1	200.9	198.6	197.4	196.2	194.9	189.9	184.7	178.4	172.5	166.3	159.8	154.5	149.5	144.5	139.8	134.3	129.3	119.9	110.1
	70,000	79.6	106.2	174.0	188.9	203.0	207.3	206.6	204.7	202.8	201.2	198.4	193.3	187.4	181.0	174.7	168.3	161.4	156.2	156.8	145.4	140.2	134.6	129.6	120.0	110.1
	80,000	86.9	116.2	184.8	197.8	208.4	211.9	210.6	208.3	206.1	203.9	199.7	194.0	187.7	181.4	174.7	168.3	161.1	155.4	149.6	144.2	139.2	133.6	128.5	118.7	108.3
	20,000	27.5	38.4	70.7	91.7	116.7	127.6	130.3	130.3	130.0	129.8	129.3	128.4	127.7	127.9	128.4	127.9	127.5	123.5	119.6	116.4	113.1	109.6	106.3	100.1	93.5
	30,000	38.6	53.0	98.3	122.2	150.0	160.8	163.4	163.3	163.0	162.7	163.3	161.3	159.2	157.8	156.3	154.1	151.8	147.0	142.5	138.5	134.6	128.9	125.0	118.4	110.4
	40,000	50.2	68.3	125.8	148.5	176.6	186.7	188.0	188.4	187.0	186.5	188.4	186.2	182.0	178.0	174.2	170.1	165.2	160.5	155.5	151.1	146.4	141.5	136.8	128.3	119.0
550	50,000	61.5	82.4	145.3	169.7	196.6	203.2	204.4	205.8	203.8	203.5	206.5	202.2	197.3	191.0	184.7	178.3	171.1	166.1	161.1	156.1	151.4	145.9	140.9	131.5	122.1
	60,000	71.4	95.8	166.3	186.4	209.5	216.5	216.8	216.0	215.0	214.4	215.1	209.9	204.1	197.6	190.7	183.8	176.2	170.7	165.2	160.0	154.8	149.1	144.0	134.0	123.8
	70,000	80.0	107.0	178.4	198.1	217.1	224.0	223.6	222.0	220.6	219.3	217.2	211.6	205.5	198.2	191.2	184.3	176.4	170.5	164.6	159.4	153.8	148.1	142.5	132.5	122.3
	80,000	87.2	116.9	189.8	208.0	222.5	229.5	228.2	226.0	224.0	222.2	217.8	211.5	204.6	197.4	190.1	182.9	175.0	168.7	162.5	157.0	151.8	145.7	140.2	129.9	119.3
	Stroke	0	0.2	1	2	5	10	15	21	26	31	41	51	62	72	82	92	103	113	123	133	143	154	164	184	205

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TABLE 10. C11-1 (DRY) Catapult (with metering rod), Mean, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) — NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND ACCUMULATOR PRESSURE

Pressure (PSI)	Stroke / Weight (LBS)	0	0.2	1	2	5	10	15	21	26	31	41	51	62	72	82	92	103	113	123	133	143	154	164	184	205
	10,000	9.9	15.8	35.7	41.4	41.0	41.9	41.7	41.4	41.0	40.7	40.1	38.9	37.6	36.5	35.5	34.4	33.2	32.1	31.1	30.1	29.1	29.9	27.0	25.0	22.9
150	20,000	16.9	28.6	47.5	52.5	52.2	53.0	52.5	51.0	51.4	50.9	49.8	48.3	46.7	45.4	44.0	42.6	41.2	39.9	38.6	37.4	36.2	34.8	33.5	31.2	28.6
	30,000	23.5	35.5	55.1	58.3	58.1	58.5	57.7	56.9	56.3	55.5	50.6	52.4	50.8	49.3	47.7	46.2	44.7	43.3	41.9	40.5	39.2	37.8	36.5	34.0	31.3
	40,000	29.9	43.8	60.0	62.0	62.1	62.0	60.8	59.9	59.2	58.3	56.5	54.7	52.9	51.2	49.6	48.1	46.4	45.0	43.6	42.2	40.9	39.5	38.1	35.5	32.7
	10,000	11.3	17.1	37.4	45.9	48.4	49.9	49.9	49.6	49.3	49.0	48.5	47.4	46.2	45.1	44.0	42.8	41.4	40.2	38.9	37.7	36.5	35.2	34.0	31.7	29.3
	20,000	20.2	27.2	52.4	62.3	65.0	66.5	66.1	65.6	65.1	64.6	63.5	61.9	60.3	58.7	57.3	55.6	53.9	52.3	50.6	49.1	47.6	45.9	44.4	41.3	38.2
200	30,000	28.4	40.3	64.5	71.6	74.0	75.0	74.3	73.5	72.7	72.0	70.5	68.6	66.7	65.0	63.1	61.3	59.3	57.5	55.8	54.1	52.4	50.6	49.0	45.6	42.2
	40,000	36.3	50.2	72.7	76.6	78.5	78.9	77.8	76.7	75.9	75.0	73.0	70.9	68.8	66.9	65.0	63.0	61.0	59.2	57.3	55.6	53.9	52.0	50.4	47.0	43.6
	50,000	42.8	58.5	77.4	80.6	81.9	81.7	80.2	79.0	77.9	76.9	74.4	72.2	69.9	67.8	65.7	63.7	61.7	59.9	58.0	56.3	54.7	52.8	51.1	47.6	44.1
	10,000	12.4	18.0	39.0	48.3	54.7	56.8	57.0	57.0	56.8	56.5	56.3	55.4	54.4	53.4	52.8	51.0	49.6	48.1	46.6	45.4	44.0	42.6	41.2	38.6	35.9
	20,000	22.5	31.6	60.8	68.8	75.6	77.8	77.7	77.5	77.0	76.5	75.6	74.3	72.8	71.2	69.7	67.8	65.8	63.9	62.0	60.2	58.4	56.6	54.8	51.3	47.7
	30,000	31.8	43.5	70.0	80.6	86.7	88.4	87.9	87.3	86.6	85.9	84.5	82.8	80.7	78.9	76.9	74.9	72.6	70.5	68.5	66.5	64.5	62.4	60.5	56.6	52.5
250	40,000	40.4	54.5	80.8	89.2	93.7	94.9	93.8	92.9	92.0	91.1	89.2	87.1	84.6	82.4	80.2	78.1	75.6	73.6	71.3	69.3	67.3	65.0	62.9	58.9	54.7
	50,000	48.4	64.3	86.4	96.6	99.6	100.0	98.4	97.1	96.0	94.9	92.3	89.8	87.1	84.7	82.2	79.9	77.4	75.3	73.1	71.0	69.0	66.6	64.5	60.3	56.0
	60,000	56.5	74.2	93.5	100.5	103.0	102.8	101.3	99.8	98.5	97.1	94.3	91.8	89.0	86.5	83.8	81.5	78.9	76.7	74.4	72.2	70.1	67.7	65.5	61.1	56.7
	70,000	64.2	84.0	98.2	103.2	105.3	104.4	103.0	101.3	99.7	98.2	95.1	92.6	89.7	87.1	84.6	82.1	79.5	77.1	74.9	72.7	70.5	68.0	65.8	61.4	56.6
	10,000	12.8	18.3	37.5	48.0	59.2	62.0	62.6	62.9	62.7	62.6	62.6	62.1	61.6	60.8	60.0	58.4	56.9	55.3	53.7	52.3	50.8	49.4	48.0	45.0	42.1
	20,000	23.8	32.8	57.0	71.8	84.4	87.5	87.9	87.9	87.6	87.3	86.7	85.7	84.5	83.2	81.7	79.6	77.5	75.4	73.2	71.2	69.3	62.7	65.2	61.2	57.2
	30,000	33.8	45.6	75.3	88.4	99.2	101.9	101.9	101.5	101.0	100.5	99.1	97.6	95.9	93.9	91.9	89.5	87.1	84.7	82.2	80.0	77.8	75.4	73.2	68.7	64.1
300	40,000	43.2	57.3	89.9	101.0	109.0	111.0	110.4	109.6	108.8	107.9	106.2	104.0	101.6	99.1	96.6	94.1	91.6	89.1	86.6	84.1	81.8	79.2	76.9	72.1	67.2
	50,000	51.8	68.1	101.0	111.2	115.6	116.9	115.7	114.4	113.3	112.4	109.8	107.1	104.2	101.3	98.4	95.8	93.2	90.6	88.2	85.5	83.3	80.5	78.1	73.1	67.9
	60,000	60.8	79.2	108.8	117.1	121.2	121.5	120.3	118.7	117.4	116.1	113.2	110.4	107.5	104.4	101.4	98.8	95.7	93.0	90.4	87.9	85.3	82.6	79.9	74.8	69.5
	70,000	68.7	89.1	113.5	120.6	123.9	123.5	122.2	120.4	118.7	117.2	114.1	111.3	108.1	105.3	102.2	99.4	96.0	93.4	90.7	88.2	85.6	82.6	80.2	74.8	69.2
	80,000	76.0	98.9	116.8	122.9	125.7	124.5	123.0	121.1	119.2	117.3	114.1	111.2	108.1	105.0	102.0	99.1	95.8	93.1	90.5	87.8	85.2	82.2	79.6	74.0	68.4
	10,000	13.3	19.0	34.2	45.5	62.4	65.9	66.8	67.6	67.6	67.6	67.9	68.0	68.0	67.5	66.9	65.5	63.7	62.0	60.4	58.8	57.3	55.8	54.3	51.3	48.1
	20,000	24.9	33.9	57.7	72.3	91.5	95.6	96.4	96.9	96.8	96.6	96.4	96.1	95.5	94.2	93.0	90.8	88.5	86.2	83.8	81.8	79.6	77.4	75.2	71.0	66.5
	30,000	34.7	46.6	75.6	92.9	109.6	113.5	113.9	114.0	113.6	113.3	112.3	111.1	109.8	107.9	105.9	103.4	100.8	98.1	95.4	93.1	90.6	87.8	85.3	80.5	75.4
350	40,000	44.3	58.9	92.9	109.5	121.7	125.0	124.6	124.0	123.4	122.8	121.2	119.3	117.0	114.5	111.9	109.2	106.2	103.6	100.9	98.2	95.5	92.6	89.9	84.6	78.9
	50,000	54.0	70.5	109.1	123.8	130.6	133.0	132.1	130.8	130.0	129.1	126.8	124.0	120.9	117.8	114.6	111.8	108.8	106.0	103.2	100.5	97.7	94.5	91.7	86.2	80.4
	60,000	63.4	82.4	119.1	130.8	136.7	138.0	136.8	135.5	134.2	133.1	130.5	127.6	124.3	121.0	117.7	114.7	111.3	108.5	105.6	102.1	99.7	96.4	93.5	87.6	81.7
	70,000	71.3	92.2	125.2	135.7	140.6	141.0	139.5	137.9	136.4	134.8	132.0	129.1	125.7	122.4	119.1	115.7	112.1	109.2	106.2	103.1	100.2	97.0	93.9	88.0	81.7
	80,000	78.3	101.0	130.1	139.6	143.8	142.9	141.3	139.4	137.7	135.7	132.6	129.7	126.3	122.9	119.6	116.1	112.4	109.3	106.2	103.1	100.0	96.8	93.7	87.5	81.9
	20,000	25.3	34.2	54.4	69.8	96.3	101.5	103.0	104.0	104.0	104.2	104.6	104.8	104.9	104.0	103.1	100.8	98.5	95.9	93.5	91.3	89.2	86.8	84.6	80.1	75.4
	30,000	35.6	47.6	78.9	95.0	118.3	123.5	124.5	125.0	124.8	124.8	124.6	123.7	122.9	121.2	119.4	116.8	113.9	111.1	108.3	105.7	103.1	100.2	97.4	92.2	86.5
	40,000	45.7	59.3	98.4	116.4	133.4	138.0	138.4	138.1	137.7	137.4	136.3	134.6	132.8	130.0	127.4	124.6	121.5	118.5	115.7	112.6	109.6	106.3	103.5	97.6	91.5
400	50,000	55.5	73.1	117.7	135.4	144.6	148.3	148.0	146.9	146.2	145.7	143.8	140.9	137.9	134.3	130.9	127.7	124.5	121.6	118.7	115.6	112.4	108.7	105.6	99.3	92.9
	60,000	65.0	85.9	132.4	143.8	151.7	154.0	153.4	152.2	150.9	149.9	148.0	145.0	141.7	137.9	134.5	131.0	127.4	124.2	121.2	118.0	114.5	110.9	107.7	101.3	94.5
	70,000	72.9	94.3	138.7	150.0	156.8	158.0	156.9	155.3	153.8	152.6	150.1	147.0	143.7	139.9	136.4	132.6	128.7	125.4	122.2	118.9	115.4	111.7	108.2	101.7	94.5
	80,000	76.1	98.7	143.8	155.7	161.3	161.0	159.5	157.9	155.9	154.1	151.6	148.3	144.9	141.1	137.5	133.5	129.3	126.0	122.4	119.1	115.6	111.9	108.4	101.5	94.3
	20,000	25.5	34.8	54.3	70.7	99.3	107.0	108.8	109.8	109.8	109.8	110.2	110.6	111.0	110.8	110.8	109.4	108.0	105.4	102.7	100.3	98.1	95.7	93.5	88.8	84.0
	30,000	35.8	47.8	77.7	97.1	124.7	132.9	134.4	134.7	134.7	135.0	135.0	134.5	133.7	132.5	131.3	129.1	126.9	123.8	120.9	118.1	115.2	112.3	109.4	103.9	98.1
450	40,000	46.2	60.8	100.4	119.5	142.7	150.0	150.7	150.6	151.0	151.1	150.9	149.1	147.0	144.4	141.8	139.0	136.1	132.9	129.5	126.9	123.3	119.8	116.7	110.7	104.2
	50,000	56.4	73.4	118.7	139.4	156.6	162.9	163.1	162.6	162.3	162.3	162.0	158.7	155.[illegible]	151.6	147.8	144.0	140.1	137.1	133.8	130.5	127.0	123.4	119.8	113.3	106.7
	60,000	65.9	85.0	131.8	150.6	165.3	169.9	169.6	168.9	168.1	167.5	166.4	163.3	159.6	155.4	151.2	147.3	143.0	139.7	136.3	132.7	129.3	125.4	121.7	115.0	108.0
	70,000	73.9	95.7	145.6	159.9	171.8	175.2	174.0	173.0	171.9	171.0	169.0	165.6	161.6	157.3	153.1	148.8	144.2	140.8	137.1	130.6	129.6	125.7	122.1	115.0	107.6
	80,000	80.7	104.4	155.3	168.7	177.5	178.9	177.6	176.5	174.8	173.4	170.8	167.1	162.7	158.4	154.2	149.6	144.4	140.9	136.9	133.2	129.5	125.5	121.8	114.6	106.9
	20,000	25.6	35.0	53.7	70.1	100.2	110.8	113.1	113.5	113.5	113.7	114.1	114.6	115.1	116.1	117.0	116.6	116.2	113.4	110.6	108.5	106.1	103.6	101.2	96.7	92.0
	30,000	36.0	48.2	75.5	96.4	128.2	139.3	141.5	141.9	141.9	142.2	143.0	142.4	141.9	141.4	140.8	139.6	137.8	134.7	131.6	128.5	125.9	122.8	119.7	114.2	108.3
	40,000	46.6	61.5	97.0	118.9	149.1	159.4	161.0	161.1	161.4	162.0	163.1	161.1	159.2	156.9	154.7	151.8	148.7	145.5	142.1	139.0	135.6	132.7	129.0	122.8	116.2
500	50,000	57.0	74.2	120.5	139.1	165.1	174.3	175.0	175.0	175.4	176.0	177.5	174.2	170.8	166.3	162.1	158.0	153.7	150.4	147.1	140.5	139.8	136.0	132.7	125.8	118.9
	60,000	66.0	85.5	137.4	155.6	177.7	185.3	185.6	185.3	185.3	185.3	185.6	181.9	177.7	173.1	168.7	164.0	159.3	155.5	151.8	145.0	144.2	140.2	136.5	129.3	121.8
	70,000	74.4	95.4	151.7	168.6	186.2	191.8	191.5	191.0	190.4	190.1	188.8	184.8	180.2	175.2	170.4	165.7	160.6	156.5	152.4	146.4	144.7	140.6	136.5	129.3	121.7
	80,000	81.2	104.7	164.5	179.6	192.4	195.7	195.2	194.1	193.2	192.2	189.7	185.3	180.4	175.1	170.0	165.0	159.8	155.4	151.3	147.2	143.4	139.0	135.2	127.6	119.7
	20,000	25.7	35.3	51.5	67.7	98.9	112.1	114.8	115.0	115.0	115.0	115.4	116.1	116.9	118.9	120.9	121.6	122.3	119.5	116.8	114.6	112.4	109.7	107.5	103.0	98.4
	30,000	36.1	48.3	72.6	94.1	130.4	144.8	147.6	147.7	148.0	148.6	150.0	149.4	149.1	149.4	150.0	149.2	148.4	145.1	141.8	139.0	136.0	132.7	129.9	124.4	118.6
	40,000	46.9	62.0	93.2	116.1	153.1	167.2	169.3	170.1	170.7	171.3	174.5	172.2	170.2	168.4	166.2	163.8	160.7	157.4	154.0	153.1	147.7	143.9	140.5	134.4	127.7
550	50,000	57.5	74.0	110.3	134.1	170.2	182.6	184.1	185.0	185.9	187.3	191.1	187.6	184.0	179.5	175.0	170.1	165.2	162.0	158.5	151.7	151.2	147.5	143.9	137.2	130.4
	60,000	66.7	86.0	131.7	155.0	185.6	196.3	197.2	197.6	198.3	200.0	202.0	197.9	192.4	187.4	182.4	177.3	171.8	168.1	164.1	157.0	156.2	152.3	148.6	141.2	133.7
	70,000	74.7	96.3	154.1	174.3	198.7	206.8	207.5	207.5	207.5	207.9	207.5	202.7	197.7	192.2	186.7	181.1	175.5	171.0	166.9	159.3	158.7	154.4	150.2	142.7	135.0
	80,000	81.5	105.2	168.5	189.8	207.2	212.9	212.8	212.4	212.1	211.7	209.3	204.1	164.7	192.5	186.6	181.1	175.0	170.5	165.7	161.6	157.4	152.9	148.7	140.8	132.8
	Stroke	0	0.2	1	2	5	10	15	21	26	31	41	51	62	72	82	92	103	113	123	133	143	154	164	184	205

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TABLE 11. V11-1 (DRY) Catapult Iwith metering rod), Lower Boundary, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) — NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND ACCUMULATOR PRESSURE

Pressure (PSI)	Stroke / Weight (LBS)	0	0.2	1	2	5	10	16	21	26	31	41	51	62	72	82	92	103	113	123	133	143	154	164	184	205
	10,000	9.2	13.1	29.2	36.6	35.0	34.7	34.7	34.6	34.3	34.1	33.8	32.9	32.0	31.4	30.8	30.3	29.8	29.2	28.5	27.8	27.1	26.4	25.7	[illegible]	[illegible]
150	20,000	15.7	21.8	39.5	46.7	45.1	44.8	44.5	44.3	43.9	43.4	42.8	41.7	40.5	39.7	38.8	38.3	37.6	36.8	35.9	35.1	34.2	33.3	32.4	[illegible]	[illegible]
	30,000	21.9	29.5	47.6	51.7	50.5	50.3	49.6	49.2	48.7	48.2	47.0	45.8	44.5	43.6	42.6	41.9	41.1	40.2	39.3	38.4	37.5	36.5	35.6	[illegible]	[illegible]
	40,000	27.8	36.8	52.7	54.8	54.1	53.9	52.8	52.1	51.6	51.0	49.5	48.2	46.8	45.8	44.6	43.9	43.0	42.1	41.1	40.2	39.2	38.3	37.3	[illegible]	[illegible]
	10,000	10.5	14.4	31.3	41.7	43.7	44.3	44.5	44.5	44.3	44.0	43.7	42.9	42.0	41.4	40.9	40.3	39.7	38.8	37.9	37.1	36.2	35.3	34.4	32.8	[illegible]
	20,000	18.8	25.3	44.3	57.2	59.5	60.0	59.9	59.8	59.4	59.0	58.3	57.0	55.8	54.9	54.1	53.3	52.3	51.2	50.1	49.0	48.0	46.7	45.6	43.4	[illegible]
200	30,000	26.4	34.9	57.2	65.7	67.7	68.0	67.5	67.1	66.6	66.0	64.9	63.5	62.0	60.9	59.8	58.9	57.7	56.6	55.3	54.1	53.0	51.6	50.5	48.0	[illegible]
	40,000	33.8	44.0	66.3	69.8	71.2	71.4	70.4	69.7	69.1	68.5	66.8	65.4	63.7	62.4	61.1	60.1	59.0	57.8	56.5	55.3	54.1	52.9	51.6	[illegible]	[illegible]
	50,000	39.8	51.3	70.6	72.9	73.9	73.9	72.4	71.5	70.8	70.1	67.9	66.4	64.7	63.3	61.7	60.7	59.5	58.2	57.0	55.8	54.6	53.3	52.1	[illegible]	[illegible]
	10,000	11.6	15.6	32.0	41.5	45.7	50.1	50.7	51.0	50.8	50.6	50.5	49.8	49.1	48.8	48.4	47.7	47.0	46.0	45.0	44.1	43.2	42.2	41.3	[illegible]	[illegible]
	20,000	20.9	27.6	48.0	60.9	68.9	70.4	70.8	70.9	70.6	70.2	69.7	68.7	67.5	66.8	66.0	65.2	64.0	62.7	61.5	60.2	59.0	57.6	56.4	53.8	[illegible]
	30,000	29.6	38.4	57.3	72.3	79.2	80.5	80.3	80.2	79.7	79.3	78.2	76.9	75.5	74.4	73.3	72.2	71.0	69.6	68.2	66.8	65.5	63.9	62.6	59.7	[illegible]
250	40,000	37.6	48.4	69.2	80.1	84.9	85.9	85.1	84.5	84.0	83.4	81.9	80.5	78.9	77.5	76.0	74.7	73.4	72.0	70.6	69.1	67.7	66.1	64.6	61.7	[illegible]
	50,000	45.0	57.2	76.1	87.2	90.0	90.4	89.0	88.2	87.5	86.9	84.8	83.1	81.3	79.5	77.9	76.6	75.1	73.8	72.3	70.8	69.3	67.7	66.2	63.2	60.1
	60,000	52.5	66.1	82.0	91.1	93.4	93.5	92.3	91.3	90.4	89.5	87.4	85.5	83.5	81.7	79.8	78.5	76.9	75.4	73.9	72.4	70.8	69.2	67.6	64.4	61.2
	70,000	59.7	74.8	86.3	93.8	95.6	95.3	94.4	93.3	92.0	91.0	88.6	86.8	84.6	82.7	80.7	79.3	77.8	76.2	74.7	73.1	71.4	69.7	68.2	64.9	61.4
	10,000	11.9	16.1	26.9	38.8	52.6	55.3	56.4	57.0	56.9	56.8	56.9	56.5	56.2	56.1	56.0	55.1	54.3	53.3	52.2	51.2	50.3	49.3	48.2	46.3	44.2
	20,000	22.1	29.0	41.2	60.0	75.6	78.6	79.5	80.0	79.7	79.6	79.3	78.6	77.8	77.2	76.8	75.6	74.5	73.1	71.6	70.4	68.9	67.5	66.1	63.4	[illegible]
	30,000	31.4	40.6	59.1	76.5	89.8	92.4	92.8	93.0	92.7	92.3	91.5	90.5	89.3	88.3	87.3	86.2	84.7	83.1	81.4	80.0	78.3	76.7	75.2	71.9	68.7
300	40,000	40.2	51.3	76.2	89.8	99.0	100.9	100.5	100.3	99.9	99.4	98.2	96.8	95.4	93.8	92.4	91.0	89.5	87.7	86.2	84.4	82.8	81.0	79.4	75.9	72.4
	50,000	48.2	61.1	87.4	100.6	105.3	106.4	105.4	104.7	104.2	103.6	101.8	100.2	98.4	96.4	94.4	93.0	91.4	89.8	88.2	86.4	84.6	82.6	81.0	77.4	73.6
	60,000	56.5	71.2	94.9	105.7	109.7	110.4	109.4	108.5	107.7	106.8	105.0	103.1	101.1	99.0	97.0	95.4	93.5	91.9	90.0	88.4	86.5	84.5	82.6	79.0	75.1
	70,000	63.9	80.0	101.8	109.6	112.8	113.1	112.2	111.1	109.9	108.8	106.6	104.7	102.4	100.4	98.1	96.5	94.4	92.7	91.0	89.2	87.3	85.3	83.4	79.5	75.3
	80,000	70.7	88.1	103.2	111.8	114.5	114.4	113.5	112.1	110.8	109.3	107.1	104.8	102.5	100.3	98.2	96.4	94.3	92.4	90.8	88.7	86.8	84.8	82.9	78.8	74.6
	10,000	12.4	16.8	24.4	32.9	54.1	58.1	59.8	60.7	60.7	60.8	61.0	61.0	61.0	61.3	61.5	60.7	59.8	58.7	57.7	56.7	55.7	54.6	53.7	51.7	49.0
	20,000	23.2	30.3	41.5	57.0	81.2	85.8	87.5	88.5	88.5	88.3	88.5	88.2	87.8	87.7	87.5	86.4	85.1	83.5	82.0	80.6	79.3	77.7	76.2	73.3	70.2
	30,000	32.3	41.9	56.6	77.1	98.0	102.4	103.4	104.1	104.0	104.8	103.5	102.8	102.1	101.4	100.4	99.1	97.6	95.8	94.1	92.4	90.7	88.9	87.2	83.8	80.3
350	40,000	41.2	52.8	74.0	95.5	110.5	113.7	114.0	114.0	113.8	113.6	113.0	111.7	110.6	109.2	107.6	106.2	104.4	102.6	100.9	99.1	97.1	95.1	93.3	89.4	85.4
	50,000	50.2	63.7	91.7	112.0	119.4	121.3	120.6	120.3	119.9	119.6	118.6	116.9	115.3	113.1	110.8	109.4	107.5	105.8	104.0	102.1	100.0	97.7	95.8	91.8	87.6
	60,000	59.0	74.2	102.3	118.2	124.5	125.8	125.0	124.5	123.8	123.2	121.7	120.0	118.0	115.9	113.5	111.8	109.7	107.7	106.0	103.9	101.7	99.6	97.4	93.1	88.8
	70,000	66.3	83.4	109.1	122.4	127.8	128.6	127.6	126.6	125.7	124.8	123.1	121.1	119.0	116.8	114.4	112.5	110.1	108.2	106.2	104.0	102.1	99.7	97.5	93.2	88.7
	80,000	72.8	91.6	114.4	126.3	130.6	131.0	129.9	128.8	127.5	126.2	124.0	122.1	119.7	117.3	115.1	112.9	110.5	108.3	106.4	104.2	102.0	99.6	97.4	92.9	88.1
	20,000	23.5	31.0	36.3	49.6	83.1	89.6	92.0	93.5	93.7	93.8	94.4	94.5	94.9	95.1	95.4	94.2	92.8	91.3	89.7	88.3	86.9	85.3	83.9	81.0	77.8
	30,000	33.1	42.9	59.4	74.7	104.2	110.1	112.1	113.3	113.3	113.5	113.9	113.7	113.5	113.1	112.6	111.0	109.4	107.7	105.8	104.1	102.3	100.4	98.5	95.0	91.1
	40,000	42.5	54.7	76.8	98.9	120.0	124.6	125.7	126.3	126.5	126.5	126.5	125.8	125.0	123.6	122.3	120.7	118.9	117.1	115.2	113.2	111.1	108.9	106.8	102.7	98.4
400	50,000	51.6	66.2	101.4	122.8	133.2	136.0	136.1	136.1	136.1	136.1	135.8	134.4	133.0	130.6	128.4	126.5	124.6	122.9	121.0	118.8	116.4	114.0	111.5	106.9	102.4
	60,000	60.5	76.4	118.2	130.0	138.6	140.9	140.7	140.4	139.9	139.4	138.9	137.2	135.5	133.1	130.8	128.6	126.5	124.5	122.6	120.0	117.8	115.1	112.9	108.2	103.3
	70,000	67.8	85.6	123.6	135.2	142.7	144.4	143.5	142.9	142.1	141.4	140.2	138.4	136.5	134.0	131.8	129.4	126.8	124.6	122.6	120.1	117.9	115.2	112.7	108.0	102.8
	80,000	70.8	89.8	125.0	140.1	146.3	147.5	146.4	145.4	144.1	142.9	141.4	139.4	137.2	134.7	132.5	129.7	127.0	124.7	122.5	120.0	117.7	115.0	112.6	107.5	102.3
	20,000	23.7	31.4	36.6	48.6	83.0	92.0	94.6	95.7	95.9	96.1	96.8	97.6	98.6	99.7	101.0	100.7	100.2	98.5	97.0	95.5	94.2	92.6	91.3	88.3	85.2
	30,000	33.3	43.4	56.7	73.9	108.0	117.4	119.8	120.9	121.2	121.6	122.6	122.8	122.8	123.0	123.5	122.6	121.5	119.7	117.9	116.0	114.2	112.2	110.3	106.7	102.8
450	40,000	43.0	55.4	76.9	96.8	100.3	132.6	135.2	136.1	136.6	137.1	138.1	137.6	136.8	135.8	134.7	133.2	131.5	129.8	127.5	125.5	123.5	121.0	119.0	115.0	110.7
	50,000	52.5	66.9	94.4	118.5	138.7	146.0	146.6	147.0	147.8	148.6	149.6	148.0	146.0	143.6	141.2	138.8	136.5	134.6	132.7	130.6	128.2	125.6	123.2	118.7	114.2
	60,000	61.3	77.7	107.2	131.3	148.8	154.3	154.6	154.9	155.2	155.4	156.0	153.8	151.6	148.9	146.1	143.6	140.9	139.0	136.8	134.1	131.8	129.1	126.7	122.0	117.1
	70,000	68.7	87.1	127.1	142.7	156.4	160.3	160.2	160.1	159.9	159.8	159.3	157.0	154.3	151.5	148.7	145.9	142.8	140.6	138.3	135.8	133.3	130.2	127.7	122.7	117.4
	80,000	75.1	95.2	137.5	151.7	161.5	163.8	163.1	162.7	162.1	161.6	160.5	157.7	154.8	151.8	149.0	145.9	142.5	140.0	137.5	134.9	132.4	129.6	126.8	121.8	116.2
	20,000	23.8	31.7	35.6	47.0	82.5	94.4	97.1	97.9	98.0	98.3	99.3	100.4	102.0	104.4	106.6	107.4	107.9	106.3	104.5	103.2	101.8	100.2	98.8	96.1	93.2
	30,000	33.5	43.8	51.1	69.6	107.7	120.9	123.3	124.3	124.8	125.5	127.0	127.4	128.0	129.2	130.4	130.2	129.8	127.9	126.2	124.3	122.5	120.7	118.7	115.3	111.5
	40,000	43.4	56.0	68.5	91.7	128.4	141.4	143.3	144.6	145.7	146.5	149.0	148.2	147.5	146.7	146.2	144.8	143.3	141.4	139.4	137.5	135.3	132.9	131.0	126.9	122.6
500	50,000	53.0	67.8	94.5	111.3	142.8	154.8	156.9	157.2	158.7	160.1	163.0	161.0	158.7	155.8	153.3	150.7	148.1	146.1	144.4	142.1	139.8	137.3	134.9	130.3	125.8
	60,000	61.4	77.9	110.5	128.9	155.5	164.7	165.7	166.5	167.7	168.9	170.4	168.0	165.3	162.3	159.3	156.3	153.4	151.0	148.9	146.5	143.8	141.1	138.7	133.9	128.9
	70,000	69.2	87.9	127.7	146.3	167.2	173.5	174.1	174.8	175.4	176.0	176.6	173.5	170.5	167.1	163.7	160.6	157.2	154.4	152.0	149.5	146.7	144.0	141.2	136.3	131.1
	80,000	75.5	96.2	144.0	161.3	175.9	178.9	179.4	179.7	179.7	180.0	179.1	176.0	172.2	168.5	164.7	161.6	157.9	155.1	152.3	149.5	146.7	143.6	141.2	135.9	130.3
	20,000	23.9	32.3	35.9	44.5	80.6	95.6	98.2	98.6	98.8	99.1	100.3	102.2	104.5	107.9	111.4	113.1	115.0	113.3	111.6	110.2	108.9	107.5	106.1	103.4	100.5
	30,000	33.6	43.9	47.2	63.2	104.7	121.7	124.2	125.2	126.0	126.7	129.0	130.0	131.2	133.2	135.2	135.8	136.4	134.4	132.6	130.9	129.4	127.4	125.6	122.3	118.9
	40,000	43.6	56.3	61.8	84.9	130.2	148.6	151.1	152.3	154.1	155.8	159.4	158.5	157.9	157.9	157.6	156.7	155.4	153.6	151.5	149.4	147.4	145.1	143.0	139.2	134.8
550	50,000	53.5	68.4	77.0	100.2	144.6	162.4	164.1	166.0	168.5	170.9	175.6	173.1	170.3	167.6	164.8	162.0	158.7	156.8	155.0	152.8	150.6	147.9	145.8	141.4	137.2
	60,000	62.0	79.0	97.5	123.4	160.7	174.5	176.1	178.0	179.9	182.2	185.1	182.2	178.9	175.4	172.1	168.9	165.4	163.1	160.9	158.3	156.0	153.2	150.9	146.1	141.3
	70,000	69.6	88.2	125.8	145.8	174.6	183.8	185.2	186.4	188.1	189.7	191.4	187.7	183.7	180.1	176.1	172.4	168.8	166.1	163.5	160.8	158.2	155.3	152.6	147.6	142.8
	80,000	75.8	96.9	143.5	167.2	186.9	191.3	192.5	193.7	192.2	162.3	195.6	191.6	187.1	182.8	178.4	174.7	170.6	167.6	164.6	161.9	159.2	155.9	153.2	147.8	142.5
	Stroke	0	0.2	1	2	5	10	15	21	26	31	41	51	62	72	82	92	103	113	123	133	143	154	164	184	205

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TABLE 12. C11-1 (WET) Catapult (with metering rod), Upper Boundary, vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) — NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND ACCUMULATOR PRESSURE

Pressure (PSI)	Stroke / Weight (LBS)	0	0.2	1	2	5	10	15	21	26	31	41	51	62	72	82	92	103	113	123	133	143	154	164	184	205
	10,000	8.6	15.1	31.9	37.2	40.9	40.8	40.0	39.4	38.8	38.3	37.4	36.5	35.6	35.0	34.3	33.9	33.4	31.9	30.3	29.5	28.9	28.0	27.3	25.7	24.1
150.	20,000	17.9	29.3	46.6	52.2	56.3	58.3	55.4	54.6	54.0	53.3	52.3	51.3	50.1	49.1	48.1	47.2	46.3	44.1	42.0	40.9	39.8	38.6	37.5	35.5	33.3
	30,000	26.5	41.5	54.9	59.2	62.8	62.9	62.0	61.3	60.7	60.2	59.2	58.2	57.1	55.8	54.5	53.3	51.8	49.5	47.1	45.8	44.5	43.0	41.8	39.6	37.3
	40,000	34.9	53.2	61.4	63.2	65.3	66.0	65.4	64.8	64.4	63.9	63.1	62.2	61.3	59.7	58.1	56.5	54.6	52.1	49.7	48.2	46.8	45.2	43.8	41.6	39.2
	10,000	10.1	16.3	37.4	43.6	48.9	49.5	48.7	48.2	47.5	46.8	45.6	44.6	43.7	43.0	42.3	41.7	41.0	39.3	37.6	36.6	35.8	34.8	33.9	32.0	30.0
	20,000	21.2	32.6	57.6	63.8	70.2	71.0	70.1	69.4	68.5	67.7	66.2	65.1	63.8	62.5	61.3	60.2	58.9	56.5	54.0	52.6	51.2	49.7	48.3	45.7	43.0
200	30,000	31.0	46.1	67.2	72.7	78.5	79.4	78.6	77.8	77.1	76.3	74.8	73.9	72.6	71.0	69.3	67.6	65.9	63.1	60.4	58.7	57.1	55.2	53.6	50.8	47.9
	40,000	40.6	59.3	73.3	78.2	82.9	83.5	82.9	82.4	81.7	81.1	79.9	78.8	77.8	75.8	73.8	71.7	69.4	66.5	63.6	61.8	59.9	57.9	56.1	53.2	50.2
	50,000	50.1	71.5	81.2	82.6	86.4	86.9	86.6	86.1	85.5	85.1	84.2	83.3	82.3	80.0	77.7	75.2	72.3	69.3	66.3	64.2	62.3	60.0	58.0	55.1	52.1
	10,000	11.2	17.2	40.5	48.3	55.4	57.0	56.4	55.9	55.2	54.4	52.7	51.9	51.0	50.3	49.5	48.7	47.9	46.1	44.3	43.2	42.2	41.1	40.0	37.9	35.7
	20,000	23.1	34.5	63.2	72.1	81.1	83.0	82.3	81.6	80.7	79.8	77.7	76.6	75.3	74.0	72.6	71.3	69.6	67.0	64.4	62.7	61.1	59.4	57.7	54.5	51.5
	30,000	34.0	49.5	76.5	84.0	92.6	94.4	93.8	93.0	92.1	91.2	89.3	88.1	86.8	85.0	83.0	81.1	78.9	75.9	72.9	71.0	69.1	66.8	64.8	61.4	57.8
250	40,000	43.5	62.7	85.1	91.8	99.4	100.9	100.4	99.8	98.9	98.0	96.6	95.4	94.0	91.8	89.4	87.0	84.3	80.9	77.7	75.5	73.3	70.8	68.6	65.1	61.2
	50,000	52.8	74.9	92.7	97.6	103.9	104.9	104.5	103.9	103.2	102.5	101.4	100.4	99.0	96.4	93.5	90.7	87.4	84.1	80.6	78.1	75.8	73.0	70.5	66.9	63.0
	60,000	62.0	79.0	96.8	101.1	107.3	108.6	108.3	107.0	107.2	106.5	105.1	103.4	101.6	98.8	96.2	93.7	90.6	87.5	84.2	81.8	79.4	76.7	74.3	70.3	66.3
	70,000	71.0	82.9	99.3	103.3	109.2	110.8	110.7	110.1	109.6	109.2	107.3	105.2	102.8	100.2	97.7	95.4	92.6	89.8	86.8	84.3	82.0	79.5	77.0	73.0	68.7
	10,000	11.9	17.9	41.1	52.0	61.2	63.9	63.6	63.3	62.5	61.7	59.5	58.9	58.1	57.2	56.5	55.6	54.5	52.7	50.8	49.7	48.6	47.2	46.1	43.7	41.2
	20,000	24.8	36.2	66.3	78.5	90.5	93.8	93.4	92.9	91.9	90.8	88.1	87.2	86.0	84.5	83.0	81.3	79.5	76.9	74.2	72.2	70.4	68.5	66.6	63.0	59.4
	30,000	35.5	51.3	82.5	93.3	105.1	108.3	107.9	107.3	106.2	105.0	102.8	101.5	100.2	98.1	96.0	93.8	91.2	88.1	85.0	82.8	80.5	77.9	75.6	71.6	67.4
300	40,000	46.2	66.1	94.3	103.4	114.3	116.9	116.5	115.8	114.7	113.8	111.9	110.6	109.1	106.5	103.7	101.1	98.0	94.6	91.1	88.5	85.9	83.0	80.4	76.1	71.6
	50,000	55.0	77.9	103.2	111.6	121.1	123.0	122.7	121.9	121.0	120.0	118.8	117.5	116.9	112.7	109.4	106.3	102.6	98.9	95.2	92.3	89.5	86.3	83.4	78.9	74.1
	60,000	64.0	90.4	110.7	117.1	126.0	127.9	127.4	126.7	125.9	125.1	123.4	121.4	119.3	116.1	113.0	110.0	106.6	103.0	99.3	96.3	93.4	90.3	87.2	82.6	77.4
	70,000	73.1	94.1	113.7	120.5	128.6	130.6	130.1	129.3	128.7	128.0	126.0	123.5	120.7	117.6	114.7	112.0	108.8	105.3	101.8	98.9	96.0	92.8	89.9	84.7	79.5
	80,000	22.4	99.7	118.5	123.9	131.0	133.0	132.4	131.7	131.3	130.8	128.3	125.1	121.6	118.9	116.2	113.6	111.0	107.4	104.0	101.1	98.1	95.1	92.2	86.9	80.0
	10,000	12.2	18.5	43.3	54.4	65.9	69.8	70.0	69.8	69.0	68.2	65.4	65.0	64.3	63.6	62.9	61.7	60.4	58.7	56.9	55.7	54.4	52.9	51.7	49.1	46.4
	20,000	25.7	37.2	68.9	83.0	97.9	102.7	102.9	102.5	101.5	100.3	97.1	96.2	95.1	93.8	92.3	90.3	88.2	85.5	82.8	80.8	78.8	76.6	74.6	70.7	66.7
	30,000	36.6	52.7	87.2	101.4	117.1	121.8	121.8	121.2	120.0	118.7	115.7	114.5	113.2	111.0	108.8	106.3	103.4	100.3	97.1	94.6	92.0	89.2	86.6	81.9	77.1
350	40,000	47.2	67.4	99.5	114.0	129.2	132.9	132.8	132.0	130.7	129.5	127.3	125.8	124.1	121.4	118.4	115.4	112.1	108.4	104.8	101.8	98.8	95.5	92.5	87.6	82.3
	50,000	56.4	78.9	111.2	123.8	136.9	139.9	139.3	138.5	137.4	136.3	134.7	133.2	131.1	127.6	124.0	120.7	116.7	112.9	108.9	105.6	102.5	98.8	95.5	90.1	84.5
	60,000	65.2	91.4	119.4	130.6	142.5	145.0	144.5	143.6	142.7	151.8	139.7	137.4	135.0	131.4	127.9	124.7	120.9	116.7	112.8	109.4	105.9	102.3	98.9	93.1	87.1
	70,000	74.7	102.8	126.1	135.7	146.1	148.3	147.5	146.7	145.9	145.0	142.7	139.8	136.7	133.2	129.9	126.9	123.2	119.0	115.0	111.5	108.0	104.4	100.9	94.8	88.6
	80,000	84.2	113.9	133.4	140.3	149.1	150.8	150.0	149.1	148.4	147.9	145.0	141.5	137.8	134.7	131.4	128.6	125.1	120.8	116.6	113.2	109.7	106.0	102.5	96.0	89.6
	10,000	12.5	19.3	42.8	55.2	68.8	74.2	74.8	74.9	74.1	73.2	70.0	69.7	69.4	68.8	68.1	66.7	65.2	63.6	62.1	60.7	59.3	57.7	56.3	53.7	50.8
	20,000	26.4	38.3	69.9	85.8	104.1	110.8	111.4	111.3	110.1	108.9	105.1	104.3	103.7	102.2	100.7	98.5	96.1	93.7	91.1	88.9	86.7	84.3	82.1	77.9	73.6
	30,000	37.6	54.1	91.7	107.0	126.6	133.0	133.4	133.1	131.6	130.2	126.8	125.7	124.4	122.0	119.8	117.0	113.9	110.8	107.6	104.7	102.1	99.0	96.2	91.0	85.7
400	40,000	48.4	69.0	106.3	121.7	140.3	145.6	145.7	145.0	143.6	142.2	139.6	137.9	136.3	133.2	129.9	126.9	123.2	119.7	116.2	112.9	109.6	105.9	102.6	97.0	91.1
	50,000	57.9	82.3	118.1	133.8	151.1	155.0	154.7	153.7	152.2	150.8	149.3	147.3	146.0	141.1	137.1	133.6	129.5	125.6	121.6	117.9	114.4	110.4	106.6	100.4	93.9
	60,000	73.2	100.1	128.1	142.5	157.5	160.9	160.0	159.1	157.8	156.8	154.7	151.9	149.1	145.2	141.4	137.8	133.9	129.5	125.2	121.4	117.5	113.3	109.5	102.9	95.9
	70,000	76.0	105.1	137.9	150.1	163.0	165.5	164.4	163.4	162.4	161.3	158.7	155.6	152.1	148.5	144.8	115.2	137.1	132.4	127.5	123.6	119.7	115.4	111.2	104.2	97.1
	80,000	85.4	115.6	146.2	157.0	167.1	169.1	167.4	166.3	165.6	165.0	161.8	158.1	153.8	150.4	147.0	143.3	139.4	134.4	129.1	125.2	121.0	116.6	112.4	105.0	97.3
	20,000	26.8	39.0	69.2	88.5	110.0	117.6	118.7	118.8	117.8	116.8	112.7	111.9	111.0	109.6	108.4	106.2	103.8	101.2	98.6	96.3	94.1	91.7	89.3	85.3	81.2
	30,000	38.0	55.1	92.6	112.1	135.1	142.7	143.5	143.2	142.2	141.0	137.4	136.3	134.9	133.0	130.9	127.8	124.6	121.3	117.9	114.9	112.0	108.9	105.8	100.5	95.0
	40,000	49.0	70.0	111.6	129.1	151.1	157.3	157.9	157.2	156.2	154.9	152.3	151.0	149.5	146.6	143.5	139.9	136.2	132.3	128.1	124.7	121.4	117.7	114.0	108.1	101.5
450	50,000	58.9	83.3	125.5	143.2	163.5	168.3	168.2	167.2	165.9	164.8	163.7	162.3	160.4	156.6	152.5	148.7	144.1	139.7	135.1	131.2	127.4	123.2	119.1	112.2	104.7
	60,000	67.7	94.9	137.0	154.1	171.4	175.4	175.1	174.0	172.9	172.0	170.6	168.4	166.1	162.1	158.2	153.9	149.2	144.1	139.1	135.1	130.9	126.2	122.0	114.6	106.9
	70,000	76.9	106.2	150.0	163.8	177.9	181.0	180.0	179.0	178.4	177.8	175.8	173.2	169.9	165.9	162.2	157.8	153.0	147.5	142.0	137.4	133.1	128.0	123.7	115.9	108.0
	80,000	86.3	117.0	158.9	172.9	183.8	185.9	184.6	183.6	183.2	182.6	180.3	177.0	173.4	169.3	165.5	161.1	156.5	150.3	144.2	139.5	134.8	129.6	124.9	117.0	108.6
	20,000	27.0	39.2	69.6	90.6	115.1	124.0	125.6	125.9	125.2	124.3	119.8	119.0	117.8	117.0	116.1	113.8	111.2	108.6	105.8	103.7	101.4	98.8	96.7	92.6	88.6
	30,000	38.4	55.6	94.9	116.5	142.9	151.5	152.8	152.8	152.1	151.2	147.4	146.3	145.2	143.4	141.6	138.5	135.1	131.5	127.9	124.8	121.7	118.6	115.5	110.1	104.4
	40,000	49.5	70.8	115.0	136.1	161.8	169.2	170.0	169.7	168.9	168.0	165.7	164.6	163.3	160.7	157.9	153.9	149.8	145.5	141.0	137.3	133.9	129.8	126.1	119.6	104.0
500	50,000	59.5	84.1	131.1	152.3	176.9	181.2	181.4	180.7	179.8	179.0	178.7	177.5	176.3	172.4	168.8	164.3	159.3	154.2	149.3	145.1	140.9	136.3	132.4	124.5	116.3
	60,000	68.6	95.9	144.6	164.5	184.5	189.2	189.1	188.1	187.4	186.8	186.2	184.7	182.8	178.8	174.8	170.1	164.6	159.0	153.2	148.8	144.2	139.1	134.7	125.7	118.2
	70,000	77.9	107.0	158.7	177.4	193.3	196.8	196.3	195.3	194.3	194.6	193.7	191.4	189.2	184.7	180.6	175.5	170.1	163.5	157.1	152.0	147.2	141.6	136.5	128.2	119.5
	80,000	87.3	118.1	172.3	188.4	200.0	202.1	201.2	200.1	200.1	200.1	198.8	195.9	193.0	188.8	184.2	179.1	173.3	166.2	158.7	153.6	148.1	142.3	136.9	128.4	119.6
	20,000	27.2	39.7	71.1	91.3	118.9	128.8	130.9	131.5	131.0	130.5	125.8	124.6	123.4	122.8	122.3	120.1	117.6	114.9	112.2	109.9	107.7	105.2	102.9	99.3	95.5
	30,000	38.6	55.9	96.3	119.7	149.7	159.8	161.6	161.9	161.4	160.8	157.2	156.1	154.9	153.5	152.1	148.8	145.1	141.5	137.6	134.6	131.6	128.2	125.2	119.7	114.1
	40,000	49.9	71.0	118.3	141.3	170.9	179.3	180.8	180.5	179.9	179.6	177.4	176.8	176.0	173.3	170.8	166.8	162.4	157.5	152.9	149.2	145.5	141.5	137.5	130.4	123.0
550	50,000	60.3	84.6	137.2	159.1	185.9	192.4	193.9	192.9	191.6	191.3	191.6	191.3	190.8	187.2	183.6	178.7	173.3	167.8	162.3	158.0	153.8	148.8	144.6	135.8	126.9
	60,000	69.1	95.8	153.1	175.2	197.6	202.8	203.4	202.4	202.3	202.0	202.4	201.3	200.4	196.4	192.3	186.9	181.2	174.4	168.0	163.3	158.2	152.9	147.9	139.1	129.8
	70,000	78.3	107.5	170.9	190.3	207.6	211.4	211.2	210.5	210.5	210.5	210.5	209.4	207.8	203.2	198.7	193.2	186.6	179.3	171.7	166.1	160.9	154.8	149.2	140.2	131.1
	80,000	88.2	118.5	185.3	203.1	215.1	217.3	217.1	216.0	216.3	216.7	216.7	214.9	212.8	207.9	202.9	197.0	190.2	181.8	173.3	167.3	161.4	154.8	148.8	140.0	130.7
	Stroke	0	0.2	1	2	5	10	15	21	26	31	41	51	62	72	82	92	103	113	123	133	143	154	164	184	205

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TABLE13. C11-1 (WET) Catapult (with metering rod), Mean, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) — NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND ACCUMULATOR PRESSURE

Pressure (PSI)	Stroke / Weight (LBS)	0	0.2	1	2	5	10	15	21	26	31	41	51	62	72	82	92	103	113	123	133	143	154	164	184	205
	10,000	8.0	13.6	28.7	33.4	35.9	35.7	35.1	34.4	34.0	33.6	32.9	32.8	32.7	32.4	32.0	31.7	31.3	30.7	30.2	29.7	29.2	28.6	28.1	27.3	26.4
150	20,000	16.7	25.9	42.4	47.6	50.9	50.8	50.0	49.1	48.6	48.1	47.2	47.1	46.8	46.3	45.7	45.2	44.5	43.7	42.9	42.2	41.5	40.7	40.1	38.9	37.5
	30,000	24.8	36.6	49.2	53.4	56.8	56.8	56.0	55.2	54.7	54.3	53.3	53.1	52.8	52.0	51.2	50.6	49.8	49.0	48.0	47.2	46.6	45.7	44.9	43.5	42.0
	40,000	32.6	46.1	54.4	56.5	59.8	59.9	59.3	58.6	58.2	57.6	56.8	56.5	56.1	55.1	54.2	53.4	52.6	51.6	50.7	49.9	49.2	48.4	47.7	46.1	44.3
	10,000	9.4	15.1	33.6	39.6	43.5	44.0	43.4	42.7	42.2	41.7	40.8	40.8	40.7	40.3	40.0	39.6	39.1	38.5	37.9	37.3	36.7	36.0	35.4	34.4	33.3
	20,000	19.8	29.2	51.8	58.0	63.4	64.0	63.3	62.4	61.7	61.1	59.9	59.7	59.5	58.9	58.2	57.6	56.8	55.8	54.9	54.0	53.2	52.3	51.4	49.8	48.2
200	30,000	29.0	41.2	59.9	65.6	71.2	71.9	71.2	70.4	69.6	69.0	67.9	67.5	67.2	66.3	65.4	64.7	63.7	62.6	61.4	60.5	59.6	58.6	57.6	55.8	53.7
	40,000	37.9	52.4	64.5	70.0	75.4	76.0	75.4	74.7	74.2	73.6	72.5	72.2	71.5	70.4	69.4	68.4	67.3	66.1	64.9	63.8	62.9	61.8	60.9	58.8	56.6
	50,000	46.8	63.0	69.7	73.2	78.3	78.9	78.4	77.7	77.2	76.8	75.9	75.2	74.6	73.2	72.0	70.9	69.7	68.4	67.0	66.1	65.0	64.0	63.0	60.8	58.4
	10,000	10.5	16.1	36.6	43.9	49.7	50.9	50.6	50.0	49.4	48.8	47.6	47.6	47.6	47.3	46.9	46.5	46.0	45.3	44.6	44.0	43.3	42.6	42.0	40.8	39.6
	20,000	21.6	31.1	56.9	65.4	73.2	74.9	74.4	73.6	72.8	72.0	70.6	70.4	70.2	69.6	68.9	68.1	67.3	66.2	65.2	64.2	63.3	62.1	61.2	59.3	57.4
	30,000	31.8	44.4	68.2	76.2	84.4	86.0	85.5	84.6	83.9	83.1	81.7	81.4	81.0	80.0	79.1	78.1	77.0	75.7	74.4	73.2	72.2	70.9	69.8	67.5	65.1
250	40,000	40.7	55.8	75.2	82.4	90.3	91.9	91.3	90.4	89.8	89.2	87.8	87.3	86.7	85.5	84.2	83.1	81.9	80.3	78.9	77.6	76.5	75.1	73.9	71.4	68.6
	50,000	49.3	66.6	81.2	87.3	94.7	95.9	95.5	94.7	94.1	93.6	92.5	91.6	90.9	89.4	87.9	86.6	85.1	83.5	81.9	80.6	79.4	78.0	76.7	73.9	70.8
	60,000	57.9	76.5	86.2	90.4	97.3	98.9	98.5	97.8	97.3	96.8	95.7	94.6	93.5	92.0	90.5	89.1	87.6	85.9	84.3	82.9	81.6	79.9	78.6	75.7	72.7
	70,000	66.4	80.7	89.5	92.8	99.2	100.5	100.4	100.2	100.0	99.5	98.1	96.9	95.6	94.0	92.5	91.1	89.4	87.8	86.1	84.6	83.2	81.5	80.0	77.0	74.0
	10,000	11.1	16.7	38.3	46.9	54.6	56.9	56.8	56.4	55.7	55.0	53.6	53.7	53.8	53.5	53.2	52.7	52.2	51.5	50.8	50.1	49.4	48.7	48.0	46.7	45.4
	20,000	23.2	32.7	61.8	71.4	81.8	84.8	84.7	84.1	83.2	82.3	80.4	80.4	80.4	79.7	79.1	78.2	77.3	76.1	75.0	73.9	72.9	71.7	70.6	68.5	66.3
	30,000	33.2	46.0	75.2	84.9	96.0	98.9	98.6	97.9	97.1	96.0	94.3	94.0	93.8	92.7	91.7	90.7	89.3	88.0	86.4	85.2	83.9	82.5	81.2	78.6	75.7
300	40,000	43.2	58.9	84.0	93.5	104.3	106.9	106.5	105.8	104.9	104.2	102.5	102.0	101.3	100.0	98.7	97.4	96.0	94.2	92.5	91.0	89.6	88.1	86.6	83.5	80.2
	50,000	51.4	69.4	91.8	100.3	110.4	112.5	112.0	111.1	110.5	109.8	108.6	107.7	106.8	105.0	103.5	101.9	100.2	98.3	96.4	94.8	93.3	91.6	90.1	86.4	82.7
	60,000	59.8	79.6	98.3	105.3	114.9	116.8	116.5	115.6	115.0	114.4	113.0	112.0	110.7	108.9	107.1	105.5	103.7	101.7	99.6	97.8	96.2	94.2	92.4	88.8	85.1
	70,000	68.3	89.9	101.8	108.2	116.9	118.8	118.7	117.8	117.4	116.8	115.4	114.0	112.2	110.4	108.6	107.0	105.0	102.9	100.7	98.9	97.1	94.9	93.1	89.5	85.7
	80,000	77.0	93.7	105.6	111.2	118.9	120.8	120.7	120.0	119.6	119.1	117.5	115.9	113.9	112.0	110.0	108.4	106.3	104.1	101.9	100.0	98.0	95.8	93.7	90.1	86.0
	10,000	11.4	17.1	39.3	48.5	58.2	61.2	62.0	61.8	61.1	60.3	58.5	58.8	59.0	58.8	58.5	58.0	57.5	56.7	56.1	55.3	54.6	53.9	53.2	51.9	50.5
	20,000	24.0	33.6	62.5	74.9	88.1	92.6	92.9	92.5	91.5	90.6	88.4	88.4	88.4	87.9	87.3	86.4	85.4	84.2	82.9	81.9	80.8	79.5	78.4	76.1	73.9
	30,000	34.2	47.3	78.7	91.7	106.0	110.3	110.5	109.8	108.9	107.9	105.8	105.6	105.3	104.2	103.2	102.1	100.8	99.2	97.5	96.1	94.8	93.1	91.8	88.7	85.6
350	40,000	44.1	60.0	90.4	102.8	116.8	120.8	120.6	119.8	118.8	117.9	116.3	116.7	114.9	113.5	112.2	110.7	109.1	107.2	105.1	103.5	101.8	100.0	98.3	94.7	91.0
	50,000	52.7	71.4	100.5	111.4	124.7	127.8	127.3	126.3	125.6	124.7	123.4	122.3	121.3	119.5	117.8	116.0	114.3	111.9	109.7	107.7	106.0	103.8	102.1	97.9	93.6
	60,000	60.9	81.3	107.2	117.8	130.1	132.8	132.5	131.5	130.8	130.1	128.5	127.2	125.6	123.8	121.8	120.0	118.0	115.5	113.0	111.0	108.9	106.7	104.4	100.1	95.6
	70,000	69.8	91.9	112.7	122.5	133.4	135.8	135.5	134.5	133.8	133.3	131.5	129.9	128.1	126.0	124.0	121.9	119.8	117.1	114.6	112.3	110.0	107.5	105.2	100.8	96.0
	80,000	78.7	101.9	117.8	126.3	135.8	138.0	137.4	136.6	136.2	135.7	133.8	131.8	129.5	127.4	125.1	123.0	120.7	117.9	115.2	112.8	110.3	107.5	105.2	100.6	95.8
	10,000	11.7	17.6	38.7	48.6	60.2	65.1	65.8	65.9	65.1	64.3	62.4	62.6	63.0	62.9	62.6	62.2	61.6	60.9	60.2	59.6	58.9	58.1	57.6	56.1	54.8
	20,000	24.7	34.4	63.1	77.2	93.5	99.7	100.5	100.4	99.4	98.3	95.8	96.0	96.1	95.6	95.1	94.2	93.2	91.9	90.7	89.4	88.4	87.2	85.9	83.5	81.0
	30,000	35.1	48.4	82.1	96.6	114.5	120.6	121.1	120.8	119.7	118.6	116.1	115.9	115.8	114.7	113.9	112.6	111.2	109.5	107.8	106.1	104.6	103.0	101.3	98.1	94.5
400	40,000	45.2	61.3	94.7	110.0	127.3	132.7	133.0	132.2	131.2	130.1	128.3	127.6	126.8	125.4	124.0	122.6	120.8	118.7	116.4	114.6	112.7	110.7	108.9	104.7	100.6
	50,000	54.1	72.7	104.7	120.6	137.2	141.4	141.1	140.0	139.0	138.3	136.8	135.6	134.5	132.6	130.9	128.9	127.0	124.3	121.9	119.7	117.5	115.1	112.9	108.1	103.2
	60,000	62.4	83.2	113.0	128.8	143.9	147.5	147.1	146.0	145.2	144.5	142.7	141.2	139.6	137.5	135.5	133.3	131.0	128.3	125.5	123.0	120.5	117.8	115.3	110.3	105.0
	70,000	71.0	93.2	121.9	135.3	149.0	151.8	151.0	149.8	149.3	148.5	146.7	144.7	142.7	140.4	138.1	135.8	133.5	130.2	127.1	124.6	121.8	118.7	116.2	110.8	105.5
	80,000	79.8	103.5	129.1	141.1	152.9	154.9	154.0	152.8	152.3	151.7	149.7	147.4	144.8	142.2	139.9	137.3	134.7	131.4	128.1	126.2	122.2	119.0	115.9	110.5	104.9
	20,000	25.0	35.0	62.7	78.6	97.3	105.3	106.6	106.9	106.0	105.2	102.3	102.1	101.9	101.7	101.7	101.0	100.1	98.8	97.6	96.5	95.3	94.3	93.1	90.6	88.2
	30,000	35.5	48.8	81.6	100.3	120.8	129.3	129.9	129.8	128.9	128.0	126.4	125.0	124.7	124.0	123.5	122.1	120.8	119.0	117.1	115.7	114.1	112.4	111.0	107.5	103.9
	40,000	45.8	77.5	96.1	115.4	136.3	143.4	143.9	143.6	142.6	141.8	139.8	139.3	138.4	137.4	136.2	134.6	132.9	130.4	128.1	126.1	124.3	122.1	121.3	115.8	111.5
450	50,000	55.0	73.7	108.6	133.2	148.7	153.7	153.7	152.8	152.0	151.2	150.4	149.3	148.4	146.5	144.9	142.7	140.6	137.7	135.0	132.6	130.2	127.5	125.4	120.3	113.0
	60,000	63.3	84.0	119.2	138.0	156.4	160.9	160.6	159.6	158.8	158.3	157.2	155.8	154.5	152.3	150.1	147.9	145.4	142.1	139.0	136.2	133.5	130.4	127.7	122.4	116.9
	70,000	71.9	94.1	131.4	146.8	162.8	165.9	165.5	164.3	164.0	163.4	162.0	160.3	158.4	155.9	153.6	151.1	148.0	144.6	140.9	137.8	134.7	132.2	128.5	122.9	116.9
	80,000	80.7	104.8	138.1	155.5	169.0	171.0	170.2	169.3	169.0	168.7	167.2	164.9	162.4	159.8	156.9	154.1	150.9	145.9	143.1	139.7	136.2	132.5	129.0	123.3	117.3
	20,000	25.2	35.1	63.4	79.6	100.8	110.7	112.7	113.4	112.8	112.1	109.0	108.4	107.6	108.2	108.8	108.0	107.1	105.8	104.6	103.6	102.8	101.7	100.6	98.2	95.8
	30,000	35.9	49.2	84.2	102.9	127.0	137.0	138.8	138.9	138.2	137.6	134.9	134.1	133.3	133.3	133.1	132.1	130.7	128.9	126.9	125.4	123.9	122.3	120.8	117.3	113.9
	40,000	46.3	62.5	100.8	120.2	145.1	153.7	154.9	154.6	154.0	153.2	151.5	151.0	150.3	149.2	148.4	146.8	144.9	142.4	139.9	138.0	135.8	133.6	131.7	127.3	122.6
500	50,000	55.6	74.2	115.2	134.7	158.8	165.8	166.1	165.1	164.5	164.0	163.4	162.8	162.4	160.3	158.6	156.5	154.2	151.0	148.0	145.4	143.0	140.1	137.5	132.2	127.0
	60,000	64.1	84.9	127.2	147.0	168.6	173.9	173.8	173.1	172.5	172.2	171.6	170.7	169.3	167.2	165.1	162.4	159.6	156.0	152.3	149.6	146.6	143.3	140.2	134.8	128.7
	70,000	72.8	95.4	138.2	158.5	177.0	180.7	180.6	179.6	179.6	179.3	178.7	177.1	175.3	172.5	170.1	167.3	163.8	159.8	155.7	152.3	148.9	145.1	141.7	135.8	129.6
	80,000	81.6	105.8	148.4	168.7	183.9	186.1	185.6	184.5	184.5	184.5	183.6	181.7	179.2	176.4	173.6	170.1	166.3	161.8	157.1	153.3	149.6	145.4	141.6	135.3	128.7
	20,000	25.4	35.4	62.3	79.4	103.1	115.1	117.7	118.9	118.5	118.2	114.7	113.4	112.4	113.4	114.5	115.6	113.3	112.1	111.0	110.1	109.2	108.3	107.4	105.0	102.7
	30,000	36.1	49.4	83.8	104.3	131.6	143.9	146.3	147.0	146.7	146.1	143.4	142.4	141.3	141.8	142.1	141.0	139.8	137.9	136.0	134.4	133.1	131.4	130.0	126.5	125.6
	40,000	46.6	62.8	101.1	123.4	152.4	162.9	164.5	164.8	164.2	163.9	162.4	161.8	161.2	160.6	160.0	158.2	156.5	153.8	151.1	149.0	147.0	144.7	142.6	138.1	133.4
550	50,000	56.4	74.9	116.1	139.3	168.0	176.5	177.5	176.5	175.6	175.4	175.7	175.4	175.3	173.4	171.8	169.5	167.0	163.6	160.4	157.5	155.0	152.2	149.3	143.9	138.3
	60,000	64.6	85.2	131.2	154.7	180.2	186.4	187.0	186.3	186.0	185.7	186.0	185.3	184.5	182.2	179.9	177.3	174.0	170.0	166.0	162.7	159.8	156.2	152.9	146.9	141.0
	70,000	73.2	96.1	145.4	169.2	190.3	194.8	194.7	194.0	194.0	194.3	194.3	193.0	191.4	188.7	186.3	183.0	179.2	174.4	170.0	166.3	162.3	158.1	154.4	148.3	141.6
	80,000	82.4	107.0	158.4	181.8	198.9	200.9	200.7	200.0	200.3	200.6	200.6	198.6	196.6	193.5	190.4	186.6	182.1	176.9	171.8	167.6	163.2	158.6	154.2	147.6	140.8
	Stroke	0	0.2	1	2	5	10	15	21	26	31	41	51	62	72	82	92	103	113	123	133	143	154	164	184	205

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TABLE 14. C11-1 (WET) Catapult (with metering rod), Lower Boundary, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) – NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND ACCUMULATOR PRESSURE

Pressure (PSI)	Stroke / Weight (LBS)	0	0.2	1	2	5	10	15	21	26	31	41	51	62	72	82	92	103	113	123	133	143	154	164	184	205
	10,000	7.4	11.7	25.4	29.5	31.0	30.7	30.3	29.4	29.2	28.9	28.4	29.0	29.7	29.7	29.6	29.4	29.1	29.4	29.8	29.5	29.2	28.9	28.6	28.4	28.2
150	20,000	15.5	22.2	38.1	42.9	45.4	45.1	44.6	43.4	43.1	42.8	42.1	42.7	43.3	43.2	43.1	42.9	42.6	43.1	43.6	43.3	43.1	42.7	42.4	41.9	41.4
	30,000	23.1	31.6	43.6	47.7	50.9	50.9	50.2	49.2	48.8	48.4	47.6	48.0	48.4	48.2	48.0	48.0	48.0	48.4	48.9	48.7	48.5	48.3	48.1	47.4	46.6
	40,000	30.3	39.2	47.7	49.9	53.8	53.9	53.3	52.5	52.1	51.6	50.9	50.9	50.9	50.7	50.5	50.6	50.7	51.1	51.6	51.5	51.5	51.5	51.4	50.4	49.2
	10,000	8.7	13.3	29.8	35.4	38.2	38.5	38.1	37.3	37.0	36.6	36.0	36.7	37.6	37.6	37.6	37.3	37.1	37.4	37.8	37.5	37.2	36.9	36.6	36.4	36.2
	20,000	18.4	25.3	46.1	52.1	56.5	57.0	56.5	55.4	54.8	54.4	53.6	54.3	55.1	55.0	55.0	54.8	54.6	55.0	55.5	55.2	54.9	54.5	54.2	53.6	53.0
200	30,000	27.0	35.8	52.6	58.6	63.9	64.5	63.9	62.8	62.3	61.9	60.9	61.4	61.7	61.6	61.5	61.5	61.4	61.9	62.4	62.1	61.9	61.6	61.4	60.4	59.4
	40,000	35.2	44.9	56.1	62.0	67.8	68.4	67.8	66.9	66.4	65.9	65.0	65.0	65.1	64.9	64.8	64.9	65.0	65.3	65.7	65.6	65.6	65.4	65.3	63.9	62.5
	50,000	43.5	53.8	58.4	63.8	70.3	70.9	70.3	69.5	69.0	68.6	67.7	67.3	66.9	66.6	66.3	66.6	67.0	67.3	67.6	67.6	67.6	67.7	67.7	66.0	64.5
	10,000	9.8	14.4	32.7	39.4	43.8	44.9	44.8	44.1	43.6	43.2	42.5	43.3	44.2	44.3	44.3	44.1	43.9	44.4	44.7	44.4	44.2	43.9	43.6	43.4	43.1
	20,000	20.1	27.1	50.7	58.9	65.5	67.0	66.7	65.7	65.1	64.5	63.5	64.4	65.2	65.3	65.3	65.2	65.1	65.5	65.8	65.6	65.2	64.9	64.5	63.9	63.2
	30,000	29.6	38.4	59.7	68.2	75.8	77.4	76.9	75.9	75.3	74.8	73.7	74.2	74.8	74.6	74.6	74.6	74.6	74.9	75.2	75.1	74.8	74.5	74.2	73.0	71.8
250	40,000	37.9	46.0	65.5	73.4	81.5	82.9	82.5	81.5	81.0	80.4	79.3	79.5	79.5	79.3	79.3	79.3	79.5	79.7	80.0	79.7	79.5	79.3	79.2	77.5	75.8
	50,000	45.8	56.9	69.8	77.1	85.7	87.0	86.4	85.5	85.0	84.5	83.4	83.1	82.5	82.4	82.2	82.5	82.7	82.9	82.9	82.7	82.7	82.5	82.4	80.3	78.1
	60,000	53.8	73.8	76.0	80.1	87.8	89.4	89.1	88.4	87.9	87.4	86.6	86.1	85.7	85.2	84.9	84.7	84.6	84.4	84.2	83.9	83.4	83.0	82.7	80.7	78.5
	70,000	61.8	77.9	79.4	82.3	89.0	90.9	90.8	90.3	89.9	89.6	88.8	88.3	87.9	87.4	86.7	86.2	85.5	85.2	84.7	84.0	83.4	82.6	82.0	80.1	78.2
	10,000	10.3	14.8	35.1	41.5	47.6	49.6	49.8	49.2	48.7	48.1	47.4	48.3	49.2	49.3	49.4	49.4	49.3	49.6	50.0	49.7	49.5	49.3	49.1	48.9	48.7
	20,000	21.6	28.7	57.0	64.2	73.1	75.8	75.8	75.1	74.4	73.7	72.5	73.5	74.5	74.6	74.6	74.6	74.6	74.9	75.2	74.9	74.6	74.3	74.0	73.3	72.5
	30,000	30.9	39.7	67.7	76.5	86.6	89.4	89.3	88.5	87.8	86.9	85.8	86.4	87.0	87.1	87.1	87.1	87.3	87.3	87.5	87.2	87.0	86.6	86.3	84.9	83.5
300	40,000	40.2	50.4	74.0	83.6	94.2	96.9	96.5	95.5	95.0	94.4	93.1	93.3	93.5	93.5	93.3	93.5	93.7	93.5	93.5	93.1	93.0	92.6	92.2	90.4	88.3
	50,000	47.8	59.2	80.4	88.7	99.6	101.8	101.4	100.3	100.0	99.4	98.2	97.9	97.5	97.3	97.3	97.5	97.6	97.3	97.1	96.7	96.5	96.1	95.9	93.3	90.7
	60,000	55.6	65.3	86.2	93.7	103.7	106.0	105.7	104.9	104.5	103.9	102.9	102.5	101.9	101.5	101.1	100.9	100.7	100.1	99.5	98.9	98.4	97.7	97.1	94.6	92.1
	70,000	63.5	84.7	90.2	96.3	105.2	107.5	107.4	106.7	106.3	105.8	105.0	104.4	103.9	103.2	102.6	101.8	101.1	100.4	99.6	98.6	97.8	96.8	96.0	93.4	91.0
	80,000	71.6	87.6	92.9	98.6	106.6	108.8	108.9	108.3	107.9	107.5	106.7	106.3	105.7	104.7	103.7	102.5	101.3	100.3	99.3	98.1	97.0	95.7	94.5	92.2	89.9
	10,000	10.6	15.3	34.9	42.1	50.0	53.0	53.5	53.3	52.7	52.0	51.2	52.1	53.0	53.2	53.4	53.5	53.6	53.8	54.0	53.9	53.8	53.7	53.5	53.4	53.2
	20,000	22.3	29.4	56.0	66.9	78.3	82.5	83.0	82.5	81.7	80.9	79.8	80.7	81.6	81.9	82.0	82.2	82.4	82.5	82.7	82.4	82.2	81.9	81.7	80.1	80.1
	30,000	31.8	40.8	70.0	81.7	94.5	98.9	99.1	98.4	97.7	96.9	95.6	96.2	96.9	97.1	97.3	97.5	97.5	97.5	97.3	96.9	96.8	96.4	96.0	94.5	92.9
350	40,000	41.0	51.6	81.4	91.5	104.9	108.8	108.8	107.7	107.3	106.6	105.2	105.4	105.6	105.8	105.8	106.0	106.0	105.6	105.4	104.8	104.4	103.9	103.5	101.3	99.1
	50,000	49.0	61.1	90.0	99.2	112.3	115.8	115.3	114.1	113.7	113.5	112.0	111.8	111.3	111.5	111.5	111.5	111.5	110.9	110.2	109.8	109.1	108.7	108.0	105.2	102.1
	60,000	56.6	69.8	95.4	105.6	118.1	121.0	120.0	119.7	119.2	119.0	117.7	117.2	116.7	116.3	116.1	115.6	115.1	114.2	113.4	112.5	111.6	110.8	110.0	106.8	103.8
	70,000	64.9	79.0	99.4	109.2	120.8	123.3	123.2	122.2	121.7	121.3	120.4	119.7	119.2	118.3	117.4	116.8	115.8	114.7	113.5	112.4	111.1	109.9	108.7	105.8	102.8
	80,000	73.2	88.3	102.4	112.2	122.7	124.9	126.0	124.0	123.6	123.1	122.3	121.6	120.8	119.7	118.4	117.0	115.8	114.5	113.1	111.6	110.2	108.5	106.9	104.0	101.0
	10,000	10.9	15.7	34.1	41.5	51.0	55.2	56.0	56.2	55.5	54.7	53.9	54.7	55.6	55.9	56.1	56.4	56.8	56.9	57.0	57.0	56.9	56.9	56.9	56.7	56.5
	20,000	23.0	30.4	55.8	68.3	82.6	88.3	89.2	89.2	88.1	87.3	86.1	87.0	88.1	88.4	88.7	89.1	89.4	89.3	89.3	89.1	88.9	88.7	88.6	87.7	87.0
	30,000	32.6	42.0	72.3	85.9	102.0	107.9	108.5	108.0	107.2	106.4	105.2	105.8	106.5	106.9	107.3	107.5	107.7	107.3	106.9	106.4	106.0	105.8	105.4	103.7	102.2
400	40,000	42.0	53.0	83.0	98.2	114.2	119.7	119.9	119.2	118.5	118.0	116.5	116.7	117.2	117.4	117.6	117.8	117.8	116.9	116.2	115.6	115.1	114.4	113.9	111.4	108.8
	50,000	50.3	62.7	91.5	107.5	123.2	127.7	127.5	126.2	126.0	125.7	124.3	124.1	123.8	124.1	124.3	124.1	124.0	122.8	121.6	120.9	120.0	119.2	118.5	115.2	111.7
	60,000	63.6	77.4	97.7	114.9	129.9	133.9	133.6	132.3	132.0	131.8	130.3	129.8	129.5	129.0	128.8	128.3	127.7	126.3	125.0	123.8	122.6	121.5	120.3	116.8	113.3
	70,000	66.0	81.1	106.5	121.1	135.6	138.4	138.2	136.9	136.7	136.2	135.2	134.4	133.6	132.8	131.8	130.8	129.7	128.2	126.7	125.2	123.7	122.1	120.6	117.1	113.4
	80,000	74.2	90.6	112.5	125.7	138.9	140.9	140.7	139.4	138.9	138.6	137.6	136.6	135.8	134.3	132.8	131.3	129.9	128.1	126.6	124.9	122.9	120.9	118.9	115.4	111.7
	20,000	23.3	30.9	55.8	68.2	84.0	92.1	93.7	94.2	93.5	92.8	91.1	91.5	91.9	92.8	93.9	94.5	95.1	95.1	95.1	95.1	95.1	95.1	95.1	94.1	93.2
	30,000	33.0	42.3	70.8	87.7	106.5	114.9	116.1	116.4	115.7	115.0	113.5	113.7	114.0	114.9	115.5	116.0	116.4	116.2	115.7	115.5	115.3	115.1	114.8	113.3	111.6
	40,000	42.6	53.9	80.7	101.6	121.5	129.1	129.9	129.4	128.9	128.4	126.9	127.1	127.2	127.7	128.1	128.4	128.6	127.9	127.1	126.6	125.9	125.4	124.9	122.4	120.1
450	50,000	51.2	64.0	91.8	112.7	133.0	139.2	139.2	138.1	137.8	137.6	136.5	136.3	136.2	136.3	136.5	136.5	136.4	135.2	134.1	133.1	132.3	131.1	130.4	127.2	123.9
	60,000	58.9	73.0	101.4	122.1	141.2	146.1	146.1	145.0	144.7	144.4	143.3	142.8	142.5	141.9	141.7	141.1	140.5	139.2	137.8	136.5	135.1	133.6	132.3	129.0	125.4
	70,000	66.9	84.9	113.1	129.9	147.4	150.8	150.7	149.5	149.2	149.2	148.4	147.6	146.4	145.6	144.8	143.7	142.4	140.8	139.4	137.5	135.9	134.1	132.4	128.9	123.4
	80,000	75.1	91.9	117.4	137.8	153.9	155.8	155.7	154.5	154.2	154.2	153.4	152.2	150.7	149.3	147.9	146.3	144.4	142.8	141.1	138.9	136.6	134.5	132.3	128.4	124.6
	20,000	23.4	31.3	55.9	67.2	84.8	95.4	97.5	98.6	98.2	97.6	95.9	95.3	95.0	96.7	98.4	99.2	100.0	100.2	100.2	100.4	100.6	100.8	101.0	100.0	99.2
	30,000	33.4	42.9	73.0	88.9	110.4	121.3	123.4	124.0	123.5	123.0	121.3	121.1	120.7	122.1	123.5	124.3	125.0	124.8	124.5	124.3	124.3	124.0	124.0	122.4	120.8
	40,000	43.1	54.4	87.1	104.9	128.8	138.6	139.9	139.9	139.3	139.1	138.0	137.7	137.5	138.3	139.1	139.6	139.9	139.3	138.5	138.0	137.5	136.9	136.3	134.2	131.9
500	50,000	51.7	64.5	99.7	117.5	142.2	150.2	150.5	149.6	149.3	148.8	148.5	148.5	148.2	148.5	148.5	148.5	148.7	147.6	146.1	145.3	144.1	143.2	142.0	139.2	136.5
	60,000	59.6	74.1	109.6	129.1	152.1	158.2	158.5	157.5	157.3	157.3	156.7	156.1	155.4	155.1	154.9	154.3	153.9	152.4	150.9	149.4	148.0	146.3	144.9	141.6	138.2
	70,000	67.7	83.8	118.1	139.9	160.9	165.0	164.8	164.2	163.9	163.9	163.6	162.4	161.4	160.5	159.6	158.3	157.0	155.5	153.7	151.9	149.8	147.7	145.6	142.0	138.2
	80,000	75.9	93.7	125.3	149.5	168.2	170.1	169.9	169.2	169.2	169.2	168.9	167.4	165.7	164.2	162.6	160.8	159.1	156.9	155.1	153.0	150.5	147.8	145.4	141.4	136.9
	20,000	23.6	31.4	51.9	65.6	84.8	98.1	101.1	102.9	102.7	102.4	100.2	99.0	97.9	100.3	102.9	103.9	105.0	105.2	105.4	105.8	106.2	106.6	107.0	106.0	104.9
	30,000	33.6	43.2	70.5	88.0	112.3	126.3	128.9	130.3	129.9	129.6	127.8	126.8	125.8	128.1	130.1	131.1	131.9	131.9	131.7	131.7	131.7	131.7	131.7	130.2	128.8
	40,000	43.3	54.7	83.7	105.1	133.2	145.4	147.4	147.7	147.4	147.2	146.3	145.7	145.2	146.3	147.5	148.0	148.9	148.0	147.5	146.9	146.3	145.7	145.4	143.4	141.3
550	50,000	52.5	65.5	95.7	120.0	150.4	160.3	161.1	160.4	159.8	159.5	159.8	159.8	159.8	159.8	159.8	160.1	160.4	159.2	157.9	156.7	155.8	154.4	153.2	150.7	148.4
	60,000	60.1	74.9	109.7	134.4	162.3	169.7	170.3	169.7	169.4	169.4	169.4	168.7	168.0	167.7	167.4	166.8	166.3	164.7	163.5	161.6	159.9	158.2	156.6	153.7	150.4
	70,000	68.1	85.9	120.5	148.4	175.4	178.3	178.1	177.8	177.8	177.8	178.1	176.8	175.4	174.4	173.4	172.4	171.0	169.3	167.3	165.4	163.1	160.9	158.6	155.0	151.2
	80,000	76.6	94.8	132.7	161.4	183.3	185.2	184.9	184.6	184.9	185.2	185.2	183.2	181.0	179.7	178.3	176.3	174.1	172.1	170.1	167.4	164.8	161.8	159.1	154.8	150.2
	Stroke	0	0.2	1	2	5	10	15	21	26	31	41	51	62	72	82	92	103	113	123	133	143	154	164	184	205

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TABLE 15. C13 Catapult, Upper Boundary, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) — NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND ACCUMULATOR PRESSURE

Pressure (PSI)	Stroke / Weight (LBS)	0	0.2	1.2	2	6	12	18	24	30	36	49	61	73	85	97	109	122	134	146	158	170	182	194	219	243
	10,000	7.9	18.0	23.9	27.0	37.4	40.1	41.7	42.9	44.0	45.0	46.0	45.5	45.0	43.6	42.1	40.7	39.2	37.8	36.3	34.9	33.5	32.0	30.6	27.6	24.9
	20,000	13.6	29.4	35.8	40.0	54.4	58.1	60.0	61.6	62.9	64.2	65.0	64.0	63.2	61.1	59.0	57.0	54.8	52.7	50.6	48.5	46.4	44.3	42.2	37.9	33.8
	30,000	17.9	37.6	44.0	48.5	64.6	68.5	70.7	72.4	73.5	74.6	75.0	73.8	72.4	69.9	67.4	65.0	62.2	59.9	57.4	54.9	52.5	49.9	47.5	42.4	37.4
200	40,000	22.4	44.6	51.5	56.1	73.3	77.2	79.5	81.1	82.1	83.0	82.9	81.2	79.4	76.5	73.8	71.0	68.0	65.2	62.3	59.6	56.8	53.9	51.1	45.3	39.8
	50,000	25.9	50.3	58.0	62.6	79.1	82.8	85.0	86.5	87.3	88.0	87.1	85.0	83.0	79.8	76.8	73.9	70.6	67.6	64.4	61.4	58.5	55.5	52.5	46.2	40.1
	60,000	29.8	54.2	60.5	66.0	84.1	87.4	89.5	91.0	91.5	91.9	90.4	87.9	85.3	82.0	78.8	75.7	72.3	69.1	65.8	62.6	59.3	56.2	52.9	46.3	39.8
	70,000	33.6	59.3	66.0	70.5	89.2	92.3	94.6	95.9	96.0	96.1	93.9	90.9	88.0	84.5	81.1	77.8	74.1	70.7	67.2	63.7	60.3	57.0	53.6	46.5	39.7
	80,000	36.8	63.5	70.0	75.0	93.9	96.6	98.7	99.9	99.7	99.4	96.6	93.2	89.7	86.2	82.6	79.0	75.2	71.6	67.9	64.3	60.8	57.2	53.6	46.2	38.9
	10,000	9.6	20.9	27.0	30.7	43.9	47.7	49.7	51.3	52.6	53.9	54.5	54.5	54.0	52.5	51.0	49.5	47.9	46.3	44.8	43.3	41.8	40.3	38.7	35.6	32.6
	20,000	17.4	35.5	43.0	48.2	68.9	74.2	77.3	79.5	81.1	82.7	83.9	82.8	81.9	79.4	77.0	74.6	42.1	69.7	67.2	64.8	62.5	60.0	57.6	52.6	47.8
	30,000	24.1	47.4	54.5	60.5	85.0	90.9	94.3	96.8	98.5	100.1	100.9	99.2	97.7	94.6	91.6	88.6	85.6	82.4	79.4	76.5	73.3	70.4	67.4	61.2	55.2
300	40,000	29.8	57.6	65.0	71.0	97.6	103.6	107.3	109.9	111.3	112.7	112.9	110.7	108.7	105.0	101.6	98.1	94.5	91.0	87.3	83.9	80.4	76.9	73.4	66.2	59.2
	50,000	35.7	65.8	74.0	80.5	107.5	113.4	117.2	119.6	120.8	122.0	121.4	118.7	115.9	112.0	108.1	104.4	100.2	96.3	92.4	88.5	84.6	80.7	76.8	68.8	61.0
	60,000	40.8	71.8	80.0	87.0	117.2	123.0	126.8	129.3	130.2	131.1	129.6	126.3	122.9	118.6	114.3	110.2	105.5	101.1	96.8	92.5	88.4	84.0	79.9	70.9	62.4
	70,000	45.8	78.4	87.0	94.0	124.6	130.0	133.6	136.0	136.5	137.0	134.7	130.7	126.9	122.4	117.7	113.3	108.2	103.7	99.1	94.4	89.9	85.3	80.8	71.3	61.9
	80,000	50.9	83.8	92.0	99.0	130.7	135.8	139.3	141.7	141.9	141.9	138.6	134.1	129.8	124.8	120.0	115.2	110.1	105.1	100.1	95.4	90.6	85.6	80.8	70.7	60.9
	10,000	10.9	23.7	30.5	34.5	46.9	51.4	54.0	55.8	57.3	58.7	60.0	59.4	58.9	57.5	56.1	54.7	53.2	51.7	50.3	48.9	47.4	46.0	44.6	41.6	38.8
	20,000	19.5	41.5	49.0	54.5	76.3	83.0	86.9	89.7	91.7	93.6	94.0	93.9	92.9	90.5	88.1	85.8	83.2	80.8	78.4	76.0	73.6	71.2	68.8	63.7	59.1
	30,000	27.3	57.1	64.0	70.0	94.7	102.3	106.9	110.0	112.0	113.9	115.0	113.4	111.9	108.8	105.7	102.6	99.5	96.4	93.3	90.2	87.2	84.1	81.0	74.6	68.6
400	40,000	35.0	70.6	78.0	84.0	110.2	118.4	123.2	126.5	128.5	130.5	131.0	128.6	126.4	122.7	119.1	115.6	111.6	107.9	104.2	100.8	97.1	93.4	89.7	82.0	74.9
	50,000	42.0	81.2	89.0	95.5	123.8	132.2	137.2	140.6	142.3	144.0	143.8	140.9	138.1	133.9	129.6	125.6	121.0	116.8	112.5	108.3	104.3	100.0	95.8	87.0	78.7
	60,000	48.9	89.3	98.0	105.0	135.3	143.6	148.7	152.3	153.6	154.9	153.8	150.3	146.8	142.3	137.6	132.9	128.0	123.2	118.5	113.7	109.0	104.5	99.8	89.9	80.6
	70,000	55.7	97.5	107.0	114.1	146.3	154.6	159.6	162.8	164.0	165.0	163.1	158.9	154.7	149.5	144.2	139.3	133.6	128.4	123.1	118.2	112.9	108.0	102.7	91.8	81.6
	80,000	62.1	104.0	115.0	122.5	157.2	165.3	170.3	173.6	174.3	174.8	171.9	167.0	162.1	156.6	150.9	145.4	139.2	133.5	127.7	122.3	116.5	111.1	105.3	93.4	82.2
	10,000	11.3	24.3	30.0	33.9	48.3	53.5	56.6	58.6	60.2	61.7	63.0	62.5	62.1	60.9	59.6	58.4	57.1	55.8	54.6	53.3	52.0	50.7	49.5	46.9	44.4
	20,000	20.8	45.0	53.3	59.0	80.0	88.0	92.7	95.9	98.1	100.4	101.9	100.9	100.0	97.7	95.6	93.5	91.2	88.9	86.8	84.5	82.3	80.1	77.8	73.3	68.9
	30,000	29.9	63.0	71.9	77.5	101.7	111.1	116.8	120.6	123.1	125.4	126.9	125.4	123.8	120.8	117.8	114.9	111.9	108.8	106.0	103.0	99.9	97.1	94.1	88.0	82.1
500	40,000	38.6	78.3	86.5	93.0	120.4	130.7	137.0	141.1	143.4	145.9	147.0	144.8	142.5	138.8	135.3	131.6	127.8	124.1	120.4	116.9	113.2	109.7	106.0	98.5	91.3
	50,000	47.0	90.4	100.0	106.5	137.1	148.2	154.7	159.1	161.4	163.6	164.0	161.2	158.5	154.1	149.7	145.6	140.8	136.4	132.1	127.9	123.6	119.2	115.1	105.9	97.4
	60,000	55.6	101.2	111.0	119.0	153.3	164.7	171.3	175.9	177.8	179.8	179.6	176.0	172.4	167.4	162.3	157.6	152.1	147.1	142.0	137.3	132.2	127.2	122.2	111.9	101.9
	70,000	63.7	111.4	122.0	130.5	167.5	179.0	185.7	190.5	192.3	193.8	192.8	188.4	184.0	178.3	173.0	167.3	161.2	155.5	149.8	144.2	138.8	133.1	127.5	115.7	104.6
	80,000	72.0	119.8	131.5	140.5	182.0	193.9	200.6	205.1	206.5	207.9	205.8	200.8	196.4	189.5	183.1	176.8	170.0	163.6	157.3	151.0	145.0	138.7	132.3	119.2	106.5
	20,000	22.1	48.7	56.0	61.0	81.9	91.1	96.9	100.5	102.9	105.1	107.0	106.1	105.3	103.4	101.5	99.6	97.6	95.7	93.8	91.9	90.0	88.1	86.2	82.3	78.5
	30,000	31.5	68.9	77.0	83.0	106.1	117.3	124.1	128.7	131.4	134.0	135.9	134.4	133.0	130.4	127.8	125.2	122.3	119.7	116.9	114.2	111.6	109.0	106.2	100.7	95.5
	40,000	40.8	86.0	93.8	99.6	125.6	138.3	145.8	150.8	153.6	156.4	157.9	156.0	154.0	150.5	147.2	144.0	140.1	136.9	133.6	130.0	126.8	123.2	119.9	112.8	106.0
600	50,000	49.8	99.5	109.0	115.9	145.0	158.6	166.6	171.9	174.8	177.5	178.9	176.1	173.4	169.4	165.1	160.9	156.6	152.3	148.3	144.1	140.1	135.8	131.6	123.0	114.8
	60,000	59.1	113.0	123.0	130.5	163.3	177.8	186.0	191.7	194.5	197.2	198.0	194.6	190.9	186.3	181.3	176.3	171.2	166.2	161.2	156.2	151.2	146.5	141.6	131.1	121.5
	70,000	68.4	125.3	136.5	144.1	180.3	195.5	203.9	209.7	212.3	214.8	214.9	210.6	206.7	200.9	195.2	189.5	183.3	177.6	171.9	166.1	160.4	154.7	149.0	137.1	125.6
	80,000	77.7	135.6	148.0	156.5	197.1	212.6	221.1	227.3	229.7	232.0	231.3	226.3	221.4	214.9	208.4	202.0	194.9	188.1	181.6	175.3	206.9	163.0	155.8	141.9	129.0
	20,000	19.7	35.2	42.0	47.0	68.4	79.9	86.1	90.3	92.2	94.0	95.5	97.3	99.1	100.1	101.2	102.2	103.3	104.3	105.5	106.5	107.5	108.6	109.6	111.7	113.9
	30,000	32.7	68.0	74.0	79.0	109.8	123.1	131.3	136.3	139.5	142.6	144.9	143.6	142.3	140.0	137.9	135.6	133.0	130.7	128.4	126.1	123.7	121.4	119.1	114.5	109.8
	40,000	41.9	87.9	96.2	103.0	131.2	146.3	155.1	161.2	164.4	167.7	170.0	168.2	166.7	163.4	160.4	157.4	154.1	151.1	148.1	144.8	141.8	138.8	135.8	129.3	123.3
700	50,000	51.8	102.9	112.2	120.0	151.1	167.7	177.3	183.8	187.3	190.6	192.8	190.5	188.1	184.1	180.4	176.7	172.4	168.7	164.7	161.0	157.0	153.3	149.2	141.2	133.5
	60,000	61.2	116.2	126.2	134.3	170.3	188.1	198.3	205.0	208.5	212.1	213.8	210.8	207.9	203.1	198.7	193.9	188.8	184.0	179.2	174.8	170.0	165.3	160.5	150.9	141.3
	70,000	71.1	129.3	141.8	150.0	189.0	207.8	217.9	225.2	228.9	232.1	233.5	229.9	226.3	220.7	215.2	209.7	203.6	198.1	192.5	187.0	181.4	175.9	170.3	158.4	147.3
	80,000	81.4	140.0	153.0	163.5	207.7	227.4	237.8	245.1	248.7	252.1	253.0	248.4	244.1	237.8	231.4	225.1	217.7	211.4	204.6	198.2	191.9	185.1	178.7	165.1	151.9
	20,000	19.9	36.5	42.0	46.0	65.4	77.2	83.7	87.9	90.1	92.1	93.8	96.1	98.5	100.0	101.4	102.9	104.6	106.1	107.7	109.2	110.6	112.1	113.7	116.9	120.0
	30,000	28.5	51.6	58.2	63.9	86.0	103.5	112.0	117.2	120.0	122.5	124.4	127.0	129.4	131.0	132.6	134.3	136.0	137.6	139.2	140.8	142.4	143.8	145.4	148.7	151.9
	40,000	42.9	89.8	96.0	105.0	134.1	152.0	162.6	169.2	173.2	177.1	180.0	178.7	177.1	174.8	172.2	169.6	166.8	164.2	161.6	159.0	156.4	153.8	151.2	145.8	140.6
800	50,000	52.6	106.2	113.9	123.0	154.8	174.6	186.1	193.2	197.7	201.7	204.9	203.1	201.2	197.6	194.3	190.7	187.1	183.8	180.2	176.9	173.3	170.0	166.7	159.5	152.6
	60,000	62.1	119.4	130.5	139.0	173.7	195.0	208.7	214.8	219.0	223.3	226.8	224.4	222.0	217.6	213.3	208.9	204.2	200.2	195.8	191.4	187.1	182.7	178.7	169.6	160.9
	70,000	72.3	133.3	145.0	154.0	193.2	215.8	228.1	236.4	240.9	245.6	248.9	245.4	242.4	237.3	232.1	226.9	221.3	216.2	210.6	205.4	200.3	195.1	190.0	178.8	168.5
	80,000	82.4	144.4	157.0	167.0	212.4	236.1	248.8	257.3	262.1	266.7	269.7	266.0	262.3	256.3	250.3	243.9	236.9	230.9	224.5	218.1	212.1	205.6	199.6	186.2	173.8
	20,000	20.1	35.6	40.0	44.0	61.3	73.1	80.0	84.2	86.4	88.5	90.4	93.2	96.1	98.2	100.2	102.1	104.1	106.1	108.0	110.0	111.9	113.9	115.8	120.1	124.0
	30,000	29.3	53.1	59.0	63.2	82.6	98.4	107.4	112.6	115.7	118.4	120.8	124.1	127.3	129.4	131.6	133.7	136.0	138.2	140.3	142.5	144.6	146.7	148.9	153.4	157.9
	40,000	37.2	66.4	73.4	79.0	103.8	123.2	134.5	140.6	144.0	147.2	150.2	153.5	156.7	159.0	160.9	163.2	165.4	167.3	169.6	171.9	173.8	176.1	178.4	182.8	187.0
900	50,000	45.4	78.4	87.2	93.8	125.6	148.8	162.0	169.2	173.1	176.9	180.0	183.1	186.2	188.1	190.4	191.9	194.0	195.9	198.2	200.1	202.0	203.9	205.8	210.2	214.0
	60,000	62.9	122.0	132.0	142.5	175.0	199.9	213.8	222.5	228.2	233.3	238.0	236.3	234.5	230.7	227.3	223.5	219.3	215.5	211.7	208.3	204.4	200.6	196.8	188.8	181.5
	70,000	73.7	134.9	147.4	156.0	194.2	220.6	235.2	244.6	250.3	255.8	260.8	258.9	256.6	252.0	247.4	242.4	237.4	232.3	227.7	223.1	218.0	213.4	208.8	198.8	189.1
	80,000	82.9	147.0	160.0	169.0	212.8	241.1	255.2	265.2	271.3	277.2	283.0	280.0	277.5	271.6	265.8	259.9	254.0	248.1	242.2	236.3	230.4	224.5	218.6	206.8	195.0
	20,000	20.5	38.3	42.0	45.0	58.0	70.1	77.3	81.6	84.0	86.2	88.4	91.7	95.3	97.7	100.2	102.5	105.2	107.5	110.0	112.5	114.8	117.3	119.8	124.9	129.9
	30,000	29.7	54.3	58.2	61.9	77.7	93.5	103.6	109.2	112.3	115.3	118.1	121.9	125.9	128.6	131.6	134.1	137.0	139.7	142.7	145.4	148.1	150.8	153.7	159.4	165.1
	40,000	37.6	68.1	73.3	77.1	95.0	119.9	129.1	135.5	139.2	142.8	146.2	150.4	154.4	157.3	160.2	162.9	166.0	168.7	171.6	174.6	177.5	180.4	183.1	189.2	195.1
1000	50,000	45.9	80.0	86.1	91.8	116.4	141.0	155.0	162.6	166.9	171.1	175.0	178.9	183.1	185.7	188.8	191.1	194.0	196.7	199.7	202.4	205.1	208.1	210.8	216.4	222.1
	60,000	54.2	90.8	99.0	106.0	136.3	165.4	181.8	190.4	195.4	200.2	204.6	208.1	211.6	214.2	216.8	219.0	221.4	224.0	226.6	229.3	231.9	234.5	236.7	242.1	246.9
	70,000	74.3	136.5	147.8	156.0	192.4	223.4	239.4	249.8	256.8	263.7	271.1	270.1	268.6	264.7	260.8	256.4	252.1	247.8	243.9	239.5	235.6	231.2	227.3	218.6	210.4
	80,000	83.3	149.5	160.0	171.0	211.2	243.8	260.4	271.6	279.1	286.4	294.8	293.2	291.6	286.4	281.2	276.0	270.3	265.1	259.9	254.7	249.5	243.7	238.5	227.6	217.2
	Stroke	0	0.2	1.2	2	6	12	18	24	30	36	49	61	73	85	97	109	122	134	146	158	170	182	194	219	243

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TABLE 16. C13 Catapult, Mean, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) — NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND ACCUMULATOR PRESSURE

Pressure (PSI)	Stroke / Weight (LBS)	0	0.2	1.2	2	6	12	18	24	30	36	49	61	73	85	97	109	122	134	146	158	170	182	194	219	243
	10,000	7.3	13.3	19.0	20.9	31.6	35.0	36.5	37.9	38.7	39.4	40.0	39.7	39.4	38.6	37.8	37.0	36.1	35.2	34.4	33.6	32.7	31.9	31.0	29.3	27.6
	20,000	12.6	22.0	28.1	32.6	46.6	50.9	53.0	54.7	55.6	56.4	57.0	56.4	55.8	54.5	53.2	52.0	50.7	49.4	48.1	46.9	45.6	44.4	43.1	40.4	37.9
	30,000	16.6	28.3	34.2	38.4	54.7	59.3	61.4	63.1	63.9	64.7	65.0	64.1	63.2	61.5	60.0	58.5	57.0	55.4	53.8	52.3	50.7	49.2	47.7	44.5	41.4
200	40,000	20.7	33.9	40.0	44.4	61.5	65.9	68.1	69.5	70.3	70.9	70.8	69.6	68.4	66.6	64.7	63.0	61.2	59.4	57.6	55.8	54.1	52.3	50.5	46.9	43.3
	50,000	24.0	38.5	44.5	48.9	65.6	69.8	71.8	73.1	73.6	74.0	73.5	72.0	70.5	68.5	66.5	64.6	62.6	60.6	58.7	56.8	54.9	52.9	51.1	47.0	43.2
	60,000	27.6	42.1	48.3	53.4	70.6	74.5	76.3	77.5	77.8	78.0	77.1	75.2	73.4	71.2	68.9	66.9	64.7	62.5	60.5	58.3	56.1	54.1	51.9	47.6	43.4
	70,000	31.1	46.4	52.8	57.3	74.8	78.3	80.0	80.8	81.0	81.0	79.6	77.4	75.3	73.0	70.5	68.4	66.0	63.7	61.3	59.0	56.7	54.4	52.2	47.4	42.9
	80,000	34.1	50.0	56.0	60.3	77.8	80.8	82.2	82.9	82.8	82.6	80.7	78.3	75.9	73.4	70.9	68.6	66.0	63.5	61.0	58.7	56.2	53.8	51.4	46.4	41.6
	10,000	8.9	16.4	22.3	25.4	37.2	41.5	43.6	45.4	46.3	47.2	48.0	47.8	47.5	46.8	46.0	45.1	44.3	43.4	42.7	41.8	41.0	40.2	39.4	37.6	36.0
	20,000	16.1	28.2	35.1	40.0	58.4	64.5	67.5	69.7	70.9	72.1	72.9	72.3	71.8	70.5	69.1	67.8	66.3	65.0	63.6	62.3	60.8	59.6	58.1	55.3	52.5
	30,000	22.3	37.8	44.5	49.4	72.5	79.2	82.7	85.0	86.3	87.4	87.9	87.0	86.1	84.2	82.4	80.7	78.8	77.0	75.3	73.5	71.8	69.9	68.1	64.4	60.9
300	40,000	27.6	46.3	53.3	58.4	82.2	89.0	92.4	94.6	95.8	96.8	96.8	95.6	94.2	92.0	89.9	87.8	85.5	83.5	81.3	79.3	77.1	75.0	72.9	68.6	64.2
	50,000	33.1	53.1	60.3	65.6	91.0	97.8	101.1	103.3	104.1	105.0	104.6	102.9	101.1	98.6	95.9	93.6	91.0	88.5	86.2	83.7	81.4	78.9	76.4	71.4	66.5
	60,000	37.8	58.6	66.0	71.8	97.4	103.7	106.9	108.7	109.4	109.9	109.1	106.7	104.5	101.8	99.0	96.4	93.6	90.9	88.1	85.5	82.8	80.0	77.4	71.9	66.3
	70,000	42.4	64.4	71.9	77.3	102.8	108.6	106.2	112.9	113.6	114.0	112.4	109.8	107.2	104.2	101.2	98.2	95.1	92.1	89.3	86.3	83.3	80.5	77.5	71.4	65.6
	80,000	47.1	69.2	77.0	84.2	108.3	113.6	116.5	117.9	118.0	118.0	115.9	112.9	109.6	106.4	103.1	100.1	96.7	93.5	90.2	87.2	83.9	80.7	77.6	71.0	64.5
	10,000	10.1	19.5	25.6	29.8	41.2	46.2	48.9	50.9	52.0	53.1	54.0	53.9	53.8	53.1	52.4	51.8	51.0	50.3	49.6	48.9	48.2	47.5	46.8	45.2	43.9
	20,000	18.1	34.3	42.1	47.3	65.1	72.4	76.3	79.0	80.5	82.1	83.0	82.5	82.2	81.0	79.7	78.4	77.1	75.9	74.7	73.5	72.3	71.0	69.8	67.1	64.7
	30,000	25.3	47.2	54.8	60.4	82.3	90.7	95.0	98.2	99.7	101.2	102.0	101.3	100.4	98.7	96.9	95.2	93.5	91.8	90.2	88.3	86.7	85.1	83.2	79.8	76.3
400	40,000	32.4	58.6	66.6	72.3	95.9	105.0	109.6	112.8	114.3	115.7	116.0	114.8	113.5	111.3	109.0	107.0	104.7	102.7	100.4	98.4	96.3	94.1	92.0	87.5	83.2
	50,000	38.9	67.7	76.1	82.3	107.3	116.4	121.1	124.1	125.5	126.8	126.6	124.8	123.1	120.4	117.8	115.3	112.7	110.3	107.6	105.2	102.5	100.1	97.4	92.1	87.1
	60,000	45.3	75.0	83.7	90.1	117.3	126.4	131.1	133.8	135.0	135.9	135.5	133.1	130.8	127.8	124.7	121.7	118.7	115.6	112.8	109.8	107.0	104.0	100.9	24.9	89.0
	70,000	51.6	82.3	91.0	97.3	126.2	134.9	139.6	142.1	142.9	143.9	142.6	139.7	136.8	133.4	130.0	126.6	123.2	119.8	116.4	113.2	109.8	106.4	103.3	96.2	89.6
	80,000	57.5	88.3	97.9	108.0	133.9	142.3	146.7	149.0	149.6	150.1	148.2	144.7	141.2	137.5	133.8	130.0	126.2	122.5	118.8	115.0	111.5	107.8	104.1	96.3	89.0
	10,000	10.5	22.6	33.8	38.0	42.7	47.3	50.3	52.5	53.7	54.8	55.8	55.9	56.8	55.5	55.0	54.5	54.0	53.5	53.0	52.5	52.0	51.5	51.0	49.9	49.0
	20,000	19.3	37.7	45.3	50.6	68.4	76.7	81.3	84.5	86.2	87.9	89.0	89.0	88.8	87.8	86.8	85.8	84.8	83.9	82.9	81.9	81.0	80.0	79.0	76.9	74.9
	30,000	27.7	52.7	61.1	67.0	88.9	98.9	104.3	107.9	109.9	111.7	112.9	112.3	111.9	110.4	109.0	107.5	105.9	104.5	103.1	101.6	99.9	98.5	97.0	94.0	91.1
500	40,000	35.7	65.7	74.8	80.9	105.2	117.2	123.3	127.2	129.2	130.8	131.9	130.7	129.7	127.8	125.7	123.8	121.7	119.8	117.7	115.8	113.9	111.9	109.8	105.8	101.8
	50,000	43.5	76.2	85.4	92.2	120.0	131.7	138.0	141.8	143.7	145.5	145.9	144.3	142.7	140.1	137.8	135.2	132.6	130.3	127.7	125.4	122.8	120.4	118.1	112.9	108.0
	60,000	51.5	85.8	95.0	102.0	134.3	146.4	152.7	156.7	158.3	159.9	160.0	157.7	155.5	152.4	149.3	146.5	143.1	140.3	137.2	134.4	131.3	128.2	125.4	119.2	113.1
	70,000	59.0	94.9	104.7	111.8	145.7	158.0	164.4	168.0	169.6	170.8	170.2	167.6	164.6	161.1	157.5	154.0	150.4	146.9	143.3	139.8	136.5	133.0	129.4	122.3	115.2
	80,000	66.7	102.6	113.4	122.7	157.4	169.7	175.7	179.2	180.5	181.8	180.5	176.8	173.4	169.4	165.4	161.3	157.0	153.0	148.9	144.9	140.9	136.9	132.9	124.5	116.5
	20,000	20.5	41.1	48.5	53.8	70.9	80.5	85.9	89.4	91.2	93.2	94.7	94.8	95.0	94.3	93.6	93.0	92.3	91.7	91.2	90.4	89.7	89.2	88.5	87.1	85.9
	30,000	29.2	58.2	67.4	73.6	93.5	105.2	111.8	116.0	118.3	120.4	122.0	121.7	121.5	120.3	119.4	118.3	117.0	115.9	115.0	113.8	112.7	111.6	110.4	108.3	106.0
	40,000	37.8	72.8	83.0	89.5	111.8	125.0	132.3	136.9	139.4	141.5	143.0	142.2	141.6	140.0	138.5	136.9	135.1	133.6	132.0	130.4	128.5	126.9	125.4	122.1	118.9
600	50,000	46.1	84.6	94.7	102.1	128.3	142.6	150.4	155.2	157.7	160.1	161.1	159.9	158.7	156.4	154.3	152.3	149.7	147.7	145.6	143.3	141.2	139.2	136.8	132.5	128.1
	60,000	54.7	96.5	106.2	113.9	143.7	158.6	166.7	171.6	174.0	176.2	177.0	175.1	173.1	170.6	167.7	164.9	162.1	159.2	156.7	153.8	151.3	148.4	145.6	139.9	134.5
	70,000	63.3	107.4	118.4	126.2	158.5	174.0	182.4	187.2	189.4	191.5	191.9	189.2	186.8	183.4	180.0	176.6	172.9	169.8	166.4	163.0	159.6	156.2	153.2	146.1	139.3
	80,000	71.9	116.8	128.8	137.4	171.5	187.5	195.9	200.7	202.6	204.7	204.4	200.8	197.6	193.7	189.8	185.8	181.6	177.6	173.7	169.8	165.9	161.9	158.0	149.5	141.6
	20,000	21.4	42.5	49.1	53.4	73.2	83.9	90.1	94.1	96.3	98.3	100.1	100.7	101.0	100.8	100.7	100.5	100.0	99.8	99.7	99.5	99.3	98.9	98.7	98.3	97.7
	30,000	30.3	60.1	69.2	75.0	95.5	108.8	116.4	121.4	124.0	126.5	128.2	128.7	128.9	128.2	127.7	127.0	126.2	125.7	125.2	124.4	123.7	123.2	122.5	121.2	119.9
	40,000	38.8	75.0	84.9	91.5	115.0	130.5	139.1	144.4	147.4	150.0	151.9	151.9	151.6	150.5	149.3	148.2	146.9	146.0	144.9	143.7	142.6	141.4	140.3	137.9	135.6
700	50,000	48.0	88.1	98.0	105.1	134.0	151.2	160.4	166.4	169.5	172.1	173.9	173.3	172.6	171.0	169.4	167.7	165.6	164.0	162.4	160.8	159.1	157.2	155.6	151.9	148.6
	60,000	56.7	99.9	109.9	117.1	150.0	168.3	178.3	184.1	187.4	190.3	191.9	190.5	189.4	186.9	184.8	182.4	179.7	177.6	175.1	173.0	170.5	168.4	166.0	161.2	156.2
	70,000	65.8	111.6	122.3	130.1	166.9	186.6	196.7	202.9	205.7	208.7	210.1	208.2	206.3	203.2	200.2	197.1	193.8	190.8	187.8	184.7	182.1	179.0	176.0	169.6	163.6
	80,000	75.4	121.4	133.2	141.9	182.9	203.5	213.8	220.0	223.0	225.9	226.8	224.4	221.5	217.9	214.3	210.2	206.3	202.6	199.0	194.9	191.3	187.7	184.0	176.0	168.3
	20,000	21.6	43.9	49.6	52.9	71.8	83.3	90.1	94.5	96.8	99.0	100.9	101.9	102.7	102.9	103.3	103.5	103.7	103.9	104.1	104.3	104.6	104.7	105.0	105.4	106.0
	30,000	31.0	61.9	71.0	76.4	97.1	112.2	120.8	126.3	129.3	132.0	134.4	135.2	136.0	136.0	136.0	135.7	135.7	135.7	135.4	135.4	135.4	135.2	135.2	134.9	134.9
	40,000	39.7	77.2	86.7	93.4	117.4	134.8	144.9	151.0	154.2	157.6	160.1	160.7	161.0	160.7	160.1	159.5	158.8	158.5	157.9	157.2	156.6	156.3	155.7	154.4	153.5
800	50,000	48.7	91.6	101.2	108.0	136.5	156.4	167.5	174.0	177.7	181.2	183.9	183.9	183.9	182.9	181.8	180.8	179.3	178.2	177.2	176.1	175.0	174.0	172.9	170.4	168.3
	60,000	57.5	103.3	113.5	120.2	153.5	174.9	186.6	193.7	197.7	201.2	204.1	203.4	203.0	201.4	199.5	197.6	195.9	194.0	192.5	190.6	189.0	187.1	185.2	181.6	178.1
	70,000	66.9	115.7	126.2	133.9	169.5	192.8	205.0	212.2	216.1	220.2	223.0	221.7	220.5	218.0	215.5	213.1	210.4	207.9	205.5	203.0	200.5	198.0	195.6	190.4	185.5
	80,000	76.3	125.9	137.6	146.3	186.5	211.0	223.7	231.3	235.5	239.4	241.9	240.1	238.4	234.8	231.8	228.7	224.9	221.8	218.3	215.2	212.1	208.6	205.5	198.6	192.0
	20,000	21.9	44.8	50.0	53.0	68.0	80.1	87.4	91.6	94.1	96.6	98.7	99.9	101.1	101.9	102.6	103.4	104.0	104.6	105.3	106.1	106.7	107.5	108.1	109.6	111.0
	30,000	31.9	63.2	70.5	75.3	92.0	108.0	117.5	123.1	126.4	129.4	132.1	133.4	134.7	135.3	135.8	136.4	136.7	137.2	137.7	138.3	138.8	139.4	139.9	141.0	142.1
	40,000	40.4	78.9	86.9	92.7	116.3	135.8	147.2	154.0	157.7	161.3	164.6	165.9	166.9	167.3	167.6	167.6	167.6	167.6	167.9	167.9	168.2	168.3	168.6	168.6	168.9
900	50,000	49.3	92.9	101.6	108.0	136.6	158.1	170.7	177.9	182.5	186.7	190.0	191.1	191.9	191.5	191.1	190.7	190.0	190.0	189.6	189.2	188.5	188.1	187.7	187.0	186.2
	60,000	58.2	104.9	114.9	122.1	154.0	178.9	192.8	200.8	205.5	210.0	214.1	215.6	215.9	214.2	212.9	211.7	210.3	209.5	208.3	207.5	206.2	205.0	204.2	202.0	199.5
	70,000	68.2	117.6	127.3	135.0	171.0	198.0	212.5	220.7	225.7	230.6	235.0	234.6	234.6	232.8	231.0	229.2	226.9	225.5	223.8	222.0	220.2	218.0	216.2	212.5	209.0
	80,000	76.8	128.4	139.0	148.4	187.2	216.4	231.5	240.2	245.6	250.4	255.0	254.0	253.1	250.7	248.3	245.5	242.5	240.1	237.2	234.9	232.0	229.7	226.8	221.4	215.7
	20,000	22.3	45.6	50.3	53.1	63.6	76.0	83.7	88.1	90.6	93.0	95.3	97.0	98.6	99.8	101.0	102.0	103.4	104.4	105.6	106.8	107.8	109.0	110.3	112.6	115.0
	30,000	32.3	64.4	70.0	74.1	86.5	103.2	113.1	118.9	122.2	125.7	128.7	130.3	132.2	133.6	134.6	135.7	136.9	137.9	139.0	140.1	141.2	142.2	143.6	145.8	148.0
	40,000	40.9	80.5	87.1	92.0	108.6	129.3	141.4	148.1	152.5	156.4	160.1	162.1	164.1	164.7	165.7	166.4	167.4	168.1	169.0	170.0	170.7	171.7	172.3	174.0	176.0
1000	50,000	49.9	94.1	101.9	108.0	130.5	154.8	168.9	176.8	181.9	186.6	191.2	192.8	194.7	195.1	195.4	195.8	195.9	196.6	197.0	197.4	197.8	198.2	198.5	199.3	200.1
	60,000	58.9	106.4	116.2	124.0	151.4	179.4	195.3	204.2	209.6	215.2	220.5	221.8	223.1	223.1	222.7	222.3	221.8	221.8	221.8	221.4	220.9	220.9	220.5	220.0	219.6
	70,000	68.8	119.4	128.3	136.0	168.1	199.0	215.7	225.4	231.2	237.3	243.0	244.0	244.9	243.9	243.0	242.1	240.6	239.6	238.7	237.8	236.8	235.9	234.9	232.5	230.6
	80,000	77.1	130.9	140.3	150.4	184.8	218.4	235.9	246.2	252.5	259.0	265.6	265.6	266.1	264.1	262.5	260.5	258.4	256.4	254.8	252.8	250.8	249.3	247.3	243.1	239.6
	Stroke	0	0.2	1.2	2	6	12	18	24	30	36	49	61	73	85	97	109	122	134	146	158	170	182	194	219	243

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TABLE 17. C13 Catapult, Lower Boundary, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) — NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND ACCUMULATOR PRESSURE

Pressure (PSI)	Stroke / Weight (LBS)	0	0.2	1.2	2	6	12	18	24	30	36	49	61	73	85	97	109	122	134	146	158	170	182	194	219	243
	10,000	6.7	8.56	13.0	16.5	28.2	32.3	34.1	35.6	36.1	36.6	37.0	36.8	36.7	36.4	36.1	35.8	35.4	35.1	34.7	34.4	34.0	33.8	33.4	32.6	31.9
	20,000	11.6	14.5	20.0	24.0	39.5	44.6	46.8	48.6	49.1	49.7	50.0	49.6	49.3	48.8	48.2	47.7	47.1	46.5	46.0	45.4	44.9	44.4	43.8	42.6	41.4
	30,000	15.3	18.9	25.0	29.2	46.8	52.1	54.2	55.9	56.4	56.9	57.0	56.5	55.9	55.2	54.3	53.7	52.9	52.2	51.4	50.6	49.9	49.2	48.4	46.8	45.4
200	40,000	19.0	23.1	29.0	33.8	52.5	57.6	59.6	61.1	61.5	61.9	61.8	61.1	60.3	59.3	58.3	57.4	56.4	55.5	54.6	53.7	52.7	51.8	51.0	49.0	47.1
	50,000	22.1	26.6	32.1	36.9	55.7	60.4	62.1	63.3	63.6	63.9	63.5	62.5	61.6	60.4	59.1	58.1	57.0	56.0	55.0	54.0	53.0	51.8	50.8	48.6	46.4
	60,000	25.4	29.9	35.5	40.0	58.1	62.2	63.8	64.6	64.7	64.9	64.3	63.1	62.0	60.6	59.3	58.1	56.9	55.8	54.6	53.4	52.3	51.0	49.8	47.3	45.1
	70,000	28.6	33.3	38.5	43.0	60.6	64.2	65.5	66.0	66.0	66.0	65.3	63.9	62.4	61.0	59.5	58.2	57.0	55.6	54.3	52.9	51.7	50.3	49.0	46.3	43.6
	80,000	31.4	36.3	42.0	46.1	61.8	64.8	65.9	66.0	66.1	65.8	64.8	63.3	61.6	60.1	58.5	57.2	55.8	54.4	53.0	51.5	50.1	48.6	47.2	44.3	41.5
	10,000	8.2	12.6	16.2	19.7	31.5	36.2	38.5	40.2	40.9	41.5	41.9	42.0	42.0	41.8	41.7	41.5	41.3	41.0	40.8	40.6	40.4	40.2	40.0	39.5	39.1
	20,000	14.8	22.0	27.0	31.0	48.4	54.8	57.9	60.0	60.9	61.6	62.0	61.9	61.8	61.4	61.0	60.5	60.1	59.6	59.2	58.7	58.3	57.9	57.4	56.4	55.5
	30,000	20.5	30.0	36.5	40.0	58.7	65.7	68.8	71.1	71.9	72.6	72.9	72.5	72.1	71.4	70.8	70.1	69.3	68.7	68.1	67.4	66.7	66.1	65.4	64.0	62.5
300	40,000	25.4	36.5	42.9	47.5	67.3	74.5	77.6	79.6	80.4	81.0	81.0	80.4	79.6	78.7	77.7	76.8	75.8	74.9	74.0	73.1	72.2	71.3	70.4	68.4	66.6
	50,000	30.5	42.8	48.6	53.5	74.2	81.1	84.2	85.9	86.5	87.0	86.9	85.9	84.8	83.5	82.3	81.2	80.0	78.9	77.8	76.5	75.4	74.3	73.0	70.7	68.3
	60,000	34.8	47.3	53.0	58.0	77.8	84.2	86.9	88.2	88.7	89.0	88.7	87.3	86.0	84.4	83.0	81.7	80.3	79.0	77.6	76.3	74.9	73.6	72.2	69.4	66.7
	70,000	39.0	52.0	58.0	62.7	82.0	87.9	90.4	91.4	91.6	91.9	91.1	89.5	87.7	86.1	84.3	82.9	81.3	79.7	78.2	76.6	75.0	73.4	71.9	68.7	65.7
	80,000	43.3	56.5	62.1	66.8	85.8	91.0	93.2	93.9	93.9	94.1	93.0	90.9	89.0	87.0	85.2	83.5	81.7	79.9	78.1	76.3	74.5	72.7	71.0	67.4	64.0
	10,000	9.3	15.4	19.9	22.6	34.3	39.7	42.4	44.3	45.1	45.8	46.4	46.7	47.0	47.0	47.0	46.9	46.9	46.9	46.8	46.8	46.8	46.8	46.7	46.6	46.6
	20,000	16.7	27.2	32.0	36.8	54.7	62.5	66.2	68.9	70.0	71.0	71.6	71.7	72.0	71.7	71.6	71.3	71.2	70.9	70.7	70.5	70.3	70.0	69.9	69.3	68.9
	30,000	23.3	37.5	43.8	48.2	68.6	77.3	81.4	84.3	85.4	86.4	87.0	87.0	86.8	86.3	85.8	85.5	84.9	84.5	84.1	83.6	83.1	82.6	82.3	81.2	80.2
400	40,000	29.8	46.8	53.1	58.0	79.4	88.6	93.0	95.7	96.7	97.8	98.1	97.7	97.3	96.4	95.8	94.9	94.1	93.3	92.6	91.9	91.1	90.4	89.6	88.1	86.6
	50,000	35.8	54.4	61.0	66.5	88.9	98.2	102.5	105.0	105.9	106.8	106.9	106.1	105.3	104.1	102.9	101.9	100.8	99.8	98.8	97.8	96.6	95.6	94.7	92.4	90.4
	60,000	41.7	60.9	67.9	73.0	96.8	106.1	110.2	112.3	113.2	113.9	113.7	112.4	111.2	109.7	108.2	106.8	105.4	104.2	102.9	101.5	100.2	98.7	97.5	94.7	91.9
	70,000	47.5	67.4	74.2	79.9	104.0	112.7	116.7	118.5	119.2	119.8	119.2	117.4	115.7	114.0	112.1	110.5	108.9	107.2	105.4	103.9	102.2	100.5	98.8	95.4	92.1
	80,000	52.9	72.8	79.8	85.0	109.7	118.1	121.7	123.1	123.6	124.0	123.1	120.9	118.7	116.7	114.5	112.8	110.6	108.6	106.7	104.7	102.7	100.7	98.8	94.6	90.9
	10,000	9.7	17.4	21.2	24.1	35.1	40.8	43.6	45.8	46.7	47.5	48.1	48.7	49.3	49.5	49.7	49.9	50.1	50.3	50.5	50.7	50.9	51.1	51.3	51.7	52.0
	20,000	17.8	30.4	35.8	39.9	57.2	65.8	70.0	73.1	74.3	75.5	76.4	77.0	77.6	77.6	77.8	77.9	77.9	78.1	78.2	78.4	78.4	78.5	78.7	78.9	79.0
	30,000	25.5	43.0	49.0	54.0	75.5	86.0	91.1	94.7	96.1	97.5	98.2	98.6	99.0	99.0	98.8	98.6	98.6	98.4	98.4	98.2	98.2	98.0	97.8	97.6	97.4
500	40,000	32.8	53.8	60.5	66.0	89.9	101.1	106.8	110.4	111.9	113.2	114.0	114.0	113.9	113.5	113.1	112.6	112.1	111.7	111.5	111.0	110.6	110.2	109.7	108.8	107.9
	50,000	40.0	63.1	70.7	76.7	102.7	114.7	120.4	126.3	122.2	126.7	127.0	126.5	126.3	125.3	124.3	123.6	122.8	122.1	121.4	120.6	119.9	119.2	118.5	116.7	115.2
	60,000	47.4	71.9	80.0	86.5	113.0	125.4	131.3	134.4	135.6	136.9	136.9	136.1	135.1	133.8	132.5	131.5	130.4	129.1	128.1	127.0	125.7	124.7	123.4	121.0	118.9
	70,000	54.3	79.9	88.0	94.8	123.5	136.1	141.7	144.5	145.9	147.0	146.8	145.2	143.8	141.9	140.3	138.9	137.2	135.8	134.2	132.5	130.9	129.5	127.9	124.8	121.5
	80,000	61.4	87.4	96.5	103.4	133.6	146.1	151.6	154.0	155.2	156.1	155.5	153.5	151.2	149.3	147.0	145.0	143.1	141.2	139.2	137.2	135.2	133.2	131.2	127.1	123.1
	20,000	18.9	33.5	39.8	43.9	58.7	67.9	72.8	76.0	77.6	78.8	79.9	81.0	82.0	82.5	83.0	83.5	84.0	84.5	85.0	85.5	86.0	86.4	86.8	87.9	88.9
	30,000	26.9	47.5	54.0	58.5	76.9	88.2	94.2	98.0	99.8	101.4	102.4	103.5	104.3	104.7	104.9	105.3	105.6	106.0	106.4	106.6	107.0	107.3	107.7	108.3	108.9
	40,000	34.8	59.7	66.4	72.0	94.9	108.1	114.9	119.0	120.8	122.8	124.0	124.5	124.9	124.9	124.9	125.2	125.2	125.2	125.4	125.4	125.4	125.4	125.7	125.7	125.9
600	50,000	42.4	69.7	77.5	83.8	110.8	125.3	133.0	137.0	139.1	140.8	141.7	142.0	142.0	141.7	141.4	141.2	140.9	140.6	140.3	140.0	139.5	139.2	138.9	138.3	137.8
	60,000	50.3	80.0	88.5	95.0	123.6	138.9	146.5	150.5	152.4	154.2	154.9	154.6	154.0	153.4	152.5	151.9	151.0	150.4	149.8	148.9	148.3	147.4	146.8	145.2	143.8
	70,000	58.2	89.5	98.4	105.5	136.2	152.2	160.0	164.0	165.7	167.5	168.0	166.7	165.7	164.5	163.2	162.2	160.9	159.6	158.3	157.4	156.1	154.8	153.9	151.2	149.0
	80,000	66.1	98.0	107.9	115.0	148.3	164.7	172.6	176.4	178.2	179.9	179.9	177.9	176.2	174.6	172.9	170.9	169.1	167.4	165.7	164.0	162.4	160.7	159.0	155.5	152.2
	20,000	23.1	50.3	54.8	57.9	66.6	76.4	82.0	85.6	87.7	89.5	91.1	91.6	91.9	91.8	91.6	91.4	91.0	90.9	90.7	90.5	90.3	90.0	89.8	89.4	88.9
	30,000	27.9	49.6	59.0	65.5	86.6	98.7	105.6	110.2	112.5	114.8	116.3	116.7	117.0	116.3	115.8	115.2	114.4	114.0	113.5	112.9	112.2	111.8	111.1	109.9	108.8
	40,000	35.7	62.0	71.0	77.0	103.8	117.8	125.4	130.2	132.9	135.3	137.0	137.0	136.8	135.7	134.7	133.7	132.5	131.7	130.7	129.7	128.6	127.6	126.6	124.4	122.3
700	50,000	44.2	73.7	82.0	88.0	111.9	128.3	137.1	142.1	144.3	146.6	148.1	148.9	149.8	150.1	150.4	150.7	151.1	151.3	151.6	151.9	152.2	152.5	152.8	153.5	154.1
	60,000	52.2	84.0	93.5	100.7	130.1	148.5	158.1	163.3	165.7	168.1	169.3	169.6	169.9	169.8	169.9	169.6	169.6	169.3	169.3	169.3	168.9	168.9	168.9	168.6	168.2
	70,000	60.5	94.2	104.0	111.3	143.7	163.4	173.3	178.5	181.2	183.7	184.9	184.6	184.2	183.5	182.8	182.1	181.3	180.9	180.2	179.5	179.1	178.4	177.7	176.6	175.1
	80,000	69.4	103.7	115.0	123.0	157.6	178.5	188.7	193.8	196.2	198.9	199.8	198.7	197.5	196.4	195.2	193.7	192.5	191.3	190.2	189.1	187.9	186.8	185.6	182.9	180.6
	20,000	23.3	51.1	54.7	57.6	65.7	76.2	82.4	86.4	88.6	90.6	92.3	93.2	94.0	94.2	94.5	94.7	94.9	95.1	95.3	95.5	95.7	95.8	96.0	96.4	97.0
	30,000	33.5	72.1	75.5	78.0	87.8	101.4	109.3	114.2	116.9	119.4	121.5	122.2	123.0	123.0	123.0	122.7	122.7	122.7	122.5	122.5	122.5	122.2	122.2	122.0	122.0
	40,000	36.5	64.5	76.0	82.0	106.5	122.2	131.4	136.9	139.9	143.0	145.2	145.8	146.1	145.8	145.2	144.6	144.0	143.8	143.2	142.6	142.1	141.8	141.2	140.0	139.2
800	50,000	44.8	76.8	86.3	94.0	123.2	141.1	151.1	157.0	160.3	163.5	166.0	166.0	166.0	165.0	164.0	163.1	161.7	160.8	159.8	158.9	157.9	157.0	156.0	153.7	151.8
	60,000	52.9	87.1	95.5	102.0	127.0	147.6	158.3	164.4	167.3	170.4	172.5	173.5	174.9	175.3	176.0	176.7	177.1	177.8	178.1	178.8	179.5	180.2	180.6	181.7	183.0
	70,000	61.5	98.0	108.0	116.0	147.2	170.4	182.8	188.9	192.6	195.7	198.0	198.4	198.7	199.1	199.1	199.1	199.1	199.2	199.5	199.5	199.5	199.5	199.9	199.9	199.9
	80,000	70.2	107.3	118.0	127.0	161.8	186.9	199.8	206.3	209.8	213.1	215.1	215.1	214.6	214.2	213.8	213.0	212.5	212.1	211.7	211.3	210.4	210.0	209.6	208.7	207.4
	20,000	23.7	51.8	56.0	59.6	70.7	82.3	89.7	93.8	96.4	98.9	101.0	100.6	100.5	99.9	99.5	98.9	98.3	97.7	97.3	96.8	96.2	95.6	95.2	94.0	92.9
	30,000	34.5	73.5	76.3	78.2	83.6	98.1	106.8	111.8	114.8	117.5	120.0	121.2	122.4	122.9	123.4	123.9	124.1	124.6	125.1	125.6	126.1	126.6	127.1	128.1	129.1
	40,000	43.6	81.4	90.0	96.0	101.0	117.9	127.8	133.7	136.9	140.1	142.9	144.1	144.9	145.2	145.5	145.5	145.5	145.5	145.8	145.8	146.1	146.1	146.4	146.4	146.7
900	50,000	48.2	88.8	101.0	105.4	122.2	142.5	153.8	160.3	164.5	168.2	171.2	172.2	172.9	172.5	172.2	171.9	171.2	171.2	170.8	170.5	169.8	169.5	169.2	168.5	167.8
	60,000	53.5	94.8	106.1	112.0	138.3	160.7	173.2	180.4	184.6	188.7	192.4	192.7	193.1	192.0	191.3	190.2	189.0	188.2	187.1	186.4	185.3	184.2	183.4	181.5	179.3
	70,000	62.7	100.3	111.0	119.5	154.2	178.5	191.6	199.0	203.5	207.9	211.9	211.5	211.5	209.9	208.3	206.7	204.6	203.3	201.7	200.1	198.5	196.5	194.9	191.6	188.4
	80,000	70.7	109.8	120.0	127.9	168.2	187.3	202.3	210.1	214.2	218.6	222.1	222.5	223.4	223.9	224.3	224.3	224.3	224.8	225.2	225.7	226.1	226.5	227.0	227.5	227.9
	20,000	24.1	52.5	57.0	60.0	71.0	84.1	92.5	97.1	99.9	102.7	105.0	104.8	104.8	104.8	104.8	104.6	104.6	104.4	104.4	104.4	104.2	104.2	104.2	104.0	103.8
	30,000	34.9	74.3	78.9	81.8	91.6	107.8	118.0	123.8	127.2	130.8	133.9	133.7	133.4	132.9	132.6	131.9	131.3	130.8	130.3	129.8	129.3	129.0	128.5	127.2	126.1
	40,000	44.2	82.9	91.6	100.8	110.9	128.2	139.4	145.8	150.1	154.3	157.9	157.6	157.3	156.4	155.2	154.0	153.1	151.9	151.0	149.8	148.9	147.7	146.5	144.3	142.2
1000	50,000	53.9	102.3	110.5	112.3	117.4	139.3	152.0	159.1	163.7	167.9	172.1	173.5	175.2	175.5	175.9	176.2	176.3	176.9	177.3	177.6	178.0	178.3	178.7	179.4	180.1
	60,000	58.6	105.3	113.0	121.4	136.4	161.6	176.0	184.0	188.9	193.9	198.7	199.9	201.0	201.0	200.6	200.2	199.8	199.8	199.8	199.4	199.1	199.0	198.7	198.3	197.9
	70,000	63.3	109.3	118.8	127.5	151.1	178.8	193.9	202.6	207.8	213.3	218.4	219.2	220.1	219.2	218.4	217.5	216.2	215.3	214.5	213.7	212.8	212.0	211.1	208.9	207.3
	80,000	70.9	112.3	123.0	131.5	165.2	195.2	210.9	220.1	225.7	231.5	237.4	237.4	237.9	236.1	234.7	232.9	231.0	229.2	227.8	226.0	224.2	222.9	221.3	217.3	214.2
	Stroke	0	0.2	1.2	2	6	12	18	24	30	36	49	61	73	85	97	109	122	134	146	158	170	182	194	219	243

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TABLE 18. C13 Costant Pressure Ctapul (CVA67), Upper Boundary, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) — NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND CSV SETTING

CSV Setting	Stroke / Weight (LBS)	0	0.2	1.2	2	6	12	18	24	30	36	49	61	73	85	97	109	122	134	146	158	170	182	194	219	243
	10,000	6.0	7.2	7.4	7.6	7.9	9.0	10.5	11.7	12.3	12.9	14.0	15.3	16.3	16.9	18.1	19.3	20.6	21.4	22.3	22.6	22.4	21.6	20.4	16.4	13.3
	20,000	10.8	12.5	12.8	13.8	14.7	15.5	17.8	19.5	20.8	21.8	23.7	25.3	26.7	28.0	29.5	31.0	32.4	33.4	34.3	34.7	34.4	33.1	30.9	25.5	19.4
	30,000	15.7	18.3	18.9	19.6	20.0	20.5	23.4	25.4	27.2	28.6	30.9	32.7	34.4	36.1	37.6	38.9	40.0	41.0	41.8	42.3	42.5	40.8	38.0	33.1	25.4
40	40,000	20.0	23.0	23.4	23.7	24.9	26.0	29.6	32.1	34.0	35.6	38.4	40.5	42.5	44.2	45.8	47.0	47.7	48.8	49.7	50.2	50.5	48.3	44.8	40.0	31.2
	50,000	25.0	29.5	30.2	31.2	32.0	33.6	37.5	40.7	42.6	44.5	47.6	49.9	52.0	53.9	55.5	56.7	57.6	58.6	59.6	59.7	58.9	55.3	50.9	43.1	32.3
	60,000	33.4	44.3	47.3	47.9	49.6	53.1	56.5	60.1	61.6	63.3	65.8	67.1	68.0	68.3	68.1	67.6	67.2	65.8	64.4	62.0	57.3	51.1	45.1	32.9	21.0
	70,000	38.2	49.4	53.9	54.8	56.5	60.4	63.7	68.0	69.2	71.0	73.5	75.0	75.7	75.9	75.4	74.5	74.2	72.5	70.8	67.7	61.1	52.9	46.2	32.5	18.3
	80,000	42.8	54.0	61.4	62.4	63.8	68.3	71.2	76.5	77.4	79.2	81.8	83.2	83.7	83.7	83.0	81.5	81.4	79.3	77.4	73.5	64.5	54.2	46.7	32.1	15.0
	10,000	7.6	10.0	10.9	12.1	12.4	13.0	14.9	16.2	17.0	17.8	19.3	20.7	21.7	22.5	23.6	24.7	25.9	26.7	27.4	27.8	28.0	28.0	27.1	23.0	19.2
	20,000	14.7	17.8	19.6	20.4	21.1	22.7	25.7	27.9	29.6	30.9	33.3	35.0	36.5	38.0	39.5	41.0	42.3	43.4	44.4	45.0	45.0	43.9	41.6	35.4	28.6
	30,000	20.1	24.7	26.7	27.8	29.8	31.2	35.4	38.1	40.4	42.1	45.0	46.8	48.9	50.7	52.3	53.7	54.7	56.0	57.2	57.9	57.8	55.7	52.1	45.0	36.2
60	40,000	26.0	32.9	33.8	34.5	36.9	39.9	45.3	48.7	51.1	53.1	56.4	58.3	60.8	62.7	64.2	65.4	66.4	67.8	69.0	69.6	69.5	66.6	61.9	53.8	42.9
	50,000	32.0	40.8	42.6	43.0	46.2	48.9	54.8	59.1	61.7	63.7	67.2	69.2	71.6	73.6	75.1	76.3	77.5	78.9	80.1	80.5	79.3	74.7	69.3	58.3	45.6
	60,000	37.9	49.0	50.8	51.4	54.6	59.2	65.6	71.0	73.5	75.6	79.2	81.5	83.6	85.4	87.1	88.1	89.6	90.9	92.0	92.0	89.4	83.1	76.8	62.2	47.3
	70,000	43.3	68.8	73.5	74.8	79.0	84.4	89.9	95.0	96.8	98.3	100.5	101.6	102.0	101.8	101.3	100.3	99.9	97.9	95.7	92.7	85.8	76.5	68.4	51.4	34.5
	80,000	55.1	74.7	82.1	83.4	87.4	93.3	98.2	103.9	105.5	107.3	109.2	110.3	110.3	110.3	109.5	108.1	107.8	105.5	103.0	99.5	90.3	79.5	70.4	52.5	33.2
	10,000	8.6	12.2	13.2	13.6	15.2	17.4	19.7	20.9	22.0	23.1	24.9	26.2	27.2	28.1	28.9	29.7	30.6	31.2	31.6	32.1	32.8	34.0	33.9	30.1	25.8
	20,000	16.4	21.3	24.1	24.6	27.2	30.8	34.6	37.1	39.2	40.8	43.4	45.1	46.8	48.1	49.4	50.6	51.4	52.5	53.6	54.3	54.7	54.2	52.3	45.7	39.1
	30,000	24.0	31.1	34.4	35.1	38.2	42.9	48.6	51.9	54.5	56.3	59.4	60.8	63.1	64.7	65.9	67.1	67.9	69.5	71.0	71.7	71.5	69.0	65.1	55.6	46.8
80	40,000	31.4	41.9	44.4	45.1	48.5	54.6	62.0	65.9	68.8	70.7	74.1	75.0	77.9	79.6	80.6	81.5	82.7	84.4	85.9	86.4	85.6	81.9	76.6	64.3	52.7
	50,000	39.1	52.9	55.1	55.4	58.9	66.7	75.2	80.4	83.5	85.6	88.9	90.3	92.6	94.2	95.3	96.4	97.8	99.5	101.0	101.5	100.0	94.8	88.5	73.9	60.0
	60,000	45.6	62.8	65.2	65.3	69.4	78.7	88.1	94.6	98.1	99.9	103.2	105.0	106.5	107.9	109.0	110.2	111.9	113.6	114.9	115.3	113.0	106.2	99.1	82.0	66.0
	70,000	60.5	90.2	94.4	95.0	99.5	108.3	116.4	121.6	124.3	125.0	126.1	126.3	125.9	125.3	124.6	123.8	123.3	121.3	118.8	116.7	110.5	101.7	92.4	73.7	55.7
	80,000	68.6	99.5	104.2	105.1	110.6	119.5	127.3	132.5	135.1	136.4	137.2	137.1	136.5	136.2	135.8	134.9	134.0	131.7	129.0	126.7	118.7	109.0	98.7	78.4	58.9
	10,000	9.3	12.9	16.6	17.2	19.7	23.6	25.5	27.1	28.2	29.5	31.5	32.4	33.1	34.0	34.7	35.6	36.6	37.1	37.6	38.1	38.7	39.6	39.6	36.1	31.5
	20,000	18.6	25.2	31.7	32.6	35.4	39.6	45.5	48.4	50.6	52.2	54.1	55.7	56.9	58.0	58.8	60.0	61.1	62.1	63.1	64.0	64.5	64.3	62.8	55.8	48.2
	30,000	27.8	38.1	46.0	46.9	50.6	56.1	63.9	67.7	70.4	71.9	74.1	75.4	76.9	78.2	79.2	80.2	81.2	82.6	83.9	84.6	84.8	83.5	80.2	69.5	59.1
100	40,000	42.3	50.3	77.0	78.3	83.1	90.1	95.6	97.7	99.4	100.4	101.8	101.5	102.2	101.8	101.1	99.9	98.4	97.2	95.6	94.0	91.2	87.7	81.5	67.3	53.7
	50,000	52.3	82.1	90.0	91.5	97.2	105.7	111.8	114.6	116.2	117.1	118.4	118.4	118.4	117.8	116.8	115.3	113.8	112.4	110.4	108.3	105.1	100.5	92.9	76.3	60.1
	60,000	62.2	96.2	102.9	104.5	111.3	121.1	127.8	131.1	133.0	133.6	134.3	134.3	134.0	133.1	132.0	130.2	128.7	127.0	124.3	122.3	118.4	112.3	103.2	84.2	65.8
	70,000	71.9	109.5	115.7	116.9	123.2	134.1	141.0	144.3	146.1	147.8	148.5	147.8	146.5	145.5	144.3	142.5	140.9	138.9	136.1	133.9	129.1	121.9	111.8	90.8	70.4
	80,000	81.1	122.5	127.9	129.3	135.7	146.5	153.3	156.7	158.9	159.5	160.8	159.3	158.2	157.4	156.3	154.4	152.6	150.5	147.5	144.8	139.1	131.3	120.1	96.8	74.7
	10,000	9.8	13.4	21.0	21.7	23.2	30.5	31.7	33.6	34.8	36.1	38.3	38.5	38.9	39.5	40.3	41.1	42.0	42.6	43.2	43.7	44.1	44.4	44.6	41.9	37.0
	20,000	19.0	27.4	38.5	40.5	43.8	48.3	56.5	59.8	62.2	63.5	64.4	65.3	65.9	66.5	66.9	68.0	69.1	70.0	70.7	71.5	72.3	72.6	71.9	65.0	56.8
	30,000	32.5	56.9	73.5	75.1	79.3	83.6	91.5	93.4	95.4	95.8	98.0	95.8	95.3	94.5	93.5	92.0	90.4	89.4	88.1	86.8	85.3	84.4	81.0	68.6	56.5
120	40,000	43.1	74.7	90.6	92.8	98.7	109.1	113.2	114.5	115.3	115.6	116.9	116.1	115.2	114.0	113.0	111.0	108.7	107.4	105.6	103.7	101.3	100.1	94.6	79.3	63.9
	50,000	53.5	90.2	106.8	109.5	116.8	128.8	133.5	134.5	135.4	135.7	136.2	135.7	134.8	133.6	132.2	129.9	127.4	125.8	123.5	121.4	118.8	116.5	109.1	91.2	72.8
	60,000	64.2	105.0	120.9	124.2	132.7	146.8	151.5	152.4	153.2	154.5	155.5	153.0	152.2	151.2	149.3	146.5	143.9	141.8	138.9	136.8	134.2	130.5	121.2	100.8	80.1
	70,000	74.8	121.3	134.5	138.1	149.1	162.4	167.2	167.9	168.8	170.1	168.8	167.9	167.1	165.6	163.6	160.8	158.0	155.9	152.8	150.5	147.9	143.6	132.5	109.5	86.5
	80,000	85.6	139.3	149.8	153.5	166.0	177.0	181.9	182.7	183.9	186.0	183.6	182.3	181.1	179.5	177.4	174.2	171.5	169.0	166.2	163.4	160.6	156.2	143.6	117.9	92.9
	10,000	12.0	23.5	31.2	34.7	40.1	45.3	46.6	47.7	48.5	49.5	50.3	50.2	49.8	49.6	49.4	48.3	47.5	47.1	46.4	45.7	44.8	44.6	44.0	41.1	38.6
	20,000	22.4	42.6	57.1	61.7	69.0	74.1	78.7	80.3	81.9	82.7	82.7	82.6	82.2	81.6	80.7	79.3	77.9	77.0	76.0	74.9	73.8	73.0	71.2	65.1	56.2
	30,000	33.2	73.9	80.1	85.5	95.6	102.0	107.6	108.0	108.5	109.0	109.0	108.7	108.3	107.5	107.0	105.3	103.3	101.9	100.6	99.2	97.7	96.3	93.1	83.3	70.6
140	40,000	44.5	85.3	99.6	105.3	118.6	128.0	132.1	132.4	133.3	133.2	133.1	132.7	132.0	130.6	129.2	127.1	124.6	123.2	121.4	119.5	117.2	115.3	110.8	97.5	83.8
	50,000	55.6	101.1	118.9	125.2	139.6	149.7	154.2	154.6	155.1	155.1	154.9	154.3	153.2	152.1	150.5	147.9	145.0	143.4	141.2	139.0	136.6	133.7	127.8	111.9	95.2
	60,000	65.8	115.5	135.2	142.2	158.0	169.6	174.6	174.8	175.1	175.1	174.5	173.8	172.6	171.4	169.6	166.6	163.7	161.5	158.8	157.0	154.3	150.3	142.8	124.3	104.6
	70,000	74.9	131.2	150.9	158.1	174.9	187.4	192.5	192.7	193.0	192.7	191.7	190.7	189.3	188.0	186.0	183.0	180.2	178.1	175.2	172.8	170.2	165.5	156.3	135.2	112.9
	80,000	85.6	150.7	169.6	176.2	192.5	205.7	210.9	210.8	211.1	210.5	209.2	207.8	206.3	204.5	202.7	199.5	196.7	194.9	192.3	189.8	186.5	181.1	170.3	146.1	121.8
	10,000	12.4	28.0	39.5	44.1	50.3	54.2	56.9	57.8	58.8	59.8	60.0	60.2	59.6	59.1	58.2	56.6	55.3	54.9	53.8	52.6	51.4	51.5	50.5	49.4	49.9
	20,000	23.0	47.4	64.7	70.3	79.9	87.7	89.6	90.5	91.3	91.9	91.8	91.7	91.0	90.2	89.1	87.0	84.9	83.8	82.7	81.4	80.1	79.1	77.2	74.4	65.5
	30,000	33.8	70.9	88.5	95.6	108.8	118.5	120.6	120.9	121.5	121.6	120.7	120.2	119.6	118.5	117.3	114.9	112.6	111.1	109.7	108.4	106.9	104.8	102.2	96.4	83.8
160	40,000	45.3	95.4	109.8	118.7	135.2	144.6	148.4	147.8	148.3	148.1	146.7	146.2	145.4	144.4	142.5	140.2	137.4	135.9	134.3	132.8	130.7	128.1	125.0	115.2	104.6
	50,000	57.1	111.8	128.8	137.9	157.1	167.2	171.8	171.1	171.3	170.8	169.5	168.9	167.7	166.5	164.7	161.7	159.1	157.3	155.2	153.7	151.3	147.7	143.8	132.0	118.2
	60,000	67.9	125.7	147.0	156.0	178.4	188.8	194.0	193.5	193.1	192.5	191.0	190.3	188.7	187.3	185.3	182.3	179.4	177.3	175.0	173.3	170.9	166.5	161.8	147.1	129.9
	70,000	77.5	142.6	165.4	173.9	196.5	207.8	212.8	212.2	211.9	210.4	208.8	207.7	205.8	204.7	202.9	199.6	196.8	195.3	192.7	190.9	187.9	183.1	176.9	159.6	139.6
	80,000	87.4	162.1	183.8	191.7	213.0	225.6	230.5	229.6	229.1	226.9	225.0	223.0	221.8	220.2	218.2	215.4	212.9	212.5	209.7	208.1	204.1	198.5	190.6	170.2	148.3
	10,000	13.3	30.4	44.9	49.4	57.3	64.8	65.4	66.5	67.5	68.0	67.8	66.5	65.1	64.2	63.5	62.6	60.0	59.1	58.2	57.3	56.3	56.1	55.2	53.4	52.1
	20,000	24.0	52.2	72.8	78.6	89.7	100.0	102.7	102.8	102.8	102.6	102.2	100.1	98.8	97.6	96.9	95.1	92.0	90.5	89.3	88.2	87.2	86.3	84.7	82.0	74.6
	30,000	34.6	78.1	99.7	106.9	119.9	131.4	134.1	135.2	134.2	133.8	132.3	130.4	129.3	127.6	126.5	124.2	121.4	119.8	118.4	117.2	115.6	114.2	112.3	107.9	98.1
180	40,000	46.3	104.9	124.7	133.3	148.5	159.8	164.0	163.8	163.8	163.0	160.6	158.9	157.7	156.0	154.0	152.0	149.5	147.8	146.4	144.7	142.7	140.7	138.4	131.8	122.6
	50,000	58.3	122.3	145.4	155.0	173.8	186.2	190.7	190.6	189.9	188.9	186.1	184.5	183.1	181.5	179.5	177.2	174.6	172.7	170.7	169.0	166.3	163.7	160.4	151.7	139.4
	60,000	69.1	135.9	162.3	171.9	194.0	206.8	212.1	211.6	210.2	208.7	205.9	204.4	203.0	201.5	199.6	197.1	194.3	192.5	190.2	188.0	185.1	181.8	177.0	166.6	150.7
	70,000	78.9	153.4	179.9	189.7	212.5	226.4	231.9	230.9	229.3	227.3	224.3	223.1	221.4	219.8	218.2	215.8	213.2	211.2	208.8	206.4	202.8	198.7	192.8	179.7	161.6
	80,000	88.6	172.6	197.4	206.7	229.4	244.3	248.9	247.8	246.1	243.5	240.7	239.4	238.5	236.8	235.1	232.5	230.2	228.8	225.8	223.2	218.4	214.1	207.3	190.6	170.7
	20,000	26.1	57.6	78.7	84.4	96.6	109.5	112.8	112.0	110.9	110.1	109.1	104.9	103.2	101.3	101.3	99.8	95.4	93.9	92.6	91.8	90.9	90.3	89.4	86.6	81.6
	30,000	36.4	86.9	111.6	118.7	131.8	144.8	148.6	148.5	147.7	146.7	144.4	140.7	139.1	136.6	135.8	133.8	130.3	128.6	127.0	126.0	124.7	124.0	123.2	120.5	114.2
	40,000	47.9	115.0	139.3	147.6	161.5	174.3	178.5	179.3	178.7	177.5	173.5	170.8	168.9	166.4	164.5	162.7	160.6	158.8	157.2	155.7	153.8	152.9	151.6	148.6	141.2
200	50,000	60.8	133.7	159.8	169.4	186.8	201.1	206.0	205.9	204.8	202.8	198.5	196.0	194.2	192.1	190.3	188.2	186.2	184.1	182.3	180.5	177.6	176.2	173.7	169.1	158.7
	60,000	71.6	147.3	175.8	186.4	207.1	223.1	228.5	227.5	225.2	222.8	218.2	216.2	214.6	212.6	211.5	209.5	206.9	205.0	203.0	200.6	197.4	195.1	190.8	185.2	171.8
	70,000	80.9	163.9	192.1	203.1	225.7	242.5	247.6	246.1	243.6	240.6	236.4	234.7	233.8	231.7	230.8	229.1	226.4	224.2	221.6	219.0	214.7	211.7	206.6	198.4	183.0
	80,000	91.1	184.3	208.8	219.0	242.9	260.8	264.5	262.9	260.2	257.0	253.0	252.6	252.1	249.8	249.3	247.0	244.6	242.2	239.0	235.3	230.2	227.0	221.5	209.9	192.5
	20,000	29.2	66.7	90.4	96.1	107.7	120.2	123.5	122.7	121.6	120.9	119.7	115.7	114.3	112.2	111.9	110.7	107.4	106.2	105.5	105.1	104.5	103.8	102.8	99.5	94.7
	30,000	39.4	98.2	127.9	134.2	145.8	157.7	160.7	159.4	158.6	157.5	155.1	151.5	149.6	146.8	145.5	143.5	140.9	139.3	138.2	137.1	136.2	135.1	133.8	129.8	123.7
	40,000	49.4	123.9	156.1	163.9	176.7	189.0	192.2	190.7	189.7	188.7	184.8	181.9	180.2	177.2	174.9	172.9	170.7	168.8	167.1	165.8	164.1	162.8	161.1	156.6	149.7
220	50,000	61.7	142.7	178.4	187.6	203.6	217.8	220.7	219.0	217.5	215.9	211.9	209.2	207.3	204.3	202.0	199.7	197.2	194.9	193.0	190.8	188.5	186.6	183.5	178.3	170.3
	60,000	73.2	157.6	195.7	206.1	225.1	240.7	243.6	241.2	239.1	237.4	233.0	230.5	228.8	225.8	223.7	221.2	218.5	216.0	213.5	210.1	207.2	205.1	200.9	195.1	185.9
	70,000	82.4	175.2	213.3	224.3	245.1	261.6	263.8	261.2	258.9	256.6	252.3	250.5	249.1	245.9	244.1	241.4	238.0	235.2	232.0	228.4	224.3	221.1	216.2	208.1	196.7
	80,000	93.3	195.7	228.2	239.5	262.0	278.0	279.8	277.1	274.7	272.3	268.6	267.2	265.7	262.8	261.4	258.5	254.4	251.0	247.2	242.8	238.0	233.7	228.4	216.8	202.4
	30,000	43.2	110.1	143.9	149.5	159.3	169.6	171.8	169.1	168.1	166.9	164.1	160.9	159.1	156.2	154.1	152.0	150.4	148.7	148.1	147.2	146.6	145.5	143.7	137.9	132.1
	40,000	52.9	135.5	175.6	182.7	194.1	205.8	206.5	204.1	202.6	201.5	198.1	194.9	192.8	189.2	186.7	184.6	182.3	180.2	178.8	177.0	175.9	174.2	171.7	165.4	159.8
240	50,000	64.0	154.3	199.6	208.4	222.4	234.2	235.5	233.5	231.7	230.5	226.6	223.8	221.3	217.7	215.2	212.0	209.3	206.5	204.5	201.6	200.0	198.0	194.8	188.4	183.2
	60,000	77.0	171.5	218.2	228.7	250.8	259.8	259.2	256.8	254.9	253.5	249.3	247.0	244.8	240.8	238.1	234.5	231.1	228.0	224.9	221.3	218.7	216.0	212.0	206.4	201.9
	70,000	85.5	186.9	233.0	244.5	267.7	278.4	277.7	274.0	272.0	270.6	266.6	264.7	262.3	258.0	255.6	251.8	247.3	243.9	240.1	235.4	231.6	228.3	223.5	215.6	209.0
	80,000	95.4	207.4	247.8	259.8	283.4	295.1	293.9	290.5	287.5	286.3	283.2	281.1	278.6	274.6	271.6	268.6	263.3	258.8	254.3	248.8	244.2	238.8	233.7	222.3	211.3
	30,000	45.5	120.8	160.3	165.0	177.7	181.0	182.0	177.9	176.5	175.8	172.5	169.7	167.9	164.4	161.6	160.1	159.0	157.5	157.8	156.9	156.9	155.3	153.2	145.1	140.2
	40,000	56.7	145.2	190.4	196.7	211.4	217.4	216.9	211.2	209.5	208.7	205.2	201.9	199.7	195.7	193.4	190.5	188.1	185.9	185.2	183.4	182.6	180.4	177.5	169.5	165.1
260	50,000	67.4	163.4	214.4	222.3	239.4	246.6	244.8	239.5	237.6	236.8	233.2	230.3	227.8	223.2	220.3	217.0	213.8	210.9	208.8	205.5	204.3	202.2	198.5	191.6	189.5
	60,000	78.9	180.4	234.3	243.9	263.2	271.5	268.3	263.3	261.7	261.2	257.4	254.7	252.3	247.3	244.1	240.0	235.6	232.4	228.7	224.1	221.8	219.6	215.9	210.3	211.6
	70,000	76.6	185.9	249.6	260.8	282.3	290.8	286.3	281.9	279.8	279.2	275.7	273.7	270.3	265.4	262.0	257.6	251.9	248.0	243.1	237.8	234.9	231.0	226.6	219.1	217.6
	80,000	98.1	217.8	264.3	277.0	299.7	308.2	303.9	299.3	296.6	296.0	293.8	291.2	287.6	282.5	278.4	274.3	267.7	262.6	256.9	250.3	246.7	240.6	235.5	224.3	217.2
	Stroke	0	0.2	1.2	2	6	12	18	24	30	36	49	61	73	85	97	109	122	134	146	158	170	182	194	219	243

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TABLE 19. C13 Constant Pressure Catapult (CVA67), Mean, Load vs STroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) — NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND CSV SETTING

CSV Setting	Stroke	0	0.2	1.2	2	6	12	18	24	30	36	49	61	73	85	97	109	122	134	146	158	170	182	194	219	243
	Weight (LBS)																									
	10,000	6.5	8.5	8.9	9.1	9.3	10.9	12.3	13.4	14.0	14.5	15.6	16.6	17.2	17.6	18.6	19.3	20.1	20.5	21.0	21.0	20.5	19.5	17.9	13.9	10.8
	20,000	11.6	14.8	16.1	16.0	16.0	18.5	20.6	22.1	23.3	24.1	25.8	27.0	28.0	28.9	29.9	30.8	31.5	32.0	32.3	32.2	31.5	29.7	27.1	21.8	15.7
	30,000	16.9	20.5	20.8	20.9	21.7	24.2	26.9	28.7	30.3	31.5	33.5	34.8	36.1	37.0	37.9	38.7	39.1	39.4	39.6	39.4	38.9	36.9	33.6	28.7	21.1
40	40,000	21.5	26.1	26.2	26.3	27.4	30.1	33.4	35.6	37.3	38.8	41.2	42.6	44.1	45.0	45.9	46.5	46.6	47.8	46.8	46.4	45.9	43.5	39.7	34.6	26.3
	50,000	26.9	32.5	32.8	33.0	34.8	37.5	41.0	43.9	45.7	47.3	49.9	51.5	52.9	54.0	54.8	55.2	55.5	55.5	55.3	54.6	52.9	49.0	44.5	36.6	26.5
	60,000	31.2	39.5	39.8	40.1	41.9	44.8	48.3	52.0	53.5	55.3	58.0	59.7	61.2	62.2	62.9	63.2	63.5	63.3	63.0	61.8	58.4	52.9	47.6	36.5	24.8
	70,000	35.7	44.4	46.0	47.3	48.5	52.0	55.3	59.6	61.1	62.8	65.6	67.4	68.7	69.7	70.2	70.1	70.6	70.1	69.6	67.9	62.7	55.3	49.4	36.6	22.8
	80,000	40.0	48.8	53.6	54.4	56.5	59.7	62.6	67.8	68.9	70.7	73.4	75.4	76.5	77.5	77.7	77.1	77.8	76.9	76.3	73.9	66.5	57.1	50.4	36.7	20.1
	10,000	8.2	11.2	12.1	12.4	13.3	15.1	16.9	18.1	18.8	19.5	20.8	21.9	22.5	23.1	23.9	24.5	25.3	25.6	25.9	25.9	25.7	25.3	24.0	19.8	16.1
	20,000	15.8	20.8	21.6	22.0	23.7	26.2	28.9	30.8	32.3	33.4	35.3	36.7	37.8	38.8	39.7	40.5	41.2	41.6	41.9	41.9	41.3	39.7	36.9	30.7	24.0
	30,000	21.6	28.5	29.7	30.3	32.2	35.6	39.4	41.7	43.7	45.1	47.5	48.8	50.4	51.5	52.3	52.9	53.2	53.7	53.9	53.7	53.0	50.4	46.5	39.4	30.7
60	40,000	28.0	37.7	38.4	38.7	40.6	44.8	49.6	52.4	54.6	56.2	59.0	60.1	61.9	63.0	63.7	64.3	64.4	64.6	64.7	64.3	63.2	59.9	55.1	46.9	36.5
	50,000	34.4	46.1	46.6	47.8	49.0	53.9	59.2	62.8	65.1	66.7	69.5	70.9	72.6	73.5	74.2	74.7	74.9	74.9	74.9	74.2	71.9	67.1	61.4	50.5	38.4
	60,000	40.7	54.4	55.1	56.4	58.1	63.5	69.2	73.8	76.0	77.7	80.5	82.1	83.3	84.2	84.8	84.9	85.5	85.4	84.9	83.8	80.2	73.6	67.2	53.2	39.1
	70,000	46.1	61.5	63.2	65.0	67.2	72.8	78.5	83.7	85.8	87.5	90.3	92.0	93.1	93.9	94.4	94.4	94.8	94.5	93.9	92.3	86.9	78.7	71.5	55.5	39.3
	80,000	51.5	67.1	71.9	73.4	75.9	81.5	86.6	92.2	94.1	95.9	98.5	100.2	101.2	102.1	102.3	101.9	102.6	102.1	101.2	99.1	91.9	82.1	73.9	57.1	38.6
	10,000	9.3	14.2	15.4	16.1	18.0	20.1	22.2	23.3	24.2	25.2	26.6	27.6	28.3	29.0	29.5	29.8	30.3	30.4	30.4	30.5	30.8	31.4	30.7	26.8	22.6
	20,000	17.6	24.8	27.8	29.5	30.9	34.6	38.1	40.1	42.0	43.3	45.4	46.8	48.0	48.9	49.5	50.0	50.1	50.2	50.4	50.6	50.2	49.7	47.4	40.6	34.0
	30,000	25.8	36.1	39.3	41.2	43.0	47.5	52.5	55.1	57.4	58.8	61.2	62.2	64.1	65.0	65.6	65.9	65.9	66.4	66.7	66.6	65.6	62.8	58.6	49.2	40.5
80	40,000	33.8	48.3	50.5	52.2	53.7	59.9	66.3	69.5	71.8	73.4	75.9	76.4	78.5	79.4	79.7	79.9	80.0	80.4	80.6	80.1	78.3	74.3	68.7	56.8	45.8
	50,000	42.0	60.0	61.3	62.8	65.2	72.2	79.7	83.9	86.6	88.1	90.4	91.0	92.8	93.5	93.8	94.0	94.3	94.5	94.3	93.8	91.2	85.8	79.2	65.1	51.8
	60,000	49.0	70.6	71.3	73.7	76.1	84.0	92.3	97.8	100.5	101.9	104.1	104.5	105.0	105.3	105.5	105.7	106.2	106.2	105.9	105.1	102.8	95.8	88.4	72.1	56.5
	70,000	56.5	80.1	80.7	82.0	85.8	94.4	102.7	108.5	111.5	112.8	114.8	115.8	116.4	116.6	116.8	117.0	117.6	117.4	116.8	115.9	111.5	103.4	95.1	77.2	60.2
	80,000	64.1	89.2	90.0	91.5	95.7	104.7	112.8	118.4	121.4	122.8	124.7	125.8	126.2	126.6	126.9	127.1	127.5	127.3	126.4	125.7	119.6	110.9	101.4	82.3	63.9
	10,000	10.0	15.4	19.2	21.1	22.3	26.7	28.3	29.6	30.6	31.7	33.3	33.9	34.3	34.9	35.4	35.7	36.0	36.1	36.2	36.2	36.4	36.7	36.3	32.5	27.9
	20,000	20.0	29.5	35.6	37.8	39.5	43.9	49.2	51.5	53.5	54.9	56.4	57.3	58.1	58.7	59.2	59.5	59.6	59.8	60.0	60.0	59.9	59.2	57.3	50.0	42.5
	30,000	29.9	44.3	51.1	53.2	56.1	61.2	67.9	70.7	73.1	74.3	75.8	76.6	77.8	78.2	78.5	78.6	78.5	78.8	78.9	78.7	77.9	76.1	72.4	61.7	51.4
100	40,000	39.5	58.7	64.3	66.5	71.4	78.8	85.0	87.9	90.0	91.1	93.2	93.4	94.6	95.1	95.3	95.1	94.9	95.1	94.9	94.4	92.9	90.4	84.9	71.5	58.3
	50,000	48.9	72.0	76.3	78.0	84.5	92.9	99.7	103.1	105.4	106.4	108.3	108.7	109.6	110.0	110.5	109.8	109.6	109.6	109.2	108.6	106.7	103.0	96.6	80.6	65.3
	60,000	58.1	85.2	89.0	91.3	97.1	107.5	114.9	119.0	121.3	122.2	123.7	124.3	125.0	125.0	125.0	124.6	124.5	124.5	123.6	123.0	120.5	115.7	108.2	89.4	71.5
	70,000	67.2	98.0	101.2	103.2	108.9	119.8	127.4	131.7	133.9	135.0	136.3	137.0	137.3	137.8	137.0	136.8	136.8	136.5	135.5	134.8	131.6	125.9	117.2	96.6	77.0
	80,000	75.8	110.2	112.8	113.9	120.7	131.6	139.1	143.1	145.5	146.7	147.8	148.3	148.3	148.6	148.3	148.1	147.8	147.5	146.5	145.7	141.8	135.2	125.1	102.8	81.6
	10,000	10.5	16.4	22.7	24.1	26.3	34.0	34.9	36.4	37.3	38.5	40.2	40.1	40.2	40.5	40.9	41.1	41.2	41.5	41.5	41.5	41.4	41.3	41.3	37.9	33.2
	20,000	20.4	32.5	42.9	45.0	47.6	53.0	60.4	62.9	65.0	66.1	66.7	67.1	67.2	67.4	67.3	67.4	67.4	67.5	67.4	67.4	67.4	67.3	66.2	58.7	50.5
	30,000	30.4	49.0	62.0	64.1	68.5	74.3	83.0	85.9	88.0	88.6	89.0	89.4	90.4	89.3	88.9	88.8	88.4	88.4	88.3	88.0	87.6	87.3	84.6	73.2	61.6
120	40,000	40.3	64.6	78.1	80.3	86.1	97.4	102.8	105.2	106.4	106.9	108.1	109.3	107.9	107.7	107.5	107.1	106.3	106.3	105.9	105.3	104.4	104.0	99.4	84.8	70.2
	50,000	50.0	78.5	93.0	95.7	103.5	115.8	121.6	123.8	125.0	125.5	126.4	126.7	126.4	126.2	126.0	125.3	124.4	124.3	123.4	122.7	121.8	120.9	115.1	97.2	79.9
	60,000	60.0	92.8	107.8	110.3	118.7	132.3	138.1	140.2	141.3	141.9	142.4	142.7	142.4	142.4	141.7	140.9	140.1	139.8	138.5	137.8	136.7	135.2	127.9	107.3	87.4
	70,000	69.9	108.3	122.6	125.0	133.9	147.6	153.5	155.6	156.8	157.1	157.4	157.4	157.4	157.1	156.3	155.4	154.5	154.2	152.8	152.0	150.8	148.9	140.0	116.9	94.9
	80,000	80.0	125.7	137.7	139.7	148.1	161.2	167.2	169.1	170.4	170.8	171.1	170.8	170.6	170.2	168.9	168.0	167.4	166.7	165.5	164.6	163.7	161.3	150.8	125.4	101.6
	10,000	11.2	19.6	30.8	32.2	35.0	40.5	42.3	43.9	44.9	46.1	47.2	47.9	48.5	48.0	47.6	47.4	47.3	47.3	47.2	47.1	46.9	46.7	46.5	44.3	41.8
	20,000	20.9	35.6	54.2	56.3	60.7	65.7	71.2	73.6	75.4	76.3	76.8	77.0	76.9	76.9	76.6	76.3	76.3	76.2	76.0	76.0	75.8	75.5	74.3	68.7	60.2
	30,000	31.0	54.7	76.8	79.1	85.2	91.4	98.2	100.6	102.2	102.6	103.0	103.0	102.8	102.6	102.3	101.9	101.5	101.5	101.3	101.1	100.6	99.8	97.4	88.2	75.9
140	40,000	41.6	73.1	94.5	97.6	105.8	114.9	120.4	122.4	123.3	123.6	125.1	124.1	123.6	123.4	122.9	122.7	122.0	122.0	121.5	121.1	120.4	119.0	115.2	103.0	89.9
	50,000	52.0	88.2	112.6	115.8	125.9	134.9	141.0	143.0	143.9	144.2	144.4	144.4	143.9	143.6	143.1	142.3	141.8	141.8	141.2	140.7	139.7	137.8	132.9	117.6	101.9
	60,000	61.5	101.6	130.9	133.8	144.1	154.0	160.3	161.9	162.6	162.9	162.9	162.9	162.3	162.3	161.4	160.5	159.9	159.9	159.0	158.4	157.2	154.6	148.7	130.6	111.7
	70,000	70.0	116.7	147.0	149.9	160.6	170.7	177.0	178.8	179.6	179.2	179.2	178.8	178.2	177.9	176.9	176.2	175.9	175.9	174.9	174.2	173.3	170.0	162.3	141.8	120.7
	80,000	80.0	135.6	164.7	167.2	178.1	188.1	194.0	194.8	195.5	194.9	194.5	194.3	194.1	193.7	193.0	191.9	191.9	192.3	191.5	190.8	189.4	185.5	176.4	152.9	129.9
	10,000	11.6	22.6	30.7	35.2	41.5	45.8	49.0	50.5	51.5	52.6	53.9	54.3	53.9	52.7	52.2	51.8	51.7	51.6	51.1	50.8	50.5	50.7	50.0	49.2	49.8
	20,000	21.5	39.9	53.9	59.6	69.9	78.4	81.4	83.3	84.3	85.1	85.3	85.5	85.2	84.9	84.2	83.8	83.4	83.3	82.9	82.8	82.3	82.0	80.6	77.9	69.2
	30,000	31.6	60.4	74.6	81.8	95.7	106.7	110.4	111.9	112.8	113.0	112.8	112.8	112.4	112.2	111.6	111.2	110.7	110.5	110.5	110.3	109.9	108.4	106.6	101.1	88.8
160	40,000	42.3	81.9	92.8	101.8	119.1	130.4	135.9	137.3	138.1	137.9	137.3	137.1	136.6	136.3	135.6	135.3	134.8	134.8	134.8	134.5	133.7	131.5	128.7	120.5	110.3
	50,000	53.4	97.4	110.6	119.8	140.3	151.9	158.2	159.6	159.9	159.9	159.3	159.0	158.1	157.9	157.0	156.7	156.4	156.4	156.1	155.8	154.9	151.7	148.4	137.5	124.6
	60,000	63.5	110.6	128.3	137.2	160.4	172.2	178.9	180.1	180.4	180.1	179.8	179.4	178.1	177.8	176.8	176.1	176.1	176.1	175.8	175.4	174.5	170.5	166.2	152.9	136.7
	70,000	72.4	126.9	145.5	154.0	177.3	190.2	196.8	198.1	197.8	197.1	196.3	195.6	194.5	194.2	193.4	192.7	192.7	193.4	193.1	193.1	191.6	187.0	181.6	165.4	146.6
	80,000	81.7	145.3	163.3	171.2	192.9	207.2	213.6	214.6	214.2	212.8	211.4	210.2	209.1	208.7	208.3	207.9	208.4	209.9	209.9	209.5	207.5	202.5	195.5	176.5	155.4
	10,000	12.5	25.5	37.4	42.0	50.2	58.3	61.5	62.1	62.3	62.8	63.0	61.8	61.2	60.8	60.5	60.6	59.1	59.0	58.7	58.6	58.2	58.3	57.7	56.6	55.6
	20,000	22.4	44.2	61.3	67.2	78.8	90.4	93.9	95.2	95.4	95.6	95.6	94.0	93.3	92.6	92.8	92.5	90.9	90.7	90.5	90.3	90.2	89.8	88.8	86.7	80.1
	30,000	32.3	66.3	83.8	91.2	105.1	118.0	122.6	124.3	124.8	124.6	123.8	122.2	121.6	121.1	120.9	120.4	119.5	119.2	119.2	119.2	118.8	118.1	116.7	113.3	104.4
180	40,000	43.3	90.2	105.7	114.5	131.1	144.1	150.1	152.2	152.6	152.4	150.6	149.5	148.9	148.4	147.8	147.5	147.2	147.2	147.2	146.9	146.4	145.0	143.3	138.3	129.6
	50,000	54.5	106.7	125.2	134.8	154.6	169.1	175.8	177.6	177.4	176.7	175.0	174.0	173.4	172.7	172.1	172.1	172.1	171.7	171.7	171.4	170.4	168.5	165.9	158.7	147.3
	60,000	64.6	119.9	141.4	151.3	174.3	189.0	196.1	197.4	196.7	196.0	194.1	193.4	192.7	191.9	191.6	191.6	191.6	191.6	191.2	190.8	189.7	186.9	183.3	173.4	159.7
	70,000	73.7	136.9	158.8	168.6	192.4	208.0	215.1	216.0	215.3	213.7	212.0	211.2	210.4	210.0	210.0	210.0	210.0	210.4	210.0	209.2	207.6	204.1	199.4	187.0	170.8
	80,000	82.8	155.3	176.0	185.1	208.2	224.9	230.1	231.2	230.9	228.9	227.0	226.6	225.7	225.7	225.7	225.7	226.2	227.0	226.2	225.7	222.8	219.4	213.5	198.0	180.2
	20,000	24.4	49.4	67.0	72.9	85.9	100.1	104.4	104.8	104.1	103.5	103.3	99.6	98.5	97.6	98.5	98.4	95.3	95.1	95.1	95.1	95.0	94.8	94.2	92.8	88.9
	30,000	34.0	74.2	94.6	101.9	116.0	130.9	136.4	138.3	138.1	137.4	136.2	133.0	131.8	130.7	131.5	131.0	129.5	129.2	129.2	129.2	129.0	128.7	128.5	127.6	122.3
	40,000	44.8	99.4	118.6	127.2	142.3	157.3	164.0	166.6	166.5	166.1	163.5	161.4	160.2	159.6	159.0	158.9	158.9	158.6	158.6	158.6	158.3	158.0	157.7	156.7	150.2
200	50,000	56.8	116.7	137.2	147.1	165.7	182.4	189.3	191.6	191.0	190.0	187.0	185.2	184.2	183.5	183.5	183.5	183.5	183.5	183.5	183.1	182.4	181.7	180.0	177.3	168.5
	60,000	66.9	129.9	153.5	164.2	186.3	203.9	211.2	212.6	211.2	209.3	206.3	205.1	204.4	204.0	204.4	204.8	204.8	204.8	204.8	204.4	202.8	201.3	198.2	193.6	182.7
	70,000	75.6	146.7	169.7	180.8	204.5	222.9	229.9	230.6	229.0	226.5	223.7	223.3	223.3	222.9	223.3	223.7	223.8	223.7	223.3	222.5	220.3	218.6	214.5	207.3	194.2
	80,000	85.1	166.0	186.0	196.7	221.0	240.2	246.0	246.2	244.5	242.3	239.8	240.3	240.3	240.3	241.2	241.6	241.6	241.1	240.2	238.9	235.7	233.4	229.4	218.9	204.4
	20,000	27.3	58.8	80.1	85.6	98.0	111.4	115.0	116.2	115.4	114.7	114.0	110.7	109.8	108.6	109.0	108.8	106.7	106.7	106.9	107.1	107.3	107.1	106.5	104.3	100.1
	30,000	36.8	84.5	110.1	116.6	129.7	143.4	148.7	149.5	149.0	148.4	146.4	143.7	142.9	141.2	141.2	140.9	140.1	139.9	140.4	140.7	140.9	140.7	140.1	137.6	132.4
	40,000	46.2	107.0	135.2	143.3	157.5	172.3	177.8	178.9	178.7	178.0	175.3	173.0	172.0	170.7	169.7	169.7	169.7	169.4	169.4	169.4	169.4	169.0	168.1	165.3	159.7
220	50,000	57.7	125.1	156.4	165.8	183.2	199.4	205.0	205.5	204.8	203.7	200.9	198.7	197.9	196.4	196.0	195.7	195.2	194.9	194.9	194.1	193.7	193.0	191.1	187.6	180.8
	60,000	68.4	140.5	173.5	184.0	204.2	222.0	226.5	226.7	225.5	223.9	220.8	219.5	218.7	217.5	217.1	216.6	216.2	215.8	214.9	214.1	212.9	211.6	208.8	204.0	196.5
	70,000	77.0	157.0	189.9	201.3	223.5	241.0	245.3	245.1	243.4	241.6	238.7	238.2	237.4	236.0	236.0	235.6	234.6	234.2	232.8	231.0	229.2	227.0	223.5	216.9	207.1
	80,000	87.2	176.7	204.4	215.8	239.4	256.6	260.2	259.9	258.1	256.2	253.7	253.7	253.2	251.8	251.8	251.8	250.3	249.3	247.4	245.0	242.2	239.4	235.1	225.3	212.5
	30,000	40.4	95.3	125.8	131.7	142.7	155.3	159.9	159.7	158.9	158.0	155.5	153.5	152.6	150.6	149.7	149.7	149.7	149.4	150.6	151.2	152.0	151.5	150.6	146.4	141.4
	40,000	49.4	117.2	153.3	160.9	174.1	188.4	192.8	192.4	191.4	190.6	187.7	185.2	184.2	182.4	181.4	180.7	180.6	180.3	180.6	180.6	181.3	180.3	178.9	174.5	169.6
240	50,000	59.8	135.4	176.5	185.3	200.9	217.3	219.5	218.8	217.6	216.8	214.4	212.4	211.2	209.2	208.0	207.2	206.8	206.0	206.0	204.8	204.8	204.0	201.6	197.4	193.0
	60,000	72.0	153.3	195.4	205.8	227.1	240.9	242.9	241.7	240.4	239.5	235.8	234.5	233.2	231.0	230.1	228.8	227.4	226.5	225.6	223.9	223.0	221.7	219.1	214.9	211.4
	70,000	79.9	168.6	209.6	221.2	243.2	257.8	259.1	257.8	256.0	255.0	252.5	251.1	249.7	247.8	246.9	245.5	243.5	242.1	240.2	237.4	236.0	233.7	230.0	224.1	218.6
	80,000	89.2	187.4	223.7	235.9	258.3	274.1	275.0	273.6	271.7	270.6	268.0	267.5	266.0	264.1	263.1	261.6	259.0	257.0	254.5	251.1	249.1	244.7	240.8	231.1	220.7
	30,000	42.5	104.7	140.8	145.7	157.7	165.5	169.3	167.7	166.4	165.8	162.6	161.0	160.4	158.0	156.4	156.4	157.3	157.4	158.9	159.8	161.3	160.8	159.2	153.2	148.6
	40,000	53.0	126.5	167.9	174.5	189.3	199.6	202.3	199.9	198.1	197.3	194.2	192.4	191.3	188.4	187.3	186.6	186.2	185.9	186.6	186.6	187.7	186.6	184.5	178.1	174.5
260	50,000	63.0	145.1	192.1	200.5	217.3	228.9	229.5	227.2	225.6	225.1	222.1	220.0	218.8	215.5	214.2	213.0	211.7	210.9	210.4	209.2	210.0	208.8	206.4	201.3	199.6
	60,000	73.7	162.0	211.8	221.8	240.2	252.9	251.6	248.8	247.4	247.3	244.1	242.3	240.5	237.3	236.0	233.7	231.8	230.4	229.1	226.4	225.9	225.0	222.4	219.1	220.0
	70,000	81.6	178.2	226.1	237.7	258.2	270.3	268.3	265.9	264.4	263.9	261.4	259.9	258.0	254.7	252.7	250.8	247.3	245.9	243.0	239.7	238.7	235.9	232.5	227.6	225.7
	80,000	91.7	197.2	239.5	252.0	274.7	286.4	284.3	282.2	279.8	279.6	277.5	276.0	273.5	270.5	268.5	266.5	262.2	259.2	256.7	251.7	250.2	245.2	240.7	232.3	224.8
	Stroke	0	0.2	1.2	2	6	12	18	24	30	36	49	61	73	85	97	109	122	134	146	158	170	182	194	219	243

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TABLE 20. C13 Constant Pressure Catapult (CVA67), Lower Boundary, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) — NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND CSV SETTING

CSV Setting	Stroke / Weight (LBS)	0	0.2	1.2	2	.6	12	18	24	30	36	49	61	73	85	97	109	122	134	146	158	170	182	194	219	243
	10,000	6.1	9.6	10.5	10.8	11.0	12.5	13.8	14.8	15.4	15.9	16.8	17.6	17.9	18.1	18.8	19.1	19.4	19.4	19.5	19.2	18.4	17.2	15.4	11.4	8.2
	20,000	10.9	17.2	17.9	18.2	18.5	20.8	22.7	24.1	25.1	25.8	27.2	28.0	28.6	29.0	29.6	29.9	30.0	30.0	29.7	29.3	28.1	26.0	22.9	17.9	11.9
	30,000	15.9	21.4	23.1	23.7	24.7	26.4	28.8	30.4	31.7	32.7	34.3	35.1	35.8	36.2	36.4	36.7	36.5	36.2	35.6	34.8	33.8	31.5	28.0	23.3	16.2
40	40,000	20.2	24.5	25.0	25.5	26.6	28.1	31.2	33.3	34.8	36.3	38.5	39.8	41.1	42.0	42.8	43.4	43.5	43.6	43.7	43.3	42.8	40.6	37.1	32.3	24.5
	50,000	25.3	30.9	31.5	32.0	32.9	34.8	38.0	40.8	42.4	43.9	46.3	47.8	49.2	50.1	50.9	51.3	51.6	51.6	51.4	50.7	49.1	45.5	41.3	34.0	24.6
	60,000	29.3	37.0	37.6	38.2	39.5	41.7	45.0	48.4	49.9	51.5	54.0	55.7	57.0	58.0	58.7	58.9	59.1	59.0	58.7	57.6	54.4	49.3	44.4	34.0	23.1
	70,000	33.6	41.6	44.7	44.0	45.1	48.3	51.4	55.5	56.8	58.4	61.0	62.6	63.9	64.8	65.3	65.2	65.7	65.2	64.7	63.1	58.3	51.4	45.9	34.0	21.2
	80,000	37.6	45.7	49.9	50.6	52.6	55.6	58.3	63.1	64.1	65.8	68.3	70.2	71.2	72.1	72.3	71.8	72.4	71.6	71.0	68.8	61.9	53.2	46.9	34.2	18.8
	10,000	8.8	13.4	13.9	14.3	14.9	17.0	18.5	19.6	20.2	20.8	21.9	22.6	23.0	23.3	23.8	24.0	24.2	24.1	24.0	23.7	23.2	22.3	20.7	16.6	12.9
	20,000	16.9	22.4	24.2	24.7	26.2	28.6	31.0	32.6	33.9	34.8	36.3	37.3	38.0	38.4	38.8	39.0	39.0	38.8	38.4	37.8	36.8	34.8	31.7	25.7	19.2
	30,000	23.1	31.9	32.9	33.5	34.8	38.0	41.3	43.2	44.9	46.0	47.7	48.5	49.6	49.9	50.1	50.1	49.7	49.2	48.5	47.7	46.3	43.5	39.4	32.6	24.4
60	40,000	26.3	35.3	35.9	37.6	38.8	41.7	46.2	48.8	50.8	52.3	54.9	55.9	57.6	58.7	59.3	59.8	59.9	60.1	60.2	59.8	58.8	55.7	51.2	43.6	34.0
	50,000	32.3	43.1	43.8	44.5	46.5	50.1	55.1	58.4	60.5	62.0	64.6	65.9	67.5	68.4	68.9	69.4	69.7	69.7	69.7	69.0	66.8	62.4	57.1	47.0	35.7
	60,000	38.3	50.9	52.0	52.9	55.0	59.1	64.4	68.7	70.7	72.3	74.9	76.3	77.5	78.3	78.8	79.0	79.5	79.4	79.0	77.9	74.6	68.5	62.5	49.4	36.4
	70,000	43.3	57.6	58.8	59.5	62.5	67.8	73.0	77.9	79.8	81.4	84.0	85.6	86.6	87.4	87.8	87.8	88.2	87.9	87.3	85.9	80.9	73.3	66.5	51.9	36.5
	80,000	48.4	62.9	66.9	67.4	70.7	75.9	80.6	85.8	87.6	89.3	91.7	93.3	94.2	95.0	95.2	94.9	95.5	95.0	94.2	92.3	85.5	76.4	68.8	53.1	35.9
	10,000	10.0	16.0	17.9	18.6	20.2	22.3	24.1	25.0	25.8	26.6	27.8	28.4	28.7	29.1	29.4	29.4	29.3	29.0	28.7	28.4	28.3	28.3	27.0	23.1	19.2
	20,000	18.8	27.7	29.9	30.8	32.8	36.5	39.4	40.9	42.4	43.5	44.9	45.9	46.7	47.1	47.2	47.1	46.8	46.3	45.8	45.3	44.5	43.2	40.5	33.9	27.8
	30,000	24.3	33.9	36.6	37.3	41.0	44.1	48.8	51.2	53.4	54.7	56.9	57.8	59.5	60.4	60.9	61.2	61.3	61.7	62.0	61.9	60.9	58.4	54.5	45.7	37.6
80	40,000	31.8	45.2	46.9	47.6	50.8	55.6	61.5	64.5	66.7	68.1	70.5	70.9	72.8	73.7	74.0	74.1	74.2	74.7	75.2	74.4	72.7	69.0	63.7	52.7	42.5
	50,000	39.5	56.2	57.5	58.7	61.6	67.1	74.1	76.0	80.5	81.9	84.0	84.6	86.3	86.9	87.2	87.4	87.7	87.8	87.7	87.2	84.8	79.8	73.6	60.5	48.1
	60,000	46.1	66.2	67.3	68.5	71.9	78.3	86.4	91.2	93.7	95.0	97.0	97.9	98.7	99.1	99.3	99.4	100.0	99.9	99.6	98.9	95.8	89.3	82.4	67.2	52.7
	70,000	53.1	74.7	75.5	76.8	80.5	87.6	95.3	100.7	103.4	104.6	106.5	107.4	108.0	108.1	108.3	108.5	109.1	108.9	108.3	107.6	103.4	96.0	88.3	71.6	55.9
	80,000	60.3	83.4	84.0	85.0	89.8	97.1	104.7	109.8	112.6	113.9	115.7	116.7	117.1	117.5	117.7	117.9	118.3	118.1	117.3	116.7	111.0	102.9	94.1	76.3	59.3
	10,000	9.4	16.2	22.2	23.0	23.7	28.3	29.6	30.6	31.3	32.2	33.4	33.6	33.7	34.0	34.2	34.0	33.7	33.5	33.0	32.7	32.4	32.3	31.4	27.5	23.3
	20,000	18.8	27.6	33.1	34.2	36.7	40.8	45.7	47.6	49.7	51.0	52.4	53.3	54.0	54.6	55.0	55.3	55.4	55.6	55.8	55.8	55.7	55.0	53.2	46.4	39.5
	30,000	28.1	41.4	47.6	48.6	52.2	57.0	63.2	65.8	68.0	69.1	70.6	71.4	72.4	72.8	73.0	73.2	73.1	73.3	73.4	73.3	72.5	70.8	67.4	57.5	47.8
100	40,000	37.1	54.9	59.9	61.2	66.5	73.4	79.1	81.9	83.8	84.8	86.8	87.0	88.1	88.5	88.7	88.5	88.5	88.4	88.3	87.9	86.5	84.1	79.0	66.6	54.3
	50,000	46.0	67.4	71.0	72.5	78.6	86.4	92.7	95.9	98.0	99.0	100.7	101.1	102.0	102.3	102.3	102.2	102.0	102.0	101.6	101.0	99.2	95.8	89.9	75.0	60.7
	60,000	54.6	79.7	82.8	84.0	90.3	100.0	106.8	110.7	112.8	113.7	115.0	115.6	116.2	116.2	116.2	115.8	115.8	115.8	115.0	114.4	112.1	107.6	100.7	83.2	66.5
	70,000	63.2	92.0	94.1	95.0	101.3	111.4	118.5	122.4	124.5	125.5	126.7	127.4	127.6	127.6	127.4	127.2	127.2	126.9	126.0	125.3	122.4	117.0	109.0	89.8	71.6
	80,000	71.3	103.3	104.9	105.9	112.2	122.4	129.3	133.1	135.3	136.4	137.5	137.9	137.9	138.2	137.9	137.7	137.4	137.2	136.2	135.5	131.8	125.8	116.3	95.6	75.9
	10,000	9.9	15.3	21.1	22.4	24.5	31.7	32.5	33.8	34.7	35.8	37.4	37.3	37.4	37.7	38.1	38.3	38.3	38.6	38.6	38.6	38.5	38.5	38.4	35.3	30.9
	20,000	19.2	30.4	39.8	41.8	44.2	49.3	56.1	58.5	60.5	61.4	62.0	62.3	62.4	62.7	62.6	62.7	62.7	62.8	62.7	62.7	62.7	62.6	61.5	54.5	46.9
	30,000	28.6	45.9	57.6	59.6	63.7	69.1	77.2	79.8	81.8	82.3	82.7	83.1	83.1	83.0	82.7	82.5	82.2	82.2	82.1	81.8	81.5	81.1	78.6	68.0	57.3
120	40,000	37.9	60.4	72.6	74.6	80.0	90.5	95.5	97.8	98.9	99.3	100.4	100.6	100.2	100.1	99.9	99.6	98.8	98.8	98.4	97.9	97.0	96.6	92.3	78.8	65.2
	50,000	47.0	73.5	86.5	89.0	96.3	107.7	113.1	115.1	116.2	116.7	117.6	117.8	117.6	117.4	117.2	116.5	115.7	115.6	114.8	114.2	113.3	112.5	107.1	90.4	74.3
	60,000	56.4	87.0	100.2	102.5	110.4	122.9	128.3	130.4	131.4	131.9	132.4	132.6	132.4	132.4	131.7	131.0	130.2	129.9	128.8	128.1	127.1	125.7	118.9	99.7	81.2
	70,000	65.0	94.2	102.5	105.1	124.4	127.1	133.6	136.3	137.7	138.5	139.2	140.2	140.7	141.8	141.8	142.6	143.7	144.7	145.2	145.8	146.3	146.3	139.9	117.6	97.7
	80,000	74.4	110.4	115.0	117.6	137.7	139.4	146.1	148.8	150.3	150.9	151.6	152.2	152.7	153.3	153.6	154.4	155.4	156.7	157.0	157.9	158.7	157.9	149.8	126.3	104.7
	10,000	10.5	18.2	28.3	29.6	32.1	37.2	38.9	40.4	41.3	42.3	43.4	43.5	43.6	43.7	43.6	43.5	43.5	43.4	43.3	43.2	43.1	43.1	42.8	40.7	38.4
	20,000	19.6	33.6	50.3	52.3	56.4	61.0	66.1	68.4	70.0	70.8	71.3	71.5	71.4	71.4	71.2	70.9	70.9	70.7	70.6	70.6	70.3	70.1	69.0	63.8	55.9
	30,000	29.1	51.0	71.3	73.3	79.0	84.8	91.0	93.3	94.7	95.2	95.4	95.5	95.4	95.2	94.8	94.5	94.1	94.1	93.9	93.8	93.2	92.5	90.3	81.7	70.4
140	40,000	39.1	68.5	87.8	90.7	98.4	106.8	111.9	113.7	114.6	114.9	115.3	115.3	114.9	114.7	114.3	114.0	113.4	113.4	113.0	112.5	111.9	110.7	107.1	95.8	83.6
	50,000	48.9	82.6	104.7	107.7	117.1	125.5	131.2	133.0	133.8	134.1	134.3	134.3	133.8	133.6	133.1	132.4	131.9	131.9	131.4	130.9	129.9	128.2	123.6	109.4	94.8
	60,000	57.8	95.1	121.6	124.3	134.0	143.1	149.0	150.5	151.1	151.4	151.4	151.4	150.9	150.9	150.0	149.2	148.6	148.6	147.8	147.2	146.1	143.7	138.2	121.4	103.8
	70,000	65.5	109.2	136.8	139.6	149.5	158.9	164.7	166.4	167.0	166.8	166.8	166.5	165.9	165.5	164.6	164.0	163.7	163.7	162.8	162.2	161.3	158.3	151.1	131.9	112.3
	80,000	75.2	126.9	153.3	155.6	165.8	175.1	180.8	182.3	183.0	182.4	182.0	181.3	180.7	180.3	179.7	178.7	178.7	179.0	178.3	177.6	176.3	172.7	164.2	142.3	120.9
	10,000	10.9	21.6	30.0	34.3	40.5	44.7	47.8	49.3	50.3	51.4	51.6	52.1	51.7	51.5	51.0	50.6	50.5	50.5	49.9	49.6	49.3	49.5	48.8	48.1	48.6
	20,000	20.2	35.3	50.1	55.4	65.0	72.9	75.7	77.5	78.4	79.1	79.3	79.5	79.2	78.9	78.3	77.9	77.5	77.4	77.1	77.0	76.5	76.2	74.9	72.4	64.4
	30,000	29.7	56.5	69.3	76.1	89.0	99.1	102.6	104.0	104.8	105.1	104.9	104.9	104.5	104.3	103.7	103.3	102.9	102.7	102.7	102.5	102.1	100.8	99.0	93.9	82.5
160	40,000	39.8	76.7	86.4	94.7	110.8	121.3	126.4	127.7	128.5	128.3	127.8	127.5	127.1	126.8	126.1	125.9	125.4	125.4	125.4	125.2	124.4	122.3	119.7	112.1	102.7
	50,000	50.2	91.9	102.8	111.3	130.4	141.2	147.0	148.3	148.6	148.6	148.1	147.8	147.0	146.7	145.9	145.6	145.3	145.3	145.0	144.7	143.9	140.9	137.9	127.7	115.7
	60,000	59.7	103.6	119.4	127.6	149.1	160.1	166.4	167.5	167.8	167.6	167.2	166.9	165.7	165.4	164.4	163.8	163.8	163.8	163.5	163.2	162.3	158.6	154.6	142.2	127.1
	70,000	68.1	118.8	135.5	143.4	165.1	177.1	183.3	184.5	184.2	183.6	182.8	182.1	181.1	180.8	180.1	179.4	179.4	180.1	179.8	179.8	178.4	174.1	169.0	154.0	136.5
	80,000	76.8	135.9	152.0	159.4	179.6	192.8	198.8	199.7	199.4	198.0	196.8	195.7	194.6	194.2	193.9	193.5	193.9	195.3	195.3	195.0	193.1	188.5	182.0	164.2	144.7
	10,000	11.5	21.1	30.4	35.0	32.4	51.9	56.1	57.4	57.7	57.9	58.1	58.3	58.3	58.6	58.8	58.8	59.1	59.4	59.6	59.7	59.7	59.7	59.6	59.2	58.5
	20,000	20.8	37.5	47.8	53.4	65.2	77.0	81.6	83.8	84.2	84.5	84.7	84.9	85.0	85.3	85.7	86.2	86.8	87.0	87.4	88.2	88.7	88.9	88.6	87.0	81.3
	30,000	30.0	53.8	65.3	72.4	86.7	100.2	106.0	108.2	109.0	109.2	109.3	109.5	110.0	110.4	110.8	111.3	112.3	113.3	114.6	115.5	116.1	115.9	115.5	113.2	105.1
180	40,000	40.7	84.4	98.4	106.6	122.0	134.1	139.8	141.7	142.1	141.8	140.2	139.2	138.6	138.1	137.6	137.3	137.1	137.1	137.1	136.8	136.3	135.0	133.4	128.8	120.7
	50,000	51.2	99.8	116.4	125.3	143.8	157.2	163.5	165.2	164.9	164.4	162.7	161.8	161.2	160.6	160.0	160.0	160.0	159.7	159.7	159.4	158.5	156.7	154.3	147.6	137.0
	60,000	60.7	112.2	131.5	140.8	162.2	175.8	182.4	183.6	183.0	182.3	180.6	179.9	179.2	178.5	178.2	178.2	178.2	178.2	177.8	177.5	176.5	173.8	170.5	161.3	148.5
	70,000	69.3	128.1	147.6	156.7	178.8	193.3	199.8	200.7	200.1	198.7	197.0	196.3	195.6	195.2	195.2	195.2	195.2	195.6	195.2	194.4	193.0	189.7	185.3	173.8	158.8
	80,000	77.8	145.2	163.7	172.2	193.7	209.2	215.0	215.6	214.9	213.0	211.2	210.8	210.0	210.0	210.0	210.0	210.4	211.2	210.4	210.0	207.2	204.1	198.6	184.3	167.7
	20,000	22.7	40.8	54.4	60.4	73.8	89.0	94.5	95.9	95.5	95.3	95.7	92.6	92.3	92.3	94.1	95.2	93.8	94.9	96.0	96.7	97.3	97.6	97.5	97.4	94.5
	30,000	31.6	60.5	74.2	81.4	96.1	112.0	119.1	122.6	123.0	122.8	122.4	119.9	119.4	119.6	121.5	122.7	122.8	124.0	125.4	126.6	127.3	127.8	128.0	128.7	124.9
	40,000	41.7	81.1	92.4	100.8	116.4	132.3	140.8	145.4	146.2	146.0	144.8	143.4	142.8	143.6	144.8	146.5	148.0	149.5	150.9	152.3	153.1	153.7	154.0	155.1	150.0
200	50,000	52.8	97.6	110.1	119.4	138.5	156.4	165.2	169.3	169.5	168.9	167.5	166.5	166.2	167.2	168.5	170.5	172.6	174.2	175.9	177.2	178.2	178.2	177.6	176.4	169.9
	60,000	62.2	110.2	125.0	135.2	157.5	176.2	185.3	188.4	187.8	186.8	185.2	184.5	184.9	185.9	187.8	190.0	192.3	194.1	196.0	197.4	197.8	197.4	195.6	191.8	183.7
	70,000	70.3	126.4	140.2	150.6	173.9	193.4	201.6	204.2	203.2	202.0	200.7	200.8	201.6	202.7	204.7	207.5	209.6	211.6	213.6	215.0	214.5	213.6	210.8	204.2	194.7
	80,000	79.1	145.5	155.5	165.5	189.4	208.6	216.1	217.6	216.8	215.6	214.7	216.0	216.8	218.1	220.6	223.1	225.9	227.5	228.8	229.2	227.9	227.1	224.2	215.4	203.9
	30,000	25.4	50.2	67.6	73.1	85.7	99.8	105.2	106.4	105.9	105.6	105.1	102.6	102.2	101.8	103.0	104.0	103.0	103.8	105.2	106.0	106.8	107.0	106.8	105.8	102.6
	40,000	34.2	68.8	87.9	94.6	108.2	123.4	130.3	133.0	132.9	132.7	131.5	129.8	129.5	129.3	130.5	131.6	132.7	134.0	135.8	137.3	138.6	139.1	139.1	138.3	134.5
	40,000	43.0	88.6	108.8	116.9	132.0	148.4	155.7	159.5	159.4	159.4	157.5	156.3	156.0	156.0	156.9	158.4	160.1	161.3	163.2	164.7	166.3	166.6	166.3	165.9	161.3
220	50,000	53.7	105.6	129.2	138.3	156.3	174.2	181.6	185.0	184.5	184.1	182.2	181.2	181.2	181.2	182.2	184.0	185.5	187.0	188.8	189.8	191.3	191.3	190.2	188.7	183.3
	60,000	64.3	121.8	146.5	156.8	177.4	196.4	203.0	205.5	204.5	203.7	202.0	201.2	201.2	201.6	202.8	204.8	206.1	207.7	209.2	210.0	211.3	210.4	208.5	205.6	200.0
	70,000	71.6	137.5	163.2	174.4	197.1	216.1	222.0	223.8	222.7	221.8	220.5	220.5	220.5	220.9	222.2	224.3	225.7	227.0	228.3	228.3	228.3	227.4	224.9	219.5	211.8
	80,000	82.0	158.2	177.0	188.3	212.0	230.7	236.0	237.1	235.8	234.9	233.9	234.4	234.8	235.3	237.1	238.9	239.9	241.3	242.2	241.7	240.8	239.0	235.9	227.4	216.9
	30,000	37.6	78.2	101.5	107.4	119.3	133.2	139.7	141.8	141.3	140.8	138.8	137.7	137.7	137.2	137.4	138.8	140.5	141.9	144.1	146.0	148.2	148.8	148.5	146.0	142.1
	40,000	46.0	97.6	126.5	134.1	148.6	164.9	171.5	173.6	173.1	172.8	170.3	169.4	169.4	168.7	169.0	170.3	172.1	173.5	175.5	177.1	178.1	178.5	177.8	176.1	172.4
240	50,000	55.6	116.1	150.2	159.3	176.1	194.2	200.0	201.6	201.0	200.6	198.2	197.4	197.0	196.3	197.0	198.2	199.8	201.0	202.5	203.3	203.9	204.1	203.1	201.7	198.2
	60,000	67.0	135.7	172.2	182.6	199.0	220.8	224.7	225.7	224.9	224.4	222.2	221.4	220.9	220.5	220.9	222.2	223.2	223.6	224.3	225.0	225.3	225.2	224.5	222.2	219.6
	70,000	75.1	150.8	186.1	197.7	218.5	236.8	240.4	241.0	239.7	239.2	237.3	237.3	236.8	236.4	237.3	238.2	239.3	240.5	240.6	239.7	238.1	237.8	235.5	231.2	226.2
	80,000	83.8	168.9	199.3	211.2	232.1	251.8	255.1	255.7	253.9	253.3	251.8	252.3	251.8	251.8	252.3	252.8	253.5	254.3	253.8	251.8	251.3	248.5	245.1	238.1	228.5
	30,000	40.0	86.7	115.5	120.4	131.4	142.9	148.8	149.9	148.8	148.2	145.2	145.0	145.5	144.4	143.5	145.2	147.6	149.1	152.0	154.3	157.5	157.5	156.9	152.8	149.0
	40,000	49.3	106.4	142.5	149.1	163.9	178.3	183.8	184.3	182.6	182.2	179.7	178.6	178.6	177.2	177.2	178.3	180.1	181.2	183.6	185.4	188.2	188.2	186.8	182.1	179.3
260	50,000	58.6	125.1	168.9	177.4	194.1	209.9	213.4	213.5	212.4	211.9	209.0	208.2	207.8	206.2	206.2	207.0	208.2	209.1	210.7	211.5	213.5	213.5	211.9	209.0	207.4
	60,000	68.5	144.5	190.7	200.9	218.8	235.3	235.7	235.3	234.8	234.8	232.1	231.2	230.3	229.0	229.0	229.0	229.4	229.9	230.3	229.4	230.4	230.2	229.5	228.1	229.0
	70,000	66.6	150.2	204.2	215.5	235.2	251.3	251.2	250.7	249.8	249.8	247.4	246.9	245.9	244.5	244.5	244.1	243.6	243.6	243.1	241.2	242.1	240.8	238.4	236.0	233.6
	80,000	86.2	178.4	215.7	228.6	251.3	265.7	266.5	266.6	264.2	264.1	262.1	262.1	261.1	260.1	260.1	259.6	257.6	257.1	256.5	253.6	254.1	249.7	246.7	241.0	232.7
	Stroke	0	0.2	1.2	2	6	12	18	24	30	36	49	61	73	85	97	109	122	134	146	158	170	182	194	219	243

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TABLE 21 C13. Constant Pressure Catapult (CVA41), Upper Boundary, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) — NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND CSV SETTING

CSV Setting	Stroke / Weight (LBS)	0	0.2	1.2	2	6	12	18	24	30	36	49	61	73	85	97	109	122	134	146	158	170	182	194	219	243
	10,000	8.3	10.9	13.3	14.4	16.5	17.4	14.4	14.3	14.6	15.6	16.2	16.4	16.4	16.3	16.1	15.8	15.5	15.2	14.8	14.5	14.1	13.5	12.7	10.0	6.5
	20,000	15.4	19.7	22.0	23.3	26.1	26.2	24.8	24.6	25.2	25.8	26.5	26.4	26.1	25.8	25.4	25.0	24.5	24.0	23.5	22.9	22.0	20.9	19.2	14.8	10.1
80	30,000	21.5	26.9	29.1	29.8	31.7	32.6	33.8	34.2	34.6	34.8	34.9	34.5	34.1	33.5	32.9	32.4	31.7	31.0	30.1	29.1	27.7	26.7	24.3	17.7	12.5
	40,000	26.5	34.5	35.1	35.2	36.9	38.7	40.4	41.1	41.8	41.7	41.6	41.2	40.7	40.0	39.2	38.6	37.8	36.7	35.7	34.5	32.7	31.3	28.3	20.6	14.4
	50,000	30.5	40.3	40.5	40.6	42.1	44.3	45.9	46.9	47.5	47.7	47.7	47.3	46.8	45.9	45.1	44.2	43.3	42.0	40.9	39.6	37.5	35.2	31.6	23.2	16.1
	60,000	33.3	45.5	45.6	45.7	47.0	49.5	51.2	52.3	53.0	53.3	53.5	53.1	52.5	51.5	50.6	49.5	48.5	47.0	45.8	44.4	42.0	38.7	34.6	25.5	17.4
	10,000	9.0	11.2	11.8	12.7	13.9	14.8	13.6	13.9	14.3	15.1	15.7	16.3	16.8	17.0	17.2	17.8	18.2	18.5	18.8	19.1	19.3	19.4	19.2	16.6	13.2
	20,000	18.9	24.4	27.0	27.5	29.6	30.6	30.2	30.4	30.9	31.4	32.0	32.0	31.9	31.6	31.3	30.9	30.4	30.0	29.4	28.8	28.1	27.0	25.2	20.3	14.5
	30,000	26.2	33.9	35.6	35.9	37.8	39.2	40.3	40.9	41.4	41.7	41.9	41.8	41.5	41.0	40.6	40.1	39.4	38.7	37.9	36.9	35.7	34.5	32.0	25.1	18.4
100	40,000	32.2	42.2	42.9	43.2	44.9	46.7	48.4	49.2	49.7	50.0	50.2	50.1	49.7	49.2	48.6	48.0	47.3	46.3	45.2	44.1	42.4	40.7	37.6	29.3	21.3
	50,000	37.1	48.6	49.4	49.7	52.0	53.8	55.6	56.5	57.2	57.5	57.7	57.5	57.2	56.6	55.9	55.1	54.3	53.2	52.0	50.8	48.7	46.5	42.6	33.1	23.7
	60,000	41.7	54.5	55.4	55.7	58.2	60.3	62.2	63.2	64.0	64.4	64.6	64.4	64.1	63.5	62.6	61.8	60.8	59.5	58.2	57.0	54.5	51.4	46.9	36.3	25.7
	70,000	45.9	59.9	60.8	61.2	64.0	66.1	68.1	69.4	70.3	70.7	71.1	70.8	70.3	69.6	68.8	67.8	66.9	65.5	64.1	62.6	59.8	56.2	50.8	38.9	27.2
	80,000	49.9	65.1	66.2	66.6	69.6	71.7	73.9	75.4	76.5	76.9	77.3	76.9	76.3	75.5	74.8	73.9	72.9	71.2	69.8	67.9	64.9	60.6	54.4	41.1	28.5
	10,000	9.7	11.4	11.8	12.4	14.0	15.2	16.5	17.2	17.7	18.1	18.7	19.2	19.7	20.0	20.1	20.7	21.0	21.2	21.6	21.9	22.1	22.6	22.7	20.0	16.5
	20,000	19.6	22.1	22.7	23.4	25.2	27.0	28.8	30.2	30.9	31.7	32.7	33.3	33.9	34.5	35.0	35.5	36.1	36.9	37.5	38.1	38.5	38.2	37.0	32.2	26.4
	30,000	27.0	30.2	31.3	31.9	34.1	36.2	38.5	40.3	41.4	42.2	43.6	44.6	45.1	45.8	46.5	47.2	47.9	48.8	49.8	50.1	50.2	49.6	47.8	41.0	32.8
120	40,000	33.3	38.4	38.9	39.3	41.8	44.3	47.1	49.1	50.4	51.4	53.0	54.0	54.7	55.6	56.4	57.2	57.9	58.9	59.9	60.4	60.3	59.3	57.0	48.2	38.1
	50,000	38.8	45.3	45.7	45.9	48.2	51.7	54.9	57.1	58.6	59.8	61.5	62.4	63.4	64.5	65.2	66.0	66.8	68.1	69.1	69.6	69.3	68.0	64.7	54.3	42.4
	60,000	44.0	51.2	51.6	52.2	55.2	59.1	62.6	64.9	66.4	67.8	69.7	70.6	71.8	72.9	73.6	74.5	75.4	76.8	77.8	78.3	77.9	76.0	71.8	59.9	46.2
	70,000	49.4	57.2	58.3	58.8	62.1	66.4	69.9	72.4	74.0	75.2	77.2	78.6	80.0	80.9	81.6	82.6	83.8	85.1	86.0	86.6	86.0	83.8	78.8	64.7	49.9
	80,000	53.2	61.9	64.1	65.5	69.0	73.7	77.3	79.9	81.8	82.8	84.9	87.0	88.3	88.9	89.7	90.9	92.1	93.4	94.3	94.7	94.0	91.3	85.5	69.2	53.2
	10,000	9.9	12.2	13.9	14.7	16.1	17.9	19.2	20.0	20.6	21.1	21.8	22.2	22.5	23.0	23.3	24.0	24.5	24.8	25.3	25.7	26.1	26.5	26.5	24.4	20.7
	20,000	19.2	23.4	26.0	26.6	28.6	31.4	33.7	35.2	36.1	36.8	37.9	38.7	39.4	40.1	40.8	41.7	42.5	43.4	44.1	44.8	45.4	45.3	44.4	39.8	33.4
	30,000	27.0	34.0	35.3	36.1	38.4	41.9	44.9	47.1	48.3	49.1	50.7	51.8	52.6	53.6	54.6	55.7	56.8	57.9	58.9	59.6	60.1	59.9	58.3	51.4	42.4
140	40,000	33.5	42.8	43.6	44.0	46.3	50.5	54.2	56.8	58.2	59.2	60.9	62.3	63.4	64.6	65.7	67.0	68.3	69.8	70.8	71.5	71.8	71.4	69.4	60.2	49.2
	50,000	40.5	51.0	51.9	52.1	55.0	59.9	64.2	67.2	68.7	70.0	72.0	73.5	74.9	76.3	77.5	78.9	80.5	82.5	83.4	84.2	84.4	83.8	80.8	69.5	56.2
	60,000	46.8	58.7	59.3	59.7	62.9	68.4	73.2	76.3	78.2	79.7	81.8	83.6	85.1	86.8	88.2	89.6	91.4	93.6	94.5	95.4	95.4	94.6	90.8	77.1	62.0
	70,000	52.3	65.9	66.2	66.5	70.1	75.7	80.7	84.1	86.0	87.4	89.8	91.9	93.7	95.3	96.7	98.7	100.4	102.6	103.6	104.5	104.7	103.3	99.1	83.0	66.2
	80,000	57.1	72.4	72.8	73.0	77.2	82.8	88.0	91.6	93.6	95.2	97.5	100.2	102.1	103.7	105.2	107.3	109.2	111.0	112.3	113.5	113.5	111.6	106.8	88.6	70.2
	10,000	9.7	11.7	13.9	15.2	18.6	20.8	22.2	23.0	23.7	24.2	25.0	25.3	25.8	26.0	26.7	27.3	28.2	28.6	29.2	29.9	30.2	30.6	30.6	29.2	25.5
	20,000	17.6	22.8	25.6	27.3	31.8	35.8	38.5	40.3	41.3	42.0	43.2	44.0	44.9	45.8	46.7	47.9	49.1	50.1	50.9	51.8	52.5	52.8	52.3	48.1	41.3
	30,000	25.1	32.2	36.3	37.7	42.2	47.1	50.9	53.6	54.7	55.7	57.2	58.5	59.8	61.1	62.1	63.9	65.6	66.9	68.0	69.1	70.0	70.3	69.2	62.8	53.0
160	40,000	32.4	41.1	46.5	47.3	51.5	57.2	61.8	65.0	66.6	67.7	69.5	71.3	72.8	74.5	75.8	78.0	80.0	82.0	83.0	84.1	85.0	85.4	83.8	74.5	62.7
	50,000	39.6	51.7	55.6	56.0	59.9	66.6	72.1	75.7	77.5	78.8	80.9	83.0	84.9	86.9	88.7	90.7	93.3	96.1	95.6	97.9	98.8	99.4	97.0	85.0	71.1
	60,000	46.3	63.1	63.7	63.9	68.2	76.4	81.6	85.7	87.7	89.2	91.5	94.1	96.2	98.5	100.7	103.0	105.7	109.0	109.4	110.7	111.5	112.2	109.3	94.5	78.4
	70,000	53.1	70.5	71.3	71.6	76.3	84.1	90.6	96.3	97.5	99.0	101.8	104.7	107.0	109.5	112.0	114.8	117.5	120.6	121.7	123.3	124.2	124.2	121.1	103.6	85.3
	80,000	58.7	76.9	77.6	77.9	83.4	91.1	98.4	103.0	105.4	107.3	110.0	113.6	116.1	118.9	121.4	124.5	127.5	129.9	131.7	133.6	134.9	134.0	130.9	110.8	90.4
	10,000	9.8	12.8	15.8	16.5	18.8	22.1	24.0	26.3	26.2	26.6	27.4	28.3	28.8	29.6	30.3	31.3	32.4	33.1	33.7	34.6	35.3	35.5	35.6	34.1	30.6
	20,000	18.8	24.1	29.5	30.4	34.0	38.7	42.1	44.4	45.6	46.6	48.1	49.3	50.5	51.7	52.8	54.5	56.1	57.5	58.6	59.8	60.7	61.2	60.9	56.8	50.0
	30,000	27.7	35.3	41.3	42.2	46.6	52.6	57.4	60.6	62.1	63.3	65.4	67.1	68.6	70.2	71.6	73.8	76.1	77.8	79.2	80.7	81.8	82.3	81.4	75.0	64.9
180	40,000	36.2	46.6	51.7	52.6	57.4	64.8	70.2	74.1	76.1	77.6	80.2	82.2	83.9	86.1	87.7	90.2	92.8	95.1	96.6	98.2	99.5	100.0	98.7	90.0	77.2
	50,000	44.1	56.9	61.4	62.2	67.5	75.8	82.0	86.5	88.9	90.7	93.5	96.0	98.0	100.3	102.3	105.0	108.0	110.9	112.4	114.0	115.4	115.9	114.2	102.9	87.7
	60,000	51.5	69.4	71.0	71.6	76.7	85.8	92.7	97.6	100.3	102.5	105.5	108.3	110.5	113.1	115.3	118.1	121.5	124.7	126.2	127.8	129.3	129.8	127.6	114.0	96.3
	70,000	59.6	79.1	79.8	80.3	85.6	95.2	102.7	107.9	110.9	113.1	116.3	119.7	122.1	125.0	127.4	130.5	134.1	137.0	139.2	140.9	142.5	142.6	140.2	124.0	103.3
	80,000	65.7	86.7	87.5	87.8	93.1	103.2	111.3	116.6	119.6	122.0	126.7	129.0	131.9	135.0	137.9	141.2	144.6	147.2	149.8	151.8	153.7	153.2	150.3	131.8	108.2
	10,000	9.7	13.1	15.2	15.8	19.2	23.4	25.9	27.8	28.8	29.3	30.0	31.7	32.7	33.6	34.6	35.9	37.4	38.3	39.1	40.2	41.2	41.4	41.5	39.8	36.7
	20,000	20.0	28.1	31.2	31.8	36.8	42.1	46.2	49.1	50.6	51.8	53.8	55.4	56.9	58.6	60.0	62.2	64.5	66.4	67.8	69.3	70.0	70.3	70.2	67.3	60.6
	30,000	30.5	44.2	45.8	46.4	51.9	58.8	64.4	68.3	70.2	72.0	74.7	76.7	78.4	80.7	82.6	85.1	87.9	90.3	92.0	94.0	95.6	96.2	95.6	89.9	79.2
200	40,000	39.8	56.9	57.5	57.9	64.2	72.1	78.3	83.0	85.4	87.5	90.7	93.0	94.9	97.6	99.6	102.6	105.9	108.4	110.5	112.6	114.4	114.8	114.2	106.6	93.2
	50,000	48.2	68.0	68.6	68.9	74.6	84.6	91.1	96.5	99.7	102.2	105.4	108.3	110.3	113.2	115.2	118.5	122.3	125.0	127.6	129.4	131.6	131.8	131.2	121.5	105.5
	60,000	55.9	78.1	78.8	79.2	85.5	95.9	103.0	109.0	112.6	115.4	118.7	121.9	124.2	127.4	129.2	132.9	136.9	139.9	142.8	144.6	146.6	147.1	146.1	134.5	115.6
	70,000	66.5	88.1	88.7	89.0	95.2	106.7	114.7	120.8	124.5	127.5	131.5	134.7	137.5	140.5	143.2	146.8	150.9	153.9	156.9	158.8	161.5	161.5	159.9	146.3	123.3
	80,000	72.1	96.3	97.2	97.8	104.5	116.0	125.2	131.3	134.8	137.5	142.3	145.6	148.5	151.7	155.0	158.5	162.6	165.3	168.8	170.8	173.8	173.5	171.2	155.6	128.2
	10,000	8.9	13.1	16.5	17.3	20.2	26.5	29.2	30.9	31.9	32.5	33.4	35.3	36.6	37.5	38.7	40.0	41.5	42.7	43.7	44.8	45.8	46.3	46.6	45.6	42.9
	20,000	18.2	26.9	34.3	35.6	40.5	47.6	52.0	54.7	56.3	57.7	60.3	62.1	63.8	65.7	67.7	69.9	72.5	74.5	76.0	77.6	78.7	79.6	79.8	77.3	72.0
	30,000	28.2	42.5	50.2	51.8	58.0	68.1	71.6	75.6	77.8	79.8	83.1	85.3	87.4	90.1	92.5	95.1	98.2	100.7	102.7	104.5	105.9	106.7	106.7	102.9	94.3
220	40,000	37.8	56.0	64.4	66.1	73.2	82.2	88.6	93.5	96.2	98.6	102.5	106.3	107.7	110.8	113.4	116.5	120.0	122.9	125.3	127.5	129.2	130.2	129.5	123.8	112.1
	50,000	46.7	69.6	76.8	78.8	87.2	96.3	103.3	108.9	112.3	115.1	119.3	122.8	125.4	128.9	131.7	135.0	139.1	142.1	144.9	147.2	149.0	149.7	149.0	141.1	126.4
	60,000	54.7	80.3	88.0	90.4	99.0	108.5	116.9	121.9	125.6	128.5	133.4	137.0	139.9	143.5	146.6	150.0	154.2	157.9	160.9	162.9	164.9	165.7	164.4	153.8	136.1
	70,000	63.7	91.9	99.4	101.8	110.4	120.2	128.2	134.2	137.9	141.0	146.4	150.0	153.1	157.1	160.5	164.1	168.4	172.1	175.5	177.9	179.8	180.1	178.3	165.5	144.1
	80,000	69.3	99.7	109.3	111.4	118.7	129.6	138.4	143.7	147.7	151.0	156.6	160.2	163.8	167.7	171.6	175.2	179.5	183.4	186.6	189.2	190.8	190.5	188.6	173.4	148.3
	10,000	9.6	13.4	13.7	16.7	20.4	29.9	32.8	34.3	35.2	36.0	37.2	39.2	40.6	41.7	43.4	44.6	46.1	47.5	48.7	49.9	50.8	51.6	52.1	52.1	50.1
	20,000	21.0	27.9	28.4	30.1	43.6	54.1	58.6	61.2	63.0	64.6	67.8	69.9	71.8	74.1	76.5	78.9	81.6	83.7	85.7	87.3	88.4	89.3	89.7	89.2	85.6
	30,000	29.2	41.9	44.9	46.7	63.3	74.9	80.3	84.4	86.7	89.1	93.1	95.7	98.2	101.4	104.0	107.1	110.3	113.0	115.2	117.2	118.2	119.0	119.7	118.8	112.9
240	40,000	37.5	55.3	57.3	61.3	79.8	92.8	98.9	103.9	106.9	109.7	114.2	117.7	120.7	124.4	127.6	130.8	134.5	138.0	140.4	142.7	144.1	144.9	145.1	142.3	133.4
	50,000	47.3	70.1	72.1	74.9	94.1	107.6	114.9	120.3	123.8	126.7	132.2	136.2	139.6	143.5	147.2	150.6	154.6	158.6	161.4	163.9	165.4	166.5	165.7	160.1	147.9
	60,000	57.1	84.2	87.9	94.1	107.0	121.0	128.7	134.4	138.3	141.4	147.5	151.9	155.4	159.7	163.8	167.3	171.7	175.7	178.9	181.4	182.9	183.9	182.7	173.9	158.2
	70,000	62.0	95.6	98.4	100.1	118.6	132.9	140.5	145.9	151.1	153.5	159.7	164.1	167.8	172.5	176.6	180.6	185.0	189.4	192.7	195.4	196.8	197.1	195.1	183.9	165.0
	80,000	68.2	107.6	110.0	112.1	129.3	143.7	151.4	156.1	160.4	164.1	170.3	174.9	178.5	183.1	187.8	191.7	196.4	201.0	204.5	207.0	208.1	207.8	205.3	191.6	169.4
	20,000	21.8	31.9	33.2	36.0	50.7	61.7	66.7	70.0	71.9	73.5	76.7	79.1	81.5	83.8	86.2	88.6	91.1	93.5	95.4	97.2	98.6	100.3	100.6	100.9	98.1
	30,000	30.1	45.0	47.1	52.1	69.8	82.6	88.6	93.6	96.2	98.7	103.0	106.2	109.1	112.5	115.4	118.3	121.7	124.4	126.9	129.1	130.7	132.1	132.8	132.9	128.4
	40,000	38.3	59.2	63.0	68.4	88.0	102.9	110.0	115.8	119.0	122.0	127.3	131.1	134.5	138.3	141.6	145.1	148.7	151.7	154.7	157.2	158.8	160.0	160.2	158.8	151.6
260	50,000	48.7	66.1	77.3	82.8	103.8	119.9	127.7	134.0	137.5	140.7	147.1	151.4	154.9	159.3	162.4	166.1	169.9	173.3	176.4	178.9	180.5	181.8	181.1	176.9	167.2
	60,000	59.1	92.0	94.1	96.0	117.3	134.3	142.4	149.0	152.9	156.4	163.0	167.8	171.6	176.1	179.5	183.3	187.0	190.4	193.5	196.9	197.6	197.9	196.9	189.8	177.1
	70,000	65.1	103.1	106.4	109.3	130.0	146.7	155.4	161.7	166.2	169.6	176.7	181.8	185.9	190.3	194.0	197.3	201.2	204.6	207.8	209.7	211.1	211.2	209.4	199.4	182.1
	80,000	71.0	114.6	117.5	120.3	138.6	155.9	164.5	170.3	175.0	178.5	185.9	191.2	195.1	199.3	203.1	206.6	210.3	213.7	216.4	218.3	219.1	218.3	215.7	203.7	181.9
	20,000	22.0	36.1	38.9	43.3	59.2	70.9	76.6	80.7	82.5	84.3	87.6	90.5	93.0	95.5	98.0	100.1	102.6	105.2	107.0	109.1	111.0	113.5	113.6	114.9	113.0
	30,000	30.5	50.5	53.2	58.4	76.7	91.1	98.3	104.3	107.0	109.5	114.6	118.4	121.4	125.1	128.2	131.4	134.4	137.2	140.2	142.9	144.9	146.7	147.4	148.9	146.4
	40,000	39.0	64.8	69.8	75.7	96.4	113.2	121.6	128.3	131.8	134.8	141.0	145.2	148.8	153.1	156.1	159.7	163.0	166.1	169.4	172.1	173.9	175.1	175.7	176.0	171.5
280	50,000	50.1	79.2	84.0	90.0	112.8	131.3	140.1	147.0	150.8	153.9	160.9	165.6	169.7	173.8	176.8	180.6	183.9	186.6	190.3	192.4	194.4	195.1	194.8	193.0	186.3
	60,000	61.5	97.5	99.6	103.7	127.6	147.4	156.2	163.3	167.5	170.6	178.1	183.3	187.4	191.8	194.4	198.1	201.3	203.9	207.2	208.7	210.6	210.6	209.9	205.2	195.6
	70,000	67.2	109.4	112.9	116.6	139.9	158.9	168.6	175.4	179.8	183.4	191.4	196.8	201.2	206.5	208.2	211.4	214.3	216.7	219.4	220.6	221.8	221.4	219.5	212.1	197.2
	80,000	73.4	121.1	124.3	128.9	150.2	168.8	178.4	185.0	190.0	193.8	201.7	207.8	212.3	216.9	219.2	221.7	224.3	226.4	228.4	229.2	229.6	228.4	226.0	215.3	194.5
	30,000	36.5	68.9	72.3	76.1	98.8	118.9	129.0	137.0	140.6	144.0	149.1	153.0	156.2	158.2	160.4	163.1	165.5	167.6	168.8	169.6	170.5	170.5	170.2	169.8	168.4
	40,000	45.6	84.6	88.1	92.8	118.3	139.4	149.3	157.6	161.6	164.7	169.9	173.3	175.4	178.1	180.2	182.6	184.8	186.5	188.2	189.9	190.6	190.6	189.9	188.1	182.6
300	50,000	55.9	116.1	138.3	145.2	170.0	186.3	191.5	194.9	197.9	200.2	203.6	205.3	206.8	208.0	206.5	203.7	200.6	198.0	196.1	193.5	190.9	188.3	185.3	178.7	169.7
	60,000	72.2	130.0	152.9	160.2	187.1	202.5	208.4	211.2	214.4	216.1	219.5	221.1	221.9	221.5	219.5	217.1	214.5	211.3	208.9	205.7	202.5	199.4	195.4	186.6	175.5
	70,000	79.8	144.4	166.1	173.1	199.2	213.2	218.7	221.3	224.6	226.8	229.9	231.6	232.8	231.5	229.5	226.6	223.8	220.1	216.8	213.1	209.7	206.0	201.5	190.2	174.9
	80,000	87.4	155.6	178.8	182.7	207.3	218.9	224.5	226.3	229.6	231.8	235.4	237.1	238.9	237.2	234.5	231.2	228.0	223.8	219.6	215.8	211.6	207.8	202.8	189.2	169.8
	30,000	38.9	98.0	130.2	135.3	156.9	176.8	183.1	187.4	191.0	194.5	198.4	199.4	198.0	196.6	194.8	192.4	189.3	187.2	183.7	180.5	177.0	174.1	171.0	164.0	158.0
	40,000	47.3	100.7	142.3	148.5	173.7	191.9	197.7	200.7	204.0	206.6	208.6	208.9	207.1	205.3	202.7	199.4	195.9	192.6	188.9	185.3	181.2	177.6	174.3	166.3	158.6
320	50,000	61.7	129.7	157.0	164.7	193.4	209.2	214.9	216.9	220.0	221.3	222.5	222.1	220.9	218.2	215.1	211.3	206.7	202.4	198.2	193.9	189.7	185.0	181.1	172.3	163.0
	60,000	76.1	148.2	172.0	180.8	211.7	226.5	230.2	231.5	234.3	234.8	234.8	234.0	233.2	230.3	226.3	221.4	216.5	210.9	206.4	201.2	196.7	191.4	187.4	177.2	165.9
	70,000	82.0	165.9	185.0	193.8	223.9	234.7	239.1	240.4	242.5	243.4	243.4	242.6	241.7	238.0	234.6	228.8	223.7	217.9	212.4	207.0	201.6	196.6	191.5	179.8	166.0
	80,000	89.5	179.4	195.7	203.7	232.9	240.6	244.1	245.0	247.1	248.4	248.4	247.2	246.3	242.1	238.7	232.4	227.2	220.8	214.9	209.0	203.5	198.4	192.9	179.2	165.5
	Stroke	0	0.2	1.2	2	6	12	18	24	30	36	49	61	73	85	97	109	122	134	146	158	170	182	194	219	243

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TABLE 22. C13 Constant Pressure Catapult (CVA41), Mean, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) — NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND CSV SETTING

Pressure (PSI)	Stroke / Weight (LBS)	0	0.2	1.2	2	6	12	18	24	30	36	49	61	73	85	97	109	122	134	146	158	170	182	194	219	243
	10,000	7.5	9.1	11.3	12.4	14.2	15.1	12.2	12.2	12.5	13.4	14.0	14.4	14.7	14.7	14.7	14.8	14.9	14.9	14.9	14.8	14.7	14.4	13.8	11.3	8.1
	20,000	14.2	16.9	19.1	20.2	22.3	23.1	21.7	21.6	22.3	23.0	23.9	24.0	24.0	24.1	24.1	24.1	24.1	24.1	24.0	23.8	23.3	22.7	21.4	17.1	12.6
80	30,000	19.9	23.6	25.2	25.9	27.6	28.7	29.8	30.5	31.0	31.3	31.6	31.7	31.6	31.6	31.5	31.4	31.2	31.1	30.8	30.4	29.7	29.0	26.8	20.6	15.3
	40,000	24.4	29.6	30.3	30.5	31.8	34.1	35.9	36.9	37.4	37.7	37.9	37.9	37.8	37.7	37.7	37.4	37.0	36.8	36.5	36.0	35.0	33.8	31.1	23.8	17.6
	50,000	27.9	34.6	35.0	35.2	36.7	39.0	40.9	42.0	42.7	43.0	43.4	43.4	43.3	43.1	42.9	42.5	42.2	41.7	41.4	40.9	39.6	37.6	34.4	26.5	19.3
	60,000	30.2	38.6	39.3	39.6	41.0	43.8	45.7	47.0	47.8	48.2	48.6	48.8	48.5	48.2	48.0	47.4	47.0	46.4	46.0	45.5	44.1	41.2	37.4	28.9	20.8
	10,000	8.8	10.9	12.7	13.6	14.9	16.2	14.9	15.2	15.5	16.2	16.7	17.1	17.3	17.4	17.4	17.5	17.6	17.6	17.6	17.6	17.5	17.3	16.8	14.2	10.8
	20,000	16.9	20.2	22.1	23.0	25.0	26.1	25.9	26.3	26.9	27.5	28.3	28.6	28.7	28.8	28.9	28.9	29.1	29.4	29.1	28.9	28.6	28.0	26.6	22.0	16.9
	30,000	23.6	28.4	29.9	30.4	32.1	33.7	35.1	35.9	36.6	37.0	37.6	37.8	37.9	38.0	38.1	38.0	38.0	37.9	37.7	37.5	36.8	36.0	33.9	27.4	21.0
100	40,000	29.0	35.6	36.4	36.6	38.2	40.4	42.3	43.5	44.2	44.6	45.2	45.5	45.5	45.6	45.7	45.6	45.4	45.2	45.1	44.7	43.7	42.5	39.7	31.9	24.1
	50,000	33.5	42.2	42.4	42.5	44.4	46.7	48.8	50.2	51.0	51.5	52.1	52.4	52.5	52.8	52.5	52.3	52.1	51.9	51.7	51.3	50.1	48.1	44.8	35.9	26.7
	60,000	37.5	47.6	47.8	47.9	50.1	52.6	54.7	56.2	57.2	57.8	58.5	58.7	58.8	59.0	58.7	58.5	58.2	57.9	57.7	57.3	55.8	53.2	49.2	39.1	28.9
	70,000	41.2	52.4	53.0	53.2	55.6	58.0	60.4	62.0	63.0	63.7	64.5	64.7	65.0	64.8	64.6	64.3	64.1	63.8	63.5	62.9	61.2	58.0	53.2	42.0	30.7
	80,000	44.7	57.2	58.0	58.3	60.8	63.3	65.7	67.4	68.7	69.3	70.0	70.2	70.4	70.2	70.1	69.9	69.7	69.2	68.9	68.1	66.3	62.4	57.0	44.3	32.2
	10,000	9.3	12.6	14.9	15.4	16.4	17.1	18.2	18.7	19.1	19.5	19.8	20.1	20.3	20.5	20.4	20.7	20.6	20.6	20.8	21.0	20.9	20.7	20.3	17.6	14.2
	20,000	18.1	22.9	26.2	26.6	27.8	29.5	30.9	31.9	32.5	33.0	33.7	34.1	34.4	34.6	34.7	34.9	34.9	35.1	35.1	35.2	35.1	34.6	33.2	28.4	22.6
	30,000	27.7	33.6	35.4	35.7	37.5	39.0	40.7	41.9	42.7	43.3	44.1	44.8	45.0	45.2	45.5	45.7	45.7	45.9	45.9	45.7	45.3	44.4	42.5	35.8	28.0
120	40,000	32.7	42.4	43.2	43.4	45.4	47.3	49.4	50.7	51.6	52.3	53.3	53.9	54.2	54.5	54.8	55.0	55.0	55.1	55.1	54.9	54.1	52.9	50.3	42.1	32.5
	50,000	39.6	49.8	50.2	50.3	52.1	54.9	57.3	58.6	59.6	60.5	61.6	62.1	62.5	63.0	63.1	63.3	63.4	63.5	63.5	63.3	62.3	60.6	57.3	47.4	36.2
	60,000	44.8	56.3	56.8	56.9	59.2	62.1	64.8	66.2	67.4	68.3	69.4	69.9	70.4	70.9	70.9	71.2	71.3	71.6	71.4	71.2	69.9	67.9	63.6	52.2	39.3
	70,000	50.0	62.7	63.1	63.2	65.3	68.8	71.6	73.3	74.6	75.5	76.7	77.4	77.8	78.3	78.5	78.7	79.0	79.0	78.9	78.5	76.9	74.4	69.5	56.2	42.1
	80,000	53.4	67.1	68.1	68.6	71.4	75.5	78.2	80.2	81.5	82.3	83.6	84.6	85.1	85.4	85.7	86.1	86.5	86.5	86.1	85.4	83.7	80.9	75.0	59.8	44.8
	10,000	9.5	13.4	15.4	16.3	18.3	19.9	21.0	21.5	21.9	22.3	22.7	22.9	23.0	23.3	23.5	23.7	23.8	23.8	24.0	24.1	24.5	24.9	24.0	21.5	18.0
	20,000	18.7	24.0	27.7	29.1	31.7	34.0	35.7	36.8	37.5	38.0	38.9	39.3	39.7	40.0	40.3	40.6	40.9	41.2	41.3	41.5	41.5	41.2	40.0	35.2	29.0
	30,000	27.8	35.1	38.2	39.4	42.4	45.1	47.4	48.8	49.7	50.4	51.5	52.3	52.7	53.2	53.6	54.1	54.4	54.7	54.8	54.9	54.6	54.0	52.3	45.4	36.7
140	40,000	34.7	45.1	46.0	46.6	51.5	54.7	57.5	59.2	60.3	61.1	62.4	63.3	63.9	64.5	65.0	65.6	65.0	66.4	66.6	66.6	66.0	65.1	62.6	53.7	43.0
	50,000	41.3	55.1	56.2	56.6	59.7	63.4	66.7	68.5	69.7	70.7	72.2	73.1	74.0	74.8	75.2	75.7	76.3	77.1	76.9	76.9	76.2	75.1	71.6	60.8	48.3
	60,000	47.3	61.8	63.9	64.2	67.4	71.5	75.2	77.3	78.7	79.8	81.3	82.4	83.3	84.2	84.8	85.4	86.1	87.1	86.7	86.7	85.8	84.4	79.9	67.3	52.9
	70,000	53.1	68.5	70.9	71.0	74.4	78.9	82.8	85.1	86.6	87.8	89.5	90.8	91.8	92.7	93.5	94.3	94.9	95.7	95.6	95.6	94.6	92.5	87.7	72.7	56.7
	80,000	57.9	75.1	77.1	77.2	81.0	85.6	89.6	92.2	93.9	95.0	96.8	98.6	99.6	100.6	101.6	102.5	103.2	103.6	103.8	103.6	102.5	100.0	94.9	77.4	59.9
	10,000	9.7	13.7	15.3	17.3	21.1	23.0	24.0	24.6	25.1	25.4	25.9	26.0	26.0	26.4	26.8	27.0	27.2	27.4	27.6	28.0	28.0	28.4	27.9	26.1	22.5
	20,000	19.2	25.1	28.5	30.6	35.4	38.7	40.8	41.9	42.7	43.2	44.2	44.7	45.3	45.8	46.2	46.8	47.2	47.7	47.9	48.3	48.4	48.4	47.6	43.1	36.5
	30,000	27.1	37.1	39.5	42.2	47.0	51.0	53.8	55.5	56.6	57.4	58.6	59.5	60.5	61.3	61.7	62.6	63.3	63.8	64.2	64.5	64.5	64.3	62.8	55.9	46.6
160	40,000	35.1	49.2	51.8	54.7	57.2	61.6	65.3	67.4	68.7	69.5	71.1	72.4	73.6	74.5	75.2	76.2	77.1	78.1	78.2	78.6	78.3	78.1	75.7	66.7	55.1
	50,000	42.5	57.6	60.6	61.8	66.5	71.3	75.5	78.0	79.6	80.7	82.4	84.0	85.3	86.4	87.6	88.5	89.6	91.3	91.8	91.2	91.0	90.5	87.2	76.0	62.3
	60,000	50.0	66.1	68.9	69.9	74.8	80.3	85.0	87.8	89.5	90.7	92.7	94.7	96.2	97.6	99.1	100.0	101.4	103.4	102.6	102.9	102.7	102.0	97.8	84.2	68.5
	70,000	54.2	73.8	76.8	77.5	82.4	88.4	93.8	96.7	98.7	100.2	102.4	104.5	106.1	107.7	109.3	110.7	112.1	113.8	113.6	114.0	113.8	112.6	108.5	92.0	74.2
	80,000	60.2	81.5	83.6	83.8	89.1	95.4	101.3	104.6	106.6	108.2	110.6	113.3	115.1	116.8	118.5	120.3	120.7	121.7	122.4	121.8	120.8	119.9	118.0	98.4	78.5
	10,000	9.9	14.1	17.5	19.0	21.8	24.6	26.0	26.8	27.5	27.9	28.4	29.1	29.4	29.9	30.5	30.8	31.3	31.6	32.0	32.4	32.6	32.7	32.6	30.8	27.4
	20,000	20.0	27.2	31.9	34.1	38.5	42.3	44.9	46.3	47.3	48.1	49.3	50.2	51.0	51.9	52.6	53.4	54.0	54.8	55.3	55.8	56.1	56.2	55.5	51.3	44.7
	30,000	28.7	39.4	45.7	47.6	52.3	57.2	60.6	62.6	63.9	65.0	66.8	68.1	69.1	70.3	71.1	72.2	73.1	74.0	74.5	75.2	75.5	75.5	74.3	67.7	57.8
180	40,000	36.3	53.9	57.7	59.3	64.5	70.0	73.9	76.4	78.1	79.4	81.3	83.1	84.4	85.9	86.8	88.0	89.2	90.3	90.8	91.4	91.8	91.6	89.9	81.1	68.7
	50,000	45.6	66.1	69.2	70.0	75.7	81.4	85.9	88.8	90.9	92.4	94.7	96.6	98.3	99.8	101.1	102.2	103.6	105.3	105.5	106.1	106.4	106.2	103.8	92.9	78.1
	60,000	53.2	72.1	78.9	79.3	84.6	91.5	96.4	99.8	102.1	103.9	106.2	108.5	110.2	112.1	113.3	114.6	116.4	118.2	118.3	118.9	119.1	118.9	115.8	102.7	85.5
	70,000	58.6	80.3	87.3	87.6	92.1	100.1	105.9	109.5	111.8	113.7	116.5	119.0	121.0	122.9	124.5	126.1	127.6	129.2	129.9	130.3	130.8	129.9	126.7	111.2	91.2
	80,000	64.0	88.5	94.0	94.4	98.7	107.8	114.1	117.6	120.4	122.4	125.4	128.3	130.3	132.3	134.3	136.0	137.6	138.8	139.8	140.1	140.5	139.6	136.2	118.3	95.3
	10,000	10.0	14.3	18.6	19.4	22.3	26.0	27.9	29.1	30.0	30.5	30.9	32.4	33.2	34.0	34.6	35.1	35.8	36.5	37.0	37.4	37.9	37.9	38.1	36.1	33.0
	20,000	20.8	29.1	34.2	37.0	42.3	46.2	49.4	51.1	52.3	53.4	55.1	56.4	57.5	58.8	59.8	60.9	61.9	63.1	63.8	64.0	64.5	64.9	64.0	61.1	54.7
	30,000	29.2	43.7	50.5	51.7	57.9	63.0	67.0	69.2	70.7	72.2	74.5	76.2	77.6	79.1	80.3	81.7	83.0	84.2	85.0	86.0	86.8	86.9	86.2	80.2	70.0
200	40,000	37.6	58.2	63.4	64.5	71.5	77.5	81.7	84.6	86.6	88.5	90.9	93.1	94.8	96.6	97.9	99.2	100.8	102.1	103.0	104.1	105.0	105.2	104.3	96.3	83.2
	50,000	46.7	68.0	75.4	76.1	83.6	90.3	94.8	98.3	100.9	103.0	106.6	108.0	109.9	111.8	113.1	114.5	116.4	117.8	118.9	120.0	120.8	121.0	120.0	110.3	94.6
	60,000	55.8	77.8	86.1	86.6	94.9	101.8	106.7	110.5	113.6	116.1	118.8	121.6	123.5	125.6	126.8	128.5	130.5	132.0	133.1	133.9	135.0	135.1	133.9	122.3	103.7
	70,000	61.4	86.9	94.8	95.8	105.1	111.8	117.8	121.8	124.9	127.3	130.8	133.6	135.7	138.0	139.6	141.2	143.1	144.4	146.0	146.8	148.1	147.8	145.8	132.2	110.1
	80,000	66.9	95.0	103.5	104.6	115.2	120.7	127.3	131.4	134.5	137.1	141.0	144.1	146.6	148.9	150.8	152.2	154.3	155.4	157.1	157.9	159.3	158.5	155.8	140.6	114.6
	10,000	10.1	14.5	20.2	21.2	23.8	29.2	31.4	32.6	33.5	34.1	34.8	36.2	37.0	37.8	38.7	39.3	40.0	40.7	41.3	41.9	42.4	43.0	43.8	41.9	38.6
	20,000	21.7	31.3	57.8	39.6	46.2	51.9	55.2	57.2	58.5	59.7	61.8	63.3	64.6	65.8	67.1	68.3	69.5	70.5	71.4	72.2	72.7	73.2	72.8	70.2	64.7
	30,000	29.1	48.2	62.5	65.4	64.9	71.4	75.4	78.0	79.8	81.5	84.2	86.0	87.9	89.3	90.9	92.3	93.7	95.1	96.0	97.0	97.5	97.9	97.4	93.1	84.4
220	40,000	38.9	63.2	67.2	69.9	80.7	88.1	92.6	95.8	98.0	100.1	103.1	105.6	107.5	109.6	111.1	112.7	114.6	116.2	117.3	118.3	119.0	119.0	118.3	112.0	100.4
	50,000	48.6	73.7	82.6	84.6	93.7	102.5	107.4	111.4	114.1	116.3	119.8	122.4	124.6	127.0	128.7	130.4	132.5	134.2	135.4	136.6	137.1	137.3	136.2	127.8	113.0
	60,000	58.3	84.2	94.8	96.7	105.3	114.5	119.9	124.0	127.3	129.8	133.3	136.5	138.7	141.4	143.3	144.9	147.2	149.1	150.4	151.2	152.0	152.0	150.4	139.8	121.8
	70,000	64.6	94.2	105.8	107.7	114.8	125.0	131.3	135.4	138.7	141.3	145.2	148.7	151.0	153.9	156.0	157.7	159.9	162.0	163.4	164.3	165.2	164.6	162.3	149.5	128.2
	80,000	70.9	104.2	117.3	118.3	124.4	134.0	140.6	144.7	147.8	150.7	155.1	158.5	161.2	163.7	166.2	168.1	170.4	172.2	173.8	174.7	175.3	174.4	171.7	156.8	131.7
	10,000	10.2	15.1	15.7	16.9	23.4	32.5	35.1	36.5	37.3	37.9	38.9	40.2	41.1	41.9	43.1	43.7	44.4	45.2	45.8	46.6	47.1	48.0	48.9	47.7	44.9
	20,000	22.4	33.0	36.2	40.5	50.0	58.5	62.2	64.2	65.7	66.9	69.5	71.1	72.5	74.0	75.6	76.7	78.3	79.3	80.1	81.1	81.6	82.0	82.3	80.9	76.5
	30,000	31.1	50.4	54.0	60.3	70.7	80.8	84.8	87.8	89.8	91.5	94.5	96.8	98.8	100.6	102.3	103.9	105.8	107.3	108.3	109.3	109.5	109.8	109.8	107.6	101.2
240	40,000	39.9	67.9	69.0	72.9	87.8	98.9	103.8	107.4	109.8	111.9	115.6	118.4	120.5	122.9	124.8	126.7	128.7	130.6	131.0	131.5	132.0	132.5	131.8	128.8	119.3
	50,000	50.3	79.5	83.3	86.7	102.2	114.1	119.6	123.8	126.6	128.8	132.9	136.1	138.8	141.3	143.7	145.6	147.7	149.9	151.2	151.8	152.0	152.0	151.5	145.3	132.2
	60,000	60.8	91.0	93.2	97.5	114.7	126.9	133.0	137.3	140.4	142.8	147.6	151.2	153.9	156.9	159.6	161.4	163.7	166.1	167.6	168.5	168.5	168.8	166.7	157.9	141.2
	70,000	66.7	101.5	104.2	105.2	125.0	137.4	143.6	147.9	151.1	154.0	158.6	162.4	165.0	168.2	171.1	173.0	175.5	178.0	179.6	180.9	180.5	180.2	177.4	166.3	146.5
	80,000	72.6	112.0	115.6	118.4	133.8	146.8	153.0	156.8	160.2	163.3	167.8	171.8	174.5	177.9	180.9	183.0	185.5	188.0	189.0	189.9	189.5	189.0	186.2	172.5	149.5
	20,000	23.2	37.0	39.0	43.6	55.0	64.8	68.8	71.3	72.9	74.2	77.0	78.9	80.5	82.1	83.7	85.0	86.6	87.9	88.8	90.0	90.6	91.9	91.9	91.4	88.0
	30,000	32.1	54.8	57.2	61.9	77.8	88.8	93.5	96.8	99.0	101.2	104.7	107.3	109.5	111.6	113.4	115.1	116.7	118.2	119.5	120.6	121.1	122.0	122.9	120.8	115.8
	40,000	41.2	73.0	75.4	78.4	96.1	108.9	114.3	118.3	120.9	123.3	127.8	131.0	133.3	135.9	137.8	139.6	141.6	143.1	144.4	145.7	146.0	146.3	146.0	143.3	135.9
260	50,000	52.4	85.4	87.4	92.5	111.5	125.4	131.5	136.0	139.1	141.5	146.6	150.2	152.9	155.8	157.6	159.7	161.4	163.1	164.6	166.5	165.8	165.8	164.6	160.0	149.5
	60,000	63.6	97.8	101.0	104.9	124.3	138.8	145.6	150.5	153.8	156.5	161.8	165.7	168.9	171.5	173.5	175.4	177.2	178.8	180.5	181.1	181.7	180.8	178.9	171.7	158.0
	70,000	70.0	109.4	112.0	116.8	135.6	149.9	157.1	161.7	165.2	168.0	174.0	178.1	180.9	184.0	186.1	187.8	189.7	191.1	192.4	192.8	192.9	191.7	189.0	179.2	161.5
	80,000	76.4	121.2	123.8	126.2	143.7	157.9	165.2	169.3	173.3	176.2	182.1	186.4	189.2	192.1	194.3	195.7	197.7	199.1	199.8	200.1	199.6	198.0	194.8	182.0	160.8
	20,000	24.0	41.2	44.4	48.5	63.3	73.6	78.1	81.1	83.0	84.5	87.5	89.7	91.7	93.6	95.4	96.7	98.3	100.0	100.9	102.4	103.5	105.5	105.3	105.9	103.5
	30,000	33.1	60.9	65.5	70.5	87.0	99.7	105.0	109.0	111.5	113.7	118.2	121.1	123.6	126.0	128.0	129.7	131.3	132.8	134.5	135.9	136.7	137.9	137.9	138.1	134.9
	40,000	42.3	80.5	83.6	87.9	105.9	121.4	127.5	132.2	135.2	137.9	143.6	147.1	149.7	152.6	154.4	156.4	158.0	159.2	159.6	161.1	161.7	162.0	161.7	160.8	156.8
280	50,000	54.2	93.3	96.2	101.9	122.9	139.3	146.1	151.1	154.5	157.5	163.6	167.5	170.5	173.4	174.8	177.1	178.2	178.5	179.5	179.8	180.5	180.1	179.2	177.0	171.1
	60,000	66.1	106.1	109.2	113.8	135.6	153.2	160.2	165.6	169.3	172.2	178.7	182.9	186.1	189.0	190.0	191.2	192.3	192.7	193.8	193.8	193.8	193.1	192.4	187.8	178.2
	70,000	73.0	118.6	120.2	125.6	146.4	163.4	171.1	176.1	180.3	183.3	190.1	194.6	198.0	200.6	202.1	203.2	203.8	204.3	204.5	204.2	204.2	203.7	201.1	192.5	177.9
	80,000	79.8	131.2	134.3	138.5	153.7	169.5	177.4	182.1	186.3	189.4	196.4	201.3	204.8	206.7	208.2	209.0	209.8	209.8	209.8	209.0	208.3	206.3	203.3	191.7	171.9
	30,000	34.8	67.2	83.7	86.9	108.8	125.5	132.7	138.0	141.3	144.3	148.7	151.3	152.5	154.2	155.1	156.0	156.6	157.2	157.5	157.8	157.5	157.5	156.6	154.8	150.7
	40,000	43.5	89.0	100.2	106.2	128.9	146.5	153.9	159.3	162.6	165.3	169.9	172.1	173.5	174.8	175.4	176.1	176.1	176.1	176.4	176.1	175.4	174.5	173.2	169.7	163.8
300	50,000	56.1	102.6	113.9	120.7	145.7	163.3	170.7	175.7	179.0	181.6	185.7	187.8	189.2	190.6	190.6	190.6	190.6	189.9	189.9	188.8	187.8	186.4	184.2	179.4	171.6
	60,000	68.8	116.1	127.7	134.9	162.0	178.9	186.3	190.9	194.4	196.4	200.0	202.3	204.2	204.9	204.5	204.2	203.3	202.2	201.8	200.3	198.8	196.6	194.3	187.2	177.0
	70,000	76.0	130.0	139.9	147.0	173.1	188.2	195.5	199.9	203.4	205.5	209.3	211.6	213.6	214.0	213.6	212.4	211.5	210.0	208.8	206.8	205.3	202.5	199.4	190.0	175.9
	80,000	83.2	143.9	150.1	156.8	181.1	194.5	201.4	205.5	208.7	211.2	215.1	217.9	219.4	219.0	219.0	217.5	216.1	214.1	212.1	210.1	207.8	204.6	200.6	189.4	171.4
	30,000	36.7	88.8	104.4	109.7	132.8	154.7	164.2	171.0	174.9	178.7	182.8	184.8	184.4	184.4	184.4	183.8	183.0	182.3	181.0	178.6	177.6	175.9	173.5	168.9	163.8
	40,000	44.6	100.1	116.0	122.4	149.0	169.2	177.6	183.7	187.0	189.8	192.0	192.5	192.0	191.7	191.4	190.0	188.9	187.1	185.3	183.6	181.1	178.7	176.2	170.3	163.7
320	50,000	58.2	114.2	130.8	138.3	167.5	186.0	193.7	199.0	202.1	204.0	205.6	206.0	205.6	204.9	203.0	201.2	199.1	196.5	193.9	191.7	189.1	185.8	183.2	175.8	167.7
	60,000	71.8	128.1	145.4	154.3	185.8	201.3	208.9	212.9	215.7	216.0	216.5	217.0	217.0	215.9	213.6	210.8	208.3	204.8	202.0	198.5	195.8	191.9	188.8	180.3	170.2
	70,000	78.7	145.8	157.6	166.2	197.2	210.0	216.9	220.3	223.1	224.4	225.3	225.3	224.9	222.9	221.2	217.3	214.2	210.6	207.4	203.8	200.2	196.2	192.6	182.6	169.8
	80,000	86.2	158.5	168.8	177.0	206.5	216.7	222.5	225.4	227.9	229.6	230.1	230.1	230.1	227.2	226.0	221.6	218.0	213.9	210.3	206.2	202.6	198.5	193.6	182.6	167.5
	Stroke	0	0.2	1.2	2	6	12	18	24	30	36	49	61	73	85	97	109	122	134	146	158	170	182	194	219	243

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TABLE 23. C13 Constant pressure Catapult (CVA41), Lower Boundary, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) — NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND CSV SETTING

CSV Setting	Stroke / Weight (LBS)	0	0.2	1.2	2	6	12	18	24	30	36	49	61	73	85	97	109	122	134	146	158	170	182	194	219	243
	10,000	6.8	8.2	10.2	11.2	12.8	13.6	11.0	11.0	11.2	12.1	12.6	13.0	13.2	13.2	13.2	13.3	13.4	13.4	13.4	13.3	13.3	13.0	12.5	10.2	7.3
	20,000	12.7	15.2	17.1	18.2	20.0	20.8	19.5	19.4	20.0	20.7	21.5	21.6	21.6	21.6	21.6	21.6	21.7	21.7	21.6	21.4	21.0	20.4	19.2	15.3	11.3
80	30,000	17.8	21.2	22.7	23.3	24.8	25.8	26.8	27.4	27.9	28.1	28.4	28.5	28.4	28.4	28.3	28.2	28.0	27.9	27.7	27.3	26.7	26.0	24.1	18.5	13.8
	40,000	21.9	26.6	27.2	27.4	28.6	30.6	32.3	33.2	33.6	33.9	34.1	34.1	34.0	33.9	33.8	33.6	33.3	33.1	32.8	32.3	31.5	30.4	27.9	21.4	15.8
	50,000	25.4	31.4	31.8	32.0	32.4	33.3	33.5	34.8	35.5	35.9	36.4	36.8	37.1	37.5	37.9	38.0	38.1	38.4	38.9	39.1	38.7	37.1	34.5	27.5	20.8
	60,000	27.7	35.4	36.1	36.4	37.1	38.0	38.1	39.5	40.4	40.8	41.4	41.8	42.0	42.3	42.7	42.7	42.9	43.1	43.6	43.9	43.3	40.9	37.8	30.2	22.6
	10,000	8.0	9.8	11.5	12.3	13.5	14.7	13.5	13.7	14.0	14.7	15.1	15.5	15.7	15.8	15.7	15.9	15.9	15.9	15.9	15.9	15.9	15.7	15.2	12.8	9.8
	20,000	15.2	18.2	19.8	20.6	22.5	23.5	23.3	23.6	24.2	24.8	25.5	25.7	25.8	25.9	26.0	26.0	26.1	26.1	26.1	26.0	25.7	25.1	23.9	19.8	15.2
	30,000	21.3	25.6	26.9	27.4	28.9	30.4	31.6	32.4	33.0	33.4	33.8	34.1	34.1	34.2	34.3	34.3	34.2	34.1	34.0	33.8	33.2	32.4	30.6	24.7	18.9
100	40,000	26.8	33.0	33.7	33.9	35.4	37.4	39.2	40.3	41.0	41.4	41.9	42.1	42.1	42.2	42.3	42.2	42.1	41.9	41.8	41.4	40.5	39.4	36.8	29.5	22.3
	50,000	30.1	38.0	38.1	38.2	39.9	42.0	43.9	45.1	45.9	46.3	46.9	47.1	47.2	47.3	47.2	47.0	46.8	46.7	46.5	46.1	45.0	43.3	40.2	32.2	24.0
	60,000	33.8	42.9	43.0	43.2	45.2	47.4	49.3	50.6	51.5	52.1	52.7	52.9	53.0	53.0	52.9	52.7	52.5	52.2	52.0	51.6	50.3	48.0	44.3	35.3	26.0
	70,000	37.1	47.2	47.7	47.9	50.1	52.3	54.4	55.8	56.8	57.4	58.1	58.3	58.3	58.3	58.2	58.0	57.7	57.4	57.2	56.6	55.1	52.3	47.9	37.8	27.7
	80,000	40.3	51.5	52.3	52.5	54.8	57.0	59.2	60.8	61.9	62.5	63.1	63.3	63.4	63.3	63.2	63.0	62.8	62.4	62.1	61.4	59.8	56.3	51.4	39.9	29.0
	10,000	8.7	11.0	13.4	13.9	14.8	15.5	16.4	16.9	17.3	17.6	17.9	18.1	18.3	18.5	18.5	18.7	18.6	18.6	18.7	18.7	18.7	18.7	18.3	15.9	12.8
	20,000	17.0	21.4	23.7	24.0	25.2	26.6	28.0	28.9	29.4	29.9	30.4	30.8	31.1	31.3	31.4	31.5	31.6	31.8	31.8	31.8	31.8	31.2	30.0	25.6	20.5
	30,000	26.0	31.1	32.1	32.3	34.0	35.4	36.9	38.0	38.7	39.2	40.0	40.6	40.8	40.9	41.2	41.4	41.4	41.5	41.5	41.4	41.0	40.2	38.5	32.5	25.3
120	40,000	30.7	38.4	39.1	39.3	41.1	42.8	44.7	45.9	46.7	47.3	48.3	48.8	49.1	49.3	49.6	49.8	49.8	49.9	49.7	49.0	47.9	45.6	38.1	29.4
	50,000	37.2	45.6	46.0	46.1	47.7	50.3	52.5	53.6	54.6	55.4	56.4	56.8	57.2	57.7	57.8	58.0	58.1	58.2	58.2	58.0	57.0	55.5	52.4	43.4	33.1
	60,000	42.1	51.0	51.5	51.5	53.6	56.3	58.7	60.0	61.0	61.8	62.9	63.3	63.8	64.2	64.2	64.5	64.6	64.8	64.7	64.5	63.3	61.5	57.6	47.3	35.6
	70,000	47.7	56.8	57.1	57.2	59.2	62.3	64.8	66.4	67.5	68.3	69.4	70.0	70.4	70.9	71.1	71.3	71.6	71.6	71.4	71.0	69.7	67.4	62.9	50.9	38.1
	80,000	50.2	60.6	61.5	61.9	64.5	68.2	70.7	72.5	73.6	74.3	75.5	76.4	76.8	77.1	77.4	77.6	78.1	78.1	77.8	77.1	75.6	73.0	67.7	54.0	40.4
	10,000	9.0	11.7	14.0	14.9	16.7	18.2	19.2	19.7	20.1	20.4	20.8	21.0	21.0	21.3	21.5	21.7	21.7	21.8	21.9	22.1	22.0	22.1	21.8	19.7	16.5
	20,000	17.6	23.2	25.1	26.3	28.6	30.7	32.3	33.3	33.9	34.4	35.1	35.5	35.9	36.2	36.5	36.7	36.9	37.2	37.3	37.5	37.5	37.2	36.2	31.8	26.2
	30,000	26.1	32.8	34.6	35.7	38.4	40.9	42.9	44.2	45.0	45.7	46.6	47.3	47.8	48.2	48.6	49.0	49.3	49.6	49.6	49.7	49.5	48.9	47.4	41.1	33.2
140	40,000	32.1	41.5	43.1	43.6	46.2	49.1	51.5	53.1	54.0	54.8	56.0	56.8	57.3	57.9	58.3	58.8	59.2	59.6	59.7	59.7	59.2	58.4	56.1	48.2	38.5
	50,000	38.4	49.9	50.9	51.3	54.1	57.4	60.4	62.0	63.2	64.0	65.4	66.3	67.0	67.7	68.1	68.6	69.1	69.9	69.6	69.6	69.0	68.0	64.8	55.1	43.7
	60,000	44.5	61.0	63.6	65.0	61.4	71.5	74.2	75.3	76.2	77.1	77.9	78.4	78.8	79.0	79.0	78.7	78.4	78.4	76.9	76.2	74.5	72.4	67.7	56.4	43.2
	70,000	48.1	63.8	64.1	64.2	67.3	71.4	74.9	76.9	78.3	79.4	80.9	82.1	83.1	83.8	84.6	85.3	85.9	86.6	86.4	85.4	85.5	83.7	79.3	65.8	51.3
	80,000	52.3	69.3	69.7	69.8	73.3	77.4	81.0	83.4	84.9	85.9	87.5	89.2	90.0	91.0	91.8	92.7	93.4	93.7	93.8	93.7	92.7	90.4	85.8	70.0	54.2
	10,000	9.2	14.0	18.9	20.4	21.5	23.6	24.4	24.7	25.1	25.2	25.4	25.3	25.1	25.3	25.5	25.2	25.0	24.9	24.8	24.8	24.5	24.4	24.0	21.9	18.7
	20,000	18.0	26.1	33.1	34.8	38.0	39.4	41.0	41.6	42.2	42.7	43.3	43.5	43.7	43.9	44.1	43.9	43.7	43.6	43.4	43.2	42.8	42.5	41.5	36.8	30.5
	30,000	25.8	37.6	44.5	46.1	48.9	52.0	54.2	55.1	55.9	56.5	57.4	58.0	58.5	58.8	58.8	58.8	58.5	58.4	58.1	57.6	56.8	56.3	54.5	47.8	38.9
160	40,000	32.9	48.5	54.5	56.0	59.2	62.8	65.4	66.5	67.4	68.2	69.3	70.2	70.8	71.2	71.3	71.2	71.1	71.2	70.4	69.9	69.0	68.0	65.2	56.8	45.8
	50,000	40.2	60.5	63.9	64.8	68.5	72.0	75.1	76.4	77.6	78.5	79.8	80.8	81.5	82.1	82.4	82.3	82.3	82.8	81.5	80.9	79.9	78.6	74.5	64.3	51.7
	60,000	46.6	70.3	71.5	72.3	76.0	80.8	84.1	85.5	86.8	88.0	89.5	90.8	91.4	92.1	92.8	92.6	92.7	93.6	91.9	91.4	90.1	88.3	83.1	71.2	56.6
	70,000	51.0	77.1	79.8	80.2	84.4	89.0	92.9	94.7	96.3	97.4	99.3	100.7	101.6	102.6	103.3	103.3	103.3	103.8	102.5	102.0	100.7	98.5	93.6	78.5	61.6
	80,000	56.6	81.8	86.2	86.5	90.8	96.0	100.6	102.7	104.5	105.8	107.5	109.6	110.5	111.5	112.3	112.7	112.5	112.5	111.9	111.3	110.1	107.5	103.0	84.6	66.6
	10,000	10.5	17.0	19.9	21.3	23.8	26.0	26.9	27.3	27.8	28.1	28.4	28.9	29.0	29.4	29.7	29.4	29.3	29.4	29.4	29.4	29.1	29.1	28.9	26.7	23.6
	20,000	20.3	31.6	35.7	37.7	41.4	44.4	46.2	46.9	47.6	48.3	49.2	49.8	50.3	50.8	51.1	51.1	50.8	51.0	50.9	50.8	50.5	50.3	49.2	45.1	38.8
	30,000	30.4	45.9	49.4	51.8	56.3	59.8	62.0	62.9	63.9	64.9	66.3	67.1	68.0	68.5	68.8	68.8	68.6	68.6	68.4	68.3	67.8	67.4	65.9	59.3	49.9
180	40,000	38.5	56.9	61.4	63.6	68.2	72.5	75.1	76.2	77.6	78.7	80.2	81.4	82.4	83.2	83.5	83.4	83.4	83.5	83.0	82.7	82.1	81.5	79.4	70.9	58.9
	50,000	48.3	69.0	71.6	73.6	78.6	83.5	86.6	87.8	89.6	90.8	92.5	93.9	95.0	95.9	96.4	96.2	96.2	96.7	95.9	95.5	95.0	94.1	91.0	79.1	66.7
	60,000	56.0	79.2	81.5	82.7	87.8	93.2	96.4	98.2	100.2	101.6	103.3	105.1	106.2	107.2	108.0	107.8	107.8	108.4	107.2	106.8	106.2	105.1	101.4	89.4	73.0
	70,000	57.4	83.4	90.5	91.3	96.2	102.0	105.9	107.9	109.9	111.4	113.7	115.7	116.9	118.0	118.9	118.9	118.9	119.1	118.4	117.8	117.2	115.7	111.9	97.2	78.1
	80,000	67.5	95.1	96.7	97.5	102.9	109.2	113.8	115.8	118.0	119.7	122.5	124.5	126.1	127.0	128.2	128.2	128.0	128.0	127.7	127.0	126.4	124.5	120.4	103.5	81.6
	10,000	10.6	17.2	20.5	21.6	24.7	28.1	29.3	29.9	30.7	31.1	31.5	32.5	33.3	33.8	34.3	34.1	34.0	34.4	34.6	34.5	34.4	34.4	34.4	32.4	29.3
	20,000	21.9	33.8	39.2	40.6	45.3	49.6	51.7	52.6	53.6	54.5	55.8	56.8	57.7	58.5	59.1	59.1	58.2	40.1	59.5	59.6	59.5	59.4	58.3	55.0	48.7
	30,000	31.0	49.0	54.9	56.5	62.3	66.9	69.3	70.2	71.4	72.7	74.6	75.9	77.2	78.0	78.6	78.6	78.6	78.9	78.8	79.1	79.1	78.9	77.9	71.8	62.1
200	40,000	40.0	63.0	68.8	70.3	76.2	81.7	84.2	85.3	87.0	88.6	90.5	92.3	93.7	94.7	95.4	95.3	95.3	95.8	95.5	95.6	95.6	95.5	94.4	86.2	73.6
	50,000	49.5	76.0	81.0	82.3	88.8	94.3	97.0	98.7	100.9	102.5	104.5	106.5	108.2	109.4	110.0	110.0	110.0	110.0	110.0	110.0	110.2	109.8	108.6	98.8	83.4
	60,000	58.4	87.8	91.4	92.6	99.5	105.4	108.4	110.6	113.0	115.0	116.8	119.3	120.9	122.4	122.9	122.7	122.9	122.7	122.7	122.5	122.7	122.5	120.9	109.5	91.4
	70,000	65.1	96.1	101.1	102.1	109.0	115.4	119.2	121.2	123.9	125.9	128.6	131.1	133.1	134.3	135.0	134.8	134.8	134.8	134.8	134.5	134.5	133.8	131.6	118.6	97.1
	80,000	71.0	103.1	108.8	109.8	116.6	123.0	127.8	129.7	132.6	134.7	138.2	140.5	142.9	143.9	145.0	144.5	144.5	144.2	144.5	143.9	143.9	142.9	140.0	125.2	100.5
	10,000	10.7	17.4	21.6	22.8	26.2	31.3	33.0	33.9	34.7	35.1	35.6	36.7	37.1	37.6	38.3	38.2	38.2	38.4	38.6	38.7	38.8	38.8	38.9	37.1	34.2
	20,000	23.0	34.6	43.3	45.1	50.3	56.3	57.8	58.9	60.0	61.0	62.6	63.7	64.5	65.2	66.0	66.1	66.1	66.4	66.6	66.6	66.6	66.2	65.9	63.1	57.3
	30,000	30.8	50.7	61.8	63.9	70.5	76.3	78.0	79.3	80.6	81.9	83.9	85.6	86.9	87.7	88.3	88.5	88.7	89.0	89.0	89.2	88.8	88.7	87.9	82.9	74.4
220	40,000	41.2	66.0	77.1	79.3	86.6	92.1	94.9	96.6	98.3	99.9	102.1	104.1	105.7	106.9	107.5	107.7	107.9	108.3	108.1	108.3	107.9	107.7	106.5	99.7	88.2
	50,000	51.3	81.2	90.5	92.7	100.5	106.3	109.6	111.7	113.8	115.6	118.1	120.4	122.0	123.4	124.3	124.3	124.6	125.0	124.8	124.8	124.3	124.1	122.5	113.9	99.0
	60,000	61.8	95.2	102.2	104.3	111.5	117.7	121.3	123.8	126.1	128.2	130.7	133.2	135.0	136.7	137.5	137.5	137.8	138.3	138.0	137.8	137.5	137.0	134.8	124.7	106.5
	70,000	67.5	103.9	112.4	114.2	121.7	127.8	132.0	134.5	137.3	139.2	142.2	145.0	146.9	148.5	149.6	149.6	149.9	150.2	150.2	149.9	149.4	148.5	145.8	133.3	112.2
	80,000	75.1	114.0	120.2	122.0	129.5	135.7	140.6	143.1	145.7	148.0	151.2	154.1	156.1	157.9	159.0	159.1	159.4	159.6	159.6	159.3	158.8	157.0	153.9	139.4	115.2
	10,000	10.8	18.0	18.6	19.7	25.8	34.5	36.9	38.2	38.8	39.3	39.9	40.7	40.9	41.5	42.4	42.4	42.5	42.5	42.6	43.0	43.3	43.6	43.6	42.0	39.6
	20,000	23.0	37.9	38.9	42.0	53.6	62.1	65.0	66.5	67.6	68.6	70.6	71.7	72.7	73.3	74.1	74.2	74.7	74.7	74.7	74.9	74.8	74.9	74.8	72.6	67.7
	30,000	33.0	56.1	58.1	62.1	75.8	84.4	87.3	89.2	90.7	92.0	94.2	95.9	97.3	98.1	98.6	99.0	99.6	100.0	100.0	100.0	99.4	99.2	98.9	95.4	88.7
240	40,000	42.3	71.4	73.8	78.0	92.9	102.5	105.7	108.0	109.8	111.6	114.0	116.3	117.8	118.9	119.6	120.1	120.8	121.2	121.2	121.2	120.3	119.8	119.0	113.8	104.3
	50,000	52.2	86.6	87.8	91.5	107.4	117.2	121.2	124.0	126.1	127.9	130.7	133.2	135.0	136.6	137.6	137.8	138.4	139.1	139.1	138.9	137.9	137.3	135.6	128.9	115.4
	60,000	62.4	98.6	99.9	103.6	119.2	129.2	133.8	136.6	138.9	140.9	144.3	147.0	149.0	150.7	152.1	152.1	152.7	153.5	153.5	153.2	151.8	151.3	148.5	140.0	122.6
	70,000	69.2	102.6	109.5	113.2	128.3	138.9	143.8	146.6	149.3	151.2	154.4	157.4	159.5	161.3	162.8	163.1	163.8	164.6	164.6	164.3	162.8	161.6	158.4	147.4	127.0
	80,000	77.0	117.2	118.2	121.5	135.7	146.9	152.1	154.7	157.5	159.7	162.9	165.7	167.9	169.8	171.6	172.0	172.7	173.6	173.6	173.3	171.7	169.8	166.1	152.3	129.6
	20,000	24.3	40.7	43.2	46.5	58.8	67.3	70.7	72.3	73.6	74.7	77.0	78.4	79.5	80.4	81.3	81.8	82.1	82.6	82.7	83.2	83.3	84.1	83.8	82.5	78.7
	30,000	33.6	61.3	65.8	70.1	84.4	93.6	96.9	99.0	100.7	102.3	105.2	107.1	108.5	109.8	110.4	110.8	111.3	111.5	111.7	111.7	111.2	111.5	110.8	108.5	103.1
	40,000	43.3	76.9	82.0	86.5	102.2	113.0	116.7	119.2	121.4	123.4	126.7	129.1	130.8	132.1	132.8	133.1	133.6	133.8	133.8	133.8	132.9	132.6	131.6	127.7	120.1
260	50,000	55.0	92.5	95.1	99.7	116.6	128.2	132.6	135.7	138.0	139.9	143.9	146.6	148.6	150.3	150.8	151.1	151.1	151.4	151.7	151.1	150.0	149.4	147.5	141.9	131.3
	60,000	65.1	104.9	106.5	110.9	128.4	140.8	145.8	149.0	151.7	153.9	158.2	161.2	163.3	164.9	165.5	165.8	165.5	165.8	165.8	164.9	163.6	162.7	160.0	152.3	138.6
	70,000	72.0	116.3	117.1	121.3	138.0	150.5	155.8	159.1	162.0	164.3	168.5	171.7	174.0	175.6	176.3	176.3	176.3	176.3	175.9	175.0	173.3	171.7	168.5	158.4	141.0
	80,000	77.5	124.0	125.7	129.7	146.1	157.6	163.2	165.9	169.3	171.7	176.0	179.3	181.7	183.0	183.7	183.7	183.7	183.3	182.3	181.3	179.7	177.3	173.7	160.7	140.0
	20,000	25.0	45.2	46.9	52.7	66.0	75.0	78.6	80.6	82.2	83.6	86.2	87.9	89.3	90.6	91.8	92.3	92.9	93.9	94.1	94.8	95.2	96.9	96.2	96.0	93.6
	30,000	34.4	67.5	75.6	80.2	95.0	105.3	108.7	111.1	113.2	115.1	119.1	121.2	122.6	124.0	125.2	125.5	125.5	125.7	126.0	126.2	125.7	126.4	125.7	124.7	121.2
	40,000	44.3	83.3	91.7	96.6	113.3	125.4	129.7	132.6	135.1	137.3	142.0	144.5	146.2	147.8	148.7	149.0	149.0	148.7	149.2	149.0	148.1	147.9	146.8	144.4	139.2
280	50,000	56.4	98.5	103.5	108.6	127.2	140.9	145.8	149.2	152.0	154.2	159.2	162.2	164.4	165.9	166.2	166.5	166.2	165.9	166.2	165.3	164.4	163.4	161.6	157.4	150.3
	60,000	66.1	111.9	113.8	118.8	138.3	153.4	159.0	162.4	165.4	167.7	173.1	176.4	179.0	180.3	180.0	180.3	179.6	179.0	179.0	177.6	176.3	175.0	172.4	165.8	156.5
	70,000	74.5	115.2	123.4	128.9	149.3	162.5	168.5	172.2	175.4	177.5	178.4	179.3	182.4	184.8	186.2	187.2	188.3	188.7	189.3	189.0	189.0	187.6	185.2	177.3	163.8
	80,000	80.5	119.2	131.9	137.0	156.9	168.3	174.3	177.5	180.7	183.0	185.0	186.9	190.1	191.9	193.3	194.0	194.8	194.8	194.8	194.1	193.3	191.6	188.8	178.0	159.6
	30,000	33.0	71.1	77.5	82.3	100.7	116.2	122.9	127.8	130.9	133.6	137.7	140.1	141.2	142.8	143.6	144.4	145.0	145.5	145.8	146.1	145.8	145.8	145.0	143.3	139.5
	40,000	41.2	86.2	93.9	99.5	120.9	137.3	144.3	149.3	152.4	154.9	159.2	161.4	162.6	163.8	164.4	165.0	165.1	165.1	165.4	165.1	164.4	163.5	162.3	159.1	153.6
300	50,000	53.3	102.4	106.4	112.7	136.1	152.5	159.4	164.1	167.2	169.5	173.4	175.4	176.7	178.1	178.1	178.1	178.0	177.4	177.4	176.4	175.4	174.1	172.1	167.6	160.3
	60,000	64.7	116.5	118.2	124.8	150.0	165.6	172.5	176.8	180.0	181.8	185.2	187.3	189.0	189.7	189.4	189.0	188.2	187.2	186.9	185.5	184.1	182.0	179.9	173.3	163.9
	70,000	71.4	128.1	129.7	136.4	160.5	174.6	181.3	185.4	188.7	190.6	194.1	196.3	198.1	198.4	198.1	197.0	196.2	194.7	193.6	191.8	190.4	187.8	184.9	176.2	163.2
	80,000	78.2	137.0	138.1	144.3	166.6	178.9	185.3	189.1	192.1	194.3	197.9	200.4	201.9	201.5	201.5	200.1	198.8	197.0	195.2	193.3	191.1	188.2	184.6	174.2	157.7
	30,000	33.8	88.2	96.1	101.0	122.3	142.4	151.1	157.4	161.0	164.4	168.2	170.1	169.7	169.7	169.7	169.1	168.5	167.8	166.6	165.3	163.4	161.9	159.7	155.5	150.8
	40,000	41.5	91.6	99.8	105.3	124.2	146.4	157.4	165.9	169.5	172.2	176.8	177.5	177.8	178.5	179.2	179.5	180.2	180.5	180.2	179.9	179.5	177.9	176.2	172.3	167.0
320	50,000	54.1	104.5	108.7	112.3	142.0	162.0	172.1	179.5	182.9	185.1	187.4	188.5	188.8	189.5	189.2	189.2	189.2	188.4	187.7	187.0	186.0	183.9	182.1	177.0	169.6
	60,000	66.8	122.0	124.5	127.7	159.1	176.8	186.2	192.6	196.0	197.3	198.9	199.2	199.6	200.0	199.3	198.2	197.7	195.9	195.1	193.6	192.5	189.6	187.4	180.8	172.0
	70,000	72.4	131.6	134.6	140.1	170.7	185.5	194.4	200.2	203.4	205.0	206.3	207.1	207.4	207.1	206.7	205.2	203.9	202.0	200.9	199.0	197.4	194.4	191.4	183.4	172.0
	80,000	78.1	136.5	141.9	149.9	179.5	191.5	199.3	204.7	207.2	208.8	210.1	210.9	211.6	210.9	210.9	208.2	206.5	204.6	203.0	200.7	198.8	195.3	191.9	182.6	168.8
	Stroke	0	0.2	1.2	2	6	12	18	24	30	36	49	61	73	85	97	109	122	134	146	158	170	182	194	219	243

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TABLE 24. C13-1 Catapult, Upper Boundary, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) – NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND ACCUMULATOR PRESSURE

Pressure (PSI)	Stroke / Weight (LBS)	0	0.3	1.5	3	8	15	23	30	38	45	60	76	91	106	121	136	151	166	181	196	211	227	242	272	302
	10,000	7.8	18.6	23.5	29.7	34.8	38.5	40.6	41.9	42.8	43.7	44.0	43.3	42.8	41.4	39.9	38.7	37.3	35.9	34.6	33.2	31.8	30.3	28.9	26.2	23.5
	20,000	13.9	30.6	37.2	45.8	52.6	57.6	60.5	62.3	63.5	64.6	64.9	63.8	62.7	60.6	58.5	56.6	54.6	52.4	50.3	48.3	46.2	44.0	42.0	37.9	33.9
	30,000	19.3	42.0	47.9	56.5	63.9	69.1	72.4	74.2	75.6	76.8	77.0	75.3	73.7	71.2	68.7	66.4	64.0	61.5	59.1	56.6	54.1	51.4	49.0	44.0	39.1
200	40,000	24.2	49.4	55.3	64.8	72.2	77.3	80.6	82.5	83.8	85.0	85.0	82.9	80.8	78.1	75.2	72.7	69.9	67.2	64.3	61.6	58.8	55.9	53.1	47.5	42.1
	50,000	28.7	56.3	62.2	71.8	78.7	83.6	86.8	88.6	89.8	91.0	90.8	88.2	85.8	82.7	79.7	77.0	74.1	71.0	67.8	65.0	61.9	58.7	56.0	49.7	43.9
	60,000	33.4	61.1	68.7	77.3	83.9	88.0	91.2	92.7	94.0	95.0	94.6	91.6	88.8	85.6	82.5	79.3	76.4	73.1	61.0	66.6	63.6	60.3	57.1	50.9	44.6
	70,000	37.0	63.0	70.1	81.3	87.0	90.5	93.4	94.8	95.9	96.9	96.2	92.9	89.6	86.5	86.2	80.1	76.9	73.5	70.2	67.0	63.9	60.3	57.2	50.6	44.1
	80,000	40.6	67.8	74.2	85.6	90.6	93.5	96.1	97.2	98.2	99.1	98.7	94.3	90.8	87.6	84.2	81.2	77.6	74.3	70.7	67.5	64.1	60.7	57.3	50.6	44.0
	10,000	9.3	22.7	27.7	35.3	41.7	46.3	49.2	50.9	52.2	53.3	54.0	53.3	52.8	51.4	49.7	48.2	46.8	45.3	43.7	42.3	40.8	39.1	37.6	34.6	31.6
	20,000	17.1	37.8	43.4	53.7	62.4	68.6	72.6	74.9	76.7	78.2	79.0	77.7	76.5	74.3	72.1	69.9	67.6	65.4	63.2	60.8	58.6	56.2	53.9	49.4	45.0
	30,000	24.3	53.4	59.0	68.6	78.4	85.4	90.1	92.6	94.7	96.2	96.5	95.2	93.4	90.5	87.7	85.0	82.2	79.4	76.5	73.6	70.8	67.9	65.0	59.2	53.7
300	40,000	30.9	63.7	69.9	79.8	89.9	97.1	102.0	104.8	106.7	108.4	109.0	106.6	104.3	100.9	97.7	94.5	91.5	88.1	84.7	81.5	78.3	74.7	71.5	65.8	58.5
	50,000	37.4	73.1	78.8	90.0	100.2	107.2	112.3	114.9	116.8	118.0	118.5	115.7	112.8	109.1	105.7	102.2	98.6	94.9	91.3	87.6	83.9	80.0	76.4	69.3	62.0
	60,000	43.8	79.9	86.4	99.3	109.0	116.9	120.8	123.3	125.3	127.0	126.9	123.3	119.8	115.9	111.8	108.2	104.3	100.2	96.1	92.3	88.2	84.0	80.2	72.2	64.3
	70,000	49.7	84.7	90.5	107.7	117.1	123.5	128.2	130.6	132.4	134.5	133.6	129.4	125.4	121.1	116.8	112.8	108.5	104.3	99.8	95.7	91.5	86.9	82.7	74.2	65.6
	80,000	55.0	91.3	98.0	115.5	124.3	129.9	134.5	136.7	138.4	139.8	139.0	134.2	129.8	123.0	120.8	116.4	111.8	107.3	102.7	98.1	93.7	89.0	84.6	75.3	66.3
	20,000	19.4	44.2	50.5	59.8	70.1	77.5	82.6	85.6	87.8	89.7	91.0	89.9	88.8	86.5	84.1	82.0	79.7	77.4	75.0	72.7	70.4	67.9	65.6	61.0	56.5
	30,000	27.9	63.3	68.9	76.5	87.2	95.7	101.7	105.1	107.6	109.7	111.0	109.3	107.6	104.6	101.6	98.8	96.0	93.1	90.1	87.3	84.3	81.1	78.3	72.6	66.8
	40,000	35.7	76.2	82.1	88.5	101.0	110.2	116.4	120.0	122.7	124.8	126.5	123.6	121.2	117.9	114.5	111.2	107.8	104.3	100.5	97.3	94.0	90.4	86.8	80.1	73.2
400	50,000	43.6	87.3	93.7	101.5	114.4	123.8	130.4	134.1	136.6	138.9	139.9	136.9	133.8	129.9	126.0	122.3	118.4	114.5	110.3	106.4	102.5	98.3	94.4	86.5	78.7
	60,000	51.7	96.2	103.4	112.8	125.8	135.3	142.0	145.5	148.1	150.4	151.0	147.2	143.7	139.3	134.8	130.6	126.4	122.0	117.3	113.1	108.7	103.9	99.7	90.9	82.2
	70,000	59.1	103.2	110.7	122.8	135.5	144.6	151.2	154.8	157.3	159.5	159.9	155.3	150.9	146.2	141.6	136.7	132.0	127.3	122.4	117.5	112.9	107.9	103.0	93.4	83.8
	80,000	66.3	111.8	119.2	134.0	146.5	155.4	162.0	165.3	167.6	169.9	169.8	164.4	159.5	154.3	149.1	143.9	138.8	133.6	128.1	123.0	117.8	112.3	107.1	96.5	86.1
	20,000	21.4	54.2	58.3	63.2	74.9	83.5	89.6	93.3	95.8	98.0	100.0	99.1	98.2	96.0	93.7	91.6	89.6	87.3	85.1	83.0	80.7	78.3	76.2	71.9	67.6
	30,000	30.9	68.9	73.7	80.9	94.7	104.8	112.0	116.4	119.4	122.0	124.0	122.5	120.9	118.2	115.2	112.4	109.7	106.7	103.9	100.9	98.2	95.0	92.2	86.5	80.7
	40,000	40.0	83.5	89.4	96.1	111.0	122.3	130.3	134.8	138.0	140.9	142.9	140.7	138.5	135.1	131.5	128.1	124.7	121.3	117.7	114.3	110.6	107.0	103.6	96.6	89.5
500	50,000	49.0	96.2	102.5	110.0	125.6	137.8	146.0	150.8	154.2	157.2	158.9	155.9	153.2	148.9	144.9	140.9	137.2	132.9	128.7	124.7	120.7	116.4	112.4	104.1	96.1
	60,000	56.4	106.4	113.6	123.5	140.2	152.6	161.5	166.1	169.5	172.5	174.0	170.5	166.7	162.0	157.4	152.8	148.5	143.5	138.9	134.3	129.7	124.7	120.1	110.6	101.3
	70,000	67.1	115.5	122.6	136.1	152.9	165.5	174.6	179.2	182.8	185.7	187.0	182.3	177.9	172.7	167.5	162.3	157.4	151.8	146.6	141.4	136.2	130.6	125.4	114.9	104.5
	80,000	76.7	126.7	134.3	149.2	166.1	179.2	188.1	192.7	196.2	199.2	200.0	194.3	189.0	183.5	177.7	171.8	166.3	160.4	154.3	148.7	142.9	136.6	130.6	119.1	107.7
	30,000	32.5	72.8	78.4	84.1	99.8	111.5	120.3	125.4	128.9	132.0	135.0	133.8	132.6	130.0	127.1	124.5	121.9	119.1	116.5	113.9	111.1	108.3	105.7	100.2	94.8
	40,000	42.7	89.3	95.2	99.8	117.2	130.6	140.3	145.8	149.6	153.2	156.5	154.3	152.4	148.9	145.7	142.4	139.2	135.7	132.2	128.9	125.7	121.9	118.7	111.9	105.2
600	50,000	52.6	103.1	109.7	115.2	134.3	148.9	159.4	165.3	169.2	172.9	176.0	173.2	170.5	166.6	162.7	158.8	154.6	150.7	146.4	142.2	138.3	134.2	130.0	121.8	113.7
	60,000	63.3	114.8	121.9	129.3	149.4	165.1	175.8	181.9	186.5	190.1	192.8	189.2	185.9	181.0	176.4	171.9	167.3	162.5	157.6	153.0	148.1	143.3	138.4	129.0	119.5
	70,000	73.0	125.8	133.9	144.2	165.5	182.2	193.4	199.6	204.1	207.7	209.9	205.6	201.4	196.1	190.9	185.3	180.0	174.4	168.8	163.5	157.9	152.3	147.0	135.8	124.9
	80,000	83.3	137.9	145.8	158.6	180.6	198.0	209.9	216.1	220.6	224.4	226.0	220.7	215.8	209.4	203.5	197.5	191.2	185.2	178.8	172.5	166.5	159.8	153.8	141.1	128.8
	30,000	34.2	75.4	80.0	84.1	101.4	114.4	124.4	130.3	134.4	138.0	141.9	141.2	140.4	137.[illegible]	135.6	133.3	131.0	128.7	126.2	123.9	121.6	119.1	116.9	112.0	107.5
	40,000	44.1	91.3	98.4	104.4	120.1	135.7	146.8	153.4	157.9	162.0	166.9	164.4	162.9	160.0	157.1	153.9	150.9	147.7	144.8	141.6	138.6	135.5	132.3	126.1	120.0
700	50,000	54.9	106.1	113.7	119.9	138.8	156.3	168.5	175.5	180.5	184.8	188.8	186.5	182.9	180.6	177.0	173.4	169.4	165.5	161.5	157.9	154.0	150.1	146.2	138.3	130.7
	60,000	65.8	118.6	125.5	132.5	155.1	174.1	186.9	194.2	199.6	204.0	208.0	204.8	201.9	197.6	193.0	188.3	184.0	179.0	174.4	170.1	165.5	160.5	155.9	146.6	137.7
	70,000	76.1	130.4	137.9	147.3	171.3	192.1	205.9	213.5	218.9	223.6	226.8	222.9	219.3	214.0	208.6	203.2	197.8	192.4	187.0	181.7	176.3	170.5	165.1	154.0	143.2
	80,000	87.2	143.2	151.1	161.3	188.1	210.4	224.7	232.4	237.7	242.7	245.8	240.7	236.2	230.0	223.8	217.7	211.5	205.3	198.8	192.6	186.4	179.4	173.2	160.5	148.2
	30,000	35.1	77.1	81.3	90.7	100.2	114.6	125.9	132.4	137.0	144.0	148.6	147.5	145.8	143.3	141.4	139.5	137.7	135.8	133.9	132.1	130.2	128.2	126.3	122.3	118.6
	40,000	45.4	93.3	98.4	107.0	121.8	139.5	152.2	159.8	165.3	170.0	174.8	174.0	173.3	170.5	167.9	165.4	162.6	160.1	157.2	154.7	151.9	149.1	146.3	140.9	135.6
800	50,000	56.3	108.4	114.2	122.2	139.6	159.6	173.8	182.0	187.7	192.9	198.0	196.6	194.8	191.7	188.2	184.6	181.1	177.6	174.1	170.9	167.4	163.7	160.2	153.1	146.5
	60,000	67.3	121.3	129.0	139.2	156.2	178.7	193.7	202.3	208.5	213.8	219.5	216.7	214.3	210.1	205.9	201.3	197.1	192.9	188.7	184.1	179.9	175.4	171.2	162.4	154.0
	70,000	78.0	134.0	142.2	153.9	173.3	198.0	214.2	223.0	229.7	235.1	239.8	236.9	233.6	228.6	223.2	218.3	212.9	207.9	202.6	197.2	192.2	186.5	181.2	170.8	160.5
	80,000	89.3	146.6	155.0	168.5	189.6	216.6	233.8	242.9	249.6	255.3	259.9	255.4	251.4	245.3	239.5	233.3	227.2	221.0	214.8	208.7	202.5	195.9	189.7	177.4	165.1
	30,000	30.4	57.4	61.3	67.5	76.0	93.3	103.1	108.8	113.2	117.2	122.4	126.4	129.9	131.5	133.4	135.2	137.1	138.7	140.6	142.5	144.1	146.1	147.7	151.5	155.0
	40,000	39.2	70.3	75.0	82.7	94.6	115.7	128.0	134.6	139.9	144.4	150.3	154.1	157.9	159.6	161.2	163.1	164.7	166.3	168.3	169.9	171.5	173.2	174.8	178.4	181.9
900	50,000	56.9	109.4	115.1	123.4	139.1	161.7	177.9	187.2	193.7	199.8	206.7	205.1	204.3	201.3	198.3	195.4	192.4	189.4	186.4	183.4	180.5	177.3	174.3	168.0	162.0
	60,000	68.0	123.0	128.7	141.0	156.4	181.9	199.5	209.4	216.5	222.6	228.8	227.7	226.0	222.4	218.3	214.6	210.5	206.5	202.8	198.7	195.0	190.7	186.6	178.9	171.1
	70,000	78.6	135.3	144.1	154.2	172.9	201.6	220.2	230.8	238.4	244.6	250.9	248.7	246.0	241.2	236.4	231.5	226.7	221.9	217.1	212.2	207.4	201.8	197.0	187.3	177.7
	80,000	90.4	147.8	156.3	165.5	189.1	221.0	240.4	251.8	259.4	266.0	271.7	268.5	265.6	259.5	253.4	247.8	242.2	236.1	230.0	224.0	218.3	211.8	205.8	194.1	182.4
	30,000	30.6	58.0	62.4	68.9	79.8	87.9	97.3	103.0	107.9	112.1	118.0	122.6	126.6	128.9	131.1	133.5	135.9	138.3	140.4	142.8	144.9	147.5	149.6	154.1	158.9
	40,000	39.5	71.1	76.5	83.0	87.7	110.3	123.0	129.6	135.2	140.0	146.9	151.4	155.9	158.1	160.4	162.7	165.3	167.5	169.8	171.7	174.0	176.4	178.7	183.2	188.0
1000	50,000	48.8	82.9	89.0	98.4	106.4	133.7	149.8	157.6	163.7	169.4	176.3	180.9	185.4	187.3	189.6	191.8	194.1	196.0	198.3	200.2	202.1	204.5	206.4	210.6	214.5
	60,000	68.3	125.7	131.4	142.3	154.4	183.8	203.9	215.1	223.1	230.4	237.9	237.6	236.7	233.2	230.2	226.7	223.3	219.8	216.4	212.9	209.5	205.8	202.3	195.4	188.5
	70,000	78.8	136.2	145.6	156.5	170.7	203.6	224.8	237.3	245.4	252.8	260.8	259.6	258.1	253.5	248.8	244.7	240.0	235.9	231.2	226.6	222.4	217.5	212.8	204.0	195.2
	80,000	90.8	149.9	158.8	170.1	185.7	222.4	244.9	257.8	266.3	274.2	281.7	279.4	277.3	271.4	266.0	260.6	255.2	249.8	243.9	238.4	232.5	226.7	220.8	209.5	198.7
	Stroke	0	0.3	1.5	3	8	15	23	30	38	45	60	76	91	106	121	136	151	166	181	196	211	227	242	272	302

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TABLE 25. C13-1 Catapult, mean, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) — NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND ACCUMULATOR PRESSURE

Pressure (PSI)	Stroke / Weight (LBS)	0	0.3	1.5	3	8	15	23	30	38	45	60	76	91	106	121	136	151	166	181	196	211	227	242	272	302
	10,000	7.4	15.1	20.0	24.0	29.8	33.4	36.0	37.5	38.3	39.0	38.9	38.5	38.2	37.4	36.5	35.7	34.8	34.0	33.2	32.3	31.5	30.6	29.8	28.1	26.4
	20,000	12.9	24.8	31.2	37.0	44.9	49.6	53.1	55.0	55.7	56.0	56.0	55.8	55.6	54.3	53.1	51.8	50.5	49.3	48.0	46.8	45.5	44.1	42.9	40.3	37.8
	30,000	17.9	34.2	39.8	45.7	54.2	59.1	62.8	64.8	66.0	66.5	66.3	66.0	65.0	63.5	61.9	60.4	58.9	57.3	55.8	54.3	52.8	51.1	49.6	46.5	43.4
200	40,000	22.4	40.4	46.7	52.2	60.6	65.3	69.1	71.0	72.1	73.0	72.9	71.7	70.6	68.8	67.1	65.5	63.7	62.0	60.2	58.5	56.7	55.0	53.3	49.8	46.3
	50,000	26.6	46.3	51.9	57.4	65.5	69.8	73.2	74.9	75.9	76.9	76.8	75.3	74.0	72.0	70.2	68.4	66.6	64.6	62.8	60.8	59.0	57.0	55.2	51.4	47.6
	60,000	30.9	50.7	56.9	62.3	69.9	73.5	76.6	78.2	79.2	79.9	79.8	78.1	76.6	74.6	72.6	70.6	68.5	66.5	64.5	62.6	60.6	58.4	56.5	52.5	48.4
	70,000	34.3	53.8	59.8	65.4	72.3	75.3	78.0	79.3	80.2	80.9	80.7	78.8	77.1	75.0	73.0	70.8	68.8	66.7	64.6	62.5	60.5	58.3	56.3	52.1	47.9
	80,000	37.6	57.0	62.8	68.0	74.1	76.4	78.7	79.7	80.4	81.1	80.9	78.8	76.9	74.9	72.7	70.6	68.3	66.2	64.1	62.0	59.9	57.7	55.5	51.2	46.9
	10,000	8.6	18.2	22.3	27.6	34.5	38.9	42.1	43.9	45.0	45.9	46.0	45.8	45.6	44.7	43.9	43.1	42.3	41.5	40.6	39.8	39.0	38.1	37.3	35.6	34.0
	20,000	15.8	30.6	36.7	44.1	53.9	59.9	64.5	67.0	68.5	69.7	70.0	69.5	69.0	67.6	66.3	65.0	63.7	62.3	61.0	59.7	58.3	57.0	55.6	53.0	50.3
	30,000	22.5	43.3	48.5	56.1	67.2	73.9	79.0	81.7	83.0	83.8	84.0	83.3	83.0	81.7	80.1	78.3	76.6	75.0	73.2	71.5	69.9	68.1	66.3	63.0	59.6
300	40,000	28.6	52.0	58.4	65.3	76.9	83.7	88.8	91.6	93.2	93.6	94.0	93.8	92.6	90.6	88.7	86.7	84.7	82.7	80.7	78.7	76.7	74.6	72.8	68.8	64.8
	50,000	34.6	60.1	65.4	73.1	84.5	91.1	96.3	98.8	100.3	101.8	102.1	100.6	99.0	96.9	94.6	92.4	90.1	88.0	85.7	83.4	81.3	78.8	76.7	72.3	67.7
	60,000	40.6	66.4	72.5	80.3	91.5	97.6	102.5	104.9	106.5	106.7	106.9	106.2	104.3	101.9	99.5	96.9	94.5	92.1	89.7	87.1	84.6	82.1	79.6	74.8	69.8
	70,000	46.0	71.0	77.3	86.4	96.9	102.5	106.9	109.0	110.5	111.7	112.0	109.8	107.7	105.0	102.3	99.7	97.0	94.3	91.6	89.1	86.5	83.6	81.1	75.8	70.4
	80,000	50.9	76.5	82.7	79.4	100.8	105.5	109.5	111.3	112.6	113.8	114.5	112.3	109.0	106.2	103.4	100.7	97.8	94.9	92.2	89.5	86.7	83.7	81.0	75.4	69.6
	20,000	18.0	35.7	41.8	48.5	60.0	67.3	72.7	75.7	77.6	79.2	80.0	79.7	79.4	78.1	76.9	75.6	74.5	73.1	72.0	70.8	69.5	68.3	67.0	64.5	62.0
	30,000	25.8	51.1	56.6	62.7	76.1	84.6	90.8	94.1	96.3	98.3	99.0	98.5	97.8	96.2	94.6	92.9	91.2	89.6	88.0	86.2	84.6	82.9	81.3	77.9	74.5
	40,000	33.1	62.0	68.0	73.7	87.9	96.8	103.4	106.9	109.1	110.9	112.0	111.0	110.0	108.0	106.0	104.0	102.0	100.0	97.8	95.8	93.8	91.7	89.7	85.7	81.7
400	50,000	40.4	71.6	77.6	83.8	98.6	107.5	114.4	117.8	119.9	122.0	122.9	121.3	120.0	117.6	115.2	113.1	110.7	108.3	105.9	103.5	101.4	98.8	96.4	91.7	86.9
	60,000	47.9	79.7	86.6	93.3	108.2	117.0	123.8	127.0	129.3	131.2	132.0	130.1	128.2	125.7	122.9	120.4	117.6	114.8	112.3	109.5	107.0	104.0	101.5	95.9	90.6
	70,000	54.7	86.2	93.4	100.8	115.4	123.7	130.2	133.3	135.4	137.2	138.0	135.8	133.6	130.5	127.6	124.7	121.6	118.8	115.7	112.8	109.9	106.8	103.7	97.7	91.8
	80,000	61.4	93.9	100.8	108.0	122.0	129.8	136.0	138.8	140.7	142.5	143.1	140.3	137.5	134.6	131.4	128.0	124.8	121.6	118.4	115.2	112.0	108.6	105.4	98.7	92.3
	20,000	19.8	43.2	49.0	51.8	64.9	73.5	79.6	83.2	85.5	87.5	88.9	90.0	88.9	87.9	86.9	85.8	84.8	83.8	82.6	81.6	80.7	79.4	78.4	76.3	74.3
	30,000	28.6	55.7	60.9	67.1	82.6	92.9	100.3	104.3	106.9	109.4	110.9	110.7	110.3	108.9	107.4	106.0	104.6	103.0	101.5	100.1	98.5	96.9	95.5	92.6	89.6
	40,000	37.0	68.1	74.5	80.2	97.3	108.5	116.7	121.0	123.8	126.2	127.0	127.0	126.7	124.6	122.7	120.9	119.0	117.2	115.3	113.2	111.3	109.3	107.5	103.8	99.8
500	50,000	45.4	79.1	85.7	92.0	109.9	121.8	130.1	134.7	137.4	140.1	141.9	140.7	139.6	137.3	135.0	132.7	130.4	127.9	125.6	123.3	121.0	118.5	116.2	111.6	107.1
	60,000	54.1	88.4	95.0	103.2	121.9	133.9	142.6	146.9	149.9	152.5	153.9	152.5	150.8	148.1	145.4	142.6	139.9	137.1	134.4	131.7	128.9	126.0	123.3	117.8	112.3
	70,000	62.1	96.7	103.9	112.3	131.3	143.1	151.9	156.1	159.0	161.6	163.5	161.8	158.8	155.6	152.5	149.3	146.2	143.0	139.8	137.0	133.8	130.5	127.3	121.0	114.7
	80,000	71.0	106.7	114.0	122.7	141.5	153.7	162.5	166.5	169.4	171.6	172.9	170.1	167.7	164.1	160.4	156.8	153.2	149.9	146.3	142.7	139.3	135.5	131.9	124.6	117.4
	30,000	30.1	58.9	65.2	71.8	86.1	98.1	106.4	111.0	114.2	117.2	119.5	119.8	120.0	118.6	117.5	116.4	115.3	113.9	112.8	111.7	110.5	109.3	108.0	105.7	103.3
	40,000	39.5	72.8	79.4	86.1	102.9	116.2	125.5	130.6	134.3	137.2	139.8	139.7	139.4	137.8	136.3	134.7	133.1	131.3	129.8	128.2	126.4	124.7	123.2	119.8	116.7
600	50,000	48.7	84.8	92.8	100.9	118.2	132.8	143.2	148.6	152.0	155.3	157.0	156.4	155.5	154.5	152.5	150.5	148.1	146.1	143.8	141.8	139.7	137.6	135.3	131.2	126.9
	60,000	58.6	95.4	103.9	112.6	131.5	146.9	157.8	163.4	167.1	170.3	172.3	171.7	170.4	167.9	165.4	162.6	160.1	157.3	154.8	152.2	149.4	146.8	144.2	138.9	133.6
	70,000	67.6	105.3	114.0	123.2	143.1	158.8	170.0	175.5	179.2	182.5	185.5	183.0	181.3	178.3	175.0	172.0	168.7	165.7	162.4	159.5	156.5	153.0	150.0	143.7	137.4
	80,000	77.1	116.1	124.7	133.7	154.9	171.1	182.8	188.0	192.8	196.1	197.9	195.4	192.3	188.5	185.0	181.2	177.7	173.8	170.4	166.5	163.1	159.3	155.5	148.2	140.9
	30,000	31.7	61.1	66.9	72.9	86.5	99.7	109.1	114.3	117.9	121.0	124.4	125.3	126.0	125.0	124.3	123.6	122.8	122.1	121.2	120.4	119.7	119.0	118.2	116.6	115.1
	40,000	40.8	74.5	81.6	87.3	105.0	120.5	131.2	137.0	141.2	144.7	148.4	148.8	149.0	147.9	146.8	145.4	144.2	142.8	141.7	140.6	139.2	138.0	136.8	134.3	131.8
700	50,000	50.8	87.4	94.9	102.0	120.4	137.7	149.6	155.8	160.2	164.0	167.8	167.6	167.6	165.7	164.1	162.2	160.7	158.8	156.9	155.3	153.5	151.8	149.9	146.4	143.0
	60,000	60.9	98.6	105.8	112.3	135.8	154.6	167.3	173.7	178.5	182.3	185.9	185.2	184.5	182.5	180.1	177.7	175.6	173.2	170.8	168.4	166.0	163.8	161.4	156.6	152.1
	70,000	70.5	109.3	117.2	125.7	149.4	169.6	183.1	189.6	194.4	198.5	201.9	200.5	199.3	196.4	193.5	190.5	187.6	184.7	182.1	178.8	175.9	172.7	170.2	164.3	158.4
	80,000	80.7	120.7	128.5	136.4	163.9	185.1	199.5	206.0	211.1	215.1	218.0	216.0	214.0	210.5	207.0	203.5	199.9	196.4	192.9	189.4	185.9	181.7	178.2	171.2	163.7
	30,000	33.5	62.5	67.7	73.4	87.8	102.7	112.9	119.0	123.2	126.8	131.2	133.7	135.0	134.2	133.2	132.9	132.7	132.4	132.2	131.9	131.4	131.1	130.8	130.3	129.5
	40,000	42.0	76.2	82.0	88.3	105.2	122.9	134.7	141.5	146.2	150.3	155.1	156.2	157.1	156.5	155.6	155.0	154.1	153.4	152.6	151.9	151.0	150.4	149.5	148.0	146.5
800	50,000	52.1	89.3	96.6	103.7	121.9	142.1	155.3	162.5	167.7	172.1	176.9	177.7	178.0	177.0	175.6	174.3	172.9	171.9	170.6	169.2	167.9	166.4	165.1	162.7	160.0
	60,000	62.3	100.9	108.5	112.0	137.4	159.5	174.3	181.9	187.4	191.9	195.8	196.2	196.5	195.1	193.2	191.0	189.1	187.3	185.5	183.6	181.8	179.4	177.6	173.9	170.2
	70,000	72.2	112.2	120.6	129.2	151.2	175.5	191.4	199.1	204.7	209.5	214.0	213.6	212.8	210.4	207.7	205.3	202.5	200.2	197.4	195.0	192.3	189.7	186.9	181.8	176.7
	80,000	82.7	123.6	132.4	141.7	165.0	190.8	208.0	216.9	221.7	226.4	230.7	229.1	227.8	224.9	221.5	218.2	214.8	211.5	208.5	205.2	201.8	198.2	194.9	188.2	181.9
	30,000	33.0	63.2	68.3	74.0	85.1	101.3	112.2	118.4	123.3	127.3	132.8	134.9	136.7	137.0	137.2	137.2	137.5	137.8	138.0	138.3	138.6	138.9	138.9	139.4	139.9
	40,000	42.6	77.2	83.4	87.9	103.4	123.2	136.3	143.7	149.1	153.6	159.3	161.4	163.0	162.7	162.6	162.3	162.3	162.0	161.7	161.7	161.4	161.1	161.1	160.7	160.1
900	50,000	52.7	90.2	97.6	104.5	119.6	142.5	157.5	165.4	171.2	176.1	182.2	183.5	184.9	184.2	183.5	182.8	182.0	181.3	180.6	179.9	178.9	178.1	177.4	176.0	174.6
	60,000	63.0	102.3	110.4	117.3	135.1	160.8	177.3	186.0	192.3	197.8	203.3	204.3	205.0	203.8	202.3	201.1	199.6	198.4	196.8	195.3	194.1	192.5	190.9	188.2	185.5
	70,000	72.8	113.3	122.5	131.8	150.9	179.2	197.9	207.0	213.4	219.3	224.5	225.1	225.0	222.9	220.8	218.7	216.6	214.5	212.3	210.2	208.1	205.9	203.3	199.5	195.3
	80,000	83.7	125.0	135.1	144.5	164.7	195.7	215.5	225.1	231.9	237.8	242.9	242.1	241.6	238.9	235.7	233.1	229.9	227.2	224.1	221.4	218.3	215.0	212.3	206.4	200.6
	30,000	33.3	63.7	68.8	73.7	85.1	95.3	106.3	112.8	117.9	122.1	128.1	131.0	133.3	134.1	134.9	135.7	136.2	137.0	137.8	138.6	139.4	140.3	141.1	142.4	144.0
	40,000	42.9	78.0	84.8	91.3	106.2	119.6	133.3	141.1	147.0	152.2	159.0	161.6	164.1	164.4	164.7	165.4	165.7	166.0	166.7	167.0	167.3	167.7	168.0	169.0	169.9
1000	50,000	53.0	90.9	98.5	106.8	125.4	143.6	160.3	169.0	175.9	181.5	188.7	191.3	193.1	193.1	193.1	193.1	192.7	192.7	192.7	192.3	192.3	191.9	191.9	191.6	191.6
	60,000	63.2	103.2	113.3	122.6	143.8	161.9	180.6	190.6	197.7	203.8	210.5	212.4	214.3	213.1	212.3	211.9	211.1	210.3	209.5	208.6	207.8	206.9	205.7	204.5	202.8
	70,000	73.0	114.0	124.2	134.7	158.8	180.0	201.0	211.3	218.6	225.2	232.0	233.1	233.9	232.5	230.8	229.4	227.7	226.4	224.6	222.8	221.0	219.6	217.8	214.7	211.6
	80,000	84.1	126.3	137.1	147.9	173.9	197.7	220.6	231.6	239.3	245.9	252.3	252.4	252.8	250.4	247.6	245.2	242.8	240.5	238.1	235.8	232.9	230.4	227.6	222.8	218.1
	Stroke	0	0.3	1.5	3	8	15	23	30	38	45	60	76	91	106	121	136	151	166	181	196	211	227	242	272	302

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TABLE 26. C13-1 Catapult, Lower Boundary, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) — NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND ACCUMULATOR PRESSURE

Pressure (PSI)	Stroke / Weight (LBS)	0	0.3	1.5	3	8	15	23	30	38	45	60	76	91	106	121	136	151	166	181	196	211	227	242	272	302
	10,000	7.0	13.9	16.7	20.0	24.1	27.4	30.3	31.7	32.4	33.0	32.5	32.4	32.4	32.1	31.7	31.3	31.0	30.6	30.4	30.0	29.6	29.3	29.0	28.3	27.5
	20,000	11.8	22.5	29.4	33.2	36.3	40.6	44.4	46.3	47.2	48.0	47.5	47.4	47.2	46.7	46.1	45.5	44.9	44.4	43.8	43.3	42.8	42.2	41.7	40.5	39.5
	30,000	16.5	31.1	36.4	40.6	43.9	48.3	52.3	54.3	55.2	56.0	55.6	55.3	55.1	54.4	53.8	52.9	52.2	51.5	50.9	50.4	49.4	48.8	48.1	46.6	45.0
200	40,000	20.6	36.8	41.1	45.8	49.4	53.6	57.5	59.3	60.2	60.9	60.7	60.4	60.0	59.3	58.4	57.5	56.6	55.8	55.0	54.2	53.3	52.5	51.7	50.0	48.2
	50,000	24.5	42.2	46.3	50.4	53.6	57.3	60.8	62.5	63.3	64.0	63.9	63.5	63.1	62.2	61.2	60.2	59.2	58.3	57.4	56.4	55.5	54.6	53.7	51.7	49.8
	60,000	28.4	46.2	49.9	52.7	55.9	59.1	62.1	63.5	64.2	64.6	64.9	64.4	64.0	62.9	61.9	60.8	59.7	58.6	57.7	56.7	55.7	54.7	53.7	51.6	49.5
	70,000	31.6	48.3	51.3	53.8	57.4	59.8	62.4	63.5	64.1	64.7	64.9	64.3	63.7	62.7	61.6	60.4	59.3	58.2	57.2	56.1	55.2	54.0	53.0	50.7	48.5
	80,000	34.6	52.1	54.0	56.2	58.9	60.7	62.7	63.5	64.0	64.6	64.9	64.2	63.6	62.6	61.4	60.1	58.8	57.8	56.7	55.5	54.5	53.3	52.2	49.7	47.4
	10,000	8.0	16.9	20.7	23.9	28.8	32.9	36.5	38.2	39.2	40.0	39.8	39.7	40.0	39.7	39.4	39.1	38.8	38.6	38.4	38.1	37.8	37.6	37.3	36.8	36.2
	20,000	14.5	27.8	31.4	38.6	44.6	50.3	55.2	57.6	58.9	59.9	59.7	59.7	59.8	59.4	58.9	58.4	57.9	57.5	57.0	56.5	56.1	55.6	55.1	54.1	53.1
	30,000	20.7	39.4	44.0	47.8	53.8	59.8	65.0	67.4	68.7	70.0	69.9	69.9	69.8	69.2	68.6	67.9	67.1	66.4	65.9	65.3	64.6	64.0	63.4	62.0	60.7
300	40,000	26.3	47.4	50.8	53.7	60.8	66.9	72.1	74.5	75.8	76.8	77.0	76.9	76.7	75.9	75.1	74.3	73.4	72.5	71.8	70.9	70.2	69.4	68.6	67.0	65.2
	50,000	31.8	54.7	58.7	62.4	67.3	73.1	78.1	80.4	81.6	82.6	82.9	82.6	82.3	81.4	80.4	79.4	78.3	77.3	76.4	75.5	74.6	73.6	72.5	70.5	68.5
	60,000	37.4	60.4	64.5	68.3	72.4	77.6	82.2	84.3	85.5	86.4	86.9	86.4	86.1	85.0	83.8	82.5	81.4	80.3	79.2	78.0	76.9	75.9	74.8	72.3	70.1
	70,000	42.3	64.8	68.7	72.5	76.0	80.5	84.6	86.3	87.4	88.3	89.0	88.3	87.8	86.7	85.4	83.9	82.6	81.3	80.1	79.0	77.7	76.4	75.1	72.5	69.9
	80,000	46.8	70.1	74.2	78.0	80.9	83.4	87.0	88.6	89.5	90.2	90.9	90.3	89.7	88.2	86.9	85.2	83.8	82.4	81.1	79.8	78.4	77.0	75.5	72.7	69.9
	20,000	16.6	32.5	36.4	40.9	50.3	57.4	63.0	65.9	67.5	68.9	69.2	69.6	70.0	69.8	69.5	69.1	68.8	68.5	68.3	68.0	67.7	67.4	67.2	66.5	66.0
	30,000	23.7	46.5	50.8	55.1	62.3	70.1	76.4	79.6	81.3	82.8	83.4	83.7	84.0	83.5	83.1	82.6	82.1	81.6	81.1	80.6	80.1	79.6	79.3	78.2	77.2
	40,000	30.5	56.5	60.3	64.6	71.7	79.9	86.4	89.5	91.3	93.0	93.6	93.8	94.0	93.2	92.7	91.8	91.1	90.5	107.7	89.5	88.6	87.8	87.1	85.7	84.4
400	50,000	37.2	65.3	69.8	75.3	80.9	89.1	95.7	98.8	100.5	102.2	103.0	103.0	103.0	102.0	101.3	100.3	99.3	98.3	97.5	96.6	95.8	94.9	94.0	92.0	90.2
	60,000	44.1	72.7	77.0	81.8	88.4	96.4	102.9	105.8	107.4	108.9	110.0	109.8	109.6	108.5	107.3	106.0	104.8	103.8	102.7	101.7	100.5	99.4	98.3	95.8	93.6
	70,000	50.3	78.7	83.2	89.1	94.7	102.1	108.2	110.8	112.5	114.1	115.0	114.8	114.3	113.0	111.7	110.2	108.7	107.4	106.2	104.9	103.6	102.0	100.7	97.9	95.3
	80,000	56.5	85.8	90.0	94.8	101.0	107.9	113.7	116.0	117.4	118.9	120.0	119.4	118.9	117.3	115.8	114.0	112.2	110.7	109.3	107.8	106.2	104.6	103.0	99.7	97.7
	20,000	18.2	39.3	43.4	48.5	54.6	63.1	69.2	72.5	74.5	76.2	77.2	78.2	79.0	79.0	79.0	79.0	78.8	78.8	78.8	78.8	78.8	78.8	78.8	78.8	78.8
	30,000	26.3	50.7	55.0	60.4	68.9	78.8	86.0	89.8	92.1	94.1	95.2	96.1	97.0	96.8	96.6	96.2	96.0	95.8	95.7	95.5	95.3	95.1	94.9	94.5	94.1
	40,000	34.0	62.0	67.5	73.2	81.4	92.0	99.7	103.8	106.1	108.3	109.7	110.4	111.0	110.6	110.1	109.7	109.3	108.9	108.4	108.0	107.6	107.1	106.9	105.8	105.0
500	50,000	41.8	72.1	76.8	81.1	91.7	102.7	110.8	114.7	117.3	119.5	120.9	121.5	121.9	121.2	120.5	119.8	119.1	118.4	117.7	117.0	116.3	115.5	115.1	113.7	112.3
	60,000	49.8	80.7	85.6	90.9	102.0	113.1	121.5	125.3	127.8	129.9	131.7	131.8	132.0	131.0	130.2	129.0	128.0	126.9	126.2	125.2	124.2	123.1	122.3	120.3	118.3
	70,000	57.1	88.2	92.5	96.7	111.6	122.6	131.3	134.8	137.4	139.4	141.0	141.1	141.0	139.7	138.4	137.0	135.7	134.3	133.3	131.9	130.6	129.2	128.1	125.4	122.8
	80,000	65.3	97.4	103.0	109.5	120.1	131.0	139.5	142.6	145.0	147.1	148.8	148.3	148.0	146.6	144.9	143.0	141.3	139.9	138.5	136.8	135.1	133.4	132.0	128.6	125.3
	30,000	27.7	53.6	57.8	62.6	70.5	81.7	89.5	93.5	96.4	98.7	100.6	102.1	103.3	103.5	103.7	103.9	104.1	104.1	104.3	104.5	104.7	104.9	105.1	105.6	106.0
	40,000	36.3	66.3	70.9	75.5	86.1	99.0	108.1	112.6	115.7	118.2	120.5	121.8	123.0	123.0	123.0	122.9	122.7	122.7	122.7	122.7	122.7	122.7	122.7	122.5	122.5
600	50,000	44.8	77.3	82.0	86.8	99.1	113.1	123.0	127.8	130.7	133.5	136.0	137.2	137.9	137.7	137.4	137.1	136.6	136.3	136.1	135.8	135.5	135.0	134.7	134.2	133.4
	60,000	53.9	87.0	92.3	98.9	111.4	125.8	136.6	141.2	144.4	147.1	149.5	150.5	151.0	150.4	149.8	149.0	148.4	147.8	147.2	146.3	145.7	145.1	144.5	143.1	141.6
	70,000	62.2	96.1	102.7	108.4	122.9	138.0	148.9	153.5	156.9	159.5	162.1	162.5	163.0	161.8	160.9	159.6	158.4	157.4	156.8	155.6	154.6	153.3	152.4	150.2	148.3
	80,000	70.9	106.0	111.4	118.2	134.2	149.6	161.0	165.7	168.5	171.3	173.7	173.8	174.1	172.4	171.1	169.4	167.8	166.5	165.1	163.8	162.2	160.7	159.1	156.1	153.5
	30,000	29.2	55.7	60.2	65.0	70.9	83.7	91.9	96.3	99.4	102.3	105.2	107.1	109.0	109.5	110.1	110.8	111.5	112.1	112.8	113.2	113.9	114.6	115.2	116.5	117.6
	40,000	37.5	67.8	72.2	78.7	84.8	99.2	108.8	113.8	117.3	120.1	123.2	125.2	126.9	127.4	127.9	128.1	128.7	129.2	129.4	129.9	130.4	130.7	131.2	132.0	133.0
700	50,000	46.7	79.6	85.4	90.1	100.5	117.0	128.0	133.4	137.2	140.4	143.7	145.3	147.0	147.0	147.3	147.3	147.6	147.6	147.8	147.8	148.1	148.1	148.4	148.7	149.0
	60,000	56.0	89.9	95.8	102.3	115.3	133.6	145.8	151.5	155.4	158.7	162.0	163.4	165.0	164.6	164.3	164.0	164.0	163.7	163.7	163.4	163.0	162.7	162.7	162.1	161.7
	70,000	64.9	99.8	106.1	112.5	128.3	147.4	160.9	166.4	170.5	174.1	177.3	178.1	179.1	178.4	178.1	177.0	176.3	176.0	175.3	174.6	173.9	173.2	172.5	171.4	170.1
	80,000	74.2	110.2	115.9	121.3	140.4	160.6	174.9	180.4	184.4	187.9	190.9	191.4	192.1	190.9	189.8	188.4	187.3	186.2	185.4	184.3	182.9	181.7	180.6	178.3	176.1
	30,000	29.9	56.9	62.0	66.5	71.0	85.2	93.9	98.7	102.4	105.5	109.5	112.1	114.6	115.8	116.9	118.1	119.0	120.2	121.4	122.5	123.5	124.7	125.9	128.0	130.3
	40,000	38.6	69.4	75.2	79.9	85.3	102.1	112.5	118.0	121.9	125.4	129.6	132.2	134.6	135.7	136.5	137.6	138.7	139.5	140.4	141.4	142.3	143.4	144.2	146.1	148.0
800	50,000	47.9	81.4	85.8	91.4	97.9	116.5	128.3	134.2	138.4	142.1	146.4	148.7	151.1	151.7	152.3	152.9	153.8	154.4	155.0	155.6	156.2	156.8	157.4	158.9	160.1
	60,000	57.3	92.0	96.7	103.8	113.1	134.2	147.7	154.0	158.7	162.5	166.6	168.8	170.8	171.2	171.5	171.8	171.8	172.2	172.5	172.8	173.2	173.5	173.5	174.2	174.9
	70,000	66.4	102.4	107.9	114.9	129.3	152.7	168.0	174.6	179.5	183.6	187.5	189.5	191.0	191.0	190.6	190.6	190.2	190.2	190.2	189.8	189.8	189.5	189.5	189.1	188.7
	80,000	76.1	112.9	117.5	123.0	142.1	167.1	184.2	190.9	195.7	200.2	203.9	204.8	206.0	205.6	204.8	204.0	203.2	202.8	202.0	201.2	200.4	199.9	199.1	197.5	196.3
	30,000	35.6	77.9	82.6	86.9	91.0	95.5	100.2	105.8	110.2	113.8	118.6	120.5	122.1	122.4	122.6	122.6	122.8	123.1	123.3	123.6	123.8	124.1	124.1	124.5	125.0
	40,000	46.0	94.4	99.3	103.6	107.5	113.1	122.9	129.5	134.5	138.4	143.7	145.6	147.0	146.7	146.7	146.4	146.4	146.1	145.8	145.8	145.5	145.2	145.2	144.9	144.4
900	50,000	48.5	82.3	87.5	93.3	108.1	128.7	142.1	146.3	154.7	159.2	164.7	165.9	167.1	166.1	165.8	165.2	164.5	163.9	163.2	162.6	161.6	161.0	160.3	159.0	157.7
	60,000	58.0	93.4	98.7	105.0	121.2	144.3	159.0	166.8	172.5	177.4	182.4	183.2	183.9	182.8	181.4	180.4	179.0	177.9	176.5	175.1	174.1	172.6	171.2	168.8	166.3
	70,000	67.0	103.5	109.6	116.8	124.2	151.2	168.7	175.9	181.4	186.0	190.8	193.3	195.6	196.0	196.4	196.7	197.1	197.5	197.9	198.3	198.7	199.1	199.5	200.2	201.0
	80,000	77.0	114.1	120.2	127.8	140.5	170.6	190.6	198.5	204.0	208.8	213.1	215.0	217.1	216.6	216.6	216.2	216.2	216.2	216.2	215.8	215.4	215.3	214.9	214.9	214.5
	30,000	36.0	78.6	82.8	87.0	91.1	98.5	107.0	113.9	118.8	123.2	128.4	129.3	130.1	129.6	128.6	128.1	127.3	126.6	125.8	125.3	124.6	123.8	123.1	121.6	120.4
	40,000	46.3	95.4	100.2	105.0	109.3	114.7	120.0	127.1	132.4	137.0	143.2	145.5	147.8	148.0	148.3	148.9	149.2	149.5	150.1	150.4	150.7	151.0	151.3	152.1	153.0
1000	50,000	57.2	110.3	114.7	119.2	124.7	129.6	143.6	151.4	157.6	162.6	169.0	171.3	172.9	172.9	172.9	172.9	172.6	172.6	172.6	172.3	172.3	171.9	171.9	171.6	171.6
	60,000	58.1	94.1	99.8	106.7	119.2	145.3	162.0	171.0	177.3	182.8	188.8	190.5	191.9	191.2	190.5	190.1	189.4	188.6	187.9	187.2	186.4	185.6	184.5	183.4	182.0
	70,000	67.2	104.1	110.4	116.8	132.3	161.7	180.5	189.8	196.3	202.2	208.3	211.3	210.1	208.9	207.3	206.1	204.5	203.3	201.7	200.1	198.5	197.2	195.7	192.9	190.1
	80,000	77.4	115.4	121.6	128.0	139.1	168.2	190.6	199.6	205.7	211.4	216.4	218.8	221.4	221.8	222.2	222.7	223.1	223.5	224.0	224.4	224.4	224.9	225.3	226.2	227.1
	Stroke	0	0.3	1.5	3	8	15	23	30	38	45	60	76	91	106	121	136	151	166	181	196	211	227	242	272	302

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TABLE 27. C13-1 Constant Pressure Catapult (CVA67), Upper Boundary, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) – NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND CSV SETTING

CSV Setting	Stroke / Weight (LBS)	0	0.3	1.5	3	8	15	23	30	38	45	60	76	91	106	121	136	151	166	181	196	211	227	242	272	302
	10,000	6.0	6.3	6.5	6.6	7.1	7.8	8.7	9.7	10.8	11.5	13.0	14.7	15.9	17.0	17.8	18.7	19.5	20.3	21.0	21.6	22.1	22.5	22.4	20.2	12.1
	20,000	10.0	11.5	11.6	11.7	12.4	13.8	16.0	17.1	18.4	19.5	21.4	23.4	25.1	26.6	27.9	29.2	30.3	31.3	32.3	33.0	33.7	34.1	33.8	29.0	18.4
	30,000	12.7	14.9	16.0	16.1	17.0	19.9	23.3	25.1	26.9	28.1	30.3	32.2	33.9	35.5	37.0	38.1	39.1	40.2	41.2	41.9	42.5	42.4	41.3	34.6	23.0
40	40,000	16.6	20.3	20.7	20.8	21.9	24.9	28.8	31.4	33.5	35.0	37.6	39.8	41.7	43.3	44.8	45.9	46.8	48.0	49.1	49.8	50.3	49.8	48.1	39.8	27.0
	50,000	20.7	25.2	25.6	25.8	26.7	29.0	33.2	36.3	38.8	40.6	43.6	46.2	48.1	49.7	51.2	52.3	53.3	54.5	55.6	56.3	56.7	55.8	53.5	43.6	30.1
	60,000	25.8	31.0	31.3	31.4	32.4	33.6	38.0	41.5	44.4	46.5	50.0	53.0	54.9	56.6	57.9	59.0	60.1	61.2	62.2	62.9	63.4	61.9	59.0	47.3	33.3
	70,000	29.8	35.8	36.3	36.5	37.3	38.6	43.3	47.1	50.2	52.4	56.3	59.4	61.6	63.2	64.4	65.6	66.5	67.6	68.6	69.3	69.7	68.0	64.5	52.3	38.1
	80,000	35.6	41.8	41.9	42.0	42.8	44.4	49.4	53.5	56.6	59.1	63.2	66.5	68.8	70.6	71.7	72.9	73.6	74.7	75.6	76.4	76.7	74.8	70.8	58.6	44.5
	10,000	6.5	9.6	9.7	9.7	10.4	11.9	13.3	14.7	15.9	17.0	18.9	20.8	22.2	23.4	23.9	25.2	26.1	26.9	27.6	28.2	28.8	29.3	29.2	26.3	17.9
	20,000	15.0	17.1	17.2	17.3	18.3	20.8	23.9	25.6	27.2	28.6	31.0	33.3	35.0	36.7	38.0	39.5	40.6	41.8	42.9	43.7	44.3	44.7	44.4	39.1	27.1
	30,000	20.0	23.8	24.0	24.2	25.6	29.8	34.2	36.7	39.0	40.5	43.0	45.2	46.9	48.6	50.1	51.3	52.4	53.7	54.8	55.6	56.2	56.0	54.9	47.3	32.9
60	40,000	25.1	30.5	30.8	31.0	32.6	37.2	42.2	45.6	48.3	50.1	53.0	55.5	57.2	58.9	60.4	61.6	62.7	64.0	65.4	66.1	66.7	66.1	64.4	54.7	38.5
	50,000	30.4	37.4	37.8	38.0	39.8	44.0	49.7	53.6	56.6	58.6	62.0	64.8	66.7	68.5	69.9	71.1	72.3	73.8	75.1	76.0	76.5	75.4	73.3	61.4	44.2
	60,000	35.6	44.2	45.5	45.8	47.7	51.0	57.3	61.9	65.1	67.4	71.1	74.3	76.2	77.9	79.3	80.5	81.8	83.2	84.6	85.5	85.8	84.4	81.6	67.8	49.8
	70,000	42.0	51.7	52.0	52.4	54.0	57.5	64.2	69.0	72.4	74.8	78.9	82.1	84.1	85.7	87.1	88.2	89.3	90.7	92.0	93.0	93.3	91.7	88.7	73.8	55.8
	80,000	46.9	57.0	59.6	59.9	61.4	66.3	72.4	77.3	81.0	83.5	87.8	91.2	93.2	94.8	95.8	97.1	97.9	99.3	100.5	101.4	101.9	99.9	96.7	81.5	63.4
	10,000	10.3	12.5	12.8	13.0	14.3	16.4	18.6	20.3	21.9	23.1	25.2	27.1	28.6	29.6	29.6	31.3	32.0	32.9	33.5	34.0	34.5	35.2	35.1	31.5	24.3
	20,000	19.6	23.0	23.3	23.7	25.7	29.3	33.5	35.8	37.8	39.5	42.3	44.6	46.2	47.8	48.8	50.4	51.4	52.7	53.2	53.5	54.0	54.0	53.0	49.8	37.5
	30,000	27.3	32.7	33.3	33.7	36.4	41.9	47.0	50.3	53.2	54.9	57.6	59.7	61.1	62.6	63.9	65.1	66.2	67.5	68.8	69.6	69.8	69.6	68.8	60.8	44.1
80	40,000	33.8	41.6	42.3	43.0	46.2	52.3	58.4	62.5	65.9	67.7	70.6	73.0	74.3	75.8	77.1	78.2	79.4	80.8	82.2	83.2	83.5	82.9	81.7	71.1	52.1
	50,000	38.3	48.5	51.0	51.7	54.9	60.9	68.3	72.8	76.3	78.3	81.4	84.0	85.4	86.9	88.2	89.3	90.6	92.1	93.7	94.7	95.0	94.2	92.6	80.0	59.9
	60,000	46.3	59.0	59.9	60.7	64.2	69.8	78.2	83.5	86.8	88.9	92.4	94.9	96.4	97.8	99.1	100.2	101.5	103.1	104.8	105.7	106.1	105.1	103.1	88.3	67.5
	70,000	52.3	66.2	69.4	70.4	74.0	79.5	88.6	93.9	97.4	99.7	103.4	106.0	107.4	108.8	109.8	110.8	112.1	113.7	115.3	116.3	116.7	115.7	113.7	97.2	75.9
	80,000	56.8	71.4	79.1	80.0	84.0	89.3	98.9	104.2	108.1	110.3	113.9	116.7	118.1	119.2	120.1	121.0	122.1	123.6	124.9	126.1	126.5	125.1	123.6	106.0	84.5
	10,000	11.4	14.2	18.2	18.6	19.9	22.7	24.6	26.6	28.2	29.7	32.0	34.0	35.1	36.1	36.2	37.6	38.5	39.3	39.9	40.4	40.8	41.4	41.4	37.8	30.8
	20,000	21.5	25.7	29.8	30.3	32.1	36.7	42.1	44.6	46.7	48.2	50.8	52.9	54.3	55.5	56.3	57.6	58.5	59.5	60.5	61.2	61.7	62.1	61.9	57.4	45.7
	30,000	31.3	38.7	41.8	42.9	46.1	52.6	58.8	62.2	64.7	66.2	68.4	70.2	71.3	72.4	73.5	74.6	75.6	76.7	77.8	78.7	79.3	79.2	78.8	71.8	53.8
100	40,000	37.7	49.7	54.6	56.3	60.9	68.5	76.6	79.7	82.5	84.3	86.6	88.4	89.4	90.6	91.8	92.9	94.2	95.6	97.0	98.0	98.7	98.5	97.9	88.2	66.3
	50,000	44.0	59.9	65.2	67.0	73.1	80.5	88.6	93.2	96.0	97.6	99.9	101.7	102.9	104.1	105.3	106.5	107.9	109.3	111.1	112.4	113.2	113.2	112.1	100.6	77.4
	60,000	51.1	68.5	74.9	76.9	83.1	90.7	99.6	104.3	107.0	108.6	110.8	112.7	113.8	114.9	116.2	117.0	118.6	120.1	122.3	123.8	124.7	124.7	123.2	109.8	86.8
	70,000	57.4	77.2	86.0	88.1	94.6	102.7	112.2	117.2	119.8	121.6	123.8	125.7	126.6	127.6	128.6	129.8	131.0	133.0	134.9	136.8	137.6	137.6	136.2	121.1	97.5
	80,000	63.8	85.1	96.7	98.8	105.0	113.9	123.5	128.2	131.3	132.8	135.2	136.9	137.6	138.4	139.2	140.6	141.6	143.5	145.3	147.2	148.2	148.0	147.0	130.6	106.8
	10,000	12.3	15.6	21.9	24.3	27.0	30.3	31.6	33.9	35.6	37.3	39.9	41.8	42.4	43.1	43.3	44.3	45.3	45.8	46.6	47.0	47.2	47.7	47.7	44.4	38.2
	20,000	23.9	30.6	35.3	38.5	42.0	47.1	54.4	57.0	59.3	60.4	62.9	64.8	65.8	66.7	67.2	67.9	68.7	69.3	70.1	70.9	71.5	71.8	71.8	68.3	57.5
	30,000	35.5	47.9	51.8	54.9	59.4	67.6	75.5	78.9	81.0	82.1	83.6	84.8	85.5	86.1	86.9	87.8	88.9	89.7	90.6	91.4	92.2	92.6	92.8	85.5	67.5
120	40,000	42.2	58.6	66.5	69.7	75.4	85.2	92.7	96.8	98.6	99.9	101.1	101.9	102.5	102.9	103.9	105.1	106.3	107.5	108.7	109.9	110.9	111.5	111.6	104.2	80.3
	50,000	49.1	69.1	79.4	82.6	89.7	99.8	108.1	112.1	113.9	115.0	115.7	116.6	117.1	117.8	118.7	119.8	121.0	122.6	124.4	126.2	127.4	128.3	128.0	119.2	94.3
	60,000	55.7	78.1	91.3	94.3	101.9	113.0	121.5	125.3	126.9	127.9	127.9	128.4	129.2	130.0	130.7	131.7	133.0	134.8	137.0	139.8	141.1	142.4	141.5	131.6	106.8
	70,000	62.0	87.7	104.0	107.1	115.1	126.0	136.0	138.9	140.1	140.9	141.2	141.5	142.1	142.6	143.2	144.3	145.7	147.6	150.1	152.9	154.3	155.8	155.3	143.6	118.6
	80,000	67.2	96.1	118.4	121.5	129.2	139.7	149.2	152.9	154.3	155.1	155.2	155.8	155.5	155.8	156.4	157.9	159.5	161.3	164.0	166.2	167.5	168.6	168.0	155.9	130.4
	10,000	12.8	16.9	24.6	28.5	32.3	36.0	38.9	41.3	43.0	44.5	46.6	48.1	48.9	49.5	49.7	50.7	51.6	52.2	52.6	53.0	53.4	53.5	53.4	49.9	44.5
	20,000	24.4	32.9	42.3	46.5	52.0	58.1	64.4	67.4	69.2	70.3	72.2	73.4	74.1	74.7	75.0	75.8	76.7	77.3	78.3	79.0	79.7	80.0	80.3	77.2	67.5
	30,000	38.3	51.3	60.8	65.7	72.3	81.1	88.5	92.0	93.5	94.5	95.1	95.5	95.9	96.1	96.8	98.1	99.3	100.2	101.3	102.3	103.2	104.0	104.3	100.1	82.1
140	40,000	45.8	64.2	80.8	86.0	90.9	101.5	109.3	112.9	114.2	115.5	115.3	115.5	115.6	116.0	116.7	118.3	119.9	121.2	122.6	124.0	125.1	126.1	126.2	120.2	98.4
	50,000	53.3	78.1	94.7	99.9	108.0	119.5	127.5	131.1	132.3	133.0	132.8	132.8	132.8	133.3	133.9	135.4	137.3	138.8	140.9	142.8	144.1	144.9	144.8	137.6	114.7
	60,000	59.4	88.9	110.7	115.9	124.5	136.8	145.1	148.4	149.1	149.6	148.8	148.8	148.8	149.1	149.7	151.1	153.2	155.3	157.9	160.2	161.7	162.6	161.7	153.6	130.2
	70,000	65.7	100.1	126.9	132.1	141.4	153.9	162.0	165.1	165.8	166.1	164.9	164.8	164.8	165.2	165.5	167.1	169.4	171.4	174.6	177.2	178.9	179.5	178.8	169.3	145.2
	80,000	71.7	110.1	167.0	172.2	181.4	190.2	194.9	194.6	194.6	194.3	192.2	190.7	189.2	187.5	186.4	184.7	182.9	182.2	182.2	181.9	180.8	179.6	176.7	165.4	140.7
	10,000	13.2	18.9	20.7	24.8	36.3	42.1	46.5	49.2	50.8	51.9	53.4	54.3	55.3	55.7	55.9	56.7	57.7	58.1	58.1	58.8	59.2	59.0	58.5	54.9	50.9
	20,000	26.8	36.7	40.7	49.4	60.4	69.9	74.9	77.9	79.3	80.2	81.3	81.6	82.0	82.0	82.3	83.1	84.0	84.7	85.6	86.4	87.2	88.1	89.0	85.6	77.6
	30,000	46.4	78.4	83.4	92.3	104.2	113.2	116.8	117.2	117.6	118.4	116.8	115.6	115.0	113.9	113.1	112.0	110.5	109.7	109.0	108.4	107.7	108.1	108.1	104.4	89.0
160	40,000	55.6	96.4	102.4	111.8	127.3	137.3	141.3	141.0	141.1	141.5	139.3	137.7	136.9	136.6	134.6	133.6	132.3	131.3	130.8	130.2	129.7	130.0	129.7	124.7	105.5
	50,000	64.7	110.9	118.5	128.9	147.6	158.8	161.9	161.3	161.0	161.0	158.1	156.9	155.7	154.2	153.1	151.6	150.4	149.3	149.0	148.7	148.1	148.1	147.1	141.5	121.1
	60,000	71.9	122.7	134.0	145.3	167.0	178.8	181.2	180.0	179.0	178.7	175.2	174.0	172.4	170.8	169.5	168.2	166.6	165.6	165.3	165.6	165.3	164.3	162.9	157.0	135.6
	70,000	79.0	136.5	153.8	164.8	185.9	198.2	200.1	198.5	197.3	196.6	192.8	191.2	189.7	188.0	186.9	185.1	183.7	183.0	182.6	182.6	182.2	181.1	178.9	172.0	151.0
	80,000	86.0	150.6	174.8	185.2	202.5	214.7	216.7	214.6	213.7	212.6	208.4	206.3	205.1	203.6	202.0	200.5	198.9	198.6	198.6	197.8	197.4	196.1	193.4	185.2	165.1
	20,000	31.3	53.0	63.6	73.3	84.8	93.0	95.9	96.8	97.3	97.5	97.1	96.2	95.3	94.1	93.2	91.8	90.6	89.7	89.4	88.8	88.3	87.8	87.2	84.9	76.8
	30,000	47.3	85.0	92.4	102.5	116.4	126.0	129.2	129.4	129.4	129.4	127.1	125.1	123.7	122.3	121.2	120.5	119.5	118.8	118.6	117.9	117.4	117.7	117.6	114.5	102.2
	40,000	57.6	105.3	112.2	123.0	141.7	152.1	155.6	155.1	154.5	154.3	151.3	148.9	147.8	146.1	145.3	144.7	143.9	143.0	142.5	141.7	140.8	140.8	140.2	135.9	121.2
180	50,000	67.9	121.7	130.8	142.9	166.0	177.3	180.0	178.8	177.8	176.9	173.4	171.3	169.7	168.5	167.5	166.5	165.6	164.9	164.0	163.0	161.8	161.0	159.7	154.2	137.9
	60,000	74.7	133.8	146.8	160.2	187.2	198.8	200.6	198.6	197.0	195.4	191.5	189.6	188.2	186.6	186.0	185.0	183.9	182.8	181.8	180.4	179.0	177.4	175.3	168.8	151.1
	70,000	81.5	146.7	165.2	179.1	206.8	218.0	219.1	216.3	214.2	212.4	208.5	206.8	205.7	204.9	204.1	202.6	201.4	200.2	198.7	197.2	195.2	192.8	190.0	182.2	164.5
	80,000	89.2	161.3	185.1	198.4	224.4	235.3	235.7	232.2	229.9	228.0	223.8	222.4	222.4	221.6	220.7	219.1	217.4	216.2	214.5	212.4	209.9	207.2	203.9	194.3	177.2
	20,000	32.0	56.2	68.9	79.8	93.1	101.2	104.6	105.1	105.1	104.9	103.6	101.9	100.2	98.5	97.0	95.9	95.2	94.2	94.2	93.7	93.5	93.1	92.5	89.9	82.4
	30,000	47.9	90.6	100.3	111.4	126.2	115.0	140.2	140.2	139.6	138.7	135.7	132.6	130.6	128.9	127.6	127.1	126.9	126.6	126.6	125.7	125.6	125.6	125.4	123.1	114.8
	40,000	59.4	113.3	121.7	133.6	155.6	166.5	169.6	168.8	167.5	166.1	162.2	159.1	157.5	156.8	154.9	154.6	154.6	154.0	153.4	151.9	151.0	150.3	150.0	146.4	136.8
200	50,000	70.8	131.2	140.3	153.8	181.2	192.4	194.2	192.6	191.1	188.8	184.7	181.8	180.1	178.8	178.1	177.7	177.4	176.7	175.4	173.3	171.6	170.1	168.7	163.2	152.0
	60,000	77.5	145.0	157.1	172.5	206.3	215.5	216.3	213.8	211.8	208.9	204.4	201.9	200.4	199.3	199.3	198.5	198.2	197.0	194.8	192.1	189.5	186.7	184.4	177.2	163.9
	70,000	84.3	157.4	174.7	191.0	225.6	235.2	235.2	231.3	228.2	225.6	221.4	219.7	219.2	218.8	218.8	217.2	216.4	214.7	211.9	208.6	204.9	201.8	198.5	189.4	175.9
	80,000	91.8	168.4	191.3	207.4	242.9	251.6	250.4	245.1	240.9	238.5	235.0	234.0	235.3	235.7	235.3	233.5	231.8	229.6	226.1	222.2	217.8	213.6	209.7	199.2	186.1
	30,000	48.2	95.7	108.2	120.3	138.0	147.1	148.7	148.4	148.0	147.3	143.9	139.8	137.4	135.6	134.5	134.2	134.2	134.2	134.0	133.2	132.9	133.4	132.6	131.5	121.2
	40,000	60.5	121.1	131.5	144.7	169.0	179.1	181.0	180.2	177.9	177.0	172.6	168.6	166.4	164.8	163.8	164.2	164.2	163.8	162.9	161.0	159.4	159.6	158.0	155.7	144.3
220	50,000	72.7	141.4	151.6	166.8	197.1	206.3	207.4	206.7	204.4	202.7	198.0	194.5	192.7	191.2	190.9	190.5	190.2	189.4	187.2	184.7	181.8	180.5	178.3	173.2	161.2
	60,000	79.6	154.4	167.4	184.5	185.5	229.1	229.6	226.0	224.4	221.8	217.0	214.8	213.6	212.9	212.5	212.1	210.9	209.3	206.1	202.5	198.1	195.5	192.2	184.2	172.6
	70,000	86.7	167.5	183.8	201.7	239.1	246.9	246.5	242.9	240.2	237.4	233.0	231.6	231.2	230.8	230.3	228.6	226.9	223.9	220.5	215.8	210.7	207.0	203.1	193.7	181.7
	80,000	95.4	183.9	200.4	218.3	255.8	263.3	260.5	255.9	252.5	250.0	246.8	245.8	246.2	246.2	245.3	242.6	239.0	235.4	231.8	225.5	220.1	215.7	211.6	200.8	189.1
	30,000	48.1	101.5	116.5	130.0	149.4	157.8	159.6	159.3	157.0	156.5	152.9	147.4	144.3	142.7	141.6	141.8	142.1	142.4	141.8	141.0	140.4	141.8	140.4	140.6	128.0
	40,000	64.1	132.5	140.1	154.7	181.0	190.0	191.4	190.2	186.8	186.1	181.5	178.9	173.3	172.0	171.3	171.7	172.0	172.0	170.3	168.3	166.0	166.9	164.6	163.8	150.2
240	50,000	75.7	151.3	160.9	177.2	209.9	219.1	219.2	217.4	214.2	212.8	207.9	203.8	201.6	200.4	200.1	200.4	199.7	198.5	195.9	192.4	188.6	187.7	184.3	180.0	167.8
	60,000	85.1	167.2	175.8	193.5	231.6	240.5	239.7	237.0	234.3	232.0	227.0	224.7	223.9	223.1	222.7	222.6	221.0	218.5	214.8	209.8	204.0	201.2	197.0	188.7	178.7
	70,000	91.0	180.4	194.5	214.3	251.7	259.6	256.8	253.5	250.7	248.2	244.2	242.7	242.3	241.8	240.9	239.1	236.0	232.5	228.0	221.9	215.2	210.9	206.9	196.2	186.9
	80,000	99.1	198.2	214.3	230.0	269.9	275.5	271.2	267.3	264.3	262.1	259.3	258.3	258.3	257.8	255.4	252.2	247.1	241.5	237.7	229.4	222.9	217.9	213.7	202.1	192.3
	40,000	64.3	138.6	148.6	164.1	192.7	200.2	200.6	199.3	194.7	194.4	189.3	182.7	179.3	177.9	177.6	178.6	179.3	179.0	176.9	174.5	172.1	173.3	170.3	170.8	155.6
	50,000	79.8	160.9	168.8	184.4	218.9	226.6	225.8	224.0	220.0	218.9	213.4	208.9	206.6	206.2	205.4	206.2	205.4	203.9	200.7	196.5	191.8	192.4	186.4	183.7	171.2
260	60,000	87.9	176.1	186.4	201.3	241.2	249.2	247.0	244.6	241.5	239.5	234.4	232.5	231.6	231.6	230.8	230.8	229.1	226.1	220.9	215.0	207.7	204.4	199.7	191.1	183.0
	70,000	94.8	192.9	199.6	220.3	262.2	268.6	264.9	261.9	259.5	257.3	253.2	251.8	251.7	251.3	249.4	247.6	243.5	238.5	233.5	225.4	217.6	212.7	208.1	197.2	190.0
	80,000	102.7	208.0	217.0	239.6	281.7	285.7	279.4	276.3	273.8	272.5	269.6	268.5	267.6	266.6	263.7	259.5	252.3	245.2	240.9	230.6	222.9	217.8	213.5	201.6	194.0
	Stroke	0	0.3	1.5	3	8	15	23	30	38	45	60	76	91	106	121	136	151	166	181	196	211	227	242	272	302

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TABLE 28. C13-1 Conatant Pressure Catapult (CVA67), Mean, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) — NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND CSV SETTING

CSV Setting	Stroke / Weight (LBS)	0	0.3	1.5	3	8	15	23	30	38	45	60	76	91	106	121	136	151	166	181	196	211	227	242	272	302
	10,000	6.5	7.2	7.5	7.7	8.3	9.0	9.9	10.8	11.6	12.5	13.9	15.3	16.2	17.1	17.7	18.2	18.7	19.1	19.5	19.8	20.1	20.2	19.9	17.7	9.8
	20,000	10.7	13.3	13.7	13.9	14.8	16.0	18.1	19.1	20.4	21.3	23.0	24.7	26.1	27.2	28.2	29.0	29.7	30.3	30.8	31.1	31.4	31.4	30.7	26.1	15.5
	30,000	15.1	18.3	18.7	19.0	20.0	22.6	25.8	27.5	29.0	30.2	32.1	33.6	34.9	35.9	36.9	37.6	38.2	38.7	39.1	39.3	39.3	38.9	37.6	30.9	19.6
40	40,000	17.9	23.3	23.8	24.1	25.3	28.0	31.7	34.0	36.0	37.4	39.6	41.4	42.8	43.8	44.7	45.3	46.0	46.4	46.7	46.7	46.6	45.8	43.9	35.5	23.2
	50,000	22.2	29.0	29.4	29.7	30.8	32.9	36.8	39.5	41.9	43.6	46.4	48.5	49.9	50.9	51.7	52.5	52.9	53.4	53.6	53.6	53.4	52.1	49.6	39.5	26.3
	60,000	28.8	35.1	35.5	35.7	36.5	37.6	41.7	45.0	47.7	49.6	52.9	55.4	57.0	57.9	58.6	59.2	59.6	59.9	60.2	60.2	59.7	57.9	54.8	42.9	29.2
	70,000	35.5	40.1	40.5	40.7	41.6	42.5	46.8	50.3	53.2	55.3	58.9	61.6	63.2	64.1	64.7	65.1	65.5	65.7	65.9	65.7	65.1	63.1	59.4	47.2	33.4
	80,000	39.7	44.9	45.1	45.3	46.1	47.3	51.8	55.5	58.4	60.8	64.5	67.2	68.9	69.9	70.2	70.6	70.7	70.9	70.9	70.7	70.1	67.8	63.6	51.6	38.4
	10,000	9.2	11.3	11.7	11.9	12.9	14.1	15.5	16.8	18.0	19.1	20.8	22.5	23.6	24.6	25.0	25.9	26.4	26.9	27.3	27.6	27.8	27.9	27.5	24.4	15.9
	20,000	16.2	20.0	20.4	20.7	22.1	24.2	27.1	28.6	30.1	31.4	33.6	35.5	37.0	38.2	39.1	40.1	40.8	41.5	42.0	42.3	42.5	42.5	41.8	36.4	24.2
	30,000	22.8	27.6	28.1	28.5	30.4	34.0	37.9	40.2	42.2	43.6	45.8	47.6	48.8	50.0	50.9	51.7	52.3	52.9	53.3	53.5	53.4	52.8	51.5	43.8	29.3
60	40,000	26.8	35.1	35.6	36.0	38.1	41.8	46.4	49.4	52.0	53.6	56.0	58.0	59.3	60.4	61.3	61.9	62.5	63.0	63.3	63.4	63.2	62.3	60.3	50.5	34.5
	50,000	32.4	42.5	43.2	43.5	45.8	48.9	54.2	57.6	60.5	62.3	65.2	67.4	68.9	69.9	70.6	71.3	71.9	72.3	72.7	72.8	72.4	71.1	68.5	56.5	39.6
	60,000	38.3	50.5	51.1	51.4	53.4	55.9	61.5	65.6	68.5	70.6	73.9	76.4	77.8	78.8	79.5	80.1	80.5	80.9	81.2	81.2	80.6	79.0	75.8	61.9	44.4
	70,000	44.5	57.6	58.1	58.4	60.3	62.6	68.8	73.0	76.3	78.3	81.9	84.5	85.9	86.8	87.4	87.8	88.2	88.5	88.7	88.5	87.9	85.9	82.4	67.6	50.1
	80,000	50.6	63.8	64.3	64.6	66.5	69.2	75.6	79.9	83.1	85.5	89.2	91.7	93.0	93.8	94.3	94.5	94.7	94.8	94.8	94.7	94.0	91.7	88.2	73.3	56.0
	10,000	11.0	14.4	15.2	15.7	17.1	19.2	21.2	22.8	24.2	25.3	27.2	28.9	30.1	31.0	30.7	32.2	32.5	33.1	33.3	33.5	33.7	33.9	33.3	29.5	22.2
	20,000	21.0	26.2	27.1	27.7	29.5	32.9	36.6	38.7	40.5	42.0	44.5	46.4	47.9	48.9	49.5	50.6	51.2	51.7	52.1	52.4	52.4	52.3	51.6	46.3	33.9
	30,000	29.2	37.6	38.7	39.2	41.7	46.6	51.2	53.9	56.6	58.0	60.2	62.0	63.0	64.1	64.9	65.5	66.0	66.4	66.8	67.0	66.8	66.0	64.9	57.0	40.3
80	40,000	35.9	47.3	48.4	49.1	52.0	57.4	62.9	66.3	69.2	70.8	73.1	75.0	75.9	77.0	77.5	78.1	78.5	78.9	79.4	79.5	79.1	78.0	76.5	66.1	47.3
	50,000	41.2	57.0	58.0	58.6	62.0	66.8	73.3	77.2	80.3	81.9	84.3	86.4	87.4	88.3	88.8	89.3	89.9	90.2	90.7	90.7	90.3	89.1	87.2	74.6	54.6
	60,000	49.4	66.2	67.7	68.4	71.8	76.4	83.9	88.3	91.3	93.0	95.7	97.8	98.7	99.4	100.0	100.3	100.9	101.2	101.6	101.6	101.1	99.7	97.4	82.7	62.0
	70,000	55.5	73.5	74.9	75.7	78.7	83.6	91.6	96.1	99.1	100.9	103.6	105.5	106.3	106.8	107.2	107.4	107.8	108.2	108.4	108.4	107.8	106.2	104.1	88.1	67.8
	80,000	61.5	79.9	85.0	85.8	89.0	94.2	102.7	107.4	110.6	112.4	115.0	117.1	117.5	118.1	118.3	118.6	118.6	118.8	118.8	118.8	118.1	116.3	114.4	97.2	76.3
	10,000	12.4	17.6	20.0	22.5	23.8	25.3	26.9	28.6	30.1	31.4	33.5	35.1	36.0	36.7	36.6	37.5	37.9	38.4	38.6	38.7	38.8	38.9	38.5	34.6	27.8
	20,000	23.1	31.5	35.0	37.2	39.4	41.9	46.8	49.0	51.0	52.3	54.7	55.2	55.6	56.5	56.9	57.5	57.9	58.2	58.5	58.7	58.7	58.6	58.1	55.1	43.1
	30,000	33.8	47.4	50.2	52.5	55.1	59.3	64.8	67.7	70.0	71.3	72.3	73.6	74.3	75.0	75.6	75.9	76.3	76.6	76.7	76.8	76.7	76.1	75.3	69.1	50.6
100	40,000	40.5	58.4	63.0	65.6	68.7	73.6	79.5	82.8	85.4	86.8	88.5	89.9	90.4	91.1	91.6	91.7	92.1	92.4	92.7	92.9	92.8	92.0	90.8	81.3	59.7
	50,000	47.3	69.4	75.5	78.0	81.2	86.1	93.0	95.6	99.1	100.6	102.1	103.4	104.1	104.5	104.9	105.1	105.5	105.9	106.5	106.8	106.7	105.8	104.0	92.9	70.0
	60,000	54.5	79.3	87.2	89.8	93.7	98.6	106.1	109.9	112.1	113.5	115.0	116.2	116.9	117.3	117.5	117.7	117.9	118.4	119.2	119.9	119.7	118.7	116.2	103.3	80.2
	70,000	61.7	89.2	98.3	101.4	105.3	109.8	118.0	121.8	124.1	125.4	127.1	128.1	128.4	128.6	128.9	128.9	129.1	129.6	130.3	130.8	130.5	129.5	127.2	112.8	89.4
	80,000	68.6	98.3	110.8	112.9	116.5	120.4	129.0	132.9	135.4	136.6	138.1	139.2	139.0	139.2	139.2	139.2	139.2	139.5	140.3	140.5	140.3	139.2	137.4	121.6	97.8
	10,000	13.2	20.9	22.6	25.8	29.6	33.3	34.3	36.3	37.7	39.2	41.4	43.0	43.4	43.9	43.8	44.2	44.6	44.8	45.1	45.1	45.0	45.0	44.8	41.0	35.0
	20,000	25.7	34.9	38.7	44.7	47.4	51.3	57.9	60.0	61.9	62.9	65.3	66.6	67.3	67.7	67.8	67.8	67.8	68.0	68.1	68.2	68.2	68.1	67.8	63.6	53.0
	30,000	38.2	56.2	59.6	63.2	66.7	72.5	79.2	81.8	83.7	84.6	85.9	86.7	87.1	87.1	87.4	87.2	87.2	87.2	87.4	87.2	87.2	87.0	86.8	80.9	61.3
120	40,000	45.5	68.0	73.2	78.0	82.8	90.0	96.2	97.5	100.9	102.0	102.8	103.2	103.4	103.2	103.6	103.4	103.6	103.8	103.9	104.1	104.1	103.9	103.3	95.8	72.2
	50,000	52.8	79.8	85.3	92.7	99.1	106.2	112.9	115.7	117.1	118.2	118.7	118.9	118.9	118.9	119.1	118.7	118.9	119.1	119.8	120.7	120.7	120.4	119.0	110.6	86.0
	60,000	59.7	89.9	100.3	107.0	113.3	121.7	128.8	131.4	132.8	133.5	133.5	133.3	133.3	133.3	133.3	132.8	133.0	133.3	134.5	136.1	136.3	136.0	133.9	124.5	99.5
	70,000	66.7	99.8	116.5	122.1	127.4	135.8	143.3	145.9	147.1	147.6	147.6	147.3	146.8	146.8	146.5	146.2	146.2	146.8	147.9	149.6	149.9	149.5	147.5	136.5	110.9
	80,000	72.3	111.8	130.7	135.8	140.9	148.8	156.6	158.9	160.2	160.8	160.5	160.1	159.3	158.9	158.6	158.3	158.3	159.0	160.2	161.1	161.4	161.6	160.0	146.9	121.0
	10,000	13.8	24.4	25.9	29.2	34.9	39.2	41.4	43.2	44.8	46.1	48.0	49.1	49.7	50.2	50.1	50.2	50.4	50.6	50.6	50.6	50.4	50.2	49.9	46.1	40.8
	20,000	26.2	35.6	42.9	46.3	55.9	63.0	68.4	70.5	72.2	73.1	74.7	75.6	76.0	76.0	76.2	75.9	75.7	75.7	76.0	76.0	76.0	76.0	75.7	72.4	62.7
	30,000	41.2	65.0	68.9	72.6	77.5	87.2	93.4	95.6	96.9	97.9	98.1	98.1	98.1	97.9	98.0	98.1	98.1	98.1	98.3	98.3	98.5	98.7	98.6	93.9	76.1
140	40,000	49.3	75.2	78.9	82.9	96.0	107.6	113.8	116.2	117.2	118.3	117.9	117.7	117.4	117.0	117.0	117.2	117.4	117.7	118.1	118.3	118.6	118.8	118.3	112.1	90.3
	50,000	57.3	85.4	96.9	99.2	113.9	127.1	133.4	135.6	136.4	137.2	136.2	135.9	135.6	135.1	135.1	135.1	135.4	135.6	136.4	137.4	137.7	137.7	136.6	129.5	106.3
	60,000	63.9	94.7	112.9	115.3	131.5	145.9	152.3	154.0	154.3	154.9	153.5	153.1	152.5	152.0	152.0	151.7	152.0	152.5	153.7	155.2	155.8	155.1	153.6	145.6	122.0
	70,000	70.5	106.4	127.8	130.3	147.5	162.5	168.9	170.4	170.8	170.8	169.2	168.5	167.8	167.2	166.9	166.9	167.2	167.9	169.5	170.7	171.4	170.7	169.0	159.6	135.5
	80,000	77.1	116.0	142.9	145.3	162.8	177.4	184.0	185.3	185.7	185.7	184.0	182.8	181.8	181.5	181.1	181.1	181.5	182.2	183.6	184.6	185.3	184.9	183.1	171.8	148.1
	10,000	14.2	28.6	29.2	29.6	40.1	45.0	48.6	50.5	51.9	52.9	54.3	54.9	55.7	55.9	55.8	55.8	55.9	55.6	55.5	55.3	54.8	54.3	50.7	46.6
	20,000	28.8	39.1	48.6	57.0	67.4	75.9	79.6	81.7	82.9	83.7	84.5	84.6	84.6	84.3	84.2	83.8	83.4	83.4	83.5	83.7	83.7	83.7	83.5	81.2	73.1
	30,000	43.4	73.8	78.8	79.9	92.4	102.7	107.8	109.5	110.2	111.0	110.0	109.2	108.7	108.1	107.9	108.3	108.1	108.3	108.7	109.0	109.2	109.8	110.2	107.0	92.0
160	40,000	52.0	86.8	88.0	97.7	114.2	125.7	131.5	132.9	133.9	134.9	131.9	130.9	130.1	129.6	129.4	129.9	130.1	130.4	130.9	131.4	131.6	132.4	132.3	128.2	109.7
	50,000	60.5	99.8	104.7	115.7	135.6	148.4	153.6	154.7	154.7	155.0	152.7	151.7	150.6	150.0	149.4	150.0	150.3	150.9	151.8	152.6	152.9	153.2	152.6	147.8	127.8
	60,000	67.2	112.0	120.2	131.8	155.1	169.1	173.6	174.2	173.6	173.6	170.7	169.9	168.6	167.7	167.0	167.3	168.0	168.6	169.9	170.9	171.6	171.2	169.9	164.6	143.8
	70,000	73.9	124.2	39.7	150.4	172.7	187.1	191.2	191.2	190.8	190.2	187.0	185.8	184.7	183.7	183.3	183.3	184.0	185.1	186.5	187.6	188.3	187.6	186.1	179.6	158.9
	80,000	80.4	137.1	158.4	169.1	187.5	201.8	205.9	205.5	205.1	204.0	200.6	198.9	198.2	197.4	197.0	197.0	197.8	199.3	200.9	201.6	202.4	201.6	199.6	191.5	172.3
	20,000	29.3	46.6	55.6	65.3	77.5	86.3	90.2	91.8	92.6	92.9	92.9	92.6	92.0	91.3	91.0	90.6	90.6	90.6	91.2	91.3	91.3	91.3	91.3	89.2	81.7
	30,000	44.2	74.6	80.4	90.4	105.1	115.7	120.3	121.6	121.9	122.1	120.5	118.9	117.9	117.3	117.0	117.5	118.0	118.2	119.1	119.1	119.6	120.3	120.7	118.6	106.7
	40,000	53.8	92.8	98.9	109.9	129.4	141.3	146.5	147.3	147.3	147.3	144.9	142.8	142.0	141.5	141.5	142.3	142.9	143.4	144.2	144.2	144.5	144.8	144.8	141.4	127.3
180	50,000	63.5	108.6	116.9	129.6	153.7	166.2	170.9	171.2	170.6	170.0	167.1	165.7	164.5	164.2	164.2	164.8	165.8	166.4	166.7	166.7	166.7	166.7	166.0	161.2	145.5
	60,000	69.8	122.4	133.3	147.1	175.7	185.7	192.4	191.8	191.0	189.7	186.5	185.3	184.2	183.9	183.9	184.6	185.3	186.0	186.4	186.4	186.0	184.9	183.4	177.3	160.6
	70,000	76.2	134.1	151.7	165.6	194.8	207.5	210.7	209.3	208.0	206.5	203.1	202.2	201.4	201.4	201.8	202.2	203.0	203.4	203.4	203.4	202.6	200.9	199.0	191.5	174.8
	80,000	83.4	146.8	170.0	183.6	210.8	222.8	225.0	223.1	220.9	219.7	216.4	215.5	215.9	216.3	216.8	216.8	217.2	217.6	217.6	216.8	216.9	214.2	211.2	202.4	186.3
	20,000	29.9	50.6	61.9	73.0	86.8	95.7	99.6	100.5	100.9	100.9	100.0	98.8	97.7	96.6	95.8	95.8	96.0	96.2	97.1	97.3	97.5	97.5	97.3	95.6	89.0
	30,000	44.8	79.7	88.9	100.1	116.5	127.1	131.2	132.5	131.9	131.4	129.0	126.4	125.0	124.0	124.0	124.5	125.5	126.2	127.4	127.5	128.2	128.7	129.2	128.2	120.5
	40,000	55.5	101.6	109.3	121.5	144.1	156.4	160.5	160.8	159.9	159.0	156.1	153.5	152.4	151.8	152.1	153.3	154.5	155.4	156.0	155.4	155.7	155.7	155.7	153.5	144.9
200	50,000	66.2	119.7	128.2	142.2	170.6	182.8	186.4	185.7	184.6	183.0	179.9	177.4	176.4	176.4	177.1	177.8	179.1	179.8	179.8	179.2	178.5	177.7	177.0	172.5	162.5
	60,000	72.5	132.4	145.0	160.9	194.5	206.3	208.7	207.3	205.6	203.5	199.7	198.0	197.2	197.3	198.4	199.2	200.3	201.1	200.0	198.8	197.7	196.0	194.1	187.2	175.7
	70,000	78.8	144.9	161.8	178.6	214.4	225.2	226.5	223.8	221.1	218.8	215.9	214.6	215.0	215.8	217.1	217.5	218.3	218.3	216.7	215.0	213.0	210.3	207.8	199.5	187.5
	80,000	85.9	157.0	178.2	194.8	230.9	239.3	239.2	236.1	232.8	230.8	228.1	228.1	229.9	231.6	232.9	232.5	232.5	232.0	230.3	228.1	225.1	221.8	218.7	209.0	197.2
	30,000	45.0	86.1	97.3	109.6	128.3	138.7	142.6	143.6	142.3	142.0	139.2	135.6	133.5	132.7	132.4	133.5	134.8	135.9	136.9	137.0	137.5	138.6	138.6	138.8	129.0
	40,000	56.5	109.2	119.5	132.9	158.3	169.9	173.7	174.0	172.0	171.1	167.6	163.9	162.4	161.7	162.4	163.7	165.3	166.2	166.2	165.9	165.6	166.2	165.3	164.6	153.4
220	50,000	68.0	129.3	139.4	154.8	186.1	197.7	200.8	200.1	198.2	196.8	192.8	190.1	188.6	188.7	189.4	190.9	192.0	192.3	191.6	190.5	189.1	188.6	186.7	183.0	172.0
	60,000	74.7	143.8	155.5	172.8	210.0	221.0	222.7	221.2	219.0	216.7	212.7	210.9	210.5	210.9	211.8	213.0	213.8	213.8	211.8	209.7	206.9	204.7	202.3	195.4	184.5
	70,000	81.0	156.4	172.2	190.7	229.5	239.2	239.6	237.2	234.5	232.4	229.0	228.0	228.4	229.3	229.7	230.2	229.7	228.9	226.7	223.3	219.8	217.0	213.9	204.8	194.4
	80,000	89.2	172.9	187.7	206.6	244.9	253.3	251.9	248.5	245.6	243.5	241.2	240.7	242.1	243.4	243.9	243.0	240.7	238.9	237.1	232.6	228.5	224.6	221.4	211.4	200.9
	30,000	45.0	90.2	103.8	117.3	137.7	147.6	151.1	152.2	150.0	149.7	146.1	141.8	139.3	138.5	138.2	139.6	141.3	142.7	143.2	143.5	144.1	145.7	144.9	146.5	134.6
	40,000	59.9	119.4	127.3	141.9	169.7	180.3	183.2	183.5	180.5	179.8	175.6	171.0	169.0	168.7	169.1	171.1	172.7	173.7	173.4	172.8	171.8	173.4	171.7	172.0	158.9
240	50,000	70.8	139.7	147.1	163.7	197.7	208.4	210.0	209.7	206.9	205.5	201.0	197.7	196.2	196.6	197.0	198.9	200.1	200.1	198.9	196.7	194.4	194.2	191.6	188.8	177.0
	60,000	79.6	154.8	163.7	182.0	221.2	231.4	231.8	230.7	228.1	226.2	221.6	220.2	219.8	220.6	221.5	222.7	223.1	221.9	219.4	216.0	211.8	209.5	206.2	199.0	189.4
	70,000	85.1	169.6	180.6	200.6	242.0	250.8	249.4	247.3	244.9	242.9	239.3	238.7	238.7	239.6	240.1	240.1	238.7	236.5	233.8	228.5	223.5	220.1	216.5	207.6	198.2
	80,000	92.6	181.8	197.4	217.9	259.2	266.1	263.3	260.7	257.7	255.9	253.6	253.5	254.0	254.9	254.4	252.6	248.8	245.1	242.7	235.8	230.6	226.5	223.2	212.9	203.6
	40,000	60.1	126.9	134.5	150.3	180.0	189.4	191.6	191.9	187.4	187.4	182.3	176.9	174.2	173.8	174.2	176.6	178.7	179.7	179.1	178.0	176.7	179.0	176.3	178.3	163.0
	50,000	74.6	150.4	158.8	171.8	207.8	217.4	218.3	217.9	213.9	212.8	208.1	204.4	202.9	202.9	203.7	205.7	206.8	206.4	204.5	201.7	198.2	198.4	195.3	192.9	180.7
260	60,000	82.2	163.4	172.7	193.6	230.8	240.0	239.3	238.5	235.3	233.3	228.6	227.6	227.2	228.1	228.9	230.7	230.2	228.5	225.1	220.8	214.4	212.3	208.1	201.2	192.6
	70,000	88.6	181.8	192.9	214.4	253.1	260.8	258.5	256.8	254.4	252.2	248.5	248.0	248.5	249.4	248.9	248.9	246.1	242.9	239.2	232.4	225.9	222.0	218.2	208.6	200.8
	80,000	96.0	198.2	208.7	231.3	269.8	275.1	270.3	268.5	266.5	264.7	262.3	262.3	262.3	262.7	261.3	258.4	252.7	247.5	245.1	235.6	229.4	224.8	221.4	211.5	202.9
	Stroke	0	0.3	1.5	3	8	15	23	30	38	45	60	76	91	106	126	136	151	166	181	196	211	227	242	272	302

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TABLE 29. C13-1 Constant Pressure Catapult (CVA67), Lower Boundary, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) — NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND CSV SETTING

CSV Setting	Stroke / Weight (LBS)	0	0.3	1.5	3	8	15	23	30	38	45	60	76	91	106	121	136	151	166	181	196	211	227	242	272	302
	10,000	6.1	8.3	8.6	8.9	9.6	10.2	11.0	11.9	12.7	13.5	14.8	16.0	16.7	17.3	17.8	17.9	18.1	18.2	18.3	18.4	18.4	18.3	17.7	15.5	7.9
	20,000	11.4	14.7	15.0	15.4	16.4	17.6	19.5	20.4	21.5	22.3	23.8	25.1	26.2	26.9	27.6	27.9	28.1	28.3	28.4	28.4	28.3	27.9	26.9	22.5	12.4
	30,000	15.9	20.1	20.6	21.1	22.3	24.7	27.5	29.0	30.4	31.4	33.0	34.1	35.0	35.5	35.9	36.2	36.5	36.4	36.3	35.9	35.4	34.8	33.3	26.7	16.0
40	40,000	18.6	25.4	25.9	26.5	27.9	30.3	33.5	35.6	37.3	38.6	40.6	41.9	42.8	43.1	43.4	43.7	43.9	43.7	43.4	42.8	42.0	41.0	38.9	30.6	19.0
	50,000	23.2	30.9	31.3	31.8	32.9	34.6	38.0	40.5	42.5	44.0	46.4	48.0	48.9	49.3	49.5	49.7	49.7	49.4	49.0	48.2	47.3	45.8	43.2	33.6	21.4
	60,000	29.8	37.0	37.4	37.7	38.4	39.4	42.9	45.9	48.3	50.0	52.8	54.8	55.9	56.2	56.2	56.2	56.1	55.8	55.2	54.3	53.2	51.1	47.9	36.6	23.8
	70,000	32.1	37.8	38.1	38.3	39.1	40.0	44.0	47.4	50.1	52.1	55.5	58.0	59.5	60.4	60.9	61.3	61.6	61.8	62.1	61.9	61.3	59.4	55.9	44.4	31.4
	80,000	35.2	43.1	43.3	43.4	44.2	45.4	49.7	53.2	56.0	58.3	61.8	64.5	66.1	67.0	67.4	67.7	67.8	68.0	68.0	67.8	67.3	65.0	61.0	49.5	36.8
	10,000	9.8	13.2	13.4	13.6	14.6	15.6	16.9	18.1	19.1	20.1	21.7	23.0	23.9	24.7	24.8	25.3	25.4	25.6	25.6	25.6	25.6	25.3	24.6	21.5	13.2
	20,000	16.9	21.9	22.3	22.8	24.5	26.2	28.8	30.1	31.5	32.5	34.4	35.9	37.1	37.9	38.4	38.9	39.1	39.1	39.1	39.1	38.8	38.3	37.2	32.0	20.2
	30,000	21.6	29.5	30.4	31.1	33.2	36.1	39.4	41.3	43.1	44.3	46.0	47.3	48.2	48.8	49.1	49.4	49.6	49.3	49.0	48.6	47.9	47.1	45.5	38.1	24.5
60	40,000	27.1	37.3	38.2	38.8	41.0	44.0	48.0	50.5	52.6	54.1	56.0	57.5	58.2	58.7	58.9	59.0	59.1	58.7	58.3	57.7	56.7	55.5	53.4	43.9	28.9
	50,000	32.8	45.4	46.1	46.7	49.2	51.5	56.0	58.9	61.3	62.9	65.3	66.9	67.7	68.1	68.2	68.3	68.2	67.7	67.3	66.4	65.2	63.7	61.0	49.5	33.6
	60,000	38.9	53.6	54.3	54.7	56.2	58.6	63.5	66.9	69.5	71.2	73.9	75.8	76.7	76.9	76.9	76.8	76.7	76.0	75.3	74.4	73.1	71.0	67.7	54.3	37.9
	70,000	41.9	54.2	54.7	55.0	56.7	58.9	64.7	68.7	71.8	73.7	77.1	79.6	80.9	81.7	82.3	82.6	83.0	83.3	83.5	83.3	82.8	80.9	77.6	63.7	47.2
	80,000	48.5	61.1	61.6	61.9	63.7	66.3	72.5	76.5	79.6	81.9	85.4	87.8	89.1	89.9	90.4	90.5	90.7	90.9	90.9	90.7	90.1	87.8	84.5	70.2	53.7
	10,000	12.0	16.9	17.9	18.5	19.7	21.8	23.6	25.0	26.3	27.4	29.0	30.4	31.3	32.0	31.6	32.6	32.6	32.9	32.7	32.6	32.5	32.1	31.0	27.2	19.9
	20,000	21.2	28.0	29.3	30.1	31.9	34.8	37.9	39.5	41.1	42.4	44.3	45.9	47.0	47.6	47.8	48.4	48.5	48.4	48.1	47.9	47.4	46.9	46.0	40.8	28.9
	30,000	29.1	39.7	41.0	41.8	44.1	48.3	51.9	53.9	56.1	57.4	58.9	60.3	61.0	61.6	61.8	61.8	61.8	61.3	60.8	60.5	59.6	58.6	57.2	49.8	34.2
80	40,000	36.1	51.3	51.9	52.5	55.0	59.6	63.9	66.5	69.0	70.3	72.0	73.3	73.7	74.3	74.3	74.1	74.0	73.5	72.8	72.4	71.2	69.9	68.0	58.3	40.5
	50,000	42.7	59.3	61.0	61.9	65.3	69.0	74.2	77.1	79.7	81.0	82.8	84.2	84.5	84.8	84.8	84.7	84.5	83.8	83.0	82.4	81.2	79.7	77.4	65.7	47.0
	60,000	46.6	62.4	63.7	64.4	67.6	71.9	79.1	83.2	86.0	87.6	90.1	92.1	93.0	93.6	94.2	94.5	95.0	95.4	95.7	95.7	95.2	93.9	91.7	77.9	58.4
	70,000	54.2	71.1	72.4	73.2	76.2	80.9	88.6	93.0	95.8	97.6	100.3	102.1	102.8	103.4	103.7	103.9	104.3	104.7	104.9	104.9	104.3	102.7	100.7	85.2	65.6
	80,000	62.4	79.5	80.9	81.8	84.8	89.8	97.9	102.3	105.4	107.1	109.8	111.5	111.9	112.5	112.7	112.9	112.9	113.2	113.2	113.2	112.6	110.8	109.0	92.6	72.7
	10,000	13.2	18.7	22.5	23.5	25.1	27.1	28.3	29.8	31.0	32.2	33.9	35.2	35.8	36.3	35.9	36.4	36.4	36.4	36.3	36.0	35.7	35.5	34.6	30.7	24.2
	20,000	24.7	32.8	36.4	37.7	40.1	43.2	47.4	49.0	50.6	51.7	53.8	55.1	55.9	56.3	56.3	56.3	56.0	55.8	55.5	55.1	54.6	54.0	53.3	48.3	36.9
	30,000	36.1	42.1	43.7	46.3	51.3	55.2	60.4	63.1	65.2	66.4	68.3	69.5	70.2	70.8	71.3	71.6	72.0	72.3	72.4	72.5	72.4	71.9	71.1	64.4	47.1
100	40,000	41.3	54.3	55.8	58.6	64.3	68.9	74.5	77.5	79.9	81.2	82.8	84.1	84.6	85.3	85.7	85.9	86.2	86.5	86.8	87.0	86.8	86.2	85.0	76.1	55.9
	50,000	48.5	67.0	69.0	70.6	77.1	81.7	88.2	91.7	94.0	95.4	96.9	98.1	98.8	99.2	99.5	99.7	100.1	100.4	101.0	101.4	101.2	100.4	98.6	88.1	66.4
	60,000	55.3	77.0	79.5	81.1	88.2	92.8	99.9	103.5	105.5	106.9	108.3	109.4	110.0	110.5	110.7	110.9	111.1	111.5	112.3	112.9	112.7	111.8	109.5	97.3	75.6
	70,000	62.1	87.4	90.1	91.9	99.7	104.0	111.7	115.3	117.5	118.8	120.4	121.4	121.6	121.8	122.0	122.0	122.3	122.7	123.4	123.9	123.7	122.7	120.5	106.8	84.6
	80,000	73.4	97.8	100.5	102.3	110.4	114.1	122.2	125.9	128.3	129.4	130.9	131.9	131.7	131.9	131.9	131.9	131.9	132.2	132.9	133.2	132.9	131.9	130.2	115.2	92.6
	10,000	14.1	18.6	22.4	25.1	27.6	31.1	32.0	33.8	35.1	36.6	38.6	40.1	40.5	41.0	40.9	41.3	41.6	41.8	42.1	42.1	42.0	42.0	41.8	38.3	32.7
	20,000	27.5	35.8	38.3	40.6	44.7	48.3	54.5	56.5	58.4	59.2	61.5	62.8	63.5	63.8	63.9	63.9	63.9	64.0	64.2	64.3	64.3	64.1	63.9	59.9	49.9
	30,000	39.6	53.2	55.1	57.7	63.5	69.0	75.4	77.8	79.7	80.5	81.8	82.6	82.9	82.9	83.2	83.0	83.0	83.0	83.2	83.0	83.0	82.9	82.7	77.0	58.4
120	40,000	47.3	67.0	69.5	72.5	79.5	86.4	92.5	95.2	96.8	97.9	98.7	99.1	99.2	99.1	99.4	99.2	99.4	99.6	99.8	100.0	100.0	99.8	99.1	92.0	69.3
	50,000	56.2	79.2	83.2	86.0	94.7	101.4	107.9	110.5	111.9	112.9	113.4	113.6	113.6	113.6	113.8	113.4	113.6	113.8	114.4	115.3	115.3	115.0	113.7	105.7	82.2
	60,000	63.8	90.7	95.7	98.6	107.3	115.3	122.1	124.5	125.8	126.5	126.5	126.3	126.3	126.3	126.3	125.8	126.0	126.3	127.5	128.9	129.2	128.9	126.9	117.9	94.3
	70,000	71.3	101.4	108.3	111.7	120.8	128.6	135.8	138.2	139.4	139.9	139.9	139.6	139.1	139.1	138.8	138.6	138.6	139.1	140.2	141.7	142.0	141.7	139.8	129.4	105.1
	80,000	77.3	110.2	122.2	124.5	133.3	140.8	148.2	150.4	151.6	152.1	151.9	151.5	150.7	150.4	150.1	149.8	149.8	150.4	151.5	152.4	152.7	153.0	151.4	139.0	114.5
	10,000	14.7	20.7	23.1	27.5	32.6	36.7	38.7	40.5	41.9	43.1	44.8	45.9	46.5	46.9	46.8	47.0	47.1	47.3	47.3	47.3	47.2	47.0	46.7	43.1	38.2
	20,000	28.0	39.8	41.5	47.9	52.8	59.5	64.6	66.6	68.2	69.0	70.5	71.4	71.8	71.8	71.9	71.7	71.5	71.5	71.8	71.8	71.8	71.8	71.5	68.3	59.2
	30,000	44.0	59.1	61.4	68.6	73.5	82.7	88.6	90.7	91.9	92.9	93.1	93.1	93.1	92.9	92.9	93.1	93.1	93.1	93.3	93.3	93.4	93.6	93.6	89.1	72.2
140	40,000	52.7	76.0	78.5	85.9	91.9	103.0	108.9	111.3	112.2	113.2	112.8	112.6	112.4	112.0	112.0	112.2	112.4	112.6	113.0	113.2	113.5	113.7	113.2	107.3	86.4
	50,000	61.3	90.9	94.4	102.5	109.1	121.8	127.9	129.9	130.8	131.5	130.5	130.2	130.0	129.5	129.5	129.5	129.7	130.0	130.7	131.7	132.0	132.0	130.9	124.1	101.9
	60,000	68.3	102.5	110.9	118.4	125.8	139.6	145.8	147.4	147.7	148.2	146.9	146.5	146.0	145.4	145.4	145.2	145.4	146.0	147.1	148.5	149.1	148.5	147.0	139.4	116.8
	70,000	75.4	114.7	128.6	134.7	141.0	155.3	161.5	162.9	163.2	163.2	161.7	161.1	160.4	159.8	159.5	159.5	159.8	160.5	162.0	163.2	163.8	163.2	161.6	152.6	129.5
	80,000	82.5	125.9	143.4	149.0	154.5	168.5	174.8	176.0	176.4	176.4	174.8	173.7	172.7	172.4	172.1	172.1	172.4	173.1	174.4	175.4	176.0	175.7	173.9	163.2	140.7
	10,000	15.2	22.7	23.3	27.9	37.8	42.4	45.8	47.6	48.8	49.8	51.1	51.7	52.4	52.6	52.5	52.5	52.5	52.6	52.3	52.2	52.0	51.6	51.1	47.7	43.8
	20,000	30.7	44.0	45.7	53.6	63.4	71.3	74.9	76.8	78.0	78.7	79.4	79.6	79.6	79.3	79.1	78.8	78.4	78.4	78.5	78.7	78.7	78.7	78.5	76.4	68.7
	30,000	40.4	64.7	67.7	76.4	88.4	98.3	103.1	104.8	105.4	106.2	105.2	104.4	104.0	103.4	103.2	103.6	103.4	103.6	104.0	104.2	104.4	105.0	105.4	102.3	88.0
160	40,000	48.3	80.1	84.0	93.2	109.0	119.9	125.4	126.8	127.1	127.7	125.9	124.9	124.2	123.7	123.4	123.9	124.2	124.4	124.9	125.4	125.6	126.3	126.3	122.4	104.7
	50,000	56.2	93.1	99.7	110.2	129.2	141.3	146.3	147.3	147.3	147.6	145.4	144.5	143.4	142.9	142.3	142.9	143.2	143.7	144.5	145.4	145.7	145.9	145.3	140.8	121.7
	60,000	62.5	104.4	114.8	125.9	148.2	161.5	165.8	166.4	165.8	165.8	163.0	162.3	161.0	160.1	159.5	159.8	160.4	161.1	162.3	163.2	163.9	163.5	162.3	157.2	137.3
	70,000	68.7	116.7	133.5	144.8	166.3	180.1	184.1	184.1	183.7	183.0	180.0	178.8	177.8	176.8	176.4	176.5	177.1	178.2	179.5	180.6	181.3	180.6	179.1	172.9	152.9
	80,000	74.8	130.5	153.7	164.1	182.0	195.9	199.8	199.5	199.1	198.0	194.7	193.1	192.3	191.6	191.2	191.2	192.0	193.5	195.0	195.7	196.5	195.7	193.7	185.9	167.2
	20,000	27.2	43.7	51.7	60.7	72.0	80.2	83.9	85.4	86.1	86.4	86.4	86.1	85.6	84.9	84.6	84.3	84.3	84.3	84.8	84.9	84.9	84.9	84.9	82.9	75.9
	30,000	41.1	70.5	77.2	86.8	100.8	111.1	115.5	116.7	117.0	117.2	115.7	114.1	113.2	112.5	112.3	112.8	113.2	113.4	114.3	114.3	114.7	115.4	115.8	113.8	102.4
	40,000	50.0	88.7	95.2	105.8	124.6	136.0	141.0	141.8	141.8	141.8	139.5	137.5	136.7	136.2	136.2	137.0	137.5	138.1	138.8	138.9	139.1	139.4	139.4	136.1	122.5
180	50,000	59.0	103.9	112.1	124.3	147.4	159.4	163.9	164.1	163.5	162.9	160.2	158.9	157.7	157.4	157.4	158.0	158.9	159.5	159.8	159.8	159.8	159.8	159.2	154.5	139.5
	60,000	64.9	115.5	127.8	141.0	168.4	180.9	184.4	183.8	183.0	181.8	178.7	177.6	176.6	176.2	176.2	176.9	177.6	178.3	178.6	178.6	178.3	177.2	175.8	169.9	153.9
	70,000	70.9	120.1	131.6	145.3	174.6	188.5	192.9	193.2	192.4	191.4	189.1	188.3	188.4	189.5	190.6	192.9	195.5	197.3	199.2	200.3	201.1	200.3	198.8	192.0	177.1
	80,000	77.6	135.0	150.7	163.9	191.7	204.8	208.6	207.9	206.6	205.5	203.5	203.0	203.9	205.5	206.7	208.7	211.1	213.1	214.7	215.6	216.0	214.7	212.6	204.5	190.4
	20,000	25.9	45.5	58.0	68.5	81.3	89.7	93.4	94.2	94.6	94.6	93.7	92.6	91.6	90.5	89.8	89.8	90.0	90.2	91.0	91.2	91.4	91.4	91.2	89.6	83.5
	30,000	41.7	76.5	85.1	95.8	111.6	121.7	125.7	126.5	126.3	125.9	123.5	121.1	119.7	118.7	118.7	119.2	120.2	120.9	122.0	122.1	122.7	123.3	123.7	122.7	115.4
	40,000	51.6	97.3	105.9	117.7	139.7	151.6	155.6	155.8	154.9	154.1	151.2	148.8	147.6	147.1	147.4	148.5	149.7	150.6	151.2	150.6	150.9	150.9	150.8	148.8	140.4
200	50,000	61.5	106.6	110.6	124.4	152.4	165.4	169.9	170.9	170.2	168.9	166.9	165.2	164.6	165.6	167.6	169.9	172.6	174.5	175.9	176.5	177.2	177.2	177.2	173.8	165.2
	60,000	67.4	119.3	127.8	143.3	177.3	189.8	193.7	193.3	192.1	190.4	188.1	187.0	186.6	188.1	190.4	193.0	195.6	197.4	198.2	198.6	198.9	197.8	197.0	190.6	181.3
	70,000	73.3	131.4	145.1	161.2	197.7	209.4	211.9	210.0	208.3	206.8	204.7	204.3	205.1	207.1	209.6	211.6	214.0	215.7	216.1	216.1	215.3	213.6	211.9	203.8	194.5
	80,000	79.9	143.8	161.7	178.4	214.4	224.8	225.7	222.4	219.7	218.5	217.2	217.7	220.3	222.8	225.4	227.1	228.9	229.7	229.7	229.3	227.6	225.3	223.1	214.1	204.6
	30,000	41.8	81.0	92.0	103.6	121.3	131.1	134.8	135.8	134.5	134.3	131.6	128.2	126.2	125.5	125.2	126.2	127.5	128.5	129.5	129.5	130.0	131.0	131.0	131.2	121.9
	40,000	52.5	97.8	102.2	115.3	140.6	152.9	158.1	159.6	158.1	157.8	154.7	151.9	151.0	151.6	153.2	155.9	158.7	160.8	162.1	162.7	163.6	164.9	165.2	165.1	155.3
220	50,000	63.2	116.2	123.1	138.4	170.2	183.0	187.2	187.9	186.4	185.4	182.2	180.3	179.6	180.7	182.5	185.4	188.2	190.0	190.8	190.8	190.8	190.8	190.0	187.5	177.4
	60,000	69.5	129.7	139.3	156.7	193.7	206.0	208.9	208.9	207.3	205.4	202.6	201.3	201.4	203.0	205.4	208.2	210.5	211.7	211.3	210.9	209.4	208.5	206.9	200.5	191.3
	70,000	75.3	143.3	156.1	174.3	213.5	224.7	226.1	224.9	223.1	221.1	218.5	218.4	219.3	221.5	223.6	225.3	227.0	227.4	227.0	225.3	223.2	220.9	218.7	211.0	201.7
	80,000	83.0	158.6	173.8	192.7	231.8	241.6	241.1	239.0	236.2	234.9	233.5	234.0	235.9	238.5	239.9	240.8	240.8	240.3	239.9	237.2	234.5	231.6	229.3	220.2	210.7
	30,000	41.8	78.8	88.3	101.5	122.2	132.9	137.7	140.0	138.2	138.2	135.0	131.4	129.6	129.9	130.4	133.1	135.8	137.9	139.8	140.8	142.4	144.9	144.6	147.2	136.0
	40,000	55.7	107.3	111.2	125.8	154.0	165.8	170.3	172.2	169.3	169.0	165.1	161.4	160.1	160.8	162.1	165.4	168.6	170.9	171.6	172.2	172.5	174.8	173.6	175.4	163.0
240	50,000	65.8	125.7	133.9	150.9	184.4	196.5	200.1	201.2	198.5	197.5	193.7	191.3	190.6	191.7	193.6	196.7	199.3	201.2	201.2	200.5	199.3	200.0	198.2	196.6	185.2
	60,000	74.0	143.4	151.3	168.7	208.3	219.6	221.4	221.4	219.7	217.7	214.0	213.0	213.5	215.2	217.3	220.2	222.3	222.7	221.9	219.8	216.9	215.5	213.4	207.1	197.9
	70,000	79.1	154.9	168.9	187.1	229.5	239.5	239.6	238.7	236.8	234.8	232.0	232.0	232.9	235.1	236.9	238.3	238.7	238.3	236.9	233.4	229.8	227.4	224.6	216.6	207.6
	80,000	86.1	170.6	182.3	203.5	245.1	253.4	251.6	250.3	247.8	246.5	244.6	245.1	247.0	249.3	249.7	249.3	247.4	245.5	245.1	239.5	235.8	232.8	229.9	221.1	212.3
	40,000	55.9	113.8	119.6	135.6	166.2	177.4	181.4	183.7	179.2	178.9	174.2	169.5	167.9	168.6	170.0	173.8	176.8	179.2	179.6	179.9	179.9	181.0	183.0	181.0	169.6
	50,000	69.3	135.6	139.4	157.2	193.8	204.7	207.2	208.7	204.8	204.1	199.5	196.6	195.8	197.0	198.6	202.5	204.8	206.0	205.2	204.1	201.7	202.8	200.5	199.6	187.6
260	60,000	76.4	153.2	161.8	177.7	219.8	230.2	231.2	231.2	228.6	227.0	222.7	221.7	222.2	224.3	226.5	229.5	231.2	230.8	228.7	225.7	221.0	219.4	216.4	210.8	201.7
	70,000	82.4	164.1	172.3	189.1	239.6	248.5	247.3	247.3	244.9	243.2	239.5	239.9	240.9	243.1	244.1	245.9	244.5	242.7	240.8	235.4	230.4	227.4	224.2	216.9	208.6
	80,000	89.3	180.1	194.5	215.3	257.1	263.7	260.5	260.5	258.0	256.7	254.8	255.2	256.2	258.1	257.6	256.6	252.3	248.5	248.0	240.1	235.3	231.7	228.8	220.7	211.7
	Stroke	0	0.3	1.5	3	8	15	23	30	38	45	60	76	91	106	121	136	151	166	181	196	211	227	242	272	302

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TABLE 30. C13-1 Constant Pressure Catapult, (CAVN68), Upper Boundary, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) – NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND CSV SETTING

CSV Setting	Stroke / Weight (LBS)	0	0.3	1.5	3	8	15	23	30	38	45	60	76	91	106	121	136	151	166	181	196	211	227	242	272	302
	10,000	9.0	14.1	15.5	16.4	18.9	19.0	18.7	18.2	17.6	17.1	16.1	15.2	14.5	14.0	13.6	12.9	12.4	12.0	11.5	11.1	10.7	10.1	9.3	7.5	4.6
	20,000	16.9	23.5	25.3	25.9	28.0	28.1	27.6	26.8	25.8	25.0	23.5	22.1	21.3	20.5	19.8	18.9	18.3	17.7	17.0	16.4	15.9	14.9	13.8	11.4	7.0
40	30,000	21.3	30.6	32.3	32.7	33.6	33.4	31.9	31.2	30.4	29.6	28.2	26.9	25.9	24.8	24.0	23.2	22.6	21.6	20.8	19.9	19.1	18.2	17.1	14.5	10.5
	40,000	24.9	36.5	38.3	38.5	38.9	38.4	37.0	35.8	34.8	33.9	32.6	31.2	30.1	29.1	28.1	27.3	26.6	25.6	24.7	23.6	22.5	21.6	20.5	17.4	13.2
	50,000	29.1	42.1	43.7	43.9	44.4	44.2	42.5	41.0	39.7	38.5	36.9	35.4	34.4	33.5	32.5	31.7	31.0	29.9	29.0	27.9	26.7	25.5	24.0	19.8	14.6
	60,000	32.0	45.7	47.7	47.8	48.2	48.2	46.4	44.9	43.3	42.0	40.4	38.8	37.8	36.8	35.9	35.1	34.4	33.2	32.2	31.1	29.7	28.5	26.8	22.0	16.2
	10,000	10.3	15.5	17.7	18.9	22.1	22.2	21.7	21.1	20.5	19.9	19.1	18.2	17.7	17.3	17.0	16.5	16.1	15.8	15.4	15.0	14.5	13.6	12.7	10.5	7.0
	20,000	19.7	28.0	30.3	31.2	33.9	34.0	33.2	32.3	31.2	30.3	28.9	27.8	27.1	26.4	25.8	25.1	24.7	24.2	23.5	22.9	22.2	21.1	19.7	16.6	11.1
	30,000	24.8	37.0	39.2	39.9	41.3	40.9	39.5	38.3	37.3	36.5	35.1	34.0	33.2	32.4	31.8	31.1	30.5	29.7	28.7	27.9	27.0	26.0	24.7	21.4	16.1
60	40,000	29.0	44.3	46.8	47.5	48.5	47.9	46.1	44.7	43.5	42.6	41.2	40.0	39.2	38.4	37.6	37.0	36.4	35.3	34.3	33.3	32.2	31.2	29.7	25.8	20.1
	50,000	33.1	50.5	53.1	53.8	55.1	54.9	53.1	51.5	50.0	48.9	47.3	45.7	44.9	44.1	43.3	42.7	42.2	41.1	40.1	39.2	38.0	36.8	34.8	29.5	22.4
	60,000	36.3	55.1	58.3	58.9	60.7	60.7	58.9	57.2	55.5	54.2	52.5	50.8	50.0	49.2	48.4	47.7	47.4	46.3	45.3	44.2	42.9	41.5	39.4	33.1	25.2
	70,000	44.1	63.8	62.2	62.9	65.0	65.1	63.3	61.7	60.2	58.9	57.1	55.6	54.7	53.9	53.1	52.4	51.9	50.7	49.6	48.3	46.9	45.4	43.2	36.7	28.5
	80,000	48.4	68.8	65.8	66.5	69.2	69.3	67.5	66.1	64.6	63.4	61.8	60.2	59.4	58.6	57.7	57.0	56.4	55.3	53.9	52.5	50.9	49.3	47.2	40.4	32.2
	10,000	11.3	17.5	19.7	21.1	25.2	25.2	24.6	23.9	23.2	22.7	22.0	21.6	21.2	21.0	20.9	20.7	20.5	20.3	20.2	19.8	19.2	18.4	16.8	14.4	10.2
	20,000	21.6	31.7	34.4	35.6	39.2	39.1	38.0	36.9	35.8	35.1	34.0	33.5	33.0	32.7	32.4	32.1	31.9	31.6	31.2	30.6	29.7	28.4	26.9	23.0	16.4
	30,000	27.9	31.7	46.2	47.5	49.4	48.9	46.9	45.6	44.5	43.7	42.6	42.0	41.7	41.4	41.2	40.9	40.5	39.8	38.9	38.2	37.3	36.2	34.7	30.7	23.8
80	40,000	32.1	51.8	55.1	56.6	58.4	57.8	55.5	53.9	52.8	52.0	50.7	49.9	49.7	49.4	49.1	48.8	48.5	47.5	46.5	45.8	44.9	43.8	41.9	37.2	29.6
	50,000	35.0	57.5	61.7	63.2	66.2	66.0	64.3	62.6	61.1	60.2	58.6	57.5	56.9	56.5	56.2	55.9	55.9	55.1	54.2	53.5	52.7	51.3	49.0	42.3	33.0
	60,000	39.8	64.8	68.2	69.7	73.4	73.6	72.0	70.4	68.9	67.8	66.0	64.7	64.1	63.8	63.4	63.1	63.4	62.6	61.8	60.9	60.0	58.6	55.8	48.0	37.3
	70,000	46.3	73.0	74.7	76.2	79.7	80.0	78.4	77.0	75.6	74.5	72.9	71.6	71.1	70.8	70.6	70.4	70.7	69.9	68.9	67.9	66.8	65.2	62.4	54.1	42.9
	80,000	50.5	78.2	79.2	80.7	84.2	85.2	83.2	81.4	80.1	79.1	77.8	76.6	76.3	76.1	76.1	76.2	76.3	75.5	74.5	73.4	71.8	70.3	67.4	59.0	47.6
	10,000	12.7	19.9	22.5	24.1	28.5	28.6	28.0	27.4	26.8	26.4	25.7	25.5	25.3	25.3	25.3	25.1	24.8	24.8	24.6	24.4	23.9	23.2	22.0	19.3	14.5
	20,000	23.9	35.6	39.0	40.4	44.6	44.8	43.8	42.7	41.8	41.2	40.3	40.1	39.9	39.8	39.7	39.5	39.2	39.1	38.8	38.3	37.7	36.7	35.3	31.0	23.6
	30,000	31.6	50.9	53.8	55.3	58.1	57.2	55.6	54.5	53.6	53.1	52.4	52.1	51.9	51.8	51.6	51.4	51.2	50.7	50.1	49.5	48.7	47.8	46.2	41.7	33.4
100	40,000	36.4	61.6	65.5	66.9	68.7	68.3	66.6	65.2	64.4	64.0	63.3	62.8	62.7	62.5	62.4	62.3	62.2	61.5	60.9	60.3	59.5	58.4	56.4	50.7	41.5
	50,000	35.7	64.3	75.7	77.1	80.3	80.2	78.7	77.1	76.2	75.6	74.6	74.0	73.9	74.0	74.0	74.0	73.9	73.6	73.2	72.8	71.8	70.3	67.2	59.5	47.9
	60,000	39.6	62.9	68.2	69.8	74.4	75.9	76.1	75.8	75.1	75.0	75.0	75.5	76.8	78.3	79.7	81.8	83.5	85.8	87.7	89.3	90.5	89.7	87.6	77.9	64.7
	70,000	44.7	70.9	76.6	78.1	82.5	84.0	84.2	84.0	83.6	83.6	83.8	84.8	86.3	87.9	89.7	92.0	94.1	96.7	98.8	100.4	101.5	100.7	98.4	87.8	73.6
	80,000	49.5	77.9	83.6	85.3	89.1	90.5	90.9	90.9	90.8	90.9	91.3	92.6	94.7	96.4	98.3	101.0	103.3	106.0	108.3	110.3	110.9	110.0	107.4	96.5	81.5
	10,000	11.6	16.7	18.4	20.2	25.4	26.1	26.3	26.1	26.1	26.1	26.4	26.9	27.4	28.0	28.6	29.6	30.3	30.9	31.6	32.3	32.8	33.1	32.7	30.7	25.0
	20,000	22.3	30.4	34.0	36.0	41.6	42.9	43.2	43.1	42.9	42.7	42.7	43.7	44.4	45.4	46.3	47.8	48.8	49.8	50.8	52.0	52.8	53.2	52.5	48.8	39.9
	30,000	29.3	45.1	48.0	49.6	53.4	54.8	55.7	56.2	56.3	56.3	56.8	57.7	58.4	59.6	60.7	62.6	64.4	65.6	67.2	68.5	69.6	70.1	69.6	65.2	55.7
120	40,000	34.5	55.9	58.7	59.9	63.1	64.7	65.8	66.6	66.9	67.2	68.1	68.8	69.9	71.5	72.9	75.3	77.4	79.2	81.2	82.8	84.0	84.8	84.1	78.0	67.5
	50,000	39.8	63.8	68.4	69.7	73.8	75.6	76.6	77.3	77.5	78.0	78.8	80.1	81.8	84.0	86.1	89.0	90.8	93.7	96.3	98.2	99.4	100.1	98.9	89.7	76.8
	60,000	45.1	71.8	77.7	79.1	83.5	85.3	86.7	87.3	87.5	88.0	89.0	90.7	93.0	95.7	98.2	101.7	103.6	107.3	110.2	112.5	113.7	114.3	112.6	101.0	85.9
	70,000	50.8	80.9	87.2	88.5	92.3	94.3	96.1	96.7	97.2	98.0	98.9	101.2	103.8	107.0	109.9	113.7	116.3	120.2	123.5	126.3	127.2	127.4	125.3	112.7	96.1
	80,000	56.4	89.4	96.1	97.3	100.5	102.5	104.5	105.6	106.1	107.0	108.2	111.0	114.1	117.4	120.7	125.0	128.3	132.3	135.9	139.0	139.9	139.4	136.7	123.4	105.4
	10,000	12.0	17.2	18.8	20.9	27.1	28.1	28.7	28.8	29.0	29.1	29.6	30.4	31.0	31.6	32.3	33.5	34.5	35.2	35.8	36.8	37.6	38.0	37.9	36.7	31.0
	20,000	22.6	31.4	35.7	38.3	46.1	47.8	48.8	49.2	49.3	49.4	50.2	51.3	52.3	53.4	54.6	56.4	57.9	59.2	60.4	61.8	63.0	63.8	63.8	61.3	51.8
	30,000	32.0	47.7	51.5	53.7	59.6	61.3	62.7	64.0	64.6	65.0	66.4	67.8	69.0	70.7	72.3	74.6	76.9	78.6	80.5	81.9	83.4	84.3	84.1	80.5	69.8
140	40,000	39.3	61.2	65.0	66.9	71.7	73.6	75.3	77.0	77.9	78.8	80.5	82.2	83.8	86.1	88.2	91.0	93.8	96.3	98.9	100.7	102.4	103.3	102.7	96.7	84.6
	50,000	45.2	71.0	76.0	78.0	83.3	85.6	87.7	89.3	90.1	91.1	92.9	95.1	97.4	100.0	102.7	106.1	109.2	112.5	115.7	118.4	120.4	121.5	120.0	110.5	95.9
	60,000	51.1	80.8	86.7	88.7	94.0	96.6	99.3	100.8	102.0	102.9	105.0	107.7	110.2	113.5	116.5	120.6	123.9	128.0	131.7	134.7	137.0	138.0	135.8	123.7	107.1
	70,000	57.2	91.1	97.6	99.4	104.6	107.4	110.2	112.1	113.5	114.9	117.3	120.3	123.4	127.0	130.3	134.7	138.6	142.9	147.3	150.7	152.7	153.2	150.5	137.4	118.9
	80,000	67.9	100.8	107.8	109.5	113.7	116.8	120.1	122.4	124.0	125.6	128.4	131.7	135.1	139.0	142.9	147.7	151.9	156.7	161.2	164.9	166.9	166.8	163.6	149.5	129.3
	10,000	12.6	18.1	19.2	21.6	29.2	30.6	31.6	32.2	32.6	32.8	33.7	34.7	35.4	36.1	36.9	38.4	39.7	40.4	41.1	42.3	43.5	44.0	44.4	44.3	38.6
	20,000	22.9	32.1	36.0	39.2	49.5	51.8	53.5	54.6	55.1	55.6	57.2	58.7	60.0	61.3	62.7	64.8	67.0	68.5	69.9	71.5	73.2	74.4	75.4	74.7	65.1
	30,000	33.9	48.8	54.1	57.0	65.5	67.6	69.6	71.7	73.1	74.1	76.6	78.8	80.7	82.9	84.9	87.8	90.7	93.1	95.3	97.0	98.8	100.1	100.6	98.1	86.4
160	40,000	43.2	64.5	70.1	72.7	79.6	81.7	84.2	87.1	89.1	90.3	93.6	96.3	98.8	101.7	104.4	107.9	111.7	114.8	117.9	120.2	122.5	123.8	123.3	117.7	104.1
	50,000	49.8	77.0	82.7	85.6	92.4	95.3	98.6	101.3	103.6	105.0	108.3	111.7	114.3	117.7	120.9	125.2	129.5	133.4	137.5	140.6	142.8	143.2	142.5	134.3	118.1
	60,000	56.3	89.4	95.0	98.3	104.6	108.1	112.2	115.2	117.6	119.1	122.9	126.7	129.7	133.2	137.1	141.7	146.9	151.3	156.2	159.7	161.9	162.9	161.1	150.1	131.8
	70,000	62.0	99.8	106.2	109.2	115.2	119.1	123.5	126.9	129.8	131.4	135.6	139.8	143.1	147.0	151.2	156.3	161.7	166.5	171.6	175.8	179.4	180.3	177.2	163.7	143.6
	80,000	67.5	109.9	116.8	119.4	124.6	129.1	133.9	137.9	141.0	142.8	147.6	151.8	155.4	159.9	164.2	169.3	175.2	180.4	185.6	190.1	193.7	194.3	190.6	176.7	154.0
	10,000	12.6	18.2	19.4	22.4	32.1	33.7	34.9	35.7	36.3	36.8	38.1	39.4	40.4	41.2	42.3	43.7	45.1	46.3	47.4	48.6	49.8	50.6	51.1	51.4	46.7
	20,000	23.4	33.6	37.9	42.0	55.6	58.6	61.0	62.4	63.5	64.3	66.7	68.7	70.2	71.7	73.8	76.2	78.4	80.6	82.7	84.5	86.4	87.9	88.9	88.8	80.8
	30,000	34.5	50.8	57.5	61.0	72.0	75.5	78.9	81.8	84.0	85.6	89.0	91.9	94.3	97.1	99.6	102.8	106.0	108.5	111.1	113.1	115.1	116.1	116.7	114.8	105.4
180	40,000	45.3	68.6	75.8	78.5	87.3	91.5	95.9	99.7	102.6	104.6	108.9	112.5	115.4	118.8	121.9	126.0	129.6	132.8	136.1	138.6	141.0	142.2	141.9	137.1	125.8
	50,000	54.4	84.5	91.2	94.2	102.4	107.4	112.4	116.6	119.9	122.0	126.4	130.3	133.1	136.7	140.3	145.1	149.3	153.2	157.3	161.0	163.0	164.3	163.7	157.3	142.5
	60,000	62.4	99.4	105.7	108.8	116.4	121.6	127.3	131.6	135.0	137.3	142.0	146.0	149.1	153.2	157.2	162.2	166.9	171.2	166.9	180.1	183.0	184.3	183.2	173.7	156.2
	70,000	68.4	111.4	118.4	121.4	128.3	134.0	139.8	144.2	147.8	150.4	155.4	159.8	163.6	168.0	172.4	177.5	182.5	187.3	192.4	196.1	199.8	200.2	198.7	185.8	166.2
	80,000	73.3	122.2	129.1	131.9	138.2	143.9	150.0	154.3	158.5	160.9	166.3	170.9	175.3	179.9	184.3	190.0	195.1	200.1	204.8	208.4	211.7	212.0	209.0	194.2	172.6
	20,000	24.3	35.0	38.1	43.4	60.6	64.2	67.3	69.4	71.0	72.4	75.5	78.0	79.7	81.8	84.3	86.9	89.2	92.1	95.2	97.1	99.3	100.7	101.9	101.2	97.4
	30,000	35.7	53.2	59.4	63.4	77.5	82.8	88.0	91.8	95.0	97.3	101.8	105.7	108.4	111.6	115.0	118.4	121.5	124.5	127.6	129.7	130.0	130.5	131.1	130.2	126.1
	40,000	46.0	70.6	79.3	82.3	92.9	99.5	106.1	111.2	115.3	118.3	123.3	128.2	131.4	135.2	139.0	143.1	146.7	149.6	153.2	154.6	155.8	156.2	156.2	154.9	147.8
200	50,000	56.7	88.4	96.3	99.3	108.8	116.0	122.9	128.4	132.7	135.6	140.8	145.4	148.5	152.2	155.9	160.9	164.6	168.3	172.6	176.0	179.7	177.7	177.7	175.3	164.3
	60,000	65.9	105.2	111.7	114.7	123.1	130.7	137.6	143.3	147.6	150.5	155.9	160.3	163.7	167.4	171.5	176.9	181.0	185.1	189.5	193.6	196.6	197.4	197.3	191.5	175.9
	70,000	72.4	119.8	126.1	129.0	137.0	144.5	151.5	157.0	161.7	164.8	170.3	175.4	179.1	183.5	187.9	193.4	197.9	201.9	206.3	209.6	212.9	213.3	211.1	202.2	184.2
	80,000	76.8	131.4	138.0	141.1	148.3	155.5	162.5	167.5	172.1	175.3	181.2	186.5	190.8	195.8	200.5	205.9	210.2	214.4	218.7	221.4	223.0	224.4	222.1	207.7	187.6
	20,000	25.9	39.5	47.2	53.2	69.5	74.1	77.8	80.4	82.5	84.1	87.6	90.4	92.3	94.5	97.2	100.1	102.9	105.8	108.3	110.7	113.0	114.9	116.5	116.0	112.3
	30,000	36.7	56.9	65.1	70.4	87.4	93.8	100.3	104.8	108.1	110.7	115.2	119.3	122.1	125.4	128.9	132.2	135.8	138.8	142.1	143.4	144.7	145.1	145.5	145.0	141.4
	40,000	46.9	75.5	83.8	88.5	104.2	111.7	119.2	124.8	129.2	132.0	137.3	142.0	145.3	148.8	152.4	156.0	159.5	162.5	165.7	166.6	167.2	168.1	168.1	166.2	158.9
220	50,000	57.6	95.2	103.1	108.0	119.8	128.1	135.8	141.3	145.8	148.9	154.2	158.7	162.0	165.6	168.9	172.9	176.1	179.1	182.0	185.0	187.6	189.0	188.6	182.3	171.2
	60,000	66.7	113.0	121.4	126.1	135.7	144.1	151.7	157.4	161.7	165.0	170.5	175.1	178.6	182.2	185.5	189.4	192.6	195.9	198.8	201.6	204.1	204.9	204.1	195.4	181.8
	70,000	74.1	128.1	136.6	140.8	149.1	157.0	164.7	170.4	175.0	178.2	183.6	188.5	192.3	196.2	200.0	203.8	206.9	210.0	213.0	215.0	216.9	216.5	214.5	204.5	189.1
	80,000	79.7	141.5	150.8	154.4	161.8	168.6	176.3	181.9	186.3	189.7	195.3	200.5	204.2	208.6	212.2	216.2	219.1	222.3	224.7	226.4	228.2	225.5	222.2	210.4	193.5
	30,000	37.2	59.7	69.1	75.7	95.9	102.9	110.5	115.6	119.5	122.0	126.7	130.6	133.6	136.6	140.2	143.3	147.1	150.4	153.5	156.2	158.4	160.2	160.8	160.5	153.8
	40,000	47.7	80.2	85.9	92.2	113.3	121.5	130.2	136.0	140.4	143.3	148.4	152.7	155.9	159.3	162.8	165.3	168.4	171.6	174.4	176.6	177.5	178.1	177.5	174.7	166.2
240	50,000	58.8	101.4	108.9	115.8	130.0	139.3	147.4	153.5	158.0	160.9	166.1	170.8	174.3	177.4	180.5	183.2	185.6	188.0	189.8	191.5	192.9	194.2	191.4	185.9	175.6
	60,000	67.6	120.5	130.7	137.0	147.2	156.6	164.6	170.6	175.0	178.2	183.8	188.6	192.0	195.4	198.0	200.6	202.9	204.7	205.9	208.0	209.1	207.8	204.6	197.1	185.5
	70,000	74.6	136.0	148.3	153.5	162.6	170.9	179.4	185.4	189.7	193.1	198.3	203.4	207.0	210.2	213.0	211.4	217.5	219.5	220.3	221.1	221.1	219.0	215.3	207.3	194.8
	80,000	81.9	151.5	164.1	168.7	176.0	183.0	191.5	197.4	201.5	204.6	210.1	215.0	218.4	222.2	224.7	227.2	228.9	229.8	230.9	232.5	231.6	226.7	222.4	213.1	200.1
	30,000	37.9	62.5	71.6	79.4	102.8	110.8	119.5	125.2	129.3	131.8	136.2	140.0	142.9	145.8	149.1	152.3	155.8	159.4	162.3	162.3	165.0	167.0	167.6	167.9	163.8
	40,000	48.7	84.5	86.3	94.4	120.6	129.8	139.1	145.1	149.7	152.4	157.0	161.2	164.1	167.0	170.0	171.9	174.5	177.1	179.4	181.4	184.0	184.6	183.0	176.7	170.6
250	50,000	70.9	138.7	145.3	152.8	167.4	174.1	178.6	181.0	184.7	187.8	192.1	195.5	197.3	197.6	198.6	196.4	193.3	191.9	189.0	186.8	184.0	180.9	176.2	167.6	159.0
	60,000	82.0	157.7	165.9	173.1	181.7	188.8	193.7	196.5	199.8	203.0	207.2	210.9	213.1	213.1	212.3	209.6	207.0	204.7	200.5	197.4	193.3	188.7	183.0	173.1	164.7
	70,000	86.5	170.7	183.8	189.8	196.6	201.5	206.5	209.1	212.5	215.5	220.0	222.9	224.5	224.5	222.9	220.5	217.7	214.4	209.7	206.0	201.3	195.3	188.9	178.9	171.3
	80,000	98.3	192.7	203.2	207.8	212.3	215.4	219.8	223.0	226.1	228.9	233.5	235.2	235.6	235.2	234.0	231.5	228.6	224.8	219.8	215.1	209.7	202.1	195.0	184.9	177.8
	Stroke	0	0.3	1.5	3	8	15	23	30	38	45	60	76	91	106	121	136	151	166	181	196	211	227	242	272	302

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TABLE 31. C13-1 constant Pressure Catapult (CVAN68), Mean, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) – NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND CSV SETTING

CSV Setting	Stroke / Weight (LBS)	0	0.3	1.5	3	8	15	23	30	38	45	60	76	91	106	121	136	151	166	181	196	211	227	242	272	302
	10,000	8.4	12.0	13.7	14.6	17.2	17.3	17.1	16.5	16.0	15.5	14.6	13.8	13.4	13.0	12.8	12.5	12.3	12.1	11.9	11.7	11.6	11.3	10.7	9.0	6.2
	20,000	15.8	21.4	22.7	23.3	25.3	25.5	25.1	24.4	23.5	22.8	21.5	20.3	19.8	19.2	18.8	18.4	18.2	17.9	17.6	17.3	17.2	16.6	15.8	13.4	9.1
40	30,000	19.9	28.1	29.2	29.6	30.6	30.4	29.6	28.7	27.9	27.2	25.9	24.9	24.2	23.6	23.2	22.7	22.3	22.0	21.6	21.2	20.9	20.2	19.4	17.0	12.9
	40,000	23.3	33.6	34.7	34.9	35.4	35.1	33.8	32.8	31.9	31.1	29.9	28.8	28.2	27.6	27.1	26.7	26.3	25.9	25.5	25.1	24.5	23.8	22.9	20.0	15.7
	50,000	27.2	38.8	39.9	40.0	40.3	40.2	38.7	37.4	36.2	35.2	33.8	32.6	32.0	31.5	31.0	30.6	30.4	29.9	29.5	29.1	28.5	27.6	26.4	22.4	17.2
	60,000	29.9	42.2	43.2	43.4	43.9	43.9	42.3	40.9	39.5	38.3	36.9	35.6	35.0	34.6	34.2	33.8	33.5	33.0	32.6	32.2	31.5	30.5	29.1	24.6	18.8
	10,000	9.6	13.9	15.7	16.8	20.1	20.2	19.9	19.3	18.7	18.2	17.4	16.8	16.5	16.3	16.2	16.0	16.0	15.9	15.8	15.7	15.5	15.0	14.3	12.3	8.8
	20,000	18.4	25.4	27.0	27.9	30.7	30.9	30.3	29.5	28.5	27.8	26.6	25.8	25.3	25.0	24.7	24.5	24.4	24.4	24.2	23.9	23.7	22.9	21.9	18.8	13.5
	30,000	23.2	33.7	35.3	36.1	37.6	37.4	36.2	35.3	34.4	33.7	32.6	31.8	31.3	31.0	30.8	30.5	30.3	30.1	29.8	29.5	29.1	28.3	27.3	24.2	18.9
60	40,000	27.1	40.5	42.3	43.1	44.2	43.9	42.3	41.3	40.2	39.5	38.4	37.5	37.1	36.8	36.6	36.4	36.2	35.8	35.5	35.1	34.6	33.9	32.6	28.9	23.1
	50,000	30.9	46.1	48.0	48.7	50.2	50.2	48.7	47.4	46.1	45.1	42.8	42.7	42.2	42.0	41.7	41.6	41.6	41.1	41.1	40.8	40.2	39.3	37.7	40.4	25.4
	60,000	33.9	50.5	52.4	53.1	54.9	55.1	53.6	52.3	50.9	49.7	48.3	47.1	46.7	46.5	46.3	46.1	46.3	46.3	45.8	45.5	44.9	43.9	42.0	36.0	28.2
	70,000	41.2	63.1	70.5	59.1	61.7	61.9	60.6	59.3	58.0	57.1	55.8	54.9	54.6	54.3	54.1	54.0	54.0	53.8	53.4	52.9	52.1	51.0	49.3	43.0	34.9
	80,000	45.2	68.1	71.5	74.5	77.4	77.8	75.9	74.1	72.3	70.9	69.2	67.7	67.2	66.8	66.6	66.3	66.5	66.2	65.8	65.2	64.4	62.9	60.6	52.3	41.7
	10,000	10.6	15.8	17.3	18.8	22.9	23.0	22.6	22.0	21.4	21.0	20.5	20.3	20.2	20.2	20.2	20.3	20.4	20.6	20.7	20.5	20.2	19.6	18.8	16.4	12.3
	20,000	20.2	28.7	30.8	32.0	35.6	36.7	35.0	34.2	33.3	32.6	31.9	31.5	31.4	31.4	31.4	31.5	13.7	32.0	32.1	32.0	31.5	30.5	29.2	25.6	19.1
	30,000	26.1	39.1	41.5	42.9	45.1	44.9	43.4	42.3	41.4	40.8	40.2	39.9	39.8	40.0	40.1	40.3	40.4	40.4	40.3	40.1	39.7	38.9	37.6	33.7	26.8
80	40,000	30.0	46.9	49.7	51.3	53.3	53.2	51.4	50.2	49.3	48.7	47.9	47.5	47.6	47.7	47.9	48.1	48.3	48.2	48.0	47.9	47.7	46.9	45.3	40.6	32.9
	50,000	32.7	52.1	55.3	56.8	60.1	60.4	59.1	57.9	56.7	55.9	54.9	54.2	54.1	54.2	54.4	54.6	55.3	55.4	55.4	55.4	55.2	54.2	52.2	45.6	36.5
	60,000	37.2	57.7	61.0	62.5	66.5	67.1	66.1	64.9	63.6	62.8	61.7	60.9	60.7	61.0	61.1	61.5	62.3	62.5	62.6	62.6	62.5	61.4	59.0	51.3	40.8
	70,000	43.3	66.8	68.9	70.4	72.3	72.9	71.8	70.7	69.6	68.7	67.8	67.1	67.4	67.5	67.8	68.3	69.2	69.5	69.6	69.6	69.2	68.0	65.5	57.4	46.5
	80,000	47.2	70.0	71.9	74.5	77.4	78.4	76.4	75.5	74.6	73.8	73.1	72.8	73.2	73.4	73.8	74.5	75.5	75.7	75.9	75.8	75.2	74.0	71.4	63.1	51.9
	10,000	11.9	17.9	19.6	21.2	25.7	26.0	25.7	25.1	24.7	24.4	24.1	24.0	24.1	24.3	24.4	24.7	24.8	25.1	25.2	25.3	25.2	24.8	24.1	21.5	16.7
	20,000	22.3	31.9	34.6	36.1	40.5	41.0	40.4	39.5	38.8	38.4	37.8	37.8	37.9	38.2	38.4	38.8	39.0	39.4	39.7	39.8	39.6	39.0	37.8	33.9	26.3
	30,000	29.1	45.3	47.8	49.2	52.4	53.2	52.0	50.4	49.8	49.4	49.0	49.0	49.2	49.5	49.9	50.4	50.7	50.9	51.2	51.2	51.1	50.6	49.4	45.0	36.9
100	40,000	34.0	55.1	57.9	59.3	61.7	61.8	60.7	60.0	59.5	59.1	58.9	58.8	59.0	59.5	59.9	60.5	61.2	61.4	61.8	63.0	62.5	61.3	59.7	54.3	45.2
	50,000	38.4	62.2	66.0	67.4	71.0	71.5	70.6	69.9	69.0	68.7	68.3	68.1	68.5	69.2	69.9	70.7	71.3	72.1	72.7	73.6	73.0	72.2	69.9	62.3	51.2
	60,000	42.6	68.8	72.9	74.4	78.4	79.2	78.7	77.9	77.1	76.7	76.2	76.1	76.7	77.6	78.3	79.4	80.3	81.3	82.1	83.0	82.6	81.4	78.7	69.5	56.9
	70,000	48.1	77.0	81.1	82.6	86.4	87.2	86.8	86.0	85.5	85.2	84.8	85.0	85.8	86.9	87.9	89.2	90.2	91.4	92.2	93.1	92.6	91.3	88.2	78.3	64.5
	80,000	53.2	84.2	88.1	89.5	92.7	93.6	93.4	92.7	92.3	92.1	91.9	92.5	93.6	94.7	96.0	97.5	98.7	100.0	100.9	101.7	101.2	99.6	96.4	85.9	71.3
	10,000	12.5	19.2	21.5	23.3	28.1	28.5	28.4	28.0	27.9	27.7	27.6	27.9	28.2	28.6	28.9	29.4	29.5	29.9	30.2	30.5	30.6	30.6	30.1	27.5	22.0
	20,000	24.0	34.6	38.1	40.0	45.2	45.9	45.7	45.1	44.8	44.6	44.4	45.0	45.4	46.0	46.6	47.3	47.6	48.1	48.5	49.1	49.3	49.3	48.4	44.3	35.5
	30,000	31.5	50.9	53.7	55.1	58.4	59.0	59.0	58.8	58.8	58.8	59.0	59.4	59.8	60.5	61.1	61.9	62.9	63.3	64.0	64.5	64.7	64.8	63.9	59.1	49.6
120	40,000	37.1	62.9	65.5	66.6	69.1	69.8	69.9	69.9	70.1	70.2	70.8	71.2	71.7	72.7	73.5	74.7	75.8	76.6	77.8	78.4	78.5	78.5	77.1	71.0	60.6
	50,000	42.8	70.7	75.0	76.0	79.6	80.3	80.5	80.4	80.4	80.7	81.2	82.1	83.1	84.5	85.9	87.5	88.3	90.0	91.5	92.5	92.7	92.1	89.9	81.3	68.4
	60,000	48.5	79.2	84.3	85.4	89.3	90.3	90.5	90.3	90.3	90.9	91.4	92.4	94.1	96.0	97.7	99.7	100.5	102.9	104.6	105.9	106.0	105.1	102.1	91.5	76.6
	70,000	54.6	88.4	93.5	94.5	97.7	98.9	99.5	99.5	99.7	100.3	101.0	102.3	104.2	106.5	108.5	110.8	112.1	114.5	116.6	117.9	117.9	116.5	113.2	101.5	85.1
	80,000	60.6	97.4	102.0	103.1	105.7	106.8	107.9	108.1	108.4	109.2	109.9	111.9	113.9	116.4	118.9	121.4	123.2	125.7	128.0	129.6	129.2	127.5	123.7	111.0	93.0
	10,000	12.9	20.2	22.5	24.5	30.3	31.0	31.1	31.0	30.9	30.9	31.3	31.7	32.2	32.6	33.0	33.5	33.8	34.2	34.5	34.9	35.3	35.4	35.2	33.7	28.1
	20,000	24.3	36.4	41.3	43.6	50.8	52.0	52.2	52.0	52.0	52.0	52.4	53.3	53.9	54.7	55.4	56.3	56.8	57.5	58.0	58.7	59.2	59.5	59.1	56.4	47.0
	30,000	34.4	54.9	58.9	60.7	65.9	66.7	67.0	67.3	67.8	68.0	69.1	70.2	71.1	72.0	73.0	74.2	75.3	76.2	77.1	77.7	78.3	78.7	78.1	74.1	63.5
140	40,000	42.3	69.6	73.4	75.0	78.9	79.7	80.2	80.7	81.6	82.1	83.6	84.8	86.1	87.5	88.9	90.4	91.8	93.2	94.6	95.4	96.1	96.5	95.4	89.0	77.1
	50,000	48.6	79.7	84.3	86.1	90.6	91.7	92.6	93.1	94.0	94.5	96.1	97.6	99.4	101.4	103.2	105.2	106.8	108.8	110.8	112.2	113.2	113.4	111.1	101.7	87.1
	60,000	54.9	90.0	95.0	96.8	101.5	102.9	104.3	104.7	105.7	106.5	108.1	110.0	112.3	114.6	116.8	119.3	120.9	123.6	125.8	127.6	128.8	128.7	125.7	113.9	97.3
	70,000	61.5	100.5	105.8	107.5	111.4	113.3	115.1	115.8	116.8	118.0	119.8	122.2	124.7	127.2	129.7	132.4	134.4	137.4	139.9	141.9	142.9	142.3	138.7	125.7	107.5
	80,000	67.6	110.6	115.8	117.1	120.6	122.6	124.8	125.9	127.3	128.3	130.8	133.4	136.1	138.8	141.8	144.5	147.0	150.3	153.0	155.2	155.7	154.8	150.6	136.5	116.6
	10,000	13.2	21.2	23.4	25.8	32.8	33.7	34.2	34.3	34.5	34.8	35.6	36.3	36.9	37.3	37.9	38.5	39.0	39.5	39.8	40.3	40.9	41.2	41.6	41.2	35.5
	20,000	24.6	38.2	43.0	46.1	55.7	57.3	58.0	58.3	58.7	59.0	60.4	61.6	62.6	63.2	64.2	65.2	66.1	66.9	67.5	68.4	69.4	70.1	70.4	70.0	60.3
	30,000	36.5	57.5	63.0	65.5	73.2	73.9	74.7	75.6	76.7	77.5	79.6	81.4	83.1	84.6	86.1	87.4	88.9	90.3	91.4	92.3	93.3	94.0	93.9	91.0	79.7
160	40,000	46.5	74.5	79.6	81.8	87.6	88.4	89.3	90.6	92.3	93.5	96.1	98.5	100.7	102.7	104.8	106.6	108.6	110.4	112.3	113.5	114.7	115.7	114.9	108.5	95.3
	50,000	53.6	87.2	91.9	94.4	100.2	101.8	103.5	105.1	106.8	107.9	110.7	113.5	115.8	118.4	121.0	123.3	125.7	128.0	130.6	132.7	134.6	135.8	133.8	124.1	108.2
	60,000	60.5	99.5	104.3	106.9	112.4	114.7	117.2	118.9	120.9	122.1	125.0	128.4	131.0	133.7	136.6	139.2	142.2	144.8	148.0	150.6	153.0	154.1	151.1	138.8	120.6
	70,000	66.7	110.7	115.6	118.2	123.1	125.8	128.6	130.8	133.0	134.6	138.1	141.5	144.4	147.3	150.5	153.4	156.6	159.5	162.7	165.4	167.7	168.5	164.9	151.2	131.2
	80,000	72.6	121.0	126.4	128.6	133.0	135.9	139.2	141.9	144.6	146.0	150.1	153.8	156.9	160.1	163.2	166.4	169.8	173.3	176.5	179.3	181.2	181.4	177.3	162.4	141.0
	10,000	13.6	21.7	24.2	27.1	36.3	37.5	38.2	38.5	39.0	39.4	40.4	41.3	42.0	42.5	43.3	44.0	44.6	45.2	45.9	46.5	47.2	47.7	48.1	47.9	42.9
	20,000	25.2	40.5	46.1	50.0	62.8	64.8	66.1	66.6	67.4	68.1	70.0	71.6	72.6	73.6	74.9	76.0	77.0	78.2	79.3	80.4	81.7	82.5	83.0	82.7	74.2
	30,000	37.1	60.6	68.2	71.3	81.2	83.2	85.1	86.5	88.4	89.6	92.5	95.0	97.0	98.7	100.4	102.0	103.6	104.9	106.5	107.4	108.4	109.0	109.0	106.2	96.5
180	40,000	48.7	79.7	87.3	89.9	97.2	99.6	102.1	104.3	106.8	108.5	111.8	115.1	117.4	119.8	121.9	124.0	126.1	128.0	129.9	131.1	132.2	133.0	132.2	126.5	114.8
	50,000	58.5	96.2	102.8	105.5	112.3	116.6	119.0	121.3	124.1	125.7	129.2	132.4	134.8	137.5	140.0	142.7	145.1	147.3	150.0	151.9	153.1	154.5	153.3	145.3	130.1
	60,000	67.1	111.0	116.8	119.5	125.8	129.8	133.6	136.2	139.1	140.8	144.4	147.9	150.7	153.4	156.1	159.1	161.9	164.3	167.3	170.0	172.5	173.0	171.8	160.5	142.4
	70,000	73.6	123.7	129.4	132.0	137.9	142.3	146.1	149.2	152.3	154.2	158.1	162.0	165.0	168.2	171.2	174.5	177.1	179.8	183.1	184.4	185.4	186.0	185.3	171.7	151.6
	80,000	78.8	134.0	139.9	142.4	147.2	151.5	155.9	158.8	162.2	164.5	168.7	172.8	176.2	179.4	182.9	186.0	188.8	191.8	194.7	195.9	196.3	195.8	194.2	179.2	157.2
	20,000	26.1	42.9	48.2	53.2	69.4	72.1	73.9	74.8	76.3	77.4	79.7	81.7	82.9	84.1	85.7	86.9	88.1	89.8	91.6	92.8	94.3	94.7	95.2	94.2	89.6
	30,000	38.4	64.1	72.4	75.9	88.4	92.0	95.3	97.5	100.1	102.0	105.5	109.1	111.0	113.0	115.3	117.0	118.8	120.1	122.1	123.0	123.9	124.4	124.4	121.9	115.0
	40,000	49.5	83.3	93.5	96.1	105.1	109.8	114.3	117.5	120.6	123.1	127.1	131.4	134.0	136.4	138.5	141.2	143.1	144.7	146.8	147.9	148.7	149.0	148.9	143.8	134.8
200	50,000	61.0	101.7	110.3	112.7	120.9	126.3	131.1	134.8	138.3	140.5	144.8	148.3	150.7	153.1	155.6	158.6	160.7	162.8	165.2	167.3	168.2	168.9	168.8	163.6	150.3
	60,000	70.9	118.3	125.3	128.0	135.1	140.6	145.9	150.0	153.5	155.7	160.0	163.5	166.2	168.5	171.2	174.5	176.8	179.1	181.8	184.1	184.8	185.5	185.1	178.4	161.1
	70,000	77.8	132.5	138.9	141.4	148.0	154.0	159.3	163.0	166.8	169.1	173.7	177.6	180.8	183.6	186.5	189.7	192.2	194.4	196.9	198.7	199.1	199.4	199.3	187.1	167.4
	80,000	82.6	143.8	149.4	152.0	158.1	163.7	168.8	172.3	176.3	178.8	183.3	187.6	191.0	194.4	197.8	201.1	203.4	205.3	207.5	208.6	208.7	208.2	205.5	191.2	169.4
	20,000	27.9	47.0	56.2	61.9	77.1	80.5	82.9	84.3	86.2	87.6	90.7	92.7	94.1	95.4	97.3	99.1	100.6	102.5	104.0	105.6	107.1	108.4	109.7	110.2	103.9
	30,000	39.5	69.0	79.1	83.7	99.1	103.5	107.7	110.3	113.2	115.5	119.2	122.6	124.6	126.6	128.9	130.6	131.6	133.3	134.7	135.7	136.1	136.8	136.8	134.5	129.3
	40,000	50.4	89.1	98.3	102.3	116.3	121.4	126.6	130.1	133.8	136.2	140.6	144.6	146.9	149.2	151.5	153.2	154.3	155.0	155.5	156.0	156.9	156.9	156.0	154.0	145.1
220	50,000	62.1	107.8	116.5	120.6	131.0	137.3	142.7	146.6	150.3	152.7	157.2	160.9	163.5	165.4	167.6	169.6	171.2	172.4	173.0	174.0	174.3	174.6	174.0	168.5	156.4
	60,000	71.7	125.1	133.9	138.1	146.3	152.8	158.4	162.6	166.3	168.9	173.1	176.9	179.6	181.7	183.8	185.9	187.0	188.4	189.8	190.8	191.5	191.5	190.0	180.9	166.2
	70,000	79.7	140.9	147.8	151.4	158.6	164.8	170.4	174.5	178.1	180.9	185.3	189.3	192.2	194.5	196.7	198.5	200.0	201.1	201.9	202.6	202.6	201.4	198.4	187.6	171.6
	80,000	85.7	154.1	160.8	164.2	170.1	175.6	181.3	184.9	188.6	191.5	195.9	200.0	203.1	205.8	207.7	209.7	210.8	212.0	212.4	212.4	211.2	209.1	204.8	192.3	174.8
	30,000	40.0	72.7	83.8	89.7	108.0	113.1	117.9	120.9	124.4	126.7	130.7	133.9	135.8	137.7	140.1	141.7	143.6	145.5	147.1	148.5	149.6	149.6	149.6	148.5	141.2
	40,000	51.3	94.2	100.7	106.5	125.4	131.1	137.2	140.9	144.8	147.4	151.7	155.3	157.4	159.3	161.4	162.6	163.8	165.0	165.8	166.2	166.5	166.5	166.3	163.8	152.1
240	50,000	63.2	114.2	121.1	127.0	139.6	146.8	152.8	156.8	160.7	163.5	167.9	171.8	174.1	176.1	177.7	178.4	179.1	179.7	180.1	180.4	180.4	179.3	177.0	170.3	160.0
	60,000	72.7	132.1	140.3	146.0	154.9	162.3	168.4	172.4	176.2	178.9	183.6	187.8	190.3	192.1	193.2	193.9	194.3	194.6	193.9	193.9	193.2	191.3	188.0	179.7	168.2
	70,000	80.2	148.9	156.6	161.6	169.0	175.4	181.5	185.8	189.5	192.3	196.9	200.6	203.3	205.2	206.3	207.1	207.1	207.1	205.9	205.1	203.6	200.8	196.5	187.3	174.7
	80,000	88.1	162.9	170.9	174.9	180.5	185.7	191.5	195.6	199.0	202.0	206.4	210.2	212.6	214.6	215.4	216.2	216.2	215.8	214.2	213.0	210.6	206.0	201.2	190.9	178.1
	30,000	40.7	77.1	87.7	95.3	116.8	122.3	128.4	131.7	135.6	137.8	142.5	145.0	146.8	148.5	151.1	152.6	154.6	156.7	157.3	157.9	158.4	159.1	159.0	157.8	152.9
	40,000	52.4	98.7	102.8	108.1	132.2	138.7	145.1	148.9	153.2	155.6	159.7	162.8	164.7	166.6	168.5	168.5	169.4	170.7	171.3	171.7	171.7	171.3	169.1	164.6	156.0
260	50,000	66.3	121.3	123.6	131.1	146.1	154.4	160.6	164.7	168.4	171.5	175.7	179.7	182.4	183.7	184.7	184.4	184.4	184.4	183.4	182.3	181.0	179.1	175.7	169.2	160.7
	60,000	76.6	141.2	145.0	152.7	161.8	170.0	176.3	180.7	184.3	187.3	192.1	196.0	196.7	197.4	197.8	197.4	197.1	196.7	196.0	194.5	192.0	188.4	183.7	176.3	167.5
	70,000	80.8	153.4	162.3	168.0	175.9	182.4	188.9	193.2	196.6	199.4	204.1	205.8	207.6	209.3	210.5	210.0	208.7	206.9	205.8	203.5	200.4	195.5	190.1	182.4	174.3
	80,000	91.9	172.3	178.6	182.9	188.9	193.4	199.8	203.9	207.3	210.3	214.4	215.4	216.6	217.7	217.3	216.5	215.7	214.5	213.3	210.5	206.9	200.2	194.6	187.0	179.0
	Stroke	0	0.3	1.5	3	8	15	23	30	38	45	60	76	91	106	121	136	151	166	181	196	211	227	242	272	302

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TABLE 32. C13-1 Constant Pressure Catapult (CVAN68), Lower Boundary, Load vs Stroke, Numerical

TABULATION OF LOAD (Kips) VERSUS STROKE (Feet) – NUMERICAL AS A FUNCTION OF LAUNCH WEIGHT AND CSV SETTING

CSV Setting	Stroke / Weight (LBS)	0	0.3	1.5	3	8	15	23	30	38	45	60	76	91	106	121	136	151	166	181	196	211	227	242	272	302
	10,000	7.9	10.7	12.0	12.9	15.4	15.6	15.4	14.9	14.4	13.9	13.0	12.4	12.3	12.1	12.0	12.0	12.2	12.3	12.4	12.4	12.5	12.3	12.0	10.5	7.8
	20,000	14.9	19.4	20.0	20.7	22.8	23.0	22.7	22.1	21.3	20.6	19.4	18.6	18.2	18.0	18.0	17.9	18.0	18.1	18.2	18.2	18.4	18.2	17.7	15.3	11.3
40	30,000	18.5	25.6	26.1	26.4	27.5	27.5	26.7	25.9	25.2	24.6	23.6	22.9	22.5	22.4	22.3	22.2	22.2	22.3	22.4	22.4	22.5	22.2	21.6	19.3	15.3
	40,000	21.7	30.7	31.1	31.3	31.9	31.7	30.6	29.7	28.8	28.2	27.2	26.6	26.2	26.2	26.1	26.0	26.0	26.1	26.3	26.4	26.4	25.9	25.2	22.5	18.1
	50,000	25.3	35.4	35.7	35.9	36.3	36.3	35.0	33.6	32.8	31.8	30.7	29.8	29.5	29.5	29.5	29.5	29.6	29.7	30.0	30.2	30.1	29.5	28.5	24.8	19.5
	60,000	27.8	38.4	38.5	38.7	39.2	39.4	38.0	36.7	35.5	34.4	33.3	32.3	32.0	32.1	32.1	32.1	32.3	32.4	32.7	32.9	32.8	32.2	31.0	27.9	21.0
	10,000	8.9	12.4	13.6	14.8	18.1	18.2	18.0	17.5	16.9	16.5	15.8	15.5	15.4	15.4	15.4	15.5	15.8	16.1	16.3	16.4	16.4	16.3	15.9	14.0	10.6
	20,000	17.1	22.7	23.7	24.6	27.5	27.8	27.4	26.7	25.9	25.3	24.3	23.7	23.5	23.5	23.6	23.8	24.1	24.5	24.8	24.9	25.0	24.6	23.9	21.0	15.8
	30,000	21.6	30.5	31.4	32.3	33.9	34.0	33.0	32.2	31.5	30.9	30.1	29.7	29.5	29.6	29.8	30.0	30.1	30.5	30.8	31.0	31.1	30.7	29.9	26.9	21.6
60	40,000	25.2	36.7	37.7	38.5	39.8	39.7	38.4	37.6	36.8	36.2	35.4	35.0	34.8	35.0	35.3	35.5	35.7	36.1	36.5	36.7	36.8	36.3	35.3	31.8	26.0
	50,000	28.7	41.7	42.6	43.3	45.0	45.2	44.1	43.0	41.9	41.0	40.1	39.5	39.3	39.5	39.8	40.2	40.6	41.1	41.6	41.9	42.1	41.4	40.1	35.1	28.1
	60,000	31.5	45.6	46.5	47.1	49.1	49.6	48.5	47.3	46.1	45.1	44.1	43.4	43.3	43.6	43.9	44.3	44.8	45.4	46.0	46.4	46.5	45.8	44.3	38.6	30.8
	70,000	38.3	53.4	49.7	50.5	52.8	53.4	52.1	51.0	49.9	48.9	48.0	47.4	47.4	47.7	48.0	48.4	49.1	49.6	50.2	50.6	50.7	49.9	48.4	42.5	34.5
	80,000	42.0	57.9	52.7	53.5	56.3	56.8	55.5	54.5	53.4	52.6	51.6	51.2	51.4	51.6	51.9	52.4	53.0	53.7	54.1	54.5	54.6	53.8	52.4	46.4	38.3
	10,000	9.9	14.1	14.6	16.0	20.1	20.3	20.0	19.6	19.1	18.8	18.5	18.5	18.7	18.8	19.0	19.4	19.8	20.3	20.6	20.7	20.7	20.6	20.2	18.0	13.9
	20,000	18.8	25.4	26.2	27.4	31.1	31.5	31.0	30.4	29.7	29.2	28.8	28.6	28.7	29.1	29.5	29.9	30.5	31.3	32.0	32.2	32.2	31.4	30.5	27.1	21.0
	30,000	24.3	34.7	35.7	37.1	39.5	39.6	38.5	37.8	37.2	36.8	36.5	36.5	36.7	37.2	37.8	38.4	38.9	39.7	40.3	40.6	40.7	40.2	39.2	35.5	28.9
80	40,000	27.9	41.5	42.2	43.8	46.1	46.3	45.1	44.4	43.8	43.4	43.0	43.0	43.4	44.0	44.7	45.3	46.1	46.8	47.4	47.9	48.1	47.7	46.5	42.0	34.7
	50,000	30.4	46.0	46.5	47.9	51.2	51.9	51.1	50.3	49.5	49.1	48.6	48.3	48.6	49.2	49.8	50.5	51.7	52.6	53.4	54.0	54.5	53.9	52.3	46.2	37.5
	60,000	34.6	50.9	51.4	52.0	55.9	56.8	56.3	55.5	54.7	54.2	53.7	53.4	53.8	54.4	55.0	55.8	57.2	58.3	59.4	60.0	60.6	59.8	57.9	50.8	41.2
	70,000	40.3	57.9	58.6	59.0	59.7	60.7	60.1	59.4	58.8	58.3	57.9	58.4	58.6	59.2	59.9	61.0	62.4	63.7	64.7	65.4	65.9	65.0	63.1	55.8	45.9
	80,000	44.4	66.7	67.5	68.9	69.4	70.0	68.9	68.1	67.3	66.6	65.9	65.7	66.0	66.2	66.5	67.2	68.1	68.3	68.5	68.3	67.8	66.7	64.4	56.9	46.8
	10,000	11.2	16.7	18.1	19.6	23.8	24.0	23.7	23.2	22.8	22.5	22.2	22.2	22.3	22.4	22.6	22.8	22.9	23.2	23.3	23.4	23.3	22.9	22.2	19.9	15.4
	20,000	21.0	29.9	32.2	33.6	37.7	38.1	37.6	36.8	36.2	35.7	35.2	35.2	35.3	35.6	35.8	36.1	36.3	36.7	37.0	37.1	36.9	36.3	35.3	31.6	24.5
	30,000	27.4	42.4	44.4	45.7	48.2	48.4	47.4	46.8	46.2	45.9	45.5	45.5	45.7	46.0	46.3	46.8	47.1	47.3	47.6	47.6	47.5	47.0	45.9	41.8	34.3
100	40,000	32.0	51.5	53.6	55.0	57.2	57.3	56.3	55.6	55.1	54.8	54.6	54.5	54.7	55.1	55.6	56.1	56.7	56.9	57.3	57.9	57.4	56.8	55.4	50.3	41.9
	50,000	36.1	57.9	60.4	61.8	65.0	65.5	64.7	64.0	63.3	62.9	62.5	62.4	62.8	63.4	64.0	64.8	65.4	66.1	66.6	67.0	66.9	66.2	63.9	44.9	46.9
	60,000	40.0	64.0	66.7	68.1	71.8	72.5	72.1	71.3	70.6	70.2	69.8	69.7	70.2	71.0	71.7	72.7	73.5	74.5	75.7	76.6	75.9	74.5	72.0	63.6	52.1
	70,000	45.2	71.5	73.9	75.3	78.7	79.5	79.1	78.4	77.9	77.6	77.3	77.5	78.3	79.2	80.1	81.3	82.2	83.3	84.1	84.7	84.4	83.2	80.4	71.4	58.8
	80,000	56.9	88.8	89.3	90.4	92.2	92.5	91.6	90.7	89.9	89.6	89.0	88.6	89.0	89.6	90.1	90.6	90.8	90.8	90.5	90.0	88.5	86.3	82.7	73.2	59.6
	10,000	11.8	18.0	20.2	21.8	26.3	26.7	26.6	26.2	26.1	25.9	25.8	26.1	26.4	26.8	27.1	27.5	27.6	28.0	28.2	28.5	28.6	28.7	28.1	25.7	20.6
	20,000	22.6	32.5	35.6	37.3	42.2	42.9	42.7	42.1	41.9	41.6	41.4	42.0	42.4	43.0	43.5	44.1	44.4	44.9	45.3	45.8	46.0	46.0	45.2	41.3	33.1
	30,000	29.6	51.4	56.3	57.4	59.9	59.9	59.2	58.3	58.2	58.1	58.1	58.1	58.1	58.3	58.4	58.4	58.4	58.2	58.2	57.8	57.3	56.9	55.6	50.8	41.8
120	40,000	34.9	63.6	69.4	70.2	72.1	72.0	71.2	70.4	70.4	70.4	70.7	70.7	70.8	71.1	71.3	71.5	71.5	71.5	71.6	71.3	70.7	69.8	67.9	62.1	51.9
	50,000	45.8	76.9	79.5	80.3	83.1	83.1	82.4	81.4	81.4	81.5	81.7	81.9	82.5	83.3	83.8	84.4	84.1	84.7	85.0	85.2	84.4	82.7	79.5	71.7	59.3
	60,000	51.9	85.4	88.5	89.4	92.5	92.6	92.0	91.1	91.0	91.2	91.6	92.0	92.8	94.1	95.0	95.8	95.3	96.6	97.1	97.4	96.6	94.1	90.2	80.6	66.0
	70,000	58.4	95.3	97.6	98.4	101.0	101.4	101.2	100.4	100.4	100.8	101.2	101.8	103.0	104.4	105.6	106.5	106.3	107.5	108.3	108.5	107.4	104.8	100.3	89.6	73.5
	80,000	64.8	104.4	106.0	106.8	108.6	109.0	109.4	108.8	108.8	109.4	109.9	111.0	112.3	114.0	115.5	116.4	116.8	118.1	118.9	119.2	117.5	114.7	109.9	97.9	80.7
	10,000	13.8	22.9	25.4	27.3	32.6	32.9	32.7	32.1	32.1	31.9	31.9	32.3	32.4	32.7	32.9	32.7	32.4	32.5	32.5	32.4	32.3	32.2	31.9	29.9	24.6
	20,000	26.0	41.0	45.9	48.2	54.8	55.2	54.8	54.0	53.8	53.7	53.9	54.4	54.8	55.2	55.5	55.4	55.0	55.0	54.9	55.0	54.9	54.8	54.0	51.2	41.9
	30,000	36.8	61.6	65.1	66.8	71.2	71.1	70.4	69.7	70.0	70.1	70.9	71.7	72.2	72.6	73.0	73.0	73.0	73.0	73.0	72.9	72.6	72.5	71.4	63.4	56.8
140	40,000	45.3	77.7	80.4	81.7	84.7	84.4	83.7	83.3	83.9	84.2	85.4	86.1	87.1	87.8	88.5	88.6	88.8	89.1	89.5	89.3	89.1	88.7	87.2	80.7	68.8
	50,000	52.0	87.8	91.5	93.0	96.6	96.7	96.5	96.0	96.6	97.1	98.1	99.3	100.5	101.6	102.8	103.4	103.4	104.1	104.9	105.3	105.3	104.6	101.7	92.6	78.1
	60,000	51.6	90.9	101.8	103.3	106.9	107.5	107.7	107.3	107.9	108.3	109.6	111.0	112.5	114.1	115.6	116.2	116.4	117.5	118.6	119.3	119.5	118.3	114.3	103.2	86.7
	70,000	57.8	101.4	112.6	114.1	117.3	118.2	118.7	118.4	119.2	120.1	121.5	123.1	125.0	126.7	128.4	129.3	129.6	131.0	132.0	132.7	132.5	130.9	126.5	114.2	95.9
	80,000	63.5	111.0	122.6	123.9	126.4	127.3	128.2	128.4	129.5	130.5	132.3	134.3	136.4	138.2	140.0	141.1	141.6	143.2	144.5	145.0	144.3	142.5	137.5	123.8	104.2
	10,000	14.1	24.5	27.4	29.6	36.2	36.6	36.5	36.2	36.1	36.7	37.1	37.6	38.0	38.2	38.6	38.3	38.1	38.2	38.3	38.2	38.1	38.4	38.6	38.0	32.3
	20,000	26.3	43.8	49.8	52.6	61.5	62.3	62.1	61.7	61.8	62.0	63.1	63.9	64.7	65.0	65.7	65.4	65.2	65.2	64.9	65.2	65.5	65.5	65.4	65.1	55.4
	30,000	39.1	65.6	70.9	73.2	79.8	79.5	78.8	78.7	79.5	80.1	81.9	83.5	84.8	85.6	85.6	86.4	86.4	86.7	86.9	86.9	87.0	87.3	86.8	83.7	72.4
160	40,000	49.8	83.8	88.1	90.1	94.8	94.3	93.7	93.9	95.1	96.0	98.2	100.3	102.3	103.5	104.6	105.0	105.2	106.0	106.6	106.8	107.2	107.6	106.5	99.8	86.7
	50,000	57.4	96.5	100.0	102.3	106.9	107.3	107.8	107.8	109.4	110.3	112.3	114.7	116.7	118.6	120.1	120.8	121.3	122.2	123.3	124.5	125.4	126.2	123.7	113.8	97.9
	60,000	64.7	109.1	112.3	114.8	119.1	120.3	121.3	121.6	123.4	124.1	126.4	129.1	131.4	133.5	135.8	136.3	137.3	138.4	139.6	141.2	142.7	143.2	139.7	127.4	109.2
	70,000	71.4	120.8	124.2	126.1	129.9	131.5	133.0	133.8	135.6	136.9	139.7	142.7	145.2	147.2	149.4	150.3	151.1	152.5	153.9	155.3	156.5	156.7	152.6	139.1	119.4
	80,000	77.7	131.9	134.7	136.5	139.7	141.4	143.0	144.4	146.7	148.1	151.4	154.7	157.4	159.5	161.6	162.5	163.7	165.3	166.8	168.3	168.9	168.2	163.9	148.9	127.9
	10,000	14.6	25.2	28.6	31.3	40.0	40.7	41.0	40.8	41.2	41.6	42.5	42.9	43.2	43.4	43.9	43.8	43.6	43.8	43.9	44.0	44.2	44.5	44.7	43.9	38.9
	20,000	27.0	46.9	53.9	57.7	69.4	70.5	70.6	70.4	71.0	71.5	72.9	74.0	74.7	75.0	75.7	75.6	75.4	75.6	75.9	76.2	76.7	77.0	77.2	76.4	67.6
	30,000	39.7	69.6	77.9	80.5	89.2	89.9	90.1	90.3	91.6	92.7	95.0	97.0	98.5	99.2	100.2	100.4	100.5	100.7	101.1	101.1	101.1	101.3	100.7	97.2	87.4
180	40,000	52.1	90.6	98.1	99.9	106.2	107.1	107.8	108.5	110.4	111.7	114.4	117.1	118.9	120.3	121.4	121.8	122.3	122.8	123.4	123.5	123.5	123.7	122.7	115.8	104.1
	50,000	62.6	106.9	113.0	115.4	121.1	122.8	124.5	125.2	127.4	128.6	131.3	134.1	135.9	137.5	139.1	139.8	140.4	141.2	142.2	143.0	143.8	144.6	142.9	133.6	117.8
	60,000	71.8	122.4	127.0	129.4	134.6	137.1	139.2	140.3	142.8	144.1	146.8	149.6	151.6	153.4	155.2	156.0	156.9	157.8	158.2	158.6	159.3	159.9	158.4	147.9	129.1
	70,000	78.6	135.0	139.5	141.7	146.4	149.1	151.4	152.9	155.6	157.1	160.0	163.3	165.6	167.5	169.4	170.7	171.3	172.2	172.9	173.3	173.8	173.2	171.4	158.0	137.2
	80,000	74.1	134.8	148.9	150.9	154.8	157.6	160.5	162.0	164.8	166.4	169.8	173.0	176.0	178.1	180.1	181.1	182.1	182.8	183.9	184.0	183.8	183.3	179.2	164.0	141.7
	20,000	27.9	50.0	57.2	62.0	77.0	78.5	79.2	79.0	80.2	81.0	83.0	84.4	85.0	85.2	86.0	86.0	86.0	86.5	87.2	87.7	88.5	89.2	89.5	88.3	81.0
	30,000	41.1	74.6	83.9	87.2	98.0	100.0	101.6	102.2	104.2	105.6	108.2	111.2	112.7	113.5	114.4	114.8	115.0	115.3	115.7	115.7	115.7	115.5	115.0	111.3	103.7
	40,000	53.0	94.8	104.7	106.8	114.1	116.8	119.2	120.6	123.3	125.2	128.0	131.2	133.2	134.3	135.3	136.3	136.8	136.8	137.3	137.3	136.8	136.8	135.7	129.6	119.9
200	50,000	65.3	113.2	121.2	123.2	129.9	133.4	136.2	138.1	141.1	142.7	145.6	148.7	150.4	151.3	152.5	153.6	154.2	154.5	155.3	155.9	156.8	157.4	156.4	148.8	134.3
	60,000	75.9	130.1	135.4	137.6	143.6	147.5	150.9	153.0	156.0	157.8	160.6	163.3	165.2	166.2	167.5	168.7	169.4	169.7	171.0	171.6	172.6	173.2	171.8	162.5	144.0
	70,000	83.2	143.8	148.1	150.1	155.9	159.7	163.3	165.6	168.8	170.4	173.5	176.4	178.8	180.1	180.8	181.2	181.6	181.9	182.6	182.9	182.6	182.0	181.0	170.0	149.1
	80,000	88.4	153.7	156.3	158.4	163.0	167.3	171.0	173.0	176.0	178.0	180.8	184.2	187.0	188.8	190.5	191.6	192.0	192.3	192.7	192.0	190.9	189.7	185.7	171.5	148.8
	20,000	29.9	54.6	64.5	69.9	83.9	86.0	87.3	87.5	89.1	90.3	93.1	94.5	95.3	95.8	97.0	97.5	98.1	98.8	99.2	100.1	101.9	102.7	103.4	102.0	95.3
	30,000	42.3	80.7	91.4	95.7	109.3	111.8	113.8	114.5	117.0	118.8	122.0	124.5	125.9	126.7	127.6	128.1	128.4	128.6	129.1	129.1	128.8	128.8	128.3	124.7	116.9
	40,000	53.9	101.2	110.4	113.7	125.6	128.7	131.7	133.2	136.1	138.2	141.6	144.8	146.4	147.2	148.1	148.4	148.6	148.6	148.6	148.4	147.8	147.2	146.5	139.3	129.9
220	50,000	66.4	119.5	127.1	130.8	139.7	144.0	147.3	149.3	152.5	154.5	157.9	160.9	162.4	163.3	163.9	164.2	164.2	163.9	163.9	163.6	163.3	162.6	160.7	153.0	140.4
	60,000	67.4	126.9	142.4	146.0	152.4	157.4	160.9	163.4	166.5	168.4	171.7	174.9	176.2	176.5	176.8	177.1	177.0	176.7	176.4	176.1	175.8	175.0	172.3	163.0	147.7
	70,000	85.3	150.9	154.0	157.1	162.7	166.9	170.9	173.2	176.2	178.5	181.6	184.6	186.6	187.3	188.0	188.4	187.7	187.0	186.3	185.2	183.9	181.9	178.4	167.2	150.8
	80,000	80.6	165.3	165.0	167.5	172.1	175.8	179.7	182.0	184.7	187.1	190.4	193.5	195.3	196.4	197.1	197.4	196.7	195.6	194.5	192.7	190.6	187.4	182.7	169.9	152.5
	30,000	42.8	85.0	95.9	102.1	118.4	121.1	123.9	124.6	127.8	129.8	133.5	135.5	136.5	137.3	138.6	138.6	139.1	139.7	139.7	139.9	139.4	139.6	138.8	135.6	128.0
	40,000	54.9	105.9	111.2	116.1	132.7	136.2	139.6	141.2	144.5	146.7	150.2	153.0	154.1	155.0	155.8	155.2	155.0	155.0	154.7	153.8	152.9	152.0	149.6	143.8	140.7
240	50,000	59.4	107.4	114.0	119.6	131.4	138.2	143.8	147.6	151.3	153.9	158.0	161.7	163.9	165.8	167.3	167.9	168.6	169.2	169.5	169.8	169.8	168.8	166.6	160.3	150.6
	60,000	68.3	124.2	131.8	137.2	145.5	152.5	158.2	162.0	165.6	168.1	172.5	176.5	178.8	180.2	180.5	181.2	181.5	181.9	181.2	181.2	180.5	179.7	176.7	168.8	158.0
	70,000	75.4	138.9	146.7	151.4	158.3	164.3	170.0	174.0	177.5	180.1	184.5	187.9	190.4	192.2	192.8	193.0	193.0	193.0	192.7	192.2	190.8	188.1	184.1	175.5	163.7
	80,000	82.8	153.1	160.6	164.3	169.6	174.5	180.0	183.8	187.0	189.8	194.0	197.6	199.8	201.3	201.8	202.1	202.1	201.7	201.3	200.1	197.9	193.6	189.1	179.3	167.4
	30,000	37.9	84.6	101.7	108.1	127.5	130.7	133.9	135.0	138.5	140.9	143.1	143.7	145.2	145.6	145.8	146.1	146.3	146.4	146.4	146.4	145.8	145.1	144.2	143.9	139.0
	40,000	48.7	103.4	111.1	117.7	136.8	142.7	146.5	148.2	151.9	154.2	157.8	160.0	160.9	161.5	162.1	160.6	160.0	160.0	159.1	158.2	156.7	155.4	151.8	147.0	138.6
260	50,000	62.3	113.9	116.1	123.1	137.3	145.1	150.8	154.7	158.2	161.2	165.1	168.8	171.3	173.6	174.5	174.2	173.6	173.2	172.3	171.3	170.0	168.3	165.1	159.0	151.0
	60,000	71.2	124.2	123.7	130.9	140.7	150.0	157.4	162.9	166.7	169.9	174.5	179.2	182.3	184.7	186.2	186.5	186.8	186.9	186.7	186.3	186.1	184.6	181.1	175.6	167.3
	70,000	75.1	135.4	139.3	145.5	153.8	161.6	169.0	174.8	178.4	181.5	185.9	190.5	193.1	196.0	196.4	196.7	196.8	196.9	196.7	196.4	196.0	192.1	187.8	182.3	173.9
	80,000	85.5	153.1	155.1	159.6	166.2	171.9	180.0	185.6	189.0	191.8	196.1	200.5	202.8	204.4	205.5	205.9	206.3	206.7	206.2	205.4	202.8	197.5	192.7	187.3	179.3
	Stroke	0	0.3	1.5	3	8	15	23	30	38	45	60	76	91	106	121	136	151	166	181	196	211	227	242	272	302

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TABLE 33. CE1-3 Catapult (capacity operation), Load vs Stroke, Nondimensional

TABULATION OF NONDIMENSIONAL LOAD VERSUS NONDIMENSIONAL STROKE

	X/R	0	.025	.050	.075	.100	.125	.150	.200	.250	.300	.350	.400	.450	.500	.550	.600	.650	.700	.750	.800	.850	.900	.950	1.000
	Weight (lbs)																								
90-90P	10,000	.410	.462	.540	.520	.508	.526	.536	.573	.604	.626	.656	.640	.627	.598	.562	.539	.512	.511	.490	.440	.372	.245	.146	0
Upper	20,000	.430	.500	.565	.560	.550	.555	.565	.590	.612	.625	.635	.630	.610	.582	.550	.525	.505	.495	.470	.430	.370	.275	.150	0
Tolerance	30,000	.452	.540	.595	.598	.590	.593	.594	.608	.621	.624	.623	.615	.594	.568	.538	.512	.496	.474	.454	.420	.368	.286	.155	0
Limit	40,000	.475	.575	.625	.635	.630	.625	.625	.527	.630	.625	.618	.600	.580	.555	.527	.500	.485	.465	.440	.410	.365	.290	.160	0
	50,000	.502	.604	.660	.674	.670	.661	.659	648	.642	.627	.616	.593	.569	.544	.516	.490	.472	.452	.429	.401	.361	.292	.167	0
	60,000	.540	.630	.700	.710	.700	.696	.690	.670	.660	.635	.615	.590	.560	.535	.505	.480	.457	.440	.420	.392	.355	.292	.180	0
	10,000	.224	.295	.372	.395	.410	.444	.466	.491	.508	.542	.572	.603	.608	.600	.598	.582	.580	.580	.574	.561	.514	.398	.237	.045
	20,000	.290	.340	.410	.440	.460	.482	.500	.520	.538	.555	.570	.585	.588	.582	.570	.565	.562	.560	.550	.535	.490	.400	.245	.030
Mean	30,000	.334	.385	.452	.490	.508	.524	.532	.546	.558	.564	.568	.570	.571	.564	.552	.548	.542	.537	.530	.512	.476	.402	.255	.023
	40,000	.370	.430	.500	.535	.550	.560	.565	.570	.572	.570	.565	.560	.555	.546	.535	.532	.525	.520	.512	.492	.465	.405	.265	.015
	50,000	.392	.475	.548	.580	.594	.600	.598	.590	.582	.574	.562	.552	.542	.528	519	.515	.509	.504	.495	.476	.554	.407	.276	.011
	60,000	.410	.520	.598	.623	.633	.635	.630	.610	.590	.575	.560	.545	.530	.510	.505	.500	.495	.490	.480	.465	.445	.410	.290	.008
90-90P	10,000	.138	.093	.171	.252	.302	.347	.378	.426	.420	.475	.508	.555	.590	.608	.620	.625	.634	.634	.646	.654	.630	.521	.330	.090
Lower	20,000	.170	.170	.260	.315	.360	.400	.420	.452	.470	.490	.510	.540	.565	.582	.595	.602	.610	.615	.625	.630	.612	.530	.340	.060
Tolerance	30,000	.202	.230	.327	.387	.420	.447	.460	.480	.494	.501	511	.526	.542	.558	.570	.578	.592	.595	.602	.605	.592	.535	.352	.045
Limit	40,000	.235	.290	.385	.440	.470	.488	.498	.505	.510	.510	.512	.517	.525	.537	.545	.555	.565	.575	.580	.580	.576	.535	.365	.030
	50,000	.267	.340	.438	.494	.518	.532	.533	.530	.522	.517	.512	.511	.512	.518	.524	.533	.543	.553	.558	.558	.557	.529	.380	.023
	60,000	.300	.370	.485	.540	.560	.570	.565	.545	.530	.522	.511	.508	.502	.500	.502	.512	.523	.530	.533	.534	.535	.520	.400	.015
	X/R	0	.025	.050	.075	.100	.125	.150	.200	.250	.300	.350	.400	.450	.500	.550	.600	.650	.700	.750	.800	.850	.900	.950	1.000

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EFFECTS OF AERODYNAMIC DRAG AND ROLLING FRICTION INCLUDED

Aerodynamic Drag, $D_i = (.011+2.2\times10^{-6}\ W)\ V_i^2$

Rolling Friction = .017W

where D_i = aerodynamic drag at any instant, pounds

V_i = velocity at any instant, feet/second

W = airplane weight, pounds

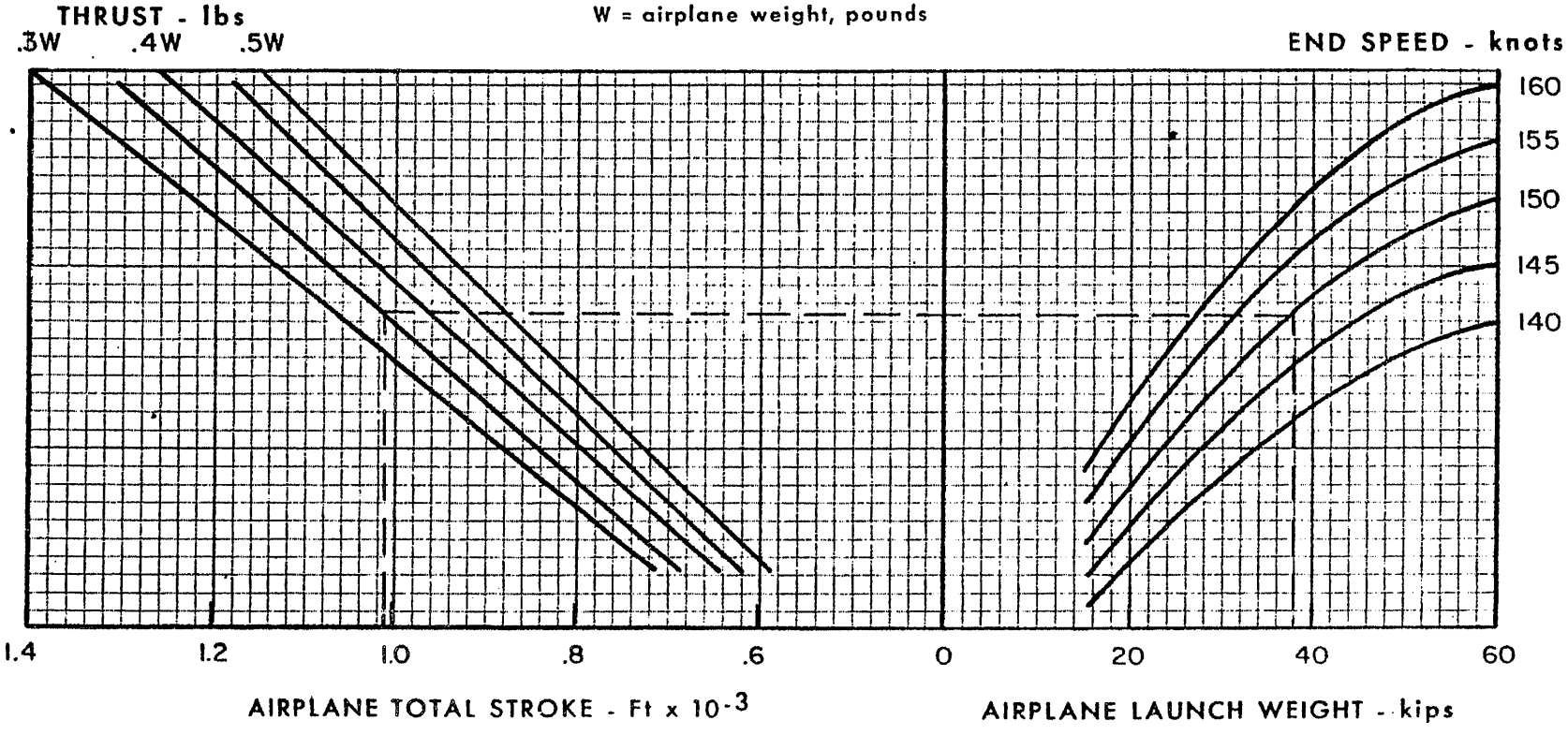

FIGURE 2. CE1-3 Catapult, Airplane Total Stroke as a Function of Airplane Weight, Thrust and End Speed

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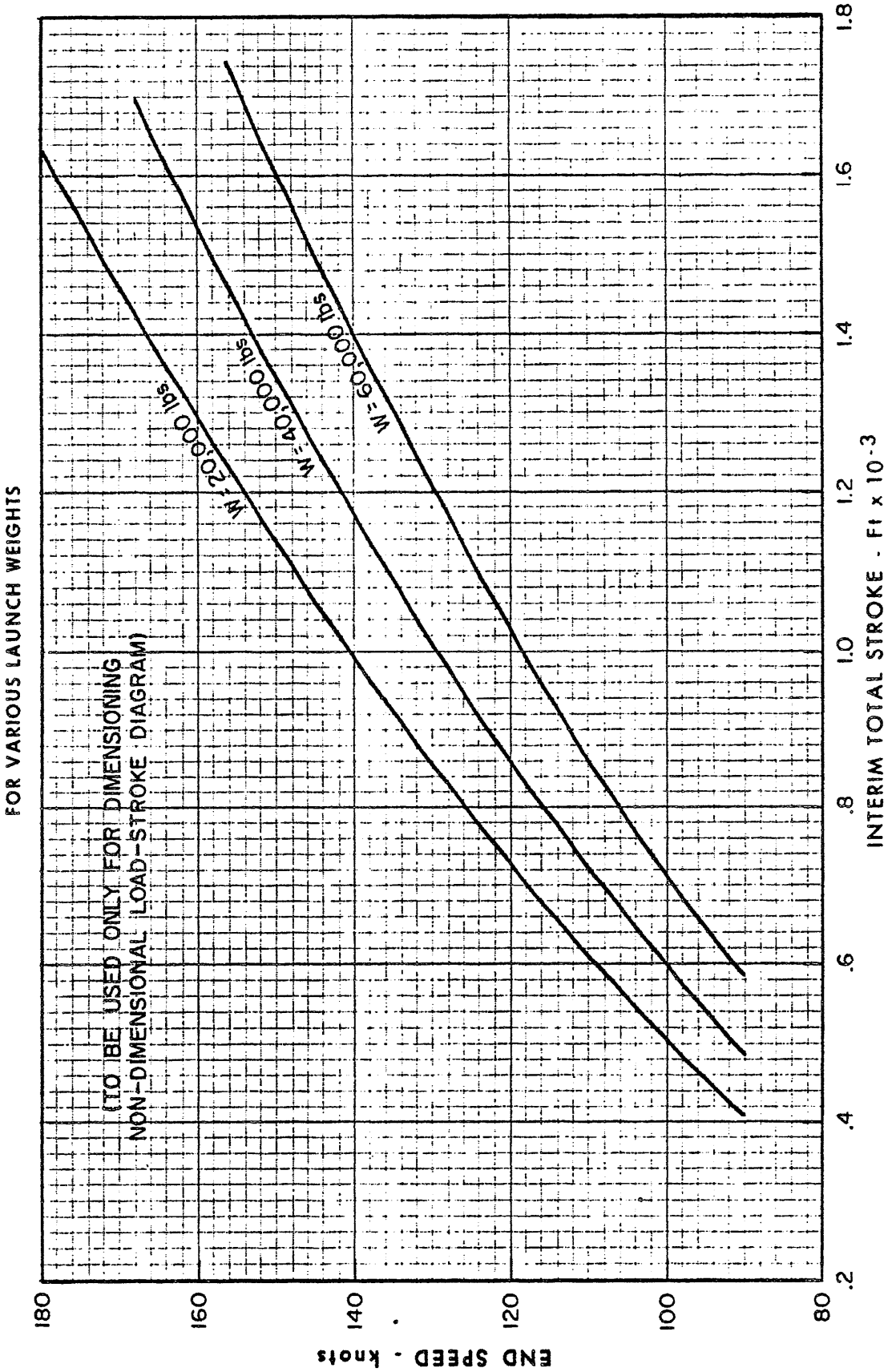

FIGURE 3. CE1-3 Catapult, End Speed vs Interim Total Stroke

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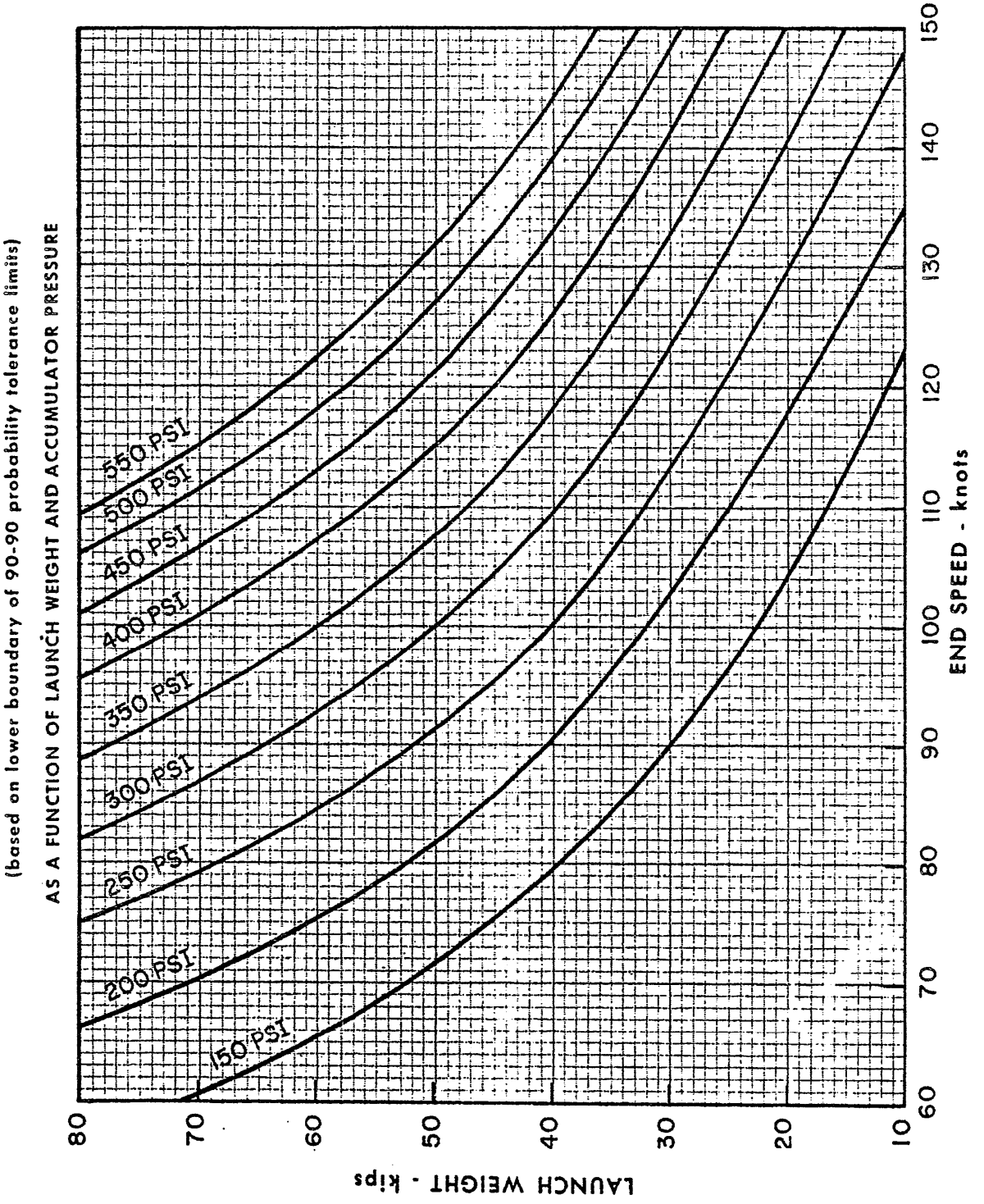

FIGURE 4.1. C7 Catapult (with metering rod), Minimum End Speed

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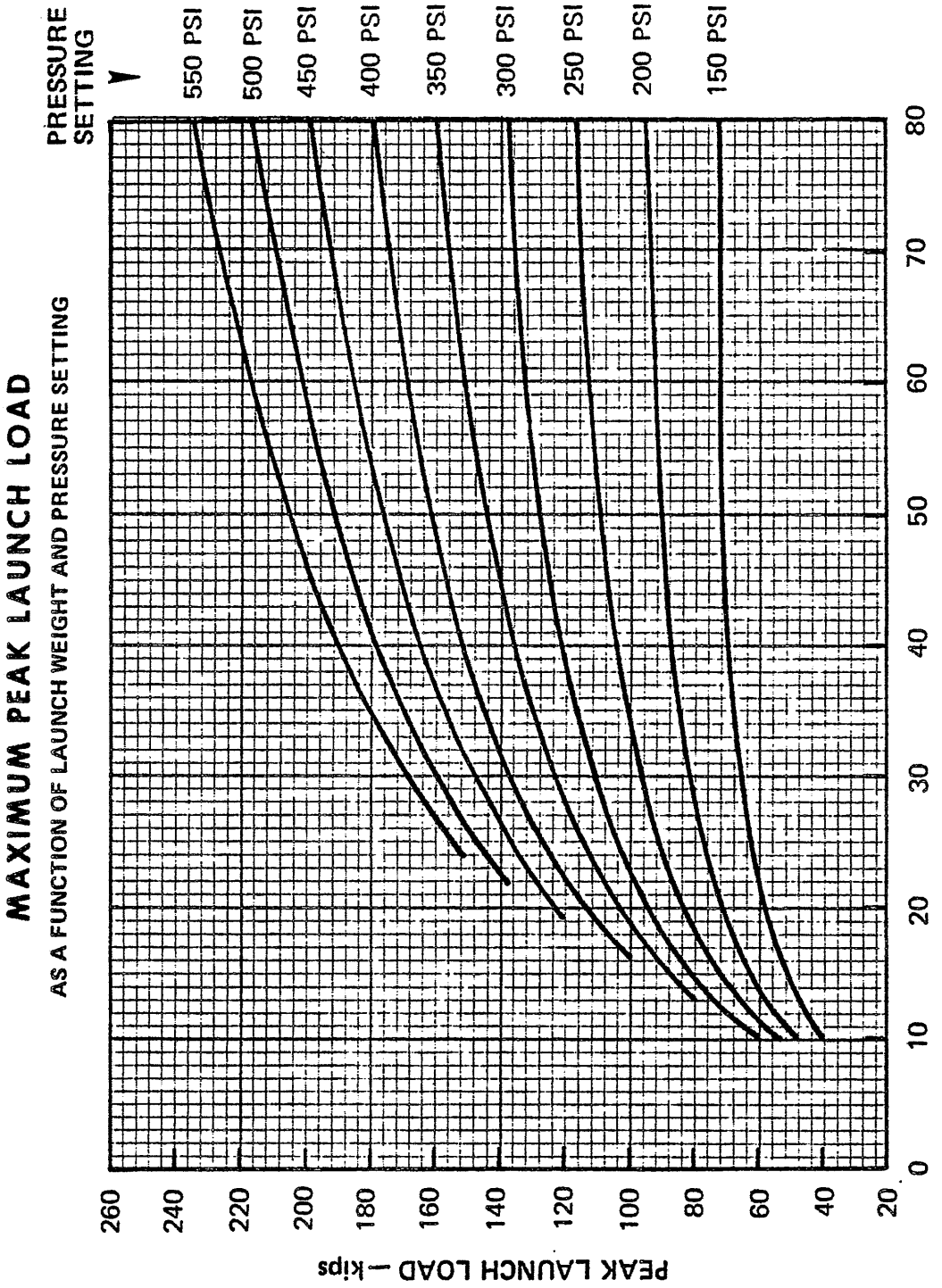

FIGURE 4.2. C7 Catapult (with metering rod), Maximum Peak Catapult Force

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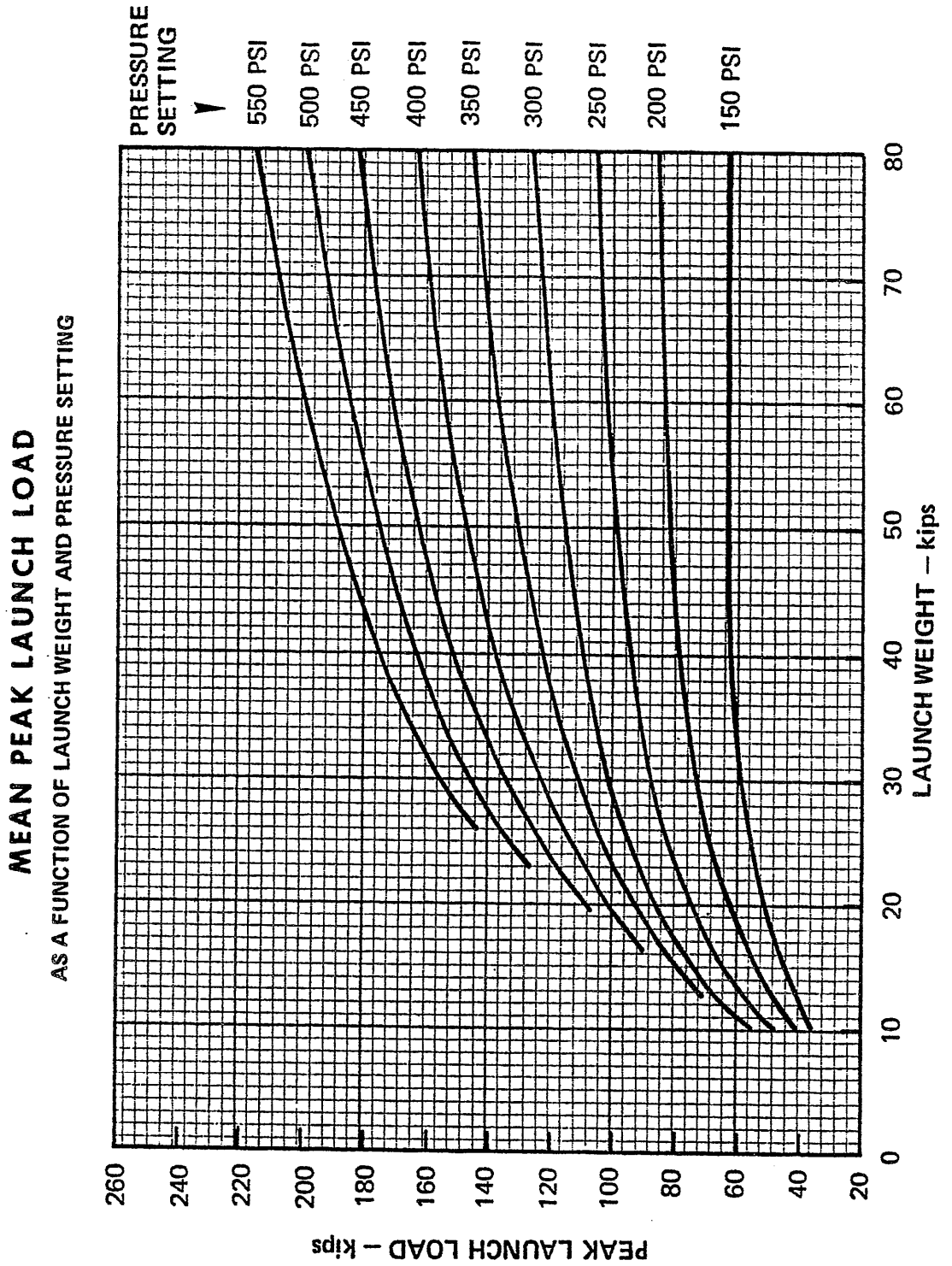

FIGURE 4.3. C7 Catapult (with metering rod), Mean Peak Catapult Force

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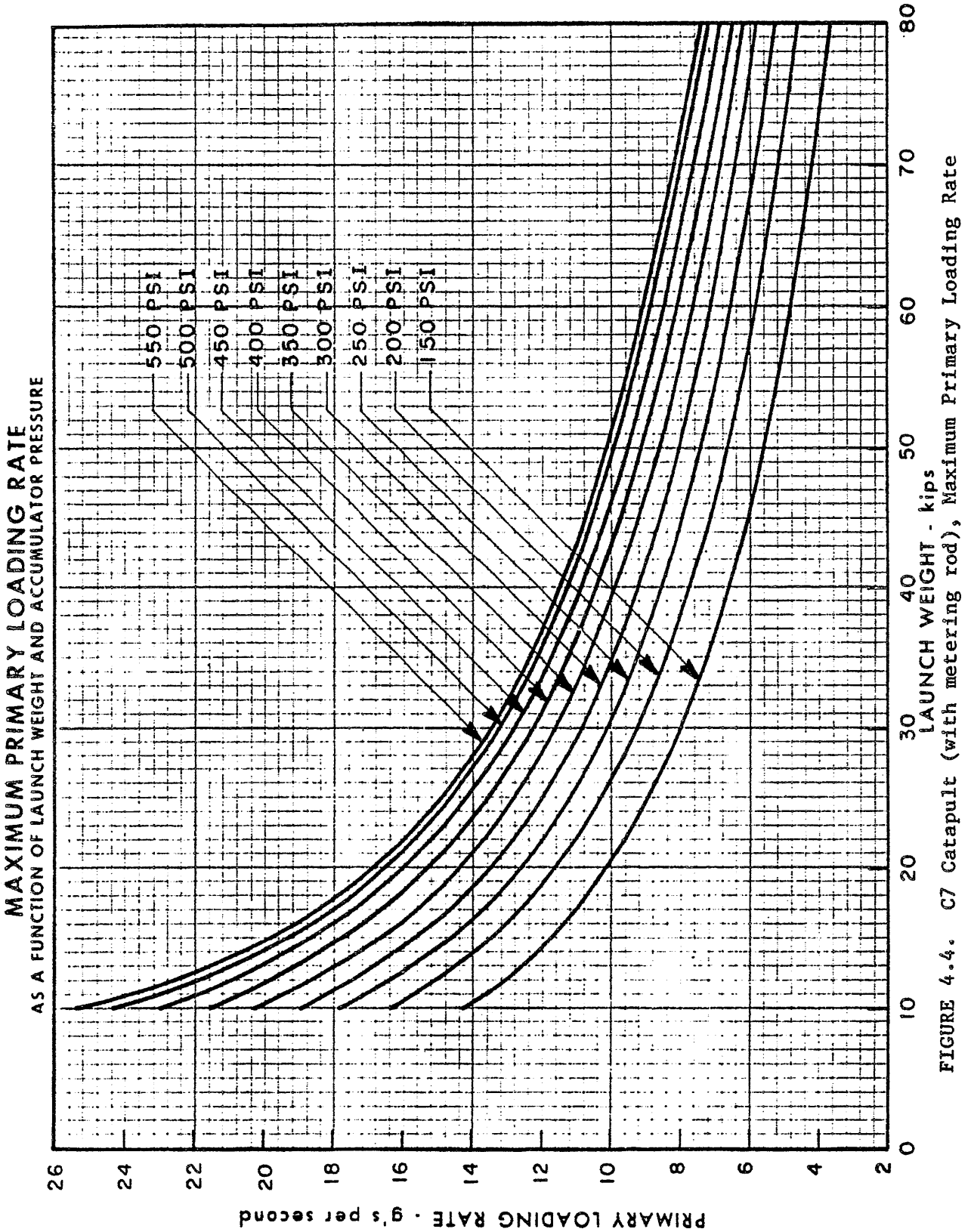

FIGURE 4.4. C7 Catapult (with metering rod), Maximum Primary Loading Rate

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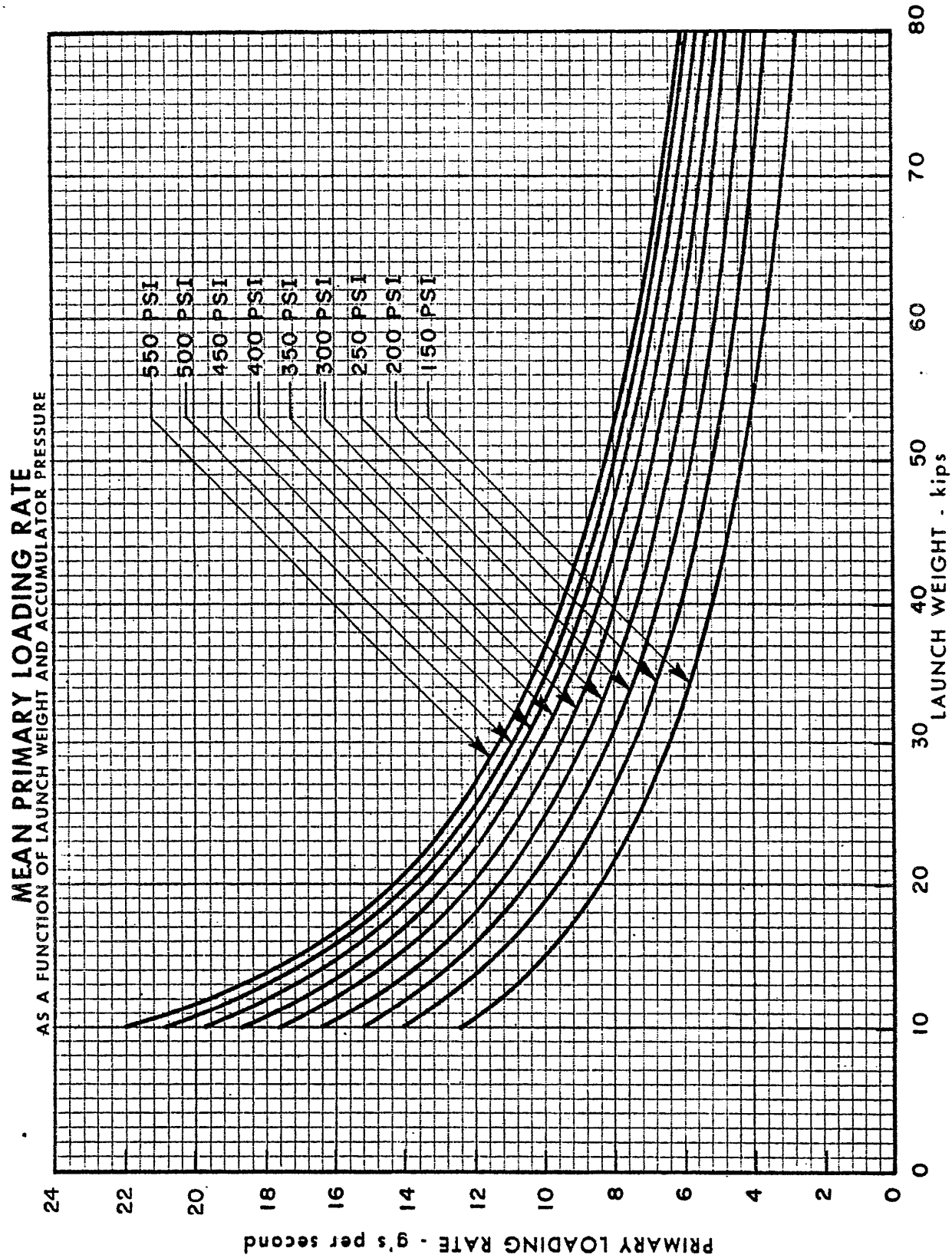

FIGURE 4.5. C7 Catapult (with metering rod), Mean Primary Loading Rate

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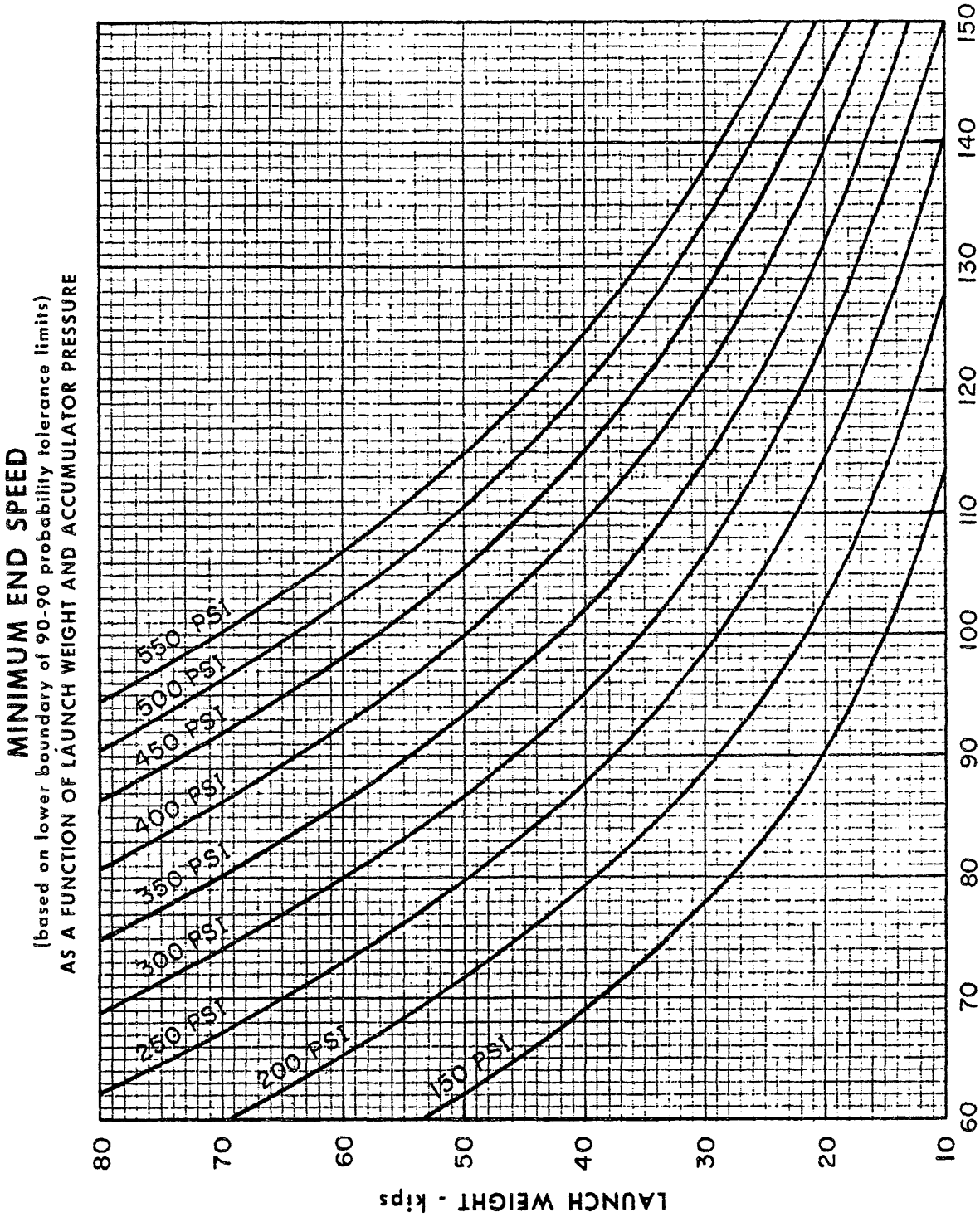

FIGURE 5.1. C11-1 (DRY) Catapult, Minimum End Speed

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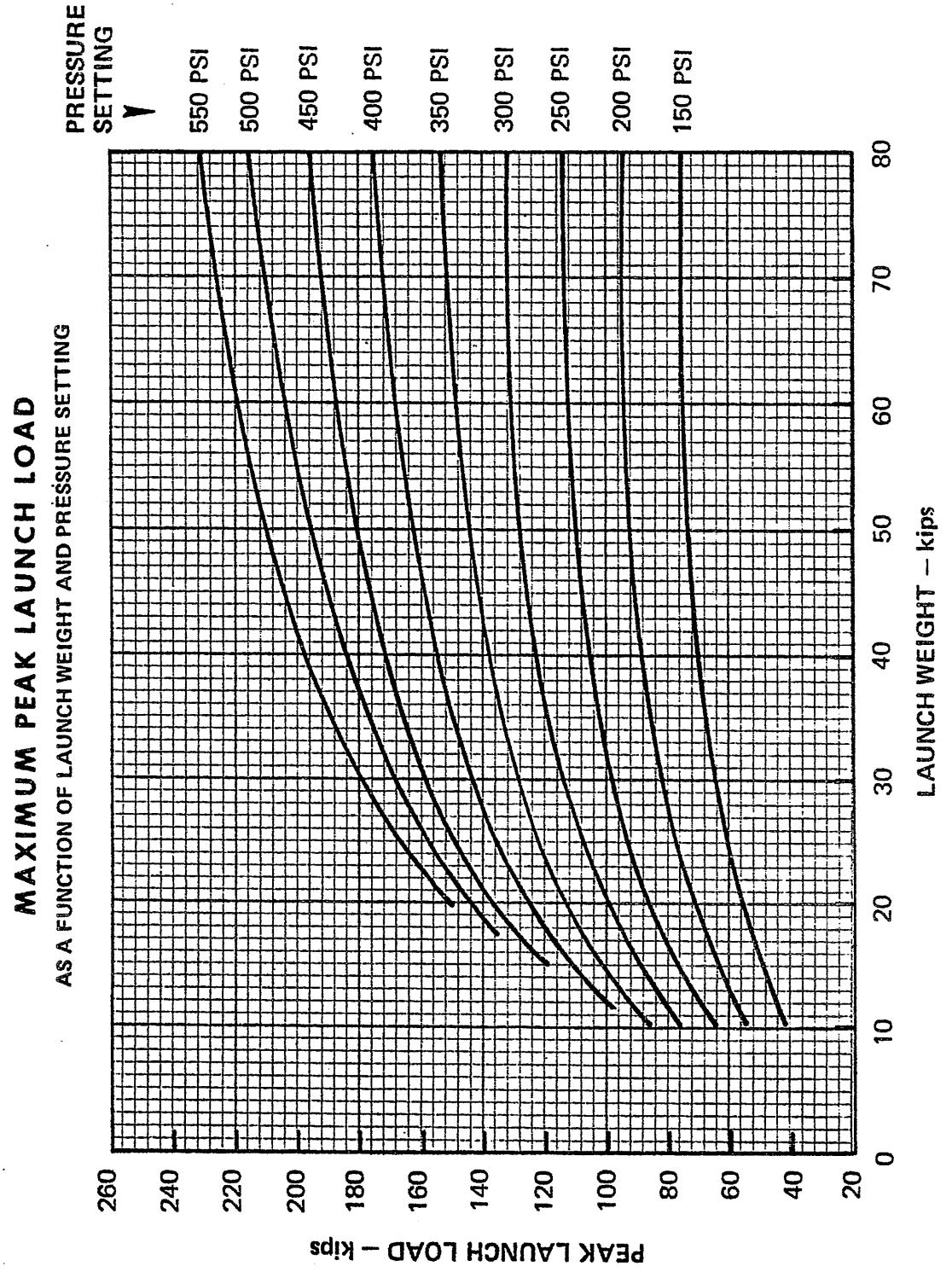

FIGURE 5.2. C11-1 (DRY) Catapult, Maximum Peak Catapult Force

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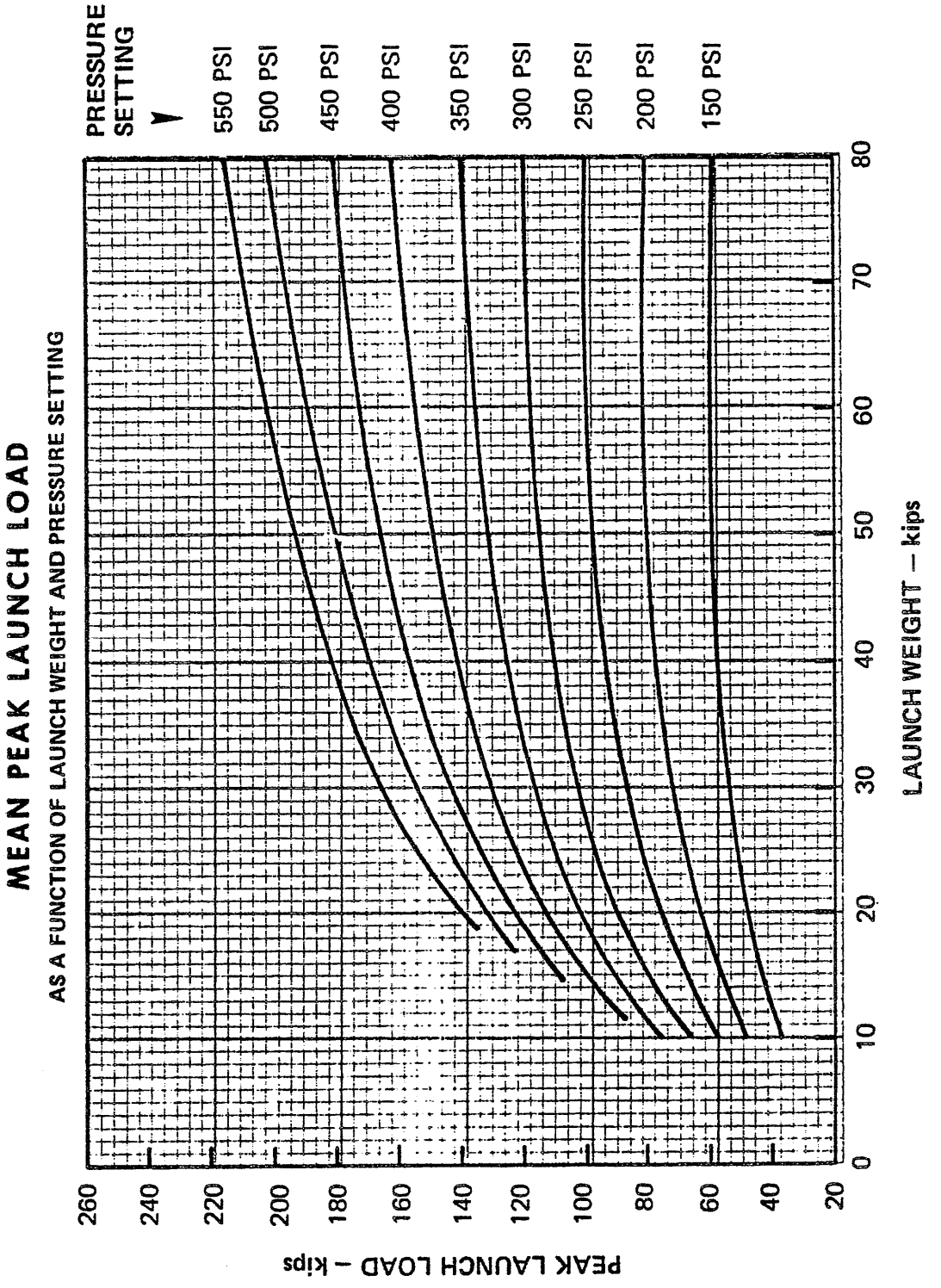

FIGURE 5.3. C11-1 (DRY) Catapult, Mean Peak Catapult Force

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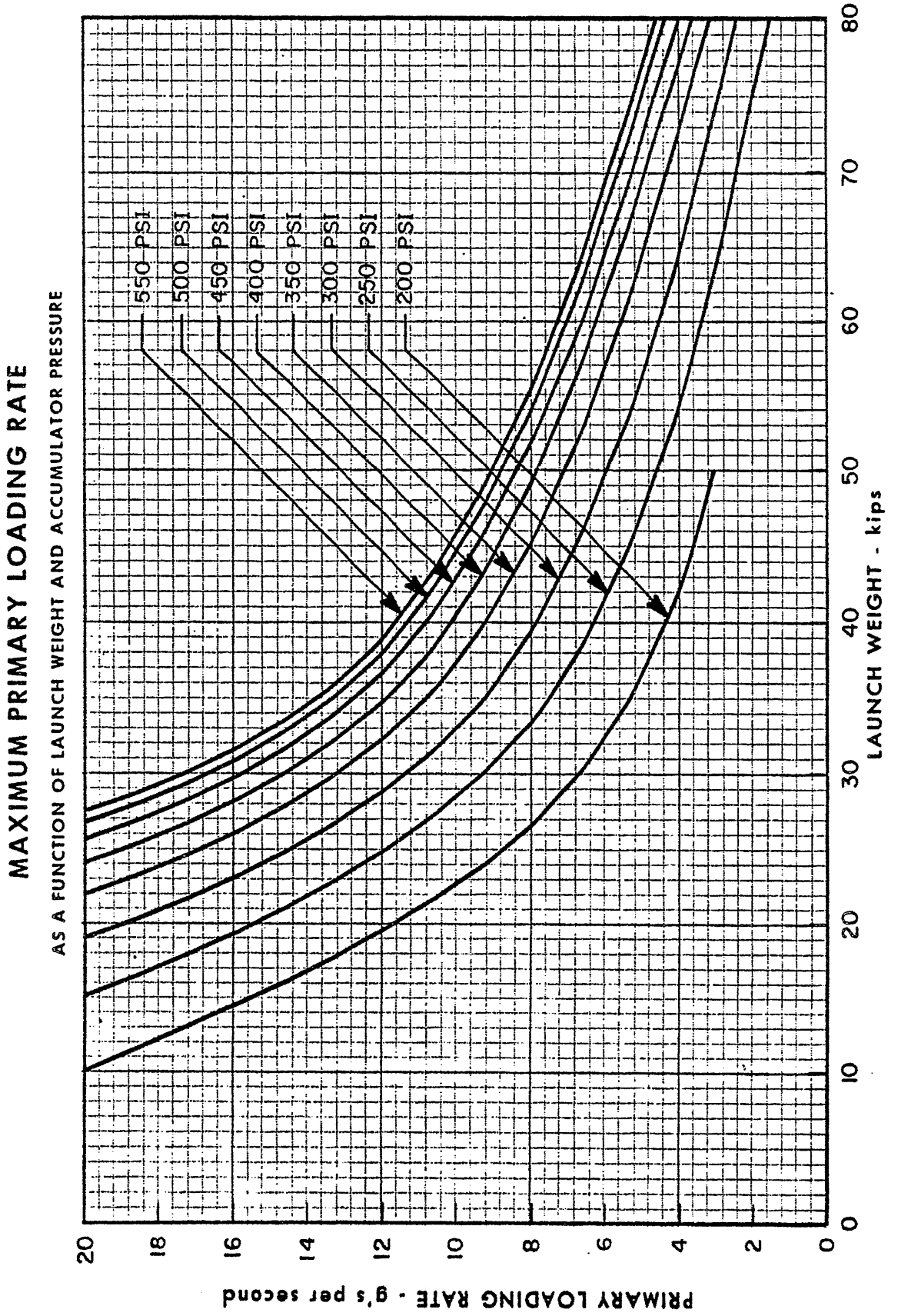

FIGURE 5.4. C11-1 (DRY) Catapult, Maximum Primary Loading Rate

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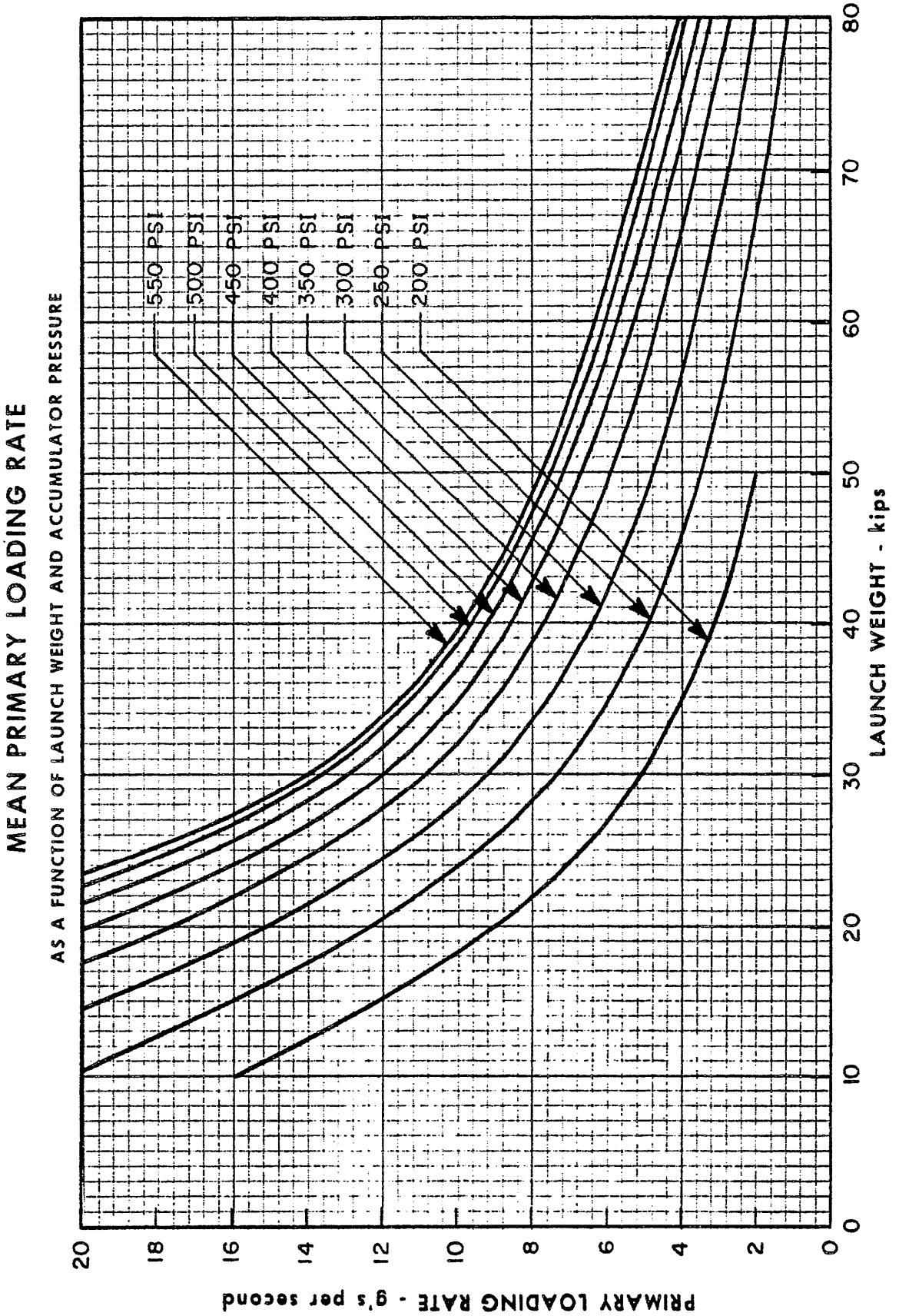

FIGURE 5.5. C11-1 (DRY) Catapult, Mean Primary Loading Rate

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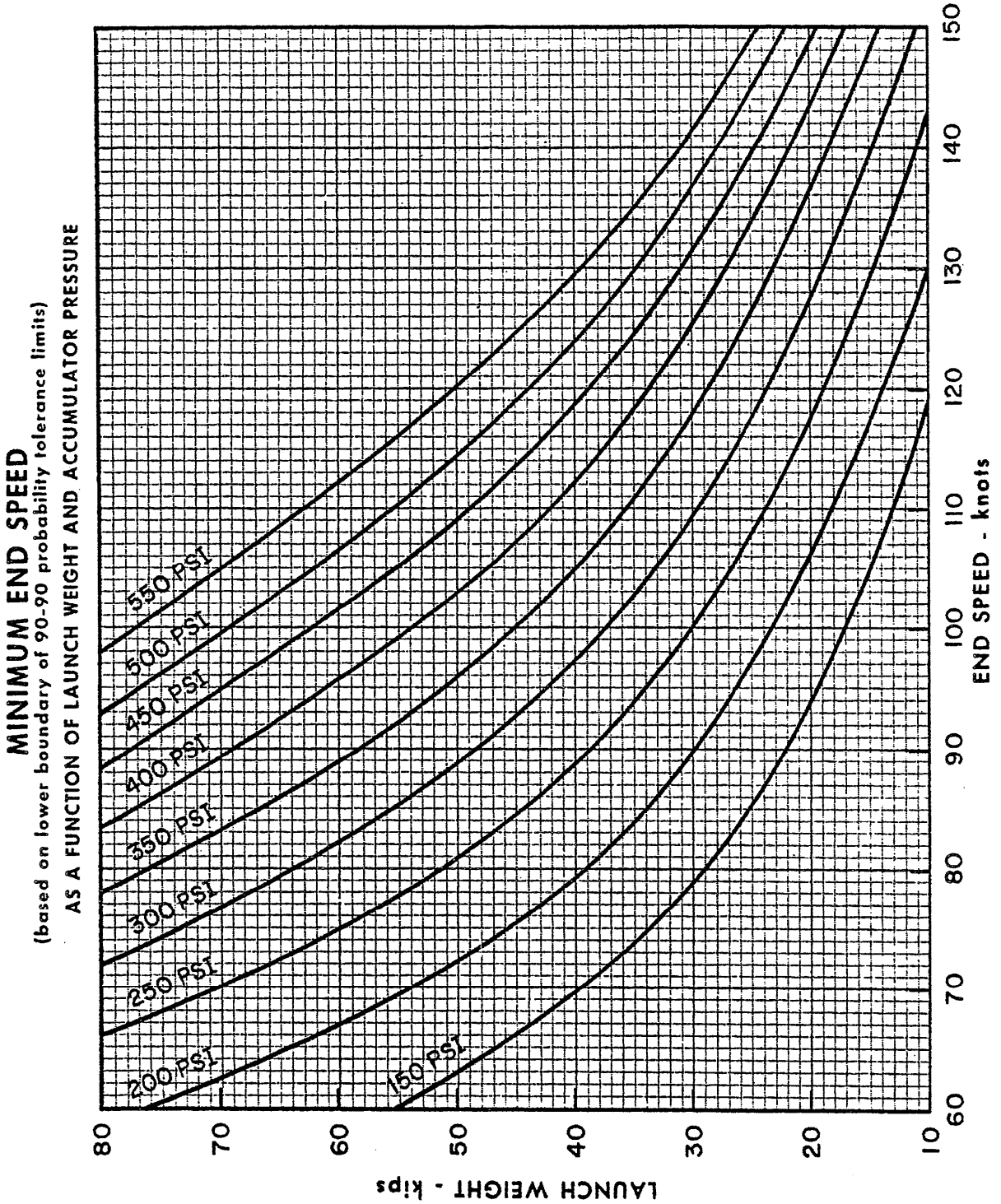

FIGURE 6.1. C11-1 (DRY) Catapult (with metering rod), Minimum End Speed

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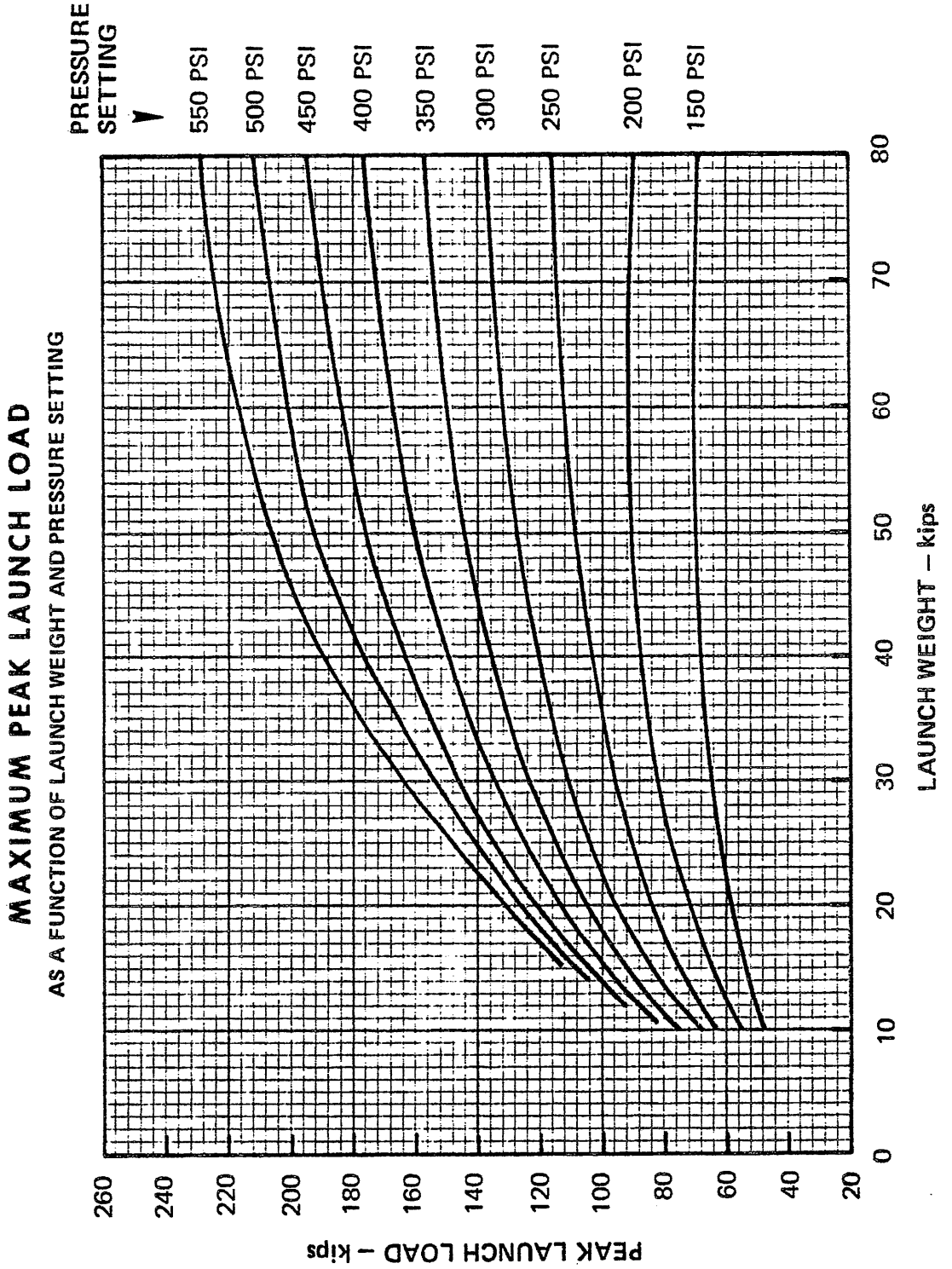

FIGURE 6.2. C11-1 (DRY) Catapult (with metering rod), Maximum Peak Catapult Force

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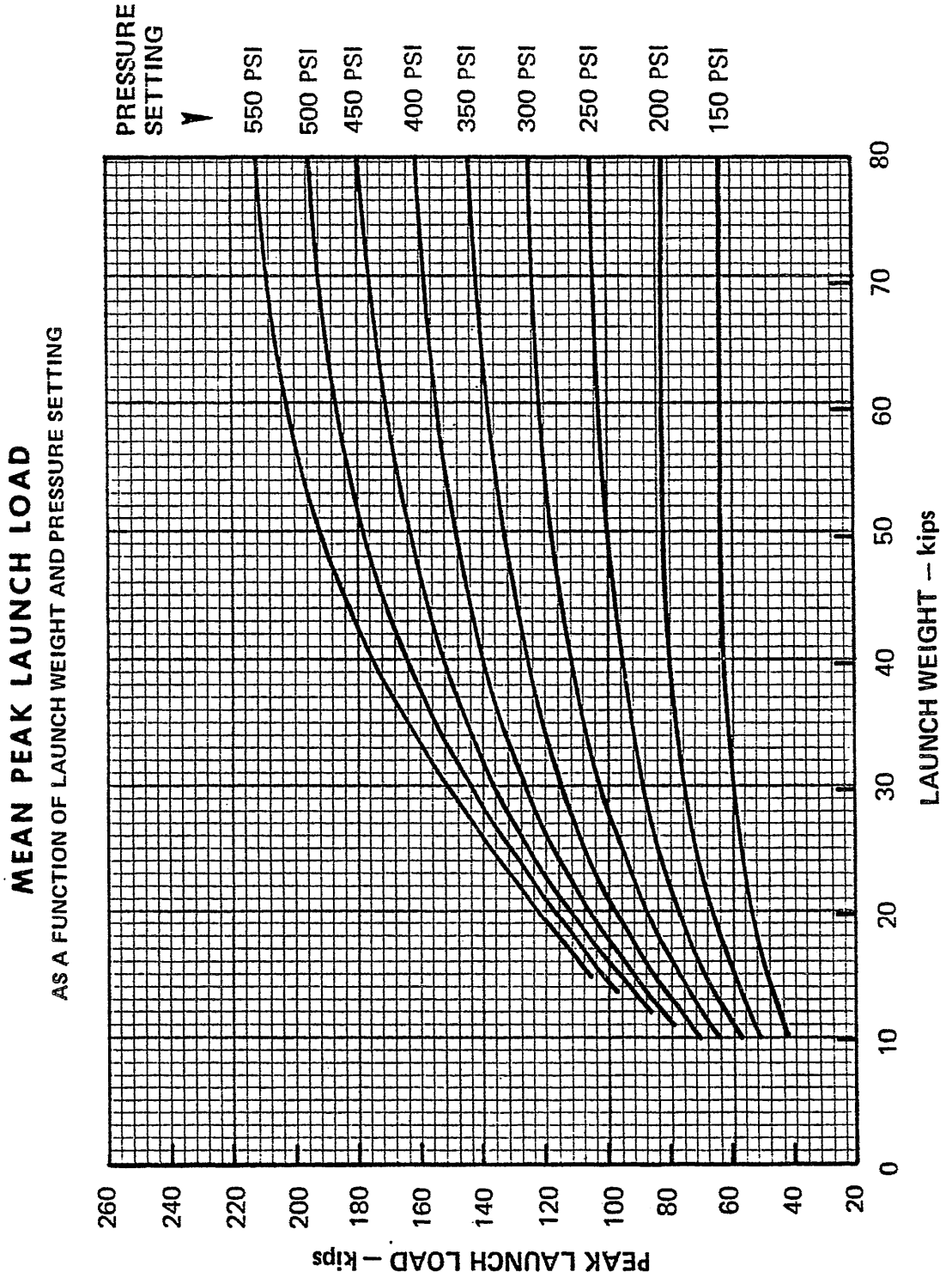

FIGURE 6.3. C11-1 (DRY) Catapult (with metering rod), Mean Peak Catapult Force

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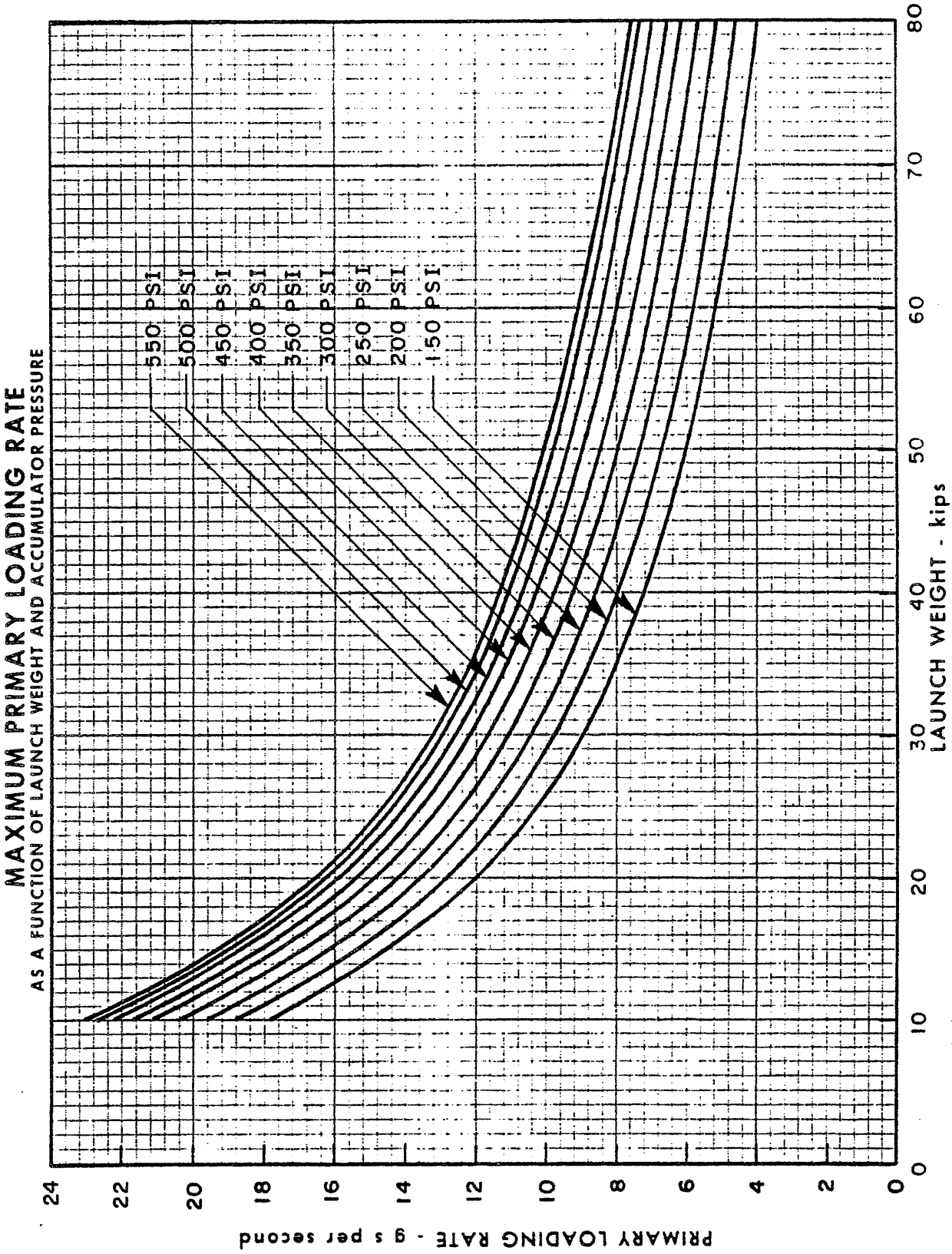

FIGURE 6.4. C11-1 (DRY) Catapult (with metering rod), Maximum Primary Loading Rate

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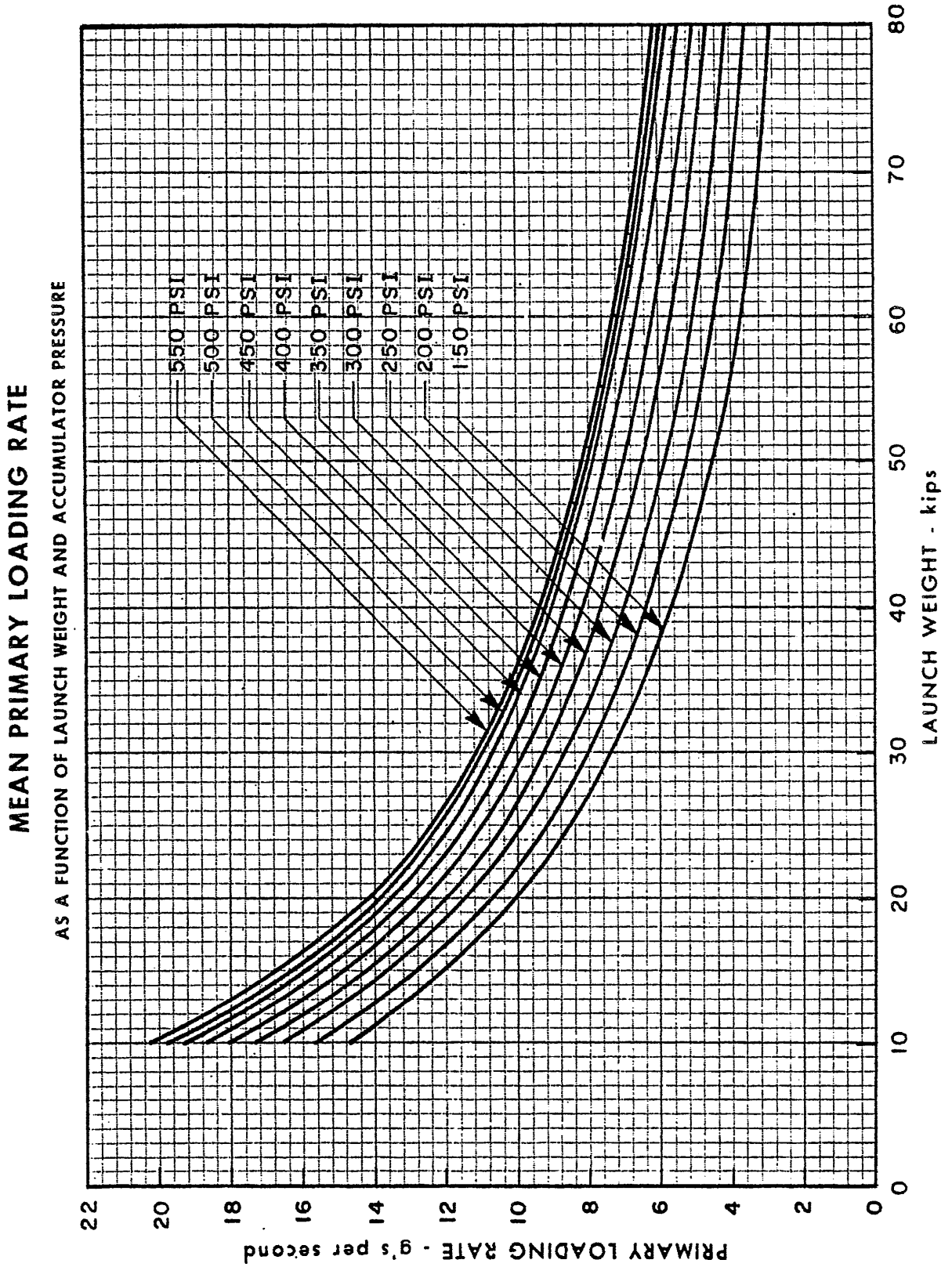

FIGURE 6.5. C11-1 (DRY) Catapult (with metering rod), Mean Primary Loading Rate

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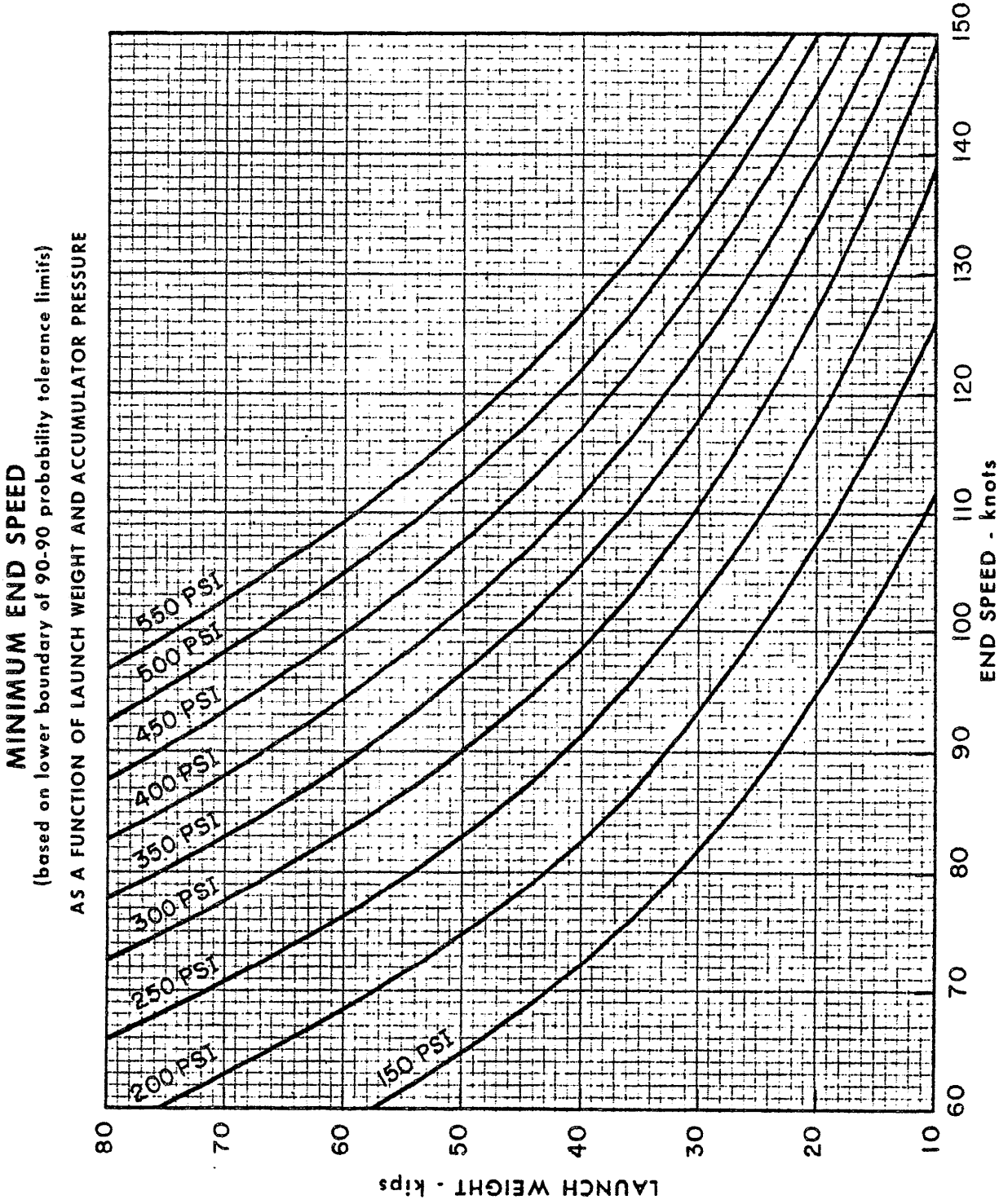

FIGURE 7.1. C11-1 (WET) Catapult (with metering rod), Minimum End Speed

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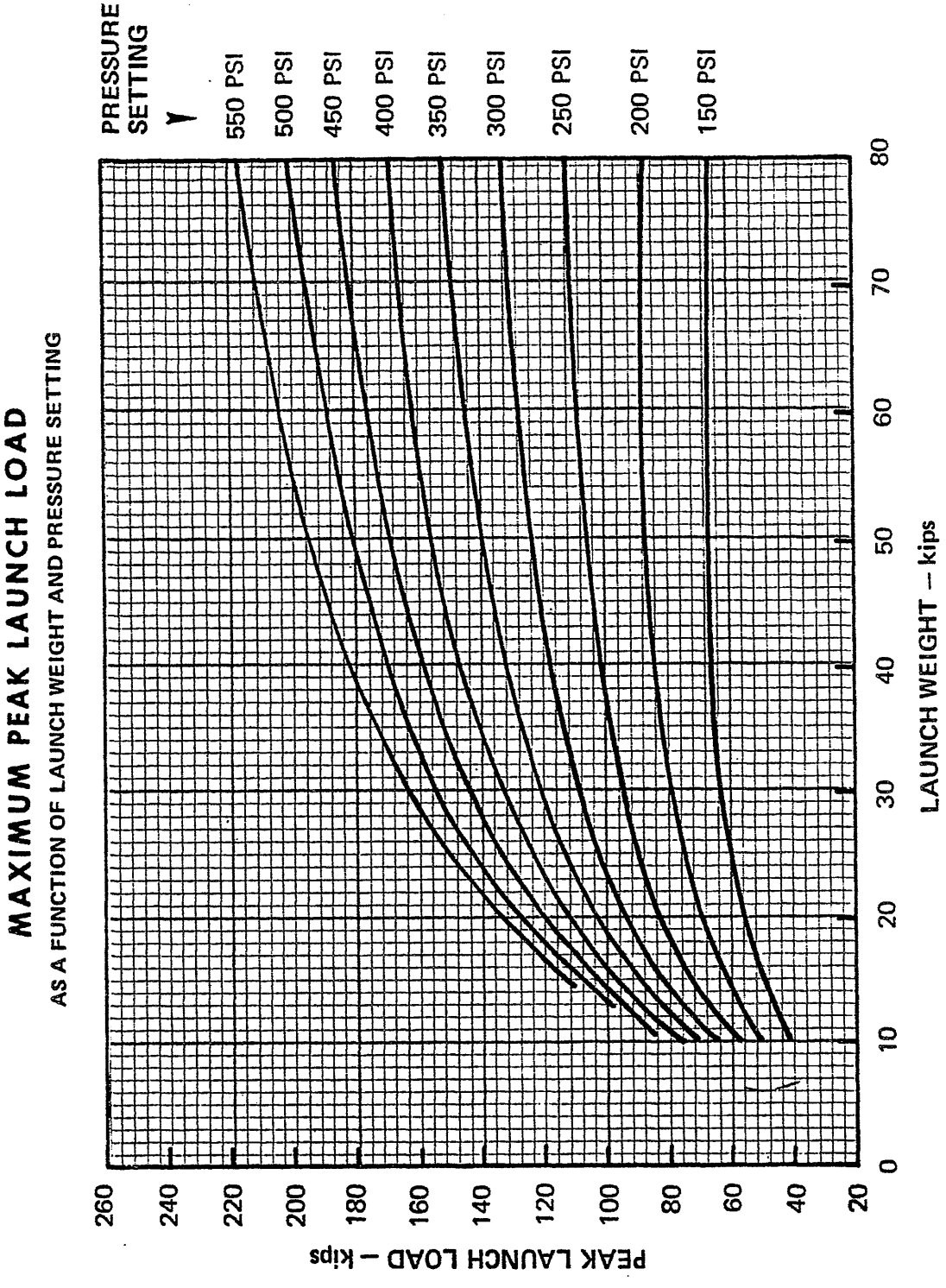

FIGURE 7.2. C11-1 (WET) Catapult (with metering rod), Maximum Peak Catapult Force

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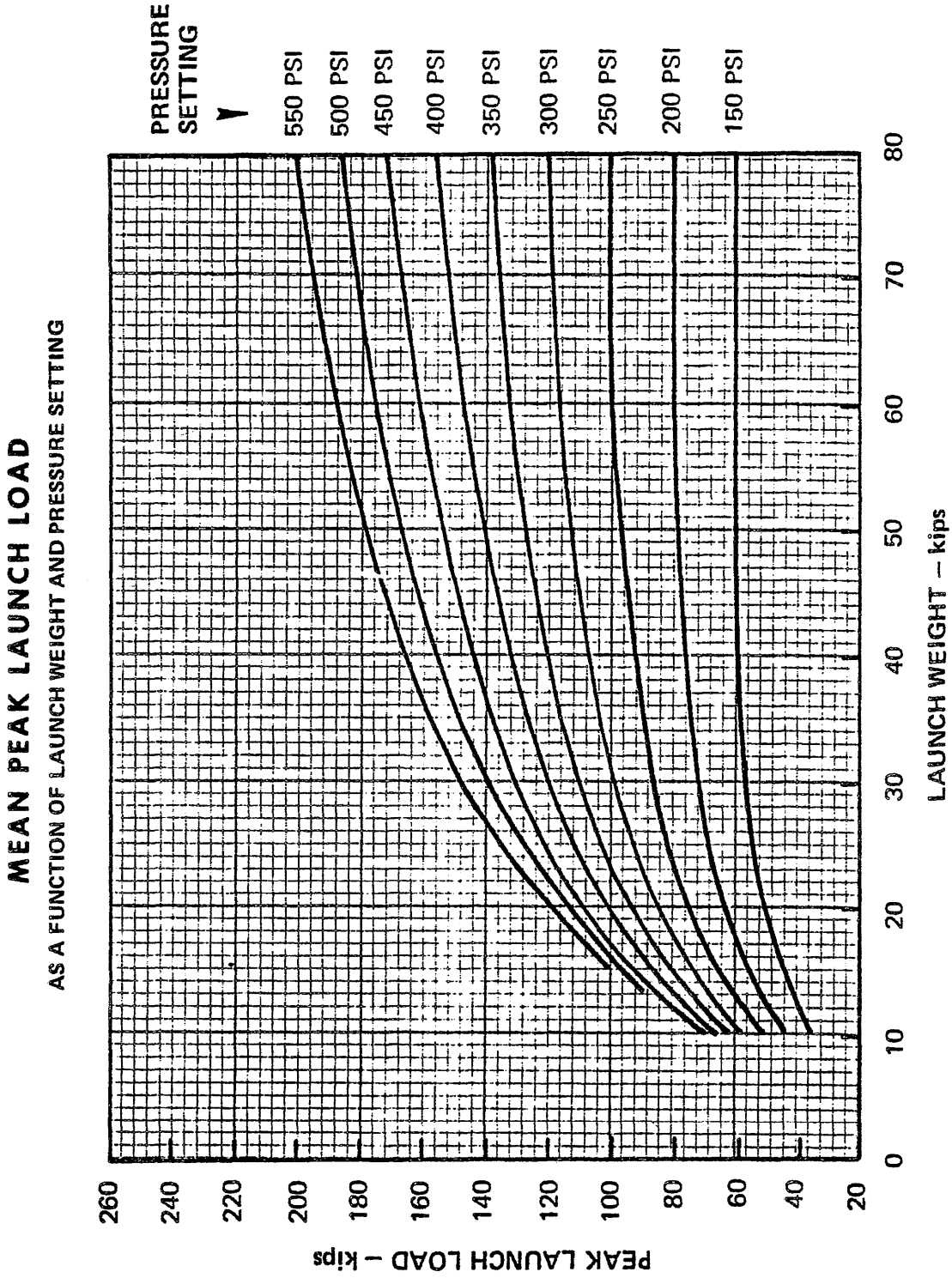

FIGURE 7.3. C11-1 (WET) Catapult (with metering rod), Mean Peak Catapult Force

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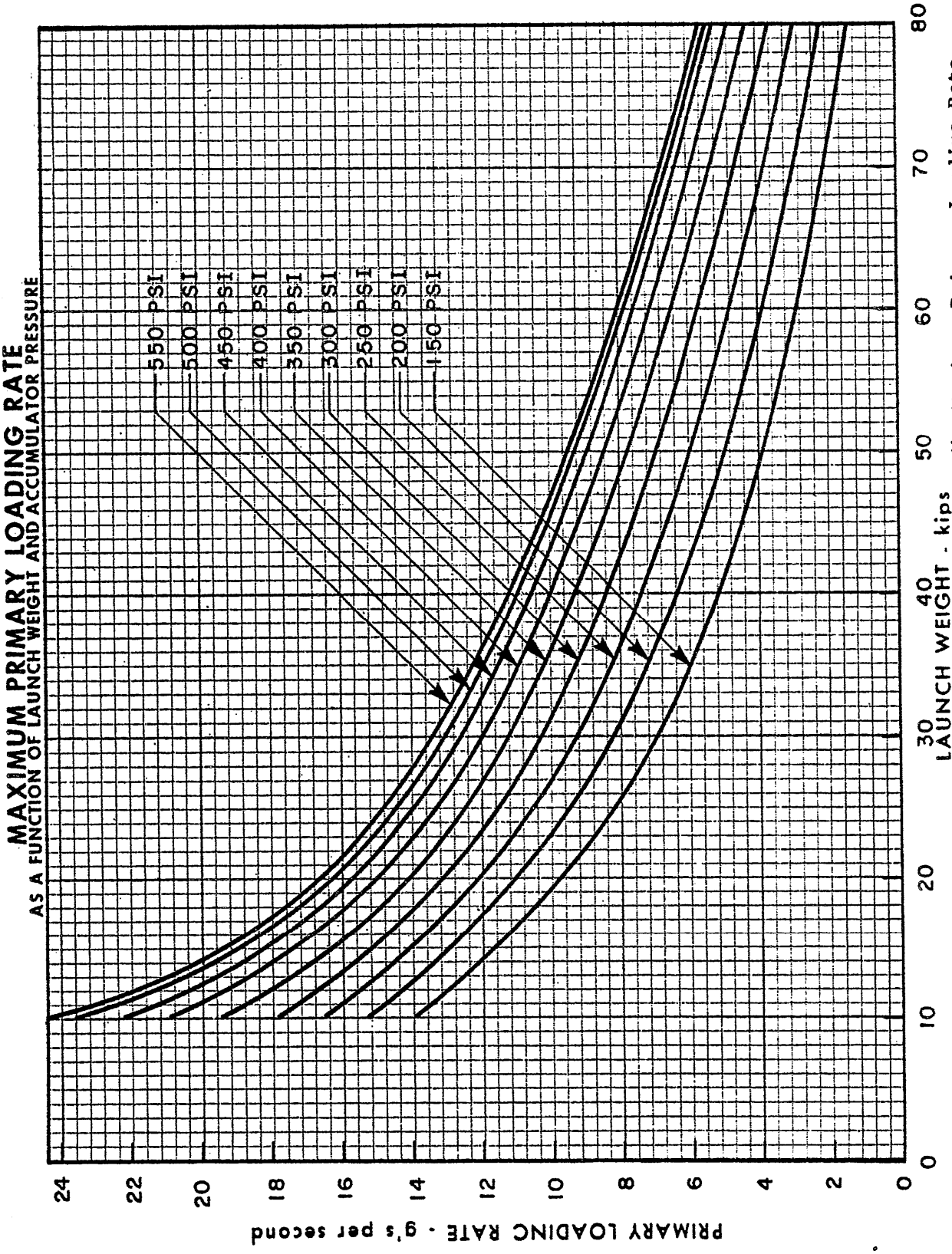

FIGURE 7.4. C11-1 (WET) Catapult (with metering rod), Maximum Primary Loading Rate

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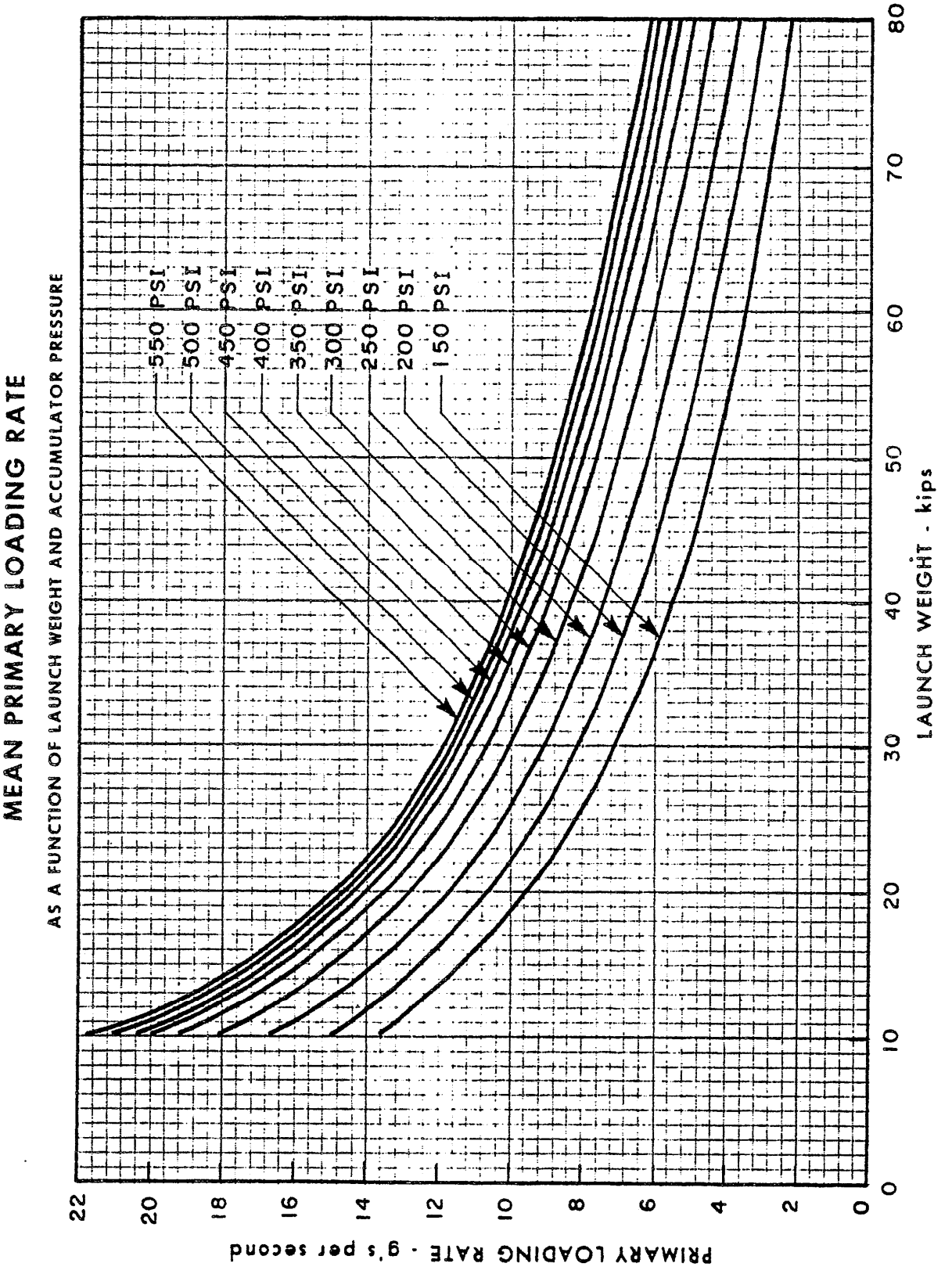

FIGURE 7.5. C11-1 (WET) Catapult (with metering rod), Mean Primary Loading Rate

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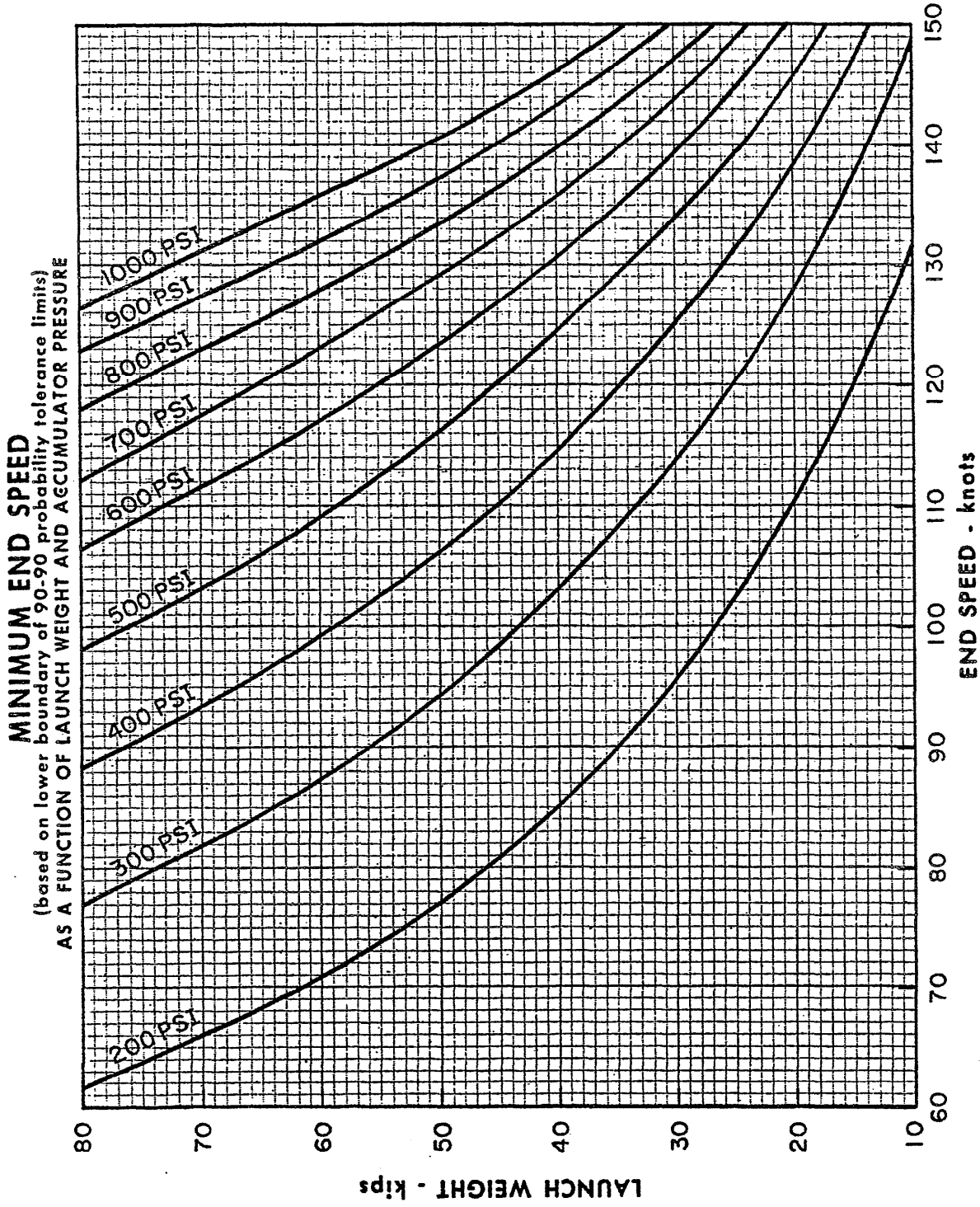

FIGURE 8.1. C13 Catapult (CVA63, 64, 65, 66), Minimum End Speed

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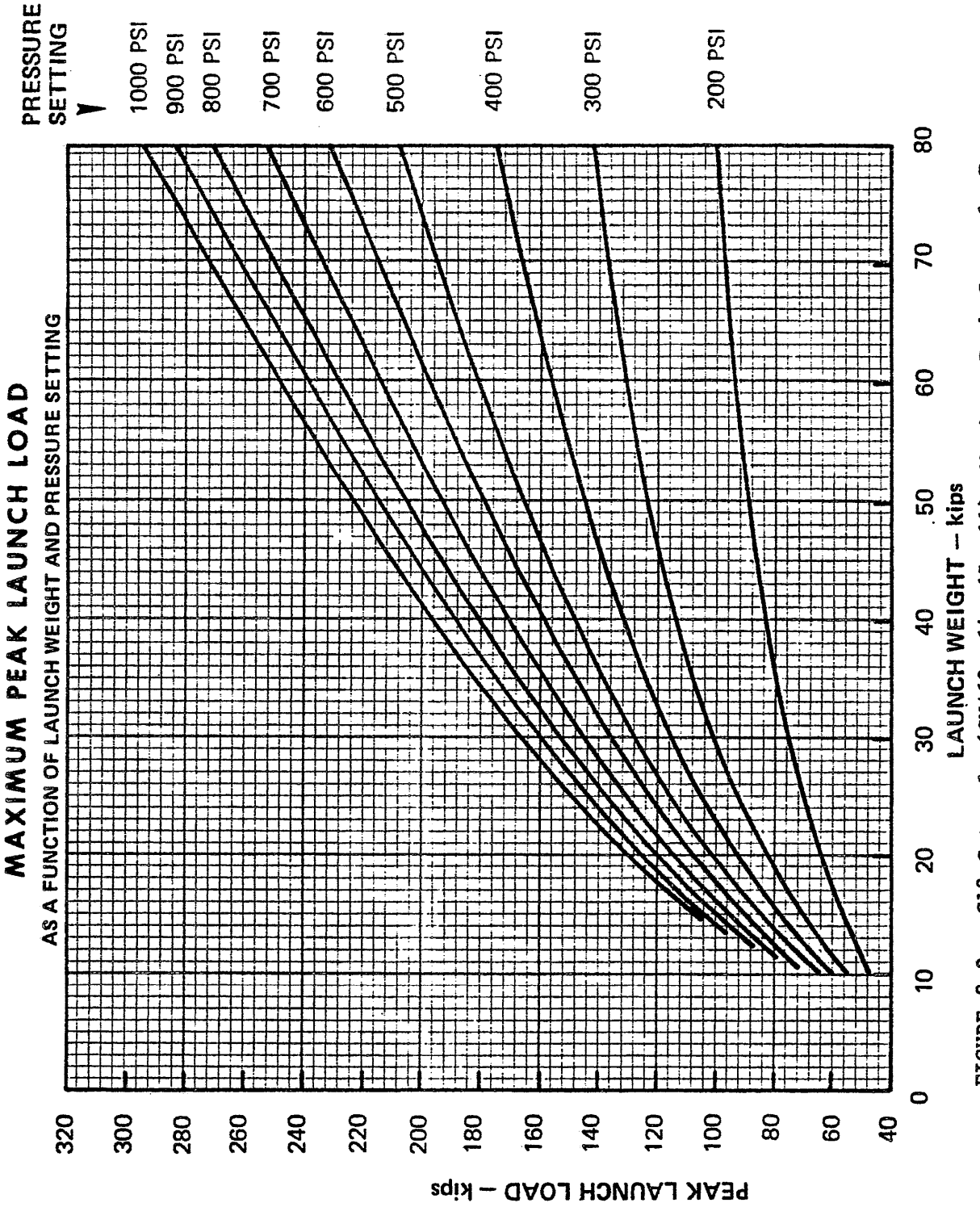

FIGURE 8.2. C13 Catapult (CVA63, 64, 65, 66), Maximum Peak Catapult Force

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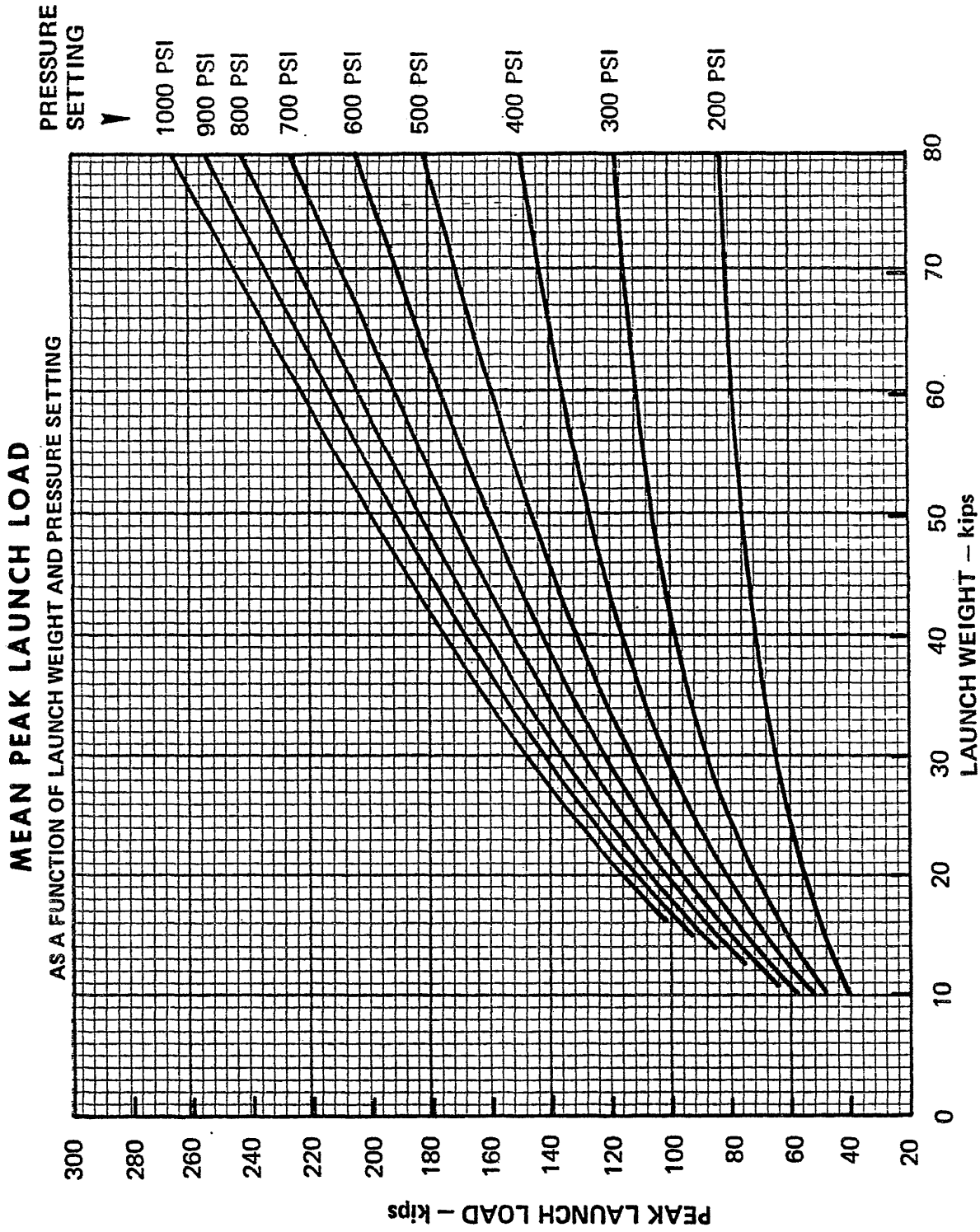

FIGURE 8.3. C13 Catapult (CVA63, 64, 65, 66), Mean Peak Catapult Force

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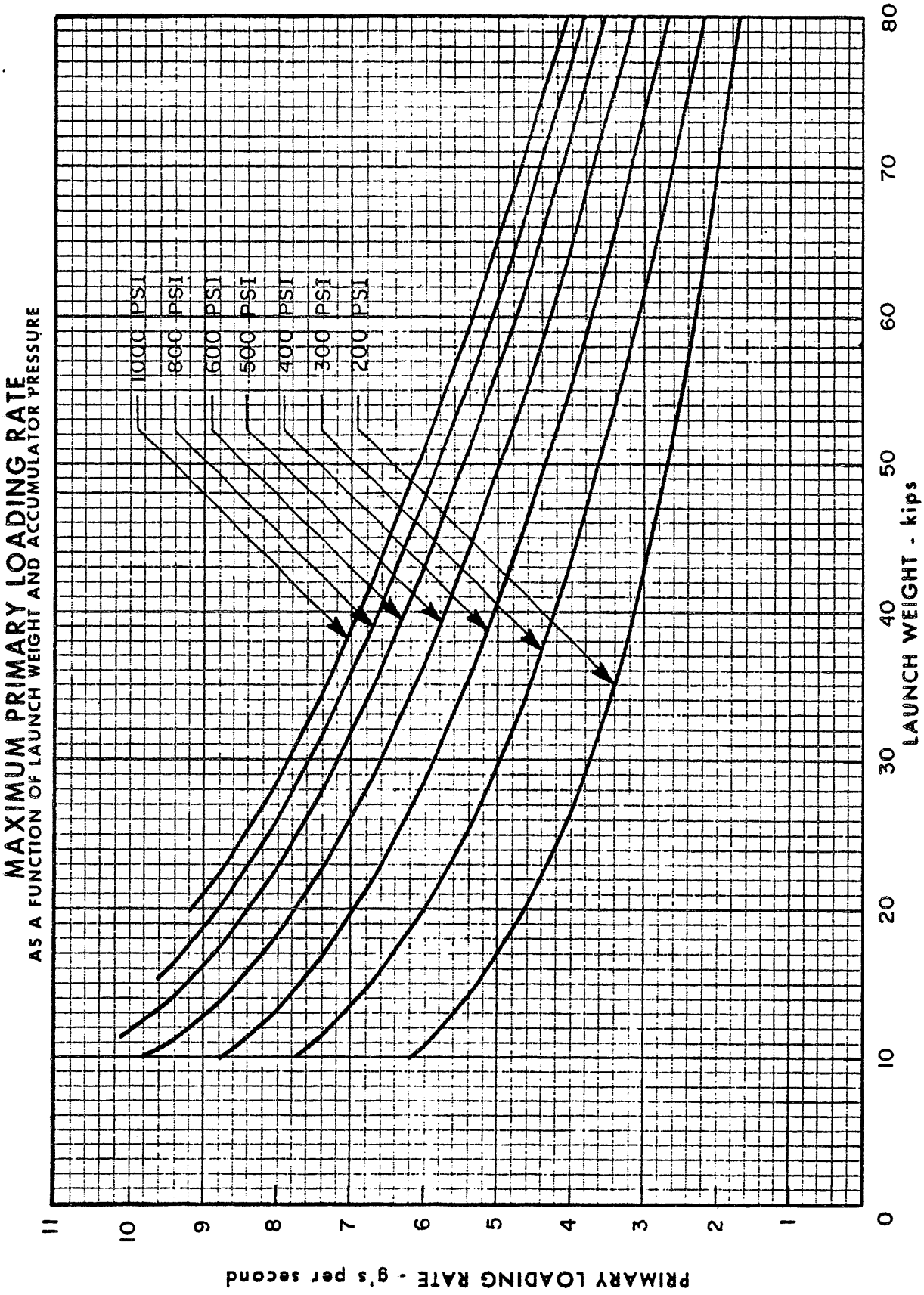

FIGURE 8.4. C13 Catapult (CVA63, 64, 65, 66), Maximum Primary Loading Rate

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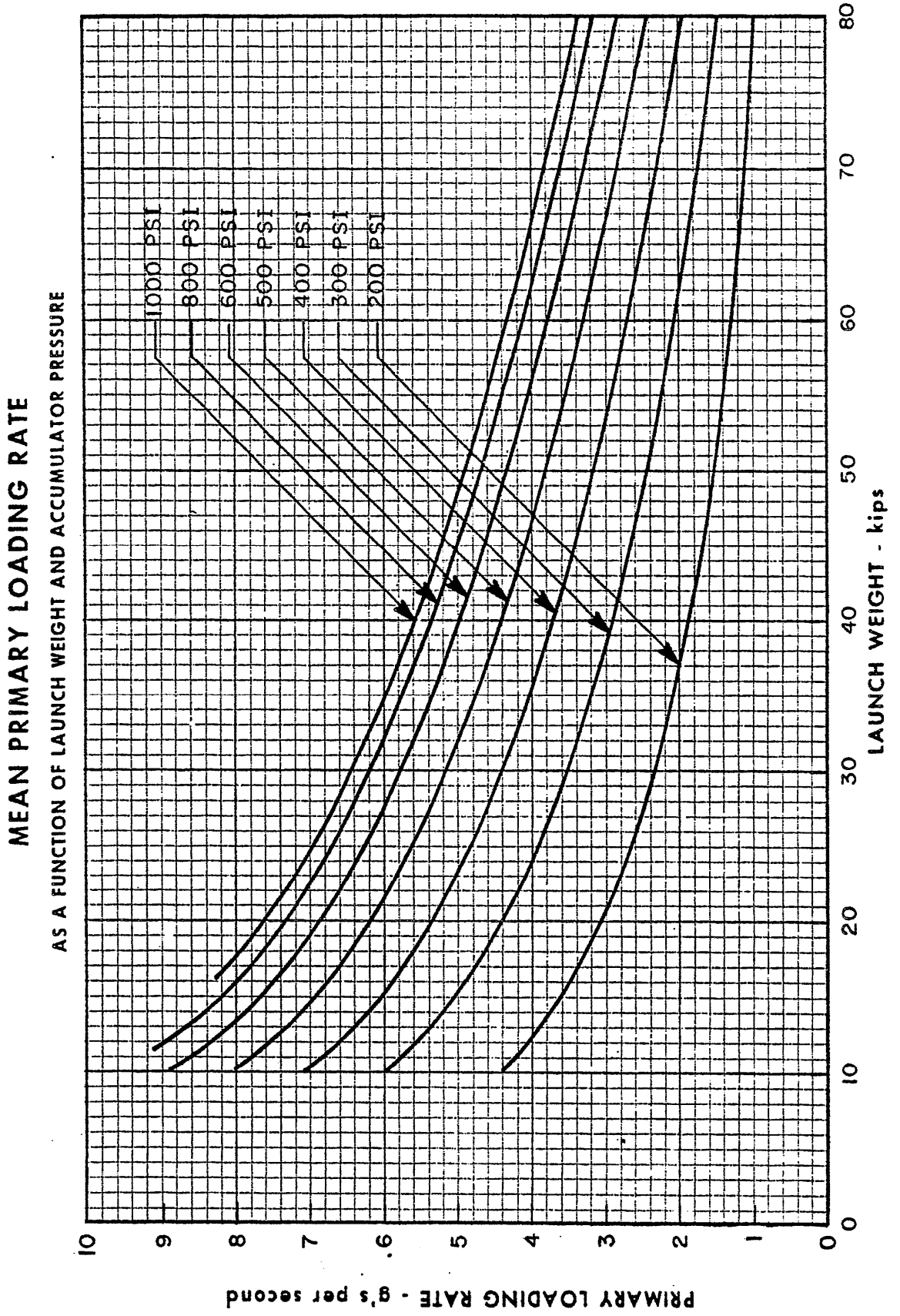

FIGURE 8.5. C13 Catapult (CVA63, 64, 65, 66), Mean Primary Loading Rate

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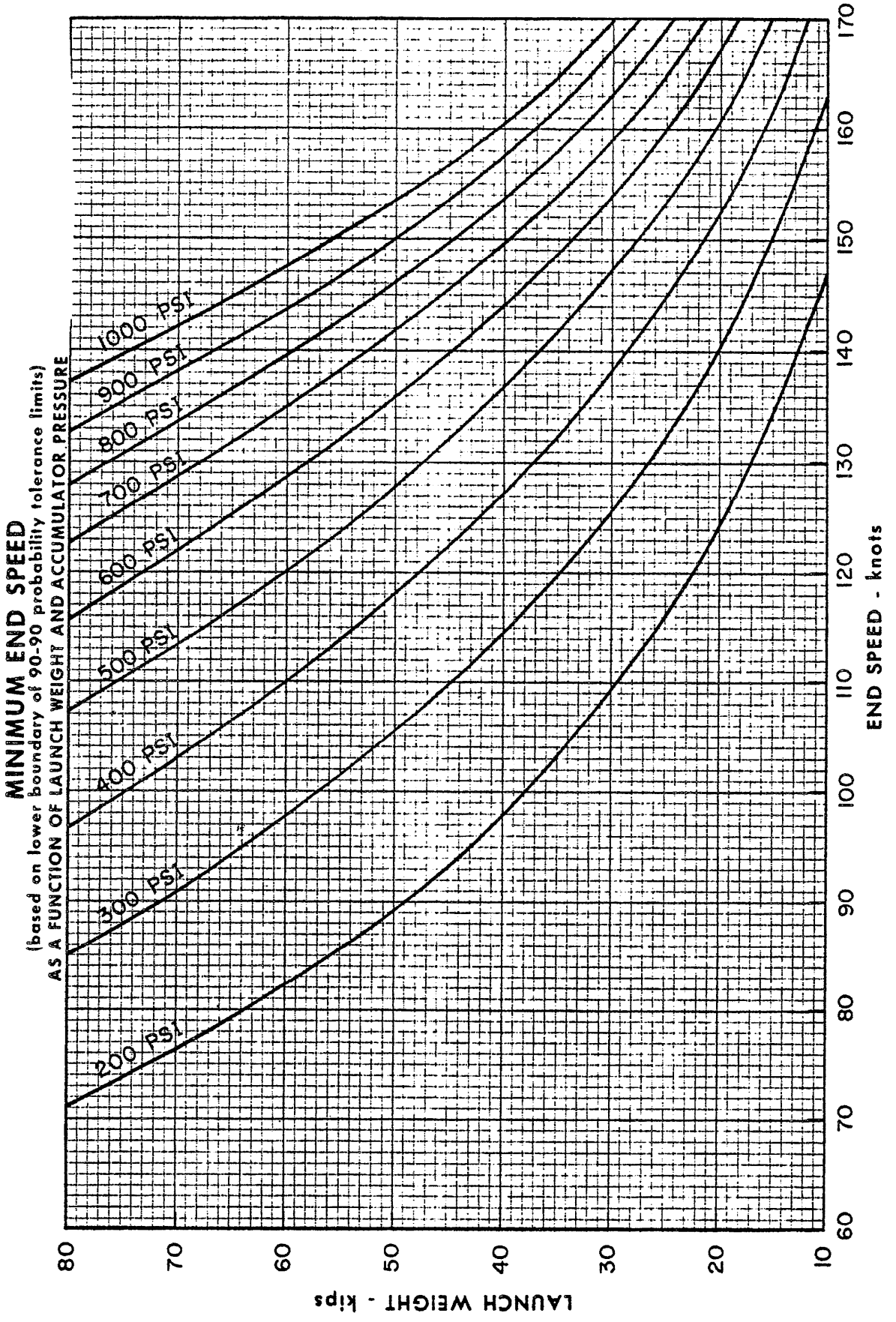

FIGURE 9.1. C13-1 Catapult (CVA66), Minimum End Speed

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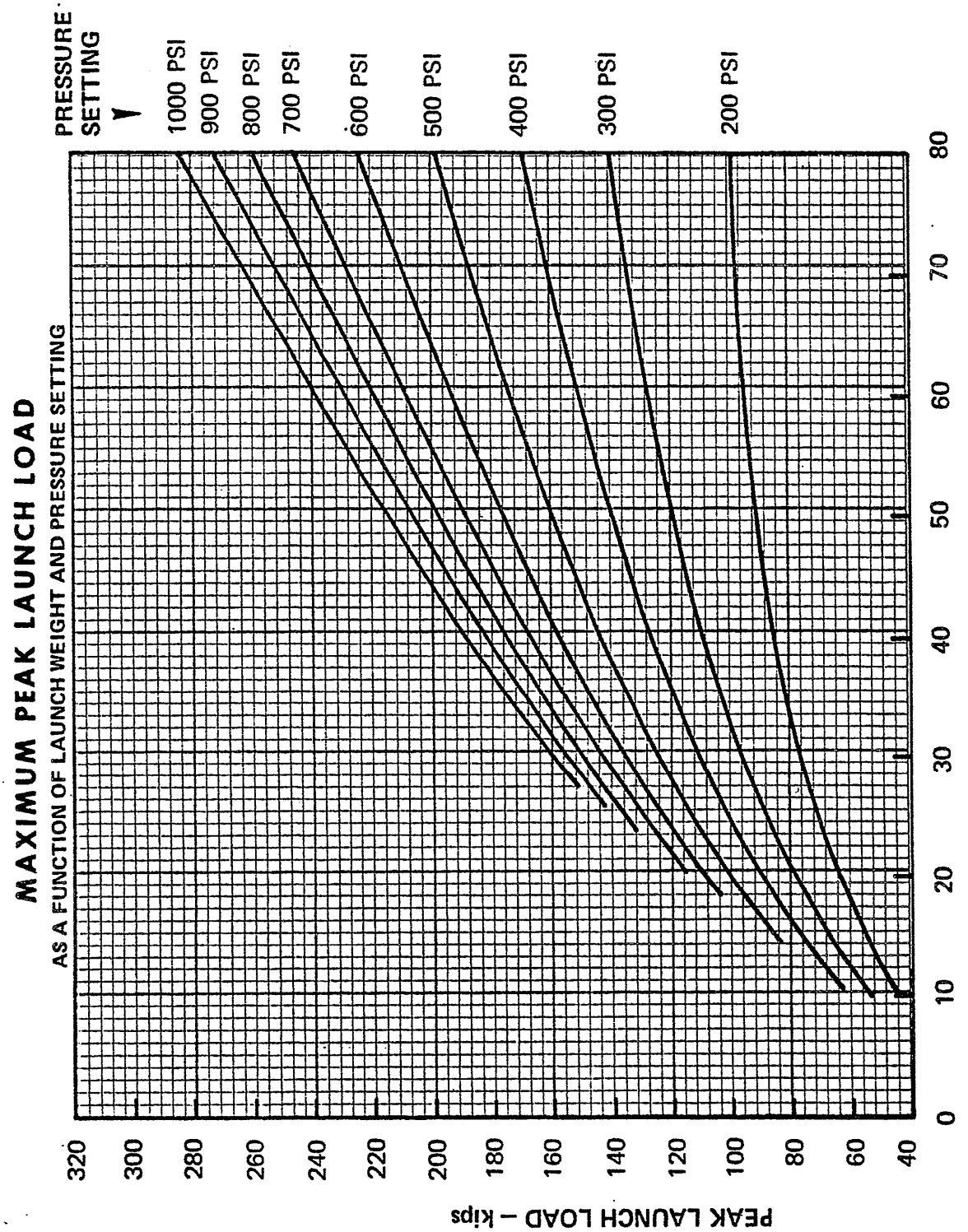

FIGURE 9.2. C13-1 Catapult (CVA66), Maximum Peak Catapult Force

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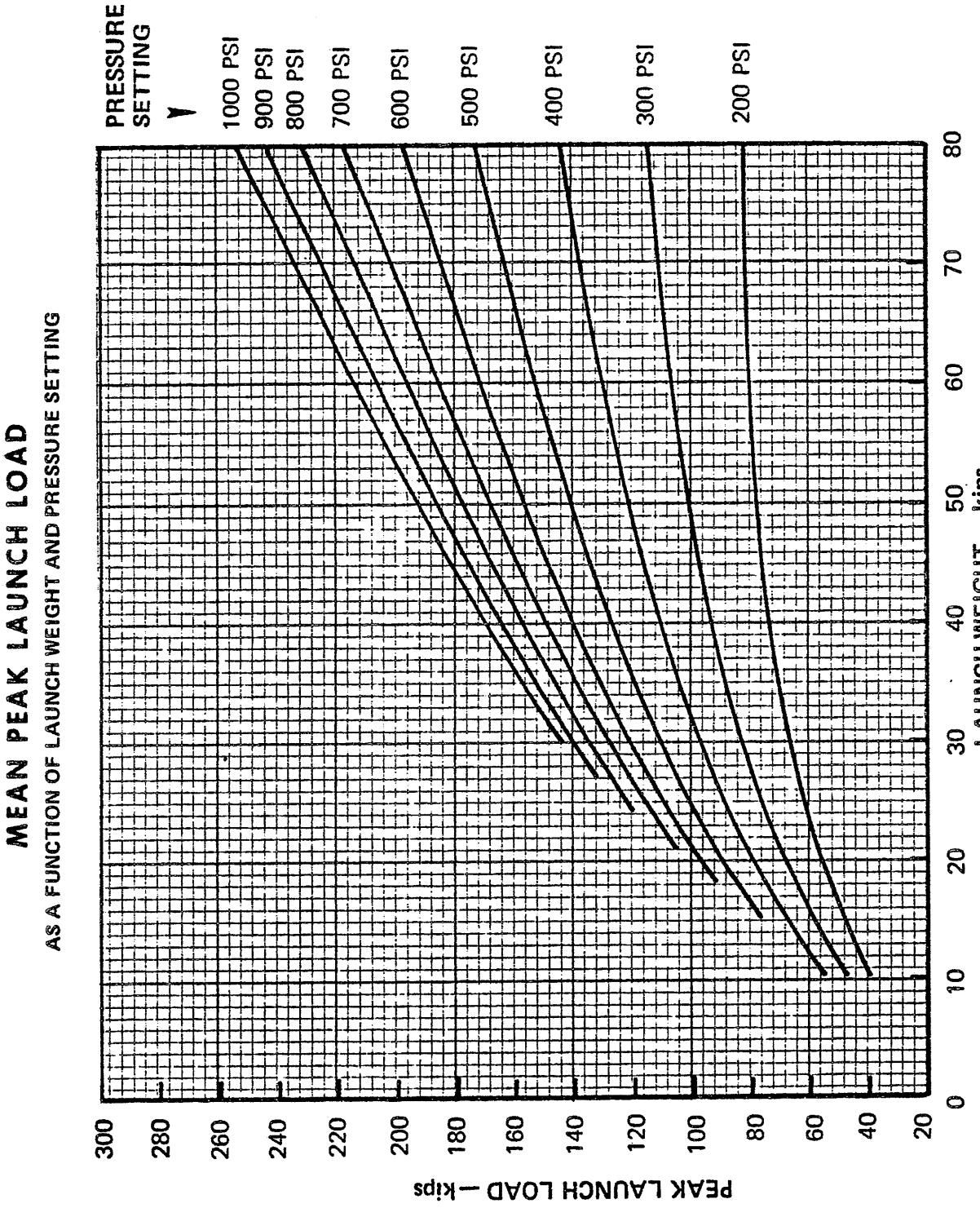

FIGURE 9.3. C13-1 Catapult (CVA66), Mean Peak Catapult Force

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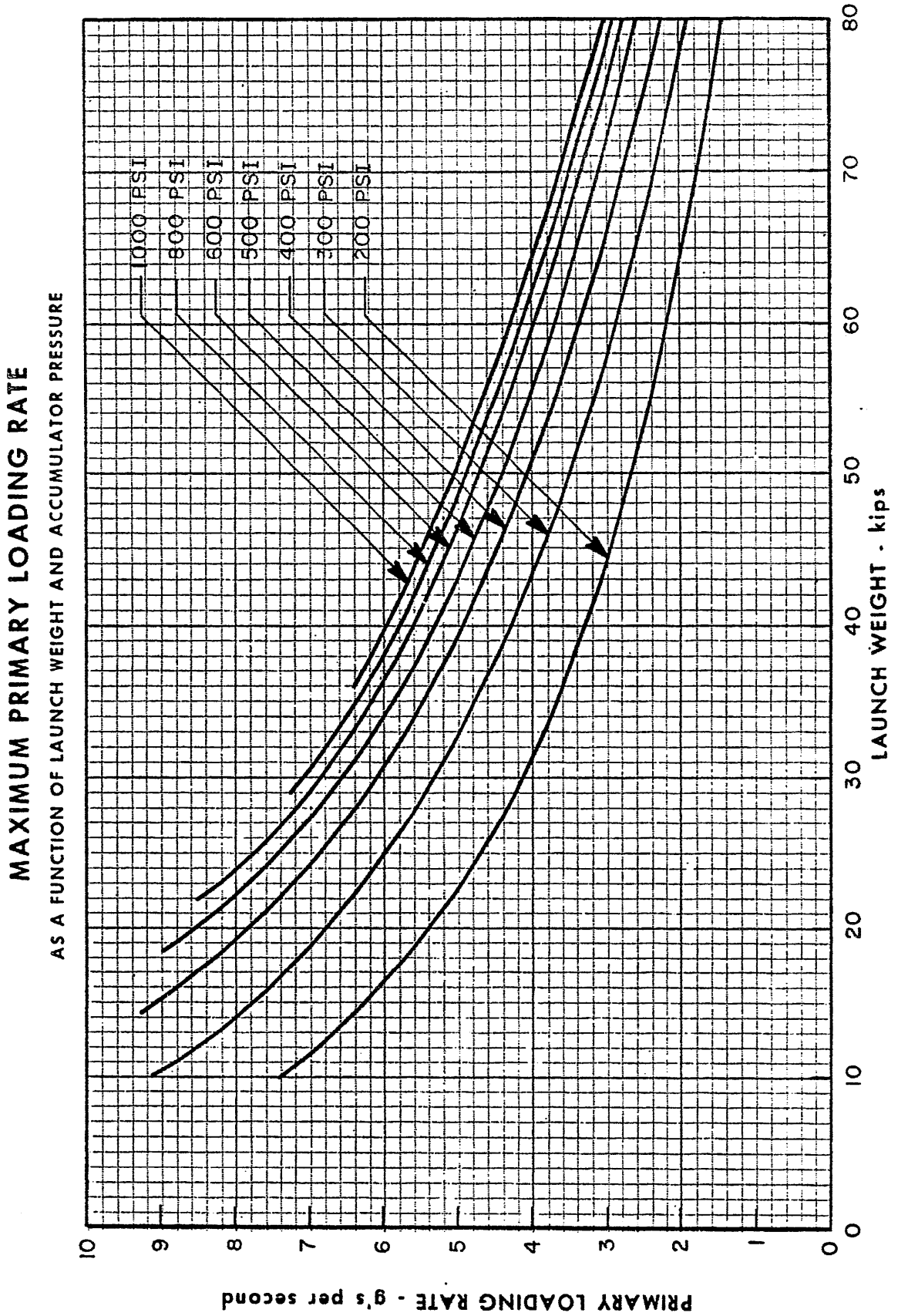

FIGURE 9.4. C13-1 Catapult (CVA66), Maximum Primary Loading Rate

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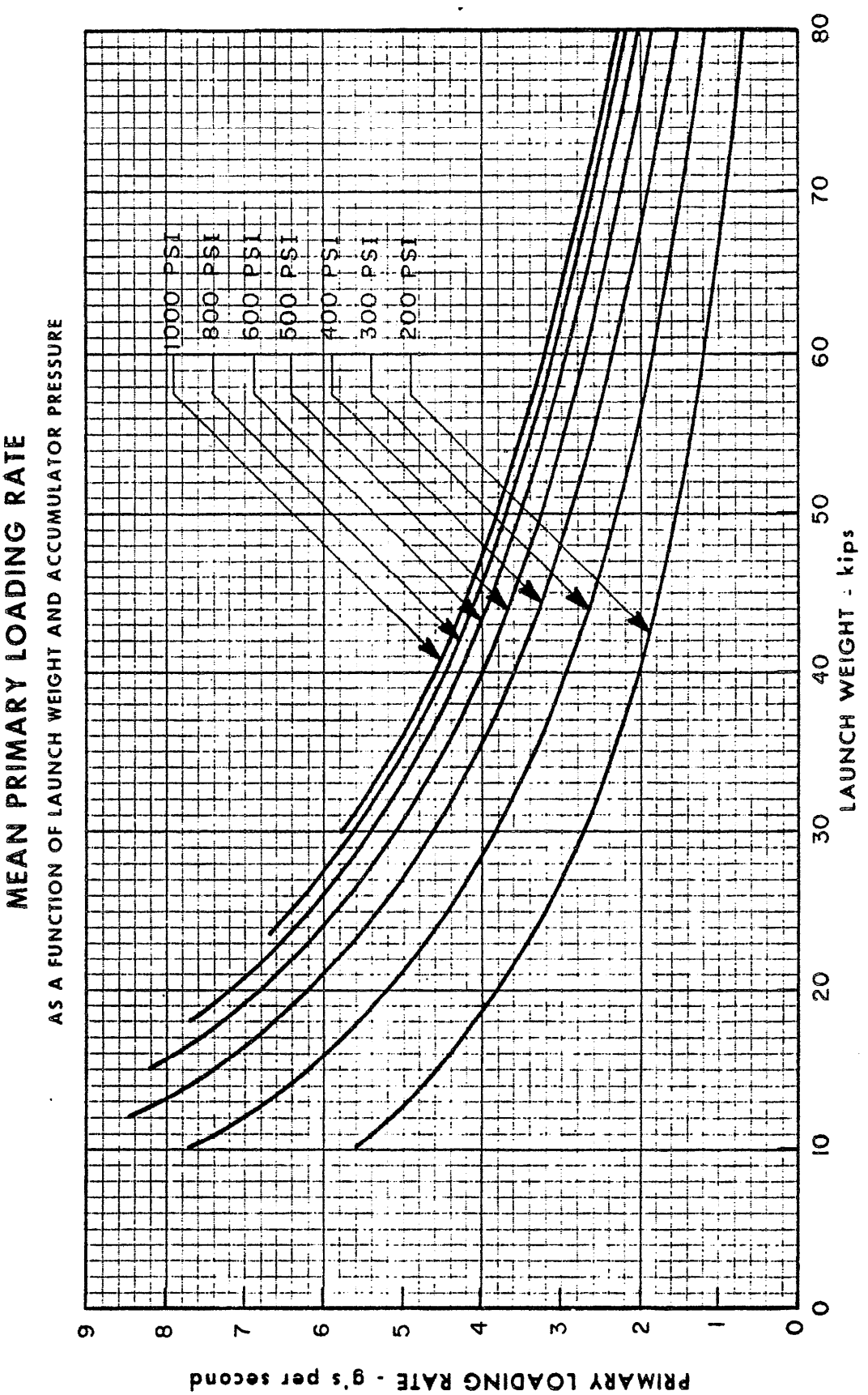

FIGURE 9.5. C13-1 Catapult (CVA66), Mean Primary Loading Rate

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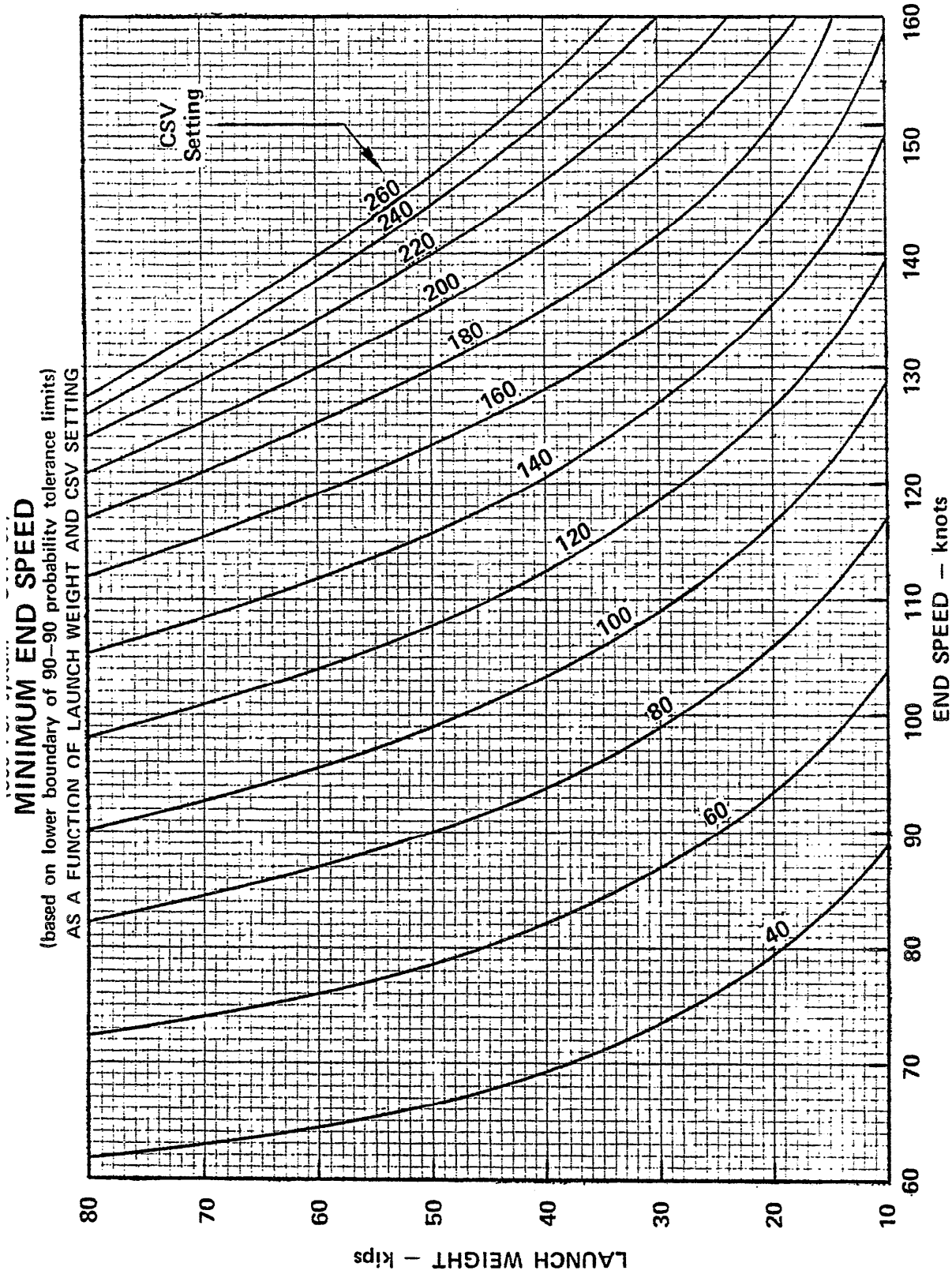

FIGURE 10.1. C13 Constant Pressure Catapult (CVA67), Minimum End Speed

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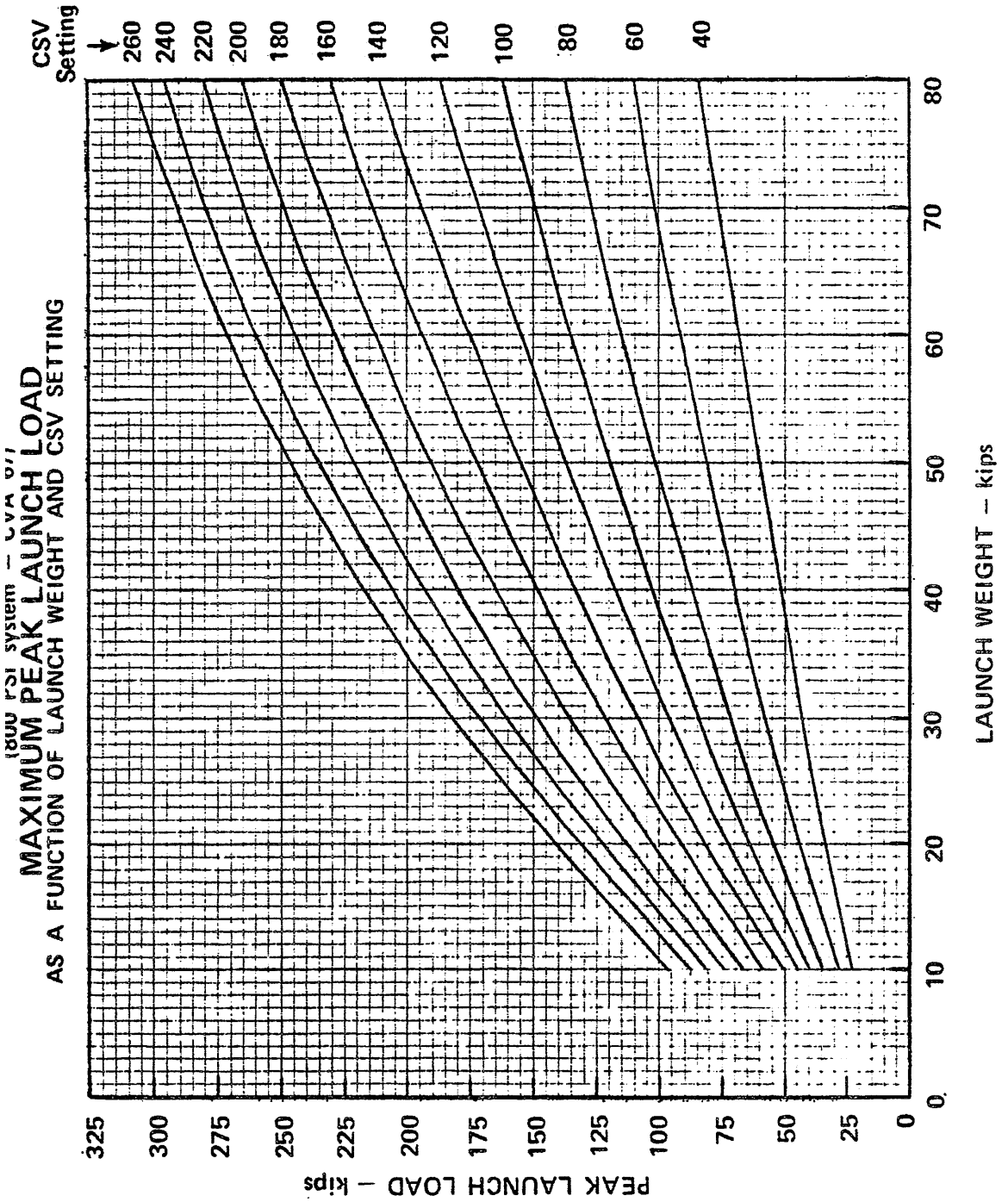

FIGURE 10.2. C13 Constant Pressure Catapult (CVA67), Maximum Peak Catapult Force

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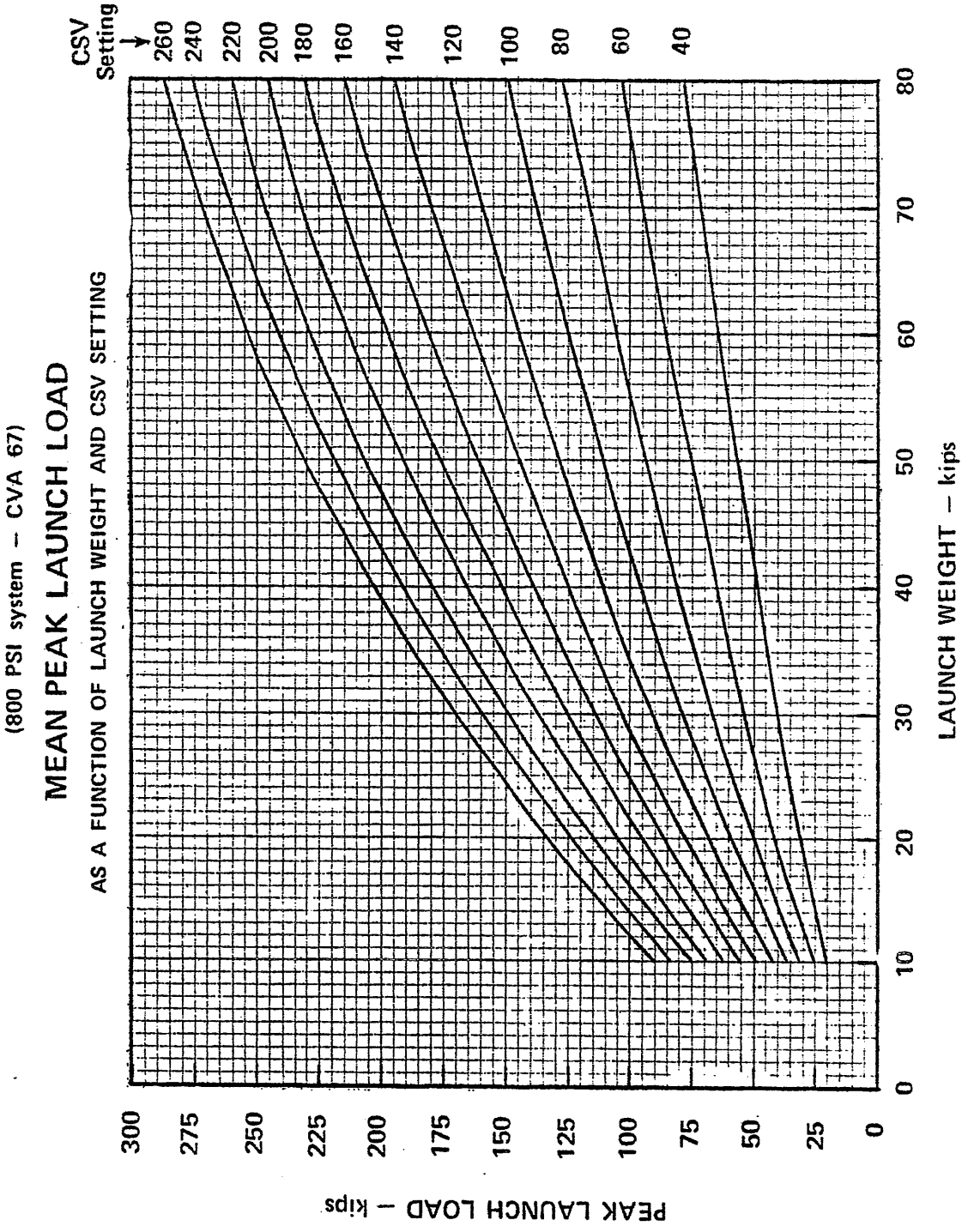

FIGURE 10.3. C13 Constant Pressure Catapult (CVA67), Mean Peak Catapult Force

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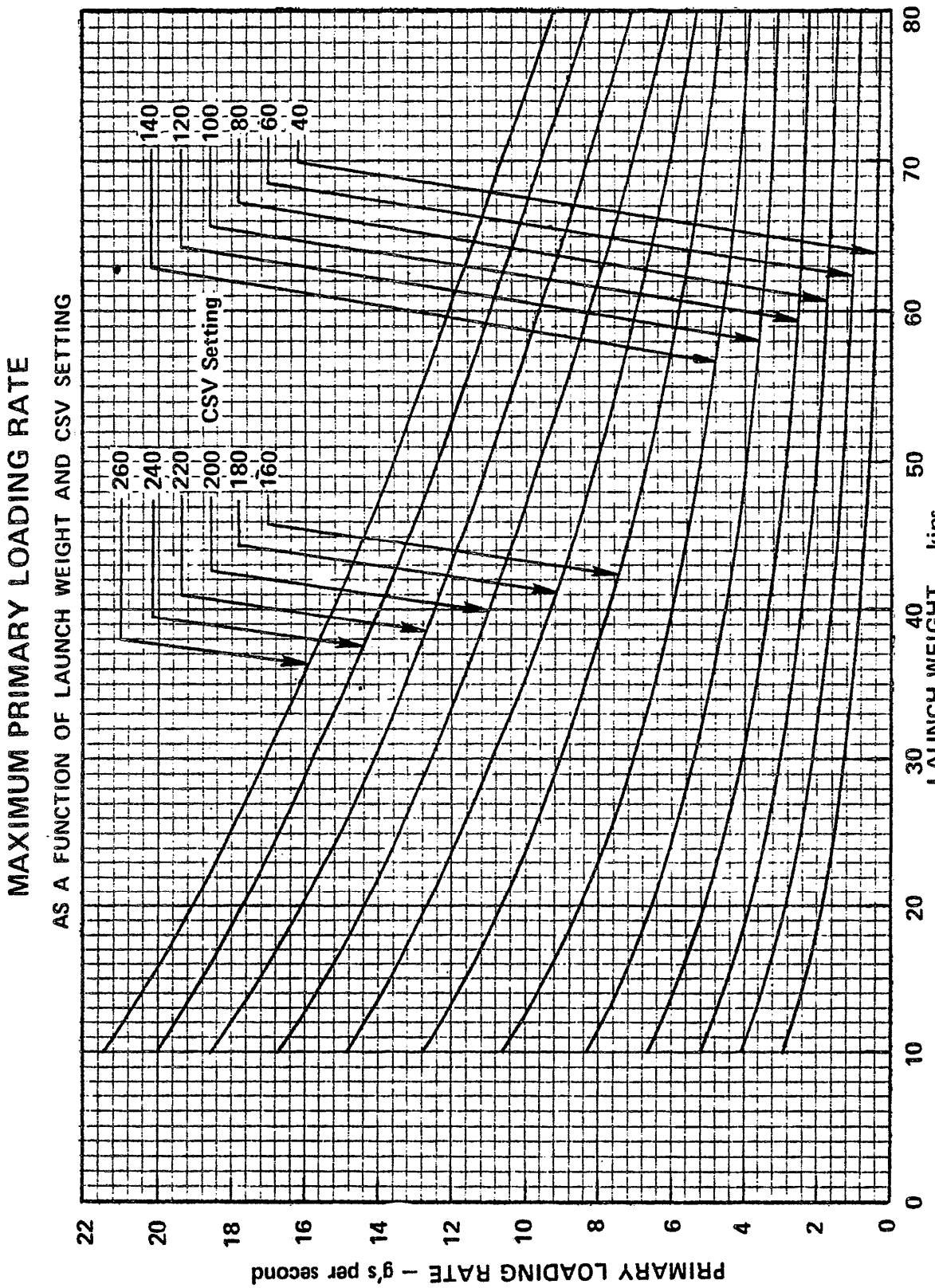

FIGURE 10.4. C13 Constant Pressure Catapult (CVA67), Maximum Primary Loading Rate

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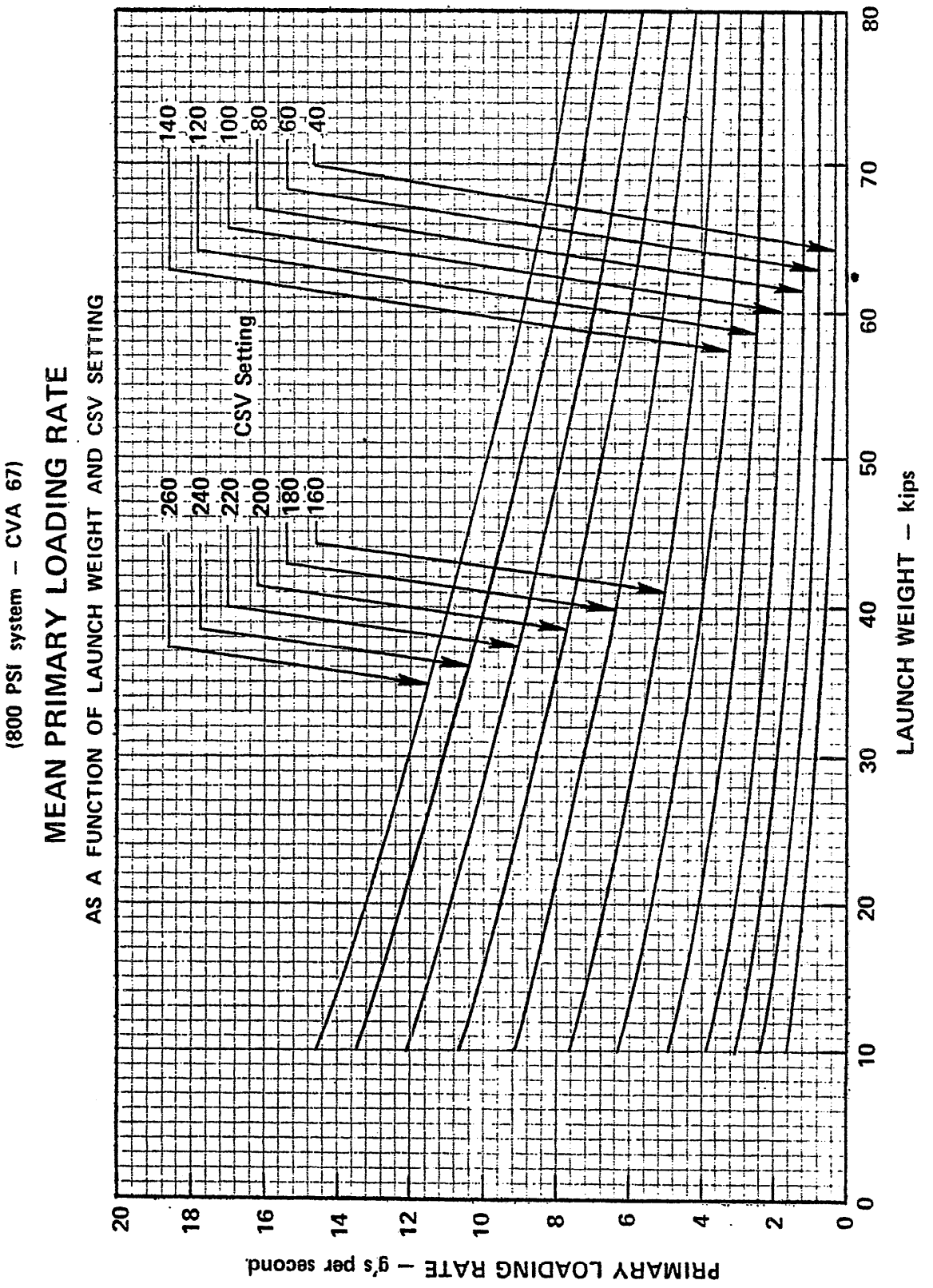

FIGURE 10.5. C13 Constant Pressure Catapult (CVA67), Mean Primary Loading Rate

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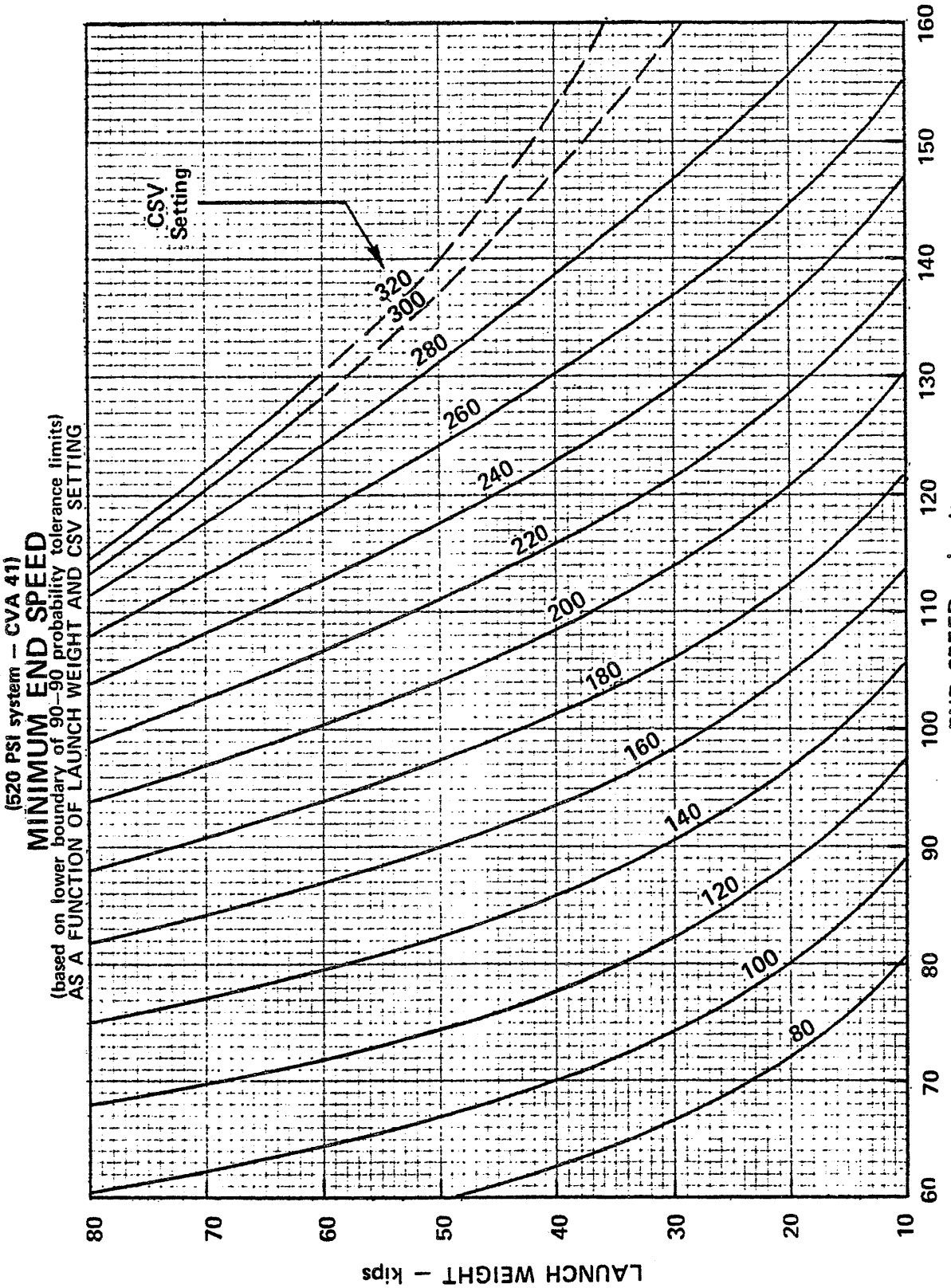

FIGURE 11.1. C13 Constant Pressure Catapult (CVA41), Minimum End Speed

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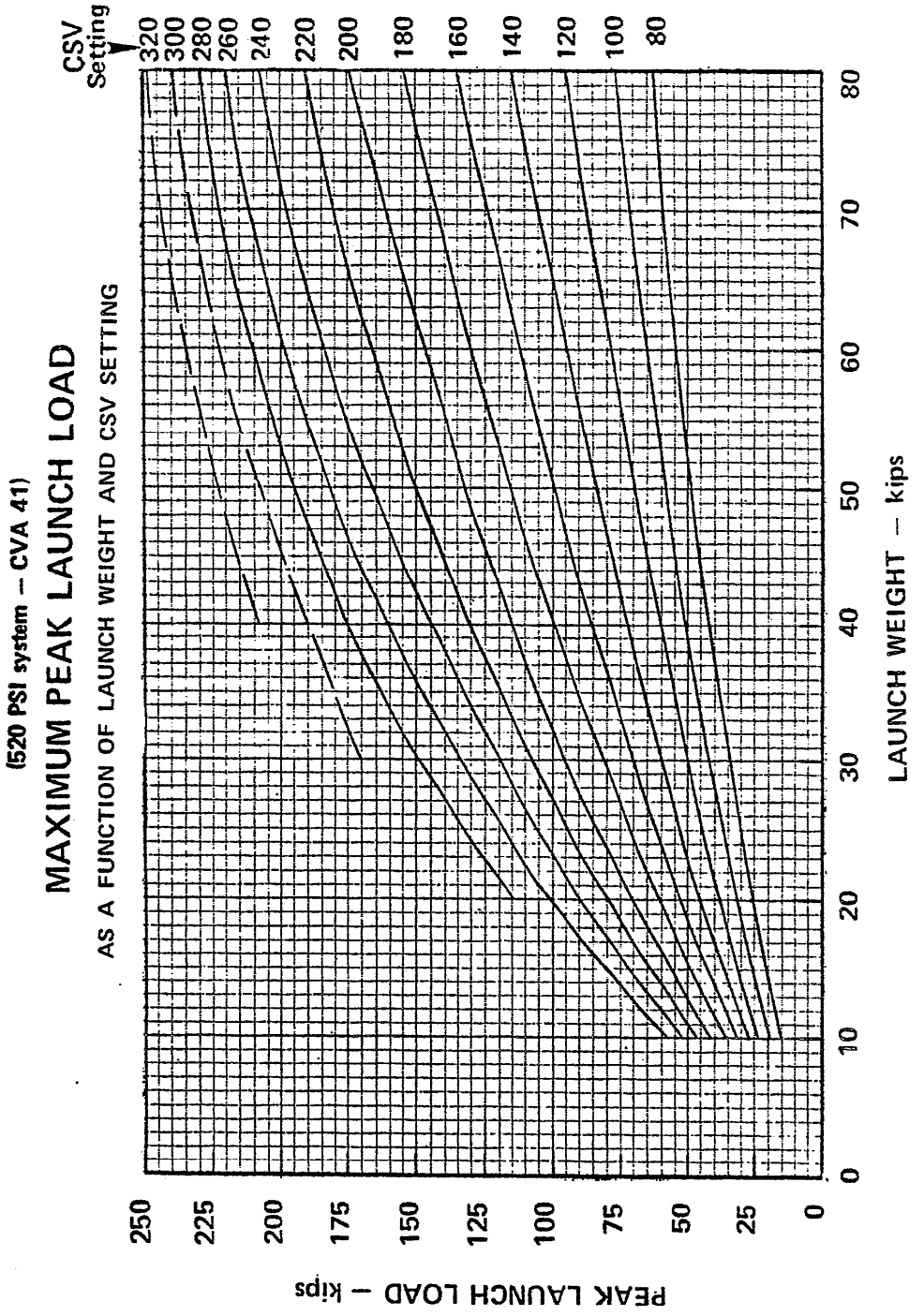

FIGURE 11.2. C13 Constant Pressure Catapult (CVA41), Maximum Peak Catapult Force

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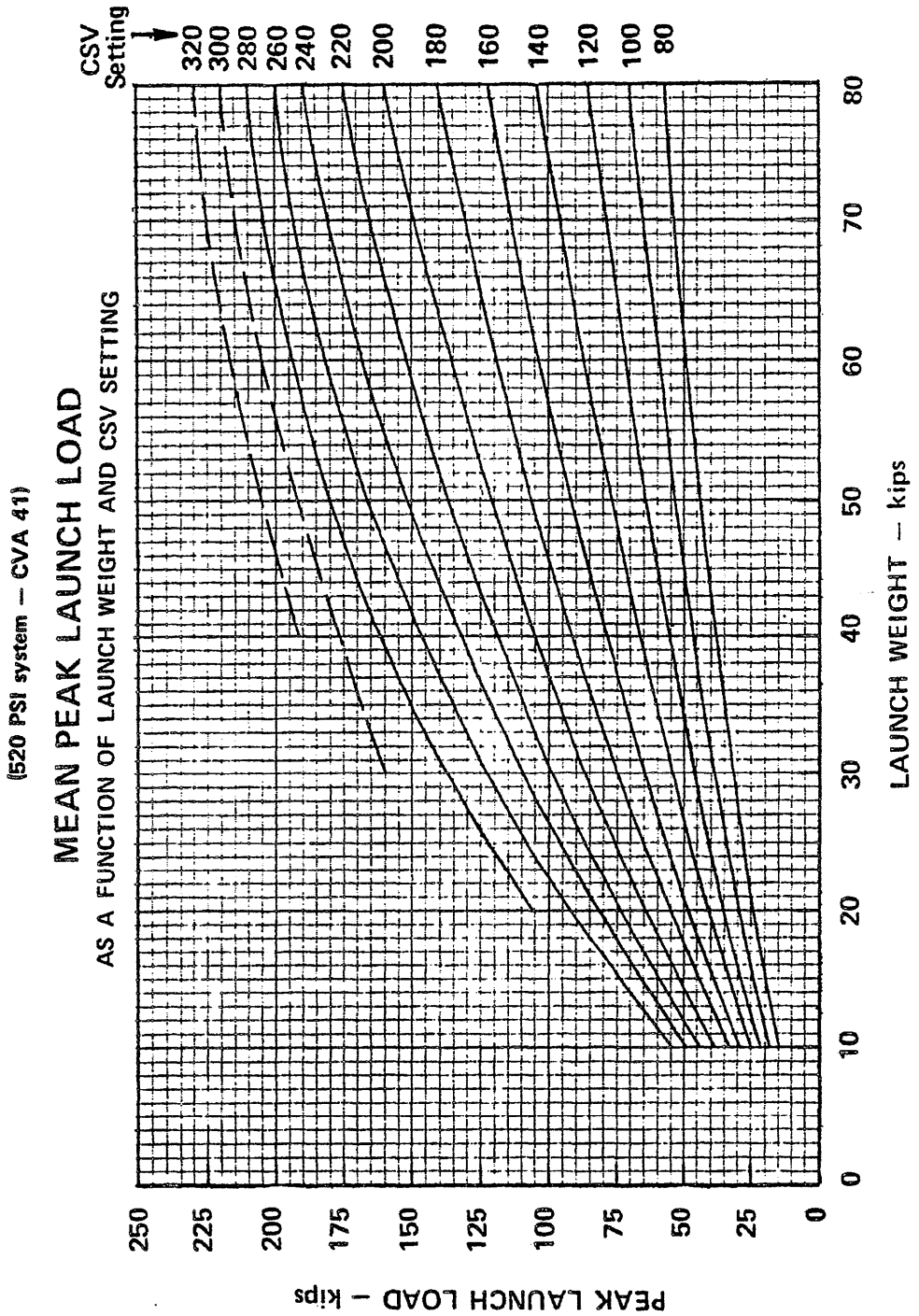

FIGURE 11.3. C13 Constant Pressure Catapult (CVA41), Mean Peak Catapult Force

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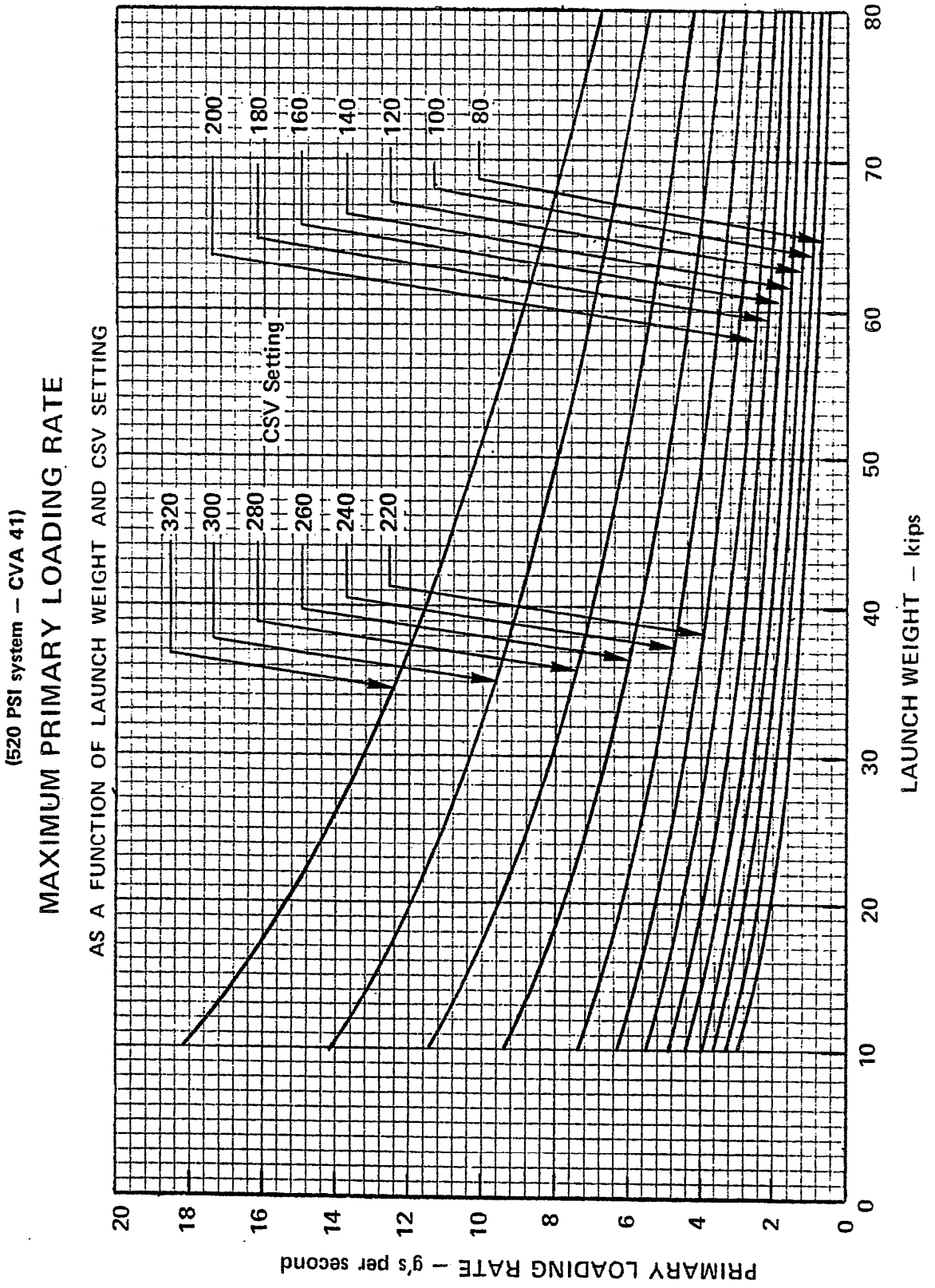

FIGURE 11.4. C13 Constant Pressure Catapult (CVA41), Maximum Primary Loading Rate

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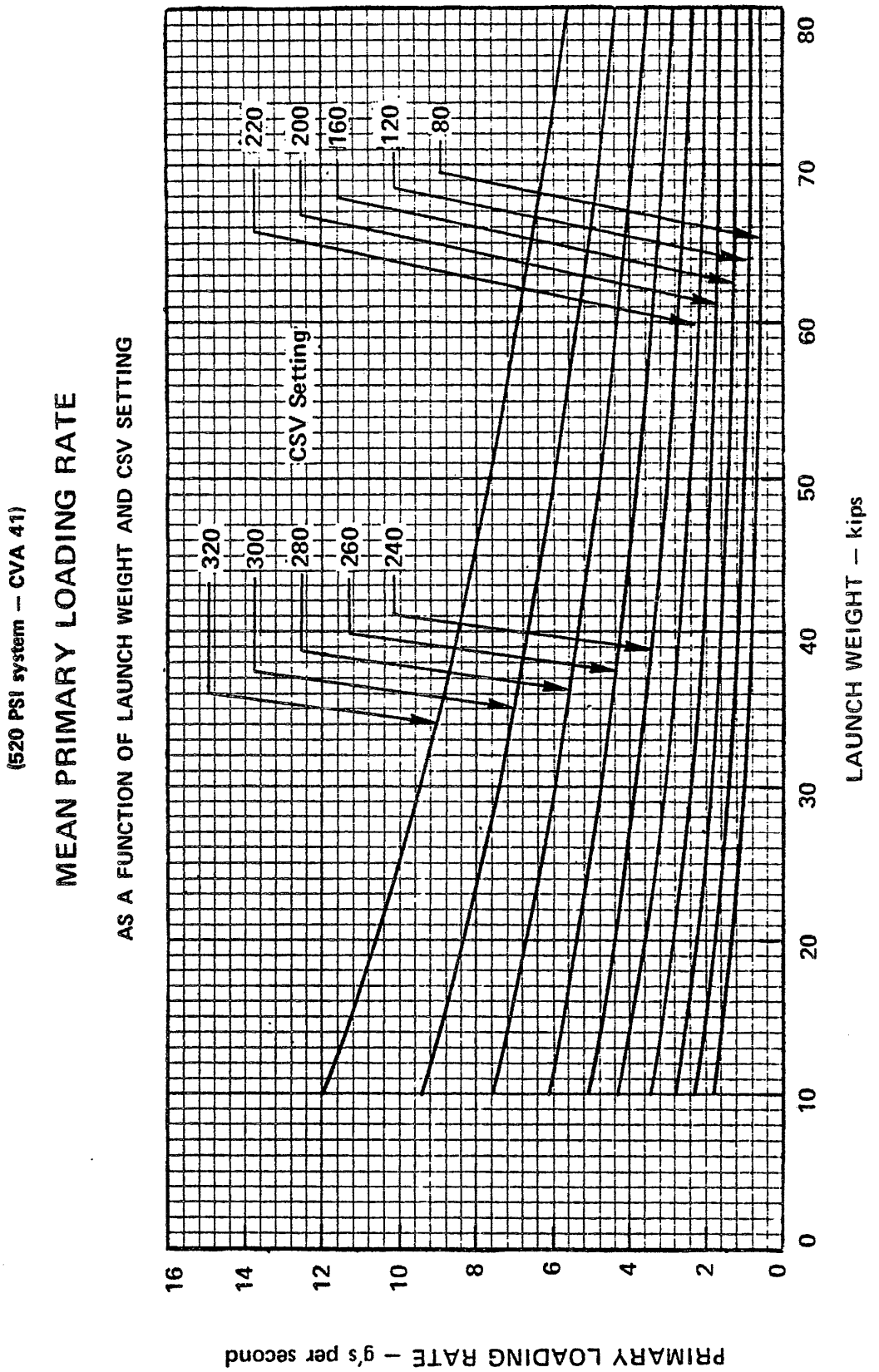

FIGURE 11.5. C13 Constant Pressure Catapult (CVA41), Mean Primary Loading Rate

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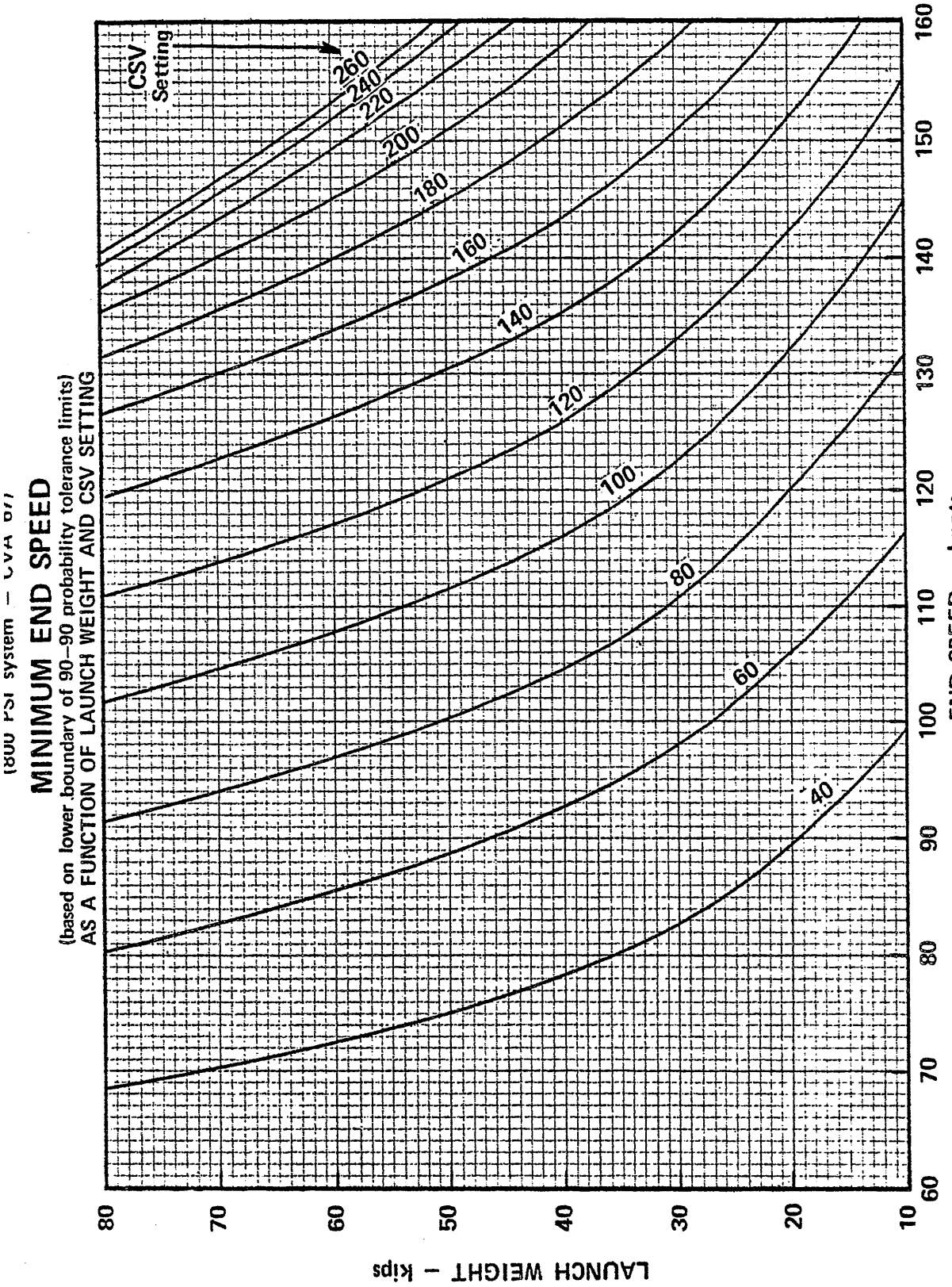

FIGURE 12.1. C13-1 Constant Pressure Catapult (CVA67), Minimum End Speed

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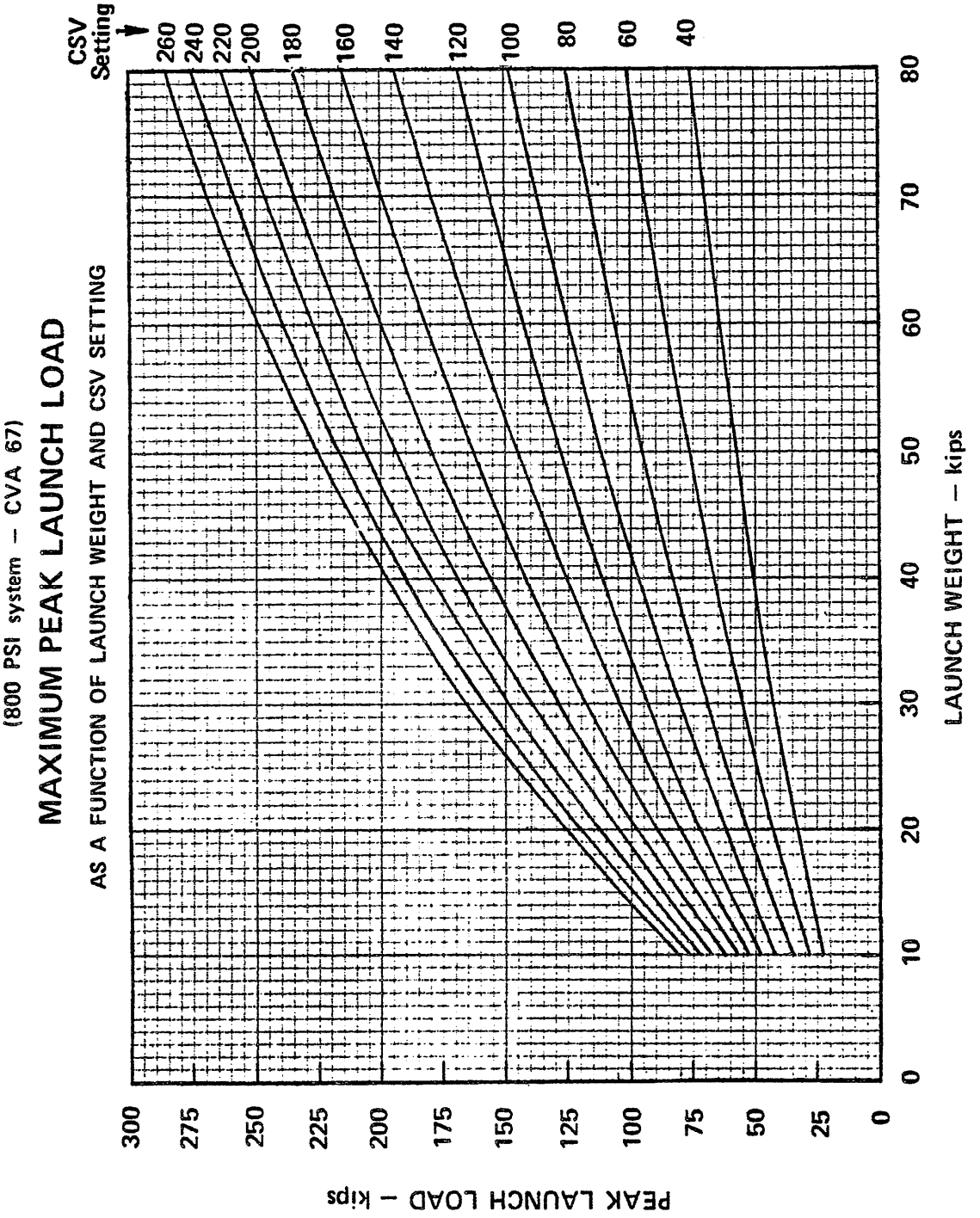

FIGURE 12.2. C13-1 Constant Pressure Catapult (CVA67), Maximum Peak Catapult Force

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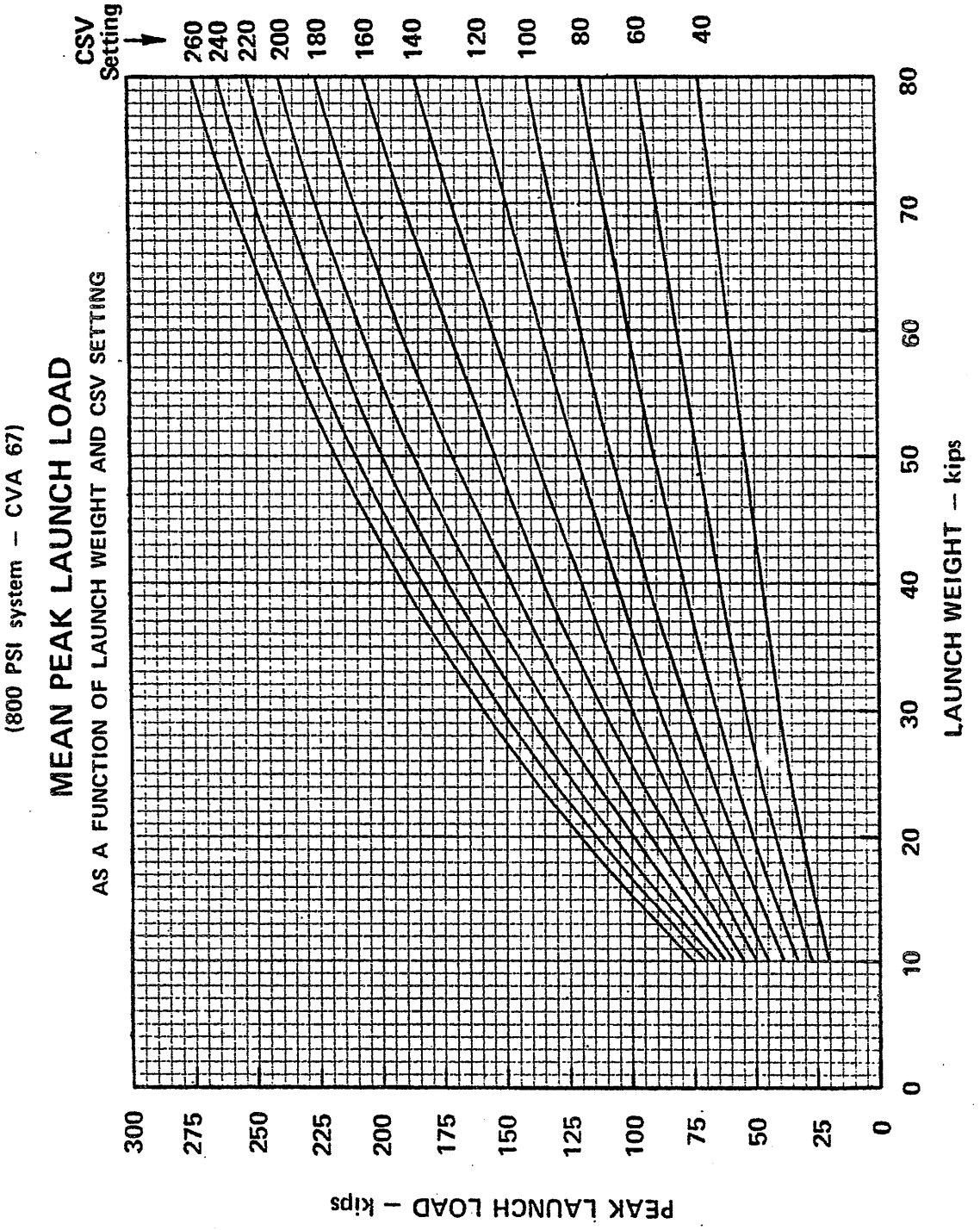

FIGURE 12.3. C13-1 Constant Pressure Catapult (CVA67), Mean Peak Catapult Force

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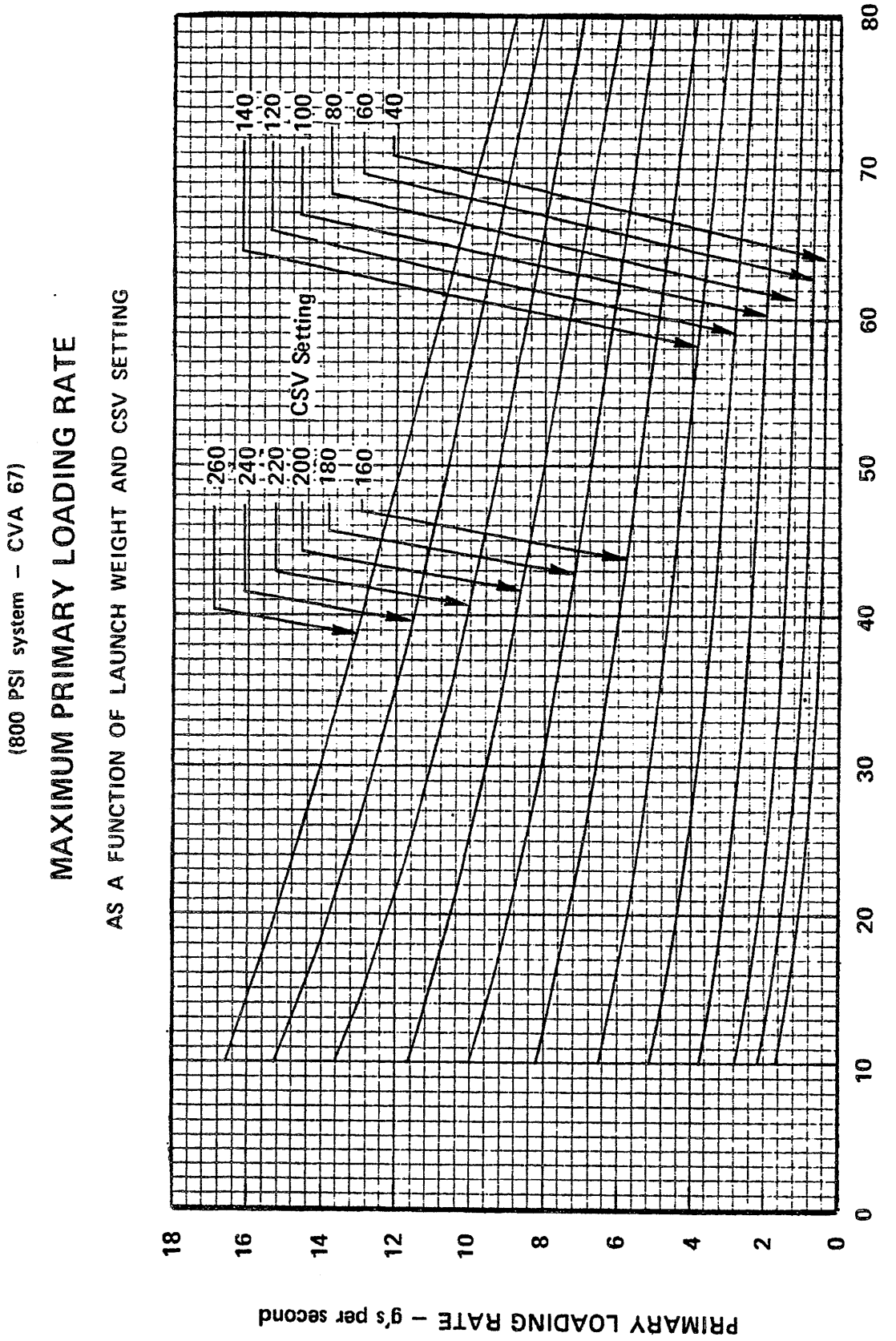

FIGURE 12.4. C13-1 Constant Pressure Catapult (CVA67), Maximum Primary Loading Rate

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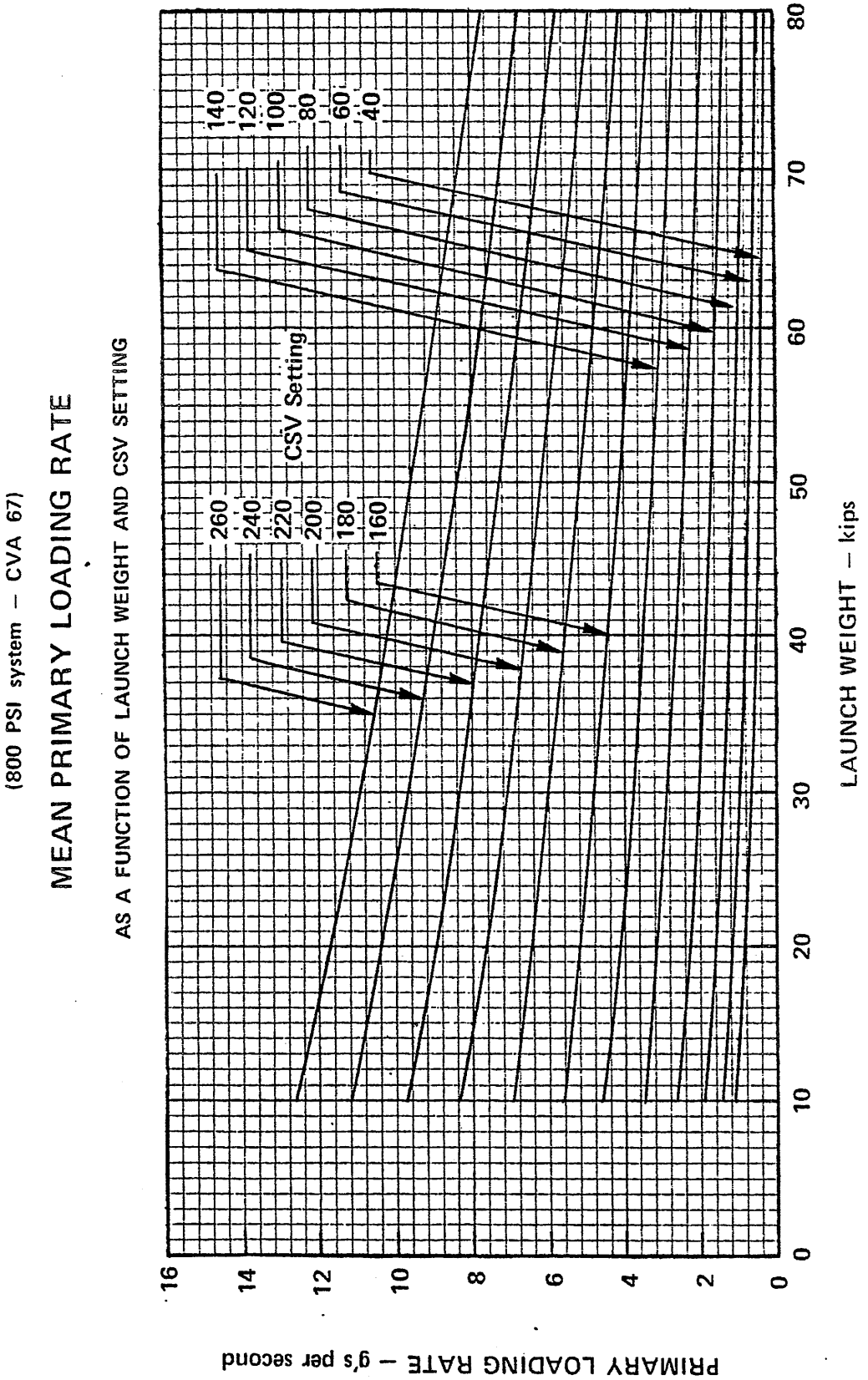

FIGURE 12.5. C13-1 Constant Pressure Catapult (CVA67), Mean Primary Loading Rate

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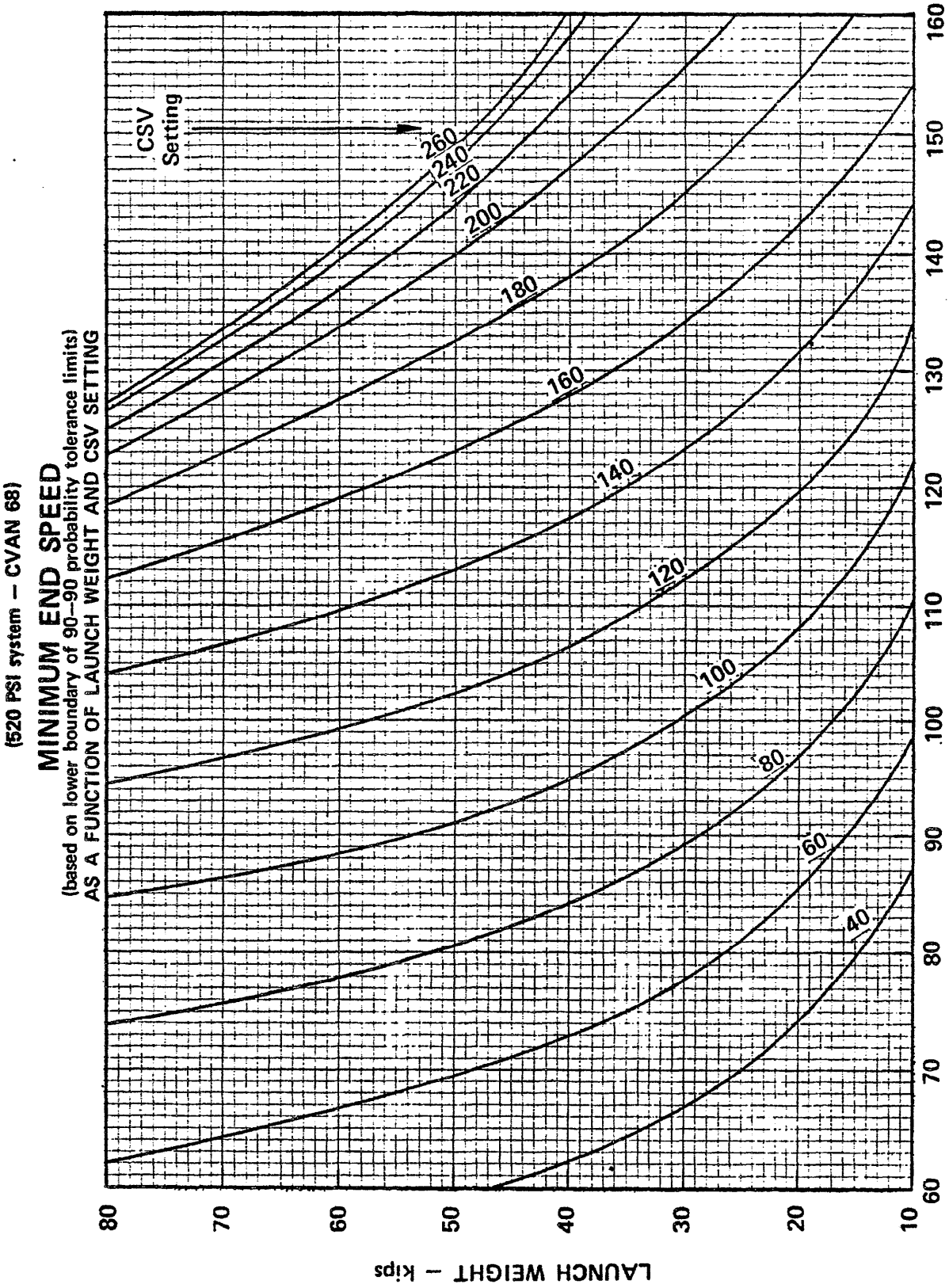

FIGURE 13.1. C13-1 Constant Pressure Catapult (CVAN68), Minimum End Speed

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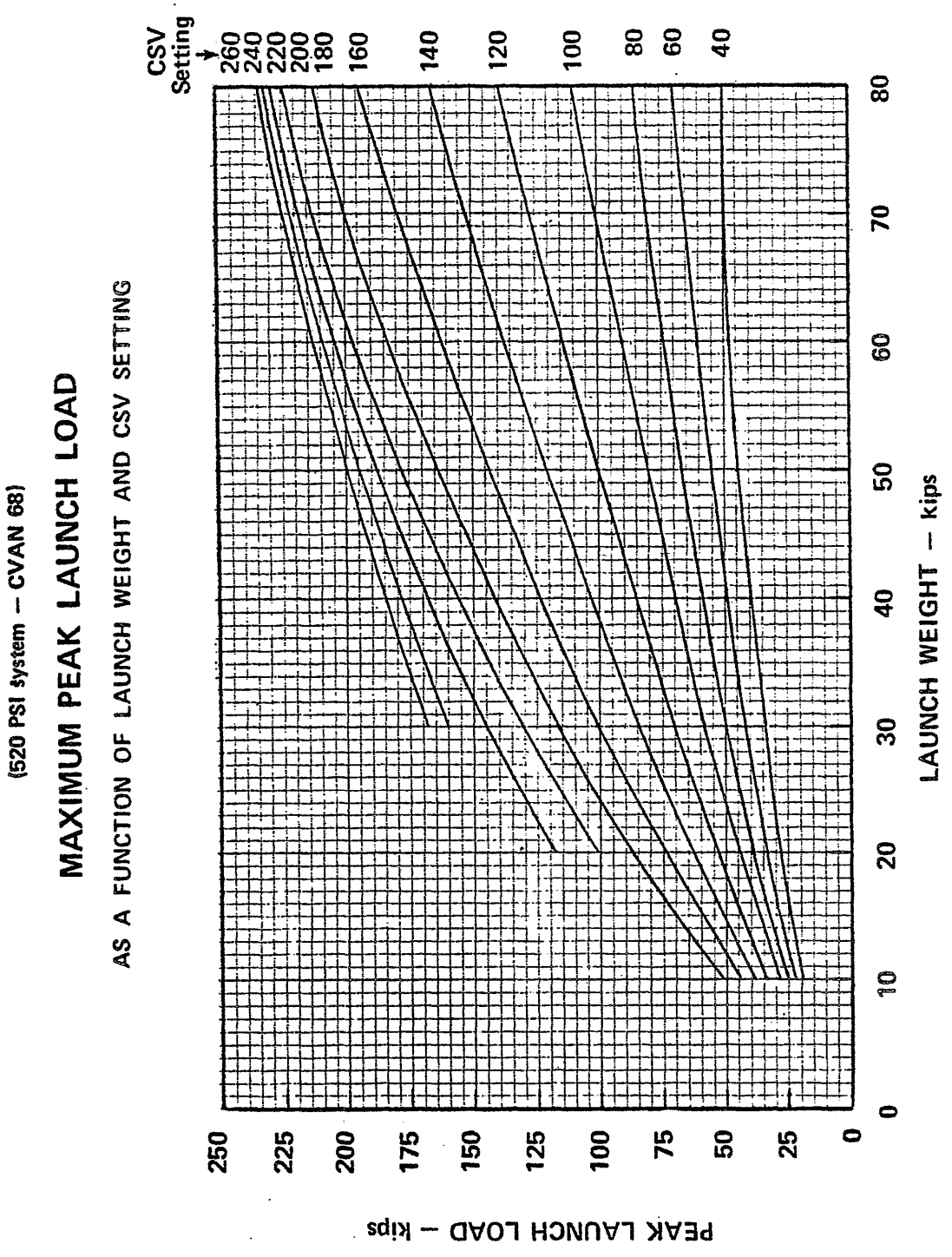

FIGURE 13.2. C13-1 Constant Pressure Catapult (CVAN68), Maximum Peak Catapult Force

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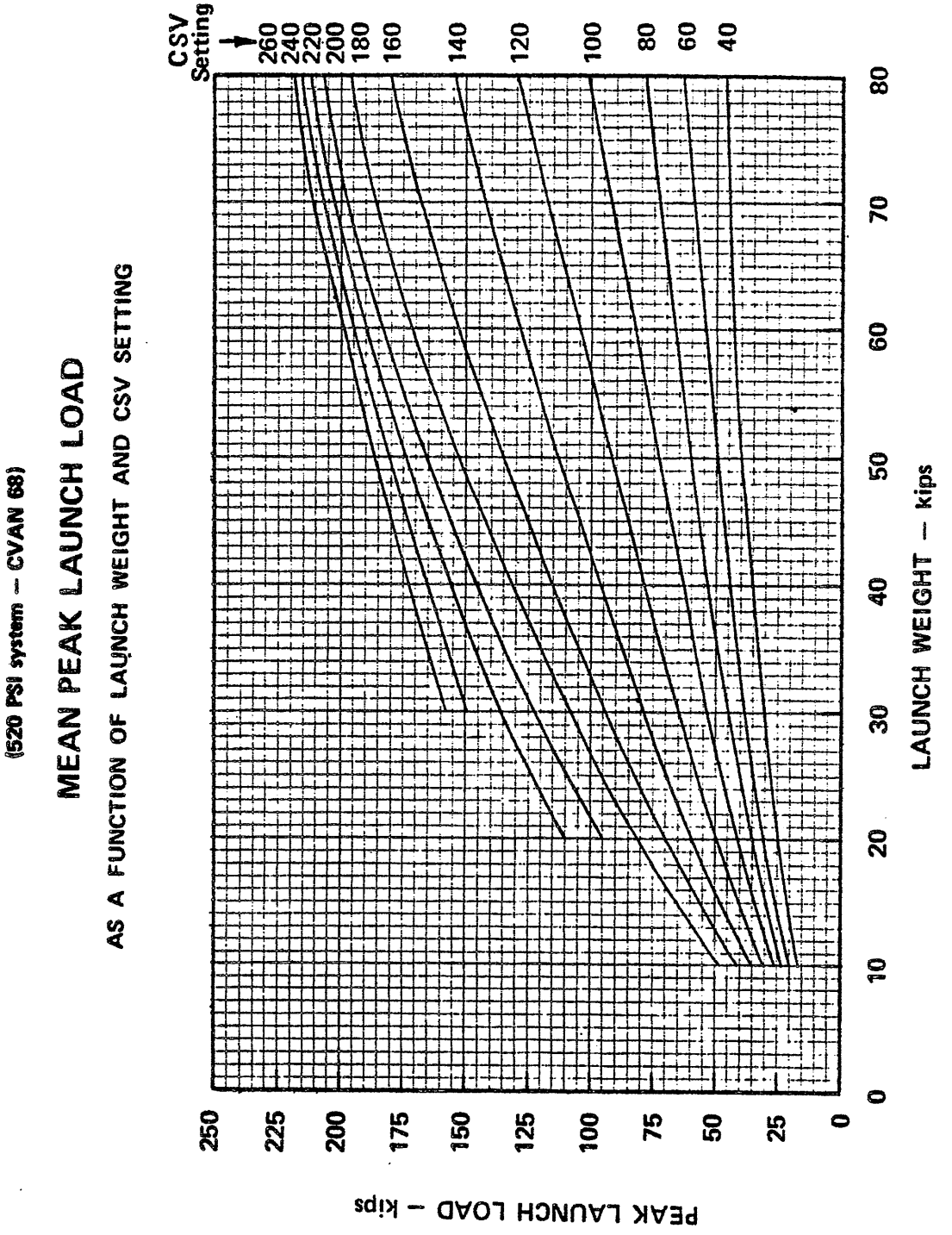

FIGURE 13.3. C13-1 Constant Pressure Catapult (CVAN68), Mean Peak Catapult Force

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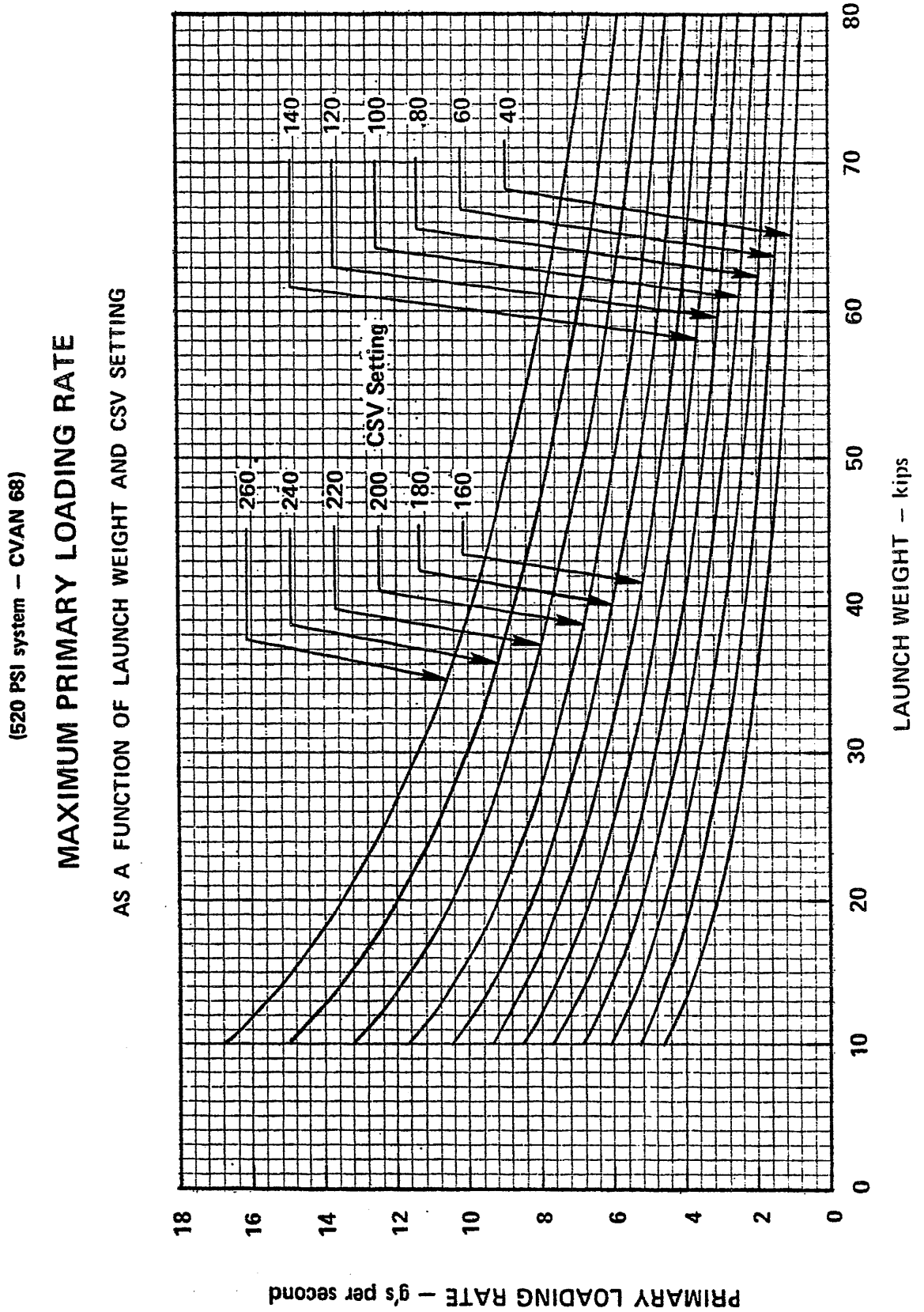

FIGURE 13.4. C13-1 Constant Pressure Catapult (CVAN68), Maximum Primary Loading Rate

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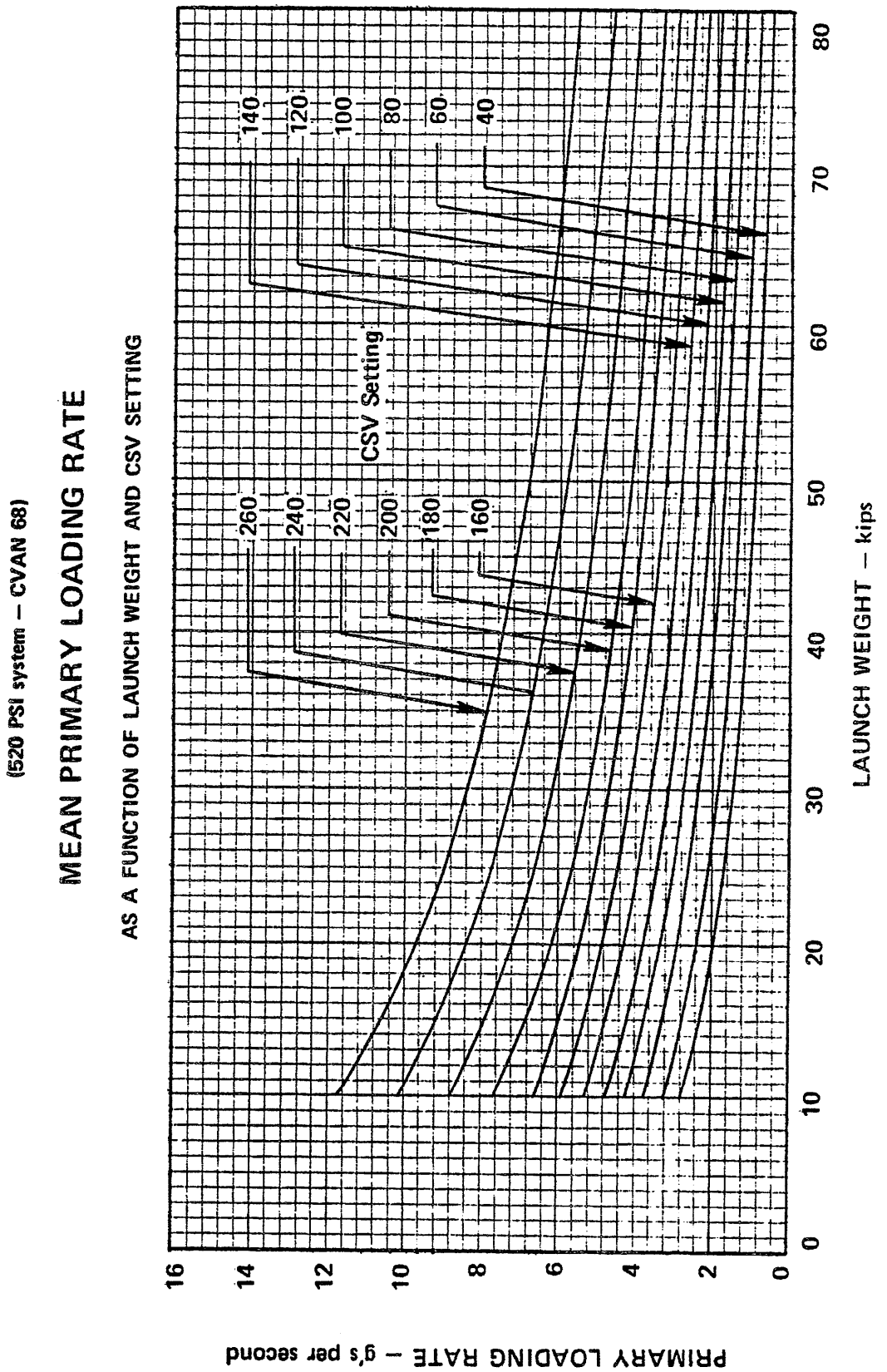

FIGURE 13.5. C13-1 Constant Pressure Catapult (CVAN68), Mean Primary Loading Rate

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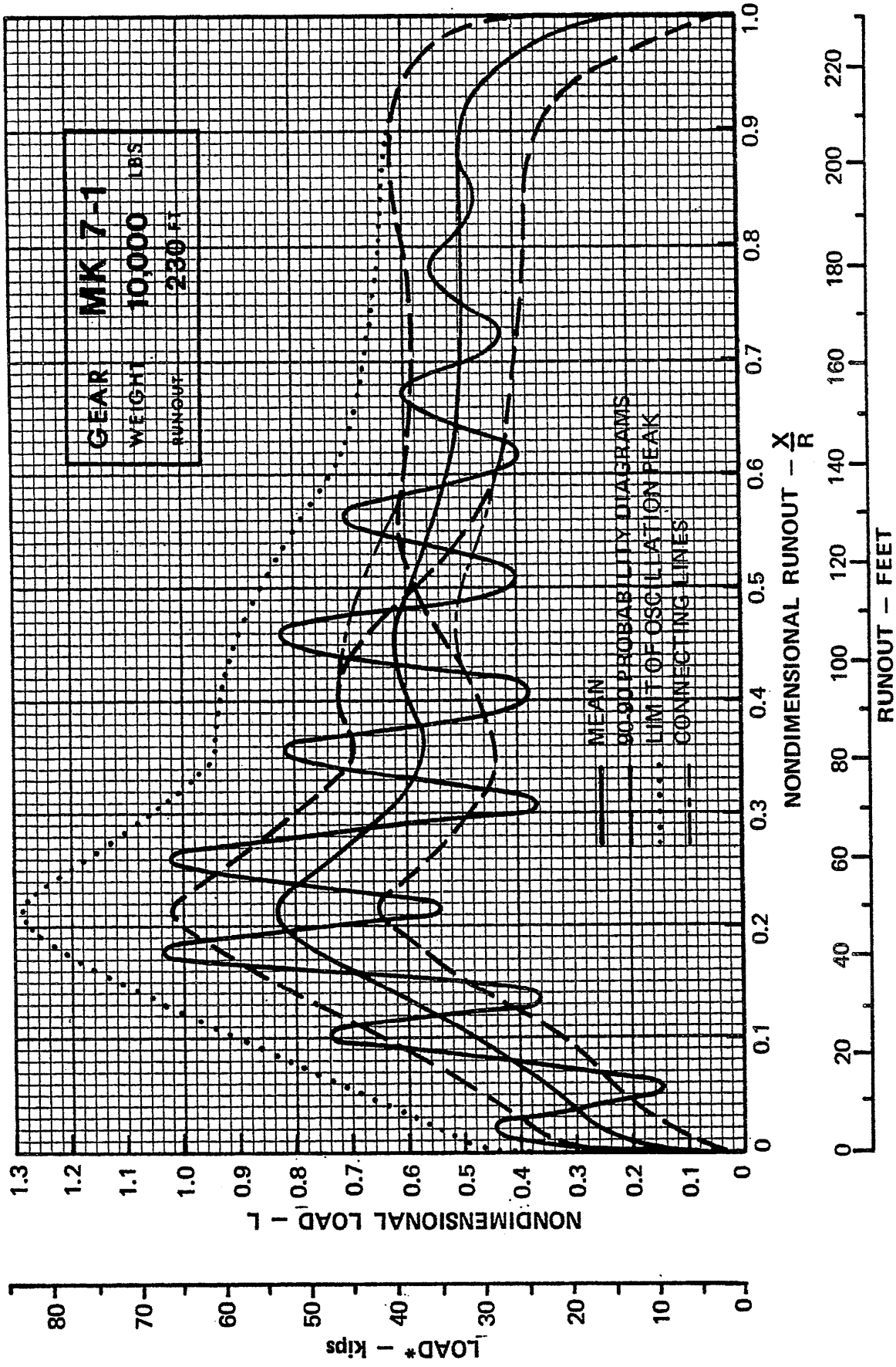

*Dimensioned load scale for 130 knots engaging speed and thrust of 0.4W only. Other engaging speeds and thrust values require correction per ratio $V_E^2/130^2$ x correction factor x dimensioned scale; where V_E is in knots.

FIGURE 14.1. MK7-1 Gear, 10,000 Lb Weight, Load vs Stroke, Nondimensional

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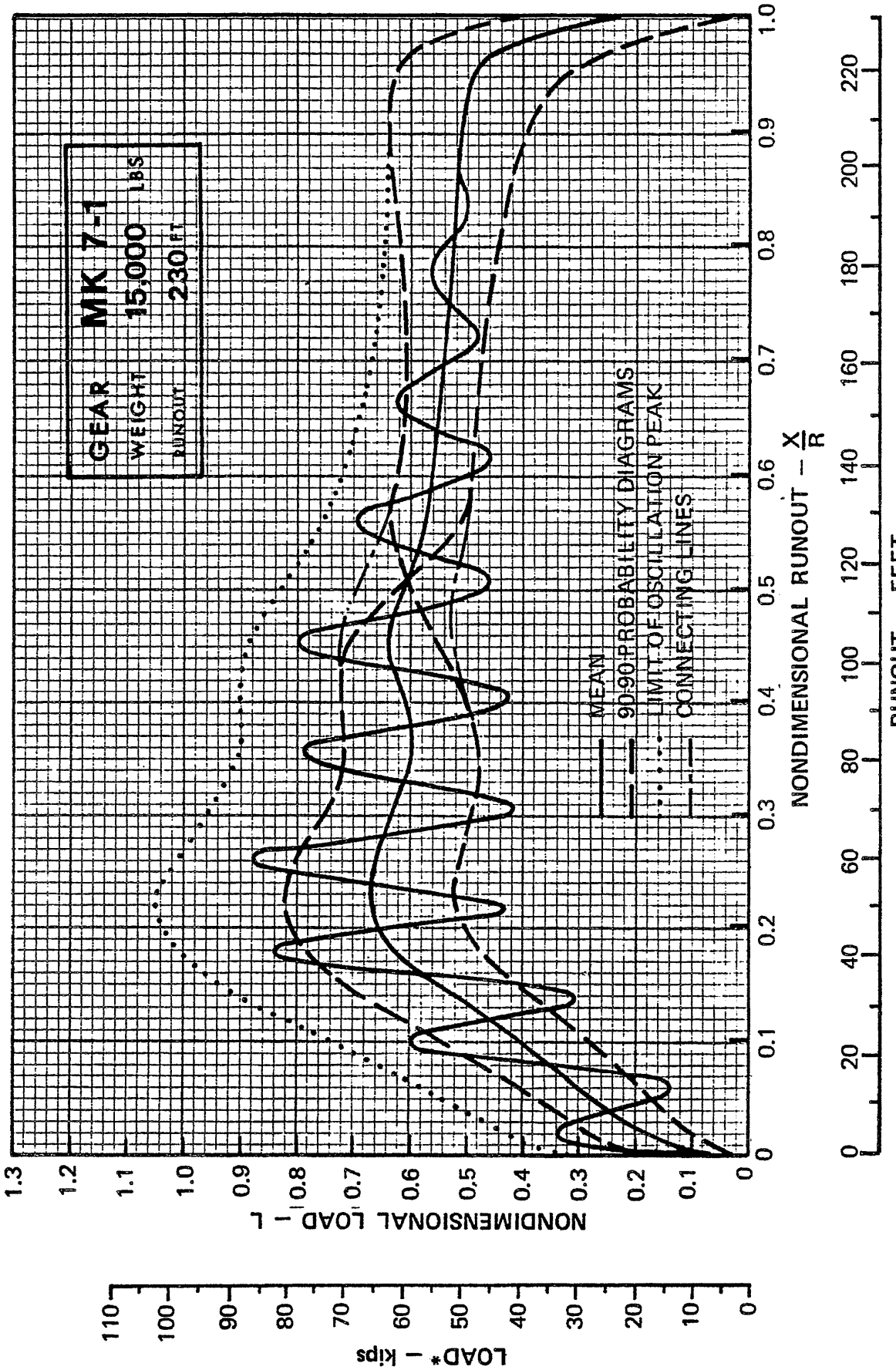

*Dimensioned load scale for 130 knots engaging speed and thrust of 0.4W only. Other engaging speeds and thrust values require correction per ratio $V_E^2/130^2$ x correction factor x dimensioned scale; where V_E is in knots.

FIGURE 14.2. MK7-1 Gear, 15,000 Lb Weight, Load vs Stroke, Nondimensional

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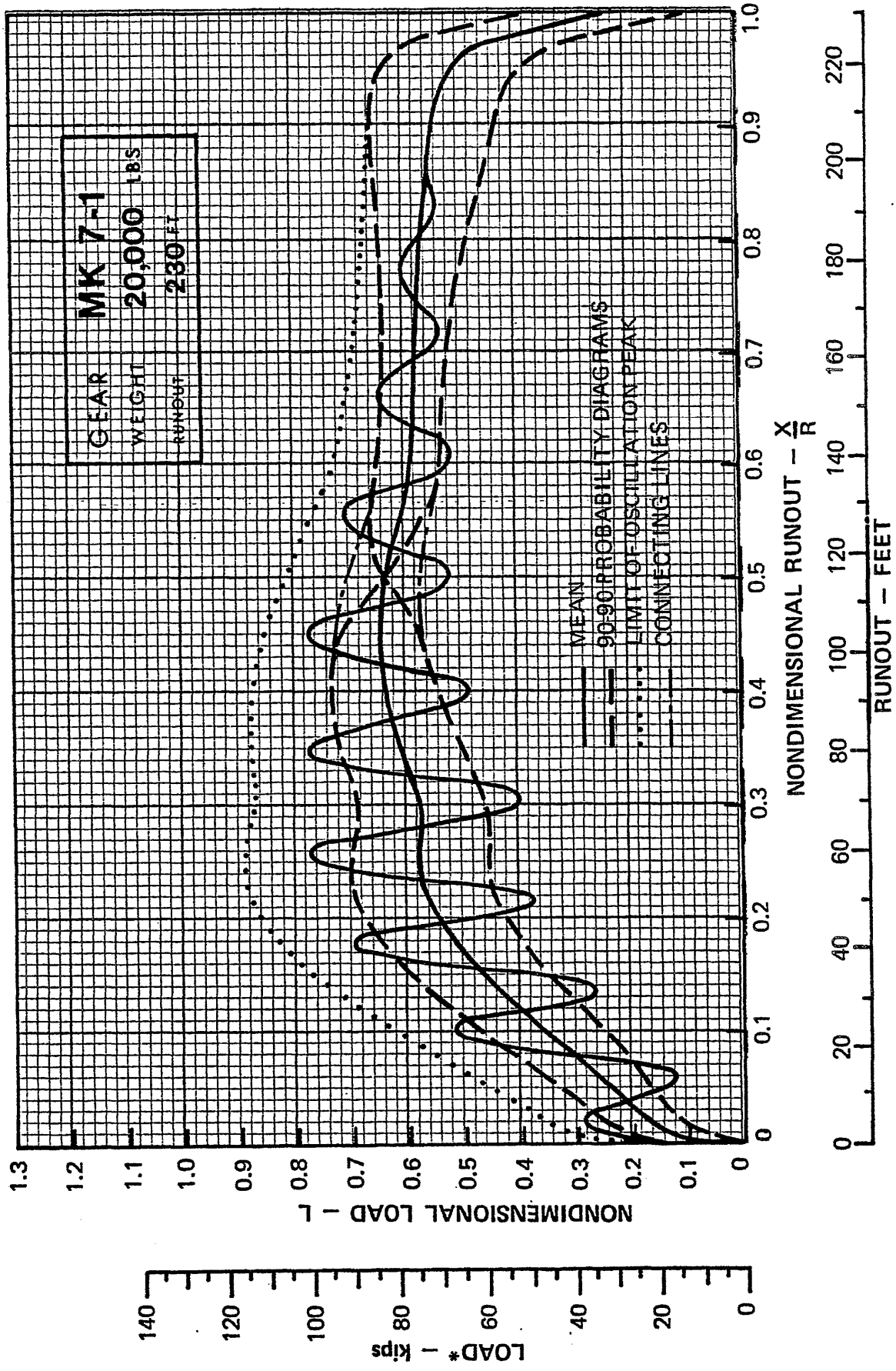

*Dimensioned load scale for 130 knots engaging speed and thrust of 0.4W only. Other engaging speeds and thrust values require correction per ratio $V_E^2/130^2$ x correction factor x dimensioned scale; where V_E is in knots.

FIGURE 14.3. MK7-1 Gear, 20,000 Lb Weight, Load vs Stroke, Nondimensional

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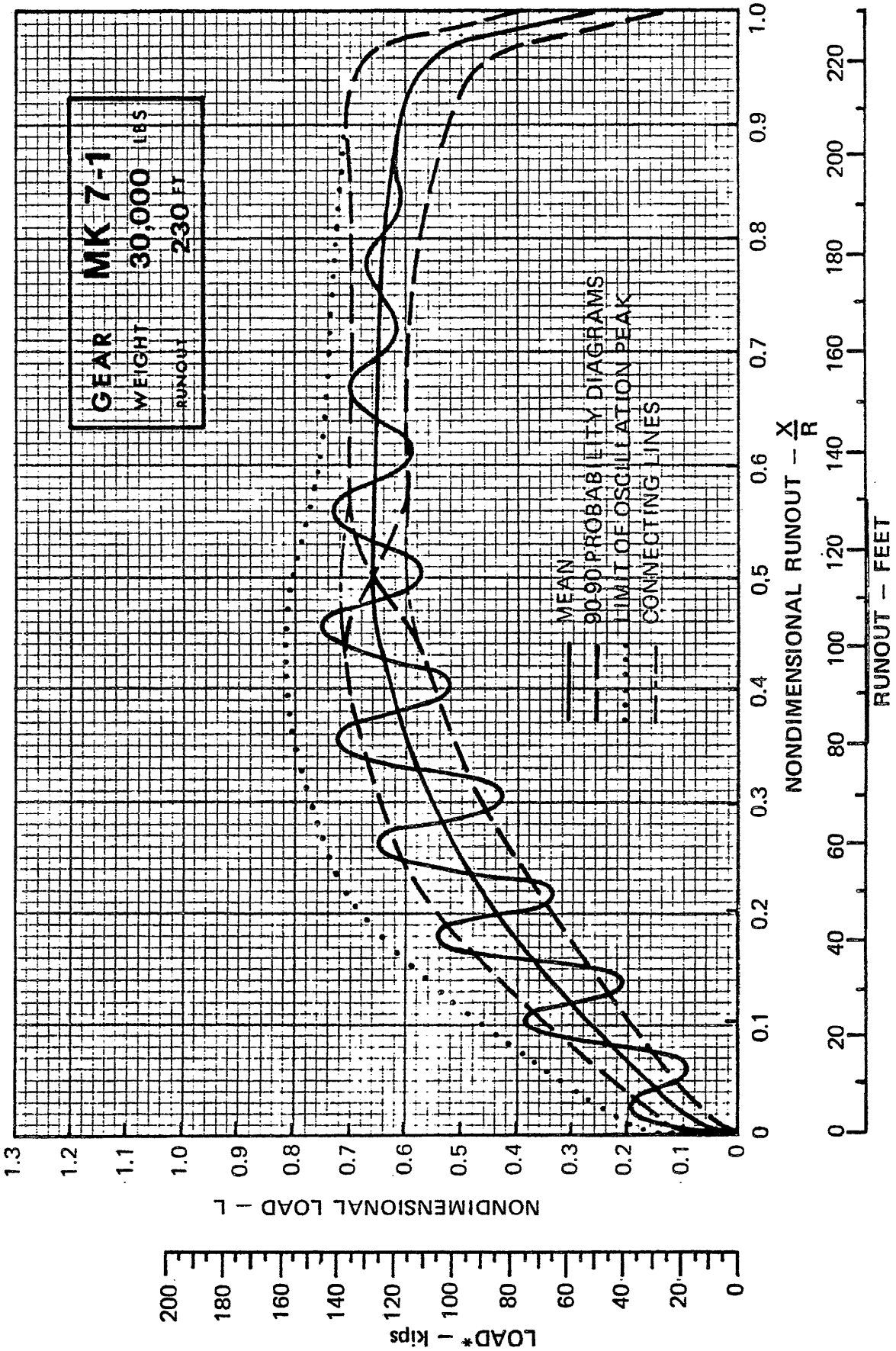

*Dimensioned load scale for 130 knots engaging speed and thrust of 0.4W only. Other engaging speeds and thrust values require correction per ratio $V_E^2/130^2$ x correction factor x dimensioned scale; where V_E is in knots.

FIGURE 14.4. MK7-1 Gear, 30,000 Lb Weight, Load vs Stroke, Nondimensional

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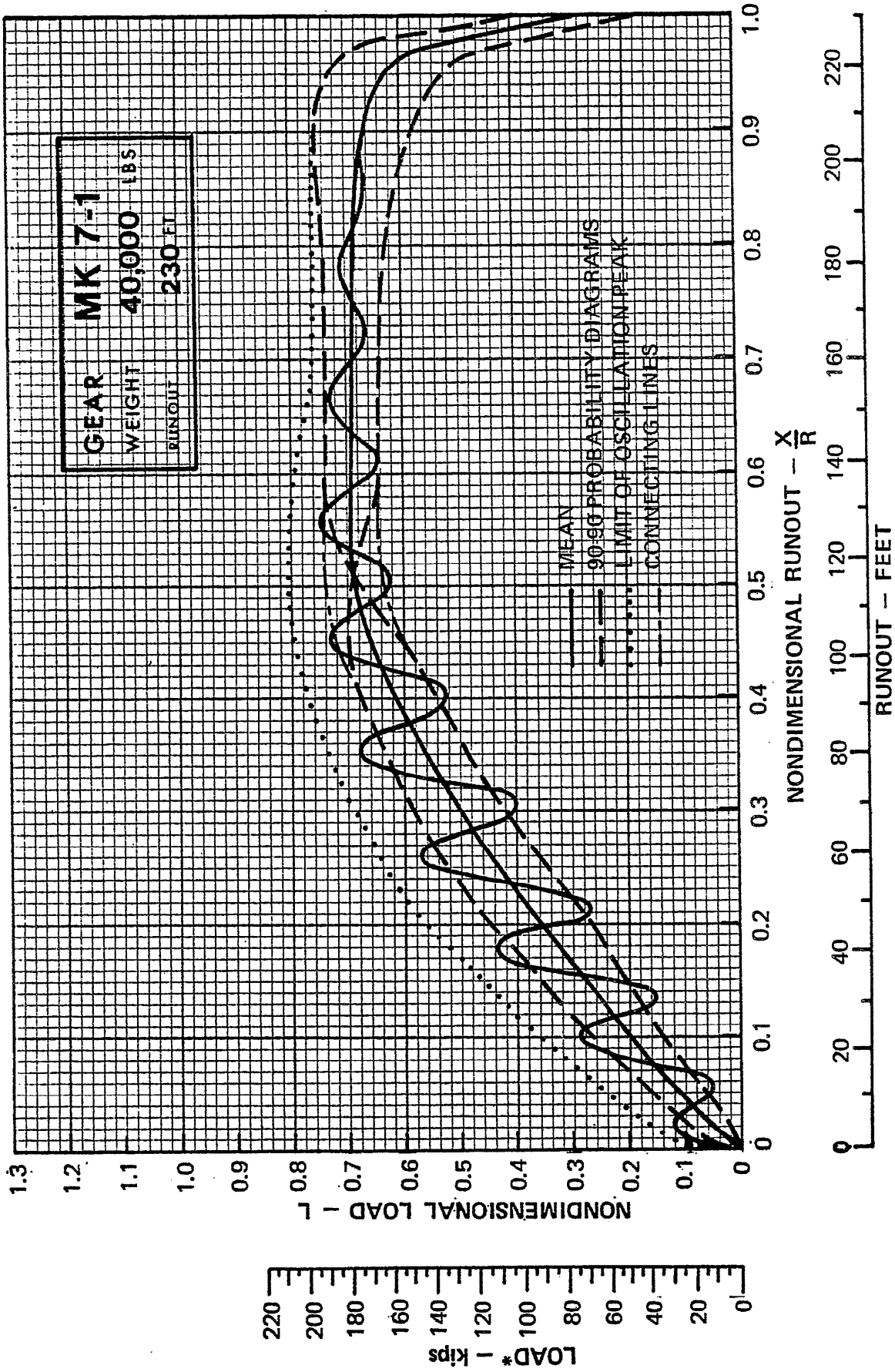

*Dimensioned load scale for 130 knots engaging speed and thrust of 0.4W only. Other engaging speeds and thrust values require correction per ratio $V_E^2/130^2$ x correction factor x dimensioned scale; where V_E is in knots.

FIGURE 14.5. MK7-1 Gear, 40,000 Lb Weight, Load vs Stroke, Nondimensional

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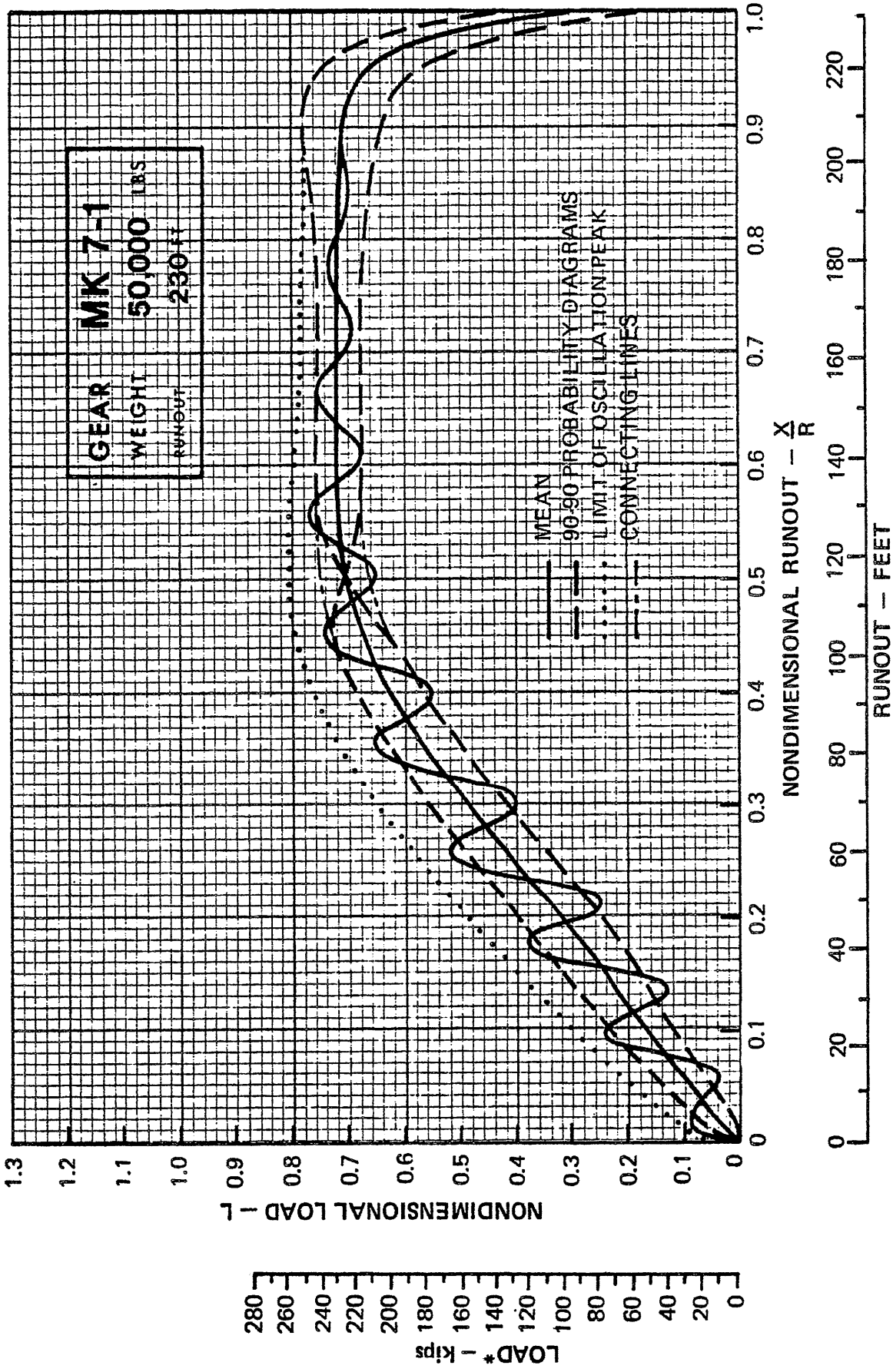

*Dimensioned load scale for 130 knots engaging speed and thrust of 0.4W only. Other engaging speeds and thrust values require correction per ratio $V_E^2/130^2$ x correction factor x dimensioned scale; where V_E is in knots.

FIGURE 14.6. MK7-1 Gear, 50,000 Lb Weight, Load vs Stroke, Nondimensional

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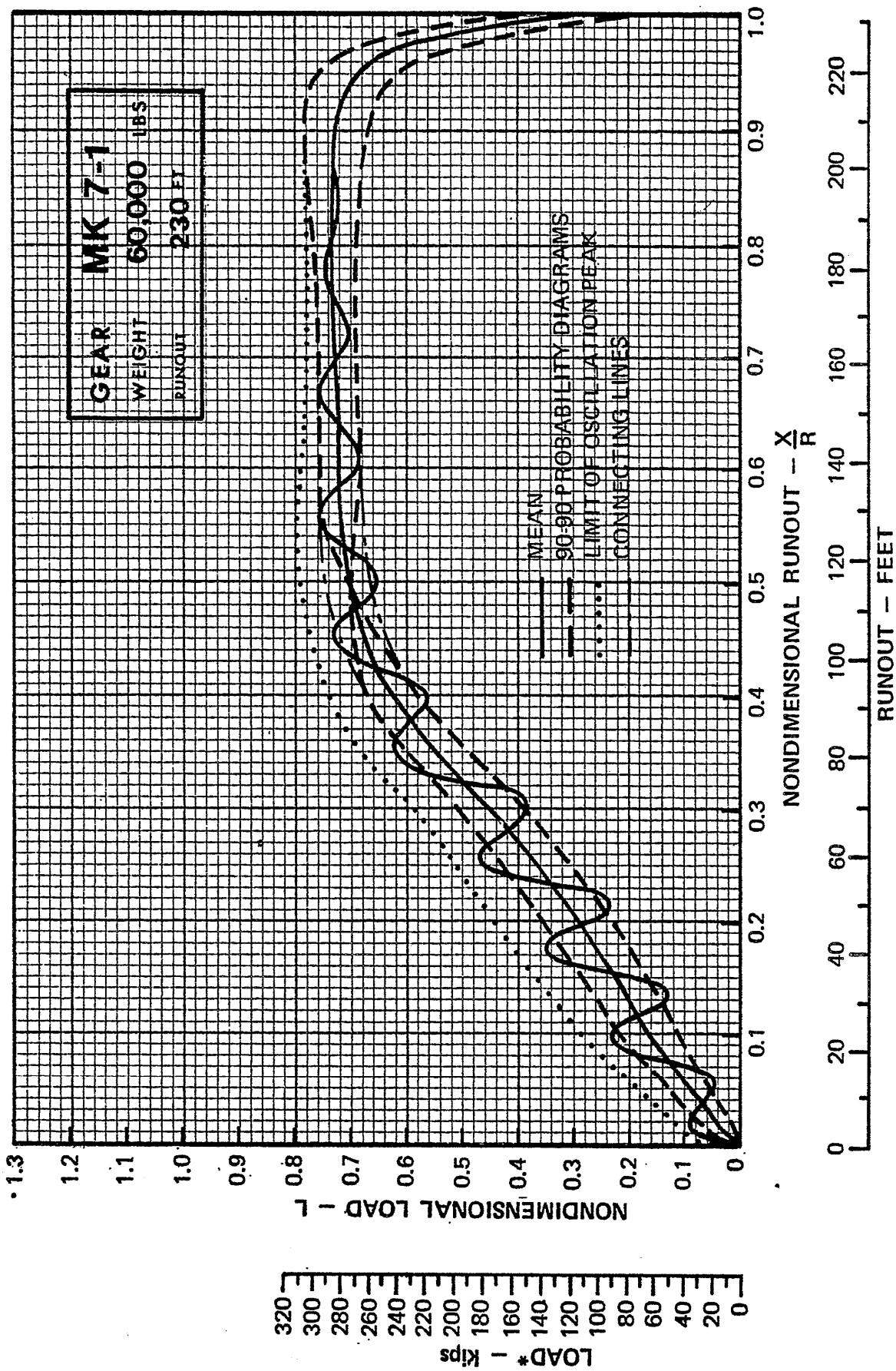

*Dimensioned load scale for 130 knots engaging speed and thrust of 0.4W only. Other engaging speeds and thrust values require correction per ratio $V_E^2/130^2$ x correction factor x dimensioned scale; where V_E is in knots.

FIGURE 14.7. MK7-1 Gear, 60,000 Lb Weight, Load vs Stroke, Nondimensional

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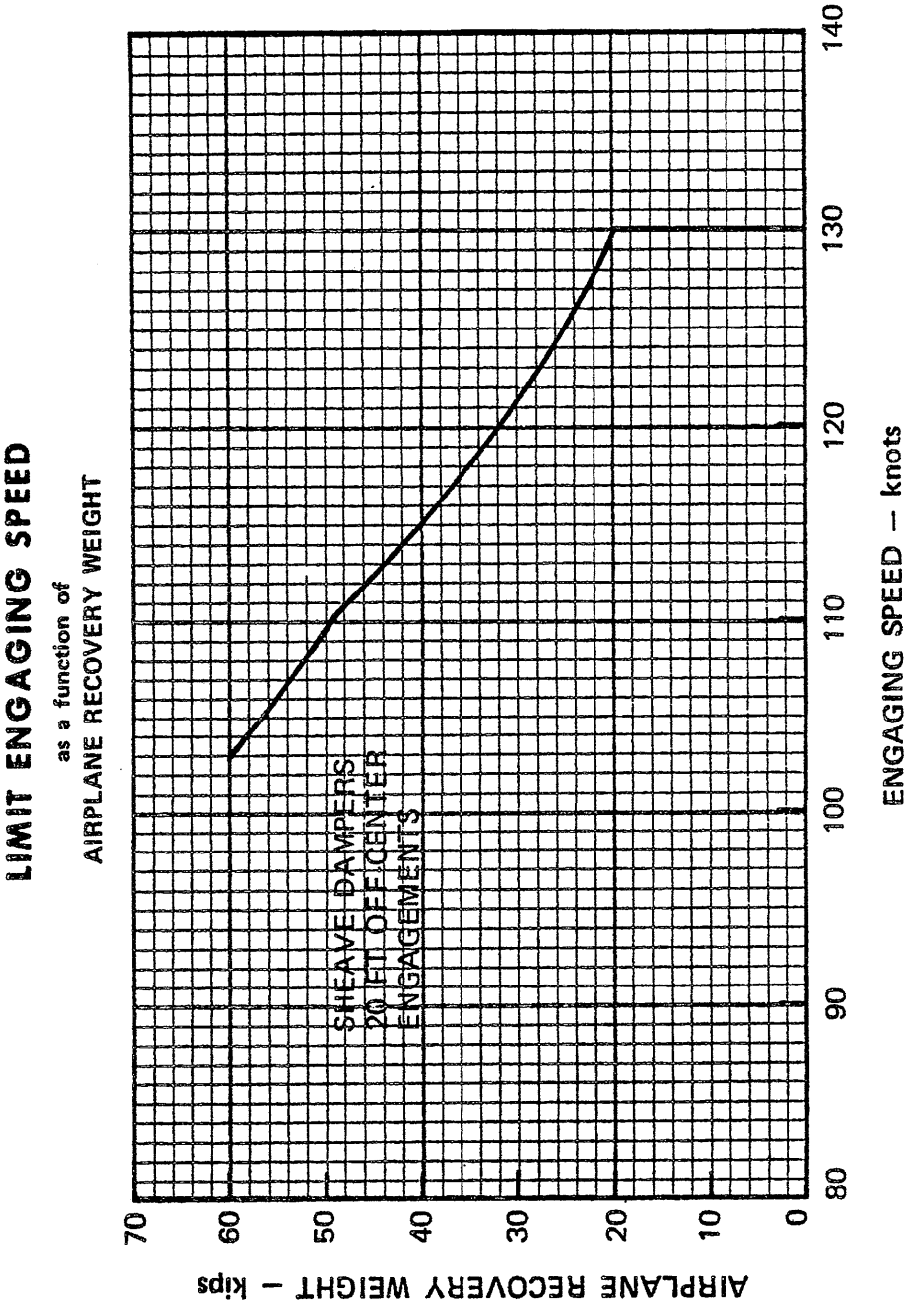

FIGURE 15.1. MK7-1 Gear, Limit Engaging Speed

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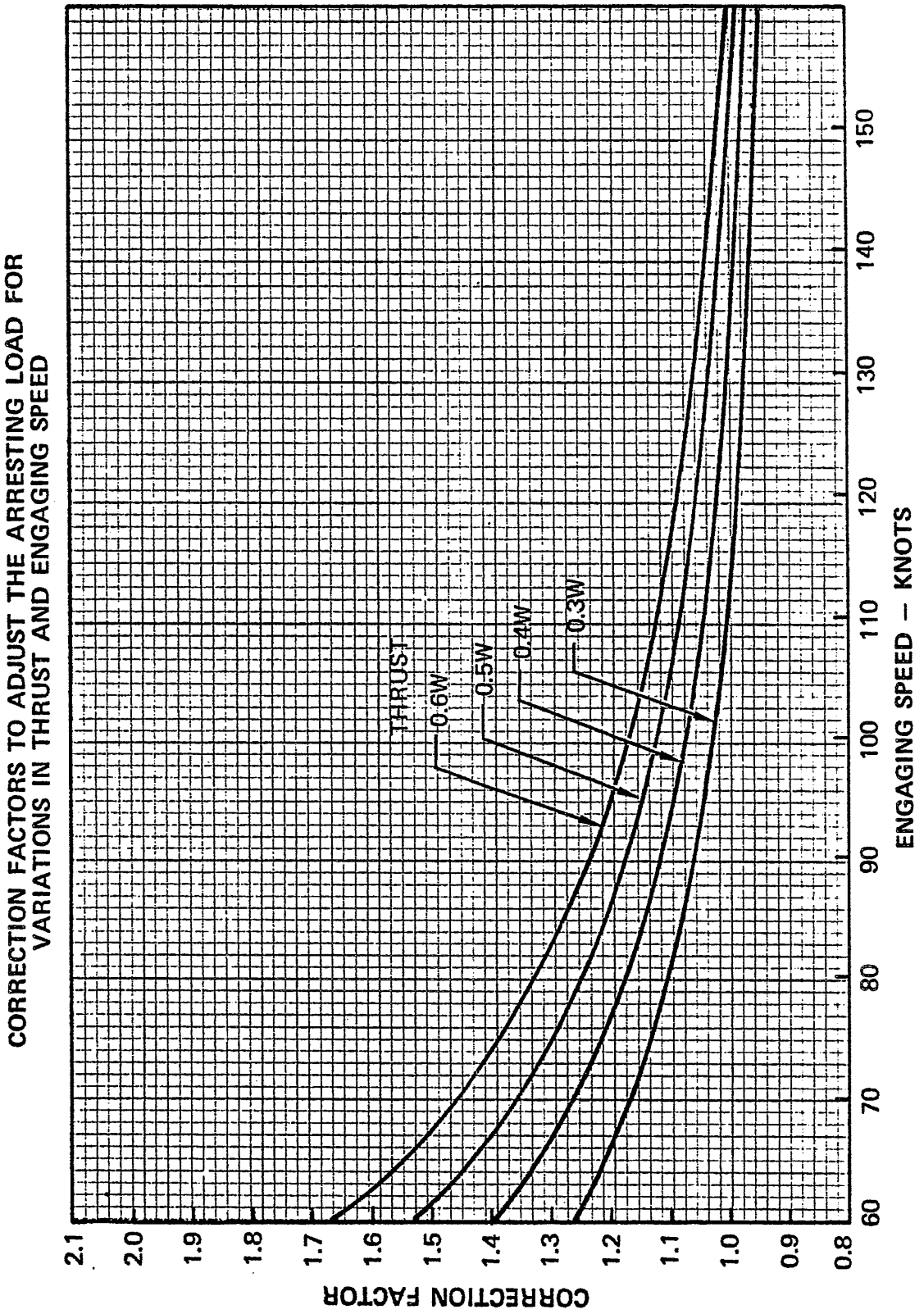

FIGURE 15.2. MK7-1 Gear, Correction Factor

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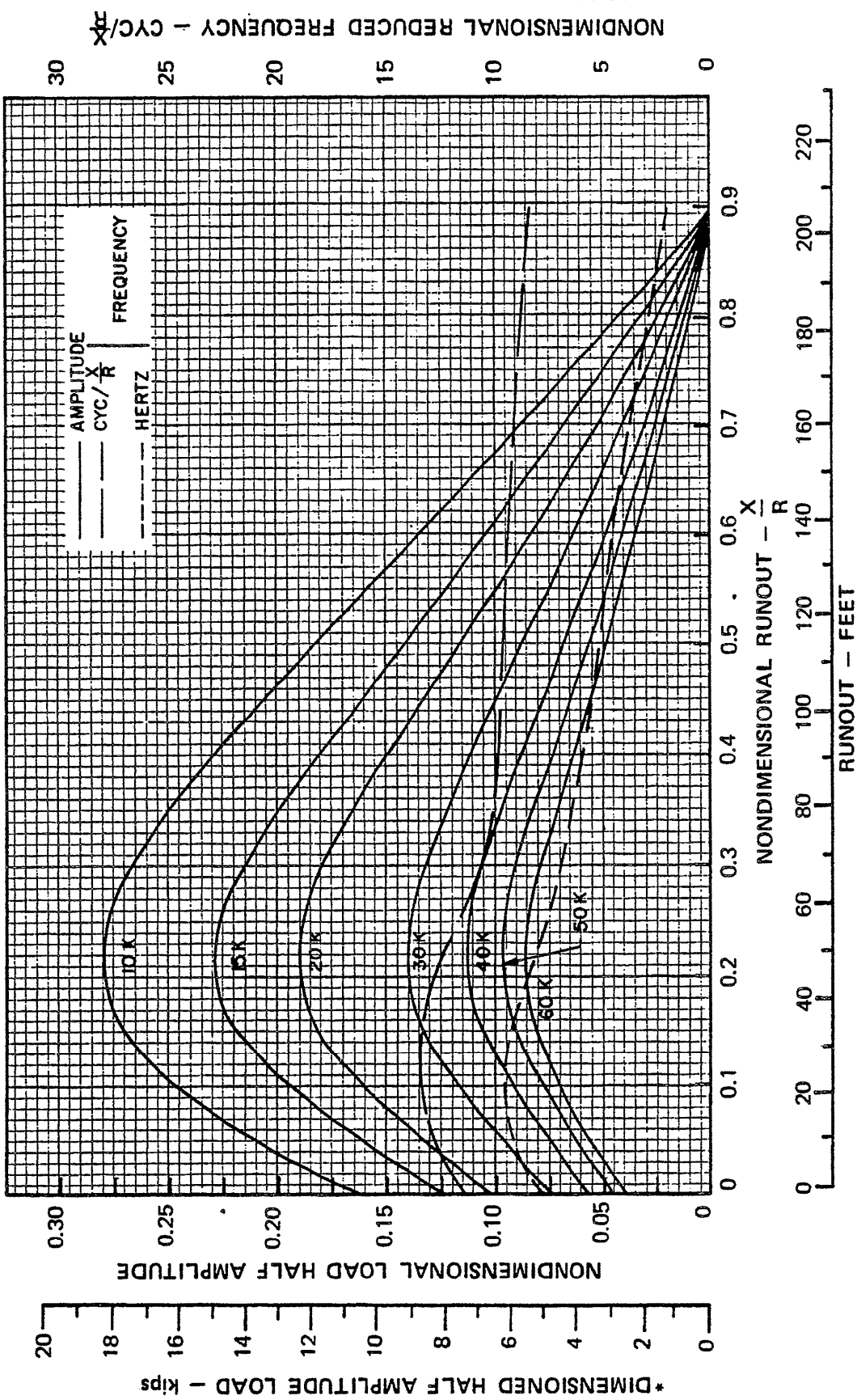

*Dimensioned half amplitude load scale for 10,000 lb airplane weight, 130 knot engaging speed, and 0.4W thrust only. Other weights and engaging speeds require correction per ratio $\frac{V_E^2 \times \text{weight}}{130^2 \times 10}$ x dimensioned scale x correction factor. V_E is in knots and airplane weight W is in kips.

FIGURE 15.3. MK7-1 Gear, Average Frequency and Amplitude of Oscillation, Nondimensional

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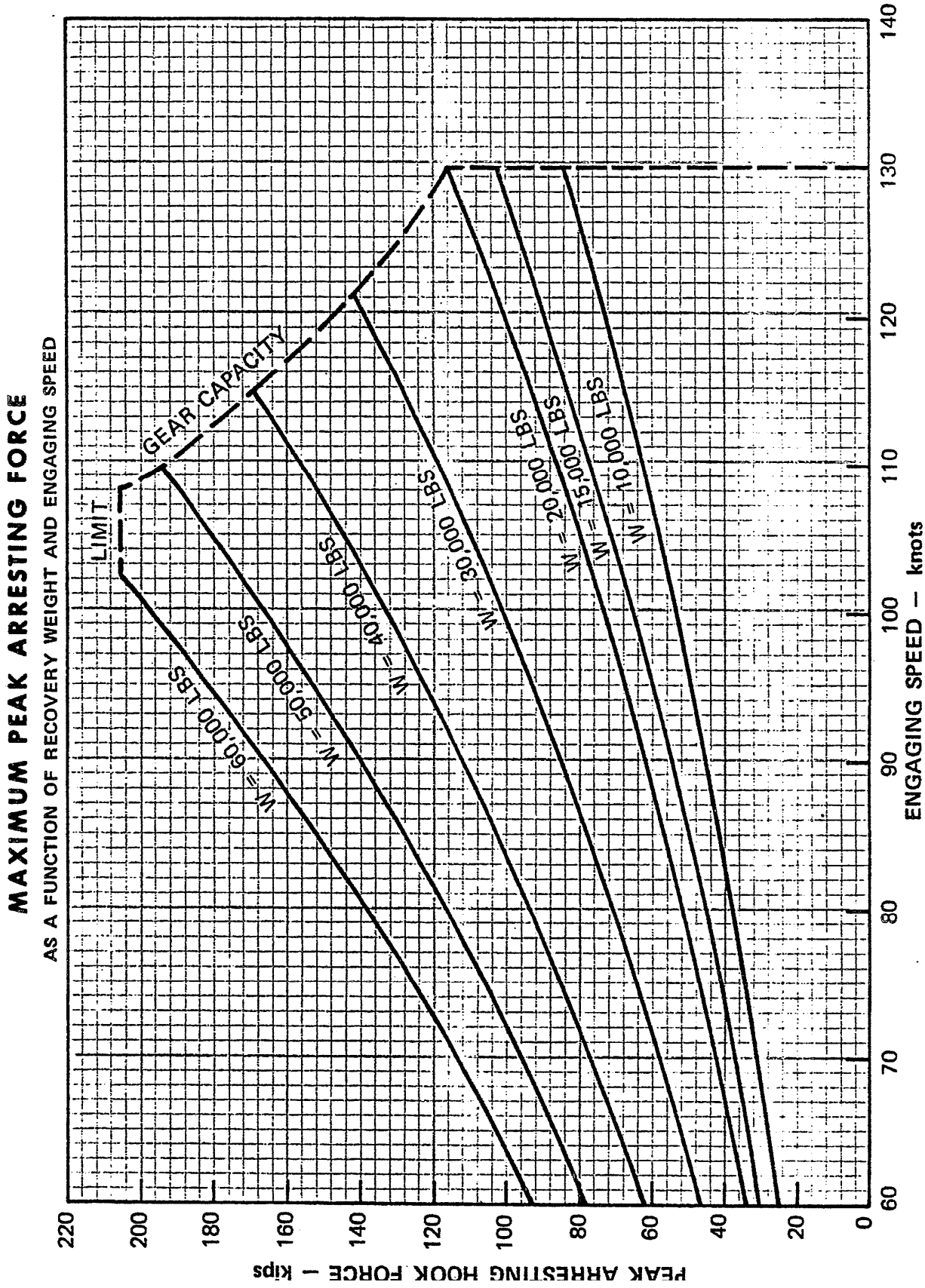

FIGURE 15.4. MK7-1 Gear, Maximum Peak Arresting Force

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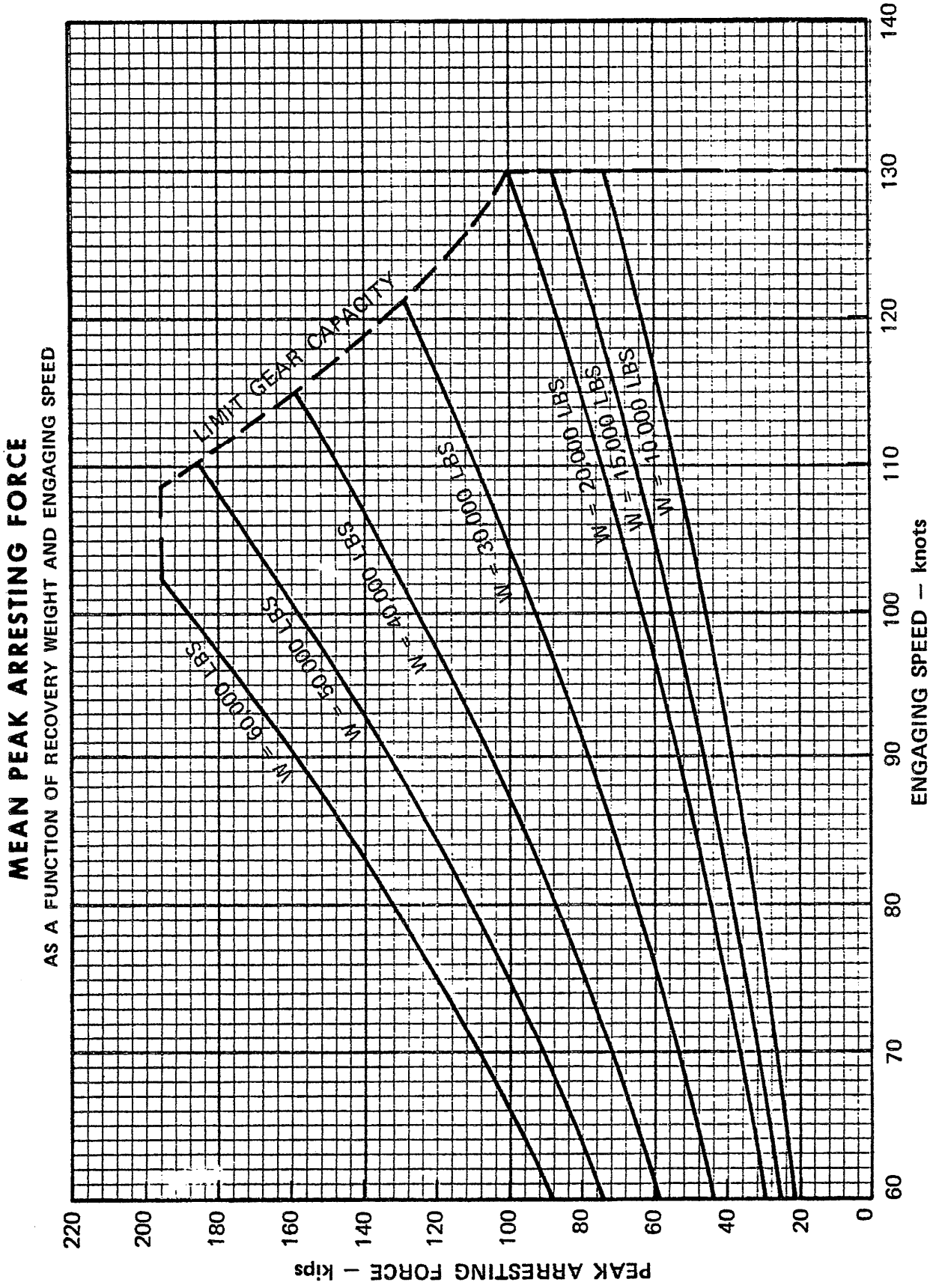

FIGURE 15.5. MK7-1 Gear, Mean Peak Arresting Force

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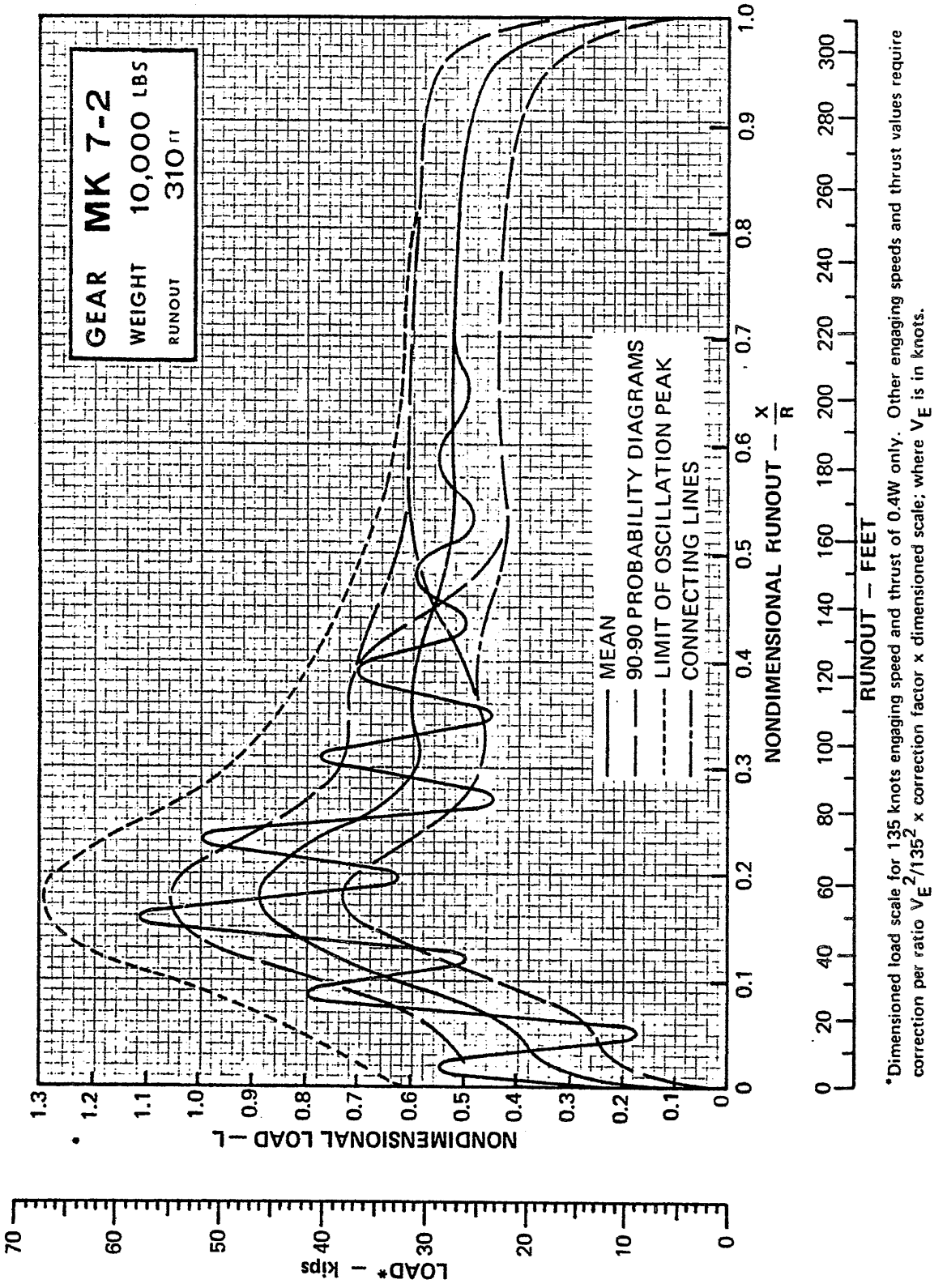

*Dimensioned load scale for 135 knots engaging speed and thrust of 0.4W only. Other engaging speeds and thrust values require correction per ratio $V_E^2/135^2$ x correction factor x dimensioned scale; where V_E is in knots.

FIGURE 16.1. MK7-2 Gear, 10,000 Lb Weight, Load vs Stroke, Nondimensional

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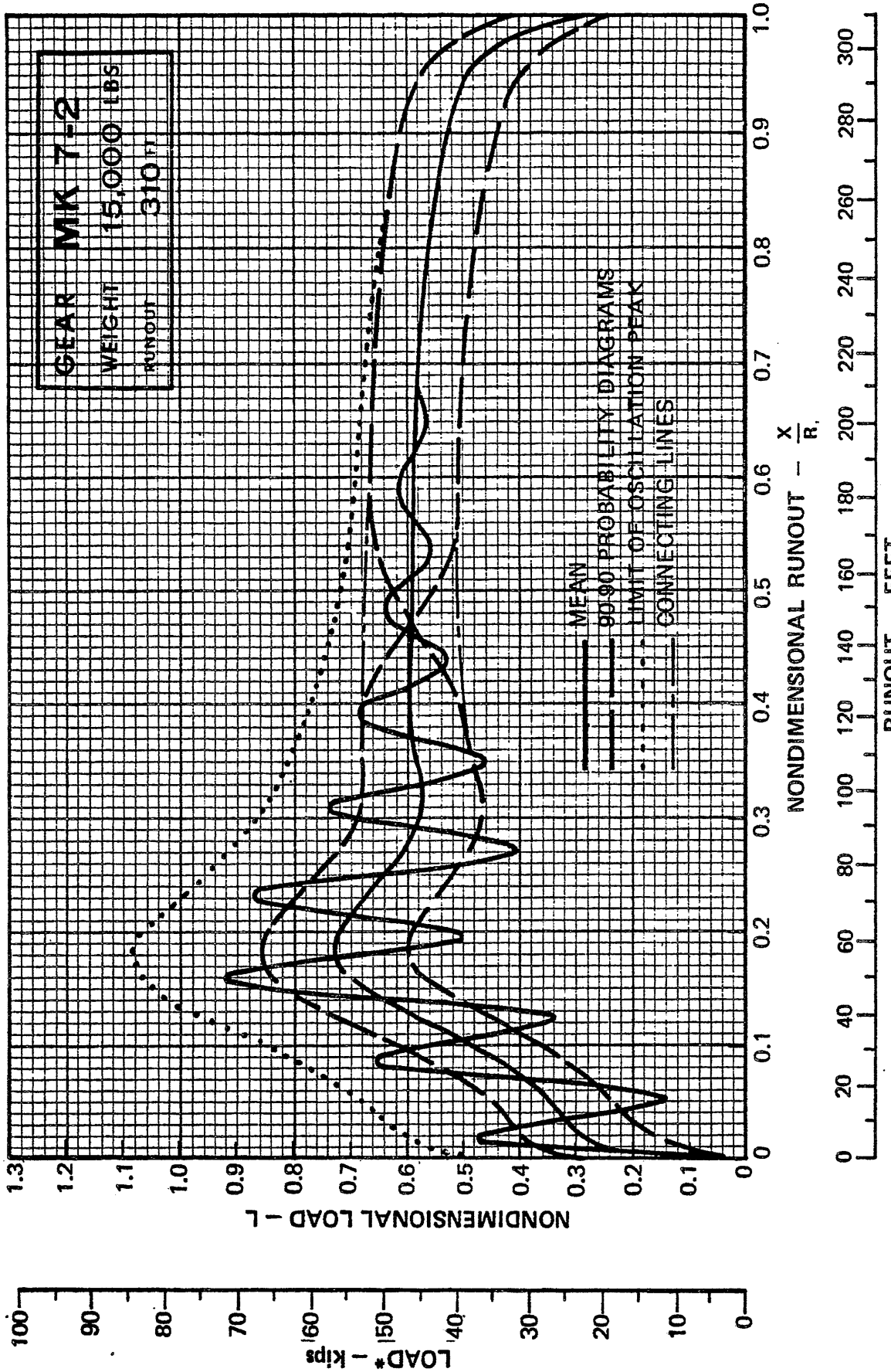

*Dimensioned load scale for 135 knots engaging speed and thrust of 0.4W only. Other engaging speeds and thrust values require correction per ratio $V_E^2/135^2$ x correction factor x dimensioned scale; where V_E is in knots.

FIGURE 16.2. MK7-2 Gear, 15,000 Lb Weight, Load vs Stroke, Nondimensional

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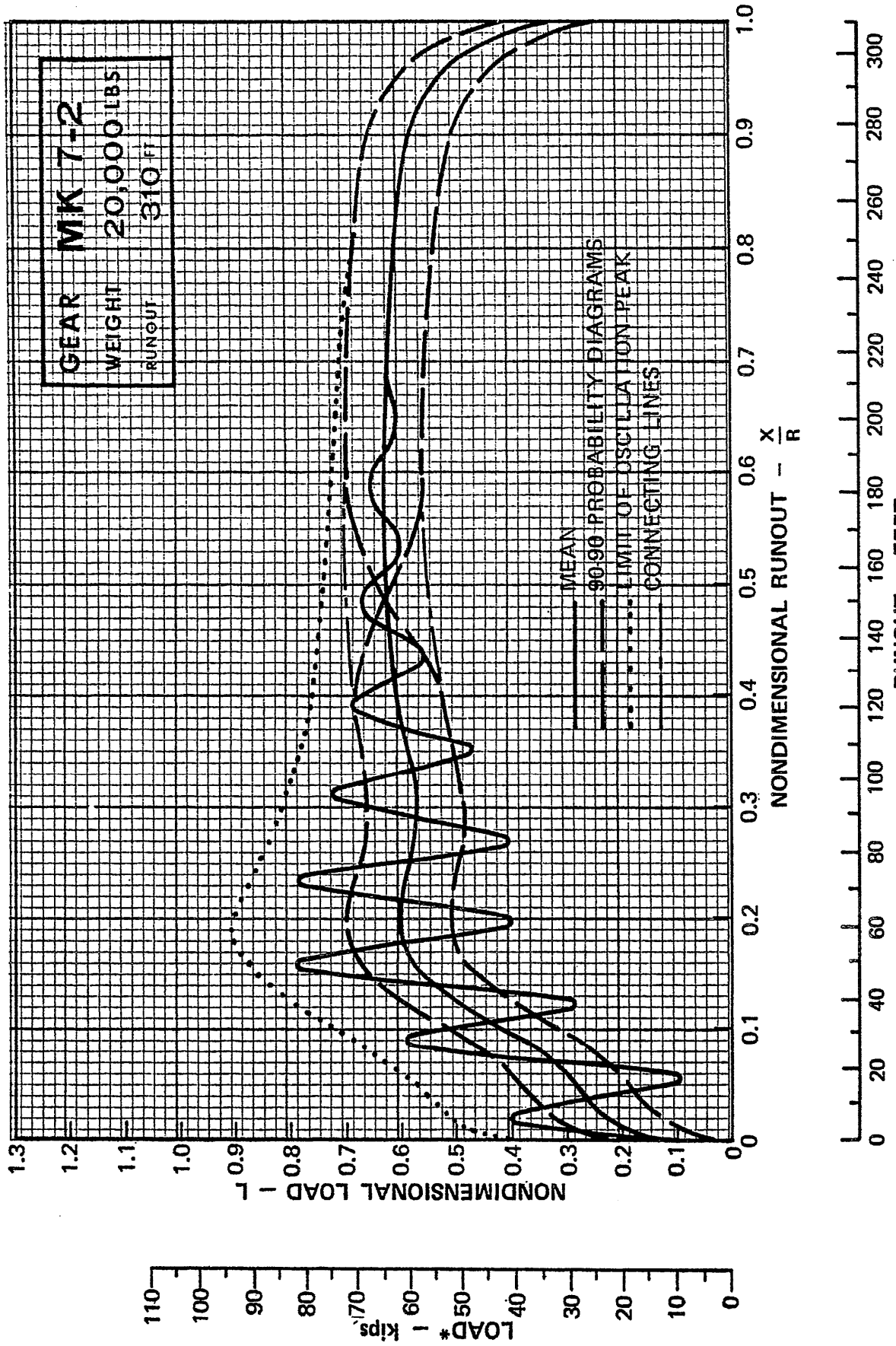

*Dimensioned load scale for 135 knots engaging speed and thrust of 0.4W only. Other engaging speeds and thrust values require correction per ratio $V_E^2/135^2$ x correction factor x dimensioned scale; where V_E is in knots.

FIGURE 16.3. MK7-2 Gear, 20,000 Lb Weight, Load vs Stroke, Nondimensional

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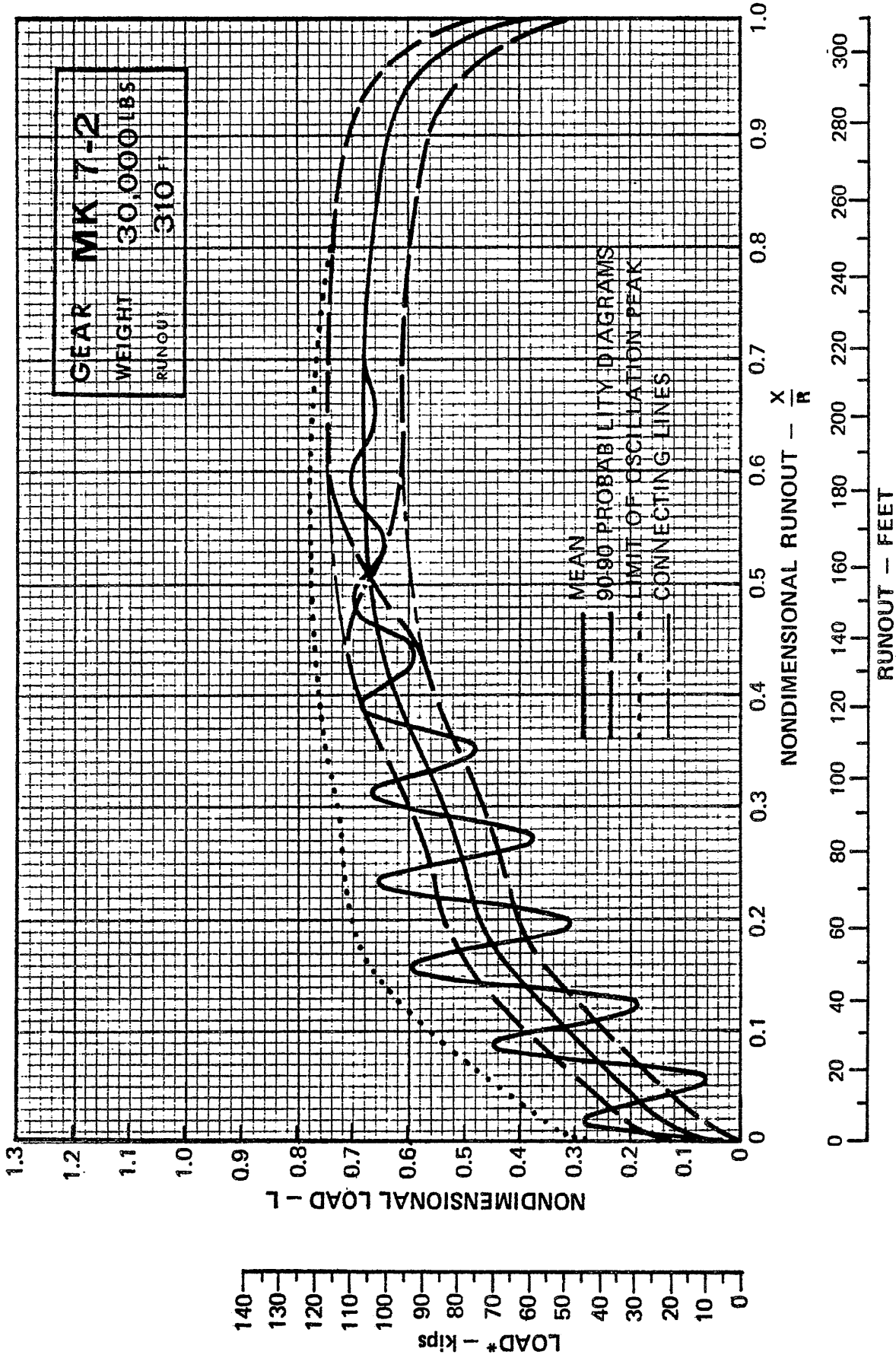

*Dimensioned load scale for 135 knots engaging speed and thrust of 0.4W only. Other engaging speeds and thrust values require correction per ratio $V_E^2/135^2$ x correction factor x dimensioned scale; where V_E is in knots.

FIGURE 16.4. MK7-2 Gear, 30,000 Lb Weight, Load vs Stroke, Nondimensional

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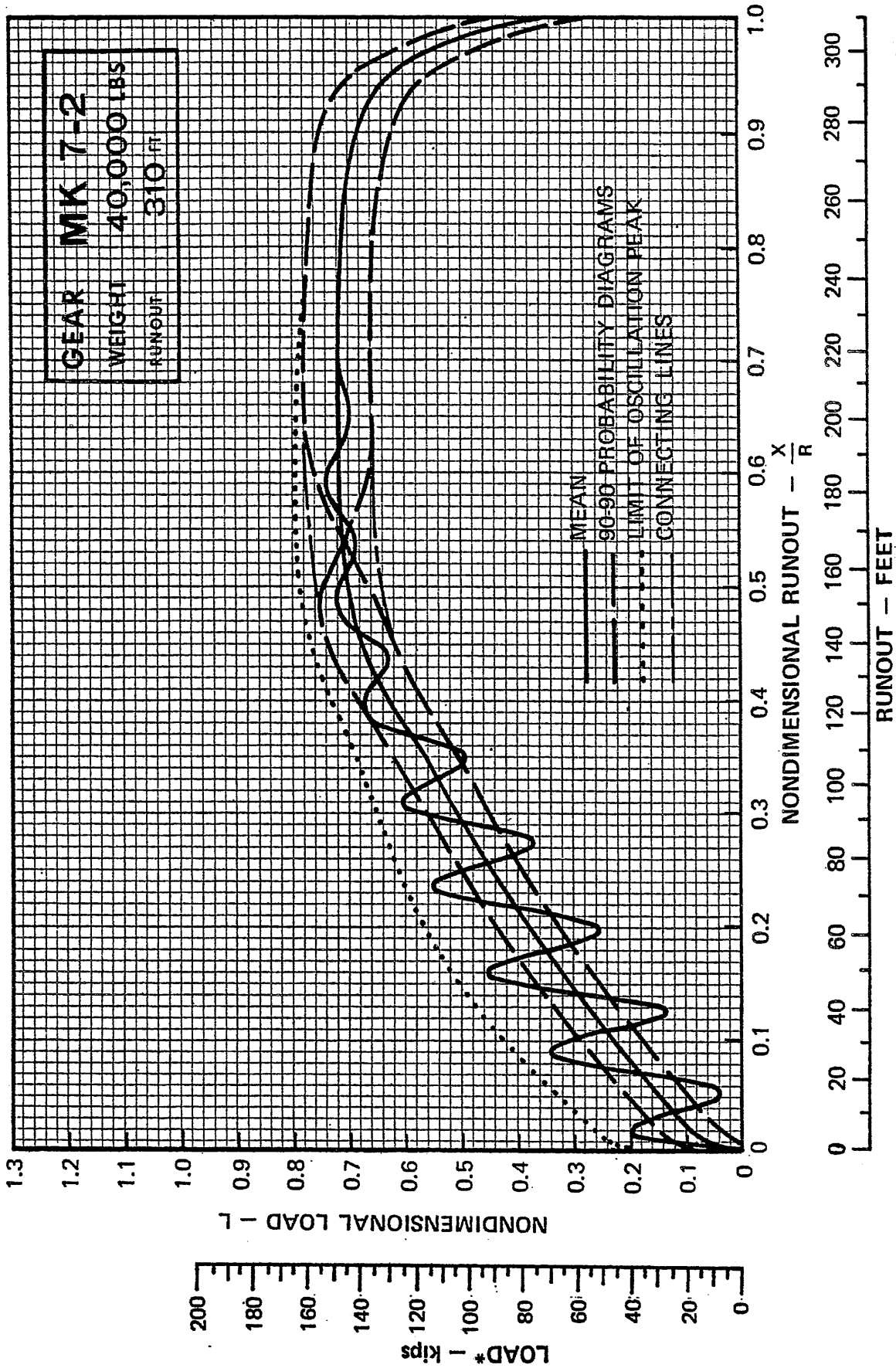

*Dimensioned load scale for 135 knots engaging speed and thrust of 0.4W only. Other engaging speeds and thrust values require correction per ratio $V_E^2/135^2$ x correction factor x dimensioned scale; where V_E is in knots.

FIGURE 16.5. MK7-2 Gear, 40,000 Lb Weight, Load vs Stroke, Nondimensional

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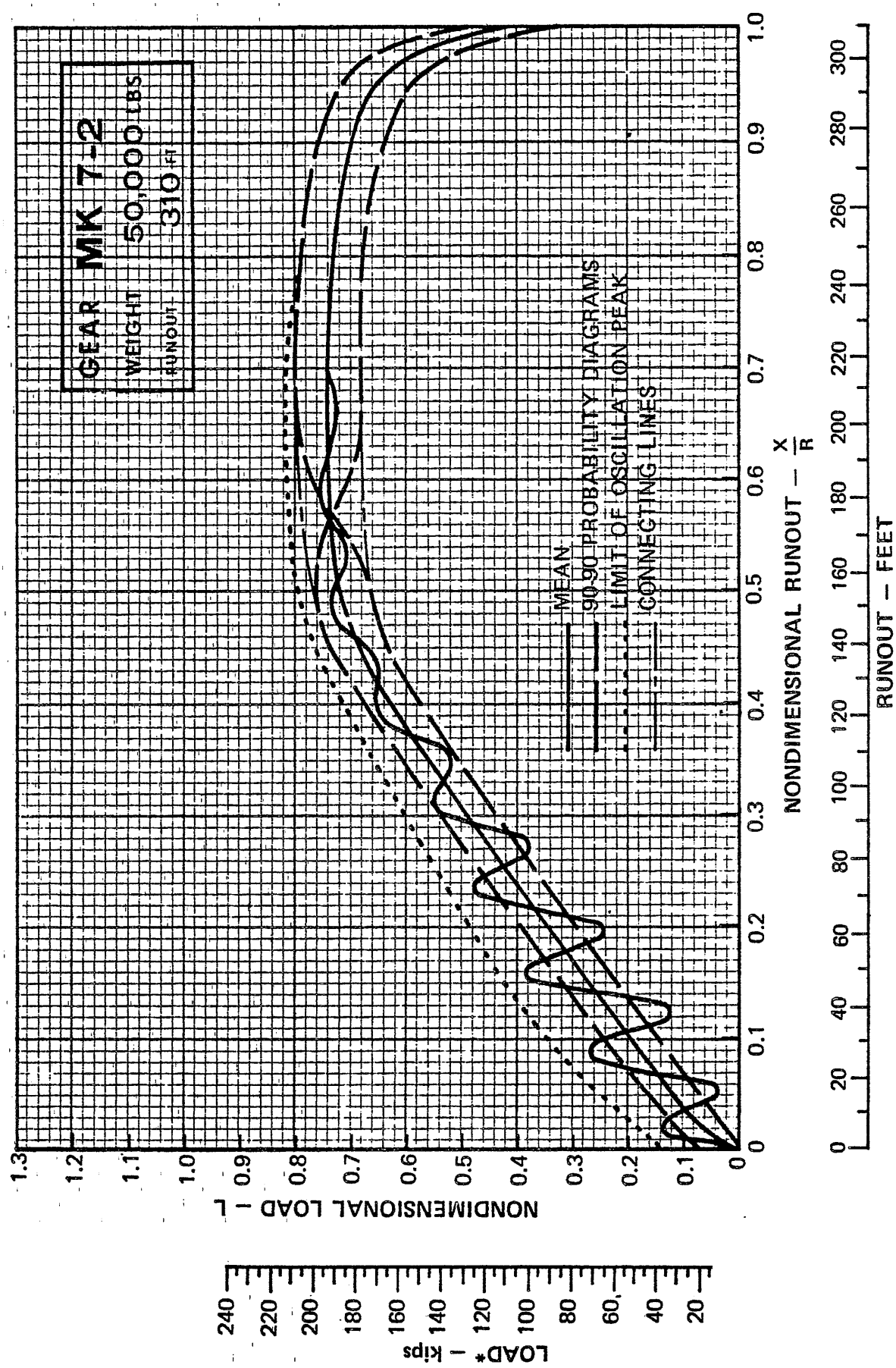

*Dimensioned load scale for 135 knots engaging speed and thrust of 0.4W only. Other engaging speeds and thrust values require correction per ratio $V_E^2/135^2$ x correction factor x dimensioned scale; where V_E is in knots.

FIGURE 16.6. MK7-2 Gear, 50,000 Lb Weight, Load vs Stroke, Nondimensional

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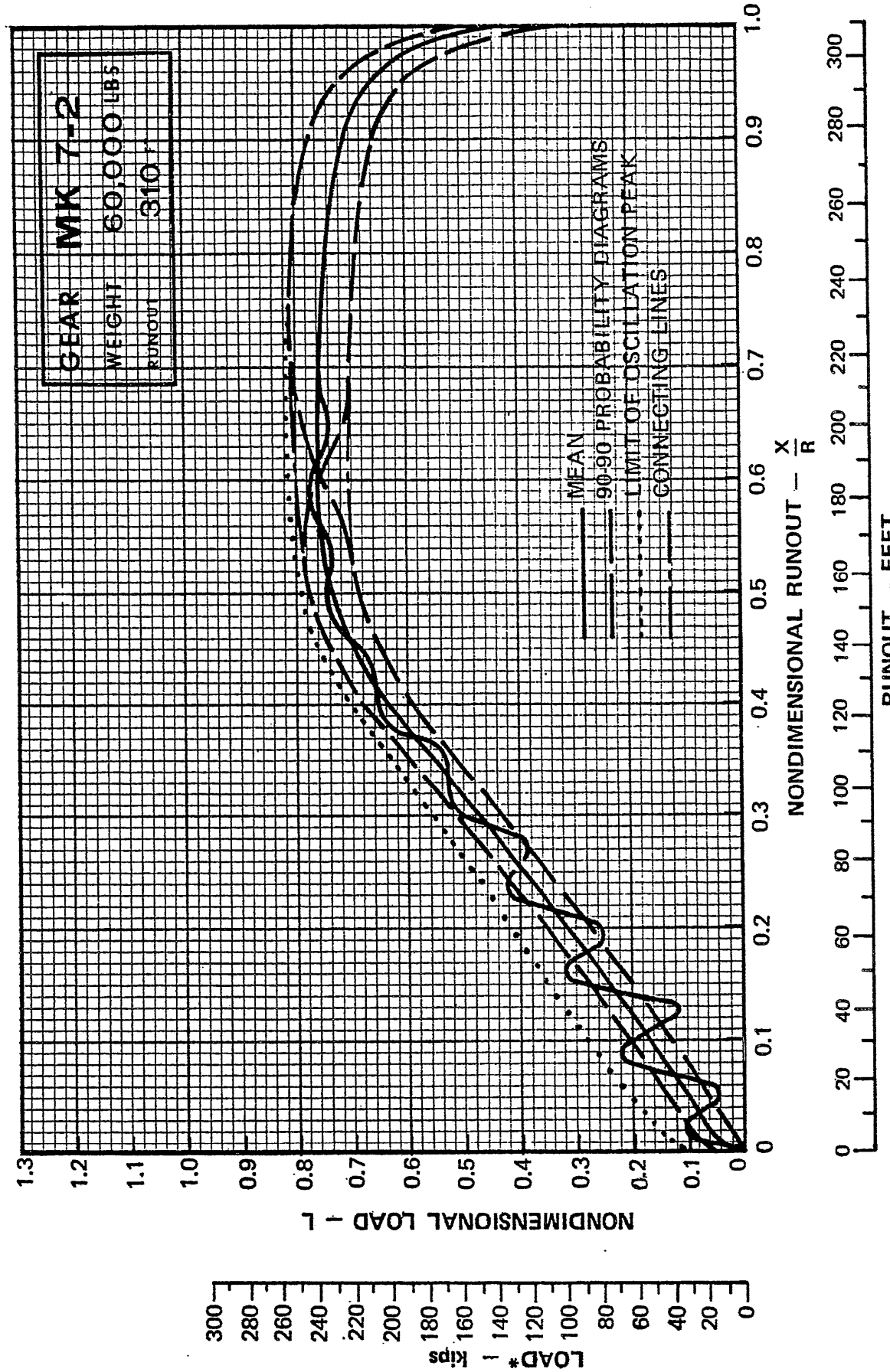

*Dimensioned load scale for 135 knots engaging speed and thrust of 0.4W only. Other engaging speeds and thrust values require correction per ratio $V_E^2/135^2$ x correction factor x dimensioned scale; where V_E is in knots.

FIGURE 16.7. MK7-2 Gear, 60,000 Lb Weight, Load vs Stroke, Nondimensional

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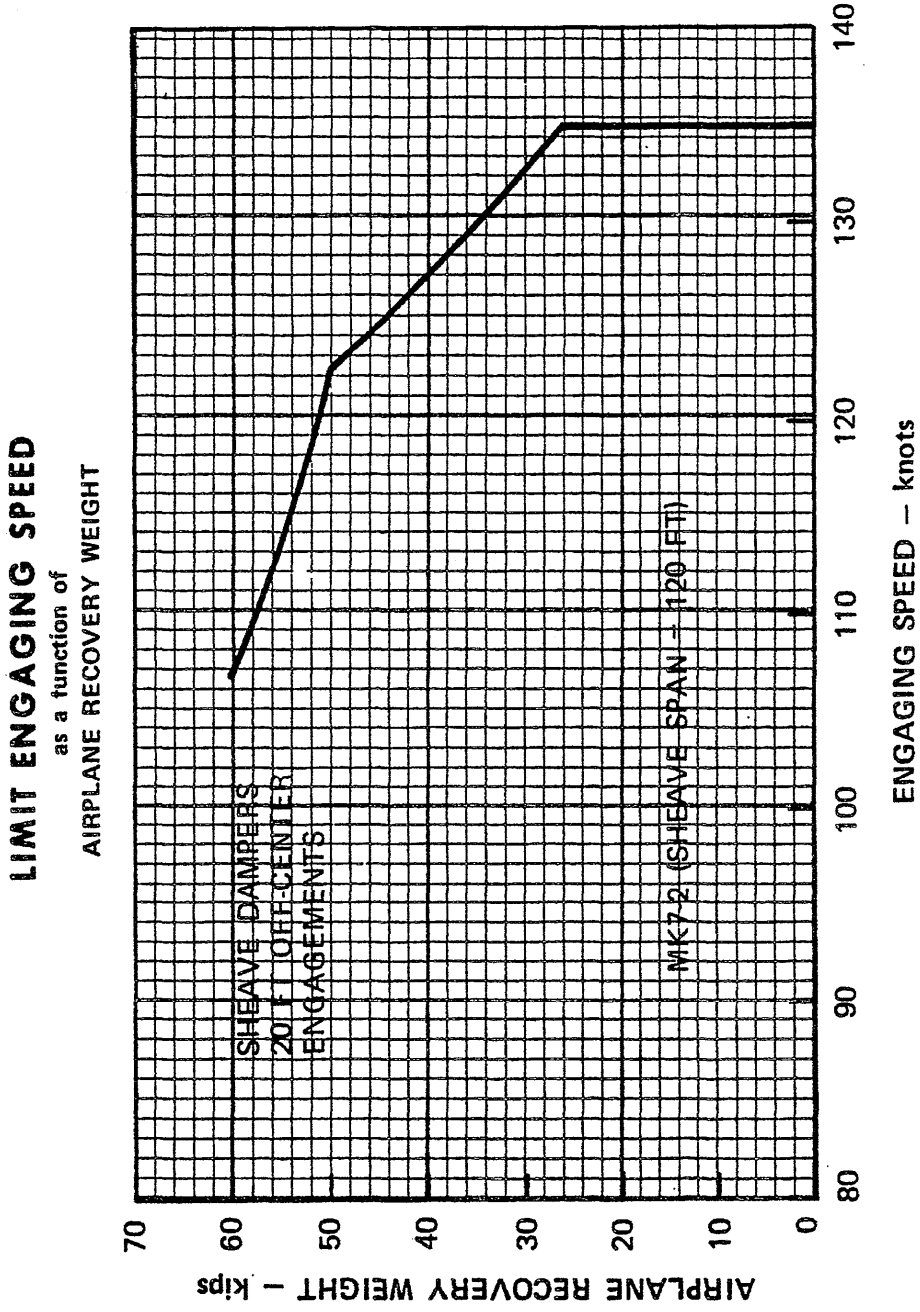

FIGURE 17.1. MK7-2 Gear, Limit Engaging Speed

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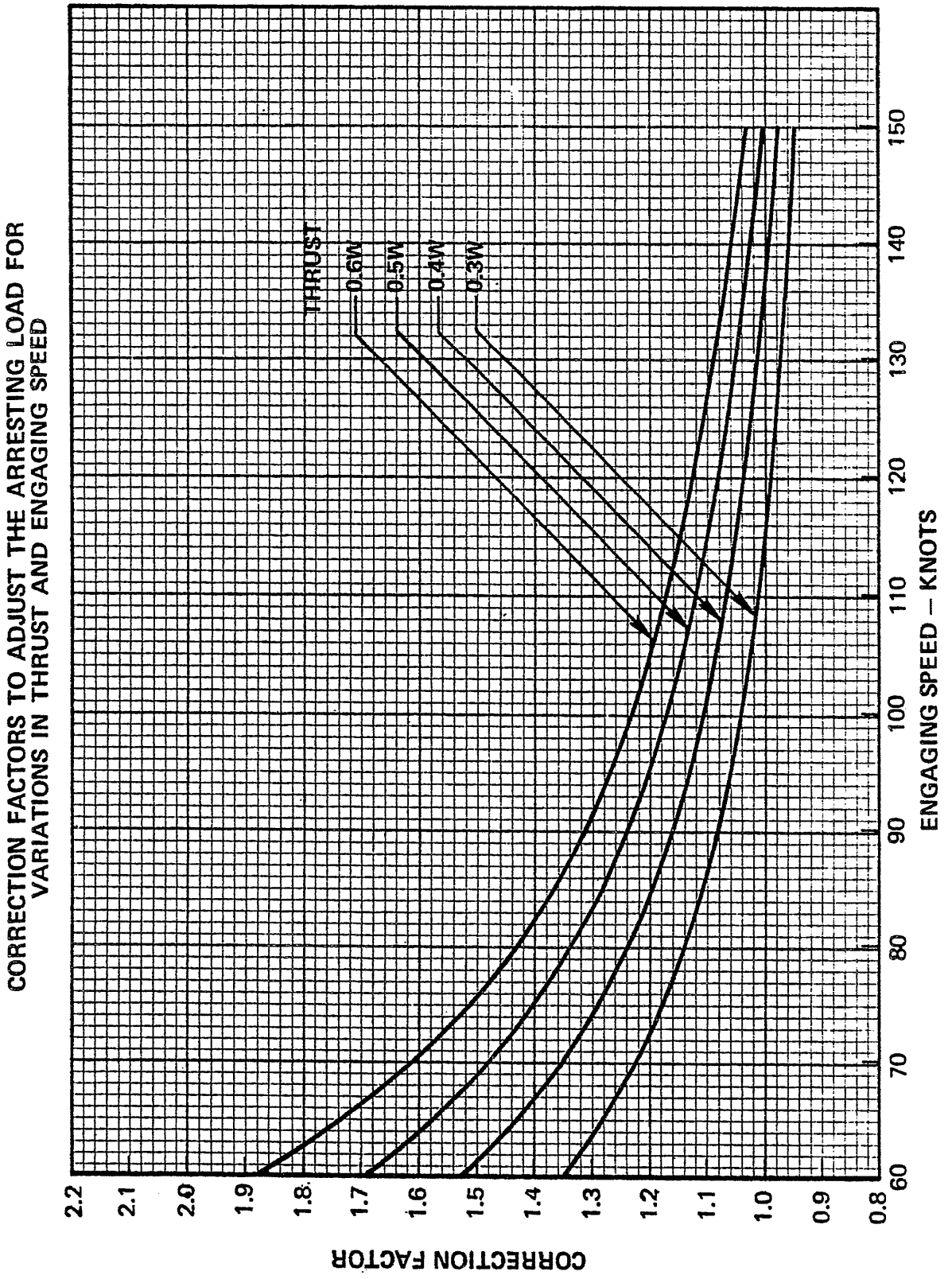

FIGURE 17.2. MK7-2 Gear, Correction Factor

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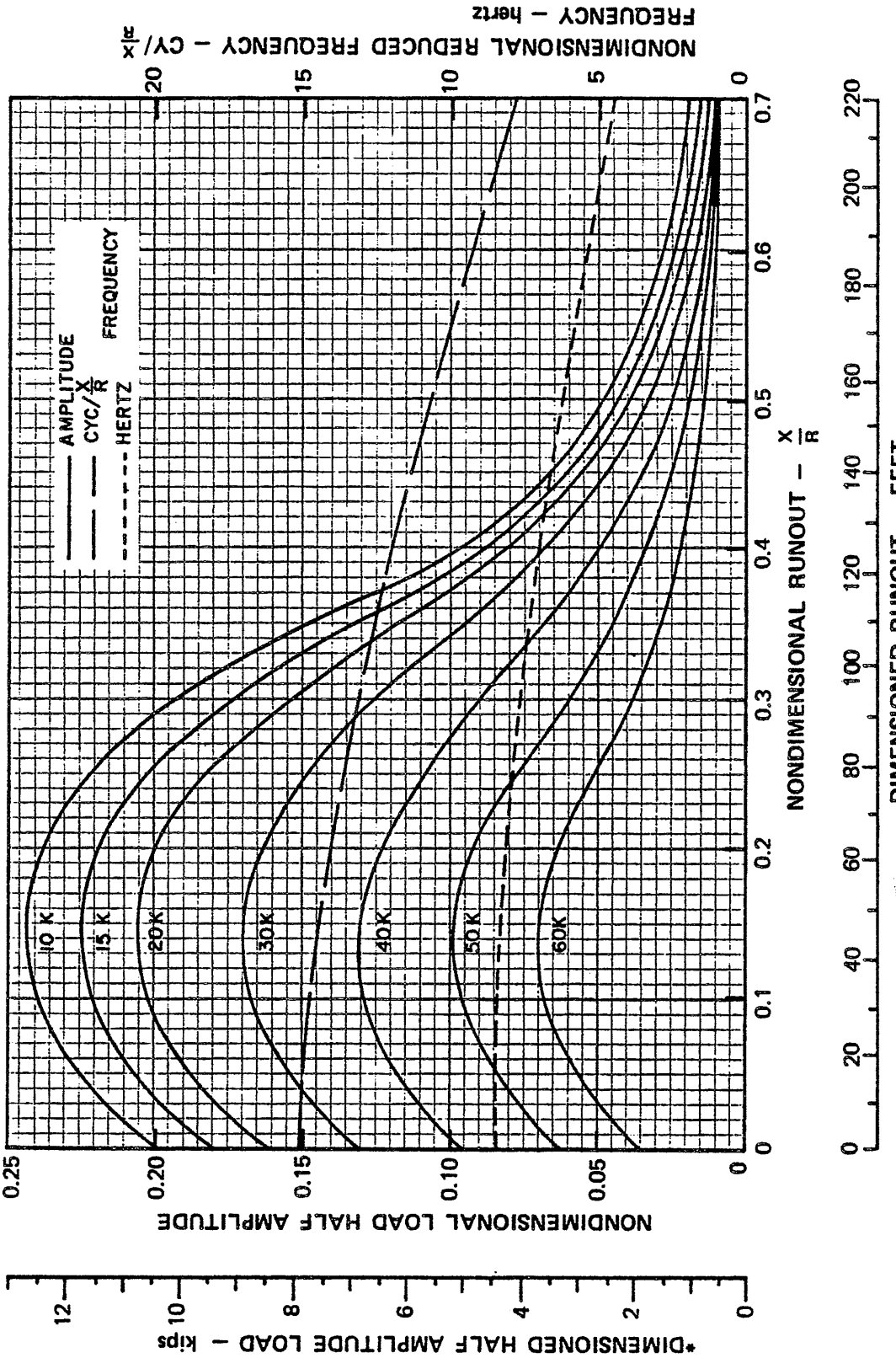

*Dimensioned half amplitude load scale for 10,000 lb airplane weight, 135 knot engaging speed, and 0.4W thrust only. Other weights and engaging speeds require correction per ratio $\frac{V_E^2 \times \text{weight}}{135^2 \times 10}$ x dimensioned scale x correction factor. V_E is in knots and airplane weight W is in kips.

FIGURE 17.3. MK7-2 Gear, Average Frequency and Amplitude of Oscillation, Nondimensional

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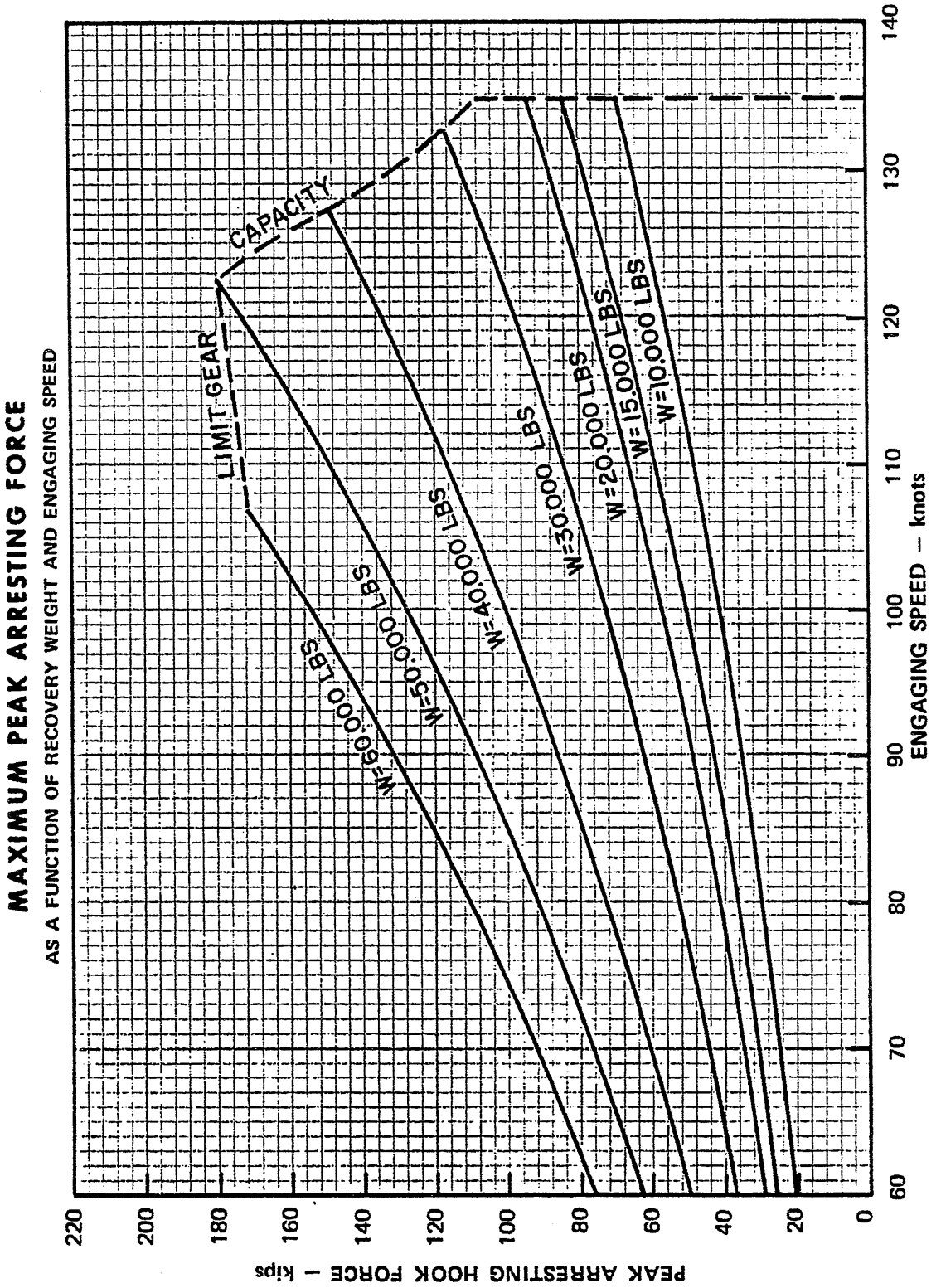

FIGURE 17.4. MK7-2 Gear, Maximum Peak Arresting Force

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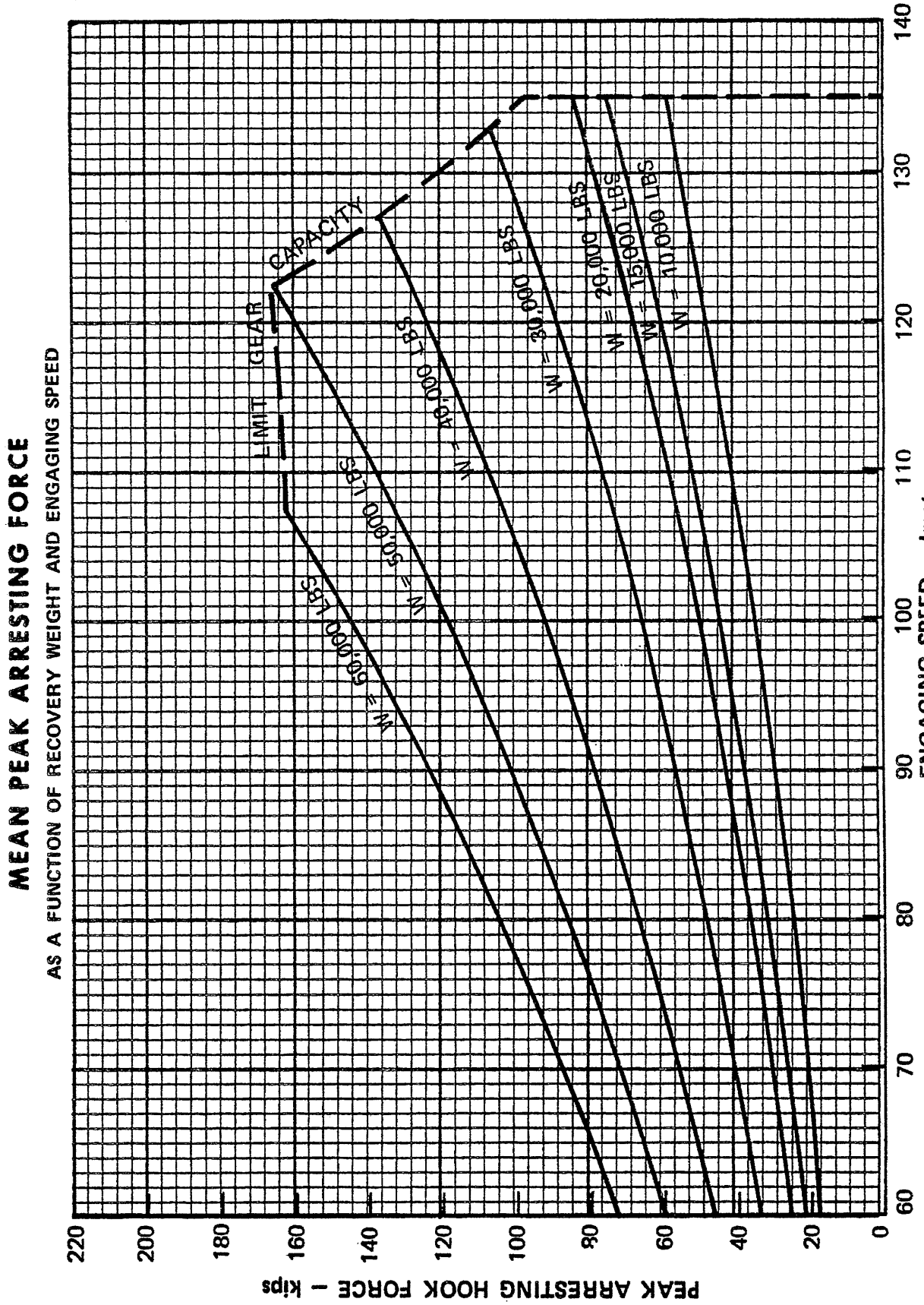

FIGURE 17.5. MK7-2 Gear, Mean Peak Arresting Force

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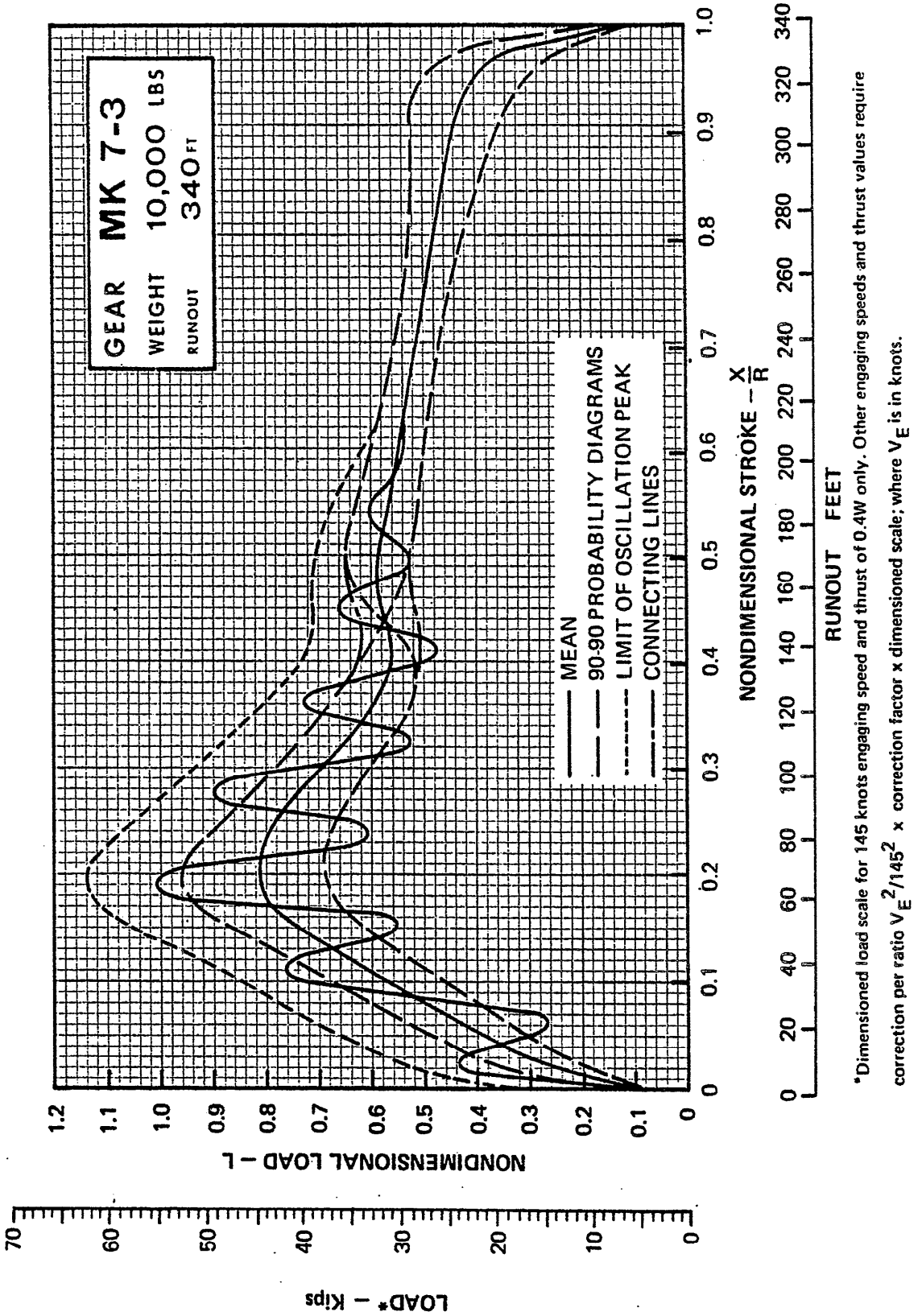

*Dimensioned load scale for 145 knots engaging speed and thrust of 0.4W only. Other engaging speeds and thrust values require correction per ratio $V_E^2/145^2$ x correction factor x dimensioned scale; where V_E is in knots.

FIGURE 18.1. MK7-3 Gear, 10,000 Lb Weight, Load vs Stroke, Nondimensional

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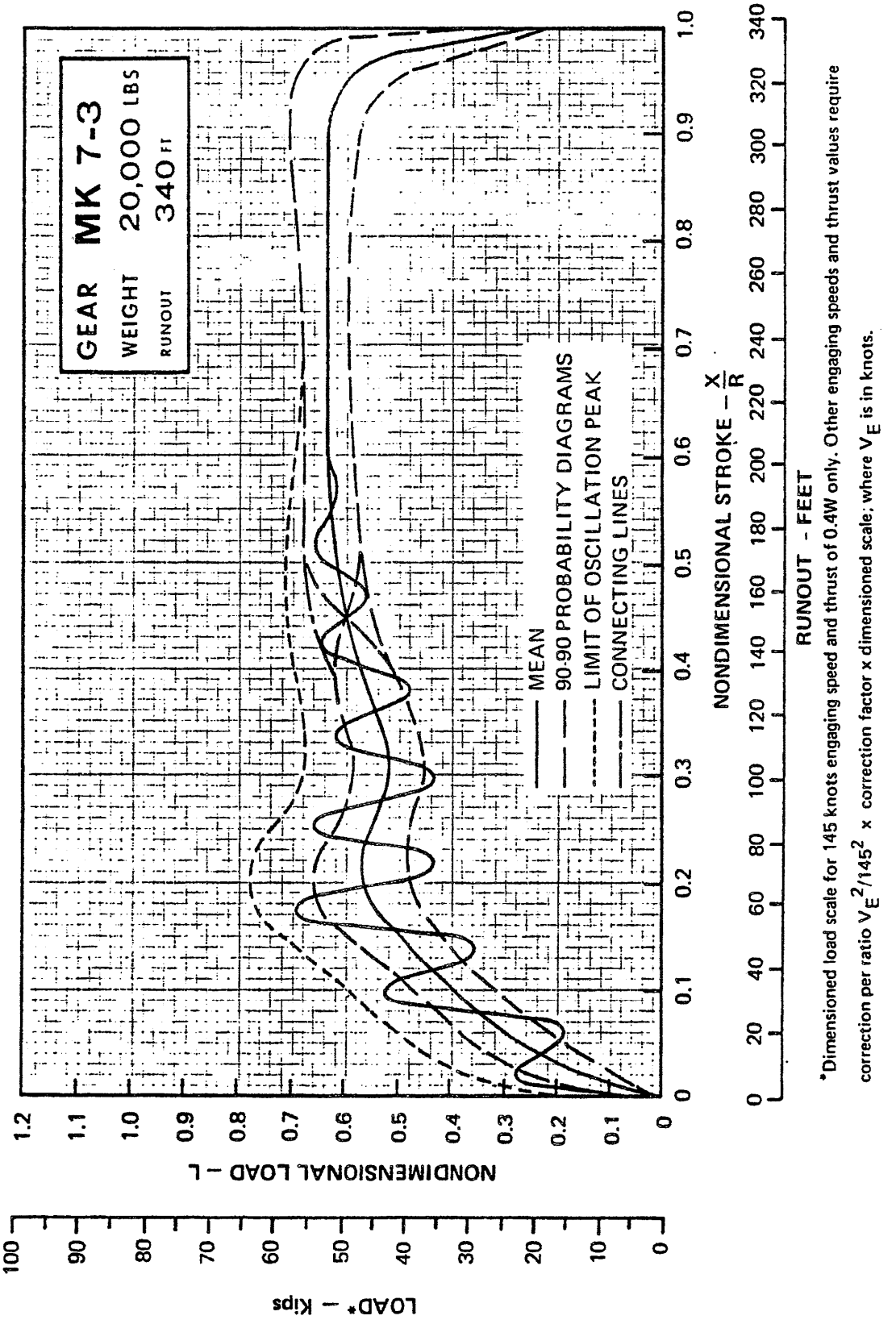

*Dimensioned load scale for 145 knots engaging speed and thrust of 0.4W only. Other engaging speeds and thrust values require correction per ratio $V_E^2/145^2$ x correction factor x dimensioned scale; where V_E is in knots.

FIGURE 18.2. MK7-3 Gear, 15,000 Lb Weight, Load vs Stroke, Nondimensional

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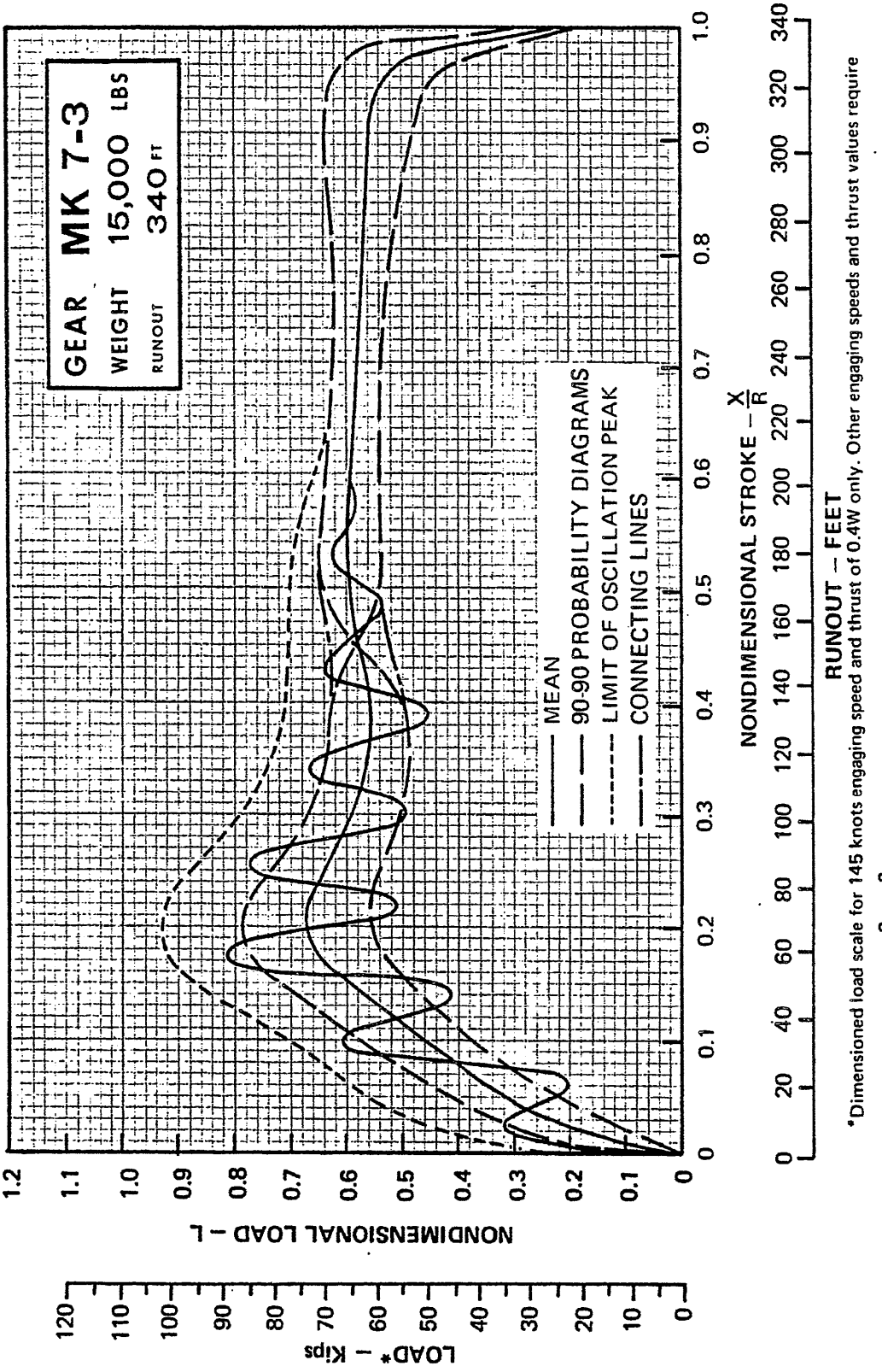

*Dimensioned load scale for 145 knots engaging speed and thrust of 0.4W only. Other engaging speeds and thrust values require correction per ratio $V_E^2/145^2$ x correction factor x dimensioned scale; where V_E is in knots.

FIGURE 18.3. MK7-3 Gear, 20,000 Lb Weight, Load vs Stroke, Nondimensional

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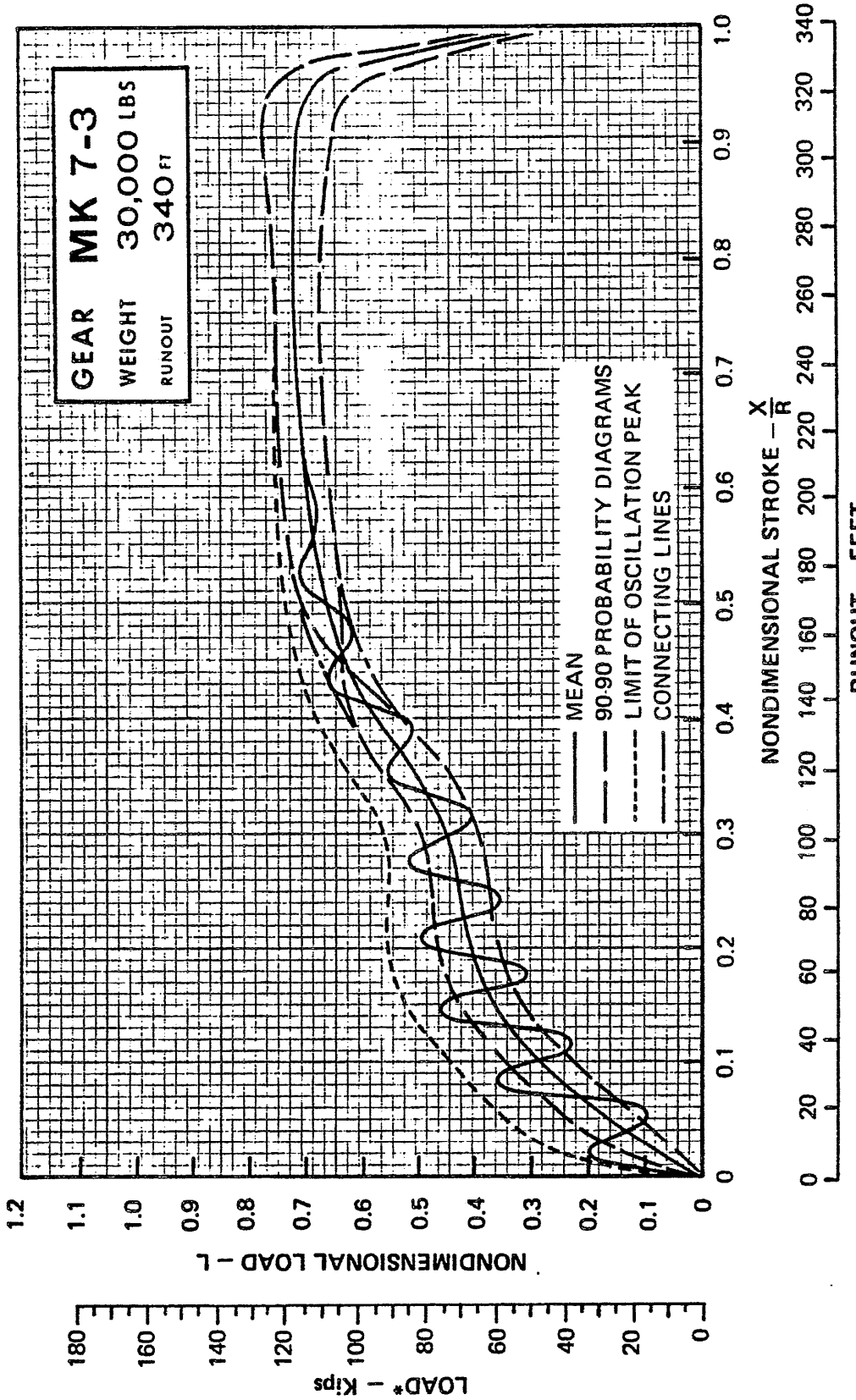

*Dimensioned load scale for 145 knots engaging speed and thrust of 0.4W only. Other engaging speeds and thrust values require correction per ratio $V_E^2/145^2$ x correction factor x dimensioned scale; where V_E is in knots.

FIGURE 18.4. MK7-3 Gear, 30,000 Lb Weight, Load vs Stroke, Nondimensional

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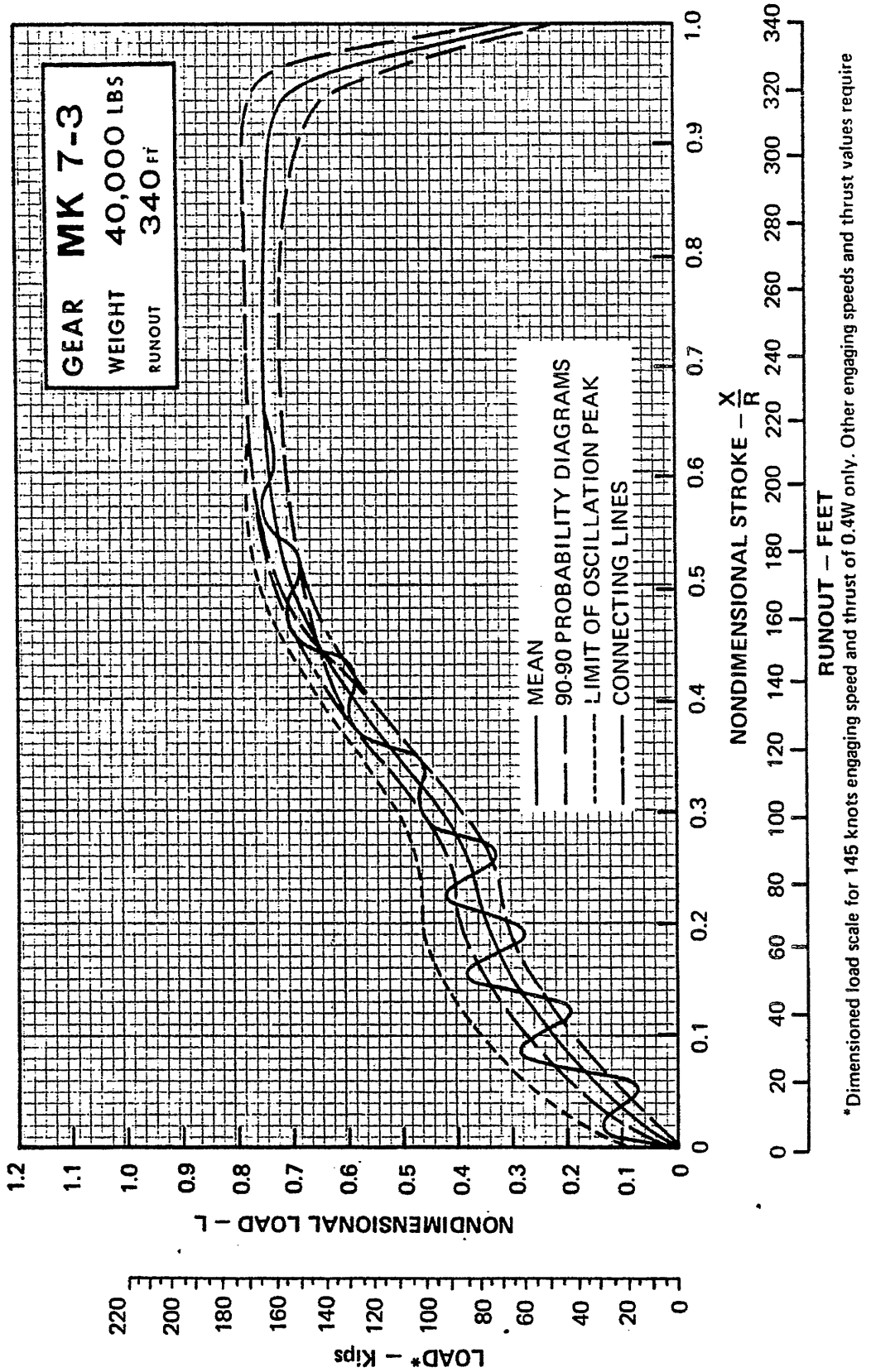

*Dimensioned load scale for 145 knots engaging speed and thrust of 0.4W only. Other engaging speeds and thrust values require correction per ratio $V_E^2/145^2$ x correction factor x dimensioned scale; where V_E is in knots.

FIGURE 18.5. MK7-3 Gear, 40,000 Lb Weight, Load vs Stroke, Nondimensional

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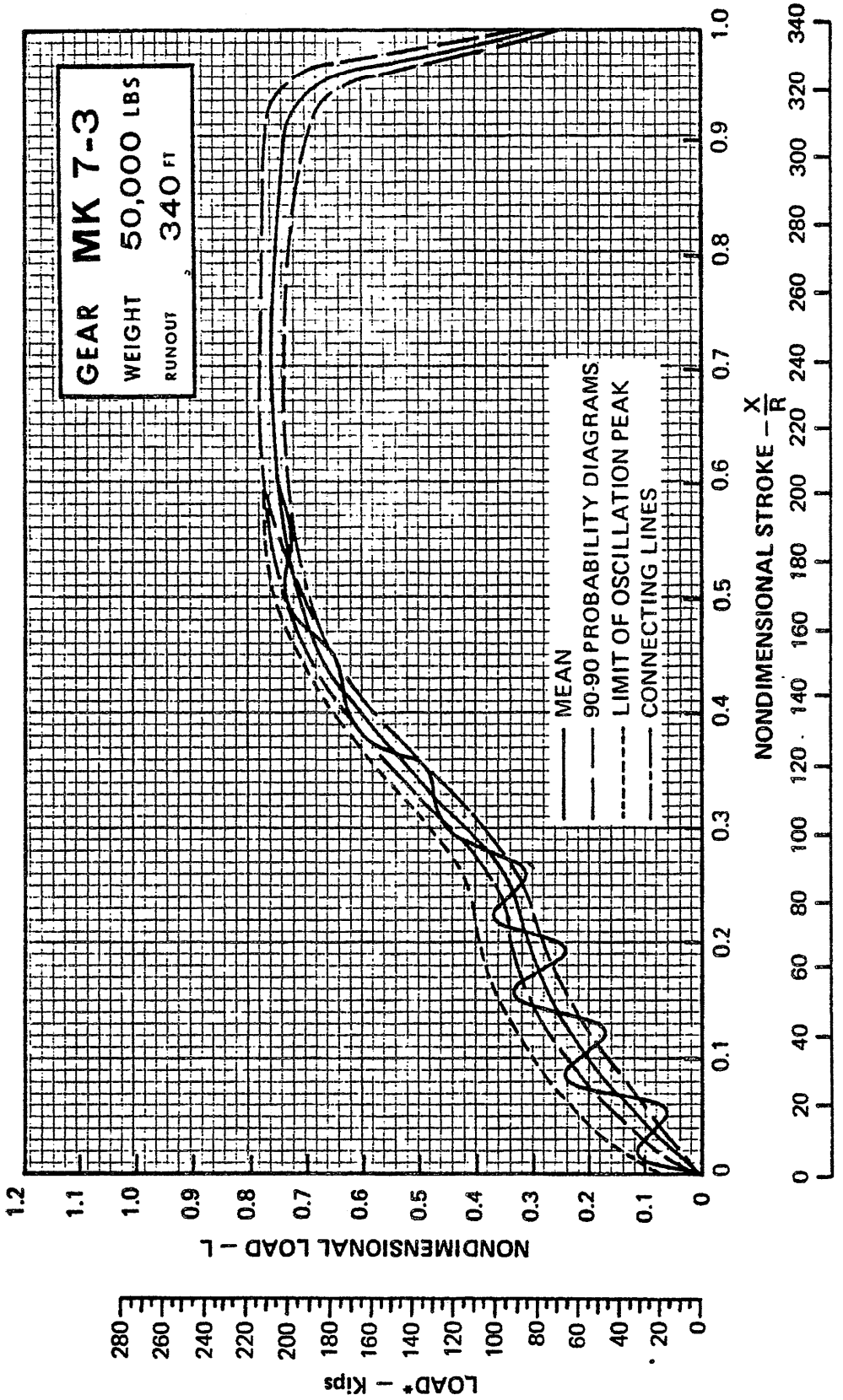

*Dimensioned load scale for 145 knots engaging speed and thrust of 0.4W only. Other engaging speeds and thrust values require correction per ratio $V_E^2/145^2$ x correction factor x dimensioned scale; where V_E is in knots.

FIGURE 18.6. MK7-3 Gear, 50,000 Lb Weight, Load vs Stroke, Nondimensional

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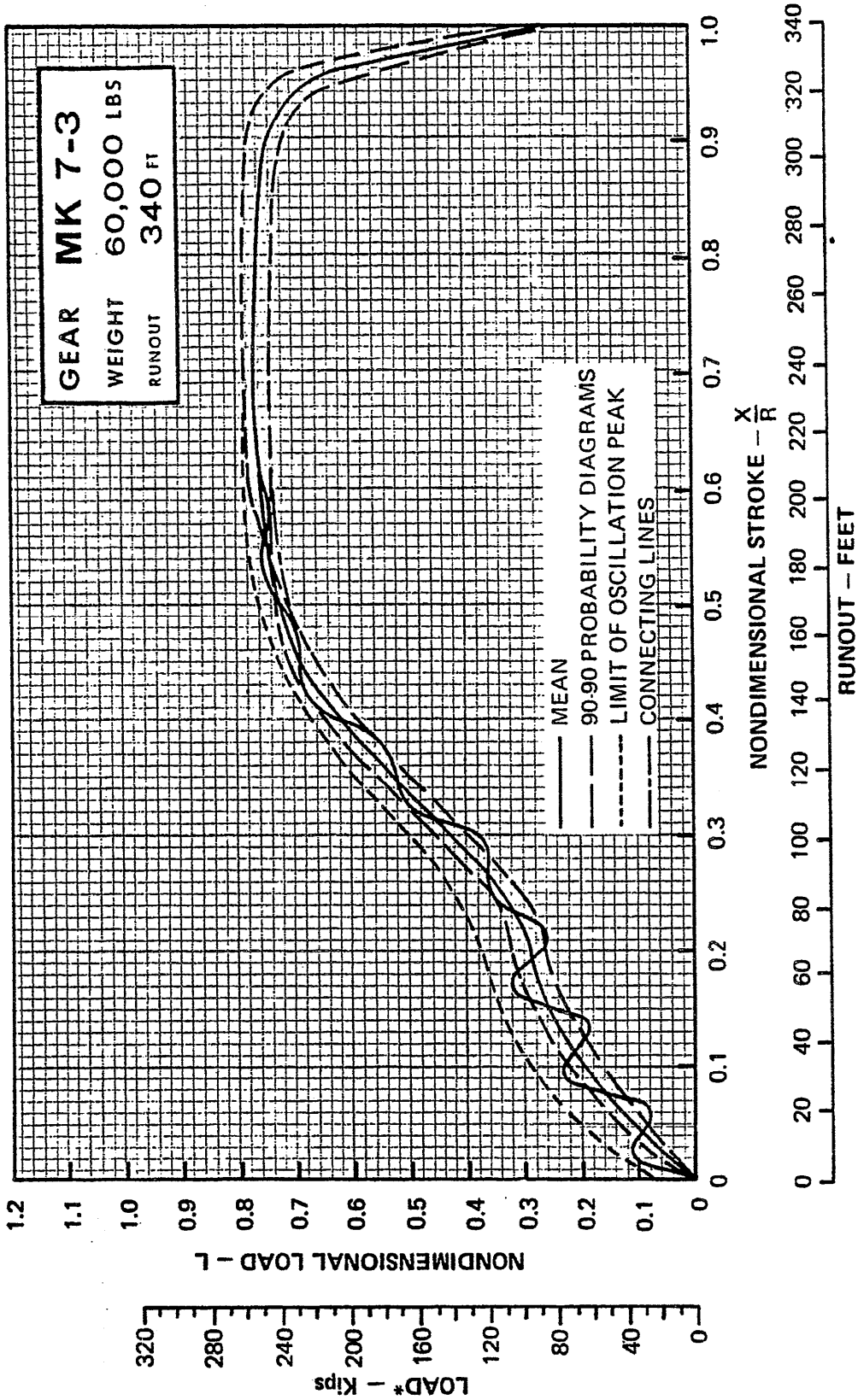

*Dimensioned load scale for 145 knots engaging speed and thrust of 0.4W only. Other engaging speeds and thrust values require correction per ratio $V_E^2/145^2$ x correction factor x dimensioned scale; where V_E is in knots.

FIGURE 18.7. MK7-3 Gear, 60,000 Lb Weight, Load vs Stroke, Nondimensional

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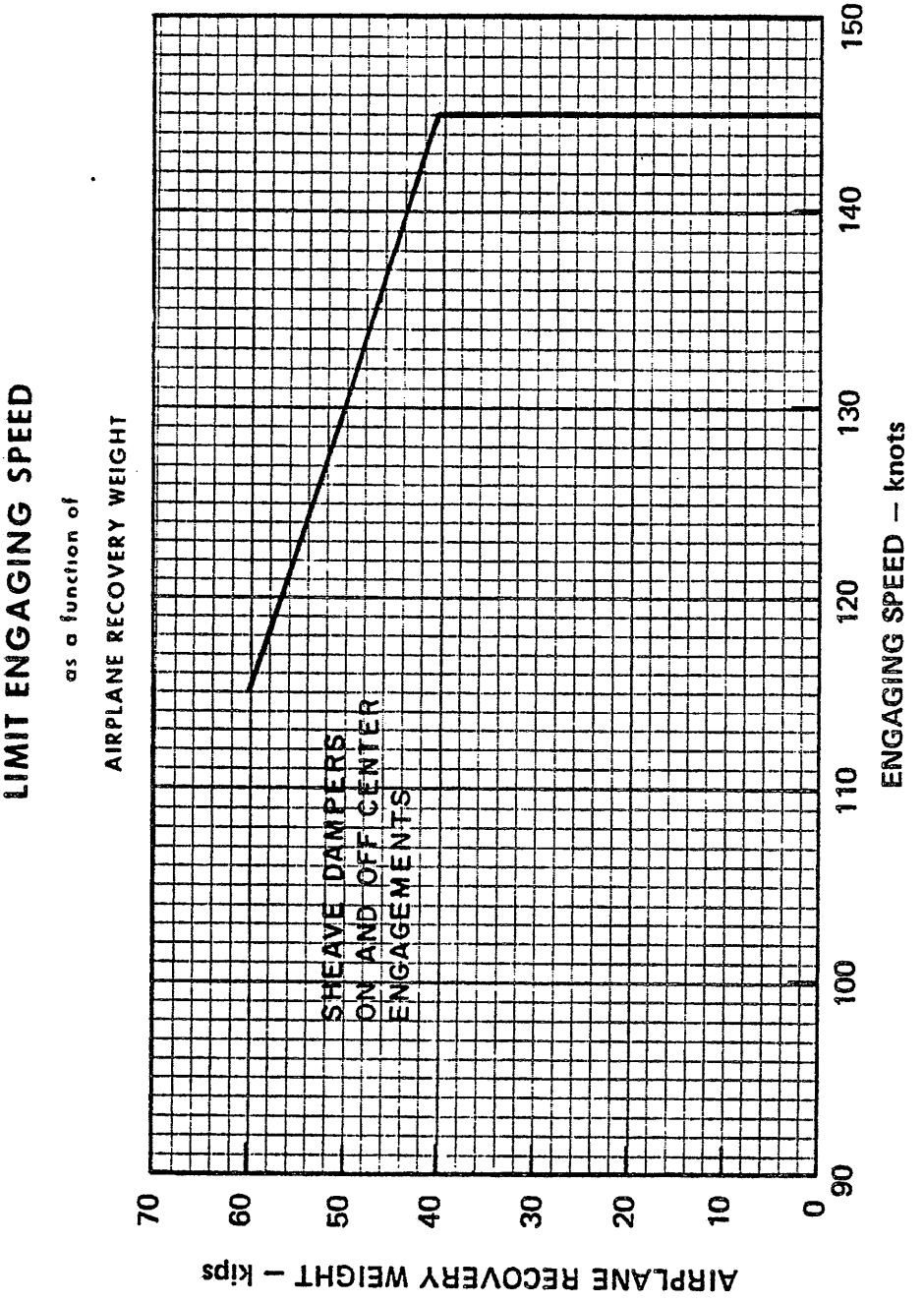

FIGURE 19.1. MK7-3 Gear, Limit Engaging Speed

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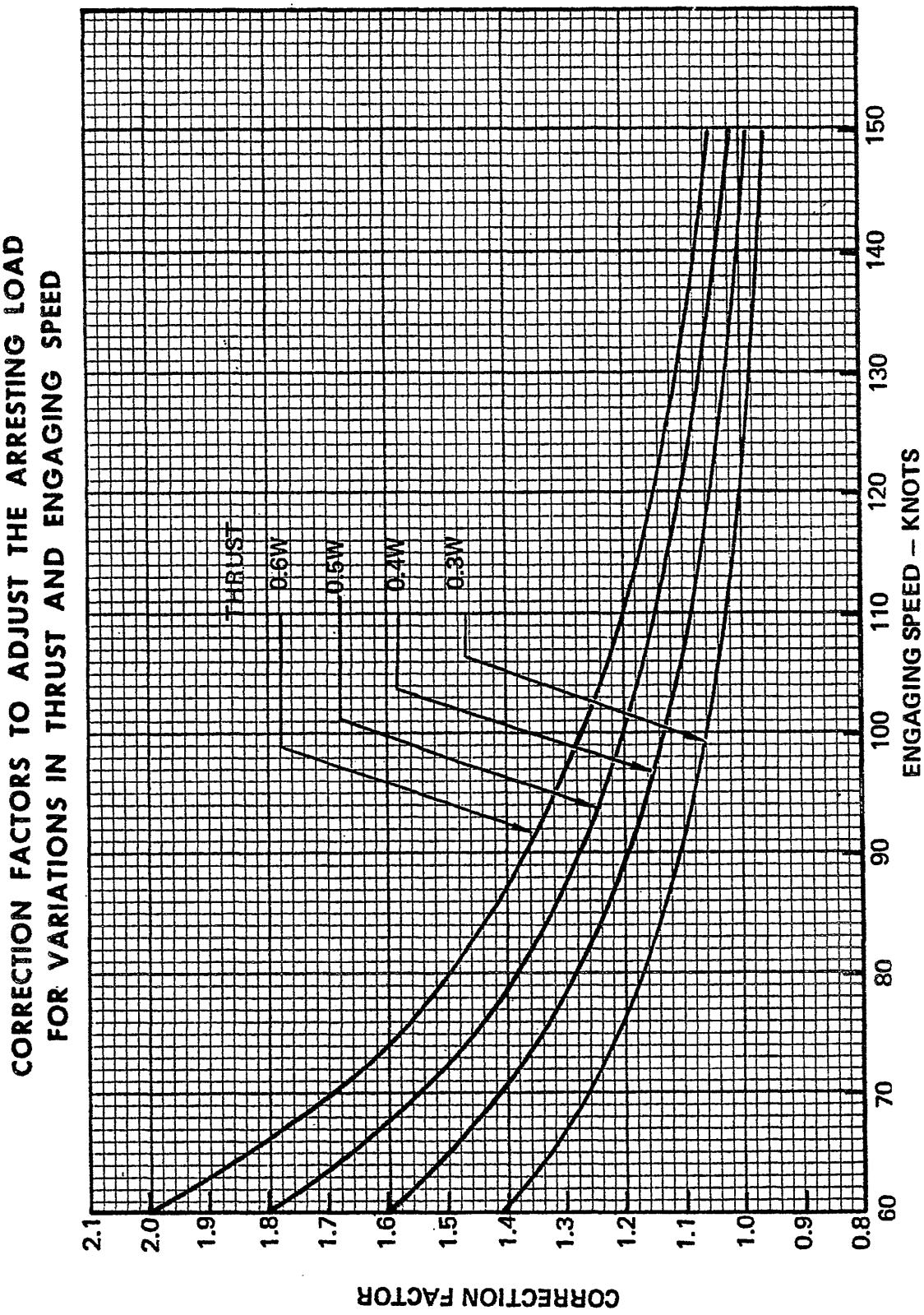

FIGURE 19.2. MK7-3 Gear, Correction Factor

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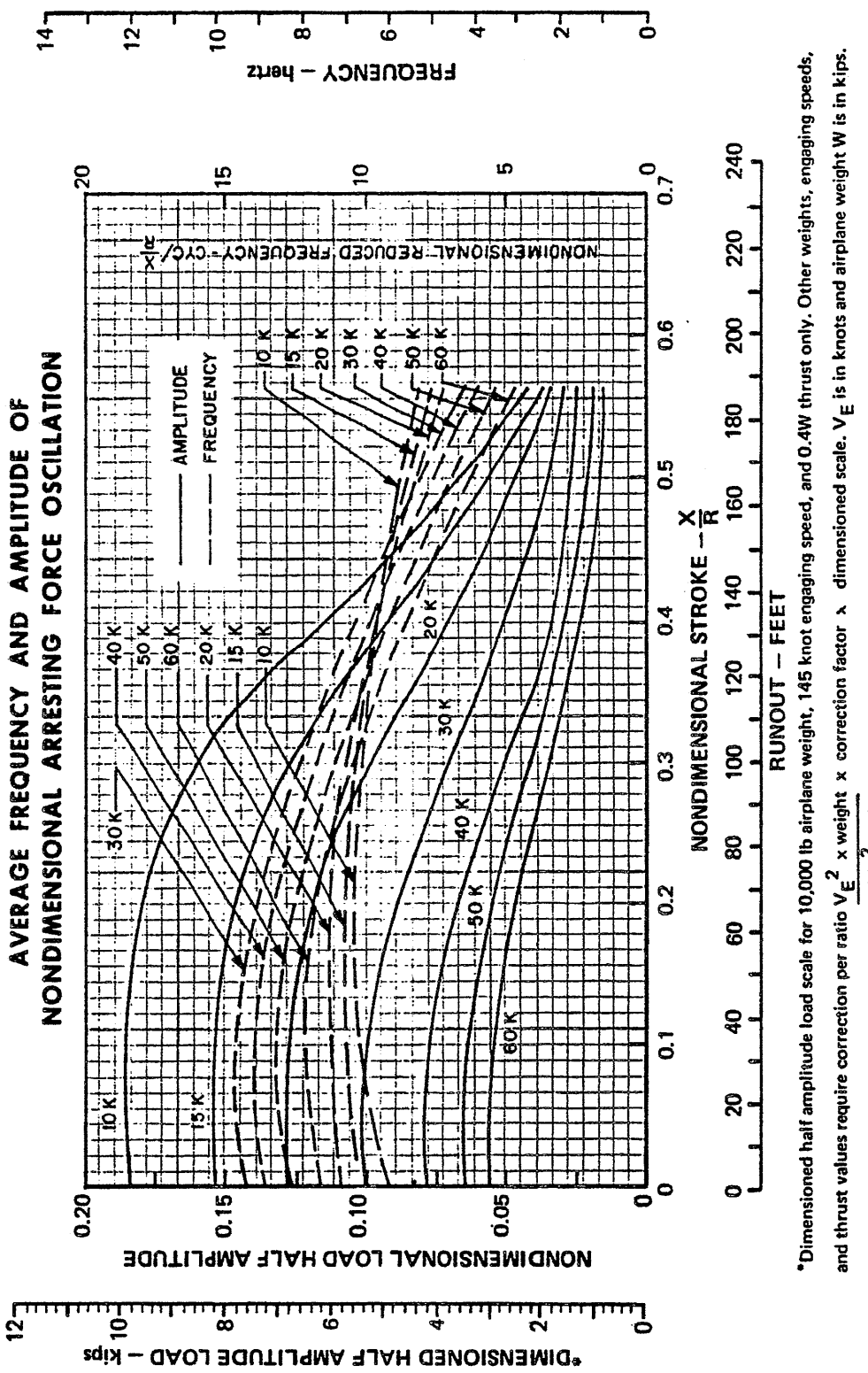

*Dimensioned half amplitude load scale for 10,000 lb airplane weight, 145 knot engaging speed, and 0.4W thrust only. Other weights, engaging speeds, and thrust values require correction per ratio $\frac{V_E^2 \times \text{weight}}{145^2 \times 10}$ x correction factor x dimensioned scale. V_E is in knots and airplane weight W is in kips.

FIGURE 19.3. MK7-3 Gear, Average Frequency and Amplitude of Oscillation, Nondimensional

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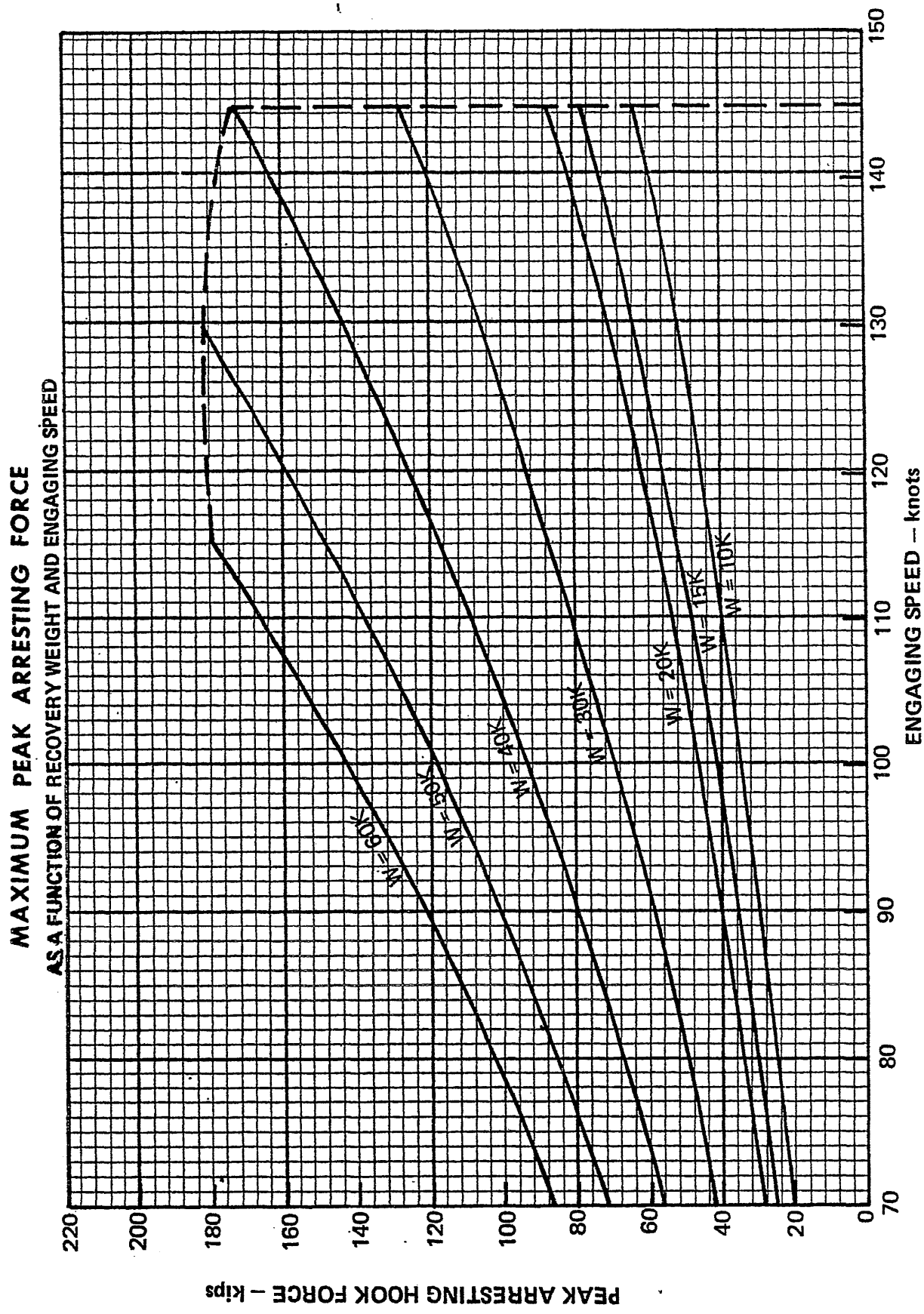

FIGURE 19.4. MK7-3 Gear, Maximum Peak Arresting Force

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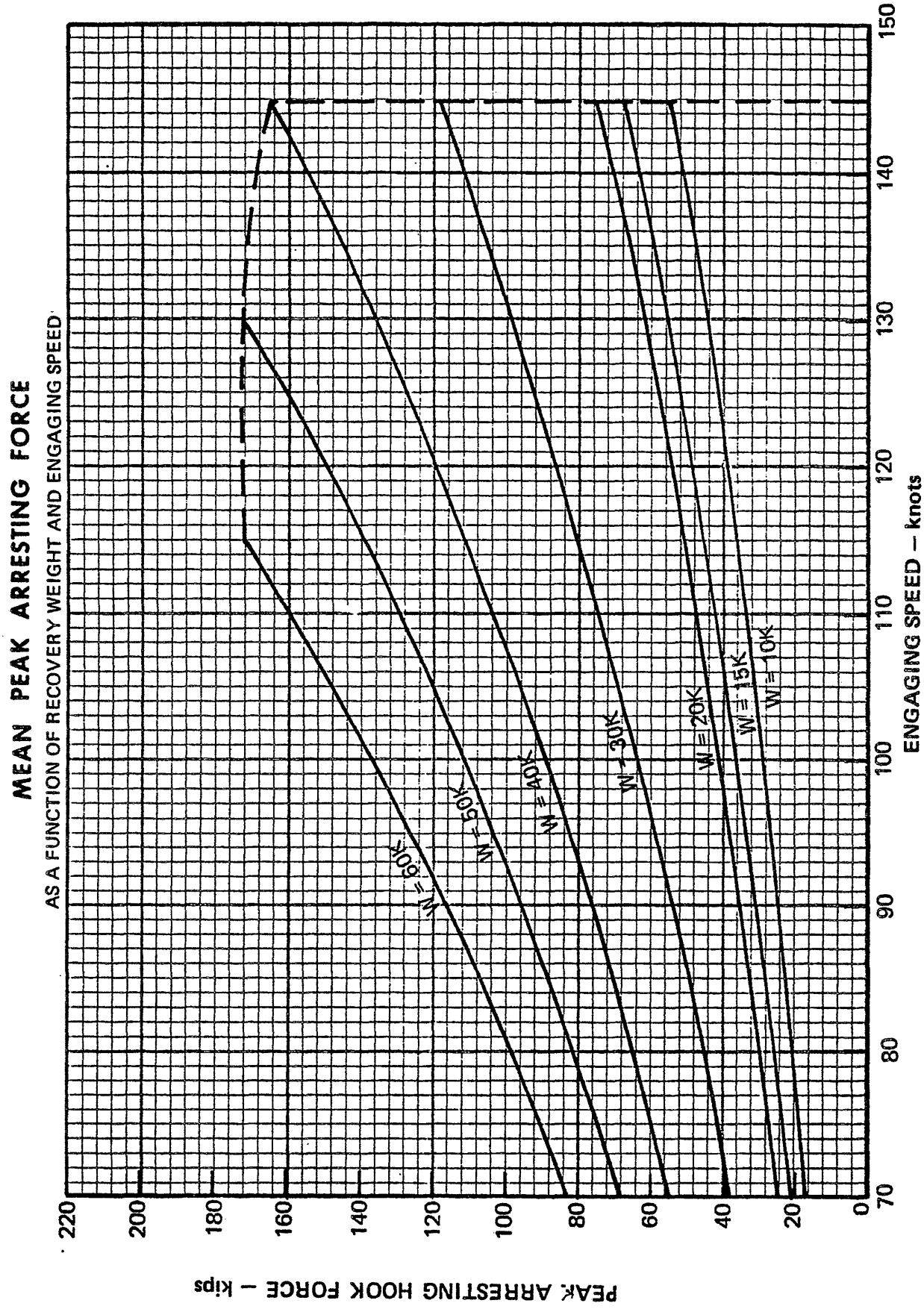

FIGURE 19.5. MK7-3 Gear, Mean Peak Arresting Force

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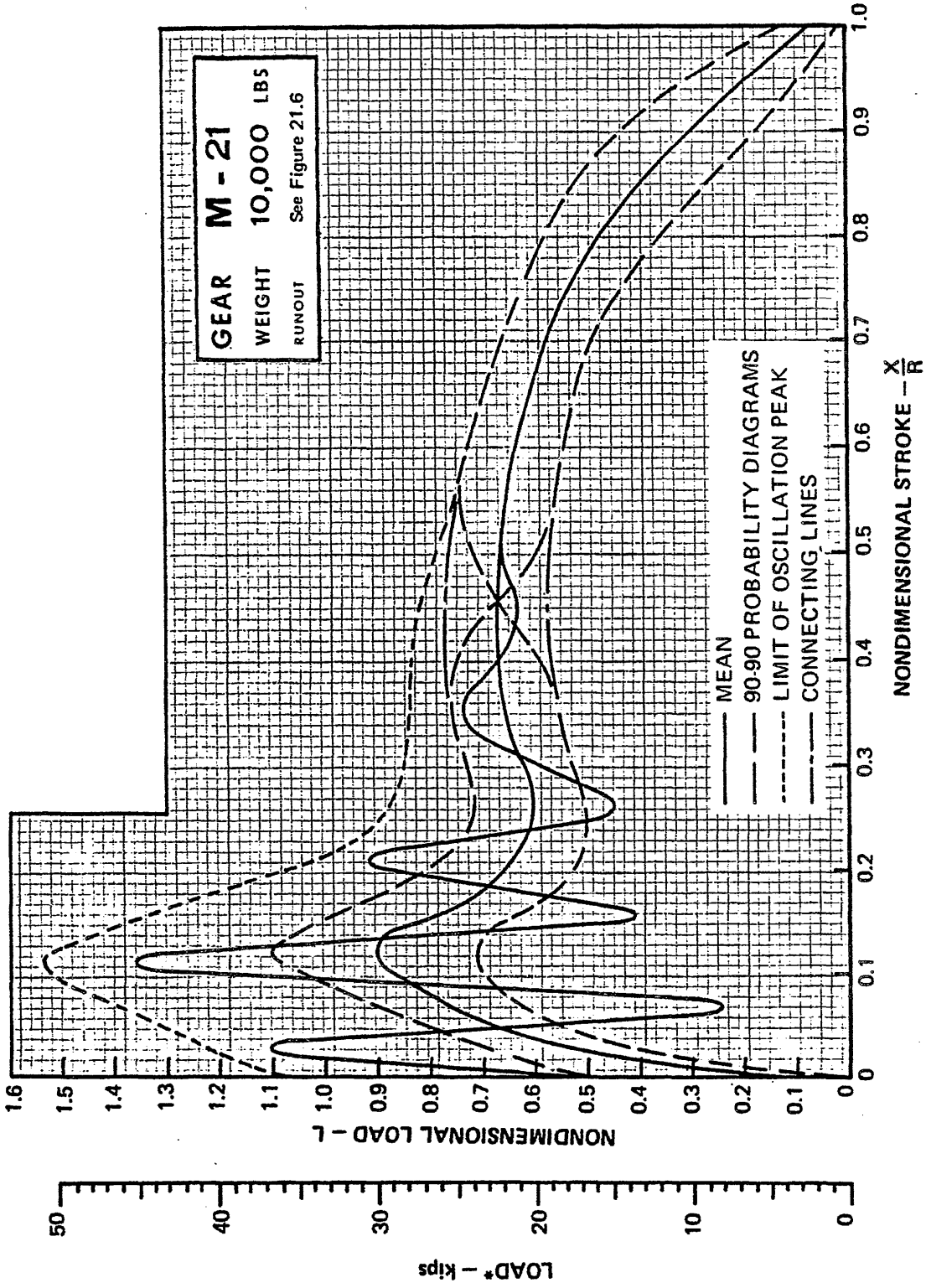

*Dimensioned scale for upper 90-90 loads, 160 knots engaging speed, thrust of .4W, and drytapes only. Other engaging speeds and thrust values require correction per ratio $\frac{V_E^2/R}{160.^2/680.}$ or $\frac{V_E^2}{37.65R}$ x correction factor x dimensioned scale. V_E is in knots and runout R is from Figure 21.6 and is in feet.

FIGURE 20.1. M-21 Gear, 10,000 Lb Weight, Load vs Stroke, Nondimensional

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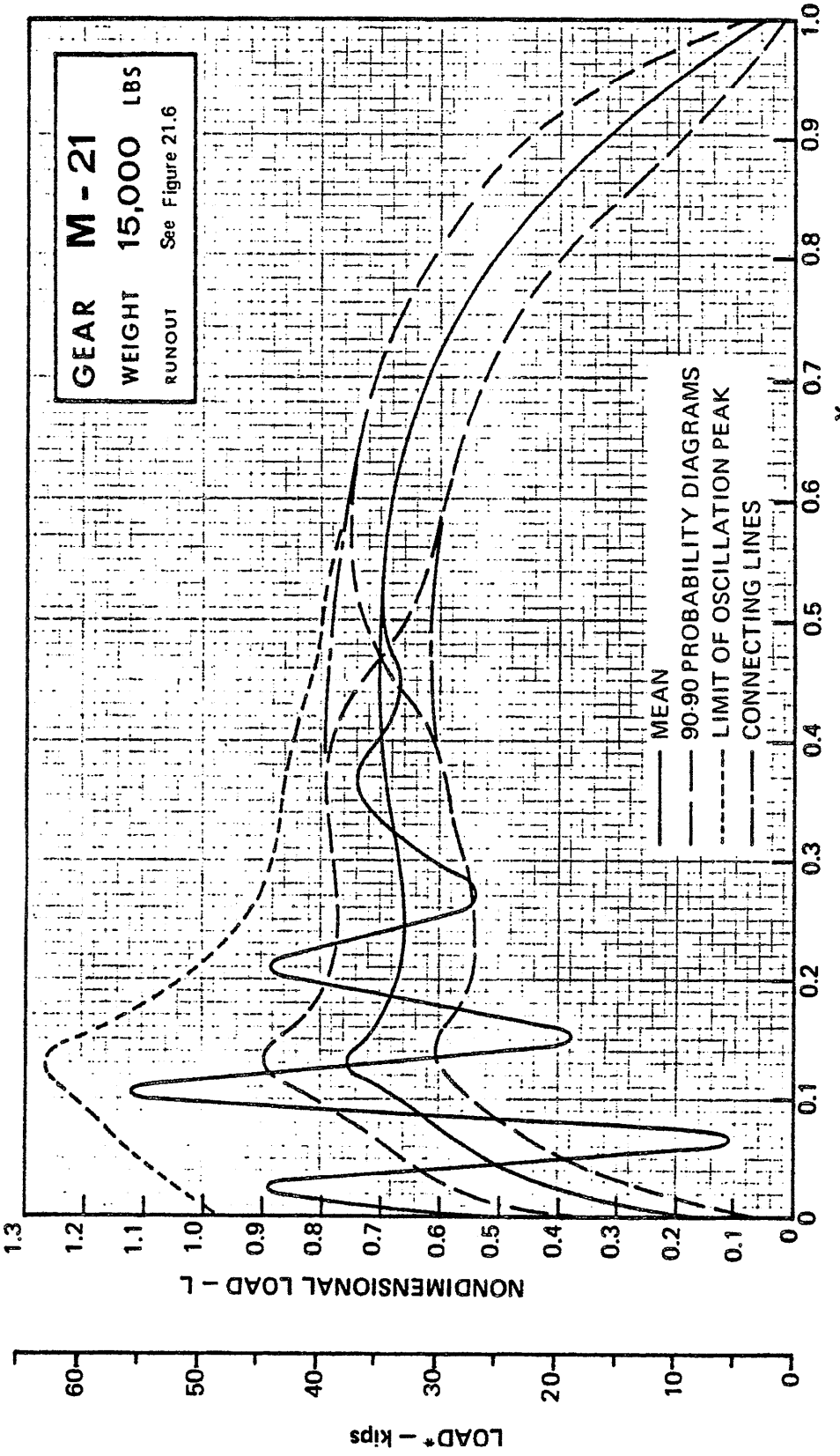

*Dimensioned scale for upper 90-90 loads, 160 knots engaging speed, thrust of .4W, and drytapes only. Other engaging speeds and thrust values require correction per ratio $\frac{V_E^2/R}{160.^2/680.}$ or $\frac{V_E^2}{37.65R}$ x correction factor x dimensioned scale. V_E is in knots and runout R is from Figure 21.6 and is in feet.

FIGURE 20.2. M-21 Gear, 15,000 Lb Weight, Load vs Stroke, Nondimensional

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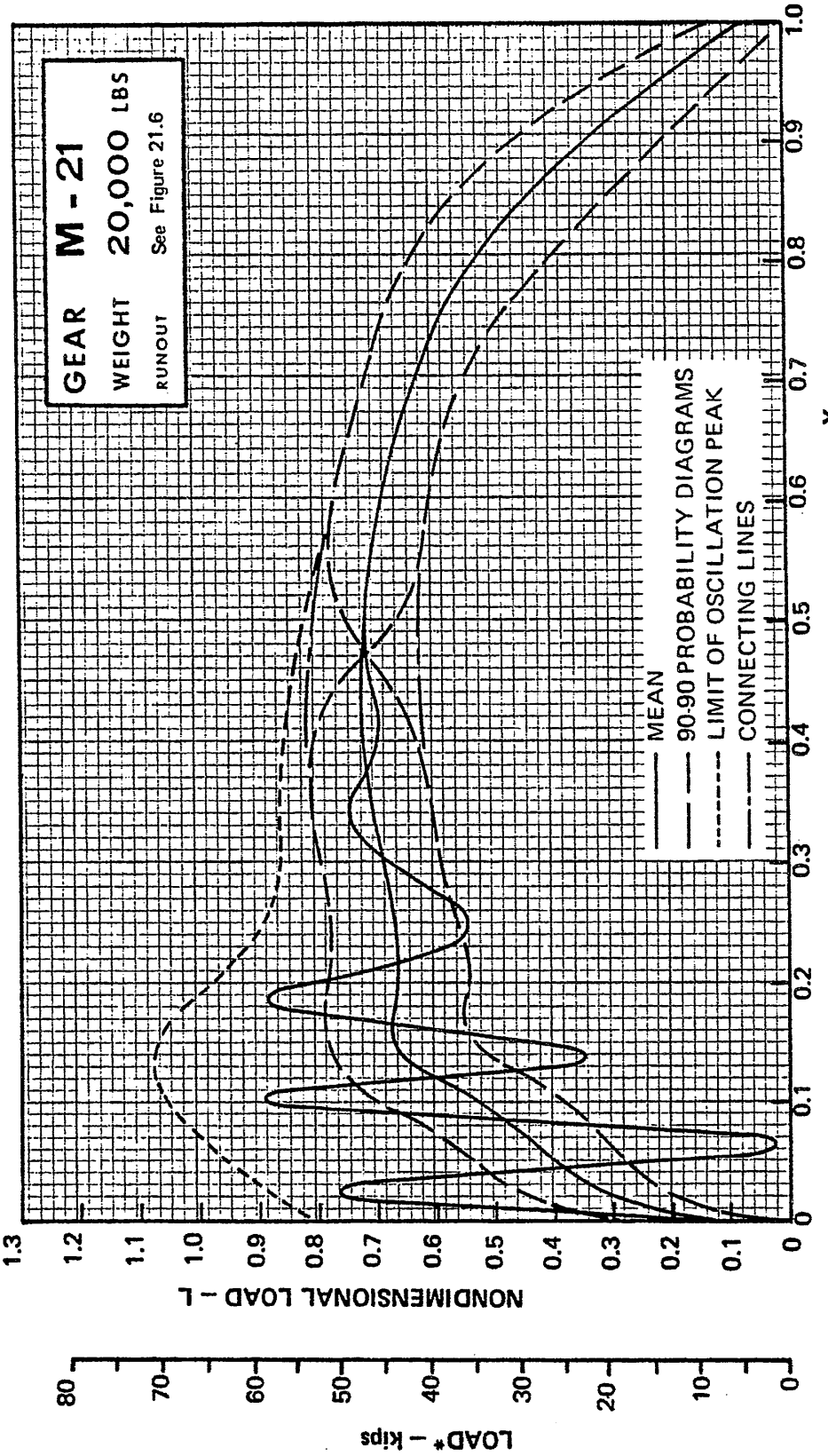

*Dimensioned scale for upper 90-90 loads, 160 knots engaging speed, thrust of .4W, and drytapes only. Other engaging speeds and thrust values require correction per ratio $\frac{V_E^2/R}{160.^2/680.}$ or $\frac{V_E^2}{37.65R}$ x correction factor x dimensioned scale. V_E is in knots and runout R is from Figure 21.6 and is in feet.

FIGURE 20.3. M-21 Gear, 20,000 Lb Weight, Load vs Stroke, Nondimensional

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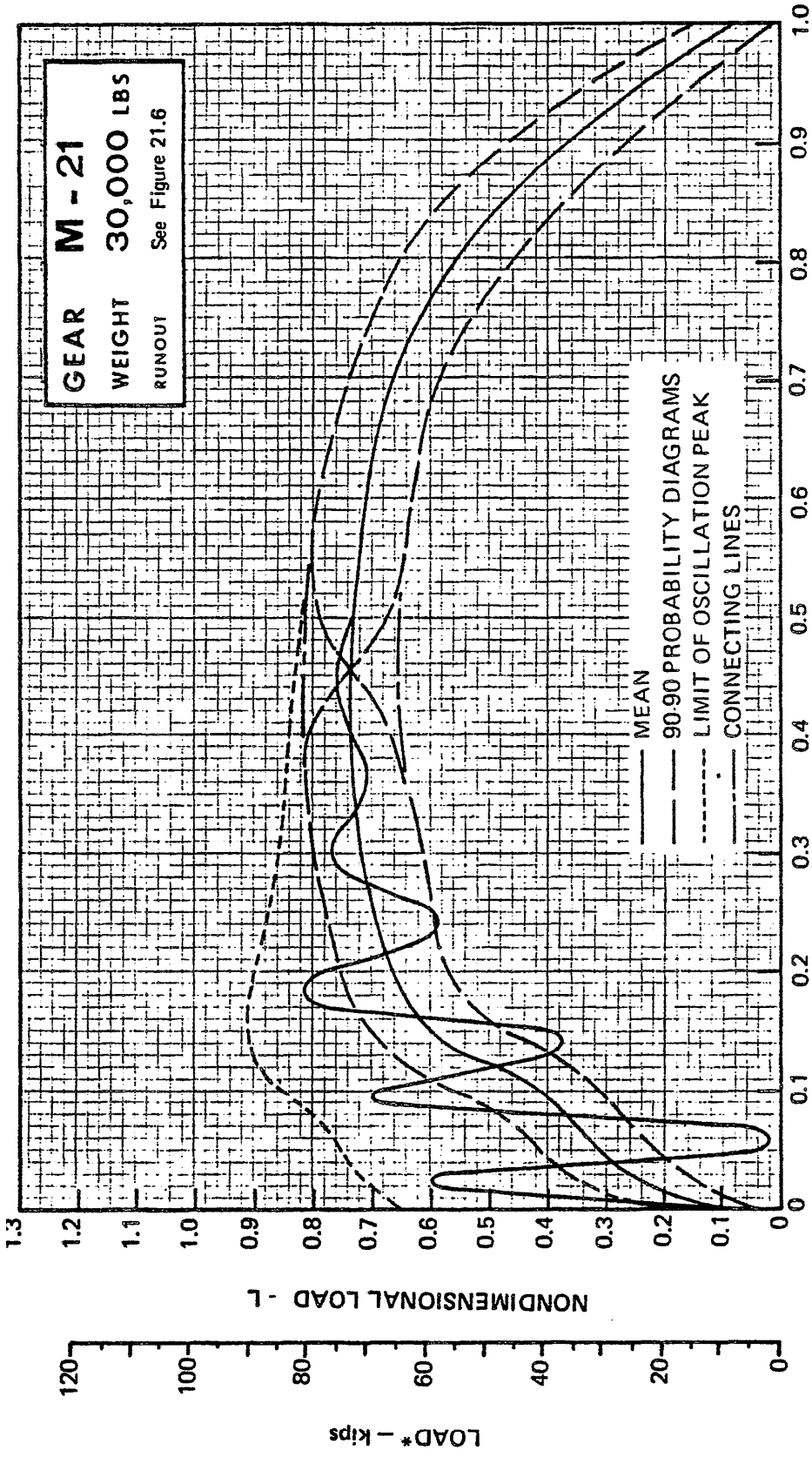

*Dimensioned scale for upper 90-90 loads, 160 knots engaging speed, thrust of .4W, and drytapes only. Other engaging speeds and thrust values require correction per ratio $\frac{V_E^2/R}{160.^2/680.}$ or $\frac{V_E^2}{37.65R}$ x correction factor x dimensioned scale. V_E is in knots and runout R is from Figure 21.6 and is in feet.

FIGURE 20.4. M-21 Gear, 30,000 Lb Weight, Load vs Stroke, Nondimensional

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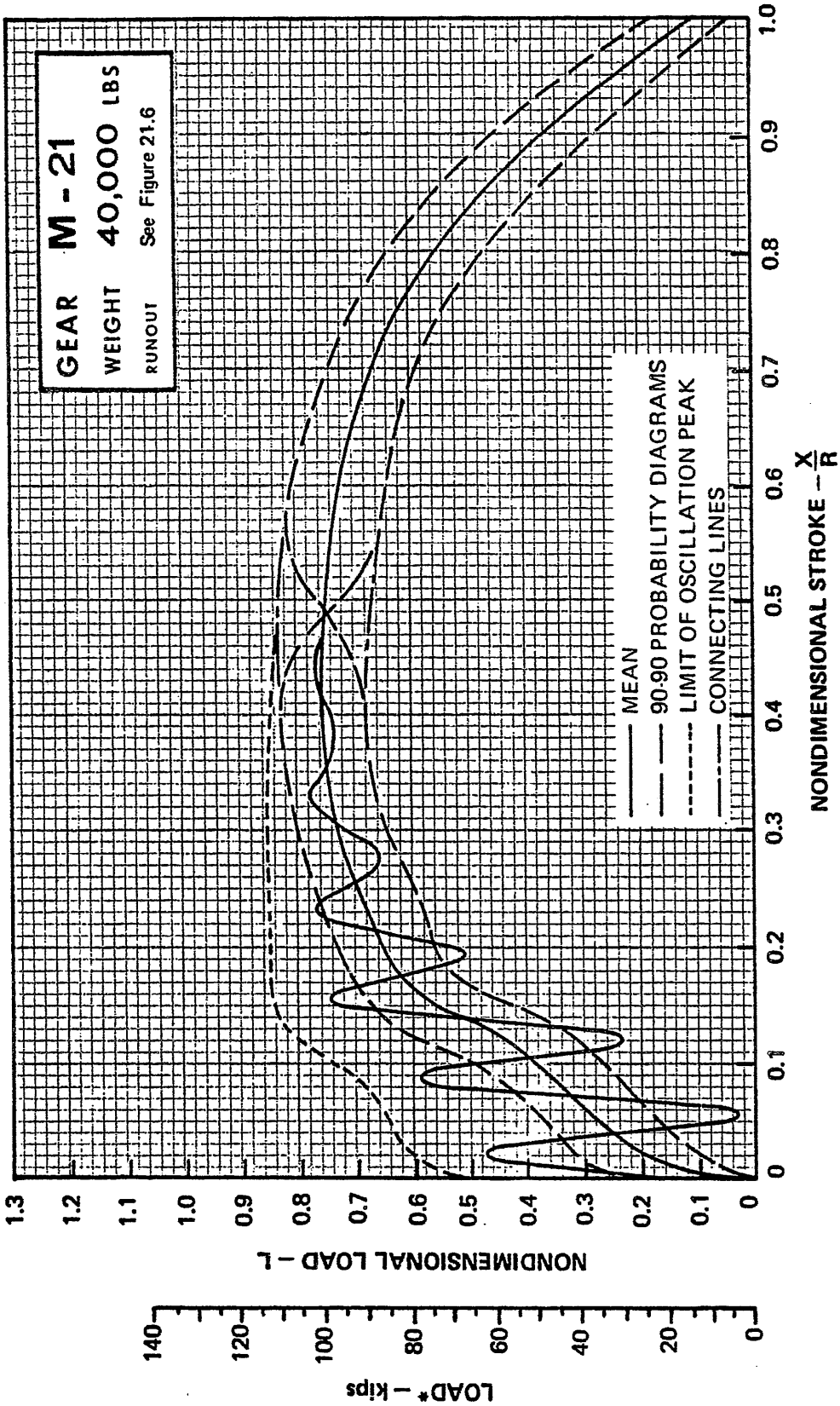

*Dimensioned scale for upper 90-90 loads, 160 knots engaging speed, thrust of .4W, and drytapes only. Other engaging speeds and thrust values require correction per ratio V_E^2/R or $\frac{V_E^2}{160.^2/680.}\ \frac{37.65R}{}$ x correction factor x dimensioned scale. V_E is in knots and runout R is from Figure 21.6 and is in feet.

FIGURE 20.5. M-21 Gear, 40,000 Lb Weight, Load vs Stroke, Nondimensional

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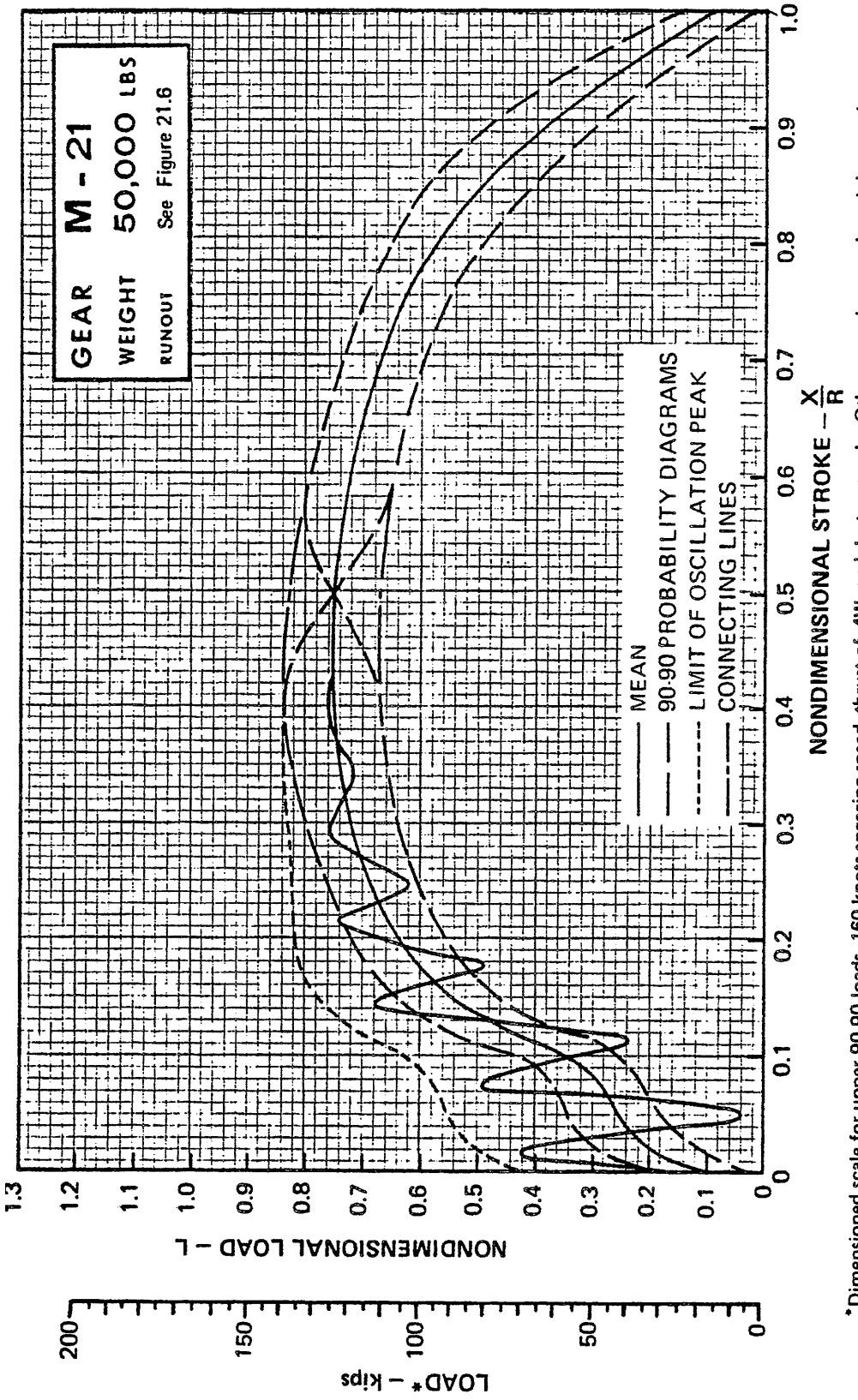

*Dimensioned scale for upper 90-90 loads, 160 knots engaging speed, thrust of .4W, and drytapes only. Other engaging speeds and thrust values require correction per ratio V_E^2/R or $\frac{V_E^2}{160.^2/680.}\ \frac{}{37.65R}$ x correction factor x dimensioned scale. V_E is in knots and runout R is from Figure 21.6 and is in feet.

FIGURE 20.6. M-21 Gear, 50,000 Lb Weight, Load vs Stroke, Nondimensional

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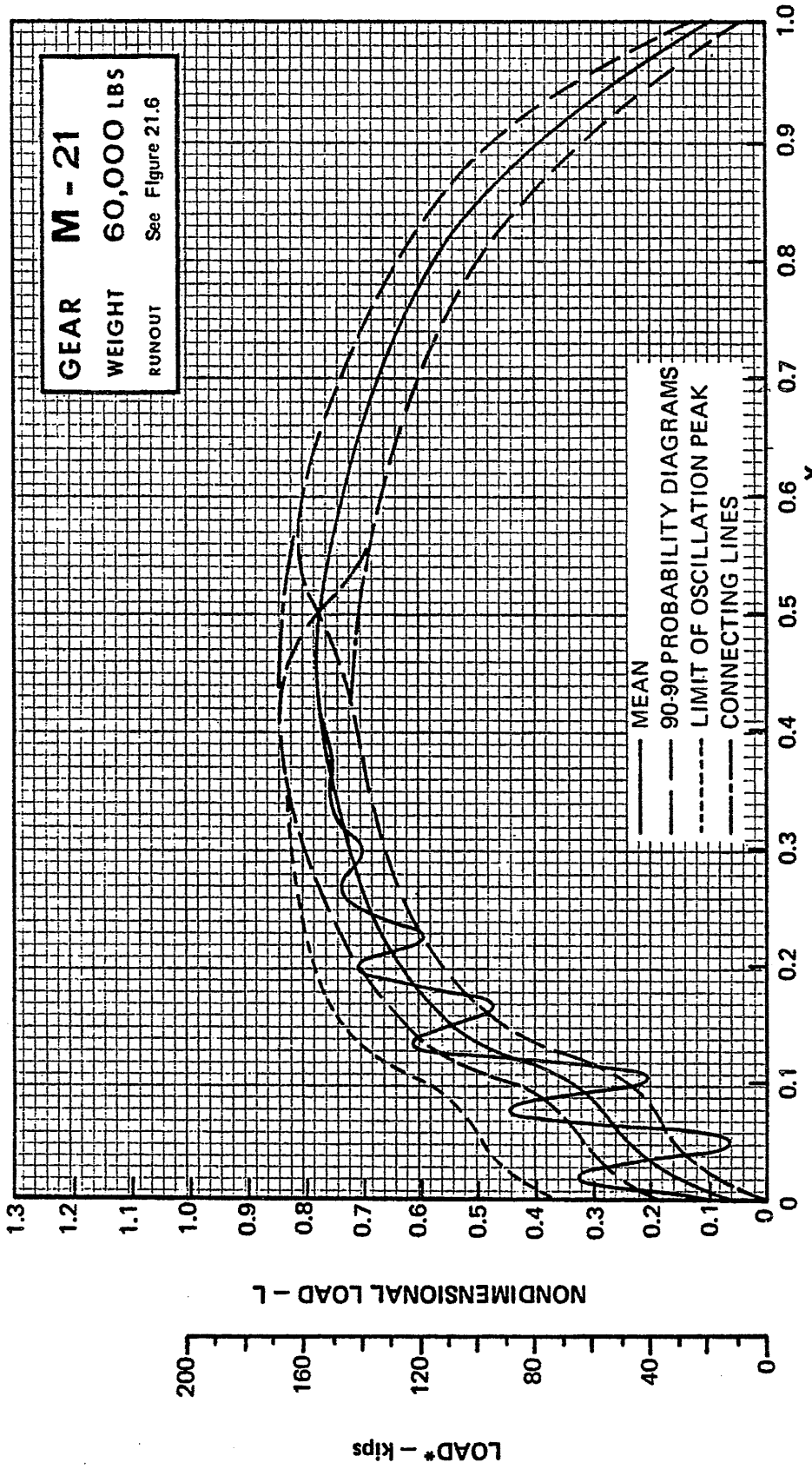

*Dimensioned scale for upper 90-90 loads, 160 knots engaging speed, thrust of .4W, and drytapes only. Other engaging speeds and thrust values require correction per ratio $\frac{V_E^2/R}{160.^2/680.}$ or $\frac{V_E^2}{37.65R}$ x correction factor x dimensioned scale. V_E is in knots and runout R is from Figure 21.6 and is in feet.

FIGURE 20.7. M-21 Gear, 60,000 Lb Weight, Load vs Stroke, Nondimensional

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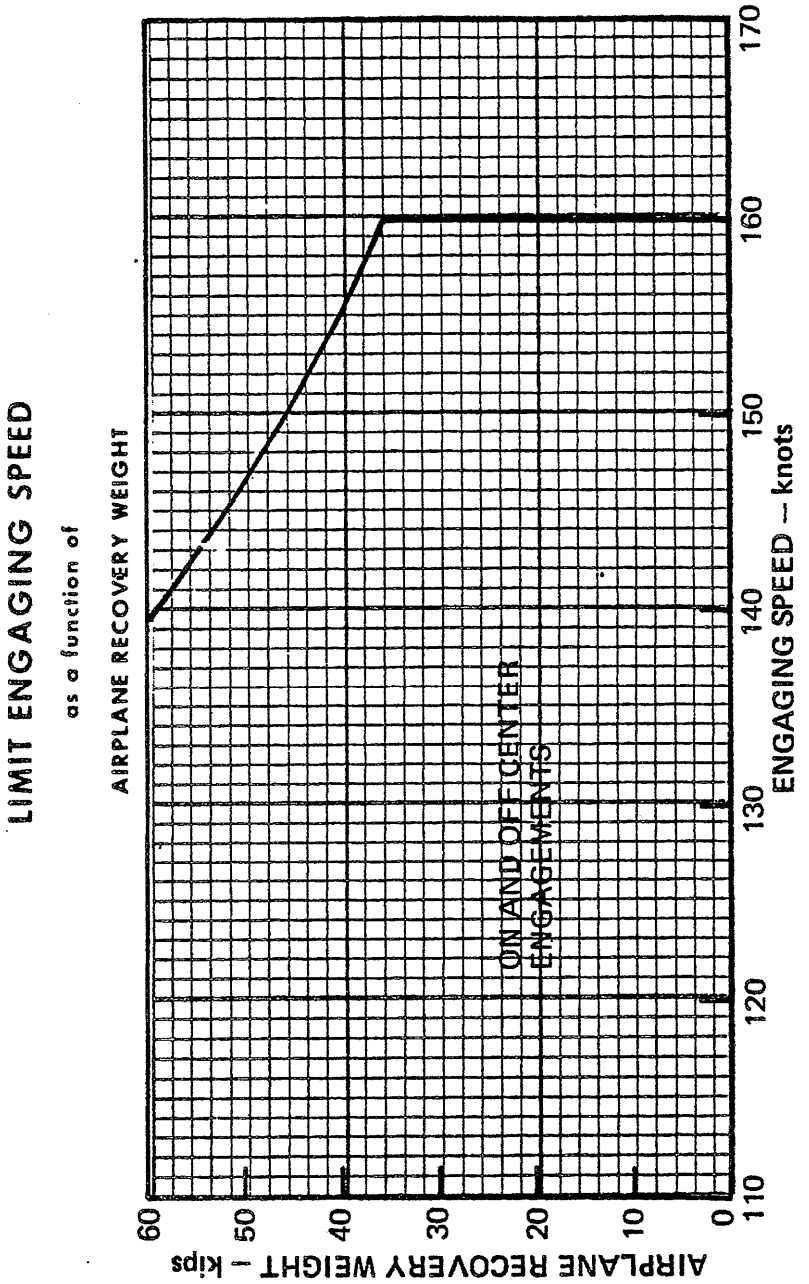

FIGURE 21.1. M-21 Gear, Limit Engaging speed

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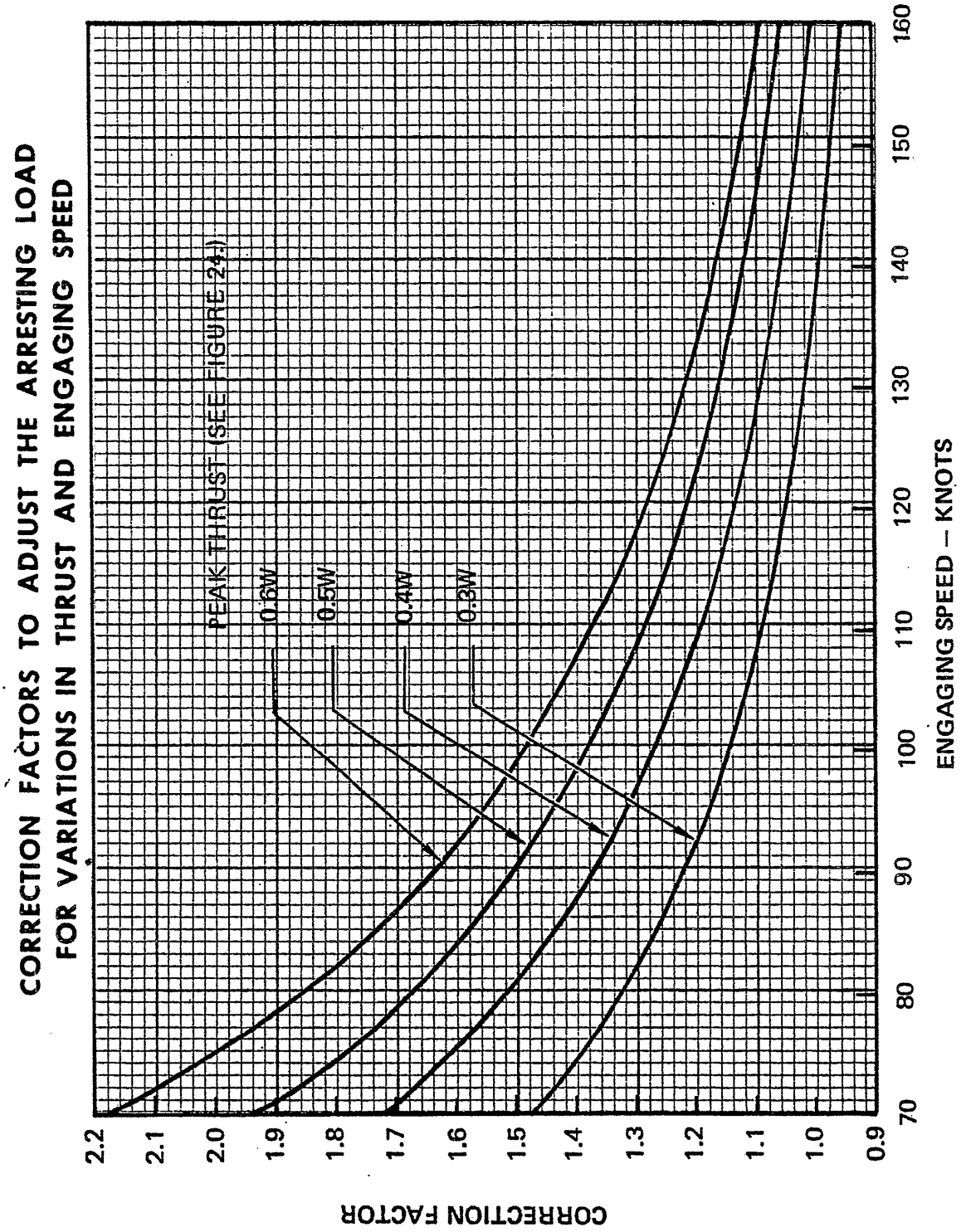

FIGURE 21.2. M-21 Gear, Correction Factor

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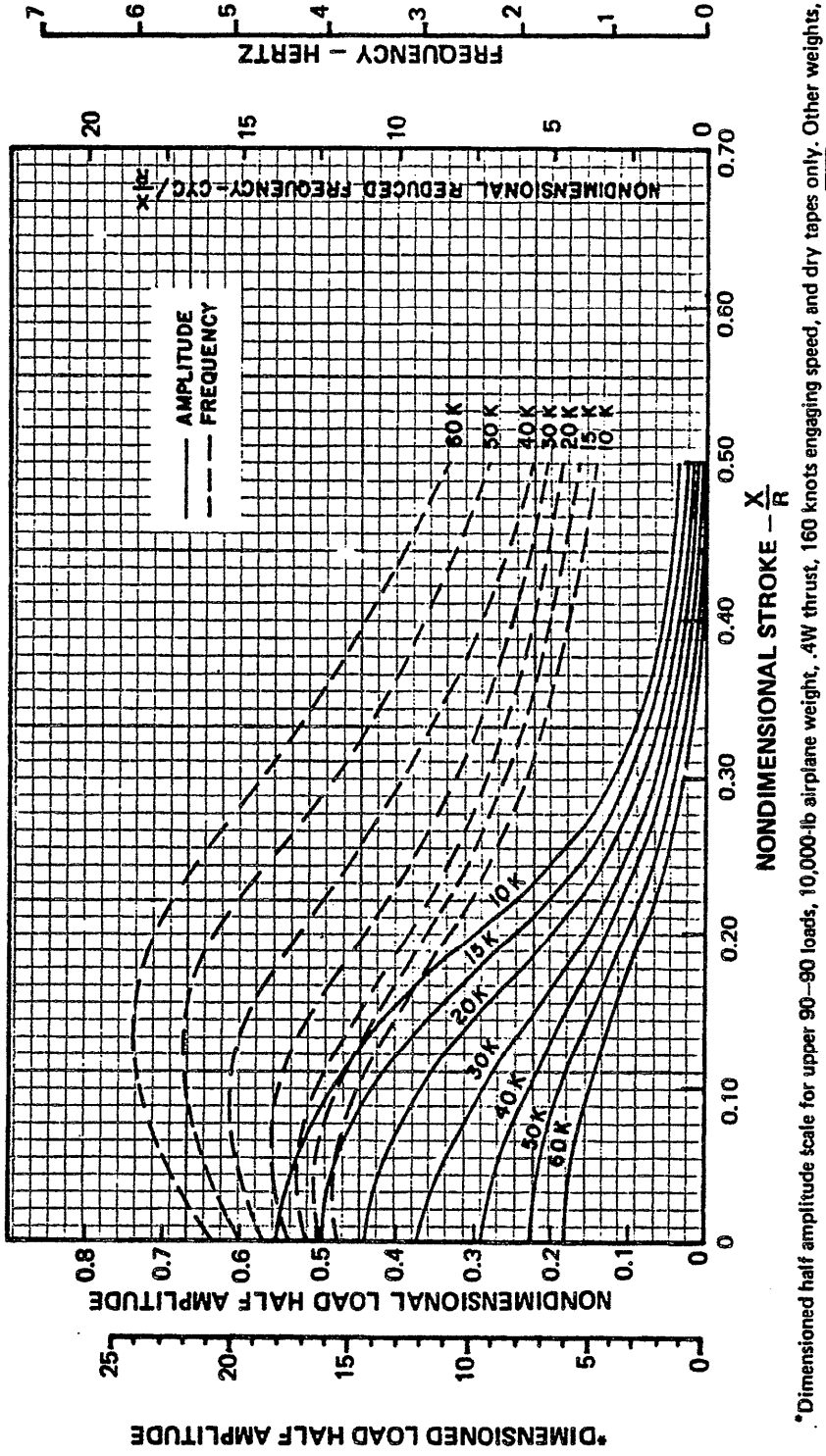

*Dimensioned half amplitude scale for upper 90—90 loads, 10,000-lb airplane weight, .4W thrust, 160 knots engaging speed, and dry tapes only. Other weights, thrust values, engaging speeds and tape conditions require correction per ratio $\frac{V_E^2 \times \text{Weight/R}}{160^2 \times 10 \,/\, 680}$ or $\frac{V_E^2 \times \text{Weight} \times \text{correction factor} \times \text{wet tape factor} \times}{376.5 \times R}$ dimensioned scale. Weight W is in kips, V_E is in knots, and runout R is from Figure 21.6

FIGURE 21.3. M-21 Gear, Average Frequency and Amplitude of Oscillation, Nondimensional

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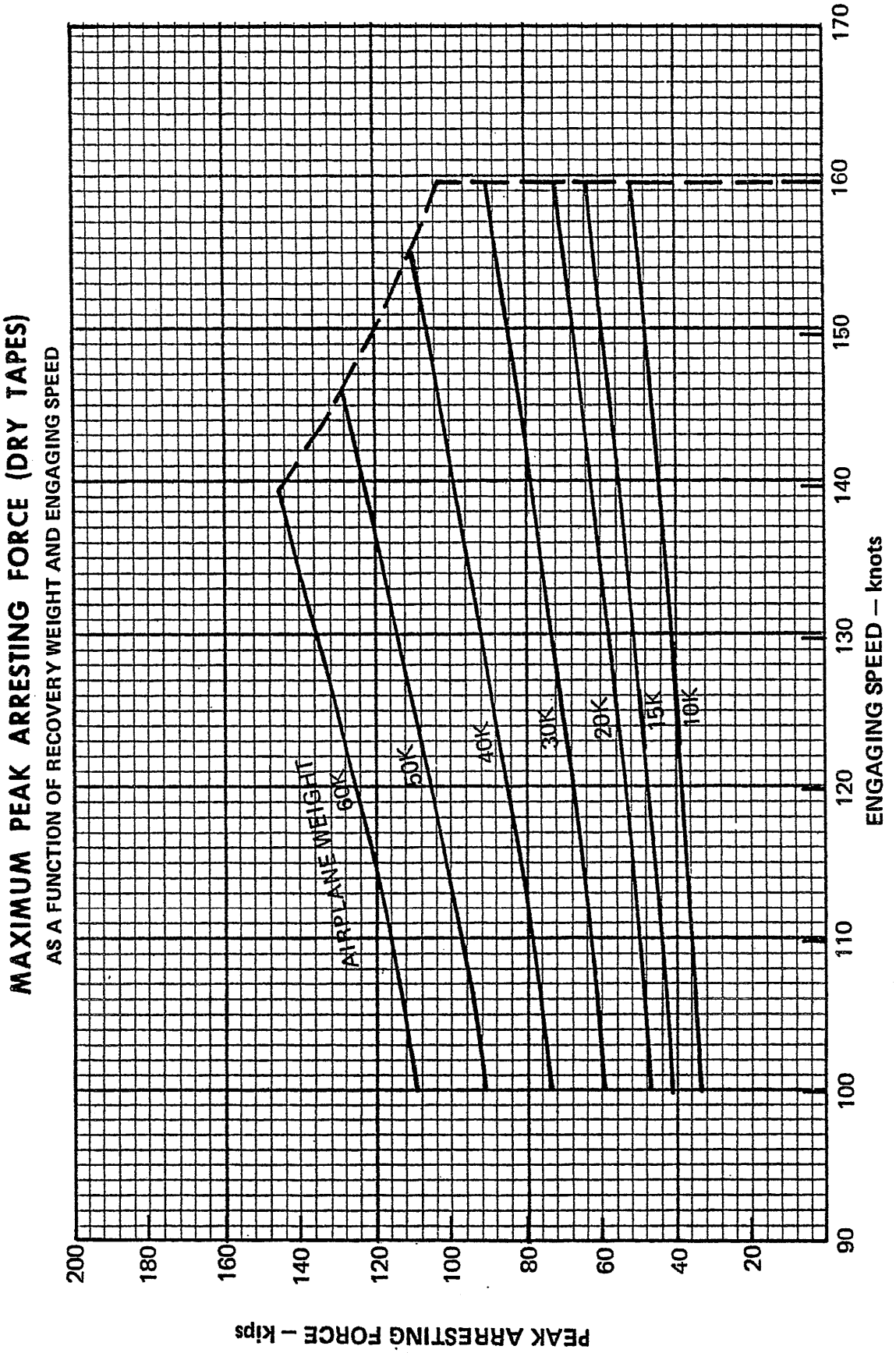

FIGURE 21.4. M-21 Gear, Maximum Peak Arresting Force (Dry Tapes)

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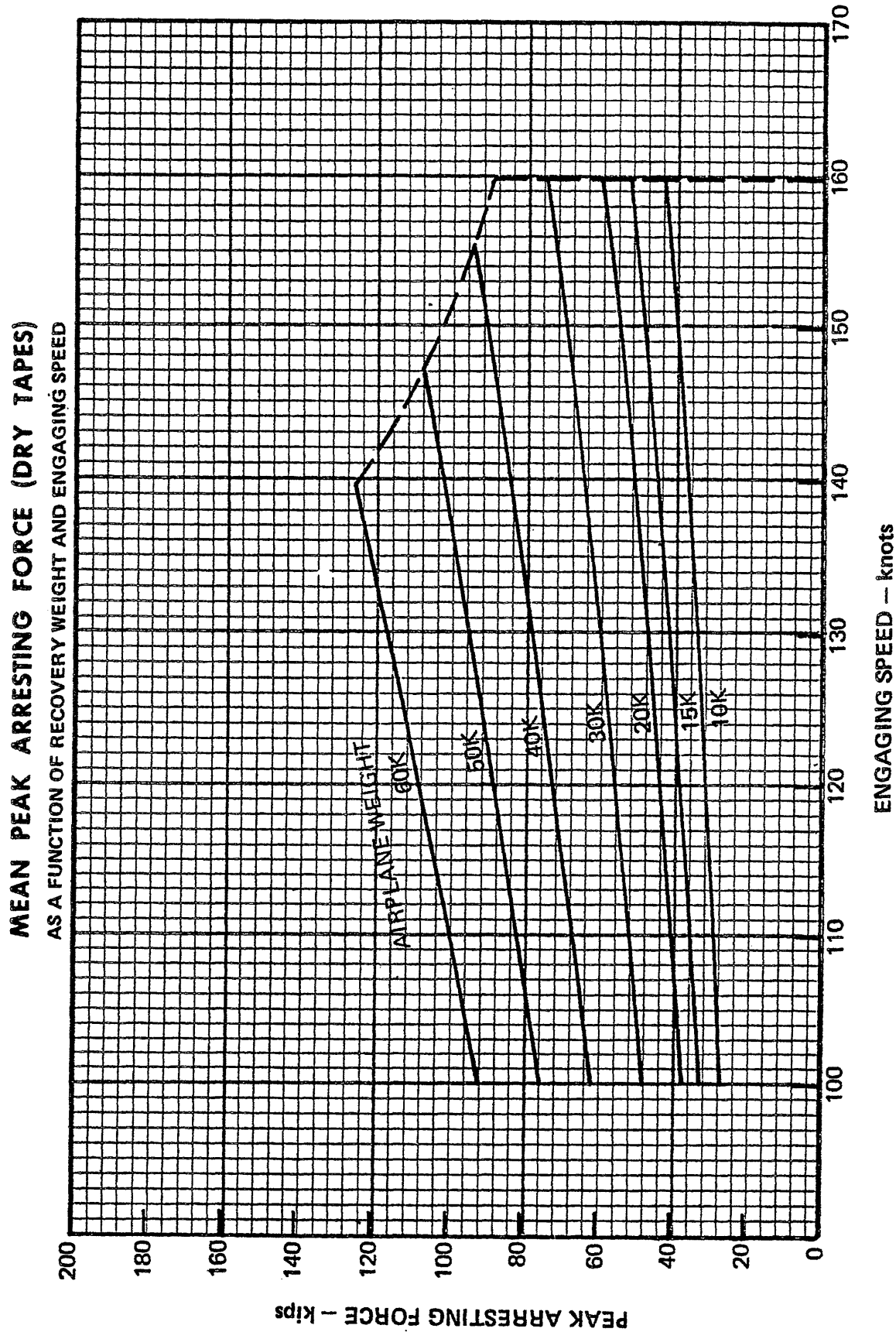

FIGURE 21.5. M-21 Gear, Mean Peak Arresting Force (Dry Tapes)

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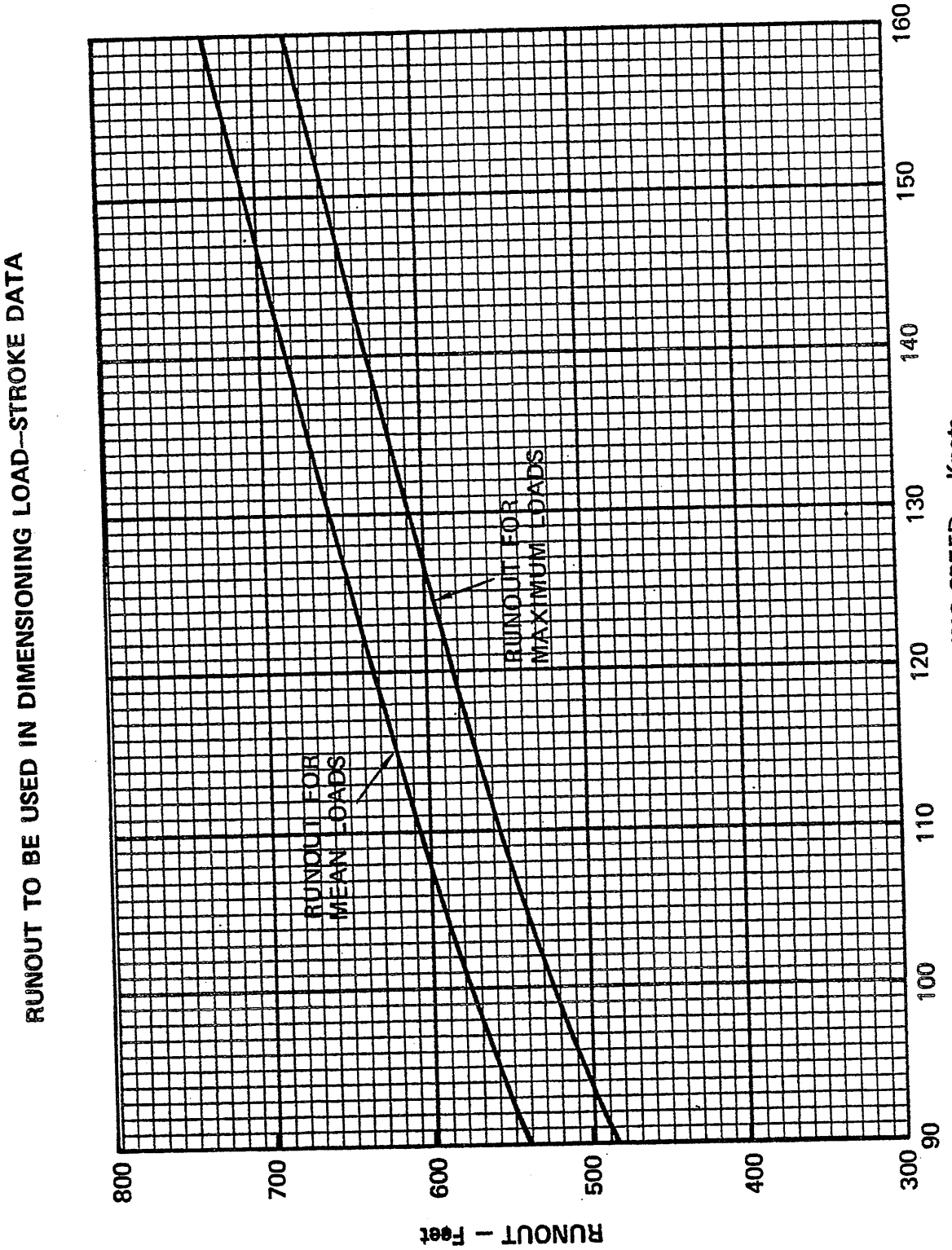

FIGURE 21.6. M-21 Gear, Runout to be Used in Dimensioning Load-Stroke Data

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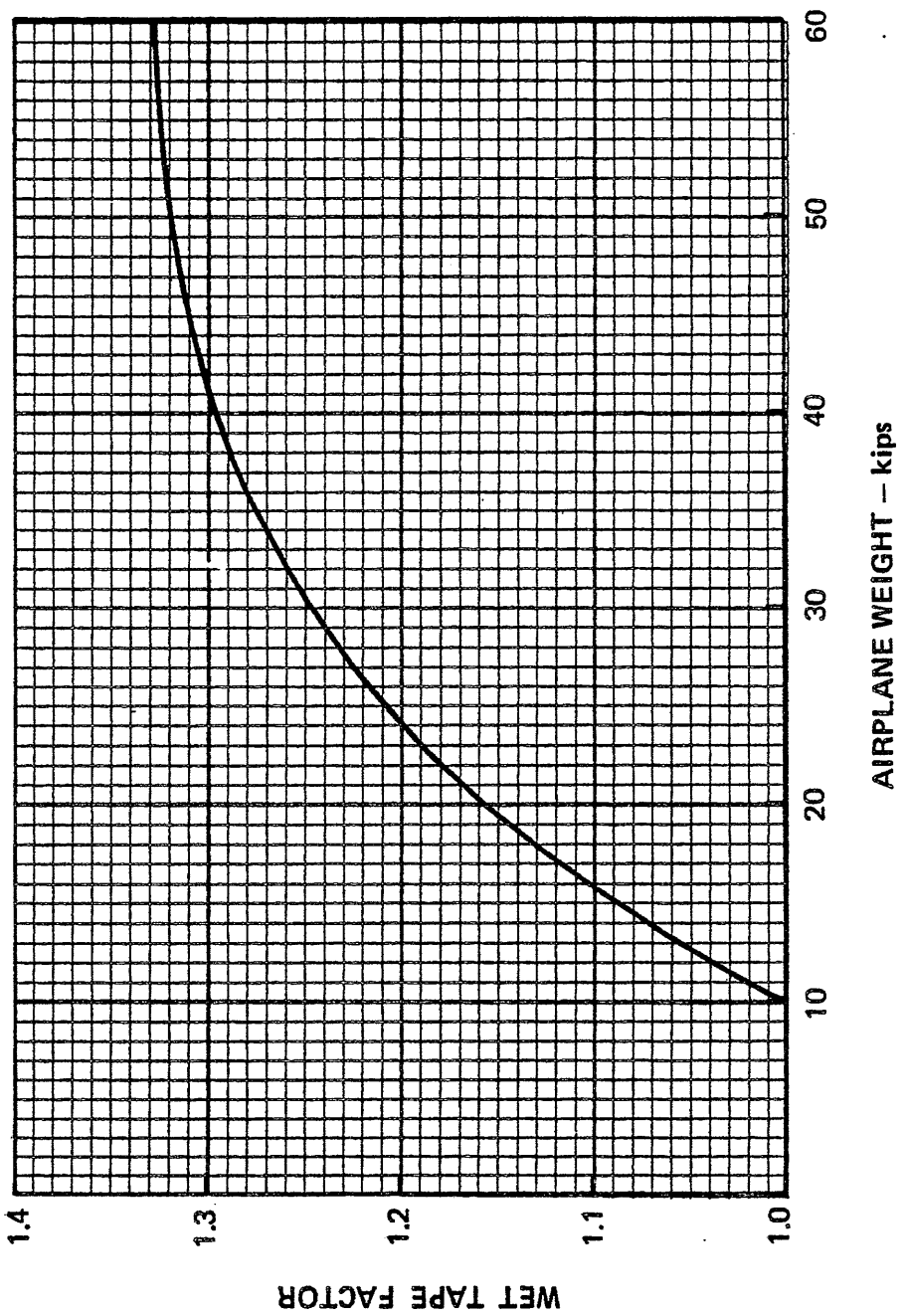

FIGURE 21.7. M-21 Gear, Wet Tape Correction Factor

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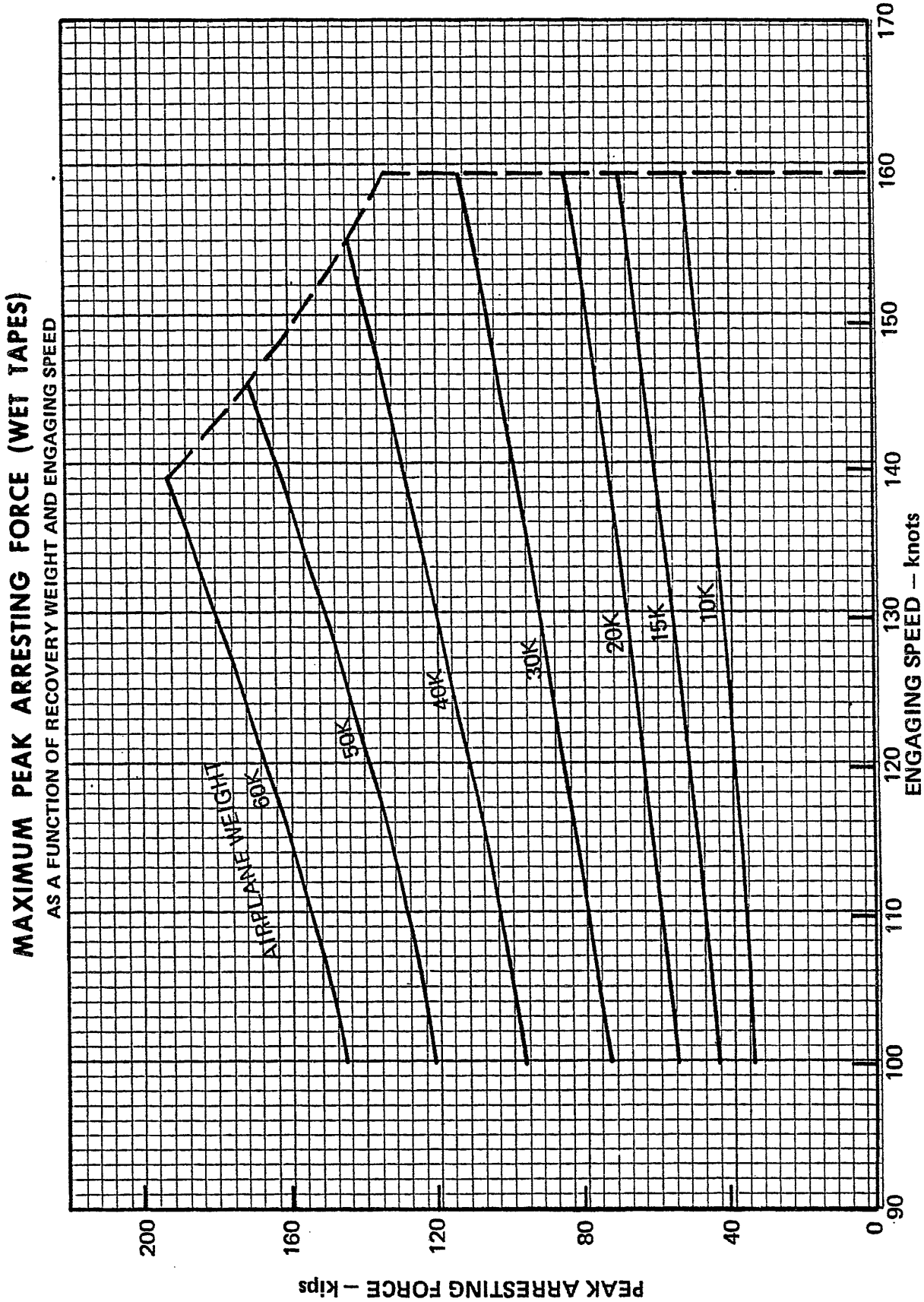

FIGURE 21.8. M-21 Gear, Maximum Peak Arresting Force (Wet Tapes)

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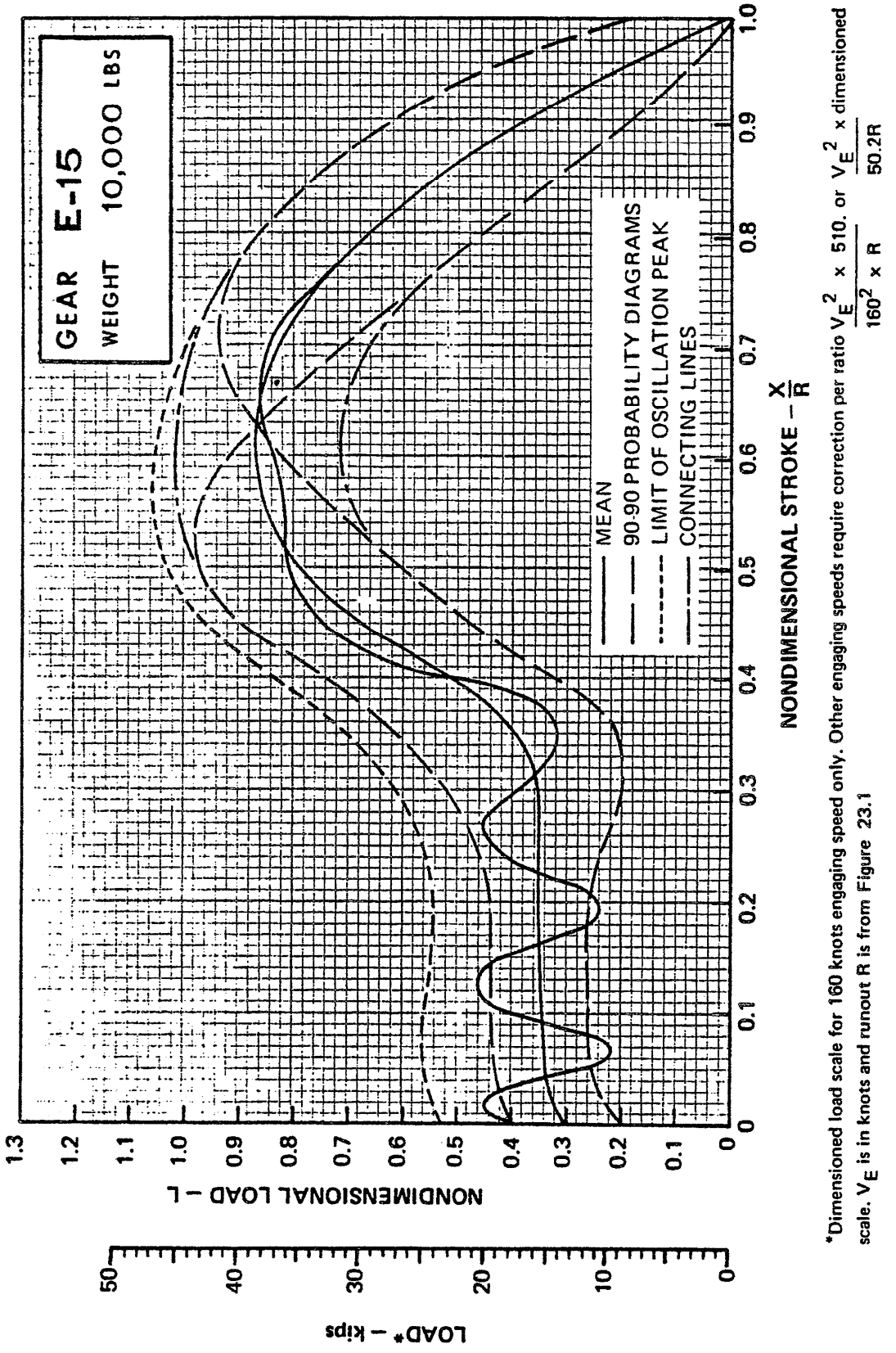

*Dimensioned load scale for 160 knots engaging speed only. Other engaging speeds require correction per ratio $\frac{V_E^2}{160^2 \times R} \times 510.$ or $\frac{V_E^2}{50.2R}$ x dimensioned scale. V_E is in knots and runout R is from Figure 23.1

FIGURE 22.1. E-15 Gear, 10,000 Lb Weight, Load vs Stroke, Nondimensional

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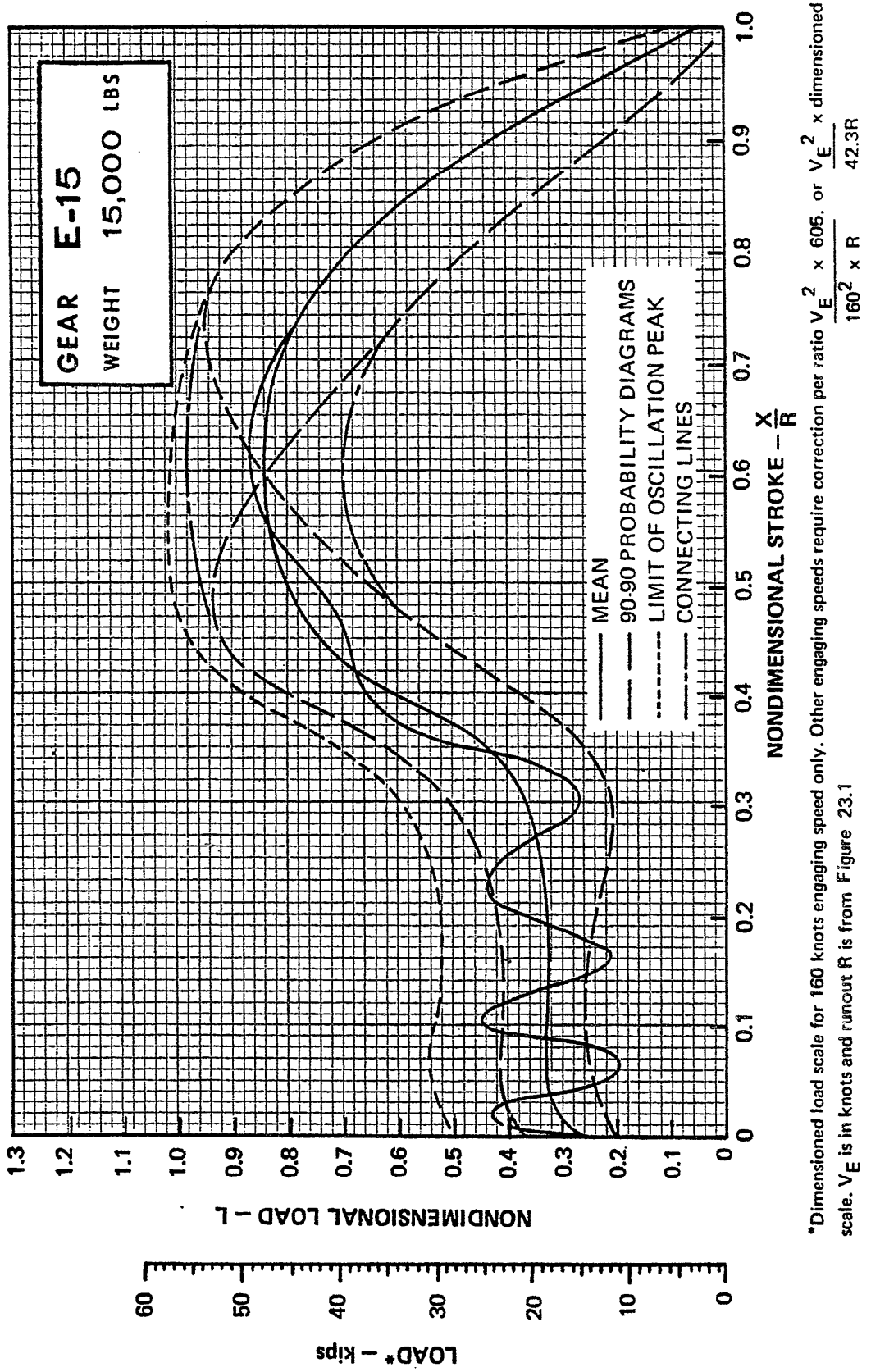

*Dimensioned load scale for 160 knots engaging speed only. Other engaging speeds require correction per ratio $\frac{V_E^2 \times 605}{160^2 \times R}$, or $\frac{V_E^2}{42.3R}$ x dimensioned scale. V_E is in knots and runout R is from Figure 23.1

FIGURE 22.2. E-15 Gear, 15,000 Lb Weight, Load vs Stroke, Nondimensional

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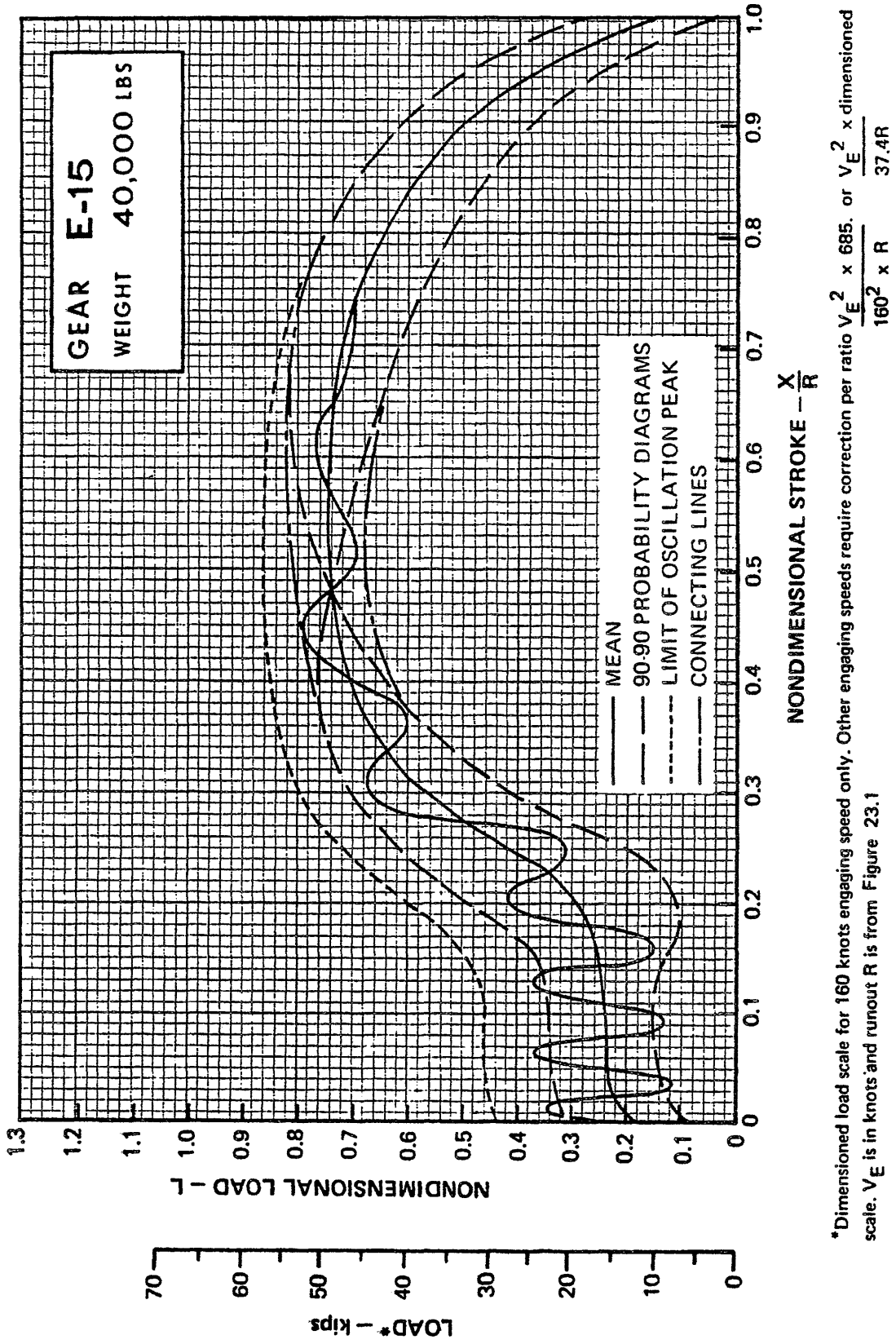

*Dimensioned load scale for 160 knots engaging speed only. Other engaging speeds require correction per ratio $\frac{V_E^2 \times 685.}{160^2 \times R}$ or $\frac{V_E^2 \times \text{dimensioned scale.}}{37.4R}$. V_E is in knots and runout R is from Figure 23.1

FIGURE 22.3. E-15 Gear, 20,000 Lb Weight, Load vs Stroke, Nondimensional

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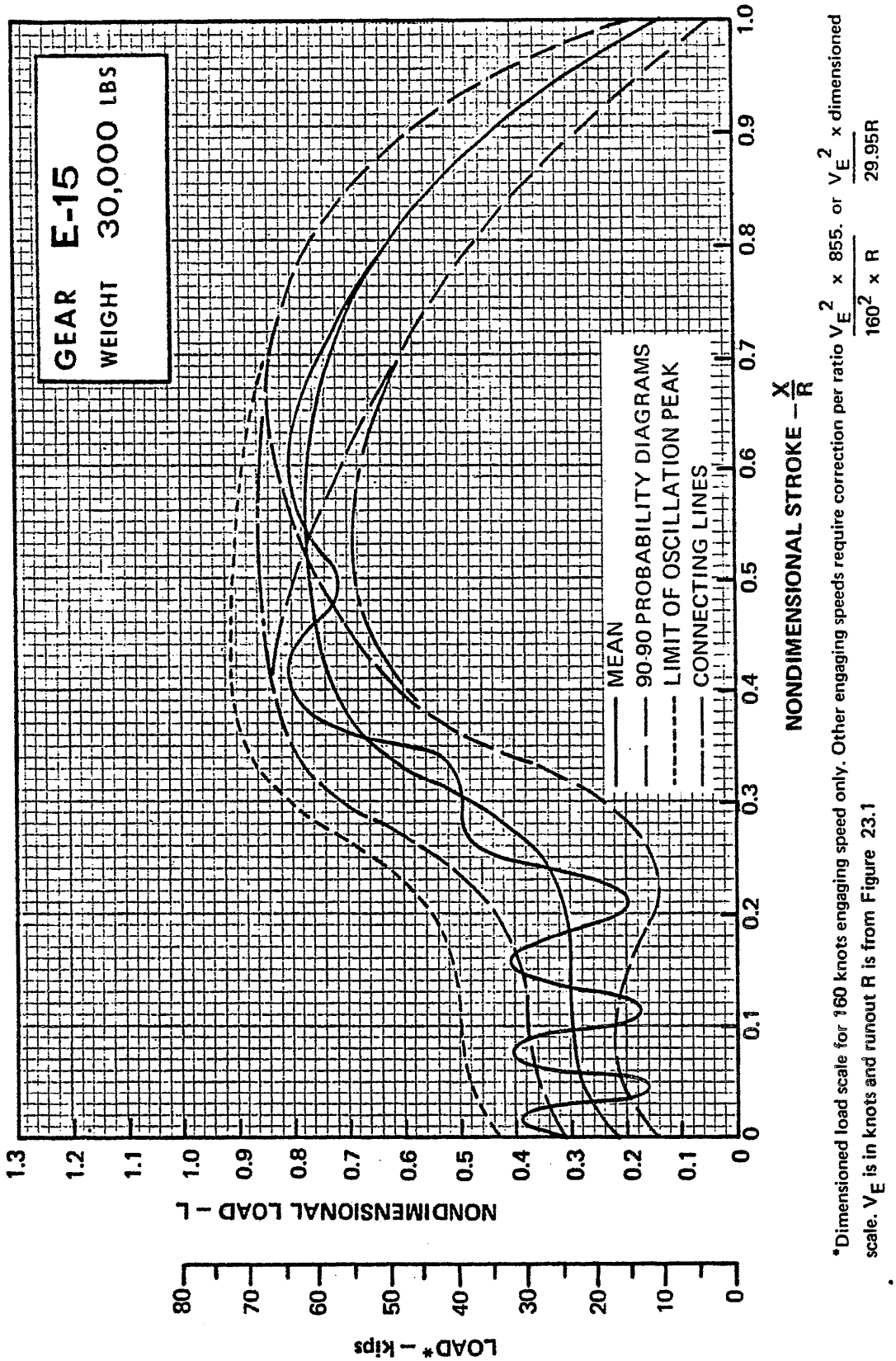

*Dimensioned load scale for 160 knots engaging speed only. Other engaging speeds require correction per ratio $\frac{V_E^2 \times 855.}{160^2 \times R}$ or $\frac{V_E^2 \times \text{dimensioned scale.}}{29.95R}$ V_E is in knots and runout R is from Figure 23.1

FIGURE 22.4. E-15 Gear, 30,000 Lb Weight, Load vs Stroke, Nondimensional

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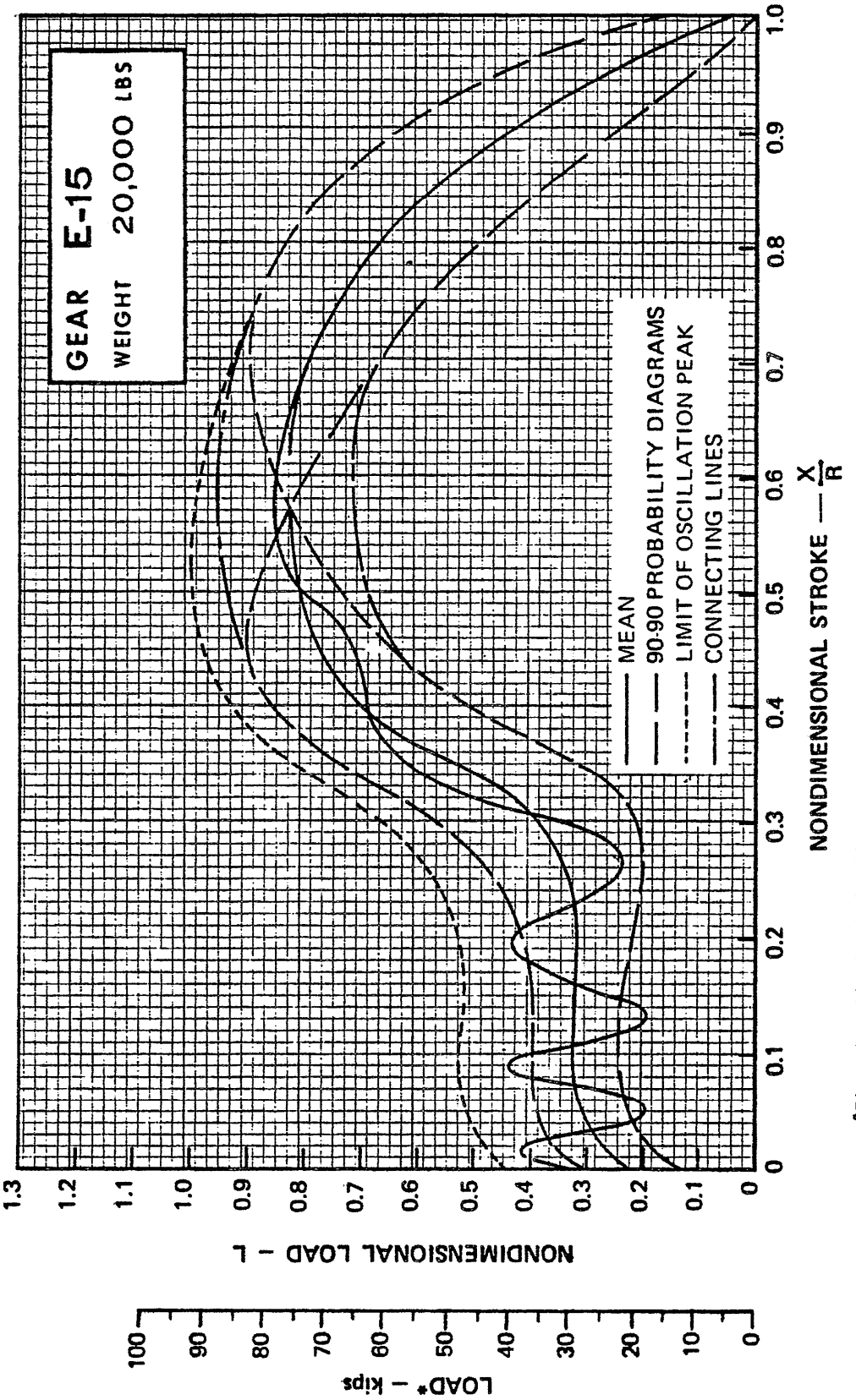

*Dimensioned load scale for 160 knots engaging speed only. Other engaging speeds require correction per ratio $\frac{V_E^2 \times 980.}{160^2 \times R}$ or $\frac{V_E^2}{26.1R}$ x dimensioned scale. V_E is in knots and runout R is from Figure 23.1

FIGURE 22.5. E-15 Gear, 40,000 Lb Weight, Load vs Stroke, Nondimensional

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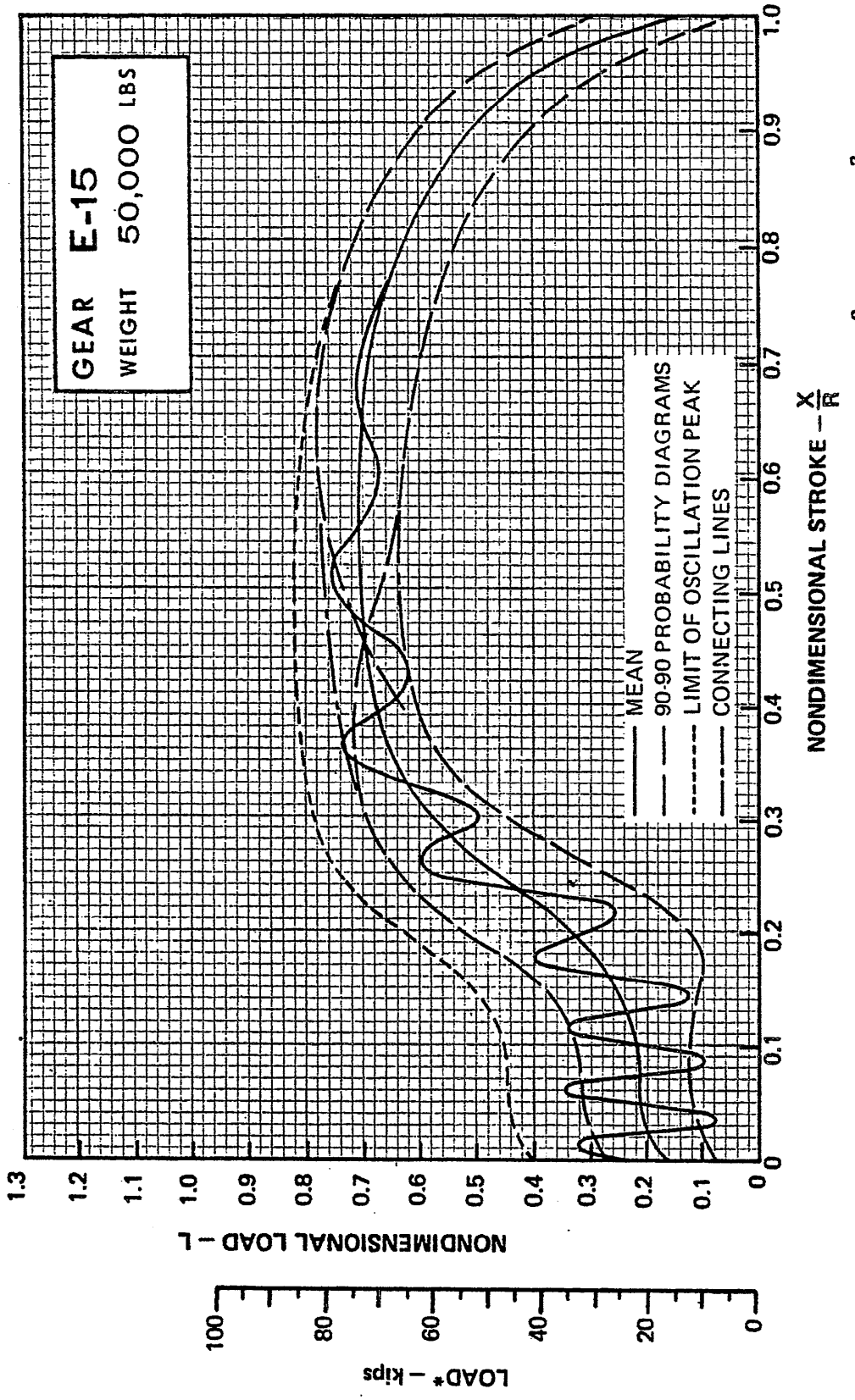

*Dimensioned load scale for 160 knots engaging speed only. Other engaging speeds require correction per ratio $\frac{V_E^2 \times 1085.}{160^2 \times R}$ or $\frac{V_E^2}{23.6R}$ x dimensioned scale. V_E is in knots and runout R is from Figure 23.1

FIGURE 22.6. E-15 Gear, 50,000 Lb Weight, Load vs Stroke, Nondimensional

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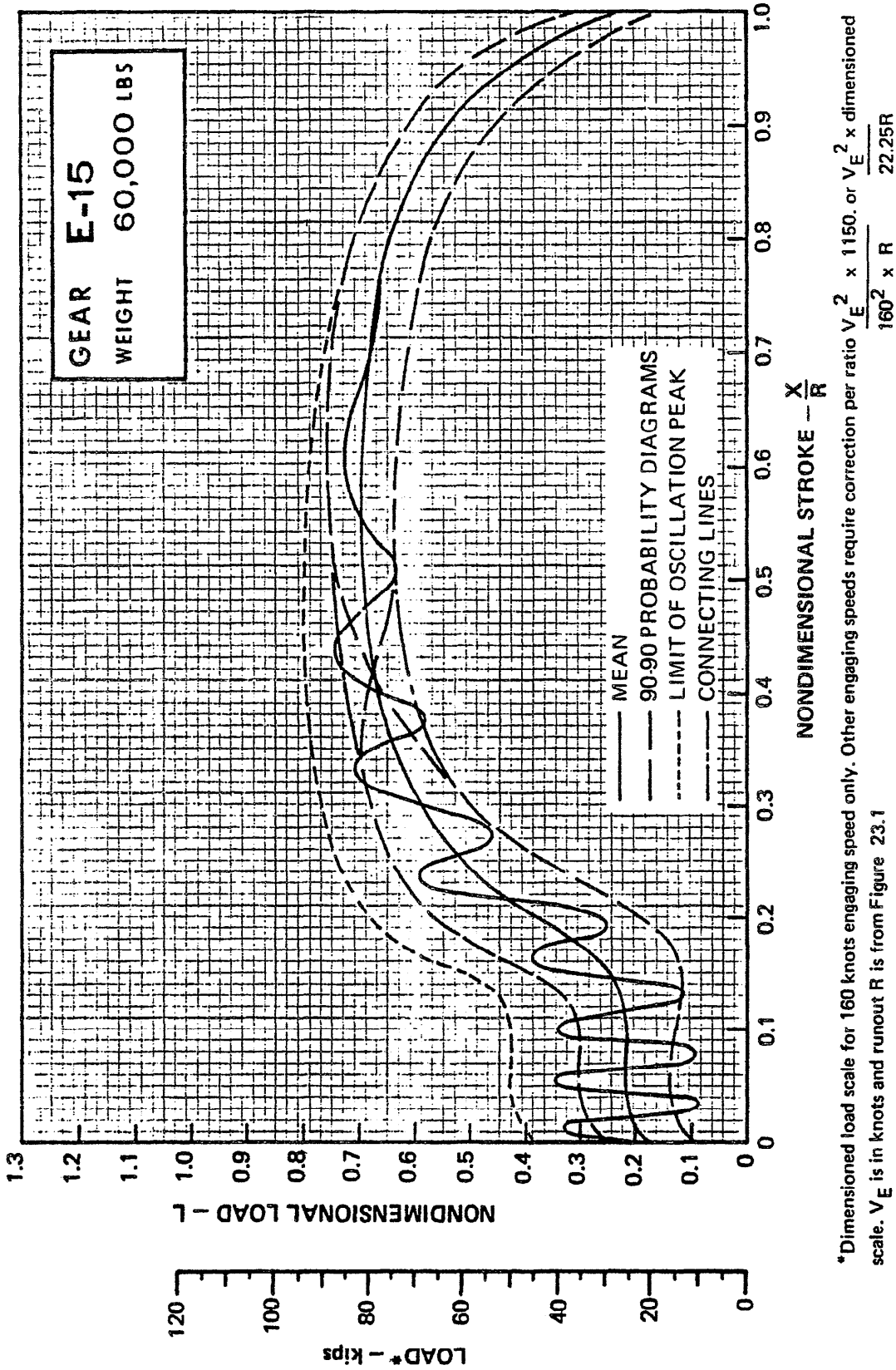

*Dimensioned load scale for 160 knots engaging speed only. Other engaging speeds require correction per ratio $\frac{V_E^2 \times 1150}{160^2 \times R}$ or $\frac{V_E^2 \times \text{dimensioned scale}}{22.25R}$. V_E is in knots and runout R is from Figure 23.1

FIGURE 22.7. E-15 Gear, 60,000 Lb Weight, Load vs Stroke, Nondimensional

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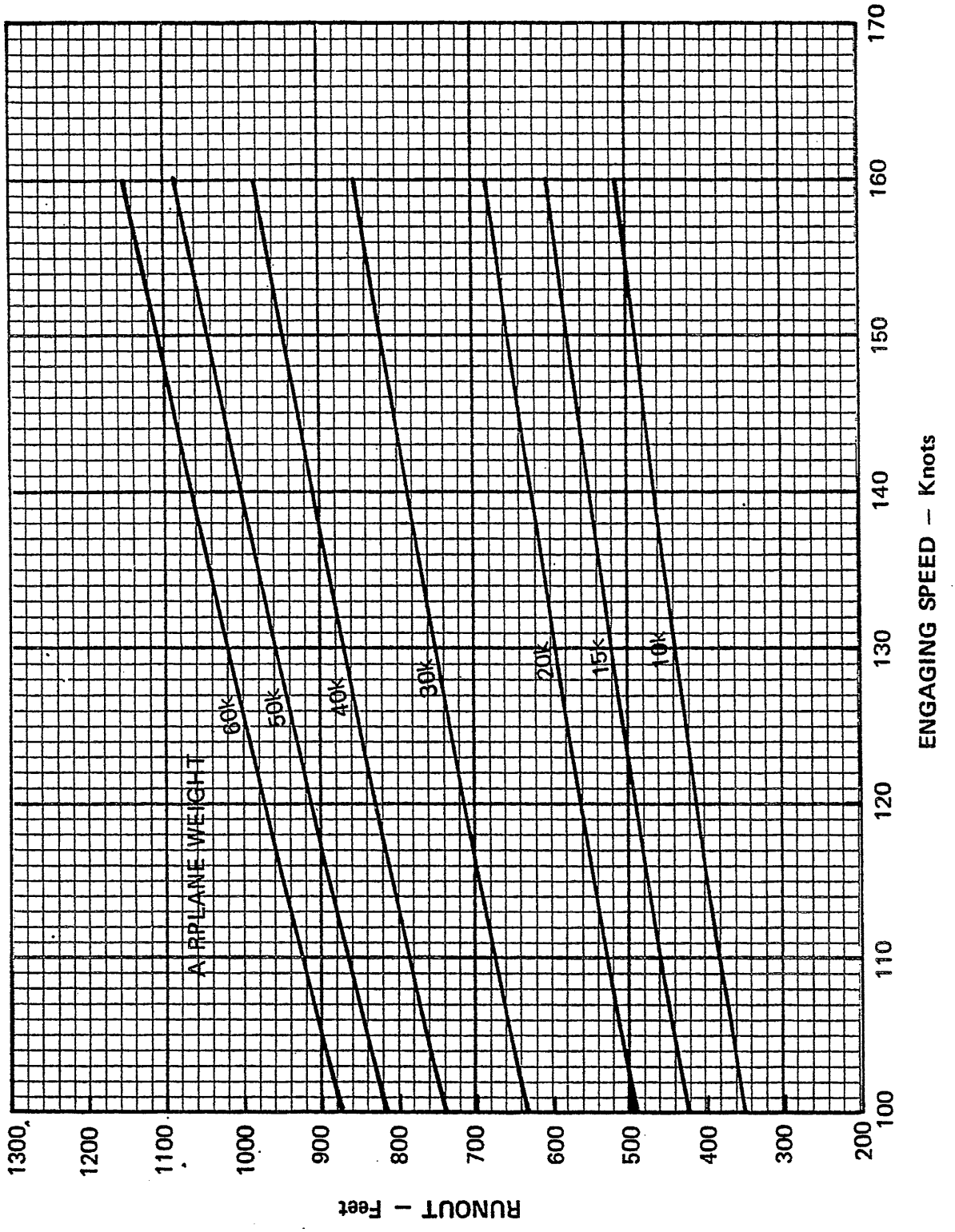

FIGURE 23.1. E-15 Gear, Runout to be Used in Dimensioning Load-Stroke Data

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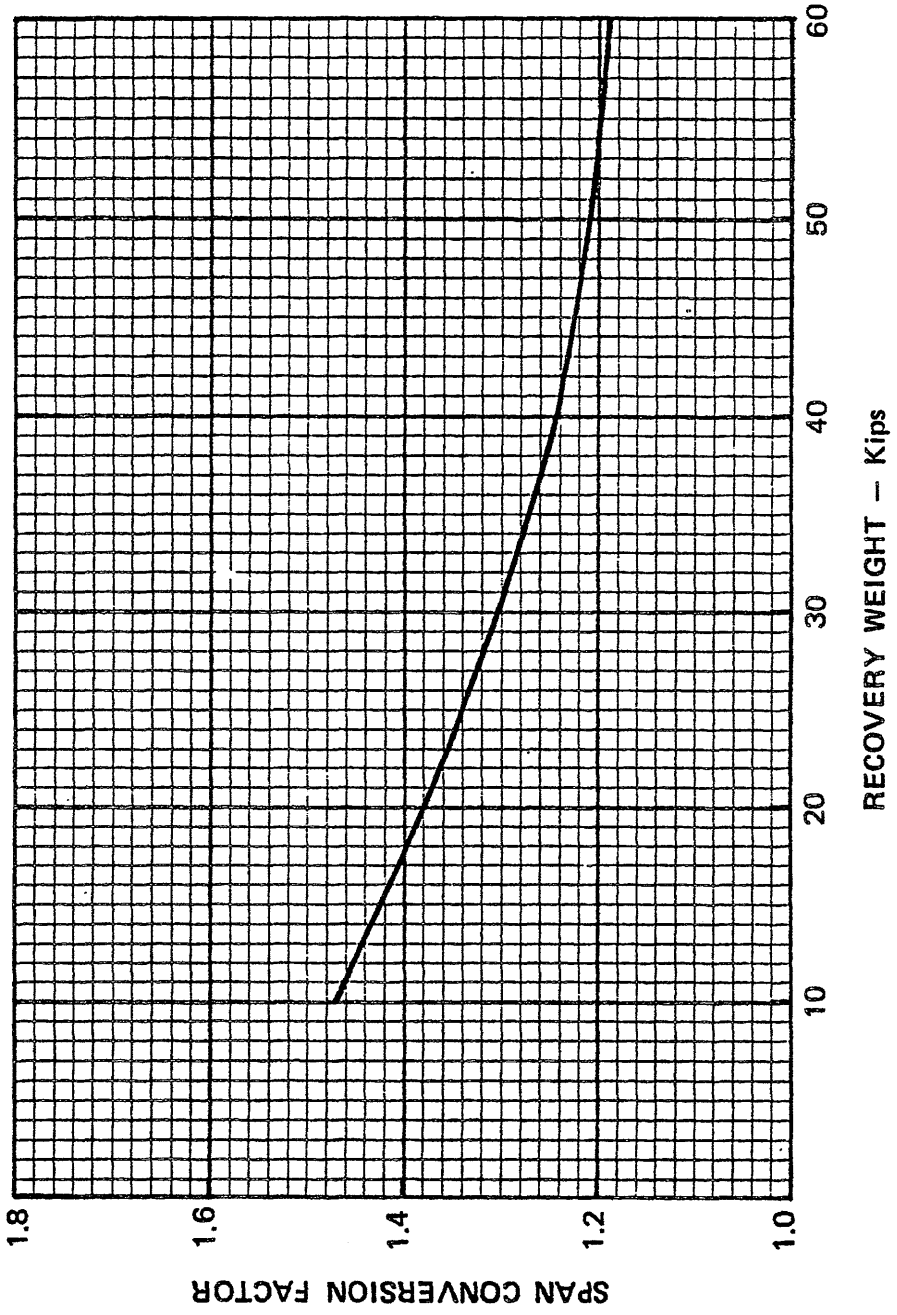

FIGURE 23.2. E-15 Gear, Span Conversion Factor

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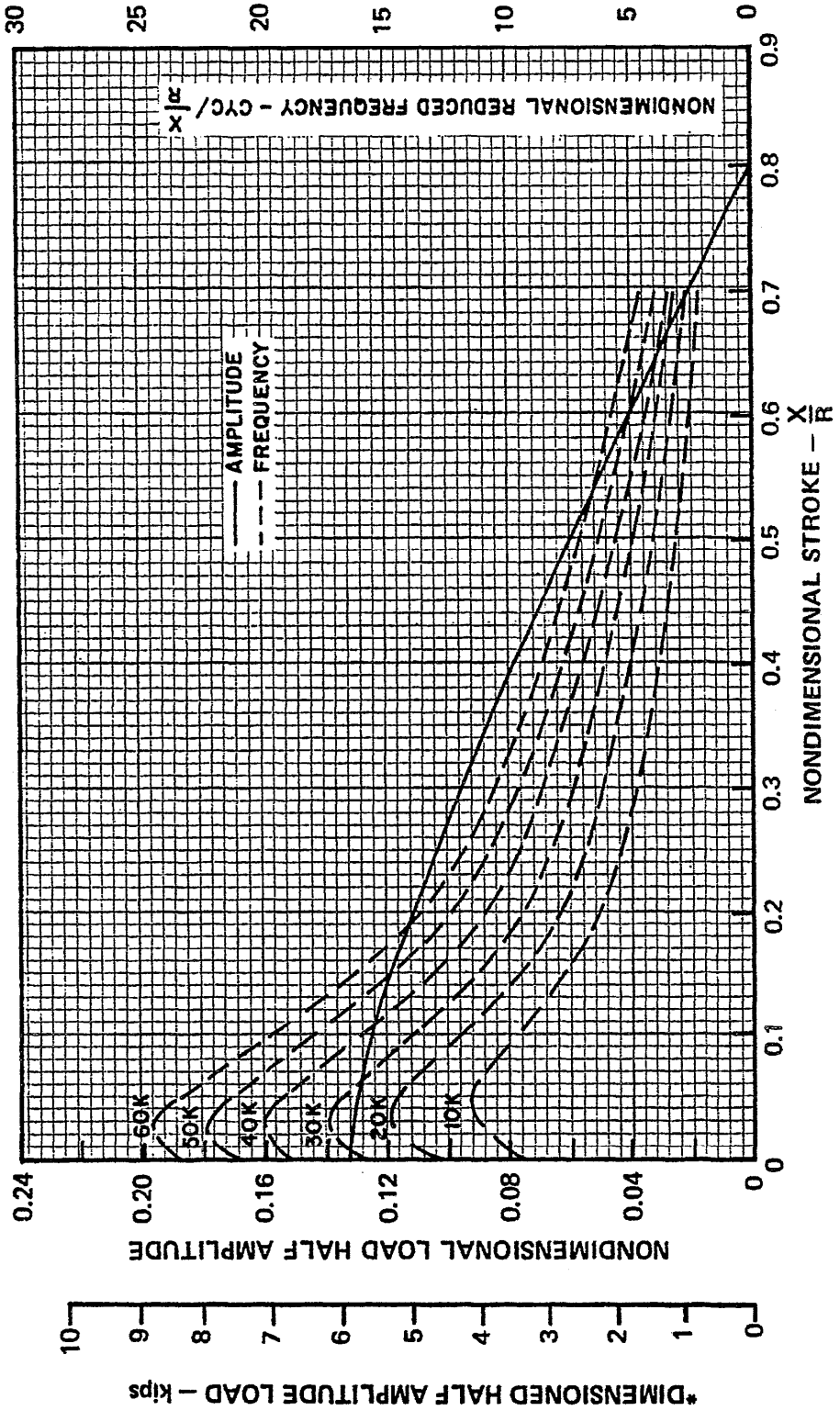

*Dimensioned half amplitude load scale for 10,000 lb airplane weight and 160 knots engaging speed only. Other weights and engaging speeds require correction per ratio $\frac{V_E^2 \times \text{weight} \times 510}{160^2 \times 10 \times R}$ or $\frac{V_E^2 \times \text{weight} \times \text{dimensioned scale}}{502 \times R}$. Weight W is in kips, V_E is in knots, and runout R is from Figure 23.1.

FIGURE 23.3. E-15 Gear, Average Frequency and Amplitude of Oscillation, Nondimensional

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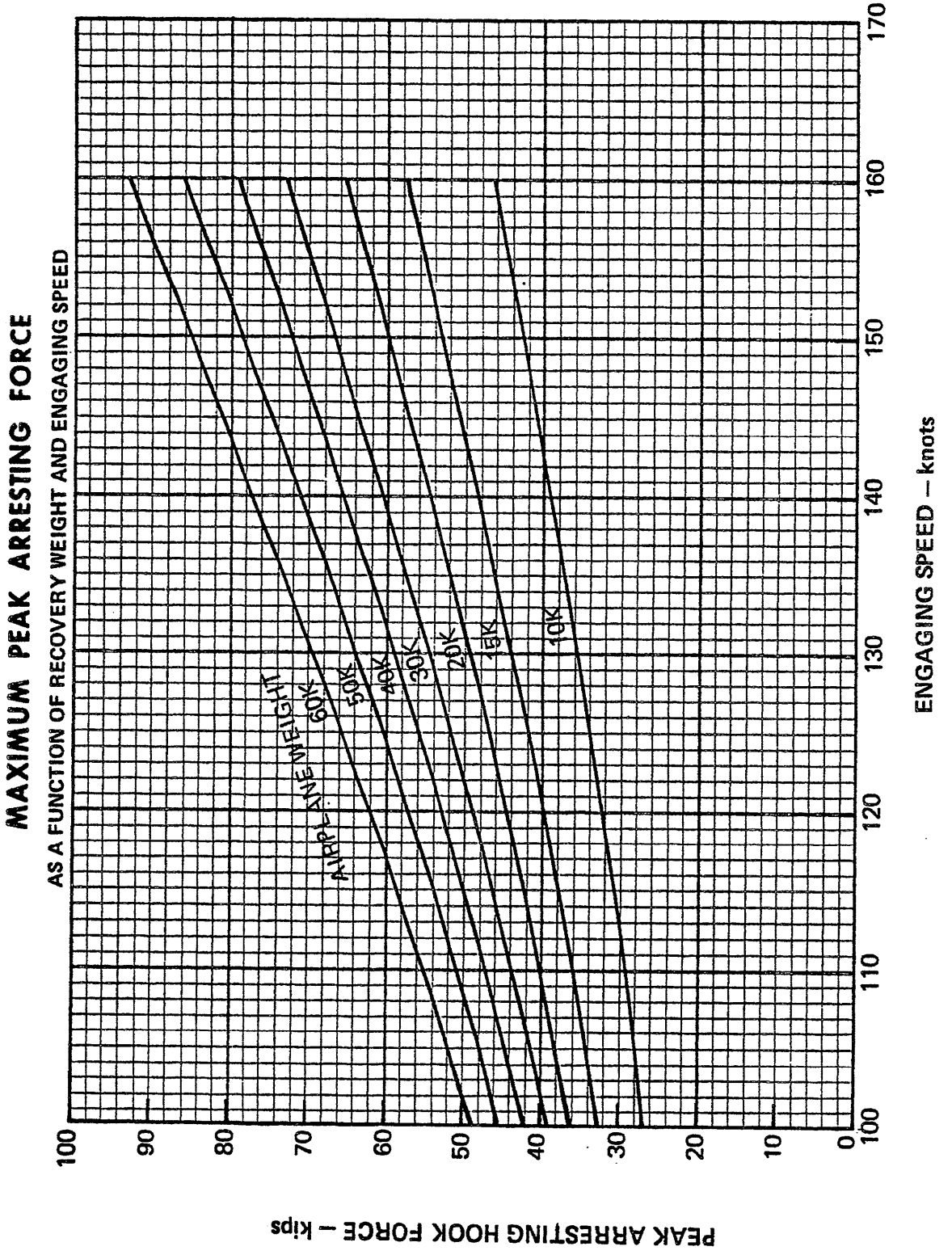

FIGURE 23.4. E-15 Gear, Maximum Peak Arresting Force

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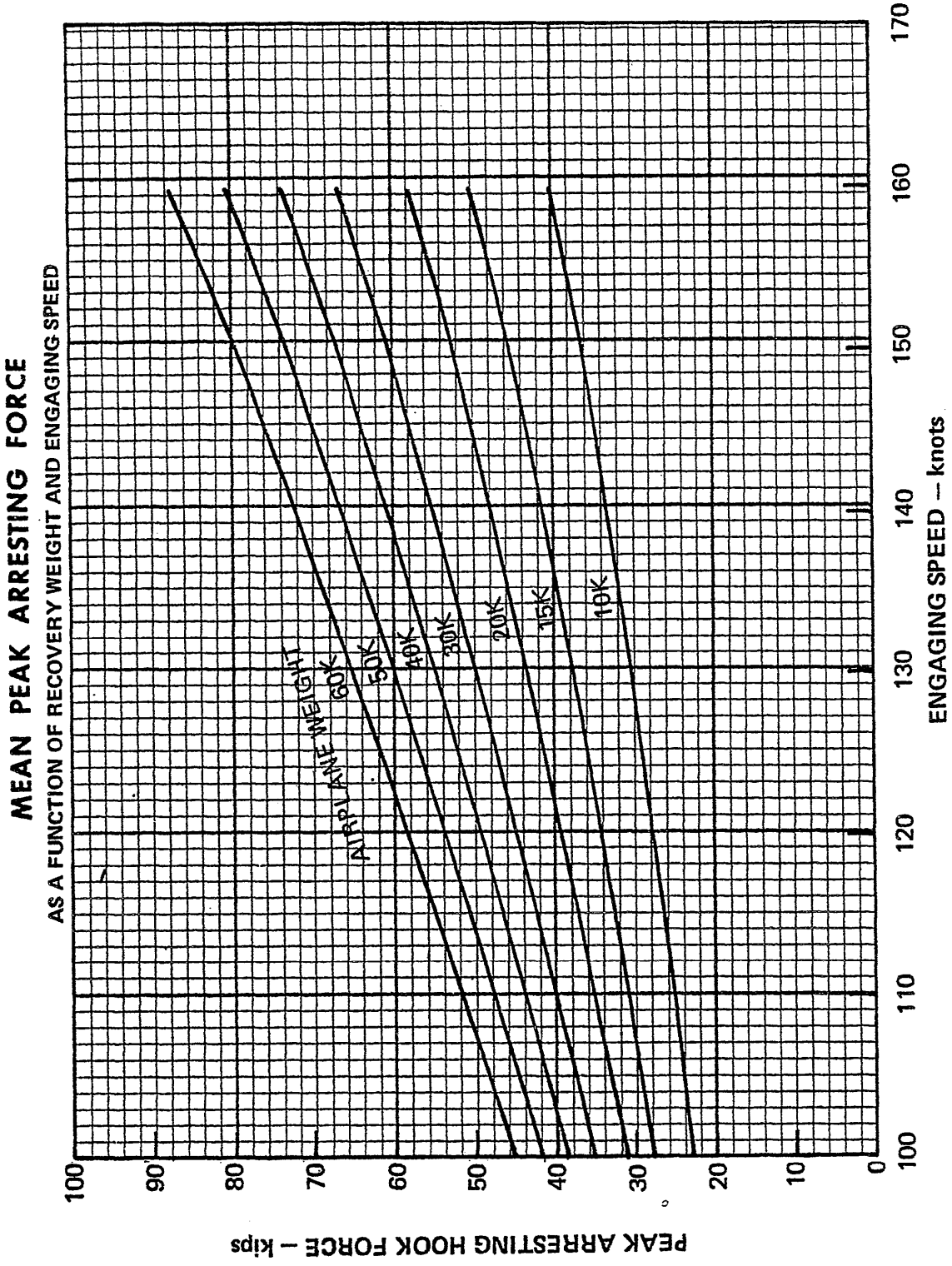

FIGURE 23.5. E-15 Gear, Mean Peak Arresting Force

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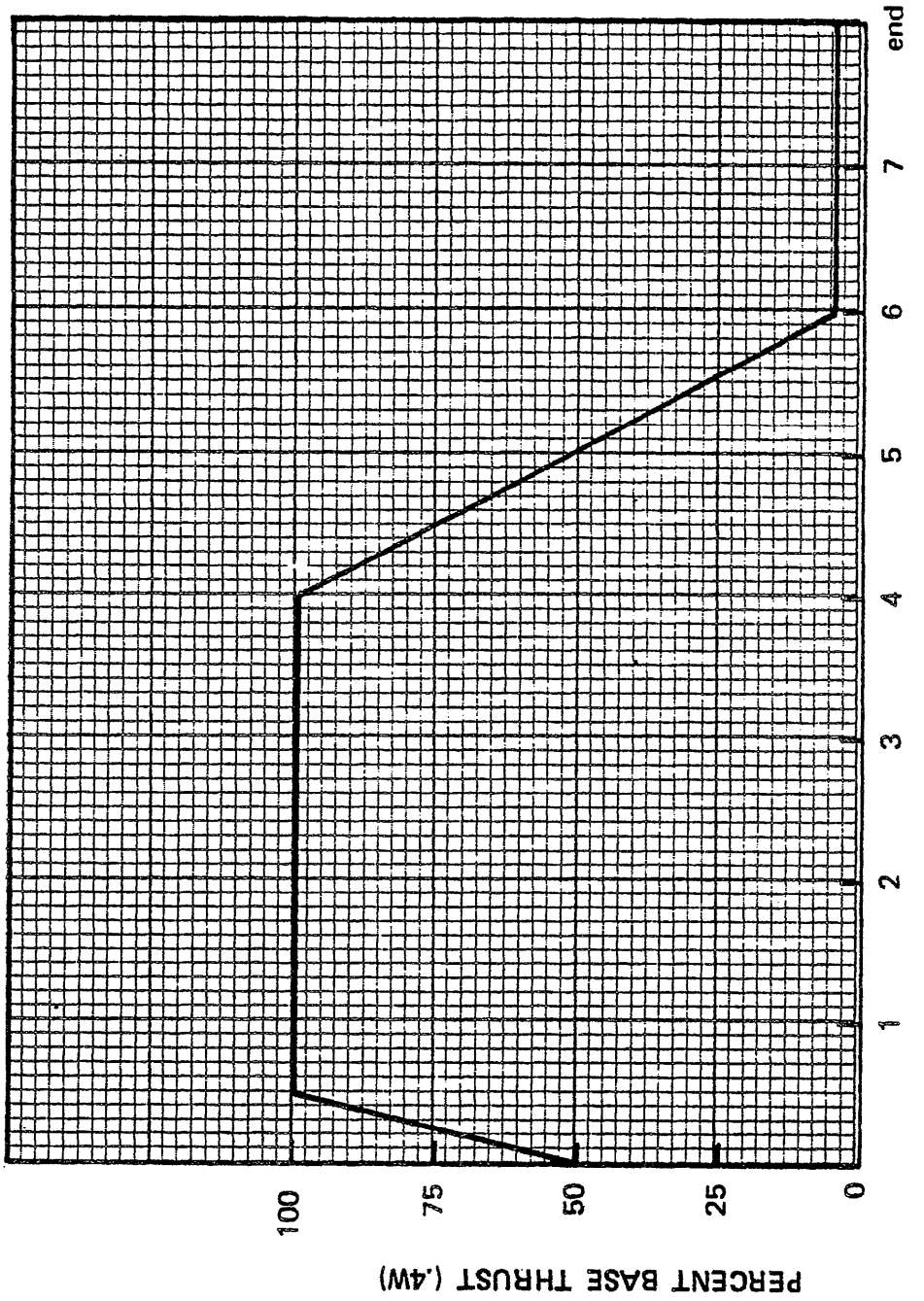

FIGURE 24. Base Thrust, SATS Arrestments

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