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SANDIA SYSTEMATIC DECLASSIFICATION REVIEW

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INCORPORATED
DALLAS, TEXAS

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PHASE II EXTERNAL STORE STUDY
SANDIA CORPORATION
PURCHASE ORDER 51-1360

REPORT 10064 1 JUNE, 1956

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PERSON VERIFYING MARKING & DATE
DATED: 6/30/97

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TABLE OF CONTENTS

VOLUME I

	Page No.
INDEX TO FIGURES	5
TABLE OF SYMBOLS	11
SUMMARY	14
1.0 INTRODUCTION	17
2.0 DESCRIPTION OF AIRPLANES AND STORE	19
2.1 F8U-1 Airplane	19
2.2 V-395 Airplane	19
2.3 Description of Store	20
3.0 STORE LOADS	24
3.1 Store Fin Loads	24
3.1.1 Wind Tunnel Tests	25
3.1.1.1 Pylon Mounted Store	26
3.1.1.2 Semi-submerged Cavity Mounted Store	27
3.1.2 Flight Loads	28
3.1.2.1 Pylon Mounted Store	29
3.1.2.2 Cavity Mounted Store	30
3.1.3 Conclusions	31
3.2 Store Pressure Distribution	53
3.2.1 Cavity Installation	54
3.2.2 Wing-Pylon Installation	55
3.3 Store Lug and Sway Brace Loads	65

UNCLASSIFIED

3.3.1 Location of Suspension System of Store 65

3.3.2 Method of Solution 66

3.3.3 Discussion of Results 68

3.3.4 Summary of Results 68

3.3.4.1 Pylon Mounted Store 68

3.3.4.2 Cavity Mounted Store 69

3.3.5 Conclusions 70

3.4 Release and Separation 96

3.4.1 Store Force Data 97

3.4.2 Method of Calculation 98

3.4.3 Validation of Separation Calculations 101

3.4.4 Store Separation Characteristics 105

3.4.4.1 Cavity Installation 106

3.4.4.2 Wing-Pylon Installation 107

3.4.5 Ejector Load Cycle 109

4.0 PERFORMANCE 123

4.1 Installed Drag of Store 123

4.2 F8U-1 Maximum Speed and Acceleration with TX-28 Store 132

4.3 Stability and Control Characteristics of F8U-1 Airplane with TX-28 Store 136

UNCLASSIFIED

[redacted]

[redacted]

UNCLASSIFIED

4.3.1 Longitudinal Stability 136

4.3.2 Directional Stability 137

4.3.3 Lateral Stability 137

4.3.4 Lateral Control 137

4.3.5 Conclusion 137

4.4 Store Delivery Maneuvers 147

4.5 Mission Profiles 170

VOLUME II

APPENDIX A Store Pressure Data, Wing-Pylon and Fuselage Cavity Installation 6

APPENDIX B Store Force Data for Separation Analysis 24

APPENDIX C Table of Cases for Store Lug and Sway Brace Load Analysis 64

APPENDIX D Tabulated Data for Store Separation Calculation 74

APPENDIX E Low Speed Wind Tunnel Test Data Report, Stability and Control, and Store Separation Investigation, V-395 and F8U-1 116

UNCLASSIFIED

[redacted]

INDEX TO FIGURES

VOLUME I

Figure No.	Title	Page No.
2.1	General Arrangement - F8U-1	21
2.2	General Arrangement - V-395	22
2.3	TX-28 Store	23
3.1 - 3.4	Fin Normal Force Coefficient vs Airplane Angle of Attack - Pylon Mount	33-36
3.5	Fin Normal Force Coefficient vs Airplane Yaw Angle - Pylon Mount	35
3.6 - 3.8	Fin Normal Force Coefficient vs Airplane Angle of Attack - Cavity Mount	38-40
3.9 - 3.10	Fin Normal Force Coefficient vs Airplane Angle of Yaw - Cavity Mount	41-42
3.11	F8U-1 Rolling Pullout - Maximum "g" Loads vs Mach Number	43
3.12	F8U-1 Rolling Pullout - Maximum Sideslip (β) vs Mach Number	44
3.13	Maximum Fin Load vs Mach Number - Pylon Mount	45
3.14	Fin Root Bending Moment vs Mach Number - Pylon Mount	46
3.15	Maximum Angle of Attack vs Mach Number - F8U-1	47
3.16	Maximum Allowable Sideslip Angle (β) vs Mach Number - F8U-1	48
3.17 - 3.18	Fin Maximum Normal Load vs Mach Number - Cavity Mount	49-50
3.19 - 3.20	Fin Root Bending Moment vs Mach Number - Cavity Mount	51-52

[redacted]

INDEX TO FIGURES (Cont'd)

3.21 - 3.24	Store Pressure Distribution - Pylon Mount	56-59
3.25 - 3.26	Store Pressure Distribution - Cavity Mount	60-61
3.27 - 3.28	Free Body Pressure Distribution	62-63
3.29	Comparison of Pressure Distribution with NACA Test Data	64
3.30	Sign Convention for Lug Load Analysis	72
3.31	Location of Store Support Members	73
3.32	Outline for IBM Calculation of Lug Loads	74
3.33	Equations for Total Forces on Store	75
3.34 - 3.35	Maximum Lug and Sway Brace Loads - Pylon Mount	76-77
3.36 - 3.37	Maximum Lug and Sway Brace Loads - Cavity Mount	78-79
3.38 - 3.40	Design Inertia Load Diagram - Pylon Mount	80-82
3.41 - 3.43	Design Inertia Load Diagram - Cavity Mount	83-85
3.44 - 3.45	Wind Tunnel Test Installation	86-87
3.46 - 3.53	Store aerodynamics Characteristics	88-95
3.54	Store Trajectories - Cavity Mount - With Ejection - Comparison W.T.T. and Calculated	110
3.55	Store Trajectories - Cavity Mount - No Ejection - Comparison W.T.T. and Calculated	111

INDEX TO FIGURES (Cont'd)

3.56	Store Trajectories - Pylon Mount - With Ejection - Comparison W.T.T. and Calculated	112
3.57	Store Trajectories - Pylon Mount - No Ejection - Comparison W.T.T. and Calculated	113-114
3.58 - 3.59	Store Pitch Angle vs Separation Distance - Cavity Mount	115-116
3.60 - 3.63	Store Pitch Angle vs Separation Distance - Pylon Mount	117-120
3.64	Store Ejector Load - Stroke Cycle	121
3.65	F7U-3 Load - Stroke Cycle	122
4.1 - 4.5	Drag at Zero Life Due to Wing Pylon Mounted Stores	125-129
4.6	Drag at Zero Lift Due to Sandia Final Store Configuration Wing Pylon Mounted vs Mach Number	130
4.7	Drag at Zero Life Due to 15 in. Diameter - Fineness Ratio 9.0 Sandia Store - Wing Pylon Mounted	131
4.8	Maximum Speed vs Altitude, F8U-1 with TX-28 Store	133
4.9	Speed vs Time in Level Flight Acceleration, F8U-1	134
4.10	Effects of Store Shape on V_{MAX} of F8U-1	135
4.11	Effect of Store on F8U-1 Longitudinal Stability, High Speed Configuration	138
4.12	Effect of Store on F8U-1 Longitudinal Stability, Landing Configuration	139
4.13	Aerodynamic Center Location, High Speed Configuration	140

INDEX TO FIGURES (Cont'd)

4.14	Aerodynamic Center Location, Landing Configuration	141
4.15	Effects of Store on Direction Stability, High Speed Configuration	142
4.16	Effects of Store on Direction Stability, Landing Configuration	143
4.17	Rolling Moments of F8U-1 with and without Store, High Speed Configuration	144
4.18	Rolling Moment of F8U-1 with and without Store, Landing Configuration	145
4.19	Effects of Store on F8U-1 Lateral Control	146
4.20 - 4.38	Phase II Escape Maneuvers	151-169
4.39	Mission Summary	171

VOLUME II

APPENDIX A

1A	Orifice Location and Number Pressure Test Store Model	9
2A-10A	Store Pressure Data, Pylon Installation	10-18
11A-15A	Store Pressure Data, Cavity Installation	19-23

APPENDIX B

1B-3B	Wind Tunnel Test Installation for Store Separation Force Data Tests	27-29

INDEX TO FIGURES (Cont'd)

VOLUME II

4B-13B	Store Normal Force and Pitching Moment Coefficients vs Store Angle of Attack at Various Store Airplane Separation Distance - Pylon Installation	30-39
14B-25B	Store Normal Force and Pitching Moment Coefficient vs Store Angle of Attack at Various Store-Airplane Separation Distance. Cavity Installation	40-51
26B-35B	Botton Fin Folded, Store Normal Force and Pitching Moment Coefficients vs Store Angle of Attack at Various Store-Airplane Separation Distance - Cavity Installation.	52-63
APPENDIX E		
1E	F8U-1 Airplane Dimensional Data	135
2E	TX-28 Store Model	136
3E-20E	Plots of Wind Tunnel Test Data	137-154
21E	Sketch of Pylon Ejection Mechanism	201
22E	Pylon Ejection Mechanism Load Characteristics of Short Spring	202
23E	Pylon Ejection Mechanism Load Characteristics of Long Spring	203
24E	Sketch of Cavity Ejection Mechanism	204
25E	Cavity Ejection Mechanism Load Stroke Characteristics	205
26E	Camera Setup for Store Drops	206
27E-51E	Multiple Exposure Photographs of Low Speed Wind Tunnel Store Drops	207-231

INDEX TO FIGURES (Cont'd)

VOLUME II

52E	Pylon Drops With Ejection, Store Pitch Angle vs Separation Distance	232
53E	Pylon Drops, No Ejection, Store Pitch Angle vs Separation Distance	233
54E	Cavity Drops, With Ejection, Store Pitch Angle vs Separation Distance	234
55E	Cavity Drops, No Ejection, Store Pitch Angle vs Separation Distance	235

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TABLE OF SYMBOLS

a_e distance from the center-of-gravity of the store to the point of application of the ejector force (ft.)

A_1 F8U-1 Airplane basic aileron.

C_{D_0} drag coefficient at zero lift.

C_L lift coefficient.

C_l rolling moment coefficient.

$C_{l_{\delta_a}} = \frac{dC_l}{d\delta_a}$

C_m pitching moment coefficient.

C_N normal force coefficient.

C_{N_F} store fin normal force coefficient.

C_n yawing moment coefficient.

$C_{n_\psi} = \frac{dC_n}{d\psi}$

C_p pressure coefficient.

C_y side force coefficient.

F_x force in a longitudinal direction (pounds)

F_y force in a lateral direction (pounds)

F_z force in a vertical direction (pounds)

g acceleration due gravity 32.2 ft/sec^2

i_w wing incidence (degrees).

LABS low altitude bombing system.

M Mach number.

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M_y	moment about a lateral axis.
M_z	moment about a vertical axis.
N_F	store fin normal force (pounds).
n_x	load factor in a longitudinal direction.
n_y	load factor in a lateral direction.
n_z	load factor in a vertical direction.
n_z^i	instantaneous load factor in a vertical direction.
n_{z_0}	load factor in a vertical direction at the beginning of a maneuver.
$\bar{R}^a$	reaction on aft sway brace (pounds).
$\bar{R}^f$	reaction on forward sway brace (pounds).
R_z^a	vertical reaction on aft lug (pounds).
R_z^f	vertical reaction on forward lug (pounds).
R_x	longitudinal reaction on lugs (pounds).
r_x	longitudinal distance between store center of gravity and airplane center of gravity (inches)
r_y	lateral distance between store center of gravity and airplane center of gravity (inches)
r_z	vertical distance between store center of gravity and airplane center of gravity (inches)
V	velocity (feet per second).
X	longitudinal distance (feet).
Y	lateral distance (feet.)

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Z	vertical distance (feet).
α_F	airplane angle of attack (degrees).
α_S	store angle of attack (degrees).
β	angle of sideslip (degrees).
δ	climb angle (degrees).
δ_a	aileron deflection (degrees).
δ_n	nose-droop deflection (degrees).
ζ	horizontal separation distance (f c).
η	vertical separation distance (feet).
θ	angle of pitch, angle of turn (degrees).
ρ	air density (slugs per cubic foot).
ϕ	angle of roll (degrees)
ψ	airplane angle of yaw (degrees)

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SUMMARY

Chance Vought Aircraft, Incorporated has conducted Phase II of an external store study for the Sandia Corporation under Sandia Purchase Order No. 51-1360. This phase of the study was made for the TX-28 store wing-pylon mounted on the F8U-1 airplane and semi-submerged in the fuselage cavity of the V-395 proposed design. The object of this phase was to evaluate: (1) store loading information, when the store is carried on the airplanes for use in store body and fin design, and (2) the airplane-store performance characteristics of the F8U-1 airplane.

The following store loading information was evaluated: store fin loads and fin root bending moments, maximum lug and sway brace loads, peak ejector loads, and the qualitative effects of the store installation on store loading indicated by comparing the store-installed and store-alone pressure distribution.

The following airplane-store performance characteristics were evaluated for the TX-28 store wing-pylon mounted on the F8U-1 airplane: installed drag of store, maximum speed and acceleration characteristics, low speed stability and control, and store delivery maneuvers.

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The data required to evaluate the above information was obtained through high speed wind tunnel tests conducted at Cornell Aeronautical Laboratory and low speed tests conducted at the Chance Vought Aircraft low speed tunnel installation. Various parts of the results were obtained through the use of machine computation using IBM.

The critical store fin load occurred when the store was mounted in the fuselage cavity of the V-395 proposed design. This critical fin load was encountered with the bottom store fin in the extended position and is 560 lb/ft^2 with a corresponding fin root bending moment of 240 lb-ft/ft^2 based on the exposed fin area.

The comparison between the pressure distributions obtained for the store installed in the fuselage cavity and for the store alone indicates the cavity installation effects produce lower loading than those expected from store alone flight. Comparison between the pylon mounted store and store alone data indicates the airloads acting on the store when pylon mounted may be critical and should be used along with free body data in determining the structural design of the store.

The critical loads applied to the store through the store suspension system as determined in the lug and sway brace load analysis are:

forward lug - 14,200 lb tension

aft lug - 17,900 lb tension

forward sway brace - 8,100 lb compression (one side)

aft sway brace - 8,100 lb compression (one side)

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Peak ejector loads required for successful separation were determined to be 20,000 lb. applied 6 inches aft of the C.G. of the store for the pylon installation and 18,000 lb applied at the C.G. of the store for the cavity installation. Smoother separation of the store occurs when released from the cavity installation. The maximum store pitch angle encountered was only 6 degrees. An abrupt nose down motion of the store occurs when the store is released from the pylon. Store pitch angles of 15 degrees are encountered during separation.

The installed drag characteristics of the TX-28 store-wing-pylon mounted on the F8U-1 airplane are verified by the installed drag data evaluated in Phase I of this study. The maximum speed of the F8U-1 with the store on is greatly reduced. The maximum speeds at 35,000 ft at maximum power for the F8U-1 airplane clean is (MN/Kts - 1.43/825) and for the F8U-1 airplane with store on is (MN/Kts - 1.24/713), a loss in speed of 112 knots. The acceleration characteristics are also reduced due to the store installation.

The installation of the wing pylon mounted store on the F8U-1 airplane produces essentially no changes in the low speed stability and control aerodynamic parameter.

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1.0 INTRODUCTION

This report presents the results for Phase II of an external store study conducted by Chance Vought Aircraft, Incorporated for the Sandia Corporation under Sandia Corporation Purchase Order No. 51-1360. This report consists of two volumes. Volume I contains the report proper and presents the results and discussions of the study. Volume II contains the appendixes to the report where additional data obtained during the study are presented.

Phase I of this study was made to obtain data that would enable the Sandia Corporation to ascertain what store design would be best suited for installation on the F8U-1 airplane and the V-395 proposed design. Various store configurations were studied to evaluate their physical compatibility with the above airplanes and their effects on aircraft performance. Using this information, supplied by Chance Vought Aircraft, and similar information obtained from other airframe manufacturers for contemporary aircraft the Sandia Corporation was able to determine the best store configuration suitable for the various aircraft.

The resulting store configuration of the Phase I study chosen by the Sandia Corporation is the TX-28.

Phase II of this study was made to evaluate the design and performance aspects of installing the TX-28 store configuration on the F8U-1 airplane and V-395 proposed design. This phase of the study also was made to evaluate various store

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loads that are associated with the two installations for Sandia Corporation's use in designing the store structure and components. The information presented in this report was separated into two categories: (1) Store loads information, and (2) Aircraft-store performance. The items investigated and presented in this report for the above categories are listed below:

Store Loads

A. Store Fin Loads

B. Store Pressure Distributions

C. Store Lug and Sway Brace Loads

D. Store Separation Force

Airplane-Store Performance

A. Store Installation Drag

B. Effects of Store Installation on the Stability and Control Characteristics of the F8U-1 airplane.

C. Maximum Speed and Acceleration Characteristics of F8U-1 airplane with TX-28 Store.

D. Store Delivery Maneuvers for F8U-1 airplane.

The above items were evaluated through the use of high and low speed wind tunnel testing and IBM machine computation. The results are present in two sections: (1) Store Loads (2) Airplane-Store Performance. Each item listed above is presented separately in its section.

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2.0 DESCRIPTION OF AIRPLANES AND STORE

2.1 F8U-1 Airplane

The F8U-1 Day Fighter is a single place, carrier-based airplane, having a high mounted, variable insidence, swept wing and a low, unit, horizontal tail. The F8U-1 airplane employed in these studies (for analysis purposes) is a modified version of the Day Fighter incorporating an aft fuselage fuel cell installation, fuselage "coking", a left wing store pylon with fuel provisions, and LABS equipment. The airplane's power plant is a Pratt and Whitney J57-P-4 (JT3W) engine incorporating afterburning and having a maximum Sea Level Static Rating of 16,000 pounds thrust. A general arrangement sketch of this airplane is given in figure 2.1. Airplane weights that are pertinent to this study are listed below:

Gross Take-off Weight without Store	25,520 pounds
Usable Internal Fuel Load	8,275 pounds
Dropable Pylon Weight	177 pounds

2.2 V-395 Airplane

The V-395 airplane is a development of the F8U-1 configuration. The basic changes from the F8U-1 are increased weight and fuel capacity, all weather capabilities, semi-submerged store cavity in fuselage, and an advanced Pratt and Whitney J57 engine. The power plant is the J57 (JT3C-20) augmented by afterburning, having a maximum Sea Level Static Rating of 17,200 pounds thrust. A general arrangement sketch

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of this airplane is shown in figure 2.2. Pertinent airplane weights are as follows:

Gross Take-off Weight without Store	29,695 pounds
Usable Internal Fuel Load	10,374 pounds

2.3 Description of Store

The store considered in this study is the Sandia TX-28 configuration. The dimensions and contours of this store can be found on the Sandia drawing DS(1326)#8806 with two exceptions: (1) Store used in this study weighs 1850 pounds (2) Store moment of inertia about Y and Z axes = 1,667,000 pound-inches^2.

A drawing of the store is presented in figure 2.3.

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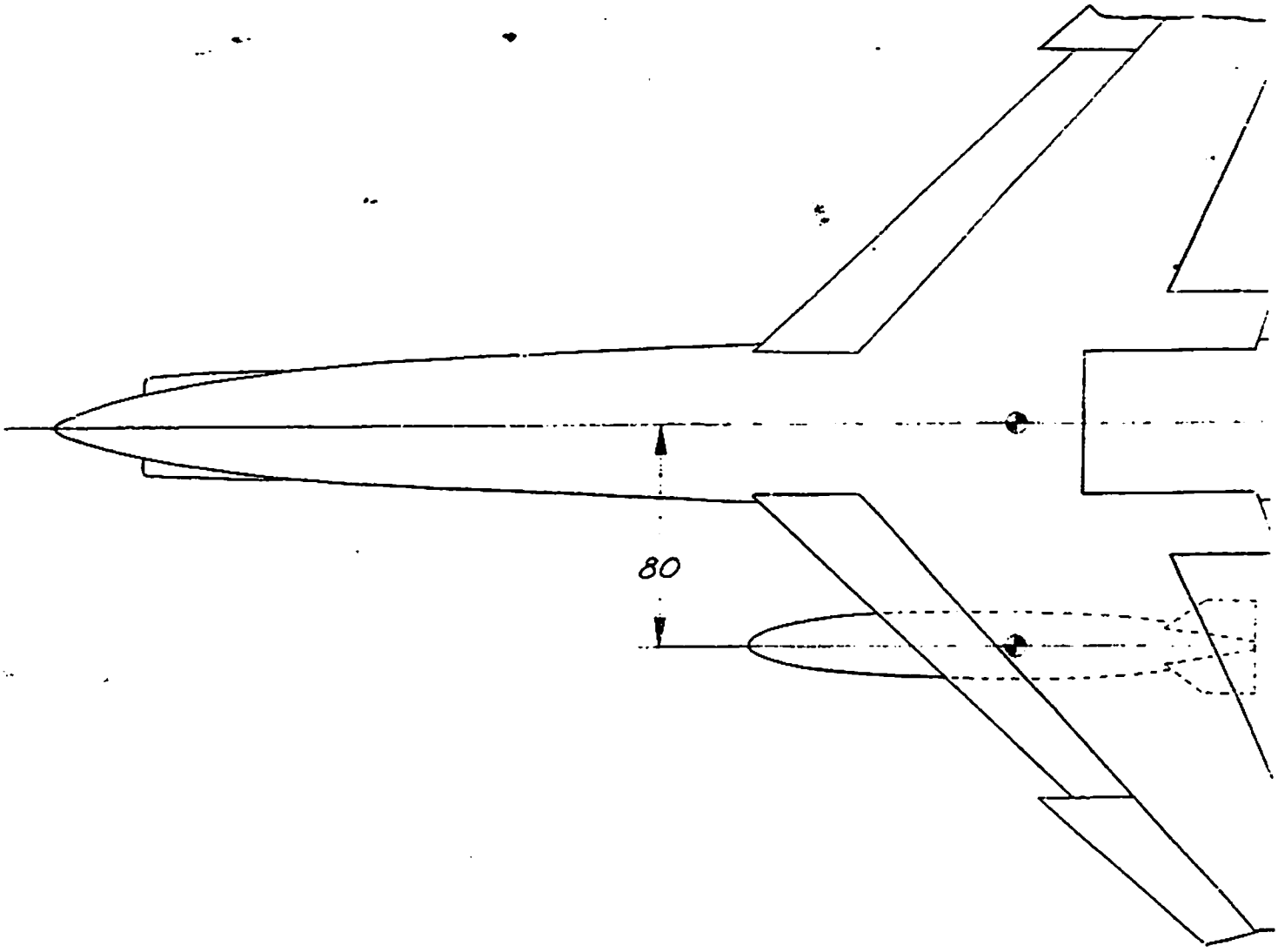
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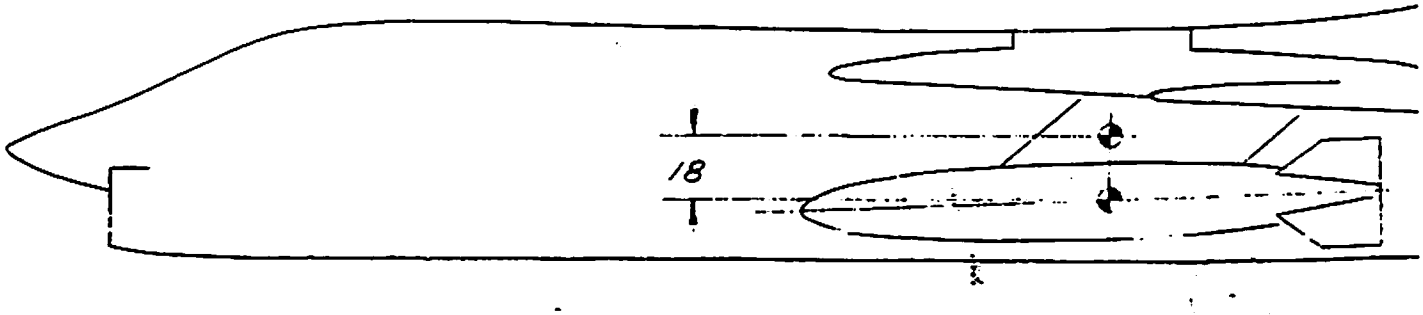
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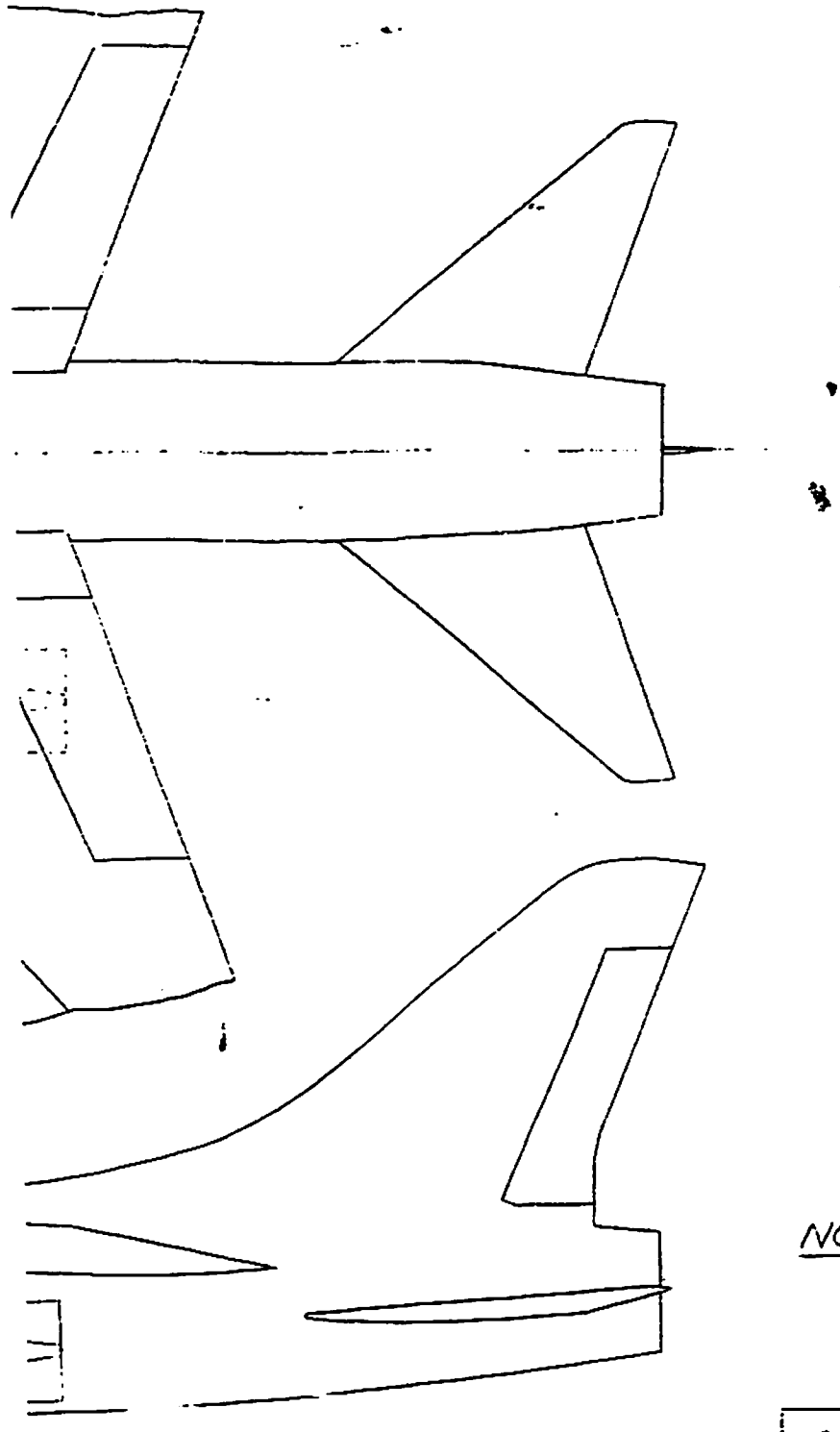
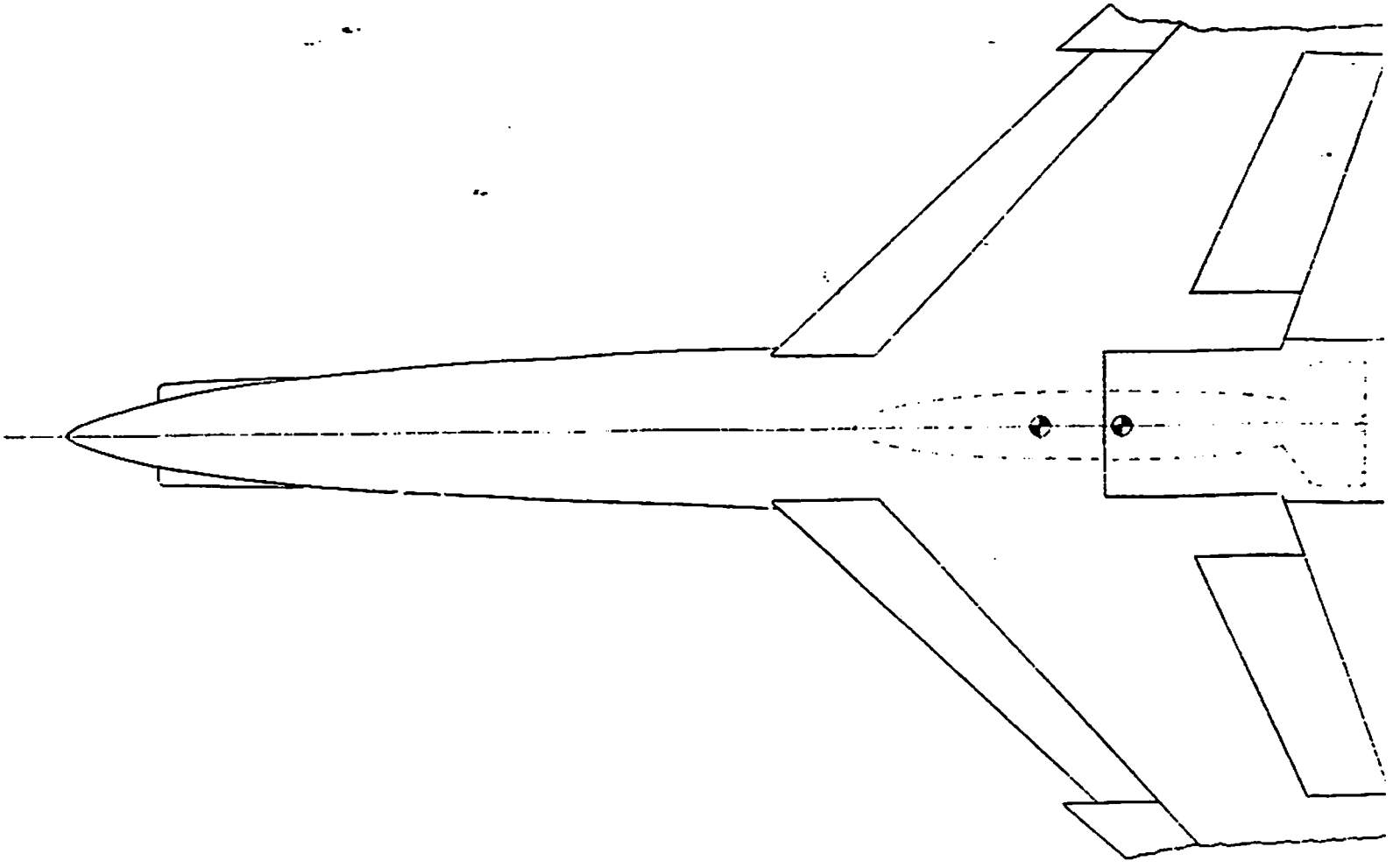
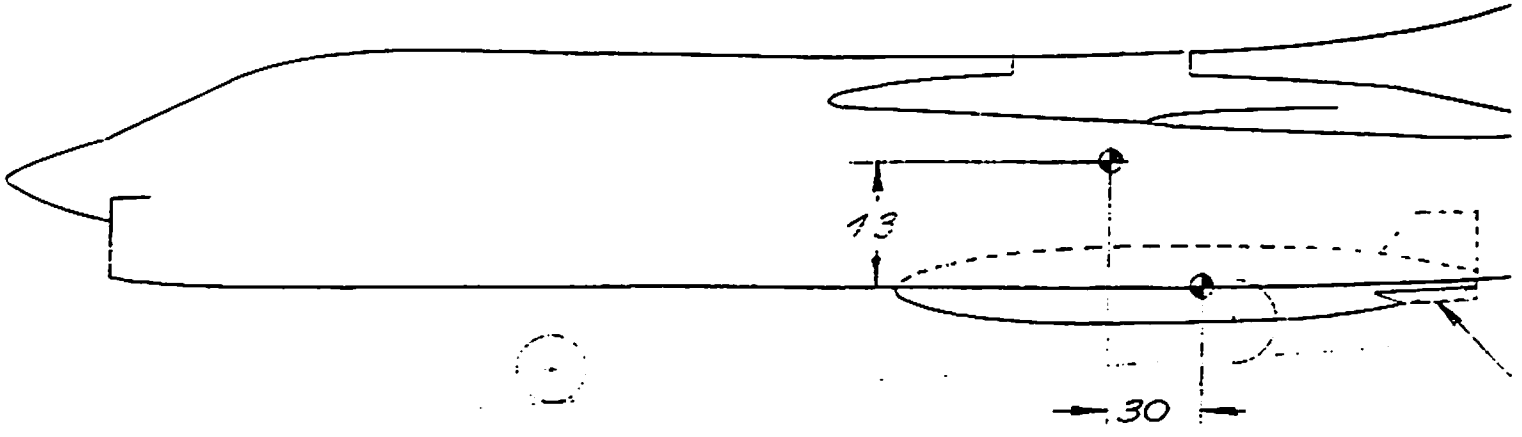


NOTE: STORE NOT TO SCALE

SANDIA EXTERNAL STORE STUDY
PHASE II
F8U-1 GENERAL ARRANGEMENT

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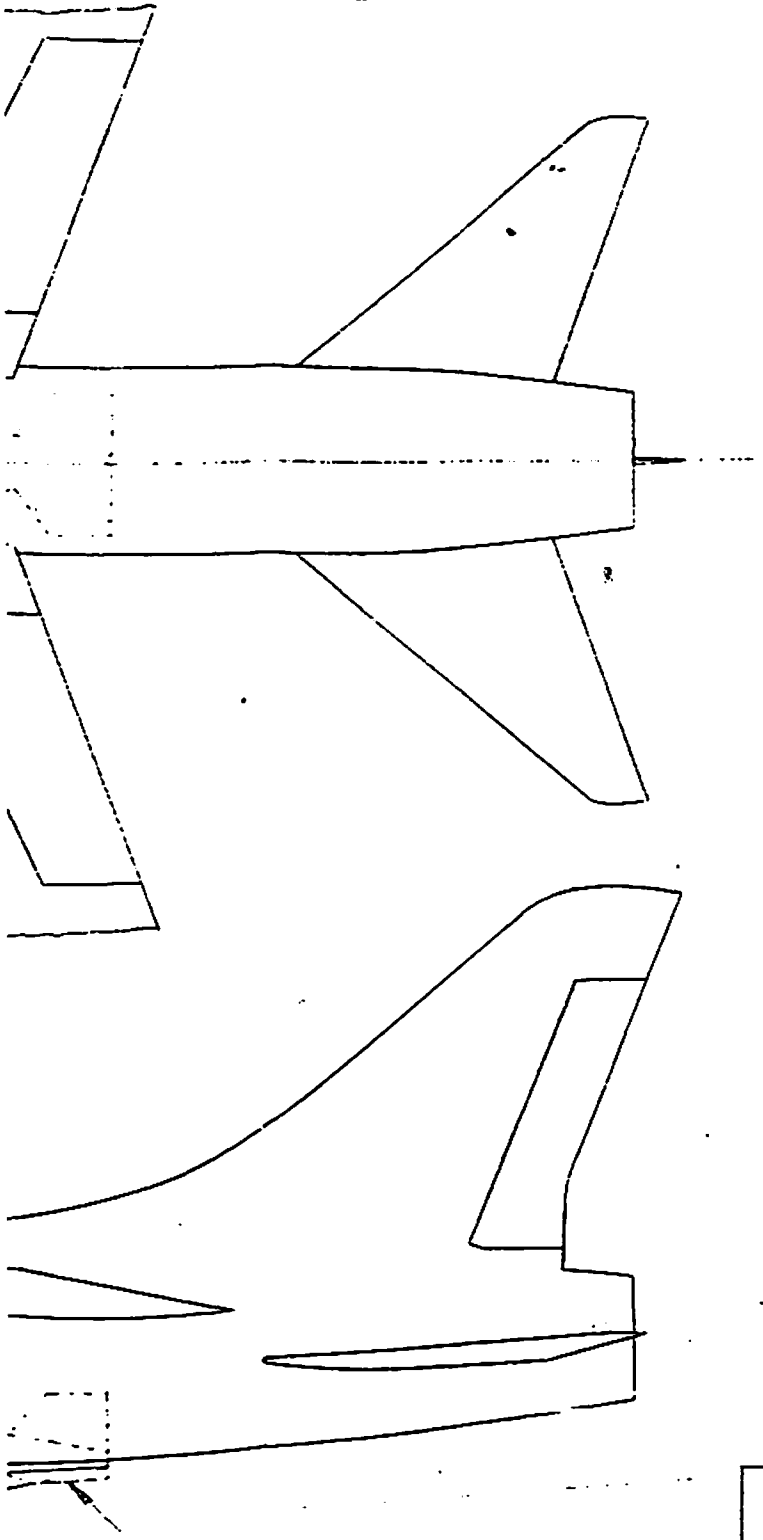

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SANDIA EXTERNAL STORE STUDY
PHASE II
V-395 GENERAL ARRANGEMENT
(ATTACK TYPE F8U AIRPLANE)

CONTOUR COORDINATES			
NOSE SECTION		TAIL SECTION	
STA	RADIUS	STA	RADIUS
[illegible]	0	65	10.000
[illegible]	[illegible]	70	9.958
5	3.114	75	9.836
11	4.660	100	9.637
14	5.843	105	9.368
[illegible]	6.738	110	9.032
2[illegible]	7.48[illegible]	115	8.633
[illegible]	8.071	120	8.180
3[illegible]	8.5[illegible]	125	7.674
[illegible]	9.005	130	7.124
4[illegible]	9.382	135	6.534
51	9.694	140	5.912
56	9.915	145	5.263
61	10.000	170	1.961
85	10.000	-	-

CONTOUR EQUATIONS

STA -125 TO STA 61.0

$Y = 10 - .0038565439 9\,X^2 + .0000912092597\,X^3 - .0000011359394 2\,X^4$

LIMITS OF X: 0 TO 62.25

STA 61.0 TO STA 85.0

Y = 10 (CYLINDER)

STA 85.0 TO STA 145.0

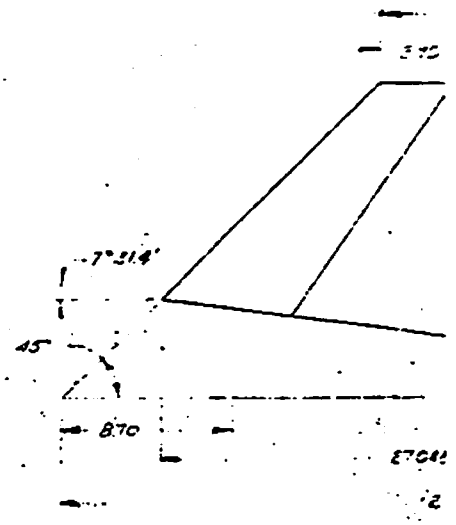
$Y = 10 - .0016937836 8\,X^2 + .0000054063029\,X^3 - .0000000146445747\,X^4$

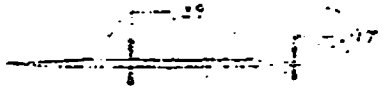
LIMITS OF X: 0 TO 60

STA 145.0 TO STA 170.0

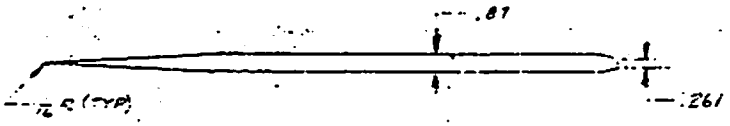
$Y = 13.18494195 - .1320462 7\,X$

LIMITS OF X, 60 TO 85





FIN TIP SECTION



FIN ROOT SECTION

FIN SHAPE
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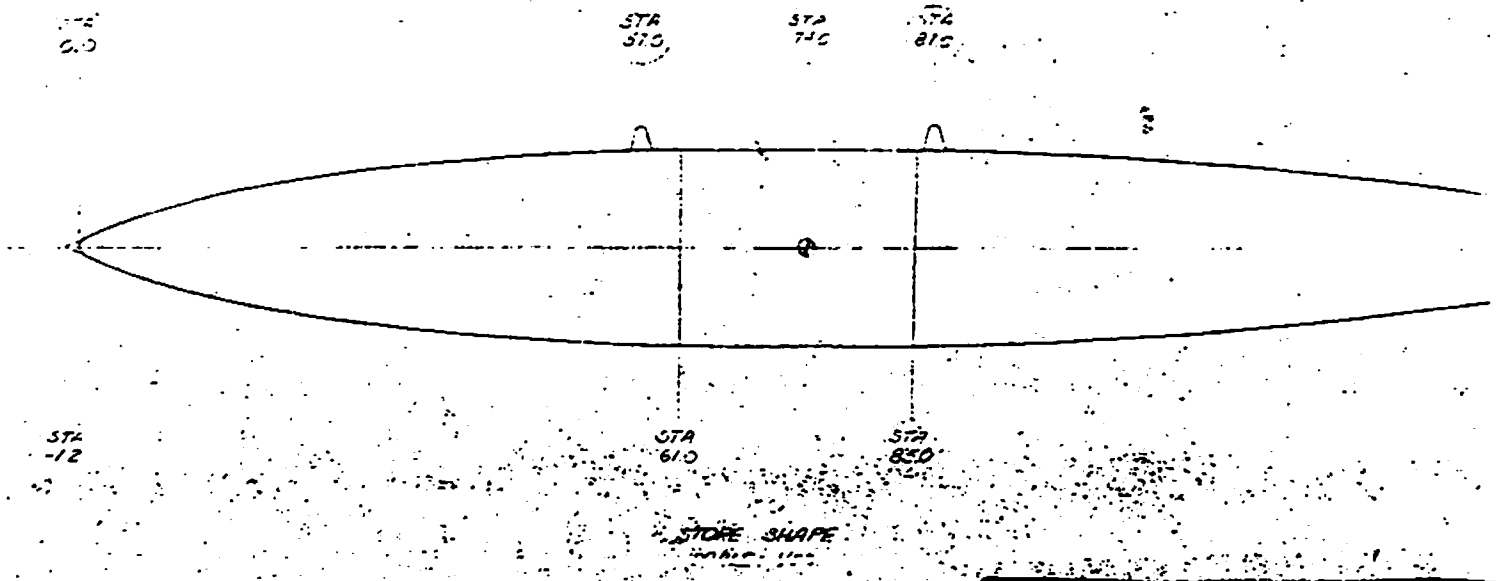

STORE SHAPE
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Fig 2.3

[redacted]

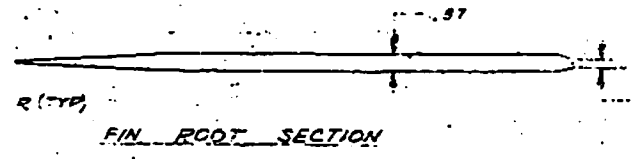
CONTOUR EQUATIONS

TO STA 61.0
.0385654399 x^2
.2092237 x^3 - .0000011359374 x^4
OF X: 0 TO 62.25

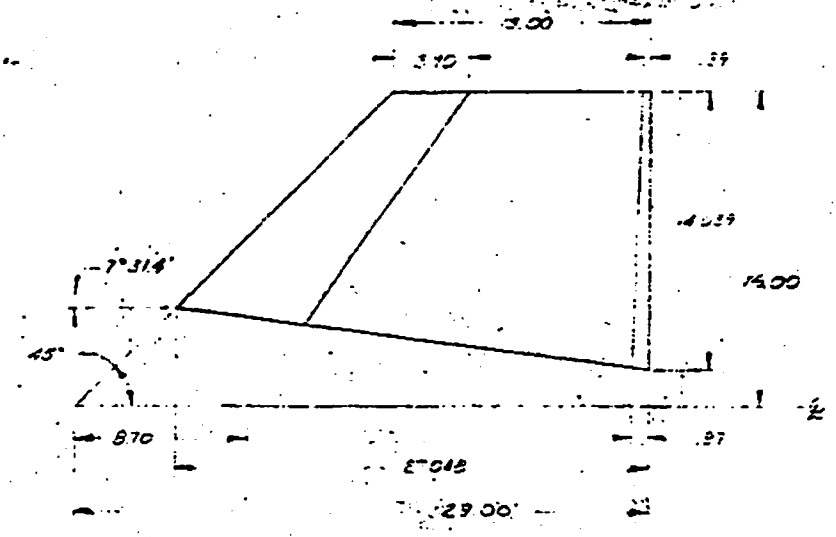
TO STA 85.0
(CYLINDER)

TO STA 145.0
.0016937836 x^2
.0540630237 x^3 - .0002003468457 x^4
OF X: 0 TO 60

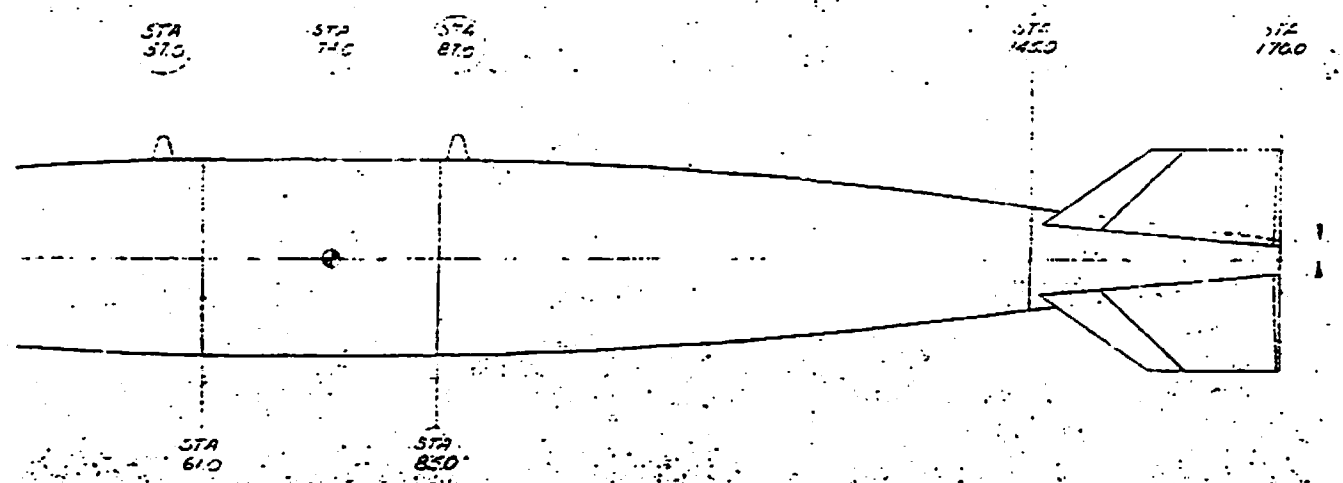
TO STA 170.0
.694195 - .13204027 X
OF X: 60 TO 85



FIN ROOT SECTION



FIN SHAPE
SCALE: 1/10



STORE SHAPE

[redacted]

SANDIA EXTERNAL STORES STUDY
PHASE II
STORE TX-2B
WEIGHT = 1850#, LENGTH = 170 IN.
MAXIMUM DIAMETER = 20 IN.
MOMENT OF INERTIA IN PITCH (I_y) = 1624.0 SLUG-FT²
MOMENT OF INERTIA IN ROLL (I_x) = 108.0 SLUG-FT²

Report No. 10064
Page No. 23
Figure No. 2.3

[redacted]

3.0 STORE LOADS

The information presented in this section was obtained to evaluate the store loads encountered when the TX-28 store is carried and delivered. These loads were evaluated for two types of store installations, wing-pylon mounted on the F8U-1 airplane and semi submerged in the fuselage cavity of the V-395 proposed design. In determining the maximum loads, the philosophy used was that the maximum loads would be those obtained in actual flight of the aircraft under study. No consideration was given to aircraft maneuvers considered emergency flight.

3.1 Store Fin Loads

Presented in this section are the results of an investigation to evaluate the fin loads and fin root bending moments associated with installation the TX-28 store on the carrying aircraft. The investigation was made to supply the Sandia Corporation with data to check the accuracy of basing fin design on loads obtained from free body tests against the loads encountered with the store attached to the airplane. Two store installations were used; the left wing-pylon of the F8U-1 airplane and the fuselage-cavity of the proposed V-395 design. The investigation consisted of: (1) wind tunnel tests to evaluate fin normal force coefficients and centers of

pressure for the two installations at various aircraft attitudes and Mach numbers; (2) calculation and evaluation of the maximum fin loads and fin root bending moments that would be encountered during flight.

3.1.1 Wind Tunnel Tests - Wind tunnel tests to determine the store fin normal force coefficients and centers or pressures were conducted at the Cornell Aeronautical Laboratory during the period November 2-4, 1955. The tests were made using an 0.042 scale model of the F8U-1 airplane with a left wing pylon. The tests to obtain data for the store semi-submerged in the fuselage cavity, for the V-395 proposed design, were also made with the F8U-1 model, modified for the cavity installation. The physical geometry of the two aircraft configurations are so similar that the data obtained requires no correction for application to the V-395 proposed design.

The fin data were obtained by instrumenting one of the four store fins with a small strain gage balance. The aft end of this store was rotated to obtain data for each fin position. Fin data were also obtained for the cavity installation with one fin in a folded position. Data were obtained at Mach numbers of .8, .9, 1.02, 1.2, at yaw angles of zero and plus and minus 5 degrees. The types of store installations used are shown in figure 2.1 and 2.2. Analysis of these data follows.

3.1.1.1 Pylon Mounted Store - The values of fin normal force coefficient (based on exposed fin area) versus angle of attack at the three positions of yaw are presented for each fin in figure 3.1 through 3.4. The data obtained show the fin normal force coefficient (C_{N_F}) as a function of the following: Mach number, airplane angle of attack (α_F) and airplane angle of yaw (ψ), and store fin position. The analysis of these data indicated that the critical design fin load coefficients are obtained from the lower outboard fin. The effects of Mach number on the normal force coefficient for this fin can be neglected since they are relatively small. The slope of the C_{N_F} of this fin with airplane angle of attack is approximately 0.018 per degree. The variation in the value of C_{N_F} with airplane yaw is approximately 0.04 per degree. The flow about this fin would appear to be essentially parallel to the free stream producing approximately zero load at $\alpha_F = 0$ and $\psi = 0$.

The other three fin C_{N_F} values are affected by the flow field of the airplane. The upper fins have relatively small changes in C_{N_F} with α_F due to the proximity to the lower surface of the wing. The inboard upper fin shows essentially a constant value of $C_{N_F} = -.06$ throughout the range of airplane attitudes tested, indicating that it was completely immersed in the flow field produced by the airplane-store installation. The inboard

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lower fin C_{N_β} changes approximately 0.1 due to 5 degrees of yaw but only a small increase with angle of attack.

The C_{N_β} of the outboard lower fin data presented in figure 3.1 was linearized to facilitate the computation of the design fin loads and bending moments. A cross plot of C_{N_β} with airplane angle of yaw at constant values of angle of attack is presented in figure 3.5. It should be realized that there is some question as to the validity of the extrapolation of the curves beyond $\psi = \pm 5^\circ$, however; the final design loads and bending moments fall within the limits of knowledge so that data beyond $\psi = \pm 5^\circ$ are of academic interest only.

Analysis of the location of the center of pressure indicated that for practical design considerations the c.p. could be considered fixed at one point. The location of the c.p. is 1.49 ft. ahead on the fin trailing edge and 1.09 ft. measured spanwise from the centerline of store. This is the value of c.p. used in calculation of the fin root bending moment.

3.1.1.2 Semi-submerged Cavity Mounted Store - The values of fin normal force coefficient (based on exposed fin area) versus angle of attack for the cavity mounted store are presented in figures 3.6 through 3.8. The store was mounted in the cavity so that the fins were horizontal and vertical. With this configuration the top fin was contained within the fuselage while the bottom fin was assumed folding. Fin normal force

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coefficients were measured as a function of airplane angle of attack at Mach numbers of .8, .9, 1.02, and 1.20. Data were obtained for one side fin and the bottom fin since the installation was symmetrical. The side fin data were obtained for airplane yaw values of $\psi = 0^\circ$ and -5°. The bottom fin in the folded position was tested at airplane yaw angles of $\psi = 0^\circ$, -5°, and 45°.

Analysis of the test data indicates that the bottom fin in the vertical position produces the critical design fin loads coefficients. The value of C_{N_F} with angle of attack is essentially a constant so that the C_{N_F} used for design can be considered as a function of airplane yaw angle only. The effects of Mach number are small and they can be neglected. The variation of fin normal force coefficient (C_{N_F}) with airplane yaw angle is presented in figure 3.9. The slope of the curve is .07 per degree of yaw.

Data are also presented for the bottom fin in the folded position. These data were assumed linear with airplane angle of attack since the design conditions occur at the low values of α_F. A cross plot of C_{N_F} as a function of airplane yaw angle is presented in figure 3.10.

3.1.2 <u>Flight Loads</u> - The loadings that the store fins will receive during carried flight are a function of the flight maneuvers and flight conditions that the carrying aircraft

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encounters. If the strength of the store fins are not to restrict the performance of the carrying aircraft they must be capable of withstanding the highest loads encountered for all flight maneuvers and conditions.

3.1.2.1 Pylon Mounted Store - The wind tunnel coefficient data indicate that the maximum store fin loading will be obtained when the aircraft obtains maximum values of angle of attack (α_F) and sideslip (β) simultaneously. Various normal flight maneuvering conditions were investigated where the airplane obtained values of α_F and β simultaneously. The maximum fin loadings occur during the termination of a rolling pull-out at 15000 feet initiated at a value of $n_{z_0} = -0.87$ g's. Values of instantaneous maximum normal acceleration, (n_{z_i}) and corresponding side-slip angles (β) for the airplane performing this maneuver are presented as a function of Mach number in figures 3.11 and 3.12. The fin loadings and root bending moments obtained for this condition are shown in figures 3.13 and 3.14. The design store fin loading was determined from these data to be 415 lb/ft^2 with a corresponding value of fin root bending moment of 150 lb-ft/ft^2 based on the exposed area of the fin.

Using conditions that exceed the normal operation of the F8U-1 airplane but not the structural limits, the maximum fin

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loads that could be obtained were also evaluated. These conditions assume that limit angles of α_F and β are attained simultaneously. The maximum value of angle of attack that the airplane can obtain at high values of dynamic pressure is a function of its design limit load factor.(1) The values of angle of attack corresponding to the limit load factor for the F8U-1 are shown in figure 3.15. The design limit load factor used to calculate these data is 5.5 "g's" which is less than that of the basic airplane. The reduction was necessary to account for the increase in combat weight due to the store and additional equipment carried by the F8U-1 airplane used for the Sandia External Store Study. The approximate allowable side-slip angles (β) for the F8U-1 airplane are presented in figure 3.16. These data are based on 100% limit load on the vertical tail. The results are presented in figures 3.13 and 3.14 for three altitudes: Sea Level, 15000 feet, and 30000 feet as a function of Mach number. The maximum loadings occur at 15,000 feet at the high values of Mach number.

3.1.2.2 Cavity Mounted Store - The maximum store fin loading that will be obtained with the store mounted in the cavity will occur when the airplane is side-slipped at its maximum allowable β at a positive angle of attack.

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(1) Conditions not limited by maximum Lift.

In the absence of maneuvering data for the V-395 airplane(2) the design flight condition for the store fin was assumed to occur at the maximum side-slip. The conditions for maximum side-slip of the V-395 proposed design are assumed for this study to be the same as those of the F8U-1 airplane, since the airplanes are very similar in performance and configuration. The fin loadings for the fin in the folded and extended position are presented in figures 3.17 and 3.18. The corresponding fin root bending moments are presented in figures 3.19 and 3.20. The fin in the extended position has a design fin loading of 560 lb/ft.^{2}, and a corresponding bending moment of 240 lb.-ft./ft^2. The fin in the folded positions has a design loading of 280 lb/ft.^{2} and a corresponding fin root bending moment of 120 lb.-ft./ft.^{2}. These loadings are based on the exposed fin areas.

3.1.3 Conclusions - The maximum fin loading and bending moments occurred on the bottom fin in the extended position when the store was mounted in the fuselage cavity of the V-395 proposed design: 560 lb./ft.^{2} and a corresponding fin root bending moment of 240 lb-ft/ft.^{2}. However, this maximum loading loses its importance if the bottom fin is actuated to the open position upon release of the store since the maximum fin loading obtained with the fin folded is 280 lb/ft.^{2} with

(2) This information is not available since the V-395 is still in the proposal stage.

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a corresponding fin root bending moment of 120 lb-ft/ft.^{2}. The maximum fin loading would then be encountered with the store pylon mounted on the left wing of the F8U-1 airplane. This maximum loading occurs of the lower outboard fin; 415 lb./ft.^{2} with a corresponding fin root bending moment of 150 lb./ft^2 based on the exposed fin area.

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SANDIA CRITICAL STORE STUDY — Figure No. 3.1

VARIATION OF FIN NORMAL FORCE COEFFICIENT WITH AIRPLANE ANGLE OF ATTACK

STORE PYLON MOUNTED

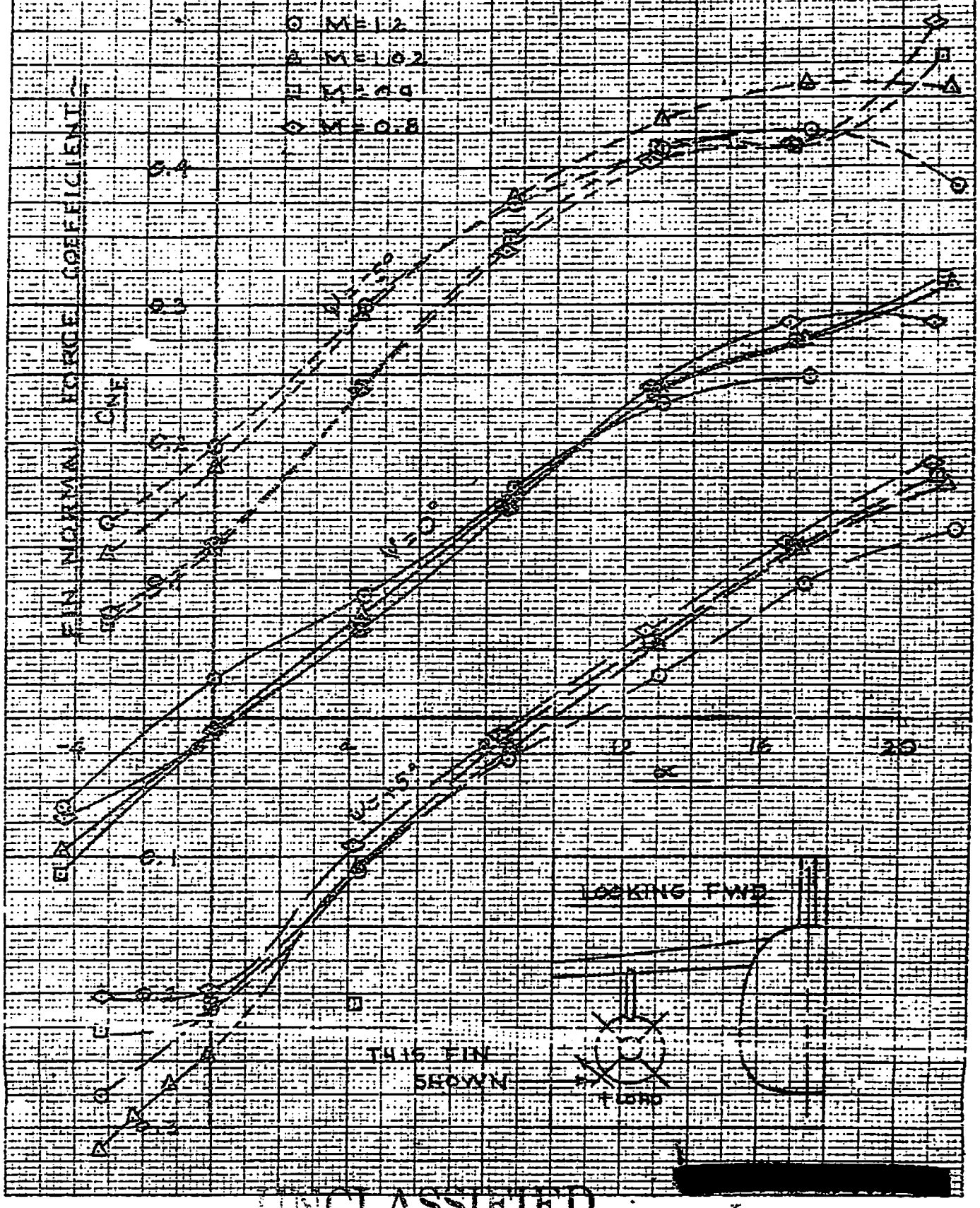
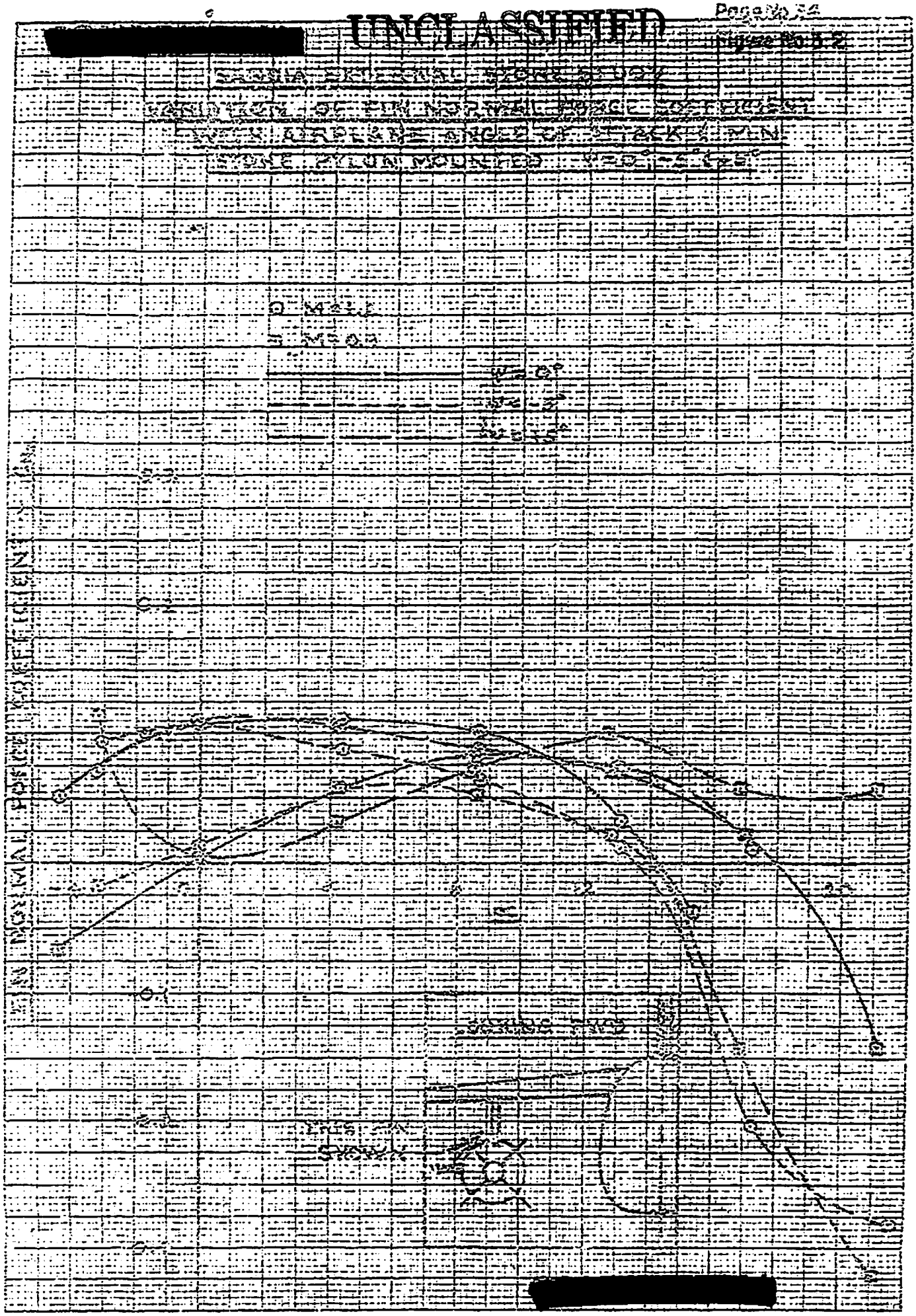


Figure No. 5.2

SIERRA INTERNAL STORE LOAD
VARIATION OF FIN NORMAL FORCE COEFFICIENT
WITH AIRPLANE ANGLE OF ATTACK, MN
STORE PYLON MOUNTED



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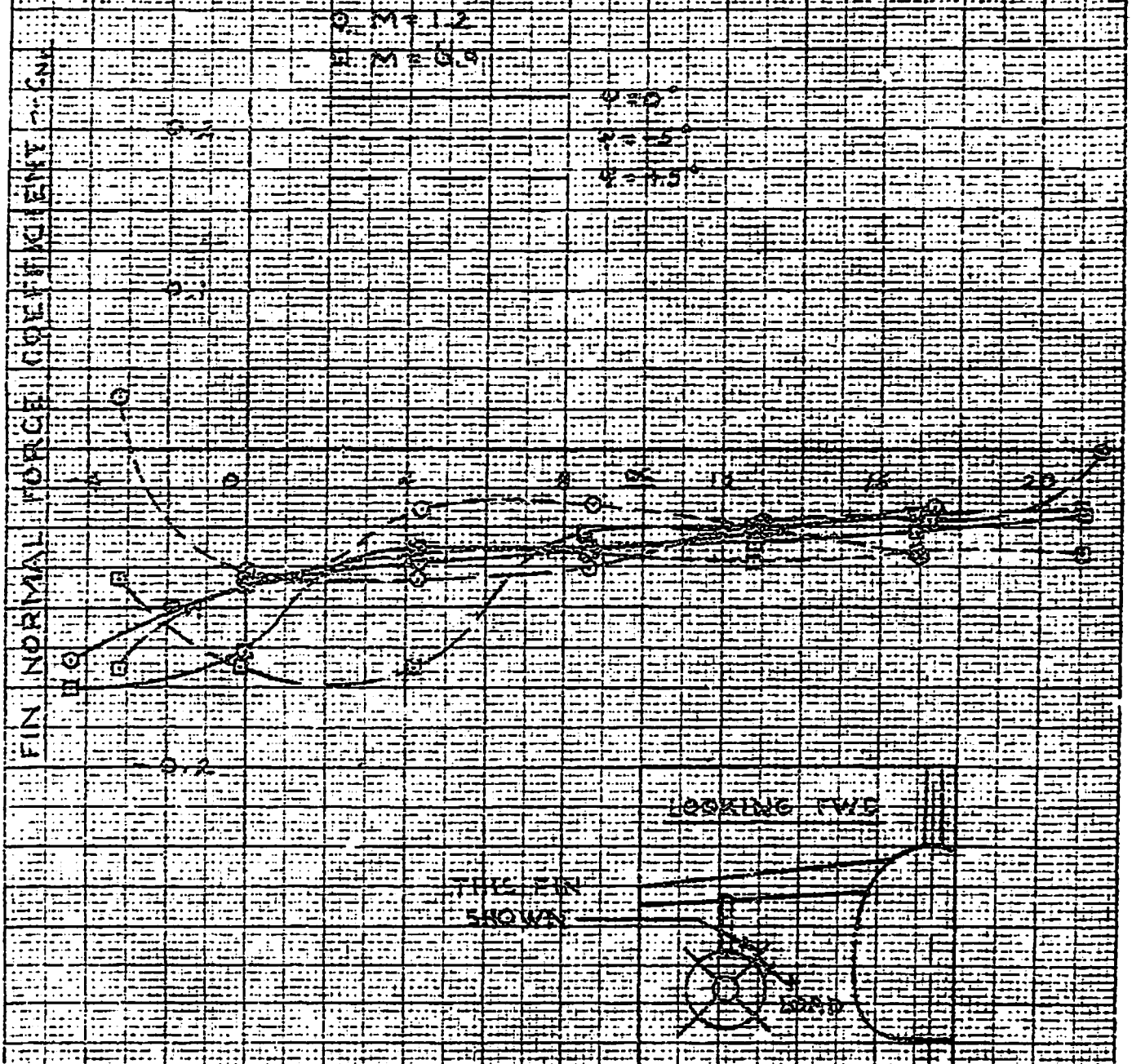
SANDIA EXTERNAL STORE SERIES
VARIATION OF FIN NORMAL FORCE COEFFICIENT
WITH AIRPLANE ANGLE OF ATTACK & M.N.
STORE PYLON MOUNTED W-D-5,245



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SANDIA EXTERNAL STORE STUDY
VARIATION OF FIN NORMAL FORCE COEFFICIENT
WITH AIRPLANE ANGLE OF ATTACK & MN
STORE PYLON MOUNTED $\psi = 0°, 5°, 15°$

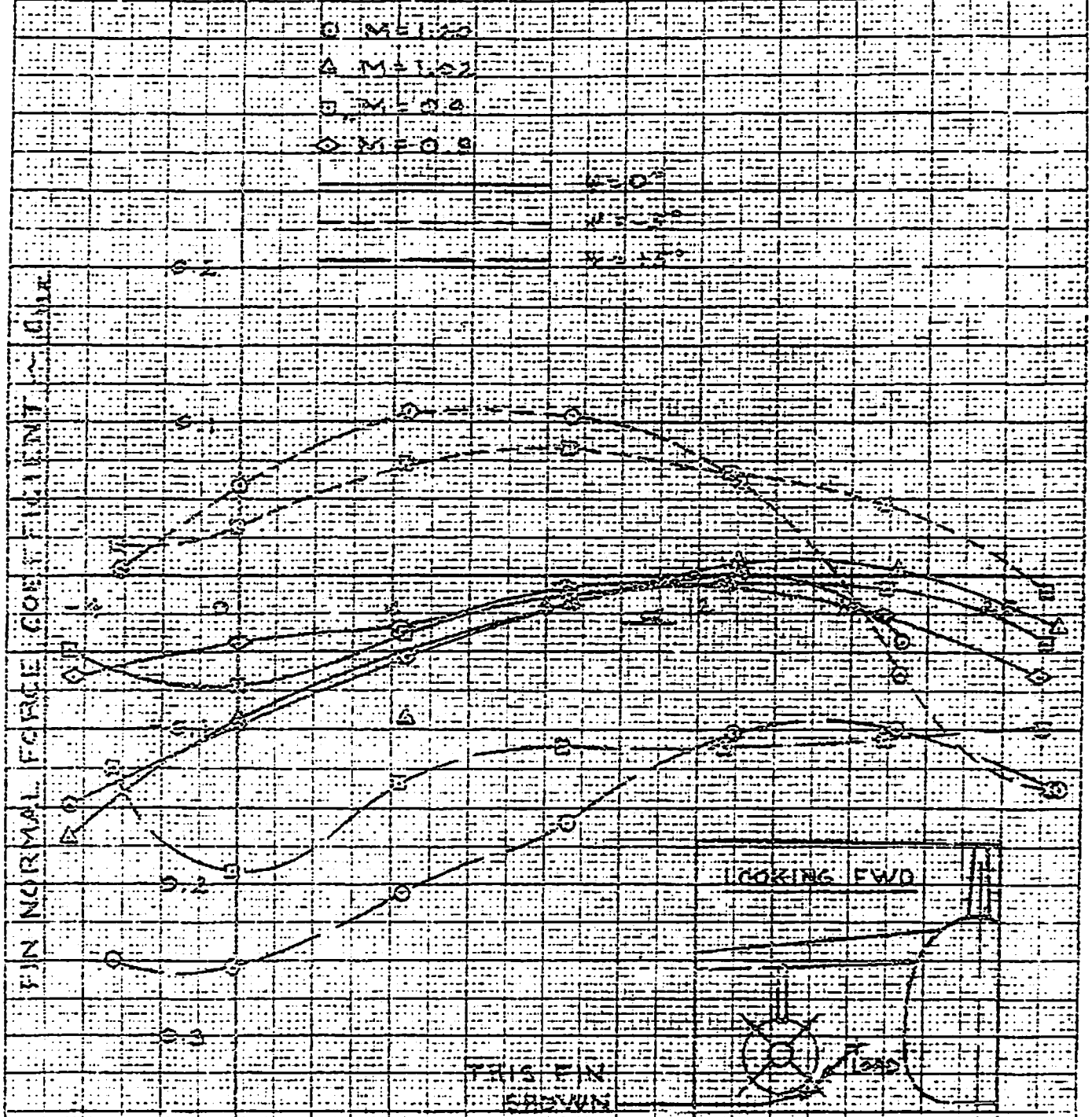

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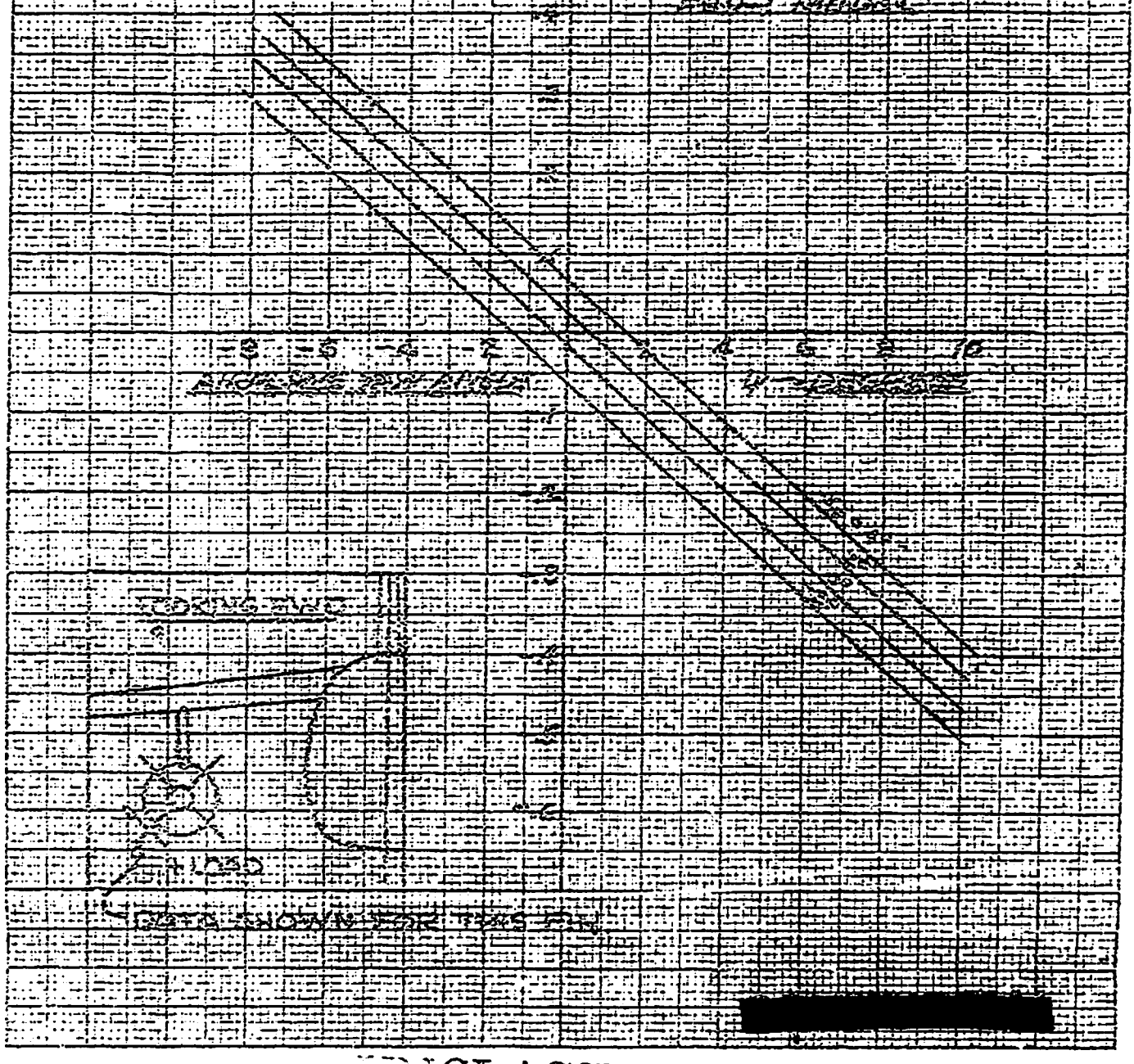
FIGURE 3

AMOUNT OF FIN NORMAL FORCE COEFFICIENT C_{N_δ} WITH AIRFOIL VARIANCE ν AT CONSTANT VALUES OF RIGHT-HANDED C_{N_δ}

DATA OBTAINED FROM WIND TUNNEL TESTS OF FINS ON SOLID FIN STICK NONSYMMETRICALLY MOUNTED ON 1.5" WING PIECE OF FIN RADIUS



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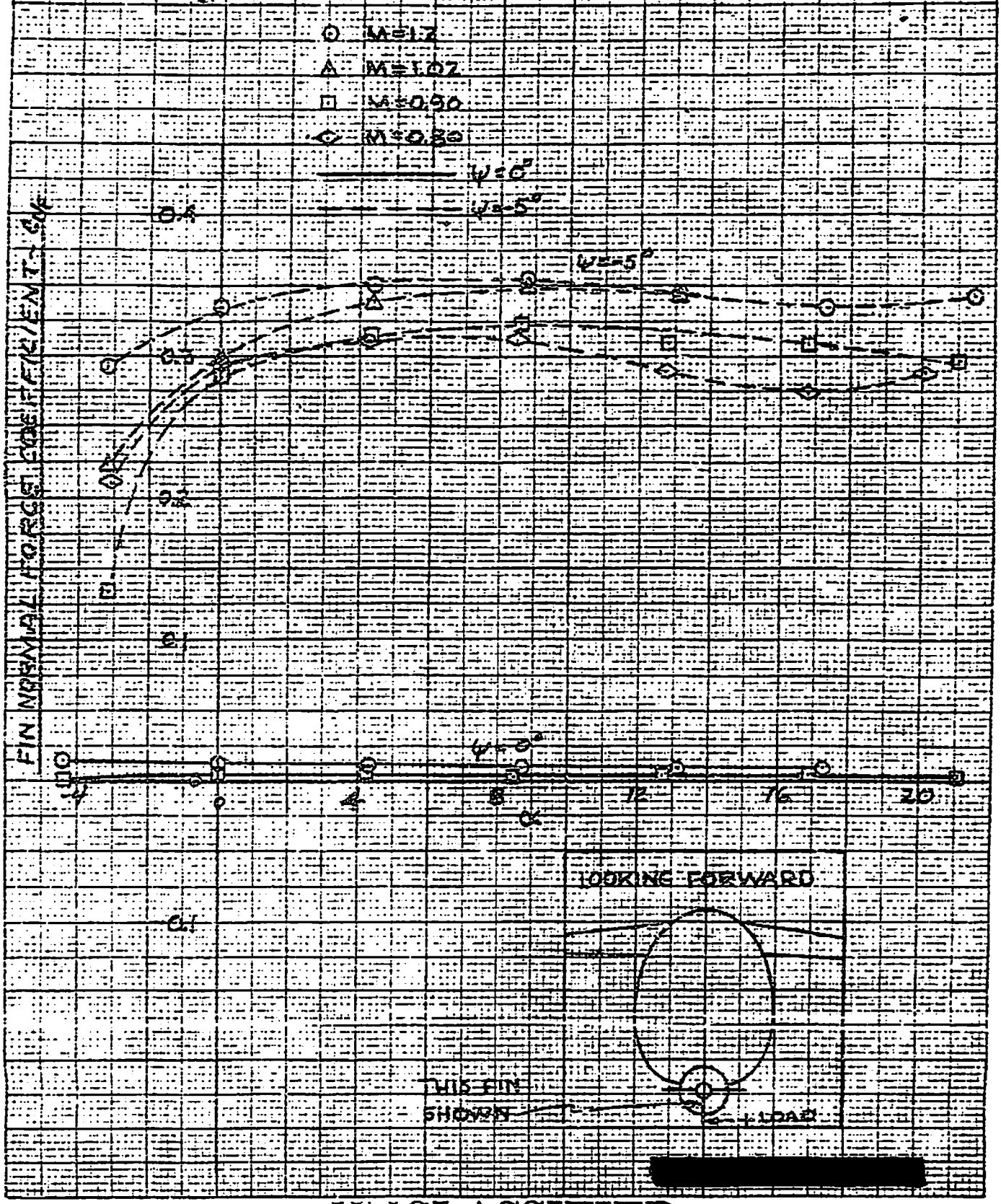
SANDIA EXTERNAL STORE STUDY
VARIATION OF FIN NORMAL FORCE COEFFICIENT
WITH AIRPLANE ANGLE OF ATTACK & M.N.
STORE CAVITY MOUNTED $\psi = 0°, -5°, +5°$



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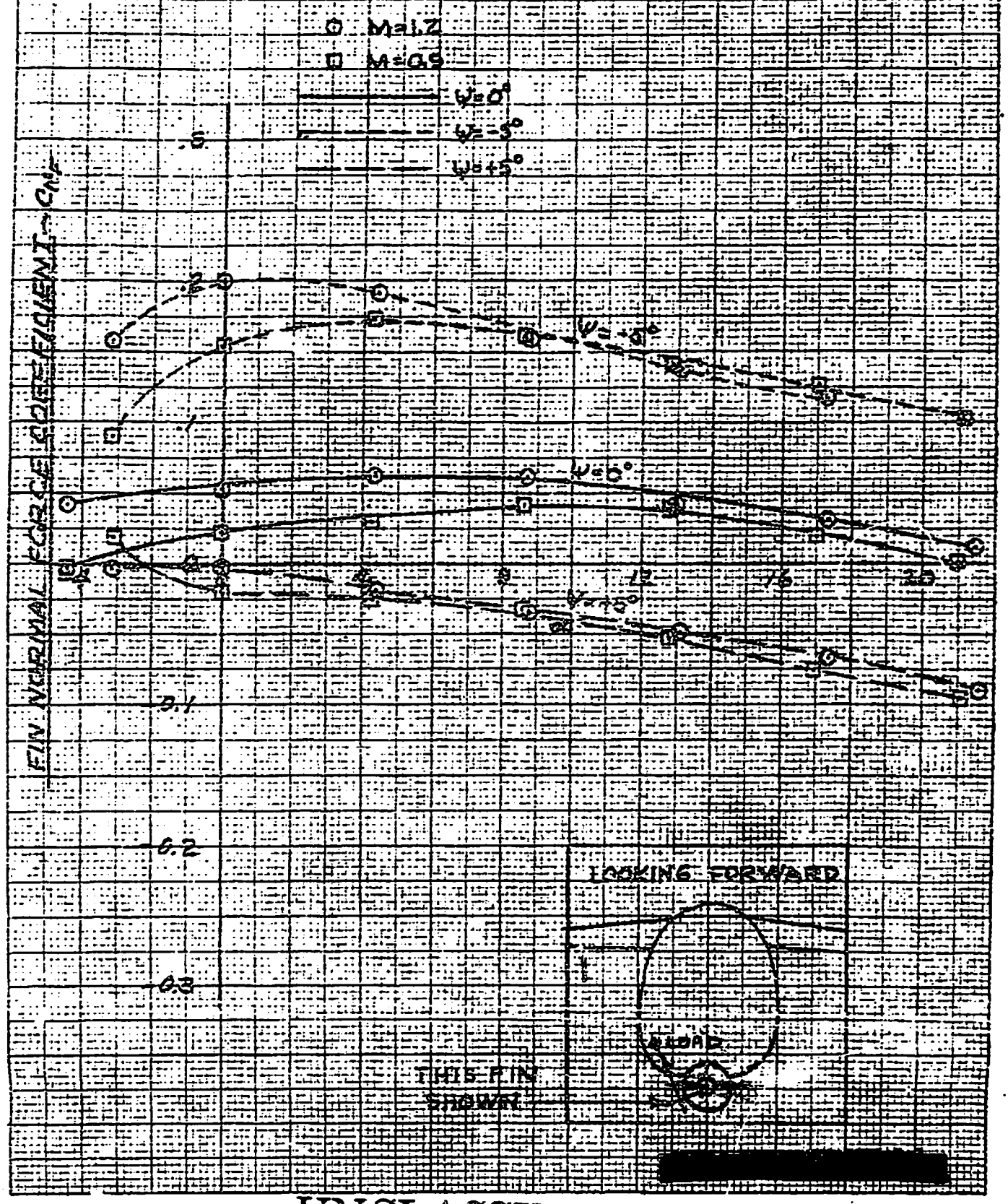
SANDIA EXTERNAL STORE STUDY
VARIATION OF FIN NORMAL FORCE COEFFICIENT
WITH AIRPLANE ANGLE OF ATTACK & M.N.
STORE CAVITY MOUNTED $\psi = -5°, 0°, \& +5°$



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SANDIA EXTERNAL STORE STUDY

VARIATION OF FIN NORMAL FORCE COEFFICIENT WITH AIRPLANE ANGLE OF ATTACK & MN

STORE CAVITY MOUNTED $\frac{1}{4}$ $\frac{W}{D}$ = 5

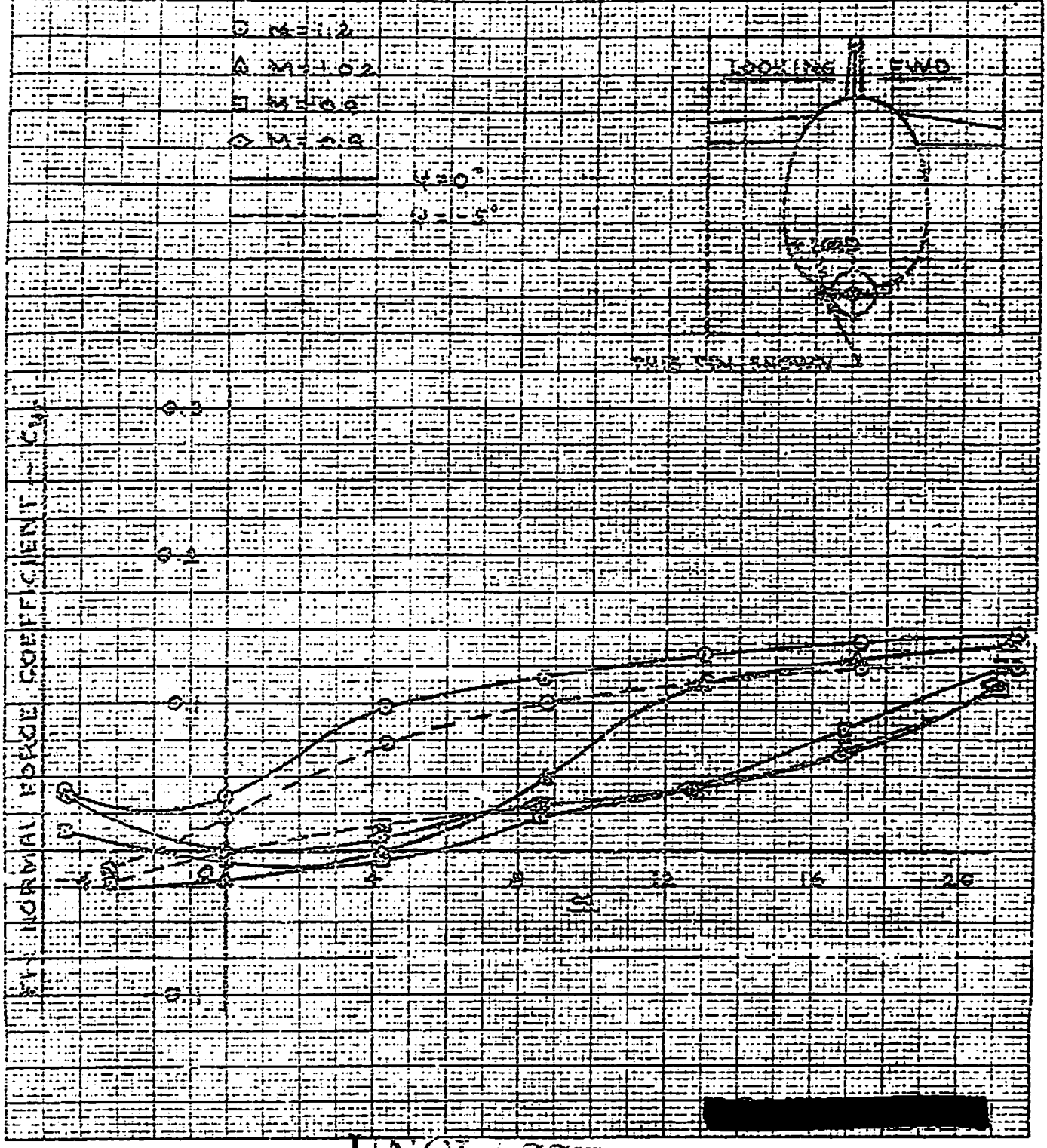

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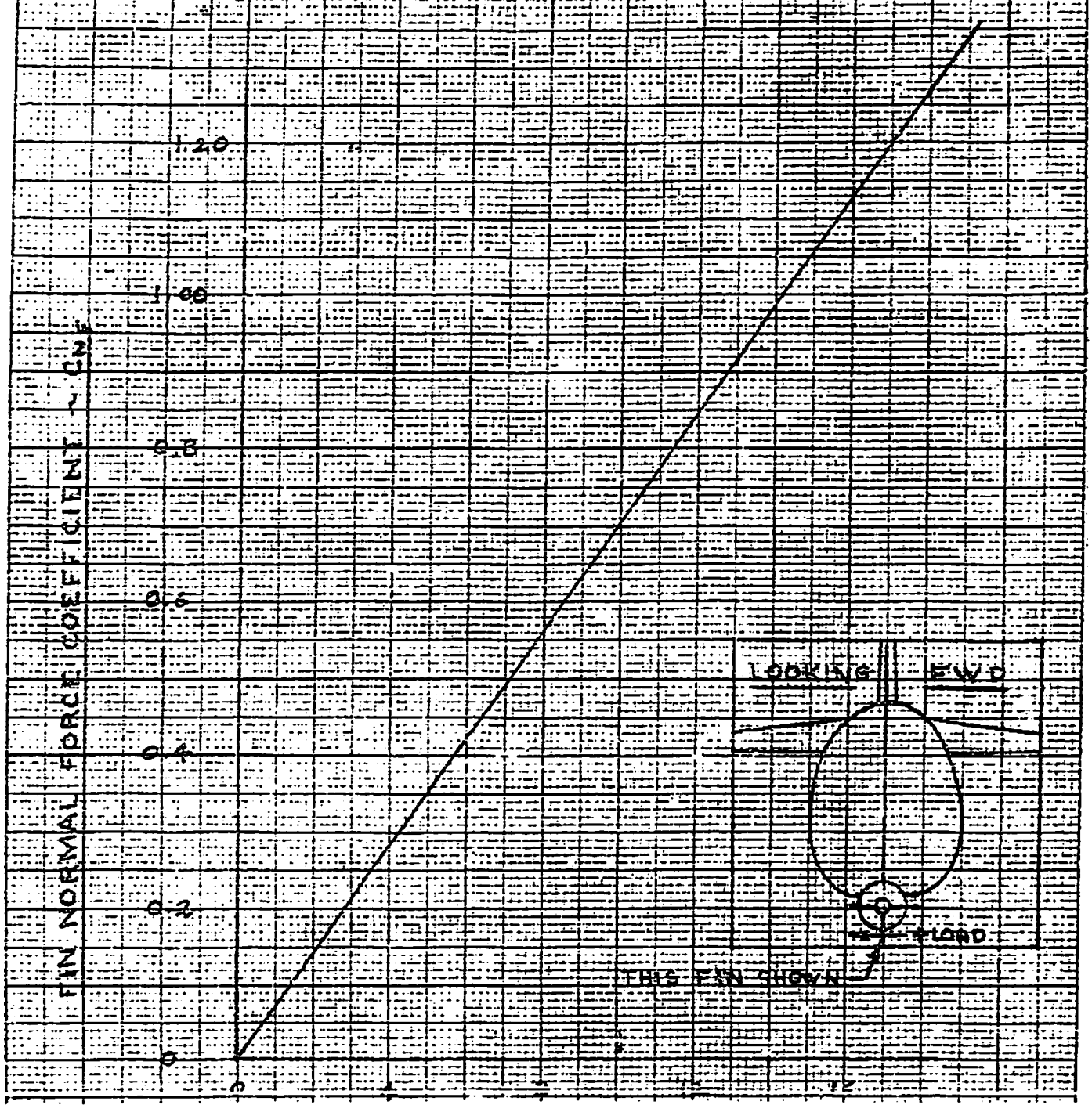
Figure No 36

SANDIA EXTERNAL STORE STUDY

VARIATION OF FIN NORMAL FORCE COEFFICIENT WITH AIRPLANE YAW - STORE CAVITY MOUNTED



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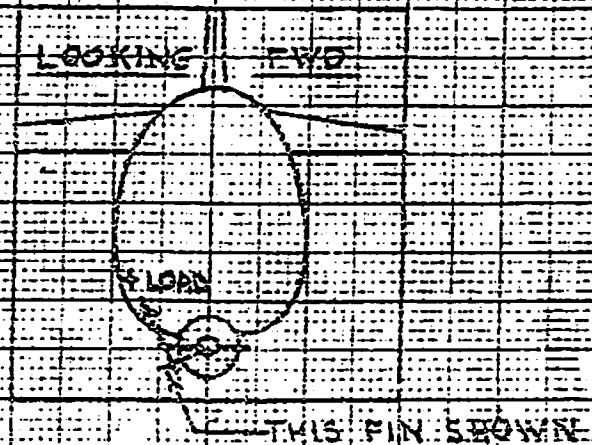
SZIGNA EXTERNAL STORE STUDY

VARIATION OF FIN NORMAL FORCE COEFFICIENT WITH AIRPLANE YAW ~ STORE GRAVITY MOUNTED



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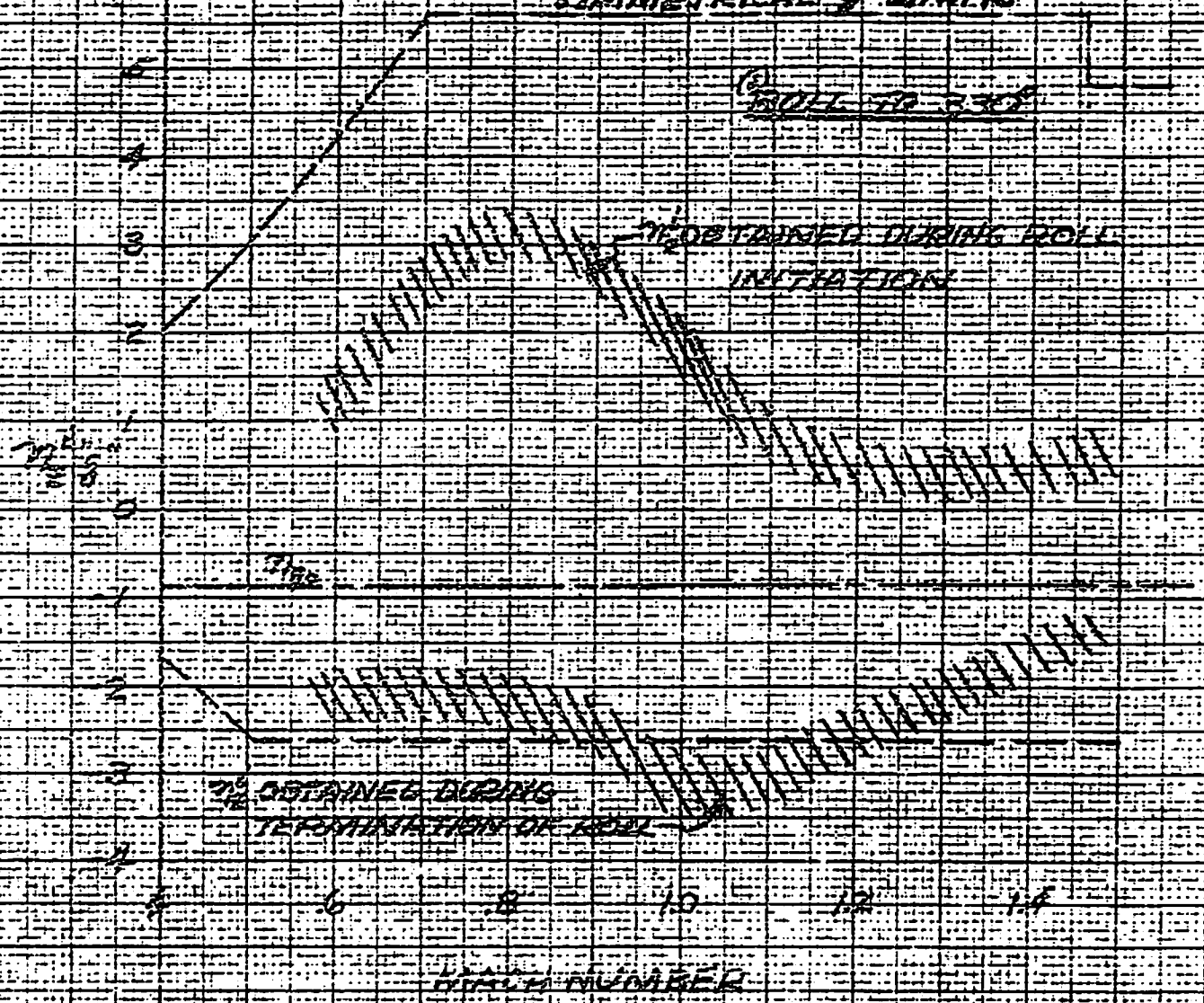
SANDIA EXTERNAL STORE STUDY
F8U-1 AIRPLANE - PULLING PULL OUT MANEUVER
$M_0 = .85$
INSTANTANEOUS NORMAL "g" LOAD
WITH MEASURED AVAILABLE ΔC_L FROM
$M_0 = .85$
WITH DAMPER
MODEL DATA CORRECTED FROM BASIC F8U-1 TO F8U-1
CONFIGURATION WITH STORE ON AT CONTRACT
WEIGHT USED FOR SANDIA STUDY



MANEUVER IN & OUT $N \geq 3.5^g$ TO STOP AT 330°

[redacted]

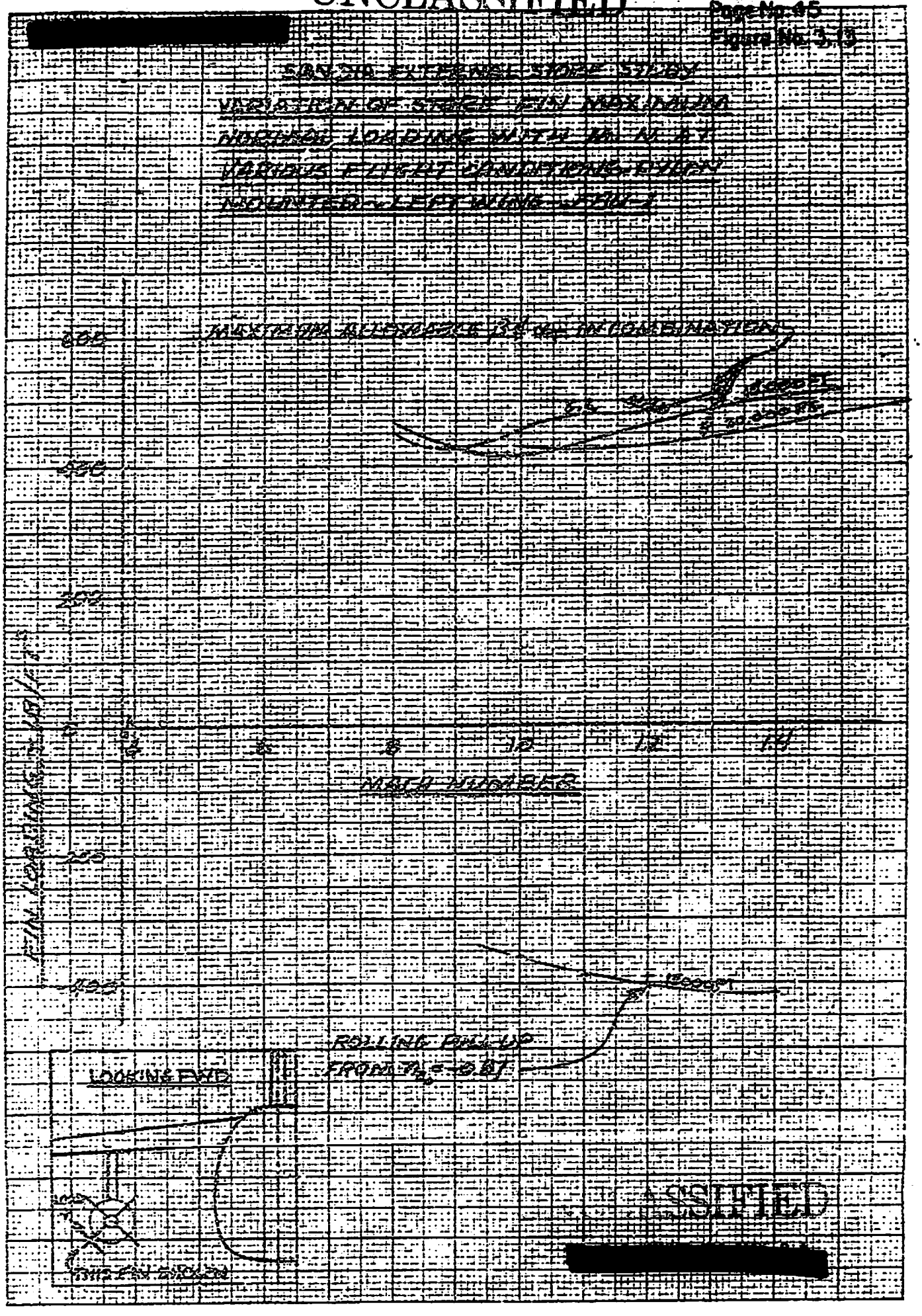
[redacted]

[redacted]

[redacted]

[redacted]

[redacted]



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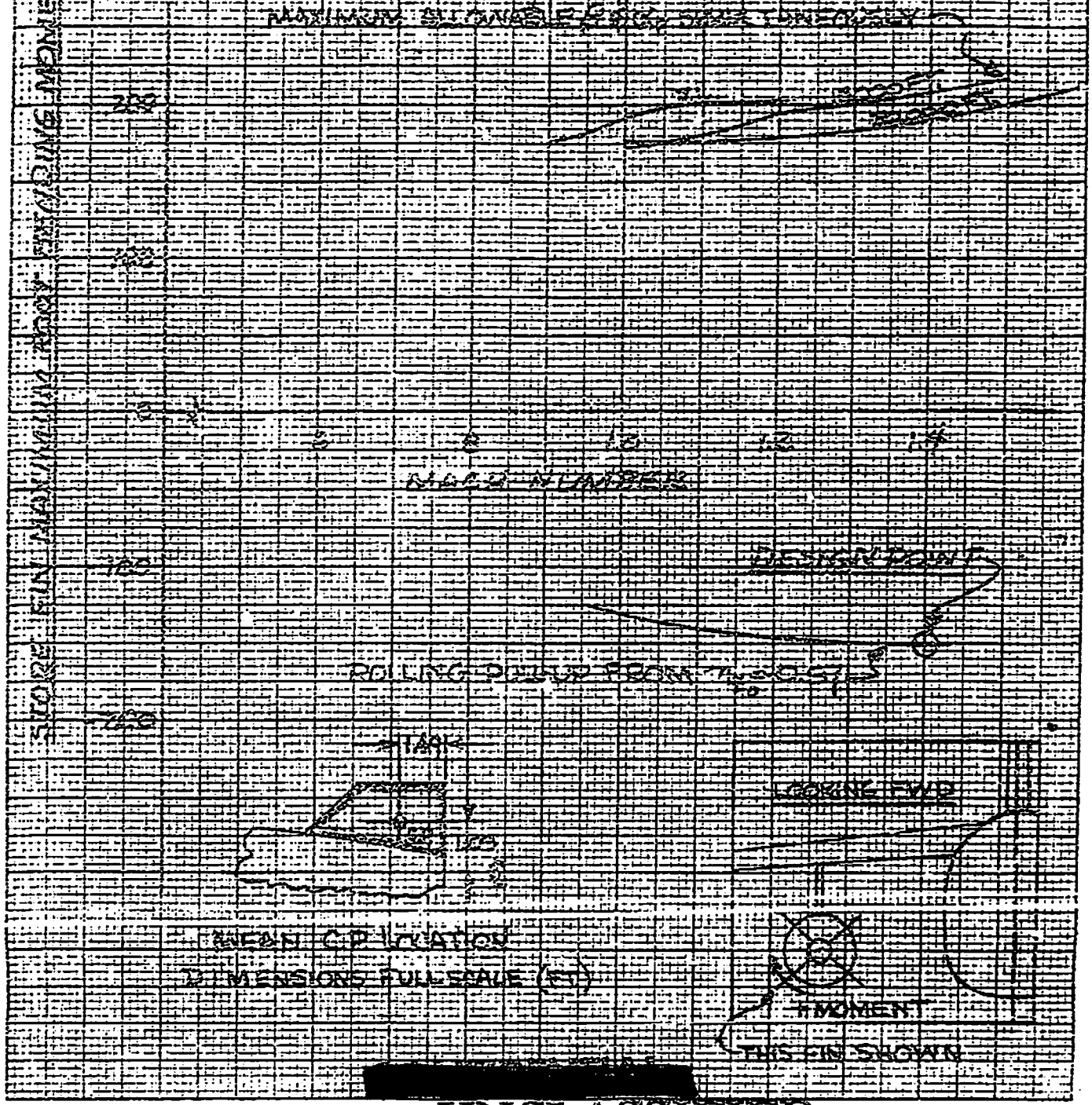
SANDIA EXTERNAL STORE STUDY

VARIATION OF WING ROOT BENDING MOMENT WITH MACH NO.

AT VARIOUS FLIGHT CONDITIONS - PYLON MOUNTED

STORE - LIFT WING - FRU



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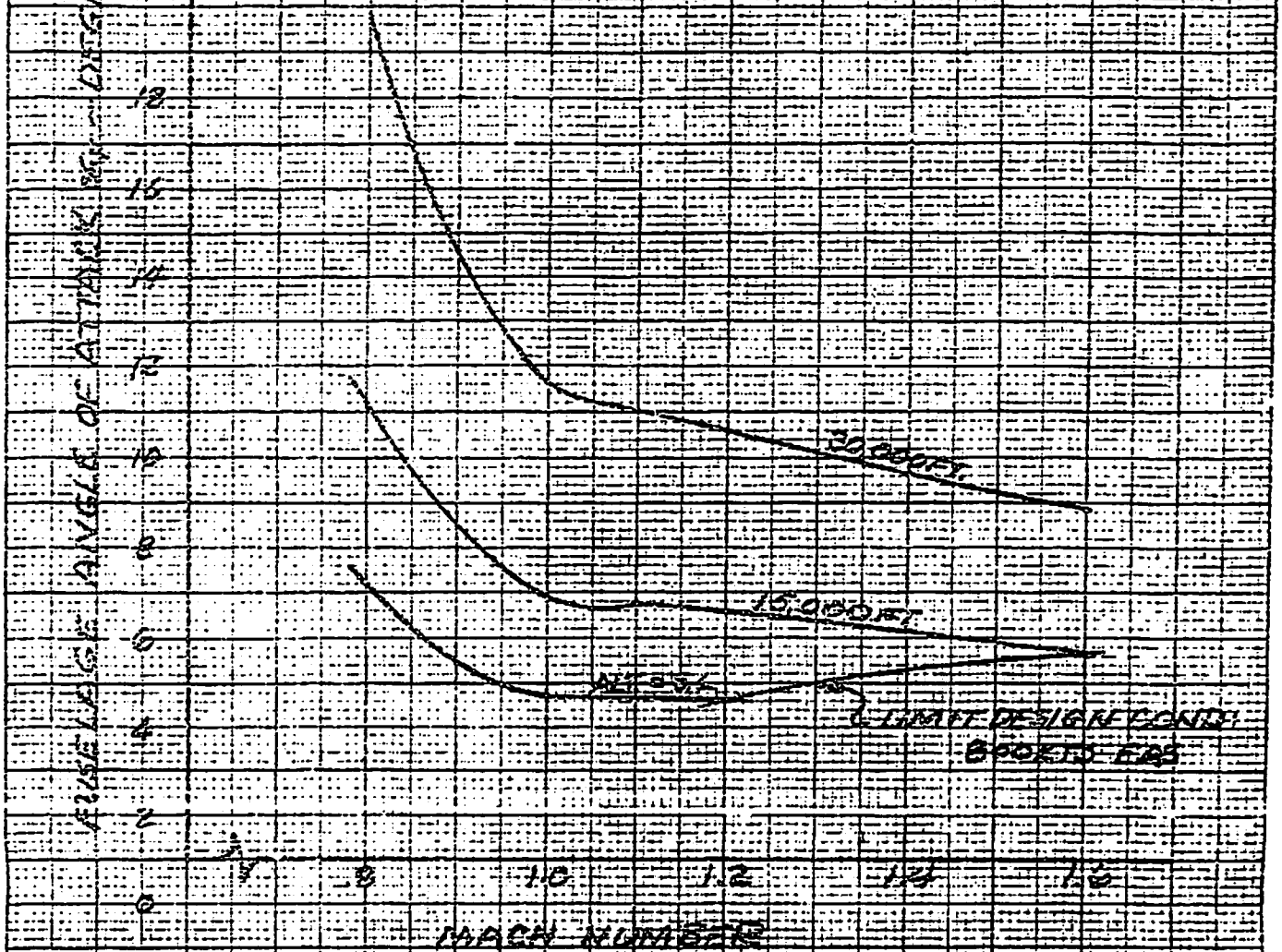
SANDIA EXTERNAL STORE STUDY

F2U-1 AIRPLANE

MAXIMUM ANGLE OF ATTACK

AT COMBAT WEIGHT - STORE ON -

AND MAXIMUM "g" = 5.5



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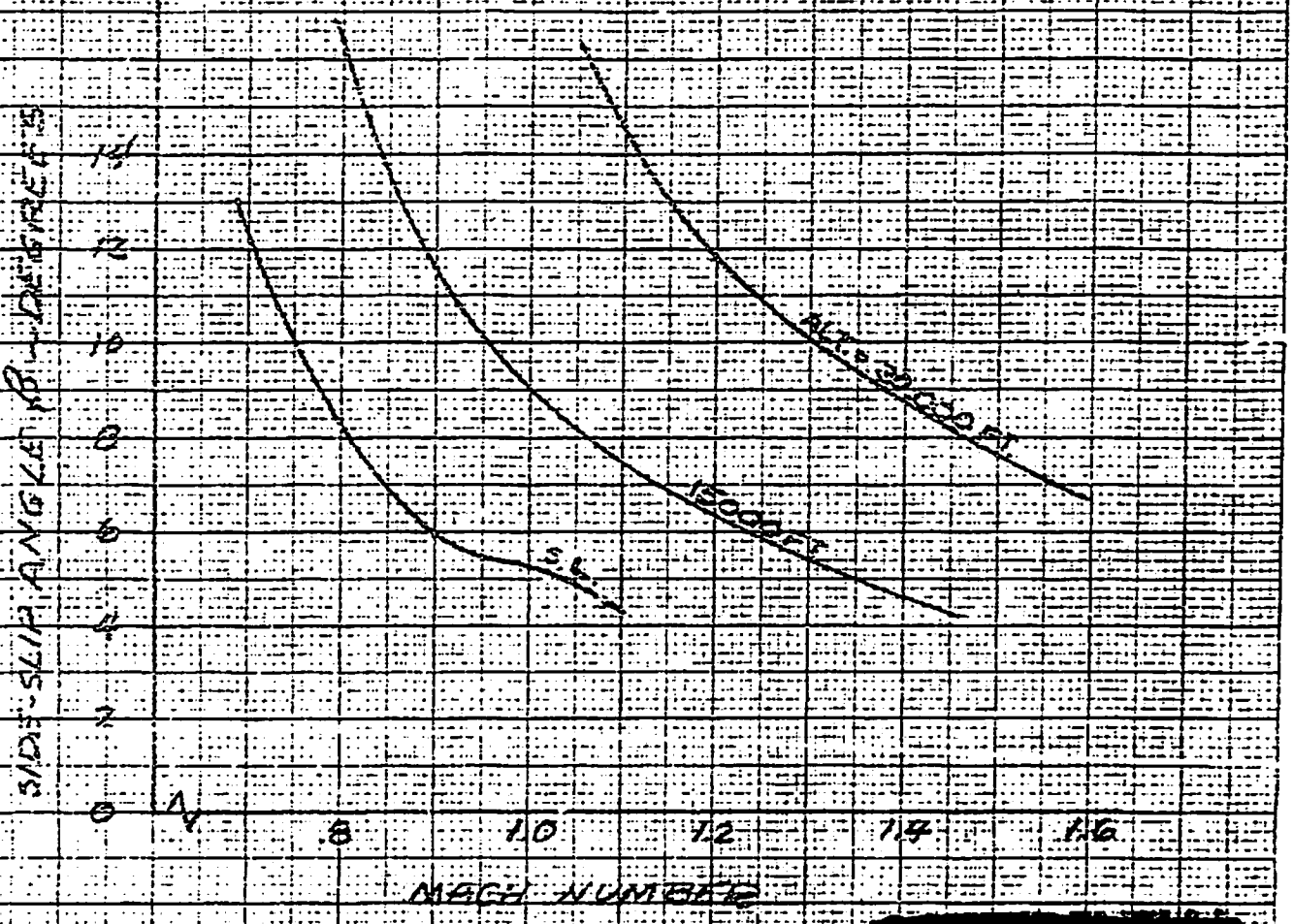
SANDIA EXTERNAL STORE STUDY

F2U-1 AIRPLANE

(APPROXIMATE) ALLOWABLE SIDE-SLIP ANGLE β

BASED UPON 100% LIMIT LOAD ON VERTICAL TAIL



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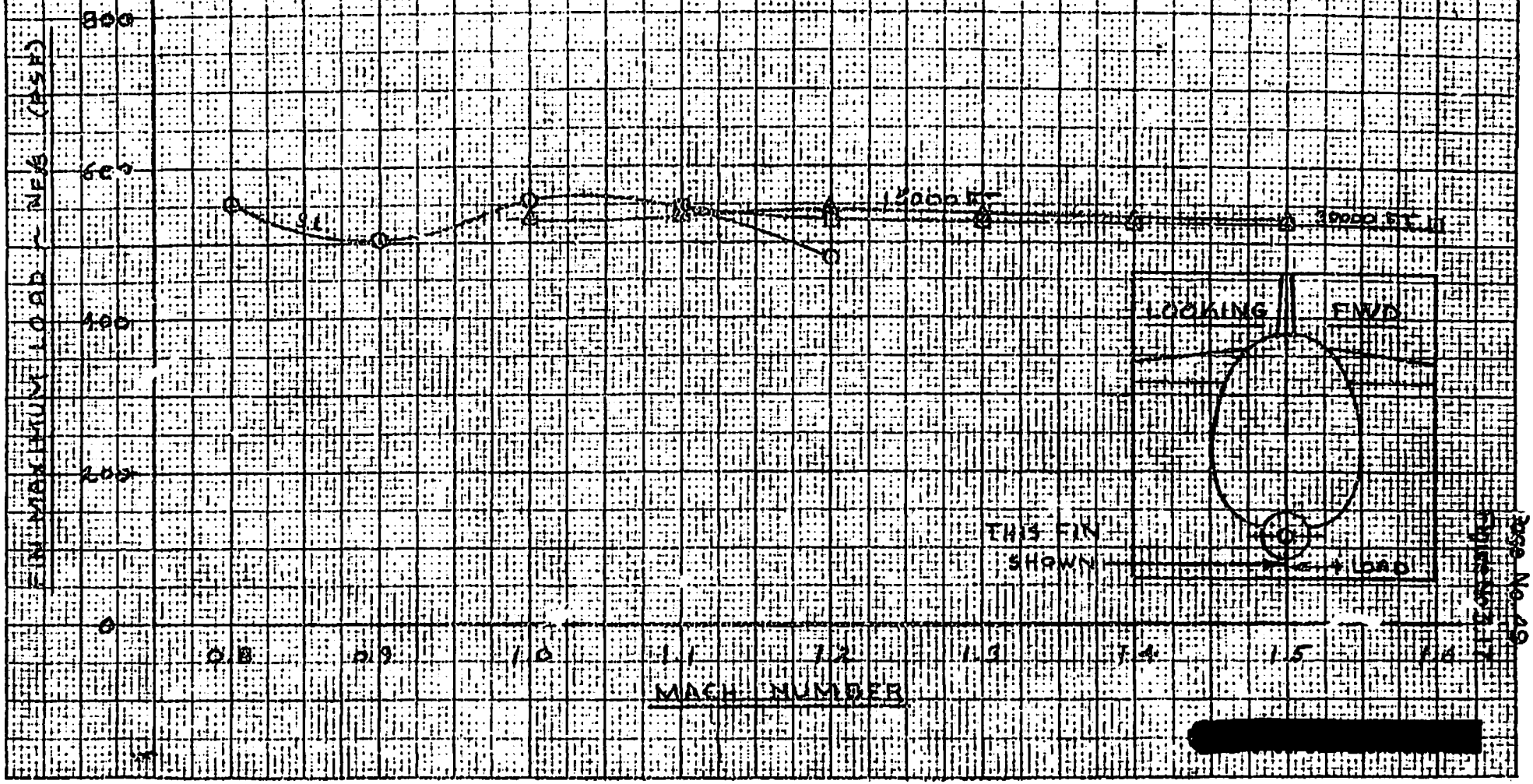
SANDIA EXTERNAL STORE STUDY

VARIATION OF FIN MAXIMUM NORMAL LOAD WITH M.N. & ALT.
BASED ON F8U-1 ALLOWABLE SIDESLIP ANGLE β
@ COMBAT WEIGHT & E.S.2 – CAVITY MOUNTED STORE



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Report No. 10064
Page No. 49

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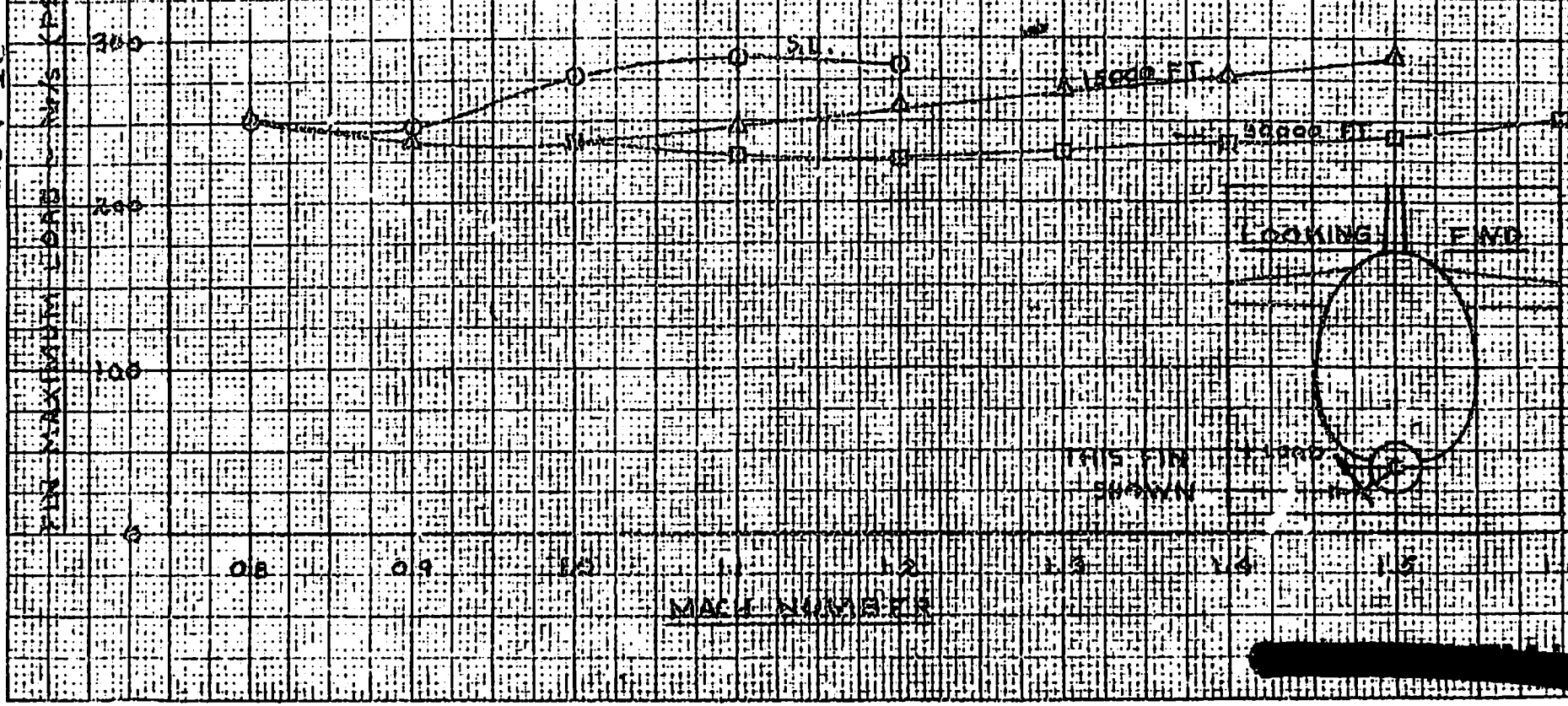
SANDIA EXTERNAL STORE STUDY

VARIATION OF FIN MAXIMUM NORMAL LOAD WITH MACH & ALT.
BASED ON FBU-1 ALLOWABLE SIDESLIP ANGLE β
@ COMBAT WEIGHT & 5.5 S → CAVITY MOUNTED STORE



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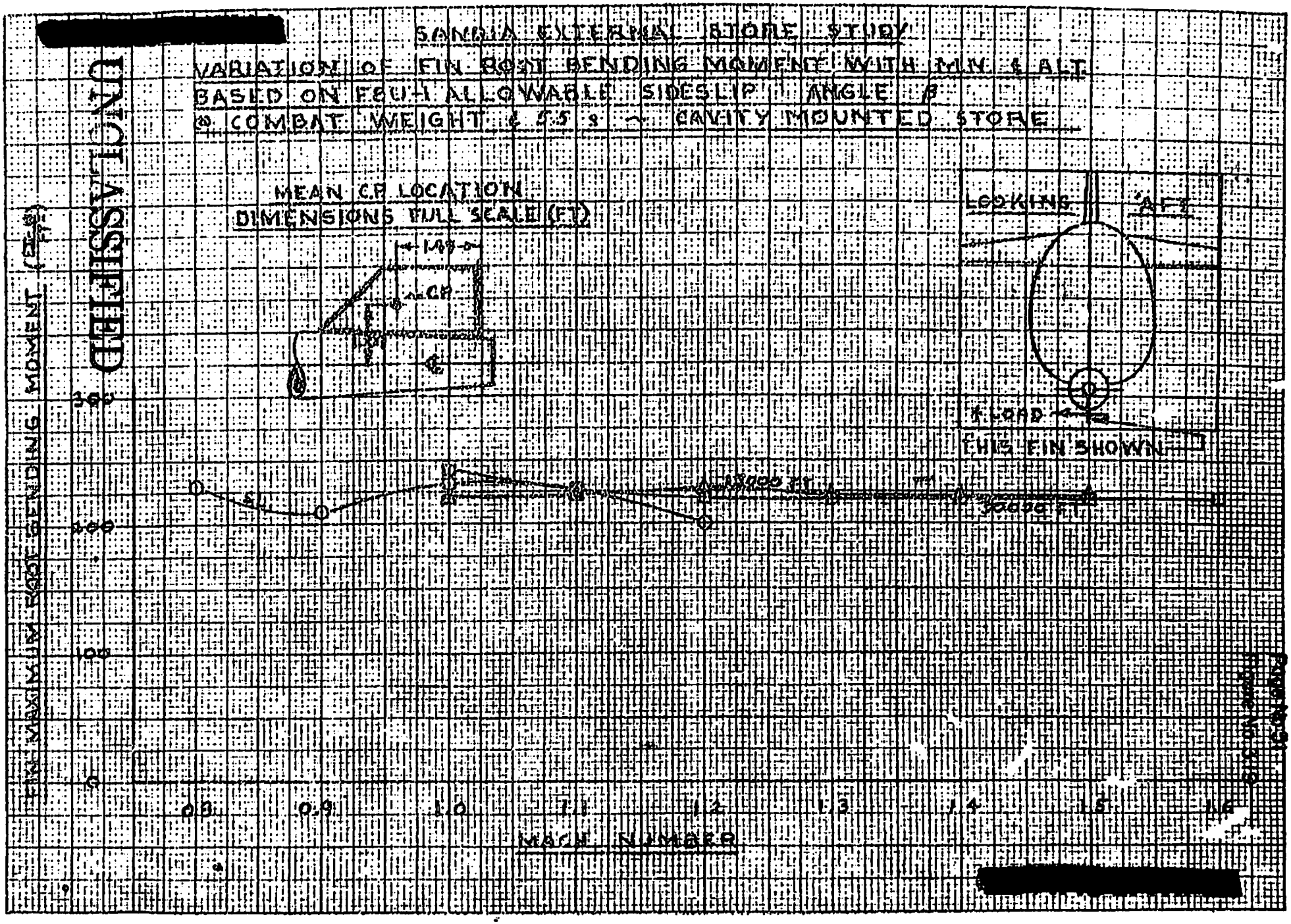
SANDIA EXTERNAL STORE STUDY

VARIATION OF FIN ROOT BENDING MOMENT WITH MN & ALT.
BASED ON FOUR ALLOWABLE SIDESLIP ANGLE β
@ COMBAT WEIGHT & 5.5 s ~ CAVITY MOUNTED STORE



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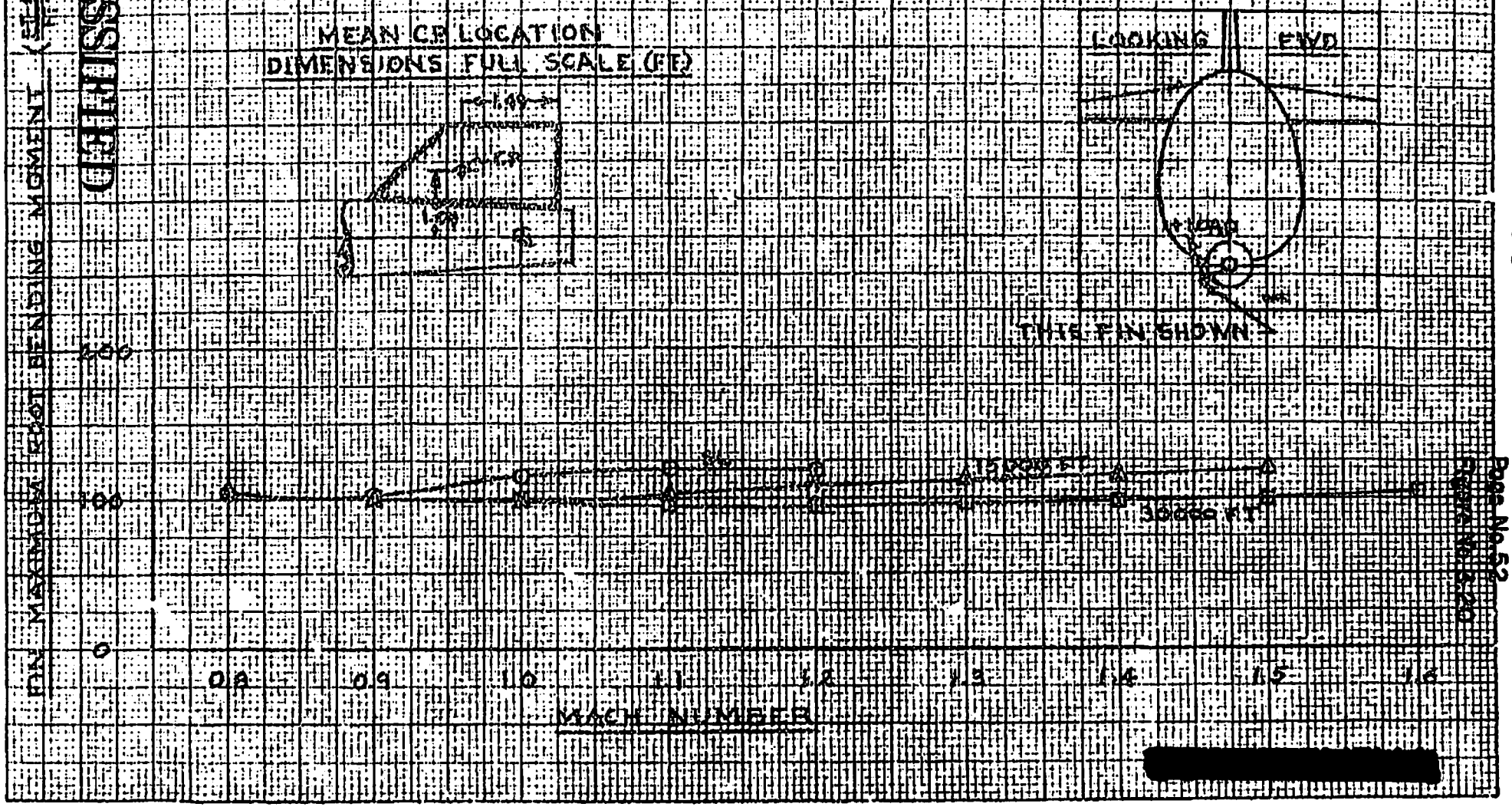
SANDIA EXTERNAL STORE STUDY

VARIATION OF FIN ROOT BENDING MOMENT WITH MN. & ALT.
BASED ON F80-1 ALLOWABLE SIDESLIP ANGLE β
@ COMBAT WEIGHT & 5.3 g — CAVITY MOUNTED STORE



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3.2 Store Pressure Distribution

The information presented in this section was obtained to assist the Sandia Corporation in determining the advisability of basing the structural design of the store on wind tunnel data derived from body-alone tests against changes in design that might be necessitated due to store installation on the airplane. Store body pressure distributions are presented for the TX-28 store pylon mounted on the lift wing of the F8U-1 airplane and semi-submerged in the fuselage cavity of the V-395 proposed design.

These pressure distributions for the store were obtained through high speed wind tunnel tests conducted at the Cornell Aeronautical Laboratory. These tests were made using an 0.042 scale model of the F8U-1 airplane and store. This airplane model was modified for fuselage-cavity installation of the store to obtain the data required for the V-395 airplane. Pressure data were obtained at 21 points on the store at Mach numbers of 0.90 and 1.20 as a function of airplane angle of attack and are presented in Appendix A, Volume II of this report. Data from these tests as obtained from Cornell Aeronautical Laboratory have been analyzed. Summary plots of the information are presented in figures 3.21 through 3.26. Free body pressure data for the TX-28 store obtained from the Sandia Corporation are shown in figures 3.27 and 3.28.

3.2.1 Cavity Installation - The pressure data for the store semi-submerged in the fuselage cavity of the V-395

proposed design are as expected. The pressure distribution acting on the store is essentially the same as for the fuselage of the airplane at the same point. A comparison of the pressure distribution acting over the store with that acting over the fuselage of an NACA tests configuration of a wing-body combination (1) similar to the V-395 is presented in figure 3.29. This plot indicates that the pressure distribution over the store installed in the fuselage cavity could be predicted from the pressure distribution over the airplane's fuselage.

Comparing the pressure data obtained for the store in the cavity with those obtained from the free body tests indicates that the free body pressure data are acceptable for use in store structural design. This statement is made assuming the pressures acting on the store surface inside the airplane are never severe.

3.2.2 Wing-Pylon Installation - The pressure distributions for the store wing-pylon mounted on the F8U-1 airplane are presented in figures 3.21 through 3.24. Analysis of these data indicates that the airloads acting on the store tend to cause the store's forward section to bend down and the aft section to bend up. This is consistant with the force data for the store presented in figure 3.45, which show a nose down pitching moment acting on the store. The variation in

(1) Donald L.Loving and Claude V.Williams "Basic Pressure Measurement on a Fuselage and a 45° sweptback wing-fuselage Combination at Transonic Speeds in the slotted Test section of the Langley 8-ft.High Speed Tunnel"NACA RM L51F05. Sept.14,1951.

pressure distribution acting over the store is due mainly to the store being located in the flow field produced by the wing. Comparison of the pressure data for the store mounted on the wing-pylon with the data from the free body tests indicates that store loadings obtained when the store is mounted on the pylon should be considered in the store structural design. The data presented herein is believed accurate and comprehensive enough for the Sandia Corporation to use in evaluating the loads acting on the store when wing-pylon mounted.

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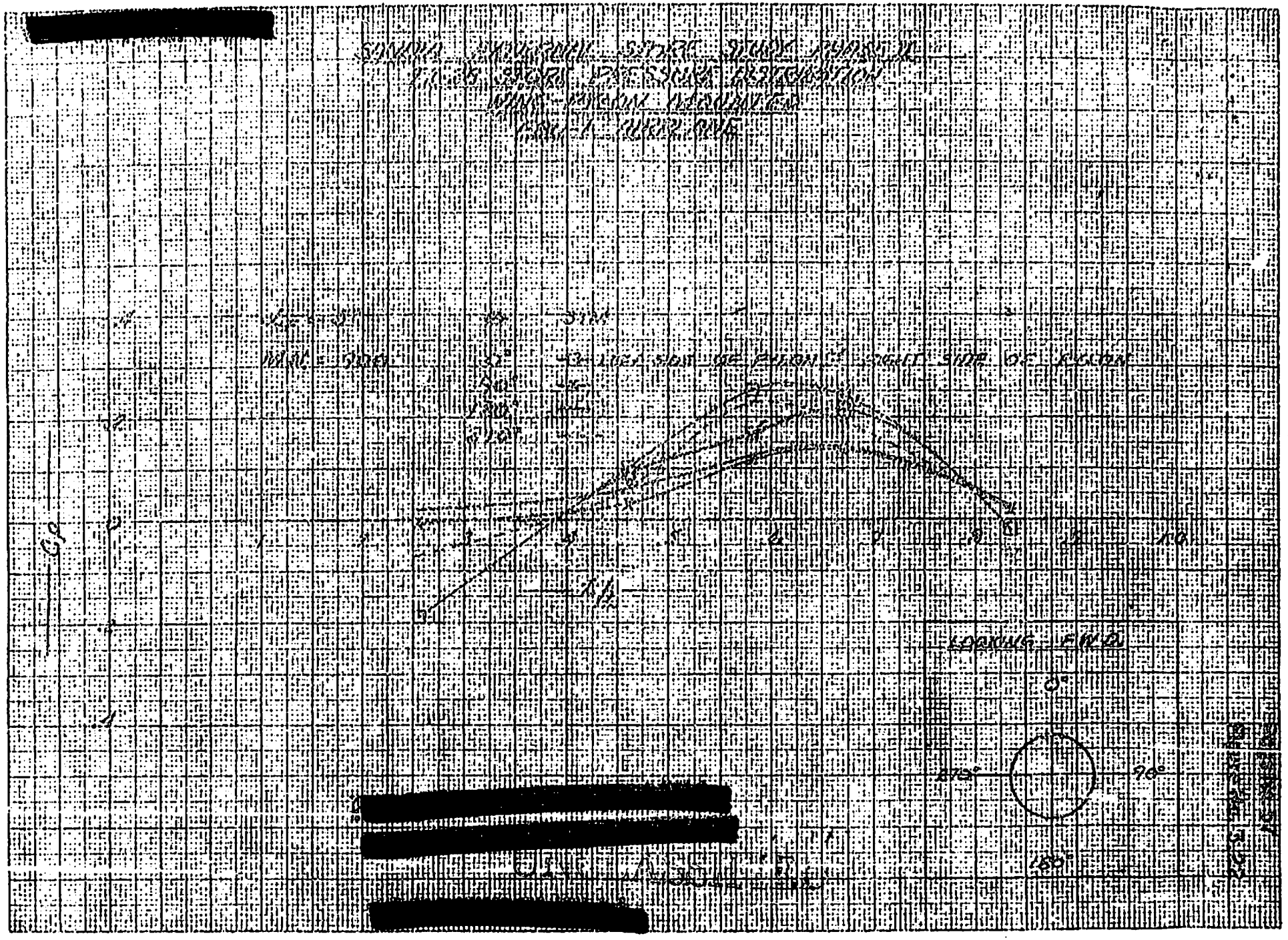

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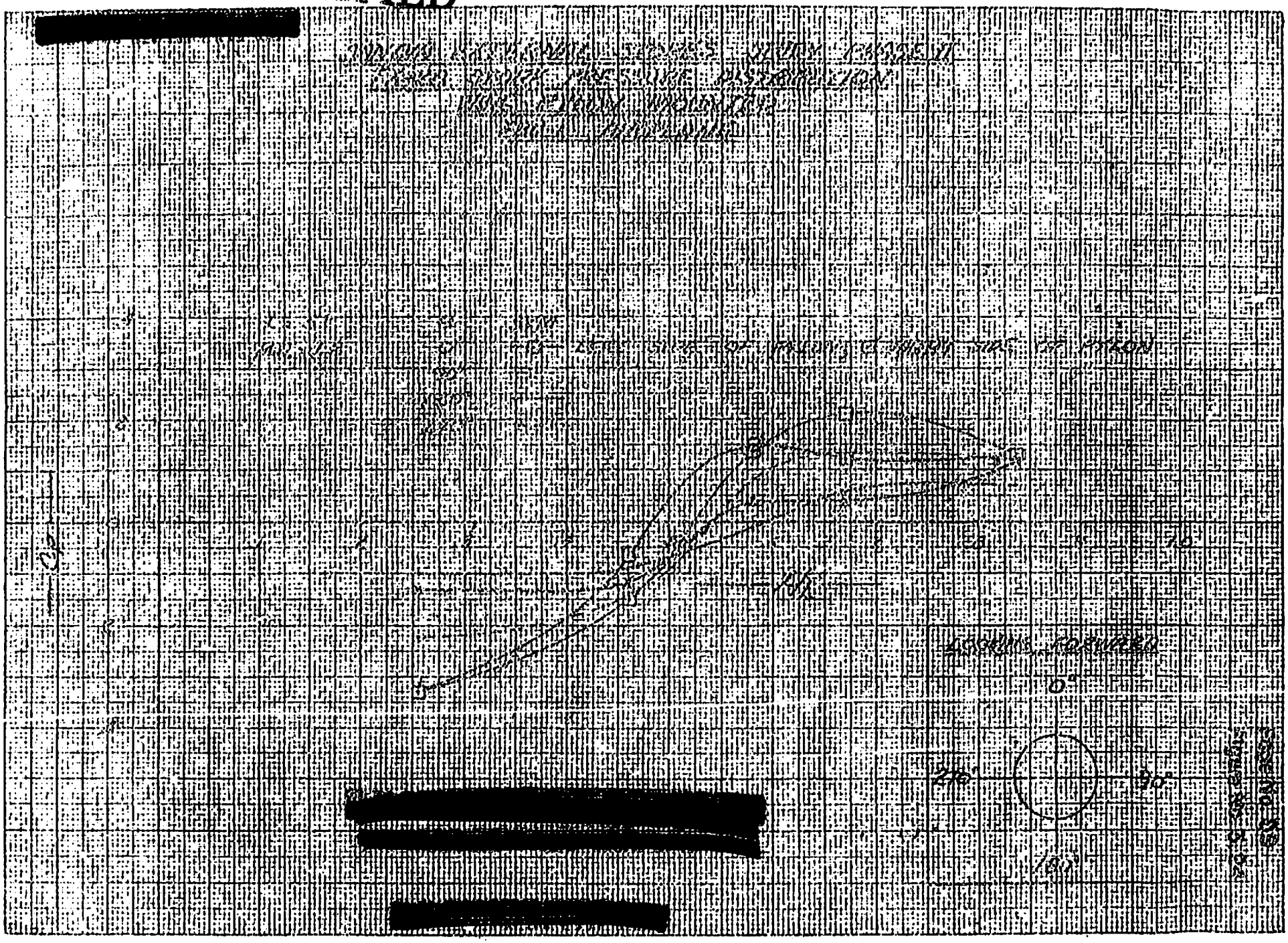

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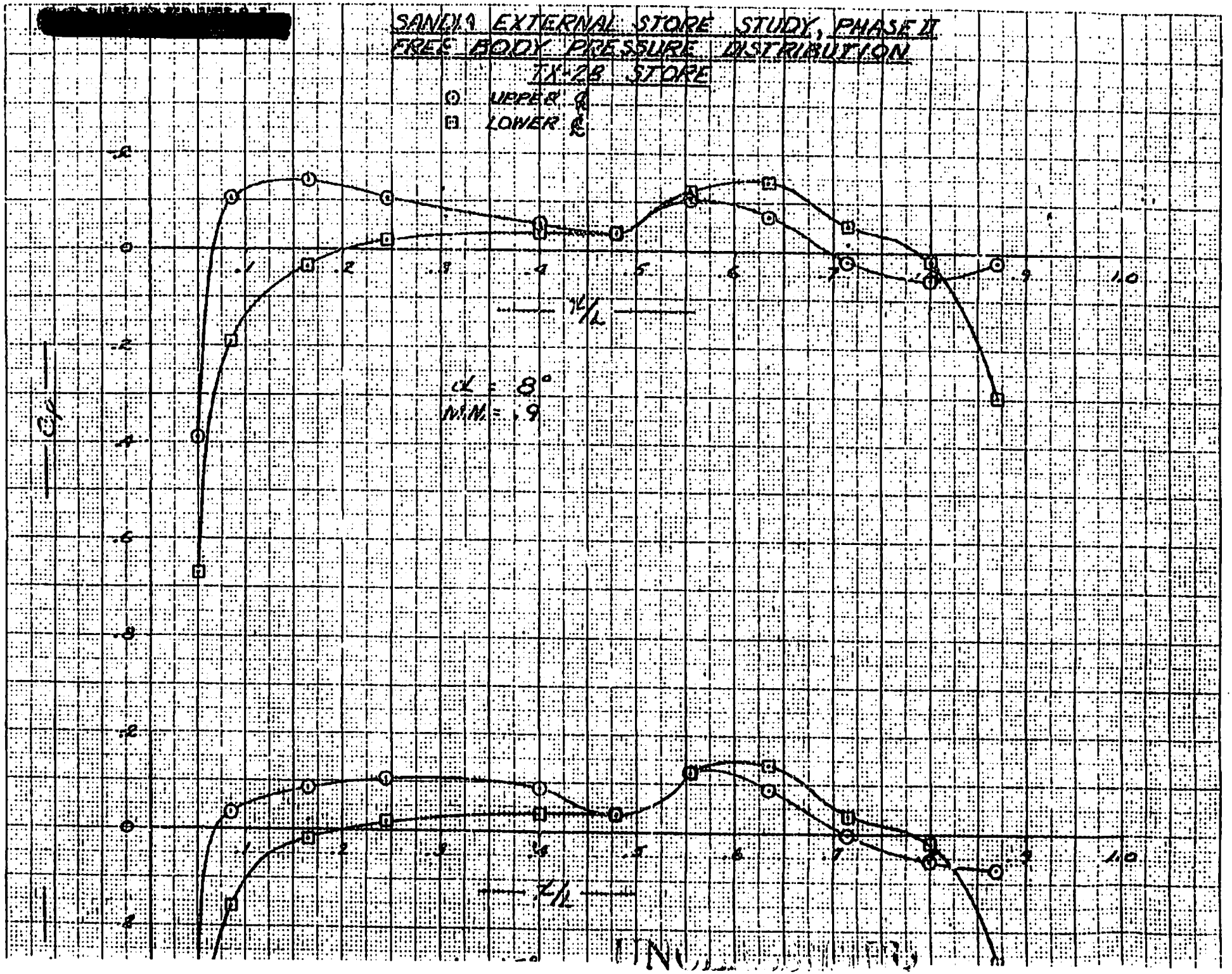
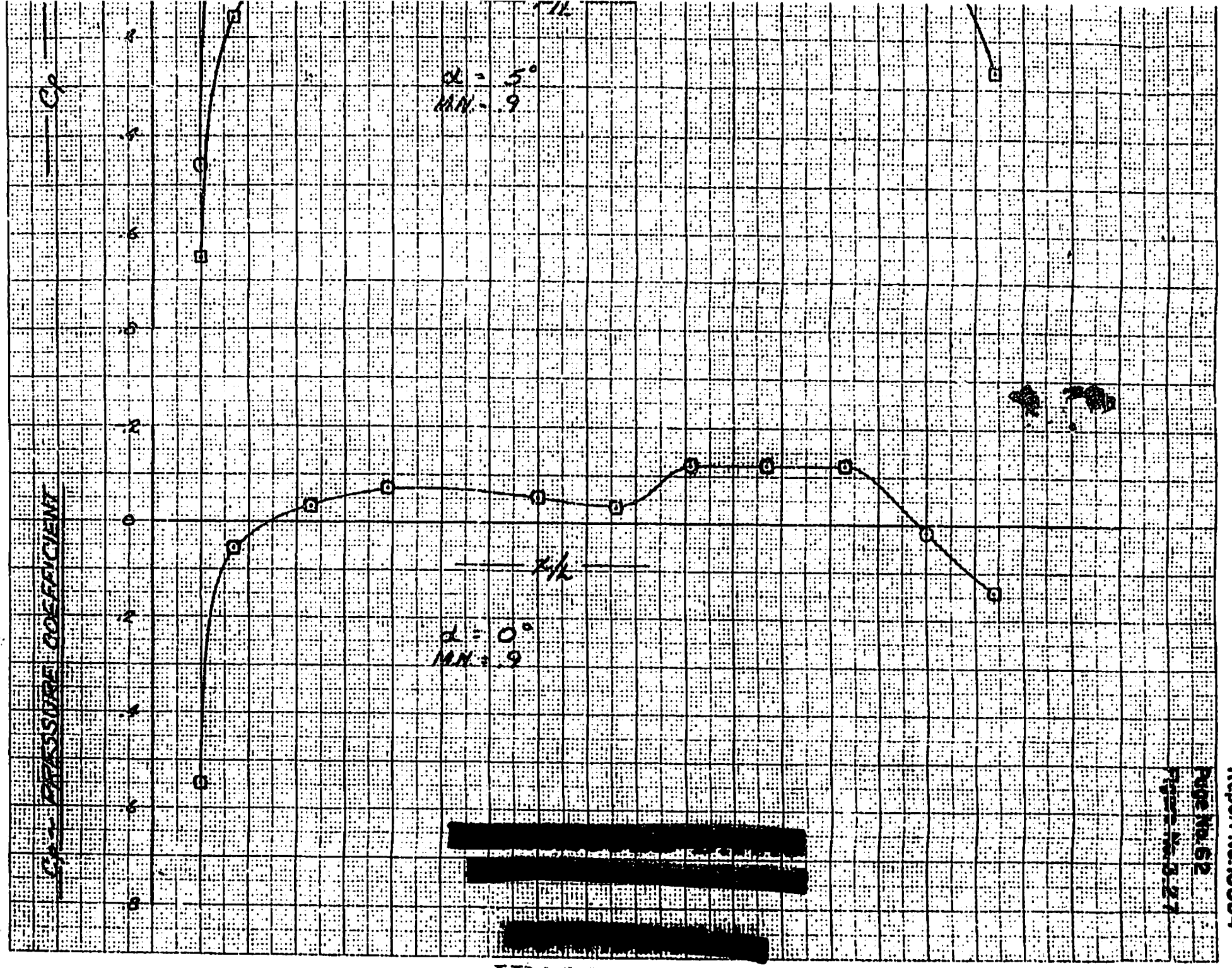

SANDIA EXTERNAL STORE STUDY, PHASE II
FREE BODY PRESSURE DISTRIBUTION
TX-2B STORE
UPPER ℄
LOWER ℄
α = 8°
M.N. = .9
-.2
0
.2
.4
.6
.8
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
Y/L
Z/L



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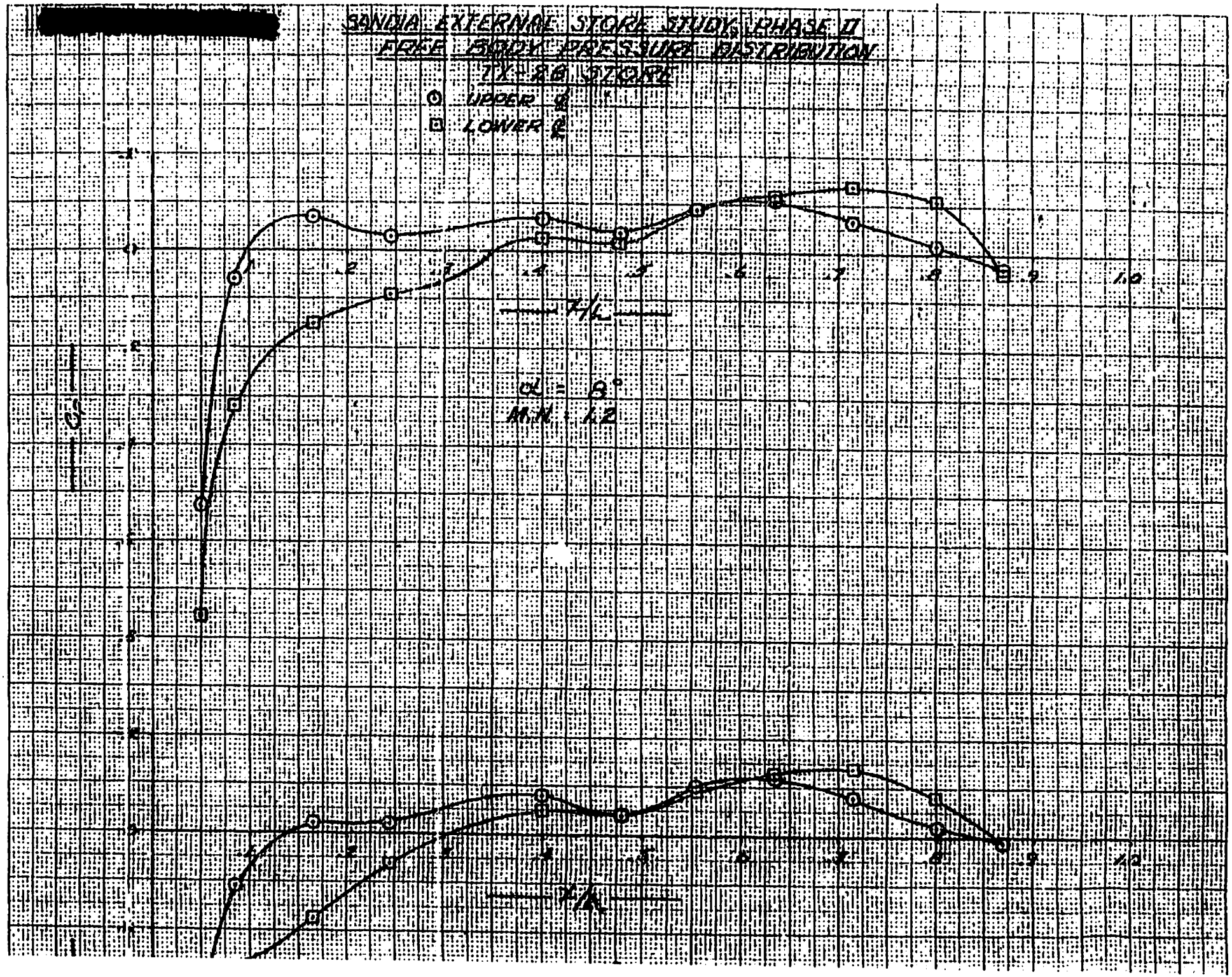

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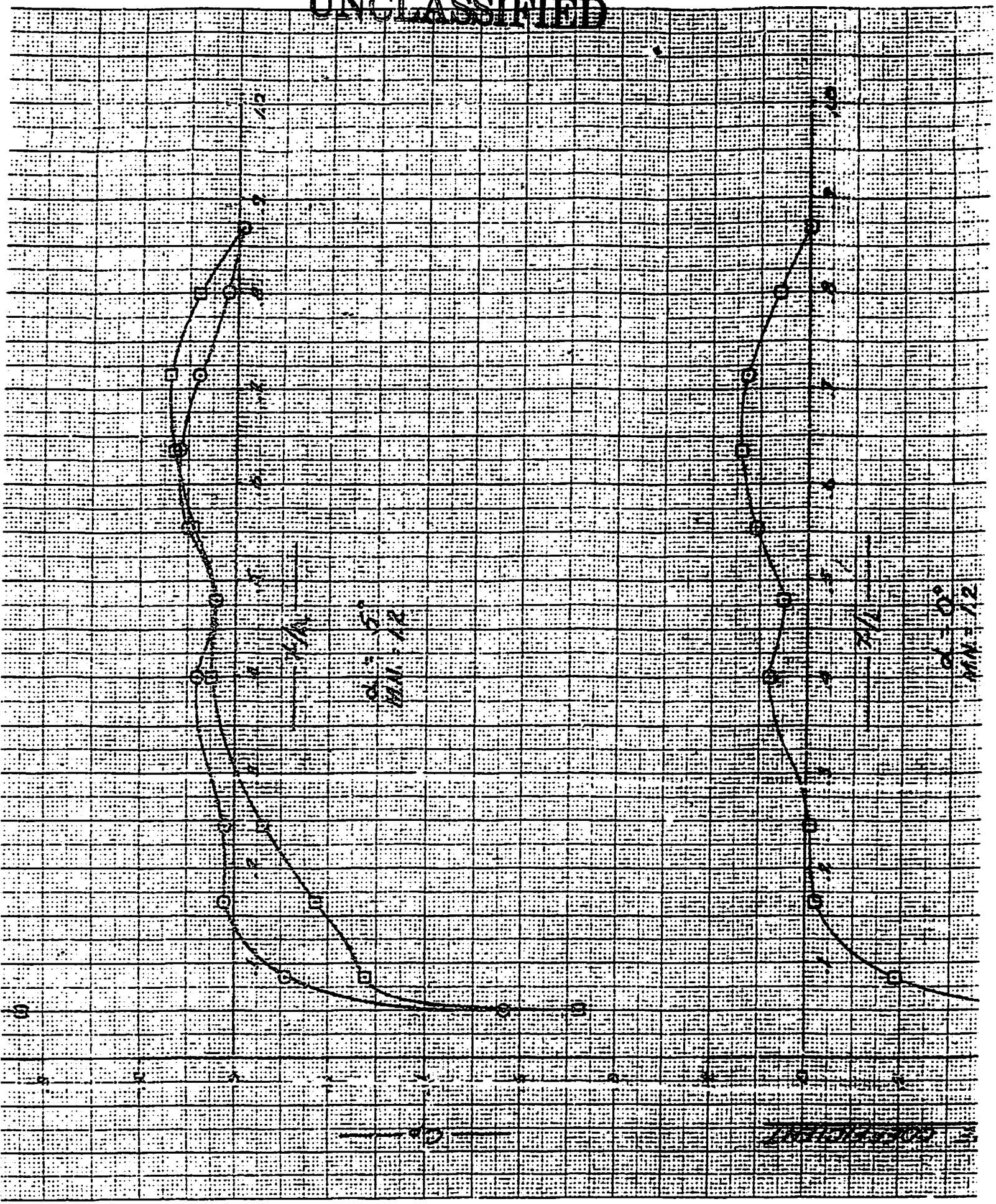

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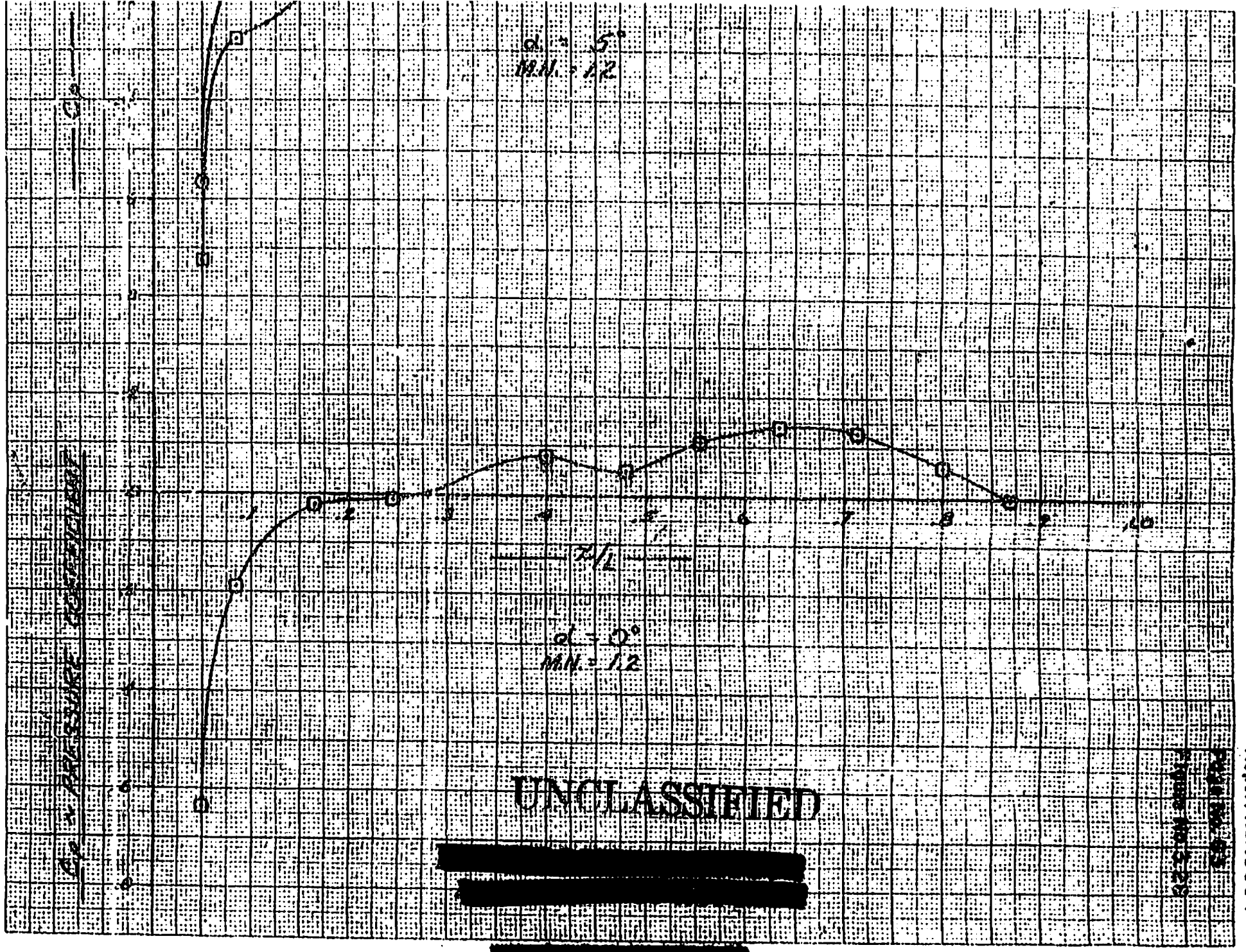

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FIGURE 4

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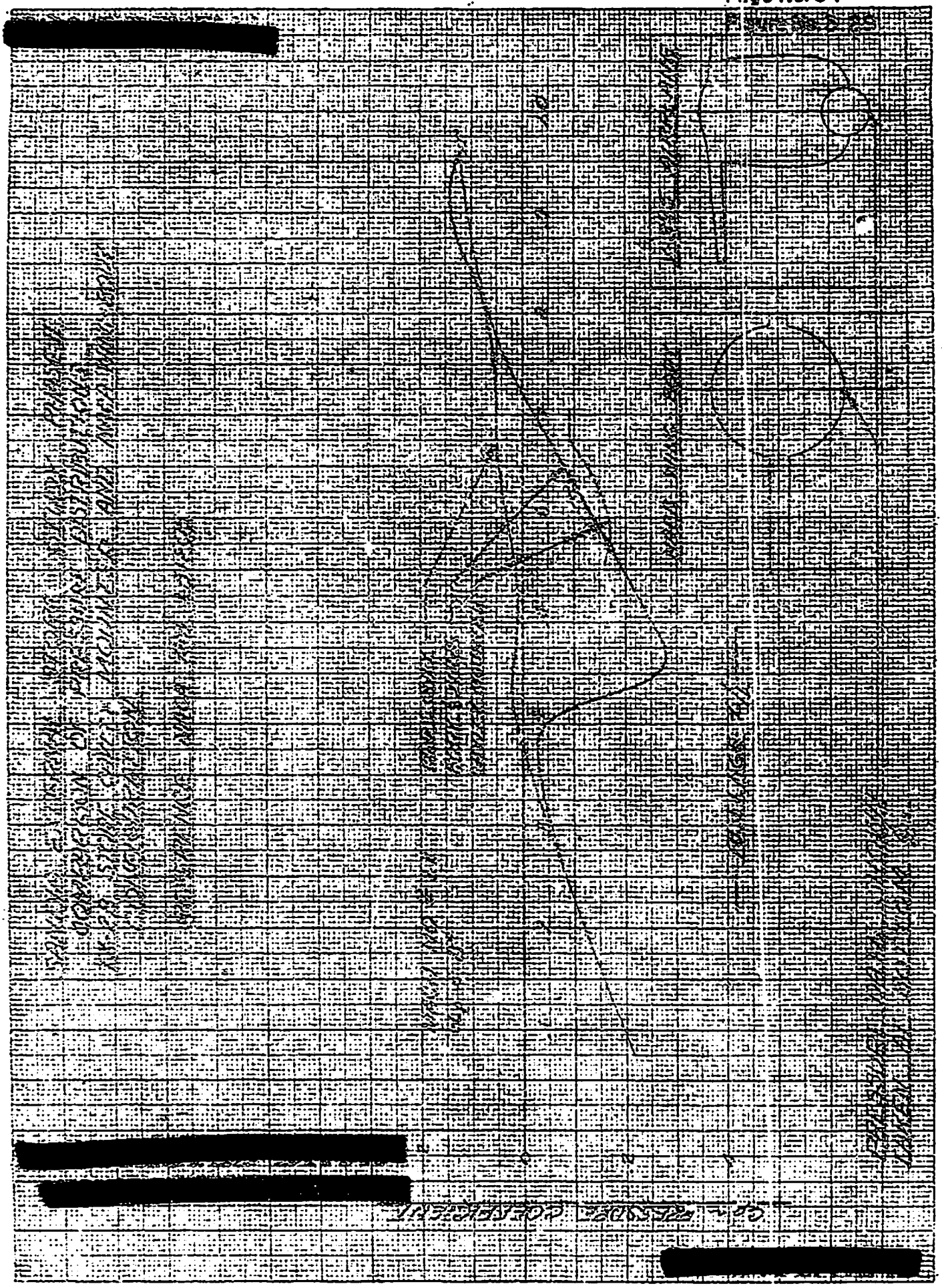

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3.3 Store Lug and Sway Brace Loads

3.3.1 Location and Suspension System of Store - An investigation of lug and sway brace loads on the TX-28 store configuration has been conducted in accordance with Paragraph 3 of Item B of Sandia Corporation Purchase Order No. 51-1360. The store was mounted in two positions: (1) on a left wing-pylon of the F8U-1 and (2) semi-submerged in a fuselage cavity of the V-395 proposed design. The locations of the store on the airplane are given on figures 2.1 and 2.2 for the pylon and cavity mounts respectively.

The store suppert system consists of two lugs and two pairs of sway braces arranged as shown in figure 3.31. For the F8U-1 installation the front sway brace is located four inches aft of the front lug. This arrangement was chosen because the pylon leading edge sweep and thickness are such that insufficient space is available within the pylon contours for installation of the sway brace forward of the front lug. This mount appears to be the most practical for an F8U-1 wing pylon installation. Details of the cavity suspension system are undetermined at this time and in order to simplify the calculations involved, the cavity mounted store was assumed to have the same support system as on the pylon mount. This assumption results in the calculated loads on the cavity mount being slightly conservative, since in the actual cavity installation there is adequate space

within the airplane fuselage for more efficient positioning of the sway braces. The data obtained are certainly valid for a general comparison of the cavity and pylon installations.

3.3.2 Method of Solution - The method used to solve for the forces on the lugs and sway braces is outlined in MIL-A-8591A (AER). Briefly, the procedure is as follows: Expressions were derived for each lug reaction in terms of the total forces and moments acting on the store. Four sets of equations are necessary for complete solution of the problem, representing the four possible variations of the loads in the support members: (1) both lugs acting in tension (2) forward lug only loaded in tension, (3) aft lug only in tension, and (4) neither lug loaded in tension. These equations were set up for solution in the IBM 650 computer and are presented in figure 3.32. The IBM input consists of values for the total forces (Fx, Fy, and Fz) and moments (My and Mz) acting at the store center of gravity. The equations for the forces on the store are shown on figure 3.33 and contain both aerodynamic and inertia effects. The aerodynamic contributions to the total loads on the store were obtained from the curves on figures 3.46 through 3.53. These curves were plotted from data obtained from Cornell wind tunnel tests of the .042 size F8U-1 and store. The wind tunnel installation used for obtaining these data is presented in figures 3.44 and 3.45.

The lug and sway brace loads were determined for various combinations of forces on the store during several maneuvers of the F8U-1 at altitudes ranging from sea level to 47,000 feet. In all cases, either airplane design load factors or maximum loads obtainable in flight were used to calculate the total forces on the store. In order to simplify the calculation of input forces, only maximum and zero values were used for the angular velocity and acceleration contributions to the store inertia loads. It is highly improbable that the maximum velocities and accelerations in pitch, yaw, and roll would ever be experienced simultaneously in flight; however, they represent the limits of the airplane's performance capabilities and thus form the boundaries for the store load analysis.

The maneuvers considered in this study consisted of the following:

(1) Symmetrical flight pull-ups at maximum plus and minus "g" and maximum and minimum flight speed.

(2) Rolling pullouts at maximum plus and minus "g" and maximum and minimum flight speed with all possible combinations of maximum angular velocities and accelerations about the pitch, roll, and yaw axes. Deceleration effects caused by afterburner cutout and speedbrake extension were also considered.

(3) Arrested landing

(4) Catapulted take-off

A list of the cases evaluated in determination of the maximum lug and sway brace loads is presented in Appendix C.

3.3.3 Discussion of Results - The results of the IBM computations are shown in figures 3.34 through 3.37. The critical load for each member is presented for flight, landing, and take-off conditions with descriptions of the maneuvers yielding these loads. Also shown on these figures are values for the maximum fore and aft load on the store for the flight, landing, and take-off conditions. This load represents the maximum shear load obtained on the critical lug, since in accordance with Paragraph 5.5.1, Item (2) of MIL-A-8591A (AER), the fore and aft load is resisted entirely by the lug which is sustaining the larger down load.

Store design load factors are given in figure 8 of MIL-A-8591A (AER) for both fuselage and wing pylon mounted stores. Comparisons of the maximum calculated loads on the store with store design loads are shown in figures 3.38 through 3.43. The points on the inertia load diagrams represent the total inertia loads on the store for the maneuvers producing the highest loads in each of the lugs and sway braces. Store inertia loads are determined by subtracting the aerodynamic effects from the total forces on the store.

3.3.4 Summary of Results

3.3.4.1 Pylon Mounted Store

A. Flight Condition. Critical loads on the lugs and sway braces in the flight condition are all produced by some

variation of a rolling pull-out at sea level. The largest lug load for the flight condition is 14,412# tension with a 1655# shear load on the forward lug. As shown on figure 3.38, the inertia loads on the store which produce this lug load are within the store design load diagram. The maneuver producing the critical load on the aft lug causes inertia loads on the store outside the design load diagram even though the tension in the aft lug for this condition is less than the critical load on the forward lug.

B. Arrested Landing Condition. The largest lug load obtained for the arrested landing condition is 16,407# tension with 14,430# shear on the aft lug. This condition occurs when maximum values of longitudinal deceleration and normal force are applied to the airplane simultaneously. It is the only condition producing store inertia loads greater than the store design values on figure 3.39.

C. Catapulted Take-off. Loads obtained in the catapulted take-off condition are all less than the maximum loads for flight and arrested landing. All critical store conditions fall within the design load diagram on figure 3.40.

3.3.4.2 Cavity Mounted Store

A. Flight Condition. All lug and sway brace loads for the flight condition were found to be less than those for the pylon mount in the flight condition. Store inertia

loads, however, exceed the design loads on figure 3.41 for critical values of both aft lug and aft sway brace reactions. Since the cavity mounted store center of gravity is below and behind the airplane c.g., both rolling and yawing accelerations of the airplane produce side forces on the store (Ref. eq. (2) of figure 3.33). These forces add to produce a total store side load of 1.75 "g" as compared to the store design side load of 1.5 "g".

B. Arrested Landing Condition. The highest lug load obtained in the analysis occurs when the aft lug is critical in the landing condition. As on the pylon mount, the store load falls outside the design diagram on figure 3.42 due to the simultaneous application of maximum normal force and longitudinal deceleration. The load on the lug for this condition is 17,885# tension with 13,570# shear, as shown on figure 3.37.

C. Catapulted Take-off Condition. The critical loads on the store support members for the cavity mount, take-off condition are of the same magnitude as those obtained for the pylon mounted store in the take-off condition. Figure 3.43 shows that when the aft lug and forward sway brace are critical, an inertia load of 2.9 "g" down occurs on the store. All other loads fall within the design load diagram.

3.3.5 Conclusions - Loads present on the store support members of the cavity mounted store are in most cases lower than

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those on the pylon mount. This is particularly significant when noting that the V-395 airplane is structurally designed to an n_z of 7 "g" in symmetrical flight and 6 "g" in the rolling pull-out maneuver. With the store pylon mounted, the F8U-1 is limited to 5.85 "g" in symmetrical flight and 4.69 "g" for rolling pull-outs. Other design conditions, such as maximum speed, angular velocities and accelerations, and allowable landing loads are the same for both airplanes.

The highest lug load obtained for the TX-28 store configuration for the installations considered was found to be 17,885# tension with 13,570# shear. The load occurs on the aft lug of the cavity mounted store in the arrested landing maneuver.

Largest load on the forward lug is 14,220 tension with 1655# shear. This load is obtained on the pylon mounted store during a rolling pull-out maneuver.

Maximum loads in the sway braces represent the maximum loads in the store sway brace pads. Critical loads are 8,140 and 8,096 compression in the forward and aft sway braces respectively.

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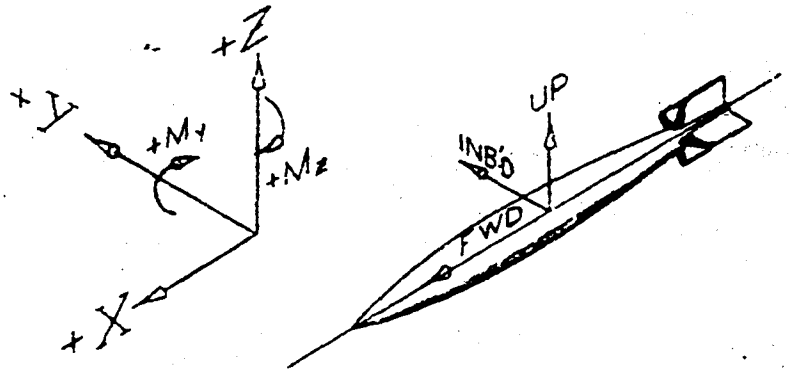
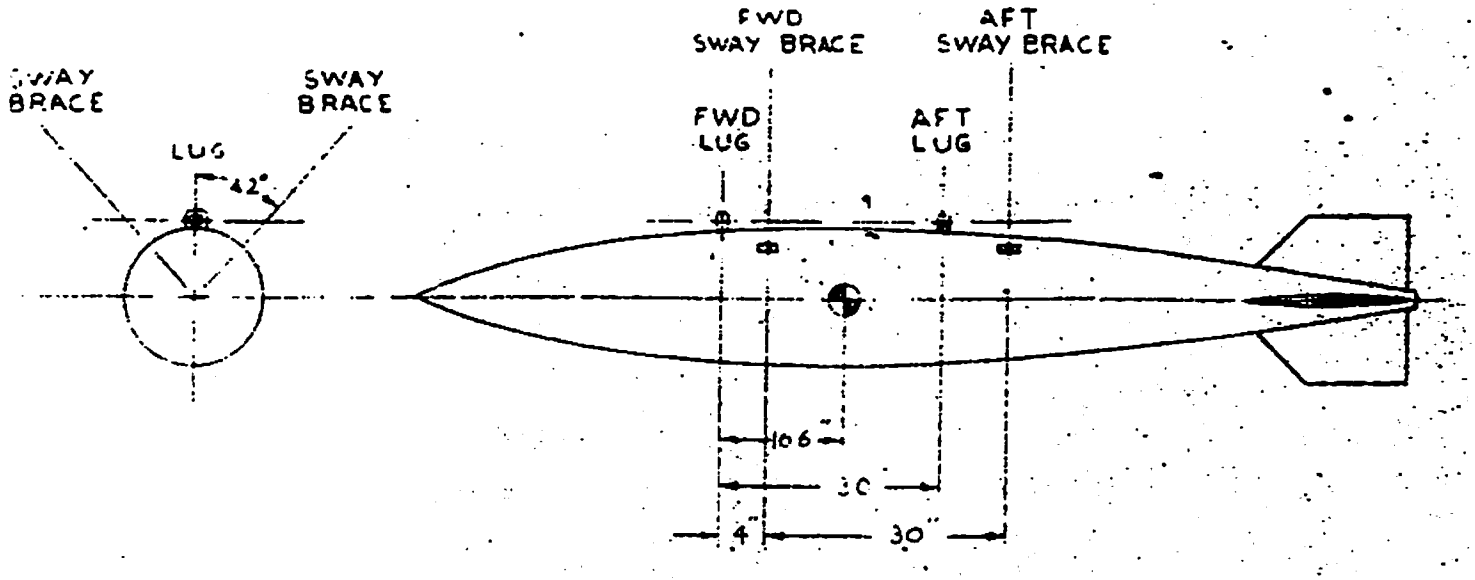
SANDIA EXTERNAL STORE STUDY
SIGN CONVENTION USED IN LUG
LOAD ANALYSIS



The following sign convention is used throughout the lug load analysis:

1. Vertical up loads are positive.
2. Forward loads are positive.
3. Side loads to the right are positive looking forward.
4. Nose up pitching moments are positive.
5. Nose right yawing moments are positive looking forward.
6. Roll to the right is positive looking forward.
7. Lug reaction is positive when lug is in tension.
8. Sway brace reaction is positive when sway brace is in compression.

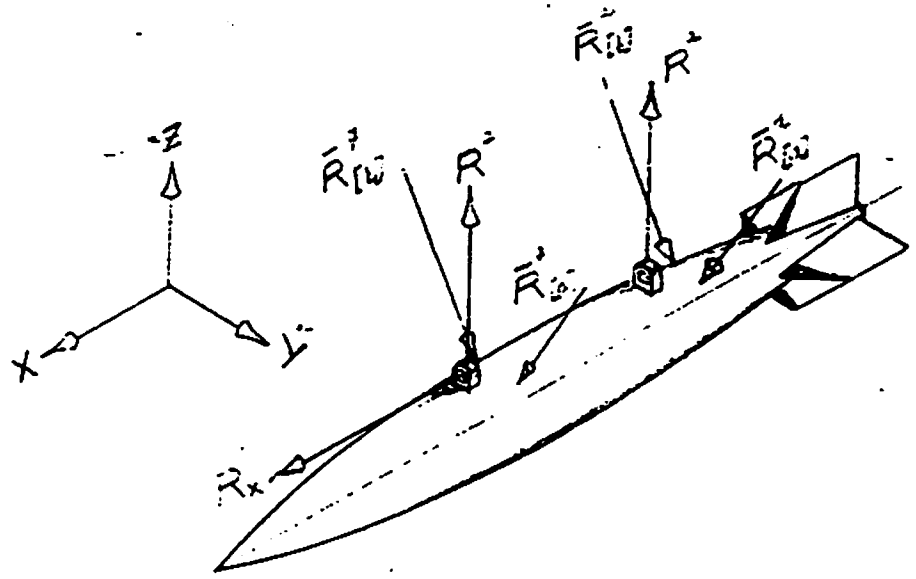
SANDIA EXTERNAL STORE STUDY
LOCATION OF STORE SUPPORT MEMBERS
TX-28 STORE



PERTINENT DIMENSIONAL DATA

1. STORE WEIGHT = 1850#
2. STORE LENGTH = 170 IN.
3. MOMENT OF INERTIA (I_Y) = 1.667×10^6 #-IN.^{2}
4. MAXIMUM DIAMETER = 20 IN.
5. STORE C.G. = F.S. 445 (PYLON MOUNT)
6. STORE C.G. = F.S. 483.5 (CAVITY MOUNT)

OUTLINE FOR SOLUTION OF



ASSUME

$R^7_z = -.375\,F_x - .446$

$R^2_z = .375\,F_x - .554\,F_z$

CASE I

$R^7_z = (+)$ $R^2_z = (+)$

BOTH LUGS PUT IN TENSION

VALUES OF R^7_z & R^2_z ARE CORRECT

SWAY BRACES

$\bar{R}^7 = [.865\,F_y + .0498\,M_z]$

$\bar{R}^2 = [.627\,F_y - .0498\,M_z]$

$\bar{R}^7_{[a]} = \bar{R}^7$

$\bar{R}^7_{[b]} = 0$

$\bar{R}^2_{[a]} = \bar{R}^2$

$\bar{R}^2_{[b]} = 0$

CASE II

$R^7_z = (+)$ $R^2_z = (-)$

$R^7_z = -.331\,F_x - .511\,F_z - .0294\,M_y + [.569\,F_y + .0327\,M_z]$

$R^2_z = 0$

SWAY BRACES

$\bar{R}^7 = [.865\,F_y + .0498\,M_z]$

$\bar{R}^2 = -.252\,F_x + .292\,F_z - .0224\,M_y - .0876\,R^7_z + [.314\,F_y - .0249\,M_z$

$\bar{R}^7_{[a]} = \bar{R}^7$

$\bar{R}^7_{[b]} = 0$

$\bar{R}^2_{[a]} = \bar{R}^2$

$\bar{R}^2_{[b]} = \bar{R}^2 - [.65$
$-.0449\,M$

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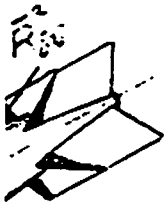
SANDIA EXTERNAL STORE STUDY

FOR SOLUTION OF LUG & SWAY BRACE REACTIONS



$R_x = -F_x$

ASSUME BOTH LUGS ACTING

$R^f_z = -.375 F_x - .446 F_z - .0333 M_y + [.496 F_y + .0272 M_z]$

$R^a_z = .375 F_x - .554 F_z + .0333 M_y + [.615 F_y - .047 M_z]$

CASE II

$R^f_z = (+) \quad R^a_z = (-)$

$R^f_z = -.331 F_x - .511 F_z - .0294 M_y + [.561 F_y + .0327 M_z]$

$R^a_z = 0$

SWAY BRACES

$\bar{R}^f = [.865 F_y + .0498 M_z]$

$\bar{R}^a = -.252 F_x + .392 F_z - .0224 M_y - .0876 R^f_z + [.314 F_y - .0249 M_z]$

$\bar{R}^f_{[a]} = \bar{R}^f$

$\bar{R}^f_{[b]} = 0$

$\bar{R}^a_{[a]} = \bar{R}^a$

$\bar{R}^a_{[b]} = \bar{R} - [.628 F_y - .0415 M_z]$

CASE III

$R^f_z = (-) \quad R^a_z = (+)$

$R^f_z = 0$

$R^a_z = .433 F_x - .485 F_z + .0385 M_y + [.539 F_y - .0428 M_z]$

SWAY BRACES

$\bar{R}^f = .252 F_x + .390 F_z + .0224 M_y + .0876 R^a_z + [.433 F_y + .0249 M_z]$

$\bar{R}^a = [.627 F_y - .0498 M_z]$

$\bar{R}^f_{[a]} = \bar{R}^f$

$\bar{R}^f_{[b]} = \bar{R}^f - [.866 F_y + .0498 M_z]$

$\bar{R}^a_{[a]} = \bar{R}^a$

$\bar{R}^a_{[b]} = 0$

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NAL STORE STUDY
& SWAY BRACE REACTIONS

$- F_x$

LUGS ACTING

$.333 M_y + [.496 F_y + .0272 M_z]$

$M_y + [.615 F_y - .047 M_z]$

CASE III

$R_z^3 = (-) \quad R_z^2 = (+)$

$R_z^3 = 0$

$R_z^2 = .433 F_x - .435 F_z + .0385 M_y + [.539 F_y - .0428 M_z]$

SWAY BRACES

$\bar{R}^3 = .252 F_x + .390 F_z + .0224 M_y + .0396 R_z^2 + [.433 F_y + .0249 M_z]$

$\bar{R}^2 = [.627 F_y - .0498 M_z]$

$\bar{R}^3_{[a]} = \bar{R}^3$

$\bar{R}^3_{[b]} = \bar{R}^3 - [.366 F_y + .0493 M_z]$

$\bar{R}^2_{[a]} = \bar{R}^2$

$\bar{R}^2_{[b]} = 0$

CASE IV

$R_z^3 = (-) \quad R_z^2 = (-)$

NEITHER LUG ACTS IN TENSION $\therefore R_z^3 = R_z^2 = 0$

SWAY BRACES

$\bar{R}^3 = .252 F_x + .390 F_z + .0224 M_y + [.433 F_y + .0249 M_z]$

$\bar{R}^2 = -.252 F_x + .282 F_z - .0224 M_y + [.314 F_y - .0249 M_z]$

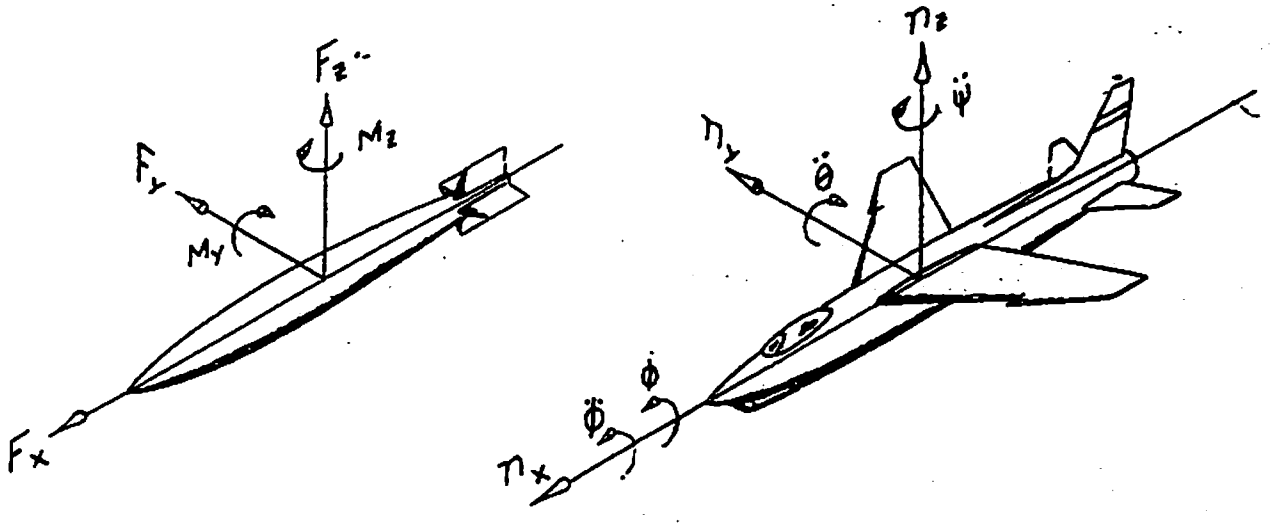
$\bar{R}^3_{[a]} = \bar{R}^3$

$\bar{R}^3_{[b]} = \bar{R}^3 - [.366 F_y + .0493 M_z]$

$\bar{R}^2_{[a]} = \bar{R}^2$

$\bar{R}^2_{[b]} = \bar{R}^2 - [.625 F_y - .0498 M_z]$

SANDIA EXTERNAL STORE STUDY
EQUATIONS FOR TOTAL FORCES ON STORE



(1) $F_x = C_x q S - n_x W - W/g\, r_y \ddot{\psi} - W/g\, r_z \ddot{\theta}$

(2) $F_y = C_y q S - n_y W - W/g\, r_y \dot{\phi}^2 + W/g\, r_z \ddot{\phi} + W/g\, r_x \ddot{\psi}$

(3) $F_z = C_z q S - n_z W - W/g\, r_y \ddot{\phi} - W/g\, r_z \dot{\phi}^2 + W/g\, r_x \ddot{\theta}$

(4) $M_y = C_m q S \ell - \frac{I_y \ddot{\theta}}{g}$

(5) $M_z = C_n q S \ell - \frac{I_y \ddot{\psi}}{g}$

SANDIA EXTERNAL STORE STUDY
MAXIMUM LUG AND SWAY BRACE
LOADS OBTAINED IN FLIGHT
PYLON MOUNTED STORE

Critical Member	Load (#)	Description of Maneuver
Fwd Lug	14220	Rolling pullout at sea level, 4.69 "g", M = 1.1. Rolling velocity = 3.84 Rad./sec. Pitching acceleration = 3 Rad./sec^2. Yawing acceleration = 1 Rad./sec^2. Rolling acceleration = 15 Rad./sec^2. Shear on lug = 1655#.
Aft Lug	12107	Rolling pullout at sea level, 4.69 "g", M = 0.4. Rolling velocity = 3.84 Rad./sec. Pitching acceleration = -3 Rad./sec^2. Yawing acceleration =-1 Rad./sec^2. Rolling acceleration = 15 Rad./sec^2. Shear on lug = 590#.
*Fwd Sway Brace	8140	Rolling pullout at sea level, -1 "g", M = 1.1 Rolling velocity = 3.84 Rad./sec. Pitching acceleration = 0. Yawing acceleration = 1 Rad./sec^2. Rolling acceleration = -15 Rad./sec^2.
*Aft Sway Brace	8096	Rolling pullout at sea level, -1 "g", M = 1.1. Rolling velocity = 3.84 Rad./sec. Pitching acceleration = 3 Rad./sec^2. Yawing acceleration = 0 Rad./sec^2. Rolling acceleration = -15 Rad./sec^2.
Maximum Fore and Aft Load	1666	Symmetrical flight at sea level, -2.75 "g", M = 1.1 Pitching acceleration = 3 Rad./sec^2. Yawing acceleration = 1 Rad./sec^2.

*This is the load on the critical side of the sway brace.

SANDIA EXTERNAL STORE STUDY
MAXIMUM LUG AND SWAY BRACE
LOADS OBTAINED IN ARRESTED
LANDING AND CATAPULTED TAKEOFF
PYLON MOUNTED STORE

A. Arrested Landing Condition

Critical Member	Load (#)	Shear on Lug	Description of Maneuver				
			n_x	n_y	n_z	$\ddot{\theta}$	$\ddot{\psi}$
Fwd Lug	10167	3330	0	1.5	6.5	12	6
Aft Lug	16407	14430	-6	1.5	6.5	-12	-6
Fwd Sway Brace	4988	-	-6	-1.5	0	-12	6
Aft Sway Brace	3212	-	0	-1.5	0	12	6
Max. Fore & Aft Load	-	14430	-6	±1.5	0	-12	-6

B. Catapulted Take-off Condition

Critical Member	Load (#)	Shear on Lug	Description of Maneuver				
			n_x	n_y	n_z	$\ddot{\theta}$	$\ddot{\psi}$
Fwd Lug	9802	12823	5.55	1.5	2.0	12	4
Aft Lug	3407	7697	5.55	1.5	2.0	-12	-4
Fwd Sway Brace	3260	-	5.55	±1.5	0	±12	±4
Aft Sway Brace	5084	-	5.55	-1.5	0	12	4
Max. Fore & Aft Load	-	12823	5.55	±1.5	0	12	4

SANDIA EXTERNAL STORE STUDY
MAXIMUM LUG AND SWAY BRACE
LOADS OBTAINED IN FLIGHT
CAVITY MOUNTED STORE

Critical Member	Load (#)	Description of Maneuver
Fwd Lug	10373	Symmetrical Flight at 17,000 feet, 7 "g", M = 1.52. Pitching acceleration = 3 Rad./sec^2. Shear on Lug = 390#.
Aft Lug	9760	Rolling pullout at sea level, 5.6 "g", M = 0.42. Rolling velocity = 3.84 Rad./sec. Pitching acceleration = -3 Rad/sec^2. Yawing acceleration = -1 Rad./sec^2. Rolling acceleration = -15 Rad./sec^2. Shear on lug = 591#.
*Fwd. Sway Brace	3235	Rolling pullout at sea level, -1 "g", M= 1.1. Rolling velocity = 3.84 Rad./sec. Pitching acceleration = $\not<$ 3 Rad./sec^2. Yawing acceleration = 15 Rad./sec^2.
*Aft Sway Brace	3243	Rolling pullout at sea level, -1 "g", M= 1.1. Rolling velocity = 3.84 Rad./sec. Pitching acceleration = $\not<$ 3 Rad./sec^2. Yawing acceleration = -1 Rad./sec^2. Rolling acceleration = $\not<$3 Rad./sec^2.
Max. Fore & Aft Load	1091	Symmetrical flight at sea level, 6 "g", M= 1.21. Pitching acceleration = 3 Rad./sec^2.

*This is the load on the critical side of the sway brace.

SANDIA EXTERNAL STORE STUDY
MAXIMUM LUG AND SWAY BRACE
LOADS OBTAINED IN ARRESTED
LANDING AND CATAPULTED TAKEOFF
CAVITY MOUNTED STORE

A. Arrested Landing Condition

Critical Member	Load (#)	Shear on Lug	Description of Maneuver				
			n_x	n_y	n_z	$\ddot{\theta}$	$\ddot{\psi}$
Fwd Lug	8899	2470	0	-1.5	6.5	12	-6
Aft Lug	17885	13570	-6	1.5	6.5	-12	-6
*Fwd Sway Brace	6169	-	-6	±1.5	0	-12	±6
*Aft Sway Brace	3812	-	0	±1.5	0	12	±6
Max. Fore & Aft Load	-	13570	-6	±1.5	6.5	-12	±6

B. Catapulted Take-off Condition

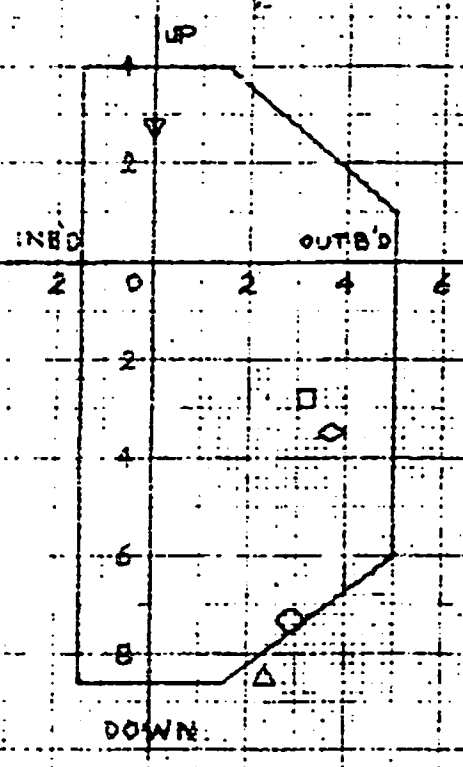
Critical Member	Load (#)	Shear on Lug	Description of Maneuver				
			n_x	n_y	n_z	$\ddot{\theta}$	$\ddot{\psi}$
Fwd Lug	8561	12720	5.55	±1.5	2.0	12	±4
Aft Lug	4683	7780	5.55	±1.5	2.0	-12	±4
*Fwd Sway Brace	2763	-	5.55	±1.5	2.0	±12	±4
*Aft Sway Brace	5777	-	5.55	-1.5	0	12	±4
Max. Fore & Aft Load	-	12270	5.55	±1.5	2	12	±4

*This is the load on the critical side of the sway brace.

SANDIA EXTERNAL STORE STUDY

COMPARISON OF MAXIMUM INERTIA LOADS WITH DESIGN LOAD FACTORS FROM MIL-A-8591A (AER) PYLON MOUNTED STORE ~ FLIGHT CONDITION

INERTIA LOAD DIAGRAM



SYM	n_x	$\dot{\theta}$	$\dot{\psi}$	
○	.35	5	1	CALCULATED
△	-.35	-3	-1	
□	.20	6	1	
◇	-.35	3	1	
▽	.35	3	0	CALCULATED
	±2	±6	0	MIL-A-8591A (AER)

EXPLANATION OF SYMBOLS

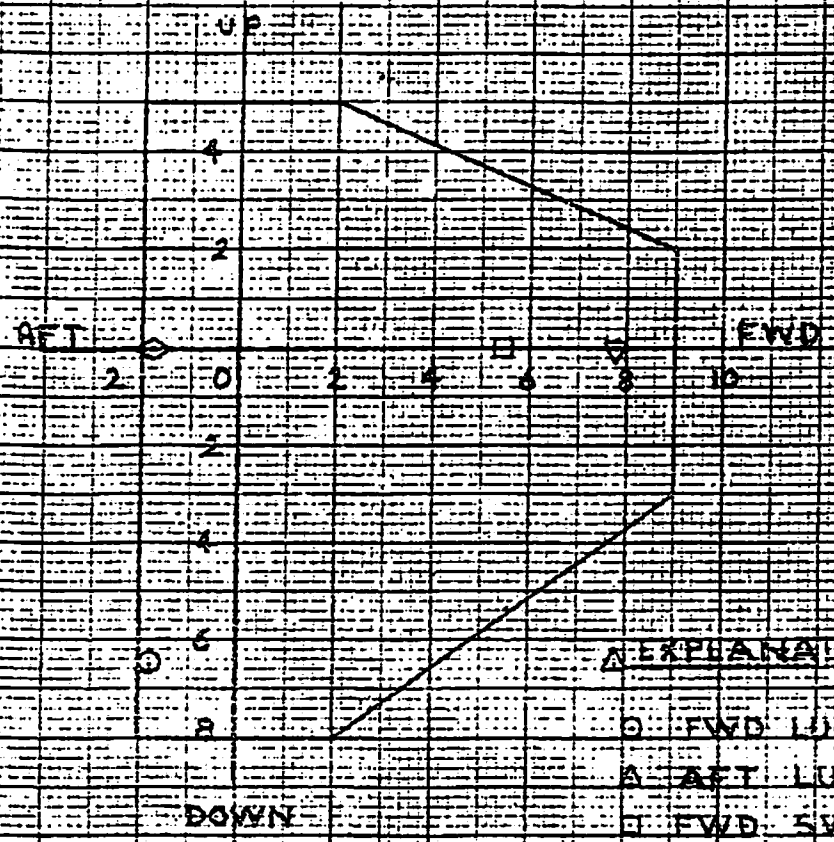
SYM	CONDITION
○	FWD LUG CRITICAL IN TENSION
△	AFT LUG CRITICAL IN TENSION
□	FWD SWAY BRACE CRITICAL IN COMPRESSION
◇	AFT SWAY BRACE CRITICAL IN COMPRESSION
▽	MAXIMUM FORE & AFT LOAD

SANDIA EXTERNAL STORE STUDY

Figure No. 3.39

COMPARISON OF MAXIMUM INERTIA LOADS WITH DESIGN LOAD FACTORS FROM MIL-A-8591A (AER) PYLON MOUNTED STORE + ARRESTED LANDING CONDITION

INERTIA LOAD DIAGRAM



EXPLANATION OF SYMBOLS

- ○ FWD LUG CRITICAL
- △ AFT LUG CRITICAL
- □ FWD SWAY BRACE CRITICAL
- ◇ AFT SWAY BRACE CRITICAL
- ▽ MAXIMUM FORE & AFT LOAD

Sym	n_y	$\ddot{\theta}$	$\ddot{\psi}$	
○	1.5	12	6	CALCULATED
△	1.5	-12	-6	
□	-1.5	-12	6	
◇	-1.5	12	6	
▽	+1.5	-12	-6	CALCULATED
	±1.5	±12	±6	MIL-A-8591A (AER)

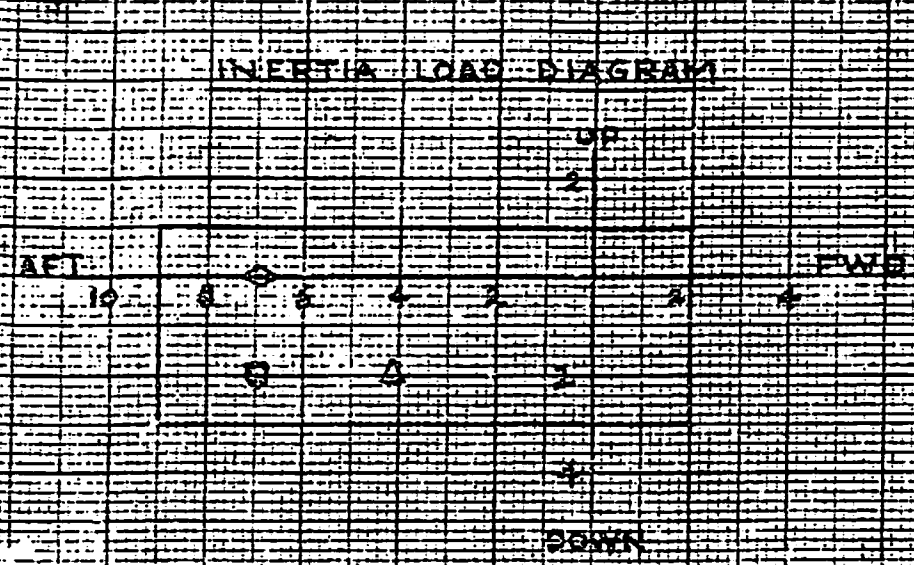
[redacted]

SANDIA EXTERNAL STORE STUDY — Figure No. 7.40

COMPARISON OF MAXIMUM INERTIA LOADS WITH DESIGN LOAD FACTORS FROM MIL-A-8591(ORD)

PYLON MOUNTED STORE — CATAPULTED TAKEOFF CONDITION

INERTIA LOAD DIAGRAM



	S_x	M_y	θ	ψ	
○	1.5	12	4		CALCULATED
△	1.5	−12	−4		
□	±1.5	±12	±4		
◇	−1.5	12	4		
▽	±1.5	12	4		CALCULATED
	±1.5	±12	±4		MIL-A-8591A(ARD)

EXPLANATION OF SYMBOLS

○ FWD LUG CRITICAL

△ AFT LUG CRITICAL

□ FWD SWAY BRACE CRITICAL

◇ AFT SWAY BRACE CRITICAL

▽ MAXIMUM FORE & AFT LOAD

[redacted]

[redacted]

SANDIA EXTERNAL STORE STUDY

COMPARISON OF MAXIMUM INERTIA LOADS WITH DESIGN LOAD FACTORS FROM MIL-A-8591A(AER)

CAVITY MOUNTED STORE – FLIGHT CONDITION

INERTIA LOAD DIAGRAM

Sym	$\ddot{x}$	$\ddot{\theta}$	$\ddot{\psi}$	
○	0	3	-1	CALCULATED
△	-33	-3	-1	
□	±33	±3	-1	
◇	±33	±3	1	
▽	+85	3	0	CALCULATED
	±2	±6	0	MIL-A-8591A(AER)

EXPLANATION OF SYMBOLS

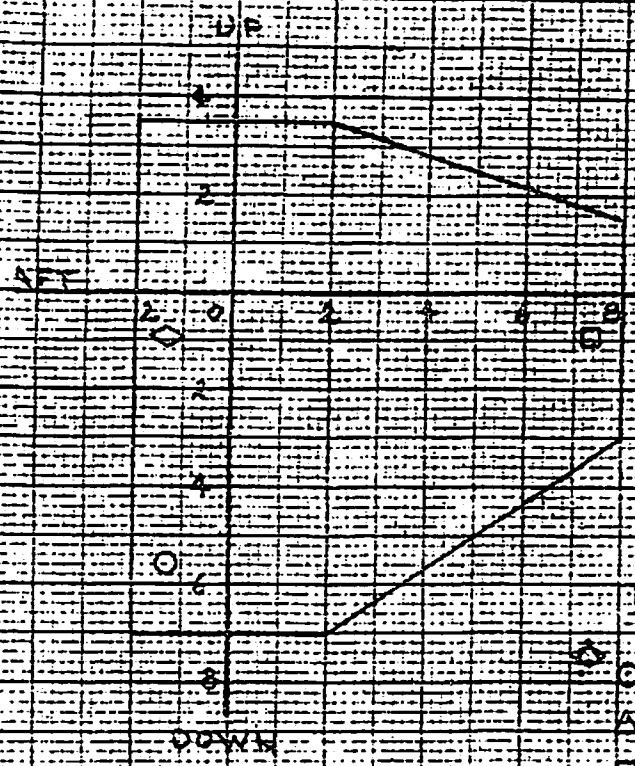
SYM	CONDITION
○	FWD LUG CRITICAL
△	AFT LUG CRITICAL
□	FWD SWAY BRACE CRITICAL
◇	AFT SWAY BRACE CRITICAL
▽	MAXIMUM FORE AND AFT LOAD

[redacted]

SANDIA EXTERNAL STORE STUDY Figure No. 3-42

COMPARISON OF MAXIMUM INERTIA LOADS WITH DESIGN LOAD FACTORS FROM MIL-A-8591 AGAINST CAVITY MOUNTED STORE — ARRESTED LANDING CONDITION

INERTIA LOAD DIAGRAM



EXPLANATION OF SYMBOLS

- ○ FWD LUG CRITICAL
- △ AFT LUG CRITICAL
- □ FWD SWAY BRACE CRITICAL
- ◇ AFT SWAY BRACE CRITICAL
- ▽ MAXIMUM FORE & AFT LOAD

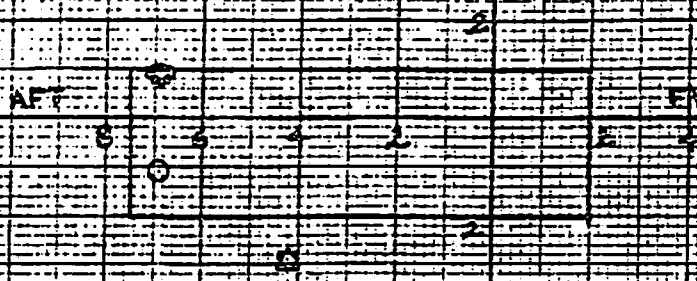
	n_M	n_y	$\dot{\theta}$	$\dot{\psi}$	
○	−1.5	12	−6		CALCULATED
△	1.5	12	−6		
□	±1.5	12	+6		
◇	±1.5	12	±6		
▽	±1.5	12	±6		CALCULATED

SANDIA EXTERNAL STORE STUDY

COMPARISON OF MAXIMUM INERTIA LOADS WITH DESIGN LOAD FACTORS FROM MIL-A-8591A(AER)

CAVITY MOUNTED STORE – CATAPULTED TAKEOFF CONDITION

INERTIA LOAD DIAGRAM



	n_x	n_y	n_z	
○	±1.5	±2	±4	CALCULATED
△	±1.5	−12	±4	
□	±1.5	+12	±4	
◇	−1.5	±2	±4	
▽	±1.5	12	±4	CALCULATED
	±1.5	±12	±4	MIL-A-8591A(AER)

EXPLANATION OF SYMBOLS

○ FWD LUG CRITICAL

△ AFT LUG CRITICAL

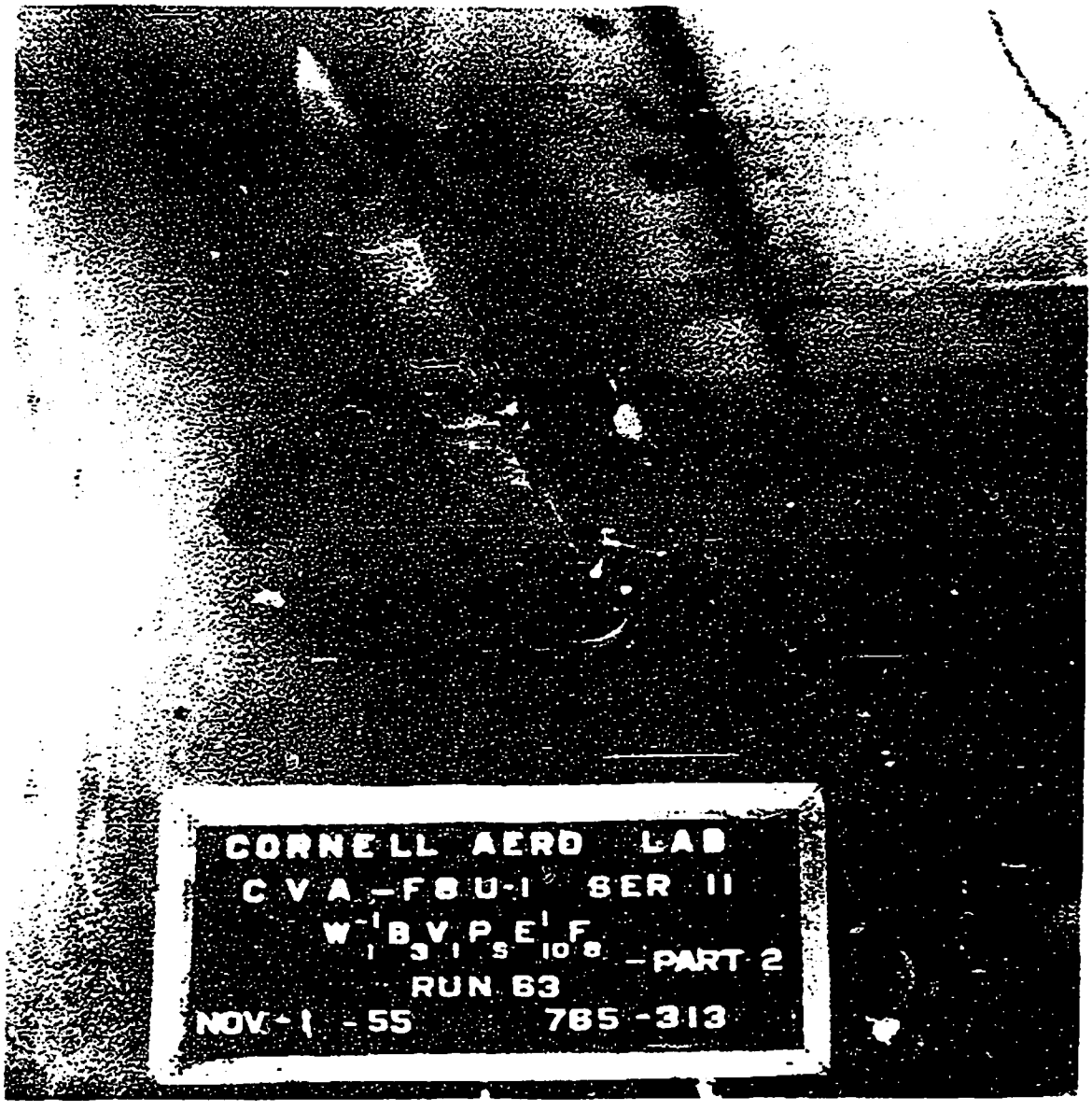
□ FWD SWAY BRACE CRITICAL

◇ AFT SWAY BRACE CRITICAL

▽ MAXIMUM FORE AND AFT LOAD

Figure No. 3.44

SANDIA EXTERNAL STORE STUDY PHASE II
WIND TUNNEL TEST INSTALLATION



This test installation was used to obtain the loads acting on the store when wing-pylon mounted on F8U-1 airplane.

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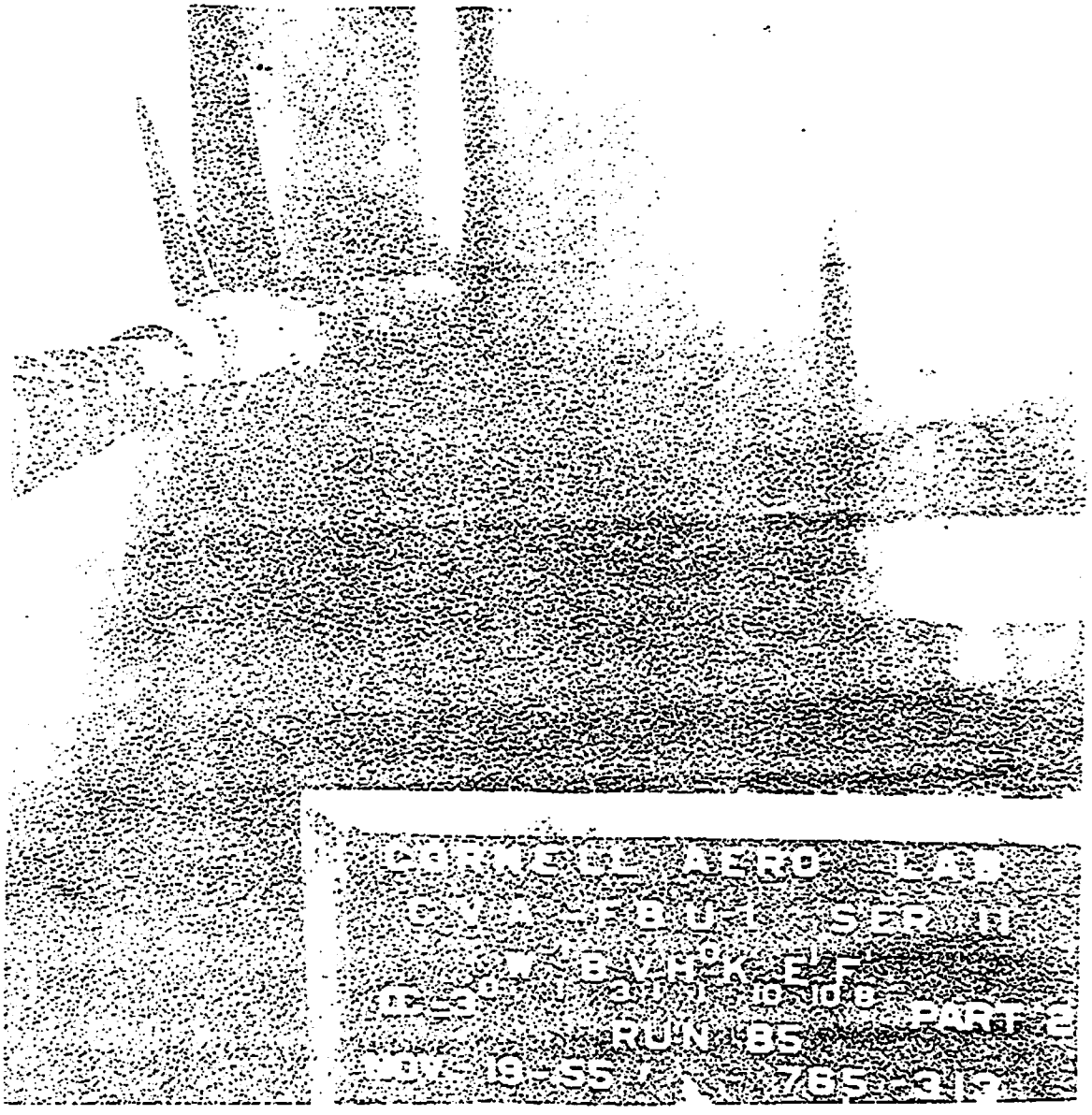
Figure No. 3.45

SANDIA EXTERNAL STORE STUDY PHASE II
WIND TUNNEL TEST INSTALLATION



This test installation was used to obtain the loads acting on the store when semi-submerged in the fuselage-cavity of the V-395 proposed design.

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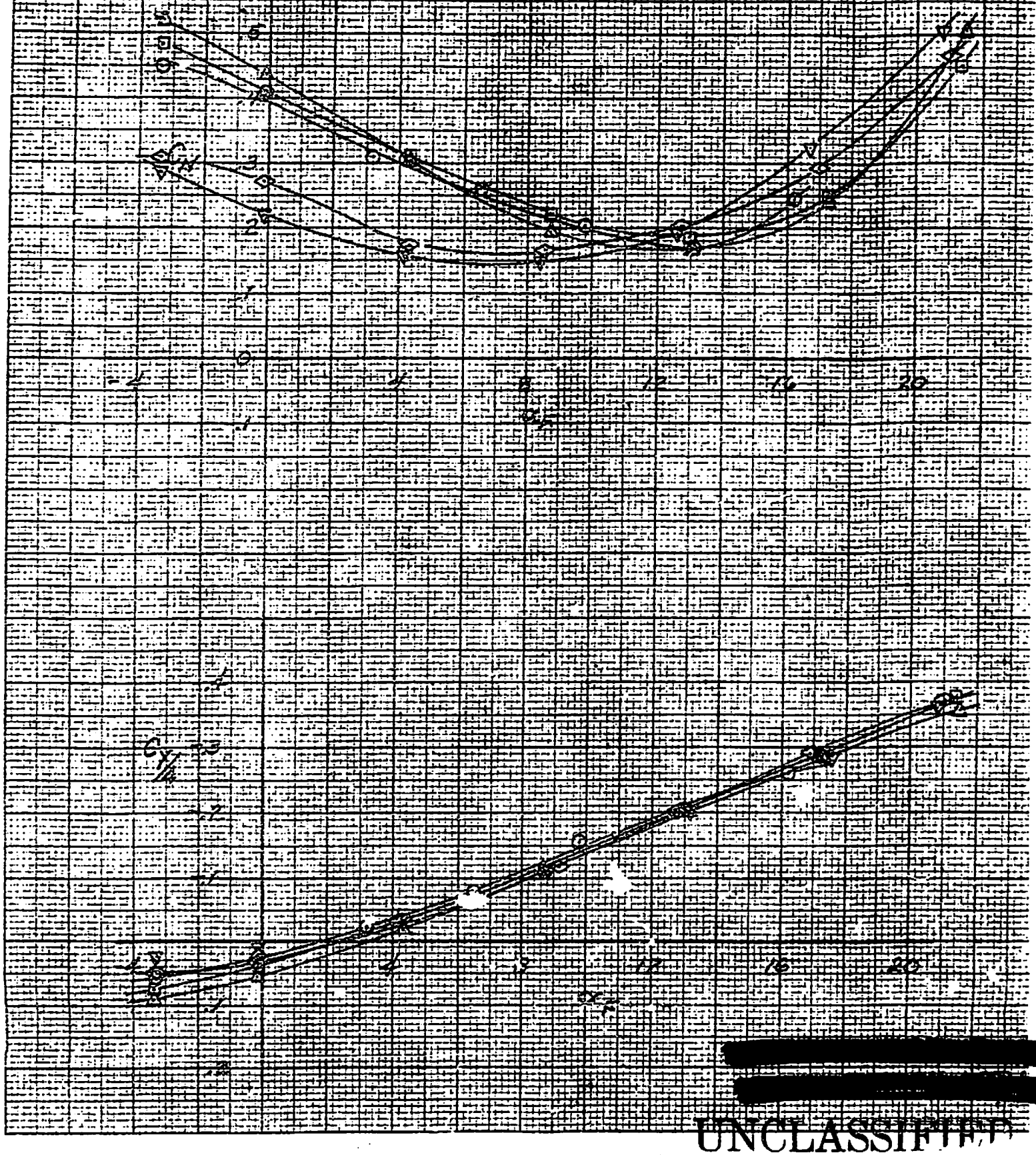
[redacted]

[redacted]

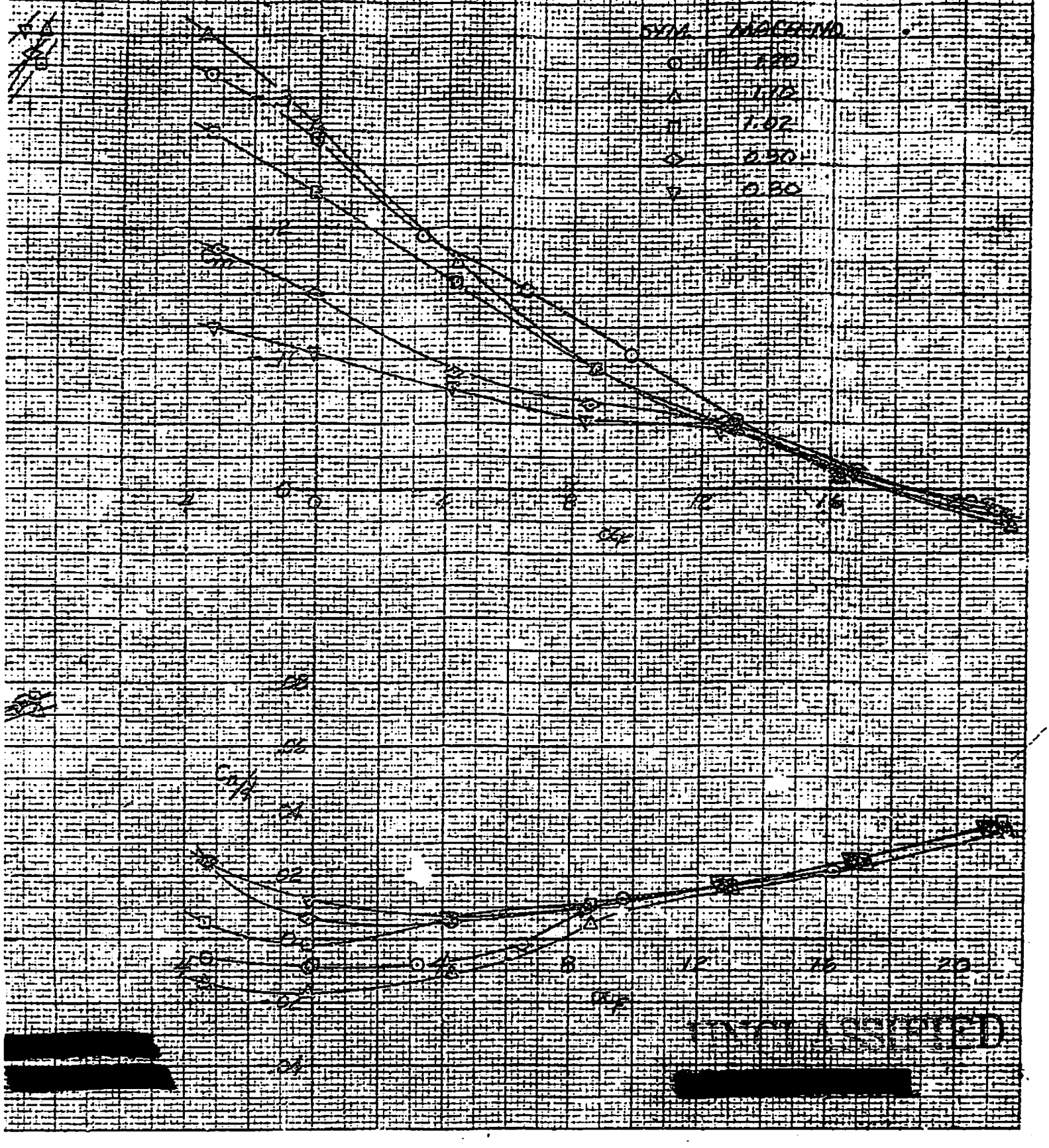
[redacted]

SONDE'S EXTERNAL AERODYNAMIC CHARACTERISTICS OF C_{m_0} ZERO YAW



[redacted]

TERRIER STORE STUDY, PHASE II
CHARACTERISTICS OF PYLON MOUNTED STORE (7-2B)
OF C_{n_β} VS α_F WITH α_F & MN
YAW CONFIGURATION W-25, VFE, F_0



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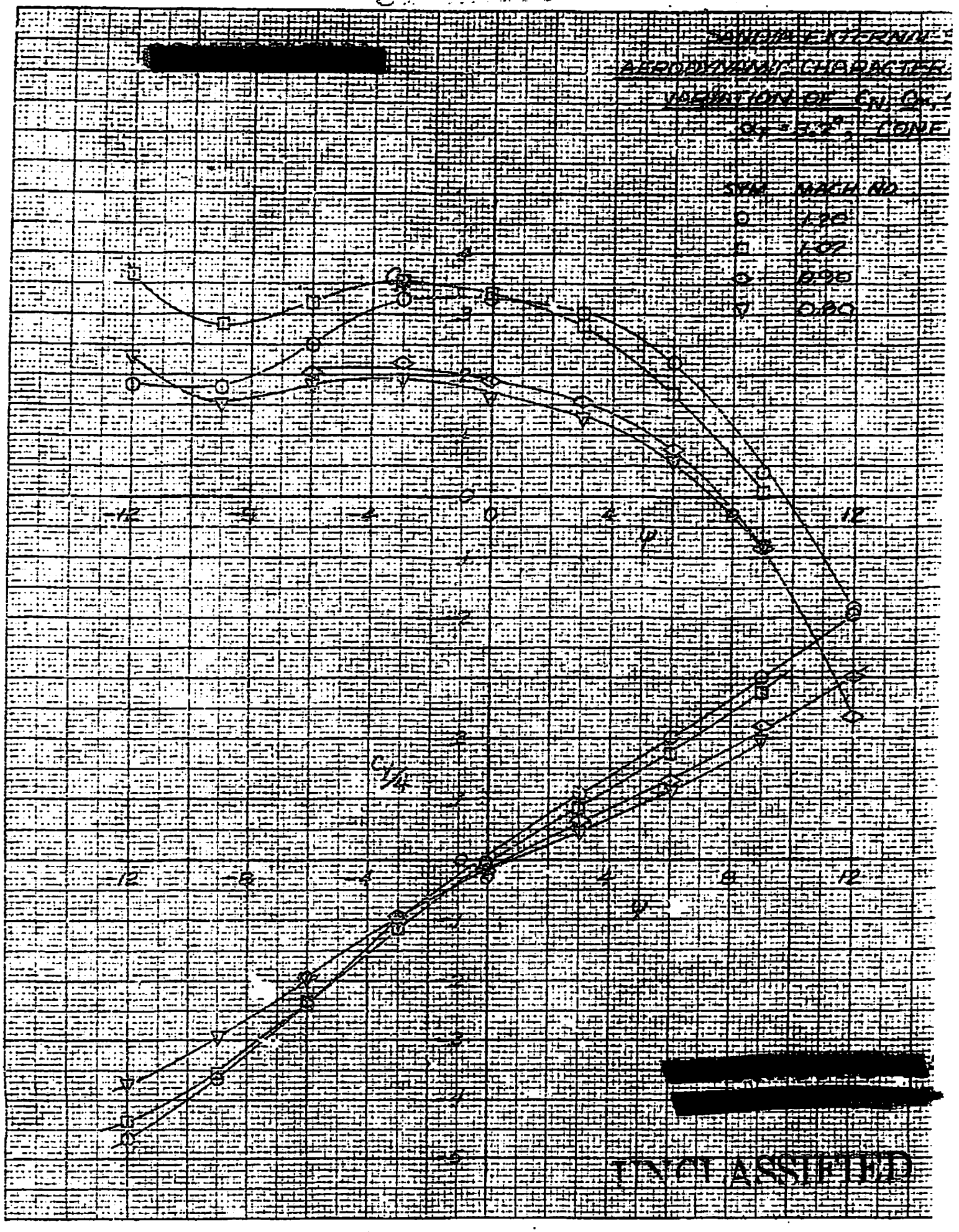

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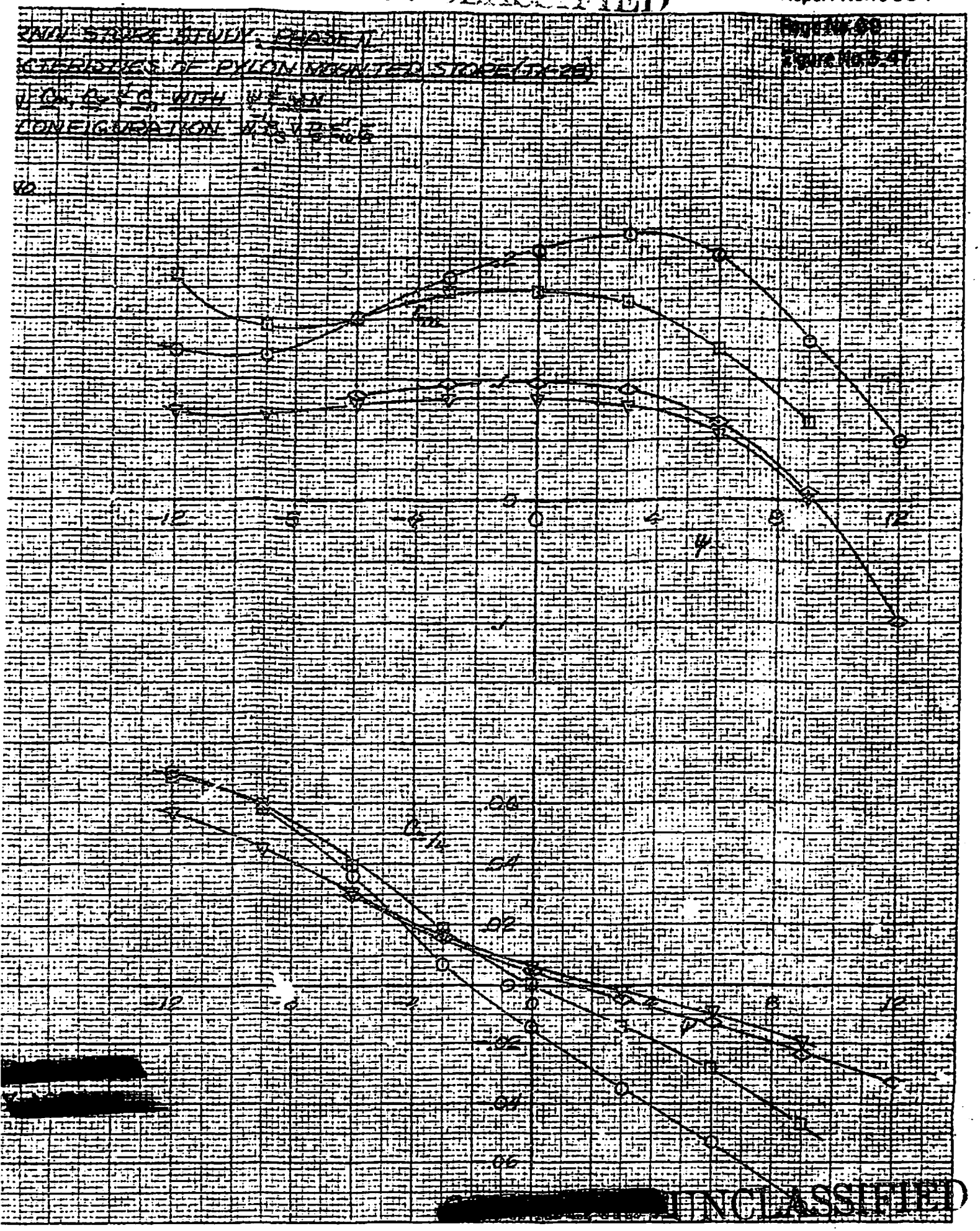

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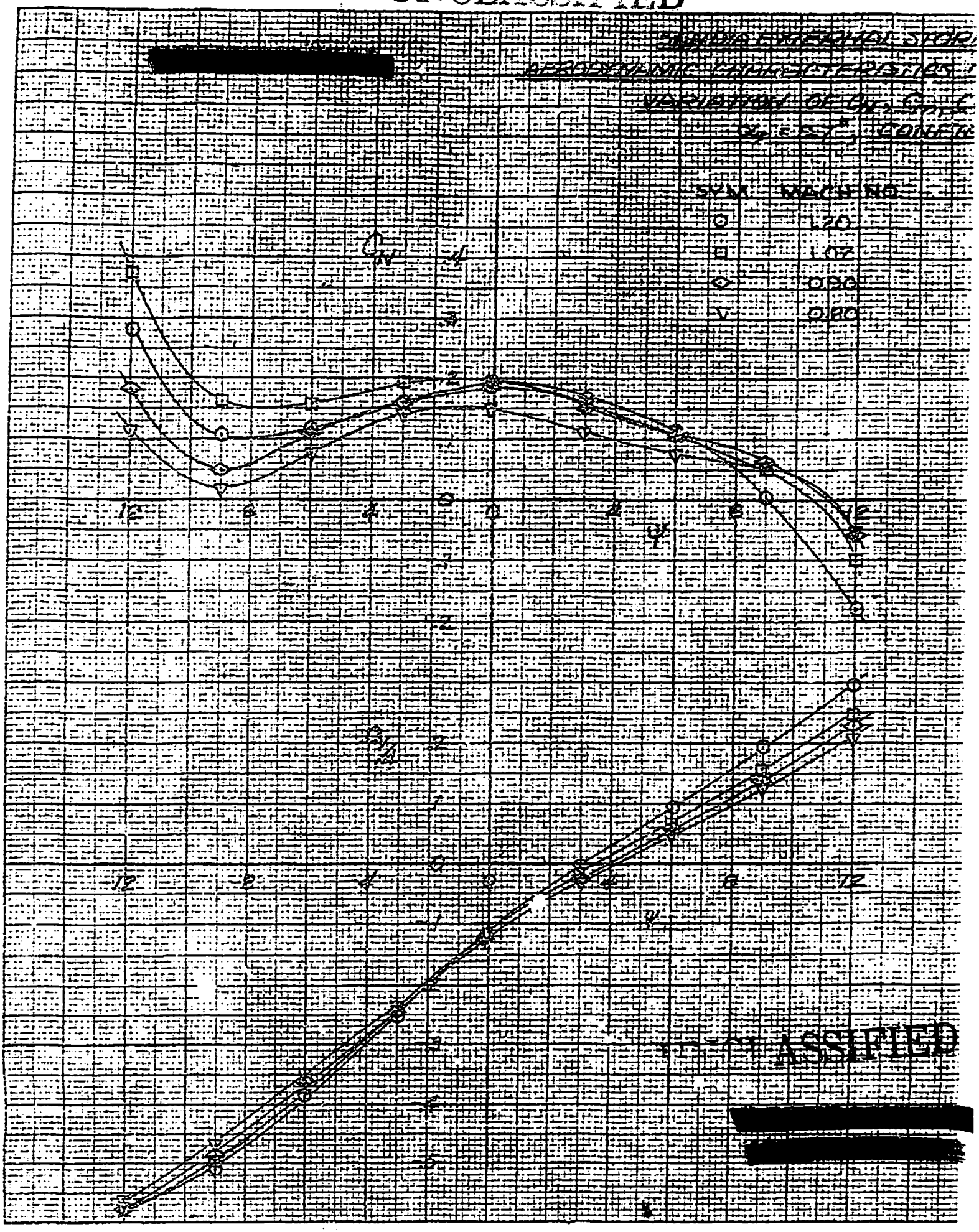

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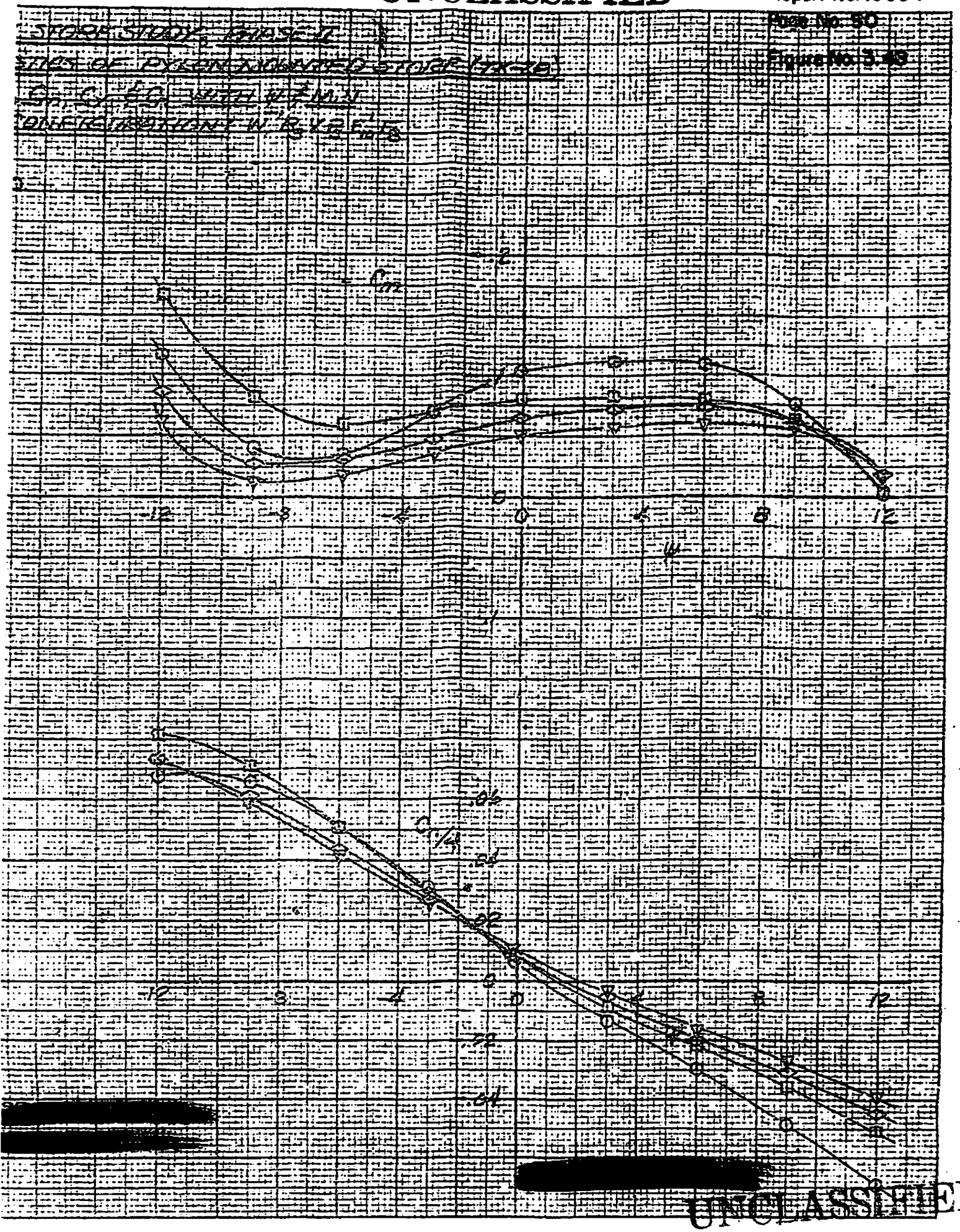

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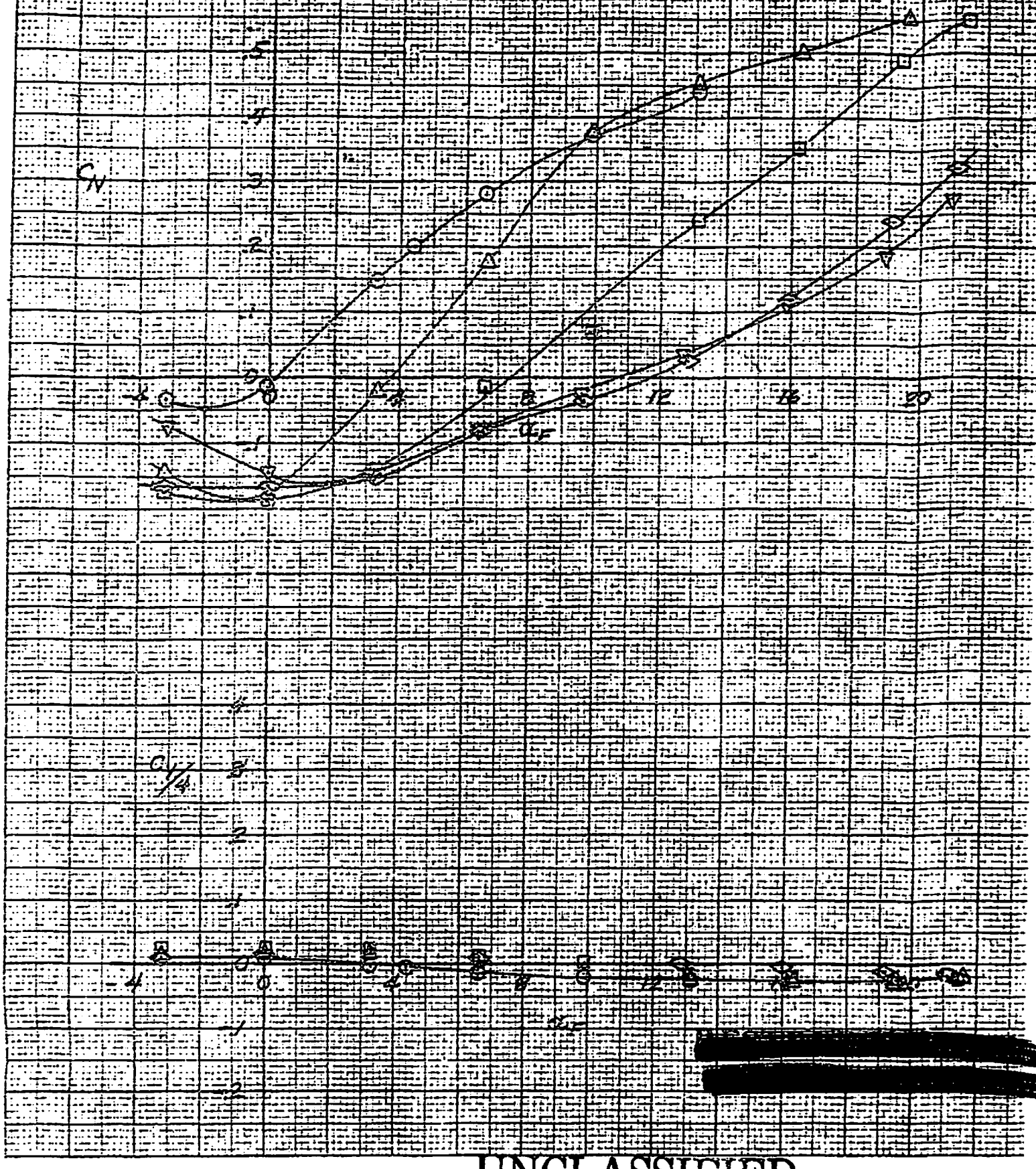
SANDIA EXTERNAL
AERODYNAMIC CHARACTERI
VARIATION OF C_N, $C_{m_{c/4}}$
$\alpha = 0$, CONFIGURE



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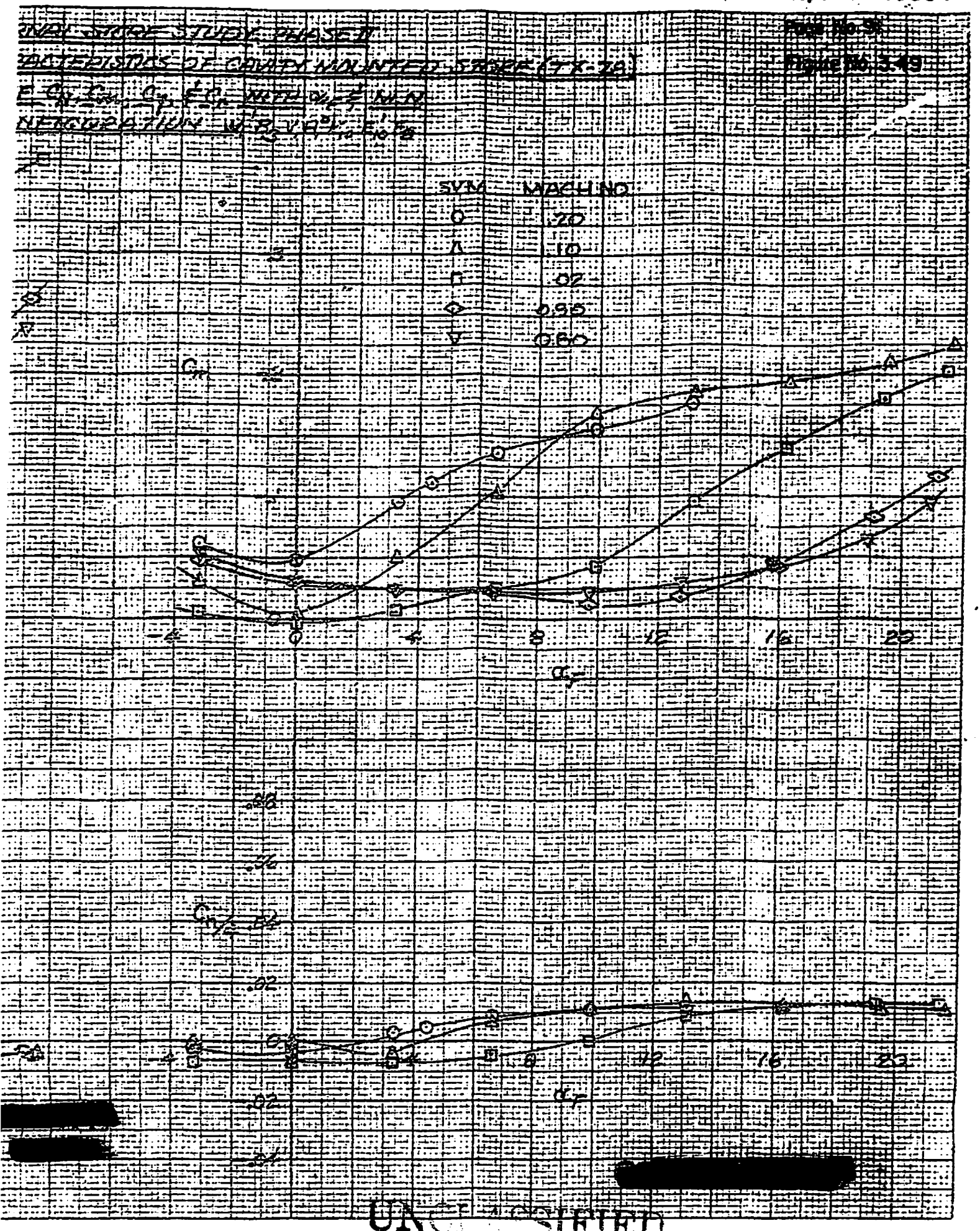
Page No. 5

Figure No. 3.49



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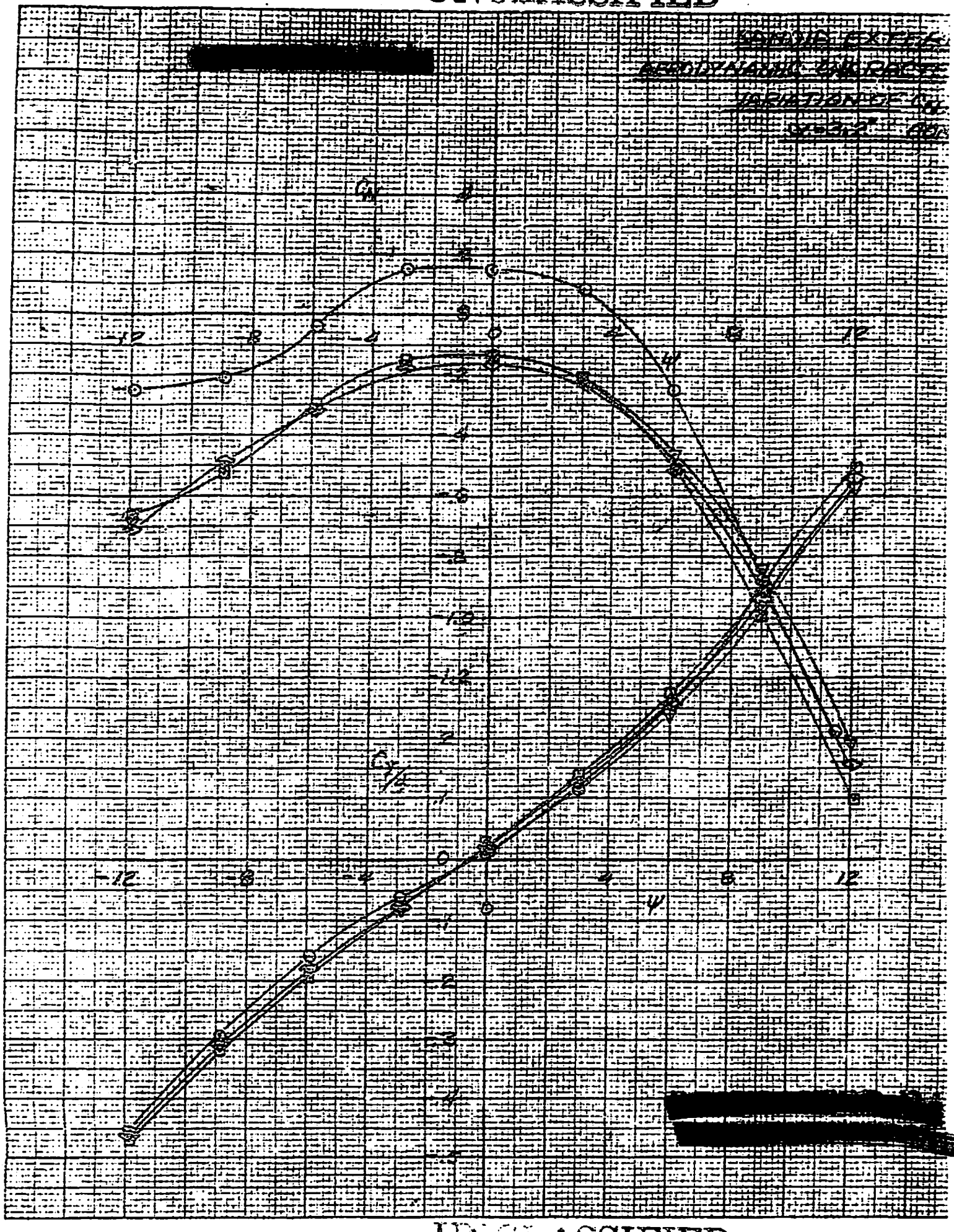

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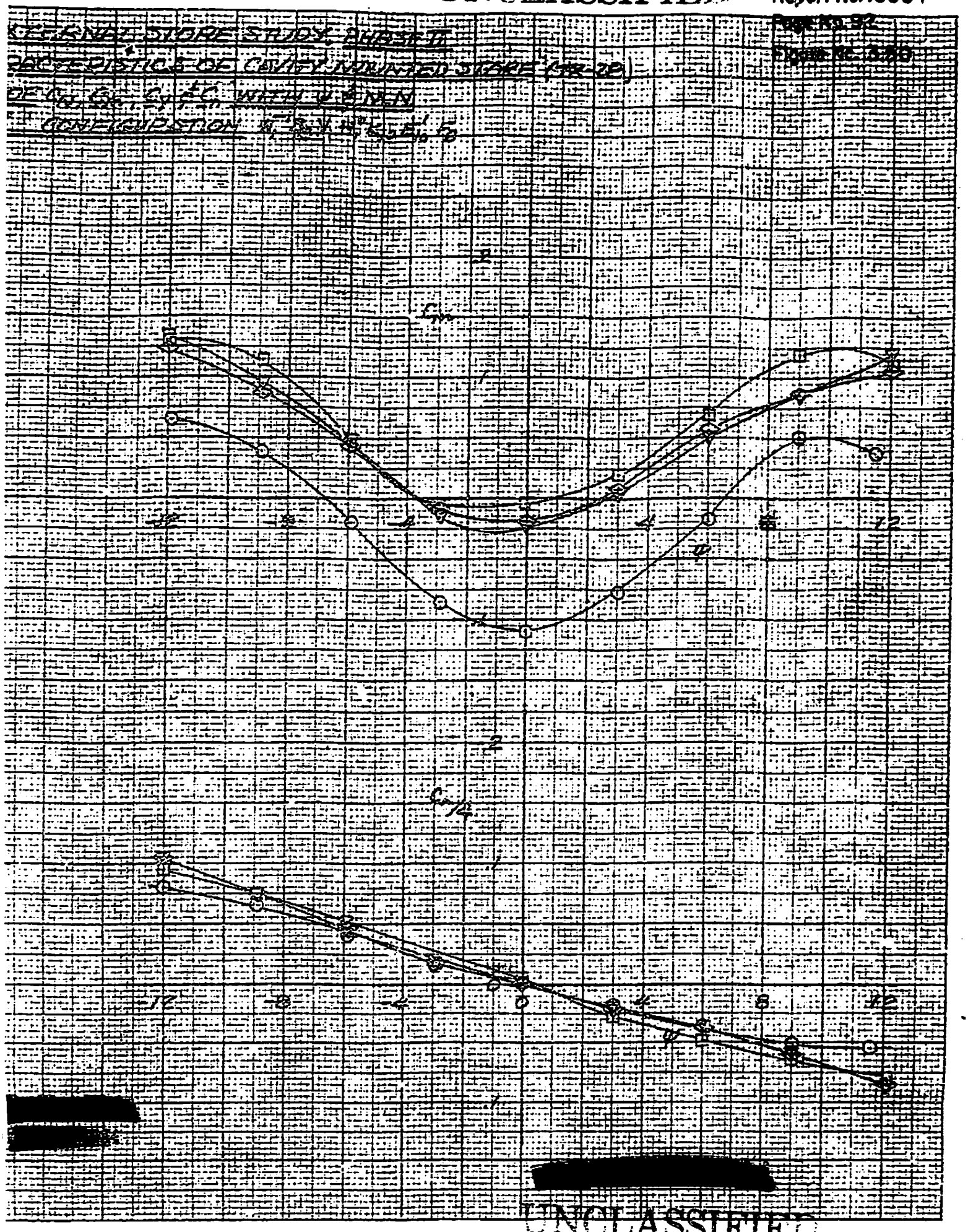

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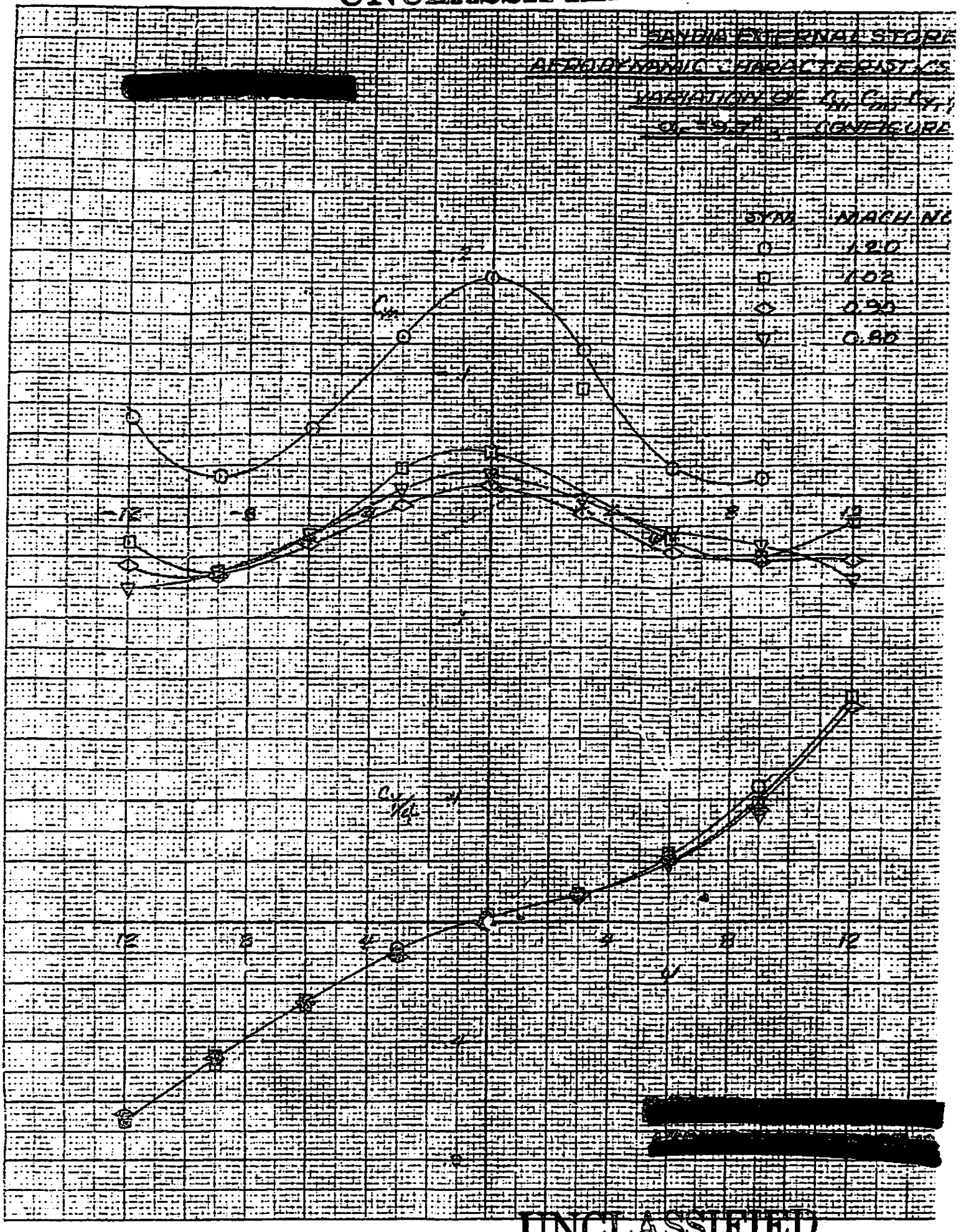

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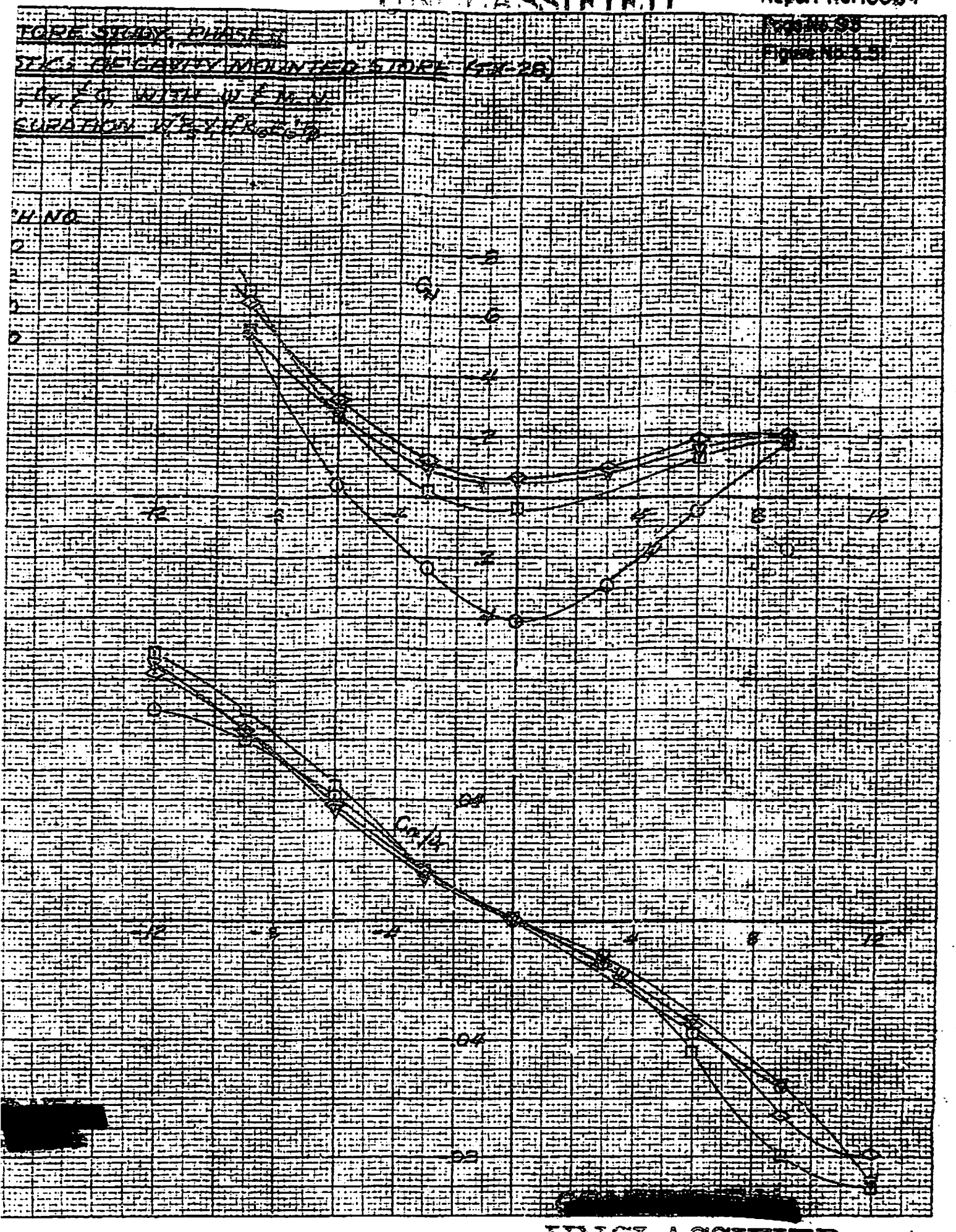
TORE STORE, PHASE
STIC: RECESSED MOUNTED STORE (GX-28)
C_L .8
.6
.4
.2
-12
-8
-4
4
8
12
$C_m/14$
.08
.04
-.02

[redacted]

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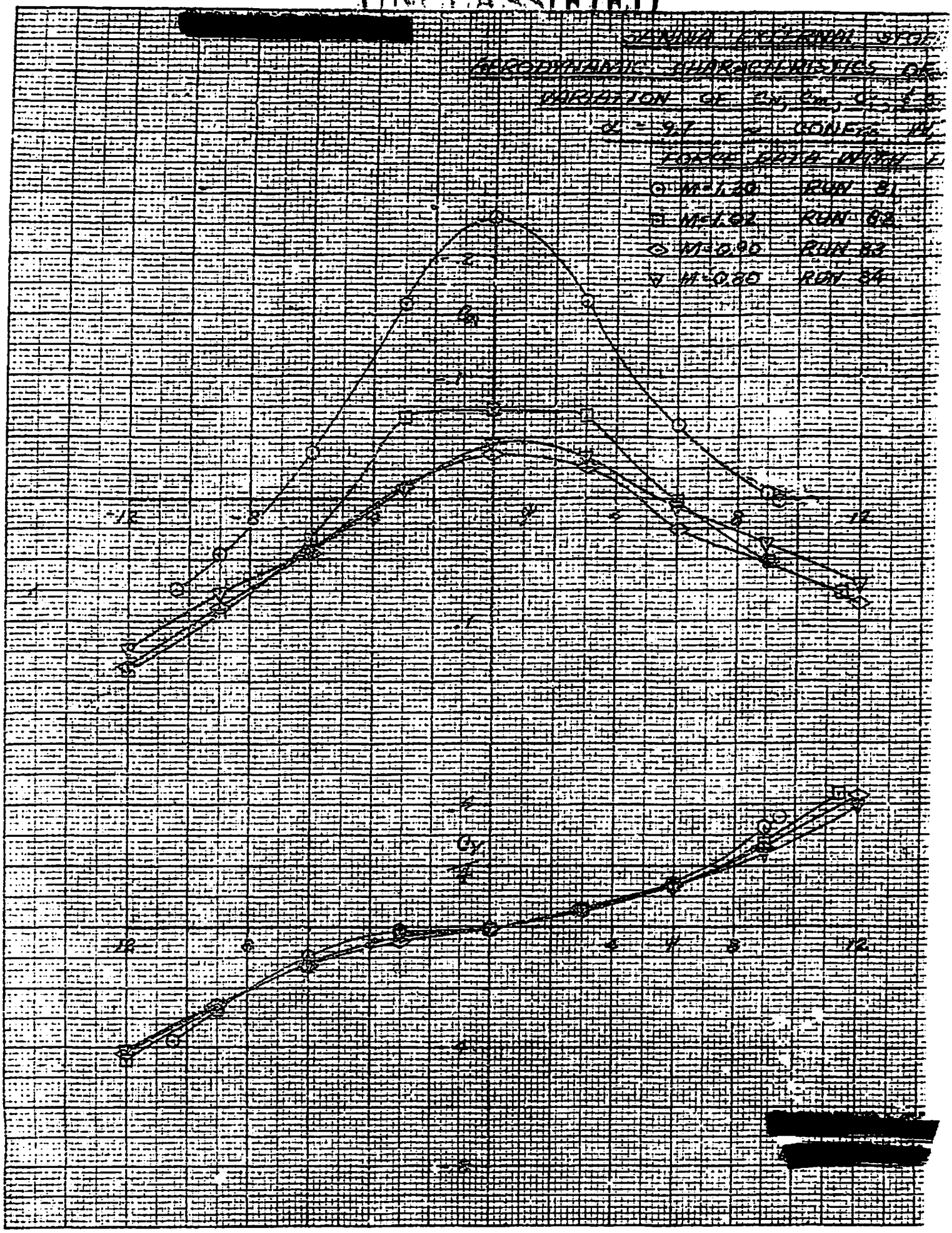
[redacted]



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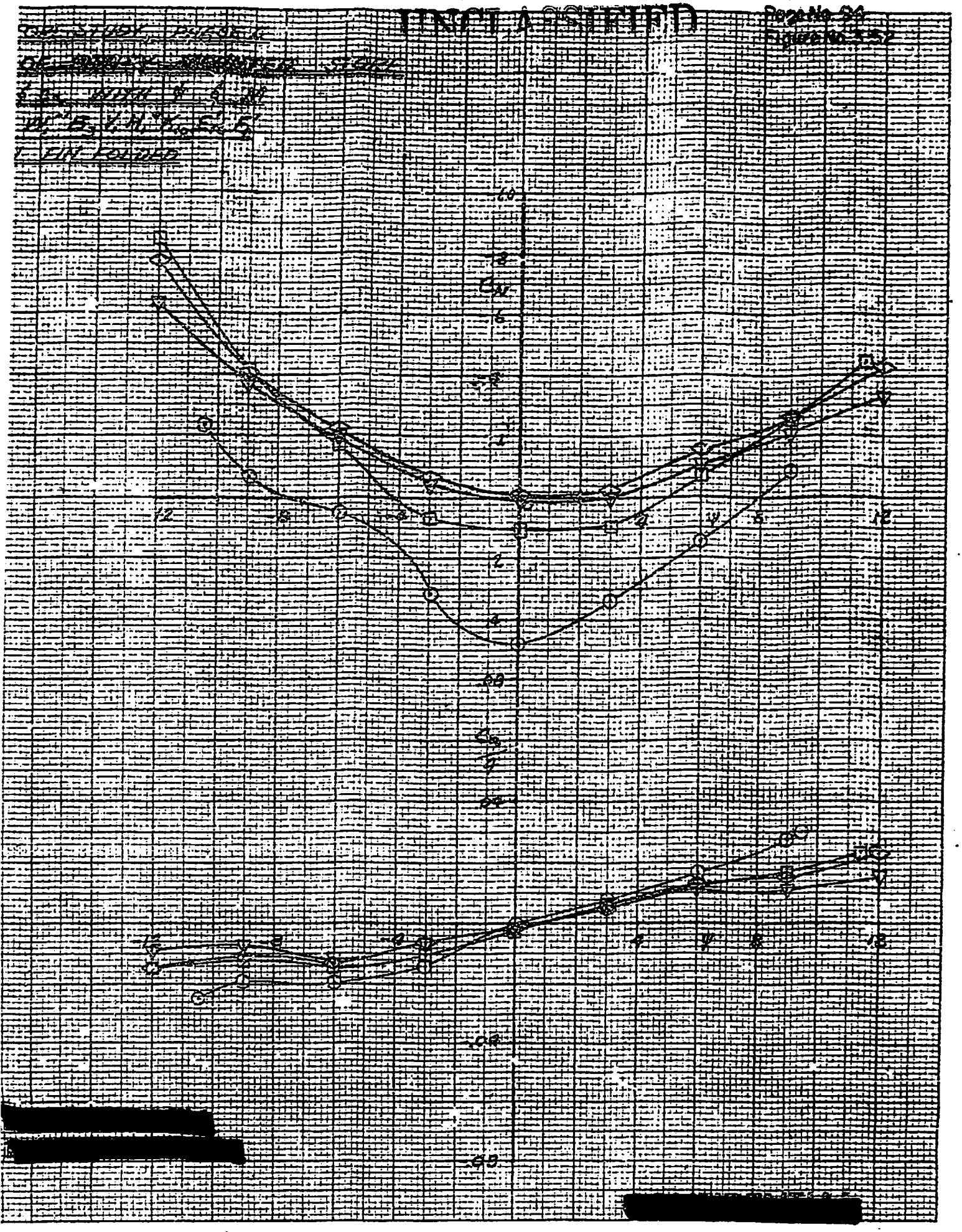

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[redacted]

SANDIA EXTERNAL STORE STUDY, PH

AERODYNAMIC CHARACTERISTICS OF CAVITY

VARIATION OF C_N, C_m, C_Y, & C_n WITH ψ &

$\alpha = 3.2$ ~ CONFIG W, B, V, H, K, E, F, S

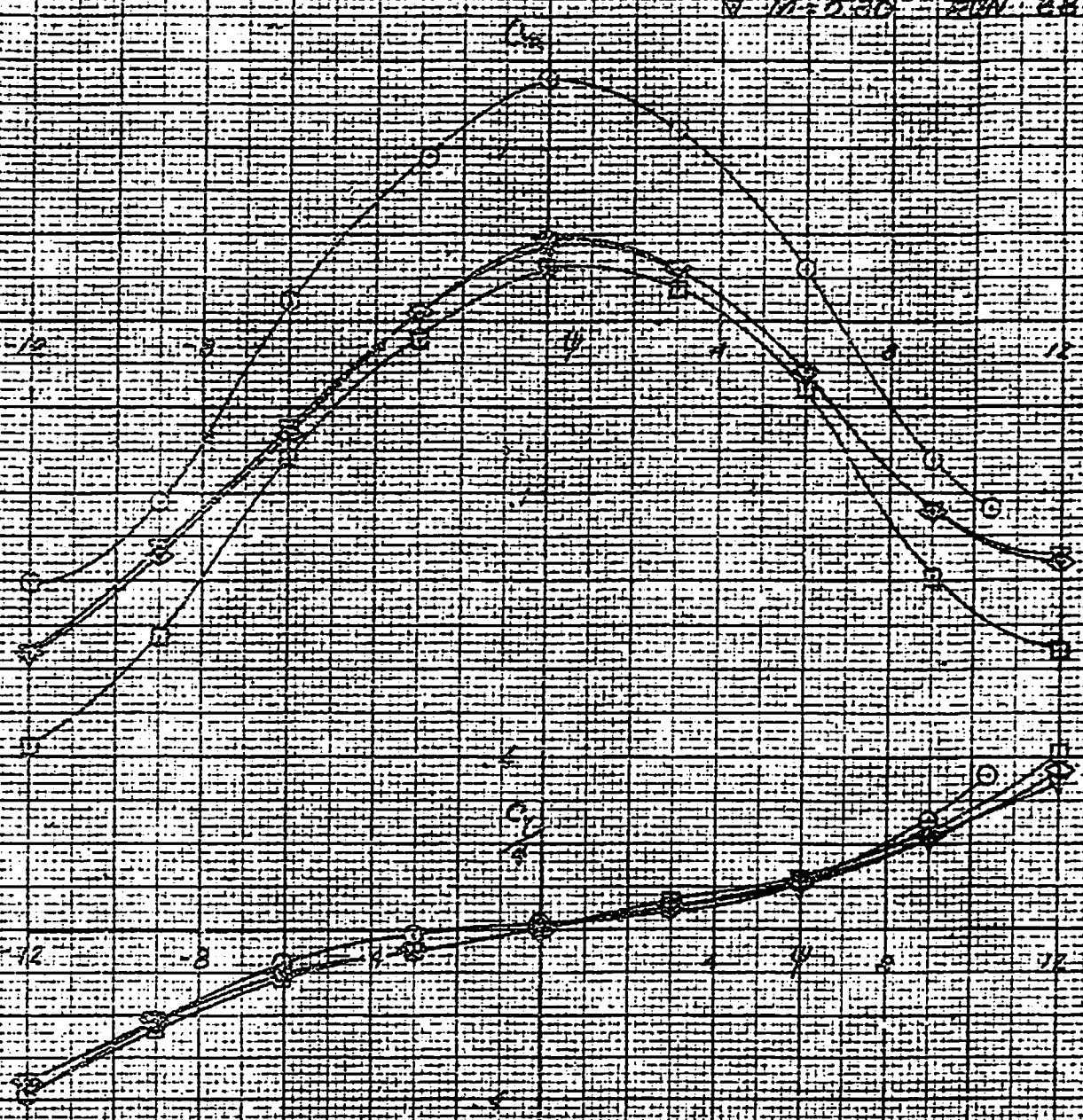
FORCE DATA WITH FIN FOLDED

○ M = 1.20 RUN 85

□ M = 1.02 RUN 86

◇ M = 0.90 RUN 87

▽ M = 0.30 RUN 88



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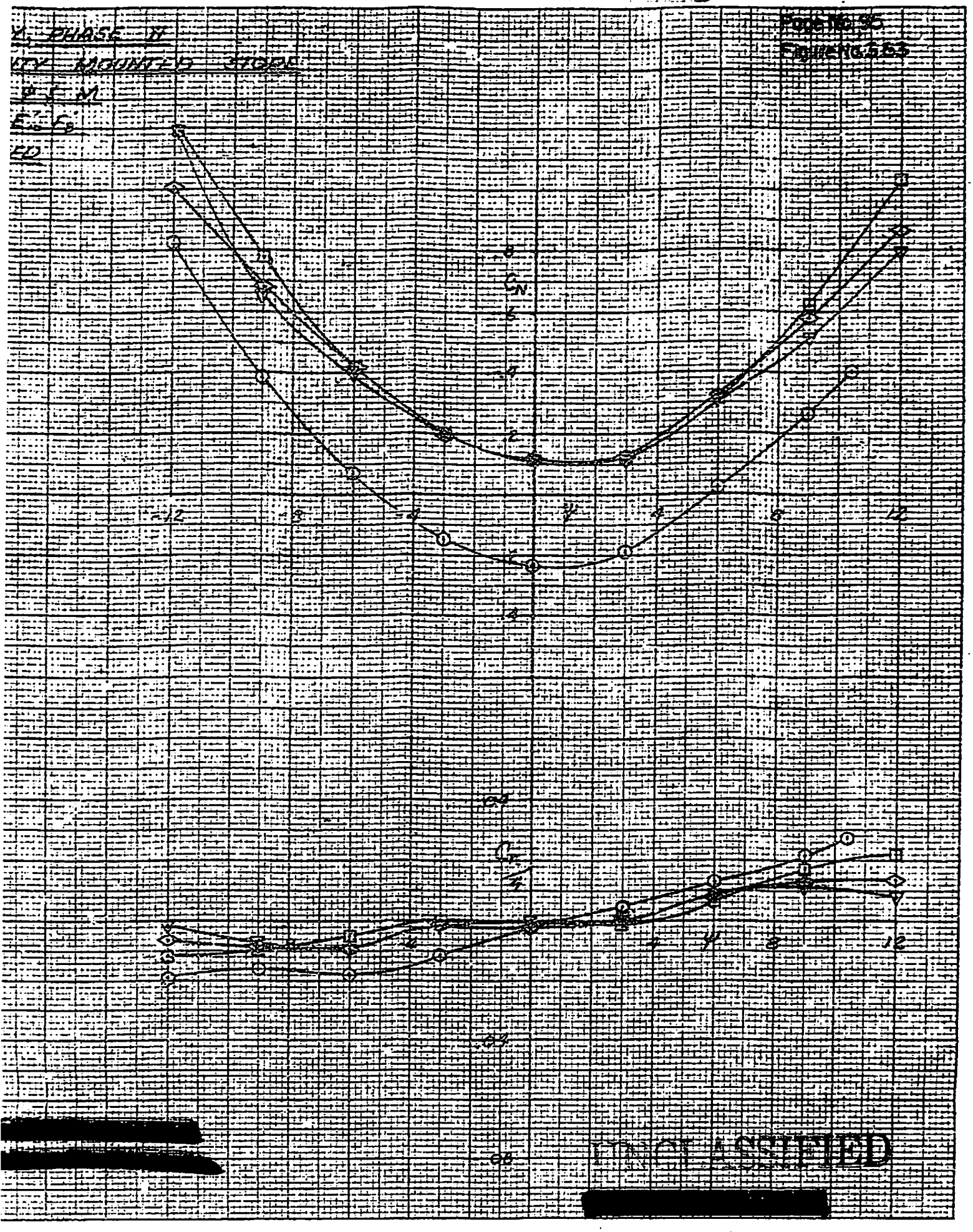

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[redacted]

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3.4 Release and Separation

The information presented in this section is the result of an investigation made to evaluate the release and separation characteristics of the TX-28 store. This investigation was made for the TX-28 store wing-pylon mounted on the F8U-1 airplane and semi-submerged in the fuselage cavity of the V-395 proposed design. The release and separation characteristics of the TX-28 store were evaluated to ascertain if store ejection would be required, where it should be applied on the store, and possible load cycle of the ejector. The criterion used for this investigation was that the level flight releases would represent the most difficult release condition.

The aerodynamic forces acting on the store during separation were determined from high speed wind tunnel tests and included the interference effects between the airplane and the store. Using these data the store motion was evaluated for three degrees of freedom during separation using a step by step calculation programmed for machine computation. The validity of the method of calculation was substantiated through the use of low speed wind tunnel drop tests. The ejection forces required for successful separation were determined over the altitude and speed range where store delivery from the airplanes used in the investigation was believed feasible.

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3.4.1 Store Force Data - The method used in this study to evaluate store release and separation characteristics is a step by step calculation of store motion during separation. In order for these calculations to correctly predict the actual store motion, the interference effects between the store and the carrying aircraft must be taken into account. To obtain data for the store that would include these effects, a high speed wind tunnel test program was conducted at the Cornell Aeronautical Laboratory. The desired data were obtained by separately sting mounting the store and measuring the forces acting on it at various store-airplane separation distances and at various store pitch angles. Pictures of the wind tunnel test setup are presented in figure 1B thru 3B of Appendix B, Volume II of this report. The airplane model was fixed at 3 degrees of fuselage angle of attack, which corresponds to an average airplane attitude for the flight range within which the store would be dropped. These tests were conducted using an .042 scale model of the F8U-1 airplane having a left wing pylon and modified for the fuselage cavity installation. The data were obtained at Mach numbers of 0.8, 0.9, 0.94, 1.02, 1.10, 1.20 for both the wing-pylon and the fuselage cavity installations. Additional data were obtained for the cavity installation with the bottom fin of the store folded as shown in figure 2.2 of section 2.2.

The force data obtained from these tests used in the analysis of the store separation calculation are presented in Appendix B Volume II of this report. The values of store [redacted]

normal force and pitching moment coefficients are presented: for the wing-pylon installation in figures 4B through 13B, for the cavity installation in figures 14B through 23B, and for the cavity installation with the bottom fin folded in figures 24B through 35B.

3.4.2 Method of Calculation - The method of calculation used to evaluate the release and separation characteristics of the TX-28 store as previously stated is a step by step procedure for the store motion in three degrees of freedom. The motion of the store was limited to motion in the vertical plane since very little motion of the store in a sideward direction or yaw would be expected under normal separation conditions. The equations of motion used for these calculations are:

$$\sum F_x = m\dot{V}$$

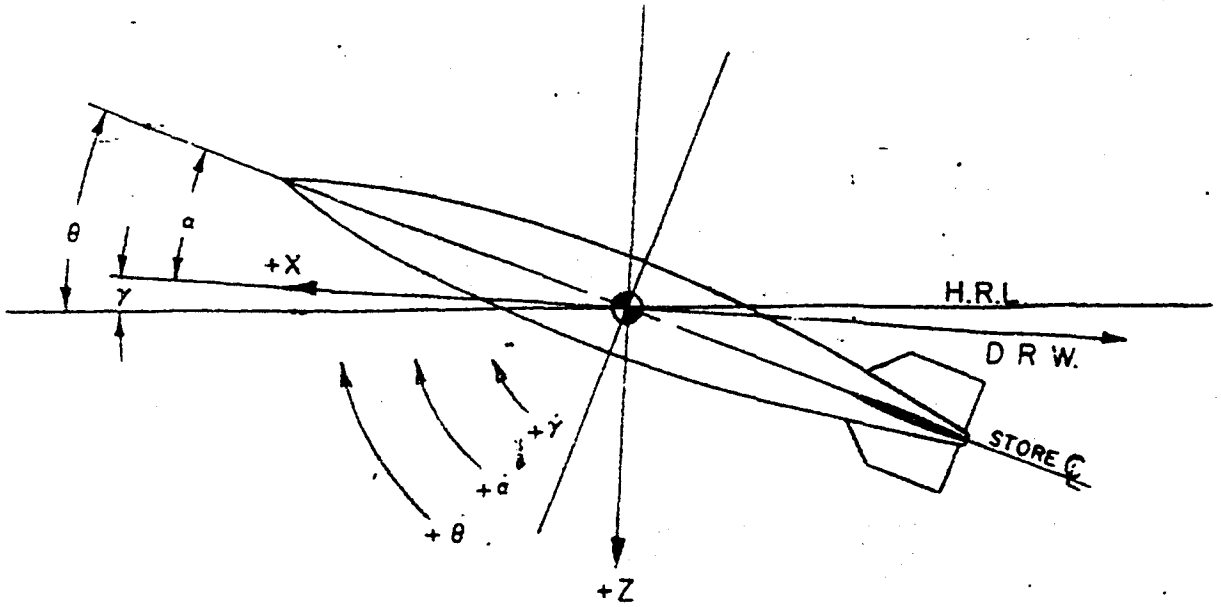
$$\sum F_z = -mV\dot{\gamma}$$

$$\sum M_{C.G.} = \dot{q} I_y$$

$$\dot{\gamma} = \left[\dot{\theta} - \alpha\right]$$

$$\dot{q} = \frac{d\dot{\theta}}{dt} = \ddot{\theta}$$

The axis system used in the calculations is shown sketched below:



Axes System Used for Calculations

The forces acting along the X and Z axes were calculated using the following equations:

$$F_X = -D - m\,g \sin\gamma$$

$$F_Z = -L + m\,g \cos\gamma$$

where: $L = C_L\, q\, S_\pi$

$D = C_D\, q\, S_\pi$

where: $C_L = C_N \cos\alpha_s - C_X \sin\alpha_s$

$C_D = C_X \cos\alpha_s + C_N \sin\alpha_s$

The moment acting about the C.G. of the store was calculated using the following equations.

M c.g. = M pitching + M damping + M ejection

where

M pitching = $C_{m_s} q S_\pi l_s$

M damping = $C_{m_{\alpha_f}} \frac{l_t \dot{\alpha}}{V} q S_\pi l_s$

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M ejection $=(F_e)(a_e)$

The values of store normal force and pitching moment coefficient (C_{N_s} & C_{m_s}) were obtained from the wind tunnel test data. The value of C_x for the store was assumed to be the store's free flight C_{D_o} at the corresponding Mach number. The value of the slope of pitching moment coefficient of the store's fins with store angle of attack ($C_{m_{\alpha f}}$) was estimated to be -2.84 per radian. The ejection force was included in the calculations in the following form.

$$F_e = KZ + b$$

The value b is the ejection force at the beginning of the ejector's stroke, K is the rate of change of ejector force with stroke and Z is the amount of stroke at any instance. The value of Z for ejector is a function of the store-airplane separation distance (η) and store pitch angle relative to the initial position. The value of Z was calculated using the following expression.

$$Z = \eta + a_e \sin(\theta - \theta_o)$$

where

θ_o is the store pitch angle at the beginning of ejection.

These calculations were made step by step as a function of time. The increment between each step was .01 seconds. The

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distance the store moves along the flight path during the time between t_i and t_j was calculated using the following equation:

$$\Delta X_{i-j} = V_i \Delta t + 1/2 \dot{V}_{i-j} \Delta t^2$$

The angle the store pitched during the time between t_i to t_j was determined as follows:

$$\Delta \theta_{i-j} = \dot{\theta}_i \Delta t + 1/2 \ddot{\theta}_{i-j} \Delta t^2$$

The separation distance obtained in a given time increment t_i to t_j was determined assuming that the airplane continues on a level flight path when the store is released The distance the store has separated fromthe airplane in the vertical direction (η) and moved relative to it horizontally (ζ) were determined using the following expressions:

$$\eta_{i-j} = X_{i-j} \sin\left[\gamma_i + \frac{\Delta\gamma_{i-j}}{2}\right]$$

$$\zeta_{i-j} = X_{i-j} \cos\left[\gamma_i + \frac{\Delta\gamma_{i-j}}{2}\right] - V_0 \Delta t$$

where

$$\Delta\gamma_{i-j} = \dot{\gamma}_i \Delta t$$

3.4.3 <u>Validation of Separation Calculation</u> - Before the results for the calculated store motion could be considered as valid, an independent check was believed necessary. This check was accomplished by comparing the store motion obtained from low speed wind tunnel store drop tests with that

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predicted by calculations for similar drop conditions.

Drop tests were made using the TX-28 store configuration scaled for simulation of full scale separation. Tests were made for both store installations being investigated. The comparison data were obtained from the drop tests by taking multiple exposure photographs of the store model during separation. The distances and store pitch angles were then scaled from these pictures. A complete description of the drop tests program is presented in Part II of Appendix E, Volume II of this report.

In calculating the store motion under similar drop conditions for comparison with the wind tunnel drop data the small effect of Reynolds number was neglected. Mach number effects were also neglected since the aerodynamic data used in the calculations were obtained at a Mach number of 0.8 where compressibility effects are small. To obtain calculated data that would be directly comparable with those of the wind tunnel drop tests requires the use of the correctly related values of air density (ρ) and velocity (V). The important parameters for comparing the full scale calculated store separations with those obtained from the wind tunnel are:

$$\mu = \frac{m}{\rho \lambda^3} = \frac{W}{\rho g \lambda^3} \qquad (1)$$

$$F = \frac{V^2}{g \lambda} \qquad \text{(Froude number)} \qquad (2)$$

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[redacted]

REVISION DATE:

These parameters require that if the computed store motion is to be comparable to the wind tunnel drop tests then the following must be true:

$$\left[\frac{m}{\rho\, l^3}\right]_{model} = \left[\frac{m}{\rho\, l^3}\right]_{full\ scale} \qquad (3)$$

and

$$\left[\frac{V^2}{l\, g}\right]_{model} = \left[\frac{V^2}{l\, g}\right]_{full\ scale} \qquad (4)$$

Using the conditions obtained from equation (3) and (4) calculations were made and the results compared with the wind tunnel data. Comparison plots of the store pitch angle versus store-airplane separation distances are presented in figures 3.54 through 3.57. Data are presented for four effective values of dynamic pressure (q = 142, 284, 556, and 890) with and without ejection for both installations. Data presented for the high effective values of dynamic pressure (q = 556 and 390) do not represent actual flight conditions since the effective air density for these cases (ρ = .0072) cannot be obtained in flight.

As previously stated the object of comparing the calculated data with wind tunnel drop data was to check the validity of the calculations for predicting actual store motion during separation. For this check to be useful, the effective

forces acting on the wind tunnel drop model must be the same as obtained full scale at the same conditions. There were, however, some forces encountered during the drop tests that would not be obtained full-scale. The most important of these forces was the preloading of the store obtained when it was attached to the airplane model. This preloading caused the store model to have initial pitching velocities that would not be obtained in an actual full-scale drop. Due to the nebulous nature of these preloadings, no attempt was made to correct for them. The effects of store preloading were reduced as the dynamic pressure (q) is increased since the store motion becomes more a function of the aerodynamic forces. It therefore follows that at the higher values of q the wind tunnel drop tests data should more nearly represent full-scale store motion. The comparison of the calculated data with the wind tunnel data at the high values of q should be the best. The data presented in figures 3.54 through 3.56 show this to be true.

The calculated and wind tunnel test data do not agree as well for the cases with ejection as for those without. This is due to difficulties encountered in determining the ejection forces to use in the calculations that would match those used for the drop tests. The exact ejection force used in the drop tests could not be determined due to fabrication tolerances and friction in the model's spring ejector. The

ejection forces used for the calculations were, therefore, only approximately equal to those used in the drop tests.

In the light of the above, the comparison of the two sets of data is very favorable. The conclusion drawn from these comparisons is that the method of calculation used will predict store motion during separation to the accuracy desired in order to predict ejection forces required for use in store design.

3.4.4 Store Separation Characteristics - The store separation characteristics were evaluated for both the fuselage cavity and wing-pylon installation. The separation characteristics were first calculated for the store separation with no ejection and then with various amounts of ejection force until the desired characteristics were obtained. In evaluating the store separation characteristics consideration was concentrated on the store pitch angle as a function of vertical separation distance. The store motion aft relative to the carrying airplane was in all cases of such small magnitude in the vicinity of the airplane that it has little significance in the store separation problem. It should be realized that this is true for the TX-28 store and the particular flight range of the carrying airplanes used in this study. Less dense stores, higher speeds, or different types of

installations could cause the store motion aft relative to the carrying airplane to become important.

3.4.1.1 Cavity Installation - The store separation from the cavity installation with no ejection is shown in figure 3.57 for four Mach numbers: 0.8, 1.02, 1.10, 1.20 at four altitudes 5000 ft., 15,000 ft., 25,000 ft., and 35,000 ft. The tabulated data for these calculations are presented in runs 1 thru 15 of Appendix D, Volume II of this report. The calculations were made for only these Mach numbers since the store force data are essentially constant below a Mach number of 0.94. For all conditions shown, the store pitches only slightly (maximum of 8 degrees) as it separates. This installation could possibly be used with no ejection; however, it is believed desirable to apply some ejection force to the store to account for release conditions that were not investigated. An ejection force of a constant 9000 lbs. acting through an ejector stroke of 0.5 ft. was chosen. The separation characteristics for the store with ejection are shown in figure 3.58 and the tabulated data for these calculations are presented in runs 16 thru 30 in Appendix D. The ejection force acts at the c.g. of the store, thus the store motion is very similar to the no ejection drops.

The TX-28 store when carried in the cavity of the V-395 proposed design must have its bottom vertical fin folded during takeoff and landing as shown in figure 2.2 of section 2.2. The folded fin can be either opened during flight, before the store is dropped, or made to open automatically upon release. The store separation characteristics discussed above are for

the case where the bottom fin is actuated to the open position before release. To evaluate the separation characteristics of the store when the bottom fin is folded at release and automatically actuated as it separates, force data were obtained for the fin folded at various separation distances from the wind tunnel tests as shown in figures 24B through 35B in Appendix B. Separation calculations were, however, not made for this case since the force data for the fin folded or open are essentially the same indicating that the separation characteristics would also be the same.

3.4.4.2 Wing-Pylon Installation - The store motion during separation from the wing-pylon installation with no ejection is presented in figures 3.59 and 3.60 and the tabulated data from the calculations are presented in runs 31-50 of Appendix D. The store upon release pitches nose down. This nose down motion increases in magnitude as the dynamic pressure and Mach number are increased. Separation characteristics for these drops with no ejection force are unsatisfactory since damage to the airplane or store or both would probably result. The problem incountered with the pylon installation is a severe nose down motion of the store. To overcome this an ejection force was applied behind the C.G. of the store. The store separation motion was evaluated for various ejection forces applied at various points on the store. Because the store's separation motion is a function

of Mach number and release altitude, the ideal ejector would vary the point of application and the force to fit the condition of release. This type of ejector is not considered practical and an ejector with a fixed load cycle and point of application to the store was chosen. The ejector design picked was a compromise between the ideal ejector design required for high-speed-low altitude releases and the ideal ejector required for low speed-high altitude releases. The use of an ejector design based upon high speed-low altitude release requirements would cause the store when released at low speeds-high altitudes to pitch nose up to such a degree as to be unexceptable. Likewise if the ejector design were based upon the low speed-high altitude release requirements, the nose down pitching tendency at the high speed-low altitude release condition would not be corrected. The compromised ejector design chosen for use throughout the release flight range has a constant force of 10,000 lb. and acts 0.5 ft. aft of the store's C.G. with a stroke of 1.0 ft. The store separation motions using this force are presented in figures 3.61 and 3.62 and the tabulated data for the calculations are presented in runs 51-70 of Appendix D. The store motions obtained for a Mach number of 1.20 at the low altitudes and Mach number of 0.8 at the high altitudes represent the worst conditions. These release conditions are, however, not within the flight range where store releases from the F8U-1 airplane are considered practical.

The F8U-1 airplane has no bombing equipment providing level bombing capability at any altitude and flights will not be made at Mach numbers of 1.20 at low altitudes with the store on.

3.4.5 Ejector Load Cycle - The ejector load cycles used in the calculations are presented in figure 3.63. These load-stroke cycles are not what would be expected for an actual ejector. To evaluate the peak ejector force the store would receive from an actual ejector an ejector system similar to that employed on the Chance Vought F7U-3 airplane was assumed applicable. Typical load-stroke cycle for the F7U-3 ejector rack are presented in figure 3.64. Using these curves as a guide the peak ejector loads acting on the store to produce essentially the same separation characteristics as calculated were estimated to be approximately twice the values presented for the constant load-stroke cycles used in the calculations. The cavity ejector would therefore apply a peak ejector load to the store of 18,000 lb. and the pylon ejector a peak value of 20,000 lbs.

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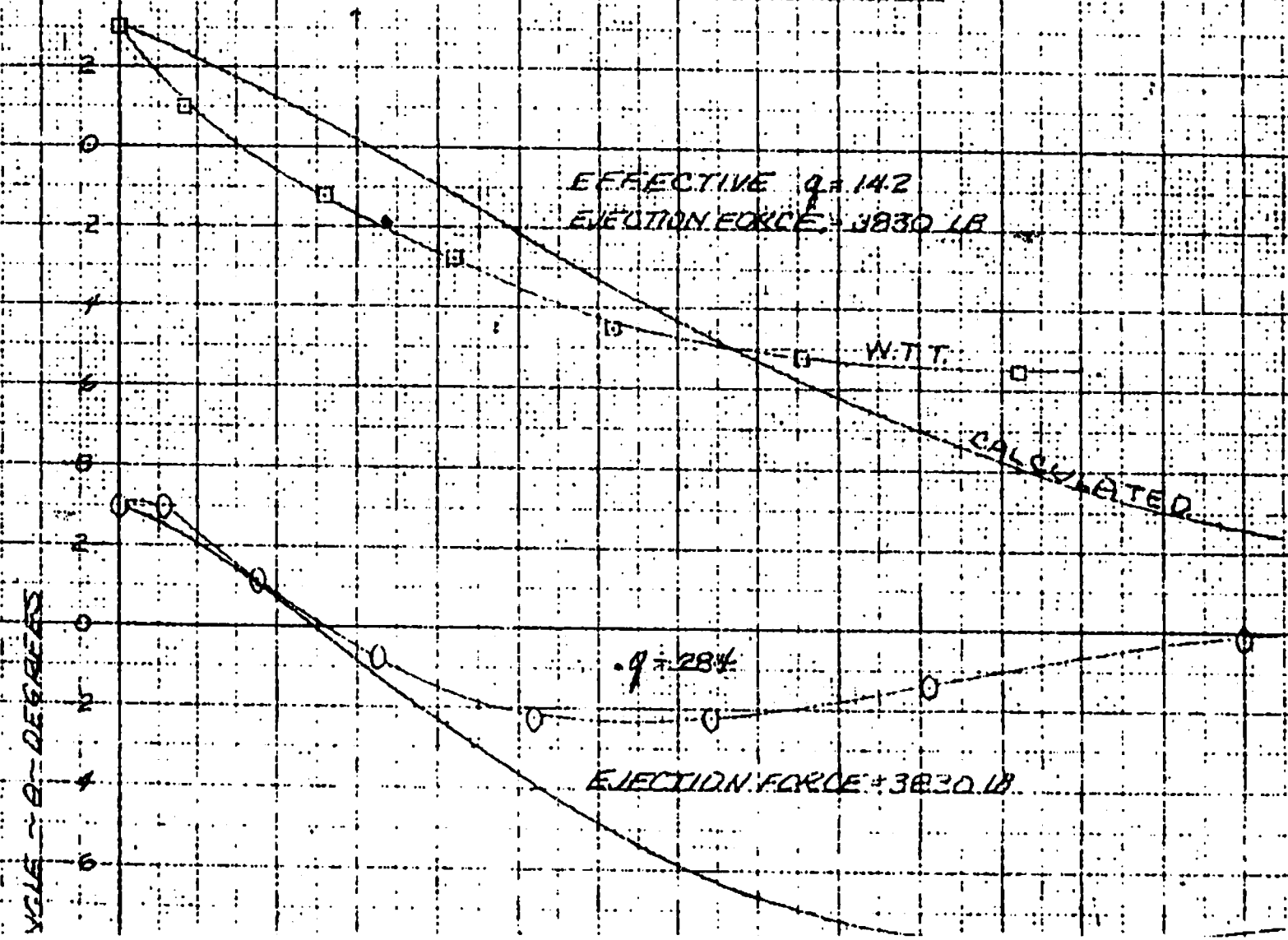
SANDIA EXTERNAL STORE STUDY PHASE II

STORE TRAJECTORIES

COMPARISON OF STORE TRAJECTORIES OBTAINED FROM LOW SPEED WIND TUNNEL DROP TESTS AND CALCULATED USING HIGH SPEED WIND TUNNEL FORCE DATA WITH EJECTION CAVITY INSTALLATION



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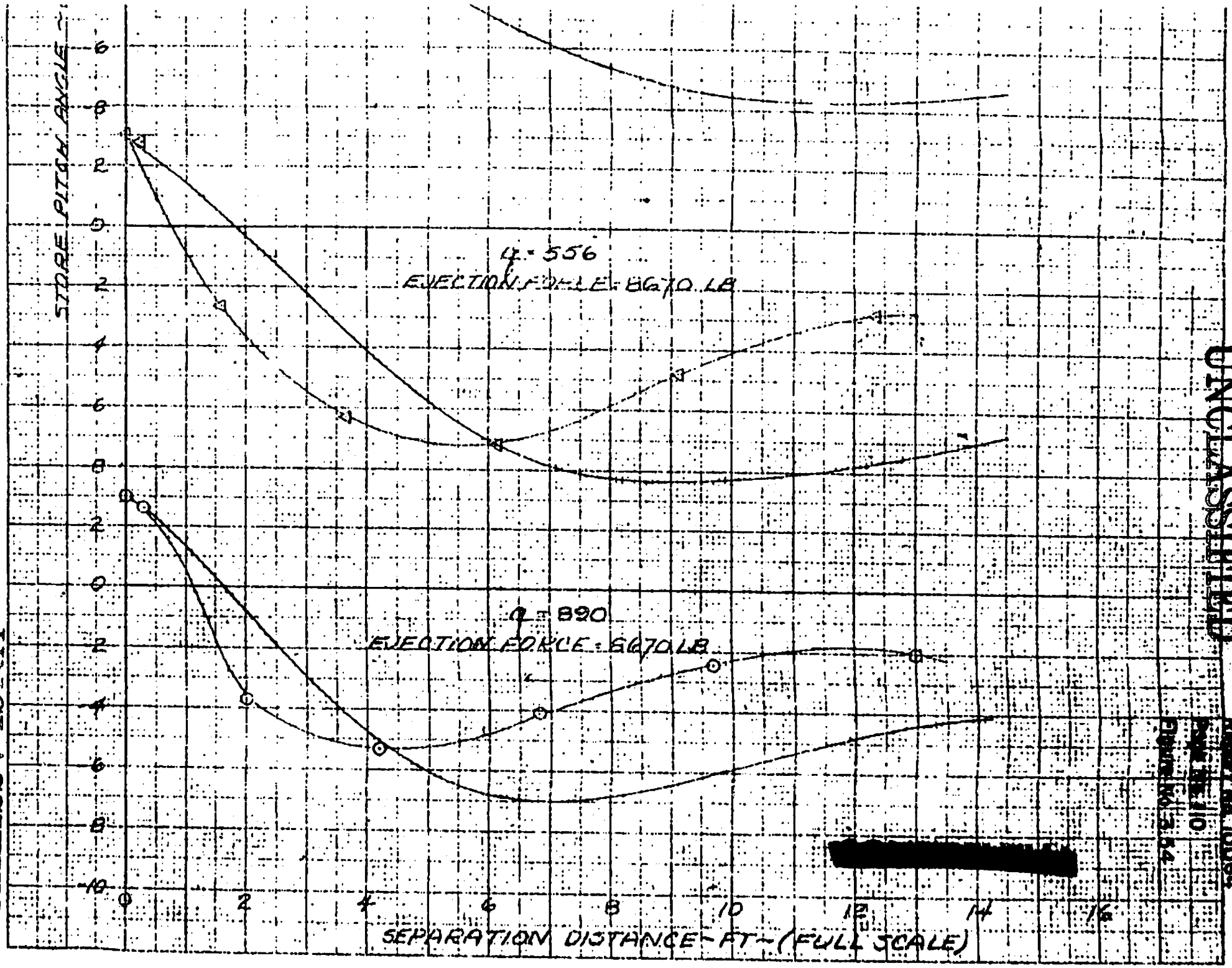

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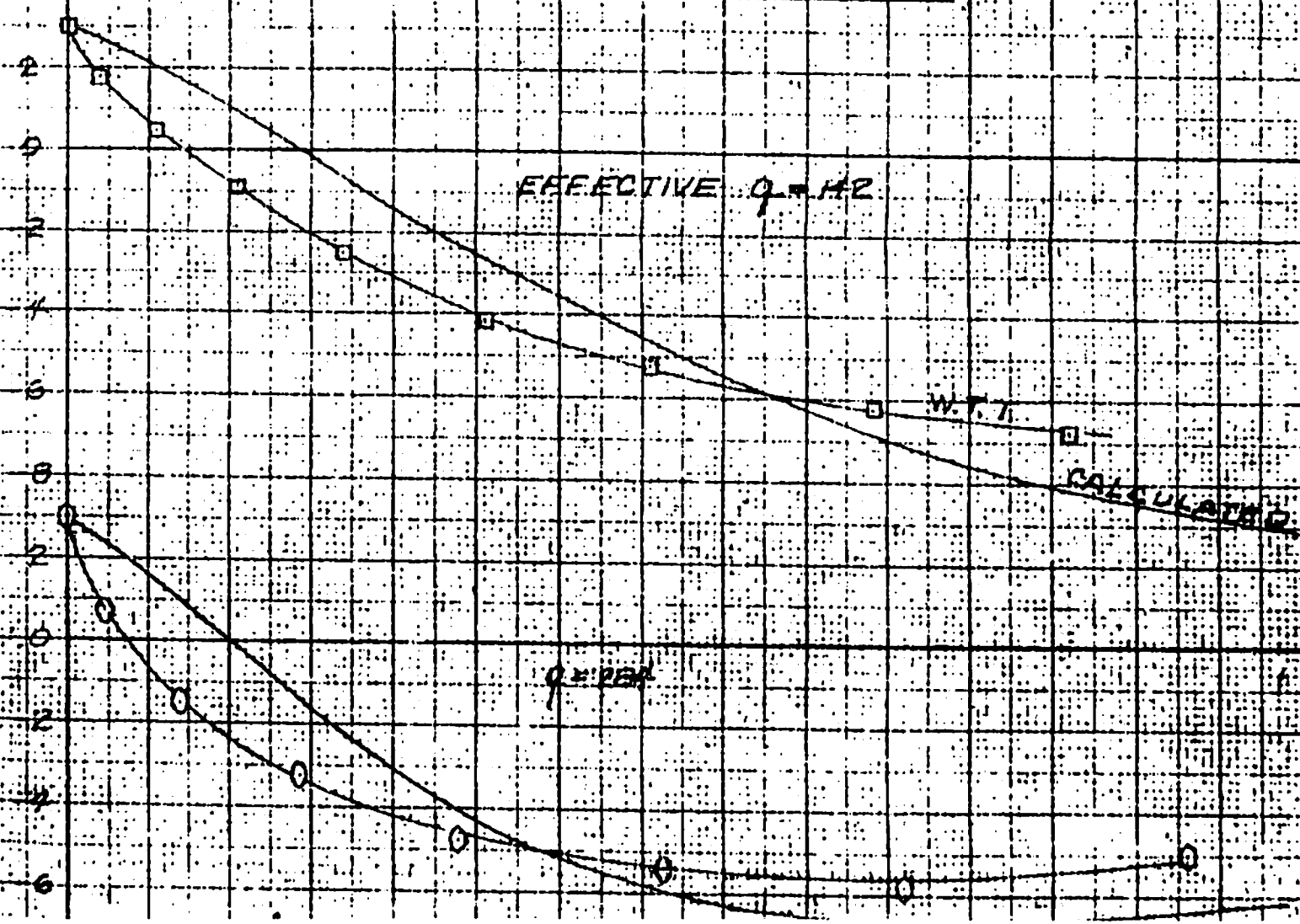
SANDIA EXTERNAL STORE STUDY PHASE II

STORE TRAJECTORIES

COMPARISON OF STORE TRAJECTORIES OBTAINED FROM LOW SPEED WIND TUNNEL DROP TESTS AND CALCULATED USING HIGH SPEED WIND TUNNEL FORCE DATA

NO EJECTION

CAVITY INSTALLATION



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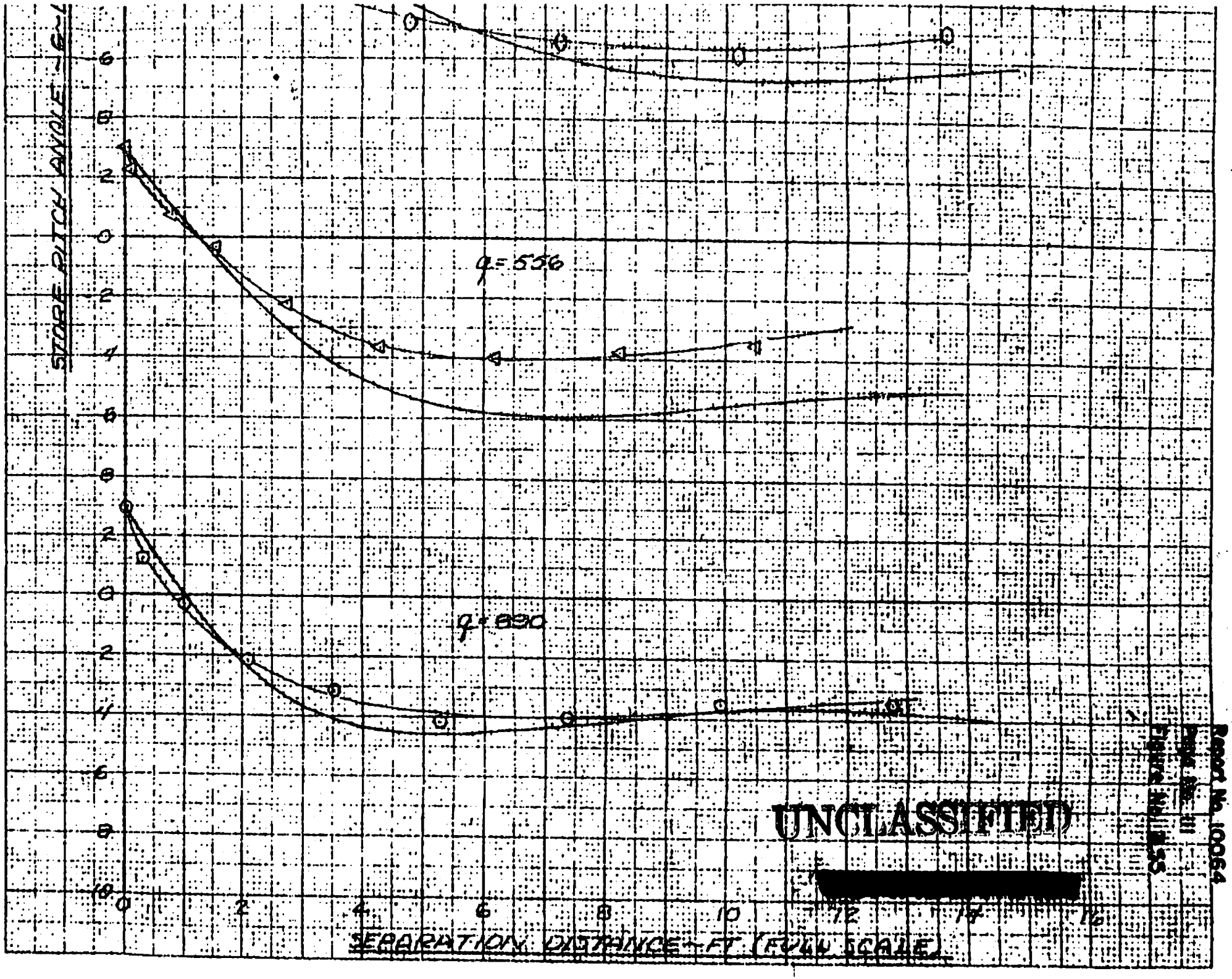

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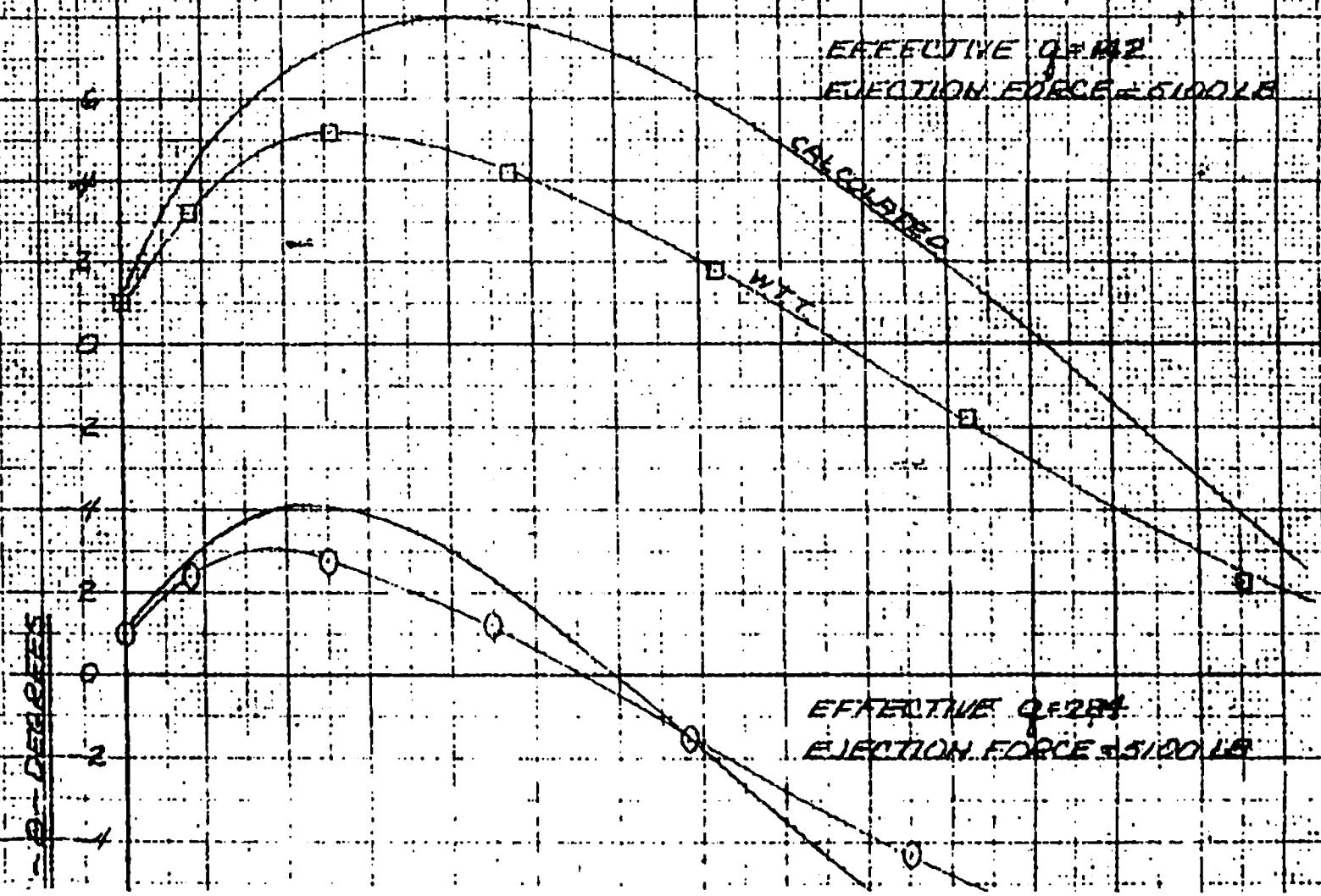
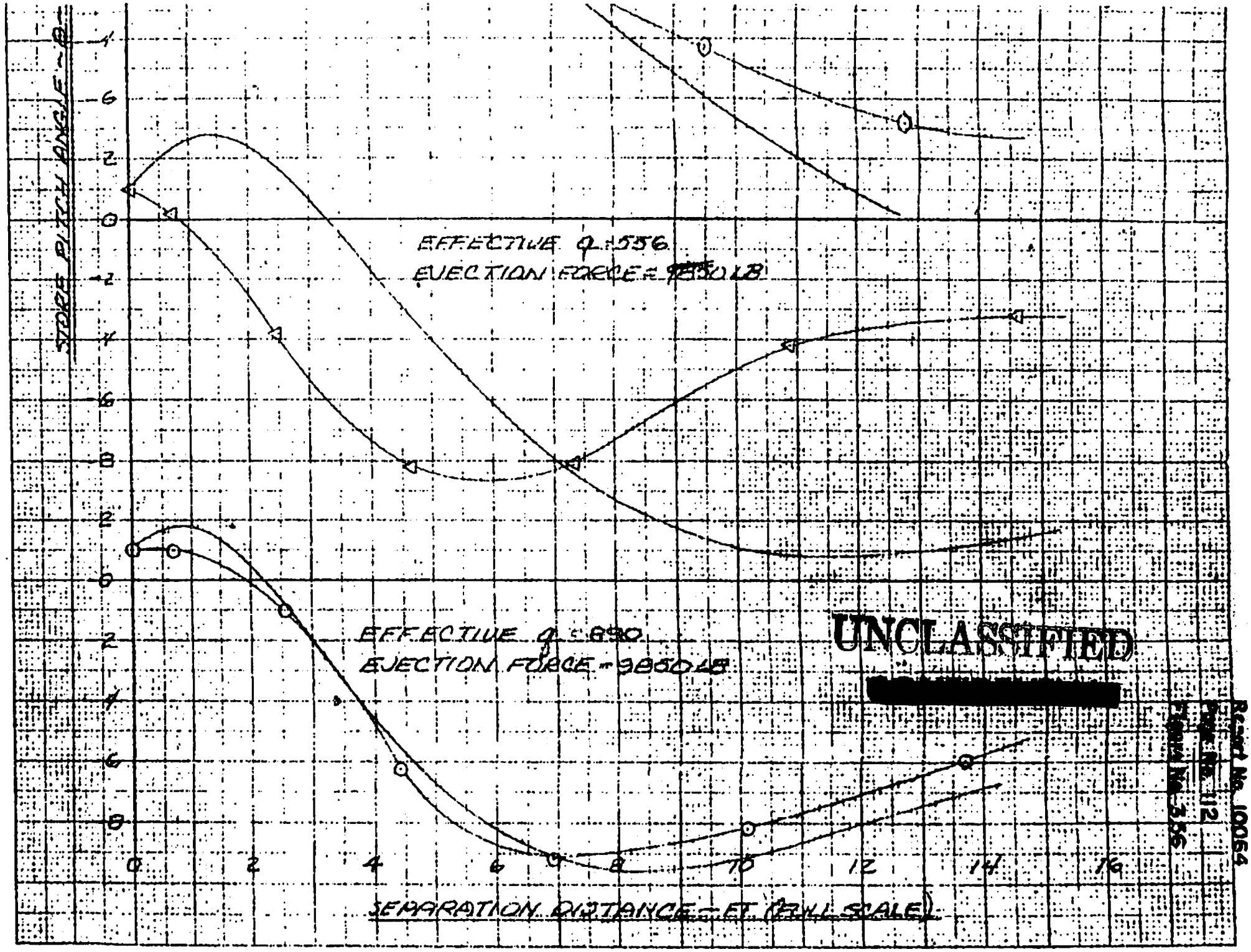
SANDIA EXTERNAL STORE STUDY PHASE II

STORE TRAJECTORIES

COMPARISON OF STORE TRAJECTORIES OBTAINED FROM LOW SPEED WIND TUNNEL DROP TESTS AND CALCULATED USING HIGHSPEED WIND TUNNEL FORCE DATA WITH EJECTION PYLON INSTALLATION





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Record No. 10064
Page No. 112
Report No. 356

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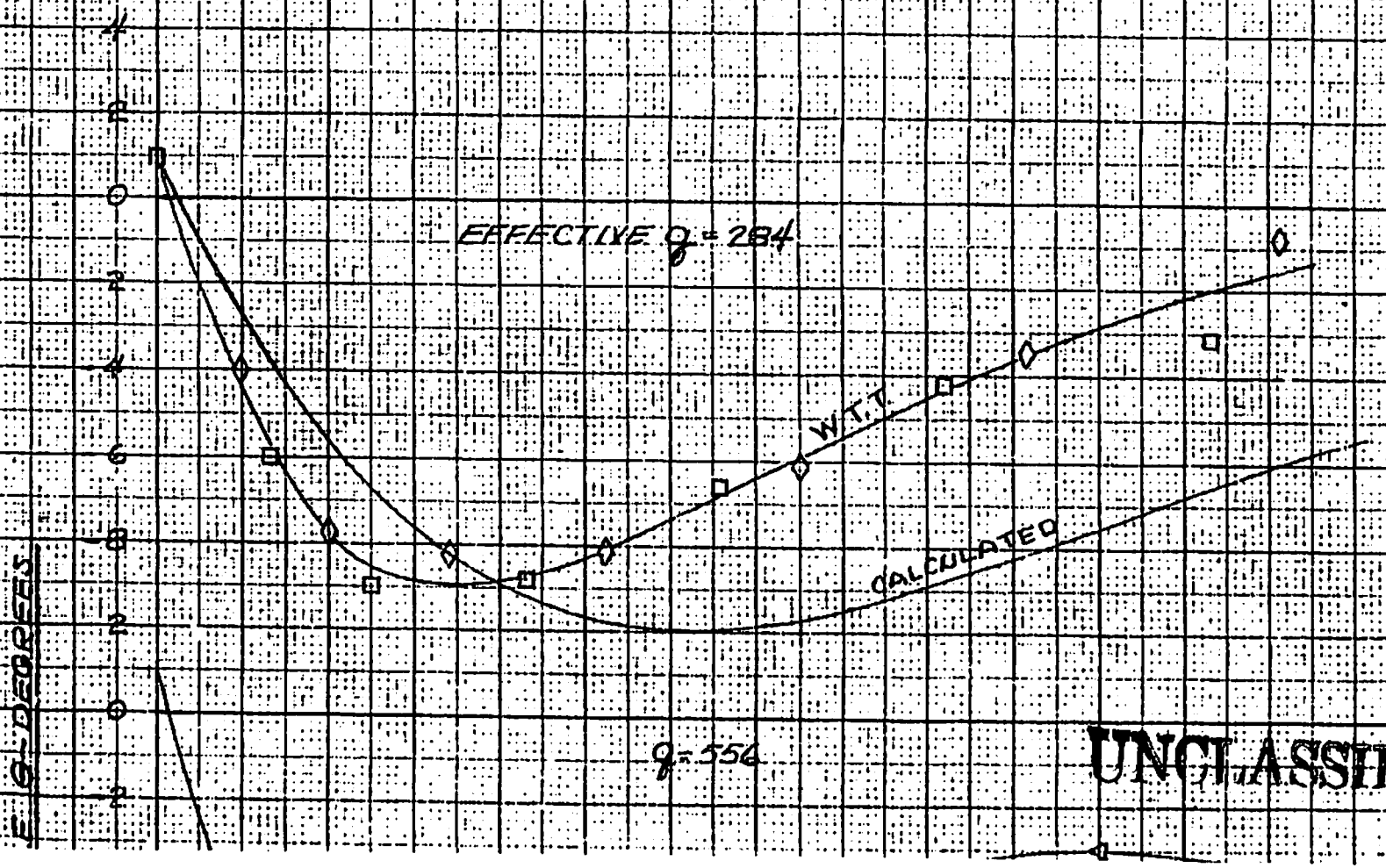
SANDIA EXTERNAL STORE STUDY, PHASE II

STORE TRAJECTORIES

COMPARISON OF STORE TRAJECTORIES OBTAINED FROM LOW SPEED WIND TUNNEL DROP TESTS AND CALCULATED USING HIGH SPEED WIND TUNNEL FORCE DATA

NO EJECTION

PYLON INSTALLATION



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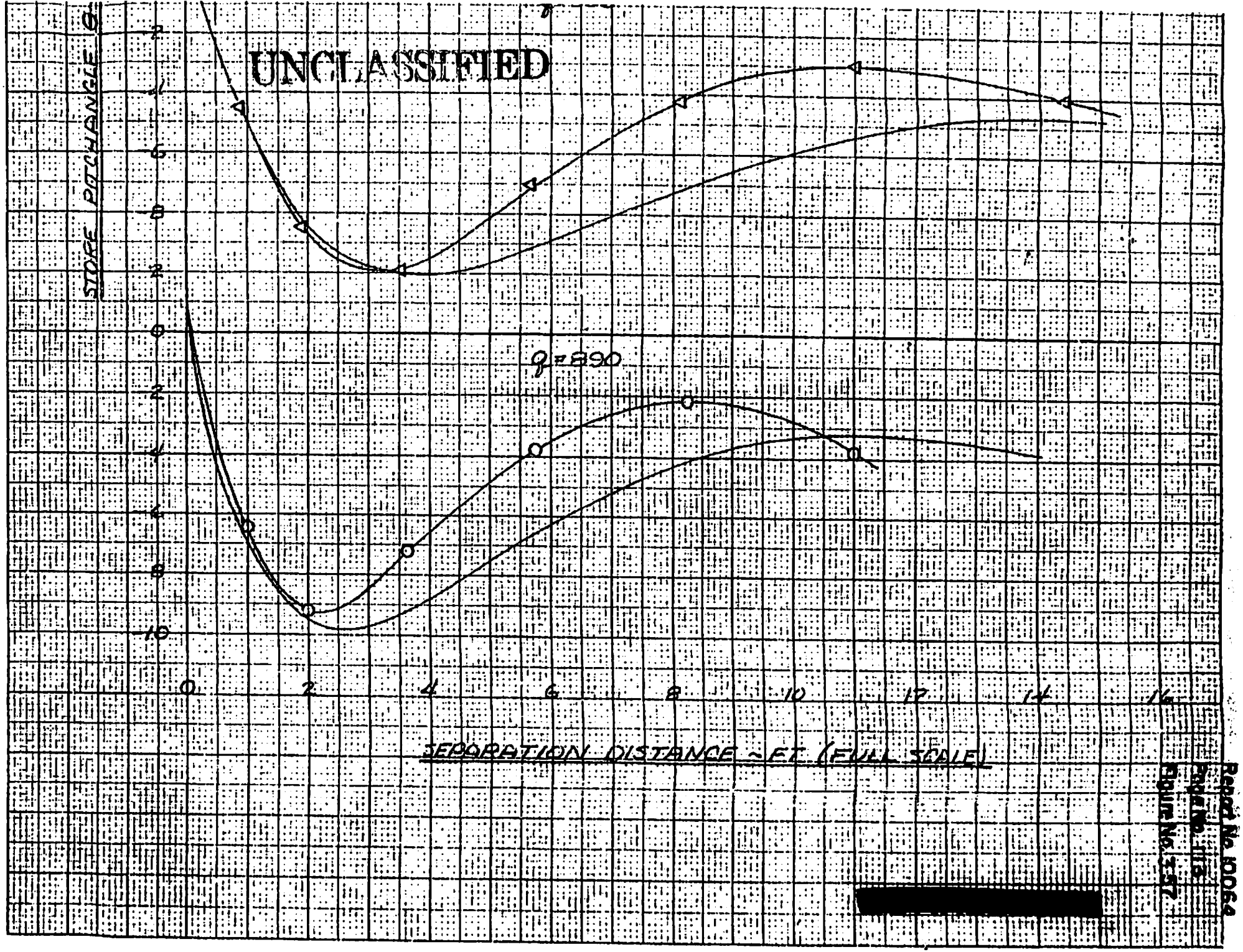

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Report No. 10064
Page No. 115
Figure No. 57

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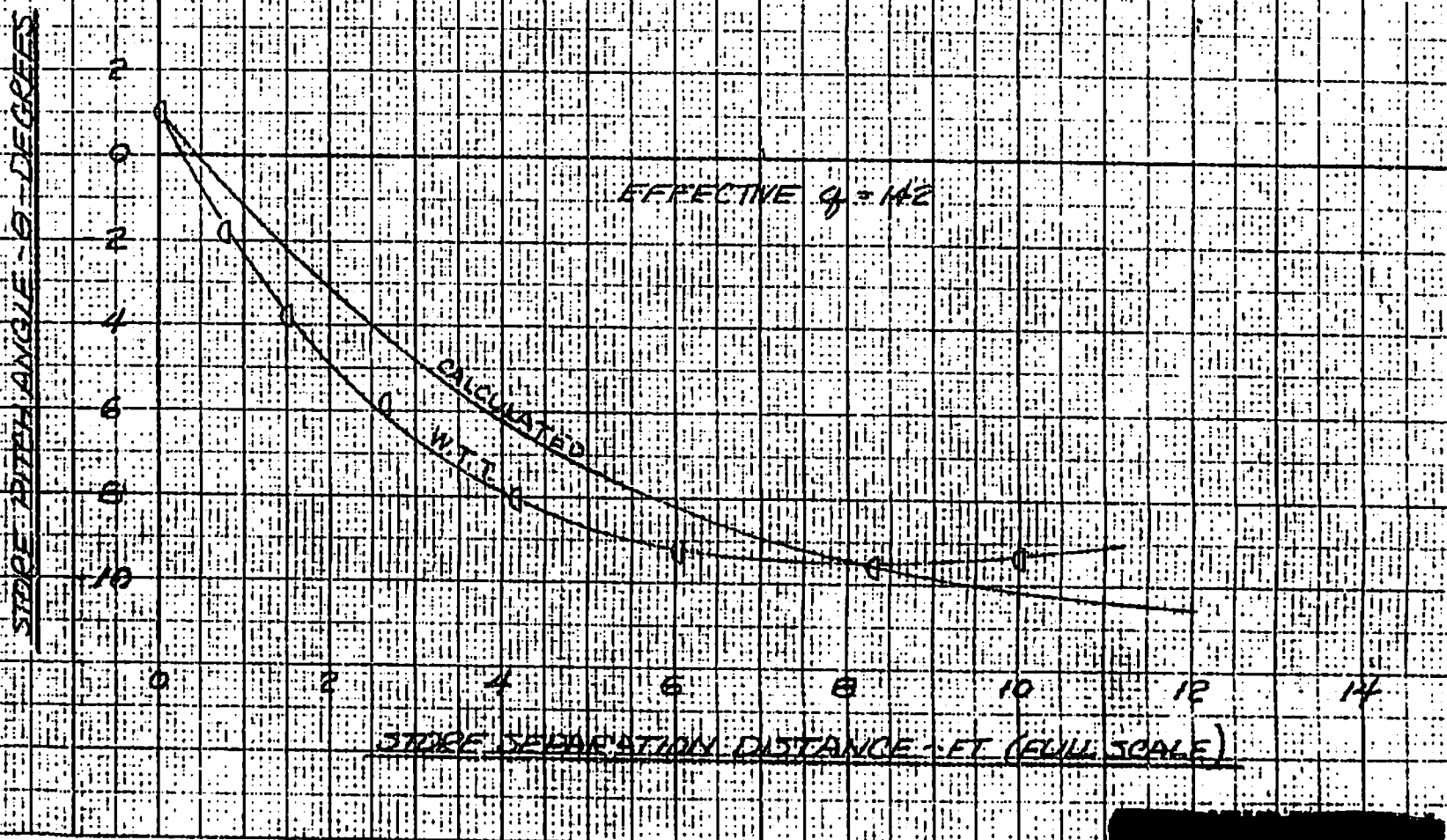
SANDIA EXTERNAL STORE STUDY, PHASE II

STORE TRAJECTORIES

COMPARISON OF STORE TRAJECTORIES OBTAINED FROM LOW SPEED WIND TUNNEL DROP TESTS AND CALCULATED USING HIGH SPEED WIND TUNNEL FORCE DATA

NO EJECTION

PYLON INSTALLATION



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Report No. 10064
Page 30-34
Figure No. 357 cont'd

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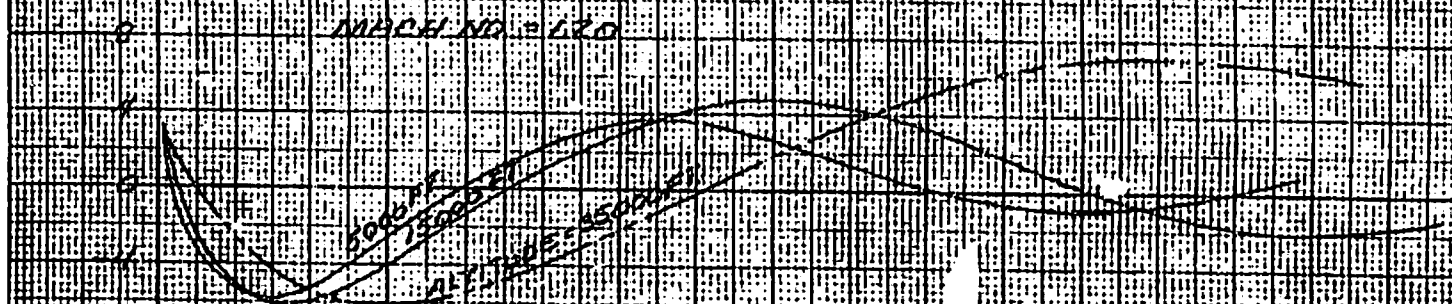
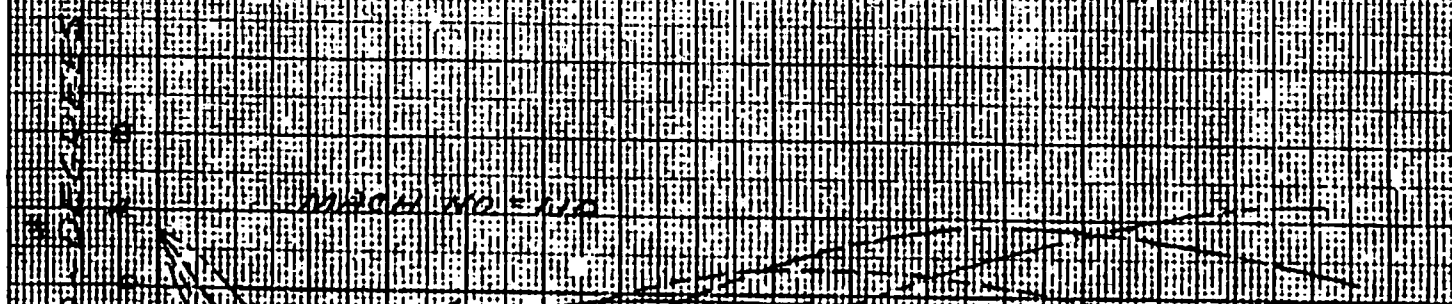
SANDIA EXTERNAL STORE STUDY PHASE II
V-395 FUSELAGE CAVITY INSTALL
STORE PITCH ANGLE VS SEPARATION DISTANCE
NO EJECTION FORCE





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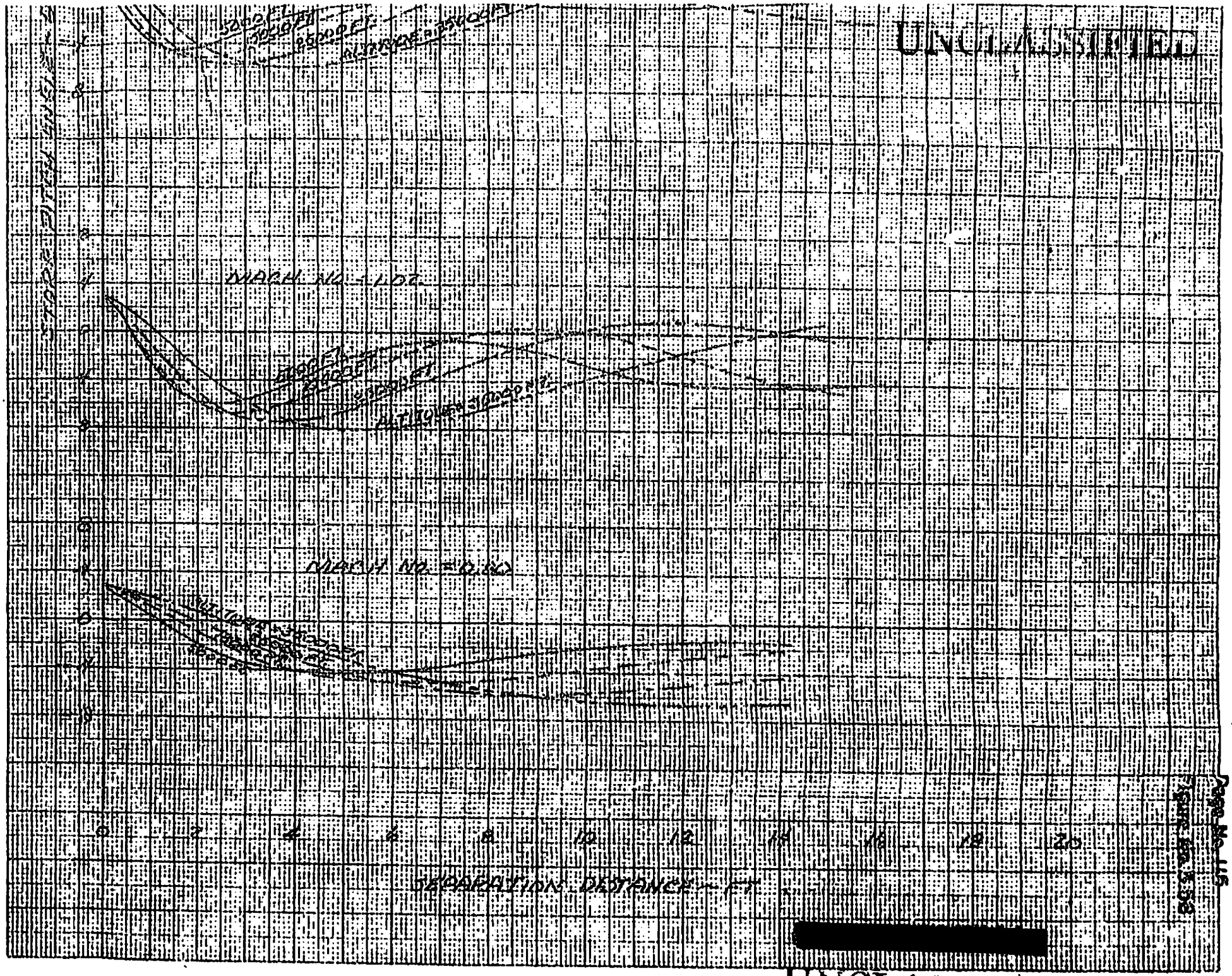

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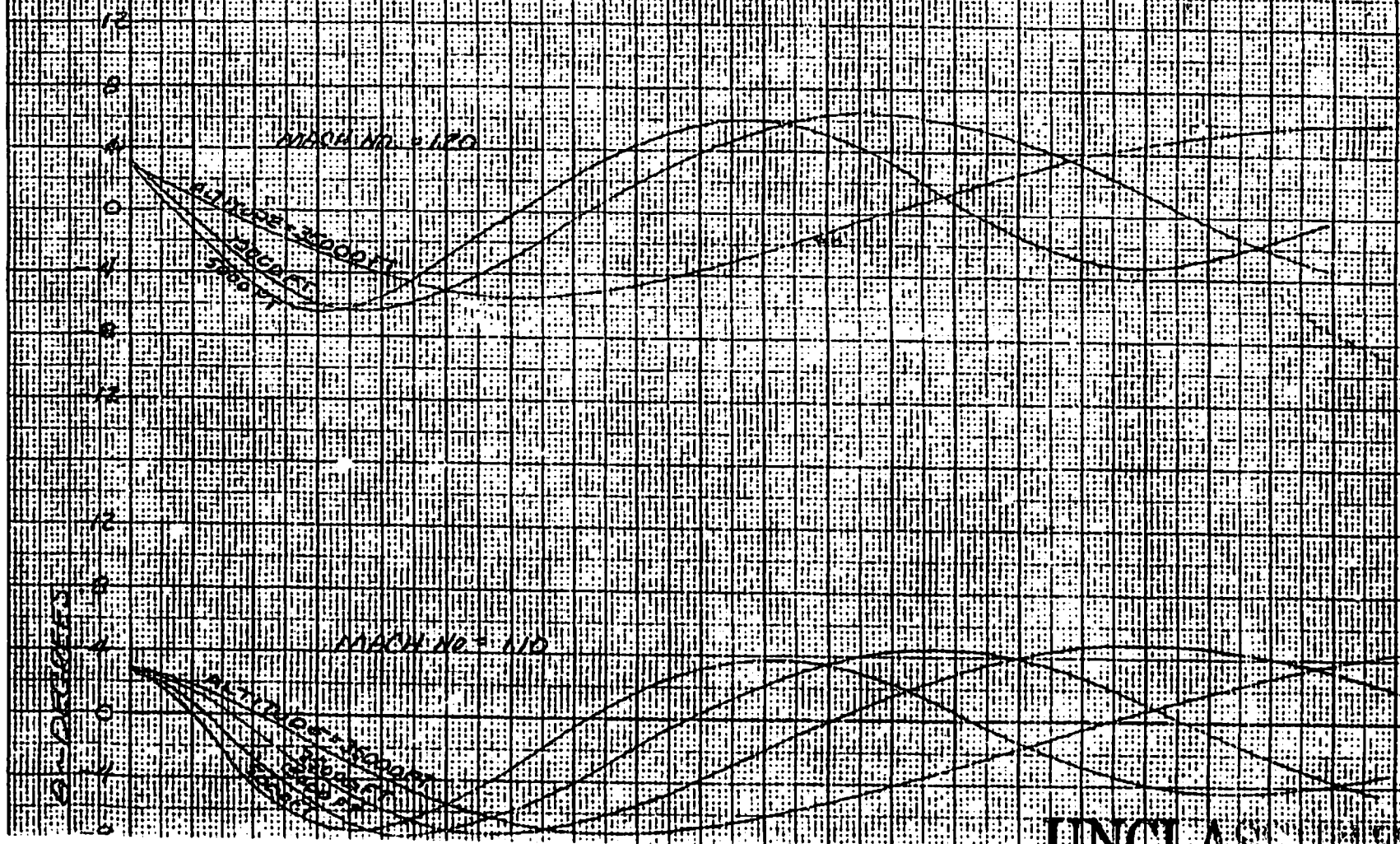
SANDIA EXTERNAL STORE STUDY PHASE II
V-3DC FUSELAGE CAVITY INSTALL
STORE PITCH ANGLE VS SEPARATION DISTANCE
EJECTION FORCE APPLIED AT STORE C.G.

EJECTION FORCE = 500 LB
EJECTOR STROKE = 2.5 FT



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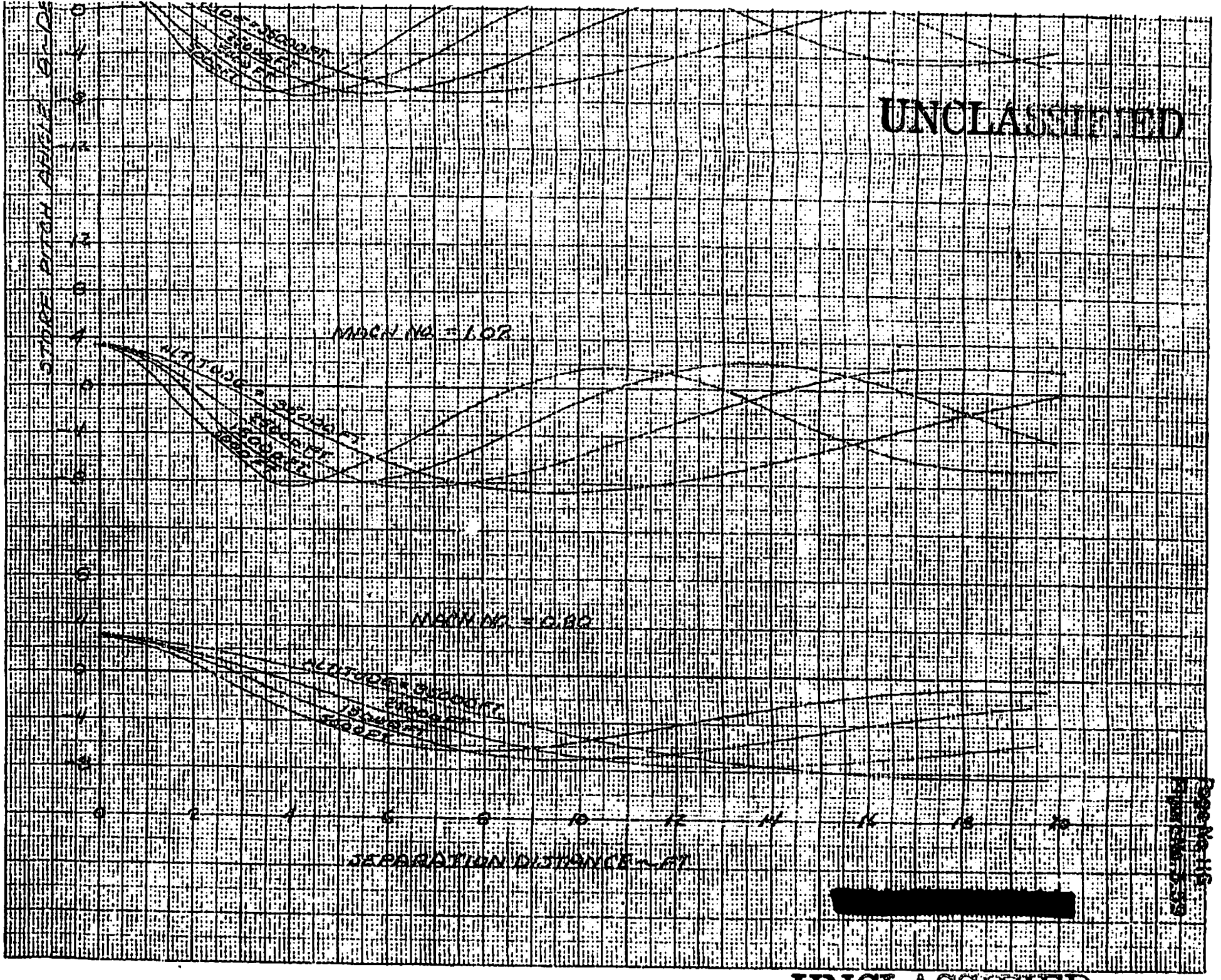

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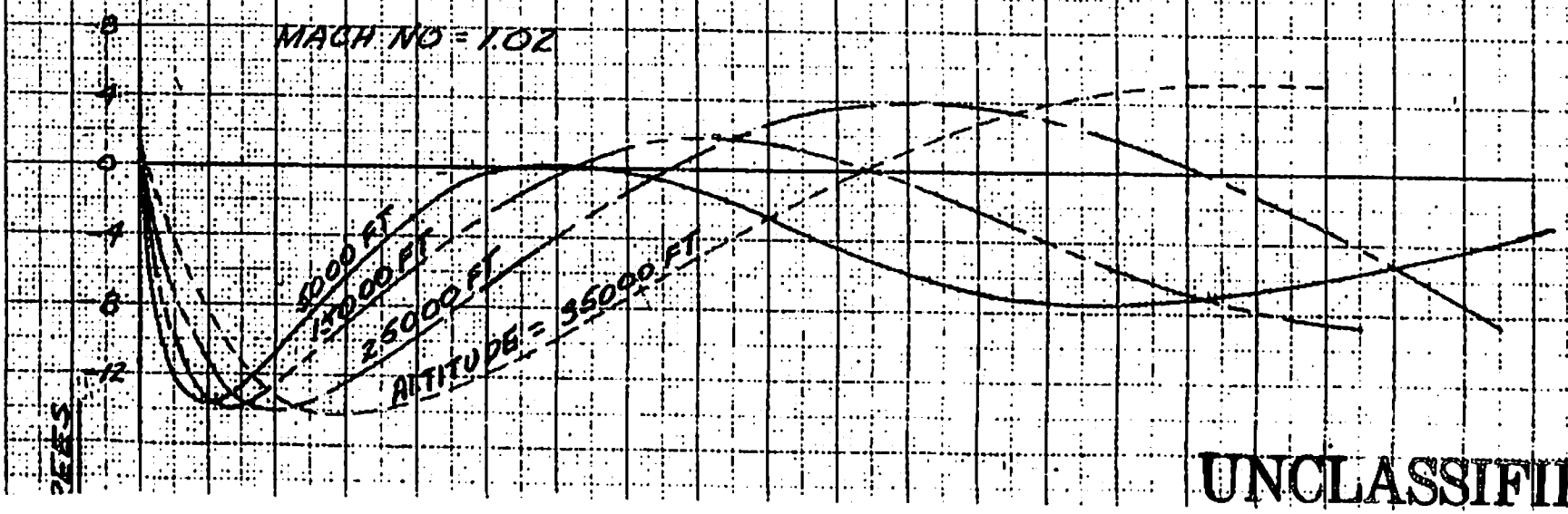
SANDIA EXTERNAL STORES STUDY PHASE II
F8U-1 PYLON INSTALL.
STORE PITCH ANGLE VS SEPERATION DISTANCE
NO EJECTION FORCE



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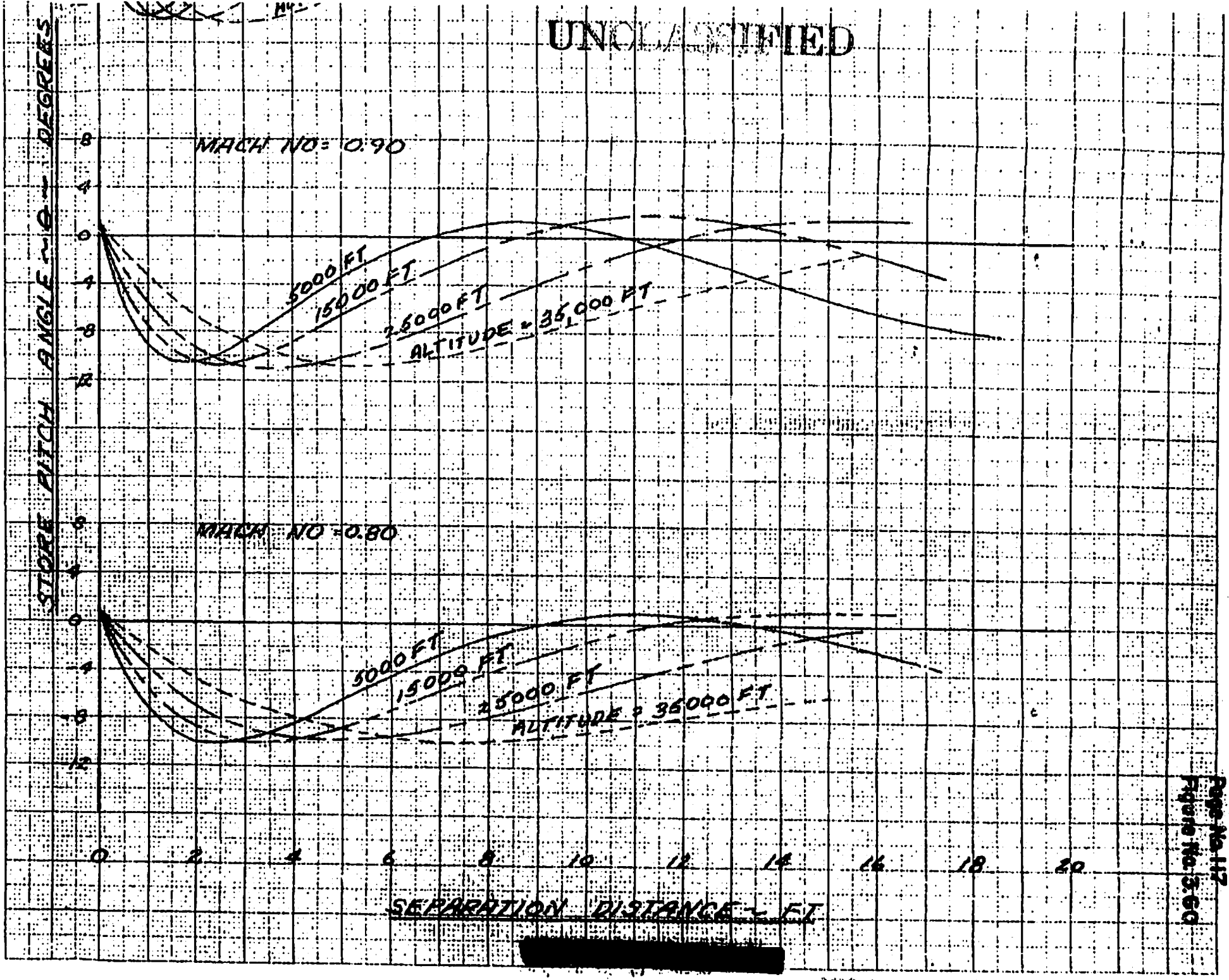

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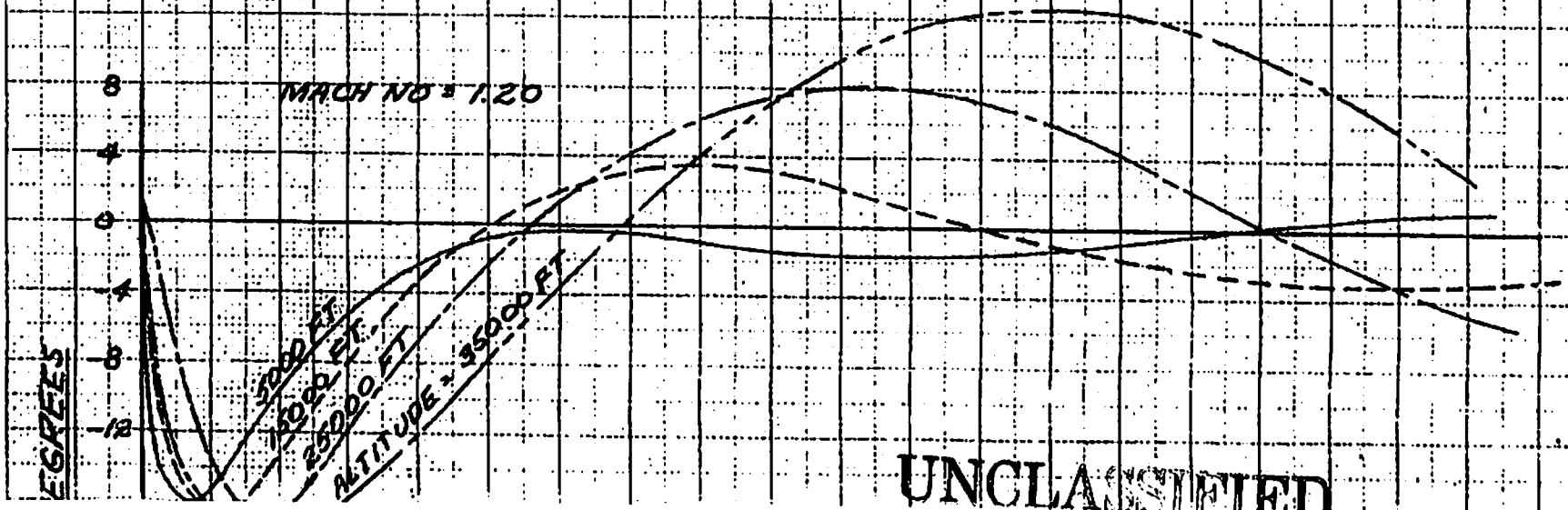
SANDIA EXTERNAL STORE STUDY PHASE II
F8U-1 PYLON INSTALL
STORE PITCH ANGLE V.S. SEPERATION DISTANCE
NO EJECTION FORCE



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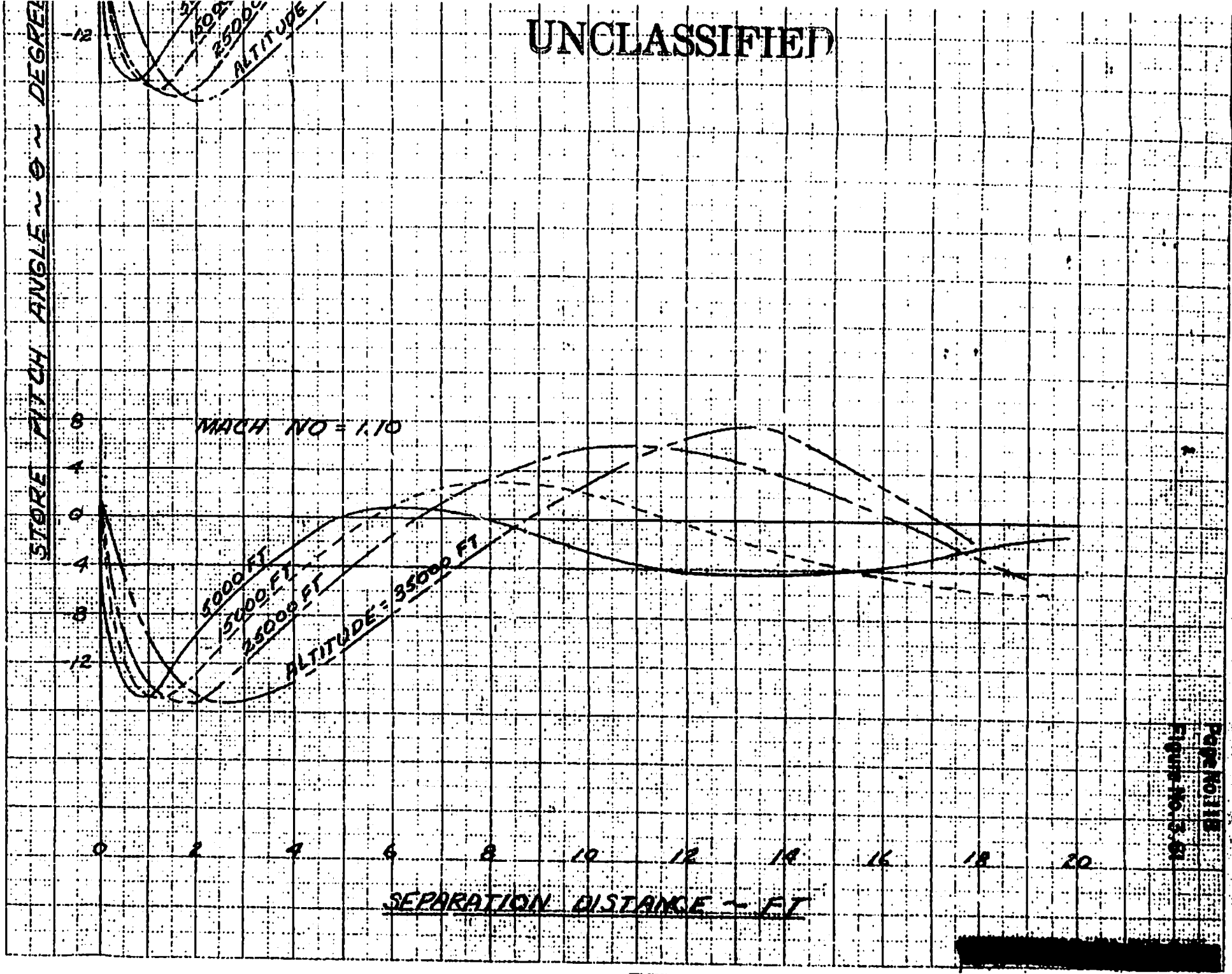
STORE PITCH ANGLE ~ θ ~ DEGREES
MACH NO = 1.10
5000 FT
15000 FT
25000 FT
ALTITUDE = 35000 FT
8
4
0
-4
-8
-12
0
2
4
6
8
10
12
14
16
18
20
SEPARATION DISTANCE ~ FT

[redacted]

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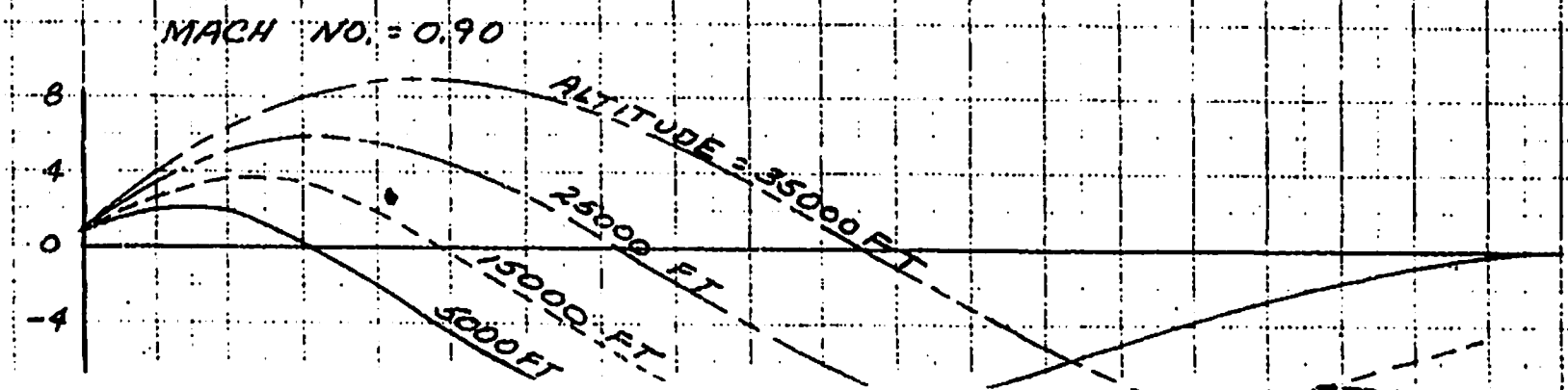
[redacted]

SANDIA EXTERNAL STORE STUDY PHASE II
F8U-1 PYLON INSTALL.
STORE PITCH ANGLE VS. SEPARATION DISTANCE

EJECTION FORCE = 10,000#
EJECTION STROKE = 1.0 FT
APPLIED 0.5 FT AFT OF
STORE C.G.



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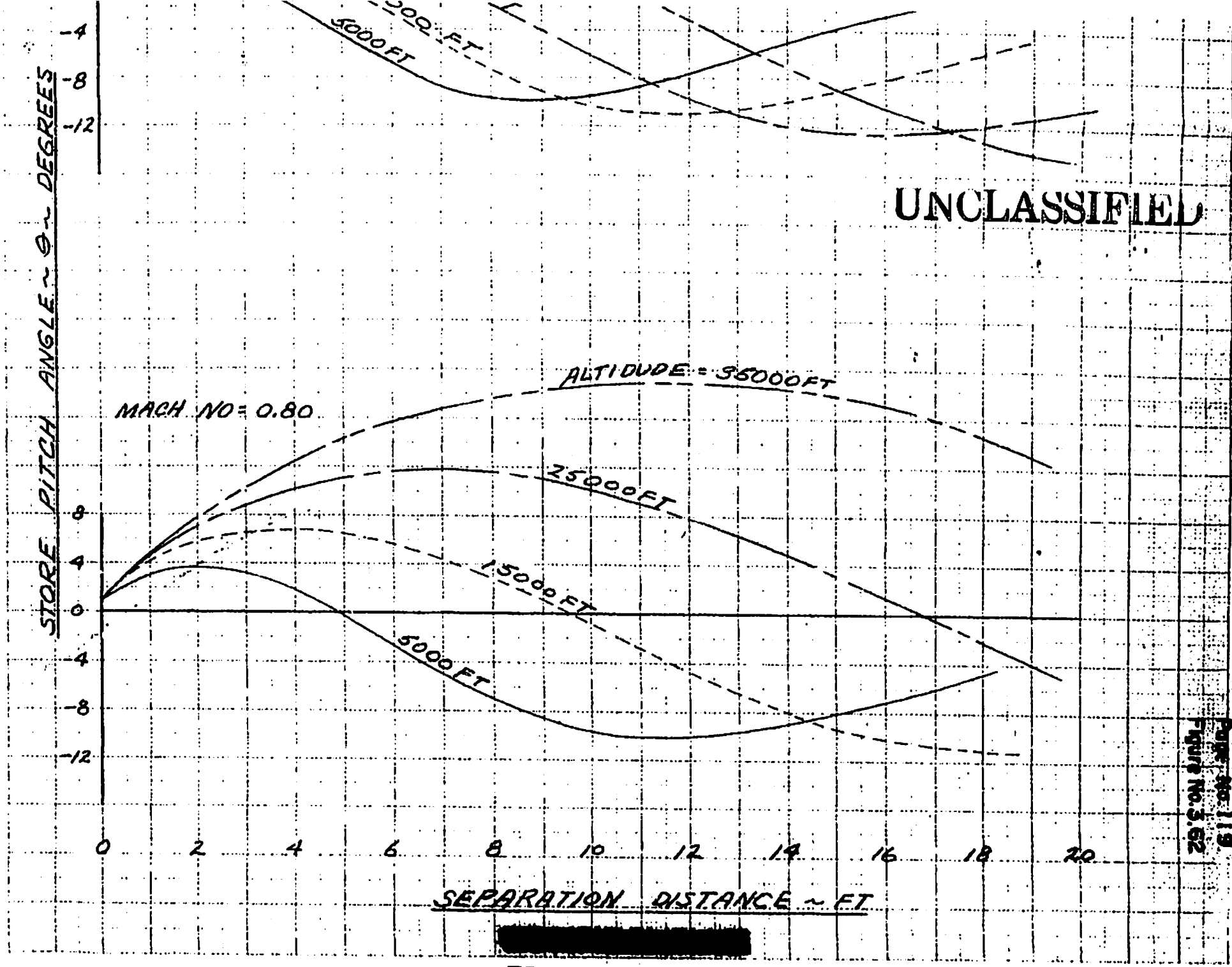
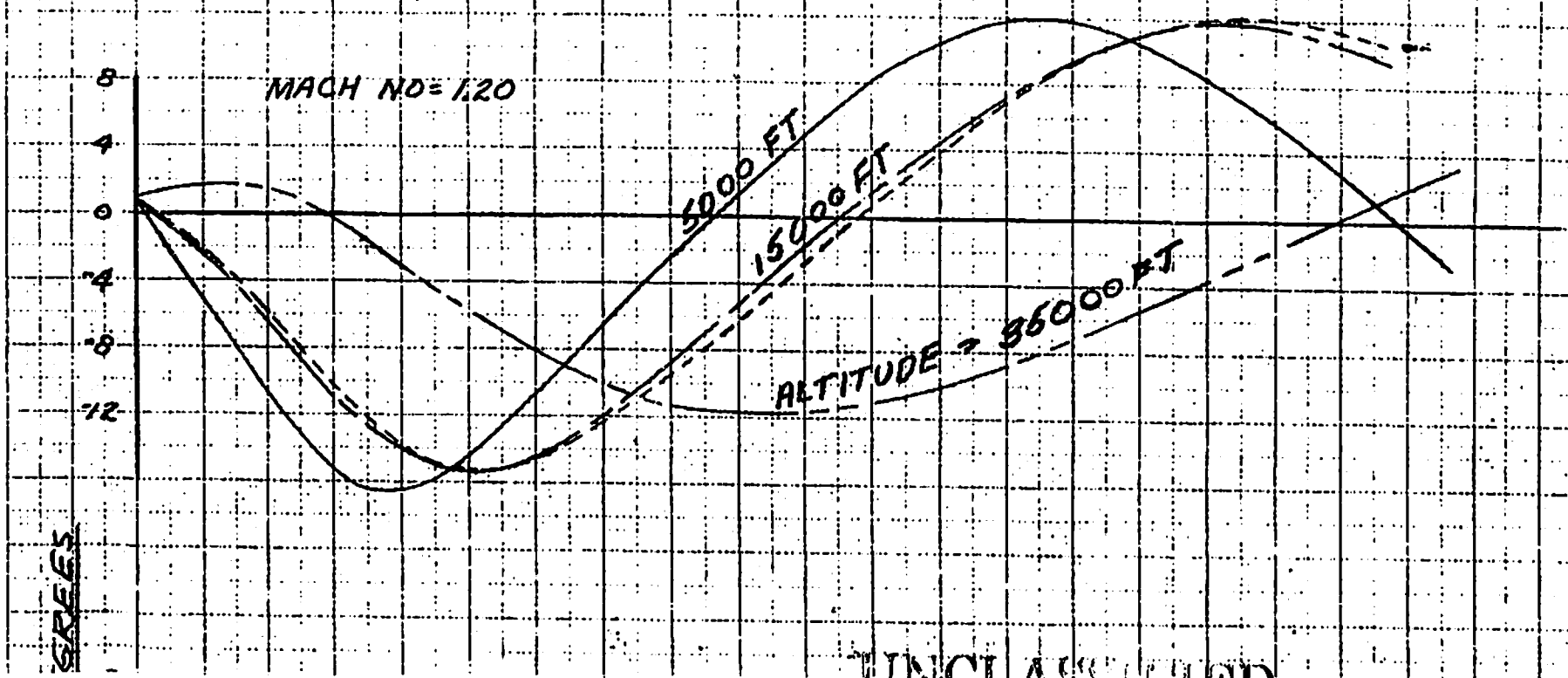

UNCLASSIFIED
ALTITUDE = 35000 FT
25000 FT
15000 FT
5000 FT
MACH NO = 0.80
STORE PITCH ANGLE ~ θ ~ DEGREES
8
4
0
-4
-8
-12
0
2
4
6
8
10
12
14
16
18
20
SEPARATION DISTANCE ~ FT
[redacted]
UNCLASSIFIED

[redacted]

UNCLASSIFIED

SANDIA EXTERNAL STORES STUDY PHASE II
F8U-1 PYLON INSTALL.
STORE PITCH ANGLE VS. SEPERATION DISTANCE

EJECTION FORCE = 10,000#
EJECTION STROKE = 1.0 FT.
APPLIED 0.5 FT. AFT. OF
STORE C.G.



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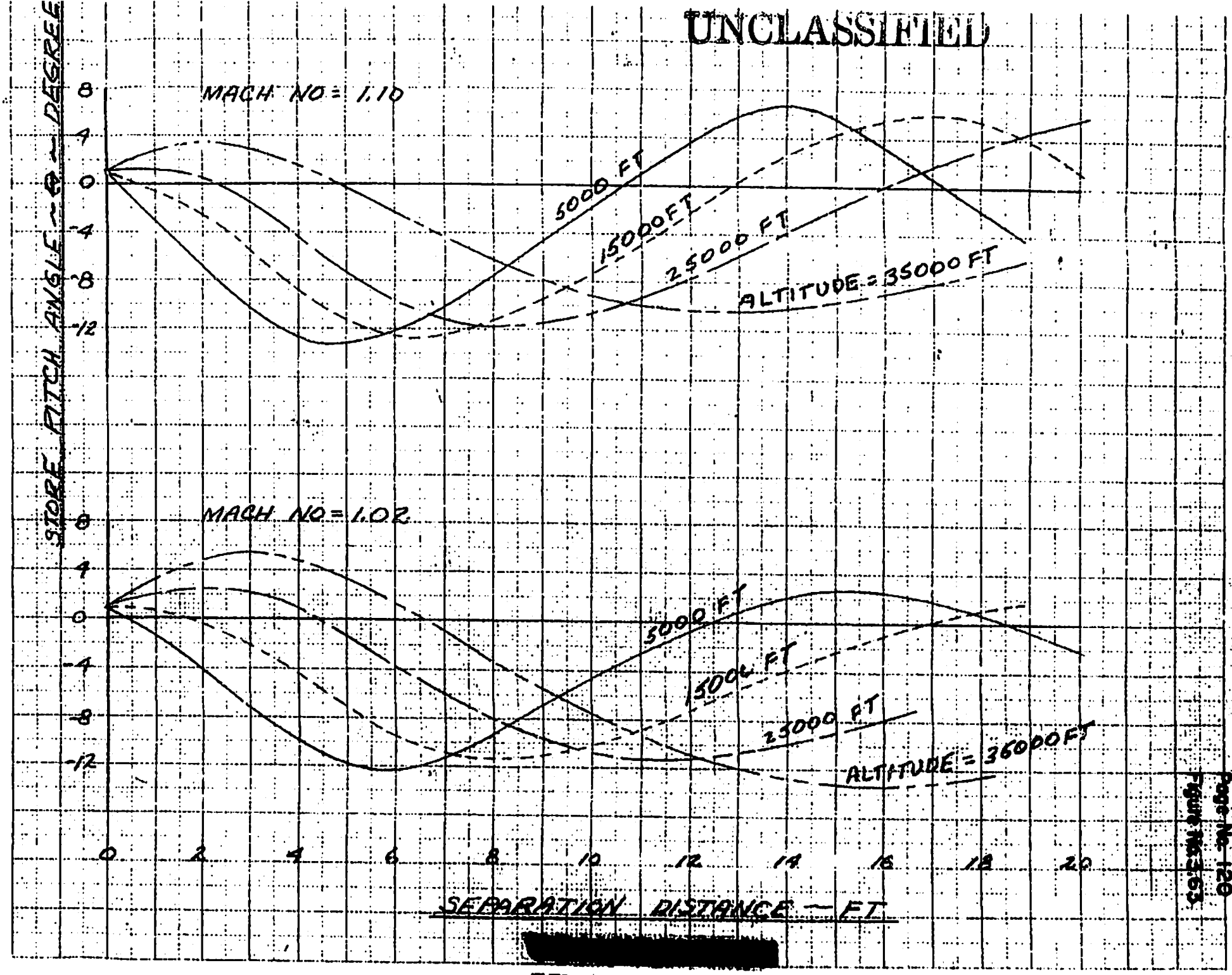
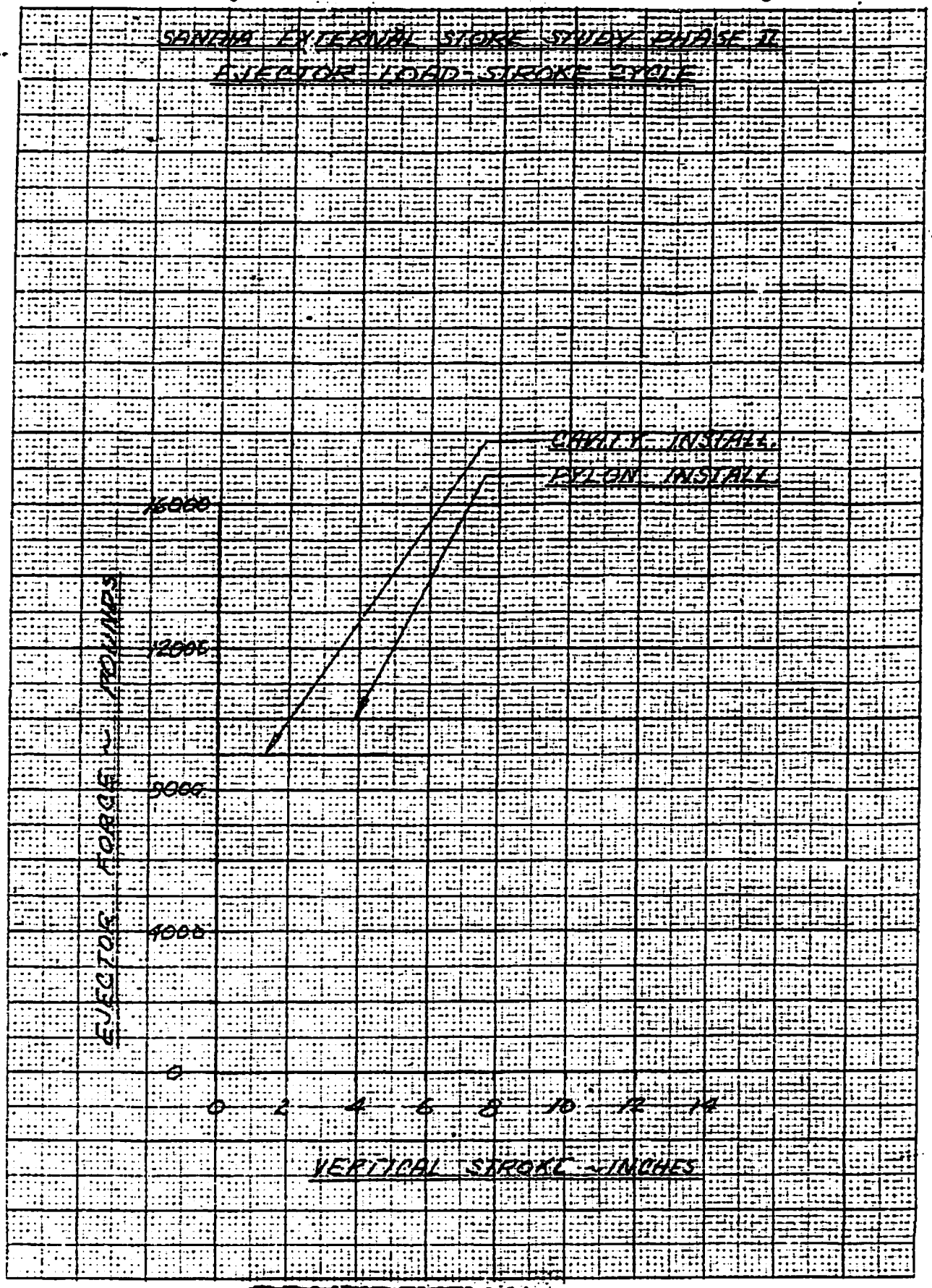
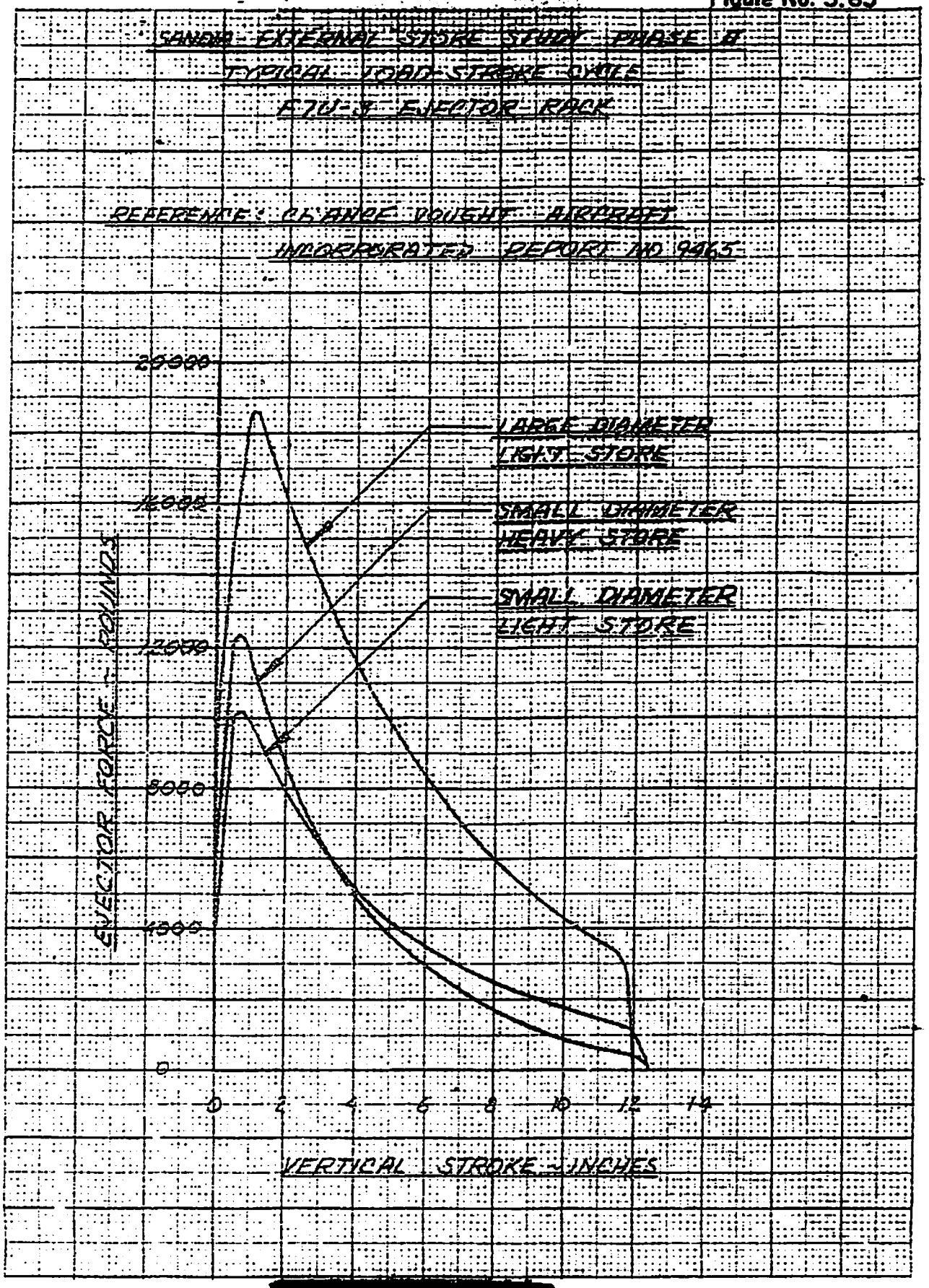

MACH NO = 1.10
5000 FT
15000 FT
25000 FT
ALTITUDE = 35000 FT
MACH NO = 1.02
5000 FT
15000 FT
25000 FT
ALTITUDE = 36000 FT
STORE PITCH ANGLE ~ θ ~ DEGREE
8
4
0
-4
-8
-12
0
2
4
6
8
10
12
14
16
18
20
SEPARATION DISTANCE — FT

[redacted]


SANDIA EXTERNAL STORE STUDY PHASE II
EJECTOR LOAD-STROKE CYCLE
CAVITY INSTALL.
PYLON INSTALL.
16000
12000
8000
4000
0
EJECTOR FORCE ~ POUNDS
0
2
4
6
8
10
12
14
VERTICAL STROKE ~ INCHES


SANDIA EXTERNAL STORE STUDY PHASE II
TYPICAL LOAD STROKE CYCLE
F7U-3 EJECTOR RACK
REFERENCE: CHANCE VOUGHT AIRCRAFT
INCORPORATED REPORT NO 9963
20000
16000
12000
8000
4000
0
EJECTOR FORCE ~ POUNDS
LARGE DIAMETER
LIGHT STORE
SMALL DIAMETER
HEAVY STORE
SMALL DIAMETER
LIGHT STORE
0
2
4
6
8
10
12
14
VERTICAL STROKE ~ INCHES

[redacted]

4.0 PERFORMANCE

This section presents information dealing with the performance of the F8U-1 airplane carrying the TX-28 store wing-pylon mounted on the left wing. The following phases of airplane-store performance are discussed:

Installed Drag of the TX-28 store.

Stability and Control Characteristics of the F8U-1 airplane with TX-28 store.

Maximum Speed and Acceleration Characteristics of the F8U-1 with the TX-28 store installed.

Delivery Maneuvers of the F8U-1 airplane with the TX-28 store.

4.1 Installed Drag of Store

Chance Vought Aircraft, under Item A of Sandia Corporation Purchase Order No. 51-1360, has evaluated the zero lift drag due to wing pylon mounted stores. Two stores were investigated, the TX-28 and a 15 in. diameter-fineness ratio store similar to the Sandia store configurations investigated in Phase I. (1)

The drag data for these stores were obtained through high speed wind tunnel tests conducted at the Cornell Aeronautical Laboratory. These tests were made using an 0.042

(1) Thomas, I.L. "Final Report, Phase I External Store Study, Sandia Contract 51-1360" Chance Vought Aircraft Report 9819 (15 June, 1955), 171-183.

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scale model of the F8U-1 airplane having a "coked" fuselage and a left wing-pylon. The store installation used is shown in figure 2.1 of section 2.1. This installation is the same as used in the Phase I study. (1)

The preliminary data from the wind tunnel tests have been analyzed and the installed drag characteristics at zero left of the stores were evaluated. The installed drag (ΔC_{Do}) is the difference between the model drag with and without the store pylon.

$$\Delta C_{Do\ STORE + PYLON} = C_{Do\ AIRPLANE + STORE + PYLON} - C_{Do\ AIRPLANE}$$

The installed drag data for these two stores are presented for comparison purposes along with the data previously obtained in Phase I (2) in figures 4.1 through 4.5. These data are shown as a function of store frontal area and fineness-ratio at Mach numbers of 0.80, 0.90, 0.94, 1.02, and 1.20. The final values of ΔC_{Do} are presented for the Sandia Final Store Configuration (TX-28) in figure 4.6 and the 15 in. diameter-fineness ratio store in figure 4.7.

The data obtained for the two stores of the Phase II tests compare favorably with the value of ΔC_{Do} that would be predicted based on the Phase I test information. The variation between the two sets of data are within the limits of accuracy expected for this type of testing.

(1) ibid 71, 77, & 78

(2) ibid, 85 [redacted]

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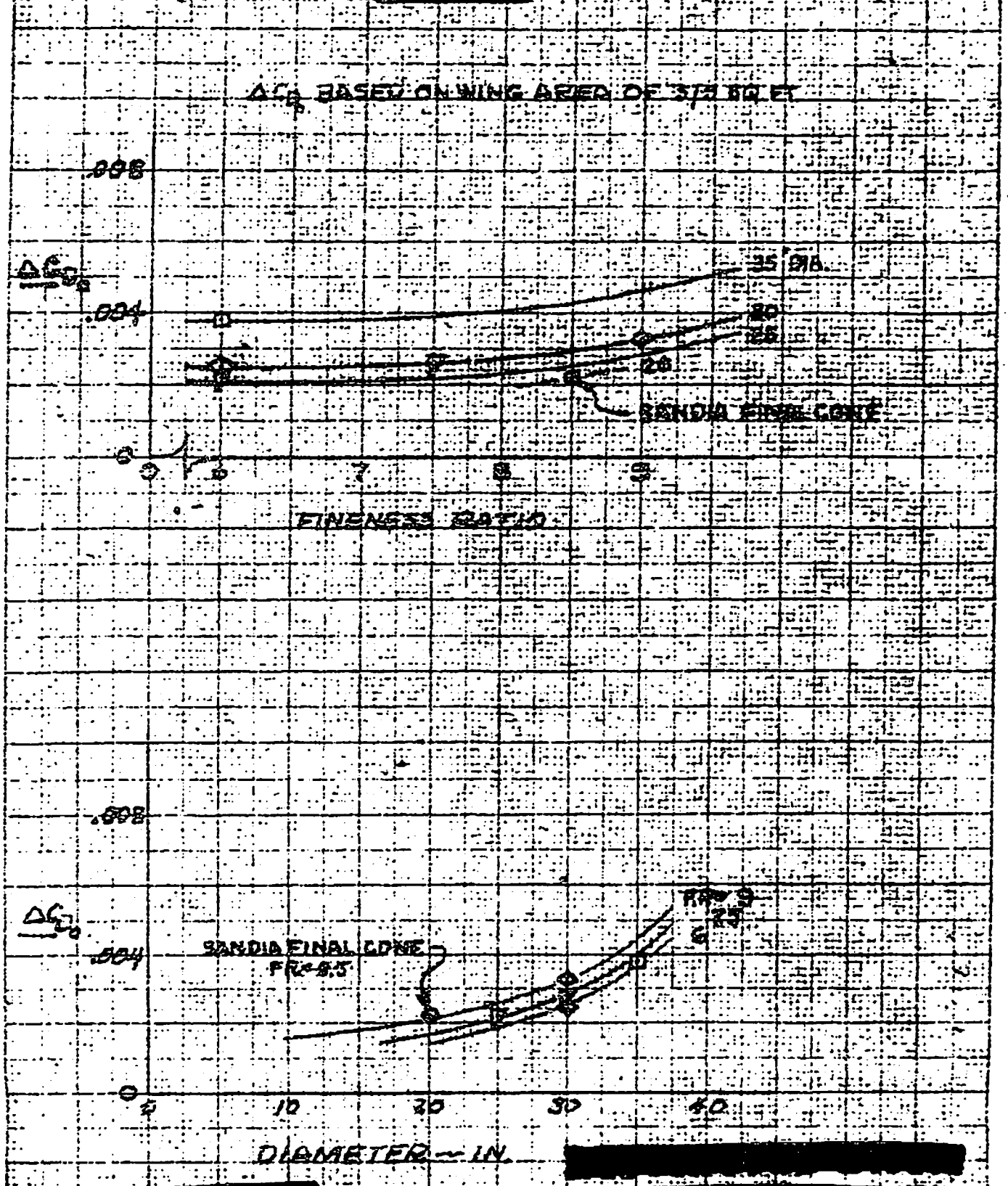
SANDIA EXTERNAL STORE STUDY

DRAG AT ZERO LIFT DUE TO WING PYLON MOUNTED STORES

M.N = 0.8



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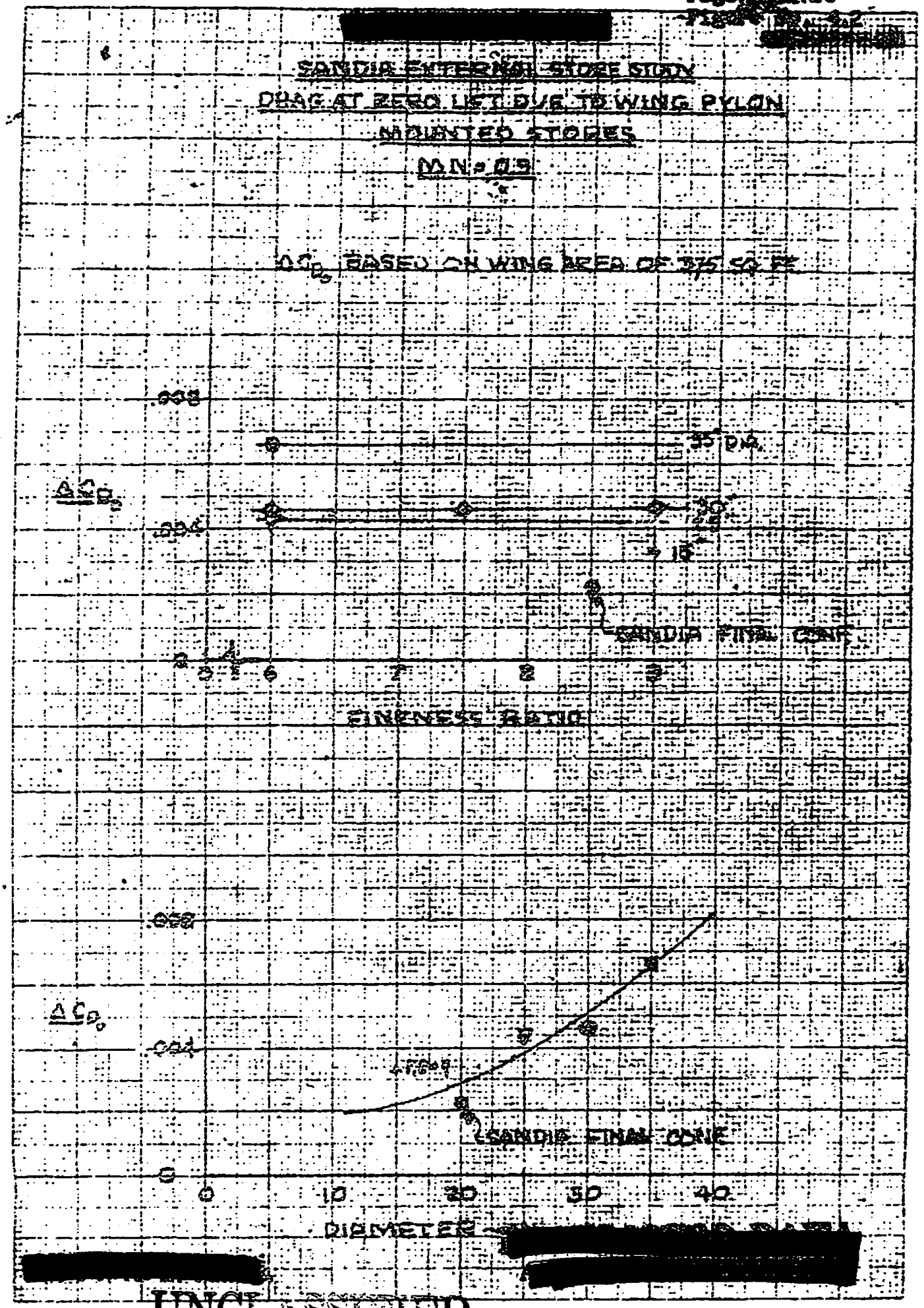

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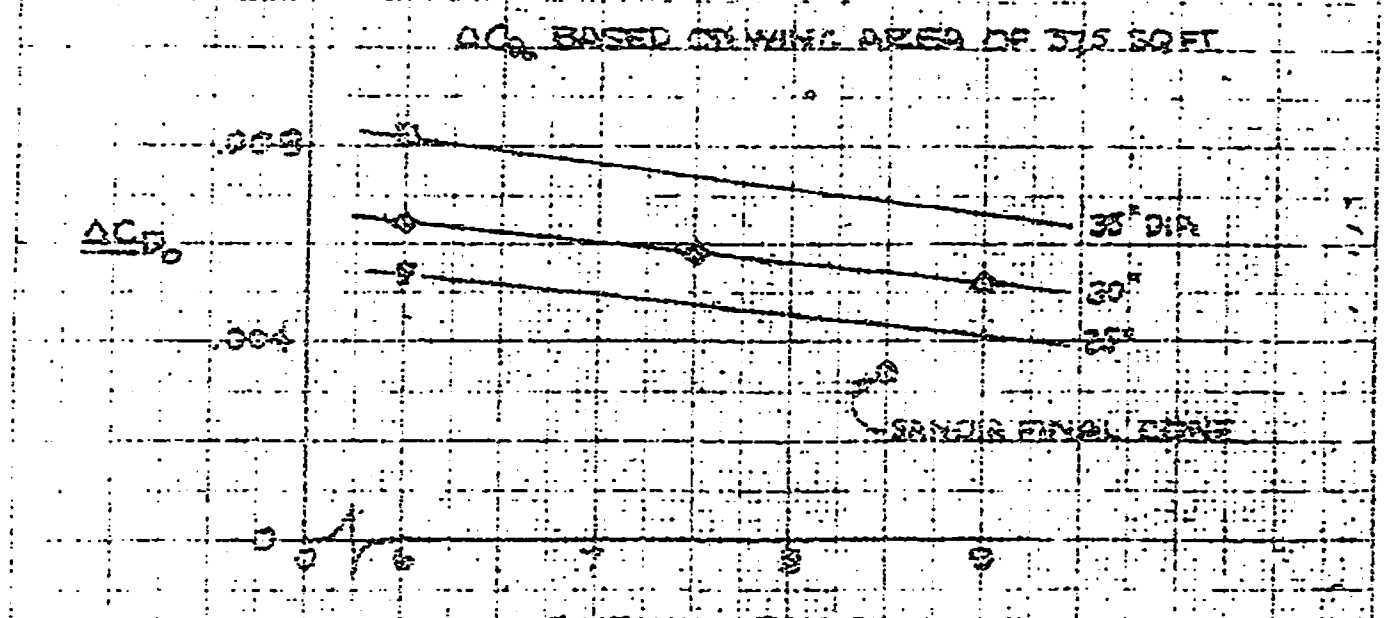
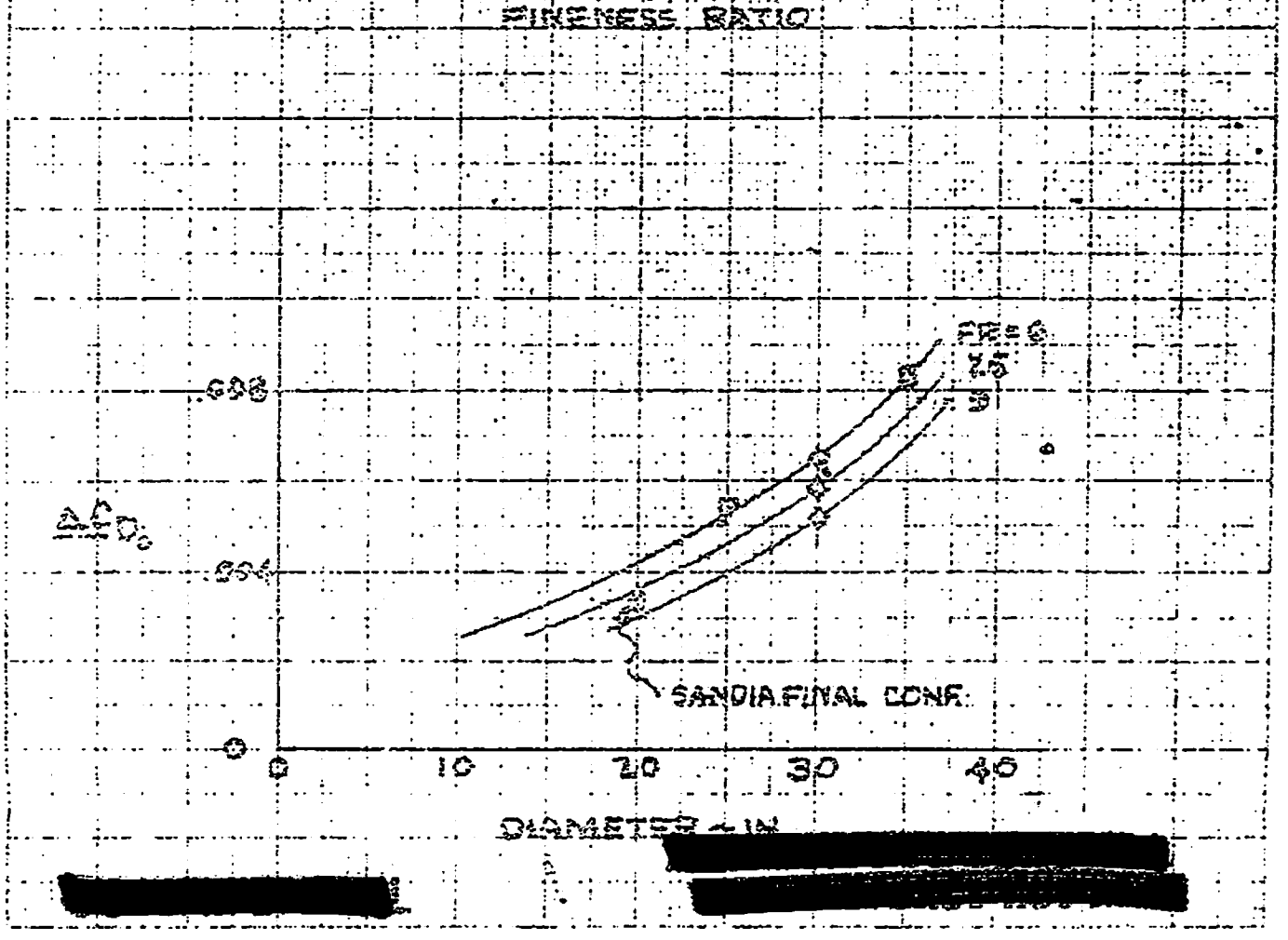
SANDIA EXTERNAL STORE STUDY

DRAG AT ZERO LIFT DUE TO WING PYLON MOUNTED STORES

M.N. 0.94





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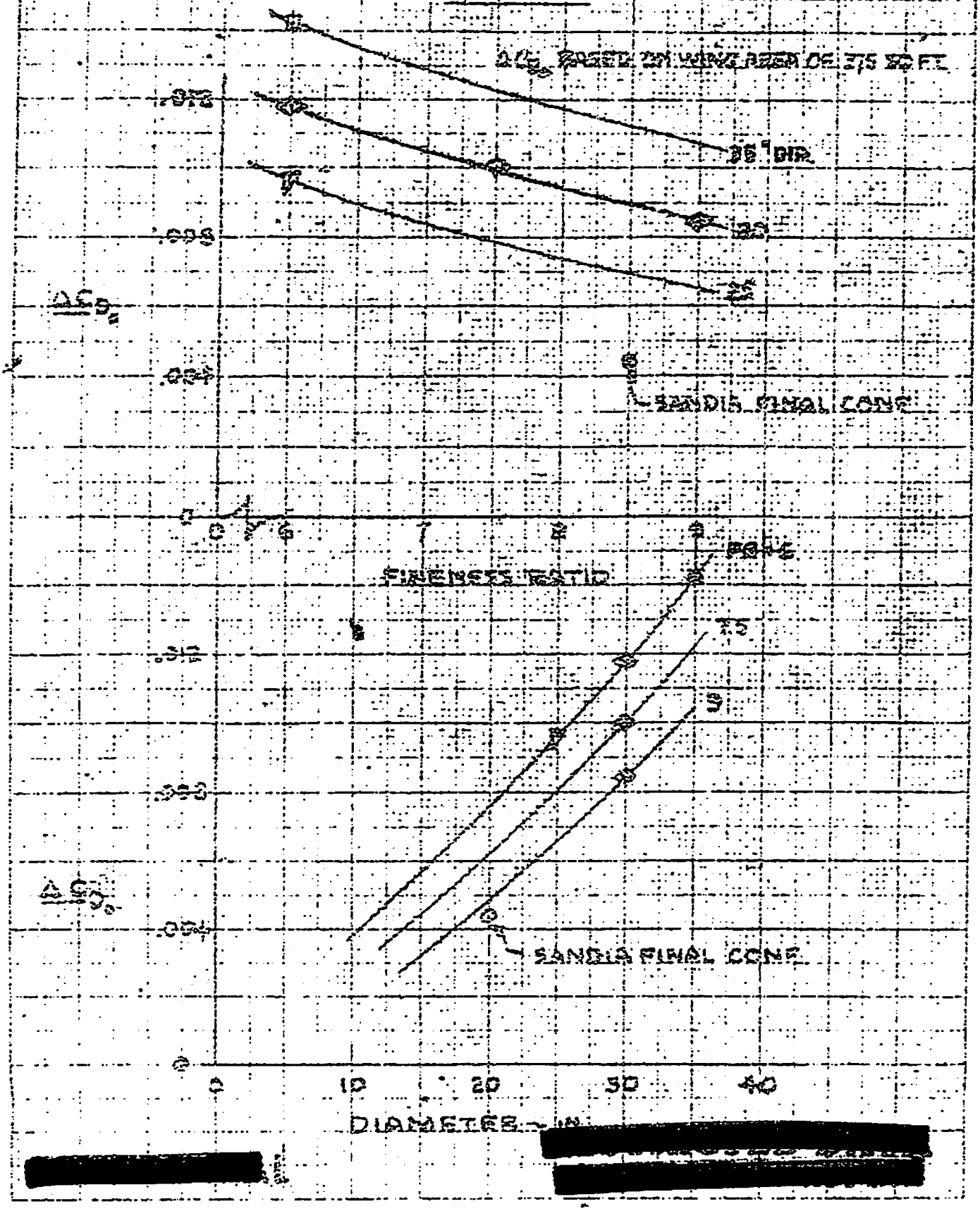
SANDIA EXTERNAL STORE STUDY

DRAG AT ZERO LIFT DUE TO WING PYLON MOUNTED STORES

M.N = 1.02



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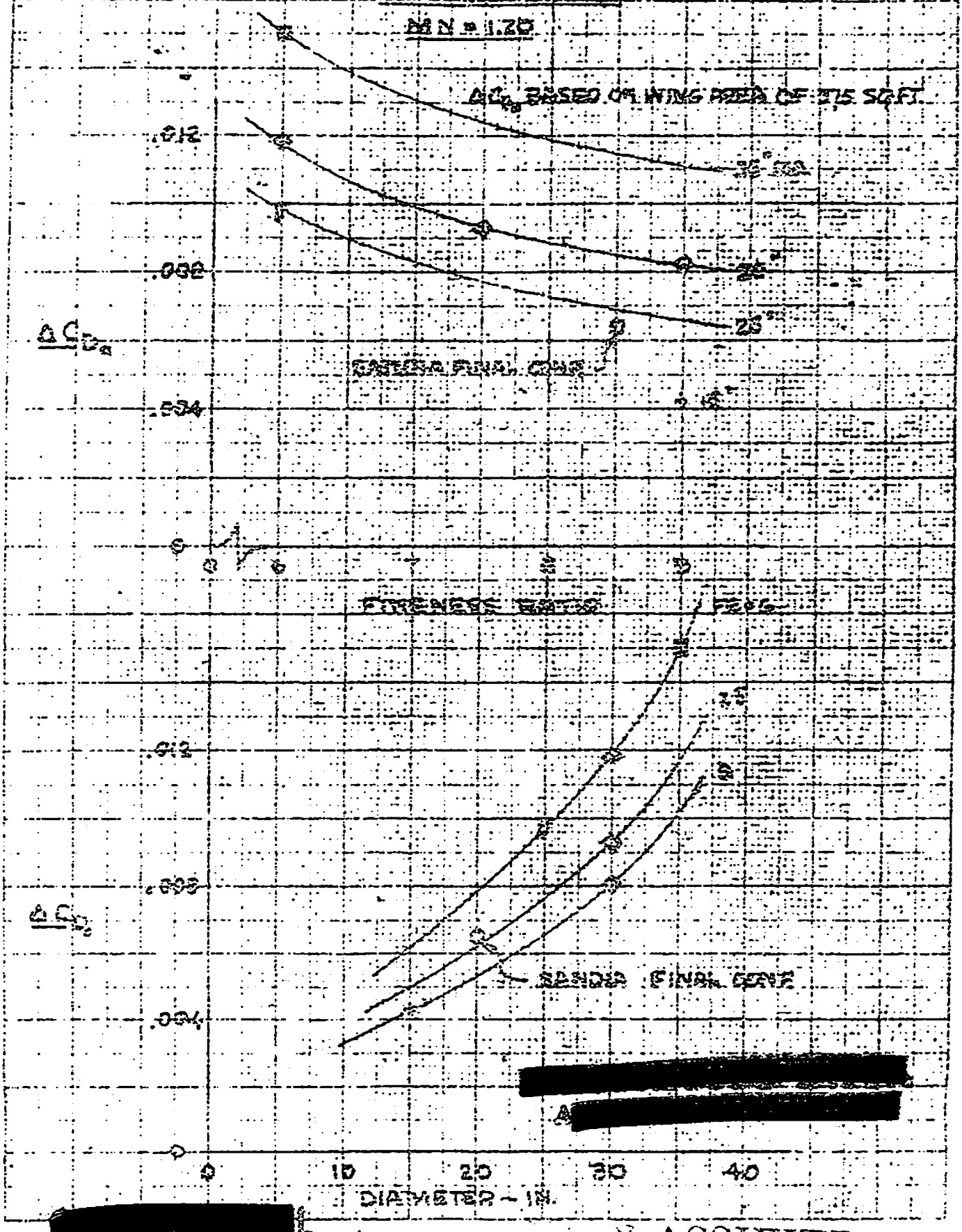

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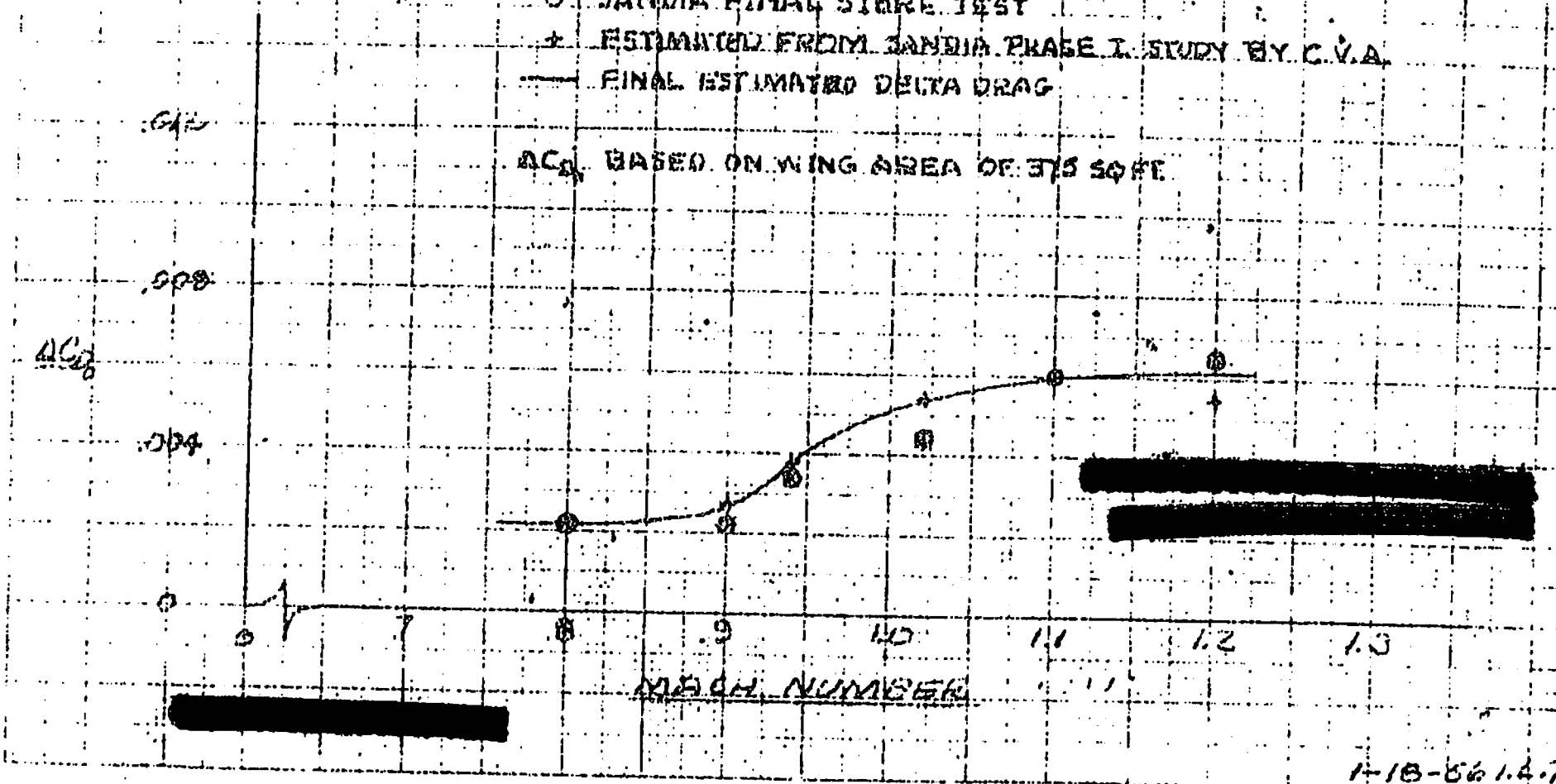
SANDIA EXTERNAL STORE STUDY
DRAG AT ZERO LIFT DUE TO SANDIA FINAL
STORE CONFIGURATION WING PYLON
MOUNTED ON F9J-4

SYM
⊙ SANDIA FINAL STORE TEST
✦ ESTIMATED FROM SANDIA PHASE I STUDY BY C.V.A.
—— FINAL ESTIMATED DELTA DRAG

ΔC_{D_0} BASED ON WING AREA OF 375 SQ FT



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Report No. 10064
Page No. 130
Figure No. 46

[redacted]

1-18-56 1.4.7.

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SANDIA EXTERNAL STORE STUDY

DRAG AT ZERO LIFT DUE TO ASIM DIAMETER ~

FINENESS RATIO SAD SANDIA STORE CONFIGURATIONS

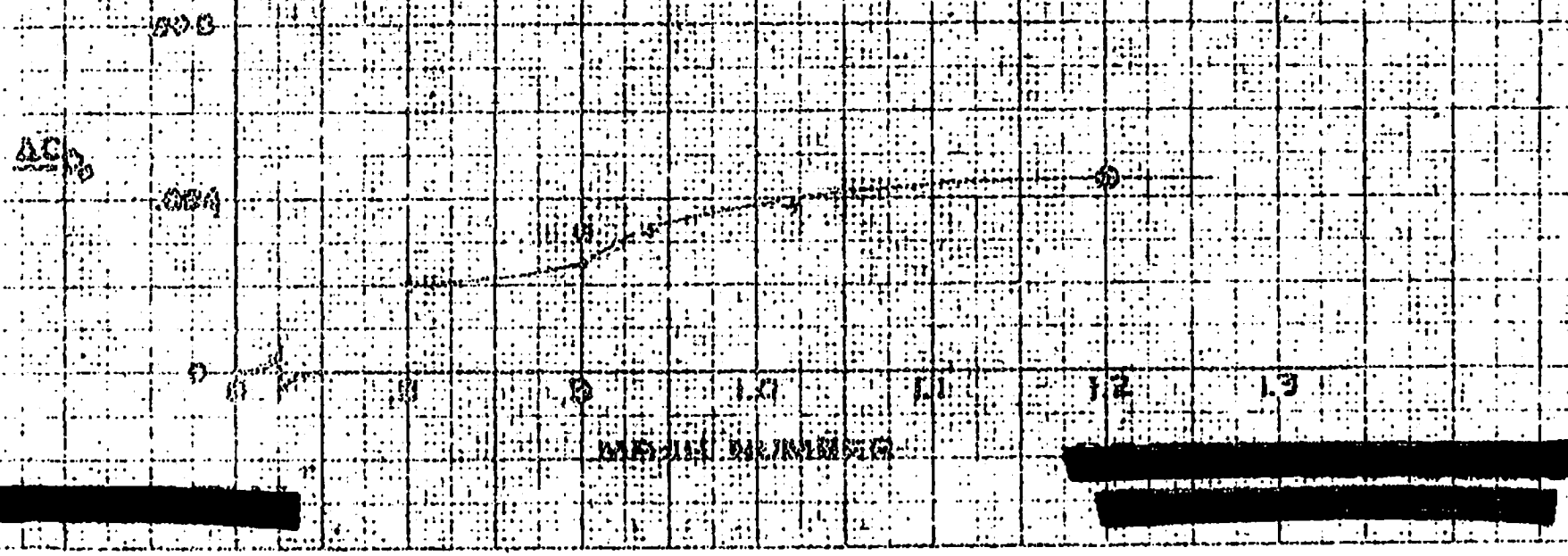
WING PYLON MOUNTED ON F8U-1 AIRPLANE

+ PHASE I TEST DATA USED TO ESTIMATE VALUES

O PHASE II TEST POINTS

—— FINAL ESTIMATED VALUES

ΔC_{D_0} BASED ON WING AREA OF 378 SQ FT.



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Report No. LD65
Page 47
Figure No. 15

4.2 F8U-1 Maximum Speed & Acceleration with TX-28 Store

In accordance with Item A of Sandia Purchase Order No. 51-1360 for the Phase II external store study, the maximum speed versus altitude and the time to accelerate to maximum speed were calculated for the F8U-1 airplane carrying the TX-28 store, pylon mounted on the left wing. The variation of maximum speed with altitude at normal, military, and maximum power is presented in figure 4.8. The acceleration characteristics are presented in figure 4.9.

Comparing these data with the performance of the basic F8U-1 airplane (1) shows the reduction in maximum speed due to the store pylon installation at maximum power, at 35,000 ft. altitude to be 112 knots from that of the basic airplane (MN/Kts. - 1.43/825). In figure 4.10 the maximum speeds at 35,000 ft. at maximum power for the F8U-1 airplane carrying the TX-28 store are compared to the maximum speeds obtained with the various store configurations of the Phase I study. Comparing the acceleration characteristics of the clean airplane and the airplane with store indicates a loss in acceleration at 35,000 ft. as shown in figure 4.9.

---

(1) Thomas, I.L. "Final Report, Phase I External Store Study, Sandia Contract 51-0923" Chance Vought Aircraft Report 9819 (15 June, 1955) 41.

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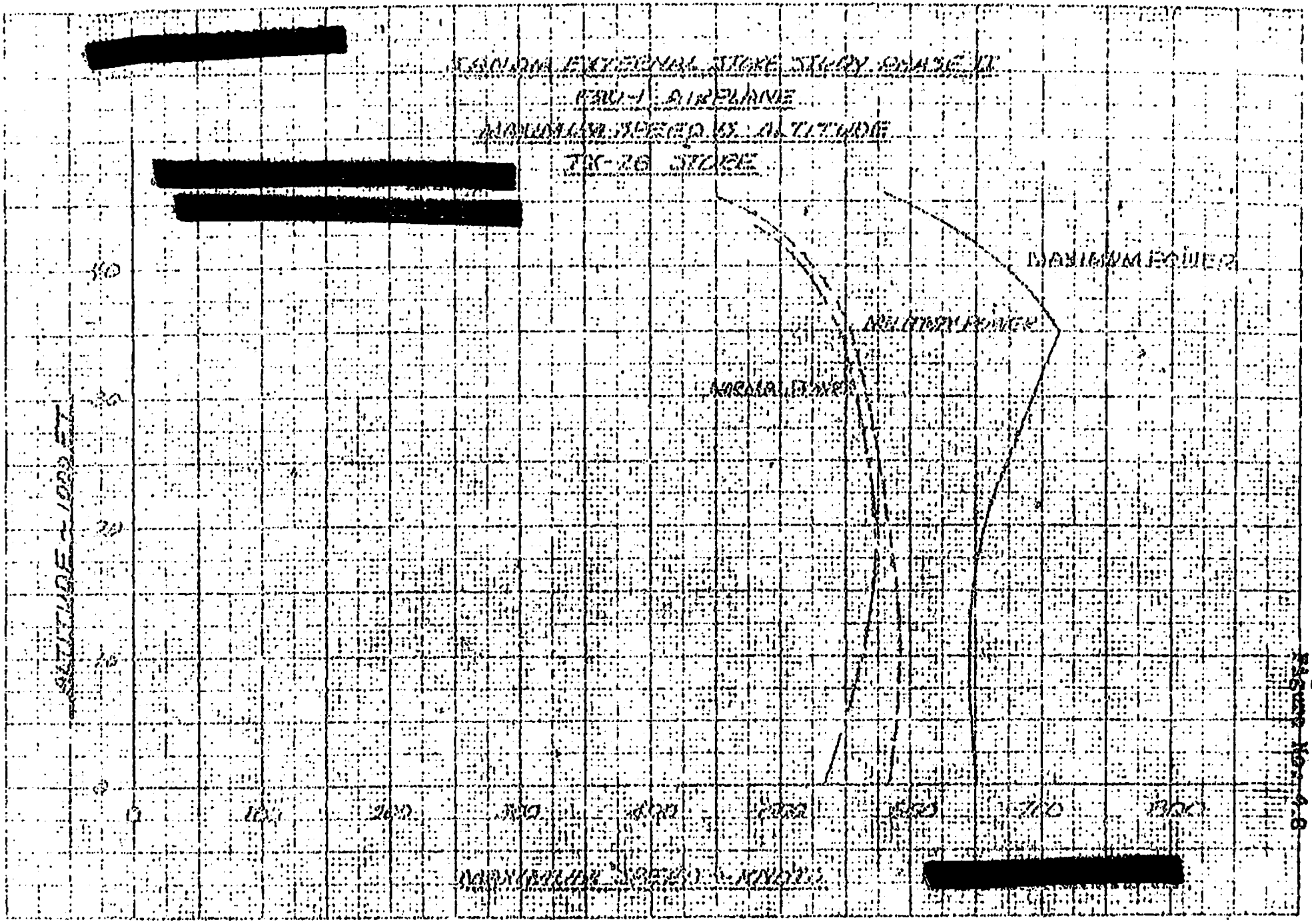
CANADA EXTERNAL STORE STUDY PHASE II

F3U-1 AIRPLANE

MAXIMUM SPEED VS. ALTITUDE

TX-26 STORE

[redacted]



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Report No. 10054
Page No. 133
Figure No. 4-8

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SANDIA SUPERSONIC EXTERNAL STORE STUDY

F8U-1 AIRPLANE

SPEED VS. TIME IN LEVEL FLIGHT ACCELERATION

AT MAXIMUM RATED POWER

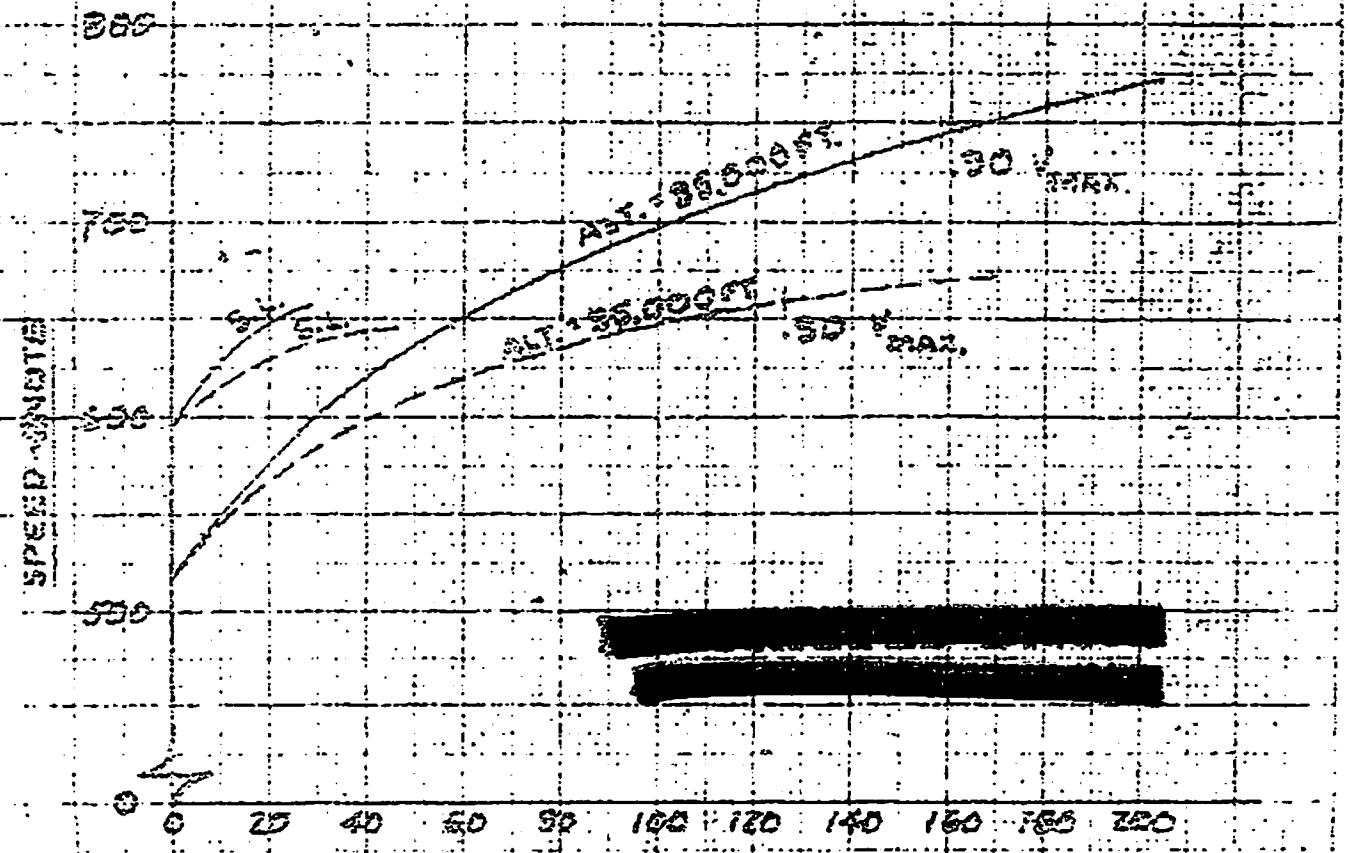
TIME = 0 AT MACH NUMBER = 0.80

COMBAT WEIGHT (CLEAN) = 22,210 LB

COMBAT WEIGHT (STORE ON) = 26,237 LB

CLEAN AIRPLANE

AIRPLANE WITH SANDIA FIRESIDE STORE



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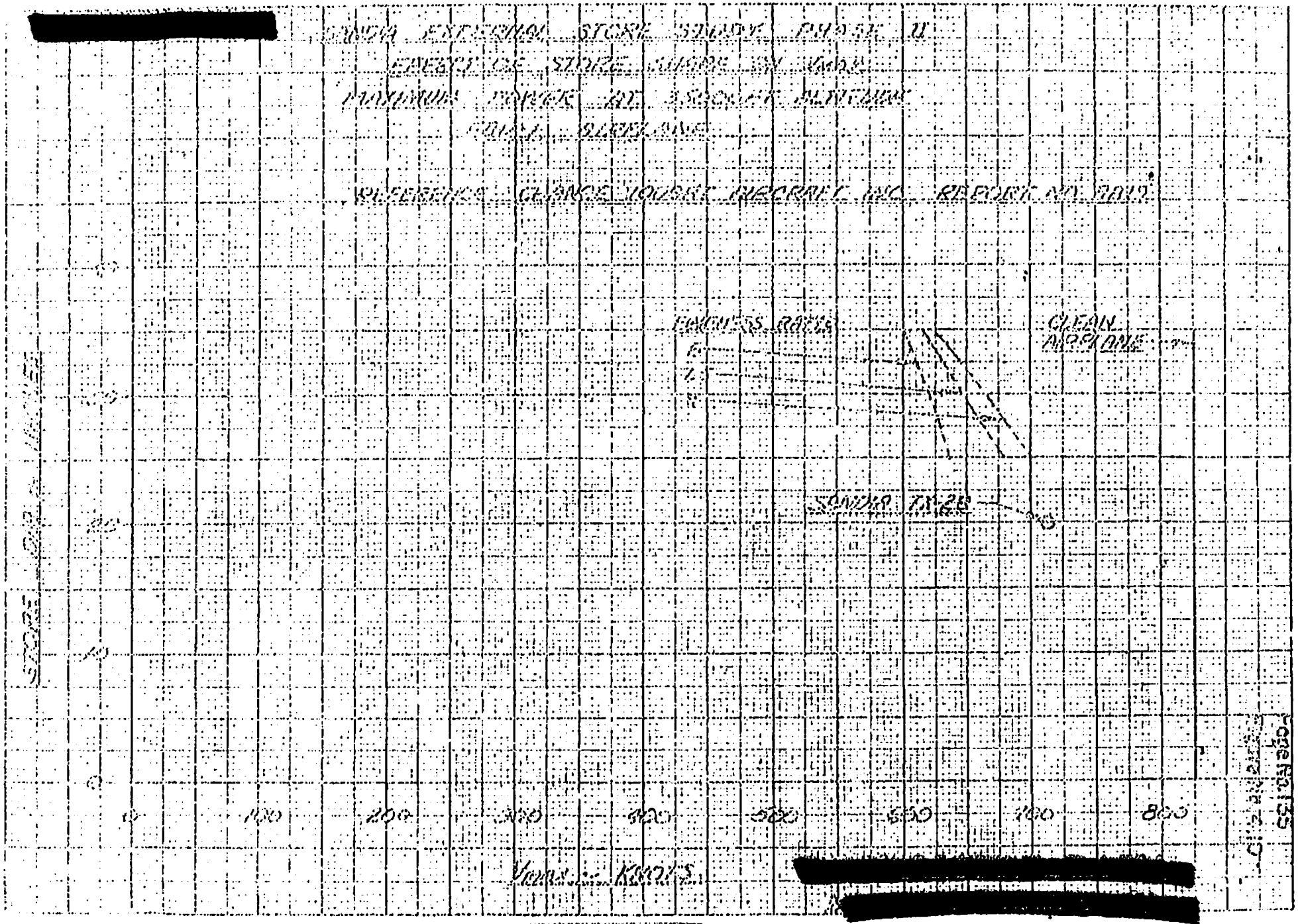

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Report No. 10054

4.3 Stability and Control Characteristics of the F8U-1 Airplane with TX-28 Store

The effect of the final store installation on the low speed lateral and directional stability and control of the F8U-1 airplane have been evaluated as requested under Item A paragraph 3 of Sandia Corporation Purchase Order No. 51-1360.

To obtain sufficient data to make this evaluation, low speed wind tunnel tests were conducted at the Chance Vought Aircraft low speed wind tunnel installation. The tests were made using an 0.15 size model of the F8U-1 airplane with the TX-28 store pylon mounted on the left wing. Data were obtained for the airplane in the high speed and landing configuration. A more detailed description of this test is presented in Part I of Appendix E, Volume II of this report. The results of the tests indicate the following:

4.3.1 Longitudinal Stability - There is a small change in the pitching moment characteristics due to the store installation in both the high speed and landing configuration. Comparisons of the pitching characteristics for the airplane with and without the store are shown in figure 4.11 for the landing configuration and in figure 4.12 for the high speed configuration. These comparisons indicate that there is a small trim change due to the store; however, these changes are of such small magnitude that they can be neglected. There is also a small variation in the aerodynamic center location due to the store installation as shown on figures 4.13 and 4.14.

These variations in a.c. location cause a reduction in the static margin of the order of 1 to 2 percent.

4.3.2 Directional Stability - There is essentially no change in the low speed directional stability of the airplane in the high speed and landing configuration due to the store as shown in figure 4.15 and 4.16.

4.3.3 Lateral Stability - The store installation did not effect the low speed lateral stability characteristics of the airplane in the high speed configuration as shown in figure 4.17. There were, however, some changes in the lateral stability for the airplane in the landing configuration as shown in figure 4.18. These changes do not present a critical problem.

4.3.4 Lateral Control - Due to the store's proximity to the aileron the effects of the installation on the aileron effectiveness were also evaluated. The results of this investigation as shown in figure 4.19, indicate that the store installation causes negligible changes in the aileron effectiveness.

4.3.5 Conclusion - The installation of the TX-28 store on a wing-pylon on the F8U-1 airplane causes little or no changes in the airplane aerodynamic stability parameters. The effects on stability and control due to the assemmetric weight concentration of the store were not evaluated since these effects were beyond the scope of this investigation.

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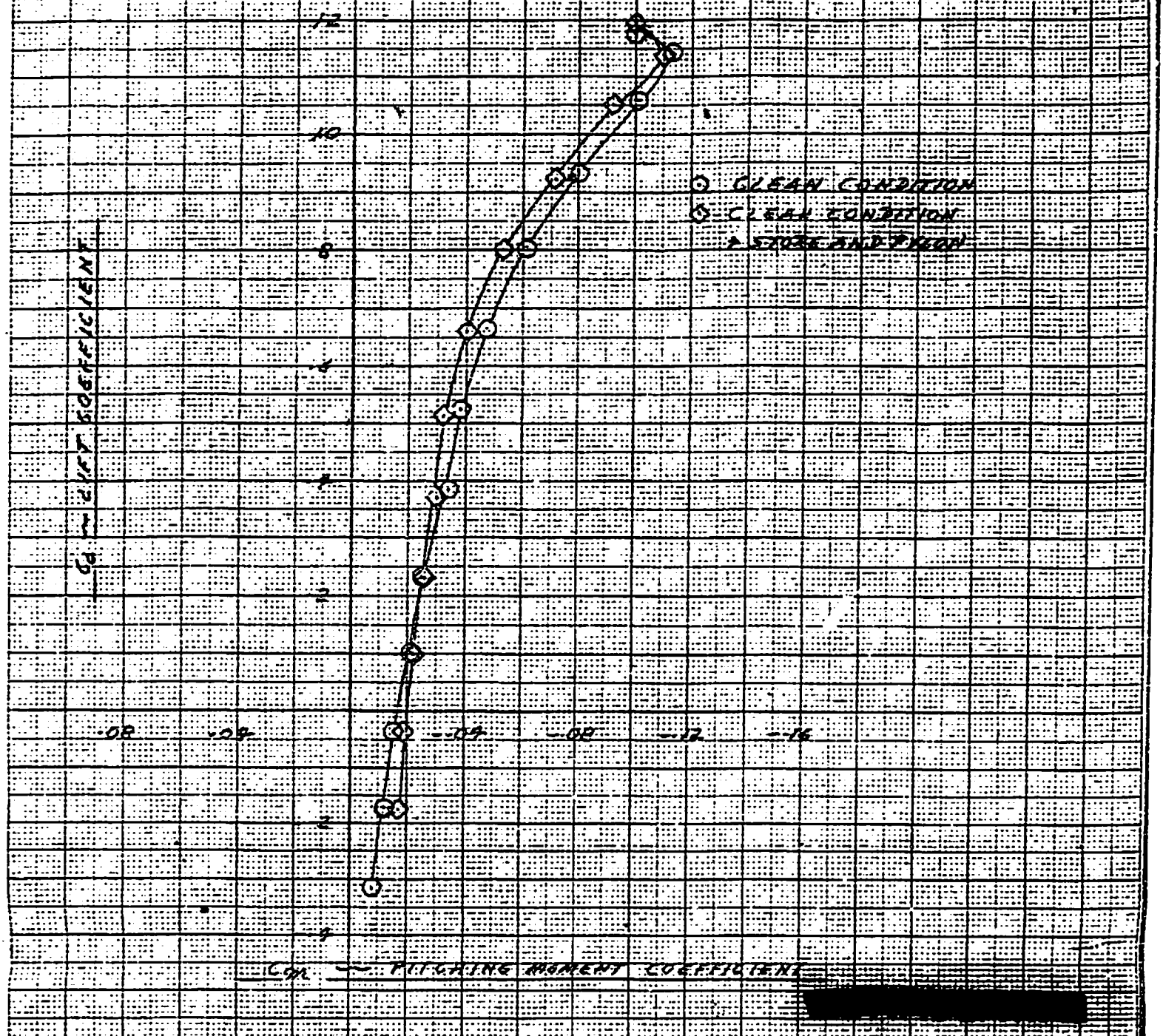
SANDIA EXTERNAL STORE STUDY PHASE II

EFFECT OF STORE ON F-104 LONGITUDINAL STABILITY

1/8-SIZE WIND TUNNEL MODEL

$i_w = 0°$ $\delta_{H.T.} = 0$ $\alpha = 0°$

$q = 30$ P.S.F. $M = .35$



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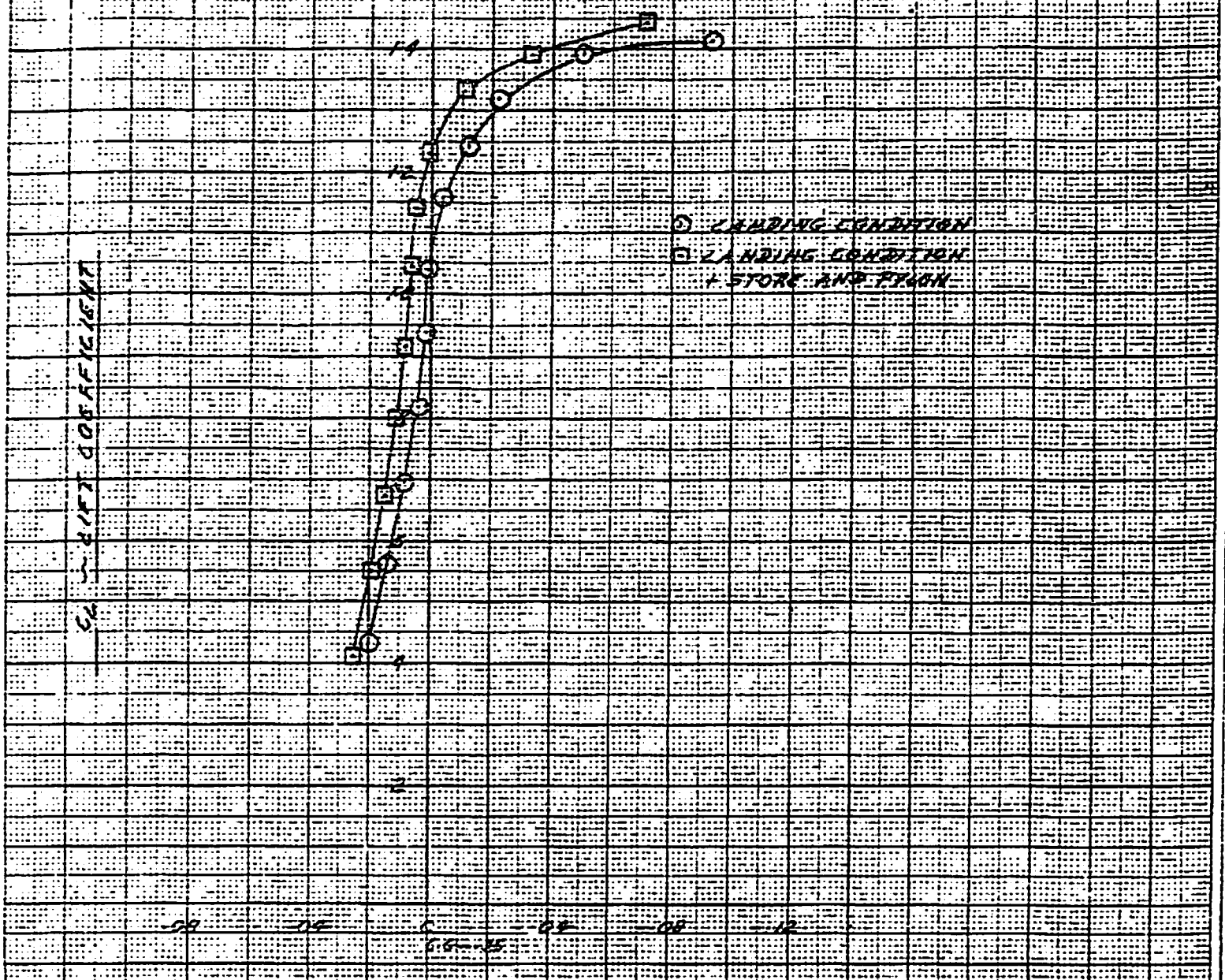
SERIES 2 EXTERNAL STORE STUDY PHASE II

EFFECT OF STORE ON FOR-AFT LONGITUDINAL STABILITY

15-SIZE WIND TUNNEL MODEL

$\alpha = 7°$, $\delta_{H/S} = 25.24$, $\delta_H = 30°$

$q = 30$ P.S.F. C.G. = 13.7%



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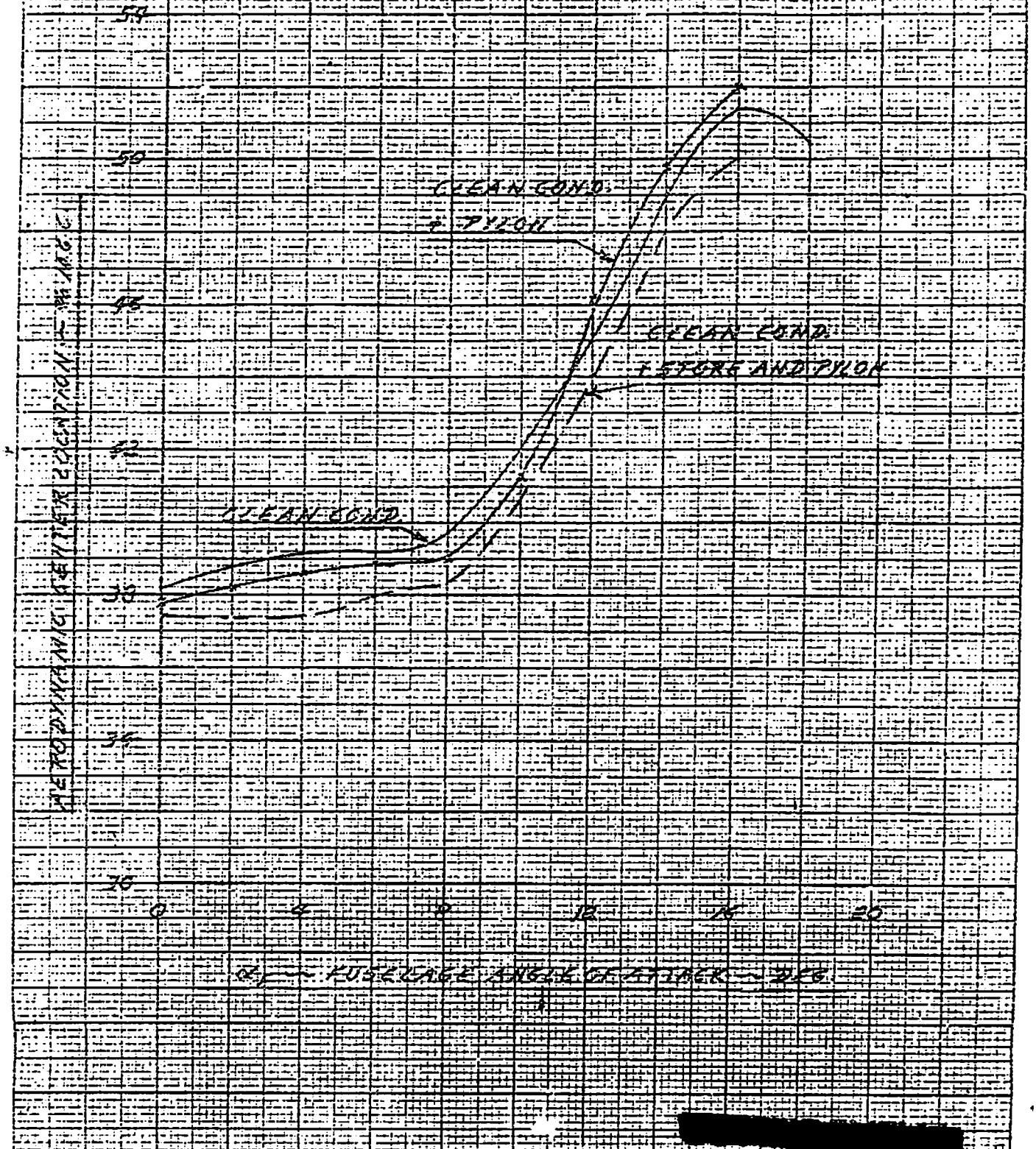
SANDIA EXTERNAL STORE STUDY
PHASE II
AERODYNAMIC CENTER LOCATION
1/5-SIZE FDU-1 WIND TUNNEL MODEL
$\alpha_w = -1°$ ZERO NOSE DROOP, $\alpha_t = 0°$
$\delta_f = 35°$ REF. C.G. = 35%



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SANDIA EXTERNAL STORE STUDY

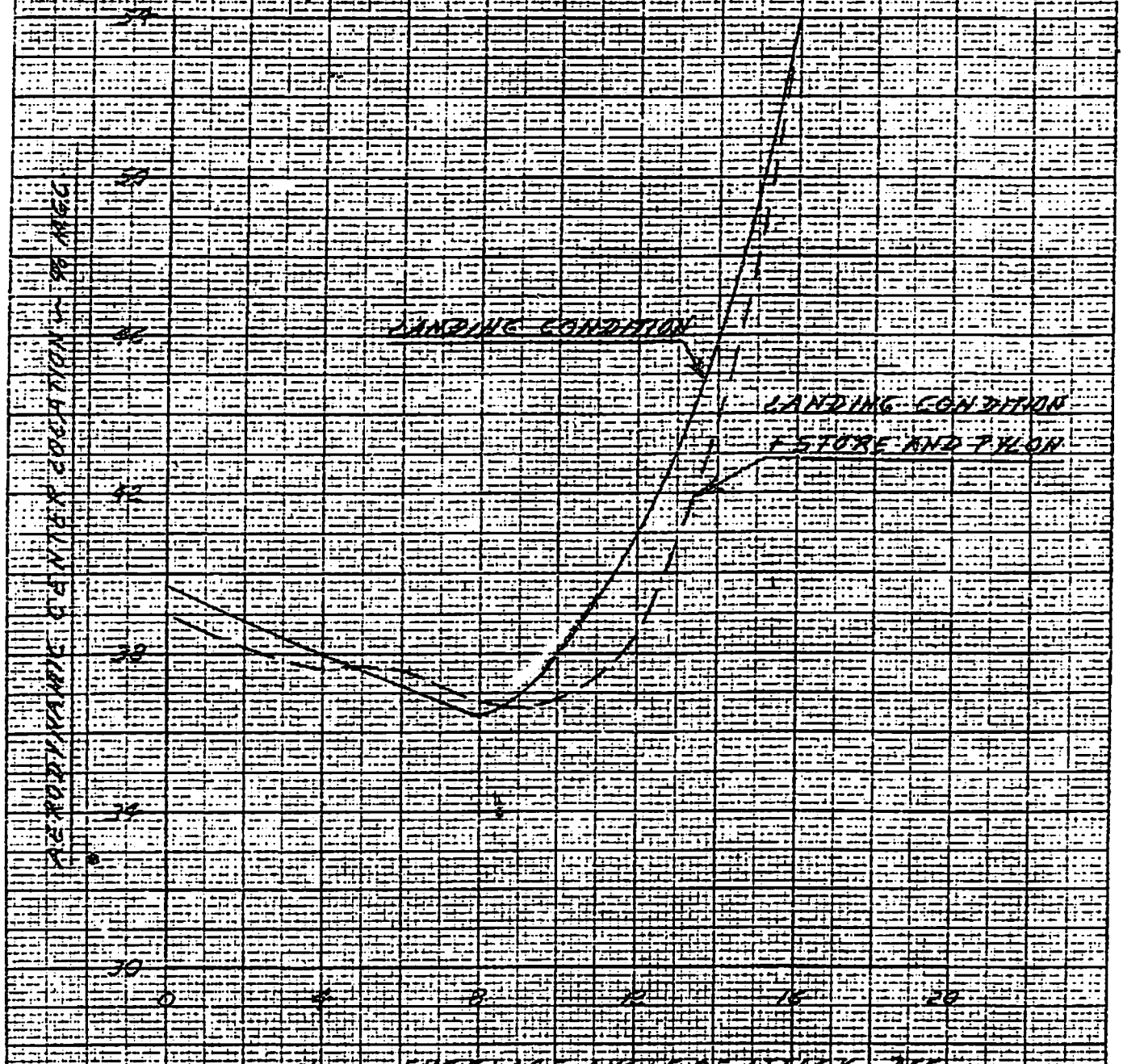
PHASE II

AERODYNAMIC CENTER LOCATION

.15 - SIZE RAY-1 WIND TUNNEL MODEL

$\delta_{W} = 7°$ $\delta_{H}/\delta_{N} = 25/37$ $\Lambda = 20°$

$q = 30$ PSF C.G. = 33%



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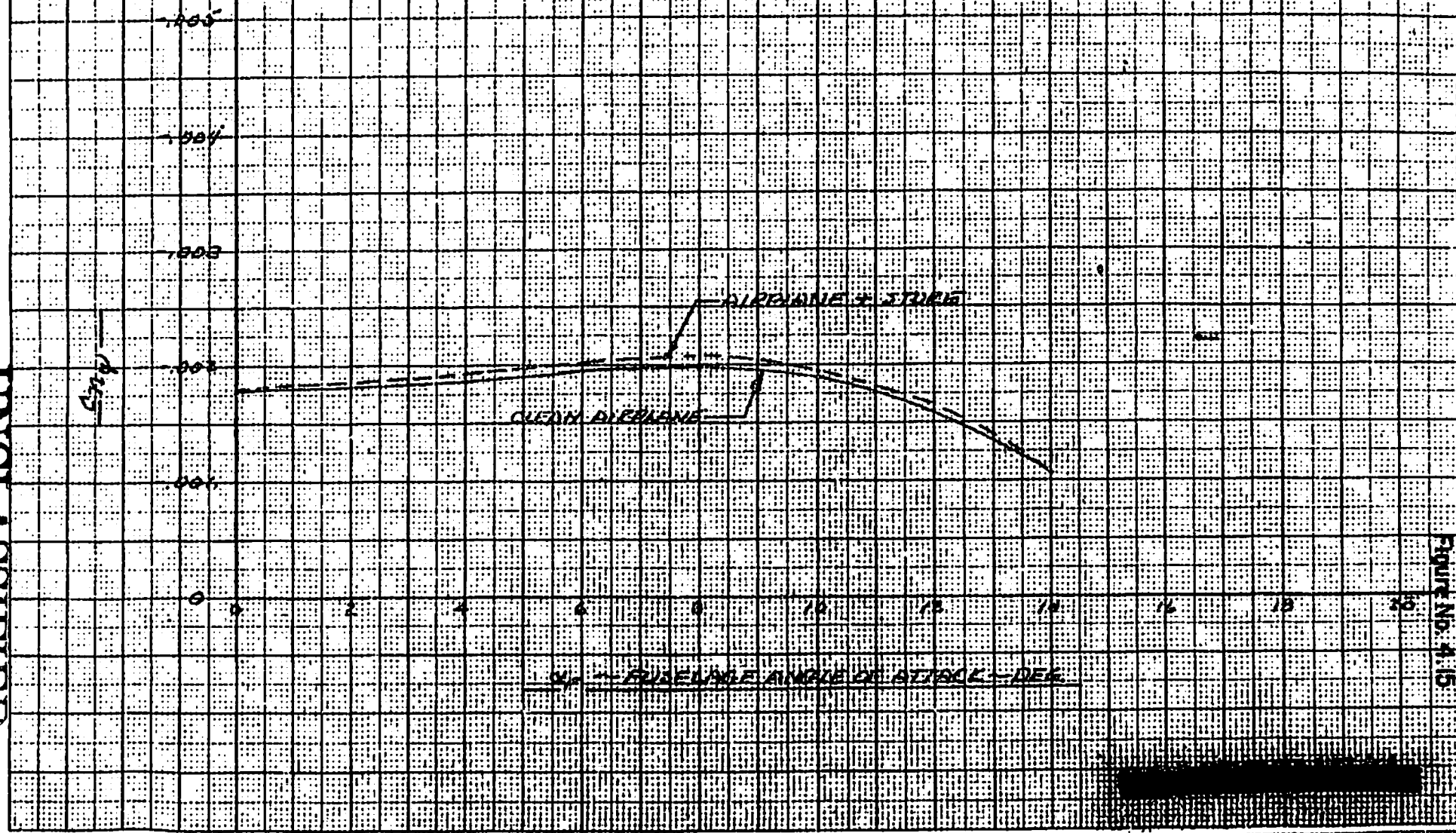
SANDIA EXTERNAL STORE STUDY
PHASE II
EFFECT OF STORE ON FOUL-H DIRECTIONAL STABILITY
.15 SIZE WIND TUNNEL MODEL

$i_w = -1°$, ZERO NOSE DROOP $A_1°$
$q = 30$ P.S.F. C.G. = 35%



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Report No. 10064
Page No. 142
Figure No. 4.15

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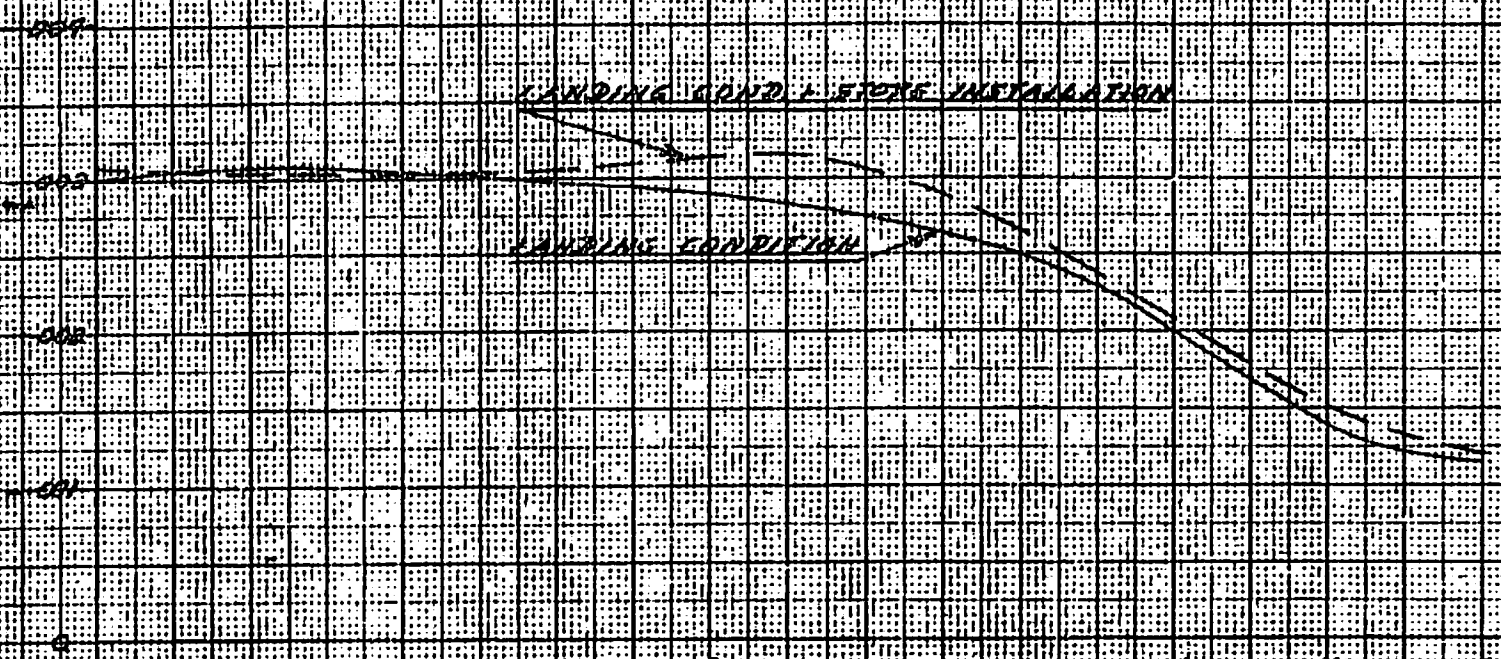
SANDIA EXTERNAL STORE STUDY
PHASE II
EFFECT OF STORE ON FOUR DIRECTIONAL STABILITY
1/5-SIZE WIND TUNNEL MODEL

$i_W = 7°$ $C_{M_{cg}} = 25\%$ $\alpha_1 = 20°$

$\gamma = 90$ MAX $c.g. = 35\%$



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Report No. 10064
Page No. 143
Figure No. 4.15

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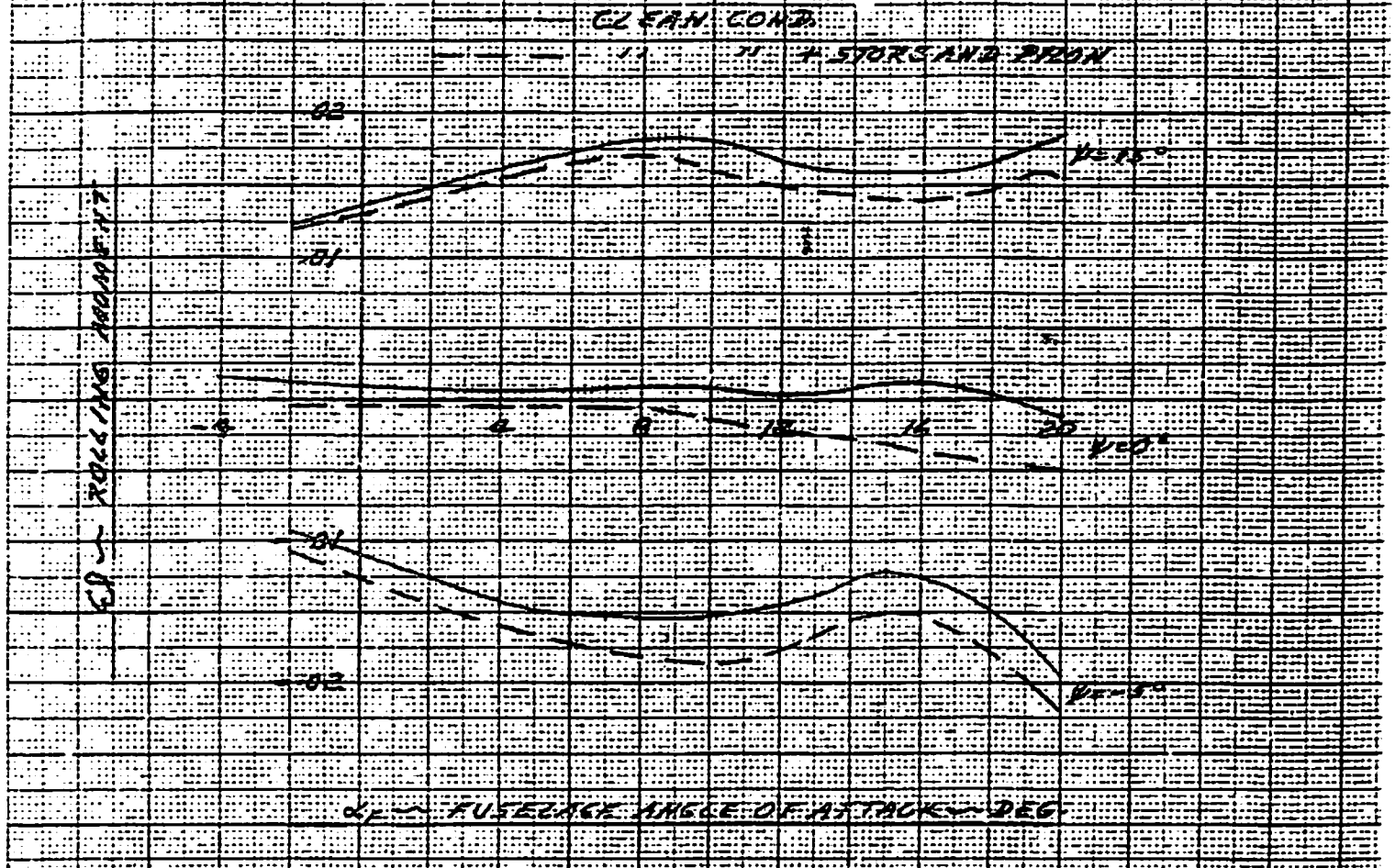
SANDIA EXTERNAL STORE STUDY
PHASE II
ROLLING MOMENTS OF F8U-1 WITH
AND WITHOUT STORE
1/5-SIZE WIND TUNNEL MODEL

$i_w = -1°$ ZERO H. DROOP, A_j °

$q = 30$ P.S.F. 0.4×35 %



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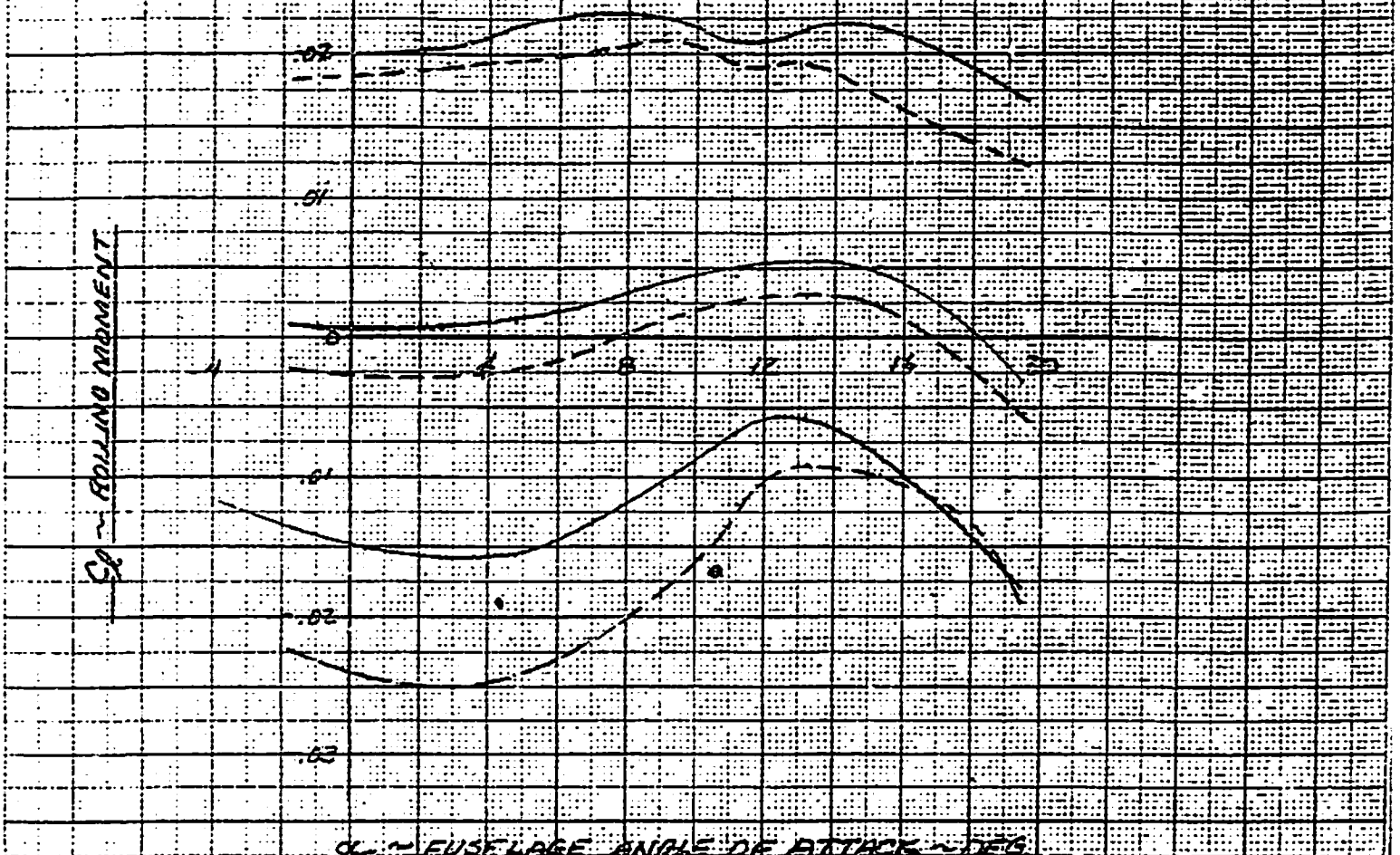
SANDIA EXTERNAL STORE STUDY
PHASE II
ROLLING MOMENTS OF F8U-1 WITH AND WITHOUT STORE
1/5 SIZE WIND TUNNEL MODEL

$i_w = 7°$, $\delta_H/\delta_T = 25°/20°$, $\beta = 20°$

$q = 50$ PSF CG = 35%



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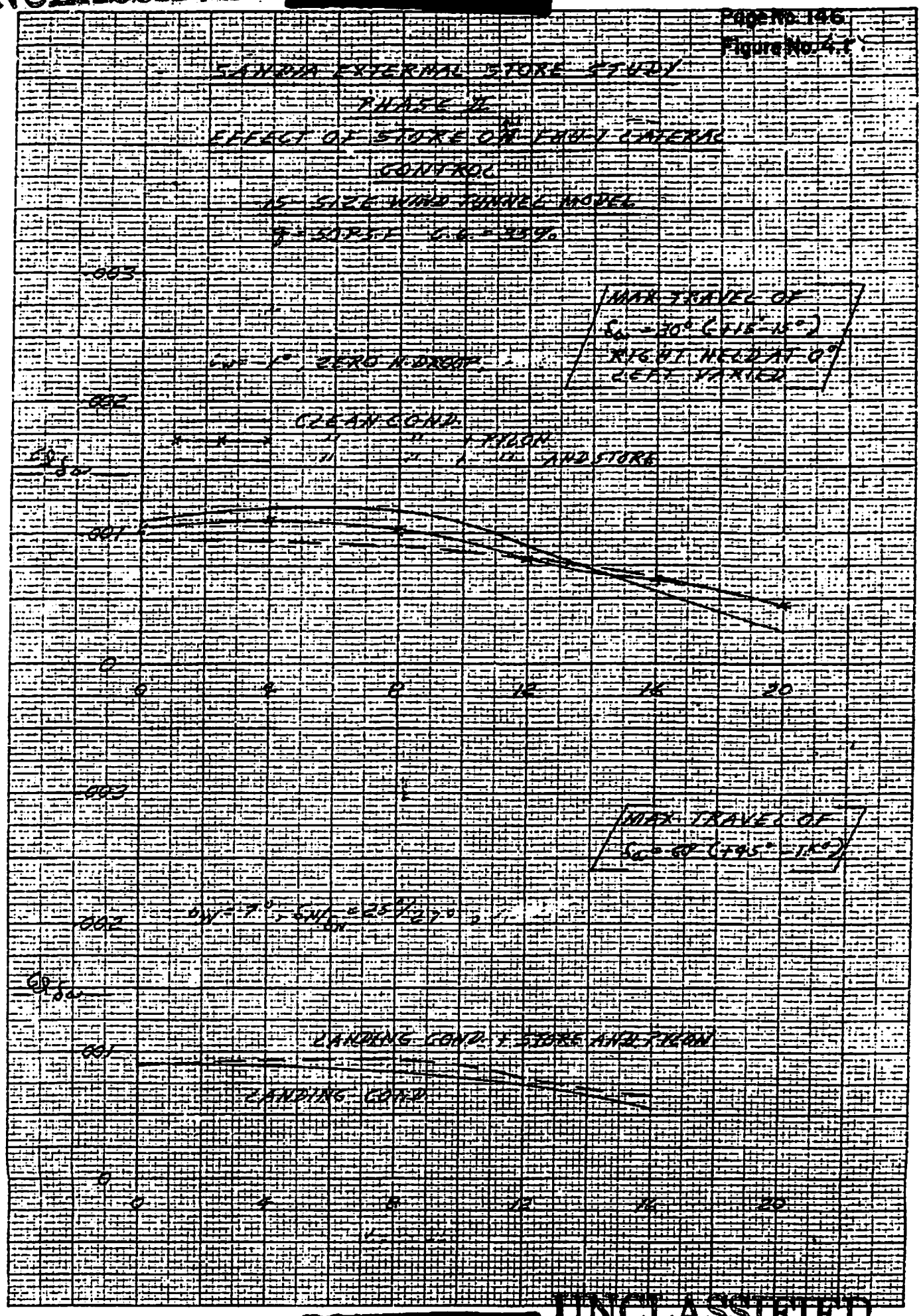
SAUNDA EXTERNAL STORE STUDY
PHASE II
EFFECT OF STORE ON LAT-DIR CONTROL
.15 SIZE WIND TUNNEL MODEL
MAX TRAVEL OF
δ_a = 30° (+15° -15°)
RIGHT HELD AT 0°
LEFT VARIED
δ_w = 1° ZERO H. DROOP
CLEAN COND.
" " PYLON
" " PYLON AND STORE
.003
.002
.001
0
$C_{l_{\delta_a}}$
0
4
8
12
16
20
MAX TRAVEL OF
δ_a = 60° (+45° -15°)
δ_w = 7°, $\delta_{H_{OT}}$ = 25°/27°
LANDING COND. + STORE AND PYLON
LANDING COND.

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4.4 Store Delivery Maneuvers - The store delivery maneuvers for the F8U-1 airplane carrying the TX-28 store are presented in this section. Of the twenty (20) maneuvers requested under Item C of Sandia Purchase Order No. 51-1360 nineteen maneuvers were calculated. The twentieth, a turn at 40,000 ft. at greater than 4 G's was not done as the 4 G turn represented the maximum lift condition. Table I presents a description of the maneuvers calculated.

In making the calculations the airplane weight was assumed to be constant (Combat weight with store on = 24,237 lb.) with the exception that weight was reduced for dropping the store and pylon at the bomb release point. The effects of thrust angle and angle of attack were assumed to be negligible.

The equations of motion were adapted to these assumptions and mechanized for use on the IBM Model 650 digital computer. The maneuvers were considered to be made up of three parts: the approach, the attack, and the escape.

Time histories of the maneuvers are presented in Figures 4.20 through 4.38. Where applicable, the following quantities are shown:

1. longitudinal distance
2. lateral distance
3. altitude
4. velocity
5. turn angle
6. dive or climb angle

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In the coordinate system used, angular measurements were assumed from 0 to ±360° measured as a change from the initial approach position in level flight. As a result, a heading of 180° represents a reversal of direction from the approach and a 225° climb angle indicates a 45° dive angle away from the target. Ordinarily, a positive dive-or-climb angle indicates a climb and a negative angle indicates a dive.

The following brief summaries may serve to amplify the figures:

Figures 4.20 - 4.27 - Self-explanatory

Figure 4.28 - Following the labs delivery the 4 G's of the wingover were used to bank and pushover, about 40% of the G's being used for banking and 60% to nose down until a dive angle of 20° was reached. During the constant 20° dive all 4 G's were applied to turn to 135°, and then the dive was continued straight ahead to 1000' at which point a 5 G pullout was made.

Figure 4.29 - Following the labs delivery the 5 G pullup was continued to 225° followed by a constant angle dive to 2000' at which point a 5 G pullout was made.

Figures 4.30 - 4.33 - Self-explanatory.

Figure 4.34 - Following the release of the store during the dive a 4 G diving turn is done at a constant dive angle of 20° to a 135° relative heading at which point a pullout is made.

Figure 4.35 - Following the release of the store during the dive, a 4 G diving turn is made, about two-thirds of the G's being used for banking and the remainder to nose up. When 135° was reached all the G's were used to pullout.

Figure 4.36 - Following the release of the store during the dive, a 4 G diving turn is made, about 42% of the G's being used for banking and the remainder to nose up. When 135° was reached all the G's were used to pull out.

Figures 4.37 - 4.38 - Self-explanatory.

TABLE I

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Description of Maneuvers Presented

Figure Number	Approach	Attack	Escape
4.20	Acceleration to V-max at 40,000'	Drop store from level flight	4G level turn through 135°
4.21	Acceleration to V-max at 40,000'	Drop store from level flight	3G level turn through 135°
4.22	Acceleration to V-max at 20,000'	Drop store from level flight	4G level turn through 135°
4.23	Acceleration to V-max at 20,000'	Drop store from level flight	3G level turn through 135°
4.24	Acceleration to V-max at 20,000'	Drop store from level flight	5G level turn through 135°
4.25	Acceleration to V-max at 10,000'	Drop store from level flight	4G level turn through 135°
4.26	Acceleration to V-max at 10,000'	Drop store from level flight	4G immelmann
4.27	Sea level entry, 4G pullup to 30°	Drop store from 30°	Complete pullup in 4G immelmann
4.28	Sea level entry, 4G pullup to 30°	Drop store from 30°	4G wingover
4.29	Sea level entry, 5G pullup to 30°	Drop store from 30°	Complete pullup in 5G half Cuban 8
4.30	Sea level entry, 4G pullup to 60°	Drop store from 60°	Complete pullup in 4G immelmann
4.31	Sea level entry, 4G pullup to 90°	Drop store from 90°	Complete pullup in 4G immelmann
4.32	Sea level entry, 4G pullup to 110°	Drop store from 110°	Complete pullup in 4G immelmann
[illegible]	[illegible]	Drop store at 20° 15,000'	Pullout in 4G immelmann

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4.29	Sea level entry, 5G pullup to 30°	Drop store from 30°	Complete pullup in 5G half Cuban 8
4.30	Sea level entry, 4G pullup to 60°	Drop store from 60°	Complete pullup in 4G immelmann
4.31	Sea level entry, 4G pullup to 90°	Drop store from 90°	Complete pullup in 4G immelmann
4.32	Sea level entry, 4G pullup to 110°	Drop store from 110°	Complete pullup in 4G immelmann
4.33	41,000' entry, MN = .8262 A max pushover to 20° and constant angle dive to 15,000'	Drop store at 20°, 15,000'	Pullout in 4G immelmann
4.34	41,000' entry, MN = .8262 A max pushover to 20° and constant angle dive to 15,000'	Drop store at 20°, 15,000'	4G during turn
4.35	41,000' entry, MN = .8262 A max pushover to 40° and constant angle dive to 20,000'	Drop store at 40°, 20,000'	4G during turn
4.36	41,000' entry, MN = .8262 A max pushover to 60° and constant angle dive to 25,000'	Drop store at 60°, 25,000'	4G during turn
4.37	41,000' entry, MN = .8262 A max pushover to 60° and constant angle dive to 25,000'	Drop store at 60°, 25,000	4G pullout with zoom at optimum rate of climb
4.38	41,000' entry, MN = .8262 A max pushover to 80° and constant angle dive to 30,000'	Drop store at 80°, 30,000'	4G pullout with zoom at optimum rate of climb

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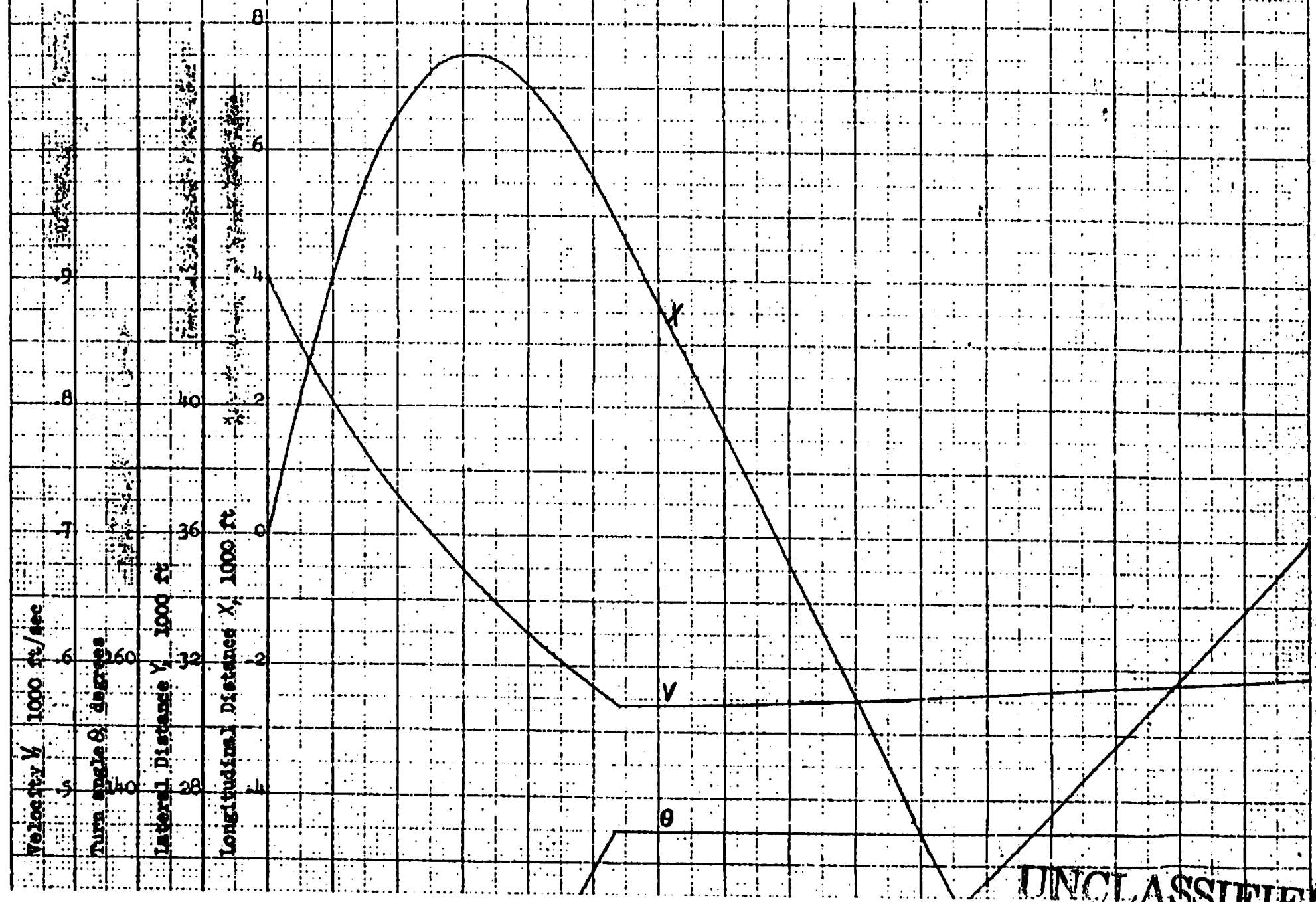
SANDIA EXTERNAL STORES STUDY PHASE II ESCAPE MANEUVERS

LEVEL RELEASE 40,000', 4 g LEVEL TURN THROUGH 135° ESCAPE



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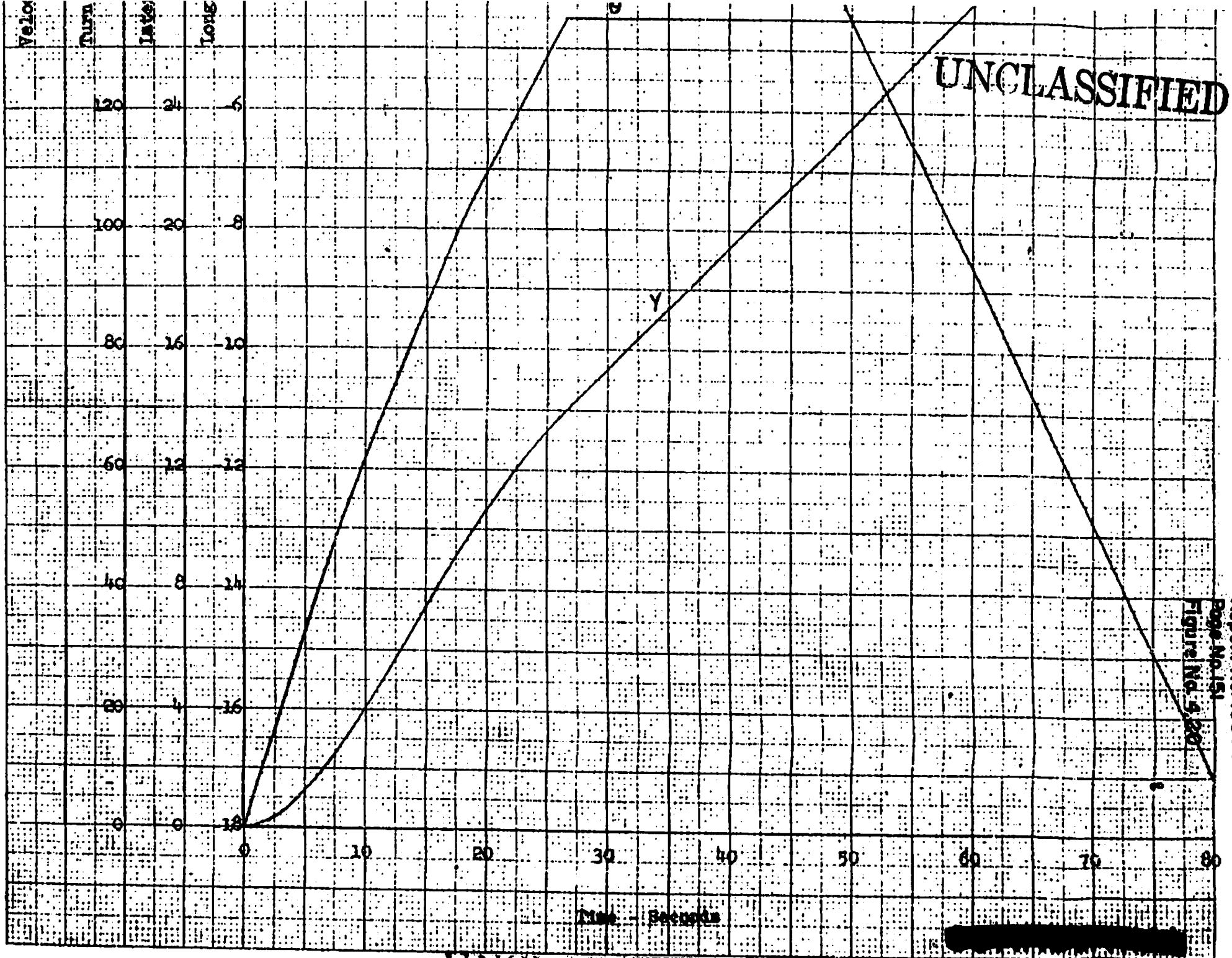

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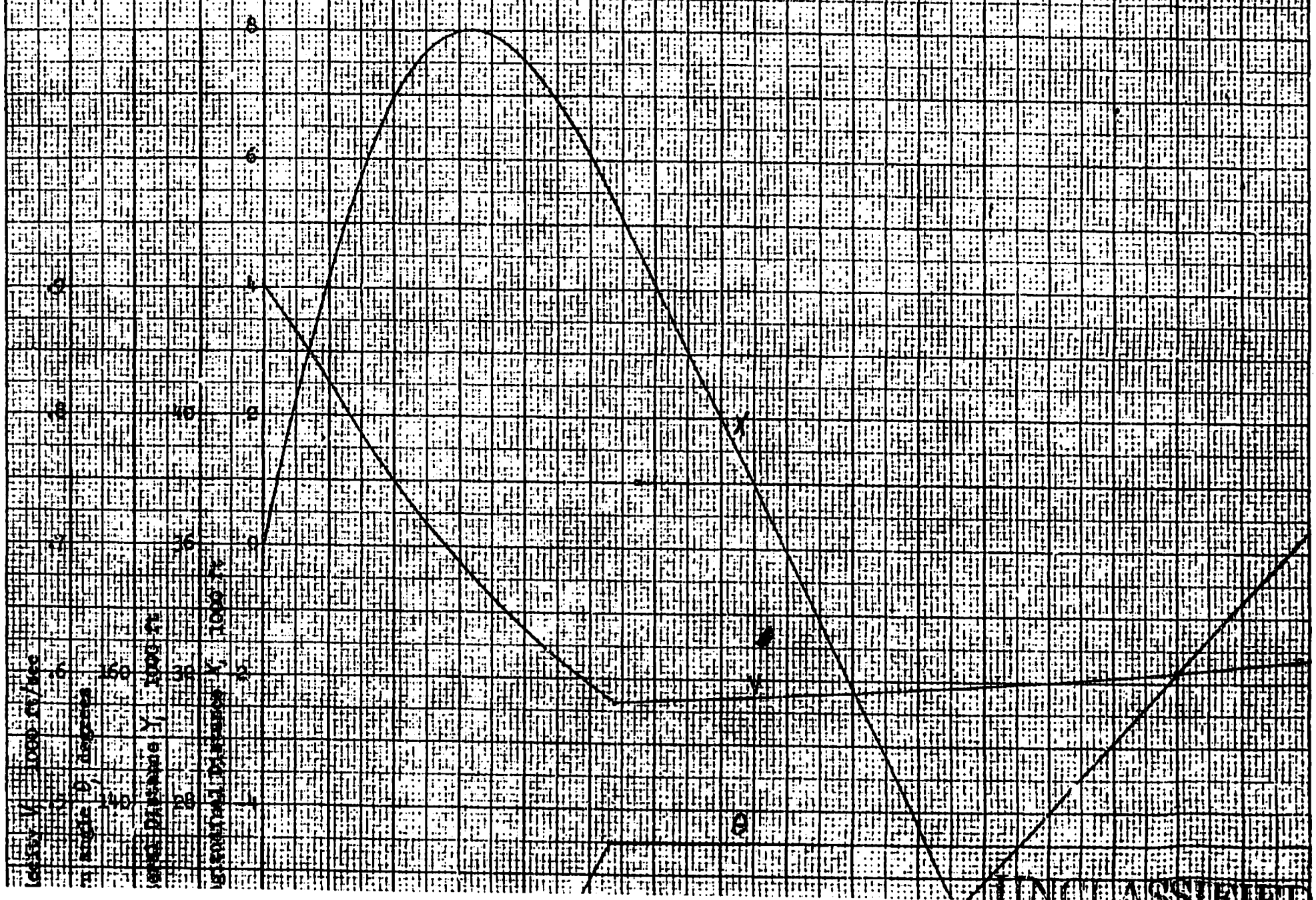
SANDIA EXTERNAL STORES STUDY PHASE II ESCAPE MANEUVERS

LEVEL RELEASE 40,000', 3 g LEVEL TURN THROUGH 135° ESCAPE



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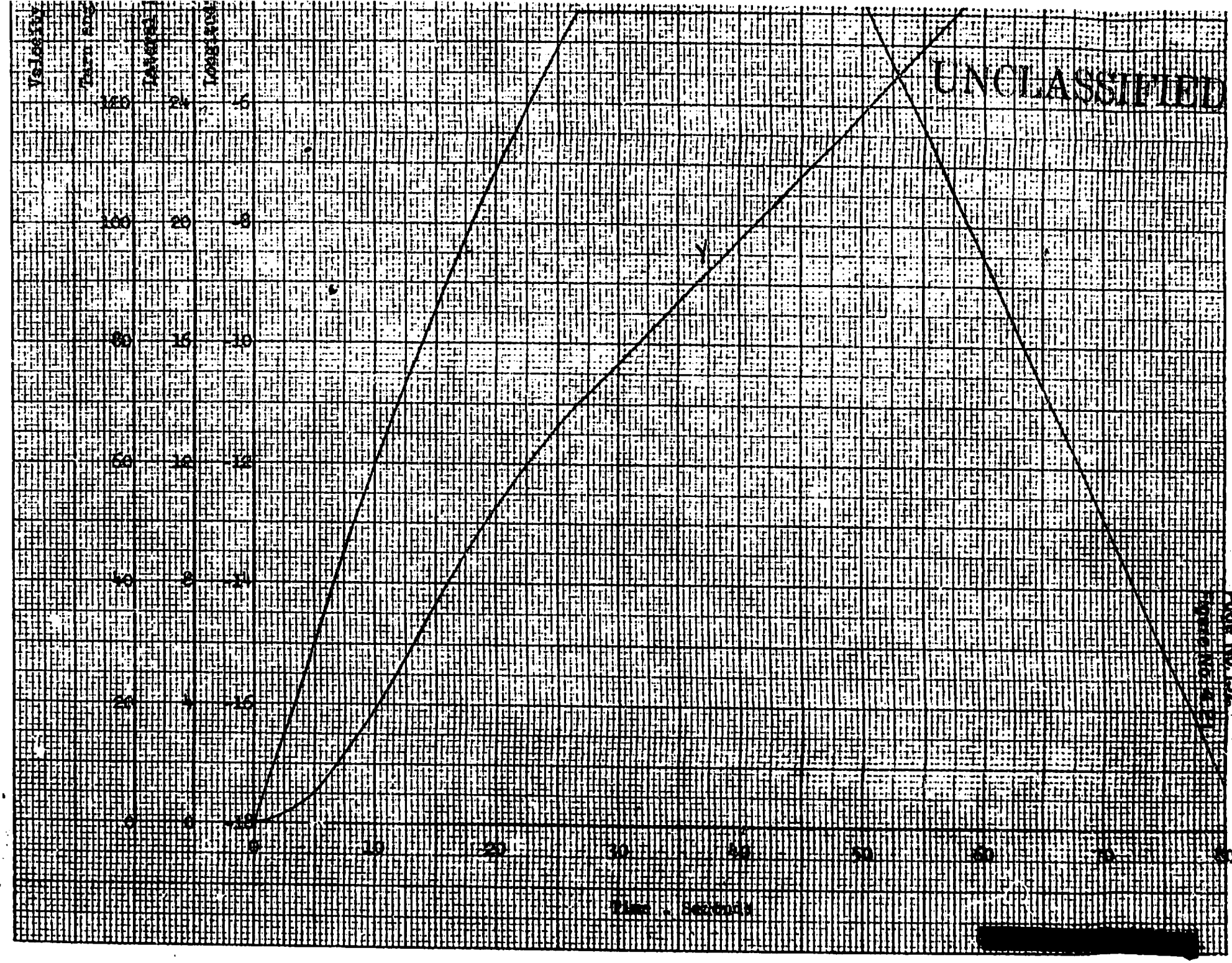
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Velocity
Turn Ang
Latitude
Longitude
Time - Seconds
0
10
20
30
40
50
60
70
80
160
140
120
100
80
60
40
20
0
24
20
16
12
8
4
0
16
8
-8
-16
-24
-32
-40
-48
-56
-64
-72
-80
-88
-96
-104
-112
-120
-128
-136
-144
-152
-160
-168
-176
-184
-192
-200
-208
-216
-224
-232
-240
-248
-256
-264
-272
-280
-288
-296
-304
-312
-320

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SANDIA EXTERNAL STORES STUDY PHASE II ESCAPE MANEUVERS

LEVEL RELEASE 20,000', 4 g LEVEL TURN THROUGH 135° ESCAPE

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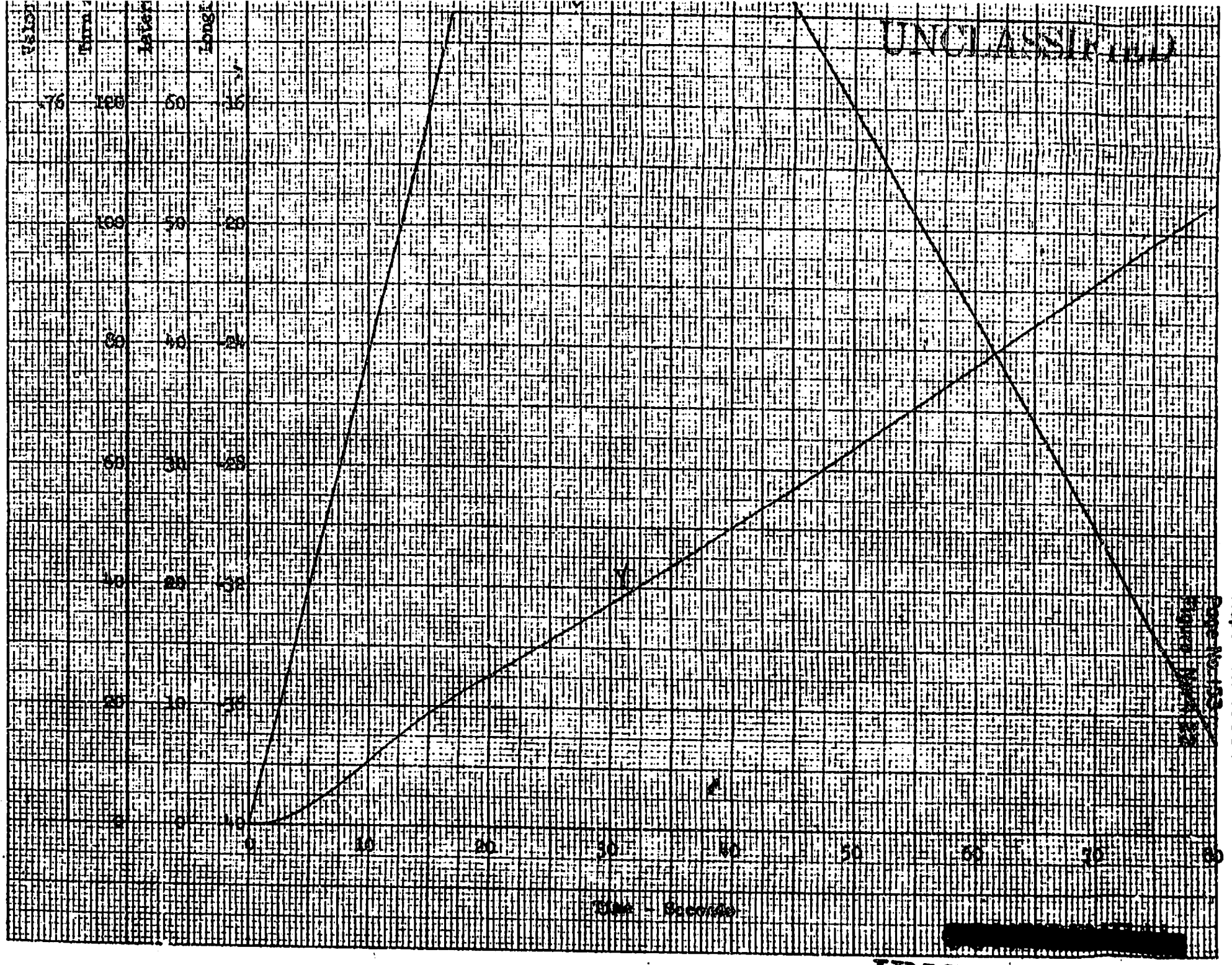

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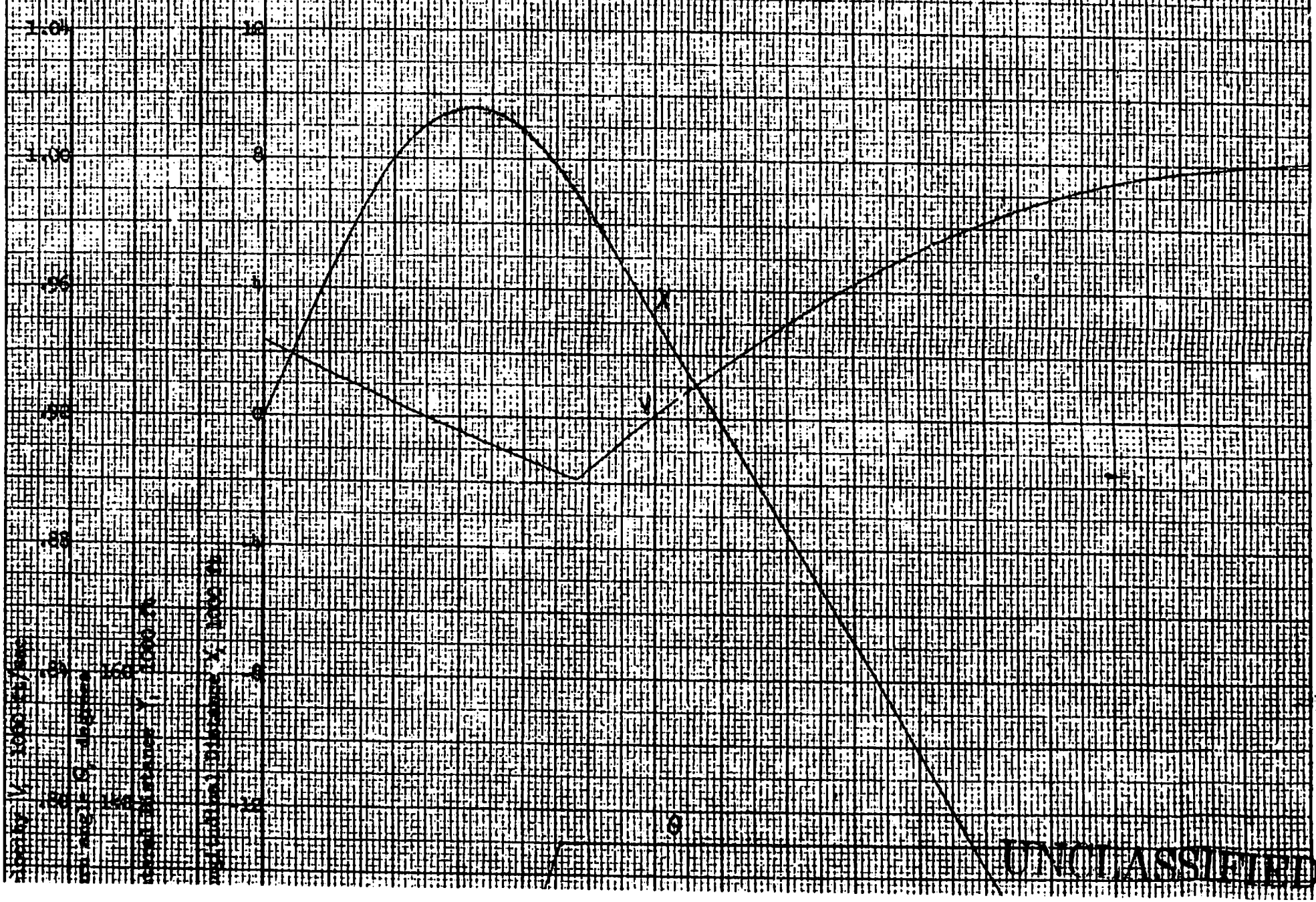
SANDIA EXTERNAL STORES STUDY PHASE II ESCAPE MANEUVERS

LEVEL RELEASE 20,000', 3 g LEVEL TURN THROUGH 135° ESCAPE



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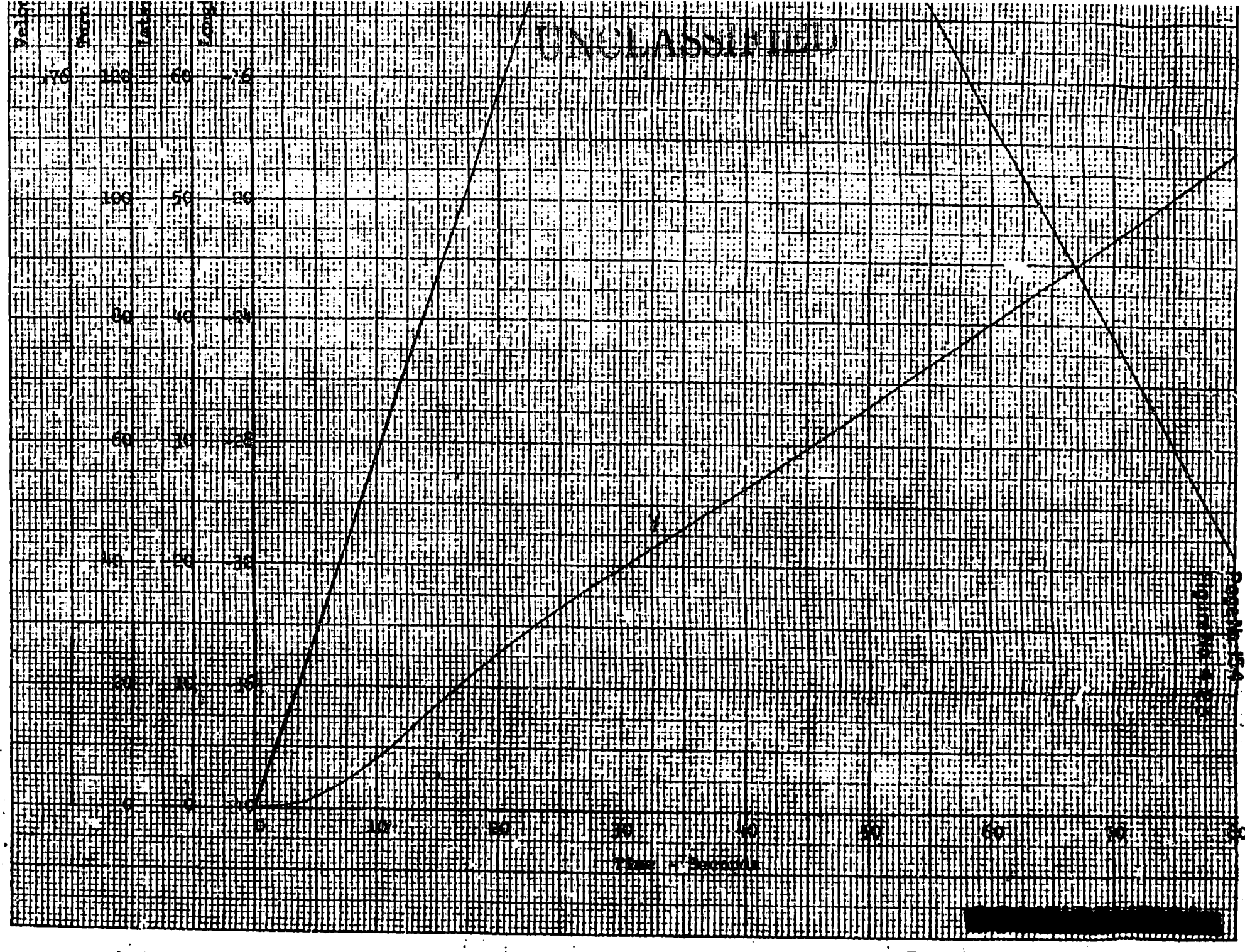

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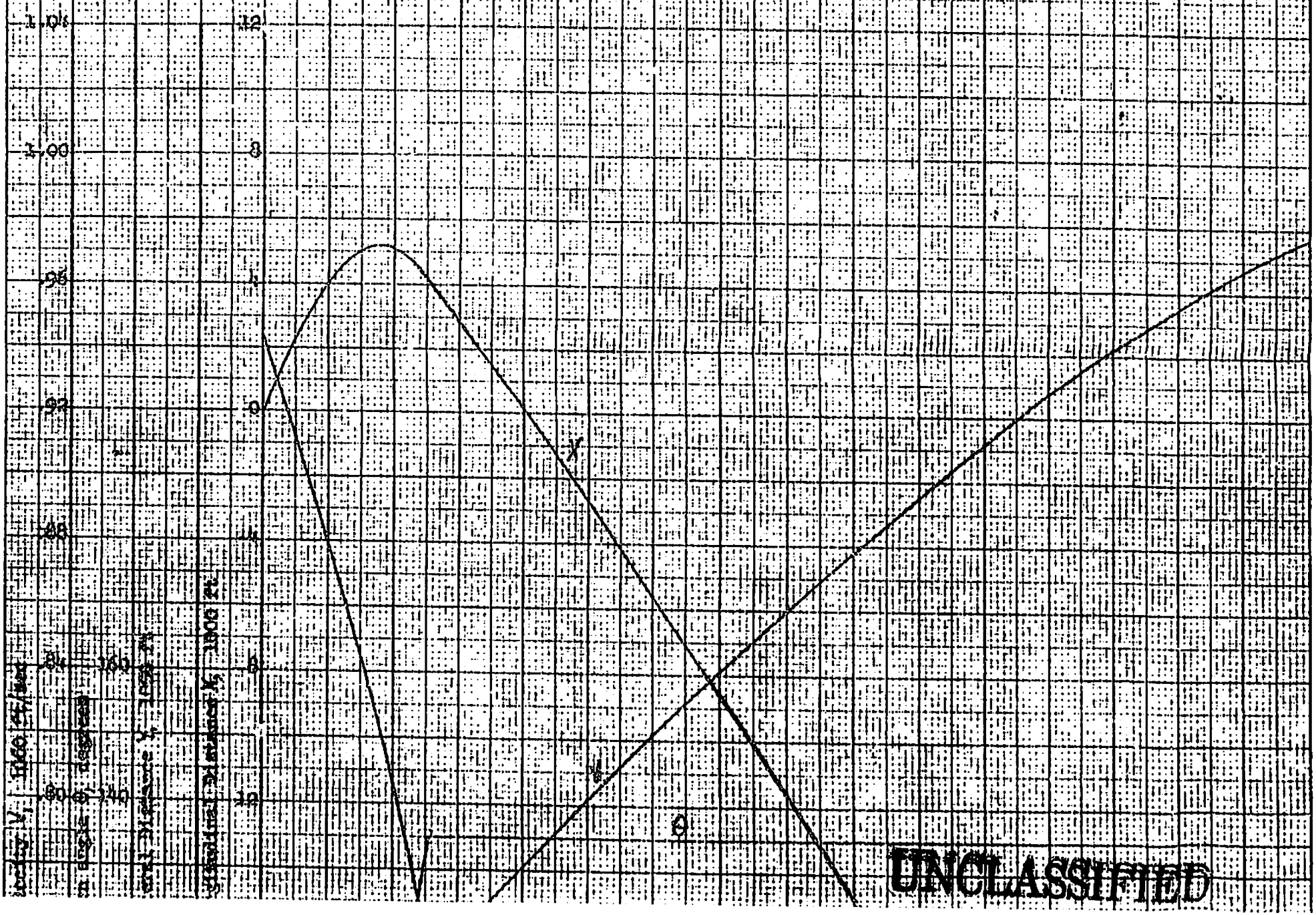
SARGOTA EXTERNAL STORES STUDY PHASE II ESCAPE MANEUVERS

LEVEL RELEASE 20,000', 5 g LEVEL TURN THROUGH 135° ESCAPE



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Velocity - V
Pitch Angle
Longitude
Time - Seconds
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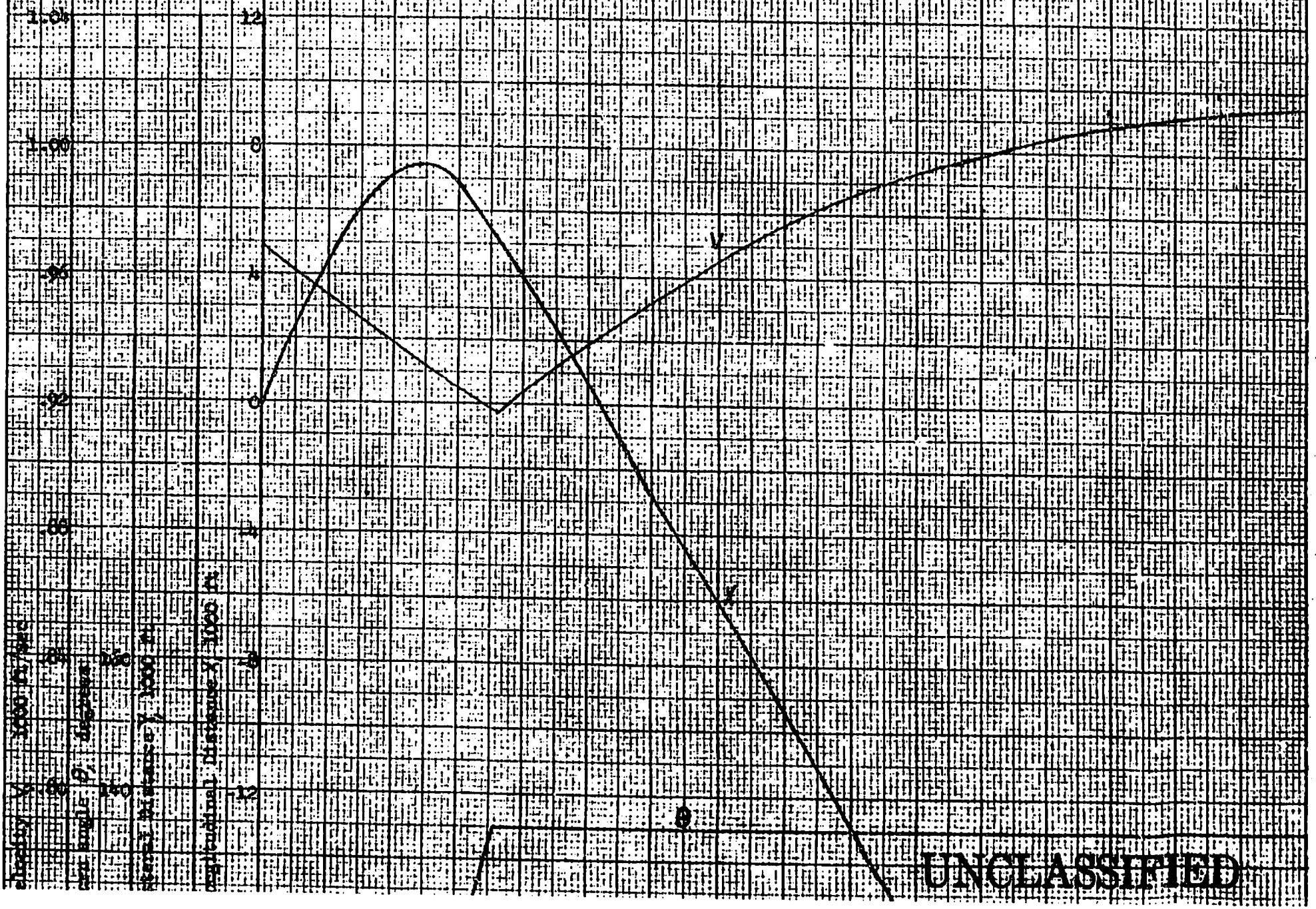
UNCLASSIFIED

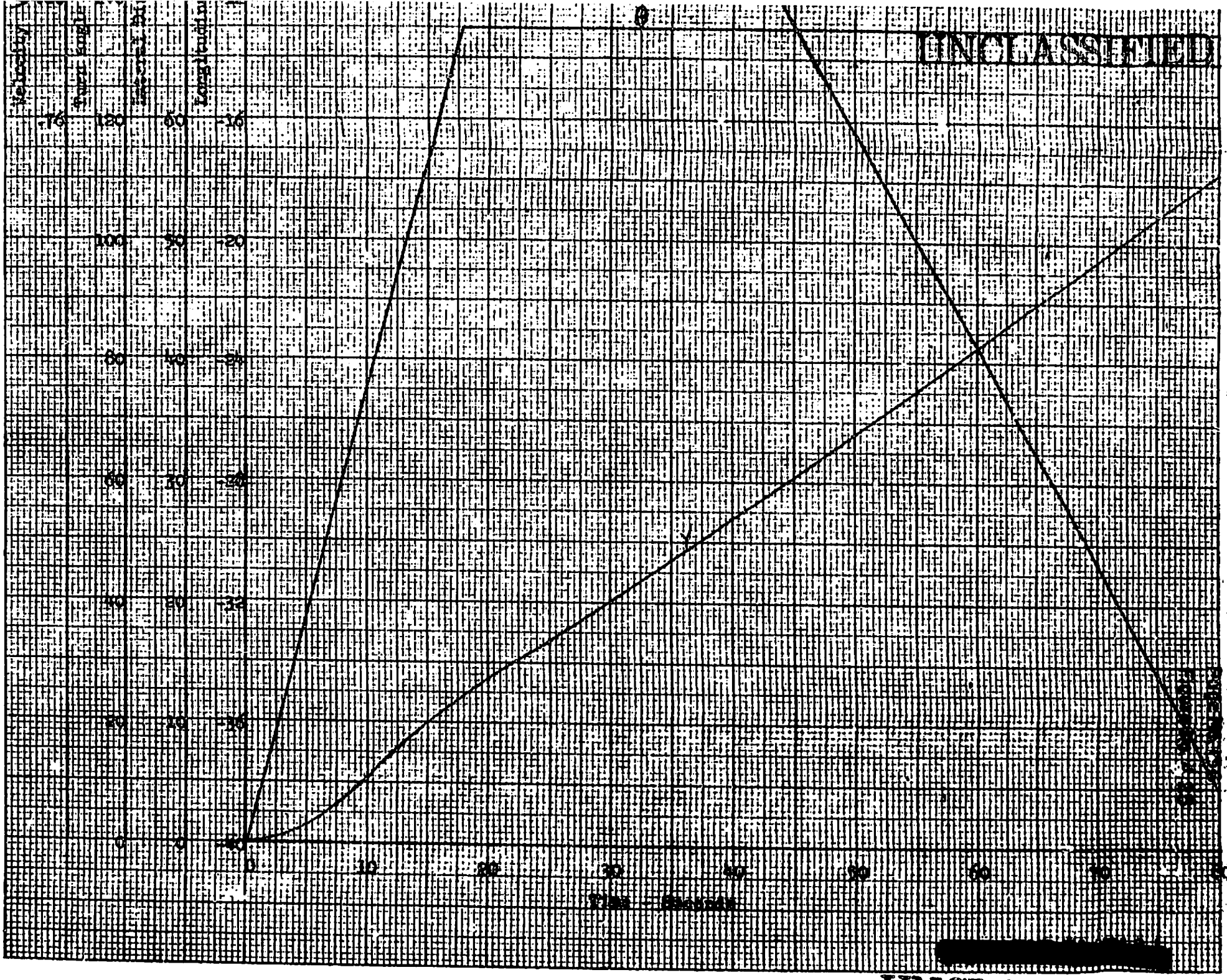
[redacted]

SANDIA EXTERNAL STORES SLOW PHASE II ESCAPE MANEUVERS

LEVEL RELEASE 10,000', 4 g LEVEL TURN THROUGH 135° ESCAPE



UNCLASSIFIED

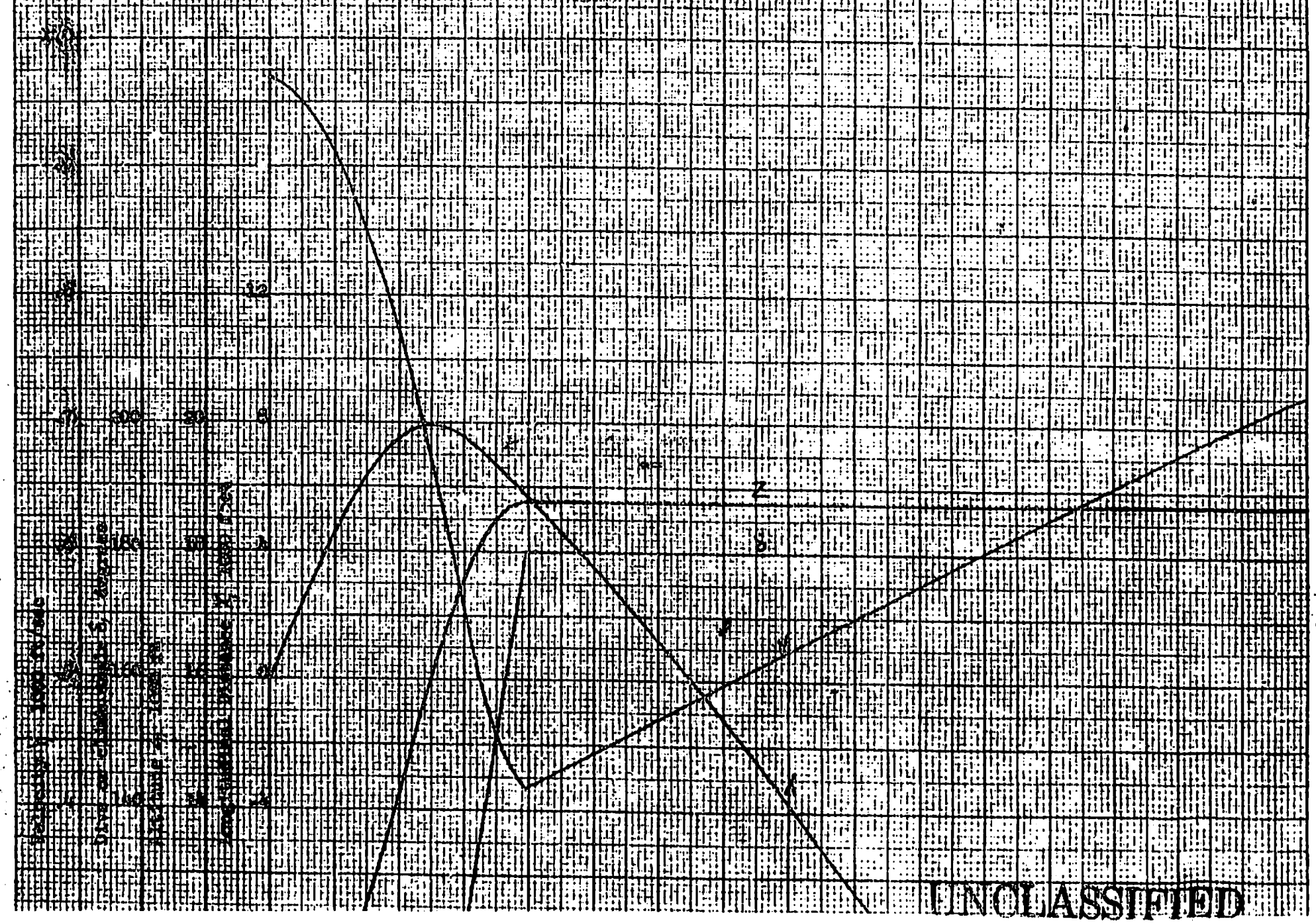

Velocity
Pitch Angle
Longitude
-16
120
60
-16
100
50
-20
80
40
-24
60
30
-28
40
20
-32
20
10
-36
0
0
0
0
10
20
30
40
50
60
70
80
TIME (SECONDS)

UNCLASSIFIED

[redacted]

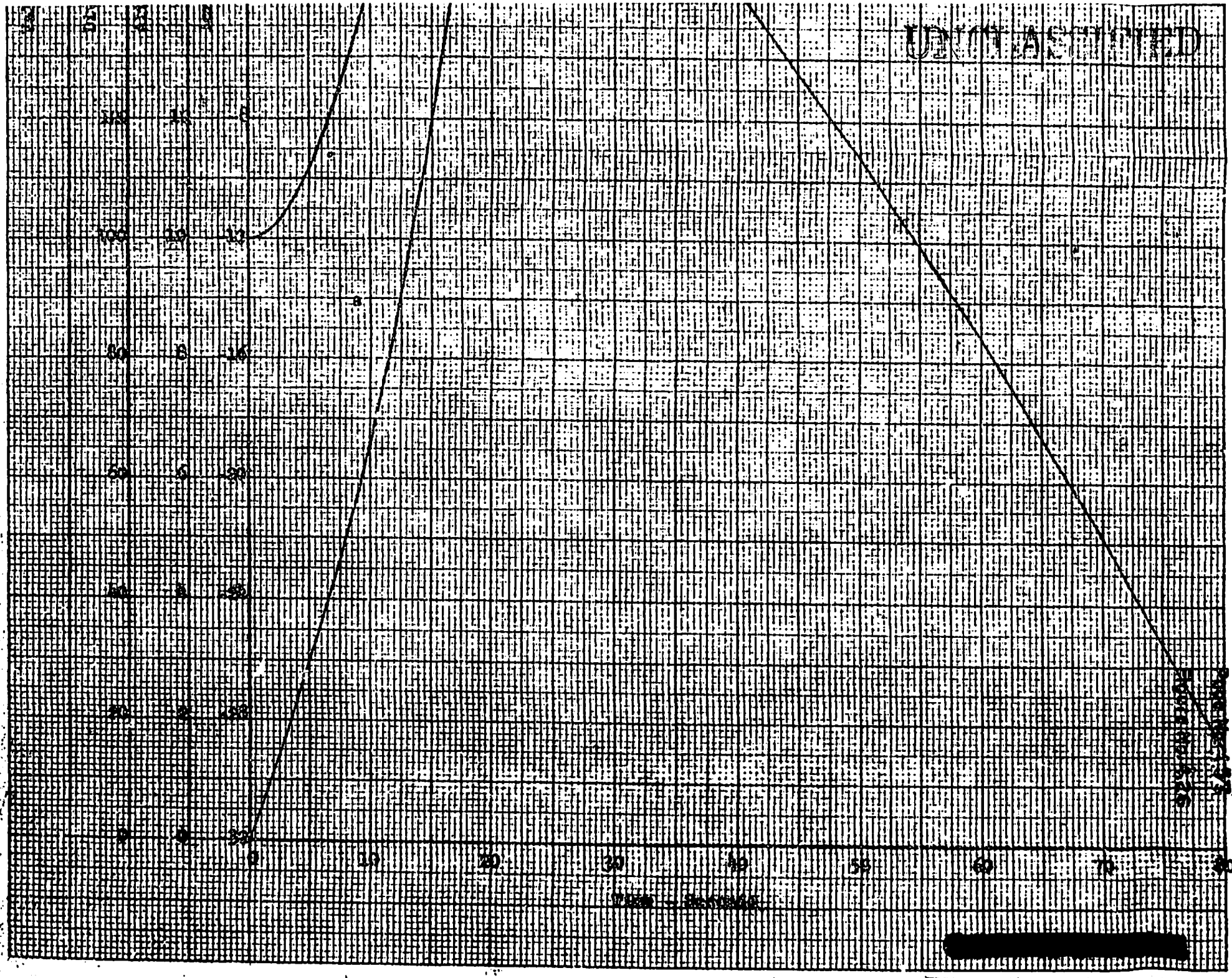
SANDIA NATIONAL STORES STUDY PHASE II ESCAPE MANEUVERS

MODEL RELEASE 10,000', K & HINEMAN ESCAPE



UNCLASSIFIED

UNCLASSIFIED

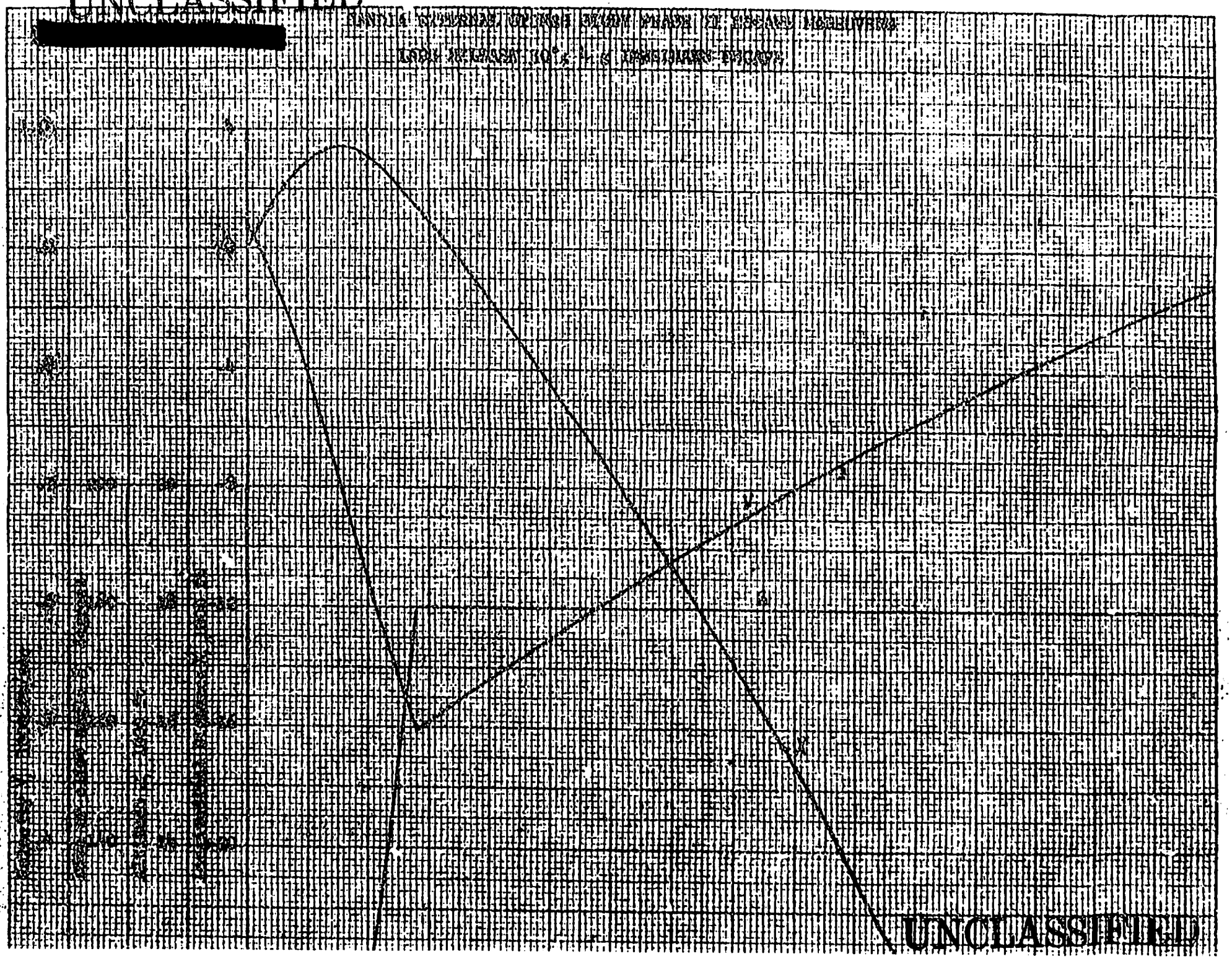


Report No. IC064

UNCLASSIFIED

UNCLASSIFIED

[redacted]



UNCLASSIFIED

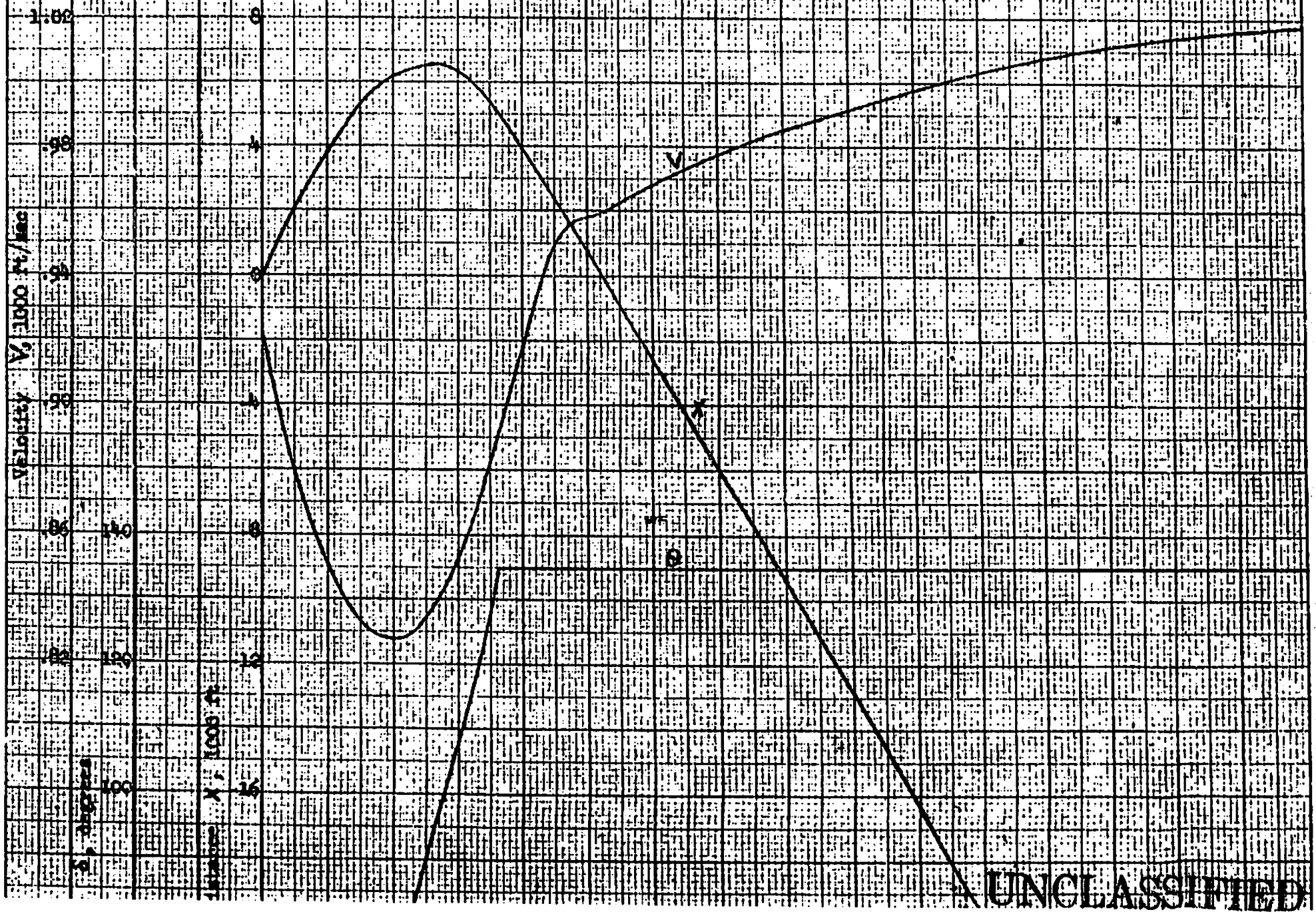
[redacted]

UNCLASSIFIED

[redacted]

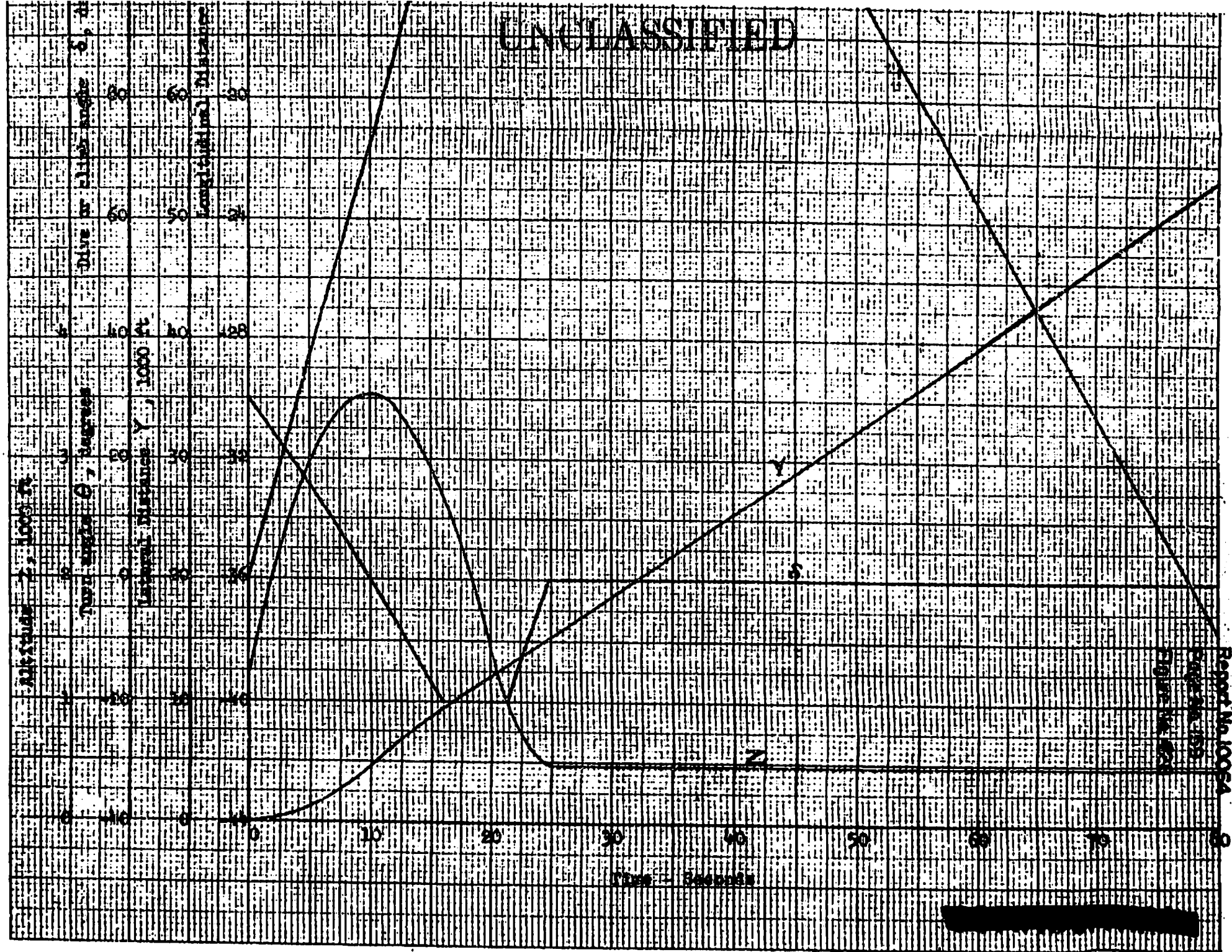
SANDIA EXTERNAL STORES STUDY PHASE II ESCAPE MANEUVERS

LABS RETRACT 30°; 4 g WINGOVER ESCAPE



UNCLASSIFIED

UNCLASSIFIED



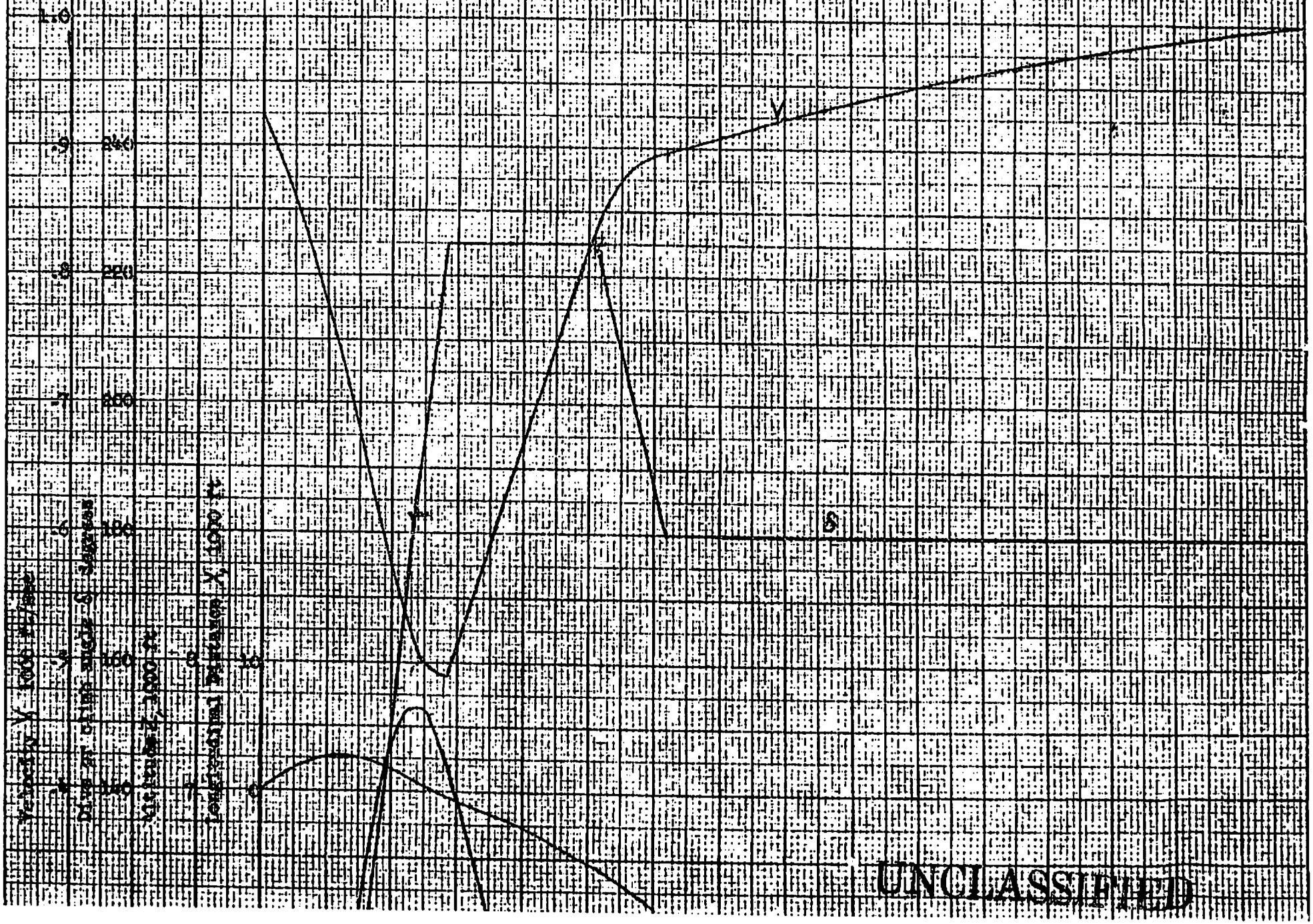
[redacted]

UNCLASSIFIED

[redacted]

SANDIA EXTERNAL STORES STUDY PHASE II ESCAPE MANEUVERS
LABS BRIEFING NOV. 5 & HALF URAN 3 ESCAPE

UNCLASSIFIED



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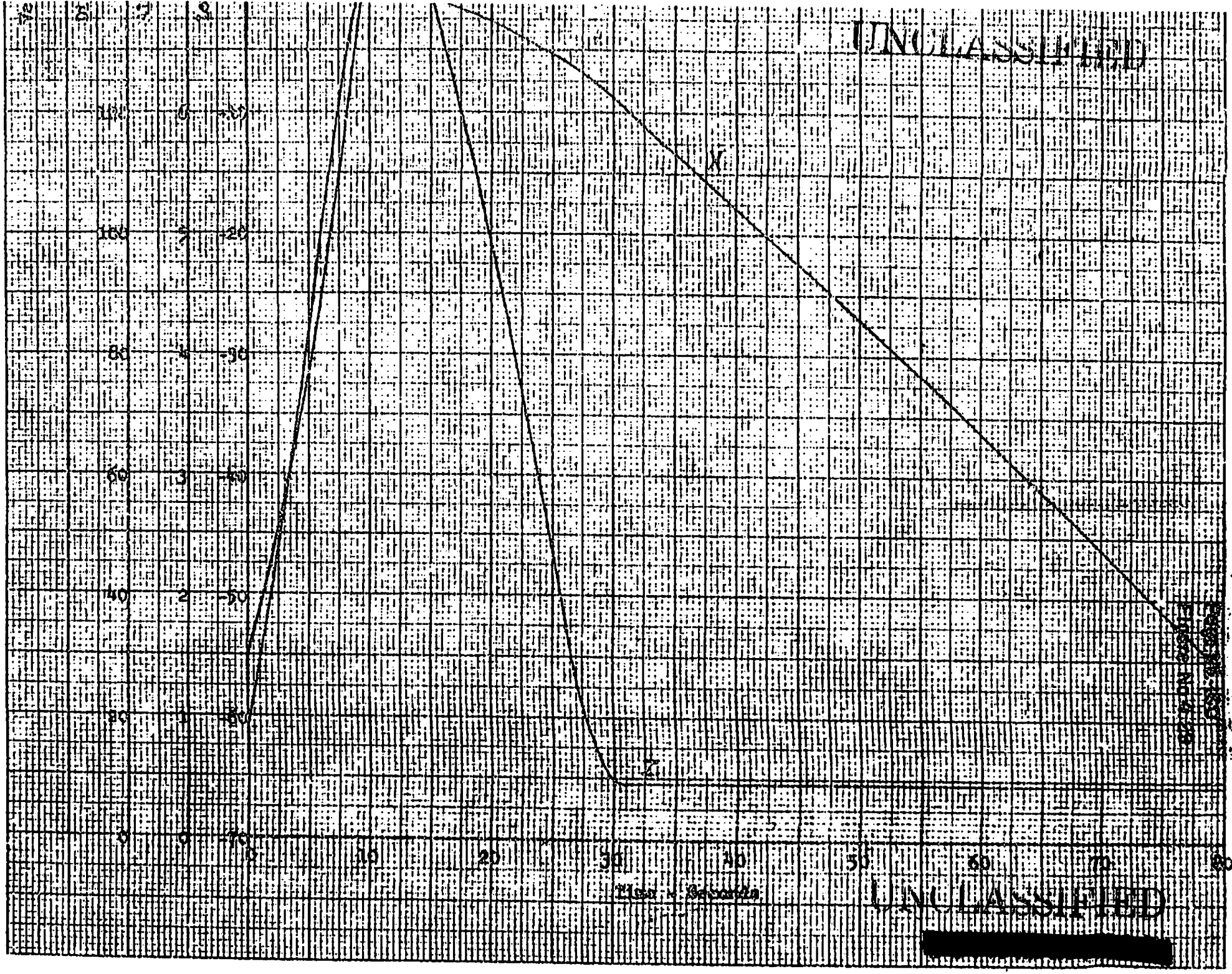
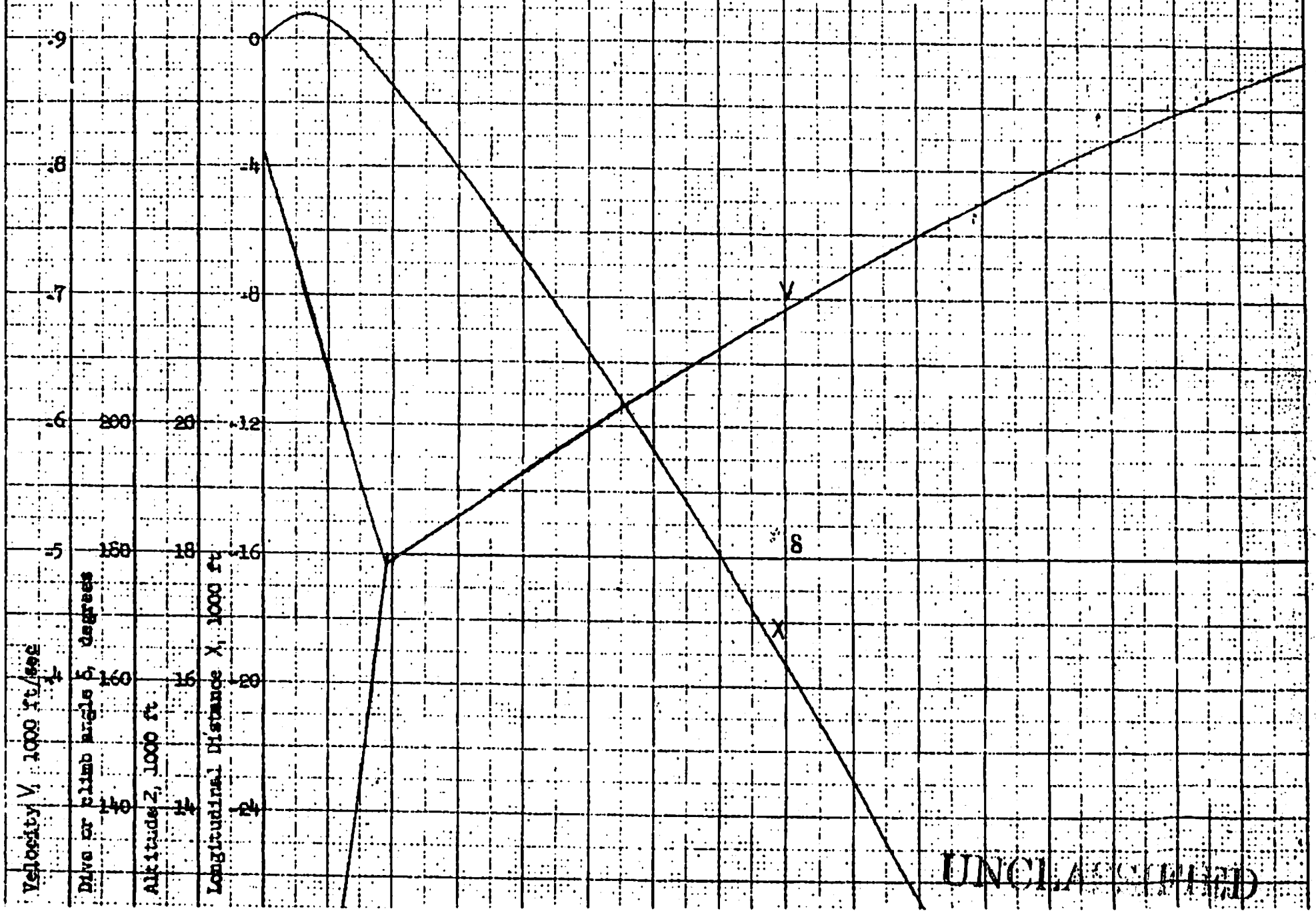

UNCLASSIFIED
X
Z
0
10
20
30
40
50
60
70
80
Time - Seconds
UNCLASSIFIED

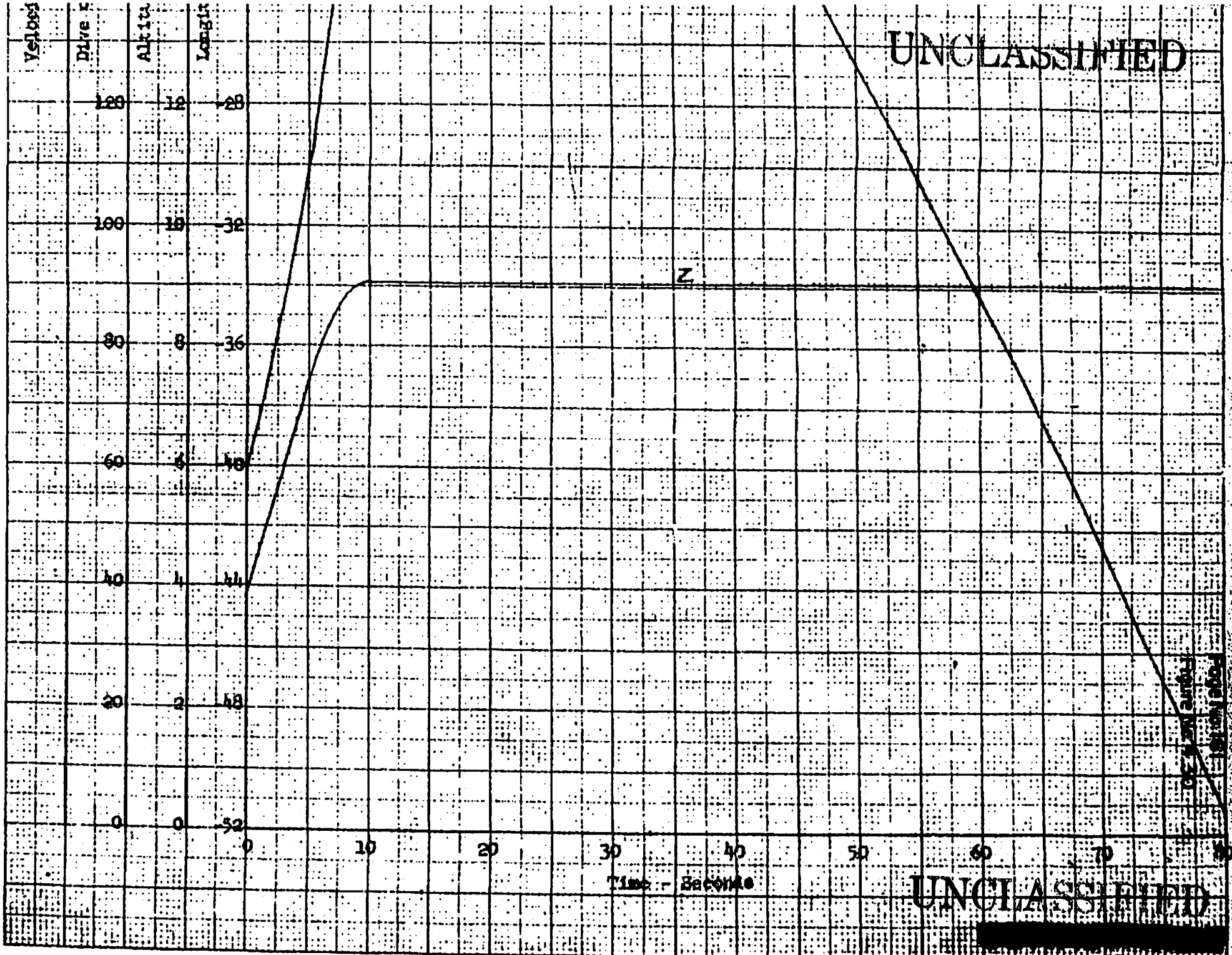
[redacted]

SANDIA EXTERNAL STORES STUDY PHASE II ESCAPE MANEUVERS

IAB3 RELEASE 60°; 4 g IMMEDIATE ESCAPE



UNCLASSIFIED



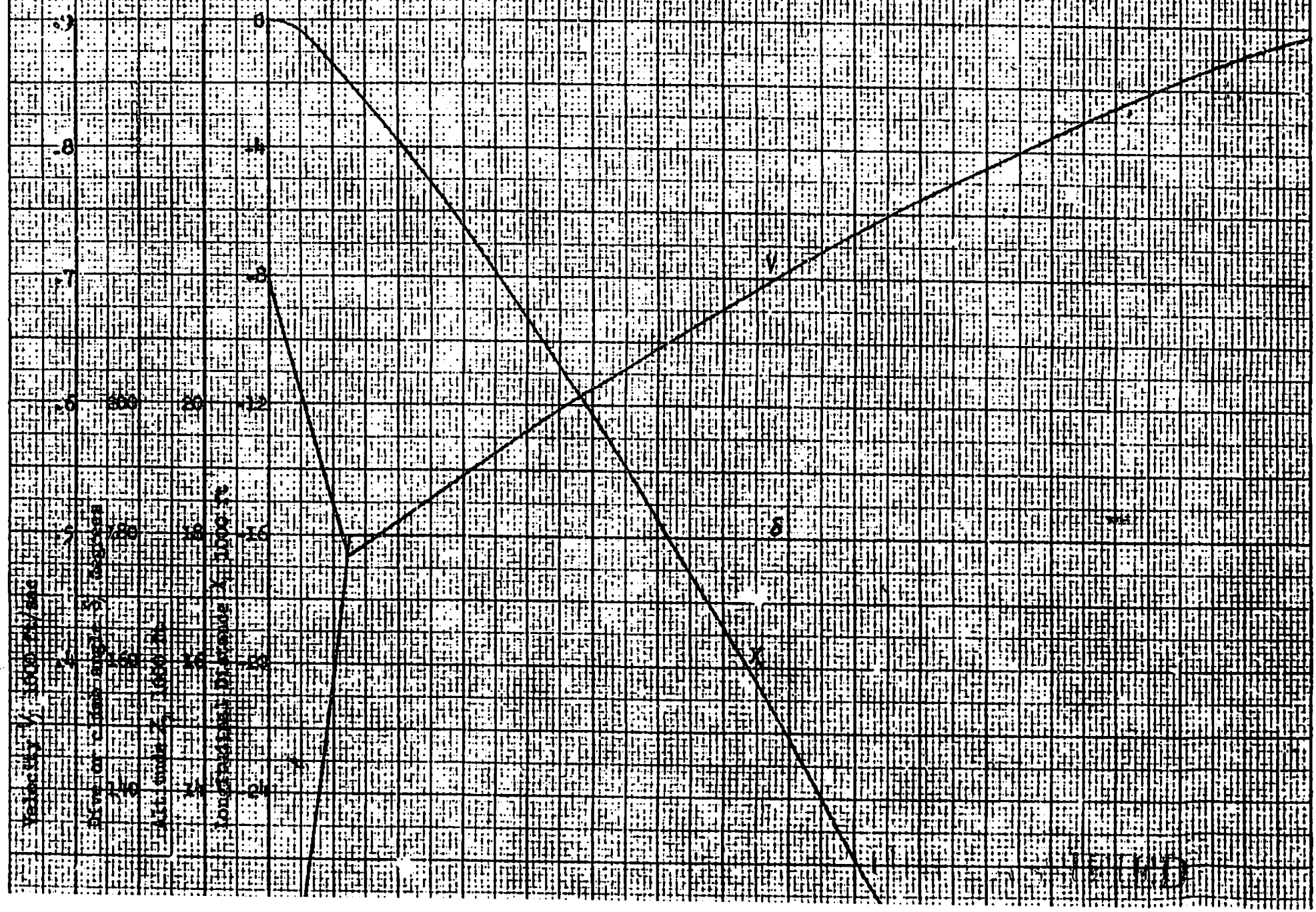
UNCLASSIFIED

UNCLASSIFIED

[redacted]

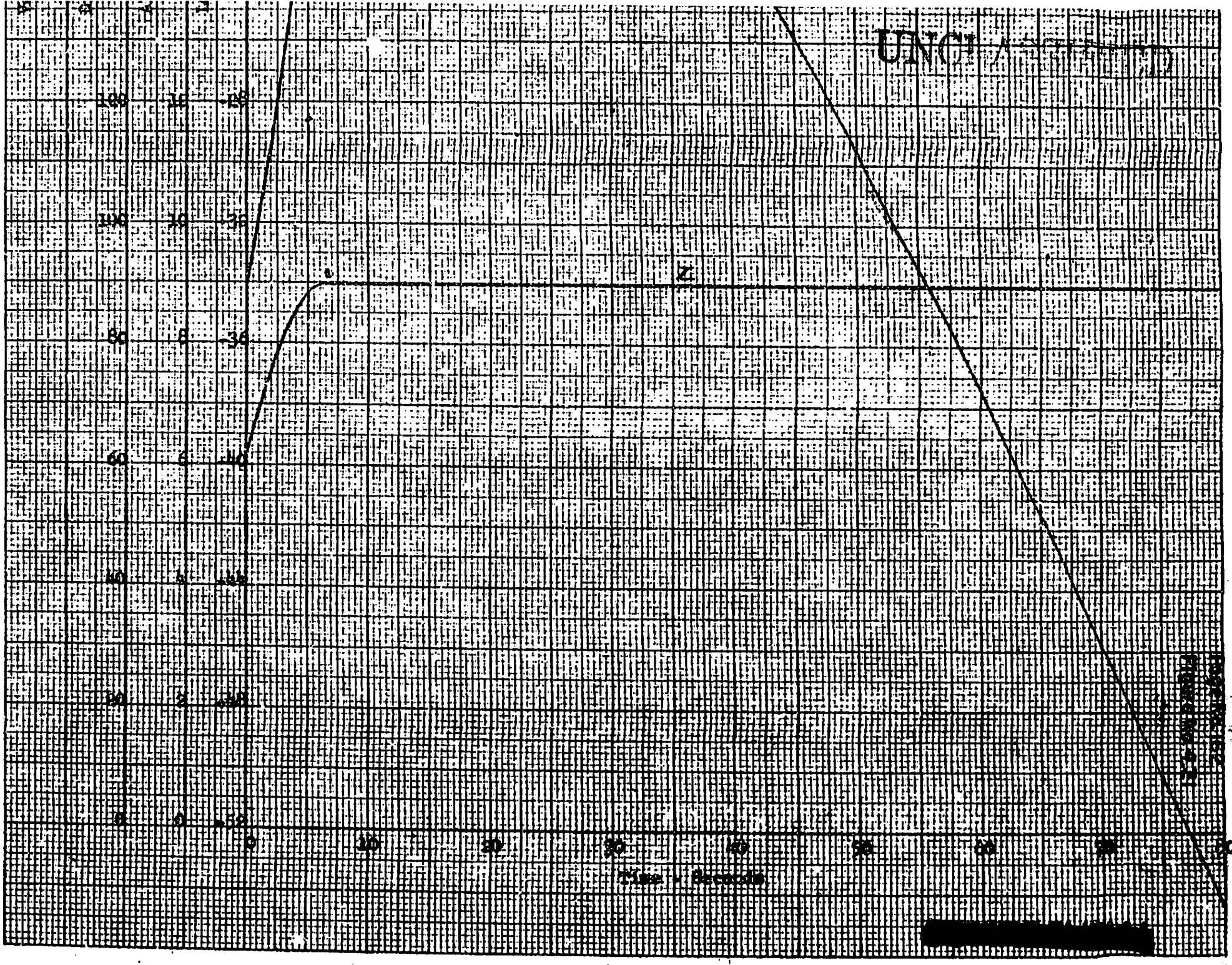
SANDIA EXTERNAL STORES STUDY PHASE II ESCAPE MANEUVERS

LABS RELEASE 90° TO 4 G IMMELMANN ESCAPE



UNCLASSIFIED

UNCLASSIFIED

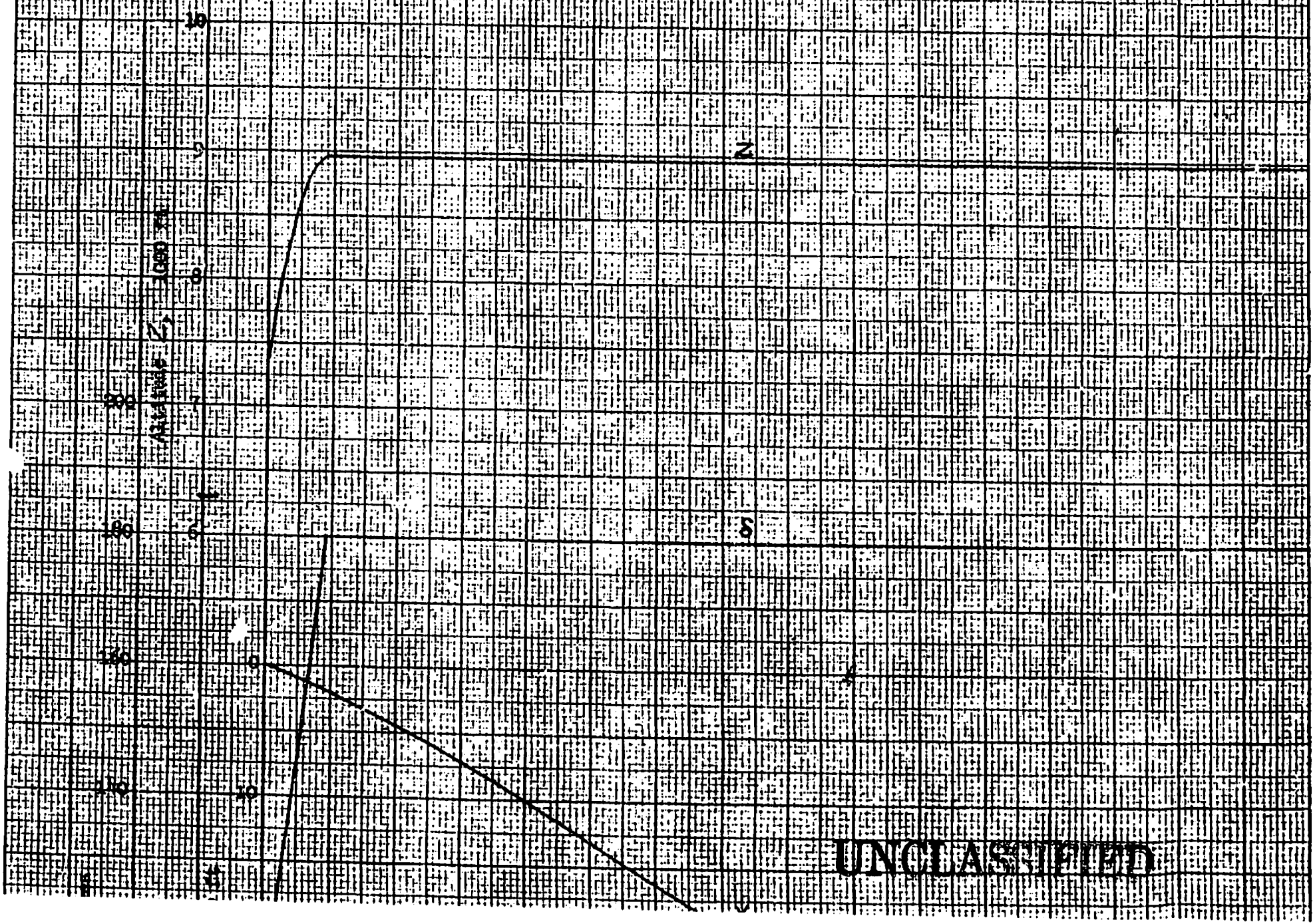


UNCLASSIFIED

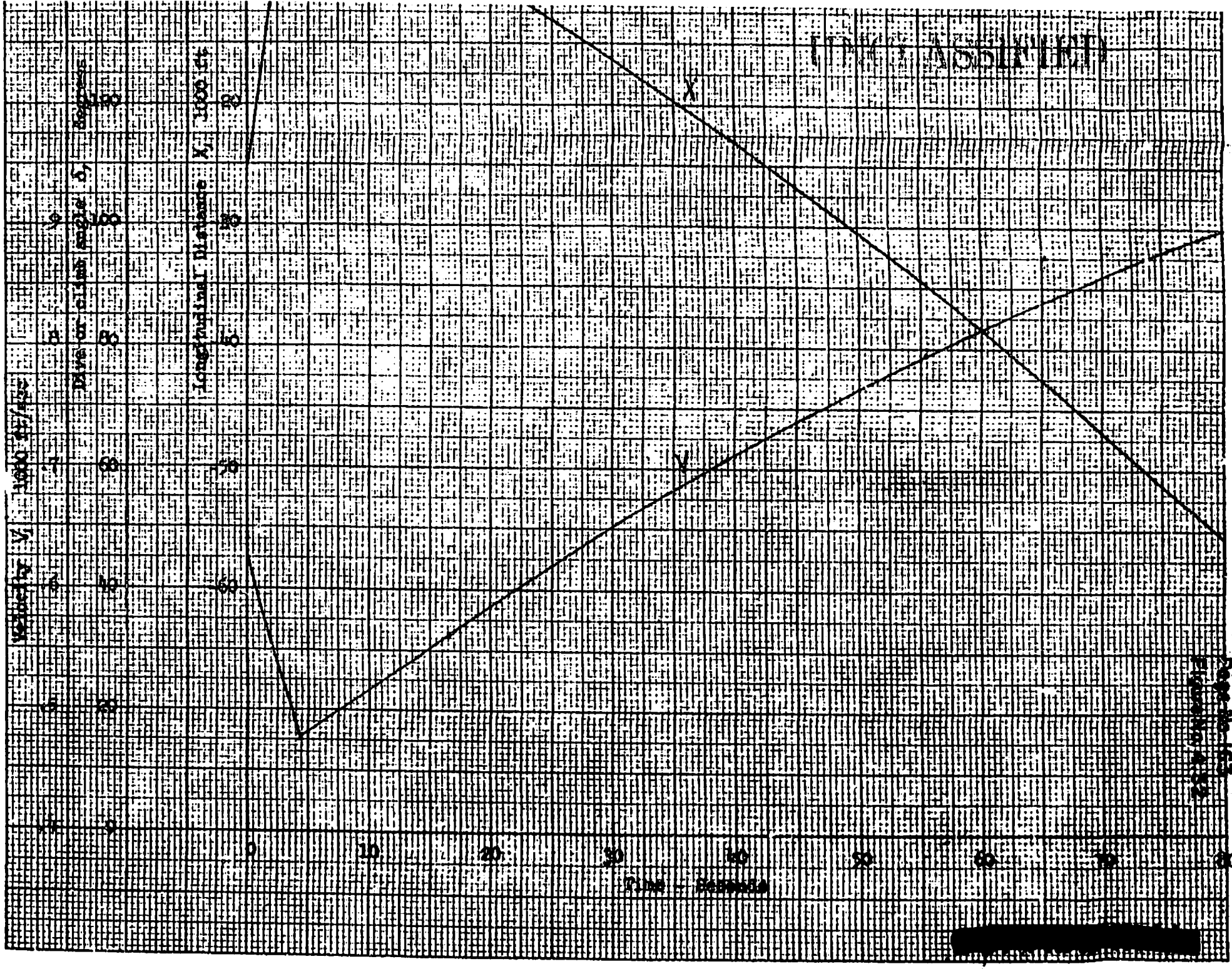
UNCLASSIFIED

[redacted] SANDIA EXTERNAL STORES STUDY PHASE II ESCAPE MANEUVERS

LAND RELEASE 110°, h = 1000 MINIMUM ESCAPE



UNCLASSIFIED



[redacted]

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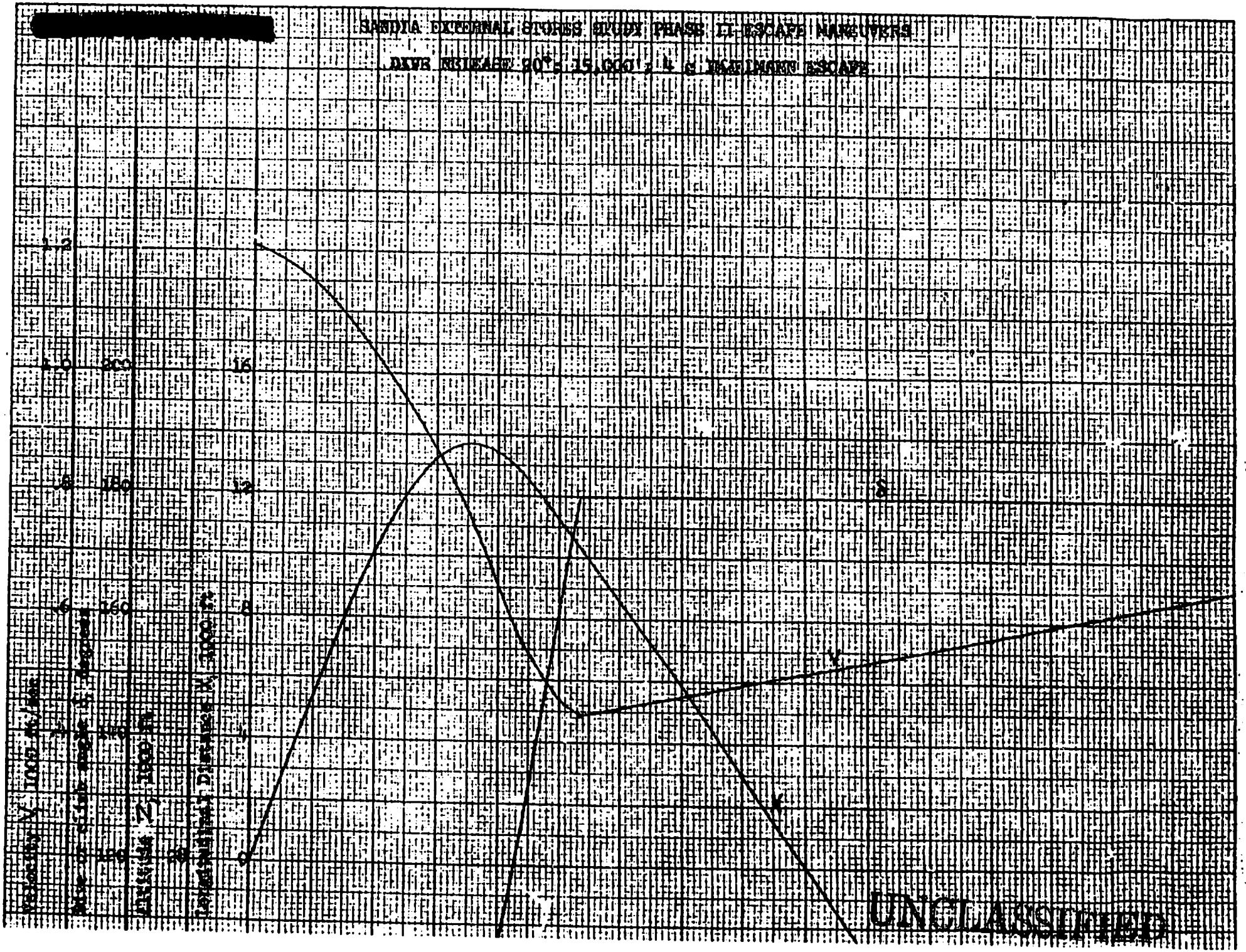
Report No. 10064
Page No. 163
Figure No. 4.42

MADE IN U.S.A.

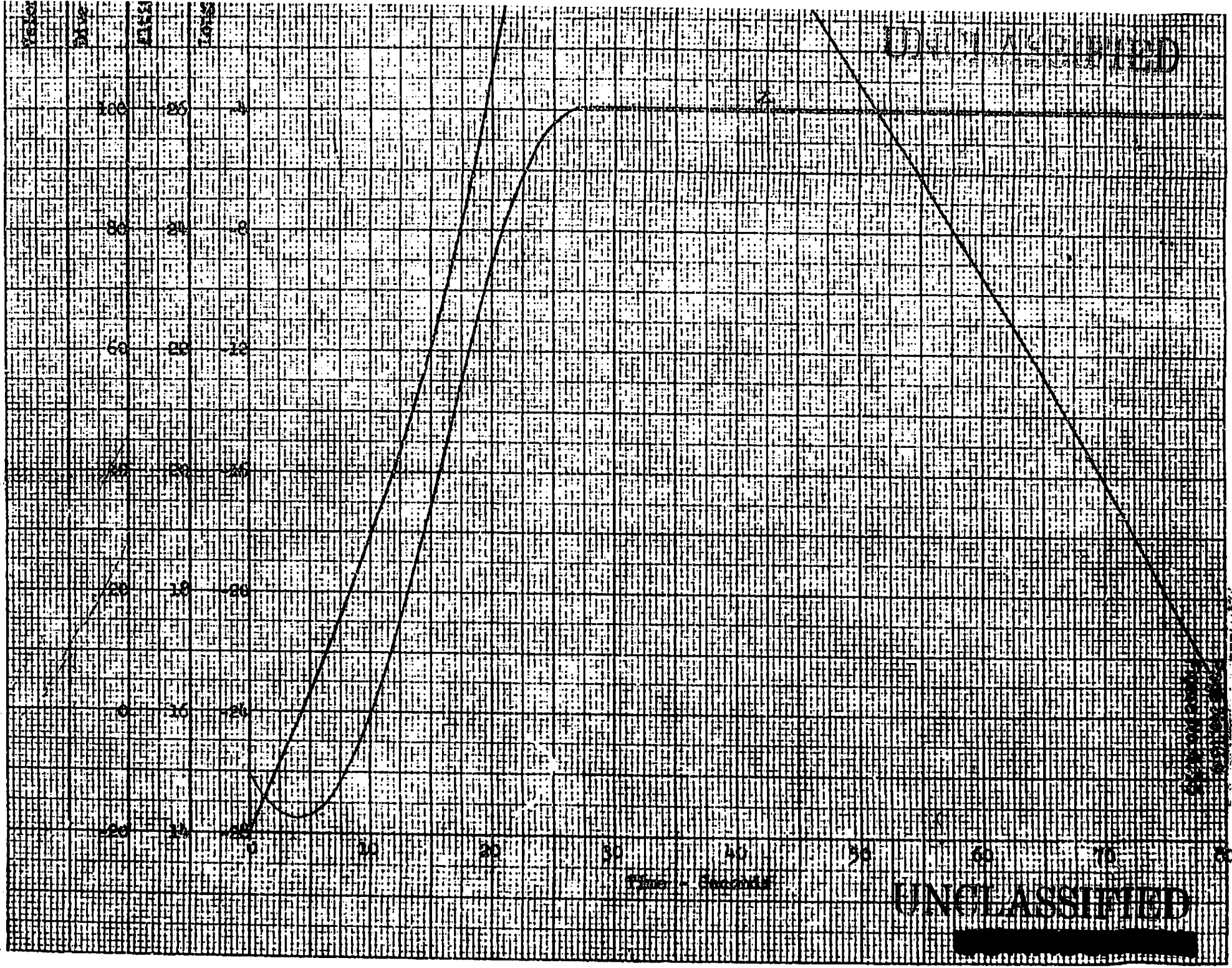
[redacted]

SANDIA EXTERNAL STORES STUDY PHASE II ESCAPE MANEUVERS

DIVE RELEASE 20°, 15,000', 4 g PARTIALLY ESCAPE



DECLASSIFIED



UNCLASSIFIED

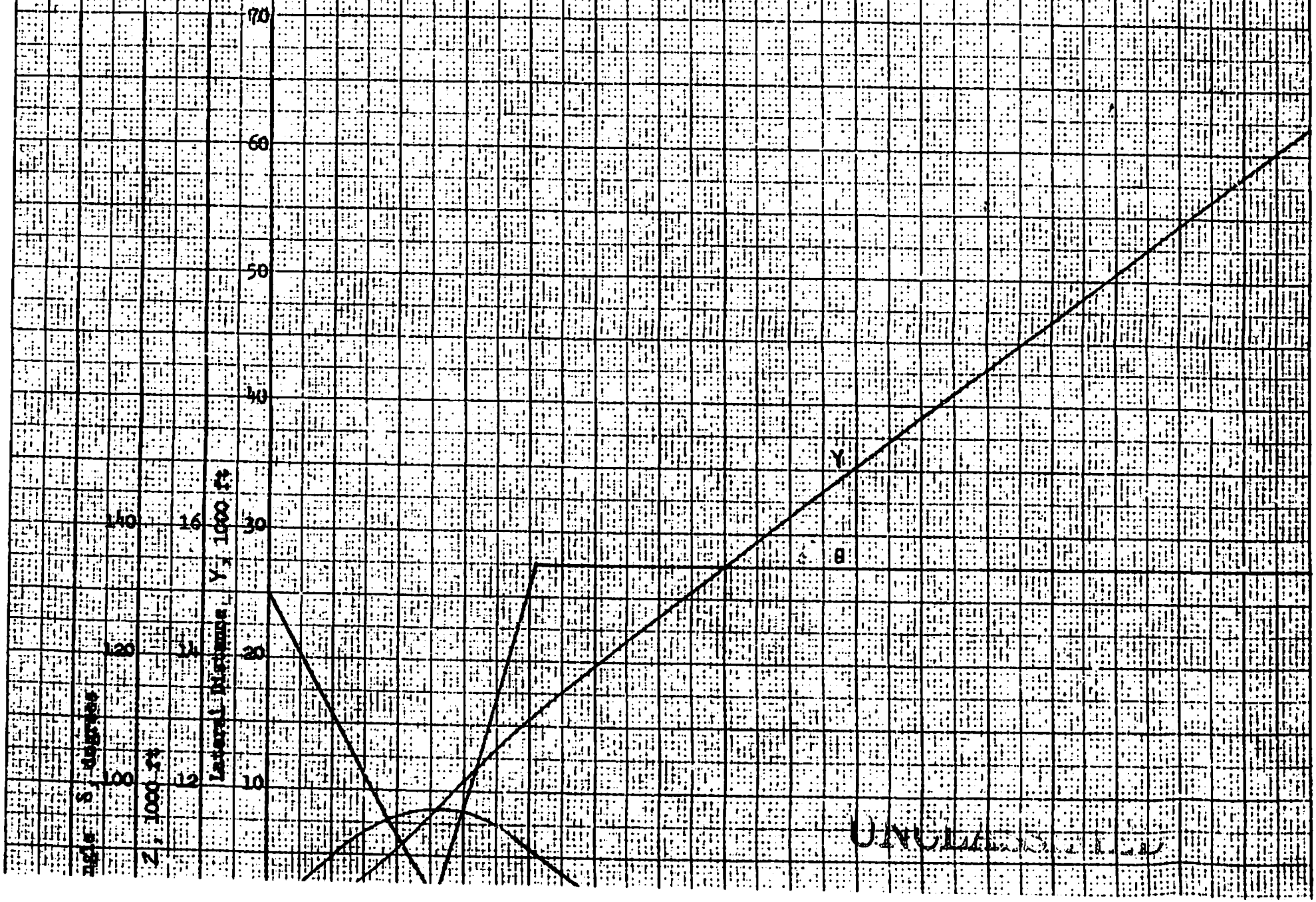
Report No. 055-4

UNCLASSIFIED

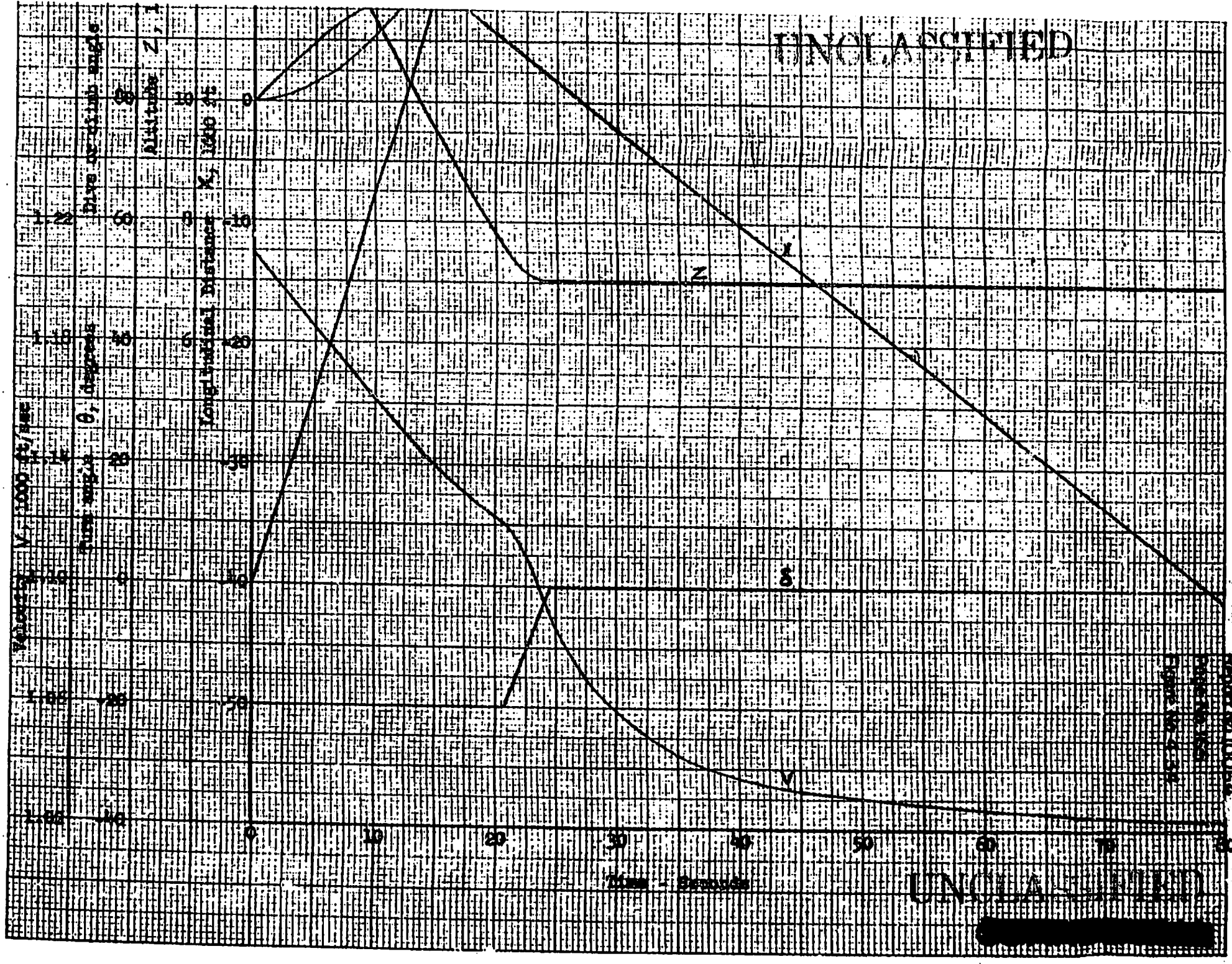
[redacted]

SANDIA EXTERNAL STORES STUDY PHASE II ESCAPE MANEUVERS

DIVE RELEASE 80°, 15,000; 4 g DIVING TURN ESCAPE



UNCLASSIFIED

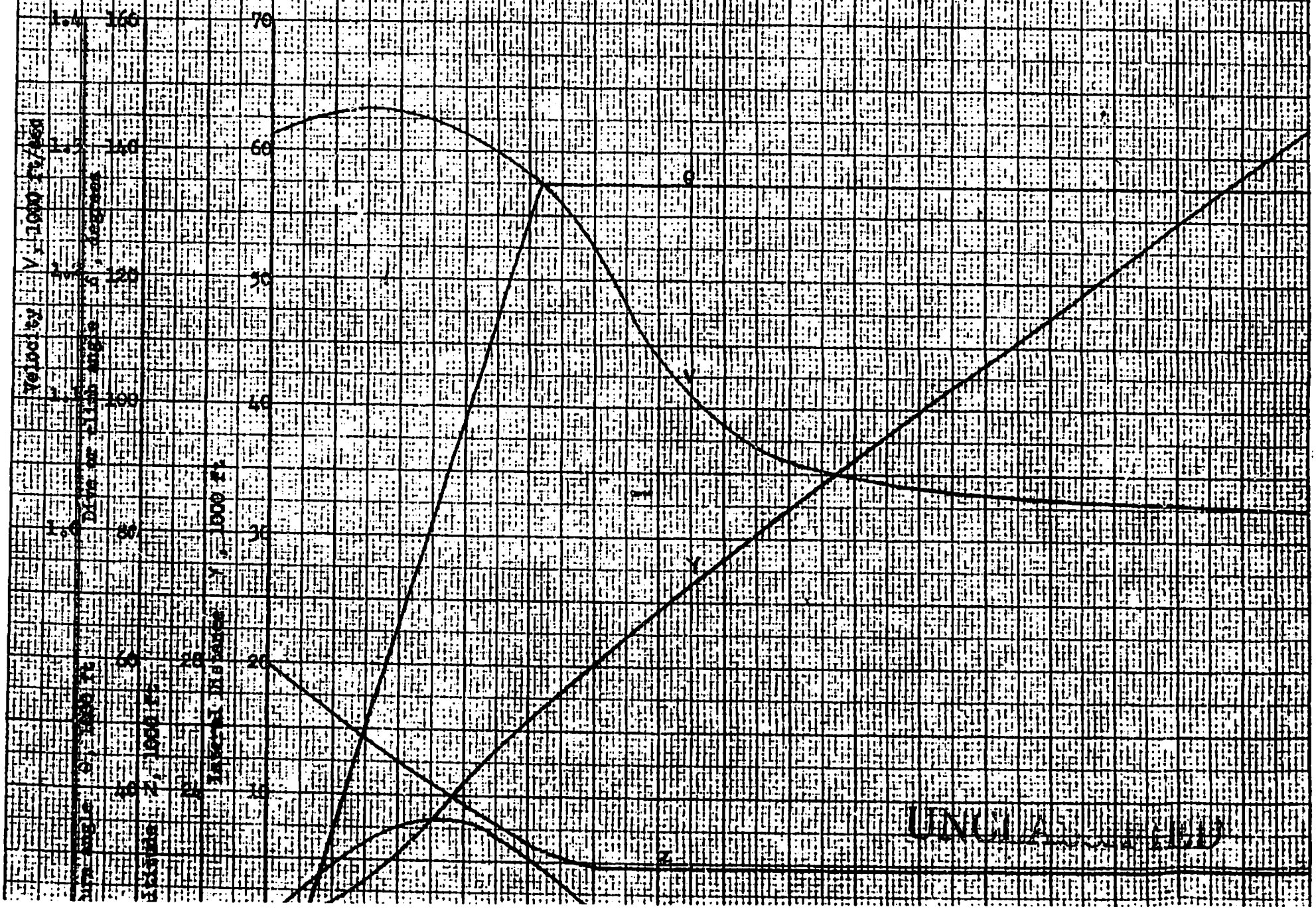

UNCLASSIFIED
Velocity V, 1000 ft/sec
Pure angle θ, degrees
Dive angle ψ, degrees
Altitude Z, 1000 ft
Longitudinal Distance X, 1000 ft
Time - Seconds
V
θ
Z
X
UNCLASSIFIED
Report No. 1006
Page No. 6
Date 9-6-54

UNCLASSIFIED

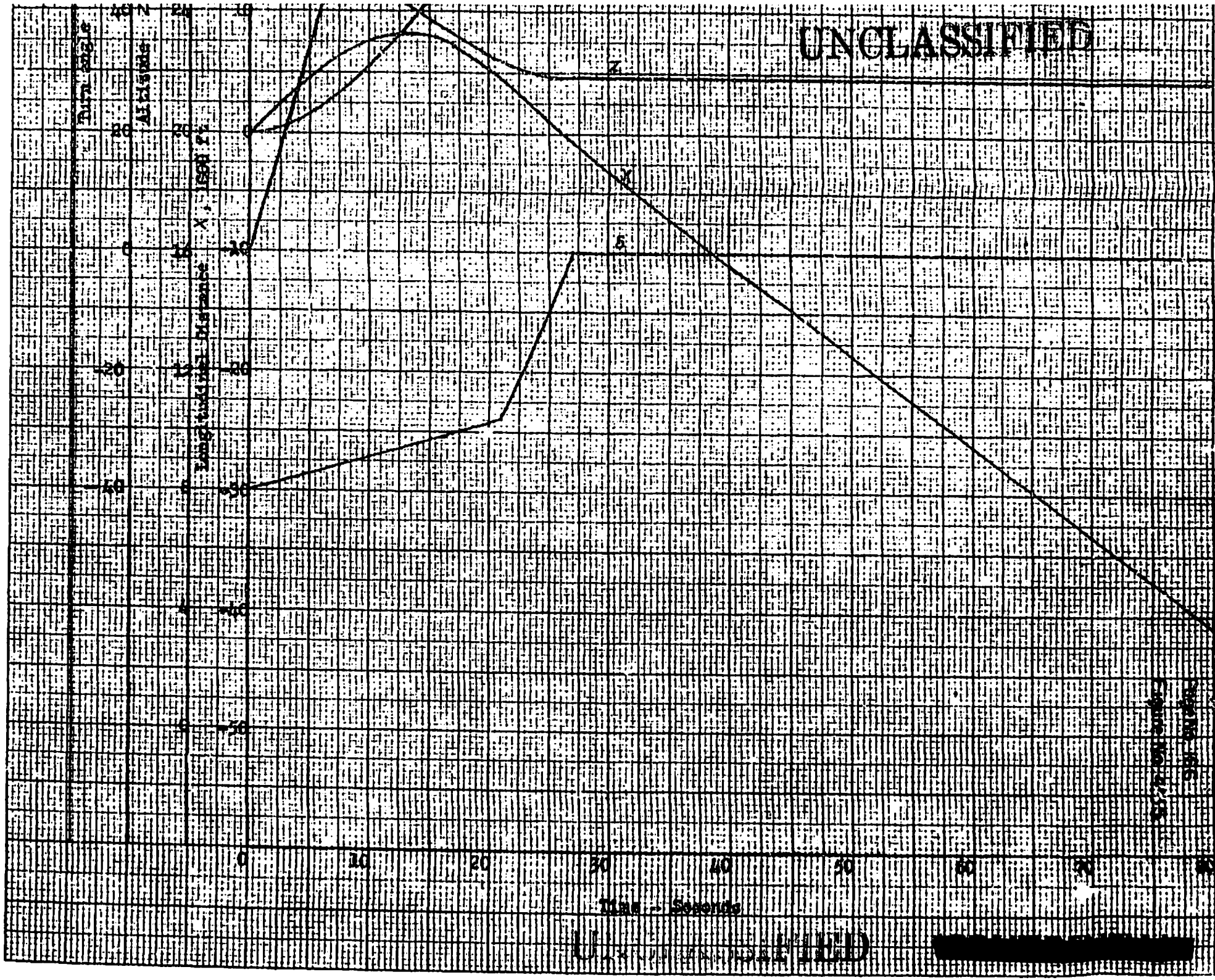
[redacted]

SANDIA EXTERNAL STORES STUDY PHASE II ESCAPE MANEUVERS

DIVE RELEASE 40°, 20,000', 4 g DIVING TURN ESCAPE



UNCLASSIFIED



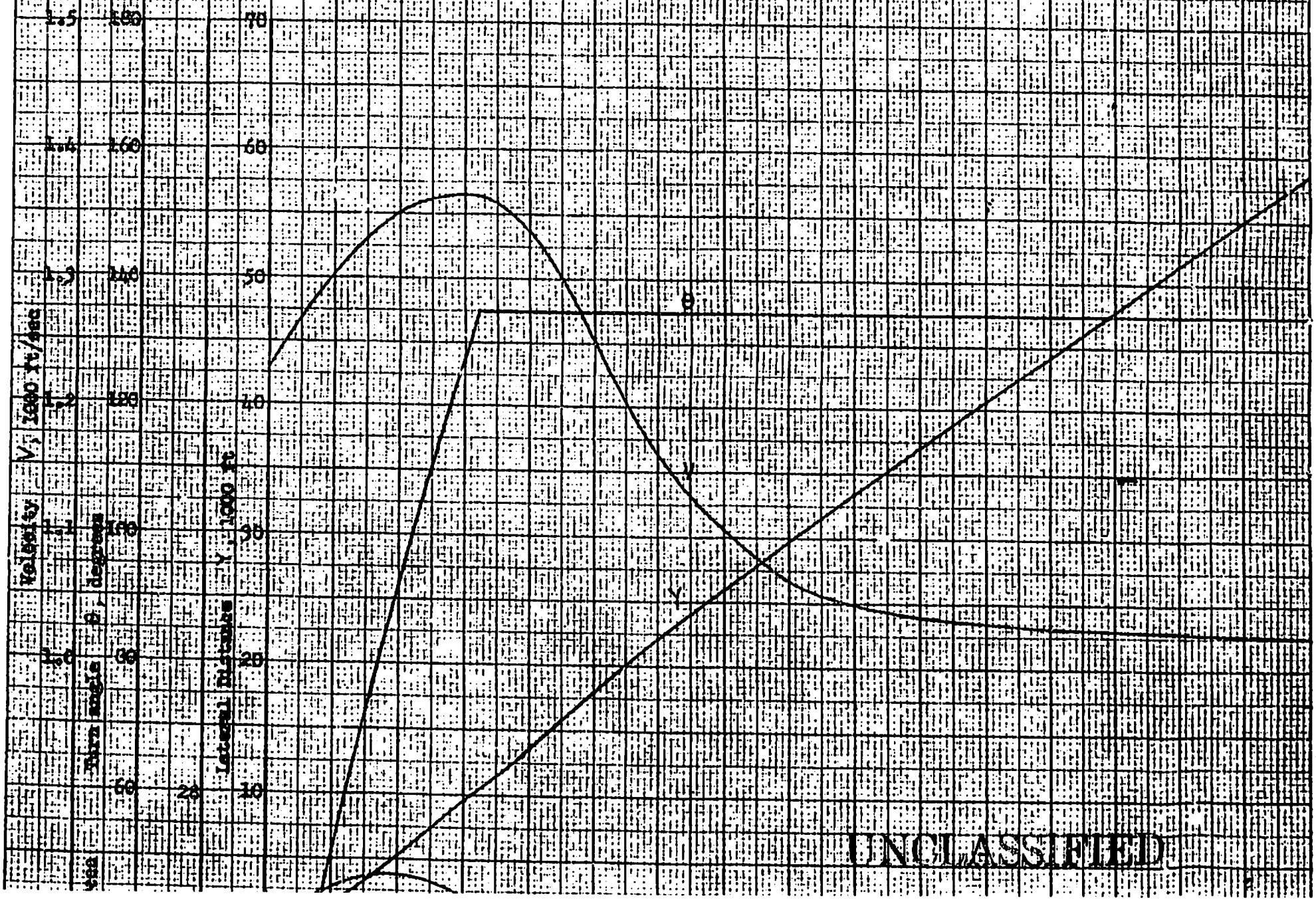
Report No. 10064
Page 86
Figure No. 42

UNCLASSIFIED

[redacted]

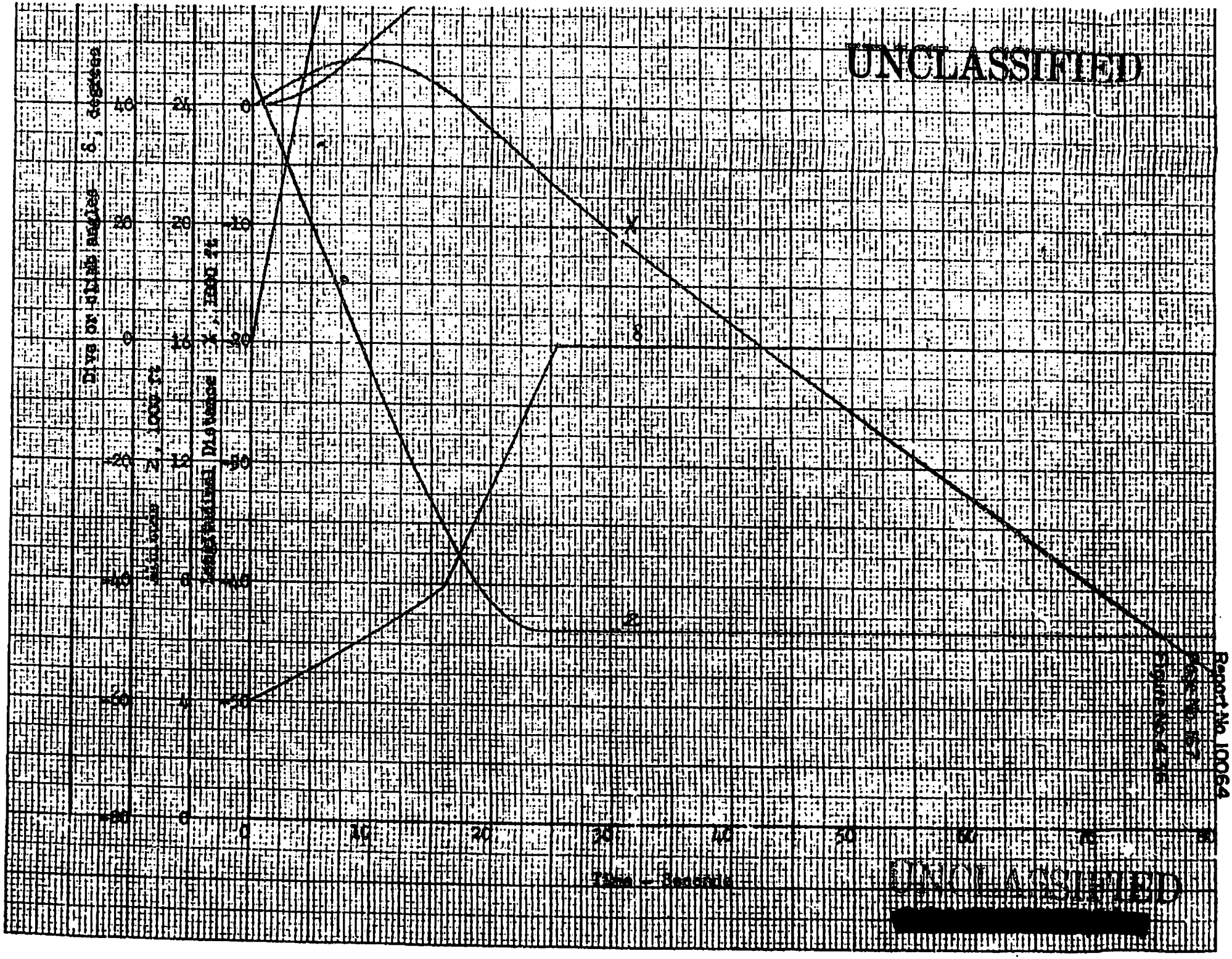
SANDIA EXTERNAL STORES STUDY PHASE II ESCAPE MANEUVERS

DIVE RELEASE 60°, 25,000' 1.4 g DIVING TURN ESCAPE



UNCLASSIFIED

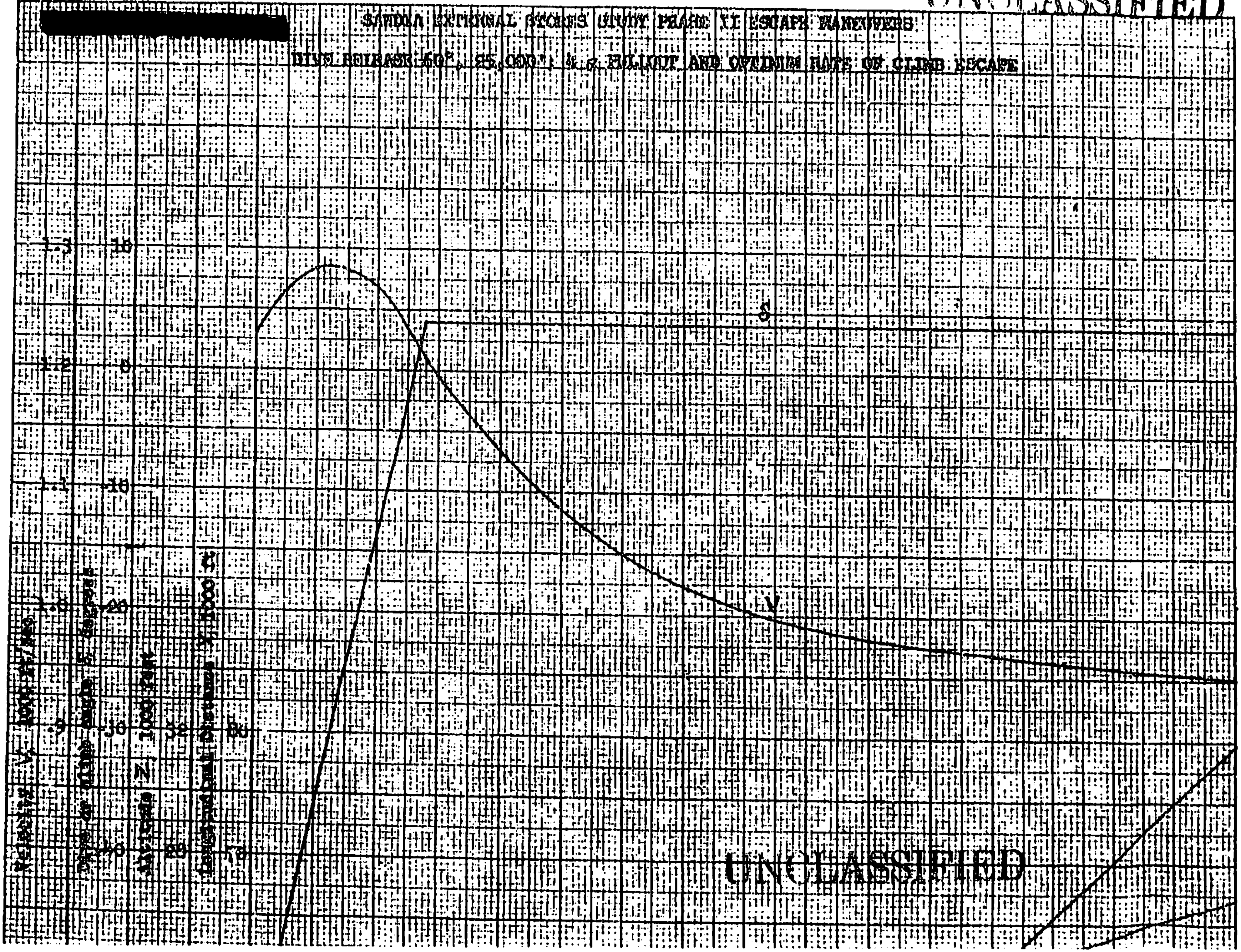
UNCLASSIFIED



UNCLASSIFIED

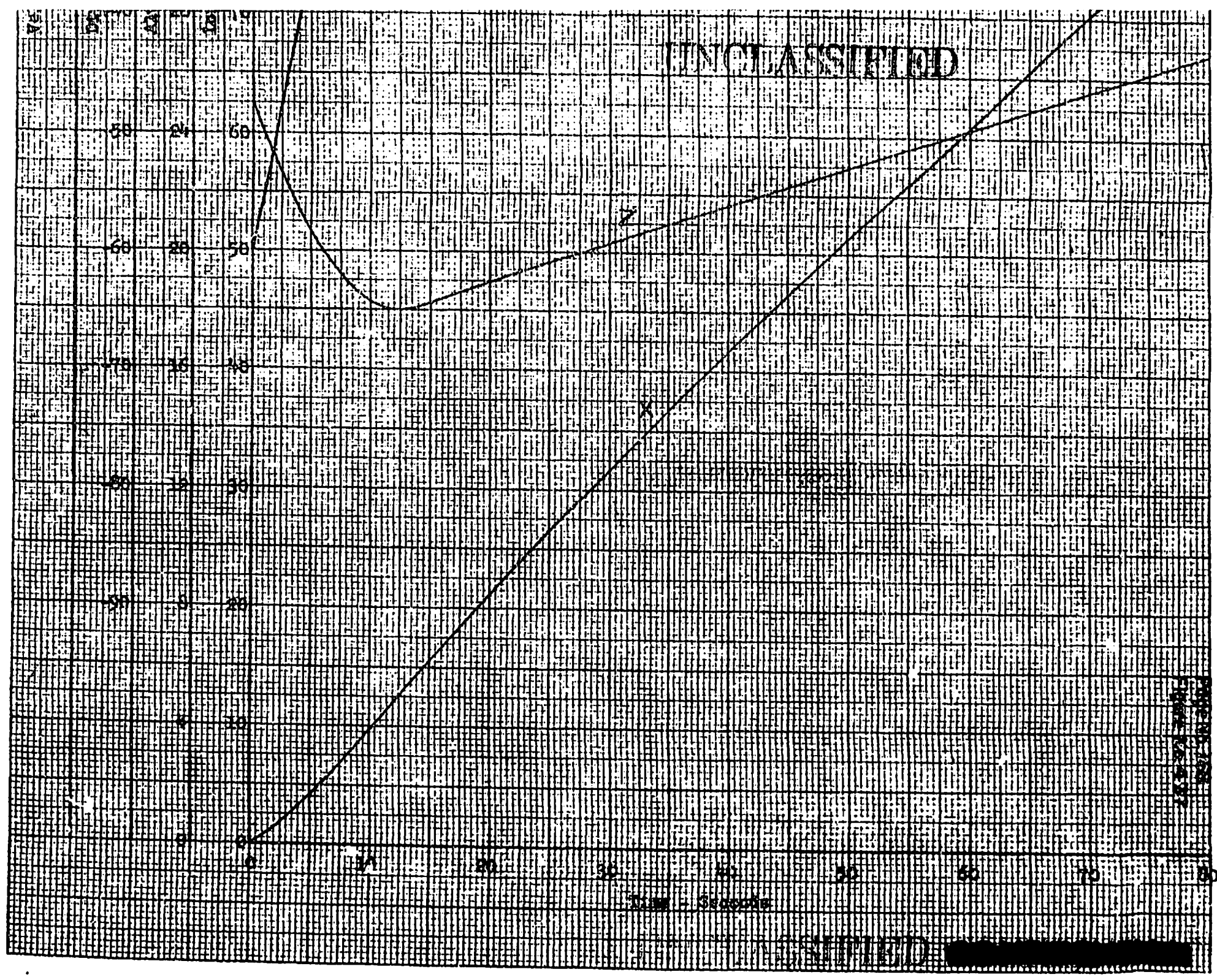
UNCLASSIFIED

[redacted]



UNCLASSIFIED

UNCLASSIFIED



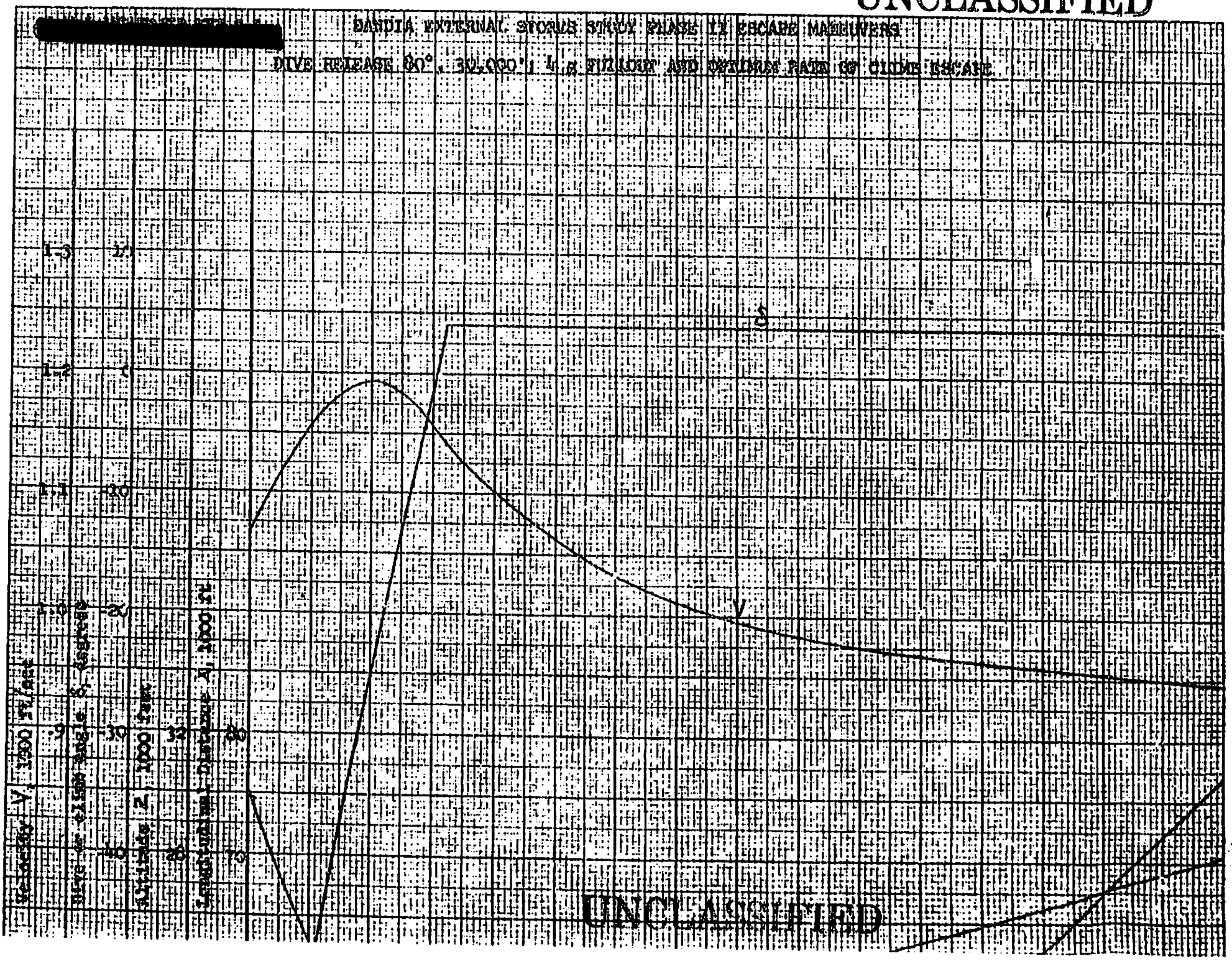
Report No. 10064

UNCLASSIFIED [redacted]

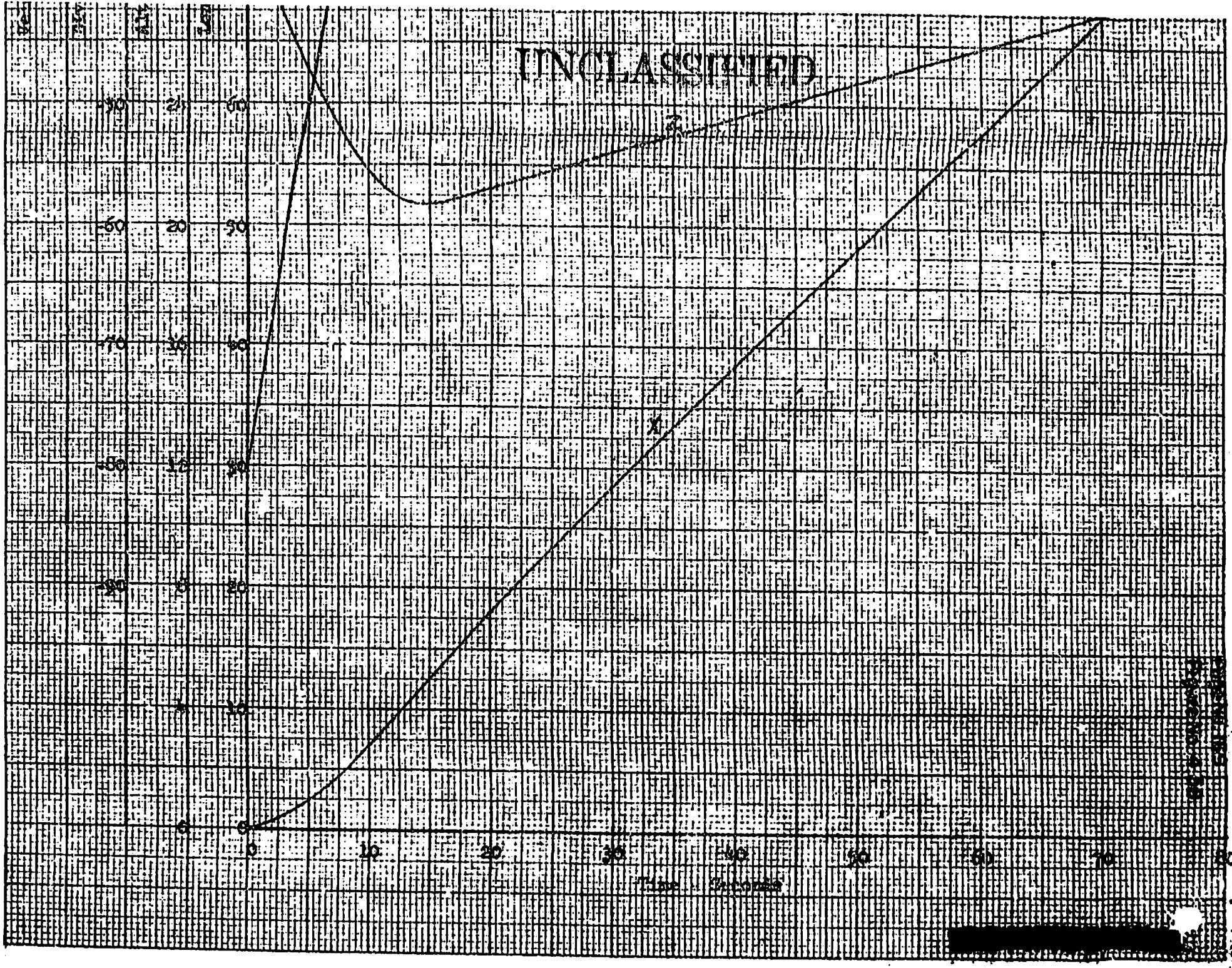
[redacted]

SANDIA EXTERNAL STORES STUDY PHASE II ESCAPE MANEUVERS

DIVE RELEASE 80°, 32,000' 1 4 g PULLOUT AND OPTIMUM RATE OF CLIMB ESCAPE



UNCLASSIFIED



[redacted]

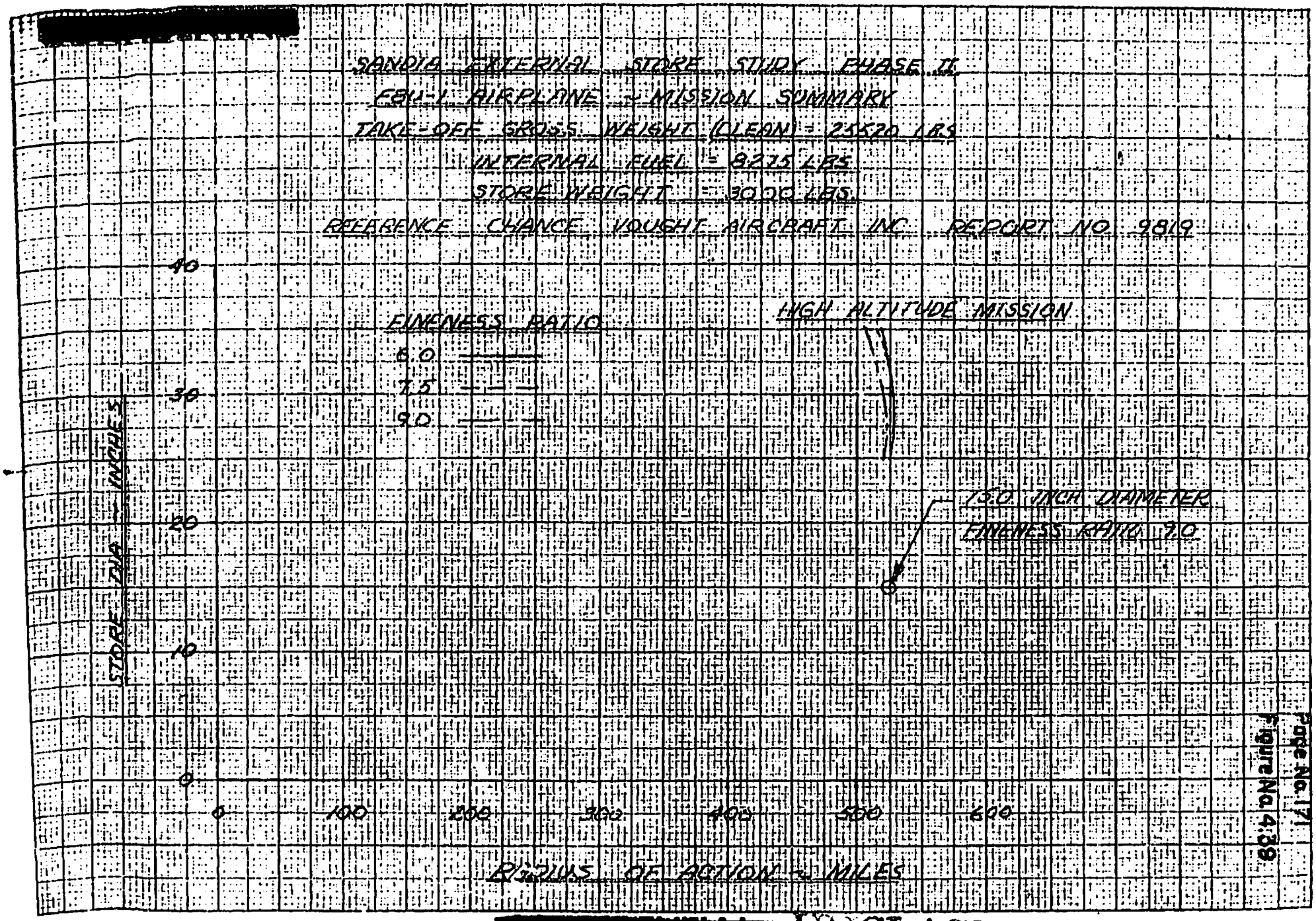
UNCLASSIFIED

4.5 Mission Profiles

The only mission profile investigated under Phase II was the High Altitude-Radius Mission (1). The F8U-1 airplane with the 15 in. diameter-fineness ratio 9.0 Sandia store configuration wing-pylon mounted was programmed through this mission. The weight of store was assumed to be 3,000 lb. A comparison of this radius of action and those obtained in the Phase I study are shown in figure 4.39. As expected, the radius of 523 na. mi. is essentially the same as for the other configuration (520 na. mi). The relatively minor effects of the store configuration on the radius of action is due to the small variation in airplane drag at cruising speed for the various store installations.

(1) Thomas, I.L. "Final Report Phase I External Store Study, Sandia Contract 51-0923" Chance Vought Aircraft Report 9819 (15 June 1955) p 28.

[redacted]



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