SC 1004-A (3-35)

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SANDIA SYSTEMATIC DECLASSIFICATION REVIEW	
1st Review Date 6-20-79	Detonic Loss (Circle Number)
Authority ☐ ADC ☒ ADD CCRP-RR	1. Classification Unchanged
Name	2. Classification Changed to: U
	3. Contains No DOE Classified Information
2nd Review Date 5-06-97	4. Coordinate With:
Authority ADD	5. Contains UCAIT
Name W. Layne	6. Comments:

SC-TM-162-57-51

RESULTS OF DYNAMIC STABILITY TESTS OF FINLESS CLASS C CONFIGURATIONS IN THE SANDIA CORPORATION 12-INCH WIND TUNNEL (PROGRAM III-19)

J. W. Arnold - 5142

SANDIA SYSTEMATIC DECLASSIFICATION REVIEW DOWNGRADING OR DECLASSIFICATION STAMP	
CLASSIFICATION CHANGED TO U	AUTHORITY: W.C. Layne
Emelda Selph 5/6/97	
PERSON CHANGING MARKING & DATE	RECORD ID: 97SN1675
Carmela M Gallegos	
PERSON VERIFYING MARKING & DATE 5/20/97	DATED: 5/6/97

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ABSTRACT

Static and dynamic stability derivatives of thirteen configurations of a special finless store are presented. Each configuration was tested at nominal Mach Nos. of 0.7, 0.8, 0.9, 0.95, 1.0, 1.1, and 1.2.

Work performed under AEC Contract AT-(29-1)-7[illegible]

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BY ORC. 2743

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Case No. 409.01

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RESULTS OF DYNAMIC STABILITY TESTS OF FINLESS CLASS C CONFIGURATIONS IN THE SANDIA CORPORATION 12-INCH WIND TUNNEL (PROGRAM III-19)

SUMMARY

Wind-tunnel tests have been performed to determine static and dynamic stability derivatives of finless Class C configurations. A total of 13 finless configurations were tested over a Mach number range of 0.7 to 1.2 in the Sandia Corporation 12-inch by 12-inch transonic blowdown wind tunnel. Two model configurations with fins were also tested for comparison. All configurations had a length of 4.812 inches and L/D of 3.5.

The results of these tests were satisfactory and will be correlated with results from additional tests by R. M. Dayhoff, 5144.

INTRODUCTION

Finless Class C model configurations, with spoiler bands added for stabilization, were tested through the transonic Mach range in the SCARF-III Wind Tunnel during February and and March 1957. These tests required 120 hours of testing time.

The purpose of the tests was to study the effects of various model modifications on the static and dynamic stability characteristics of the models. These modifications consisted of changes in nose shape, changes in size, number and/or location of spoiler bands. Additional tests will be conducted on configurations showing the most promising stability characteristics.

This report presents a chronological tabulation and description of the tests performed, plus supplementary information describing the model configurations, test setups, and testing conditions. Brush oscillograph records of all the dynamic tests performed are on file in Building 865. These tests were conducted for R. M. Dayhoff, 5144.

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AERODYNAMIC NOMENCLATURE

C_{m_α}	Rate of change of pitching moment coefficient with angle of attack, per degree, $\left[\partial C_m/\partial\alpha\right]_{\alpha\to 0}$
C_{m_q}	Rate of change of pitching moment coefficient with reduced pitching velocity ($\dot{\theta}d/2V$), per radian, $\left[\partial C_m/\partial\left(\frac{\dot{\theta}d}{2V}\right)\right]_{\dot{\theta}\to 0}$
$C_{m_{\dot{\alpha}}}$	Rate of change of pitching moment coefficient with reduced rate of change of angle of attack ($\dot{\alpha}d/2V$), per radian, $\left[\partial C_m/\partial\left(\frac{\dot{\alpha}d}{2V}\right)\right]_{\dot{\alpha}\to 0}$
$C_{m_q} + C_{m_{\dot{\alpha}}}$	Dynamic stability derivative, per radian
D	Maximum diameter of model (exclusive of bands), ft
I	Model moment of inertia, slug-ft^2
K_I	Dynamic rig calibration constant, $\left[I/P^2_{wo}\right]$
L	Model length, ft
M	Test section Mach number, dimensionless
P	Period of model oscillation, sec
P_o	Stagnation chamber pressure, psia
q	Test section dynamic pressure, psia
R_n	Reynolds number per foot, $\left[\rho V/\mu\right]$
$T_{1/2}$	Time required for model to damp to one-half amplitude, sec
T_2	Time required for model to diverge to twice amplitude, sec
V	Test section velocity, ft/sec
ρ	Test section density, slugs/ft^3
μ	Test section viscosity, slugs/ft sec

Subscript wo refers to wind-off conditions
Subscript won refers to wind-on conditions
Barred symbols indicate averaged values at the three conditions where damping envelopes were obtained.

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Equipment

The Class C tests were conducted using dynamic rig No. 10. The damping envelopes (output of the strain gages) were recorded on a brush oscillograph recorder. The dynamic rig strain gages are made of 0.032-inch-thick spring steel. Due to fatigue, the first set of gages began slipping and a new set was installed beginning with run No. 64. The calibration constant (K_1) for the first set of gages was 0.075757 and for the second set 0.08772.

The strain gages are arranged to allow model oscillation in a horizontal plane. This arrangement minimizes the gravity effects on models where the center of gravity is not on the axis of rotation.

The models were made of machined brass and so designed to allow for minor configuration changes by using interchangeable parts. Split spoiler bands were used so the bands could be located at any body station. Sketches of the 15 configurations tested are presented in Figs. 1 and 2. Photographs of configurations 1, 4, 6, 8, 10, 12, and 15 are presented in Figs. 3 through 9.

Results

The average tunnel flow conditions for each run are tabulated in Fig. 10. Three damping envelopes were obtained during each run and averaged values of $T_{1/2}$, P, and flow conditions were used to calculate the static and dynamic stability derivatives.

Static stability derivatives of configurations 1 through 15 are presented as a function of Mach number in Figs. 11a through 25a. The dynamic stability derivatives of configurations 1 through 15 are presented as a function of Mach number in Figs. 11b through 25b.

J. W. ARNOLD - 5142

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July 16, 1957

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L = 4.812 inches for all configurations
L/D = 3.5 for all configurations

For Model Parts See Dwgs

SK(5143)81238	SK(5143)81275
SK(5143)81251	SK(5143)81276
SK(5143)81252	SK(5143)81279

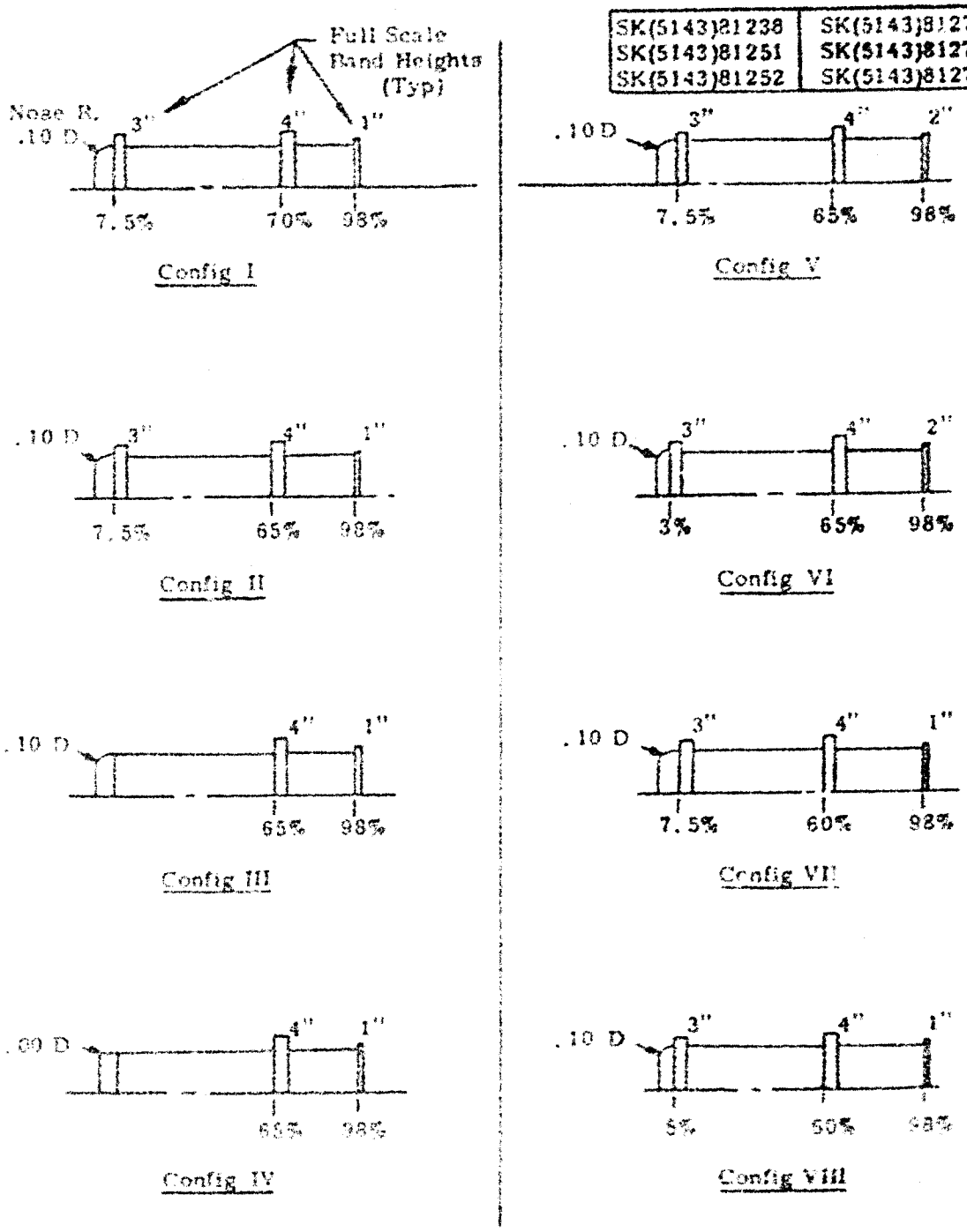

Fig. 1 -- Sketches of configurations

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L = 4.812 inches for all configurations
L/D = 3.5 for all configurations

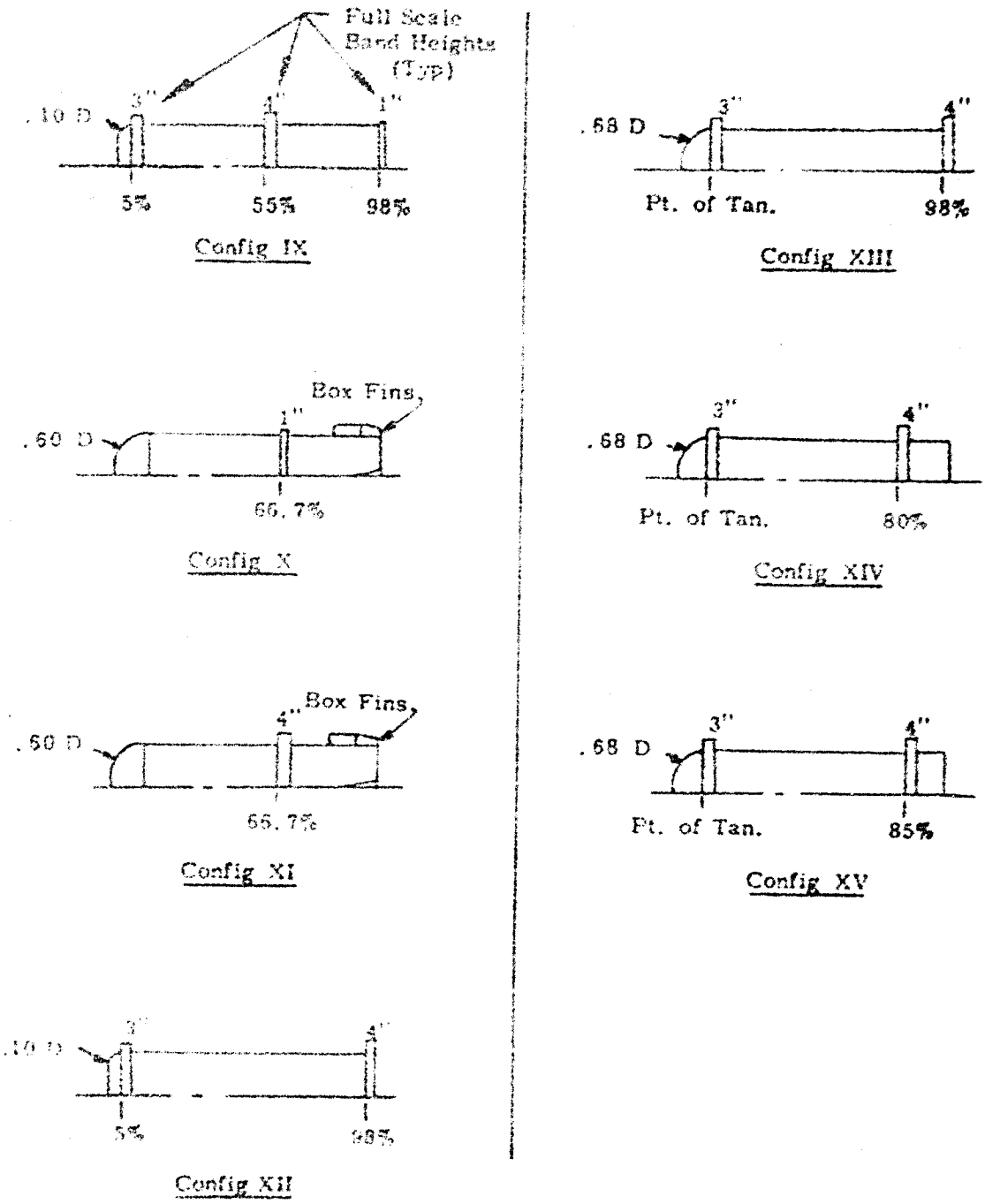

Fig. 2 -- Sketches of configurations

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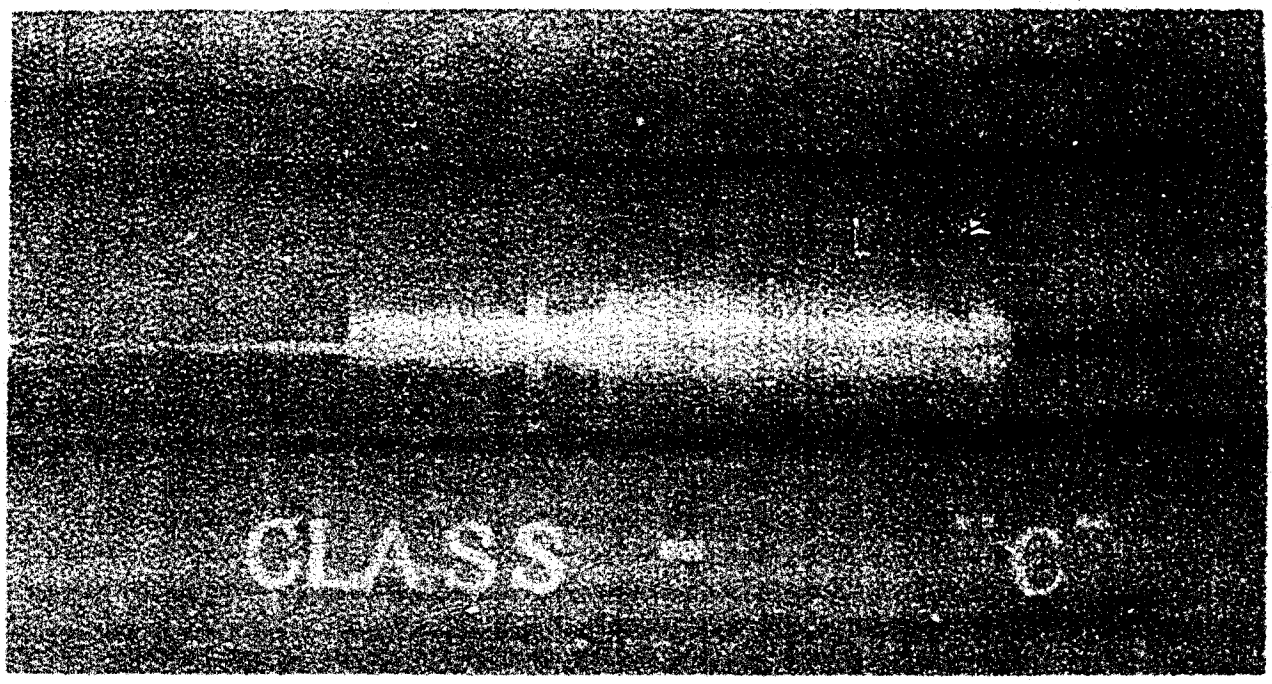

Fig. 3 -- Photograph of configuration No. 1

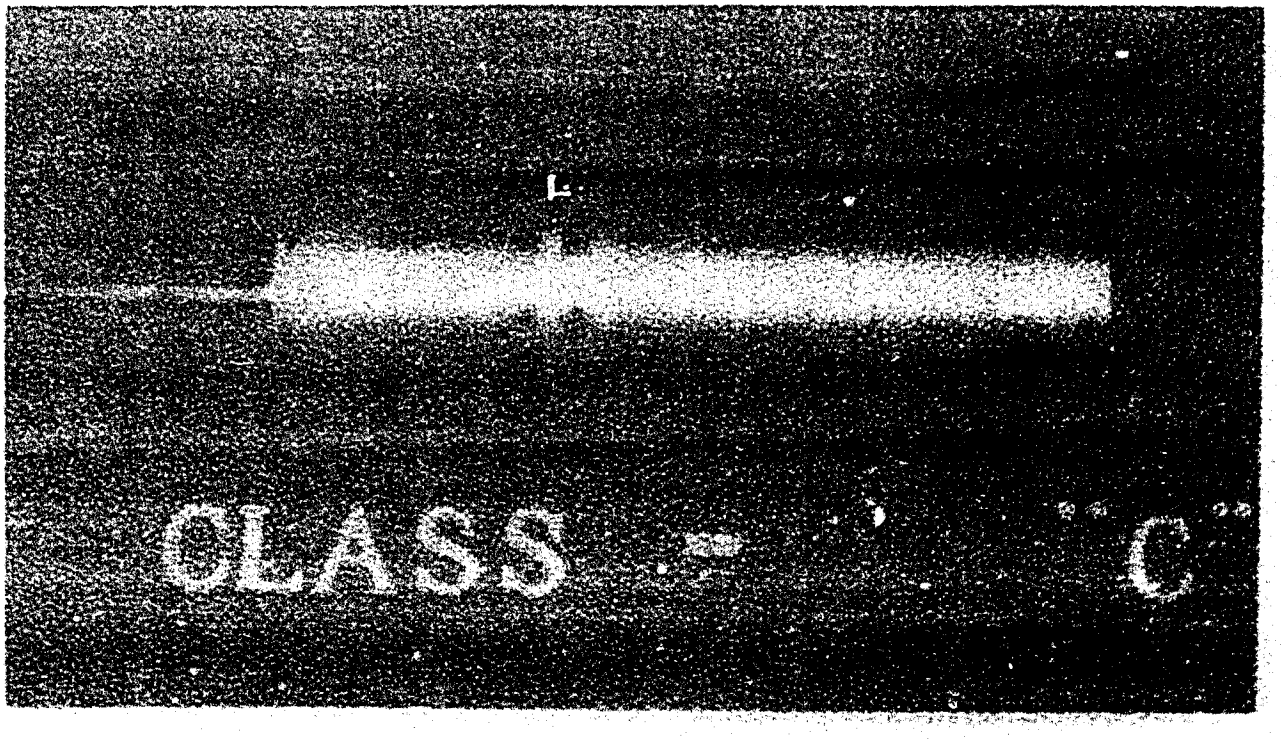

Fig. 4 -- Photograph of configuration No. 4

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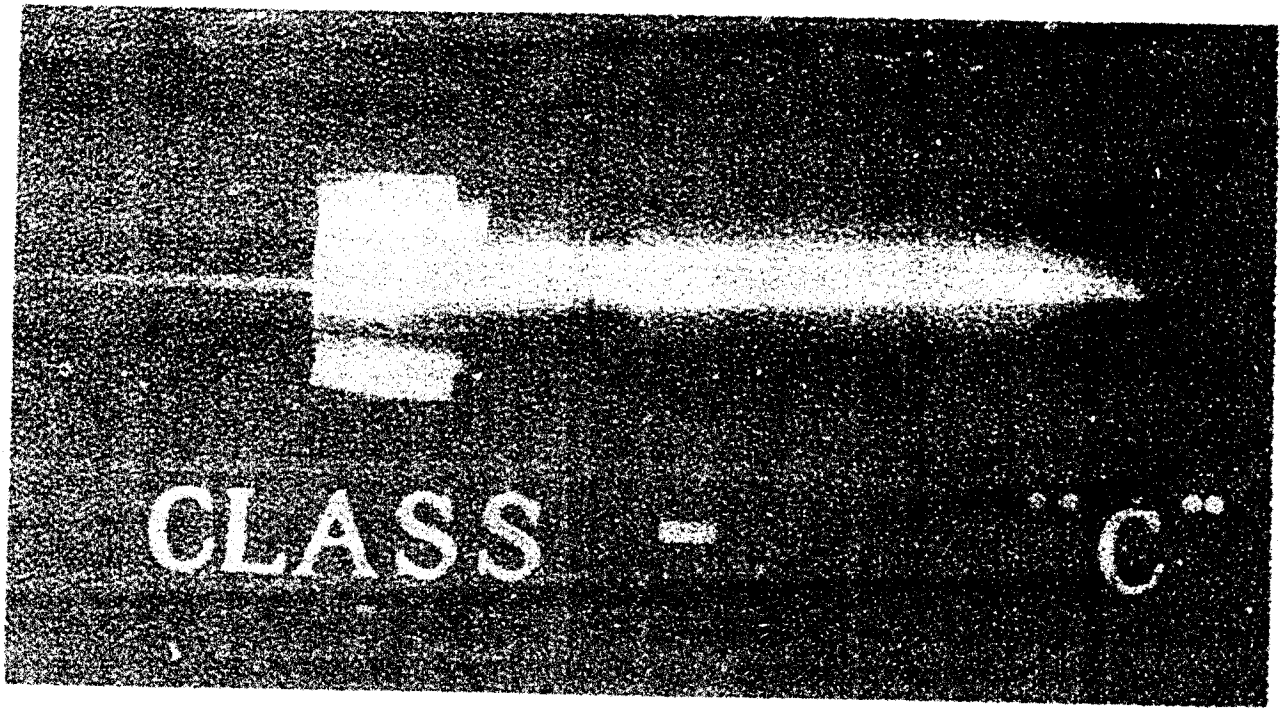

Fig. 7 -- Photograph of configuration No. 10

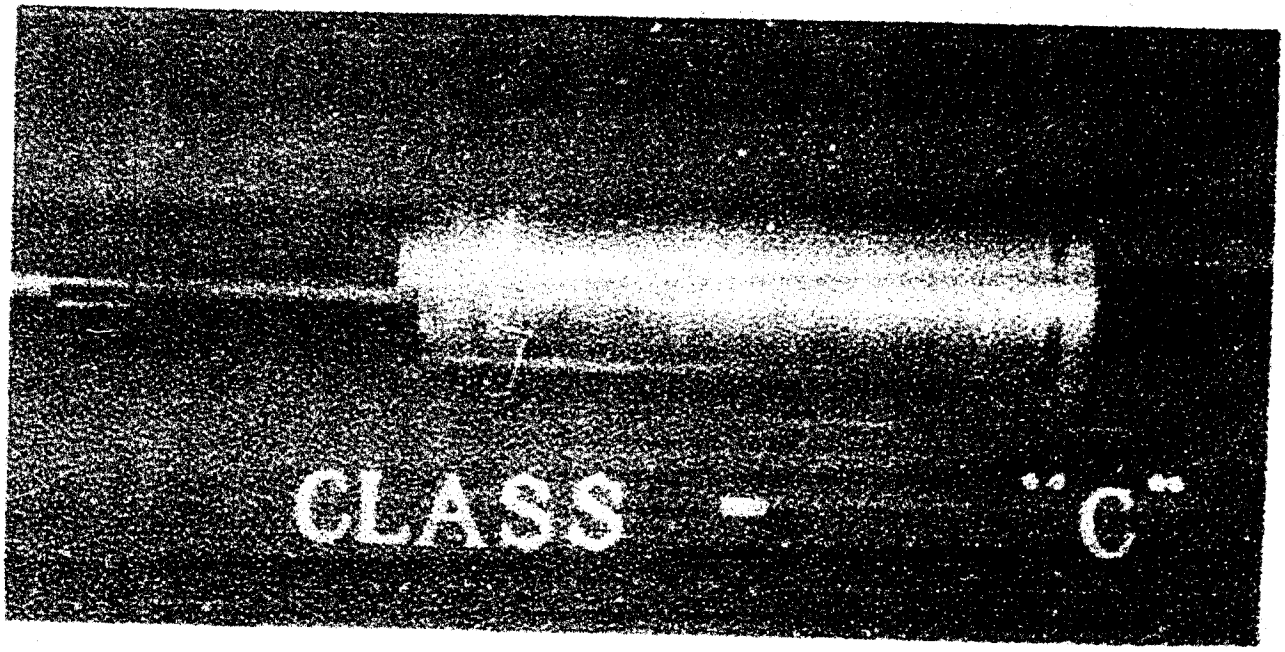

Fig. 8 -- Photograph of configuration No. 12

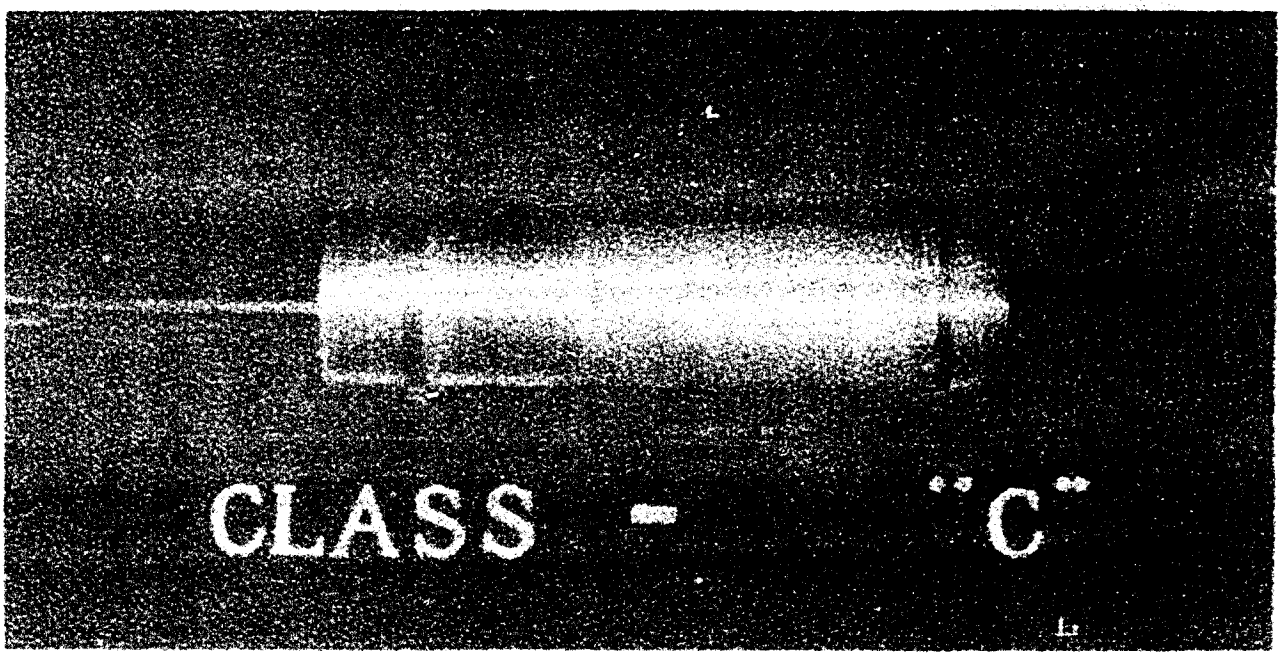

Fig. 9 -- Photograph of configuration No. 15

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DATE		12" TUNNEL SCHEDULE						TEST: CLASS "C" (III-19)		
RUN NO.	CONFIG NO.	MACH NO.	$\overline{P}_o$ PSIA	$\overline{q}$ PSIA	RUN TIME SECS	$\overline{R}_n$* PER FOOT	DEW POINT			
1	1	0.680	17.240	4.259	15.16	4.64	-12			
2	Run no good - regulator was unstable									
3	1	0.870	17.236	5.576	15.77	5.60	-15			
4	1	0.915	16.931	5.091	15.85	5.18	-15			
5	1	0.921	16.625	5.771	15.80	5.36	-15			
6	1	0.934	16.944	5.870	18.70	5.53	-15			
7	1	1.029	10.613	6.286	16.83	5.38	-15			
8	1	1.022	24.552	9.232	17.35	8.00	-15			
9	1	1.067	24.591	9.555	18.90	7.98	-15			
10	1	1.132	26.589	10.725	14.61	8.34	-15			
11	1	1.235	30.635	12.873	13.80	11.20	-23			
12	2	0.715	15.791	3.898	13.27	3.49	-23			
13	2	0.802	16.135	4.760	14.27	4.86	-23			
14	2	0.912	15.910	5.385	10.15	4.95	-23			
15	2	0.916	16.149	5.510	11.66	5.00	-23			
16	2	1.018	15.884	5.958	12.33	5.10	-23			
17	2	1.116	26.009	10.409	11.47	8.55	-23			
18	2	1.163	27.533	11.321	--	9.07	-23			
19	3	1.215	28.370	12.481	11.48	10.84	-16			
20	3	1.113	26.010	10.453	11.50	8.99	-16			
21	3	1.015	16.35	6.072	11.62	5.25	-16			
22	3	0.956	16.09	5.700	11.53	5.08	-16			
23	3	0.897	15.86	5.279	11.64	4.86	-16			
24	3	0.807	15.86	4.708	11.48	4.62	-16			
25	3	0.723	15.896	4.104	11.48	4.32	-16			
26	4	0.711	15.69	3.923	11.66	4.21	-16			
27	4	0.798	15.75	4.619	11.32	4.50	-16			
28	4	0.897	15.65	5.205	11.73	4.74	-16			
29	4	0.956	15.57	5.516	11.65	4.84	-16			
30	4	1.000	16.16	5.924	11.84	5.52	-8			
31	4	1.150	27.55	11.314	11.53	9.95	-8			
32	4	1.208	29.72	12.337	7.12	10.50	-8			
33	5	0.711	15.17	4.111	11.40	4.30	-8			
34	5	0.796	15.74	4.584	11.63	4.59	-8			
35	5	0.900	15.81	5.295	11.92	4.95	-8			
36	5	0.953	15.50	5.452	11.81	4.95	-8			
37	5	1.005	15.53	5.765	12.02	5.06	-8			
38	5	1.097	25.35	10.013	11.84	8.80	-8			

REMARKS: *All Reynolds numbers $R_n \times 10^6$

FIGURE 10 - TABULATED AVERAGE FLOW CONDITIONS FOR EACH RUN

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DATE

12" TUNNEL SCHEDULE

TEST: CLASS "C" (III-19)

RUN NO.	CONFIG NO.	$\overline{\text{MACH NO}}$	$\overline{P_o}$ PSIA	$\overline{q}$ PSIA	RUN TIME SECS	$\overline{R_u}$* PER FOOT	DEW POINT
39	5	0.182	28.31	11.772	12.22	10.10	-8
40	6	0.712	16.725	4.345	11.25	4.66	-15
41	6	0.852	16.400	4.833	12.00	4.88	-15
42	No good - front spoiler band missing						
43	7	0.799	16.148	4.736	11.53	4.82	-15
44	7	0.705	16.208	4.042	11.18	4.46	-15
45	7	0.897	16.121	5.383	12.02	5.11	-15
46	7	0.943	16.005	5.684	11.95	5.20	-15
47	7	1.007	16.530	6.147	11.80	5.58	-15
48	7	1.121	26.620	10.780	11.65	9.63	-15
49	7	1.208	30.050	12.580	12.12	10.86	-15
50	8	0.717	16.623	4.244	11.45	--	-15
51	8	0.805	16.400	4.852	11.41	--	-15
52	8	1.010	16.276	6.070	11.75	--	-15
53	8	1.121	26.133	10.486	11.40	--	-15
54	8	1.215	29.557	12.351	15.40	--	-15
55	8	0.945	16.117	5.665	16.35	--	-15
56	8	0.891	16.543	5.523	12.35	--	-15
57	9	0.719	16.673	4.194	11.43	4.67	-15
58	9	0.811	16.612	4.964	11.80	5.00	-15
59	9	0.899	16.334	5.471	11.92	5.13	-15
60	9	0.952	16.189	5.732	13.00	4.98	-15
61	9	1.000	16.069	5.940	12.00	5.20	-15
62	9	1.117	26.181	10.487	11.72	8.78	-15
63	9	1.206	29.368	12.277	12.20	10.10	-15
64	10	0.722	17.130	4.414	11.80	4.71	-47
65	10	0.808	16.005	5.272	11.90	4.95	-47
66	10	0.910	16.636	5.638	12.25	5.13	-28
67	10	0.962	16.639	5.865	11.95	5.15	-28
68	10	1.033	16.546	6.232	12.40	5.13	-28
69	10	1.142	26.924	10.925	11.99	8.95	-28
70	10	1.221	29.906	12.520	12.17	10.21	-28
71	11	1.213	29.482	12.312	12.08	10.00	-40
72	11	1.120	26.446	10.694	12.54	8.63	-40
73	11	1.008	16.590	6.286	12.14	5.63	-42
74	11	0.959	16.341	5.458	12.02	5.33	-42

REMARKS: * All Reynolds numbers $R_u \times 10^6$

FIGURE 10 - CONTINUED

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DATE		12" TUNNEL SCHEDULE						TEST: CLASS "C" (III-19)
RUN NO.	CONFIG NO.	MACH NO.	$\bar{P}_o$ PSIA	$\bar{q}$ PSIA	RUN TIME SECS	$\bar{R}_N$* PER FOOT	DEW POINT
75	11	0.900	16.373	5.493	11.88	5.00	-42
98	11	0.807	16.573	4.927	12.16	4.79	-40
99	11	0.718	16.414	4.199	11.99	4.38	-40
76	12	1.208	29.415	12.260	12.44	10.00	-42
77	12	1.131	26.432	10.662	12.39	8.88	-42
78	12	1.005	16.281	6.308	12.16	5.06	-42
79	13	1.208	29.183	12.165	12.43	--	-42
80	13	1.127	26.113	10.515	--	--	-42
81	13	1.018	17.370	6.515	12.00	--	-53
82	13	0.927	16.917	5.840	11.95	--	-53
83	13	0.712	16.516	4.177	11.80	4.63	-53
84	14	1.209	29.840	12.443	12.51	10.53	-53
85	14	1.127	26.688	10.743	12.40	9.12	-53
86	14	1.006	16.467	6.120	12.10	5.33	-53
87	14	0.955	16.507	5.859	12.13	5.18	-53
88	14	0.900	16.268	5.453	12.30	4.95	-53
89	14	0.803	16.242	4.792	11.82	4.68	-53
90	14	0.717	16.289	4.156	12.03	4.44	-53
91	15	1.040	26.313	10.036	--	8.94	-53
92	15	0.714	16.703	4.253	12.34	4.98	-40
93	15	0.897	16.557	5.520	12.27	5.22	-40
94	15	0.794	16.387	4.751	12.21	4.91	-40
95	15	0.949	16.376	5.744	12.17	5.17	-40
96	15	1.111	26.530	10.457	12.40	8.84	-40
97	15	1.205	29.630	12.335	12.47	10.10	-40

REMARKS:

*All Reynolds numbers $R_n \times 10^6$

FIGURE 10 - CONTINUED

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FIGURE 11. STATIC STABILITY DERIVATIVE VS MACH NO. FOR CONFIGURATION I

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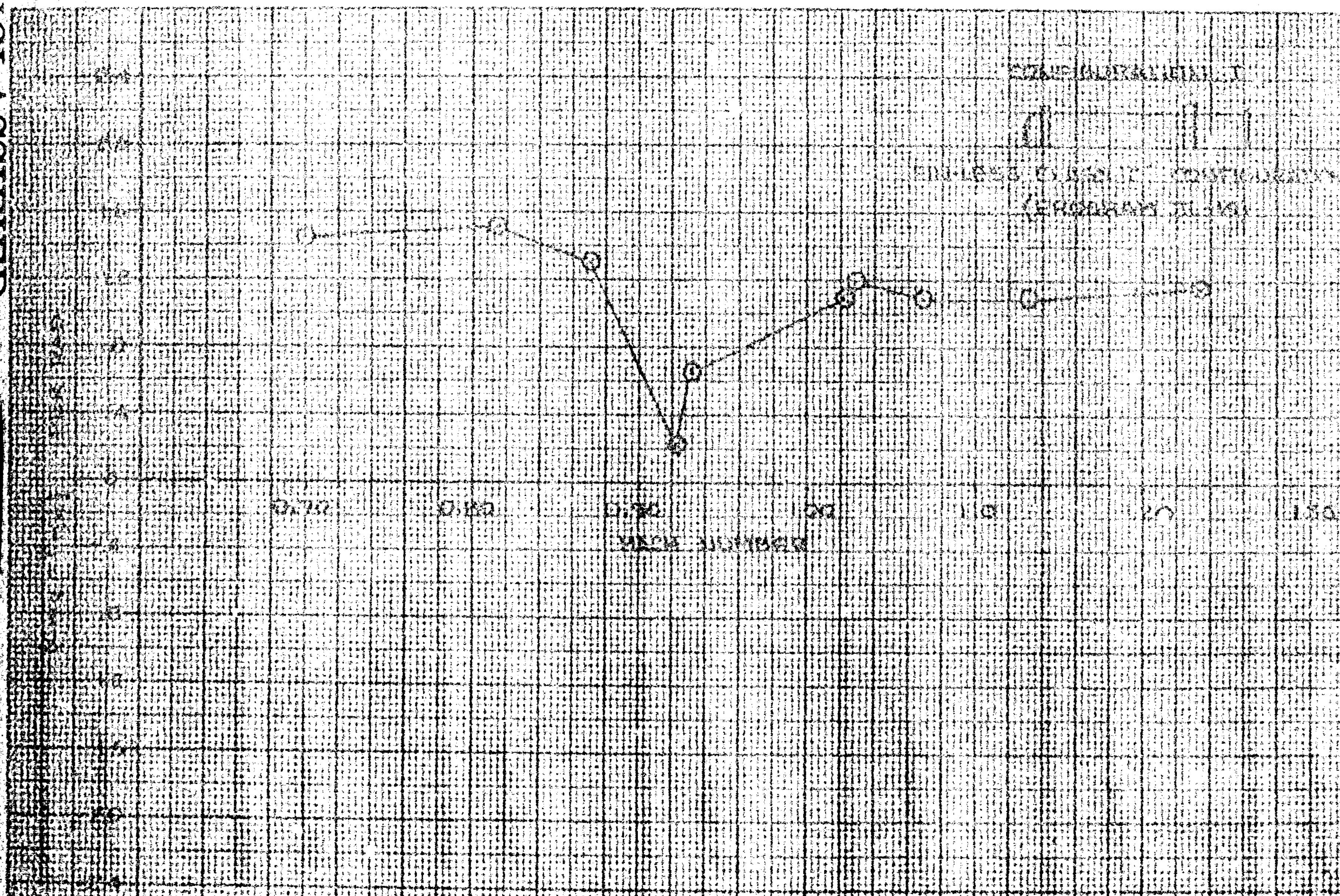

FIGURE 16 - DYNAMIC STABILITY DERIVATIVE VS. MACH FOR CONFIGURATION I

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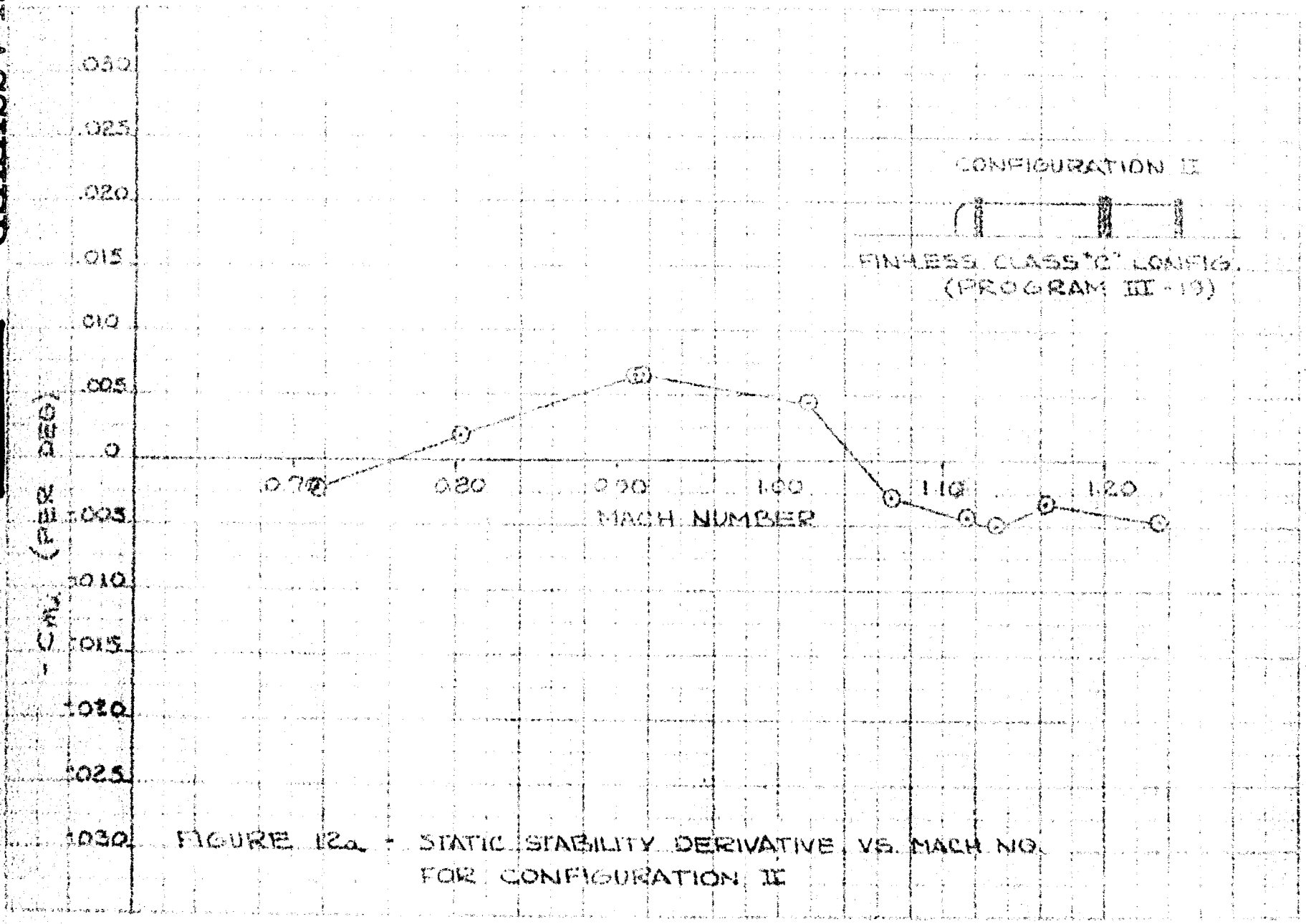

FIGURE 12a - STATIC STABILITY DERIVATIVE VS. MACH NO. FOR CONFIGURATION II

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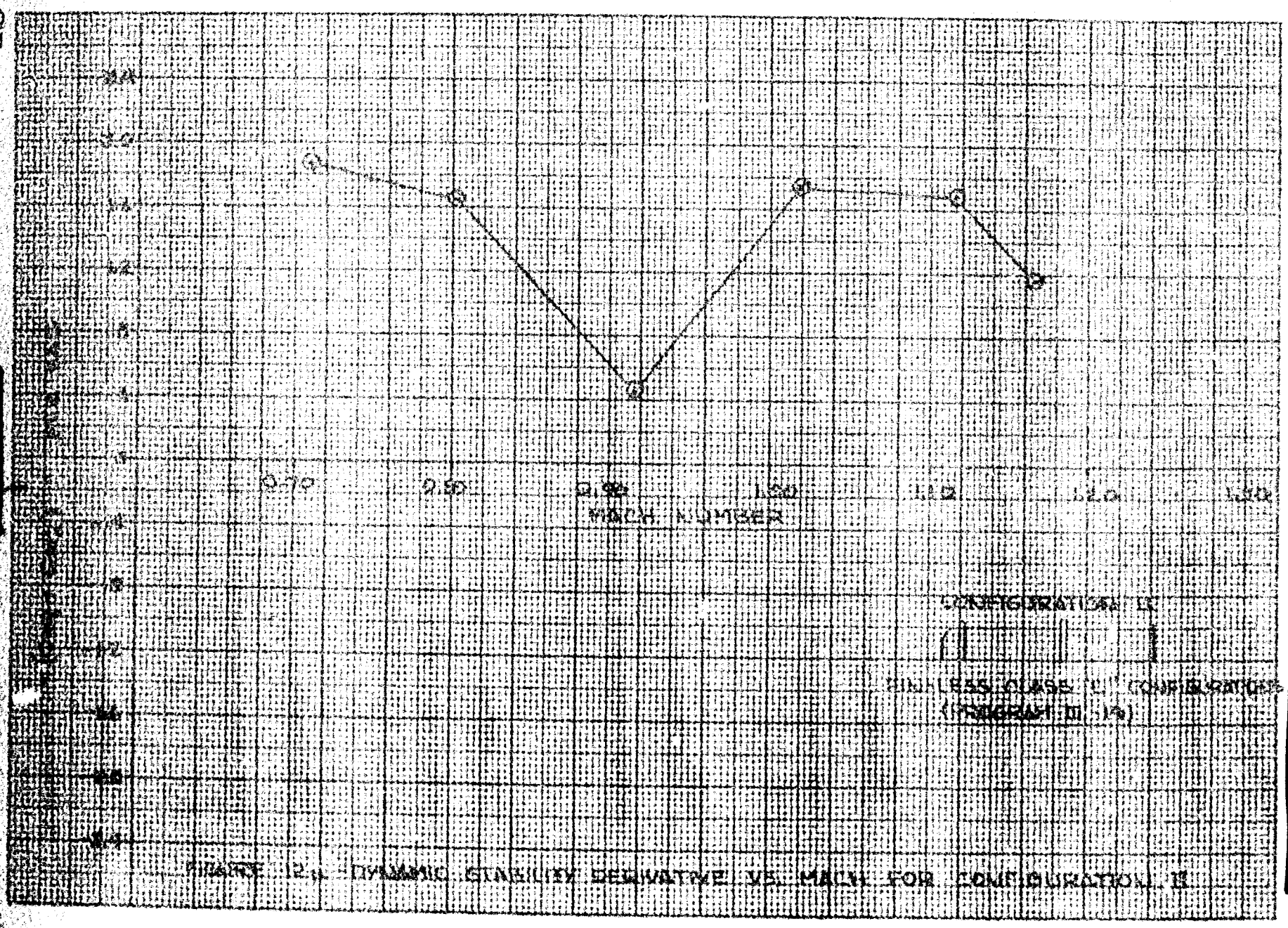

FIGURE 12. DYNAMIC STABILITY DERIVATIVE VS. MACH FOR CONFIGURATION II

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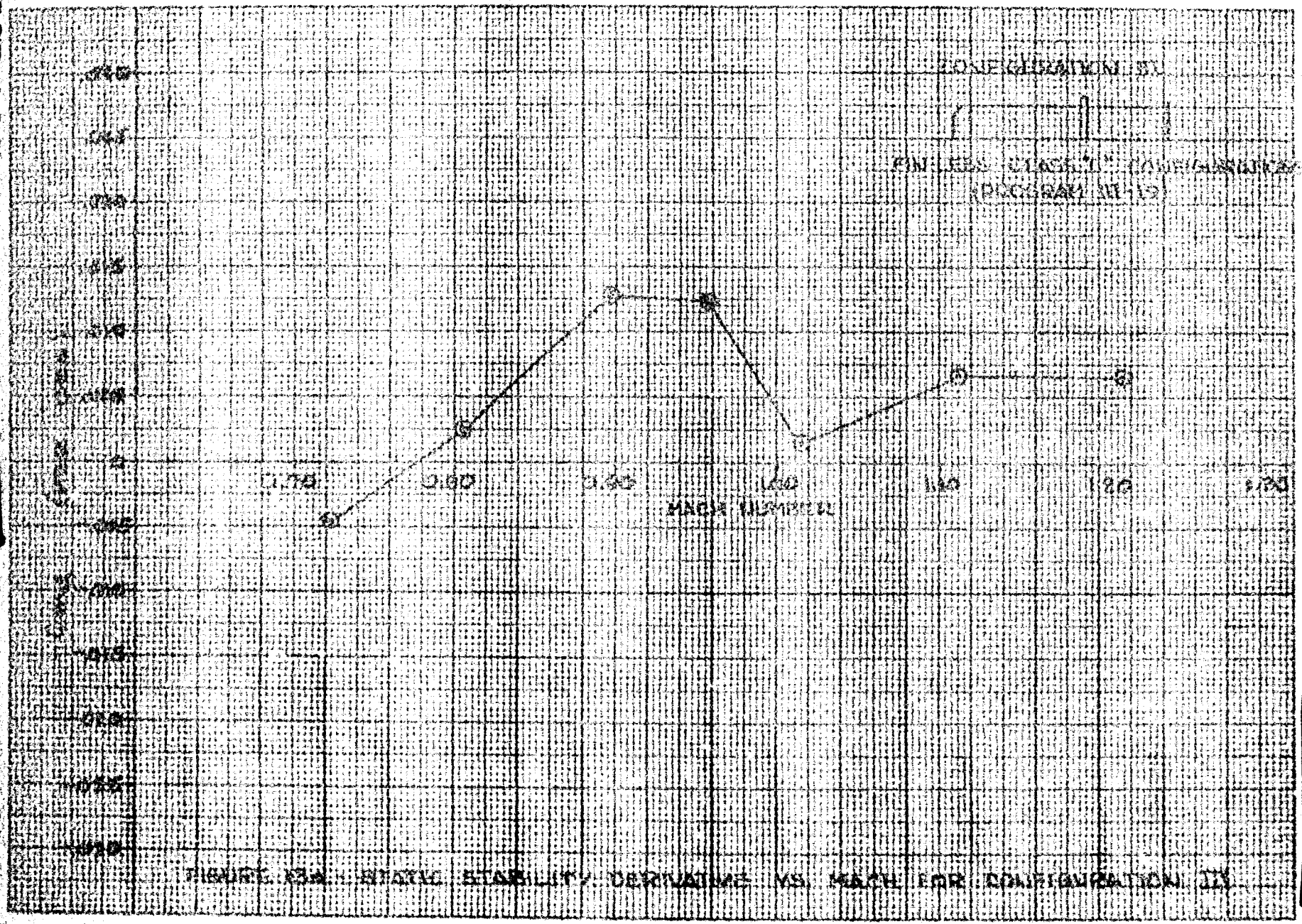

FIGURE 63A. STATIC STABILITY DERIVATIVES VS. MACH FOR CONFIGURATION III

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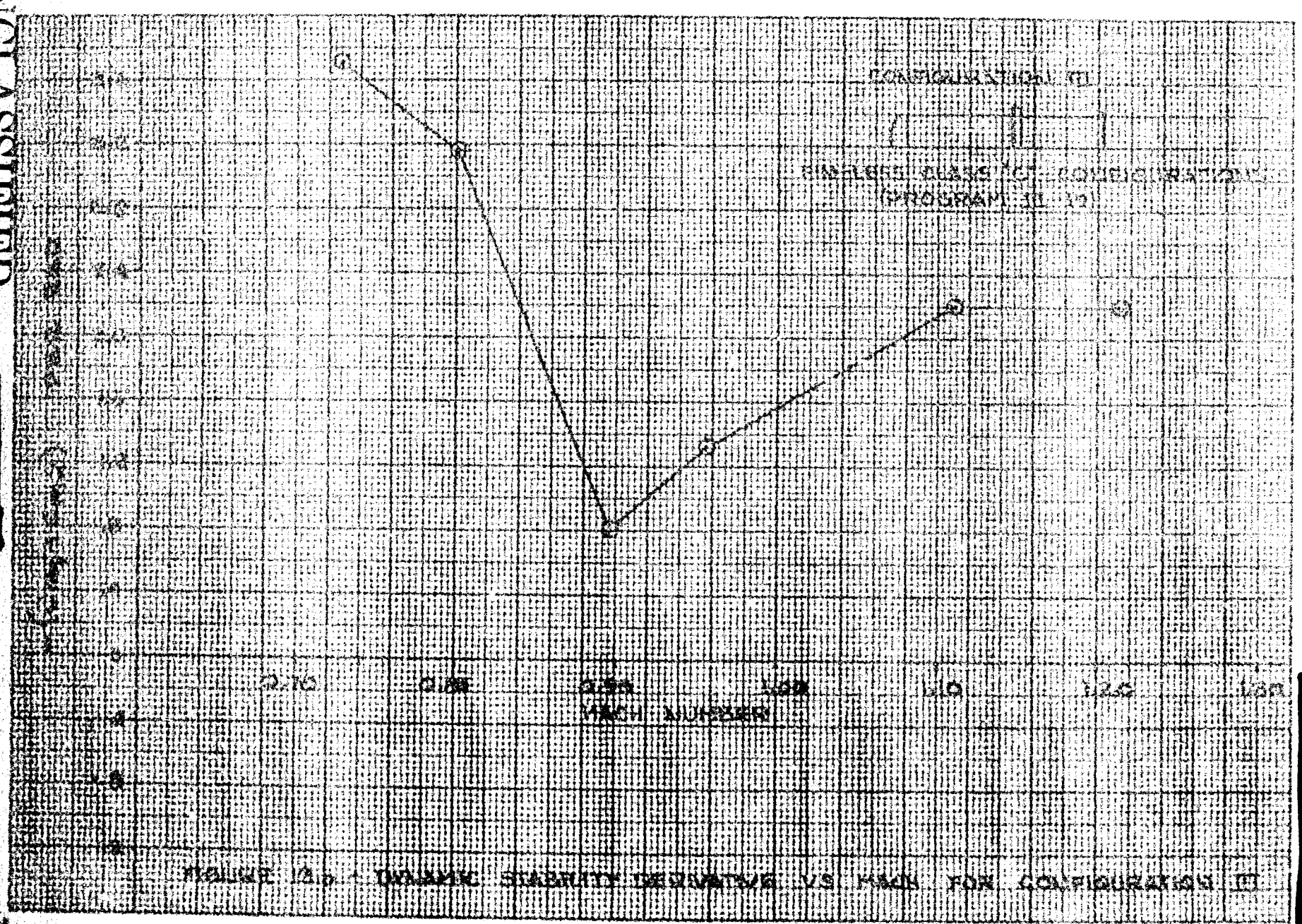

FIGURE 12b - DYNAMIC STABILITY DERIVATIVE VS MACH FOR CONFIGURATION III

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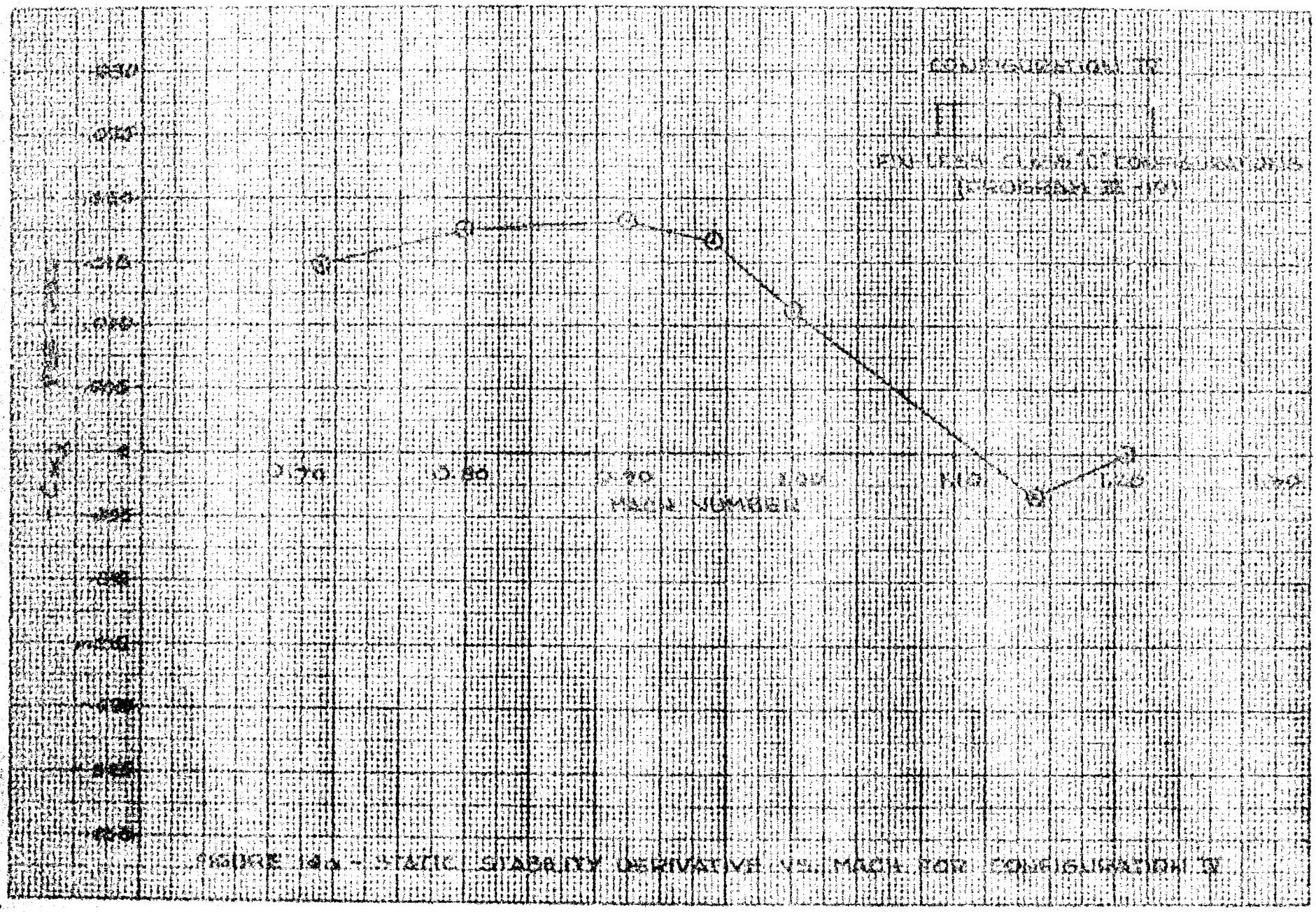

FIGURE 14a - STATIC STABILITY DERIVATIVE VS. MACH FOR CONFIGURATION IV

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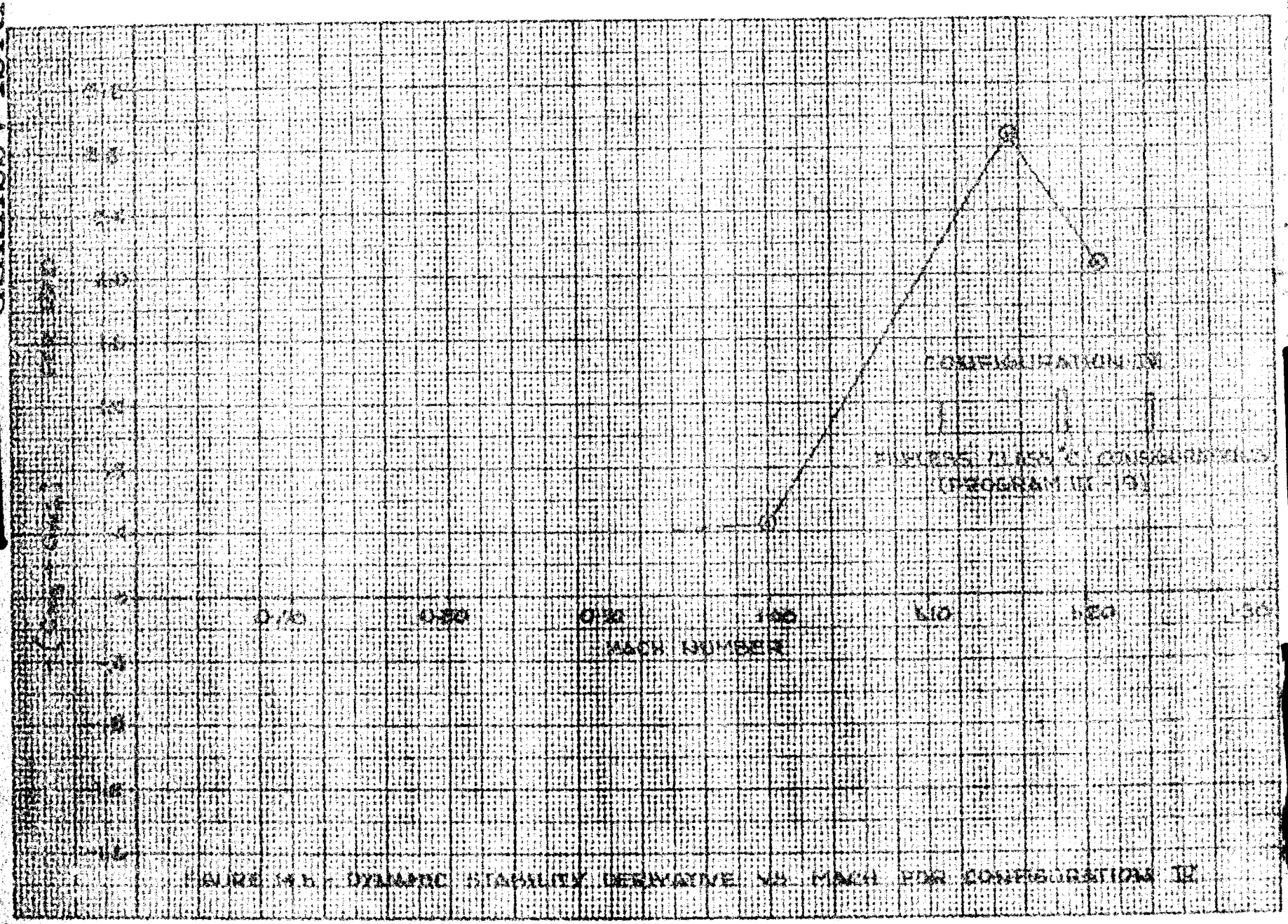

FIGURE 44b. DYNAMIC STABILITY DERIVATIVE VS. MACH FOR CONFIGURATION IV.

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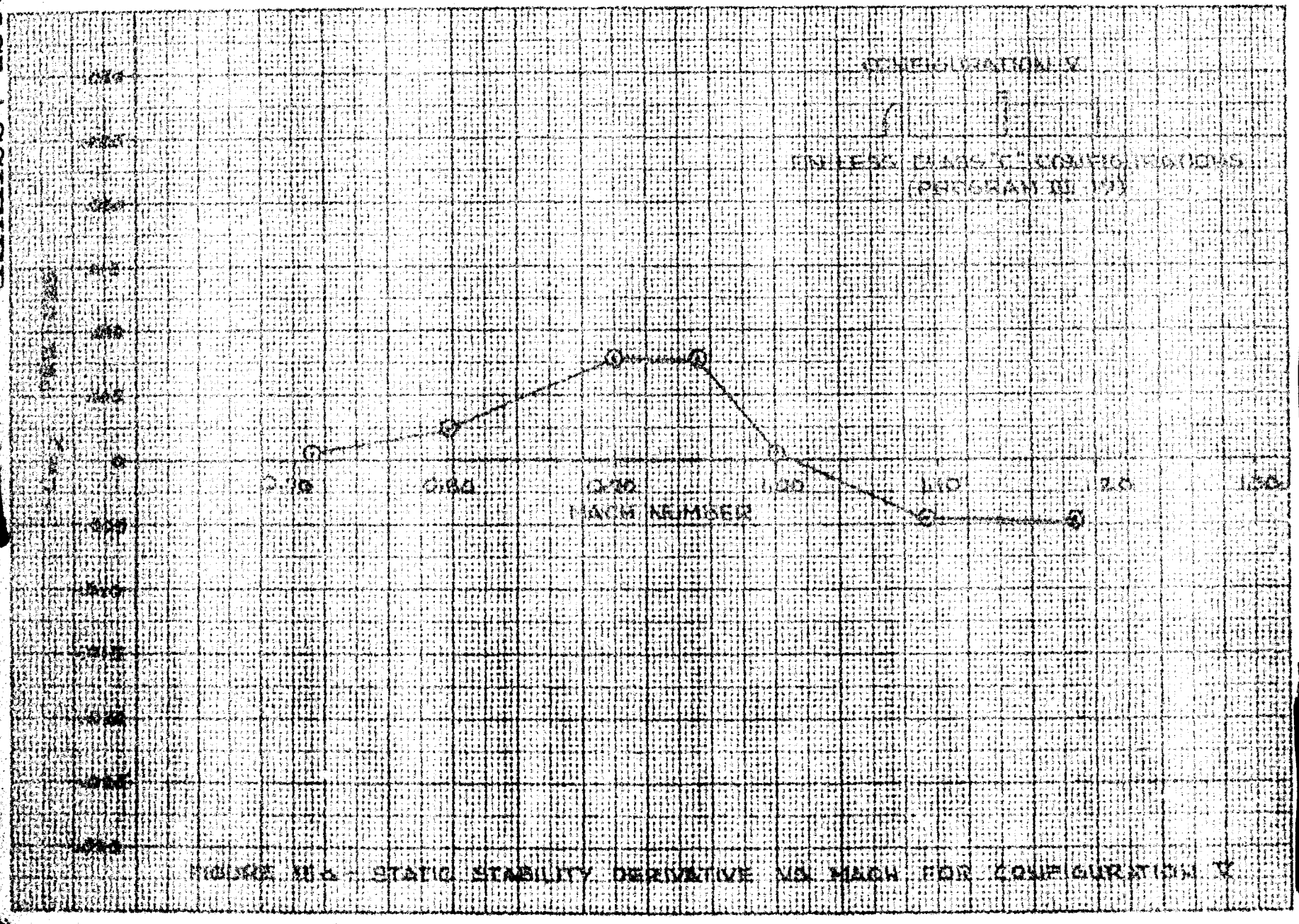

FIGURE 11b - STATIC STABILITY DERIVATIVE VS. MACH FOR CONFIGURATION V

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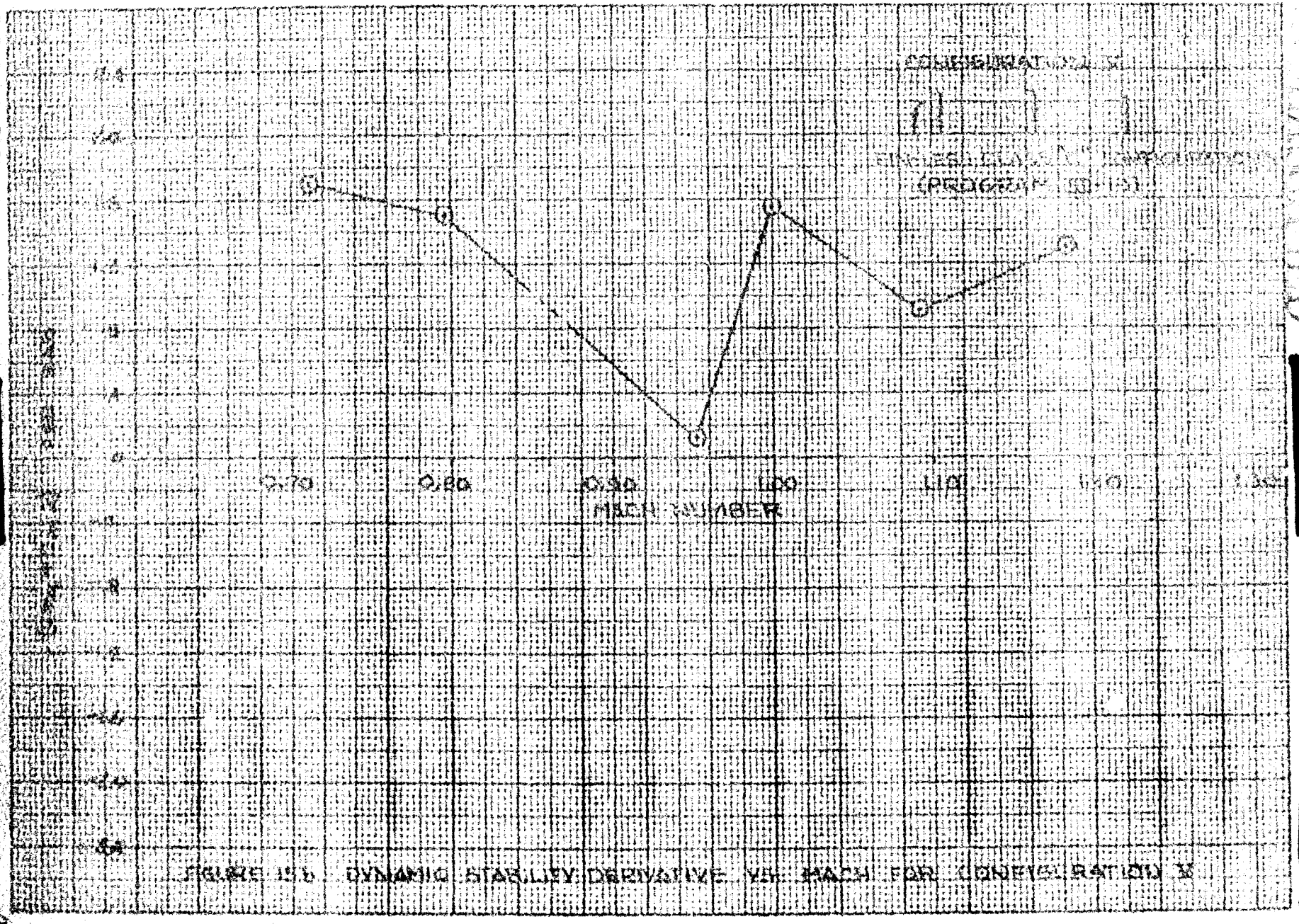

FIGURE 15b DYNAMIC STABILITY DERIVATIVE VS. MACH FOR CONFIGURATION X

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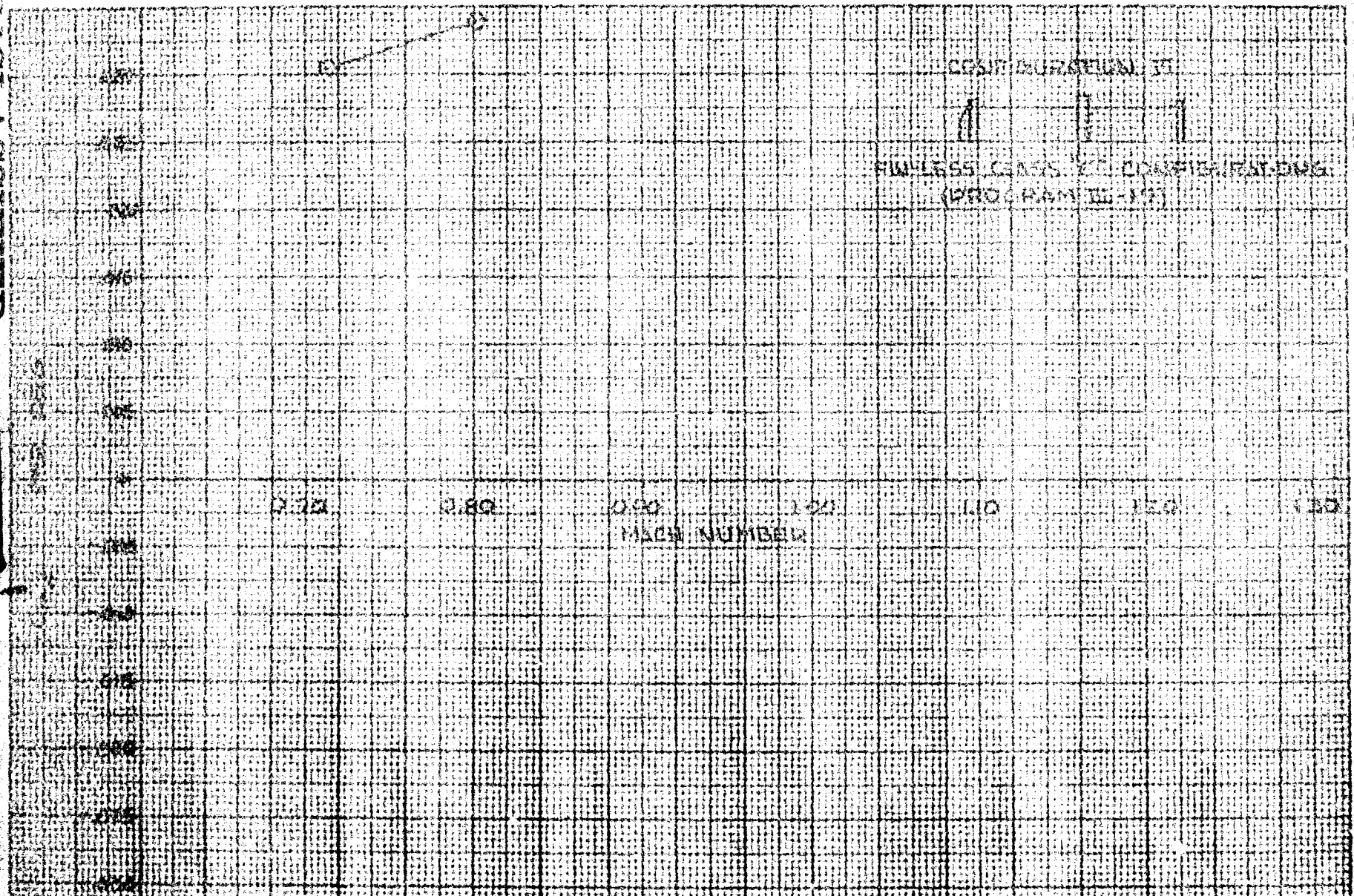

FIGURE 18A STATIC STABILITY DERIVATIVE VS MACH FOR CONFIGURATION II

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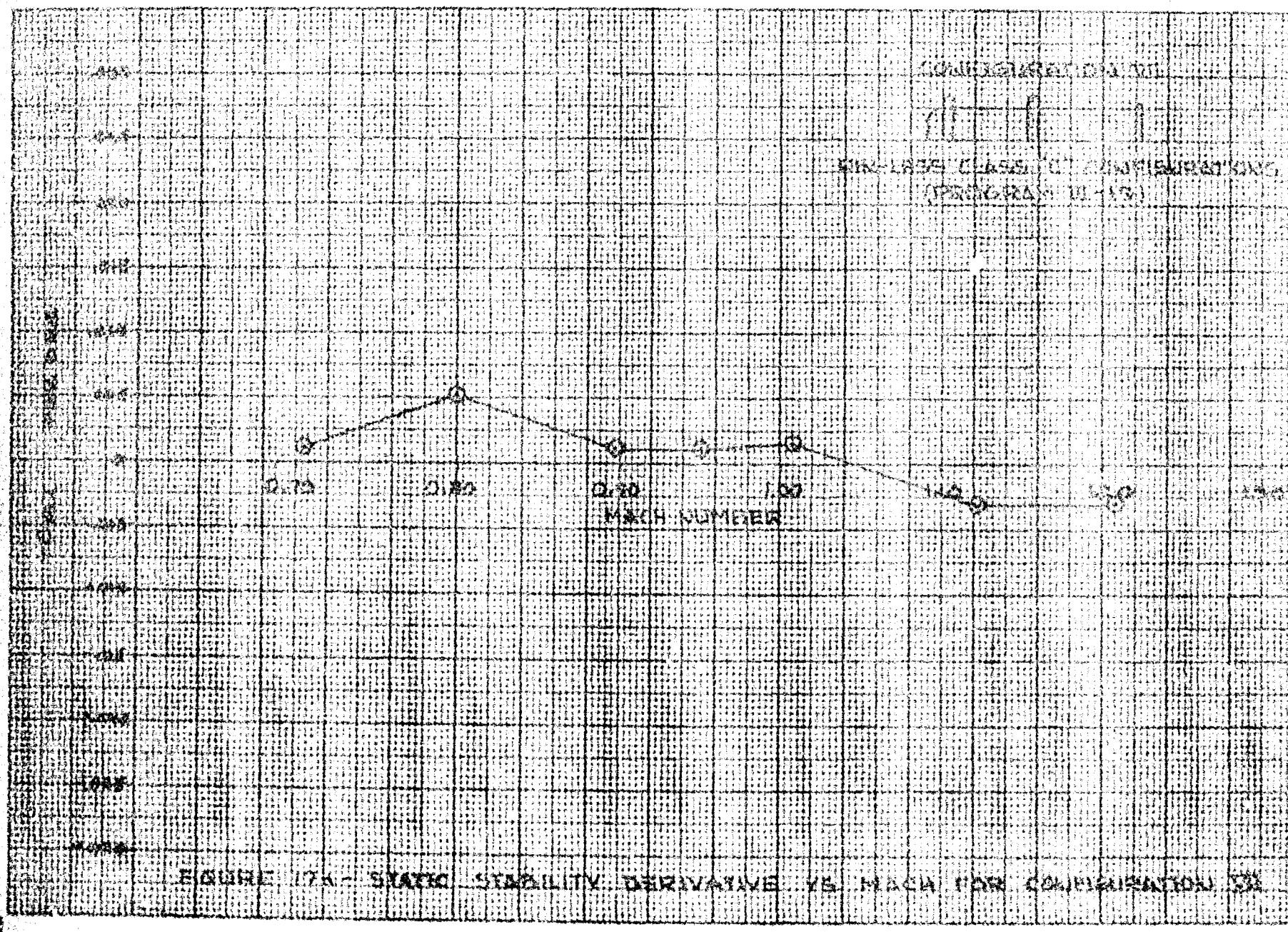

FIGURE 17A - STATIC STABILITY DERIVATIVE VS. MACH FOR CONFIGURATION 32

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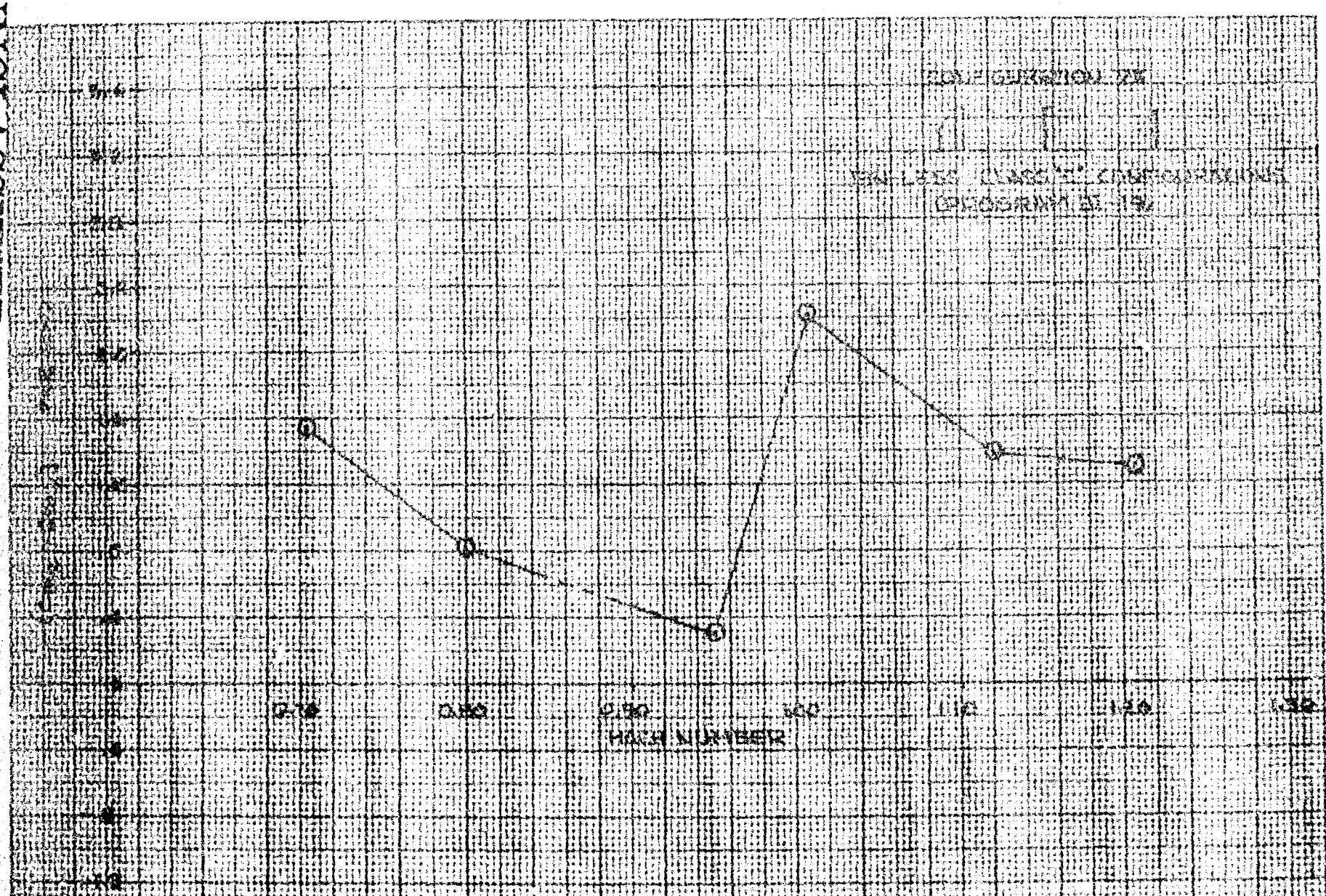

FIGURE 17b - DYNAMIC STABILITY DERIVATIVE VS. MACH FOR CONFIGURATION XII

UNCLASSIFIED

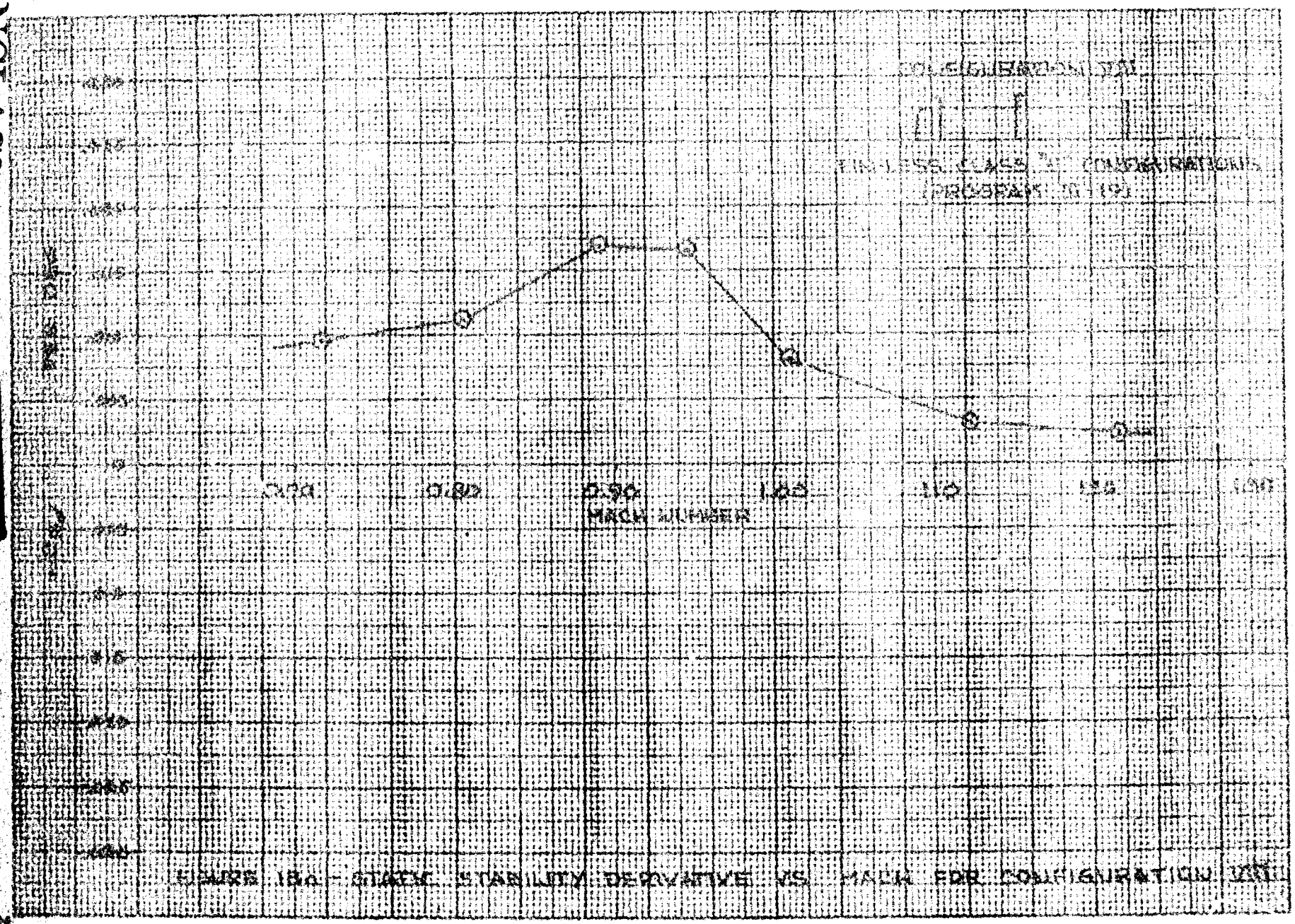

FIGURE 18a - STATIC STABILITY DERIVATIVE VS MACH FOR CONFIGURATION XXII

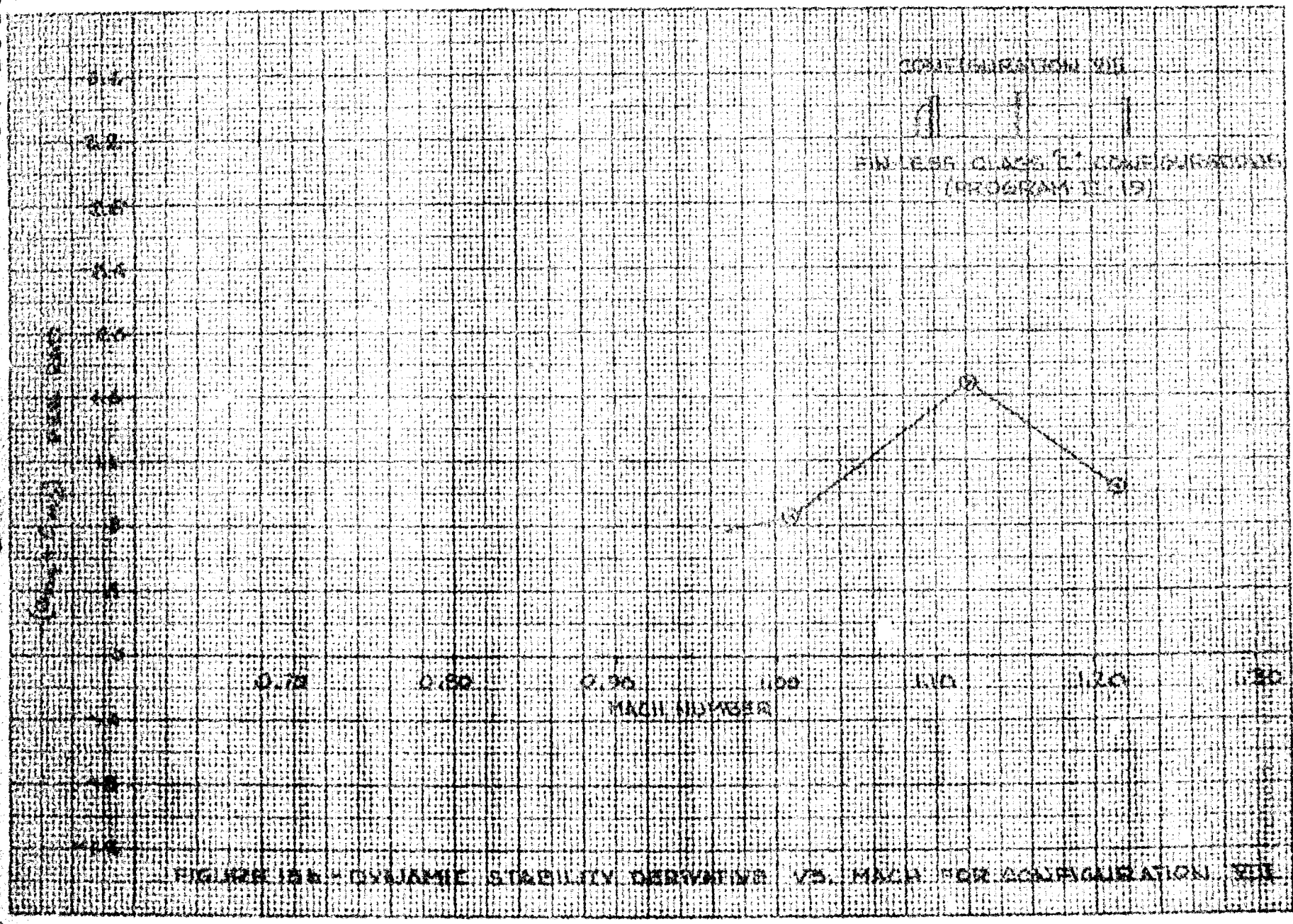

FIGURE 15a.- DYNAMIC STABILITY DERIVATIVE VS. MACH FOR CONFIGURATION VIII

UNCLASSIFIED

[redacted]

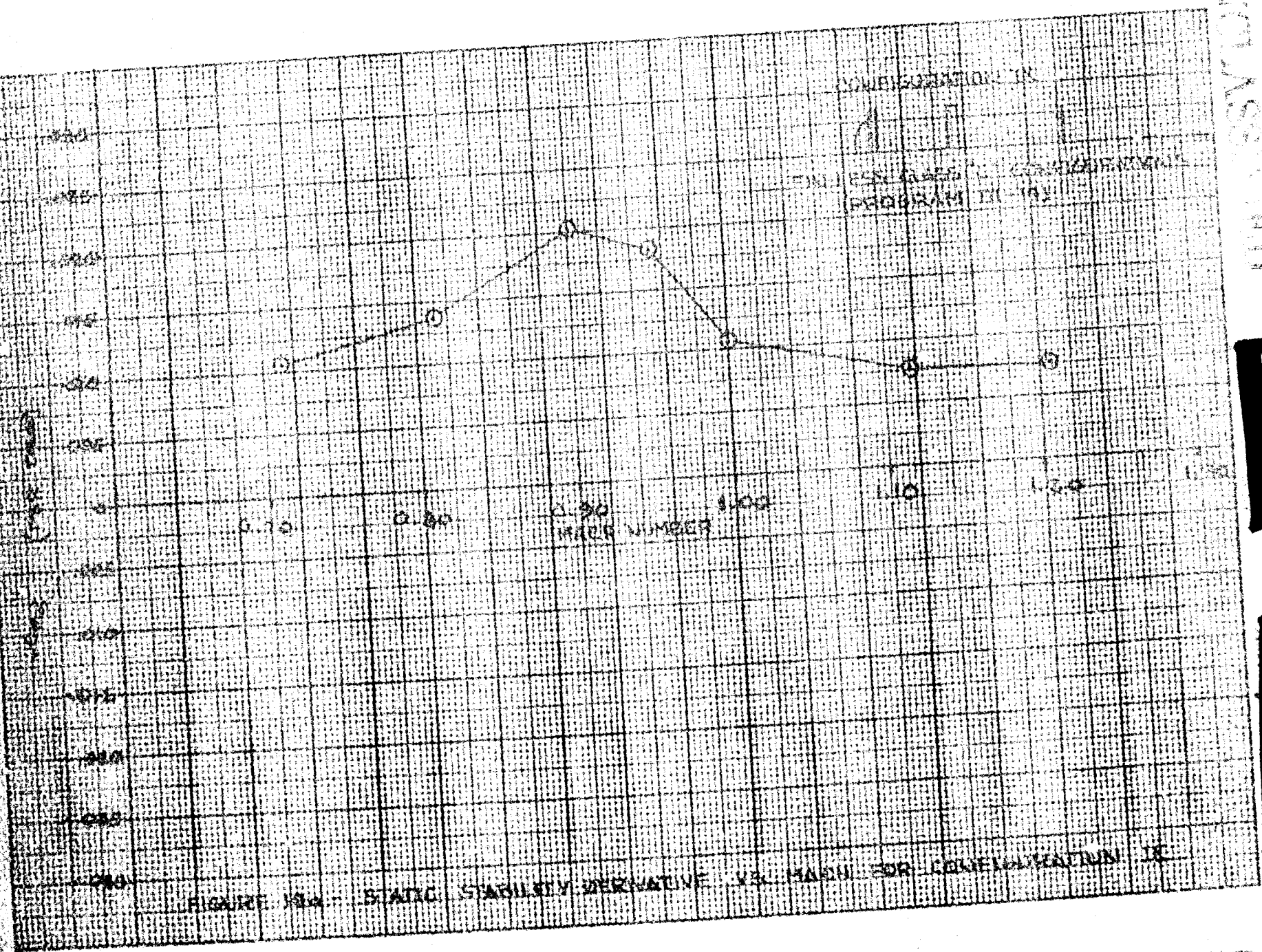

FIGURE 14a - STATIC STABILITY DERIVATIVE VS. MACH FOR CONFIGURATION IX

[redacted]

UNCLASSIFIED

UNCLASSIFIED

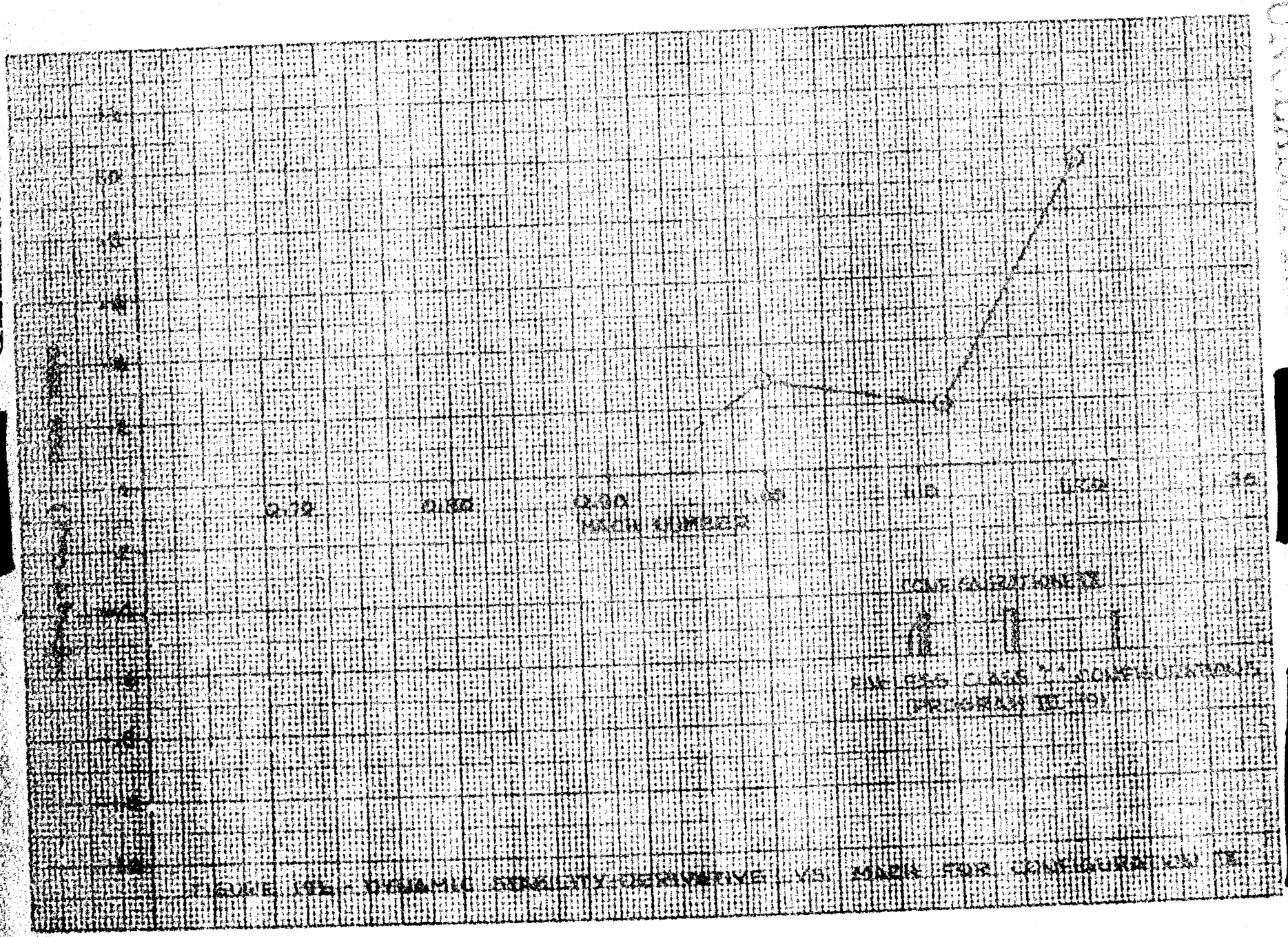

FIGURE 195. DYNAMIC STABILITY-DERIVATIVE VS. MACH FOR CONFIGURATION III.

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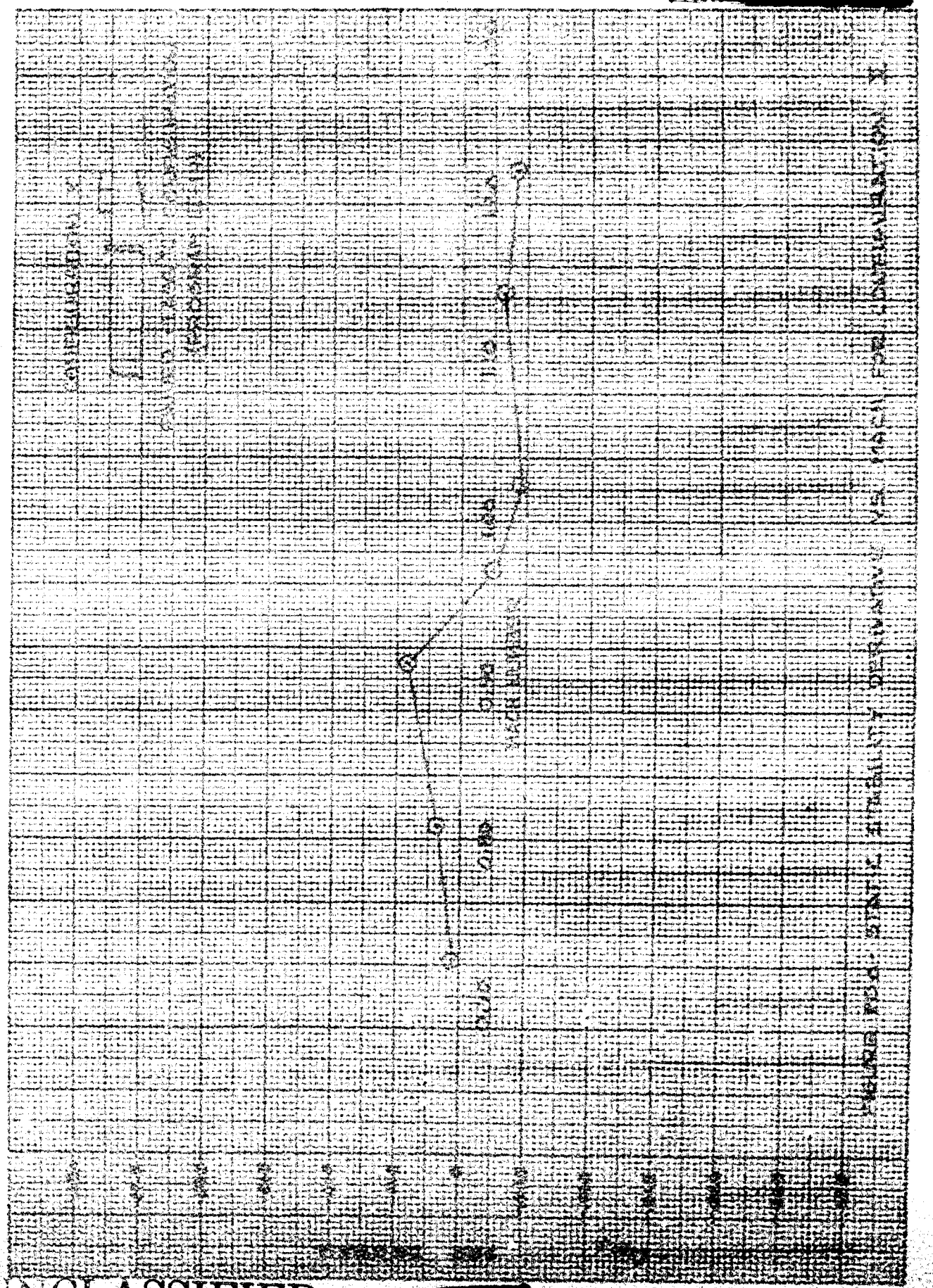

FIGURE 20.0 - STATIC STABILITY DERIVATIVE VS MACH FOR LONGITUDINAL X

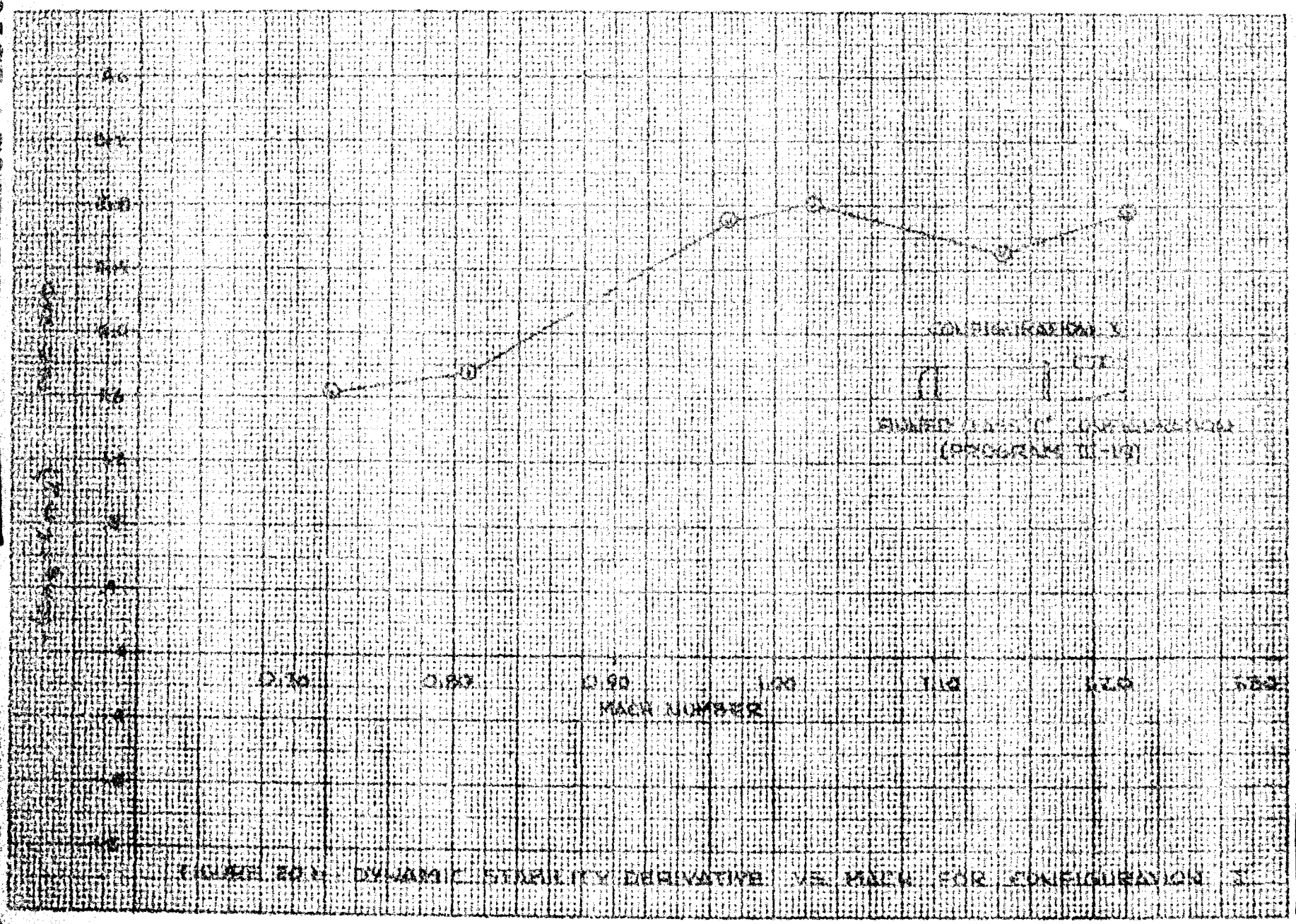

FIGURE 20 DYNAMIC STABILITY DERIVATIVE VS. MACH FOR CONFIGURATION X

UNCLASSIFIED

[redacted]

FIGURE 21A STATIC STABILITY DERIVATIVE VS MACH FOR CONFIGURATION II

UNCLASSIFIED

[redacted]

UNCLASSIFIED

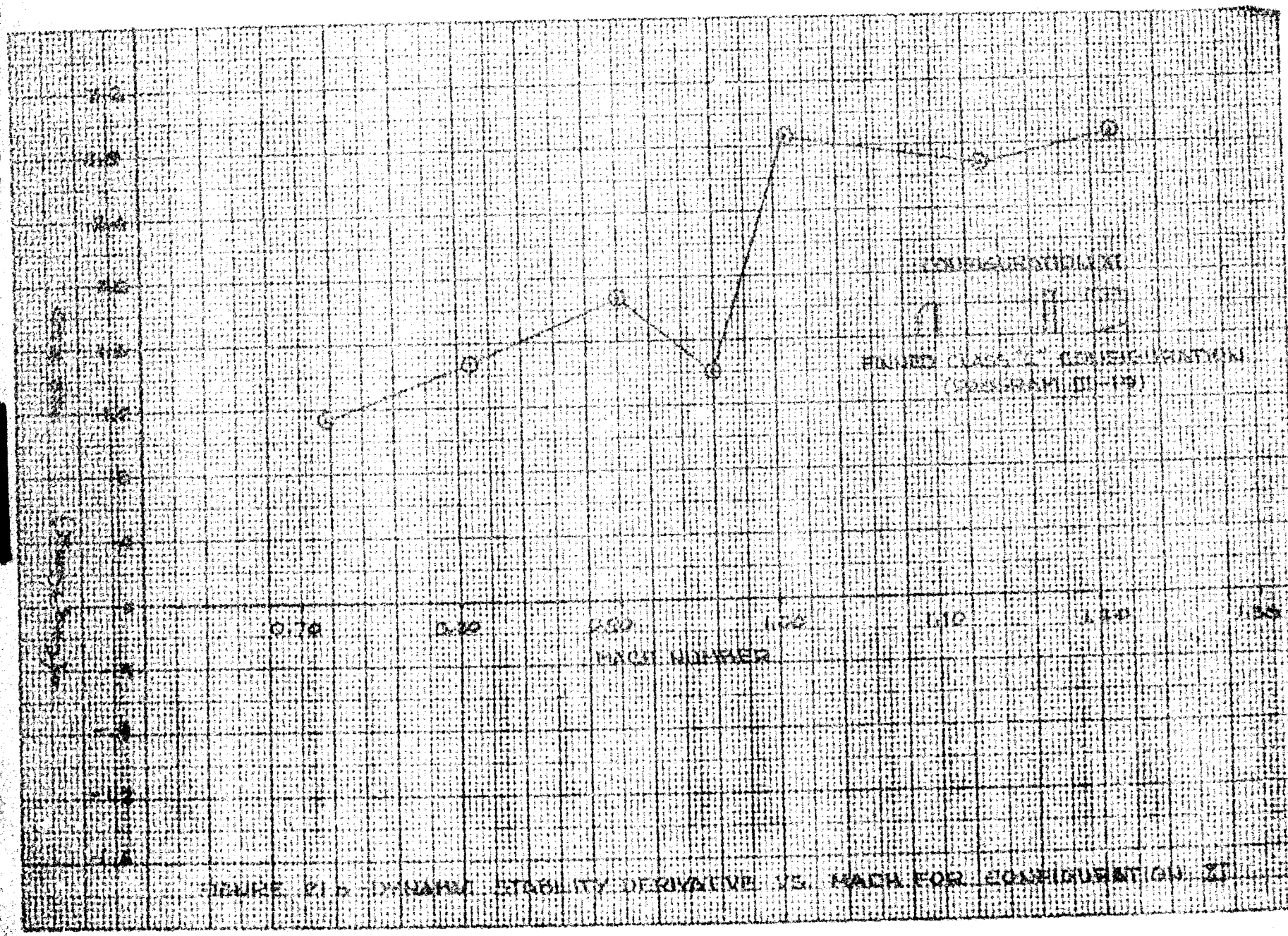

FIGURE 21 b DYNAMIC STABILITY DERIVATIVE VS. MACH FOR CONFIGURATION XI

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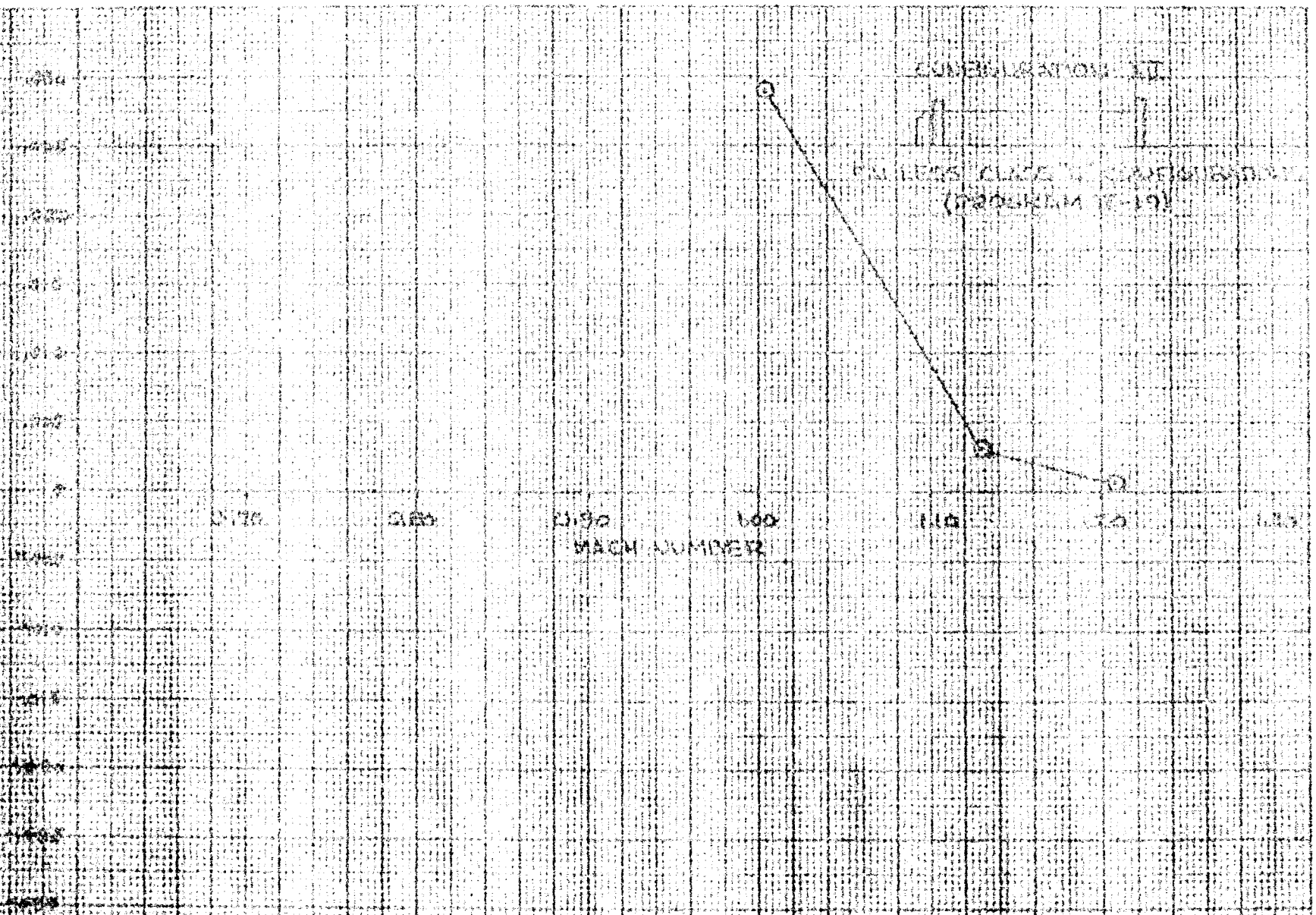

FIGURE 22 d - STATIC STABILITY DERIVATIVE VS. MACH FOR CONFIGURATION XIC

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FIGURE 23.A. STATIC STABILITY DERIVATIVE VS. MACH NO. CONFIGURATION XIII

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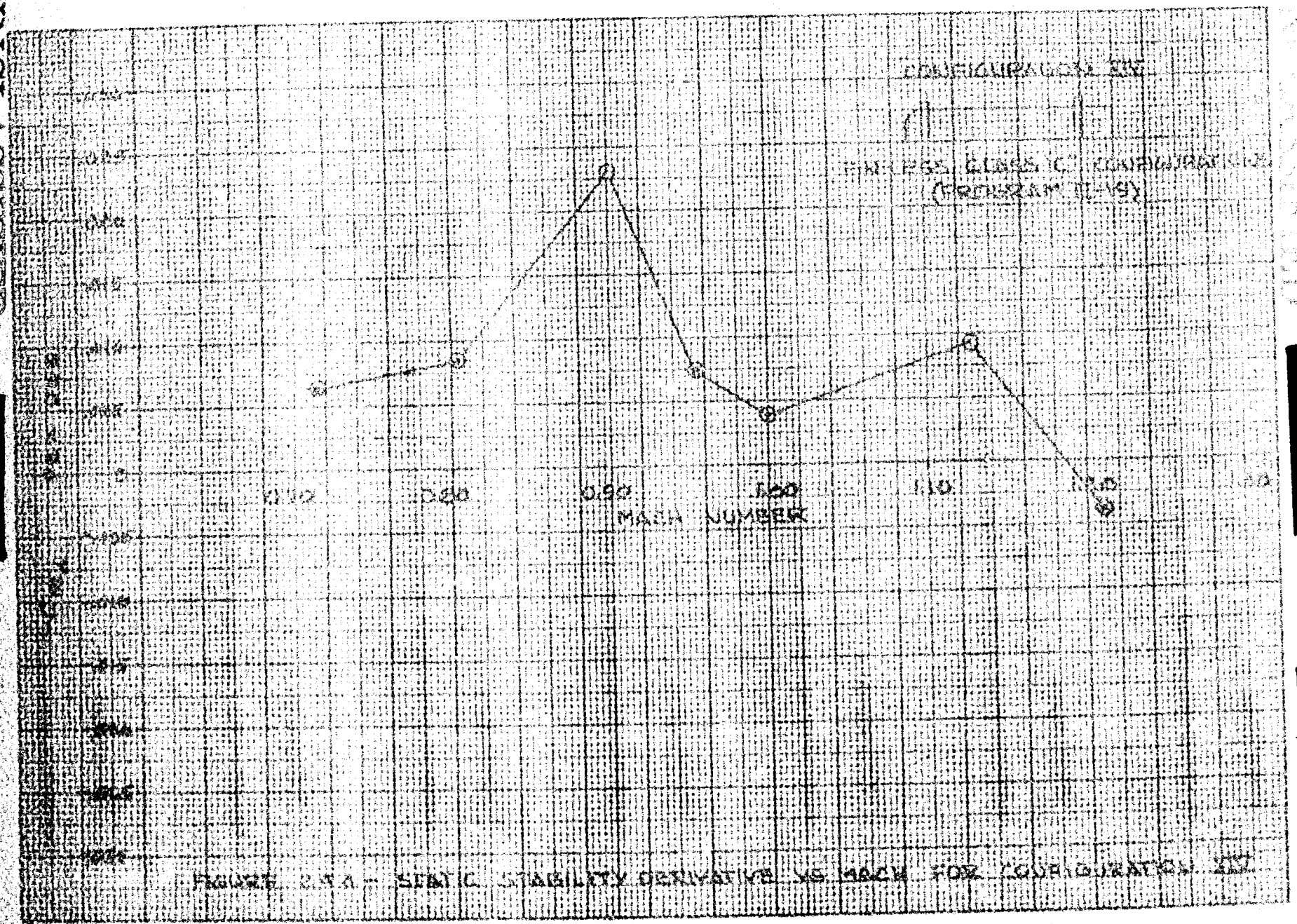

FIGURE 27A - STATIC STABILITY DERIVATIVE VS MACH FOR CONFIGURATION 107

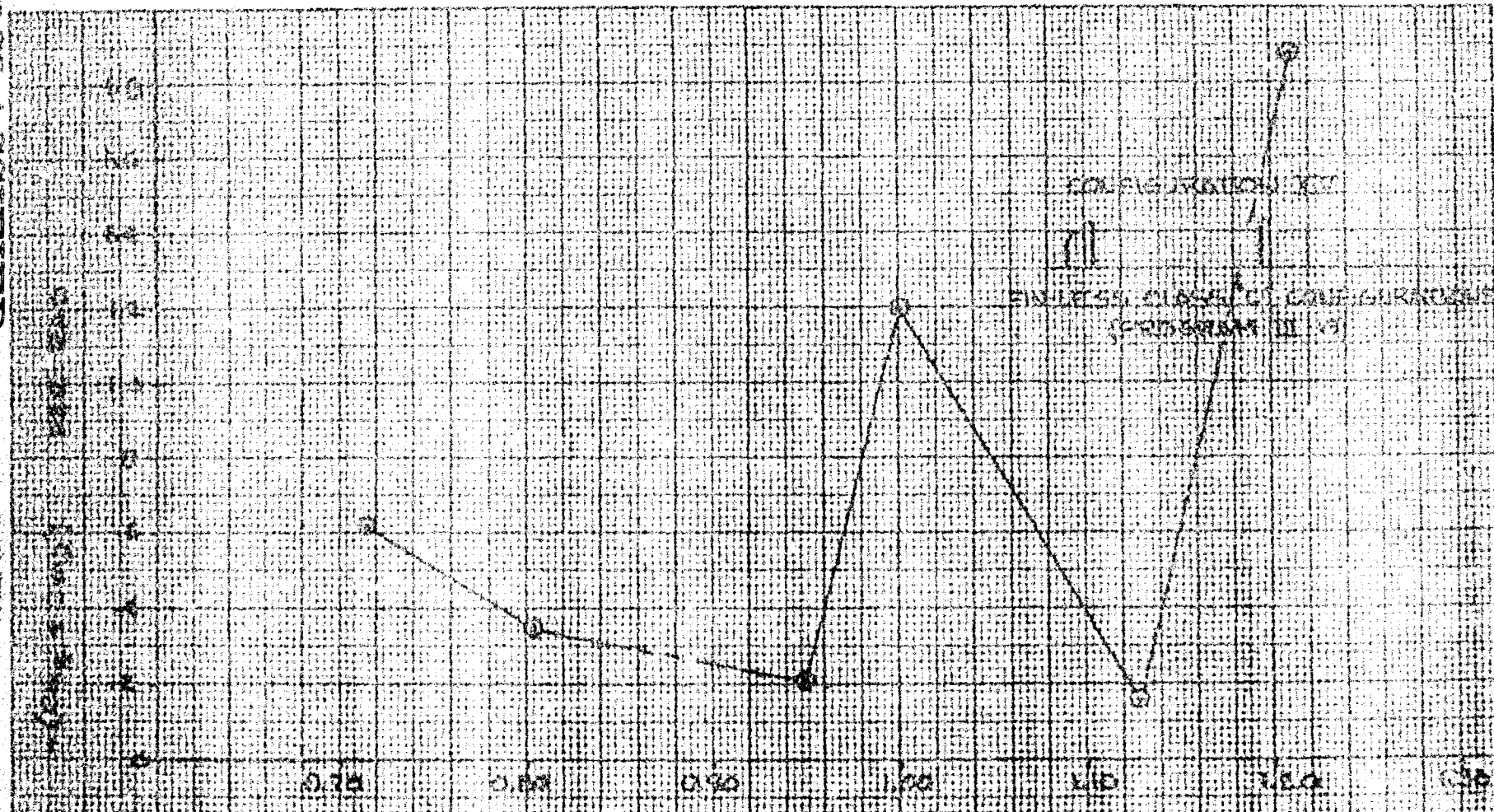

FIGURE #9b - DYNAMIC STABILITY DERIVAT VE VS MACH FOR FOLDED CONFIGURATION

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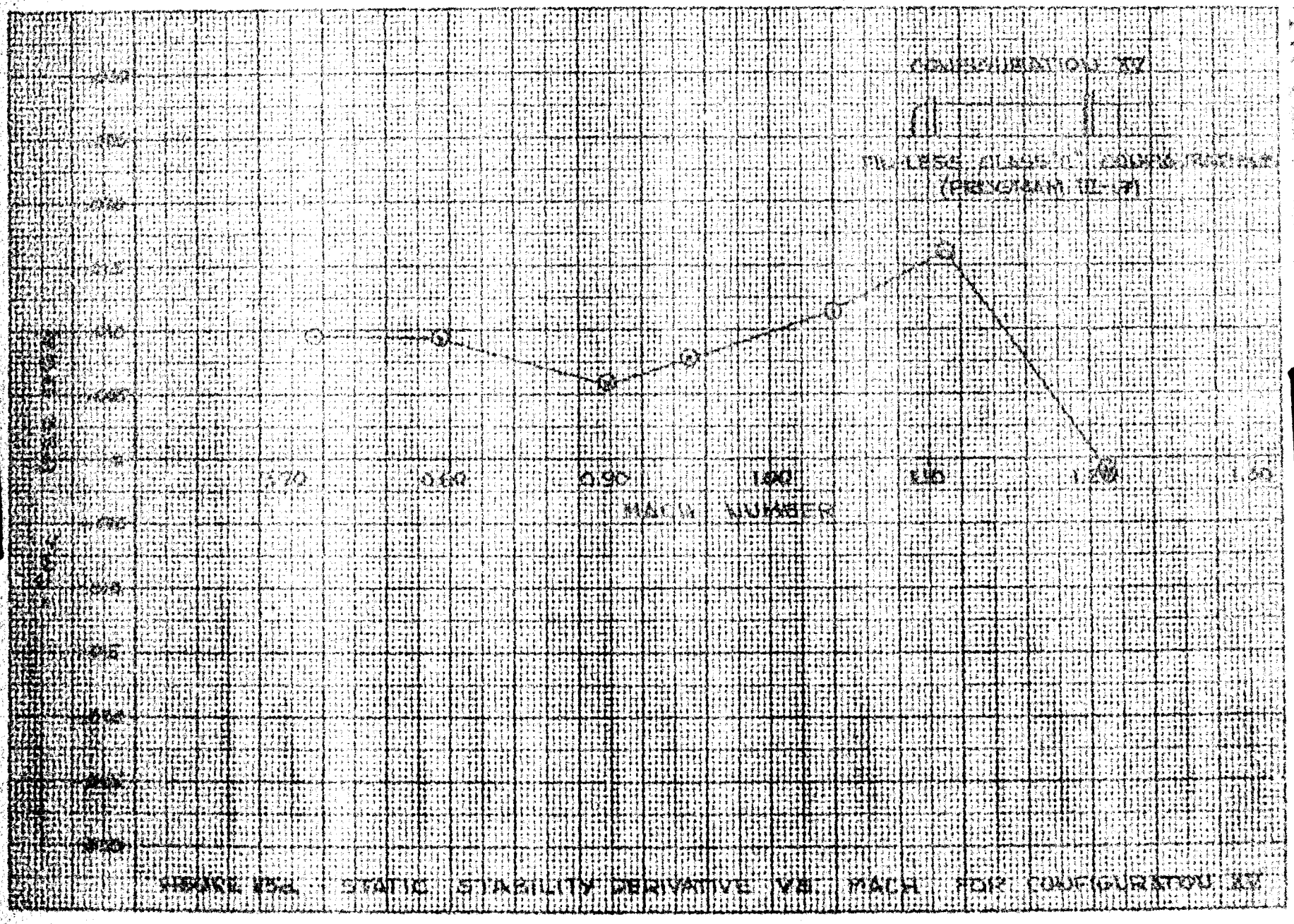

FIGURE 154. STATIC STABILITY DERIVATIVE VS. MACH FOR CONFIGURATION 37

UNCLASSIFIED

UNCLASSIFIED

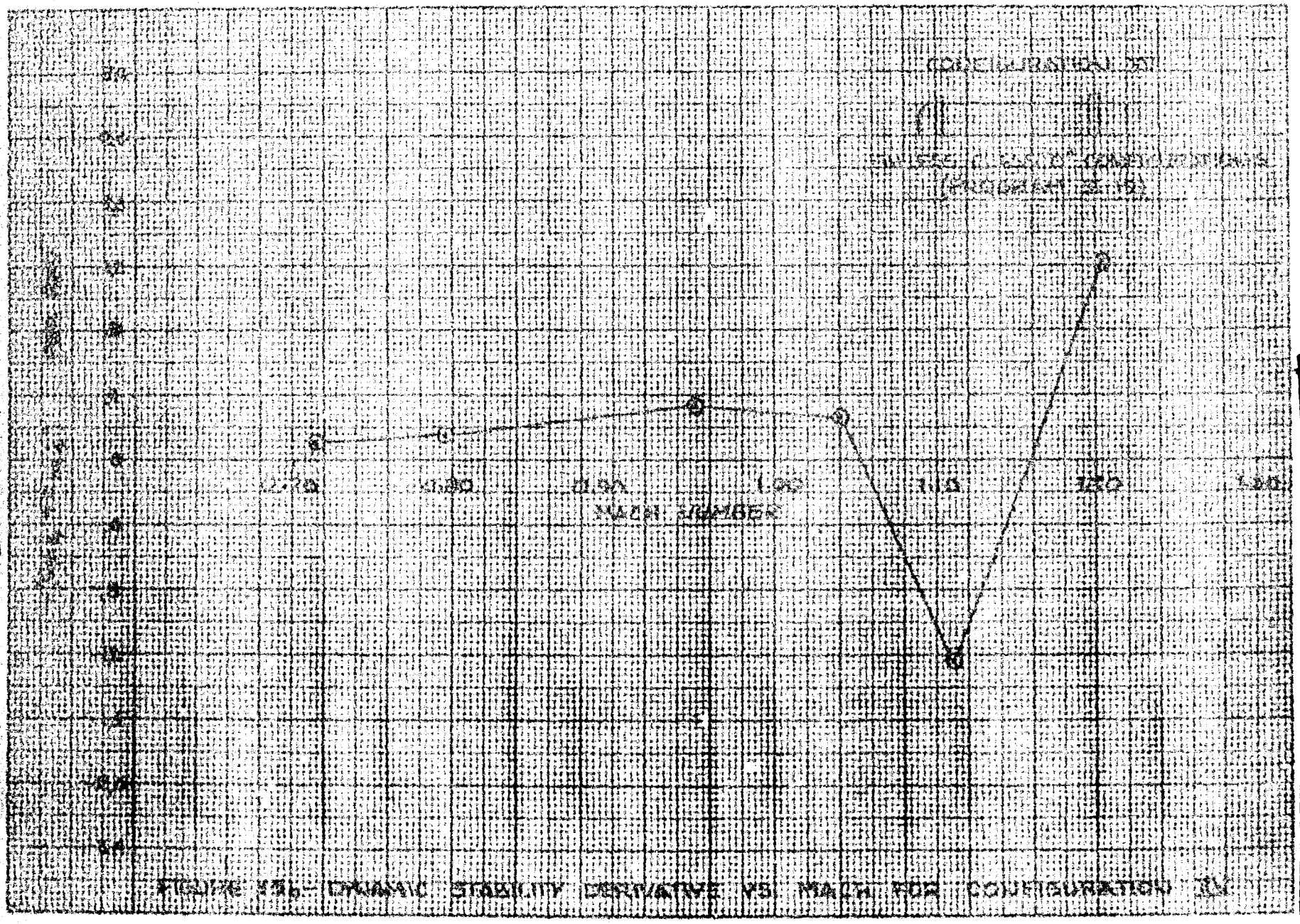

FIGURE 33b - DYNAMIC STABILITY DERIVATIVE VS MACH FOR CONFIGURATION 30

UNCLASSIFIED