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TECHNICAL MEMORANDUM
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WIND-TUNNEL TESTS OF THE STATIC AND DYNAMIC STABILITY CHARACTERISTICS OF FOUR BALLISTIC RE-ENTRY BODIES

By William R. Wehrend, Jr., and David E. Reese, Jr.

Ames Research Center
Moffett Field, Calif.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WASHINGTON June 1960

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TECHNICAL MEMORANDUM X-369

WIND-TUNNEL TESTS OF THE STATIC AND DYNAMIC STABILITY CHARACTERISTICS OF FOUR BALLISTIC RE-ENTRY BODIES*

By William R. Wehrend, Jr., and David E. Reese, Jr.

SUMMARY

The static and dynamic stability characteristics of four ballistic re-entry type configurations were studied. These bodies were a 20° semivertex-angle cone, the same 20° cone with a rounded tip, a paraboloid of revolution, and a truncated cone with a spherical-segment nose. In addition to the four basic nose shapes, tests were conducted of each body with one or more afterbodies.

The Mach number range for the test was from 0.65 to 2.20 and the angle-of-attack range from -4° to +21°. Presented are measurements of the normal force, axial force, and pitching moment from the static tests, and the damping-in-pitch moment from the dynamic tests.

The results of the damping-in-pitch tests were compared with theory. The data for the sharp cone were compared with a combination first- and second-order linear theory, and data for all four configurations were compared with Newtonian impact theory. The agreement between the cone data and the linear theory was good in the high Mach number range. The high Mach number data for the sharp and blunt cone agreed well with impact theory but the paraboloid and truncated cone did not give good agreement.

The results of the damping-in-pitch tests for the models with the afterbodies showed that the addition of the afterbodies caused an unstable shift in the damping curves.

*Title, Unclassified

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INTRODUCTION

One of the problems of designing a shape suitable for ballistic re-entry is that of obtaining sufficiently high drag to minimize heating difficulties without adversely affecting the dynamic stability. One indication of the dynamic stability is the damping in pitch. In addition, it has been shown in reference 1 that the dynamic behavior of a re-entry vehicle is also a function of the static forces and moments. For example, in the case of a very blunt shape, the lift-curve slope may be negative, thus aggravating a condition of low or unstable damping. Consequently, the present investigation of the four ballistic re-entry bodies included a study of both the damping in pitch and the static forces and moments in order to enable as complete an understanding of their dynamic behavior as possible.

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The bodies chosen for the investigation were selected for two reasons: first, for general information on the dynamic stability of some high-drag configurations that might be suitable for a re-entry vehicle, and second, for a comparison with the damping-in-pitch theories of reference 2. In reference 2, two theories to estimate damping in pitch were presented that would apply to some nonslender bodies of revolution. The principal theory was a form of linear theory and this, of course, can only apply to sharp-nosed bodies in the supersonic speed range. The other was Newtonian impact theory which can apply to both pointed and round-nosed bodies. For comparison with the linear theory, data were obtained on a 20° semivertex-angle cone. The remaining bodies were a 20° semivertex-angle cone with a round nose, a paraboloid of revolution, and a truncated cone with a slightly rounded nose. Data for these bodies were compared with impact theory. The Mach number range for the tests was from 0.65 to 2.20.

SYMBOLS

C_A axial-force coefficient, $\dfrac{\text{axial force}}{(1/2)\rho V^2 S}$

C_{A_b} base axial-force coefficient, $\dfrac{\text{base axial force}}{(1/2)\rho V^2 S}$

C_D drag coefficient, $\dfrac{\text{drag force}}{(1/2)\rho V^2 S}$

C_L lift coefficient, $\frac{\text{lift force}}{(1/2)\rho V^2 S}$

C_{L_α} lift-curve slope at zero angle of attack, $\frac{\partial C_L}{\partial \alpha}$, per radian

C_m pitching-moment coefficient, $\frac{\text{pitching moment}}{(1/2)\rho V^2 SD}$

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$C_{m_q} + C_{m_{\dot{\alpha}}}$ damping-in-pitch coefficient, $\frac{\partial C_m}{\partial (qD/V)} + \frac{\partial C_m}{\partial (\dot{\alpha}D/V)}$, per radian

C_{m_α} pitching-moment curve slope at zero angle of attack, $\frac{\partial C_m}{\partial \alpha}$, per radian

C_N normal-force coefficient, $\frac{\text{normal force}}{(1/2)\rho V^2 S}$

C_{N_α} normal-force curve slope at zero angle of attack, $\frac{\partial C_N}{\partial \alpha}$, per radian

D body base diameter

k reduced frequency, $\frac{\omega D}{V}$

l body length

M Mach number

q pitching velocity

R Reynolds number based on D

S base area, $\frac{\pi D^2}{4}$

t	time
V	free-stream velocity
α	angle of attack, deg
$\dot{\alpha}$	variation of angle of attack with time, $\frac{d\alpha}{dt}$, radians/sec
α_n	nominal angle of attack, deg
ρ	air density
σ	radius of gyration
ω	circular frequency of oscillation, radians/sec

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APPARATUS

Wind Tunnel and Balances

The tests were performed in the Ames 6- by 6-Foot Supersonic Wind Tunnel. This wind tunnel is a closed-circuit variable-density type with the floor and ceiling perforated to permit testing at transonic Mach numbers. The Mach number range is from 0.65 to 2.20.

The static forces and moments were measured by means of a conventional six-component strain-gage balance. The models and balance were mounted on a 3-1/4-inch-diameter sting. A typical installation is shown in figure 1(a).

In the damping-in-pitch tests a single-degree-of-freedom forced-oscillation system was used which permits a small amplitude of oscillation. A similar system is described in reference 3. The balance itself is essentially a set of crossed flexures which act as a mechanical spring and also fix the oscillation axis of the model. The model is driven by an electromagnetic shaker and oscillates at a constant amplitude and at the natural frequency of the system. The models were sting-mounted as shown in figure 1(b). The sting is 2 inches in diameter and has a pair of stiffener plates positioned perpendicular to the oscillation axis of the model. The plates are required to minimize sting motion.

Models

The four basic configurations used in this investigation were a 20° semivertex-angle cone, the same cone with a round nose, a paraboloid of revolution, and a 30° semivertex-angle truncated cone with a slightly rounded nose. The nose shapes remained the same for all of the tests, but a series of modifications were made to the flat base of each model. Sketches of the model configurations are shown in figures 2(a) and 2(b).

The base modifications to the 20° cones were spherical segments attached to the model base (see dashed lines in fig. 2(a)). The purpose of the spherical bases was to minimize the effect of the flat base on the damping in pitch and to permit the measurement of the forebody damping. Choosing the radius of the sphere so that its center coincided with the moment center on the body minimized the base effects. In this way the line of action of any pressure forces on the base would pass through the moment center and the resultant base moment would be zero. Tests with these spherical bases were performed only on the dynamic balance.

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The afterbodies tested on the paraboloid and the truncated cone are the conical sections shown by the dashed lines in figure 2(b). Two sizes of conical bases were investigated on the truncated cone, whereas only one size was tested on the paraboloid. Both static and dynamic tests were performed with these afterbodies.

In figures 2(a) and 2(b), it should be noted that there is a cylindrical sleeve on the rear of each model. This sleeve was required to mount the models on the balance because of the short length of the model nose sections and would not normally be a part of a re-entry configuration.

The maximum diameter was the same for all four of the basic nose shapes. This diameter of 6.363 inches gives a wind-tunnel blockage of 0.614 percent in the 6- by 6-Foot Wind Tunnel.

TESTS AND PROCEDURES

The Mach number range for both the static and the dynamic tests was from 0.65 to 2.20. The angle-of-attack range was from -4° to $+21^{\circ}$ for the static tests, and -4° to a maximum of $+18^{\circ}$ for the dynamic tests. The maximum angle of attack for the dynamic tests was sometimes limited to less than 18° because of the model fouling against the sting. The variation of Reynolds number with Mach number is shown in figure 3.

The quantities determined from the static tests were the normal force, axial force, and pitching moment. The base axial force was also measured for the configurations without an afterbody. The axial force presented in the report is the total axial force on the balance with no adjustment of base pressure. It is believed that this total force is a realistic estimate of the actual force on a re-entry vehicle since the base pressures on such a vehicle are not modified by the presence of such factors as a jet exhaust.

The quantity determined from the damping-in-pitch tests was the damping moment from which $C_{m_q} + C_{m_{\dot{\alpha}}}$ was evaluated. Since the balance is a small oscillation device, the damping moments were measured with the model set at some nominal angle of attack and oscillated $\pm 2^{\circ}$ about that position.

The sketches of the models (fig. 2) show two moment centers for each configuration. The moment center used for the reduction of the static data was always taken as the forward position. Damping moments were measured about both moment centers.

During the static tests, the mounting sleeve at the rear of each model was covered by a sleeve attached to the sting. This cover sleeve shielded the mounting sleeve from the wind stream so this part of the model did not affect the force readings. A sketch showing a typical static installation is shown in figure 2(c). The model motion did not permit a similar setup during the dynamic runs so that the mounting sleeve was exposed to the air stream for this part of the test.

Accuracy

An estimate of the accuracy of the data is given as follows:

Static data		Dynamic data	
C_A	±0.010	$C_{m_q} + C_{m_{\dot{\alpha}}}$	±0.04
C_N	±0.004	K	±0.0001
C_m	±0.0005		

The above figure for the damping derivative, $C_{m_q} + C_{m_{\dot{\alpha}}}$, applies only to the sharp and blunt cones, and the paraboloid. The truncated cone buffeted significantly in the wind tunnel so that the data are probably less accurate than indicated by this figure. It was not possible to make a separate accuracy estimate for this body.

RESULTS AND DISCUSSION

The data in this report are presented both in figures and tables. The figures show only the data necessary to describe the general characteristics of the vehicles and all of the data on these figures are for the forward moment center. A complete listing of all the data is given in tables I and II. The data in the tabulation include dynamic data for both moment centers, and damping for any other moment center can be computed by use of the transfer equations of reference 1.

Cones

Typical experimental results obtained for the sharp and blunt cones are presented in figures 4 through 8. Figures 4, 5, and 6 are plots of force and moment coefficients versus angle of attack for representative subsonic, transonic, and supersonic Mach numbers. Summary plots of the data, presented in figures 7 and 8, show that changing from a sharp to a blunt nose had only a small effect on the static and dynamic derivatives. On the other hand, the addition of the spherical base caused an unstable shift in the damping curve. The effect was most pronounced in the subsonic speed range where the models with the spherical bases became unstable.

Figure 7(b) shows a comparison of the damping data for the cones with the theories of reference 2. The theories only consider the effect of the forebody so the comparison should be made with the data for the models with the spherical bases. The linear theory is the result given by the combined first- and second-order linear theory and applies only to the sharp cone. The agreement between theory and experiment is good at the higher Mach numbers of the test. Although poor agreement is indicated at the lower supersonic Mach numbers, the experimental data approach the theoretical curve asymptotically and the theory predicts the trend of decreased damping with increasing Mach number. Figure 7(b) also indicates that Newtonian impact theory provides a satisfactory estimate of the damping at the higher Mach numbers for both the sharp and the blunt cones.

As stated in the introduction, the stability parameter given in reference 1, $(C_D - C_{L_\alpha} + (C_{m_q} + C_{m_{\dot{\alpha}}})(D/\sigma)^2)$, shows that the dynamic stability characteristics of re-entry vehicles depend on the static characteristics as well as on the damping in pitch. If this parameter is positive, the body may have a divergent oscillation. The lift-curve slope, C_{L_α}, is of importance in the parameter since it can be either positive or negative and, if negative, is a destabilizing term. The data for the sharp and the blunt cones, figure 8, show that C_{L_α} is

positive for both bodies and, since the flat-based bodies also have stable damping, they would not encounter any dynamic stability difficulties.

Paraboloid and Truncated Cone

The data for the paraboloid and the truncated cone are shown in figures 9 through 15. Figures 9 and 10 show static coefficients versus angle of attack for representative subsonic, transonic, and supersonic Mach numbers. Figures 11 and 12 are summary curves of zero angle-of-attack values of the static coefficients and show the variation of these coefficients with Mach number for the models with the various afterbodies.

The main effect of adding the afterbodies to both nose shapes was to lower the value of the normal-force curve slope, C_{N_α}, particularly in the lower speed range. The variation of the axial-force coefficient, C_A, was unchanged and the pitching-moment curve slope, C_{m_α}, was made more stable for the truncated cone but was unchanged for the paraboloid. The same general effect was noted in the subsonic investigation of reference 4. Considering the change in plan-form area, it might be expected that the normal force would be increased rather than decreased by adding the afterbodies. A check on the flow conditions as shown by shadowgraph pictures does not show any change in the shock pattern or size of the wake behind the body, so the reasons for the unexpected effects of the conical afterbodies remain unexplained.

The damping-in-pitch data for the paraboloid and truncated cone are given in figures 13 and 14, respectively. All of the afterbody configurations are shown on these plots and the figures include data for all Mach numbers of the investigation. The damping data for the paraboloid are fairly constant through the angle-of-attack range except for the unstable dips that occur at about 4° angle of attack in the supersonic speed range. The damping data for the truncated cone show very erratic variations with angle of attack with both stable and unstable regions indicated at most Mach numbers. For the paraboloid, the addition of the afterbodies caused only minor changes in the damping. On the other hand, the various afterbody configurations for the truncated cone caused large changes in the magnitude of the damping but the same general shape of the curves was retained. In both cases, the models with the afterbodies were generally less stable than the flat-based models.

A theoretical value of the damping-in-pitch coefficient for the paraboloid and the truncated cone can be obtained from Newtonian impact theory. The theory only considers the forces on that part of the body exposed to the air stream and assumes that the forces are zero on any portion of the body in the wake. The values of $C_{m_q} + C_{m_{\dot{\alpha}}}$ computed by this theory are -0.028 for the paraboloid and -0.036 for the truncated

cone. Both of these values are referred to the forward moment center. A comparison of these values with the higher Mach number data of figures 13 and 14 shows that the agreement is only fair for the paraboloid and poor for the truncated cone. One reason for the poor agreement is that the Newtonian theory as presented in reference 1 states that $C_{m_{\dot{\alpha}}}$ is assumed to be zero and the damping in pitch is therefore given by C_{m_q} alone. Since the theory states that C_{m_q} cannot give an unstable value of damping and the data show regions of unstable damping, the theory is simply not adequate for these bodies in this Mach number range.

The erratic behavior of the damping makes it difficult to predict the effect of damping on the dynamic stability parameter of reference 1, but the effect of the static characteristics can be seen. The lift-curve slope, C_{L_α}, for both of these bodies is negative through most of the Mach number range (see fig. 15). Only for the configurations without a tail cone does C_{L_α} become positive, and then for only a portion of the Mach number range. This negative value is an unstable term in the stability parameter and, combined with unstable damping, could cause dynamic stability difficulties for these bodies.

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Results of two previous investigations of the damping in pitch of the paraboloid and the truncated cone are reported in references 4 and 5. One of the investigations was performed at subsonic speeds in the Ames 12-Foot Wind Tunnel while the other was performed in the 8- by 7-foot test section of the Ames Unitary Plan Wind Tunnel in the Mach number range from 2.5 to 3.5. Figure 16 shows a comparison of the data from these two tunnels with the data of the present investigation. It should be noted that the data of the present report have been transferred, by the method of reference 2, to the moment centers used in the other investigations. The subsonic comparison is made for a Mach number of 0.80 since both the 12-Foot and the 6- by 6-Foot Wind Tunnels test at this Mach number. The supersonic comparison was made between data of the 6- by 6-Foot Wind Tunnel at a Mach number of 2.2 and data of the 8- by 7-foot test section at a Mach number of 2.5 because the wind-tunnel Mach number ranges do not overlap. Comparison of the data presented in figure 16 shows that the agreement for the paraboloid is moderately good. A similar comparison for the truncated cone shows the agreement to be poor where the 6- by 6-Foot Wind Tunnel damping results are an order of magnitude larger than the data for the other tunnels. In order to determine why this large difference exists, the effects of differences in the Reynolds number, the reduced frequency, and the model geometry for the three tests were assessed. Also, the operation of the dynamic balance and computing program was checked. None of these checks gave an explanation for the discrepancy.

A final point should be noted as a possible trouble source. In order to make the comparison shown in figure 16, the damping data from the present investigation were transferred to the moment centers used in the

other wind tunnels. The transfer equation used is based on linear aerodynamics and it is possible that this equation is not applicable to nonlinear data as were obtained for the truncated cone. The authors of reference 4 used the same equation on the data for the truncated cone where data for three moment centers were available. They found that they were not able to transfer these data satisfactorily (these results were not published in ref. 4). A similar check was made by the present authors on some unpublished data for a 20° cone (a larger model than the one used in this investigation). In this case the data were reasonably linear and the comparison of transferred and nontransferred data was good. The difficulty thus appears to be only with the nonlinear data, and it may be that the transfer equation is the source of the poor agreement between the results from the 6- by 6-Foot Wind Tunnel and the results from the other wind tunnels.

CONCLUSIONS

The static and dynamic tests of the re-entry models lead to the following conclusions:

1. Changing the sharp tip of the 20° cone to a round tip has only small effects on either the static or the dynamic stability coefficients.

2. The addition of the spherical base to the cones causes a decrease in the damping in pitch.

3. The static tests of the paraboloid and the truncated cone show that the addition of the conical afterbodies causes a decrease in the normal force even though the plan-form area is increased. The lowered normal force is accompanied by a more stable pitching moment for the truncated cone.

4. The addition of the conical afterbodies on the paraboloid and truncated cone causes a less stable value of damping in pitch and indicates that the flat base is stabilizing.

5. The pointed cones have a positive lift-curve slope which contributes stable damping, whereas the paraboloid and the truncated cone have negative values of the lift-curve slope through most of the Mach number range, contributing to unstable damping.

6. The combination first- and second-order linear theory gives a good estimate of the damping in pitch for the cone at the higher Mach numbers but predicts values too low for the lower supersonic speed range.

7. Newtonian impact theory gives a good estimate of the damping in pitch for the sharp and the blunt cones at the higher Mach numbers of the test.

Ames Research Center
National Aeronautics and Space Administration
Moffett Field, Calif., Feb. 19, 1960

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TABLE I.- STATIC STABILITY DATA

(a) Sharp cone; center of moments at 0.778 l

α	C_N	C_A	C_m
M = 0.65			
-00.0	0.011	0.494	-.0059
-01.0	-0.020	0.489	-.0085
-02.0	-0.042	0.490	-.0104
-03.1	-0.064	0.485	-.0111
00.9	0.035	0.491	-.0049
01.9	0.054	0.492	-.0024
02.8	0.075	0.490	-.0006
06.0	0.142	0.484	.0053
09.0	0.209	0.478	.0092
11.9	0.276	0.470	.0162
14.9	0.347	0.456	.0228
17.8	0.414	0.441	.0324
20.8	0.484	0.427	.0443
M = 0.80			
-00.0	0.009	0.541	-.0036
-01.0	-0.020	0.541	-.0056
-02.1	-0.044	0.538	-.0068
-03.0	-0.068	0.536	-.0077
00.9	0.034	0.541	-.0030
01.9	0.055	0.542	-.0007
02.9	0.080	0.539	.0006
05.9	0.151	0.529	.0038
09.0	0.224	0.523	.0081
12.0	0.296	0.512	.0143
14.9	0.372	0.498	.0210
17.9	0.445	0.481	.0306
20.9	0.519	0.464	.0404
M = 0.90			
00.2	0.015	0.622	-.0032
-00.9	-0.015	0.625	-.0051
-01.9	-0.038	0.612	-.0065
-02.9	-0.061	0.618	-.0065
01.1	0.038	0.622	-.0025
02.2	0.062	0.621	-.0010
03.1	0.085	0.618	-.0005
06.1	0.157	0.621	.0020
09.2	0.230	0.618	.0054
12.2	0.306	0.590	.0113
15.1	0.376	0.571	.0189
18.1	0.452	0.558	.0289
21.2	0.529	0.539	.0375
M = 1.00			
00.2	0.017	0.923	-.0030
-00.7	-0.009	0.923	-.0046
-01.7	-0.033	0.924	-.0056
-02.8	-0.056	0.918	-.0058
01.2	0.039	0.914	-.0022
02.3	0.064	0.918	-.0015
03.2	0.085	0.922	-.0009
06.3	0.154	0.921	.0006
09.3	0.224	0.905	.0036
12.2	0.293	0.874	.0088
15.2	0.364	0.844	.0164
18.2	0.437	0.825	.0274
21.2	0.512	0.817	.0349
M = 1.10			
00.2	0.013	0.906	-.0040
-00.7	-0.012	0.904	-.0048
-01.7	-0.033	0.903	-.0056
-02.8	-0.056	0.901	-.0064
01.3	0.033	0.901	-.0020
02.2	0.055	0.904	-.0016
03.2	0.076	0.901	-.0009
06.3	0.141	0.900	.0013
09.3	0.206	0.881	.0036
12.3	0.271	0.853	.0085
15.2	0.340	0.827	.0152
18.3	0.410	0.809	.0248
21.3	0.481	0.804	.0325
M = 1.20			
00.2	0.012	0.894	-.0027
-00.7	-0.013	0.897	-.0050
-01.8	-0.037	0.895	-.0066
-02.8	-0.060	0.893	-.0072
01.2	0.033	0.893	-.0010
02.2	0.057	0.890	-.0001
03.2	0.079	0.891	.0018
06.2	0.149	0.876	.0048
09.3	0.219	0.859	.0101
12.4	0.292	0.842	.0163
15.2	0.359	0.820	.0241
18.2	0.430	0.819	.0305
21.2	0.502	0.810	.0363
M = 1.30			
00.1	0.012	0.849	-.0019
-00.8	-0.013	0.851	-.0031
-01.8	-0.037	0.853	-.0053
-02.8	-0.064	0.851	-.0063
01.1	0.038	0.848	.0002
02.1	0.062	0.849	.0018
03.1	0.089	0.843	.0034
06.2	0.165	0.832	.0077
09.2	0.240	0.825	.0128
12.1	0.316	0.814	.0195
15.2	0.391	0.799	.0253
18.2	0.462	0.793	.0289
21.2	0.535	0.776	.0352
M = 1.50			
00.0	0.010	0.747	-.0040
-00.9	-0.016	0.750	-.0043
-01.9	-0.042	0.749	-.0056
-03.0	-0.071	0.740	-.0060
01.1	0.041	0.747	-.0028
02.0	0.068	0.749	-.0025
03.0	0.097	0.745	-.0011
06.0	0.184	0.737	.0012
09.0	0.268	0.732	.0054
12.1	0.351	0.729	.0126
15.0	0.428	0.731	.0171
18.0	0.505	0.737	.0237
21.1	0.582	0.727	.0320
M = 1.70			
00.0	0.009	0.675	-.0027
-00.9	-0.018	0.675	-.0029
-01.9	-0.043	0.674	-.0040
-03.0	-0.074	0.662	-.0050
01.0	0.040	0.672	-.0017
02.0	0.066	0.671	-.0010
03.0	0.094	0.664	-.0008
06.0	0.179	0.654	.0024
09.0	0.265	0.651	.0045
12.0	0.353	0.647	.0086
15.0	0.439	0.653	.0137
18.0	0.519	0.663	.0185
21.1	0.603	0.664	.0242
M = 1.90			
00.1	0.013	0.622	-.0023
-00.9	-0.016	0.621	-.0024
-01.9	-0.043	0.616	-.0036
-02.9	-0.073	0.607	-.0046
01.1	0.041	0.620	-.0011
02.1	0.070	0.614	-.0002
03.2	0.099	0.606	.0006
06.2	0.182	0.592	.0043
09.1	0.270	0.588	.0073
12.2	0.358	0.585	.0117
15.2	0.445	0.594	.0144
18.1	0.528	0.598	.0191
21.2	0.614	0.606	.0222
M = 2.20			
00.7	0.022	0.538	-.0007
-00.2	-0.005	0.541	-.0017
-01.2	-0.035	0.540	-.0028
-02.2	-0.062	0.536	-.0038
01.8	0.051	0.539	.0001
02.7	0.080	0.538	.0007
03.7	0.107	0.531	.0026
06.8	0.196	0.520	.0057
09.8	0.279	0.516	.0085
12.8	0.365	0.513	.0117
15.8	0.451	0.518	.0154
18.7	0.537	0.533	.0187
21.8	0.623	0.548	.0205

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TABLE I.- STATIC STABILITY DATA - Continued
(b) Blunt cone; center of moments at 0.703 l

α	C_N	C_A	C_m
M = 0.65			
-00.0	0.009	0.494	-.0029
-00.0	0.009	0.494	-.0029
-01.0	-0.014	0.496	-.0039
-02.0	-0.035	0.496	-.0044
-03.0	-0.058	0.492	-.0054
00.9	0.028	0.498	-.0026
01.9	0.052	0.496	-.0016
02.9	0.077	0.495	-.0014
06.0	0.143	0.488	.0008
09.0	0.211	0.482	.0032
12.0	0.281	0.471	.0065
14.9	0.344	0.454	.0100
17.9	0.414	0.440	.0166
20.9	0.483	0.421	.0220
M = 0.80			
-00.0	0.011	0.550	-.0023
-01.0	-0.014	0.548	-.0027
-02.0	-0.037	0.545	-.0037
-03.0	-0.063	0.544	-.0042
01.1	0.037	0.549	-.0025
02.0	0.060	0.547	-.0016
02.9	0.084	0.549	-.0014
06.0	0.156	0.542	-.0008
09.0	0.229	0.530	.0016
12.0	0.305	0.518	.0047
15.0	0.382	0.499	.0101
17.9	0.455	0.482	.0157
20.9	0.529	0.462	.0217
M = 0.90			
00.1	0.015	0.631	-.0032
-00.8	-0.010	0.633	-.0026
-01.8	-0.033	0.627	-.0026
-02.8	-0.059	0.637	-.0030
01.1	0.040	0.641	-.0024
02.1	0.064	0.633	-.0029
03.1	0.089	0.631	-.0021
06.2	0.162	0.624	-.0019
09.2	0.236	0.624	-.0016
12.2	0.315	0.597	.0015
15.2	0.391	0.571	.0080
18.1	0.468	0.557	.0154
21.2	0.544	0.531	.0200
M = 1.00			
00.2	0.019	0.920	-.0020
-00.6	-0.005	0.932	-.0023
-01.7	-0.028	0.929	-.0026
-02.7	-0.052	0.931	-.0025
01.3	0.043	0.929	-.0022
03.3	0.090	0.923	-.0027
06.3	0.162	0.922	-.0037
09.3	0.231	0.902	-.0022
12.4	0.307	0.874	.0023
15.3	0.380	0.845	.0089
18.3	0.457	0.818	.0157
21.3	0.528	0.808	.0184
M = 1.10			
00.3	0.014	0.907	-.0025
-00.7	-0.009	0.906	-.0023
-01.6	-0.031	0.904	-.0021
-02.7	-0.051	0.900	-.0028
01.3	0.036	0.903	-.0021
02.3	0.057	0.904	-.0019
03.3	0.080	0.899	-.0021
06.3	0.145	0.895	-.0031
09.3	0.216	0.877	-.0015
12.3	0.285	0.854	.0025
15.4	0.353	0.829	.0084
18.3	0.425	0.807	.0138
21.3	0.492	0.795	.0168
M = 1.20			
00.2	0.014	0.889	-.0015
-00.6	-0.008	0.890	-.0027
-01.8	-0.032	0.887	-.0038
-02.7	-0.056	0.886	-.0041
01.2	0.038	0.891	-.0007
02.3	0.063	0.878	-.0002
03.2	0.086	0.887	.0005
06.3	0.157	0.877	.0030
09.3	0.231	0.865	.0072
12.2	0.306	0.844	.0128
15.2	0.377	0.825	.0181
18.3	0.449	0.817	.0229
21.3	0.536	0.804	.0231
M = 1.30			
00.1	0.011	0.854	-.0021
-00.8	-0.014	0.854	-.0033
-01.8	-0.037	0.853	-.0048
-02.8	-0.065	0.851	-.0053
01.1	0.036	0.851	-.0003
02.1	0.062	0.851	.0006
03.1	0.087	0.848	.0018
06.2	0.166	0.843	.0044
09.2	0.243	0.834	.0079
12.2	0.321	0.821	.0128
15.2	0.399	0.815	.0159
18.2	0.474	0.811	.0167
21.2	0.555	0.802	.0168
M = 1.50			
00.0	0.005	0.759	-.0038
-01.0	-0.021	0.756	-.0035
-01.9	-0.047	0.757	-.0038
-03.0	-0.075	0.756	-.0039
01.0	0.035	0.758	-.0033
02.0	0.063	0.759	-.0033
03.0	0.093	0.757	-.0029
06.1	0.181	0.757	-.0032
-05.6	-0.275	1.420	.0299
12.1	0.351	0.756	.0005
15.0	0.432	0.761	.0012
18.0	0.510	0.775	.0025
21.1	0.587	0.775	.0042
M = 1.70			
00.0	0.011	0.699	-.0035
-00.9	-0.016	0.698	-.0031
-01.9	-0.043	0.697	-.0027
-02.9	-0.071	0.694	-.0020
01.0	0.039	0.698	-.0044
02.0	0.067	0.696	-.0039
03.0	0.096	0.691	-.0046
06.1	0.180	0.686	-.0054
09.1	0.266	0.685	-.0059
12.0	0.353	0.688	-.0063
15.0	0.436	0.698	-.0062
18.0	0.520	0.712	-.0076
21.1	0.596	0.721	-.0064
M = 1.90			
00.1	0.014	0.657	-.0021
-00.8	-0.015	0.655	-.0014
-01.9	-0.042	0.653	-.0007
-02.9	-0.070	0.647	.0002
01.1	0.040	0.653	-.0026
02.1	0.067	0.650	-.0029
03.1	0.096	0.643	-.0046
06.2	0.179	0.632	-.0058
09.1	0.264	0.629	-.0074
12.2	0.351	0.633	-.0086
15.2	0.436	0.645	-.0092
18.1	0.516	0.656	-.0118
21.1	0.595	0.672	-.0134
M = 2.20			
00.7	0.020	0.582	-.0019
-00.2	-0.005	0.581	-.0009
-01.2	-0.031	0.581	-.0003
-02.3	-0.056	0.578	.0006
01.7	0.048	0.579	-.0029
02.7	0.076	0.576	-.0033
03.7	0.103	0.572	-.0046
06.7	0.186	0.567	-.0076
09.7	0.266	0.564	-.0094
12.8	0.348	0.568	-.0110
15.8	0.430	0.582	-.0140
18.7	0.512	0.598	-.0159
21.7	0.592	0.612	-.0174

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TABLE I.- STATIC STABILITY DATA - Continued

(c) Paraboloid without tail cone; center of moments at 1.226 l

α	C_N	C_A	C_m
M = 0.65			
-00.0	0.009	0.646	-.0030
-01.0	-0.000	0.646	-.0035
-02.0	-0.016	0.646	-.0040
-03.0	-0.031	0.647	-.0033
-04.0	-0.046	0.648	-.0026
00.9	0.021	0.648	-.0032
01.9	0.034	0.650	-.0031
02.9	0.048	0.651	-.0027
04.0	0.064	0.649	-.0032
06.0	0.091	0.651	-.0025
08.9	0.138	0.653	-.0005
12.0	0.185	0.646	.0040
14.9	0.230	0.630	.0093
17.9	0.275	0.601	.0159
20.9	0.320	0.565	.0228
M = 0.80			
-00.0	0.010	0.714	-.0026
-01.0	-0.005	0.708	-.0027
-02.0	-0.021	0.710	-.0029
-03.0	-0.034	0.709	-.0036
-04.0	-0.054	0.712	-.0027
01.0	0.022	0.714	-.0020
02.0	0.038	0.713	-.0026
03.0	0.056	0.716	-.0028
04.0	0.072	0.716	-.0025
05.9	0.101	0.715	-.0021
09.0	0.153	0.729	.0006
11.9	0.203	0.698	.0066
15.0	0.257	0.669	.0125
17.9	0.309	0.637	.0199
20.9	0.358	0.598	.0278
M = 0.90			
00.1	0.014	0.804	-.0027
-00.8	-0.001	0.800	-.0025
-01.8	-0.020	0.809	-.0021
-02.8	-0.031	0.809	-.0019
-03.8	-0.050	0.815	-.0015
01.2	0.029	0.795	-.0023
02.1	0.042	0.797	-.0022
03.1	0.059	0.799	-.0030
04.2	0.073	0.813	-.0026
06.2	0.106	0.821	-.0033
09.1	0.157	0.807	.0009
12.2	0.211	0.782	.0065
15.2	0.265	0.747	.0131
18.1	0.321	0.709	.0215
21.2	0.372	0.678	.0274
M = 1.00			
00.2	0.014	1.089	-.0023
-00.7	-0.002	1.098	-.0018
-01.7	-0.016	1.090	-.0016
-02.8	-0.031	1.093	-.0008
-03.8	-0.044	1.097	-.0005
01.3	0.027	1.093	-.0019
02.3	0.044	1.091	-.0030
03.3	0.059	1.098	-.0037
04.3	0.073	1.109	-.0038
06.3	0.105	1.100	-.0028
09.3	0.155	1.068	.0040
12.3	0.209	1.024	.0098
15.3	0.260	1.011	.0142
18.3	0.309	0.970	.0200
21.3	0.356	0.958	.0251
M = 1.10			
00.3	0.010	1.062	-.0020
-00.7	-0.004	1.062	-.0021
-01.6	-0.020	1.062	-.0004
-02.7	-0.032	1.064	-.0014
-03.6	-0.047	1.072	-.0007
01.3	0.025	1.063	-.0020
02.3	0.039	1.066	-.0025
03.3	0.051	1.068	-.0028
04.3	0.068	1.075	-.0029
06.3	0.098	1.065	-.0020
09.3	0.145	1.041	.0042
12.3	0.193	1.009	.0094
15.3	0.239	0.984	.0140
18.3	0.289	0.958	.0188
21.4	0.333	0.939	.0237
M = 1.20			
00.2	0.011	0.993	-.0023
-00.7	-0.002	0.983	-.0022
-01.7	-0.018	0.977	-.0020
-02.7	-0.031	0.989	-.0014
-03.7	-0.047	1.001	-.0006
01.2	0.023	1.003	-.0012
02.2	0.039	1.023	-.0015
03.2	0.053	1.040	-.0020
04.3	0.069	1.055	-.0026
06.2	0.099	1.053	-.0026
09.2	0.149	1.024	.0030
12.3	0.198	0.996	.0093
15.3	0.246	0.950	.0140
18.2	0.290	0.960	.0201
21.2	0.335	0.955	.0238
M = 1.30			
00.1	0.009	1.117	-.0008
-00.8	-0.005	1.117	-.0016
-01.8	-0.020	1.115	-.0019
-02.8	-0.035	1.117	-.0023
-03.8	-0.052	1.115	-.0023
01.2	0.026	1.116	-.0006
02.1	0.040	1.116	.0002
03.1	0.056	1.116	.0001
04.2	0.073	1.116	-.0003
06.2	0.105	1.106	.0008
09.1	0.153	1.079	.0056
12.2	0.201	1.045	.0110
15.2	0.248	1.013	.0152
18.1	0.292	1.006	.0206
21.1	0.335	0.990	.0236
M = 1.50			
00.0	0.005	1.114	-.0009
-00.9	-0.010	1.113	-.0018
-01.9	-0.029	1.109	-.0029
-02.9	-0.044	1.105	-.0028
-04.0	-0.062	1.099	-.0030
01.0	0.022	1.113	-.0001
02.0	0.040	1.112	.0002
02.9	0.058	1.108	.0006
04.0	0.077	1.105	.0016
06.0	0.110	1.095	.0030
09.0	0.160	1.071	.0070
12.0	0.210	1.042	.0121
15.0	0.257	1.013	.0169
18.0	0.301	1.007	.0206
21.0	0.340	0.993	.0236
M = 1.70			
00.0	0.008	1.083	-.0010
-00.9	-0.006	1.084	-.0018
-01.9	-0.026	1.080	-.0028
-03.0	-0.043	1.073	-.0035
-04.0	-0.060	1.068	-.0040
01.0	0.025	1.082	-.0004
02.0	0.043	1.080	.0004
03.0	0.060	1.078	.0011
04.0	0.081	1.073	.0018
06.0	0.115	1.063	.0038
09.0	0.166	1.043	.0077
12.0	0.215	1.019	.0125
15.0	0.260	0.993	.0167
18.0	0.304	0.989	.0209
21.1	0.345	0.973	.0245
M = 1.90			
00.1	0.007	1.057	-.0008
-00.8	-0.007	1.055	-.0019
-01.8	-0.027	1.052	-.0023
-02.9	-0.045	1.046	-.0027
-03.9	-0.061	1.038	-.0043
01.2	0.026	1.055	.0007
02.1	0.044	1.052	.0012
03.1	0.061	1.044	.0025
04.2	0.082	1.041	.0029
06.1	0.116	1.028	.0059
09.1	0.170	1.011	.0098
12.2	0.222	0.994	.0141
15.1	0.269	0.970	.0177
18.1	0.311	0.963	.0217
21.1	0.349	0.949	.0253
M = 2.20			
00.6	0.015	0.989	.0002
-00.2	-0.001	0.990	-.0010
-01.2	-0.020	0.990	-.0020
-02.3	-0.038	0.987	-.0029
-03.3	-0.054	0.981	-.0042
01.8	0.032	0.989	.0018
02.7	0.051	0.985	.0021
03.7	0.070	0.981	.0031
04.8	0.088	0.978	.0049
06.8	0.125	0.968	.0069
09.7	0.176	0.952	.0107
12.8	0.227	0.937	.0147
15.8	0.275	0.924	.0190
18.7	0.316	0.915	.0223
21.7	0.354	0.907	.0266

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TABLE I.- STATIC STABILITY DATA - Continued

(d) Paraboloid with tail cone; center of moments at 1.226 l

α	C_N	C_A	C_m
M = 0.65			
-00.0	0.006	0.645	-.0023
-01.1	-0.002	0.647	-.0037
-02.0	-0.012	0.645	-.0033
-03.0	-0.024	0.644	-.0032
-04.1	-0.036	0.645	-.0029
00.9	0.015	0.645	-.0030
02.0	0.025	0.646	-.0024
02.9	0.035	0.651	-.0027
04.0	0.045	0.655	-.0021
06.0	0.067	0.659	-.0002
08.9	0.106	0.659	.0016
12.0	0.154	0.651	.0062
14.9	0.198	0.641	.0126
17.9	0.249	0.604	.0182
20.9	0.294	0.567	.0250
M = 0.80			
-00.0	0.006	0.708	-.0025
-01.0	-0.005	0.711	-.0026
-02.0	-0.017	0.710	-.0030
-03.0	-0.030	0.709	-.0028
-04.0	-0.041	0.714	-.0032
01.0	0.018	0.714	-.0018
01.0	0.031	0.708	-.0021
01.9	0.032	0.712	-.0021
02.9	0.041	0.711	-.0020
04.0	0.055	0.715	-.0020
06.0	0.079	0.720	-.0011
08.9	0.126	0.719	.0034
12.0	0.177	0.702	.0080
14.9	0.234	0.674	.0137
17.9	0.289	0.637	.0216
21.0	0.339	0.602	.0288
M = 0.90			
00.1	0.010	0.795	-.0020
-01.7	-0.014	0.806	-.0017
-02.8	-0.026	0.799	-.0017
-03.9	-0.035	0.804	-.0018
01.2	0.022	0.822	-.0020
02.1	0.035	0.798	-.0019
03.1	0.046	0.802	-.0023
04.2	0.056	0.802	-.0026
06.2	0.082	0.824	-.0017
09.1	0.131	0.816	.0022
12.2	0.189	0.783	.0078
15.2	0.247	0.752	.0152
18.1	0.307	0.705	.0213
21.1	0.358	0.682	.0281
M = 1.00			
00.3	0.011	1.087	-.0022
-00.7	-0.003	1.080	-.0020
-01.7	-0.015	1.085	-.0014
-02.7	-0.027	1.089	-.0007
-03.7	-0.036	1.102	-.0003
01.4	0.023	1.086	-.0020
02.3	0.032	1.094	-.0031
03.3	0.042	1.105	-.0039
04.2	0.057	1.109	-.0040
06.3	0.090	1.093	-.0013
09.3	0.141	1.067	.0042
12.3	0.197	1.027	.0105
15.3	0.247	0.985	.0161
18.2	0.297	0.941	.0208
21.2	0.350	0.915	.0255
M = 1.10			
00.3	0.008	1.056	-.0018
-00.7	-0.002	1.057	-.0017
-01.6	-0.015	1.057	-.0015
-02.6	-0.024	1.062	-.0012
-03.7	-0.038	1.068	-.0005
01.4	0.020	1.058	-.0021
02.3	0.031	1.067	-.0027
03.3	0.040	1.073	-.0035
04.3	0.053	1.074	-.0031
06.3	0.084	1.062	-.0012
09.2	0.133	1.038	.0042
12.3	0.184	1.003	.0093
15.4	0.235	0.963	.0144
18.3	0.283	0.931	.0197
21.3	0.329	0.907	.0241
M = 1.20			
00.2	0.007	0.977	-.0017
-00.7	-0.003	0.971	-.0017
-01.7	-0.015	0.971	-.0015
-02.6	-0.027	1.007	-.0005
-03.7	-0.036	1.021	-.0004
01.3	0.020	1.022	-.0013
02.3	0.031	1.043	-.0017
03.2	0.042	1.057	-.0021
04.3	0.055	1.068	-.0021
06.3	0.086	1.062	-.0007
09.3	0.137	1.033	.0039
12.3	0.188	0.962	.0092
15.2	0.239	0.937	.0146
18.2	0.287	0.935	.0196
21.3	0.333	0.945	.0249
M = 1.30			
00.0	0.007	1.117	-.0012
-00.8	-0.005	1.116	-.0015
-01.8	-0.019	1.117	-.0017
-02.9	-0.035	1.114	-.0021
-03.8	-0.047	1.113	-.0020
01.2	0.022	1.117	-.0002
02.1	0.035	1.117	-.0001
03.1	0.049	1.118	-.0000
04.2	0.065	1.116	.0000
06.2	0.096	1.106	.0017
09.1	0.145	1.077	.0059
12.1	0.197	1.041	.0115
15.2	0.242	1.011	.0160
18.1	0.289	0.994	.0208
21.1	0.333	0.981	.0252
M = 1.50			
00.0	0.006	1.117	-.0013
-00.9	-0.010	1.113	-.0024
-01.9	-0.027	1.111	-.0026
-03.0	-0.043	1.106	-.0031
-04.0	-0.062	1.100	-.0035
01.0	0.021	1.114	-.0002
02.0	0.038	1.113	.0005
03.0	0.057	1.109	.0003
04.0	0.073	1.104	.0015
06.0	0.106	1.093	.0028
09.0	0.155	1.069	.0072
12.0	0.205	1.041	.0120
15.0	0.252	1.019	.0168
18.0	0.299	1.003	.0208
21.0	0.340	0.986	.0253
M = 1.70			
00.0	0.008	1.088	-.0016
-00.9	-0.008	1.086	-.0020
-02.0	-0.024	1.083	-.0031
-03.0	-0.042	1.076	-.0039
-04.0	-0.060	1.070	-.0041
01.0	0.024	1.088	-.0006
01.9	0.040	1.084	.0005
03.0	0.057	1.080	.0011
04.0	0.077	1.075	.0017
06.0	0.109	1.062	.0046
09.0	0.161	1.040	.0080
12.0	0.210	1.018	.0124
15.0	0.257	1.001	.0168
17.9	0.303	0.988	.0213
21.0	0.342	0.970	.0253
M = 1.90			
00.1	0.008	1.065	-.0012
-00.8	-0.008	1.060	-.0021
-01.8	-0.025	1.058	-.0032
-02.9	-0.044	1.049	-.0039
-03.9	-0.059	1.041	-.0046
01.1	0.025	1.060	-.0001
02.1	0.043	1.056	.0004
03.1	0.060	1.051	.0022
04.2	0.082	1.042	.0028
06.2	0.116	1.030	.0051
09.2	0.171	1.012	.0093
12.2	0.222	0.995	.0134
15.1	0.268	0.979	.0175
18.2	0.312	0.968	.0220
21.1	0.351	0.950	.0255
M = 2.20			
00.7	0.014	0.993	.0001
-00.2	-0.003	0.996	-.0013
-01.3	-0.020	0.993	-.0028
-02.3	-0.038	0.989	-.0037
-03.3	-0.056	0.984	-.0045
01.7	0.032	0.993	.0010
02.8	0.053	0.987	.0017
03.7	0.069	0.983	.0029
04.8	0.091	0.977	.0038
06.8	0.122	0.964	.0063
09.7	0.174	0.953	.0104
12.8	0.226	0.938	.0146
15.8	0.273	0.929	.0186
18.7	0.317	0.921	.0231
21.8	0.356	0.908	.0268

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TABLE I.- STATIC STABILITY DATA - Continued

(e) Truncated cone without tail cone; center of moments at 1.982 l

α	C_N	C_A	C_m
M = 0.65			
-00.0	0.004	0.698	-.0016
-01.1	-0.008	0.698	-.0015
-01.9	-0.022	0.701	-.0006
-02.9	-0.032	0.696	-.0012
-04.0	-0.046	0.693	-.0003
01.0	0.013	0.700	-.0011
01.9	0.025	0.696	-.0012
02.9	0.038	0.700	-.0022
03.9	0.051	0.699	-.0020
06.0	0.077	0.702	-.0017
08.9	0.116	0.704	.0013
11.9	0.164	0.694	.0073
12.0	0.164	0.694	.0073
14.9	0.212	0.675	.0132
18.0	0.255	0.649	.0208
20.9	0.275	0.650	.0230
M = 0.80			
-00.0	0.002	0.774	-.0005
-01.1	-0.011	0.771	-.0020
-02.0	-0.024	0.770	-.0019
-03.0	-0.038	0.764	-.0026
-04.0	-0.051	0.766	-.0024
00.9	0.018	0.774	-.0011
02.0	0.034	0.765	-.0008
02.9	0.045	0.771	-.0003
04.0	0.061	0.769	.0001
06.0	0.091	0.770	.0014
08.9	0.142	0.760	.0085
11.9	0.199	0.738	.0159
15.0	0.236	0.734	.0206
18.0	0.250	0.743	.0220
21.0	0.261	0.753	.0238
M = 0.90			
00.2	0.009	0.852	-.0007
-00.8	-0.006	0.856	-.0011
-01.8	-0.020	0.852	-.0015
-02.8	-0.034	0.848	-.0017
-03.8	-0.049	0.851	-.0022
01.1	0.023	0.854	-.0003
02.1	0.037	0.847	-.0000
03.1	0.051	0.856	.0003
04.2	0.068	0.848	.0011
06.1	0.102	0.859	.0029
09.1	0.158	0.842	.0106
12.1	0.217	0.829	.0195
15.1	0.250	0.802	.0245
18.1	0.266	0.804	.0273
21.1	0.291	0.818	.0317
M = 1.00			
00.2	0.009	1.133	-.0004
-00.7	-0.004	1.134	-.0014
-01.7	-0.019	1.129	-.0013
-02.8	-0.034	1.134	-.0021
-03.8	-0.046	1.133	-.0022
01.2	0.023	1.139	.0000
02.3	0.037	1.137	.0006
03.3	0.052	1.142	.0007
04.2	0.068	1.145	.0002
06.2	0.101	1.139	.0030
09.3	0.162	1.104	.0125
12.3	0.219	1.065	.0246
15.3	0.281	1.040	.0350
18.2	0.320	1.021	.0407
21.3	0.357	1.001	.0460
M = 1.10			
00.3	0.007	1.107	-.0006
-00.7	-0.007	1.107	-.0012
-01.6	-0.020	1.107	-.0018
-02.6	-0.033	1.101	-.0022
-03.7	-0.048	1.100	-.0024
01.3	0.022	1.104	-.0005
02.3	0.034	1.104	.0005
03.3	0.050	1.110	.0002
04.4	0.064	1.112	.0010
06.4	0.095	1.105	.0036
09.2	0.149	1.076	.0118
12.3	0.205	1.038	.0232
15.3	0.259	1.017	.0328
18.2	0.297	0.999	.0378
M = 1.20			
00.2	0.007	0.992	-.0006
-00.7	-0.008	0.987	-.0015
-01.7	-0.022	0.980	-.0022
-02.7	-0.036	0.979	-.0029
-03.7	-0.051	0.991	-.0033
01.2	0.024	1.007	.0007
02.2	0.037	1.023	.0013
03.3	0.053	1.038	.0024
04.2	0.069	1.051	.0025
06.2	0.104	1.046	.0071
09.3	0.160	1.042	.0152
12.2	0.217	1.022	.0267
15.3	0.261	1.000	.0326
18.2	0.296	0.978	.0370
21.3	0.325	0.933	.0411
M = 1.30			
00.2	0.008	1.165	-.0003
-00.8	-0.009	1.164	-.0017
-01.8	-0.024	1.161	-.0039
-02.8	-0.042	1.157	-.0054
-03.8	-0.060	1.152	-.0074
01.1	0.026	1.160	.0018
02.1	0.041	1.157	.0034
03.1	0.058	1.155	.0049
04.3	0.080	1.151	.0082
06.2	0.114	1.140	.0116
09.1	0.172	1.117	.0214
12.2	0.218	1.092	.0265
15.1	0.256	1.074	.0321
18.2	0.290	1.059	.0364
21.1	0.319	1.040	.0399
M = 1.50			
00.0	0.005	1.161	-.0009
-00.9	-0.016	1.160	-.0036
-01.9	-0.040	1.157	-.0073
-03.0	-0.061	1.153	-.0094
-04.0	-0.081	1.150	-.0120
01.1	0.030	1.161	.0032
02.0	0.050	1.157	.0057
03.0	0.072	1.154	.0087
04.0	0.095	1.151	.0111
06.1	0.131	1.145	.0155
09.0	0.176	1.127	.0191
12.0	0.218	1.109	.0248
15.0	0.254	1.094	.0306
18.0	0.283	1.081	.0353
21.0	0.310	1.066	.0382
M = 1.70			
00.0	0.005	1.120	-.0003
-00.9	-0.018	1.121	-.0027
-01.9	-0.039	1.121	-.0047
-03.0	-0.061	1.119	-.0068
-04.0	-0.078	1.117	-.0088
01.0	0.029	1.120	.0011
02.0	0.051	1.119	.0033
03.0	0.071	1.119	.0058
04.0	0.093	1.120	.0079
06.0	0.128	1.118	.0121
09.0	0.172	1.113	.0185
12.0	0.213	1.104	.0244
15.0	0.245	1.096	.0289
18.0	0.275	1.085	.0329
21.0	0.301	1.101	.0364
M = 1.90			
00.1	0.005	1.109	-.0005
-00.9	-0.012	1.107	-.0023
-01.9	-0.031	1.106	-.0037
-02.9	-0.049	1.104	-.0050
-03.9	-0.067	1.103	-.0063
01.1	0.025	1.107	.0006
02.1	0.044	1.108	.0027
03.1	0.062	1.108	.0041
04.2	0.083	1.108	.0060
06.1	0.118	1.106	.0105
09.1	0.167	1.105	.0178
12.2	0.210	1.107	.0239
15.1	0.242	1.099	.0283
18.2	0.271	1.088	.0327
21.1	0.295	1.083	.0357
M = 2.20			
00.8	0.012	1.082	.0006
-00.2	-0.003	1.080	-.0005
-01.2	-0.018	1.081	-.0017
-02.3	-0.035	1.080	-.0032
-03.3	-0.050	1.077	-.0044
01.7	0.027	1.081	.0018
02.7	0.045	1.080	.0027
03.6	0.059	1.078	.0044
04.7	0.077	1.074	.0055
06.7	0.108	1.072	.0097
09.6	0.156	1.072	.0157
12.8	0.199	1.080	.0214
15.7	0.233	1.081	.0273
18.7	0.263	1.082	.0310
21.7	0.290	1.080	.0342

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TABLE I.- STATIC STABILITY DATA - Continued

(f) Truncated cone with small tail cone; center of moments at 1.982 l

α	C_N	C_A	C_m
M = 0.65			
-00.0	0.005	0.702	-.0025
-01.0	-0.003	0.707	-.0005
-02.0	-0.010	0.705	.0005
-03.0	-0.019	0.704	.0012
-04.0	-0.027	0.707	.0019
01.0	0.013	0.706	-.0034
01.9	0.019	0.706	-.0045
02.9	0.028	0.710	-.0063
04.0	0.038	0.713	-.0068
06.0	0.061	0.719	-.0084
08.9	0.100	0.720	-.0059
11.9	0.147	0.713	-.0009
14.9	0.195	0.687	.0058
17.9	0.241	0.662	.0119
20.9	0.251	0.686	.0124
M = 0.80			
-00.0	0.006	0.770	-.0024
-01.0	-0.005	0.766	-.0018
-02.0	-0.016	0.767	-.0011
-03.0	-0.025	0.769	-.0002
-04.0	-0.038	0.774	-.0001
01.1	0.019	0.767	-.0027
01.9	0.028	0.778	-.0035
03.0	0.038	0.778	-.0043
04.0	0.048	0.777	-.0051
06.0	0.076	0.783	-.0036
09.0	0.127	0.777	.0023
11.9	0.186	0.755	.0096
15.0	0.222	0.746	.0145
17.9	0.240	0.755	.0160
20.9	0.250	0.765	.0168
M = 0.90			
00.0	0.008	0.861	-.0017
-00.8	-0.001	0.856	-.0017
-01.8	-0.013	0.863	-.0008
-02.8	-0.022	0.866	-.0002
-03.8	-0.033	0.870	.0015
01.2	0.019	0.871	-.0027
02.1	0.030	0.859	-.0029
03.1	0.041	0.857	-.0047
04.2	0.053	0.876	-.0047
06.2	0.084	0.881	-.0021
09.1	0.143	0.869	.0058
12.2	0.206	0.855	.0157
15.2	0.242	0.835	.0200
18.1	0.261	0.812	.0226
21.1	0.282	0.810	.0257
M = 1.00			
00.2	0.008	1.131	-.0019
-00.7	-0.001	1.138	-.0022
-01.7	-0.014	1.130	-.0012
-02.7	-0.024	1.146	-.0003
-03.8	-0.035	1.135	.0005
01.3	0.020	1.140	-.0032
02.3	0.030	1.136	-.0049
03.3	0.042	1.151	-.0054
04.3	0.057	1.150	-.0039
06.2	0.091	1.138	.0001
09.2	0.151	1.110	.0092
12.2	0.214	1.057	.0213
15.3	0.276	1.041	.0319
18.3	0.319	1.024	.0378
21.2	0.355	1.002	.0422
M = 1.10			
00.3	0.006	1.101	-.0021
-00.7	-0.003	1.100	-.0018
-01.7	-0.016	1.101	-.0016
-02.7	-0.026	1.106	-.0003
-03.6	-0.035	1.110	-.0001
01.2	0.018	1.104	-.0025
02.3	0.027	1.110	-.0034
03.3	0.038	1.114	-.0039
04.3	0.052	1.112	-.0033
06.3	0.086	1.099	.0009
09.3	0.140	1.067	.0090
12.3	0.199	1.034	.0204
15.4	0.255	1.026	.0300
18.3	0.298	0.998	.0353
21.3	0.333	1.017	.0385
M = 1.20			
00.2	0.007	0.984	-.0017
-00.7	-0.006	0.987	-.0018
-01.7	-0.017	0.996	-.0019
-02.7	-0.027	1.011	-.0013
-03.7	-0.038	1.031	-.0008
01.2	0.019	1.018	-.0009
02.2	0.030	1.041	-.0018
03.2	0.042	1.058	-.0027
04.3	0.060	1.073	-.0024
06.3	0.094	1.061	.0019
09.2	0.151	1.042	.0110
12.3	0.213	0.988	.0230
15.3	0.257	0.982	.0299
18.2	0.294	0.976	.0348
21.2	0.325	1.023	.0374
M = 1.30			
00.1	0.008	1.164	-.0009
-00.8	-0.008	1.164	-.0027
-01.8	-0.021	1.162	-.0044
-02.8	-0.037	1.159	-.0051
-03.9	-0.053	1.158	-.0068
01.2	0.023	1.163	.0006
02.1	0.040	1.161	.0013
03.1	0.054	1.161	.0028
04.2	0.073	1.159	.0057
06.2	0.105	1.145	.0079
09.1	0.168	1.117	.0188
12.2	0.214	1.091	.0230
15.2	0.256	1.072	.0290
18.1	0.289	1.059	.0339
21.1	0.319	1.041	.0369
M = 1.50			
00.0	0.006	1.166	-.0013
-00.8	-0.013	1.164	-.0047
-02.0	-0.037	1.159	-.0074
-03.0	-0.059	1.155	-.0097
-04.0	-0.077	1.152	-.0122
01.1	0.030	1.163	.0020
02.0	0.050	1.161	.0044
02.9	0.071	1.156	.0071
04.0	0.091	1.152	.0096
06.0	0.126	1.141	.0124
09.1	0.172	1.123	.0160
12.0	0.214	1.106	.0232
15.0	0.252	1.091	.0283
18.0	0.284	1.081	.0318
20.9	0.309	1.066	.0351
M = 1.70			
00.0	0.005	1.126	-.0021
-00.9	-0.015	1.127	-.0039
-01.9	-0.038	1.125	-.0056
-03.0	-0.057	1.121	-.0073
-04.0	-0.075	1.118	-.0087
01.0	0.026	1.122	.0004
02.0	0.048	1.121	.0019
03.0	0.068	1.119	.0043
04.1	0.090	1.118	.0060
06.0	0.123	1.115	.0107
09.0	0.169	1.110	.0167
12.0	0.209	1.102	.0221
15.0	0.243	1.095	.0271
18.0	0.274	1.085	.0309
21.0	0.298	1.100	.0329
M = 1.90			
00.1	0.005	1.111	-.0011
-00.8	-0.008	1.109	-.0029
-01.8	-0.027	1.107	-.0036
-02.9	-0.044	1.103	-.0053
-03.9	-0.064	1.102	-.0063
01.1	0.022	1.111	-.0000
02.1	0.040	1.109	.0012
03.1	0.059	1.107	.0027
04.2	0.080	1.106	.0045
06.1	0.116	1.103	.0090
09.2	0.166	1.105	.0162
12.1	0.207	1.107	.0210
15.1	0.240	1.102	.0264
18.1	0.270	1.094	.0297
21.1	0.294	1.097	.0314
M = 2.20			
00.7	0.011	1.081	-.0004
-00.2	-0.002	1.077	-.0011
-01.3	-0.015	1.078	-.0028
-02.3	-0.031	1.074	-.0042
-03.2	-0.044	1.070	-.0048
01.7	0.026	1.079	.0008
02.7	0.040	1.076	.0017
03.7	0.058	1.071	.0025
04.8	0.075	1.069	.0048
06.7	0.106	1.066	.0088
09.8	0.156	1.071	.0140
12.7	0.195	1.074	.0195
15.7	0.232	1.076	.0239
18.7	0.262	1.074	.0277
21.7	0.285	1.072	.0304

TABLE I.- STATIC STABILITY DATA - Concluded

(g) Truncated cone with large tail cone; center of moments at 1.982 l

α	C_N	C_A	C_m
M = 0.65			
-00.0	0.006	0.713	-.0011
-01.0	0.005	0.712	.0010
-01.9	0.003	0.714	.0028
-03.0	-0.000	0.718	.0045
-04.0	-0.009	0.724	.0051
00.9	0.010	0.719	-.0039
01.9	0.012	0.722	-.0060
02.9	0.018	0.725	-.0083
04.0	0.024	0.730	-.0085
05.9	0.045	0.738	-.0097
09.0	0.084	0.739	-.0067
12.0	0.133	0.729	-.0021
14.9	0.181	0.707	.0043
17.9	0.233	0.681	.0077
20.9	0.246	0.700	.0069
M = 0.80			
-00.0	0.005	0.780	-.0017
-01.0	-0.001	0.776	-.0002
-02.0	-0.007	0.780	.0012
-03.0	-0.015	0.785	.0024
-04.0	-0.022	0.788	.0018
01.0	0.012	0.782	-.0022
02.0	0.019	0.785	-.0045
02.9	0.026	0.791	-.0050
04.0	0.036	0.797	-.0058
06.0	0.065	0.806	-.0043
09.0	0.119	0.798	.0016
12.0	0.176	0.775	.0077
15.0	0.219	0.768	.0119
17.9	0.236	0.779	.0130
20.9	0.246	0.790	.0126
M = 0.90			
00.1	0.008	0.846	-.0009
-00.8	0.001	0.854	.0002
-01.8	-0.006	0.870	.0020
-02.8	-0.010	0.881	.0026
-03.8	-0.020	0.886	.0030
01.2	0.015	0.869	-.0033
02.1	0.020	0.870	-.0041
03.2	0.030	0.882	-.0061
04.2	0.042	0.902	-.0063
06.2	0.072	0.904	-.0024
09.1	0.133	0.898	.0051
12.1	0.198	0.852	.0141
15.2	0.238	0.843	.0181
18.2	0.258	0.834	.0203
21.1	0.272	0.849	.0200
M = 1.00			
00.3	0.009	1.138	-.0025
-00.7	0.001	1.137	-.0013
-01.7	-0.008	1.133	.0005
-02.8	-0.013	1.147	.0023
-03.7	-0.021	1.146	.0029
01.3	0.011	1.144	-.0034
02.3	0.019	1.143	-.0048
03.2	0.032	1.151	-.0053
04.3	0.047	1.153	-.0033
06.3	0.082	1.136	.0017
09.2	0.144	1.108	.0104
12.3	0.212	1.059	.0215
15.3	0.276	1.036	.0311
18.4	0.322	1.016	.0359
21.3	0.360	1.035	.0388
M = 1.10			
00.3	0.004	1.102	-.0005
-00.7	-0.003	1.103	-.0005
-01.6	-0.007	1.106	-.0000
-02.7	-0.014	1.110	.0012
-03.7	-0.023	1.112	.0013
01.3	0.013	1.106	-.0028
02.2	0.019	1.110	-.0037
03.3	0.028	1.116	-.0034
04.4	0.044	1.114	-.0024
06.4	0.079	1.103	.0020
09.3	0.133	1.075	.0102
12.3	0.196	1.032	.0204
15.3	0.255	1.009	.0287
18.3	0.302	0.992	.0330
21.3	0.334	1.011	.0354
M = 1.20			
00.2	0.008	0.977	-.0003
-00.7	-0.002	0.993	-.0004
-01.6	-0.009	1.003	-.0004
-02.7	-0.018	1.021	.0015
-03.7	-0.025	1.035	.0014
01.3	0.016	1.021	-.0014
02.2	0.021	1.052	-.0030
03.2	0.030	1.068	-.0037
04.3	0.045	1.076	-.0029
06.3	0.083	1.070	.0020
09.2	0.142	1.045	.0118
12.3	0.209	0.986	.0223
15.2	0.256	0.972	.0285
18.2	0.296	0.974	.0324
21.2	0.325	1.028	.0343
M = 1.30			
00.1	0.009	1.173	-.0008
-00.8	-0.005	1.174	-.0015
-01.8	-0.017	1.169	-.0031
-02.9	-0.033	1.166	-.0044
-03.8	-0.051	1.165	-.0065
01.1	0.021	1.171	.0008
02.1	0.035	1.169	.0022
03.1	0.053	1.169	.0043
04.1	0.072	1.163	.0070
06.2	0.098	1.141	.0086
09.1	0.166	1.110	.0177
12.1	0.211	1.086	.0225
15.2	0.254	1.068	.0280
18.1	0.291	1.054	.0321
21.1	0.317	1.086	.0336
M = 1.50			
00.0	0.005	1.170	-.0008
-00.9	-0.013	1.169	-.0037
-01.9	-0.033	1.163	-.0060
-02.9	-0.053	1.155	-.0085
-04.0	-0.072	1.151	-.0110
01.1	0.026	1.163	.0018
02.0	0.045	1.158	.0046
02.9	0.067	1.153	.0069
04.0	0.089	1.148	.0096
06.0	0.124	1.133	.0124
09.1	0.167	1.115	.0169
12.0	0.213	1.098	.0223
15.0	0.251	1.088	.0274
18.0	0.284	1.079	.0302
21.0	0.308	1.104	.0321
M = 1.70			
-00.0	0.003	1.119	-.0012
-01.0	-0.018	1.119	-.0033
-01.9	-0.035	1.121	-.0045
-02.9	-0.052	1.115	-.0059
-03.9	-0.069	1.111	-.0077
01.0	0.025	1.118	.0008
02.0	0.045	1.116	.0026
03.0	0.066	1.113	.0045
04.0	0.084	1.111	.0065
06.0	0.119	1.107	.0110
09.0	0.167	1.102	.0167
12.0	0.208	1.096	.0218
15.1	0.244	1.095	.0252
18.0	0.274	1.087	.0281
21.0	0.300	1.097	.0300
M = 1.90			
00.1	0.006	1.099	-.0002
-00.8	-0.009	1.098	-.0017
-01.8	-0.025	1.099	-.0026
-02.8	-0.040	1.095	-.0040
-03.9	-0.059	1.094	-.0055
01.1	0.022	1.100	.0005
02.1	0.038	1.095	.0014
03.1	0.057	1.095	.0029
04.2	0.078	1.094	.0052
06.2	0.115	1.094	.0084
09.1	0.162	1.094	.0153
12.1	0.204	1.101	.0210
15.1	0.241	1.100	.0243
18.1	0.269	1.089	.0272
21.1	0.295	1.091	.0288
M = 2.20			
00.7	0.012	1.067	-.0003
-00.2	-0.000	1.067	-.0008
-01.2	-0.013	1.067	-.0015
-02.3	-0.026	1.065	-.0024
-03.3	-0.042	1.062	-.0038
01.7	0.024	1.065	.0011
02.7	0.037	1.064	.0018
03.7	0.053	1.062	.0031
04.7	0.071	1.062	.0046
06.7	0.102	1.063	.0086
09.7	0.150	1.065	.0127
12.7	0.194	1.065	.0177
15.7	0.229	1.072	.0223
18.7	0.261	1.066	.0255
21.7	0.289	1.061	.0268

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$k = \frac{\omega D}{V}$

TABLE II.- DAMPING-IN-PITCH DATA

(a) Sharp cone; center of moments at 0.778 l

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 0.65		
-00.1	-0.37	.0569
-01.2	-0.32	.0569
-03.2	-0.35	.0571
00.8	-0.31	.0571
02.9	-0.36	.0570
06.0	-0.40	.0570
09.1	-0.34	.0573
12.3	-0.35	.0572
M = 0.80		
-00.1	-0.38	.0468
-01.1	-0.38	.0467
-03.2	-0.43	.0466
00.8	-0.36	.0467
02.9	-0.41	.0467
06.1	-0.35	.0468
09.2	-0.36	.0467
12.3	-0.41	.0468
15.5	-0.42	.0469
M = 0.90		
-00.1	-0.48	.0415
-01.1	-0.48	.0416
-03.1	-0.51	.0416
01.0	-0.47	.0417
02.9	-0.55	.0415
06.1	-0.52	.0417
09.2	-0.62	.0416
12.3	-0.71	.0416
15.4	-0.63	.0418
M = 1.00		
-00.2	-0.55	.0380
-01.1	-0.54	.0381
-03.1	-0.54	.0380
00.8	-0.52	.0380
02.9	-0.58	.0380
06.0	-0.58	.0379
09.2	-0.79	.0379
12.3	-0.84	.0381
15.4	-0.85	.0384
M = 1.10		
-00.1	-0.59	.0349
-01.1	-0.59	.0349
-03.1	-0.57	.0349
00.8	0.61	.0350
02.9	-0.57	.0349
06.0	-0.66	.0349
09.1	-0.79	.0349
12.3	-0.88	.0350
15.4	-0.82	.0355
M = 1.20		
-00.0	-0.66	.0321
-01.1	-0.59	.0320
-03.2	-0.68	.0321
00.6	-0.62	.0321
03.0	-0.69	.0321
06.3	-0.75	.0323
09.4	-0.56	.0326
12.6	-0.44	.0330
M = 1.30		
-00.1	-0.70	.0303
-01.1	-0.64	.0302
-03.2	-0.75	.0302
00.9	-0.59	.0304
03.0	-0.73	.0304
06.2	-0.62	.0305
09.4	-0.43	.0307
12.4	-0.39	.0309
M = 1.50		
-00.1	-0.50	.0278
-01.0	-0.51	.0278
-03.2	-0.66	.0278
00.9	-0.54	.0277
02.8	-0.68	.0277
05.9	-0.39	.0280
09.1	-0.43	.0280
12.1	-0.41	.0279
15.3	-0.50	.0278
18.3	-0.51	.0278
M = 1.70		
-00.1	-0.39	.0258
-01.1	-0.44	.0258
-03.0	-0.61	.0258
00.9	-0.46	.0258
02.9	-0.59	.0258
06.0	-0.53	.0259
09.0	-0.39	.0260
12.0	-0.42	.0260
15.1	-0.34	.0260
18.0	-0.40	.0258
M = 1.90		
-00.1	-0.42	.0242
-01.1	-0.35	.0242
-03.0	-0.45	.0242
00.9	-0.45	.0242
02.9	-0.59	.0241
05.9	-0.68	.0242
09.0	-0.40	.0242
12.0	-0.42	.0243
15.0	-0.37	.0243
17.8	-0.38	.0243
M = 2.20		
-00.0	-0.32	.0227
-01.0	-0.39	.0226
-02.0	-0.39	.0226
00.9	-0.39	.0225
02.9	-0.49	.0225
05.9	-0.48	.0225
09.0	-0.69	.0225
11.9	-0.36	.0225
15.0	-0.27	.0226
17.9	-0.44	.0226

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TABLE II.- DAMPING-IN-PITCH DATA - Continued
(b) Sharp cone; center of moments at 0.892 l

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 0.65		
-00.4	-0.37	.0484
-02.7	-0.33	.0484
-06.1	-0.39	.0483
-09.6	-0.46	.0484
-12.9	-0.45	.0485
-00.4	-0.26	.0491
-00.4	-0.17	.0490
-00.4	-0.25	.0491
M = 0.80		
-00.5	-0.37	.0393
-02.8	-0.35	.0391
-06.4	-0.43	.0391
-10.0	-0.49	.0392
-13.5	-0.54	.0392
-00.4	-0.32	.0393
M = 0.90		
-00.3	-0.36	.0349
-02.7	-0.42	.0347
-06.5	-0.60	.0345
-10.1	-0.63	.0345
-13.7	-0.66	.0347
M = 1.00		
-00.3	-0.39	.0319
-02.7	-0.43	.0317
-06.4	-0.58	.0316
-10.2	-0.77	.0315
M = 1.10		
-00.5	-0.39	.0295
-02.8	-0.45	.0293
-06.5	-0.53	.0291
-10.2	-0.86	.0290
-08.3	-0.61	.0290
M = 1.20		
-00.3	-0.56	.0268
-02.9	-0.56	.0267
-06.7	-0.84	.0265
-10.7	-0.90	.0268
-04.2	-0.66	.0265
M = 1.30		
-00.3	-0.76	.0252
-01.9	-0.83	.0250
-07.0	-0.69	.0252
-10.7	-0.45	.0256
-03.0	-0.85	.0250
-01.6	-0.75	.0250
M = 1.50		
-00.4	-0.53	.0232
-03.0	-0.74	.0230
-06.7	-0.48	.0230
-10.6	-0.43	.0231
-04.8	-0.71	.0229
-01.7	-0.61	.0231
M = 1.70		
-00.4	-0.52	.0219
-02.8	-0.52	.0218
-06.4	-0.85	.0217
-10.0	-0.52	.0218
-13.5	-0.36	.0219
-08.1	-0.71	.0217
-04.5	-0.74	.0216
M = 1.90		
-00.3	-0.39	.0211
-02.6	-0.47	.0210
-06.1	-0.62	.0209
-09.6	-0.82	.0208
-12.9	-0.49	.0208
-11.2	-0.72	.0208
M = 2.20		
-01.5	-0.51	.0195
-01.5	-0.50	.0195
-00.2	-0.46	.0195
-02.6	-0.46	.0194
-05.8	-0.43	.0194
-09.1	-0.57	.0194
-12.6	-0.78	.0193

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TABLE II.- DAMPING-IN-PITCH DATA - Continued

(c) Sharp cone with spherical base; center of moments at 0.778 l

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 0.65		
-00.1	0.06	.0566
-01.2	0.05	.0565
-03.2	0.04	.0565
01.0	0.09	.0565
02.9	0.12	.0565
06.1	0.12	.0565
09.3	0.02	.0563
12.2	-0.01	.0563
15.3	-0.02	.0564
18.4	-0.05	.0565
M = 0.80		
-00.1	-0.07	.0459
-01.1	-0.07	.0459
-03.2	-0.09	.0459
00.9	-0.10	.0459
03.0	-0.08	.0458
06.2	-0.07	.0458
09.3	-0.07	.0458
12.4	-0.08	.0457
15.4	-0.10	.0457
M = 0.90		
-00.1	-0.34	.0408
-01.1	-0.32	.0408
-03.2	-0.35	.0407
01.0	-0.34	.0408
03.0	-0.35	.0407
06.1	-0.36	.0408
09.2	-0.37	.0408
12.3	-0.37	.0408
15.4	-0.40	.0408
M = 1.00		
-00.0	-0.43	.0374
-01.1	-0.43	.0373
-03.1	-0.43	.0373
00.9	-0.46	.0374
06.1	-0.45	.0374
02.9	-0.48	.0374
09.3	-0.34	.0374
12.4	-0.36	.0374
15.4	-0.47	.0377
M = 1.10		
-00.0	-0.42	.0344
-01.0	-0.43	.0345
-03.1	-0.40	.0344
-01.1	-0.44	.0345
01.0	-0.47	.0345
03.0	-0.51	.0344
06.1	-0.50	.0345
09.3	-0.33	.0345
12.4	-0.40	.0347
15.5	-0.46	.0348
M = 1.20		
-00.0	-0.48	.0319
-01.1	-0.40	.0319
-03.1	-0.41	.0320
01.1	-0.49	.0319
03.1	-0.50	.0319
05.3	-0.56	.0320
09.5	-0.48	.0322
12.6	-0.36	.0325
00.0	-0.46	.0319
-01.1	-0.40	.0319
-03.2	-0.42	.0320
M = 1.30		
-00.1	-0.55	.0300
-01.0	-0.54	.0301
-03.1	-0.48	.0302
01.0	-0.54	.0301
03.2	-0.47	.0302
06.2	-0.40	.0302
09.4	-0.34	.0304
12.6	-0.38	.0305
M = 1.50		
-00.0	-0.45	.0279
-01.1	-0.38	.0280
-03.1	-0.48	.0279
-00.0	-0.44	.0278
00.8	-0.47	.0278
02.9	-0.48	.0277
06.0	-0.34	.0278
09.1	-0.34	.0276
12.3	-0.42	.0276
15.4	-0.47	.0275
18.6	-0.54	.0273
-00.1	-0.47	.0276
M = 1.70		
-00.0	-0.32	.0255
-01.0	-0.27	.0254
-03.0	-0.36	.0254
00.9	-0.27	.0254
02.9	-0.31	.0254
06.0	-0.34	.0255
09.2	-0.25	.0255
12.1	-0.23	.0255
15.1	-0.29	.0254
18.0	-0.34	.0253
M = 1.90		
-00.0	-0.28	.0240
-01.0	-0.26	.0240
-03.0	-0.26	.0239
00.9	-0.24	.0239
02.9	-0.29	.0238
06.0	-0.34	.0239
09.0	-0.29	.0239
12.0	-0.34	.0239
15.1	-0.31	.0239
17.9	-0.31	.0239
M = 2.20		
00.0	-0.31	.0221
-01.0	-0.28	.0221
-03.0	-0.31	.0219
01.0	-0.25	.0220
03.0	-0.22	.0219
05.9	-0.19	.0220
09.0	-0.31	.0220
12.0	-0.31	.0220
15.1	-0.31	.0220
18.0	-0.18	.0220

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TABLE II.- DAMPING-IN-PITCH DATA - Continued

(d) Sharp cone with spherical base; center of moments at 0.892 l

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 0.65		
00.6	-0.17	.0489
-00.5	-0.14	.0488
-02.8	-0.19	.0486
-06.2	-0.13	.0485
-09.7	-0.13	.0486
-13.0	-0.10	.0486
M = 0.80		
00.6	-0.20	.0393
-00.4	-0.21	.0392
-02.9	-0.16	.0391
-06.5	-0.16	.0391
-10.0	-0.19	.0391
-13.6	-0.11	.0392
M = 0.90		
00.7	-0.30	.0349
-00.4	-0.32	.0346
-02.8	-0.31	.0345
-06.6	-0.23	.0346
-10.2	-0.25	.0346
-13.8	-0.31	.0345
M = 1.00		
00.8	-0.39	.0319
-00.4	-0.33	.0318
-02.8	-0.38	.0317
-06.6	-0.27	.0317
-10.2	-0.25	.0318
M = 1.10		
00.6	-0.38	.0294
-00.4	-0.35	.0294
-02.9	-0.37	.0292
-06.6	-0.23	.0292
-10.3	-0.23	.0293
M = 1.20		
-00.4	-0.44	.0268
-03.0	-0.35	.0268
-06.8	-0.46	.0267
-10.7	-0.54	.0268
M = 1.30		
-00.4	-0.60	.0250
-03.0	-0.60	.0249
-06.9	-0.60	.0250
-10.8	-0.28	.0252
-08.8	-0.49	.0250
-00.4	-0.57	.0251
M = 1.50		
00.7	-0.50	.0230
-00.5	-0.39	.0230
-02.9	-0.45	.0229
-06.7	-0.62	.0228
-10.5	-0.33	.0227
-08.6	-0.44	.0227
-04.8	-0.66	.0228
-02.9	-0.38	.0229
M = 1.70		
00.6	-0.38	.0217
-00.5	-0.38	.0217
-02.9	-0.32	.0216
-06.4	-0.50	.0215
-10.0	-0.42	.0215
-13.5	-0.31	.0215
-04.6	-0.42	.0216
M = 1.90		
00.7	-0.40	.0207
-00.4	-0.32	.0207
-02.7	-0.34	.0206
-06.2	-0.37	.0205
-09.5	-0.41	.0205
-12.9	-0.40	.0205
00.7	-0.32	.0206
M = 2.20		
00.7	-0.41	.0194
-00.4	-0.48	.0194
-02.7	-0.51	.0193
-06.0	-0.40	.0193
-09.3	-0.52	.0192
-12.6	-0.57	.0192
-05.8	-0.44	.0192

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TABLE II.- DAMPING-IN-PITCH DATA - Continued
(e) Blunt cone; center of moments at 0.703 l

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 0.65		
-00.2	-0.33	.0627
-01.2	-0.32	.0625
-03.3	-0.34	.0625
00.7	-0.34	.0624
02.7	-0.34	.0624
05.7	-0.36	.0625
08.8	-0.35	.0624
11.8	-0.33	.0627
14.8	-0.33	.0627
17.8	-0.27	.0630
M = 0.80		
-00.3	-0.35	.0515
-01.2	-0.33	.0516
-03.2	-0.36	.0516
00.6	-0.40	.0515
02.6	-0.35	.0515
05.6	-0.39	.0515
08.7	-0.41	.0516
11.8	-0.47	.0515
14.8	-0.44	.0517
17.8	-0.36	.0518
M = 0.90		
-00.2	-0.52	.0462
-01.2	-0.48	.0462
-03.3	-0.48	.0462
00.7	-0.44	.0461
05.7	-0.51	.0461
02.7	-0.50	.0463
08.7	-0.61	.0462
11.7	-0.67	.0461
14.8	-0.61	.0461
17.8	-0.51	.0464
M = 1.00		
-00.2	-0.51	.0425
-01.3	-0.49	.0424
-03.2	-0.52	.0424
00.7	-0.51	.0425
02.6	-0.50	.0424
05.6	-0.70	.0421
08.7	-0.84	.0421
11.7	-0.90	.0422
14.8	-0.82	.0425
17.8	-0.70	.0429
M = 1.10		
-00.3	-0.49	.0395
-01.3	-0.50	.0396
-03.2	-0.53	.0395
00.6	-0.54	.0395
02.7	-0.58	.0395
05.6	-0.68	.0393
08.6	-0.92	.0391
11.8	-0.87	.0392
14.8	-0.85	.0395
17.8	-0.70	.0397
M = 1.20		
-00.3	-0.59	.0359
-01.3	- .59	.0360
-03.2	-0.69	.0360
00.7	-0.62	.0360
02.7	-0.67	.0359
05.9	-0.69	.0360
09.0	-0.65	.0361
12.1	-0.55	.0364
15.2	-0.54	.0365
18.1	-0.33	.0371
M = 1.30		
-00.3	-0.68	.0336
-01.2	-0.66	.0336
-03.4	-0.81	.0336
00.7	-0.70	.0336
02.7	-0.79	.0337
05.9	-0.65	.0340
09.0	-0.46	.0343
11.9	-0.37	.0345
14.9	-0.30	.0349
17.9	-0.27	.0352
M = 1.50		
-00.3	-0.50	.0310
-01.2	-0.51	.0310
-03.3	-0.63	.0311
00.7	-0.51	.0311
02.7	-0.68	.0310
05.6	-0.36	.0313
08.6	-0.34	.0314
11.6	-0.31	.0314
14.5	-0.33	.0315
17.5	-0.32	.0316
M = 1.70		
00.2	-0.40	.0289
-01.2	-0.36	.0289
-03.1	-0.49	.0289
00.7	-0.41	.0288
02.6	-0.49	.0288
05.5	-0.38	.0289
08.5	-0.25	.0291
11.4	-0.23	.0291
14.2	-0.23	.0292
17.0	-0.26	.0291
M = 1.90		
-00.3	-0.33	.0272
-01.2	-0.31	.0271
-03.0	-0.35	.0271
00.7	-0.33	.0271
02.5	-0.33	.0271
05.5	-0.50	.0271
08.5	-0.22	.0272
11.3	-0.18	.0272
14.3	-0.16	.0272
17.0	-0.14	.0272
M = 2.20		
-00.2	-0.21	.0254
-01.2	-0.31	.0253
-02.1	-0.26	.0253
00.7	-0.34	.0252
02.6	-0.29	.0253
05.5	-0.34	.0252
08.4	-0.42	.0252
11.4	-0.24	.0252
14.2	-0.27	.0252
17.1	-0.21	.0251

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TABLE II.- DAMPING-IN-PITCH DATA - Continued
(f) Blunt cone; center of moments at 0.855 l

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 0.65		
00.4	-0.26	.0556
-00.7	-0.31	.0553
-02.8	-0.32	.0556
-06.2	-0.43	.0555
-09.6	-0.42	.0555
-12.8	-0.45	.0555
M = 0.80		
00.5	-0.32	.0451
-00.6	-0.29	.0449
-02.9	-0.30	.0450
-06.5	-0.35	.0450
-09.9	-0.50	.0449
-13.3	-0.53	.0452
M = 0.90		
00.5	-0.33	.0400
-00.6	-0.36	.0399
-02.9	-0.38	.0399
-06.5	-0.51	.0398
-10.0	-0.70	.0397
-13.5	-0.70	.0399
M = 1.00		
00.6	-0.33	.0368
-00.5	-0.35	.0366
-02.8	-0.33	.0366
-06.4	-0.48	.0364
-10.0	-0.80	.0360
-08.2	-0.61	.0361
M = 1.10		
00.5	-0.34	.0339
-00.6	-0.34	.0339
-02.8	-0.38	.0335
-06.4	-0.58	.0335
-10.1	-0.92	.0333
-08.2	-0.61	.0333
M = 1.20		
00.5	-0.57	.0309
-00.6	-0.56	.0308
-03.0	-0.66	.0307
-06.7	-0.75	.0305
-10.6	-0.98	.0306
-08.7	-0.93	.0304
-04.9	-0.74	.0304
M = 1.30		
00.6	-0.72	.0289
-00.7	-0.74	.0288
-03.2	-0.82	.0286
-07.0	-0.63	.0290
-10.7	-0.47	.0294
-08.8	-0.50	.0292
-07.0	-0.66	.0289
-05.1	-0.80	.0287
M = 1.50		
00.6	-0.56	.0267
-00.7	-0.55	.0266
-03.1	-0.68	.0265
-06.8	-0.39	.0267
-10.3	-0.39	.0268
-13.8	-0.31	.0271
-04.9	-0.51	.0265
-01.8	-0.67	.0265
-00.7	-0.55	.0265
M = 1.70		
00.4	-0.46	.0253
-00.6	-0.53	.0253
-02.9	-0.57	.0252
-06.4	-0.61	.0251
-09.7	-0.42	.0253
-13.0	-0.25	.0254
00.5	-0.49	.0253
M = 1.90		
00.5	-0.38	.0243
-00.6	-0.38	.0242
-02.7	-0.42	.0241
-06.0	-0.52	.0241
-09.4	-0.56	.0241
-12.4	-0.40	.0242
M = 2.20		
00.5	-0.31	.0227
-00.2	-0.29	.0226
-02.7	-0.34	.0226
-05.8	-0.29	.0225
-09.1	-0.45	.0224
-12.2	-0.54	.0224
01.6	-0.26	.0225

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TABLE II.- DAMPING-IN-PITCH DATA - Continued

(g) Blunt cone with spherical base; center of moments at 0.703 l

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 0.65		
-00.0	0.13	.0618
-00.9	0.11	.0616
-03.0	0.12	.0617
01.0	0.17	.0617
03.1	0.16	.0616
06.1	0.15	.0619
09.2	0.10	.0617
12.2	-0.07	.0616
15.2	-0.00	.0618
18.1	-0.09	.0617
M = 0.80		
00.1	-0.04	.0511
-01.0	-0.05	.0510
-03.0	-0.06	.0510
01.0	-0.04	.0510
03.1	-0.08	.0510
06.0	-0.05	.0508
09.1	-0.02	.0508
12.2	-0.10	.0508
15.2	-0.13	.0507
18.2	-0.17	.0505
M = 0.90		
00.0	-0.32	.0453
-00.9	-0.33	.0453
-02.8	-0.32	.0453
01.1	-0.33	.0453
03.0	-0.36	.0453
06.1	-0.31	.0456
09.2	-0.35	.0453
12.1	-0.36	.0453
15.3	-0.39	.0454
18.1	-0.43	.0454

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 1.00		
00.0	-0.42	.0416
-00.9	-0.43	.0415
-02.8	-0.44	.0416
01.1	-0.44	.0416
03.1	-0.49	.0416
06.1	-0.44	.0416
09.2	-0.38	.0415
12.2	-0.43	.0415
15.2	-0.46	.0417
18.1	-0.53	.0417
M = 1.10		
00.0	-0.45	.0383
-00.9	-0.44	.0385
-02.9	-0.45	.0384
01.0	-0.46	.0384
03.1	-0.49	.0384
06.1	-0.45	.0383
09.1	-0.37	.0383
12.2	-0.46	.0384
15.2	-0.49	.0386
18.1	-0.53	.0385
M = 1.20		
00.1	-0.48	.0356
-00.8	-0.46	.0356
-03.0	-0.49	.0356
00.1	-0.49	.0356
01.0	-0.50	.0356
03.1	-0.51	.0356
06.2	-0.52	.0355
09.4	-0.57	.0355
12.4	-0.55	.0357
15.6	-0.54	.0357
18.5	-0.32	.0363

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 1.30		
00.0	-0.55	.0333
-00.8	-0.57	.0333
-03.0	-0.53	.0334
01.0	-0.56	.0333
03.2	-0.57	.0334
06.3	-0.48	.0336
09.3	-0.36	.0337
12.4	-0.34	.0339
15.4	-0.28	.0342
18.3	-0.26	.0346
M = 1.50		
00.0	-0.41	.0307
-00.9	-0.39	.0307
-00.8	-0.37	.0307
-02.9	-0.40	.0307
01.1	-0.40	.0307
03.0	-0.41	.0307
06.0	-0.33	.0308
09.0	-0.25	.0308
12.0	-0.28	.0309
14.8	-0.32	.0308
17.8	-0.34	.0309
M = 1.70		
00.0	-0.27	.0288
-00.8	-0.27	.0288
-02.8	-0.32	.0289
01.0	-0.26	.0287
03.0	-0.34	.0286
05.9	-0.27	.0287
08.9	-0.24	.0287
11.8	-0.17	.0287
14.6	-0.20	.0287
17.3	-0.26	.0287

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 1.90		
00.0	-0.19	.0267
-00.8	-0.19	.0267
-02.7	-0.17	.0267
01.0	-0.21	.0267
03.0	-0.23	.0267
05.9	-0.23	.0266
08.9	-0.25	.0267
11.8	-0.21	.0267
14.6	-0.21	.0267
17.4	-0.23	.0266
M = 2.20		
00.1	-0.27	.0248
-00.8	-0.22	.0248
-02.7	-0.19	.0247
01.1	-0.22	.0247
03.0	-0.16	.0247
05.8	-0.19	.0247
08.8	-0.25	.0247
11.7	-0.19	.0246
14.6	-0.19	.0246
17.4	-0.24	.0246

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TABLE II.- DAMPING-IN-PITCH DATA - Continued

(h) Blunt cone with spherical base; center of moments at 0.855 l

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 0.65		
00.4	-0.12	.0552
-00.7	-0.09	.0550
-02.9	-0.13	.0549
-06.4	-0.11	.0549
-09.7	-0.10	.0549
-12.9	-0.08	.0550
-00.6	-0.09	.0553
M = 0.80		
00.5	-0.13	.0449
-00.7	-0.12	.0449
-02.9	-0.15	.0448
-06.4	-0.13	.0448
-10.0	-0.11	.0446
-13.3	-0.11	.0445
M = 0.90		
00.4	-0.30	.0395
-00.6	-0.26	.0395
-03.0	-0.26	.0394
-06.6	-0.23	.0395
-10.0	-0.22	.0395
-13.5	-0.31	.0394
-11.9	-0.25	.0394

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 1.00		
00.6	-0.37	.0367
-00.6	-0.37	.0366
-02.9	-0.43	.0365
-06.5	-0.23	.0366
-10.1	-0.29	.0365
-13.6	-0.35	.0364
-04.7	-0.30	.0366
M = 1.10		
00.5	-0.39	.0338
-00.6	-0.41	.0338
-02.9	-0.35	.0338
-06.5	-0.24	.0338
-10.2	-0.25	.0337
-13.6	-0.31	.0337
M = 1.20		
00.6	-0.59	.0310
-00.6	-0.56	.0309
00.6	-0.62	.0310
-03.0	-0.52	.0308
-06.8	-0.42	.0308
-10.6	-0.44	.0308
00.6	-0.65	.0308
-00.6	-0.55	.0309

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 1.30		
00.6	-0.73	.0288
-00.7	-0.65	.0288
-03.2	-0.65	.0287
-06.8	-0.64	.0287
-10.6	-0.42	.0290
-08.6	-0.57	.0288
00.5	-0.73	.0288
00.5	-0.72	.0288
-00.5	-0.62	.0287
M = 1.50		
00.5	-0.60	.0265
00.5	-0.57	.0265
-00.7	-0.50	.0264
-03.1	-0.57	.0263
-06.8	-0.61	.0263
-10.2	-0.28	.0264
-13.8	-0.35	.0265
-08.4	-0.42	.0263
-06.6	-0.62	.0262
-00.5	-0.53	.0264
M = 1.70		
00.5	-0.42	.0253
-00.6	-0.41	.0252
-02.9	-0.40	.0252
-06.4	-0.51	.0251
-09.7	-0.41	.0252
-12.9	-0.24	.0251
-06.2	-0.44	.0250
-04.6	-0.42	.0250

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 1.90		
00.4	-0.27	.0239
-00.6	-0.37	.0239
-02.8	-0.33	.0238
-06.1	-0.35	.0237
-09.3	-0.43	.0237
-12.5	-0.36	.0238
-00.5	-0.31	.0238
M = 2.20		
00.4	-0.29	.0225
-00.5	-0.37	.0224
-02.6	-0.36	.0223
-05.9	-0.37	.0223
-09.1	-0.45	.0223
-12.2	-0.38	.0223
00.5	-0.34	.0223
00.5	-0.27	.0223
-00.5	-0.30	.0223

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TABLE II.- DAMPING-IN-PITCH DATA - Continued

(i) Paraboloid without tail cone; center of moments at 1.226 l

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 0.65		
00.6	-0.02	.0674
-00.3	-0.02	.0672
-01.4	-0.10	.0673
-02.3	-0.08	.0674
01.7	-0.05	.0673
02.5	0.00	.0671
03.7	-0.01	.0671
06.8	0.03	.0677
09.8	-0.02	.0677
12.9	-0.05	.0676
16.0	-0.05	.0676
19.1	-0.16	.0678
M = 0.80		
00.7	-0.11	.0555
-00.3	-0.02	.0554
-01.3	-0.11	.0554
-02.3	-0.10	.0555
01.7	-0.02	.0553
02.7	-0.06	.0555
03.7	-0.00	.0553
06.8	0.02	.0554
09.9	0.04	.0553
13.1	-0.08	.0551
16.2	-0.14	.0552
19.3	-0.10	.0553
M = 0.90		
00.7	-0.08	.0493
-00.2	-0.09	.0494
-01.3	-0.12	.0493
-02.4	-0.12	.0494
01.6	-0.03	.0493
02.7	-0.05	.0494
03.7	0.00	.0493
06.7	-0.06	.0494
09.9	-0.02	.0493
13.1	-0.05	.0493
16.3	-0.14	.0494
19.3	-0.13	.0494

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 1.00		
00.6	-0.01	.0459
-00.4	-0.01	.0457
-01.4	-0.03	.0458
-02.3	-0.00	.0457
01.7	0.04	.0459
02.7	0.17	.0461
03.6	0.51	.0461
04.5	0.44	.0461
05.5	0.10	.0458
06.7	-0.10	.0454
09.9	-0.06	.0455
13.1	-0.10	.0455
16.3	-0.07	.0456
19.2	-0.13	.0458
M = 1.10		
00.5	-0.02	.0424
-00.3	-0.05	.0424
-01.3	-0.05	.0425
-02.3	0.01	.0424
01.6	0.01	.0423
02.6	0.19	.0426
03.6	0.64	.0428
04.6	0.42	.0425
05.5	-0.03	.0421
06.7	-0.13	.0419
09.8	-0.09	.0353
13.1	-0.07	.0421
16.3	-0.07	.0423
19.2	-0.11	.0423
M = 1.20		
00.6	-0.09	.0393
-00.2	-0.06	.0393
-01.3	-0.10	.0393
-02.4	-0.01	.0394
01.8	-0.01	.0392
02.6	-0.04	.0393
03.7	0.06	.0393
04.7	0.42	.0395
05.6	0.55	.0395
06.6	0.14	.0392
07.7	-0.02	.0391
09.8	-0.10	.0391
13.1	-0.11	.0391
16.3	-0.08	.0393
19.4	-0.12	.0394

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 1.30		
00.5	-0.09	.0370
-00.4	-0.07	.0370
-01.4	-0.08	.0371
-02.3	-0.04	.0371
01.7	0.00	.0370
02.6	0.07	.0371
03.7	0.59	.0372
04.6	0.51	.0372
05.6	0.18	.0370
06.7	-0.11	.0369
09.9	-0.11	.0368
13.1	-0.08	.0368
16.2	-0.04	.0371
19.3	-0.14	.0370
M = 1.50		
00.5	-0.08	.0332
-00.4	-0.10	.0332
-01.5	-0.16	.0332
-02.5	-0.13	.0332
01.7	-0.04	.0332
02.7	-0.06	.0332
03.7	0.02	.0332
04.7	0.46	.0333
05.6	0.53	.0333
06.7	0.10	.0331
09.9	-0.14	.0330
13.1	-0.10	.0330
16.2	-0.05	.0333
19.2	-0.06	.0334
M = 1.70		
00.5	-0.10	.0309
-00.4	-0.14	.0309
-01.5	-0.17	.0309
-02.5	-0.16	.0308
01.6	-0.10	.0308
02.6	-0.04	.0308
03.6	-0.00	.0308
04.6	0.17	.0308
06.7	-0.05	.0307
09.8	-0.14	.0306
13.0	-0.12	.0306
16.1	-0.10	.0306
19.0	0.01	.0308

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 1.90		
00.5	-0.21	.0286
-00.4	-0.21	.0286
-01.5	-0.16	.0286
-02.4	-0.21	.0286
01.6	-0.08	.0286
02.6	-0.06	.0286
03.7	0.03	.0287
04.6	0.07	.0286
06.7	-0.15	.0286
09.8	-0.13	.0285
12.9	-0.15	.0285
16.0	-0.09	.0286
19.0	-0.17	.0286
M = 2.20		
00.6	-0.28	.0267
-00.4	-0.38	.0266
-01.4	-0.35	.0266
-02.3	-0.36	.0266
01.6	-0.14	.0266
02.6	-0.04	.0266
03.6	0.00	.0266
04.7	-0.10	.0266
06.8	-0.16	.0265
09.8	-0.32	.0265
12.8	-0.17	.0264
15.9	-0.19	.0264
18.9	-0.24	.0266

[redacted]

TABLE II.- DAMPING-IN-PITCH DATA - Continued

(j) Paraboloid without tail cone; center of moments at 1.540 l

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 0.65		
01.2	-0.05	.0521
00.1	-0.02	.0521
-00.9	-0.14	.0520
-02.0	-0.08	.0521
02.4	-0.11	.0521
03.2	-0.02	.0520
04.4	-0.04	.0520
07.6	0.03	.0521
M = 0.80		
01.2	0.01	.0424
00.1	-0.11	.0423
-01.0	-0.01	.0419
-02.0	-0.12	.0420
02.4	-0.04	.0421
03.3	-0.00	.0419
04.5	-0.03	.0419
05.6	0.00	.0420
M = 0.90		
01.3	-0.06	.0370
00.1	0.00	.0368
-00.9	-0.04	.0370
-02.0	-0.04	.0368
-03.1	-0.11	.0369
02.3	-0.00	.0368
03.5	-0.03	.0370
04.6	0.08	.0370
M = 1.00		
01.1	0.02	.0341
00.0	-0.00	.0341
-01.0	0.01	.0343
-02.1	0.07	.0341
-03.2	0.38	.0343
02.2	0.17	.0344
03.2	0.79	.0346
04.3	0.39	.0344
05.3	0.13	.0341
M = 1.10		
01.1	0.02	.0315
00.0	0.00	.0316
-01.1	-0.02	.0315
-02.1	0.13	.0316
-03.1	0.58	.0320
02.2	0.26	.0318
03.2	0.81	.0320
04.3	0.47	.0318
05.4	0.03	.0315
M = 1.20		
01.2	-0.00	.0292
00.1	0.03	.0292
-01.0	-0.01	.0291
-02.1	0.06	.0292
02.3	0.03	.0291
03.4	0.01	.0291
04.6	0.67	.0292
05.6	0.36	.0292
06.7	0.04	.0290
M = 1.30		
01.1	-0.09	.0274
00.0	-0.04	.0274
-01.1	-0.01	.0274
-02.2	-0.03	.0275
02.3	0.01	.0274
03.6	0.07	.0275
04.6	0.67	.0277
05.5	0.74	.0277
06.7	0.10	.0275
M = 1.50		
01.1	-0.05	.0247
00.0	-0.10	.0247
-01.1	-0.11	.0247
-02.3	-0.11	.0247
-03.3	-0.10	.0248
02.3	-0.06	.0247
03.4	-0.01	.0248
04.6	0.11	.0248
05.7	0.71	.0251
M = 1.70		
01.1	-0.08	.0233
00.0	-0.08	.0232
-01.1	-0.13	.0232
-02.3	-0.15	.0232
-03.3	-0.14	.0232
02.2	-0.02	.0232
03.2	-0.01	.0231
04.4	0.13	.0232
05.6	0.28	.0232
06.7	0.20	.0232
M = 1.90		
01.1	-0.18	.0218
-00.0	-0.17	.0217
-01.1	-0.17	.0218
-02.2	-0.15	.0217
02.3	-0.07	.0218
03.2	-0.01	.0218
04.4	0.09	.0218
05.6	0.12	.0218
07.7	0.02	.0218
M = 2.20		
01.0	-0.28	.0203
00.0	-0.15	.0203
-01.1	-0.21	.0202
-02.3	-0.27	.0203
02.2	-0.16	.0203
03.2	0.01	.0203
04.2	0.07	.0203
05.4	0.02	.0203
07.6	-0.24	.0204

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[redacted]

TABLE II.- DAMPING-IN-PITCH DATA - Continued

(k) Paraboloid with tail cone; center of moments at 1.226 l

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 0.65		
00.6	-0.05	.0655
-00.3	-0.07	.0653
-01.3	-0.07	.0653
-02.3	-0.09	.0652
01.6	-0.04	.0653
02.6	0.02	.0653
03.6	0.04	.0652
04.6	0.03	.0651
06.7	-0.00	.0653
09.8	-0.00	.0651
12.9	-0.01	.0648
16.0	0.02	.0651
19.0	-0.09	.0653
M = 0.80		
00.6	-0.09	.0534
-00.3	-0.11	.0533
-01.3	-0.00	.0533
-02.3	-0.10	.0534
01.6	-0.05	.0533
02.7	-0.04	.0536
03.6	-0.03	.0536
04.7	-0.03	.0538
06.7	0.00	.0537
09.9	-0.10	.0537
13.1	-0.05	.0537
16.2	-0.05	.0536
19.3	-0.08	.0538
06.8	0.02	.0535
07.8	-0.04	.0536
M = 0.90		
00.6	-0.05	.0478
-00.2	-0.02	.0478
-01.4	-0.11	.0478
-02.2	-0.14	.0481
01.6	-0.04	.0478
02.7	-0.04	.0477
03.6	-0.07	.0478
04.6	0.00	.0479
06.8	-0.05	.0479
09.8	-0.06	.0477
13.1	-0.07	.0477
16.3	-0.08	.0477
19.3	-0.11	.0479
M = 1.00		
00.5	0.02	.0444
-00.3	0.03	.0443
-01.5	0.04	.0442
-02.3	0.20	.0445
01.4	0.15	.0444
02.5	0.55	.0448
03.5	0.23	.0444
04.5	-0.10	.0441
06.6	-0.08	.0440
09.8	-0.05	.0441
13.1	-0.06	.0441
16.2	-0.04	.0439
19.2	-0.11	.0442
M = 1.10		
00.4	0.00	.0410
-00.4	0.05	.0408
-01.4	0.10	.0409
-02.3	0.36	.0411
01.4	0.21	.0411
02.5	0.56	.0412
03.5	0.16	.0409
04.5	-0.11	.0407
06.7	-0.11	.0406
09.9	-0.05	.0405
13.1	-0.05	.0407
16.2	-0.07	.0407
19.2	-0.10	.0407
M = 1.20		
00.6	0.00	.0379
-00.3	-0.01	.0379
-01.4	-0.07	.0380
-02.3	-0.06	.0380
01.6	-0.01	.0379
02.5	0.06	.0380
03.6	0.36	.0381
04.5	0.39	.0380
05.3	0.05	.0380
06.7	-0.09	.0378
09.8	-0.09	.0378
13.1	-0.09	.0378
16.2	-0.07	.0378
19.3	-0.07	.0379
06.7	-0.07	.0377
M = 1.30		
00.4	-0.06	.0359
-00.4	-0.06	.0358
-02.4	0.38	.0360
-02.4	0.35	.0361
-01.4	0.01	.0359
01.5	0.01	.0359
02.7	0.45	.0360
03.5	0.20	.0359
04.5	-0.06	.0357
06.7	-0.09	.0356
09.9	-0.03	.0357
13.0	-0.05	.0356
16.2	-0.03	.0358
19.2	-0.10	.0358
M = 1.50		
00.4	-0.06	.0323
-00.4	-0.11	.0323
-01.5	-0.09	.0322
-02.4	-0.02	.0322
01.7	-0.02	.0322
02.6	0.06	.0323
03.6	0.44	.0324
04.5	0.23	.0324
05.6	-0.13	.0322
06.7	-0.11	.0321
09.9	-0.05	.0322
13.1	-0.04	.0322
16.2	-0.02	.0322
19.2	-0.00	.0323
M = 1.70		
00.5	-0.06	.0298
-00.3	-0.12	.0298
-01.4	-0.16	.0298
-02.4	-0.03	.0298
01.6	-0.04	.0298
02.6	0.04	.0298
03.6	0.09	.0299
05.6	-0.09	.0297
06.8	-0.09	.0297
09.8	-0.09	.0297
13.0	-0.08	.0297
16.1	-0.08	.0298
19.2	-0.05	.0299
M = 1.90		
00.6	-0.18	.0280
-00.3	-0.16	.0280
-02.4	-0.08	.0280
01.6	-0.05	.0280
02.6	0.04	.0280
03.6	0.07	.0280
04.6	-0.07	.0279
06.7	-0.06	.0279
09.7	-0.12	.0278
12.8	-0.13	.0278
15.9	-0.21	.0279
18.9	-0.10	.0279
M = 2.20		
00.5	-0.14	.0258
09.7	-0.10	.0256
-02.4	-0.10	.0259
00.5	-0.20	.0258
01.4	-0.03	.0258
03.5	0.08	.0258
06.6	-0.17	.0257
09.5	-0.24	.0256
12.8	-0.16	.0256
15.8	-0.05	.0258
18.8	-0.15	.0258
03.5	-0.10	.0257
01.5	-0.11	.0256

[redacted]

TABLE II.- DAMPING-IN-PITCH DATA - Continued

(l) Paraboloid with tail cone; center of moments at 1.540 l

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k	α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k	α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k	α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 0.65			M = 1.00			M = 1.30			M = 1.90		
01.2	-0.00	.0498	01.1	0.17	.0335	01.2	-0.04	.0269	01.1	-0.09	.0211
00.2	0.11	.0499	00.1	0.05	.0334	00.1	-0.08	.0269	00.0	-0.17	.0211
-00.9	0.17	.0501	-01.0	0.13	.0335	-01.0	0.09	.0270	-01.0	-0.20	.0211
-01.9	0.12	.0499	-01.9	0.50	.0336	-02.2	0.61	.0271	-02.0	-0.17	.0211
-02.9	0.15	.0499	-02.9	0.66	.0336	-03.1	0.39	.0271	-03.1	-0.03	.0212
02.3	0.20	.0499	-04.0	0.20	.0333	-04.2	-0.07	.0268	02.3	0.01	.0212
03.3	0.02	.0499	02.1	1.00	.0337	02.3	0.26	.0269	03.4	0.14	.0212
04.4	0.25	.0501	03.2	0.48	.0335	03.4	0.62	.0270	04.4	0.16	.0212
05.4	0.14	.0498	04.3	0.00	.0326	04.5	0.21	.0269	05.5	0.01	.0212
07.6	0.18	.0500	05.5	-0.09	.0331	05.6	-0.06	.0267	06.5	-0.14	.0212
						06.8	-0.20	.0267	07.8	-0.10	.0211
M = 0.80			M = 1.10			M = 1.50			M = 2.20		
01.3	-0.09	.0402	01.0	0.14	.0309	01.1	-0.13	.0240	01.1	-0.12	.0197
00.2	-0.05	.0403	00.1	0.05	.0308	00.0	-0.14	.0240	00.0	-0.12	.0197
-00.9	-0.07	.0402	-01.0	0.20	.0309	-01.1	-0.12	.0241	-02.0	-0.18	.0197
-02.0	-0.01	.0403	-02.1	0.88	.0310	-02.2	-0.02	.0242	02.2	0.16	.0198
-03.0	-0.00	.0403	-03.1	0.40	.0310	-03.3	0.50	.0243	03.3	0.13	.0198
02.4	0.06	.0403	02.2	0.92	.0311	02.4	-0.05	.0241	04.4	0.00	.0197
03.4	0.00	.0405	03.2	0.37	.0309	03.5	0.12	.0242	05.4	-0.03	.0197
04.5	0.04	.0406	04.3	-0.04	.0306	04.6	0.67	.0244	07.7	-0.15	.0196
05.5	0.04	.0406	05.5	-0.07	.0304	05.6	0.20	.0243	08.7	-0.22	.0196
M = 0.90			M = 1.20			M = 1.70					
01.3	0.15	.0360	01.2	0.01	.0284						
00.3	-0.02	.0357	00.2	0.10	.0284	01.1	-0.15	.0227			
-00.8	-0.03	.0358	-00.8	0.11	.0285	00.1	-0.14	.0226			
-01.9	-0.12	.0358	-02.0	0.14	.0285	-01.0	-0.18	.0226			
-02.9	-0.04	.0359	-03.1	0.21	.0285	-02.1	-0.10	.0226			
01.3	-0.00	.0359	02.4	0.14	.0284	-03.2	0.19	.0227			
02.4	-0.02	.0361	02.4	0.18	.0284	02.3	-0.04	.0225			
03.4	-0.01	.0360	03.5	0.84	.0284	03.5	0.16	.0226			
04.5	0.00	.0360	04.4	0.52	.0285	04.5	0.27	.0226			
05.6	-0.03	.0358	05.5	-0.02	.0282	05.6	-0.02	.0225			
			06.7	-0.16	.0282						

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TABLE II.- DAMPING-IN-PITCH DATA - Continued

(m) Truncated cone without tail cone: center of moments at 1.982 l

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 0.65		
00.0	-0.33	.1001
-00.8	-0.20	.1002
-01.9	-0.31	.1003
-02.9	-0.30	.1001
01.1	0.07	.1001
02.1	0.07	.1003
03.1	-0.04	.1000
06.1	-0.18	.0992
09.2	-1.42	.0985
12.1	-2.05	.0983
15.2	-1.89	.0984
18.2	-1.79	.0988
M = 0.80		
00.0	-0.26	.0823
-00.9	-0.11	.0824
-01.9	-0.17	.0824
-02.9	-0.22	.0823
01.1	0.07	.0828
02.1	0.06	.0828
03.2	0.01	.0829
04.1	-0.15	.0823
06.1	-0.20	.0822
09.2	-0.94	.0819
12.2	-1.09	.0820
15.2	-0.93	.0826
18.2	-0.86	.0827
M = 0.90		
00.0	-0.16	.0737
-00.9	-0.15	.0741
-01.9	-0.09	.0738
-02.9	-0.16	.0739
01.1	0.14	.0742
02.1	0.16	.0742
03.1	0.02	.0740
04.1	-0.16	.0734
06.1	-0.25	.0735
09.2	-0.92	.0732
12.2	-0.79	.0738
15.3	-0.45	.0742
18.3	-0.69	.0740
M = 1.00		
00.0	-0.28	.0678
-00.9	-0.21	.0679
-01.9	-0.15	.0681
-02.9	-0.00	.0680
01.0	0.00	.0680
02.0	0.19	.0681
03.1	0.30	.0678
04.1	0.31	.0673
05.1	0.03	.0676
06.2	-0.29	.0673
09.3	-0.95	.0670
12.3	-0.81	.0674
15.3	-0.62	.0680
18.4	-0.38	.0679
M = 1.10		
00.0	-0.33	.0627
-00.9	-0.21	.0630
-01.9	-0.15	.0629
-02.9	0.02	.0629
01.1	0.01	.0630
02.0	0.15	.0631
03.1	0.28	.0626
04.0	0.35	.0625
05.1	0.14	.0625
06.1	-0.23	.0621
09.1	-0.83	.0619
12.3	-0.80	.0623
15.3	-0.49	.0628
18.4	-0.32	.0632
M = 1.20		
00.0	-0.20	.0585
-00.9	-0.14	.0585
-01.8	-0.19	.0585
-02.8	-0.43	.0580
01.0	-0.03	.0583
02.1	-0.04	.0582
03.1	-0.02	.0585
04.1	-0.20	.0581
06.2	-0.43	.0577
09.3	-1.02	.0575
12.3	-0.66	.0580
15.4	-0.30	.0584
18.4	-0.20	.0585
M = 1.30		
00.0	-0.42	.0549
-00.9	-0.40	.0549
-01.9	-0.47	.0550
-02.9	-0.50	.0548
01.1	-0.20	.0549
02.1	-0.16	.0549
03.2	-0.21	.0547
04.1	-0.13	.0545
05.2	-0.00	.0545
06.2	-0.26	.0545
09.3	-0.63	.0545
12.3	-0.42	.0550
15.4	-0.23	.0551
18.4	-0.22	.0553
M = 1.50		
00.1	-0.66	.0497
-00.9	-0.61	.0497
-01.9	-0.61	.0497
-03.0	-0.54	.0498
01.1	-0.40	.0495
02.2	-0.38	.0495
03.2	-0.40	.0495
04.2	-0.23	.0494
06.2	-0.48	.0496
09.3	-0.65	.0497
12.2	-0.47	.0498
15.4	-0.22	.0501
18.3	-0.23	.0502
M = 1.70		
00.1	-0.37	.0449
-00.9	-0.48	.0448
-01.9	-0.45	.0449
-02.9	-0.37	.0449
01.1	-0.08	.0450
02.1	0.00	.0450
03.2	0.03	.0450
04.1	0.12	.0449
06.2	-0.25	.0449
09.3	-0.88	.0449
12.2	-0.37	.0451
15.3	-0.09	.0453
18.3	0.00	.0455
M = 1.90		
00.1	-0.54	.0424
-01.0	-0.51	.0421
-02.0	-0.09	.0421
-02.8	-0.53	.0421
01.1	0.04	.0423
02.1	-0.00	.0420
03.1	-0.11	.0420
04.1	-0.21	.0420
06.2	-0.41	.0419
09.3	-1.49	.0418
12.2	-0.64	.0420
15.3	-0.24	.0423
18.2	-0.07	.0426
M = 2.20		
00.0	-1.01	.0394
-00.9	-0.16	.0394
-01.9	-0.36	.0394
-02.8	-0.47	.0394
01.1	0.19	.0395
02.1	0.19	.0395
03.1	0.05	.0394
04.1	-0.22	.0393
06.1	-0.53	.0391
09.2	-1.49	.0391
12.2	-2.54	.0390
15.3	-0.53	.0395
18.2	-0.10	.0397

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TABLE II.- DAMPING-IN-PITCH DATA - Continued

(n) Truncated cone without tail cone; center of moments at 2.492 l

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 0.65		
00.2	-0.26	.0811
-00.7	-0.33	.0808
-01.8	-0.21	.0807
-02.8	-0.21	.0807
01.2	-0.05	.0807
02.2	-0.00	.0808
03.3	-0.08	.0809
06.3	0.03	.0807
09.4	-1.02	.0802
12.5	-1.83	.0798
15.4	-0.64	.0804
18.5	-0.22	.0808
M = 0.80		
00.1	-0.29	.0663
-00.8	-0.19	.0663
-01.7	-0.19	.0662
-02.8	-0.19	.0664
01.3	-0.03	.0662
02.3	0.01	.0665
03.3	-0.00	.0667
06.4	-0.09	.0663
09.4	-0.79	.0661
12.4	-0.70	.0665
15.5	-0.14	.0673
18.5	-0.08	.0675
M = 0.90		
00.2	0.04	.0595
-00.8	-0.14	.0593
-01.9	-0.01	.0594
-02.8	0.00	.0593
01.3	0.15	.0594
02.3	0.17	.0594
03.3	0.08	.0592
06.4	-0.29	.0590
09.5	-0.95	.0588
12.6	-0.91	.0595
15.6	-0.06	.0604
18.6	-0.49	.0602

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 1.00		
00.2	-0.27	.0547
-00.8	-0.09	.0549
-01.8	-0.06	.0548
-02.7	0.16	.0549
01.2	0.06	.0549
02.2	0.32	.0548
03.3	0.63	.0546
04.3	0.54	.0538
05.4	-0.13	.0544
06.4	-0.37	.0541
09.5	-1.11	.0541
12.7	-0.96	.0541
15.7	-0.87	.0548
18.9	-0.37	.0550
M = 1.10		
00.1	-0.36	.0513
-00.8	-0.18	.0513
-01.8	-0.09	.0515
-02.9	0.18	.0512
-03.8	0.63	.0513
01.2	-0.02	.0512
02.2	0.23	.0511
03.3	0.58	.0510
04.3	0.53	.0508
05.3	-0.02	.0504
06.4	-0.39	.0503
09.6	-1.32	.0499
12.7	-0.93	.0503
15.8	-0.83	.0507
18.9	-0.28	.0511
M = 1.20		
00.2	-0.10	.0464
-00.7	-0.03	.0466
-01.8	-0.07	.0466
-02.8	0.04	.0465
-03.8	0.15	.0466
-05.0	-0.08	.0465
-05.9	-0.36	.0464
01.3	0.02	.0466
02.2	-0.01	.0465
03.3	0.06	.0465
04.4	-0.13	.0462
05.5	-0.34	.0460
06.4	-0.19	.0461
09.6	-1.68	.0459
12.7	-0.23	.0465
15.8	-0.34	.0467
18.9	-0.23	.0469

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 1.30		
00.2	-0.31	.0435
-00.8	-0.29	.0435
-01.8	-0.34	.0434
-02.8	-0.33	.0435
01.3	-0.15	.0435
02.3	-0.12	.0434
03.4	-0.04	.0434
04.4	0.29	.0433
05.5	-0.04	.0433
06.5	-0.41	.0432
09.7	-0.51	.0434
12.7	-0.29	.0437
15.8	-0.14	.0439
18.9	-0.14	.0439
M = 1.50		
00.1	-0.79	.0386
-00.7	-0.62	.0387
-01.9	-0.59	.0388
-02.9	-0.46	.0390
01.0	-0.50	.0388
02.0	-0.34	.0389
03.5	-0.07	.0390
04.4	0.03	.0390
06.5	-0.07	.0392
09.7	-0.58	.0394
12.7	-0.19	.0395
15.8	-0.12	.0397
18.9	-0.11	.0398
M = 1.70		
00.1	-0.49	.0359
-00.7	-0.39	.0358
-01.7	-0.48	.0359
-02.9	-0.34	.0359
01.2	-0.24	.0359
02.3	-0.16	.0359
03.3	-0.11	.0359
06.5	-0.26	.0359
09.6	-0.53	.0361
12.7	-0.43	.0363
15.8	-0.13	.0364
18.8	-0.12	.0367

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 1.90		
00.2	-0.52	.0338
-00.8	-0.43	.0338
-01.9	-0.52	.0338
-02.9	-0.52	.0338
01.2	-0.16	.0339
02.3	-0.09	.0339
03.4	-0.26	.0337
04.4	-0.31	.0337
06.4	-0.49	.0336
09.6	-0.78	.0337
12.6	-0.52	.0338
15.7	-0.17	.0341
18.7	-0.15	.0343
M = 2.20		
00.1	-0.59	.0316
-00.8	-0.32	.0317
-01.8	-0.44	.0317
-02.8	-0.53	.0315
01.2	-0.05	.0317
02.2	-0.10	.0316
03.3	-0.25	.0315
04.3	-0.39	.0314
06.3	-0.52	.0314
09.5	-1.87	.0313
12.4	-1.71	.0314
15.6	-0.52	.0316
18.6	-0.23	.0317

[redacted]

TABLE II.- DAMPING-IN-PITCH DATA - Continued

(o) Truncated cone with small tail cone; center of moments at 1.982 l

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 0.65		
00.1	-0.48	.0940
-00.7	0.00	.0942
-01.8	-0.08	.0940
-02.8	-0.10	.0952
01.2	0.27	.0950
02.1	0.29	.0951
03.1	0.12	.0951
04.1	0.11	.0944
06.1	-0.01	.0945
09.2	-1.16	.0940
12.1	-1.63	.0936
15.1	-1.69	.0935
18.2	-1.56	.0938
M = 0.80		
00.1	-0.12	.0778
-00.8	0.02	.0780
-01.8	0.01	.0780
-02.8	-0.10	.0782
01.2	0.25	.0781
02.1	0.33	.0782
03.2	0.14	.0780
04.2	-0.06	.0777
06.1	-0.16	.0776
09.3	-0.78	.0771
12.2	-0.97	.0773
15.2	-0.72	.0779
18.2	-0.55	.0779
M = 0.90		
00.1	-0.02	.0697
-00.9	0.12	.0699
-01.8	0.09	.0696
-02.8	0.05	.0697
01.2	0.41	.0700
02.1	0.41	.0698
03.2	0.18	.0697
04.1	-0.03	.0693
06.2	-0.19	.0694
09.3	-0.76	.0691
12.2	-0.58	.0696
15.3	-0.16	.0698
18.2	-0.26	.0701

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 1.00		
00.1	-0.11	.0643
-00.9	0.00	.0640
-01.9	0.38	.0632
-02.8	0.81	.0632
01.1	0.37	.0632
02.1	0.83	.0631
03.1	0.70	.0634
04.1	-0.06	.0638
06.1	-0.30	.0635
09.1	-0.59	.0633
12.3	-0.76	.0636
15.4	-0.52	.0638
18.4	-0.50	.0641
M = 1.10		
00.1	-0.23	.0591
-00.7	-0.01	.0593
-01.9	0.34	.0595
-02.7	0.87	.0594
01.2	0.29	.0594
02.1	0.79	.0594
03.0	1.06	.0594
04.1	0.11	.0591
06.1	-0.22	.0586
09.3	-0.66	.0586
12.3	-0.70	.0586
15.4	-0.40	.0590
18.4	-0.28	.0594
M = 1.20		
00.1	-0.00	.0552
-00.8	0.17	.0553
-01.8	0.19	.0552
-02.8	0.30	.0551
01.1	0.22	.0552
02.2	0.26	.0552
03.1	0.26	.0550
04.2	0.10	.0546
06.2	-0.58	.0543
09.3	-1.06	.0544
12.3	-0.54	.0548
15.4	-0.28	.0552
18.3	-0.13	.0552

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 1.30		
00.1	-0.43	.0516
-00.8	-0.32	.0517
-01.9	-0.35	.0518
-02.9	-0.27	.0517
01.2	-0.10	.0518
02.1	-0.06	.0519
03.2	-0.02	.0517
04.2	0.43	.0516
05.2	0.36	.0516
06.3	-0.51	.0515
09.3	-0.49	.0516
12.3	-0.37	.0517
15.4	-0.14	.0520
18.4	-0.09	.0523
M = 1.50		
00.1	-0.76	.0470
-00.9	-0.86	.0469
-01.9	-0.53	.0471
-02.9	-0.43	.0471
01.2	-0.27	.0470
02.2	-0.22	.0470
03.2	-0.11	.0470
04.2	-0.04	.0469
06.3	-0.59	.0470
09.3	-0.53	.0470
12.3	-0.38	.0472
15.4	-0.18	.0474
18.4	-0.09	.0475
M = 1.70		
00.1	-0.38	.0424
-00.9	-0.51	.0423
-01.9	-0.44	.0423
-02.9	-0.24	.0424
01.1	-0.02	.0425
02.1	0.13	.0426
03.2	0.33	.0425
04.1	0.12	.0423
06.3	-0.37	.0423
09.3	-0.65	.0424
12.2	-0.35	.0425
15.3	-0.05	.0428
18.4	0.05	.0430

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 1.90		
00.0	-0.79	.0399
-00.9	-0.15	.0400
-01.9	-0.35	.0398
-02.9	-0.41	.0397
01.2	0.31	.0399
02.1	0.29	.0399
03.2	0.08	.0397
04.1	-0.15	.0396
06.2	-0.43	.0396
09.3	-0.95	.0396
12.3	-0.73	.0398
15.3	-0.13	.0400
18.3	-0.03	.0402
M = 2.20		
00.0	0.20	.0374
-00.9	0.08	.0374
-01.9	-0.12	.0373
-02.7	-0.34	.0372
01.1	0.35	.0372
02.1	0.28	.0370
03.1	-0.00	.0370
06.2	-0.46	.0368
09.3	-1.36	.0367
12.2	-1.70	.0368
15.3	-0.44	.0371
18.2	-0.17	.0373

[redacted]

TABLE II.- DAMPING-IN-PITCH DATA - Continued

(p) Truncated cone with small tail cone; center of moments at 2.492 l

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 0.65		
00.2	-0.11	.0759
-00.7	0.11	.0762
-01.7	-0.06	.0762
-02.7	-0.08	.0762
01.3	0.32	.0763
02.3	0.22	.0762
03.4	0.20	.0760
04.3	-0.04	.0759
06.4	-0.05	.0758
09.3	-0.61	.0756
12.4	-0.84	.0756
15.5	-0.42	.0753
18.5	-0.16	.0757
M = 0.80		
00.2	0.04	.0625
-00.6	0.01	.0625
-01.7	-0.01	.0625
-02.7	0.02	.0626
01.3	0.18	.0626
02.3	0.24	.0624
03.3	0.14	.0624
04.3	0.14	.0623
05.4	-0.04	.0620
06.4	-0.09	.0621
09.5	-0.79	.0618
12.6	-1.23	.0619
15.6	-0.37	.0628
18.6	0.06	.0633
M = 0.90		
00.3	-0.01	.0555
-00.8	-0.16	.0552
-01.7	0.31	.0554
-02.7	0.41	.0552
01.3	0.41	.0554
02.3	0.37	.0555
03.3	0.26	.0553
04.3	-0.08	.0550
06.4	-0.50	.0549
09.5	-1.02	.0548
12.6	-1.28	.0552
15.7	0.00	.0558
18.6	-0.19	.0560
M = 1.00		
00.2	-0.13	.0507
-00.8	-0.14	.0506
-01.8	0.46	.0511
-02.7	1.15	.0510
01.4	0.62	.0511
02.3	1.25	.0511
03.3	0.62	.0508
04.3	-0.35	.0503
06.5	-0.55	.0504
09.6	-0.85	.0502
12.7	-1.02	.0503
15.8	-1.23	.0507
18.9	-0.44	.0508
M = 1.10		
00.2	-0.23	.0478
-00.8	0.00	.0476
-01.7	0.51	.0478
-02.7	1.05	.0478
01.3	0.23	.0474
02.3	1.04	.0477
03.3	0.74	.0473
04.3	-0.36	.0471
06.5	-0.75	.0467
09.6	-1.22	.0467
12.7	-1.03	.0468
15.9	-0.76	.0473
19.0	-0.45	.0474
M = 1.20		
00.2	-0.07	.0435
-00.7	0.14	.0436
-01.7	0.35	.0436
-02.6	0.43	.0434
01.4	0.00	.0434
02.3	0.07	.0433
03.3	0.23	.0433
04.3	-0.32	.0431
06.5	-0.96	.0429
09.6	-1.41	.0428
12.7	-0.83	.0432
15.9	-0.41	.0436
19.0	-0.44	.0438
M = 1.30		
00.3	-0.54	.0406
-00.8	-0.55	.0405
-01.8	-0.58	.0406
-02.7	-0.28	.0405
01.4	-0.42	.0405
02.4	-0.33	.0405
03.4	-0.02	.0405
06.5	-1.02	.0403
09.7	-0.66	.0404
12.7	-0.55	.0407
15.9	-0.29	.0409
18.9	-0.21	.0410
M = 1.50		
00.2	-0.90	.0360
-00.8	-0.91	.0361
-01.8	-0.79	.0362
-02.8	-0.55	.0362
01.3	-0.71	.0362
02.4	-0.50	.0362
03.5	-0.10	.0363
04.5	-0.14	.0363
06.6	-0.65	.0365
09.7	-0.56	.0366
12.8	-0.55	.0367
15.9	-0.40	.0369
18.9	-0.26	.0371
M = 1.70		
00.2	-0.53	.0332
-00.7	-0.52	.0333
-01.8	-0.36	.0333
-02.8	-0.05	.0334
01.4	-0.33	.0334
02.3	-0.12	.0335
03.5	0.14	.0334
04.4	-0.08	.0334
06.5	-0.48	.0334
09.6	-0.54	.0336
12.7	-0.46	.0337
15.8	-0.26	.0339
18.8	-0.21	.0341
M = 1.90		
00.2	-0.75	.0315
-00.7	-0.17	.0315
-01.7	-0.30	.0314
-02.8	-0.51	.0314
01.3	-0.15	.0314
02.3	-0.12	.0313
03.4	-0.42	.0313
06.5	-0.78	.0312
09.6	-1.66	.0313
12.6	-0.66	.0315
15.8	-0.36	.0316
18.8	-0.18	.0317
M = 2.20		
00.2	-0.54	.0294
-00.7	-0.20	.0294
-01.7	-0.41	.0294
-02.7	-0.63	.0293
01.3	-0.19	.0293
02.3	-0.28	.0293
03.3	-0.43	.0293
06.4	-0.87	.0291
09.5	-1.66	.0290
12.5	-2.08	.0291
15.6	-0.53	.0293
18.6	-0.56	.0294

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TABLE II.- DAMPING-IN-PITCH DATA - Continued

(q) Truncated cone with large tail cone; center of moments at 1.982 l

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 0.65		
00.9	0.16	.0899
01.9	0.39	.0901
02.8	0.16	.0902
03.8	0.13	.0893
04.9	0.00	.0892
06.8	-0.27	.0889
09.9	-1.42	.0888
12.8	-1.13	.0884
15.9	-0.81	.0889
19.0	-1.28	.0886
-00.2	0.07	.0894
-01.0	-0.09	.0894
-02.0	-0.26	.0894
M = 0.80		
00.8	-0.06	.0741
-00.1	0.08	.0737
-01.0	0.25	.0736
-02.1	-0.19	.0738
01.8	0.40	.0736
02.8	0.17	.0737
03.9	0.07	.0735
04.6	-0.20	.0731
06.8	-0.33	.0732
10.0	-0.86	.0732
12.9	-1.02	.0732
16.0	-0.61	.0741
19.0	-0.77	.0743
M = 0.90		
00.5	-1.25	.0659
00.5	0.13	.0660
-00.1	0.32	.0657
-01.1	0.05	.0657
-02.1	-0.13	.0657
01.8	0.47	.0659
02.8	0.41	.0659
03.9	0.02	.0655
04.8	-0.20	.0652
06.9	-0.40	.0652
10.0	-1.02	.0651
13.0	-0.72	.0654
M = 1.00		
00.8	0.20	.0608
-00.1	0.24	.0607
-01.1	0.66	.0608
-02.1	0.69	.0607
01.8	0.95	.0607
02.8	0.78	.0606
03.8	-0.31	.0600
04.9	-0.58	.0601
06.9	-0.55	.0600
10.0	-0.76	.0596
13.1	-0.75	.0598
M = 1.10		
00.1	0.05	.0559
-00.8	0.28	.0558
-01.8	1.02	.0560
-02.7	0.46	.0558
01.2	0.63	.0556
02.1	1.19	.0558
03.2	0.14	.0554
04.2	-0.13	.0556
06.2	-0.20	.0555
09.3	-0.38	.0554
12.3	-0.51	.0554
15.5	-0.17	.0556
18.5	-0.13	.0557
18.5	0.07	.0557
M = 1.20		
00.0	0.24	.0516
-00.7	0.47	.0516
-01.8	0.50	.0518
-02.7	0.12	.0516
-03.8	-0.03	.0517
01.2	0.43	.0518
02.2	0.46	.0517
03.2	0.37	.0516
04.2	-0.32	.0513
06.2	-0.67	.0511
09.3	-0.65	.0511
12.4	-0.38	.0515
15.4	-0.04	.0517
18.5	0.10	.0520
M = 1.30		
00.2	-0.20	.0483
00.2	-0.12	.0484
-00.9	-0.24	.0483
-01.8	-0.22	.0484
-02.8	-0.29	.0483
01.2	-0.05	.0483
02.2	0.07	.0484
03.2	-0.09	.0483
04.3	0.19	.0481
05.3	-0.34	.0482
06.2	-0.51	.0482
09.4	-0.27	.0483
12.3	-0.23	.0485
15.5	0.08	.0487
18.5	0.15	.0490
M = 1.50		
-00.8	-0.37	.0431
-01.8	-0.37	.0433
-02.8	-0.32	.0434
00.1	-0.52	.0431
01.2	-0.11	.0433
02.2	-0.05	.0434
03.3	0.05	.0433
04.2	0.05	.0432
05.3	-0.22	.0433
06.3	-0.39	.0434
09.4	-0.36	.0435
12.3	-0.16	.0436
15.4	0.05	.0439
18.5	0.09	.0440
M = 1.70		
00.2	-0.34	.0400
-00.8	-0.17	.0400
-02.8	-0.26	.0399
01.3	0.11	.0400
02.2	0.31	.0400
03.2	0.28	.0399
04.1	0.13	.0398
05.3	-0.34	.0397
06.3	-0.22	.0398
09.3	-0.51	.0399
12.3	-0.18	.0401
15.4	0.12	.0403
18.4	0.24	.0405
M = 1.90		
00.2	0.19	.0376
-00.9	-0.03	.0376
-01.9	-0.12	.0375
-02.9	-0.23	.0374
01.1	0.26	.0375
02.2	0.19	.0374
03.2	0.00	.0373
06.3	-0.82	.0370
09.4	-0.68	.0373
12.3	-0.47	.0374
15.4	-0.02	.0376
18.3	0.32	.0379
M = 2.20		
00.1	0.46	.0351
-00.8	0.85	.0352
-01.8	0.18	.0351
-02.8	-0.29	.0349
01.1	0.61	.0350
02.1	0.40	.0349
03.2	-0.05	.0349
06.2	-0.49	.0347
09.3	-0.87	.0346
12.3	-0.83	.0347
15.3	-0.10	.0349
18.3	-0.17	.0350

[redacted]

TABLE II.- DAMPING-IN-PITCH DATA - Concluded

(r) Truncated cone with large tail cone; center of moments at 2.492 l

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	k
M = 0.65		
00.4	0.26	.0693
-00.5	0.36	.0695
-01.5	0.04	.0696
-02.6	0.10	.0699
01.3	0.74	.0696
02.3	0.75	.0697
03.4	0.68	.0696
04.4	0.38	.0692
06.4	0.32	.0700
09.4	-0.45	.0693
12.5	-0.66	.0695
15.5	-0.44	.0697
18.6	-0.24	.0700
M = 0.80		
00.3	0.37	.0578
-00.6	0.49	.0578
-01.5	0.23	.0580
-02.5	0.01	.0580
01.4	0.81	.0577
02.4	0.61	.0577
03.4	0.45	.0576
04.4	0.08	.0574
06.5	-0.21	.0574
09.6	-0.66	.0573
12.6	-1.10	.0576
15.7	0.18	.0585
18.7	-0.04	.0583
M = 0.90		
00.3	0.78	.0516
-00.5	0.74	.0518
-01.6	0.29	.0517
-02.6	0.05	.0517
01.4	0.93	.0516
02.3	0.69	.0517
03.4	0.25	.0513
04.4	-0.05	.0514
06.5	-0.39	.0512
09.6	-0.87	.0511
12.7	-0.81	.0517
15.8	0.25	.0524
18.8	0.16	.0525
M = 1.00		
00.3	0.77	.0475
-00.6	0.86	.0477
-01.6	1.46	.0477
-02.6	0.91	.0476
01.4	1.51	.0476
02.3	1.26	.0474
03.4	-0.02	.0471
06.6	-0.66	.0470
09.7	-0.64	.0466
12.8	-0.97	.0469
15.9	-0.94	.0472
19.0	-0.16	.0476
M = 1.10		
00.3	0.31	.0439
-00.6	0.71	.0440
-01.6	1.34	.0440
-02.6	0.58	.0439
01.5	1.28	.0440
02.4	1.53	.0438
03.4	0.13	.0437
04.4	-0.65	.0433
06.6	-0.68	.0434
09.7	-0.52	.0431
12.8	-1.00	.0432
16.0	-0.57	.0436
19.0	-0.15	.0438
M = 1.20		
00.3	0.39	.0406
-00.5	0.70	.0407
-01.6	0.57	.0407
-02.6	-0.00	.0406
01.4	0.55	.0407
02.4	0.60	.0407
03.5	-0.08	.0405
06.6	-1.19	.0401
09.8	-1.17	.0400
12.9	-0.46	.0405
16.0	-0.13	.0407
19.1	-0.20	.0408
M = 1.30		
00.4	-0.65	.0379
-00.6	-0.57	.0380
-01.5	-0.54	.0380
-02.5	-0.56	.0379
01.5	-0.33	.0379
02.5	-0.40	.0378
03.5	-0.30	.0379
04.5	0.04	.0378
05.6	-0.81	.0377
06.6	-0.67	.0377
09.8	-0.50	.0378
12.9	-0.26	.0381
16.0	-0.12	.0383
19.0	0.00	.0385
M = 1.50		
06.7	-0.35	.0345
09.8	-0.23	.0345
12.9	-0.11	.0346
16.0	-0.11	.0348
19.0	0.07	.0349
00.3	-0.70	.0340
-00.7	-0.70	.0340
-01.8	-0.70	.0341
-02.7	-0.48	.0341
01.3	-0.49	.0340
02.5	-0.33	.0341
03.5	0.10	.0342
04.6	-0.07	.0341
05.6	-0.74	.0342
M = 1.70		
00.3	-0.37	.0311
-00.6	-0.47	.0311
-01.7	-0.12	.0312
-02.7	-0.15	.0312
01.4	-0.20	.0311
02.4	0.22	.0312
03.5	0.22	.0311
06.7	-0.31	.0312
09.8	-1.02	.0312
12.8	-0.18	.0314
15.9	-0.03	.0316
19.0	-0.00	.0317
M = 1.90		
00.4	0.49	.0294
-00.6	0.50	.0294
-01.6	0.05	.0293
-02.7	-0.34	.0292
01.4	0.51	.0293
02.4	0.11	.0293
03.5	-0.26	.0291
06.6	-0.28	.0291
09.7	-1.39	.0292
12.6	-0.30	.0294
15.9	0.13	.0295
18.8	0.34	.0297
M = 2.20		
00.3	-0.03	.0273
-00.6	0.76	.0274
-01.6	0.45	.0274
-02.7	0.02	.0272
01.4	0.55	.0273
02.5	0.19	.0273
03.4	0.19	.0271
06.5	-0.16	.0270
09.6	-1.04	.0270
12.6	-0.86	.0271
15.7	-0.07	.0273
18.7	0.20	.0274

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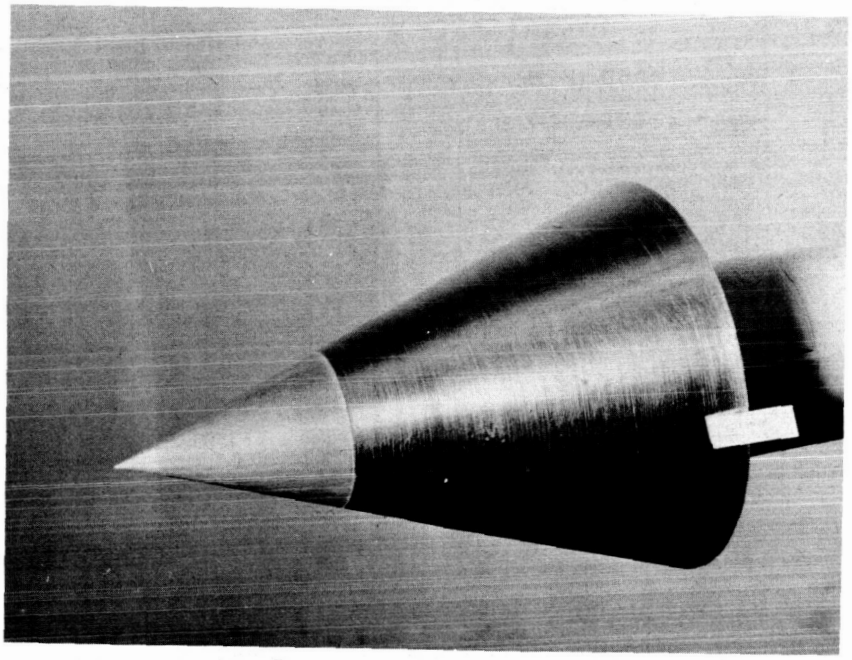
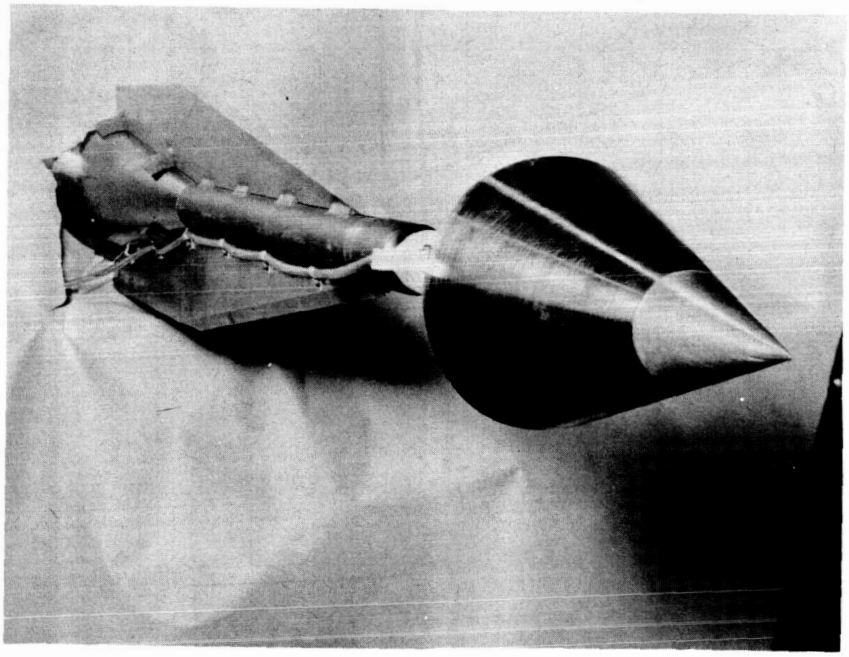


A-25064

(a) Static.



A-25065

(b) Dynamic.

Figure 1.- Photographs of sharp cone mounted on static and dynamic stings.

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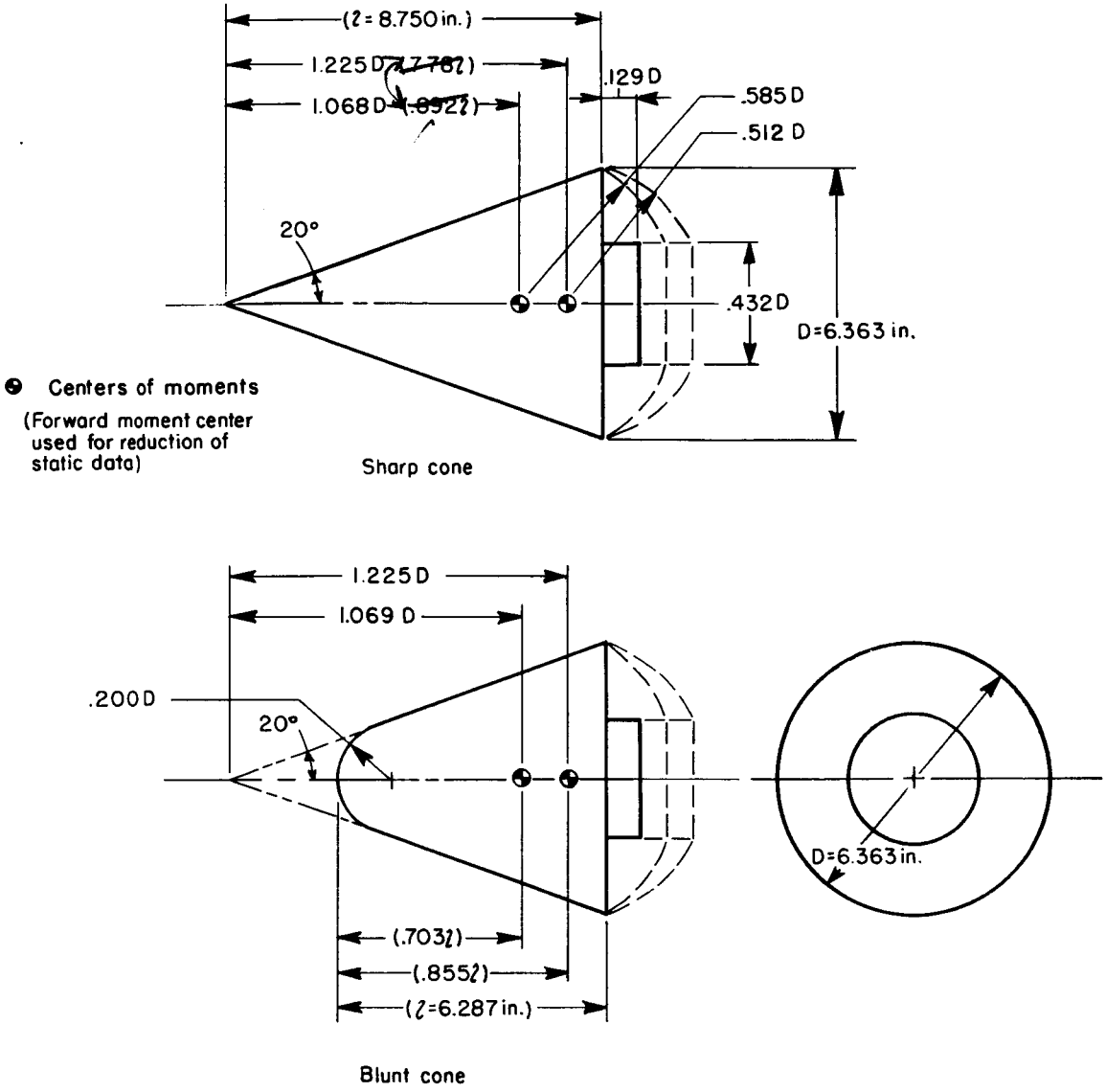

(a) Sharp and blunt cones.

Figure 2.- Drawing of models.

A 2.94

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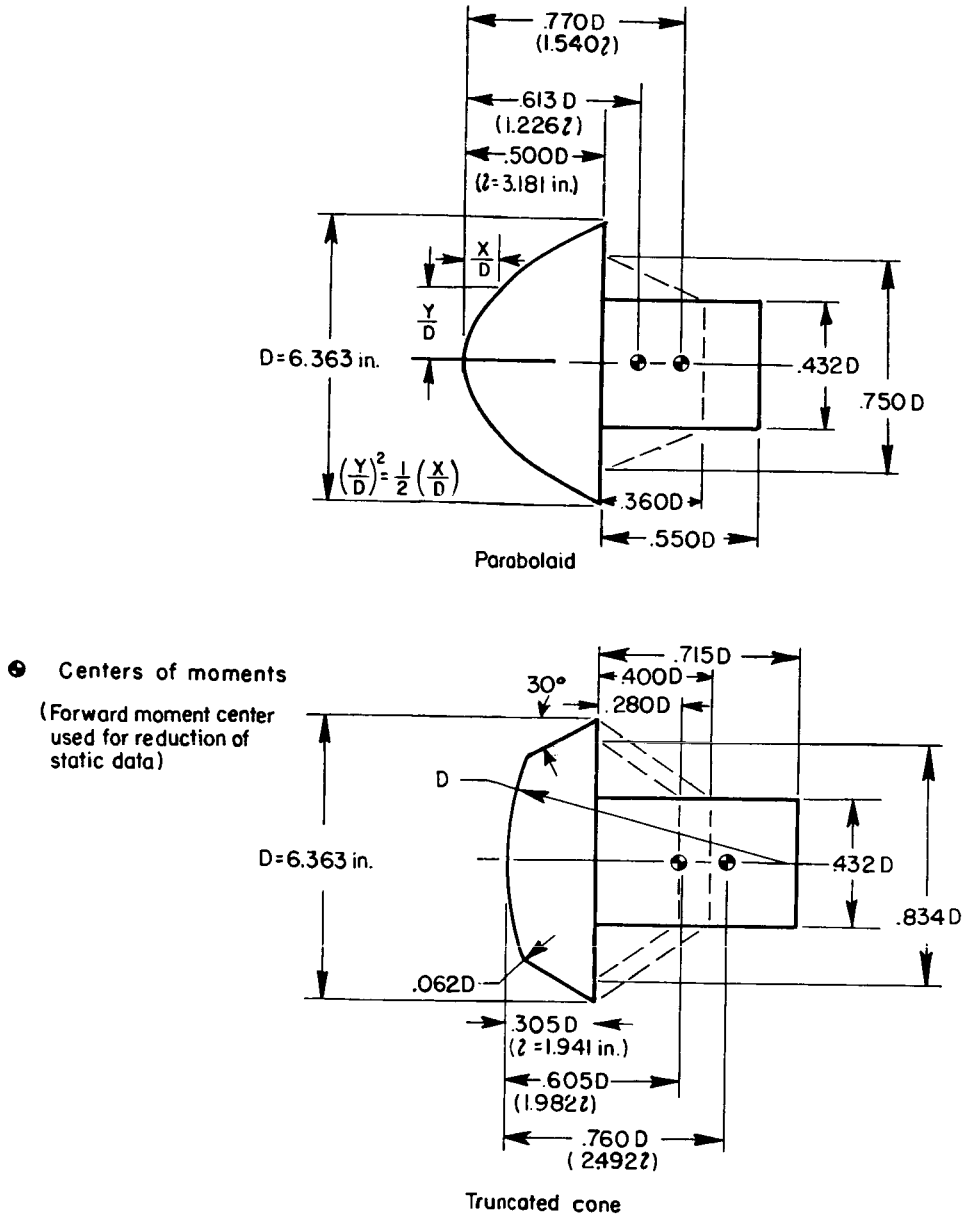

(b) Paraboloid and truncated cone.

Figure 2.- Continued.

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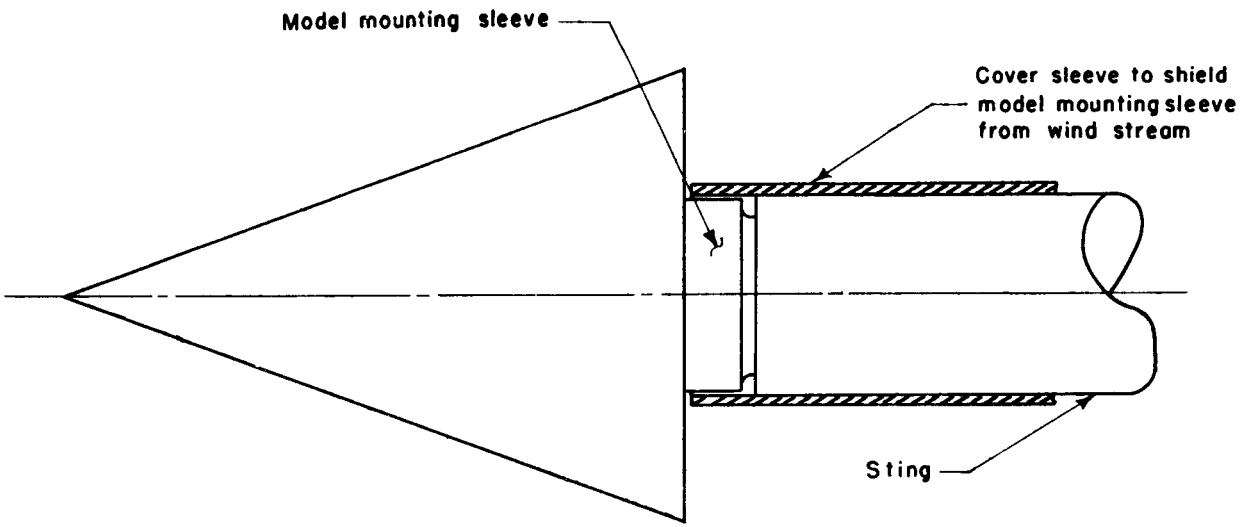


(c) Typical model installation for static tests.

Figure 2.- Concluded.

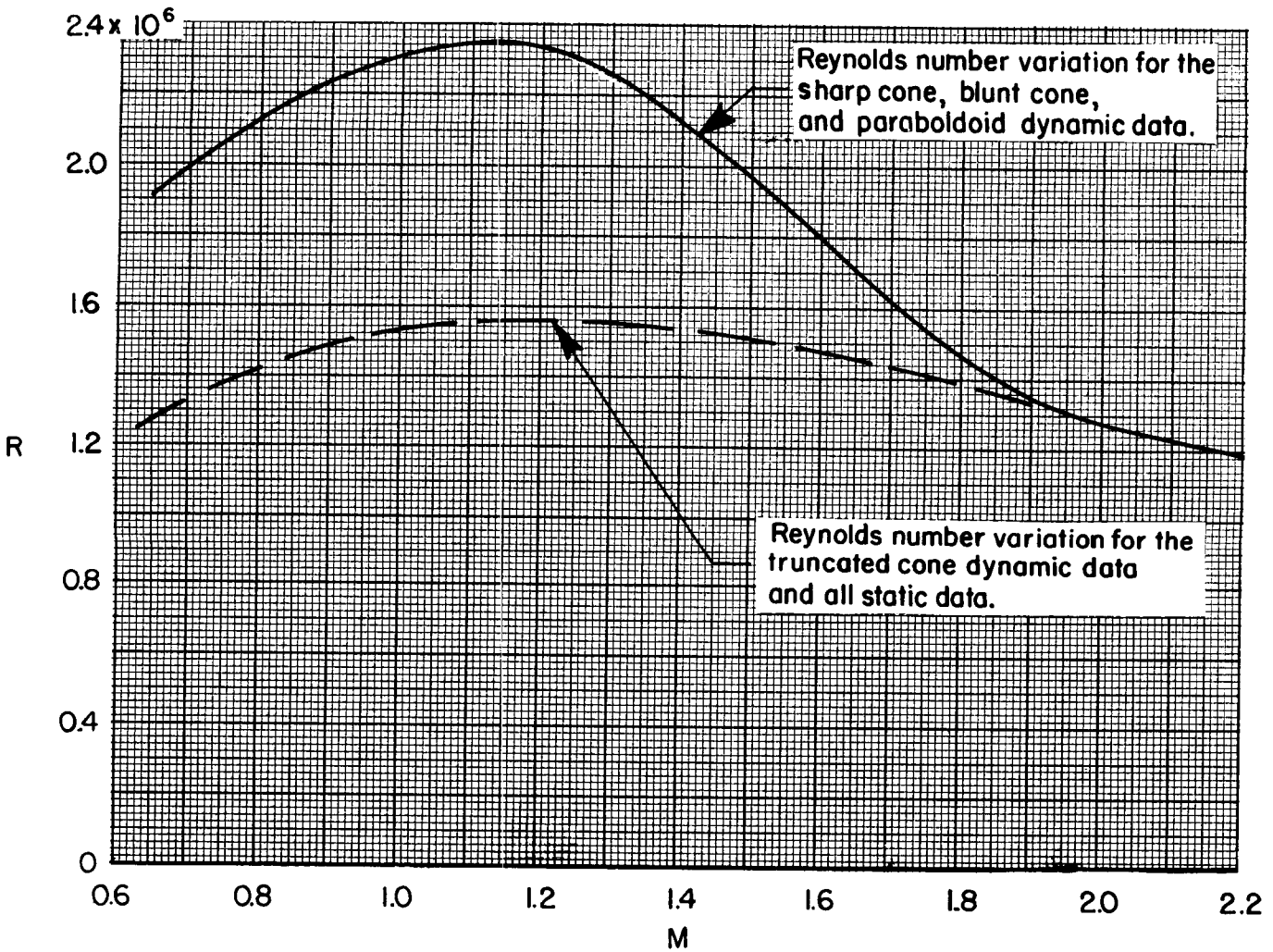


Figure 3.- Reynolds number versus Mach number.

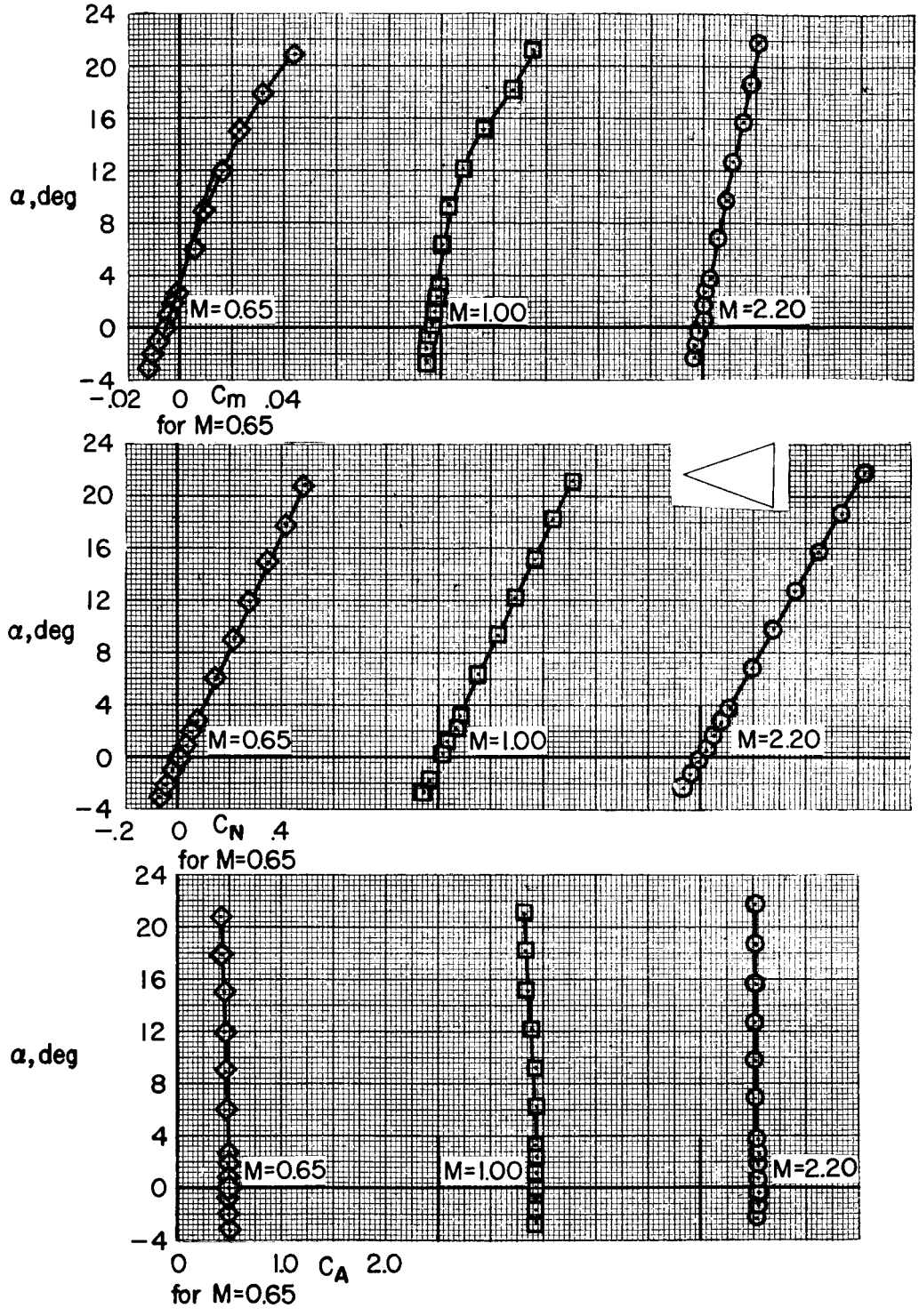


Figure 4.- Static aerodynamic characteristics of the sharp cone; moment center at 0.~~892~~ 77 l.

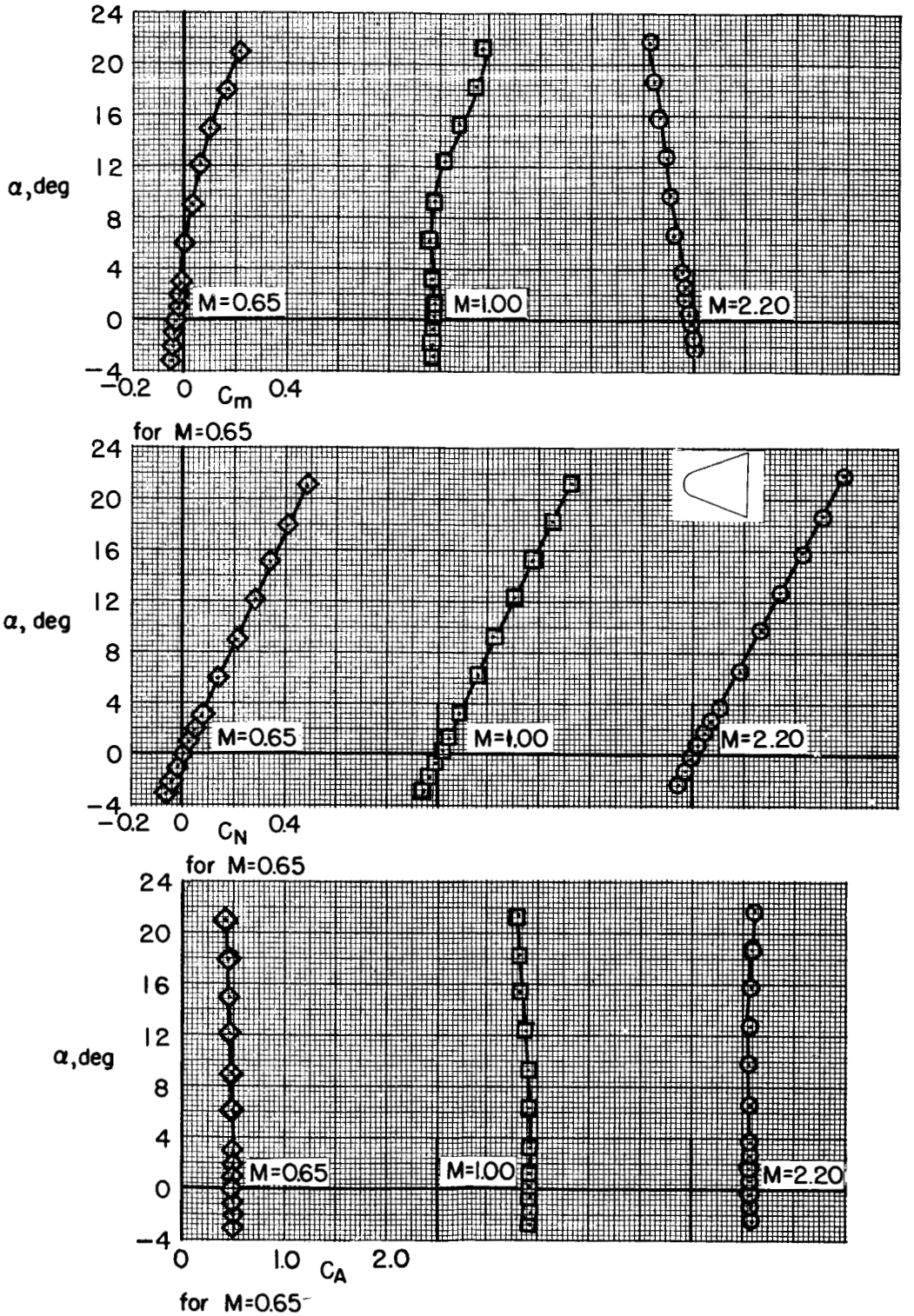
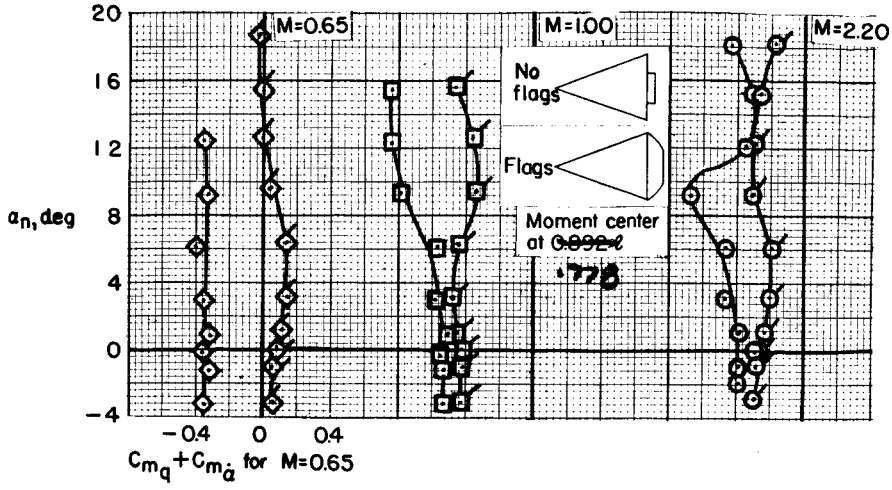
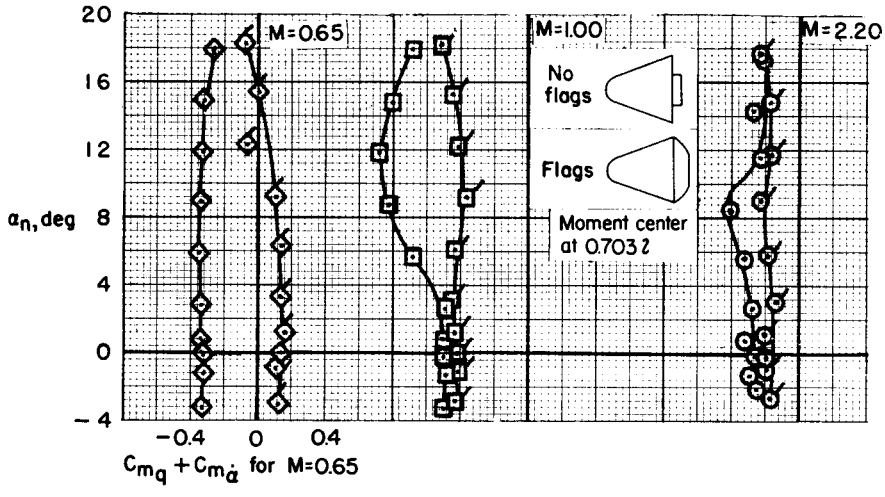


Figure 5.- Static aerodynamic characteristics of the blunt cone; moment center at 0.703 l.



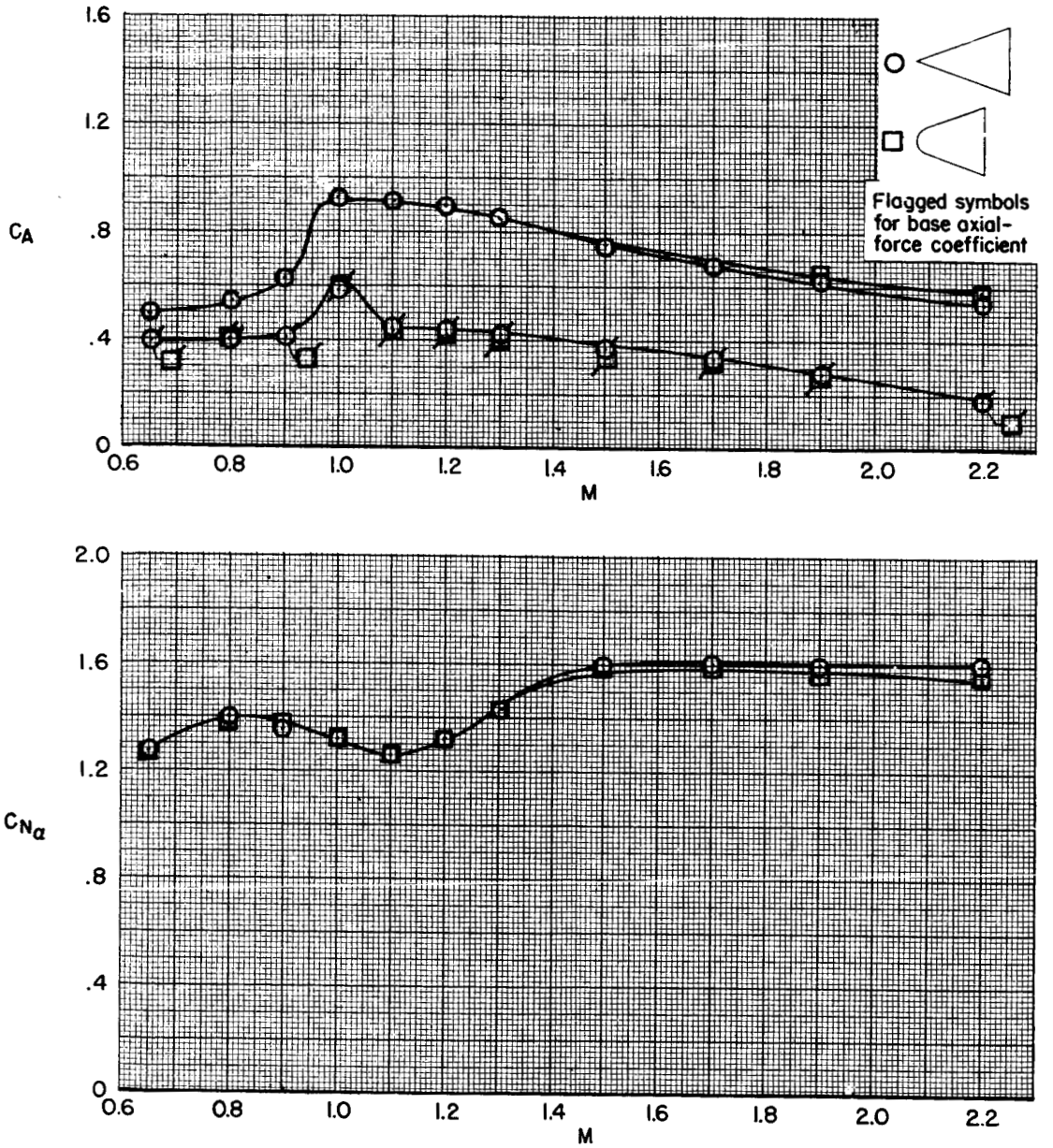
(a) Sharp cone.



(b) Blunt cone.

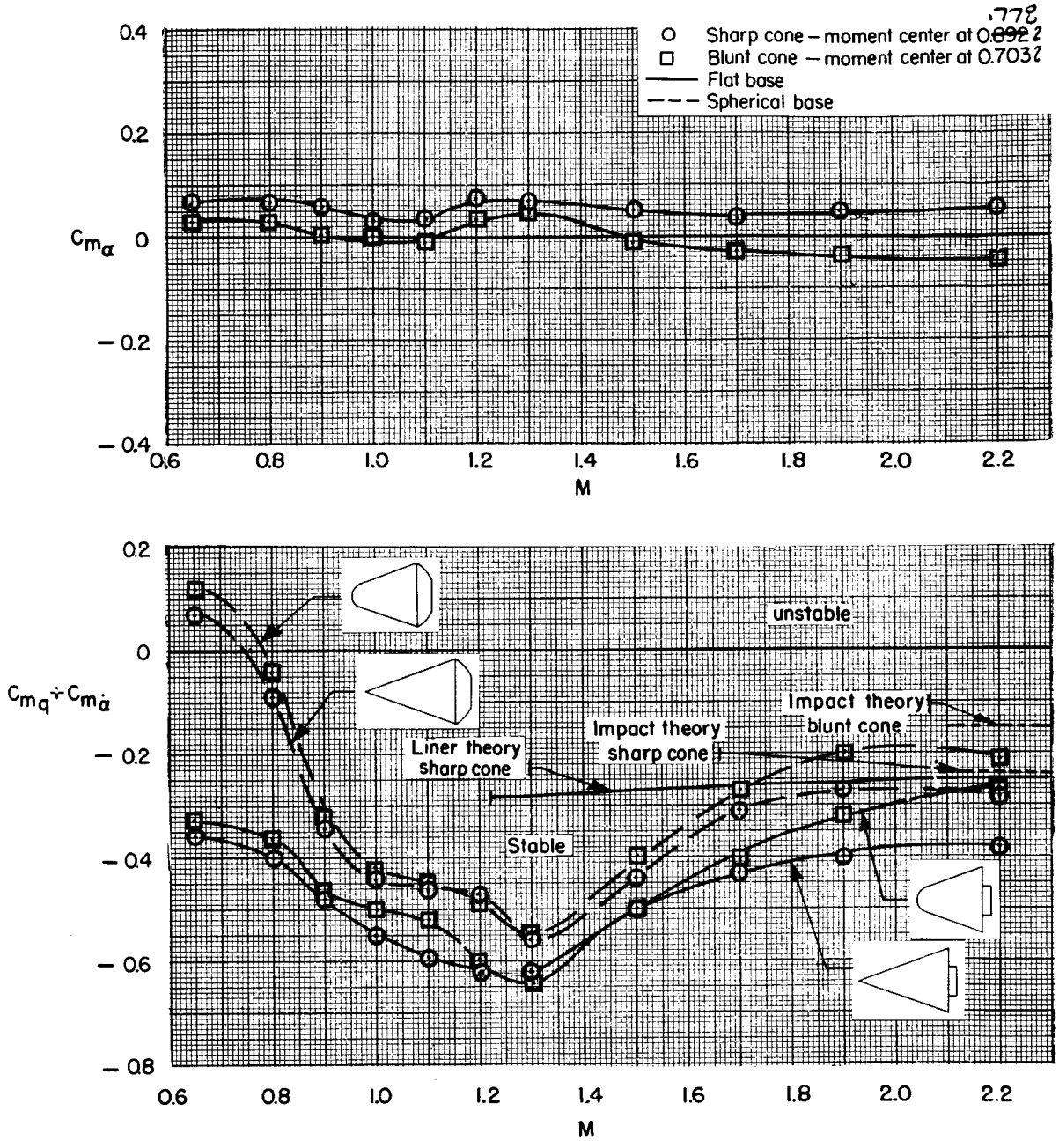
igure 6.- Damping in pitch versus angle of attack of the sharp and blunt cones with both spherical and flat bases.

A294



(a) C_A and C_{N_α} versus Mach number.

Figure 7.- Axial-force coefficient and stability derivatives of the sharp and blunt cones at zero angle of attack.



(b) C_{m_α} and $C_{m_q} + C_{m_{\dot{\alpha}}}$ versus Mach number.

Figure 7.- Concluded.

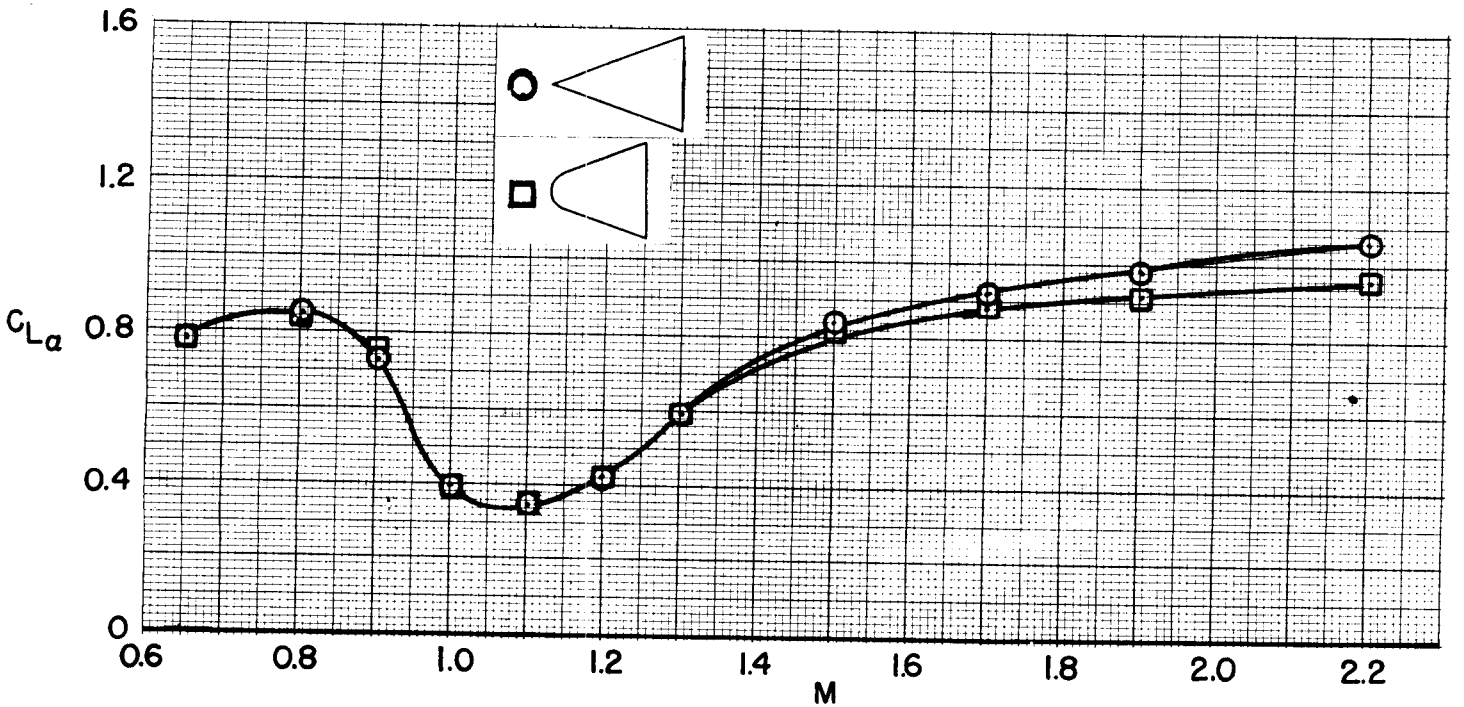


Figure 8.- Lift-curve slope at zero angle of attack versus Mach number of the sharp and blunt cones.

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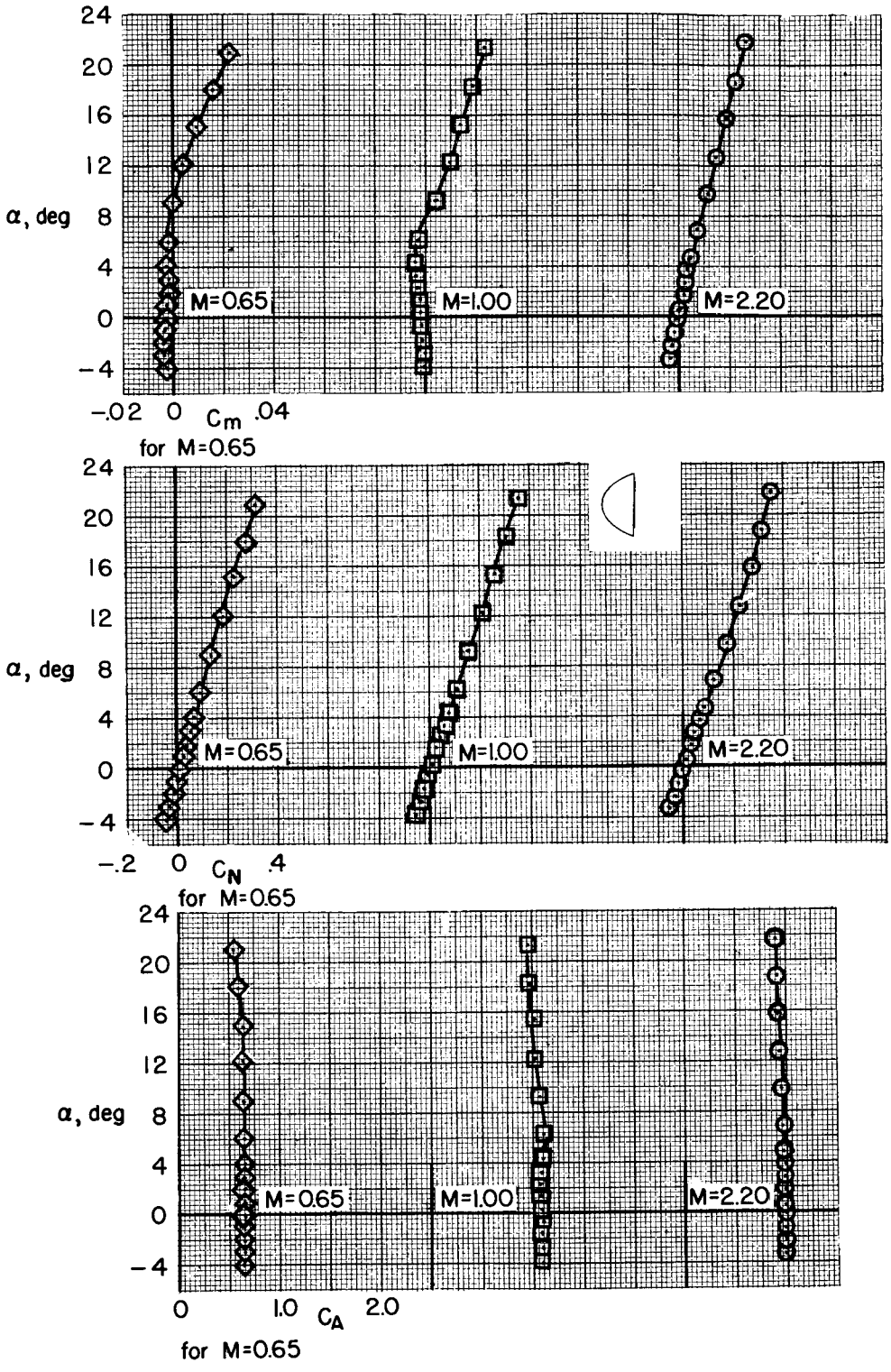

Figure 9.- Static aerodynamic characteristics of the paraboloid without an afterbody; moment center at 1.226 l.

[redacted]

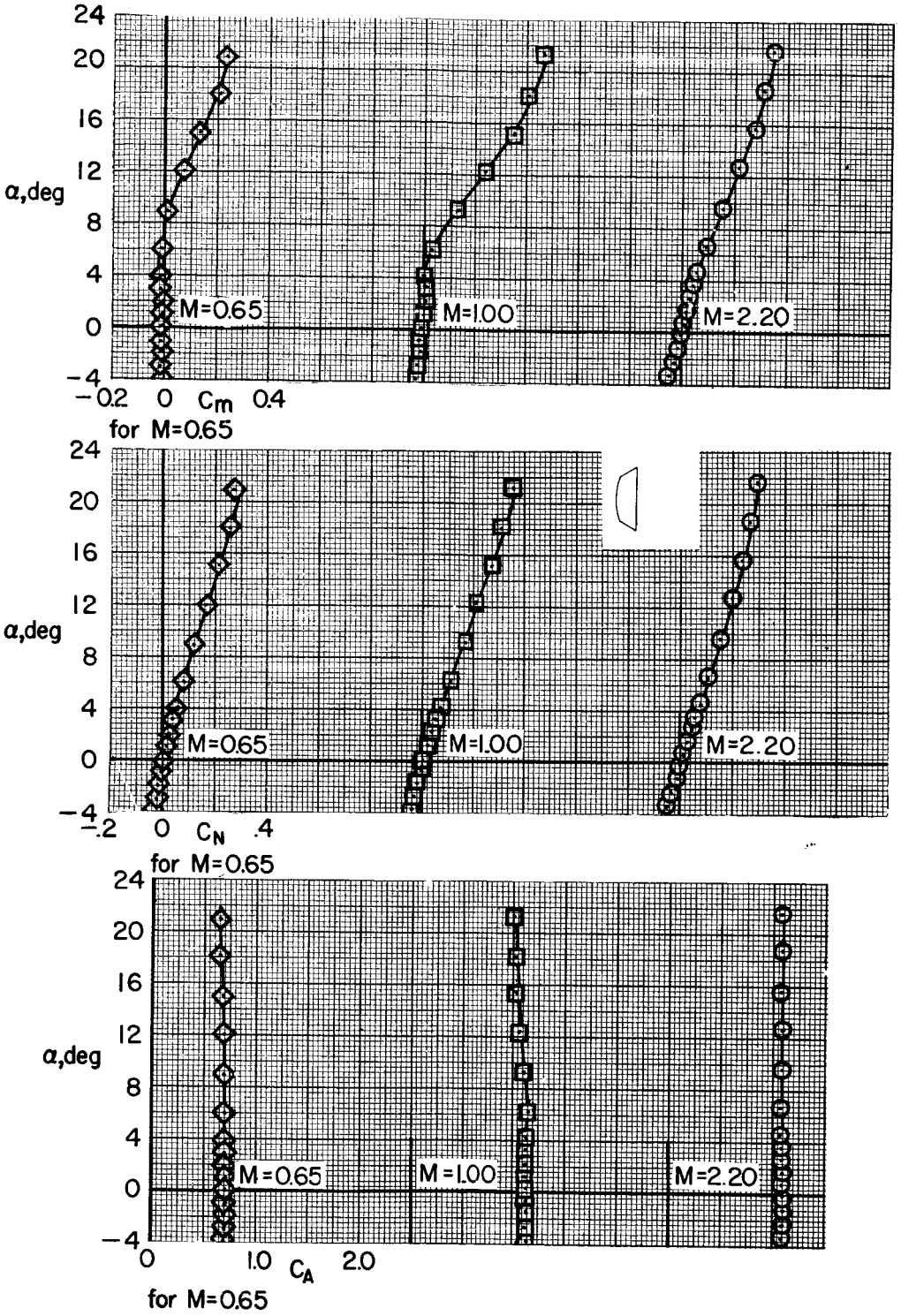

Figure 10.- Static aerodynamic characteristics of the truncated cone without an afterbody; moment center at 1.982 l.

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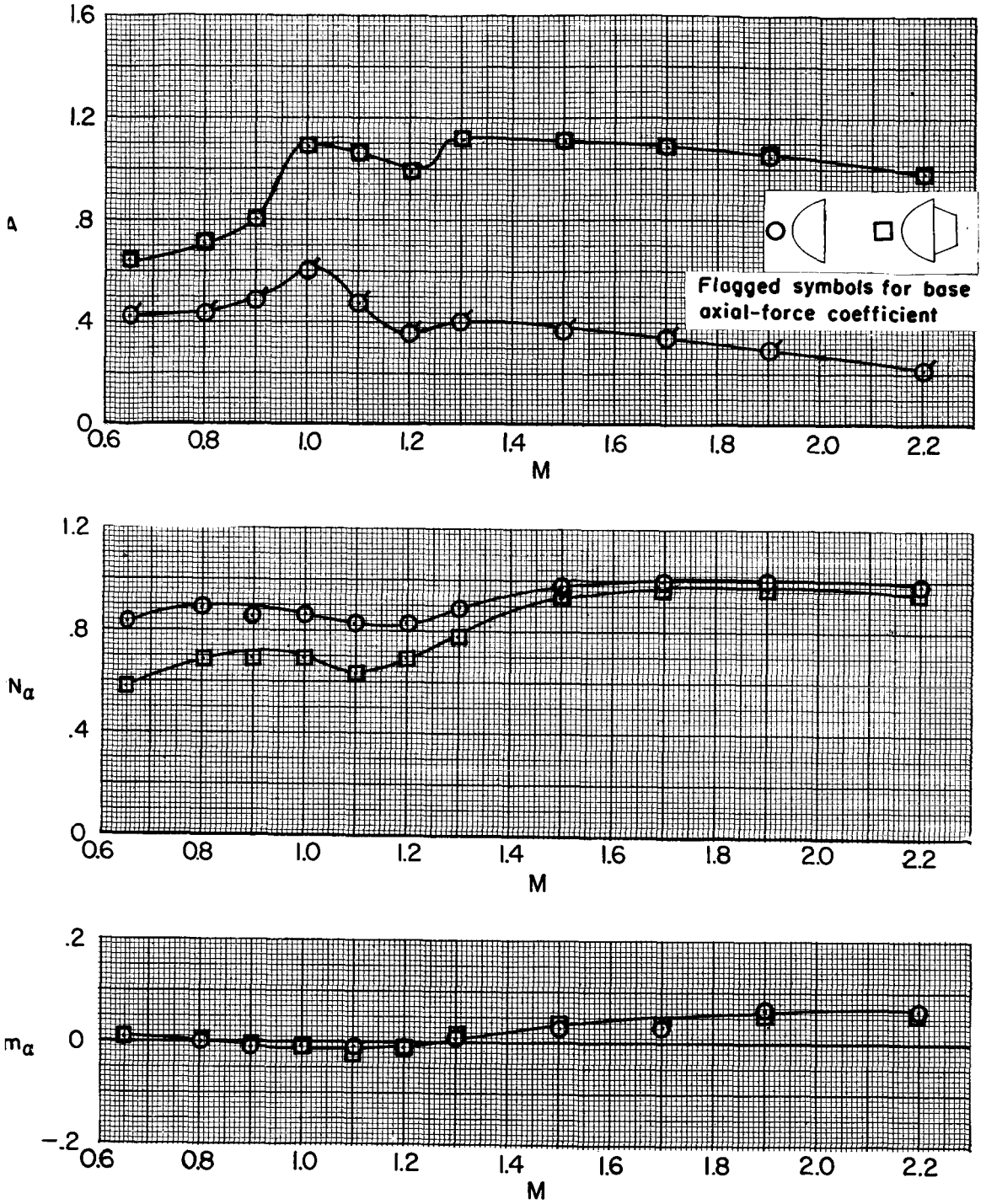

Figure 11.- Axial-force coefficient and stability derivatives at zero angle of attack of the paraboloid without and with an afterbody; moment center at 1.226 l.

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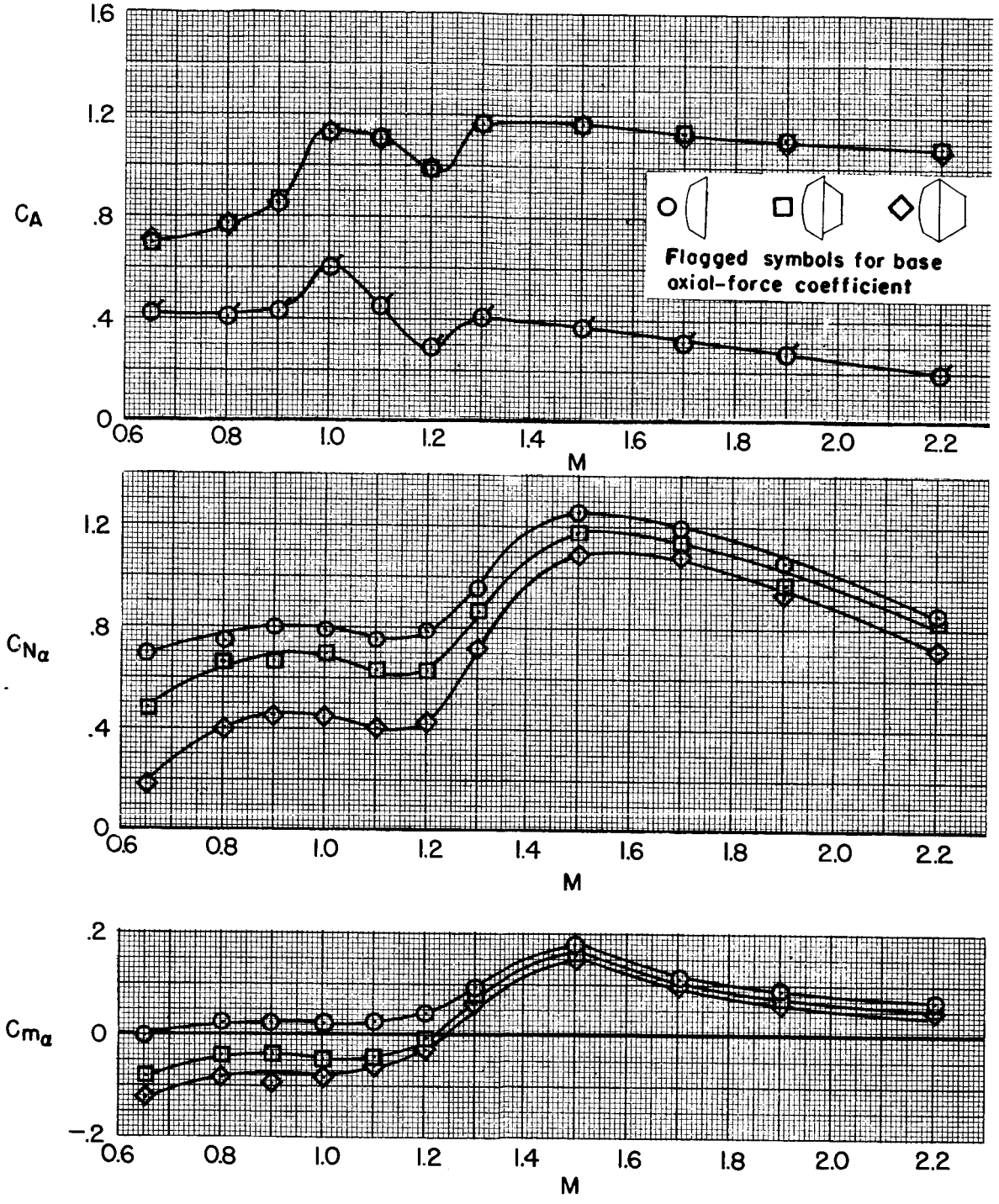

Figure 12.- Axial-force coefficient and stability derivatives at zero angle of attack of the truncated cone without an afterbody and with small and large afterbody; moment center at 1.982 l.

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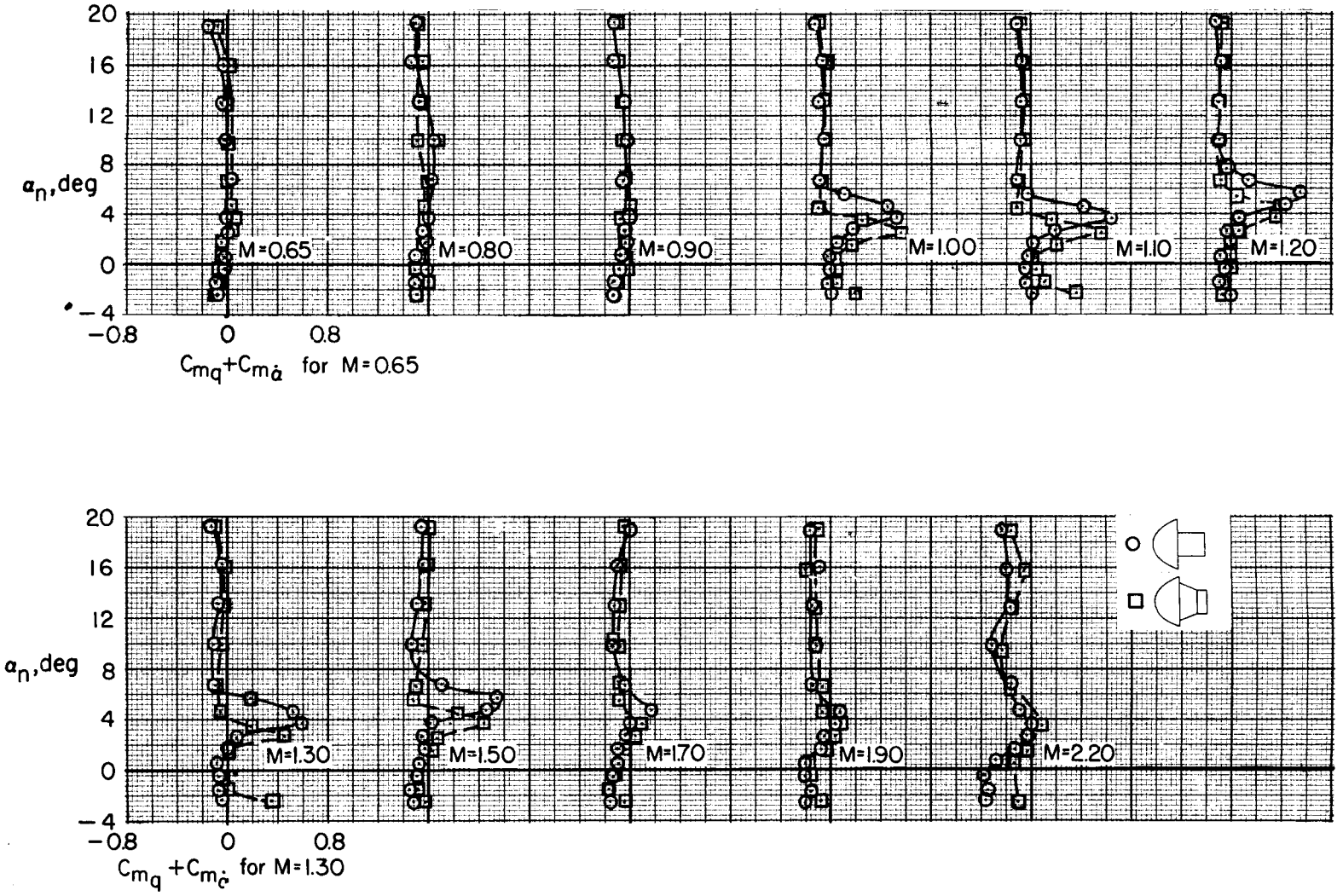

Figure 13.- Damping in pitch versus angle of attack of the paraboloid with and without a tail cone; moment center at 1.226 l.

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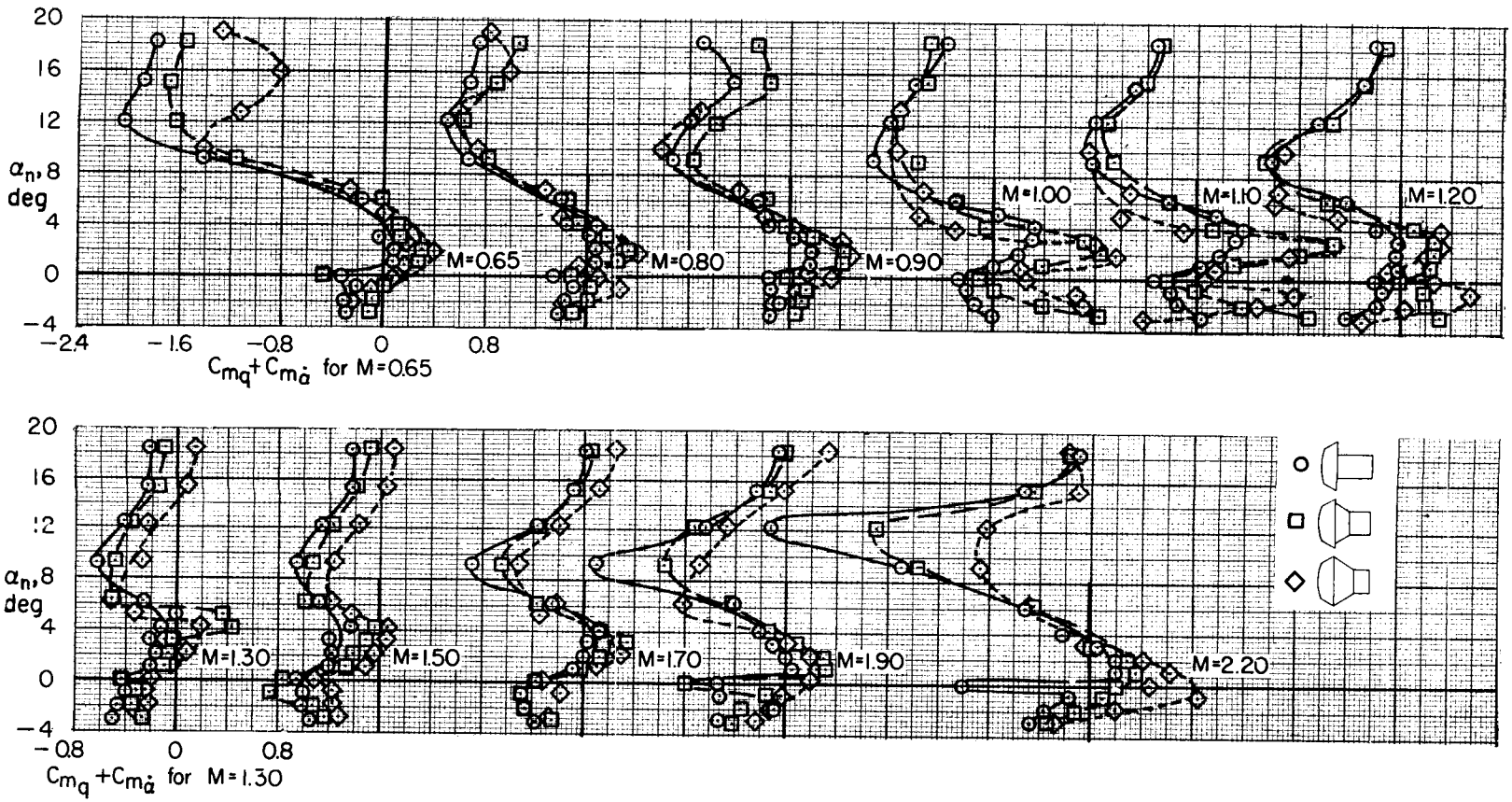

Figure 14.- Damping in pitch versus angle of attack of the truncated cone with the large tail cone, small tail cone, and without a tail cone; moment center at 1.982 l.

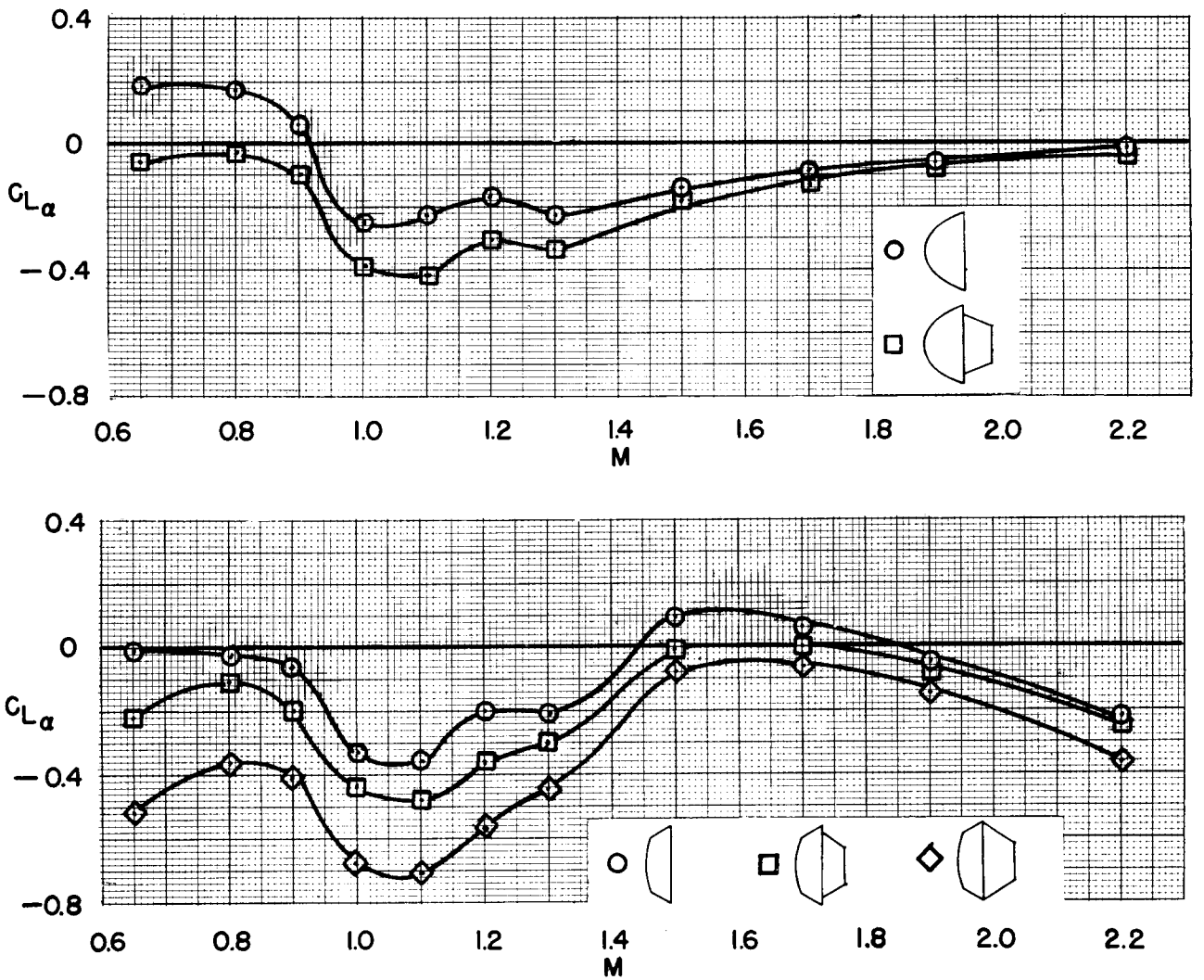

Figure 15.- Lift-curve slope at zero angle of attack versus Mach number for the paraboloid and the truncated cone.

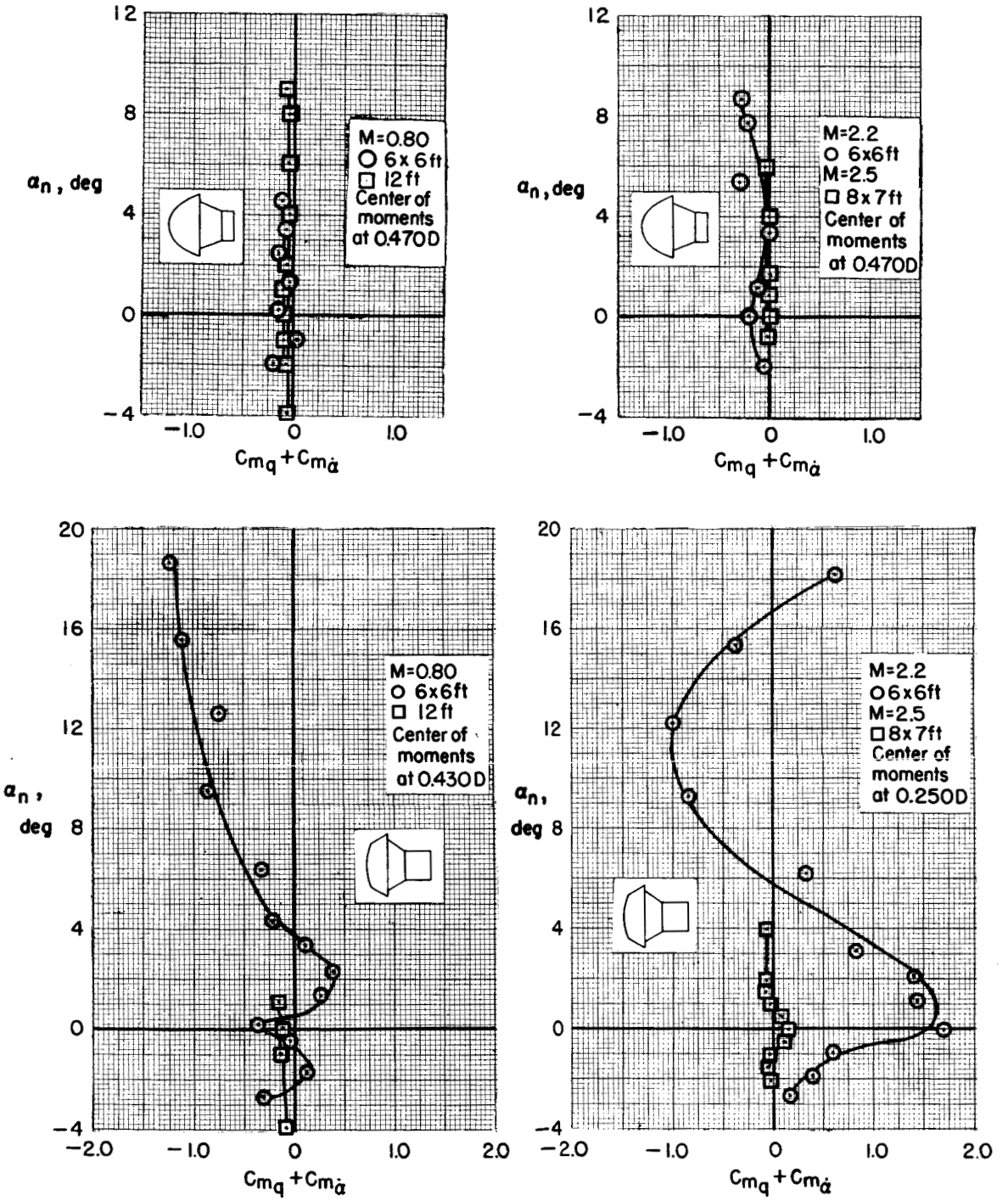

Figure 16.- Comparison of data from several Ames wind tunnels for the paraboloid and the truncated cone.