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AN EXPERIMENTAL EVALUATION OF AERODYNAMIC DAMPING MOMENTS OF CONES WITH DIFFERENT CENTERS OF ROTATION

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AN EXPERIMENTAL EVALUATION OF AERODYNAMIC DAMPING MOMENTS OF CONES WITH DIFFERENT CENTERS OF ROTATION

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SUMMARY

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The static and dynamic stability characteristics of a 12-1/2° semivertex angle cone were studied. The cone was tested with both sharp and blunt tips and with a flat base and spherical segment afterbodies. The tests were performed at Mach numbers from 0.25 to 2.20 for angles of attack from -13° to +18°. The Reynolds number varied from 0.68 million to 1.54 million based on model base diameter. Presented are measurements of the normal force, axial force, base pressure, and pitching moment from the static tests, and the damping-in-pitch moment from the dynamic tests. The reduced frequency varied from 0.013 to 0.133 during the oscillatory tests.

The damping-in-pitch moments were measured for three moment centers. The measured values from two of the moment centers were then used to compute the damping moment for the third location, and the transferred and the measured damping were compared. The transfer technique was found to be valid for the models investigated.

Tests with different sting diameters and lengths showed that, in general, the damping moment was not sensitive to variations of sting geometry.

INTRODUCTION

Wind-tunnel measurements of aerodynamic damping of models of flight vehicles are frequently made with a small-amplitude single-degree-of-freedom balance system. A typical forced-oscillation system is described in reference 1. The balance portion of this system is generally instrumented so that the damping is measured only about the oscillation axis of the balance. Design changes in the flight vehicle may make it imperative to know the damping about some other moment center and since additional wind-tunnel tests are not always possible, one would like to be able to compute the damping about the new moment center from the data already available. With the method used in reference 2 to transfer the damping moment it is necessary to know the damping about two moment centers in order to compute the value for a third. Because of the poor agreement between the transferred and measured damping in reference 2 where damping moments were transferred in order to compare data from two wind tunnels, there was a question of whether this method could be used for blunt reentry type bodies. The present investigation was therefore undertaken to check experimentally the use of the transfer technique on reentry shapes.

The basic configuration for the study, a 12-1/2° semivertex angle cone, was tested with a sharp tip and with a blunt spherical tip. Both models were tested with flat bases and spherical segment afterbodies. The results of static and dynamic measurements are presented for all the configurations so that not only could the accuracy of the transfer of the damping moment be checked but the data would be sufficiently complete for fundamental research information. The tests were conducted in the Ames 6- by 6-Foot Supersonic Wind Tunnel at Mach numbers from 0.25 to 2.20.

To determine the significance of model-support interference, the effects of sting length and diameter on the damping in pitch were also evaluated at angles of attack near 0° and Mach numbers of 0.65, 1.00, and 1.60.

SYMBOLS

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

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

C_{D_o} total drag coefficient at zero angle of attack

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, $\frac{m}{(1/2)\rho V^2 Sd}$

$C_{m_q} + C_{m_{\dot{\alpha}}}$ 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} variation of pitching-moment coefficient with angle of attack at zero angle of attack, $\frac{\partial C_m}{\partial \alpha}$, per radian

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

$C_{N_q} + C_{N_{\dot{\alpha}}}$ damping-in-pitch normal-force coefficient, $\frac{\partial C_N}{\partial (qd/V)} + \frac{\partial C_N}{\partial (\dot{\alpha} d/V)}$, per radian

C_{N_α}	variation of normal-force coefficient with angle of attack at zero angle of attack, $\frac{\partial C_N}{\partial \alpha}$, per radian
C_{p_b}	base pressure coefficient, $\frac{p_b - p_s}{(1/2)\rho V^2 S}$
d	body maximum diameter
K	reduced frequency parameter, $\frac{\omega d}{V}$
M	Mach number
m	pitching moment
$m_q + m_{\dot{\alpha}}$	damping-in-pitch moment, $\frac{\partial m}{\partial(qd/V)} + \frac{\partial m}{\partial(\dot{\alpha}d/V)}$
m_α	variation of pitching moment with angle of attack, $\frac{\partial m}{\partial \alpha}$
N	normal force
$N_q + N_{\dot{\alpha}}$	damping-in-pitch normal force, $\frac{\partial N}{\partial(qd/V)} + \frac{\partial N}{\partial(\dot{\alpha}d/V)}$
N_α	variation of normal force with angle of attack, $\frac{\partial N}{\partial \alpha}$
p_b	static pressure at model base, measured at the opening in the model base and at the side of the sting
p_s	free-stream static pressure
q	pitching velocity, radians/sec
R	Reynolds number based on d
S	base area, $\frac{\pi d^2}{4}$
t	time
V	free-stream velocity
x	transfer distance, positive toward base of model
α	angle of attack
$\dot{\alpha}$	variation of angle of attack with time, $\frac{\partial \alpha}{\partial t}$, radians/sec

ρ air density

ω circular frequency of oscillation, radians/sec

Subscripts

0, 1, 2 moment center locations

0-1, 0-2 distance between moment centers, positive toward model base

APPARATUS

Wind Tunnel and Balances

The aerodynamic measurements were made 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 0.25 to 2.20.

The static aerodynamic forces and moments were measured by means of a conventional six-component strain-gage balance within the model. The balance and models were supported in the wind tunnel by a 2-inch-diameter sting.

The aerodynamic damping moments were measured with a single-degree-of-freedom forced-oscillation system which permits a small amplitude of oscillation (about $\pm 3\text{-}1/2^{\circ}$). A similar balance system is shown in reference 1. The balance on which the model was mounted is essentially a set of crossed flexures that act as a mechanical spring and also fix the oscillation axis of the model. The model is driven by an electromagnetic shaker in a pitching motion, and oscillates at some predetermined amplitude and at the natural frequency of the system. The information necessary to compute the damping moment was obtained from a calibrated strain-gage system within the balance. The models were sting mounted as shown in figure 1.

Models

The basic shape of the models of this investigation was a right circular cone with a $12\text{-}1/2^{\circ}$ semivertex angle. One version of the model had a pointed nose and another had a spherically blunted nose. In addition, the models were tested with flat bases and with spherical segment afterbodies. Sketches of the models are shown in figure 2(a). The purpose of the spherical segment afterbodies was to minimize the moment contribution of the base so that the forebody damping could be measured. The radius of each afterbody was chosen so that the center of the sphere coincided with the center of moments. The line of action of pressure forces on the base then passed through the moment center and, aside from the tangential friction forces, the resultant base moment was zero.

A solid model was used during most of the tests, but during the test concerned with sting interference effects, a partly hollow model was also used. Figure 2(b) shows the shape of the hollow chamber.

In order to allow the model to oscillate without hitting the sting, the clearance hole in the base of the model was made fairly large. The hole was circular and gave a clearance of about 3/8 inch all around the sting.

The maximum diameter of the models was 6.36 inches. This gives a ratio of 0.00614 for the model maximum area to the cross-section area of the wind-tunnel test section.

Sting Configurations

For most of the oscillation tests, the sting was 2 inches in diameter and had a pair of stiffener plates perpendicular to the oscillation axis of the model (see fig. 2(c)). These plates minimized sting deflection and reduced unwanted vertical motion of the model moment center. For the static tests, a plain 2-inch-diameter sting was used.

In the phase of the investigation concerned with the effects of sting length and diameter on the damping moment, the sting length and diameter were varied by means of fairings. No sting stiffener plates were used in this phase of the test. Figure 2(c) is a sketch of the different sting configurations. The length was varied by use of a sheet-metal cone representing the conical portion of the basic model support that could be moved along the sting and positioned at any location. The three sting lengths studied were the normal full length (basic) sting, half normal length, and zero length.

The variation of sting diameter was accomplished by the addition of constant diameter wood sleeves around the sting. The three diameters considered were 2, 2-1/2, and 3 inches. The sleeves extended inside the model base so that it was necessary to enlarge the circular hole in the model base to accommodate the larger sting diameters.

TESTS AND PROCEDURES

Measurements were taken during the static and oscillation tests for Mach numbers from 0.25 to 2.20 and angles of attack from -13° to $+18^{\circ}$. The variation of Reynolds number with Mach number is shown in figure 3.

The quantities measured during the static tests were the normal force, axial force, pitching moment, and the base pressure. The axial-force data presented in the report are the total axial forces acting on the strain-gage balance with no adjustment of the base pressure.

The quantity measured during the oscillation tests was the aerodynamic damping moment from which the parameter $C_{m_q} + C_{m_{\dot{\alpha}}}$ was evaluated. The measurements were made at reduced frequencies from 0.013 to 0.133. The damping moments were measured with the model set at a nominal angle of attack and then oscillated $\pm 1\text{-}1/2^{\circ}$ about this position. The damping moments were measured about all three of the moment centers shown on figure 2(a).

As previously stated, the models were constructed with either a flat or a spherical segment base. For oscillation tests conducted with a spherical based configuration, the center of the spherical segment always coincided with the particular moment center or oscillation axis being used.

Accuracy

The accuracy of the data estimated from repeated measurements is as follows:

Static data		Dynamic data	
C_A	±0.010	$C_{m_q} + C_{m_{\dot{\alpha}}}$	±0.10
C_N	±0.004	K	±0.0001
C_m	±0.001		
C_{p_b}	±0.003		
α	±0.10		

RESULTS AND DISCUSSION

Transfer Equation

The equations for transferring rotary aerodynamic derivatives from one pitch axis location to another are frequently given in dynamic stability literature. For an arbitrary displacement in only the longitudinal direction of the origin of the system of axes (moment center) the equations are considerably simplified. A derivation of the transfer equation for aerodynamic damping-in-pitch moment for an arbitrary longitudinal displacement of the moment center is given in the appendix and the equation is repeated here in conventional coefficient form:

$$\left(C_{m_q} + C_{m_{\dot{\alpha}}}\right)_o = \left(C_{m_q} + C_{m_{\dot{\alpha}}}\right)_1 + \frac{x_{o-1}}{d}\left(C_{N_q} + C_{N_{\dot{\alpha}}}\right)_1 - \frac{x_{o-1}}{d}\left(C_{m_\alpha}\right)_1 - \left(\frac{x_{o-1}}{d}\right)^2 C_{N_\alpha}$$

This equation, of course, was derived with the usual limitations and assumptions involved in stability derivative concepts. The derivatives are assumed linear, at least for small variations of α, $\dot{\alpha}$, and q, and the principle of superposition is employed.

From the transfer equation it can be seen that in order to compute the damping moment for center (0), not only the damping moment for location (1) but also the damping normal force and the static stability characteristics must be known. With the measurement system employed for the data of this report, only a dynamic moment about the oscillation axis of the balance and the static stability characteristics are obtained. As a result, in order to transfer damping moments with this system, it is necessary to measure the damping moment for two locations of the oscillation axis and the static stability characteristics. If the damping normal force is eliminated from the moment transfer, the following equation is then obtained:

$$\left(C_{m_q} + C_{m_{\dot{\alpha}}}\right)_0 = \frac{\frac{x_{0-1}}{d}\left(C_{m_q} + C_{m_{\dot{\alpha}}}\right)_2 - \frac{x_{0-2}}{d}\left(C_{m_q} + C_{m_{\dot{\alpha}}}\right)_1}{\left(\frac{x_{0-1}}{d} - \frac{x_{0-2}}{d}\right)} - \left(\frac{x_{0-1}}{d}\right)\left(\frac{x_{0-2}}{d}\right) C_{N_\alpha}$$

The subscripts on the damping derivatives refer to the moment center locations and the terms x_{0-1} and x_{0-2} are the distances between the moment centers. The transfer distances are measured from the moment center about which the damping moment is to be computed to the moment centers where the damping is known (distances measured toward the rear of the model are considered positive).

Damping-Moment Transfer

One purpose of the present investigation was to check the adequacy of the damping-moment transfer relationship for an axisymmetric entry-type body. This type of vehicle would have a fairly blunt forebody and a large base area. It would also be likely to have stability characteristics somewhat nonlinear with angle of attack. The procedure of the study was to measure the damping moments about three moment centers and then compute the damping for each location using the measured damping values from the other two. A comparison was then made between the measured and transferred values.

The variations of the damping-in-pitch coefficients with angle of attack are shown in figure 4 for the sharp and blunt cones with both flat and rounded bases. Both the measured values of damping and the transferred values are shown. Data are compared only for Mach numbers 0.65, 1.00, 1.30, and 2.20, which are considered representative of the subsonic, transonic, and supersonic speed ranges. Measured data for other Mach numbers are included in table I. It should be noted that the transfer was made using the damping values shown by the curves faired through the measured readings. This was necessary since the data for the various moment centers rarely were taken at identical angles of attack.

The agreement between the measured and transferred data as shown on figure 4 varies a great deal depending on Mach number and configuration. For the majority of the data the agreement is good; that is, the transferred data give a reasonable value of the damping as compared with the measured value. In other cases the agreement ranges from fair to poor. It appears that throughout the Mach number range the agreement was better for the blunt cone than for the sharp cone.

It is not clear why there is such a variation in agreement between the measured and the transferred data. Nonlinearity with angle of attack does not seem to be the reason since the blunt cones at $M = 1.00$ have measured data that are nonlinear and the transferred points are generally in good agreement. One possibility is that the transfer equation shows that for the small moment center transfer distances considered in this investigation, the transfer is nearly linear with moment center location. The discrepancies may therefore be the result of some nonlinearity with moment center movement not accounted for in the derivation of the transfer equation. The most likely reason for the poor agreement is that the transfer computation involves the difference between two numbers of similar magnitudes which may tend to magnify small irregularities in the measured damping readings.

For the sharp cone with the spherical base, damping was measured for only the middle moment center (fig. 4(c)). This means, of course, that no transfer of the damping moment could be made. The data for this model are included throughout the report because they may be of general interest since the shape is related to the others considered in the report.

The static characteristics for the models are shown in figure 5. As with the damping data, results are shown only for Mach numbers of 0.65, 1.00, 1.30, and 2.20. Data for other Mach numbers are presented in table II. Figure 5 also shows that the value of C_{N_α} is nearly constant with angle of attack for all models.

Figure 6 shows the variation of the zero angle-of-attack values of both the static and dynamic stability derivatives with Mach number. One set of transferred damping moments is also shown, as well as a comparison of measured damping with linear theory for the sharp cone. Comparing the transferred and measured damping shows that the transfer is generally satisfactory throughout the Mach number range. The data for the sharp cone show somewhat poor agreement in the transonic and subsonic speed ranges, but those for the blunt cone show good agreement throughout the entire range. The poor agreement for the sharp cone would be expected in light of figure 4.

The comparison of the linear theory with the experimental data shown in figures 6(a) and 6(b) shows good agreement for the static characteristics and reasonable agreement for the damping in pitch. The theory shown is the combination first- and second-order linear theory given in reference 3 applicable to sharp-nosed cones. A comparison of the theoretical damping value with the measured damping for both the cone with the flat base and with the spherical base shows that the theory agrees best for the model with the spherical base, as would be expected.

The effect of the alternate oscillation axes on the zero angle-of-attack values of damping moment coefficients is shown in figure 7. The linear theory values for the sharp cone and the transferred damping moments for all the bodies are shown. Both the transferred and the theoretical damping show the same trends as the measured values for movement of the moment center.

Shape Changes

In addition to the variation of damping due to movement of the moment center, figure 7 also shows the effect of blunting the nose of the cone and the effect of the addition of the spherical base. Both of these modifications had a destabilizing effect on the damping. As seen in figures 4 and 6, this destabilizing shift is typical throughout the entire Mach number range and also throughout most of the angle-of-attack range. The most pronounced change occurred at subsonic Mach numbers with the addition of the spherical base where the damping became unstable for both the sharp and the blunt cones. These changes in damping level are similar to those shown in reference 2.

Sting Interference

A second phase of the investigation was concerned with possible sting interference effects on the damping moments for the model shapes under consideration. Since the base has a sizable effect on the damping, especially at subsonic speeds, it was reasoned that the sting configuration might also have some effect. The round-nosed cone with both the flat and the spherical bases was used for this part of the investigation. The damping was measured only at Mach numbers of 0.65, 1.00, and 1.60 and at zero angle of attack.

The damping was measured for three sting diameters and for three lengths of the 2-inch-diameter sting with the hollow model. Since the sting used for these tests did not incorporate the stiffeners previously described, the solid model was also tested with the unstiffened 2-inch-diameter sting. (Figure 2(b) is a sketch of the various sting configurations.)

As can be seen on figure 8, the damping was not affected by changes in sting length or diameter, or by the presence of the stiffener plates at the supersonic or sonic speeds for the model with either the flat or spherical bases. This was also true at a Mach number of 0.65 for the model with the flat base. However, at a Mach number of 0.65 for the model with the spherical base there was a significant effect on the damping as a result of both diameter and length, and also some effect due to the stiffeners. The variation of sting diameter caused the greatest change in damping and it appears that even the smallest diameter used was not small enough to eliminate the effect on damping. The variation of sting length also caused a change in damping level but the longest sting (the length used for the data previously described) appears to be sufficiently long to eliminate sting length effects. The reasons for the damping variation with sting configuration for the model with the spherical base and not for the flat-based model are not apparent. The damping variation with sting configuration would be less with the spherical base than with the flat base if the predominate effect of the sting on the damping were the result of base-pressure effects.

CONCLUDING REMARKS

The results of the present investigation show that the usual method of computing the damping-in-pitch moments for an arbitrary moment center from damping values measured at two other moment centers gave satisfactory agreement between the transferred and measured damping of both the sharp- and blunt-nosed cones. The transfer was satisfactory whether the damping was stable or unstable even when the measured damping was nonlinear with angle of attack.

It was also shown that the effect of either blunting the nose of the cone or changing from a flat to a spherical base caused a decrease in the damping-in-pitch moments. In the subsonic speed range this shift in damping for the change from the flat to spherical base was large enough to change the damping from stable to unstable. The damping-in-pitch moment of the blunt cone with either the flat or spherical base was not affected by changes in sting length or diameter at transonic or supersonic speeds. Such was also the case with the flat base at $M = 0.65$. With the spherical base at $M = 0.65$, however, there was a significant effect of both sting length and diameter on the damping-in-pitch moment within the ranges investigated.

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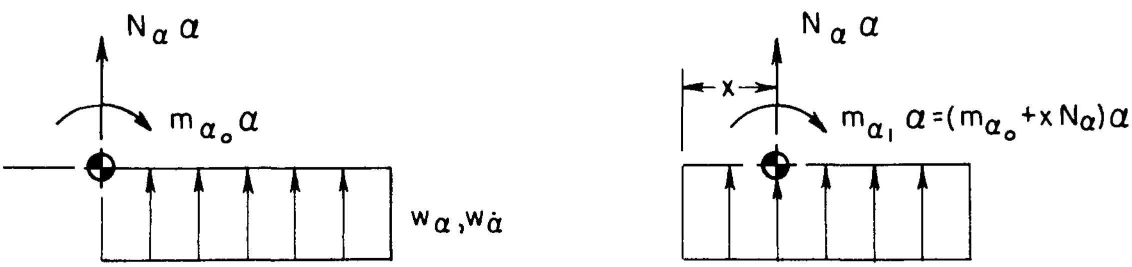
APPENDIX

DERIVATION OF THE TRANSFER EQUATION FOR DAMPING MOMENTS

In the analysis that follows, the transfer equation is derived by considering the change in the forces and moments on the body produced by changes in downwash distribution as the pitch axis location is moved. It is assumed that the transfer takes place in a direction perpendicular to the normal force vector so that any contribution of the axial force to the damping in pitch is zero. In addition, the forces and moments due to angle of attack are considered separately and then summed to give the final moment equation. To simplify the analysis, it will be assumed that the transfer is to be made between a rotation axis at the nose of the body and some point aft a distance x from the nose. It is not necessary that one of the transfer points be the nose of the body. The resulting transfer equation will be the same for transfer between any two moment center locations.

The first point to be considered is the summation of moments due to the effects of angle of attack, α, and time rate of change of angle of attack, $\dot{\alpha}$. In both cases, the downwash, or crossflow, will be uniform along the body length. This downwash will give rise to some normal force and pitching moment at the nose of the body (sketch (a)).



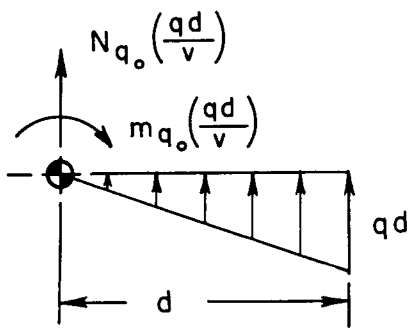
Moment center at nose — Moment center at x aft of nose

Sketch (a)

For some other moment center the downwash distribution along the body in a pure plunging motion does not change. As a result, the normal force is the same but the pitching moment about this other moment center is different. This is shown on the right side of sketch (a). As a result, the following moment equations can be written. The moments and forces have been changed to coefficient form by dividing by $[(1/2)\rho V^2 Sd]$.

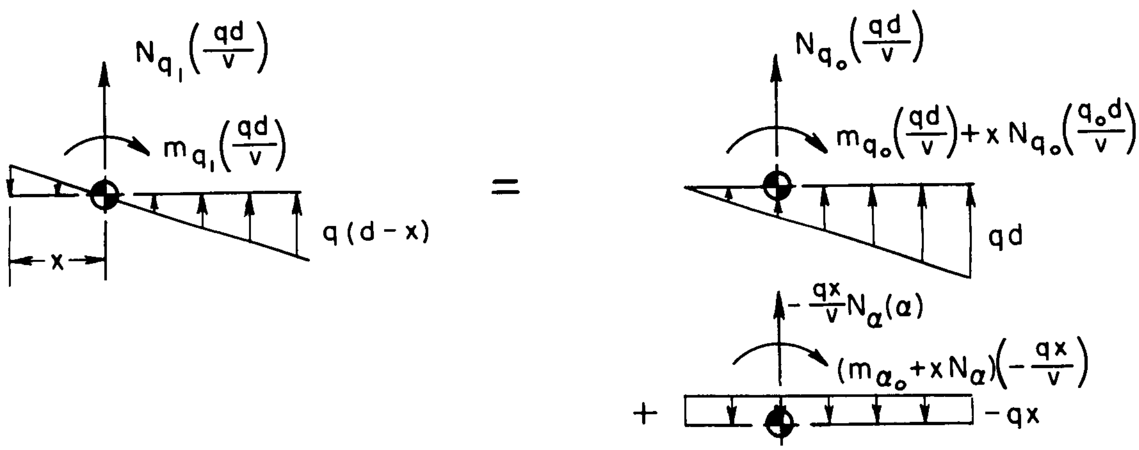
$$C_{m_{\alpha_1}} = C_{m_{\alpha_O}} + \frac{x}{d} C_{N_\alpha}$$

$$C_{m_{\dot{\alpha}_1}} = C_{m_{\dot{\alpha}_2}} + \frac{x}{d} C_{N_{\dot{\alpha}}}$$



Sketch (b)

The transfer relation due to the pitch rate q is more complicated. For a body pitching about the nose, the downwash distribution due to pitching only is shown in sketch (b). (For convenience the body length is taken equal to d, but the equation derived applies to a body of arbitrary length.) This downwash distribution gives rise to some pitching normal force and moment as shown. If the body is now pitching about some point a distance x from the nose, the downwash is as shown in the left part of sketch (c). This downwash may be considered as that due to pitching about the nose plus a



Sketch (c)

uniform angle-of-attack type downwash proportional to the pitch rate and distance the moment center was moved. The moments and forces for each of these downwash distributions are shown (sketch (c)) resolved about moment center 1. Summing the moments due to the pitching and plunging downwash results in the following equation changed to coefficient form by dividing by $[(1/2)\rho V^2 Sd]$.

$$C_{m_{q_1}} = C_{m_{q_o}} + \frac{x}{d} C_{N_{q_o}} - \frac{x}{d} C_{m_{\alpha_o}} - \left(\frac{x}{d}\right)^2 C_{N_\alpha}$$

The damping coefficient is the sum of the q and $\dot{\alpha}$ terms so the final transfer equation is,

$$(C_{m_q} + C_{m_{\dot{\alpha}}})_1 = (C_{m_q} + C_{m_{\dot{\alpha}}})_o + \frac{x}{d} (C_{N_q} + C_{N_{\dot{\alpha}}})_o - \frac{x}{d} C_{m_{\alpha_o}} - \left(\frac{x}{d}\right)^2 C_{N_\alpha}$$

A more detailed derivation of the above transfer equation is given in reference 4, where the transfer is considered with both a horizontal and a vertical translation of the pitch axis.

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TABLE I.- DAMPING-IN-PITCH DATA

(a) Sharp cone with flat base; center of moments at 0.834d from model base

M = 0.25

α	$C_{m_q}+C_{m_{\dot\alpha}}$	K
-02.1	-1.055	.0832
-03.2	-1.190	.0827
-05.1	-1.327	.0826
-02.1	-1.215	.0821
-01.1	-1.209	.0821
00.8	-1.177	.0830
03.8	-1.351	.0825
06.8	-1.309	.0824
09.7	-1.485	.0818
12.7	-1.320	.0813
15.8	-1.658	.0820

M = 0.65

α	$C_{m_q}+C_{m_{\dot\alpha}}$	K
-02.1	-1.232	.0332
-01.2	-1.165	.0332
00.7	-1.269	.0330
03.6	-1.391	.0332
06.5	-1.545	.0329
09.5	-1.467	.0329
12.3	-1.547	.0329
14.4	-1.468	.0329
-02.1	-1.227	.0331
-03.0	-1.227	.0331
-05.0	-1.157	.0331

M = 0.80

α	$C_{m_q}+C_{m_{\dot\alpha}}$	K
-02.0	-1.323	.0276
-01.2	-1.403	.0276
00.7	-1.464	.0276
03.5	-1.719	.0277
06.2	-1.611	.0275
-02.1	-1.503	.0276
-03.0	-1.510	.0278
-04.8	-1.333	.0277
-07.6	-1.209	.0277
-10.4	-1.104	.0279
-13.1	-1.251	.0279
-14.0	-1.035	.0279

M = 0.90

α	$C_{m_q}+C_{m_{\dot\alpha}}$	K
-01.9	-2.006	.0247
-01.0	-2.110	.0246
00.7	-2.083	.0246
03.6	-2.507	.0247
-01.9	-1.926	.0247
-02.9	-1.901	.0248
-04.6	-1.515	.0249
-07.2	-1.608	.0250
-10.0	-1.366	.0251
-12.8	-1.311	.0252
-13.5	-1.317	.0251

M = 1.00

α	$C_{m_q}+C_{m_{\dot\alpha}}$	K
-01.9	-2.247	.0227
-01.0	-2.356	.0225
00.8	-2.503	.0225
-01.8	-1.932	.0226
-02.7	-1.779	.0227
-04.6	-1.795	.0229
-07.1	-1.355	.0231
-10.1	-1.256	.0233
-12.4	-1.285	.0232
-13.3	-1.255	.0233

M = 1.10

α	$C_{m_q}+C_{m_{\dot\alpha}}$	K
-01.8	-1.893	.0210
-00.8	-2.074	.0209
00.9	-2.320	.0208
-01.7	-2.014	.0210
-02.6	-1.995	.0210
-04.6	-1.668	.0211
-07.1	-1.480	.0213
-09.8	-1.377	.0213
-12.5	-1.223	.0215
-13.2	-1.239	.0215

M = 1.20

α	$C_{m_q}+C_{m_{\dot\alpha}}$	K
-01.7	-1.570	.0198
-00.8	-1.672	.0198
00.9	-2.192	.0196
-01.7	-1.527	.0198
-02.5	-1.509	.0199
-04.4	-1.321	.0199
-06.9	-1.162	.0199
-09.5	-1.262	.0200
-12.0	-1.425	.0200
-12.9	-1.296	.0199

M = 1.30

α	$C_{m_q}+C_{m_{\dot\alpha}}$	K
-01.8	-1.568	.0186
-01.0	-1.886	.0185
00.6	-2.277	.0185
-01.9	-1.766	.0186
-02.7	-1.808	.0187
-04.5	-1.491	.0187
-07.0	-1.064	.0188
-09.5	-0.878	.0189
-12.0	-1.106	.0189
-12.9	-1.291	.0189

M = 1.60

α	$C_{m_q}+C_{m_{\dot\alpha}}$	K
-01.9	-1.545	.0160
-02.9	-1.422	.0161
-04.6	-1.141	.0161
-02.0	-1.395	.0161
-01.3	-1.485	.0160
00.6	-1.546	.0161
-07.2	-1.017	.0162
-09.8	-0.941	.0162
-12.3	-0.987	.0163
-13.1	-1.039	.0163

M = 1.90

α	$C_{m_q}+C_{m_{\dot\alpha}}$	K
-01.8	-1.243	.0142
-02.7	-1.347	.0143
-04.5	-0.814	.0144
-01.8	-1.153	.0143
-00.9	-1.357	.0142
00.8	-1.468	.0142
03.6	-1.981	.0143
-07.1	-0.603	.0143
-09.7	-0.559	.0145
-12.2	-0.622	.0145
-13.0	-0.661	.0145

M = 2.20

α	$C_{m_q}+C_{m_{\dot\alpha}}$	K
-01.4	-1.425	.0132
-02.3	-0.599	.0132
-04.0	-0.786	.0133
-01.3	-1.460	.0131
-00.4	-1.502	.0131
01.5	-1.567	.0131
-06.7	-0.765	.0132
-09.4	-0.961	.0132
-12.0	-1.112	.0133
-13.1	-0.495	.0133

TABLE I.- DAMPING-IN-PTICH DATA - Continued

(b) Sharp cone with flat base; center of moments at 0.677d from model base

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
M = 0.25		
-01.4	-0.551	.0966
-02.3	-0.538	.0972
-04.3	-0.563	.0966
-01.2	-0.654	.0977
-00.3	-0.603	.0977
01.6	-0.607	.0983
04.7	-0.570	.0971
07.7	-0.761	.0970
10.7	-0.803	.0971
13.8	-0.623	.0970
16.8	-0.563	.0970
M = 0.65		
-01.4	-0.700	.0384
-02.4	-0.852	.0386
-04.4	-0.835	.0386
-01.4	-0.743	.0385
-00.4	-0.735	.0384
01.6	-0.752	.0384
04.7	-0.779	.0384
07.7	-0.794	.0384
10.9	-0.695	.0383
14.0	-0.688	.0382
17.2	-0.788	.0379
-01.4	-0.835	.0383
M = 0.80		
-01.4	-1.043	.0318
-02.3	-1.046	.0317
-04.4	-0.993	.0318
-01.3	-0.974	.0317
-00.4	-0.927	.0316
01.6	-1.069	.0315
04.7	-1.007	.0317
07.8	-0.958	.0317
10.8	-0.919	.0316
14.0	-0.761	.0316
17.2	-0.969	.0311
M = 0.90		
-01.1	-1.331	.0282
-02.2	-1.334	.0281
-04.2	-1.187	.0283
-01.2	-1.549	.0282
-00.2	-1.425	.0282
01.8	-1.478	.0282
04.8	-1.333	.0282
07.9	-1.398	.0284
10.9	-1.293	.0284
14.1	-1.329	.0283
17.2	-1.405	.0283
M = 1.00		
-01.0	-1.664	.0258
-02.1	-1.540	.0259
-04.1	-1.472	.0260
-01.1	-1.575	.0257
-00.1	-1.770	.0255
01.8	-1.854	.0257
04.9	-1.767	.0256
08.0	-1.654	.0259
11.1	-1.212	.0261
14.1	-1.162	.0261
17.2	-1.305	.0260
M = 1.10		
-01.1	-1.618	.0237
-02.1	-1.491	.0239
-04.1	-1.324	.0241
-01.1	-1.615	.0237
-00.1	-1.731	.0236
01.9	-1.873	.0237
04.8	-1.851	.0238
08.0	-1.657	.0239
11.1	-1.201	.0242
14.0	-0.995	.0241
17.1	-1.261	.0240
M = 1.20		
-01.1	-1.365	.0222
-02.0	-1.043	.0223
-04.0	-1.120	.0223
-01.1	-1.356	.0222
-00.2	-1.590	.0221
01.8	-1.593	.0220
04.9	-1.234	.0222
08.0	-1.001	.0223
10.9	-0.926	.0223
14.0	-1.009	.0221
17.2	-1.196	.0220
M = 1.30		
-01.3	-1.410	.0208
-02.3	-1.186	.0209
-04.3	-1.069	.0211
-01.2	-1.392	.0209
-00.3	-1.598	.0209
01.7	-1.846	.0208
04.7	-1.050	.0210
07.7	-0.834	.0212
10.8	-0.876	.0211
13.7	-1.122	.0210
16.8	-1.179	.0208
M = 1.60		
-01.4	-1.277	.0179
-02.4	-1.103	.0179
-04.3	-0.983	.0181
-01.3	-1.217	.0179
-00.3	-1.205	.0179
01.5	-1.431	.0178
04.6	-1.071	.0179
07.6	-0.685	.0181
10.5	-0.891	.0181
13.5	-0.986	.0181
16.5	-0.987	.0181
M = 1.90		
-01.2	-1.382	.0160
-02.2	-1.118	.0161
-04.2	-1.025	.0162
-01.2	-1.267	.0160
-00.2	-1.046	.0160
01.7	-1.075	.0160
04.8	-0.792	.0161
07.8	-0.741	.0162
10.8	-0.608	.0162
13.9	-0.837	.0162
16.8	-0.721	.0161
M = 2.20		
-00.3	-1.086	.0149
-01.6	-1.221	.0150
-03.6	-0.903	.0151
-00.6	-1.311	.0149
00.3	-1.233	.0149
02.3	-1.192	.0150
05.3	-1.204	.0150
08.3	-0.980	.0150
11.3	-0.899	.0150
14.4	-0.795	.0150
17.3	-0.792	.0150

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

(c) Sharp cone with flat base; center of moments at 0.520d from model base

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
M = 0.25		
-00.4	-0.805	.1104
-01.5	-0.805	.1111
-03.5	-0.721	.1105
-00.4	-0.624	.1098
00.5	-0.617	.1097
02.5	-0.678	.1117
05.5	-0.680	.1116
08.6	-0.747	.1110
11.7	-0.415	.1110
14.7	-0.272	.1097
17.8	-0.236	.1110
M = 0.65		
-00.6	-0.708	.0416
-01.6	-0.629	.0418
-03.8	-0.795	.0419
-00.5	-0.737	.0417
00.4	-0.788	.0416
02.5	-0.674	.0417
05.9	-0.758	.0417
09.1	-0.554	.0421
12.3	-0.494	.0419
15.6	-0.468	.0421
18.0	-0.590	.0421
M = 0.80		
-00.6	-0.836	.0341
-01.6	-0.670	.0341
-03.9	-0.864	.0341
-00.6	-0.745	.0341
00.4	-0.626	.0341
02.6	-0.702	.0339
05.9	-0.623	.0342
09.3	-0.501	.0343
12.7	-0.596	.0343
13.8	-0.625	.0343
14.9	-0.635	.0342
M = 0.90		
-00.4	-1.051	.0303
-01.4	-0.865	.0305
-03.7	-0.937	.0302
-00.3	-0.933	.0302
00.6	-0.932	.0303
02.8	-0.939	.0303
06.2	-1.011	.0303
09.5	-0.809	.0305
13.0	-0.819	.0305
14.1	-0.815	.0306
15.2	-0.976	.0305

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
M = 1.00		
-00.2	-1.112	.0278
-01.3	-0.994	.0278
-03.6	-1.120	.0279
-00.2	-0.872	.0277
00.7	-0.977	.0276
02.9	-1.125	.0276
06.3	-0.987	.0278
09.9	-0.818	.0281
13.2	-0.830	.0280
14.4	-0.828	.0280
M = 1.10		
-00.3	-0.913	.0256
-01.4	-1.111	.0256
-03.6	-1.110	.0257
-00.2	-1.052	.0257
00.7	-1.141	.0257
03.0	-1.281	.0255
06.3	-1.102	.0257
09.7	-0.890	.0259
13.1	-0.797	.0259
14.2	-0.840	.0258
M = 1.20		
-00.3	-1.002	.0236
-01.4	-0.993	.0237
-03.7	-0.949	.0238
-00.3	-0.861	.0237
00.7	-1.015	.0236
02.9	-1.195	.0236
06.4	-0.720	.0237
09.8	-0.909	.0237
12.2	-0.901	.0237
M = 1.30		
-00.6	-1.066	.0222
-01.6	-1.113	.0222
-03.9	-0.932	.0223
-00.5	-1.099	.0222
00.4	-1.119	.0222
02.7	-1.092	.0222
06.2	-0.801	.0223
09.6	-0.887	.0223
13.1	-0.726	.0224

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
M = 1.60		
-00.6	-1.090	.0193
-01.7	-0.938	.0194
-03.9	-0.853	.0195
-00.6	-1.070	.0192
00.4	-1.017	.0193
02.6	-1.120	.0192
06.1	-0.856	.0193
-05.5	-0.865	.0163
12.9	-0.697	.0193
14.2	-0.739	.0193
M = 1.90		
-00.3	-0.971	.0172
-01.4	-1.015	.0172
-03.7	-1.038	.0173
-00.4	-1.072	.0172
00.6	-1.051	.0172
02.8	-1.015	.0172
06.1	-0.822	.0173
09.5	-0.620	.0173
12.9	-0.789	.0172
M = 2.20		
00.2	-0.893	.0162
-00.7	-1.147	.0162
-02.5	-0.851	.0163
00.2	-0.976	.0162
01.3	-1.285	.0161
03.4	-1.057	.0162
06.7	-0.720	.0162
10.0	-0.634	.0162
13.3	-0.805	.0161
16.6	-0.845	.0161

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

(d) Sharp cone with spherical base; center of moments at 0.677d from model base; center of spherical base at 0.677d

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
M = 0.25		
-01.3	0.330	.0928
-02.2	0.438	.0955
-04.2	0.344	.0955
-01.4	0.441	.0960
-00.4	0.394	.0960
01.6	0.443	.0960
04.7	0.637	.0953
07.6	0.687	.0952
10.7	0.688	.0949
13.6	-0.348	.0950
16.7	-0.816	.0954
M = 0.65		
-01.5	0.353	.0388
-02.3	0.470	.0387
-04.3	0.113	.0386
-01.4	0.470	.0387
-00.4	0.447	.0388
01.5	0.588	.0388
04.5	0.705	.0387
07.6	0.709	.0384
10.7	0.258	.0382
13.7	-0.498	.0382
17.0	-0.715	.0378
M = 0.80		
-01.3	-0.174	.0320
-02.4	-0.297	.0321
-04.4	-0.369	.0319
-01.5	-0.134	.0320
-00.4	-0.216	.0321
01.5	-0.115	.0320
04.6	-0.171	.0319
07.6	-0.091	.0318
10.7	-0.514	.0316
13.8	-0.913	.0314
17.0	-0.887	.0311
M = 0.90		
-01.2	-0.976	.0283
-02.3	-0.872	.0286
-04.2	-0.945	.0286
-01.3	-0.965	.0285
-00.2	-0.938	.0284
01.7	-0.983	.0283
04.7	-1.039	.0284
07.8	-1.188	.0282
10.9	-1.031	.0284
13.9	-1.211	.0283
17.0	-1.170	.0280

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
M = 1.00		
-01.1	-1.381	.0256
-02.1	-1.437	.0255
-04.0	-1.241	.0257
-01.1	-1.369	.0256
-00.1	-1.429	.0256
01.8	-1.553	.0254
04.9	-1.690	.0256
08.0	-1.509	.0256
11.0	-1.193	.0257
14.2	-1.033	.0256
17.3	-1.105	.0256
M = 1.10		
-01.2	-1.329	.0236
-02.1	-1.269	.0236
-04.2	-1.088	.0237
-01.1	-1.437	.0236
-00.1	-1.474	.0236
01.8	-1.466	.0234
04.9	-1.807	.0235
08.0	-1.288	.0235
11.0	-1.104	.0237
14.0	-1.109	.0237
17.2	-1.097	.0237
M = 1.20		
-01.2	-1.152	.0223
-02.0	-0.822	.0221
-04.0	-0.825	.0222
-01.0	-1.003	.0223
-00.1	-1.389	.0222
01.8	-1.557	.0220
04.8	-0.972	.0220
07.8	-0.900	.0220
11.0	-1.039	.0220
14.0	-0.898	.0219
17.1	-1.147	.0217
M = 1.30		
-01.2	-1.298	.0207
-02.3	-0.950	.0207
-04.2	-0.960	.0208
-01.2	-1.330	.0207
-00.2	-1.253	.0207
01.7	-1.520	.0208
04.7	-1.028	.0208
07.8	-0.847	.0210
10.7	-0.972	.0209
13.6	-0.796	.0208
16.8	-1.101	.0207

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
M = 1.60		
-01.5	-0.975	.0178
-02.4	-1.027	.0179
-04.6	-0.749	.0179
-01.3	-1.011	.0179
-00.4	-1.116	.0178
01.5	-1.102	.0179
04.6	-1.087	.0180
07.5	-0.584	.0180
10.6	-0.689	.0180
13.6	-0.828	.0180
16.6	-0.864	.0179
M = 1.90		
-01.1	-1.080	.0160
-02.2	-0.988	.0160
-04.2	-0.824	.0161
-01.1	-0.995	.0159
00.0	-1.000	.0159
01.7	-1.006	.0159
04.7	-0.638	.0160
07.8	-0.775	.0160
10.8	-0.760	.0160
13.8	-0.696	.0160
16.5	-0.901	.0160
M = 2.20		
-00.6	-0.730	.0148
-01.6	-0.895	.0149
-03.5	-0.853	.0149
-00.6	-1.208	.0148
00.3	-1.037	.0148
02.3	-0.752	.0148
05.3	-1.155	.0148
08.3	-0.661	.0149
11.3	-0.873	.0148
14.3	-0.884	.0148
17.3	-0.920	.0148

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

(e) Blunt cone with flat base; center of moments at 0.562d from model base

M = 0.25

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
-01.0	-0.471	.1216
-01.9	-0.539	.1201
-03.9	-0.403	.1202
-00.8	-0.491	.1188
00.0	-0.521	.1208
02.0	-0.636	.1208
05.1	-0.488	.1207
08.0	-0.684	.1192
11.0	-0.675	.1213
14.1	-0.501	.121[illegible]
17.1	-0.396	.12[illegible]

M = 0.65

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
-01.0	-0.681	.0474
-01.9	-0.728	.0474
-03.9	-0.772	.0476
-01.0	-0.698	.0475
00.0	-0.677	.0477
01.9	-0.678	.0475
04.9	-0.760	.0475
07.9	-0.826	.0475
10.9	-0.714	.0477
13.9	-0.632	.0477
17.0	-0.628	.0477

M = 0.80

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
-00.9	-0.755	.0394
-02.0	-0.872	.0394
-03.9	-0.867	.0394
-01.0	-0.789	.0394
00.0	-0.740	.0392
01.9	-0.814	.0393
05.0	-0.875	.0393
07.9	-0.876	.0394
10.9	-0.730	.0395
13.9	-0.710	.0398
17.0	-0.686	.0396

M = 0.90

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
-00.7	-1.100	.0350
-01.7	-0.988	.0351
-03.8	-1.056	.0351
-00.8	-1.073	.0351
00.1	-1.036	.0351
02.1	-1.101	.0351
05.0	-1.221	.0351
08.0	-1.164	.0354
11.1	-0.954	.0354
14.0	-0.940	.0357
17.0	-0.818	.0359

M = 1.00

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
-00.7	-1.453	.0318
-01.7	-1.398	.0318
-03.6	-1.279	.0320
-00.7	-1.414	.0319
00.2	-1.465	.0318
02.2	-1.435	.0316
05.2	-1.643	.0318
08.3	-1.574	.0319
11.4	-1.793	.0321
14.3	-1.552	.0323
17.3	0.045	.0332
15.2	-1.195	.0325
16.3	-0.486	.0327

M = 1.10

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
-00.7	-1.409	.0292
-01.5	-1.408	.0292
-03.6	-1.336	.0295
-00.6	-1.376	.0294
00.2	-1.507	.0292
02.2	-1.662	.0293
05.3	-1.690	.0294
08.3	-1.703	.0296
11.3	-1.742	.0296
14.4	-1.193	.0301
17.4	-0.375	.0306

M = 1.20

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
-00.7	-1.176	.0276
-01.7	-1.101	.0277
-03.6	-0.898	.0279
-00.7	-1.176	.0276
00.2	-1.216	.0276
02.1	-1.314	.0277
05.1	-0.842	.0280
08.0	-0.751	.0282
11.0	-0.788	.0285
13.7	-0.815	.0287
16.4	-0.762	.0289

M = 1.30

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
-00.7	-1.046	.0263
-01.7	-0.805	.0263
-03.5	-0.787	.0264
-00.7	-0.939	.0262
00.2	-1.083	.0264
02.0	-1.267	.0264
04.9	-0.691	.0266
07.7	-0.572	.0269
10.5	-0.657	.0270
13.3	-0.797	.0270
16.0	-0.811	.0272

M = 1.60

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
-00.9	-0.522	.0229
-01.7	-0.522	.0230
-03.6	-0.460	.0230
-00.8	-0.611	.0230
00.1	-0.633	.0229
01.9	-0.670	.0229
04.7	-0.958	.0230
07.4	-0.507	.0231
10.3	-0.471	.0231
12.9	-0.512	.0231
14.6	-0.547	.0234

M = 1.90

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
-00.7	-0.283	.0206
-01.6	-0.401	.0206
-03.4	-0.542	.0206
-00.7	-0.416	.0205
00.1	-0.486	.0204
01.9	-0.559	.0203
04.8	-0.897	.0203
07.7	-0.512	.0207
10.4	-0.549	.0207
13.1	-0.556	.0206
15.9	-0.606	.0206

M = 2.20

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
-00.2	-0.587	.0188
-01.0	-0.431	.0186
-02.9	-0.499	.0187
-00.2	-0.449	.0187
00.7	-0.511	.0187
02.5	-0.397	.0186
05.4	-0.662	.0187
08.3	-0.525	.0187
11.4	-0.441	.0187
13.9	-0.476	.0190
16.7	-0.676	.0191

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

(f) Blunt cone with flat base; center of moments at 0.445d from model base

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
M = 0.25		
-00.3	-0.373	.1314
-01.4	-0.405	.1321
-03.3	-0.480	.1323
-03.3	-0.220	.1323
-00.3	-0.293	.1323
00.6	-0.360	.1321
02.6	-0.404	.1322
05.6	-0.187	.1320
08.6	-0.572	.1320
11.7	-0.259	.1322
14.7	-0.143	.1330
17.7	-0.160	.1321
M = 0.65		
-00.3	-0.553	.0519
-01.4	-0.581	.0518
-03.5	-0.621	.0518
-00.3	-0.514	.0520
00.5	-0.551	.0518
02.6	-0.481	.0518
05.8	-0.654	.0519
08.8	-0.422	.0521
11.9	-0.762	.0521
15.0	-0.782	.0523
18.2	-0.753	.0525
M = 0.80		
-00.4	-0.688	.0428
-01.4	-0.672	.0427
-03.5	-0.707	.0426
-00.4	-0.695	.0424
00.5	-0.701	.0425
02.6	-0.666	.0424
05.8	-0.690	.0425
09.0	-0.699	.0426
12.1	-0.675	.0427
15.3	-0.689	.0429
[illegible].6	-0.700	.0426
M = 0.90		
-00.2	-0.700	.0372
-01.2	-0.748	.0372
-03.3	-0.842	.0373
-00.2	-0.785	.0373
00.7	-0.757	.0373
02.8	-0.909	.0371
06.0	-0.941	.0374
09.2	-0.754	.0375
12.4	-0.605	.0378
15.5	-0.549	.0379
18.7	-0.557	.0381
M = 1.00		
00.0	-1.111	.0337
-01.2	-1.076	.0336
-03.3	-0.996	.0339
-00.1	-1.054	.0338
00.9	-1.082	.0335
03.1	-1.184	.0338
06.3	-0.892	.0337
09.5	-1.104	.0339
12.8	-1.943	.0344
11.7	-1.599	.0342
16.0	-2.698	.0357
18.9	-0.128	.0360
18.0	0.857	.0365
M = 1.10		
-00.1	-1.085	.0310
-01.1	-1.109	.0310
-03.4	-1.023	.0311
-00.1	-1.207	.0310
-11.4	-1.273	.0268
03.0	-1.192	.0309
06.3	-1.042	.0313
09.5	-1.280	.0314
12.8	-1.651	.0315
16.1	-1.718	.0327
18.9	0.098	.0335
17.2	-0.258	.0331
18.1	0.847	.0337
M = 1.20		
-00.2	-0.920	.0289
-01.2	-0.963	.0290
-03.4	-0.883	.0292
-00.1	-0.893	.0289
00.7	-1.013	.0289
02.9	-0.937	.0291
06.1	-0.623	.0294
09.3	-0.803	.0296
12.5	-0.669	.0298
15.7	-0.517	.0302
18.7	-0.485	.0305
M = 1.30		
-00.2	-0.775	.0274
-01.3	-0.710	.0276
-03.3	-0.637	.0277
-00.2	-0.831	.0275
00.6	-0.876	.0275
02.8	-0.747	.0277
05.8	-0.544	.0279
09.0	-0.453	.0282
12.1	-0.480	.0283
15.1	-0.422	.0284
18.1	-0.460	.0285
M = 1.60		
-00.3	-0.556	.0242
-01.6	-0.497	.0242
-03.4	-0.361	.0243
-00.4	-0.556	.0242
00.6	-0.468	.0242
02.5	-0.668	.0242
05.6	-0.539	.0243
08.6	-0.271	.0245
11.6	-0.300	.0245
14.6	-0.303	.0246
17.5	-0.328	.0247
M = 1.90		
-00.3	-0.252	.0219
-01.2	-0.330	.0219
-03.1	-0.326	.0219
-00.2	-0.295	.0219
00.7	-0.210	.0219
02.7	-0.455	.0218
05.6	-0.269	.0219
08.7	-0.194	.0220
11.7	-0.265	.0220
14.7	-0.188	.0221
17.5	-0.260	.0221
M = 2.20		
00.3	-0.226	.020[illegible]
-00.6	-0.163	.0203
-02.8	-0.215	.0204
00.3	-0.296	.0203
01.2	-0.234	.0203
03.3	-0.246	.0203
06.2	-0.715	.0203
09.3	-0.118	.0203
12.3	-0.152	.0204
15.2	-0.190	.0204
18.2	-0.236	.0205

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

(g) Blunt cone with flat base; center of moments at 0.328d from model base

M = 0.25

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
00.1	-0.287	.1302
-00.7	-0.252	.1287
-02.8	-0.292	.1303
00.2	-0.183	.1300
01.2	-0.433	.1301
03.2	-0.354	.1300
06.3	-0.397	.1293
09.2	-0.479	.1295
12.4	-0.228	.1306
15.3	0.034	.1296
18.4	0.066	.1300

M = 0.65

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
00.1	-0.456	.0506
-00.8	-0.449	.0507
-02.9	-0.476	.0503
00.1	-0.576	.0505
01.2	-0.455	.0508
03.3	-0.564	.0507
06.7	-0.596	.0510
09.8	-0.653	.0512
12.0	-0.417	.0514

M = 0.80

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
00.1	-0.464	.0404
01.2	-0.589	.0402
03.6	-0.536	.0404
06.9	-0.672	.0405
00.1	-0.546	.0405
-00.8	-0.451	.0405
-03.0	-0.544	.0406
-06.3	-0.680	.0406
-09.5	-0.529	.0408
-13.0	-0.510	.0410
-13.9	-0.477	.0414

M = 0.90

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
00.3	-0.659	.0359
01.5	-0.707	.0358
03.8	-0.877	.0357
00.4	-0.610	.0359
-00.6	-0.708	.0359
-02.9	-0.732	.0358
-06.3	-0.806	.0360
-09.5	-0.867	.0360
-12.9	-0.697	.0363
-14.2	-0.862	.0365

M = 1.00

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
00.5	-0.999	.0324
01.5	-1.040	.0323
04.0	-1.098	.0324
00.5	-0.985	.0324
-00.5	-1.048	.0323
-02.9	-1.115	.0325
-06.2	-0.917	.0326
-09.6	-1.117	.0330
-13.1	-2.707	.0334
-14.2	-2.788	.0337
-10.7	-1.361	.0328

M = 1.10

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
00.6	-0.998	.0300
01.7	-1.115	.0301
04.0	-1.205	.0301
00.5	-1.079	.0301
-02.9	-1.122	.0301
-00.9	-1.055	.0301
-06.2	-0.927	.0304
-09.7	-1.389	.0305
-13.1	-3.359	.0310
-14.5	2.638	-.0313
-10.6	-1.804	.0305

M = 1.20

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
00.5	-1.079	.0273
01.7	-0.983	.0274
03.9	-0.881	.0276
-00.7	-1.072	.0274
-02.9	-1.098	.0276
-06.5	-0.728	.0279
-09.8	-0.805	.0282
-13.1	-1.195	.0286
-14.1	-1.036	.0285
00.6	-1.040	.0275

M = 1.30

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
00.3	-0.854	.0261
-00.8	-0.885	.0261
-02.8	-0.856	.0263
00.2	-0.787	.0261
01.3	-0.842	.0262
03.7	-0.579	.0263
-06.4	-0.495	.0266
-09.6	-0.567	.0268
-12.7	-0.811	.0269
-13.9	-0.870	.0269

M = 1.60

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
00.2	-0.603	.0232
-00.9	-0.735	.0232
-03.0	-0.516	.0232
00.2	-0.628	.0232
01.2	-0.499	.0232
03.4	-0.783	.0232
06.8	-0.327	.0234
10.0	-0.318	.0236
-06.1	-0.335	.0234
-09.3	-0.444	.0235
-12.6	-0.874	.0235
-13.5	-1.172	.0235

M = 1.90

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
00.3	-0.477	.0214
-00.6	-0.533	.0213
-02.8	-0.419	.0212
00.3	-0.433	.0213
01.4	-0.428	.0213
03.5	-0.570	.0213
06.8	-0.303	.0213
10.0	-0.251	.0214
13.2	-0.280	.0214

M = 2.20

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
00.8	-0.293	.0198
02.0	-0.206	.0198
03.9	-0.270	.0198
07.2	-0.305	.0198
10.3	-0.041	.0198
13.5	-0.015	.0198
16.6	-0.283	.0198
19.7	-0.215	.0199
00.9	-0.361	.0197
-02.1	-0.056	.0196

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

(h) Blunt cone with spherical base; center of moments at 0.562d from model base, center of spherical base at 0.562d

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
M = 0.25		
-01.0	0.646	.1187
-02.0	0.803	.1180
-04.0	0.364	.1196
-00.8	0.730	.1188
00.0	0.608	.1187
02.0	0.572	.1193
05.0	-0.351	.1184
08.0	0.888	.1185
11.0	0.460	.1205
14.0	0.092	.1197
17.0	-0.171	.1196
M = 0.65		
-00.8	0.462	.0483
-01.9	0.310	.0483
-03.9	0.387	.0483
-00.9	0.501	.0483
00.0	0.462	.0483
01.9	0.595	.0481
04.9	0.615	.0481
07.9	0.710	.0481
10.9	0.158	.0478
13.8	-0.377	.0474
16.9	-0.565	.0473
M = 0.80		
-00.9	-0.176	.0400
-01.9	-0.145	.0399
-03.9	-0.023	.0401
-01.0	-0.203	.0400
00.0	-0.091	.0398
01.9	-0.011	.0399
04.9	0.007	.0399
07.9	-0.203	.0397
10.9	-0.480	.0395
13.8	-0.680	.0396
17.0	-0.729	.0393
M = 0.90		
-00.8	-0.646	.0358
-01.7	-0.699	.0357
-03.7	-0.689	.0357
-00.8	-0.666	.0358
00.1	-0.683	.0357
02.0	-0.662	.0356
05.0	-0.844	.0356
08.1	-0.807	.0356
11.0	-0.813	.0357
13.9	-0.840	.0358
16.8	-0.913	.0357

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
M = 1.00		
-00.8	-0.943	.0318
-01.7	-1.024	.0316
-03.7	-0.962	.0319
-00.7	-1.004	.0317
00.1	-1.008	.0318
02.1	-1.154	.0318
05.2	-1.411	.0316
08.1	-1.300	.0319
11.4	-1.725	.0319
14.3	-3.048	.0330
17.1	-1.364	.0338
M = 1.10		
-00.7	-0.993	.0292
-01.6	-1.024	.0293
-03.7	-0.947	.0293
-00.7	-1.043	.0293
00.2	-1.078	.0292
02.1	-1.226	.0292
05.2	-1.489	.0292
08.1	-1.348	.0292
11.3	-1.726	.0294
14.3	-1.793	.0299
17.3	-0.274	.0311
M = 1.20		
-00.8	-0.785	.0276
-01.9	-0.711	.0277
-03.6	-0.673	.0277
-00.7	-0.753	.0277
02.0	-0.791	.0276
05.1	-0.584	.0277
00.1	-0.762	.0276
08.1	-0.747	.0279
10.8	-0.735	.0281
13.6	-0.671	.0284
16.3	-0.668	.0286
M = 1.30		
-00.8	-0.520	.0263
-01.8	-0.506	.0264
-03.6	-0.431	.0264
-00.9	-0.554	.0264
00.0	-0.496	.0264
02.0	-0.748	.0263
04.7	-0.427	.0265
07.6	-0.510	.0266
10.5	-0.580	.0267
13.1	-0.586	.0267
15.8	-0.667	.0268

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
M = 1.60		
-00.9	-0.328	.0228
-01.9	-0.445	.0229
-03.6	-0.319	.0230
-00.9	-0.280	.0229
00.0	-0.328	.0229
01.8	-0.364	.0229
04.5	-0.536	.0229
07.4	-0.335	.0230
10.2	-0.313	.0231
12.8	-0.437	.0232
15.5	-0.506	.0232
M = 1.90		
-00.7	-0.288	.0206
-01.7	-0.076	.0206
-03.6	-0.181	.0206
-00.8	-0.268	.0206
00.1	-0.230	.0206
01.9	-0.274	.0205
04.7	-0.463	.0205
07.6	-0.316	.0205
10.4	-0.452	.0206
13.1	-0.463	.0206
15.9	-0.457	.0206
M = 2.20		
-00.3	-0.159	.0190
-01.2	-0.229	.0190
-03.0	-0.042	.0190
-00.2	-0.191	.0189
00.6	-0.117	.0189
02.5	-0.304	.0189
05.4	-0.562	.0189
08.2	-0.751	.0189
11.2	-0.325	.0190
13.9	-0.334	.0190
16.7	-0.539	.0190

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

(i) Blunt cone with spherical base; center of moments at 0.445d from model base, center of spherical base at 0.445d

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
M = 0.25		
-00.4	0.400	.1299
-03.3	0.290	.1293
-01.3	0.405	.1293
-00.3	0.367	.1315
00.5	0.510	.1300
02.6	0.396	.1293
05.6	0.001	.1277
08.6	0.516	.1314
11.7	0.140	.1305
14.7	0.009	.1290
17.9	-0.262	.1298
M = 0.65		
-00.4	0.376	.0516
-01.4	0.426	.0513
-03.5	0.407	.0515
-00.4	0.370	.0513
00.5	0.408	.0514
02.6	0.389	.0512
05.7	0.283	.0512
08.9	0.104	.0511
12.0	-0.252	.0510
15.0	-0.259	.0510
18.2	-0.359	.0510
M = 0.80		
-00.4	0.013	.0424
-01.5	0.029	.0420
-03.5	0.080	.0422
-00.4	0.014	.0421
00.5	0.032	.0421
02.6	0.033	.0421
05.8	0.001	.0418
08.9	-0.251	.0416
12.1	-0.400	.0418
15.3	-0.458	.0418
18.6	-0.461	.0418
M = 0.90		
-00.2	-0.537	.0373
-01.3	-0.564	.0373
-03.3	-0.605	.0373
-00.2	-0.528	.0374
00.7	-0.527	.0373
02.8	-0.526	.0374
06.0	-0.578	.0376
09.2	-0.590	.0374
12.4	-0.618	.0374
15.5	-0.685	.0375
18.7	-0.651	.0377
M = 1.00		
00.0	-0.746	.0340
-01.2	-0.760	.0342
-03.3	-0.815	.0341
-00.1	-0.793	.0341
00.8	-0.763	.0340
03.0	-0.836	.0341
06.3	-0.835	.0341
09.5	-1.056	.0340
13.0	-1.969	.0342
15.9	-2.891	.0355
19.0	-0.190	.0359
18.0	-0.256	.0359
M = 1.10		
-00.1	-0.748	.0311
-01.2	-0.767	.0311
-03.2	-0.791	.0310
-00.1	-0.740	.0310
00.7	-0.847	.0311
03.1	-0.877	.0312
06.3	-0.954	.0310
09.5	-1.225	.0310
12.8	-1.430	.0311
16.1	-1.870	.0323
19.1	-0.167	.0328
17.9	-0.241	.0326
M = 1.20		
-00.2	-0.721	.0290
-01.3	-0.665	.0290
-03.3	-0.636	.0291
-00.2	-0.615	.0291
00.7	-0.678	.0291
03.0	-0.609	.0291
06.1	-0.618	.0292
09.3	-0.698	.0293
12.6	-0.621	.0297
15.5	-0.405	.0300
18.4	-0.434	.0302
M = 1.30		
-00.3	-0.511	.0276
-01.3	-0.599	.0276
-03.3	-0.530	.0277
-00.2	-0.546	.0276
00.6	-0.466	.0277
02.8	-0.496	.0277
05.8	-0.551	.0277
09.1	-0.488	.0279
12.1	-0.491	.0280
15.1	-0.472	.0281
18.1	-0.474	.0283
M = 1.60		
-00.3	-0.363	.0242
-01.4	-0.297	.0242
-03.3	-0.479	.0243
-00.4	-0.352	.0242
00.6	-0.355	.0242
02.6	-0.361	.0242
05.6	-0.519	.0242
08.6	-0.296	.0243
11.6	-0.405	.0244
14.5	-0.326	.0245
17.5	-0.437	.0245
M = 1.90		
-00.1	-0.268	.0219
-01.2	-0.256	.0219
-03.1	-0.262	.0219
-00.2	-0.285	.0219
00.7	-0.304	.0219
02.7	-0.324	.0219
05.8	-0.455	.0218
08.7	-0.273	.0218
11.6	-0.336	.0219
14.7	-0.373	.0219
17.6	-0.299	.0220
M = 2.20		
00.3	-0.351	.0203
-00.7	-0.370	.0203
-02.7	-0.294	.0203
00.3	-0.328	.0203
01.3	-0.296	.0203
03.2	-0.291	.0203
06.3	-0.286	.0203
09.3	-0.411	.0203
12.3	-0.259	.0203
15.2	-0.309	.0204
18.2	-0.308	.0204

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

(j) Blunt cone with spherical base; center of moments at 0.328d from model base, center of spherical base at 0.328d

M = 0.25

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
00.1	0.002	.1315
-00.8	-0.034	.1315
-02.8	-0.068	.1309
00.1	0.040	.1315
01.1	-0.071	.1323
03.1	0.035	.1317
06.2	-0.073	.1315
09.2	-0.139	.1301
12.3	-0.114	.1317
15.3	-0.111	.1309
18.4	-0.178	.1295

M = 0.65

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
00.1	0.099	.0498
01.1	0.061	.0498
03.3	-0.013	.0501
06.6	-0.083	.0497
09.8	-0.191	.0498
00.0	0.098	.0498
-00.9	0.011	.0498
-03.2	0.027	.0501
-06.2	0.192	.0503
-09.3	0.043	.0500
-12.6	-0.157	.0500
-13.6	-0.210	.0500

M = 0.80

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
00.1	-0.078	.0408
01.2	-0.092	.0408
03.4	-0.133	.0407
06.8	-0.181	.0406
00.1	-0.047	.0408
-01.1	-0.027	.0408
-02.9	-0.116	.0406
-06.4	-0.050	.0406
-09.6	-0.288	.0404
-12.9	-0.354	.0403
-13.8	-0.397	.0407

M = 0.90

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
00.3	-0.358	.0358
01.5	-0.447	.0359
03.8	-0.456	.0360
07.2	-0.437	.0361
00.3	-0.453	.0360
-00.7	-0.452	.0359
-03.0	-0.496	.0360
-06.4	-0.560	.0361
-09.6	-0.642	.0360
-12.8	-0.617	.0361
-13.9	-0.839	.0362

M = 1.00

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
00.5	-0.564	.0326
01.7	-0.603	.0329
03.9	-0.722	.0327
00.5	-0.625	.0326
-00.6	-0.693	.0326
-02.9	-0.697	.0328
-09.6	-1.114	.0325
-13.2	-2.413	.0330
-14.2	-3.494	.0333
-06.2	-0.763	.0326

M = 1.10

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
00.5	-0.610	.0299
01.6	-0.644	.0299
04.0	-0.755	.0298
07.4	-0.972	.0299
11.1	-2.253	.0316
00.4	-0.676	.0298
-00.5	-0.647	.0299
-02.9	-0.696	.0299
-06.4	-0.910	.0299
-09.7	-1.139	.0299
-13.3	-2.956	.0305
-10.8	-1.488	.0300

M = 1.20

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
00.5	-0.642	.0276
-00.7	-0.672	.0276
-03.0	-0.673	.0276
00.3	-0.599	.0276
01.5	-0.597	.0276
04.0	-0.596	.0277
07.4	-0.655	.0278
11.0	-1.351	.0294
-06.3	-0.740	.0278
-09.8	-0.738	.0280
-13.2	-1.086	.0283
-14.1	-1.024	.0283

M = 1.30

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
00.2	-0.307	.0263
-00.8	-0.445	.0263
-03.1	-0.647	.0264
00.2	-0.461	.0264
01.4	-0.384	.0263
03.7	-0.509	.0263
07.1	-0.523	.0264
10.6	-0.598	.0267
14.1	-1.193	.0287

M = 1.60

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
00.2	-0.266	.0232
-00.8	-0.204	.0232
-03.1	-0.349	.0232
00.1	-0.198	.0232
01.3	-0.218	.0232
03.3	-0.226	.0232
06.8	-0.304	.0233
10.1	-0.236	.0234
13.3	-0.254	.0235
16.5	-0.307	.0236
19.7	-0.717	.0244

M = 1.90

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
00.3	-0.172	.0212
-00.6	-0.162	.0212
-02.7	-0.016	.0211
00.3	-0.114	.0211
01.4	-0.214	.0211
03.6	-0.090	.0210
06.8	-0.247	.0211
10.0	-0.042	.0212
13.2	-0.132	.0212
16.6	-0.175	.0213
19.5	-0.182	.0213

M = 2.20

α	$C_{m_q}+C_{m_{\dot{\alpha}}}$	K
01.0	-0.180	.0199
-00.1	-0.280	.0199
-02.3	-0.309	.0199
00.9	-0.152	.0199
02.0	-0.272	.0198
04.1	-0.152	.0199
07.1	-0.199	.0198
10.5	-0.019	.0199
13.6	-0.076	.0199
16.7	-0.226	.0199
19.8	-0.128	.0200

TABLE II.- STATIC STABILITY DATA

(a) Sharp cone with flat base; center of moments at 0.677d from model base

α	C_m	C_N	C_A	C_{p_b}
M = 0.25				
-02.9	-.0172	-0.116	0.347	.3544
-01.0	-.0129	-0.068	0.337	.3621
00.0	-.0088	-0.041	0.342	.3504
02.9	-.0066	0.063	0.342	.3387
05.9	.0178	0.142	0.330	.3544
08.9	.0249	0.243	0.344	.3544
12.0	.0207	0.362	0.322	.3662
14.9	.0130	0.470	0.309	.3811
18.0	.0058	0.603	0.309	.4158
M = 0.65				
-03.0	-.0093	-0.095	0.365	.3493
-00.9	-.0042	-0.037	0.365	.3494
00.0	-.0039	-0.010	0.366	.3425
02.9	.0059	0.083	0.366	.3519
05.7	.0111	0.170	0.367	.3600
08.9	.0154	0.270	0.363	.3623
11.9	.0214	0.361	0.356	.3745
14.9	.0250	0.455	0.346	.3957
17.9	.0321	0.549	0.337	.4226
M = 0.80				
-03.0	-.0061	-0.096	0.393	.3495
-01.0	-.0026	-0.036	0.391	.3491
00.0	-.0022	-0.005	0.391	.3512
02.9	.0042	0.092	0.394	.3491
05.9	.0063	0.190	0.391	.3503
08.9	.0105	0.289	0.386	.3606
11.9	.0126	0.386	0.383	.3760
14.9	.0169	0.483	0.374	.4040
17.9	.0215	0.581	0.366	.4326
M = 0.90				
-02.8	-.0042	-0.089	0.442	.3497
-00.9	-.0031	-0.030	0.435	.3559
00.1	-.0025	0.002	0.439	.3501
03.0	.0016	0.097	0.444	.3469
06.1	.0031	0.198	0.440	.3544
09.1	.0051	0.297	0.430	.3694
12.1	.0066	0.396	0.429	.3801
15.0	.0077	0.496	0.420	.3989
18.0	.0091	0.606	0.408	.4331
M = 1.00				
-02.7	-.0045	-0.080	0.719	.5214
-00.7	-.0031	-0.023	0.717	.5250
00.2	-.0036	0.012	0.719	.5258
03.1	-.0010	0.102	0.711	.5212
06.2	.0008	0.196	0.700	.5236
09.2	.0021	0.293	0.705	.5305
12.2	.0033	0.392	0.700	.5562
15.2	.0042	0.494	0.701	.5886
18.2	.0040	0.601	0.696	.6179
M = 1.10				
-02.6	-.0046	-0.078	0.720	.3897
-00.7	-.0038	-0.027	0.720	.3919
00.3	-.0036	0.005	0.716	.3994
03.2	.0007	0.092	0.713	.3942
06.2	-.0012	0.184	0.708	.3887
09.3	.0003	0.276	0.705	.3935
12.3	.0003	0.368	0.702	.4055
15.2	.0003	0.466	0.701	.4481
18.3	.0001	0.566	0.697	.4802
M = 1.20				
-02.8	-.0013	-0.091	0.602	.3790
-00.7	.0009	-0.029	0.607	.3841
00.2	-.0015	0.003	0.607	.3885
03.1	-.0015	0.099	0.600	.3800
06.1	-.0017	0.199	0.606	.3868
09.2	-.0020	0.303	0.617	.4087
12.2	.0004	0.401	0.622	.4265
15.1	.0034	0.498	0.627	.4519
18.1	.0063	0.604	0.638	.4870
M = 1.30				
-02.9	-.0019	-0.097	0.560	.3540
-00.8	-.0010	-0.035	0.566	.3564
00.1	-.0015	-0.004	0.564	.3608
03.0	-.0039	0.097	0.561	.3514
06.1	-.0070	0.201	0.569	.3597
09.1	-.0085	0.303	0.578	.3784
12.0	-.0087	0.407	0.584	.3937
15.0	-.0082	0.513	0.593	.4182
18.1	-.0060	0.629	0.607	.4566
M = 1.60				
-02.9	.0011	-0.105	0.450	.2795
-01.0	.0001	-0.047	0.456	.2798
00.0	.0001	-0.017	0.459	.2867
02.9	.0000	0.078	0.449	.2820
05.9	-.0020	0.176	0.454	.2820
09.0	-.0042	0.280	0.465	.2940
12.0	-.0063	0.386	0.472	.3072
14.9	-.0102	0.497	0.481	.3239
17.9	-.0141	0.624	0.489	.3474
M = 1.90				
-02.8	.0007	-0.092	0.386	.2251
-00.7	-.0011	-0.030	0.398	.2302
00.1	.0005	-0.002	0.401	.2379
03.1	-.0012	0.093	0.390	.2366
06.0	-.0025	0.191	0.392	.2332
09.2	-.0041	0.296	0.398	.2377
12.1	-.0063	0.405	0.403	.2486
15.0	-.0087	0.521	0.406	.2605
18.1	-.0113	0.649	0.410	.2695
M = 2.20				
-02.3	.0011	-0.082	0.337	.1931
-00.2	.0018	-0.024	0.355	.1980
00.7	.0009	0.009	0.350	.2042
03.6	.0011	0.100	0.336	.2001
06.7	-.0016	0.201	0.336	.1952
09.8	-.0035	0.306	0.339	.1958
12.7	-.0062	0.413	0.343	.1999
15.6	-.0095	0.532	0.345	.2034
18.7	-.0145	0.672	0.354	.2074

TABLE II.- STATIC STABILITY DATA - Continued

(b) Sharp cone with spherical base; center of moments at 0.677d from model base, center of spherical base at 0.677d

α	C_m	C_N	C_A	C_{p_b}
M = 0.25				
-02.9	.0095	-0.127	0.321	.3465
-01.0	.0052	-0.068	0.326	.3465
00.0	.0097	-0.048	0.335	.3465
02.9	.0198	0.055	0.340	.3426
05.9	.0247	0.144	0.330	.3504
09.0	.0438	0.223	0.333	.3585
12.0	.0556	0.296	0.337	.3662
15.0	.0672	0.380	0.335	.3898
18.0	.0925	0.461	0.338	.4182
M = 0.65				
-03.0	-.0071	-0.091	0.362	.3627
-01.0	-.0033	-0.033	0.364	.3581
00.0	-.0021	-0.003	0.365	.3552
02.9	.0063	0.084	0.367	.3591
05.9	.0121	0.175	0.365	.3652
08.9	.0182	0.265	0.365	.3718
11.9	.0269	0.350	0.361	.3912
15.0	.0345	0.435	0.357	.4102
17.8	.0476	0.509	0.347	.4263
M = 0.80				
-03.1	-.0023	-0.097	0.395	.3637
-01.0	.0009	-0.034	0.395	.3629
00.0	.0007	-0.002	0.397	.3552
03.0	.0043	0.093	0.400	.3629
05.8	.0068	0.189	0.395	.3622
08.9	.0118	0.284	0.391	.3708
12.0	.0173	0.375	0.389	.3992
14.9	.0241	0.468	0.383	.4190
17.8	.0326	0.555	0.374	.4441
M = 0.90				
-02.9	-.0024	-0.090	0.446	.3648
-00.7	-.0010	-0.027	0.444	.3657
00.2	.0007	0.010	0.442	.3608
03.1	.0026	0.097	0.448	.3625
06.1	.0043	0.195	0.444	.3673
09.1	.0069	0.293	0.444	.3824
12.0	.0095	0.387	0.442	.3995
15.2	.0145	0.485	0.435	.4244
18.0	.0183	0.584	0.420	.4477
M = 1.00				
-02.7	-.0053	-0.080	0.720	.5453
-00.7	-.0038	-0.023	0.725	.5353
00.3	-.0032	0.016	0.726	.5386
03.2	.0060	0.098	0.724	.5211
06.1	.0078	0.191	0.721	.5352
09.2	.0077	0.290	0.719	.5548
12.2	.0085	0.387	0.715	.5683
15.2	.0073	0.486	0.707	.5887
18.2	.0076	0.593	0.701	.6218
M = 1.10				
-02.7	-.0058	-0.080	0.725	.4035
-00.6	-.0046	-0.024	0.722	.3840
00.2	-.0049	0.005	0.722	.4023
03.2	.0053	0.087	0.720	.3752
06.3	.0051	0.180	0.722	.3986
09.2	.0052	0.270	0.721	.4142
12.3	.0046	0.363	0.718	.4305
15.2	.0045	0.459	0.710	.4524
18.3	.0034	0.558	0.702	.4738
M = 1.20				
-02.8	.0009	-0.097	0.611	.3845
-00.7	.0000	-0.033	0.616	.3889
00.2	.0007	0.001	0.615	.3959
03.2	.0038	0.099	0.609	.3833
06.2	.0028	0.199	0.624	.3969
09.2	.0031	0.298	0.635	.4223
12.2	.0043	0.395	0.641	.4353
15.1	.0068	0.494	0.644	.4554
18.2	.0082	0.604	0.650	.4840
M = 1.30				
-02.9	-.0011	-0.099	0.576	.3566
-00.8	.0009	-0.035	0.581	.3684
00.1	.0009	-0.003	0.581	.3720
03.1	-.0011	0.098	0.574	.3581
06.1	-.0044	0.202	0.586	.3700
09.2	-.0065	0.306	0.598	.3920
12.1	-.0069	0.406	0.603	.4013
15.1	-.0053	0.512	0.610	.4235
18.1	-.0039	0.628	0.620	.4491
M = 1.60				
-02.9	.0070	-0.112	0.465	.2936
-01.0	.0061	-0.049	0.473	.2970
00.0	.0074	-0.019	0.477	.3054
03.0	.0068	0.081	0.466	.2936
05.9	.0048	0.178	0.470	.2900
09.0	.0029	0.281	0.478	.2995
12.0	.0005	0.389	0.483	.3125
15.0	-.0023	0.501	0.492	.3315
18.1	-.0076	0.628	0.505	.3493
M = 1.90				
-02.9	.0012	-0.091	0.393	.2364
-00.8	.0016	-0.030	0.406	.2434
00.1	.0014	-0.001	0.408	.2507
03.1	.0012	0.097	0.396	.2448
06.0	.0001	0.192	0.399	.2347
09.0	-.0029	0.298	0.403	.2413
12.1	-.0050	0.407	0.410	.2531
15.1	-.0085	0.524	0.418	.2599
18.1	-.0105	0.650	0.432	.2697
M = 2.20				
-02.3	.0103	-0.088	0.334	.1993
-00.2	-.0022	-0.015	0.345	.2073
00.6	-.0015	0.009	0.346	.2121
03.7	-.0018	0.105	0.331	.2025
06.7	-.0056	0.206	0.334	.1946
09.8	-.0097	0.310	0.339	.1919
12.7	-.0133	0.421	0.349	.2003
15.7	-.0165	0.540	0.361	.2051
18.6	-.0210	0.667	0.369	.2108

TABLE II.- STATIC STABILITY DATA - Continued

(c) Blunt cone with flat base; center of moments at 0.445d from model base

α	C_m	C_N	C_A	C_{p_b}
M = 0.25				
-03.0	-.0175	-0.100	0.299	.3346
-01.0	-.0168	-0.041	0.318	.3189
00.0	-.0084	-0.021	0.315	.3308
02.9	.0083	0.073	0.317	.3308
05.9	.0166	0.145	0.315	.3504
09.0	.0266	0.232	0.310	.3387
12.0	.0410	0.307	0.303	.3504
15.0	.0556	0.382	0.309	.3554
17.9	.0745	0.446	0.302	.4157
M = 0.65				
-03.0	-.0103	-0.090	0.361	.3419
-01.0	-.0049	-0.033	0.367	.3417
00.0	-.0026	-0.003	0.367	.3425
02.9	.0053	0.086	0.365	.3412
05.9	.0160	0.170	0.359	.3483
08.9	.0259	0.257	0.354	.3494
11.9	.0370	0.343	0.353	.3676
14.9	.0447	0.430	0.349	.3939
17.9	.0552	0.503	0.342	.4218
M = 0.80				
-03.0	-.0097	-0.092	0.393	.3473
-01.0	-.0044	-0.031	0.397	.3443
-00.1	-.0026	-0.000	0.397	.3451
02.9	.0072	0.094	0.394	.3499
05.9	.0173	0.189	0.390	.3485
08.9	.0256	0.285	0.389	.3592
11.9	.0360	0.376	0.389	.3804
14.9	.0459	0.469	0.386	.4056
18.0	.0567	0.563	0.384	.4374
M = 0.90				
-02.9	-.0079	-0.089	0.441	.3490
-00.8	-.0043	-0.024	0.446	.3435
00.1	.0006	0.008	0.447	.3511
03.0	.0072	0.103	0.448	.3540
06.1	.0163	0.202	0.450	.3630
09.1	.0261	0.301	0.456	.3689
12.1	.0360	0.401	0.452	.3905
15.1	.0426	0.505	0.444	.4123
18.1	.0492	0.610	0.426	.4443
M = 1.00				
-02.7	-.0110	-0.078	0.718	.5068
-00.7	-.0049	-0.019	0.723	.5164
00.2	.0005	0.013	0.721	.4968
03.2	.0094	0.106	0.719	.5192
06.2	.0200	0.199	0.715	.5300
09.2	.0336	0.293	0.721	.5360
12.2	.0463	0.392	0.716	.5570
15.2	.0508	0.509	0.706	.5874
18.3	.0490	0.644	0.704	.6212
M = 1.10				
-02.7	-.0104	-0.080	0.719	.3773
-00.7	-.0046	-0.023	0.716	.3805
00.3	-.0014	0.010	0.718	.3773
03.1	.0074	0.093	0.715	.3718
06.2	.0184	0.183	0.716	.3819
09.2	.0299	0.272	0.718	.3875
12.3	.0427	0.367	0.711	.4084
15.2	.0513	0.470	0.709	.4452
18.3	.0445	0.601	0.718	.4973
M = 1.20				
-02.8	-.0085	-0.096	0.658	.3747
-00.8	-.0045	-0.028	0.656	.3739
00.2	.0004	0.007	0.655	.3735
03.1	.0077	0.110	0.657	.3756
06.2	.0141	0.219	0.669	.3886
09.2	.0203	0.332	0.687	.4110
12.2	.0255	0.436	0.700	.4358
15.2	.0280	0.543	0.718	.4658
18.2	.0282	0.657	0.740	.5032
M = 1.30				
-02.8	-.0056	-0.100	0.651	.3491
-00.7	-.0037	-0.032	0.648	.3496
00.1	-.0015	0.003	0.648	.3486
02.8	.0013	0.105	0.650	.3485
06.0	.0054	0.218	0.663	.3612
09.2	.0067	0.334	0.682	.3846
12.1	.0097	0.442	0.698	.4067
15.1	.0128	0.548	0.716	.4276
18.2	.0131	0.660	0.744	.4697
M = 1.60				
-02.9	.0007	-0.104	0.611	.2909
-01.0	.0008	-0.045	0.612	.2861
00.0	.0006	-0.011	0.613	.2873
02.9	.0015	0.087	0.612	.2873
05.9	.0000	0.190	0.618	.2919
09.0	.0003	0.292	0.630	.3004
12.0	-.0020	0.392	0.641	.3133
14.9	-.0038	0.493	0.658	.3321
17.9	-.0076	0.601	0.676	.3511
M = 1.90				
-02.8	-.0011	-0.080	0.572	.2346
-00.8	-.0014	-0.024	0.574	.2342
00.1	-.0012	0.007	0.574	.2312
03.0	-.0026	0.095	0.576	.2382
06.0	-.0044	0.191	0.579	.2404
09.0	-.0048	0.282	0.583	.2435
12.1	-.0064	0.374	0.592	.2487
15.1	-.0083	0.470	0.604	.2621
18.1	-.0109	0.565	0.618	.2704
M = 2.20				
-02.3	.0003	-0.068	0.546	.1881
-00.2	-.0017	-0.015	0.548	.1938
00.6	.0004	0.011	0.549	.1976
03.7	-.0022	0.094	0.543	.1986
06.7	-.0041	0.182	0.540	.2002
09.7	-.0050	0.268	0.543	.1971
12.7	-.0063	0.353	0.551	.1985
15.7	-.0090	0.444	0.565	.2024
18.7	-.0117	0.534	0.575	.2088

TABLE II.- STATIC STABILITY DATA - Continued

(d) Blunt cone with spherical base; center of moments at 0.445d from model base, center of spherical base at 0.562d

α	C_m	C_N	C_A	C_{p_b}
M = 0.25				
-02.9	-.0031	-0.120	0.304	.3580
-01.0	-.0071	-0.061	0.316	.3308
00.0	-.0100	-0.035	0.323	.3426
02.9	.0165	0.049	0.336	.3426
06.0	.0265	0.115	0.339	.4088
08.9	.0225	0.230	0.321	.3695
12.0	.0319	0.328	0.319	.3811
15.0	.0385	0.422	0.327	.4205
17.9	.0331	0.528	0.339	.4438
M = 0.65				
-03.1	-.0103	-0.088	0.364	.3562
-01.0	-.0041	-0.035	0.367	.3522
00.0	-.0019	-0.007	0.368	.3545
02.9	.0070	0.083	0.369	.3545
05.9	.0175	0.170	0.366	.3681
08.9	.0267	0.261	0.365	.3847
11.9	.0341	0.348	0.363	.4067
14.9	.0421	0.434	0.357	.4272
17.9	.0483	0.519	0.353	.4521
M = 0.80				
-03.0	-.0096	-0.090	0.394	.3612
-01.0	-.0046	-0.033	0.399	.3576
00.0	-.0011	-0.002	0.399	.3581
02.9	.0079	0.093	0.397	.3594
05.9	.0167	0.190	0.396	.3684
08.9	.0261	0.287	0.396	.3869
12.0	.0339	0.387	0.401	.4043
14.9	.0429	0.479	0.394	.4356
17.9	.0509	0.578	0.392	.4560
M = 0.90				
-02.9	-.0095	-0.088	0.446	.3602
-00.8	-.0030	-0.026	0.445	.3577
00.1	.0001	0.006	0.444	.3472
02.9	.0065	0.097	0.450	.3631
06.1	.0160	0.204	0.455	.3809
09.1	.0258	0.303	0.456	.4017
12.1	.0342	0.405	0.457	.4214
15.1	.0414	0.512	0.451	.4362
18.1	.0465	0.622	0.435	.4645
M = 1.00				
-02.7	-.0099	-0.079	0.713	.5191
-00.7	-.0039	-0.022	0.713	.5232
00.3	.0005	0.014	0.712	.5199
03.1	.0095	0.102	0.703	.5199
06.2	.0210	0.200	0.725	.5482
09.2	.0334	0.296	0.724	.5637
12.3	.0430	0.400	0.716	.5771
15.3	.0478	0.523	0.709	.6151
18.2	.0449	0.654	0.707	.6380
M = 1.10				
-02.8	-.0111	-0.079	0.717	.3823
-00.7	-.0041	-0.025	0.698	.3715
00.3	.0005	0.007	0.715	.3757
03.2	.0086	0.093	0.713	.3897
06.2	.0177	0.186	0.721	.4062
09.3	.0304	0.280	0.717	.4296
12.3	.0405	0.370	0.716	.4368
15.2	.0487	0.479	0.712	.4672
18.2	.0416	0.607	0.715	.4968
M = 1.20				
-02.7	-.0078	-0.099	0.662	.3842
-00.8	-.0030	-0.032	0.657	.3794
00.3	.0006	0.005	0.654	.3785
03.2	.0080	0.114	0.661	.3854
06.2	.0140	0.222	0.676	.4011
09.2	.0199	0.332	0.693	.4223
15.1	.0271	0.550	0.723	.4743
18.2	.0259	0.662	0.737	.5023
12.1	.0237	0.441	0.705	.4442
M = 1.30				
-02.9	-.0051	-0.106	0.657	.3623
-00.8	-.0030	-0.036	0.652	.3588
00.1	-.0011	0.001	0.651	.3543
03.1	.0019	0.111	0.658	.3602
06.0	.0042	0.222	0.671	.3715
09.2	.0059	0.336	0.688	.3891
12.2	.0082	0.446	0.699	.4090
15.1	.0113	0.553	0.716	.4300
18.1	.0106	0.667	0.741	.4665
M = 1.60				
-02.9	.0013	-0.108	0.612	.2881
-00.9	.0017	-0.048	0.616	.2931
00.0	.0015	-0.013	0.617	.2931
02.9	.0022	0.084	0.614	.2943
05.9	.0016	0.186	0.623	.2981
09.0	.0004	0.289	0.629	.3100
12.0	-.0023	0.391	0.639	.3230
15.0	-.0046	0.494	0.654	.3359
18.0	-.0094	0.605	0.671	.3537
M = 1.90				
-02.9	.0008	-0.082	0.575	.2352
-00.8	-.0015	-0.025	0.576	.2396
00.1	.0005	0.001	0.578	.2403
03.1	-.0021	0.095	0.579	.2429
06.1	-.0040	0.187	0.578	.2415
09.1	-.0047	0.281	0.581	.2473
12.1	-.0069	0.376	0.590	.2508
15.1	-.0108	0.474	0.601	.2576
18.2	-.0133	0.571	0.615	.2739
M = 2.20				
-02.2	.0001	-0.068	0.540	.1949
-00.2	.0004	-0.017	0.542	.1976
00.8	.0009	0.014	0.543	.2007
03.6	-.0017	0.093	0.538	.1992
06.7	-.0035	0.180	0.538	.1971
09.7	-.0053	0.269	0.539	.1976
12.7	-.0078	0.356	0.547	.1976
15.7	-.0102	0.445	0.558	.1992
18.7	-.0146	0.541	0.571	.2056

TABLE II.- STATIC STABILITY DATA - Continued

(e) Blunt cone with spherical base; center of moments at 0.445d from model base, center of spherical base at 0.445d

α	C_m	C_N	C_A	C_{p_b}
M = 0.25				
-02.9	-.0114	-0.090	0.343	.3308
-01.0	-.0056	-0.048	0.344	.3346
00.0	-.0032	-0.028	0.350	.3346
02.9	.0181	0.062	0.346	.3346
05.9	.0169	0.134	0.365	.3943
09.0	.0239	0.246	0.339	.3585
12.0	.0317	0.330	0.337	.3869
15.0	.0382	0.423	0.337	.4110
17.9	.0421	0.512	0.344	.4473
M = 0.65				
-02.9	-.0101	-0.087	0.374	.3561
-01.0	-.0039	-0.034	0.376	.3577
00.0	.0004	-0.006	0.376	.3584
02.9	.0091	0.081	0.376	.3616
05.9	.0174	0.169	0.371	.3668
09.0	.0268	0.261	0.374	.3788
11.9	.0356	0.341	0.373	.4015
14.9	.0430	0.432	0.364	.4219
17.9	.0507	0.510	0.358	.4536
M = 0.80				
-03.0	-.0088	-0.090	0.405	.3615
-01.0	-.0036	-0.032	0.406	.3581
00.0	.0002	-0.002	0.407	.3564
02.9	.0101	0.090	0.402	.3616
05.9	.0184	0.190	0.403	.3634
08.9	.0266	0.284	0.401	.3804
11.9	.0348	0.380	0.400	.4013
14.9	.0421	0.479	0.400	.4285
17.9	.0505	0.569	0.393	.4504
M = 0.90				
-02.8	-.0092	-0.086	0.453	.3604
-00.8	-.0036	-0.024	0.455	.3591
00.1	.0005	0.009	0.454	.3558
03.1	.0099	0.101	0.453	.3558
06.0	.0172	0.202	0.453	.3697
09.1	.0264	0.302	0.460	.3887
12.1	.0339	0.402	0.452	.4166
15.0	.0413	0.505	0.450	.4338
18.1	.0469	0.621	0.439	.4593
M = 1.00				
-02.7	-.0103	-0.077	0.723	.5182
-00.7	-.0031	-0.021	0.720	.5069
00.2	.0007	0.012	0.719	.5123
03.2	.0106	0.106	0.717	.5182
06.2	.0216	0.199	0.723	.5347
09.2	.0332	0.294	0.726	.5561
12.2	.0446	0.395	0.721	.5757
15.2	.0478	0.517	0.707	.5954
18.2	.0453	0.652	0.709	.6361
M = 1.10				
-02.6	-.0098	-0.079	0.721	.3806
-00.8	-.0036	-0.025	0.717	.3875
00.4	.0003	0.009	0.720	.3668
03.2	.0098	0.093	0.717	.3901
06.2	.0194	0.185	0.726	.3965
09.3	.0301	0.278	0.725	.4174
12.3	.0419	0.371	0.715	.4322
15.2	.0464	0.476	0.714	.4532
18.3	.0408	0.607	0.717	.4970
M = 1.20				
-02.6	-.0082	-0.097	0.667	.3851
-00.7	-.0026	-0.028	0.659	.3800
00.2	.0018	0.005	0.657	.3802
03.3	.0087	0.115	0.664	.3818
09.2	.0208	0.330	0.695	.4175
12.2	.0244	0.437	0.707	.4378
15.2	.0260	0.551	0.723	.4667
18.2	.0256	0.660	0.738	.4992
M = 1.30				
-02.9	-.0054	-0.103	0.662	.3630
-00.7	-.0032	-0.033	0.657	.3569
00.1	-.0011	0.001	0.656	.3548
03.0	.0028	0.108	0.660	.3571
06.1	.0046	0.221	0.673	.3700
09.2	.0062	0.334	0.692	.3864
12.0	.0085	0.443	0.700	.4048
15.1	.0111	0.552	0.716	.4285
18.1	.0100	0.663	0.739	.4602
M = 1.60				
-02.9	.0020	-0.108	0.615	.2899
-01.0	.0018	-0.047	0.619	.2900
00.0	.0015	-0.013	0.618	.2912
02.9	.0018	0.085	0.616	.2926
05.9	.0016	0.187	0.624	.2950
09.0	.0001	0.287	0.628	.3046
12.0	-.0023	0.391	0.641	.3151
15.0	-.0055	0.493	0.653	.3281
17.9	-.0088	0.595	0.666	.3412
M = 1.90				
-02.8	-.0012	-0.080	0.580	.2374
-00.8	.0003	-0.026	0.581	.2374
00.1	.0007	0.006	0.582	.2404
03.1	-.0015	0.094	0.583	.2424
06.1	-.0034	0.187	0.582	.2427
09.0	-.0048	0.280	0.581	.2432
12.1	-.0064	0.375	0.591	.2497
15.0	-.0097	0.467	0.600	.2513
18.1	-.0133	0.566	0.616	.2610
M = 2.20				
-02.1	.0007	-0.070	0.544	.1913
-00.1	.0006	-0.012	0.545	.1929
00.8	.0008	0.014	0.545	.1977
03.7	.0008	0.094	0.542	.1994
06.7	-.0019	0.180	0.536	.1968
09.7	-.0049	0.267	0.537	.1919
12.8	-.0072	0.354	0.548	.1945
15.7	-.0111	0.445	0.561	.1993
18.6	-.0151	0.535	0.570	.2029

TABLE II.- STATIC STABILITY DATA - Concluded

(f) Blunt cone with spherical base; center of moments at 0.445d from model base, center of spherical base at 0.323d

α	C_m	C_N	C_A	C_{p_b}
M = 0.25				
-02.8	-.0050	-0.139	0.342	.3506
-01.0	.0065	-0.102	0.340	.3385
00.0	.0090	-0.082	0.347	.3385
02.9	.0167	0.002	0.341	.3426
06.0	.0331	0.080	0.377	.4371
09.0	.0347	0.211	0.341	.3780
12.0	.0411	0.305	0.330	.3854
15.0	.0453	0.404	0.315	.4182
17.9	.0473	0.510	0.336	.4421
M = 0.65				
-03.0	-.0078	-0.095	0.372	.3613
-01.0	-.0025	-0.042	0.375	.3591
00.0	.0010	-0.012	0.373	.3568
02.9	.0119	0.076	0.374	.3652
05.9	.0209	0.162	0.368	.3736
08.9	.0289	0.255	0.371	.3855
11.9	.0370	0.343	0.369	.4053
14.9	.0446	0.431	0.364	.4333
17.9	.0510	0.515	0.355	.4585
M = 0.80				
-03.0	-.0078	-0.097	0.404	.3646
-01.0	-.0019	-0.039	0.407	.3625
00.0	.0010	-0.007	0.409	.3628
02.9	.0105	0.086	0.406	.3694
05.9	.0187	0.186	0.404	.3800
09.0	.0271	0.284	0.403	.3999
11.9	.0350	0.382	0.404	.4158
14.9	.0428	0.482	0.401	.4415
17.9	.0501	0.574	0.392	.4614
M = 0.90				
-02.9	-.0078	-0.093	0.454	.3656
-00.8	-.0019	-0.030	0.452	.3611
00.1	.0010	0.002	0.454	.3537
03.1	.0090	0.100	0.457	.3758
06.1	.0179	0.202	0.462	.3951
09.2	.0264	0.306	0.465	.4030
12.1	.0342	0.405	0.463	.4283
15.1	.0411	0.513	0.459	.4594
18.1	.0471	0.623	0.438	.4698
M = 1.00				
-02.7	-.0096	-0.083	0.727	.5245
-00.7	-.0026	-0.023	0.718	.5290
00.3	.0012	0.010	0.716	.5141
03.2	.0114	0.101	0.724	.5296
06.1	.0212	0.197	0.722	.5620
09.2	.0331	0.297	0.730	.5730
12.2	.0446	0.395	0.717	.5852
15.2	.0476	0.519	0.730	.6305
18.1	.0454	0.654	0.711	.6448
M = 1.10				
-02.6	-.0098	-0.084	0.723	.3981
-00.7	-.0033	-0.029	0.719	.3838
00.2	.0003	0.002	0.718	.3904
03.2	.0097	0.091	0.722	.3868
06.1	.0189	0.181	0.733	.4141
09.3	.0304	0.278	0.726	.4301
12.3	.0415	0.373	0.717	.4440
15.2	.0498	0.481	0.728	.4894
18.3	.0413	0.613	0.720	.5051
M = 1.20				
-02.7	-.0061	-0.105	0.669	.3898
-00.7	-.0016	-0.035	0.661	.3813
00.2	.0012	0.000	0.659	.3777
03.2	.0085	0.113	0.667	.3832
06.2	.0148	0.220	0.678	.4003
09.2	.0202	0.333	0.693	.4219
12.2	.0253	0.440	0.708	.4430
15.1	.0273	0.549	0.719	.4680
18.2	.0261	0.666	0.739	.5045
M = 1.30				
-02.9	-.0052	-0.106	0.663	.3597
-00.9	-.0032	-0.038	0.658	.3563
00.1	.0008	-0.002	0.658	.3540
03.1	.0032	0.107	0.663	.3598
06.1	.0041	0.223	0.675	.3715
09.1	.0074	0.336	0.688	.3879
12.2	.0099	0.446	0.699	.4043
15.1	.0116	0.555	0.716	.4275
18.1	.0105	0.669	0.742	.4638
M = 1.60				
-03.0	.0024	-0.114	0.617	.2888
-01.0	.0016	-0.049	0.620	.2891
00.0	.0018	-0.015	0.622	.2904
02.9	.0032	0.082	0.620	.2954
05.9	.0025	0.185	0.625	.2977
09.0	.0013	0.287	0.629	.3061
12.0	-.0016	0.393	0.639	.3179
15.0	-.0049	0.496	0.653	.3320
17.9	-.0087	0.604	0.670	.3451
M = 1.90				
-02.8	.0005	-0.083	0.585	.2382
-00.8	.0005	-0.028	0.584	.2381
00.0	.0001	-0.001	0.588	.2422
03.1	.0000	0.090	0.585	.2451
06.1	-.0016	0.187	0.582	.2458
09.2	-.0039	0.281	0.585	.2450
12.1	-.0062	0.377	0.593	.2486
15.1	-.0106	0.476	0.604	.2552
18.1	-.0134	0.573	0.617	.2642
M = 2.20				
-02.2	.0007	-0.070	0.544	.1921
-00.1	.0009	-0.020	0.551	.1943
00.7	.0011	0.009	0.549	.1985
03.7	.0004	0.091	0.544	.1985
06.7	-.0016	0.177	0.536	.1979
09.8	-.0039	0.267	0.541	.1943
12.7	-.0069	0.357	0.549	.1978
15.6	-.0108	0.451	0.563	.2010
18.7	-.0151	0.546	0.574	.2058

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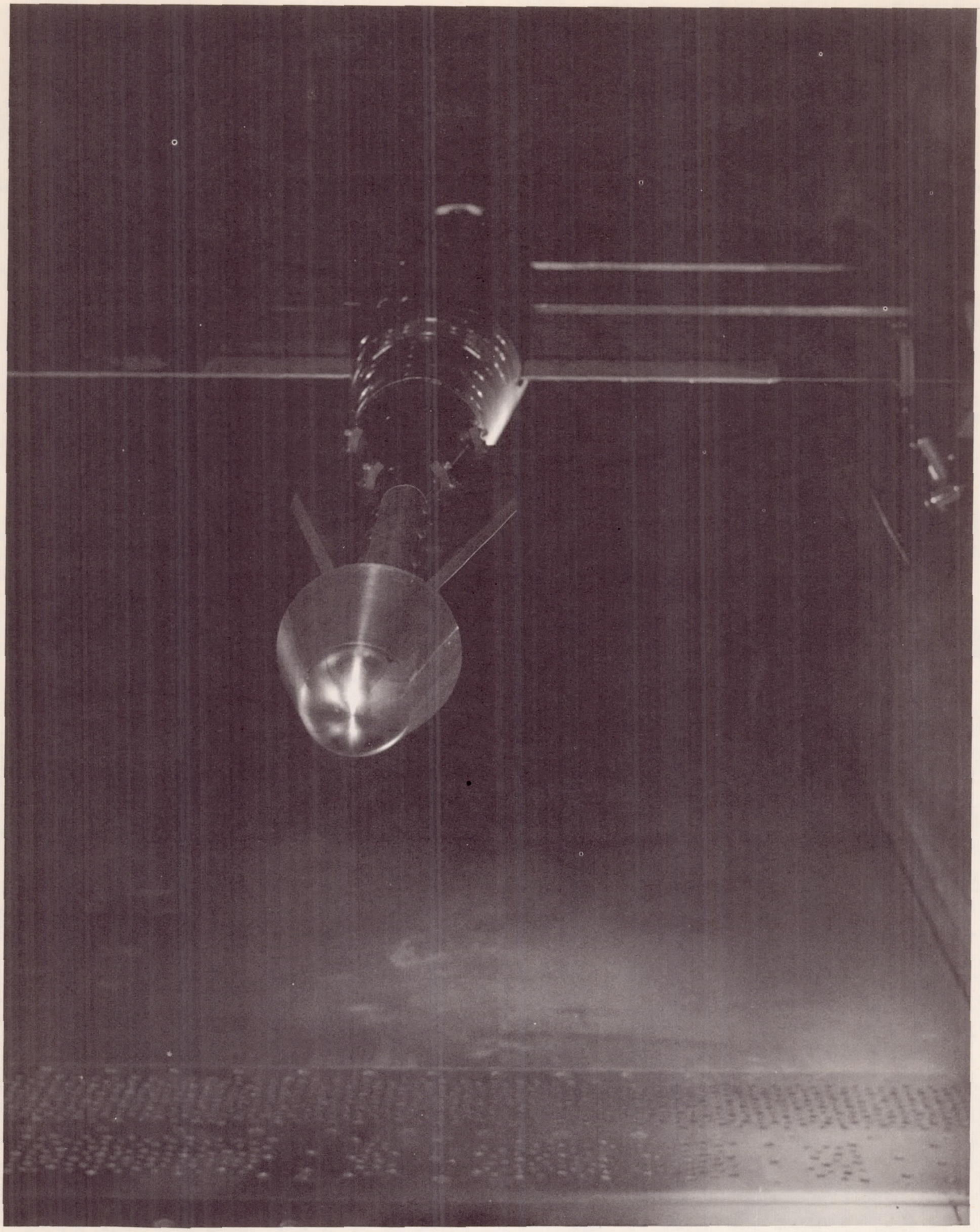

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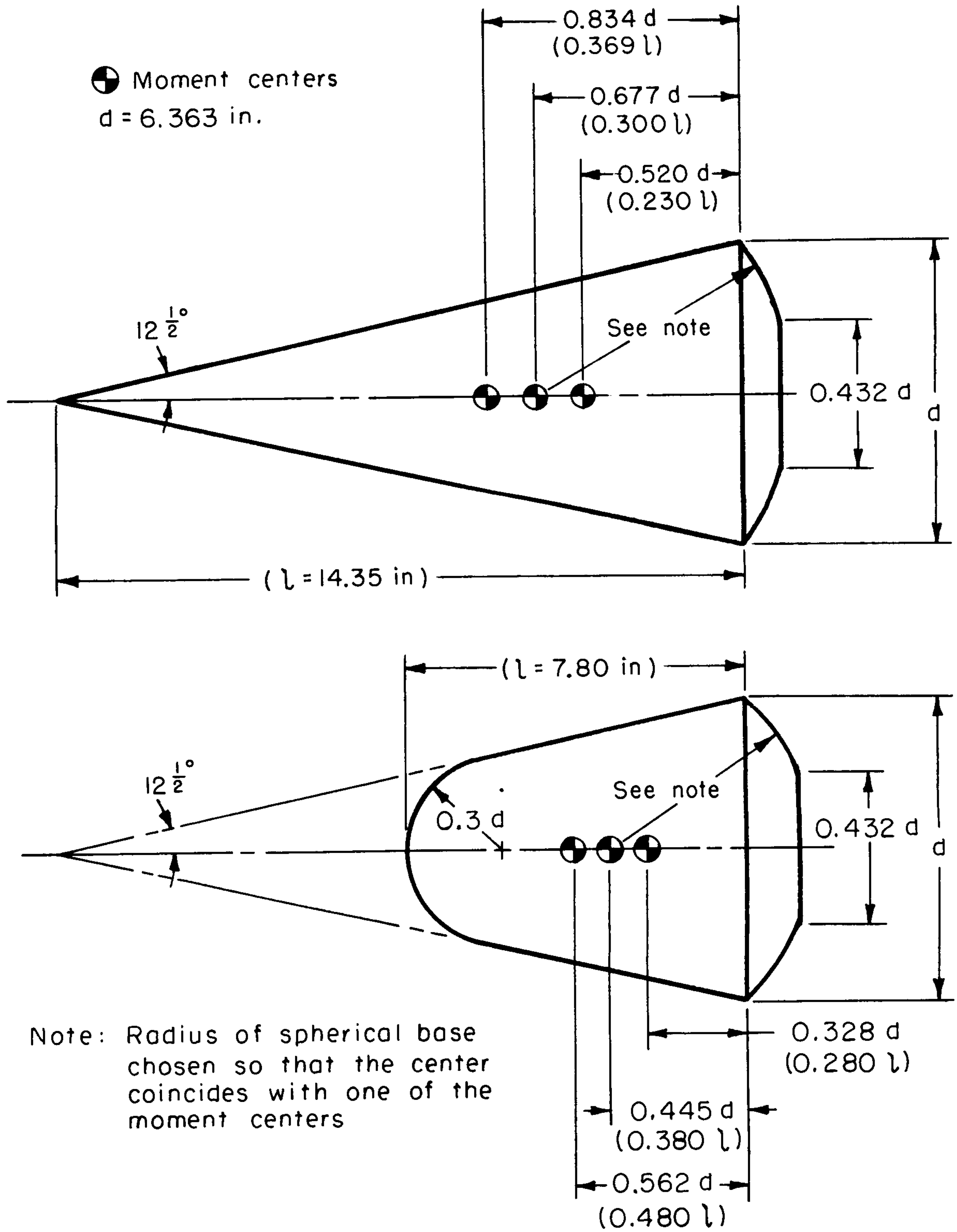
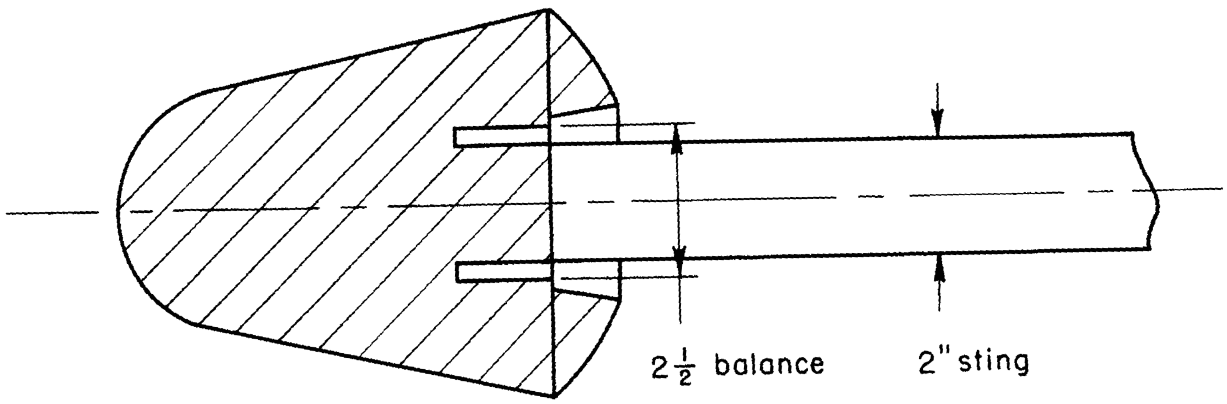
Figure 1.- Photograph of model mounted on dynamic apparatus.

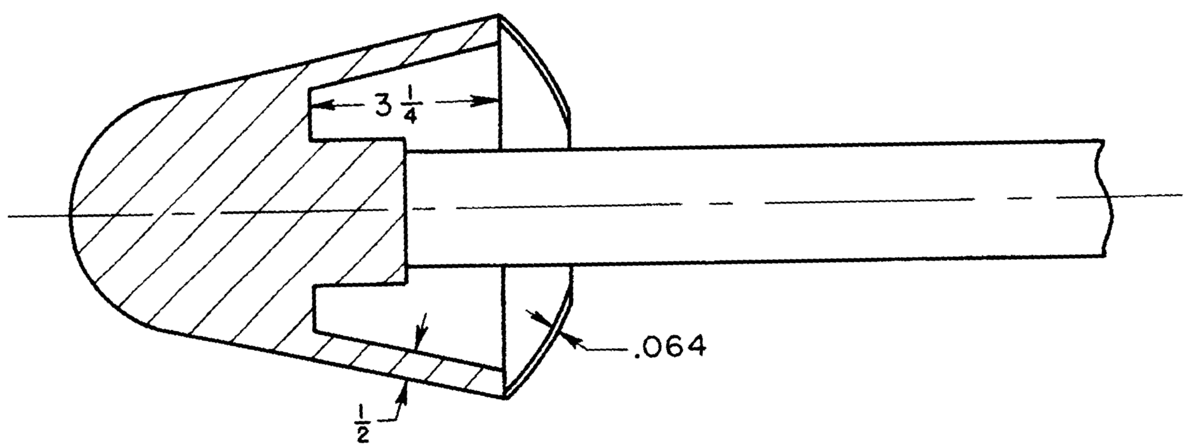


(a) Sketches of models.

Figure 2.- Geometry of the models.



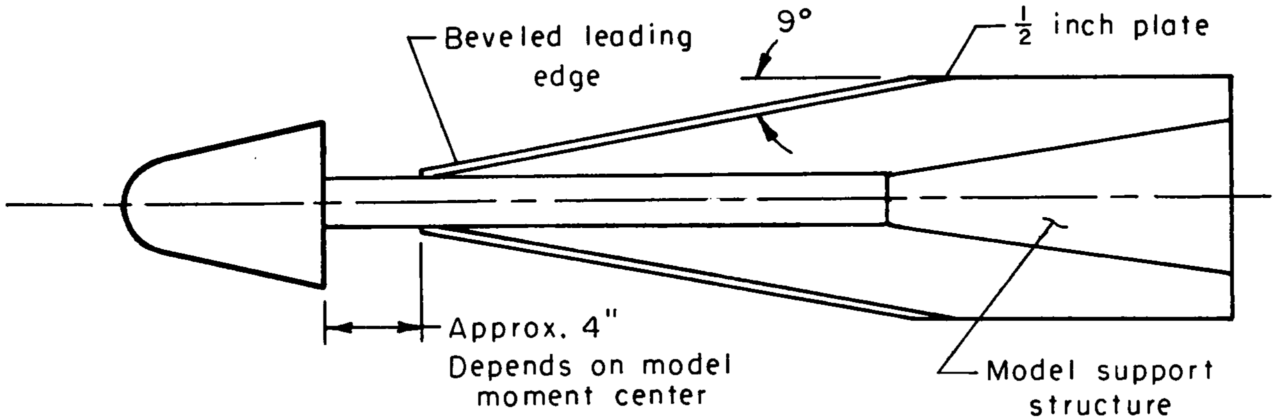
Solid model



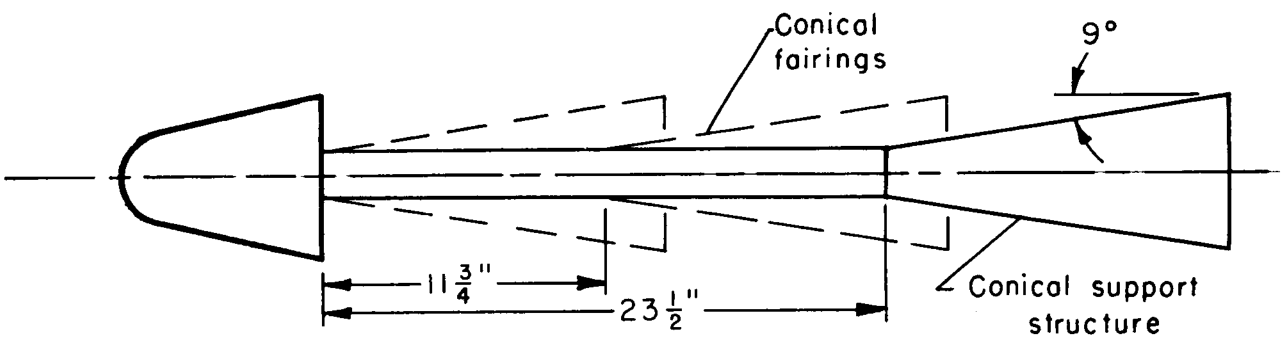
Hollow model

(b) Model interiors.

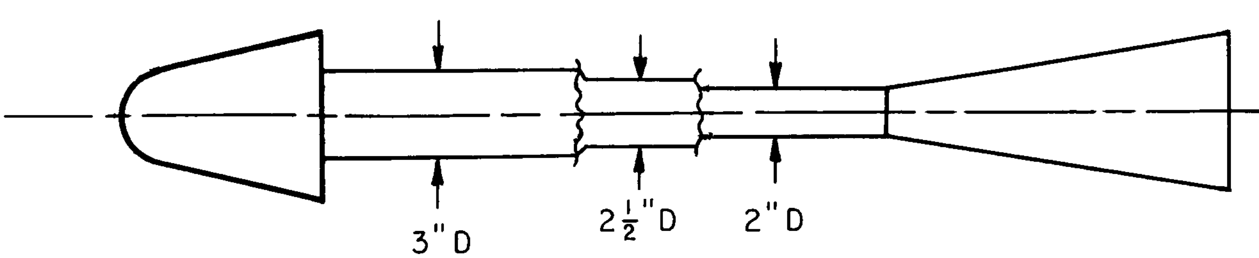
Figure 2.- Continued.



Standard sting setup



Setup for variation of sting length



Setup for variation of sting diameter

(c) Sting modifications.

Figure 2.- Concluded.

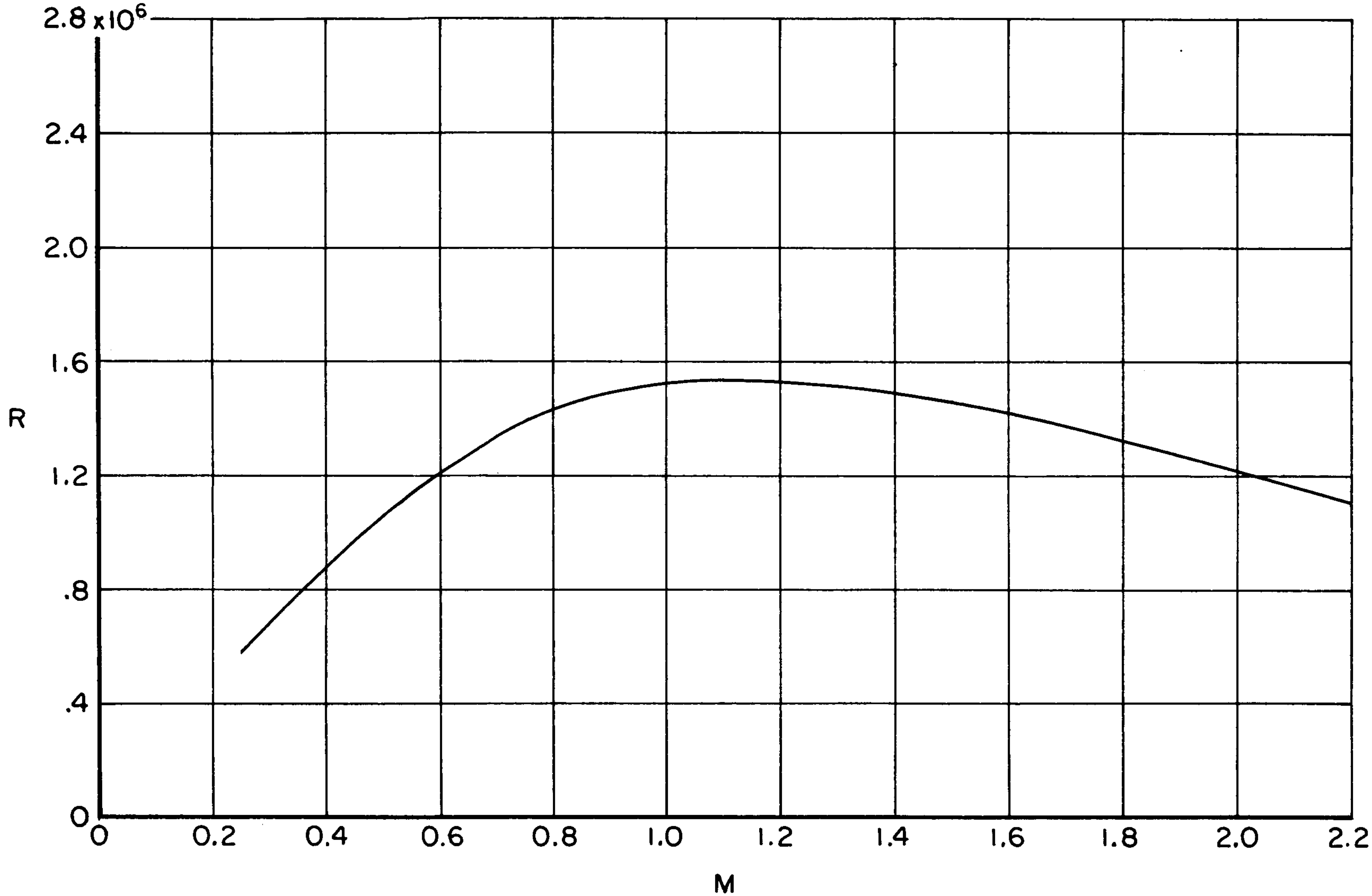
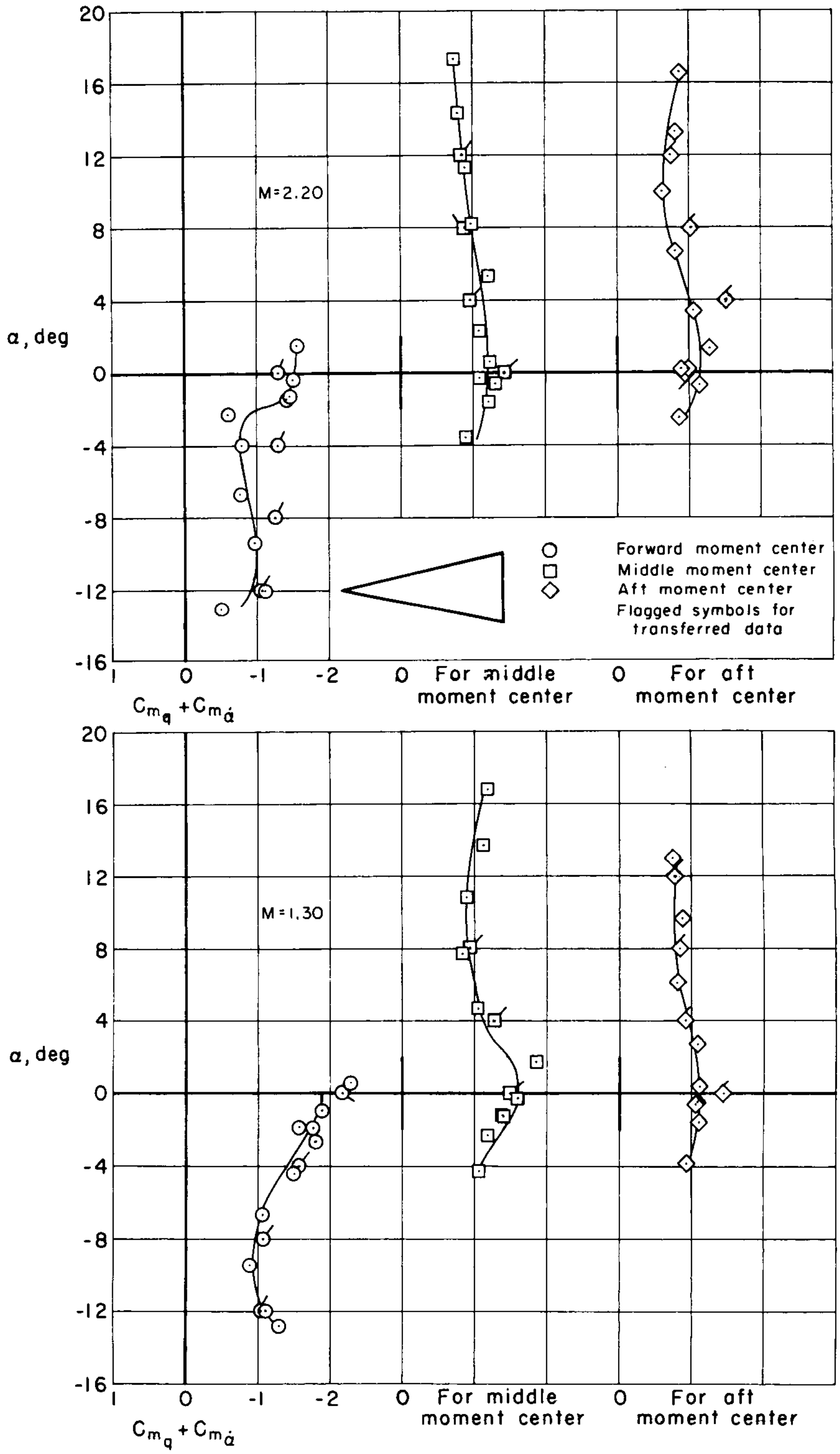
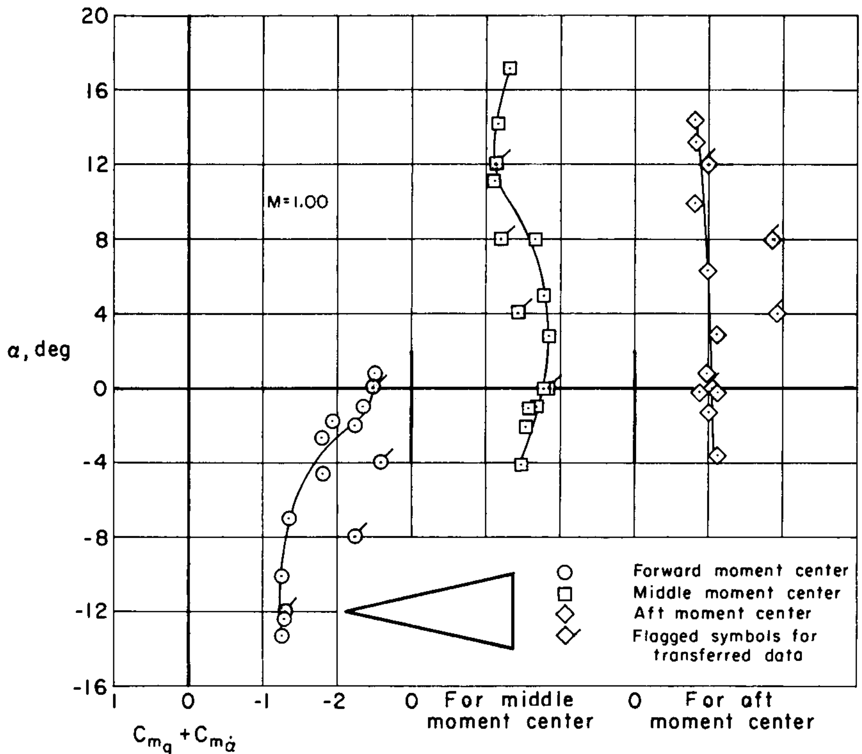


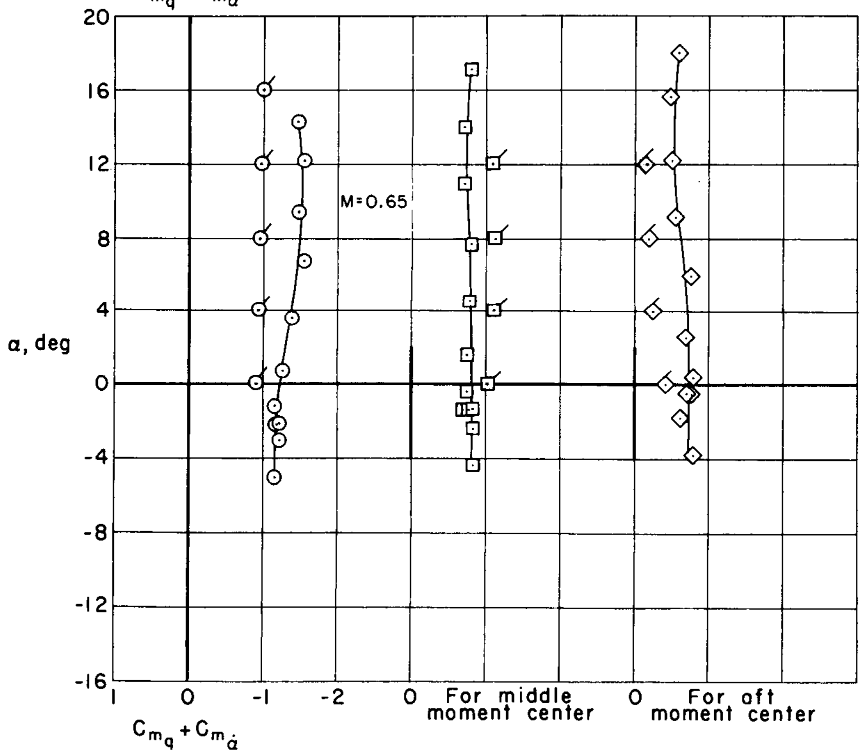
Figure 3.- Variation of test Reynolds number with Mach number.



(a) Sharp cone with flat base; M = 2.20 and 1.30.

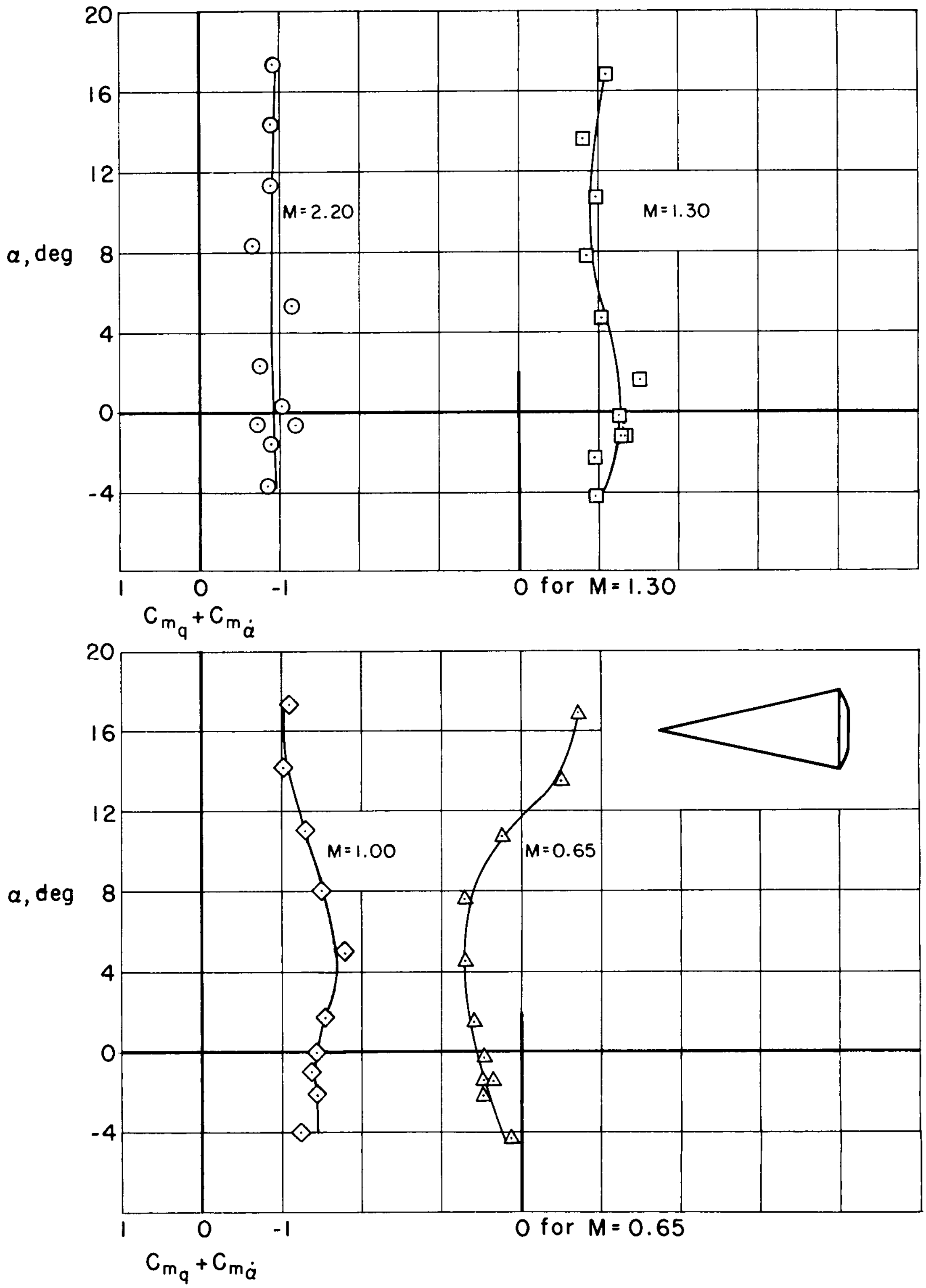
Figure 4.- Variation of the dynamic stability characteristics with angle of attack.





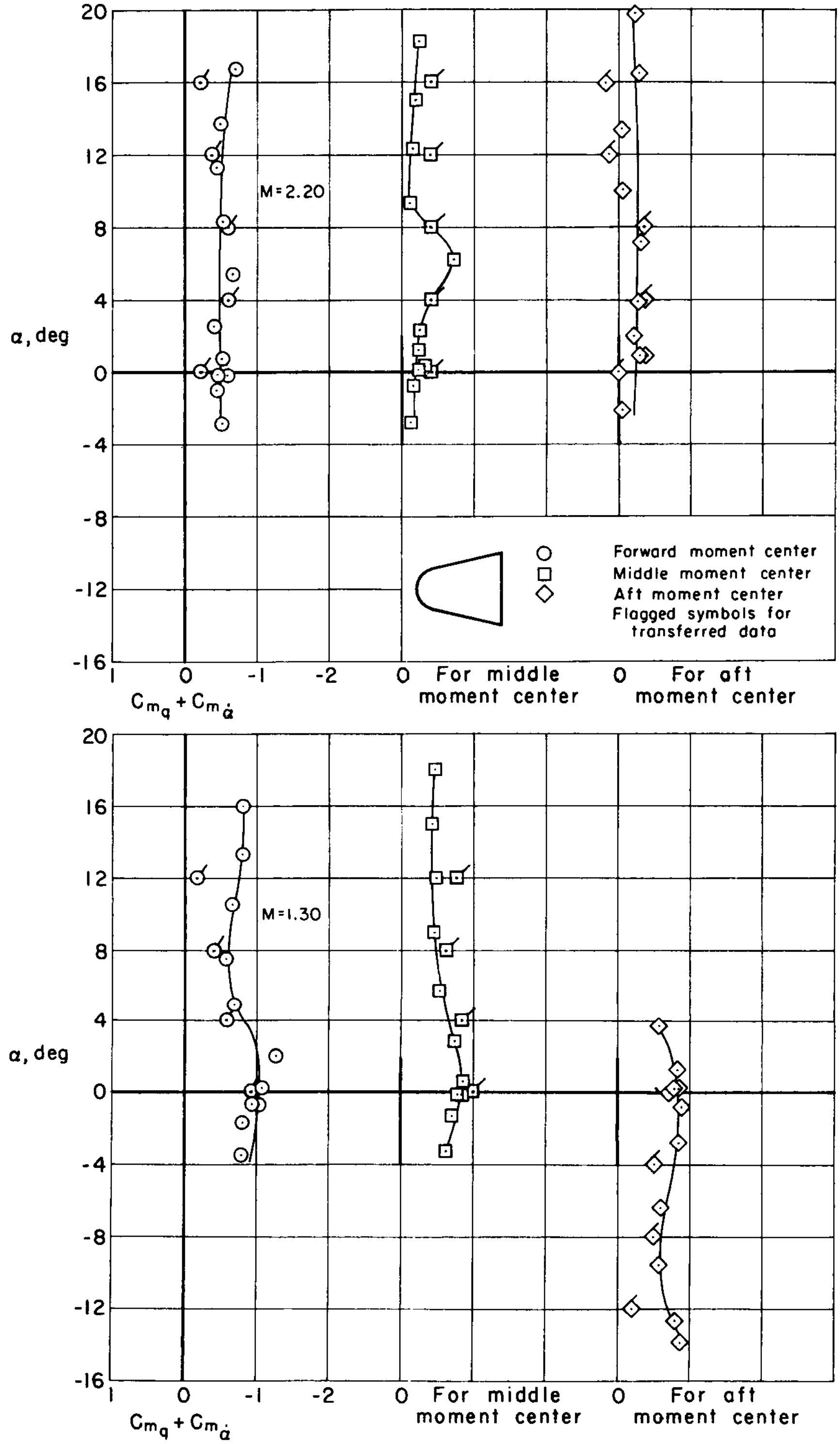
(b) Sharp cone with flat base; M = 1.00 and 0.65.

Figure 4.- Continued.



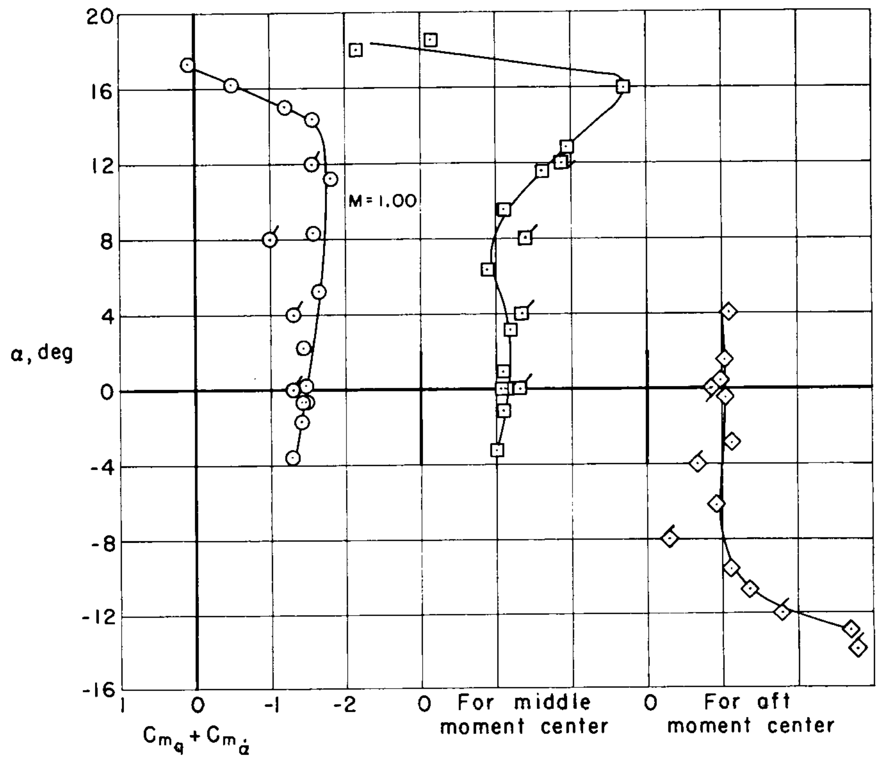
(c) Sharp cone with spherical base; middle moment center.

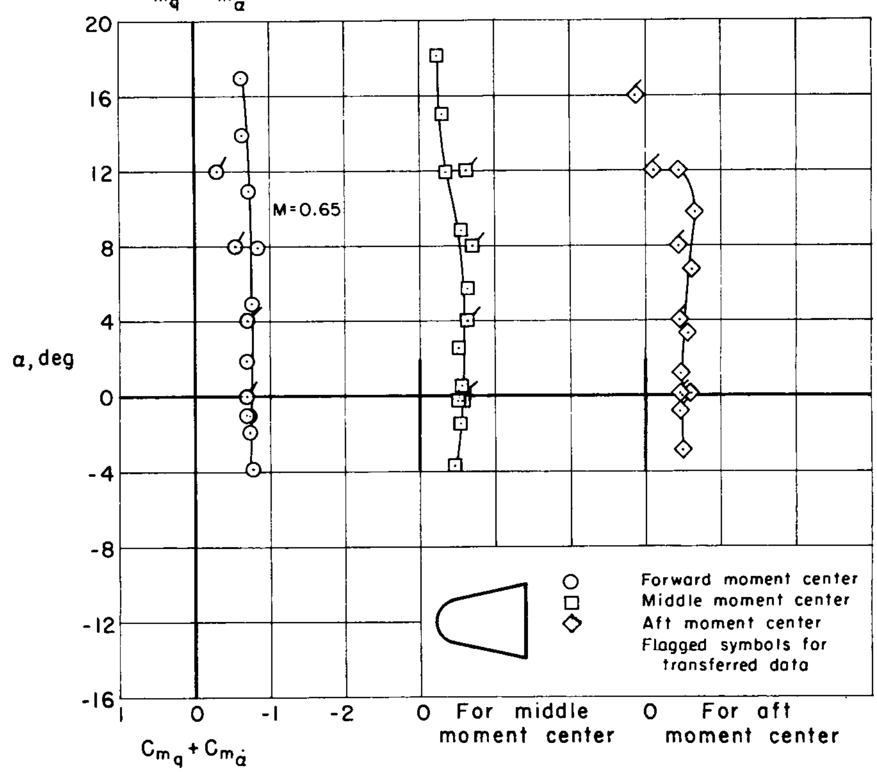
Figure 4.- Continued.



(d) Blunt cone with flat base; M = 2.20 and 1.30.

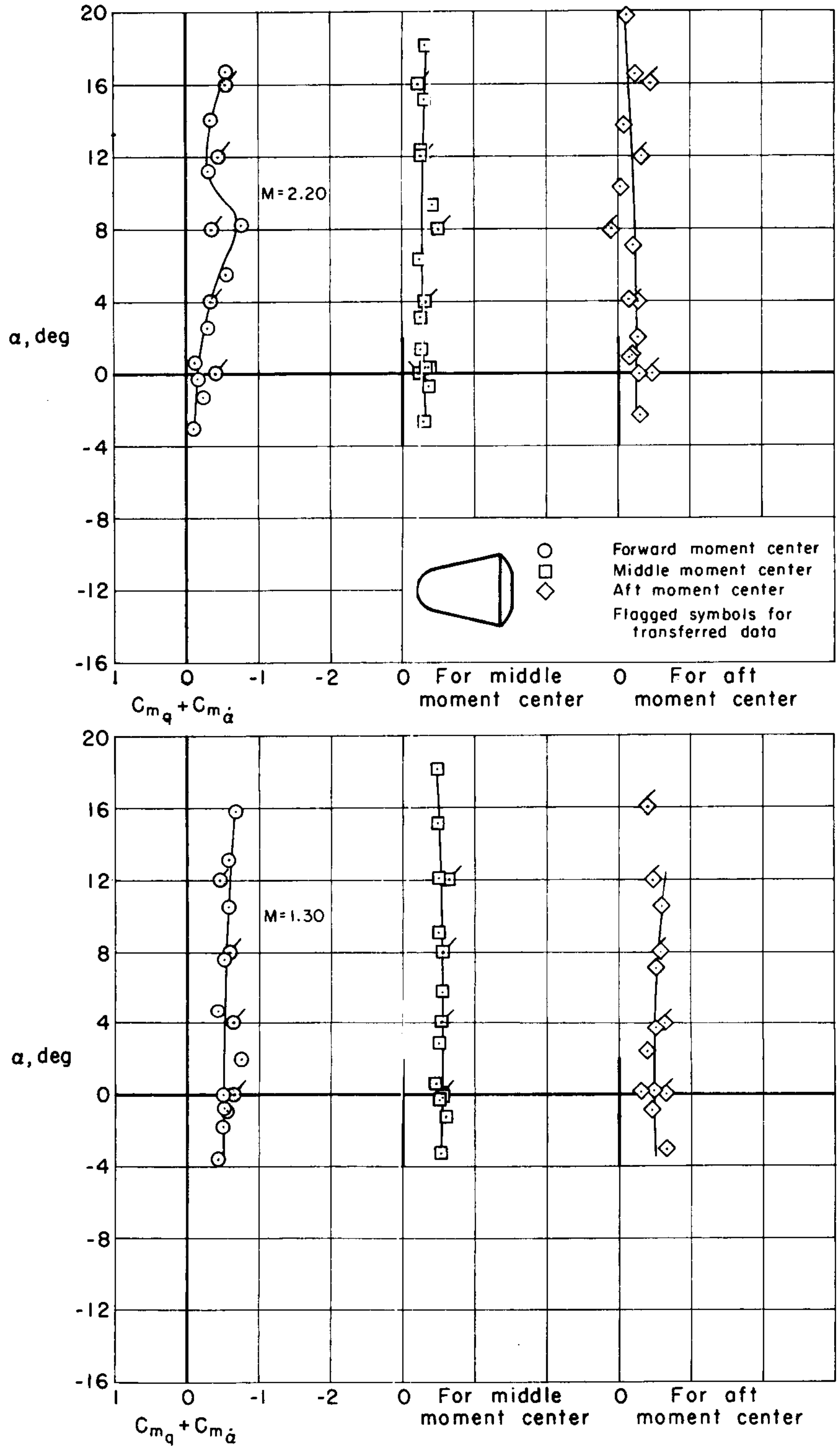
Figure 4.- Continued.





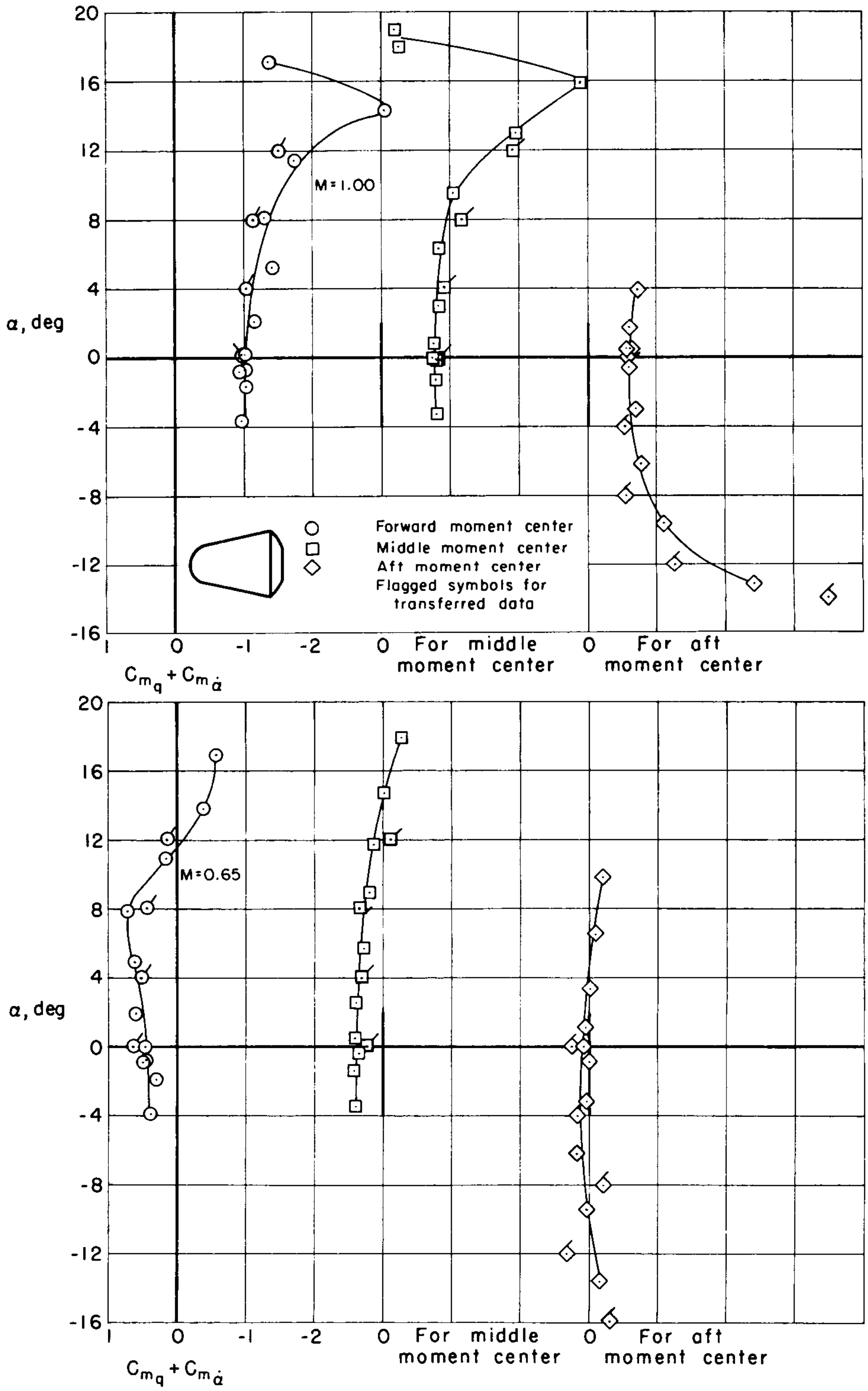
(e) Blunt cone with flat base; M = 1.00 and 0.65.

Figure 4.- Continued.



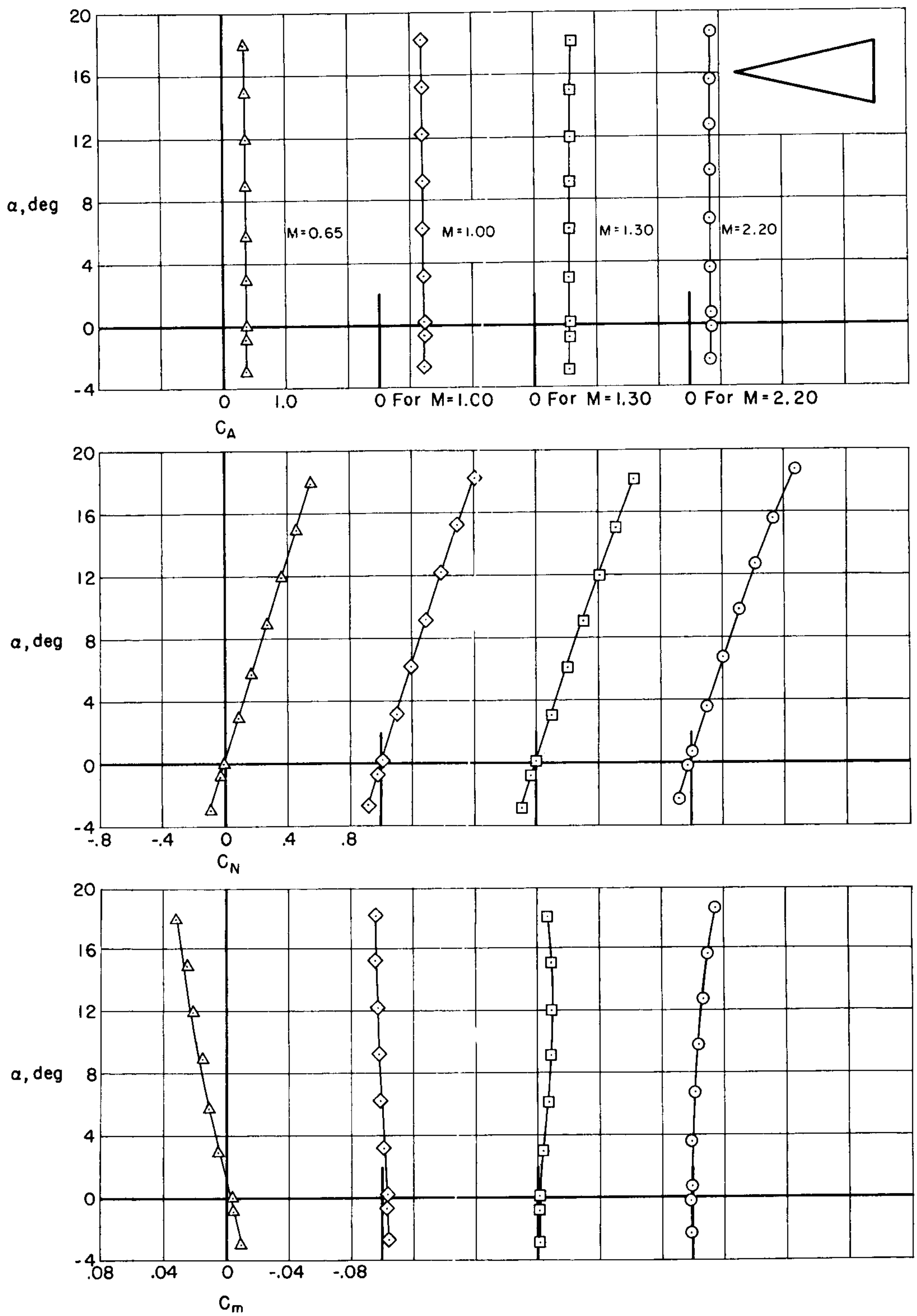
(f) Blunt cone with spherical base; M = 2.20 and 1.30.

Figure 4.- Continued.



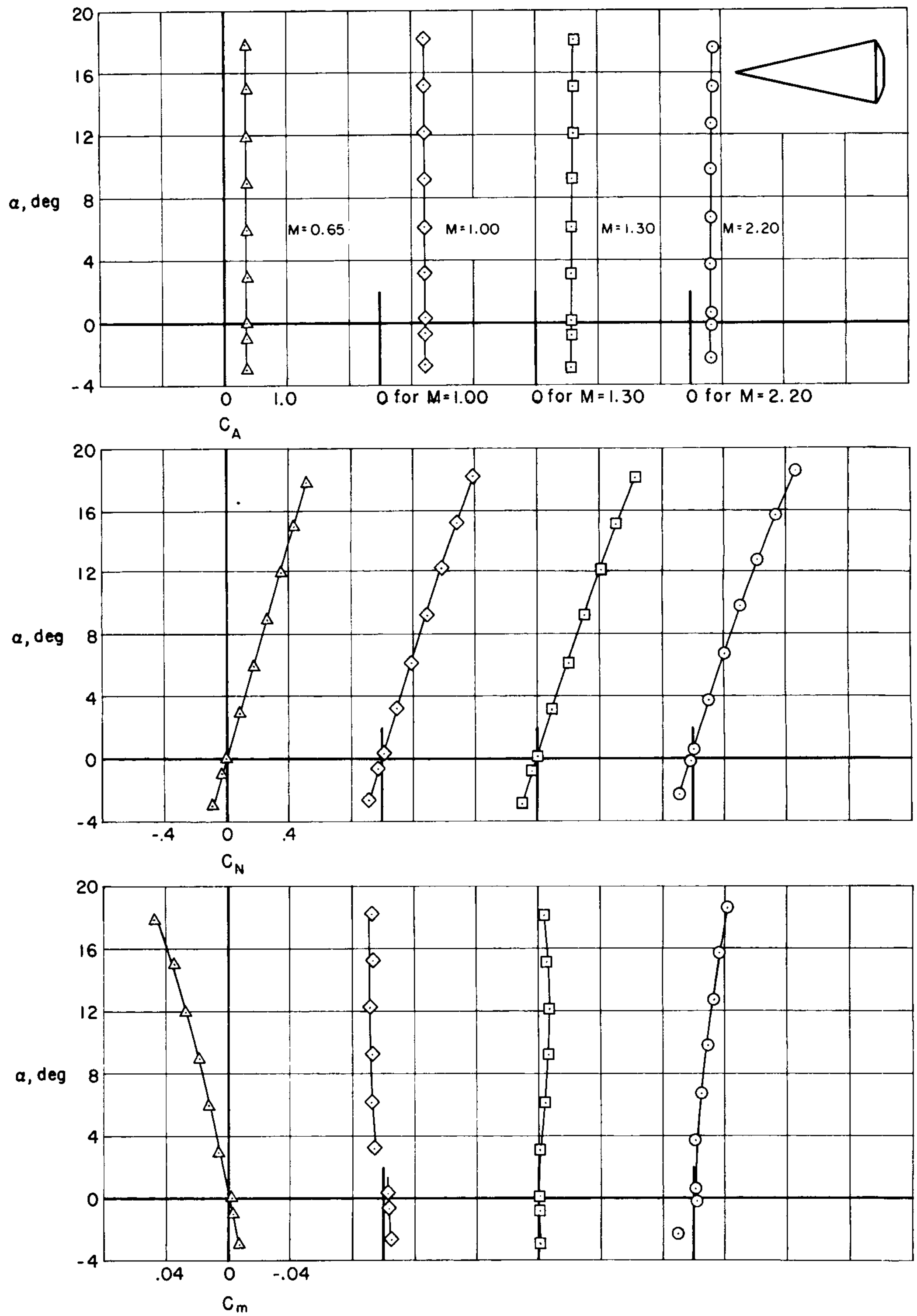
(g) Blunt cone with spherical base; M = 1.00 and 0.65.

Figure 4.- Concluded.



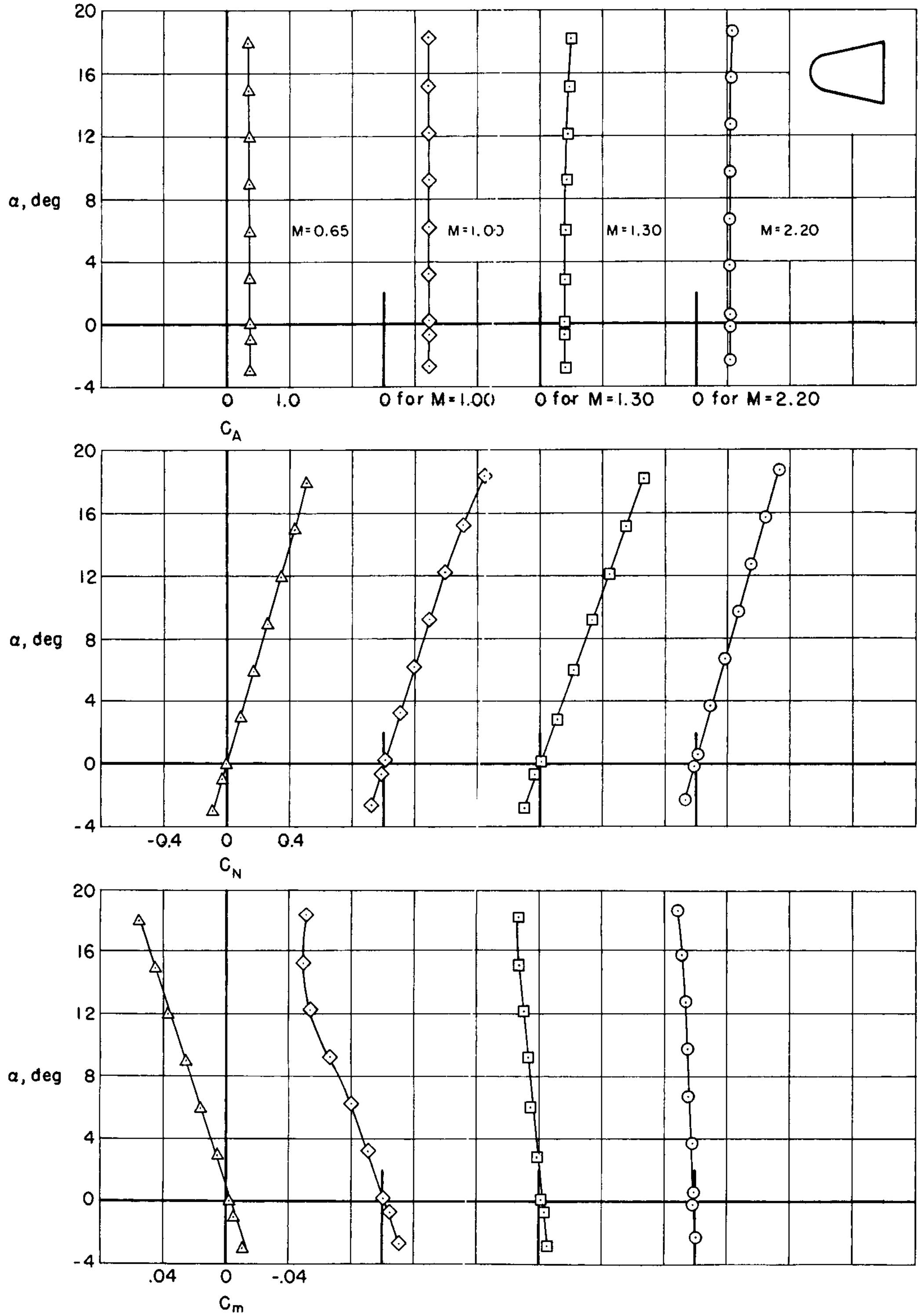
(a) Sharp cone with flat base.

Figure 5.- Variation of the static stability characteristics with angle of attack.



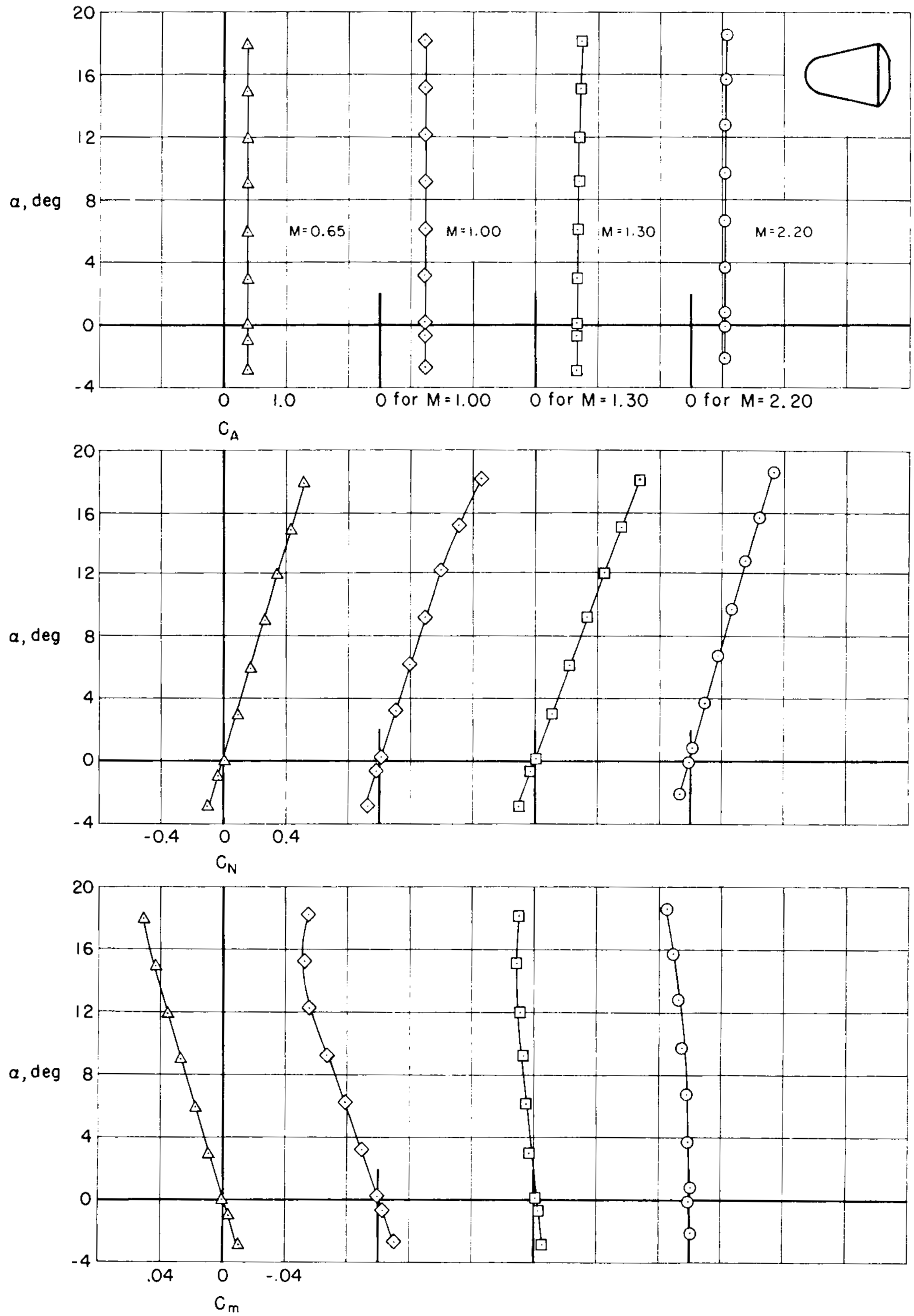
(b) Sharp cone with spherical base.

Figure 5.- Continued.



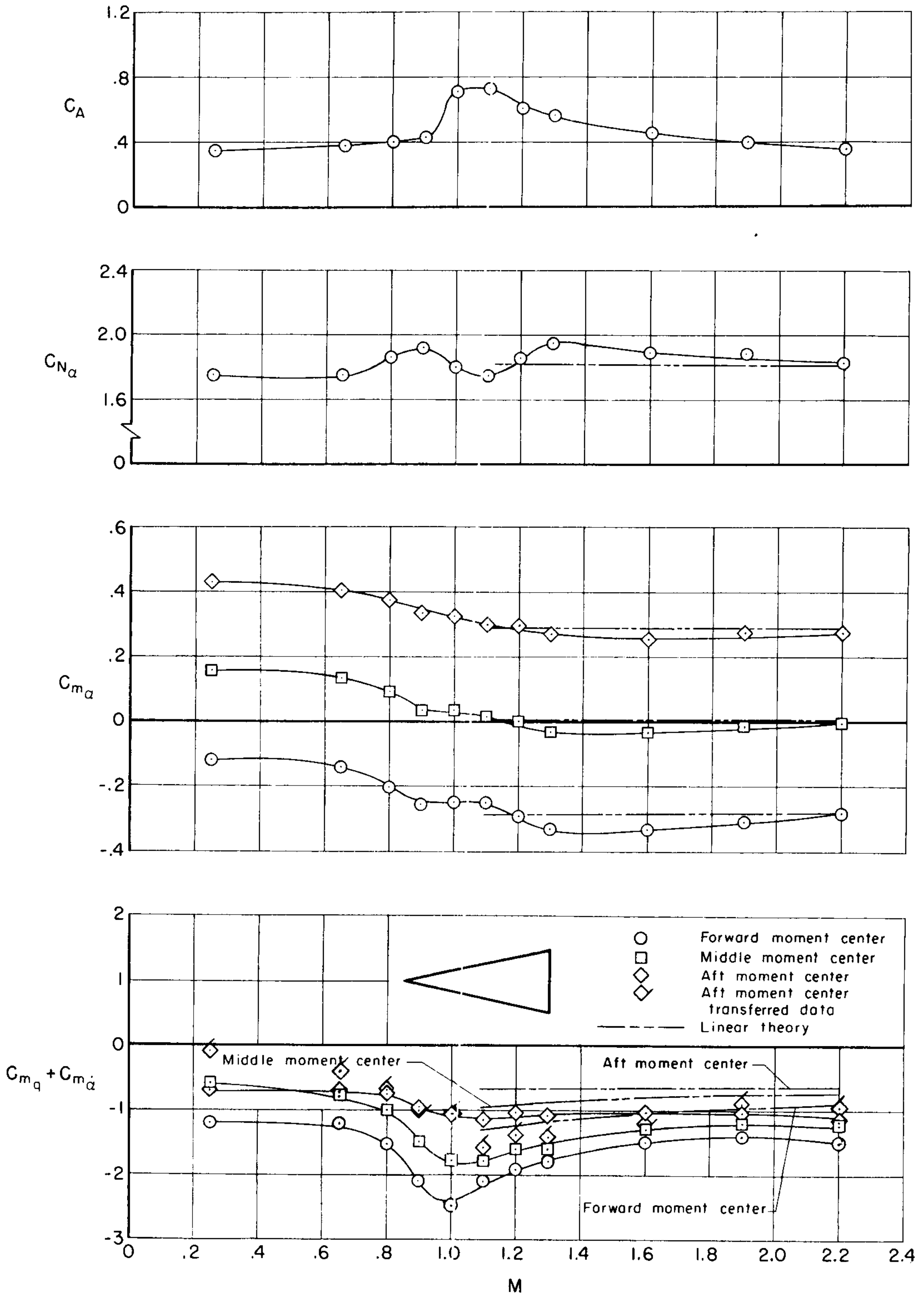
(c) Blunt cone with flat base.

Figure 5.- Continued.



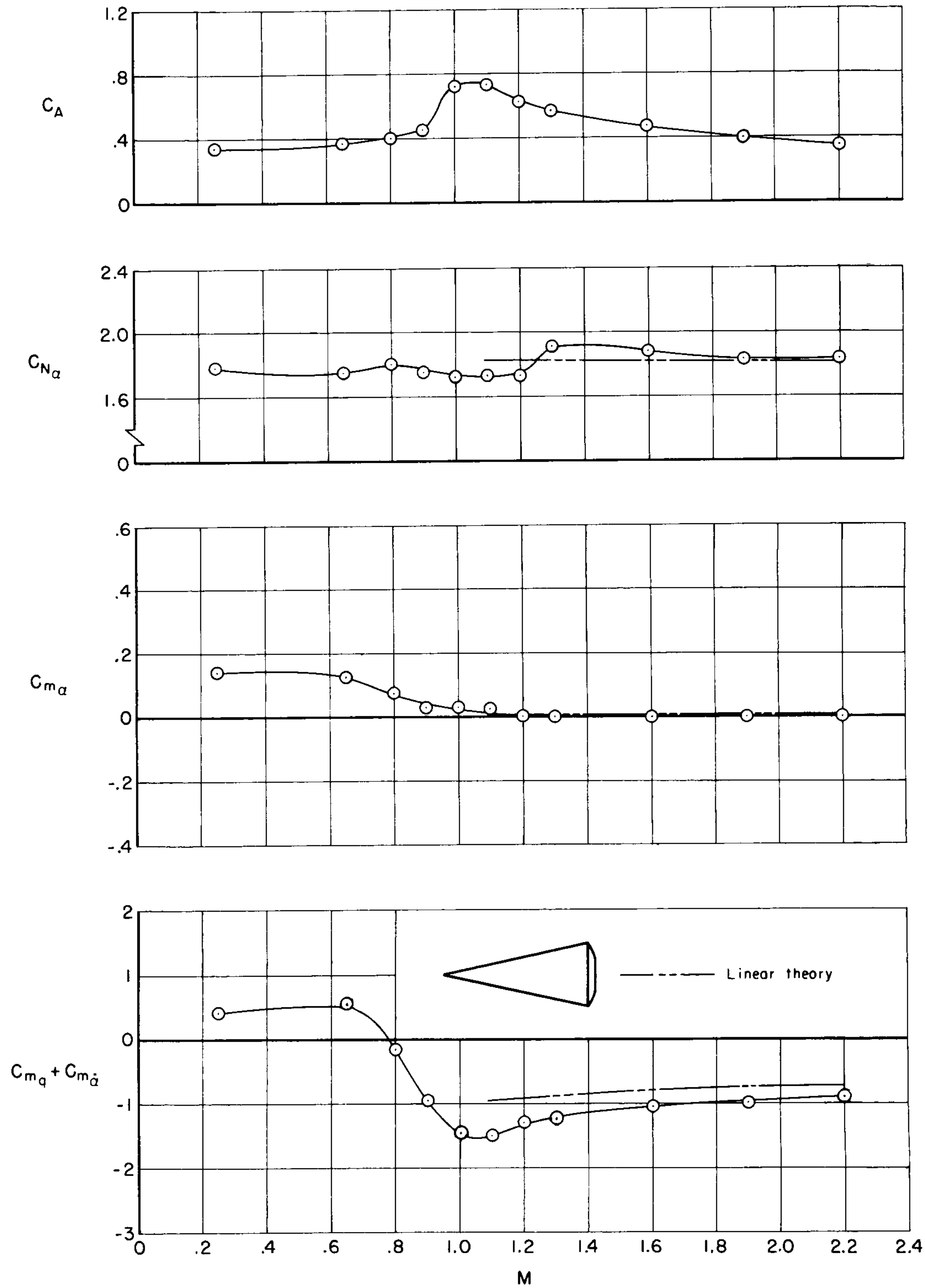
(d) Blunt cone with spherical base.

Figure 5.- Concluded.



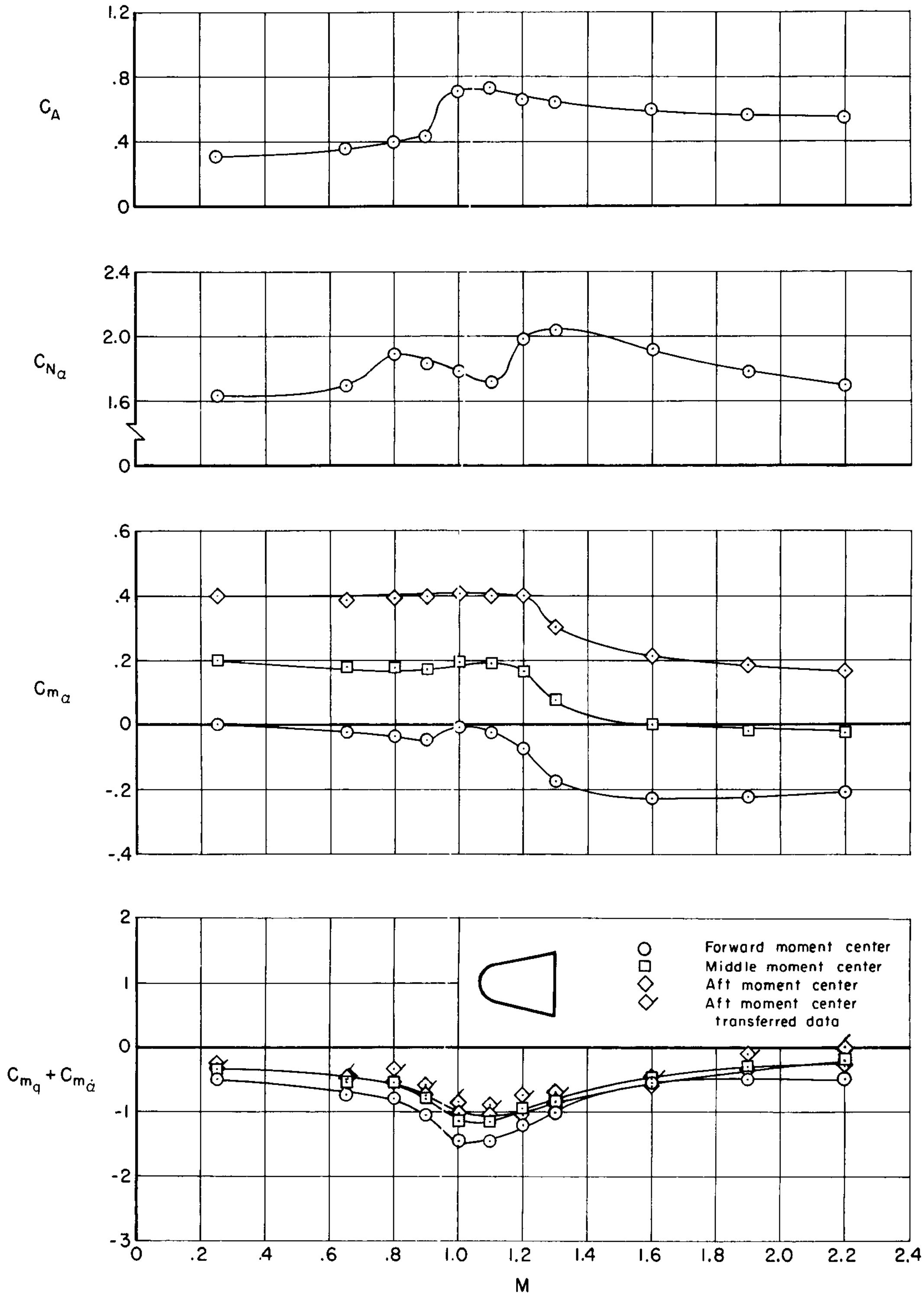
(a) Sharp cone with flat base.

Figure 6.- Stability derivatives and axial-force coefficients for model at zero angle of attack.



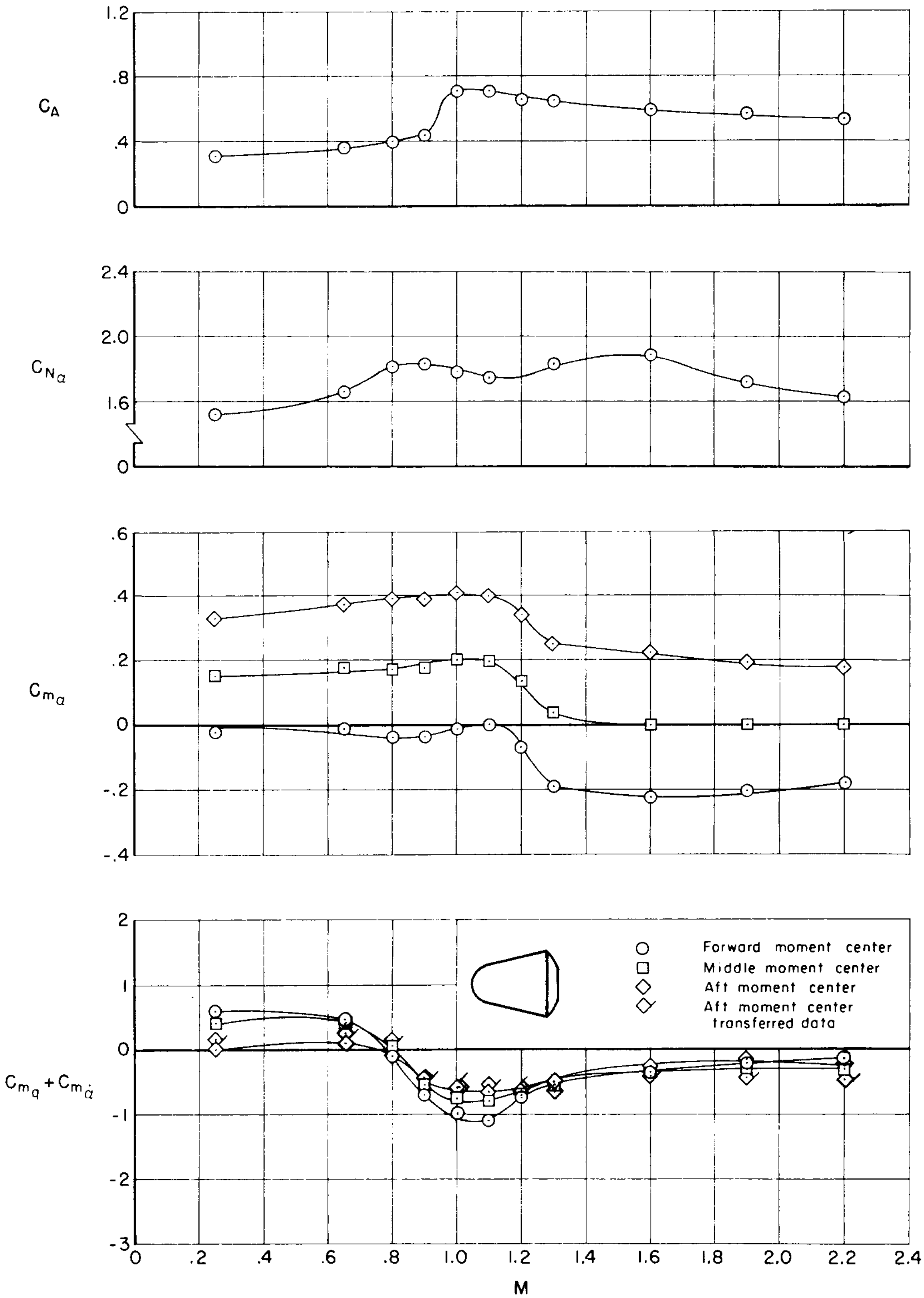
(b) Sharp cone with spherical base; middle moment center.

Figure 6.- Continued.



(c) Blunt cone with flat base.

Figure 6.- Continued.



(d) Blunt cone with spherical base.

Figure 6.- Concluded.

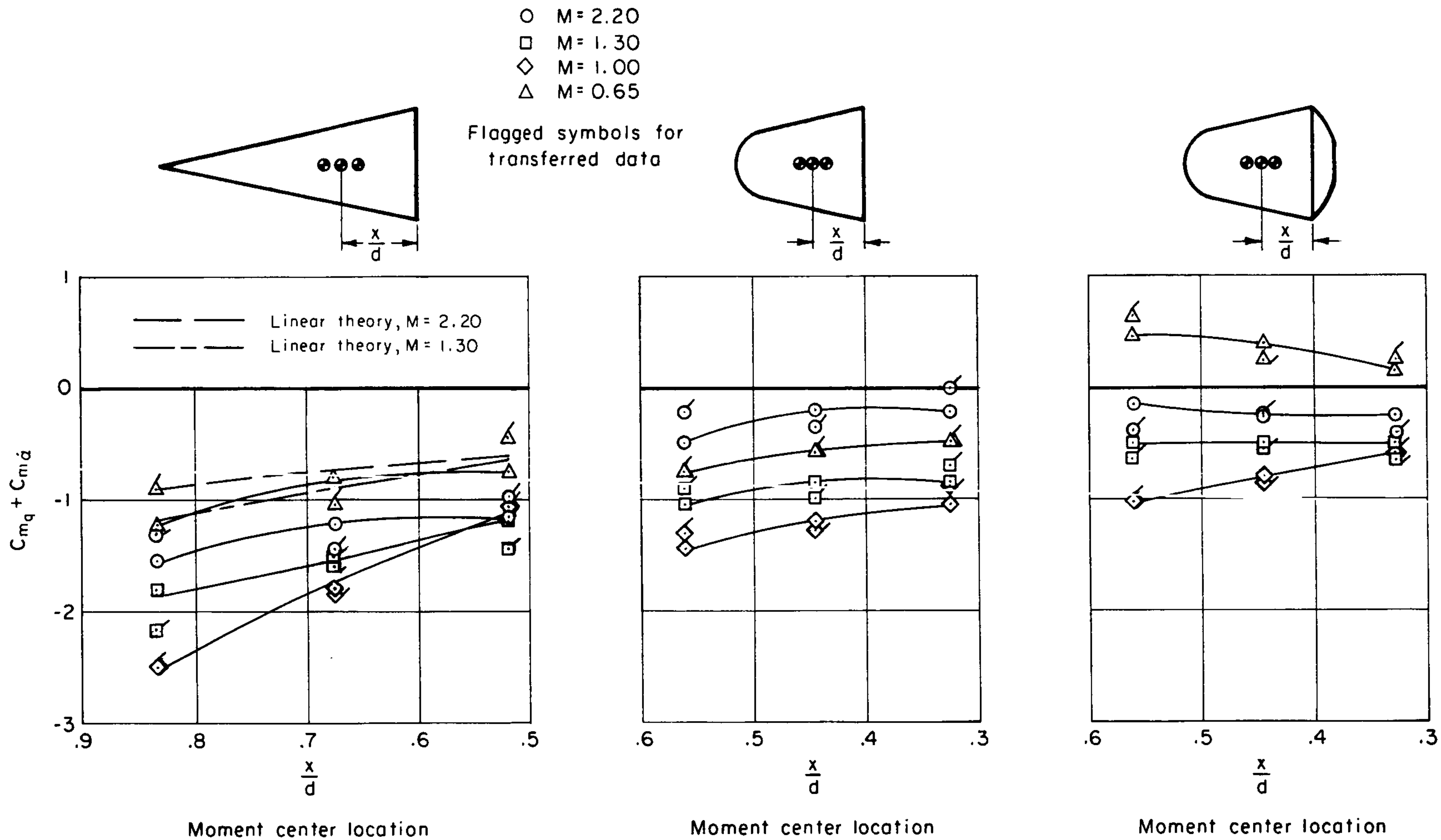


Figure 7.- Effect of alternate moment centers on the zero angle of attack values of the damping in pitch.

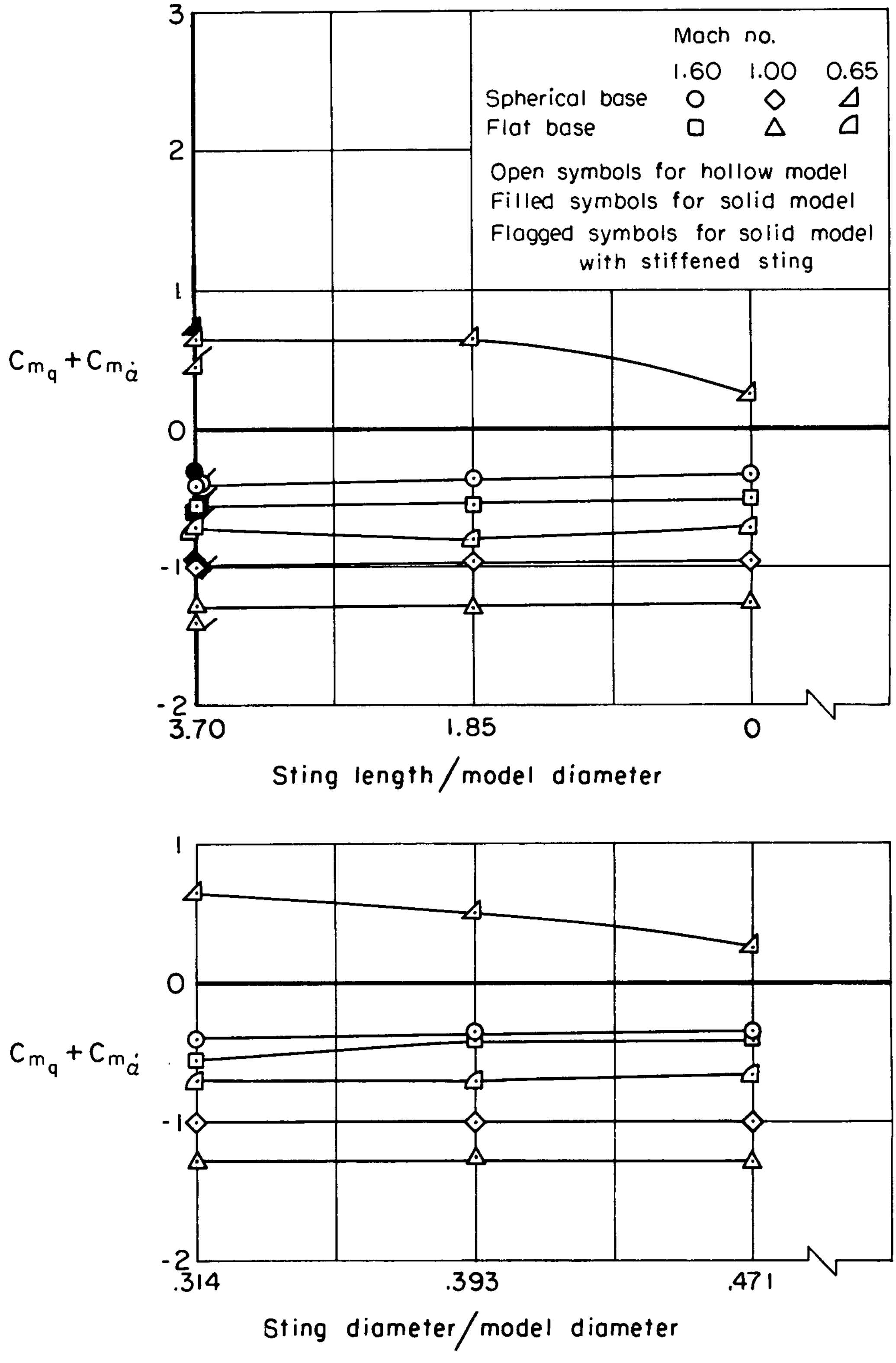


Figure 8.- Effects of sting configuration on the damping in pitch for the blunt cone; angle of attack at zero and forward moment center.

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