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TECHNICAL MEMORANDUM
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WIND-TUNNEL INVESTIGATION OF THE STATIC STABILITY OF A 1/56-SCALE MODEL OF THE X-1E AIRPLANE AT MACH NUMBERS OF 2.37, 2.98, AND 4.01

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Declassified July 11, 1961

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON August 1959

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SUMMARY

An investigation has been conducted in the Langley high Mach number jet at Mach numbers of 2.37, 2.98, and 4.01 to determine the static stability characteristics of a 1/56-scale model of the X-1E airplane and the effects on those characteristics of combining with the airplane various ventral- or X-fin arrangements located at the base of the airplane, or forebody strakes that extended from the nose to the wing leading edge.

Results indicate that the basic airplane becomes statically unstable directionally near Mach number 3 and longitudinally near Mach number 4. Results also indicate that the base-located fins provide stabilizing increments in directional stability roughly proportional to the lateral projection of the total fin area with accompanying increases in longitudinal stability.

The forebody strakes had no significant effect on directional stability, and their use resulted in reduced margin of static longitudinal stability at all Mach numbers and in longitudinal instability at the highest Mach number.

A limited comparison between wind-tunnel data and full-scale flight-test data revealed that the directional stability parameter C_{n_β} of the present wind-tunnel tests is reasonably indicative of flight data if flexibility effects of the full-scale vertical tail are considered.

INTRODUCTION

The growing need for flight data at higher and higher supersonic Mach numbers has led to a reexamination of the characteristics of existing experimental aircraft. The examination reveals that in order to boost the Mach number potentiality of these aircraft (assuming the power requirements can be met) it is necessary to maintain longitudinal and directional stability. Tests have shown that the level of static stability of supersonic aircraft decreases with increasing Mach number and ultimately results in
instability. Directional stability is especially sensitive to increasing L
Mach number and high angles of attack. (See refs. 1 to 3.) In order to 1
extend the Mach number range of supersonic airplanes, it becomes necessary 8
to overcome the loss of stability as the Mach number increases. 8

A wind-tunnel program was conducted in the Langley high Mach number jet on a 1/56-scale model of the X-1E research airplane to investigate the static stability characteristics of a supersonic airplane, and to determine methods of improving the stability. The airplane was tested without fins, with one, two, three, or four fins located at the base of the airplane, or with a pair of strakes located on the forebody. The tests were conducted at Mach numbers of 2.37, 2.98, and 4.01 and Reynolds numbers of 1.25×10^6 to 2.08×10^6, based on the wing mean aerodynamic chord, for angles of attack of -9° to 15° and angles of sideslip of -1° to 5°.

SYMBOLS

The forces and moments are referred to the body axes (fig. 1), and the reference center of moments is located at the 20-percent mean-aerodynamic-chord station.

b	wing span
c_t	tail chord
c_w	wing chord
$\bar{c}$	wing mean aerodynamic chord
C_l	rolling-moment coefficient, M_X/qSb
C_m	pitching-moment coefficient, $M_Y/qS\bar{c}$

C_N	normal-force coefficient, $-F_Z/qS$
C_n	yawing-moment coefficient, M_Z/qSb
C_Y	side-force coefficient, F_Y/qS
C_{l_β}	effective-dihedral parameter, $\partial C_l/\partial\beta$ (average slope of experimental data, $\beta = 0^\circ$ to 5°)
$\partial C_m/\partial C_N$	longitudinal-stability parameter
C_{n_β}	directional-stability parameter, $\partial C_n/\partial\beta$ (average slope of experimental data, $\beta = 0^\circ$ to 5°)
F_Y	force along Y-axis
F_Z	force along Z-axis
M	free-stream Mach number
M_X	moment about X-axis
M_Y	moment about Y-axis
M_Z	moment about Z-axis
p_t	stagnation pressure
q	free-stream dynamic pressure
R	Reynolds number
S	total wing area
α	angle of attack
β	angle of sideslip
ΔC_{n_β}	incremental C_{n_β} contributed by fins

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APPARATUS AND TESTS

Model

The airplane of this investigation was a 1/56-scale model of the X-1E research airplane (fig. 2) modified to the extent that the base was circular (as in ref. 1) instead of cloverleaf shaped. The basic model was tested alone, in combination with either of two sets of one, two, three, or four fins which extended between the 82-percent and 100-percent body stations (figs. 2 and 3(a)), or in combination with one or two forebody strakes (extremely low-aspect-ratio horizontal fins) which extended from the nose of the body to the wing leading edge (fig. 3(b)). The two sets of fins are designated fixed and jettisonable.

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Fixed fins.- The fixed or permanent-type fins were tested in groups of one, two, or three ventral or four in an X-arrangement. They were designed to give ground clearance when the airplane landed. The same general type of fins was successfully used in reference 4 at a Mach number of 2.01. The major difference between the fins of reference 4 and the fixed fins of the present tests is that those of the present tests contributed a laterally projected area equal to 20 percent of the fuselage afterbody corresponding to the fin chord while those of the reference contributed no additional area.

Jettisonable fins.- The jettisonable or temporary-type fins were also tested in groups of one, two, or three ventral or four in an X-arrangement. They were designed to give ground clearance only when the X-1E was attached to the mother-ship for take-off, and would necessarily be jettisoned in order to land the airplane. They contributed a laterally projected area equivalent to 54 percent of the corresponding fuselage afterbody. With one exception, the only difference in arrangement and geometry between the two sets of fins was the fin span. The one exception was a single jettisonable fin which had a 15° wedge section rather than the flat-plate section of the other fins. The wedge section was used to increase the lift effectiveness of the fin, as was discussed in reference 5.

Strakes.- The third type of directional-stability-improvement device of this investigation used with good results at lower supersonic (ref. 6) and at subsonic (refs. 7 and 8) Mach numbers was the forebody fins or strakes. The strakes were mounted on the fuselage center line normal to the plane of symmetry, and they had an exposed span approximately equal to 10 percent of the maximum fuselage diameter and a thickness equal to one and one-half percent of the fuselage diameter.

Roughness.- The basic airplane and the airplane in combination with one jettisonable ventral fin were tested with and without strips of No. 60

carborundum grains to determine the effects of fixed boundary-layer transition. The strips consisted of a 1/8-inch band around the nose and 1/16-inch strips 1/8-inch behind the leading edges of the wing and the horizontal and vertical tails. All other configurations were tested without roughness. A photograph of the basic model is shown in figure 4.

Tunnel and Tests

The tests were conducted in the Langley high Mach number jet at Mach numbers of 2.37, 2.98, and 4.01. Other test conditions are given in the following table:

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M	p_t, lb/sq in. abs	R (based on $\bar{c}$)
2.37	50	1.25×10^6
2.98	75	1.38
4.01	180	2.08

The stagnation temperature varied from approximately 75° F to approximately 30° F during each test. The Reynolds numbers are computed for an average temperature of 50° F.

An internal five-component strain-gage balance was used to measure normal force, pitching moment, rolling moment, yawing moment, and side force for all configurations for an angle-of-attack range of -9° to 15° combined with an angle-of-sideslip range of -1° to 5°. All angles were set directly by the use of a lens-prism embedded in the model wall. The tests were made with air having less than 5×10^{-6} pounds of water per pound of dry air. The static temperature and pressure in the test section did not reach values for which liquefaction of the air would occur.

PRECISION OF DATA

The maximum probable uncertainties involved in measuring the angles, forces, and moments and in determining the aerodynamic coefficients have been estimated and are given in the following table:

α, deg	±0.1
β, deg	±0.1
C_N	±0.004
C_m	±0.006
C_l	±0.001

C_n . . . . ±0.0015
C_Y . . . . ±0.004

RESULTS AND DISCUSSION

The basic data are presented in figures 5 to 15 for representative angles of attack and sideslip, and a complete listing of the data appears in tables I to III.

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An index to the experimental-data figures is given in the following table:

Basic Airplane

General results.- Three points should be mentioned concerning figure 5 which shows the aerodynamic characteristics for the airplane without directional-stability-improvement devices ("fixes").

The first point to be noted is the effects of the roughness strips (also shown in figs. 10(a), 11(a), and 12(a)) which were added to fix boundary-layer transition. The overall effects of the roughness appear to be quite small, usually within the accuracy of the data. The yawing-moment results indicate the greatest roughness effects, but two factors in addition to roughness contribute to this apparent effect: First, the yawing-moment beams of the balance were loaded in these tests to only a small percentage of their design load, contributing to the inaccuracy of the yawing-moment data as indicated in the section entitled "Precision of Data." Second, the yawing-moment beams were affected to some extent by temperature changes, which resulted in yawing-moment zero shifts. These two factors explain why the yawing-moment curves do not go through the origin and also why the repeatability of the yawing-moment level is poor. The slopes of the curves appear to be repeatable and are considered more accurate than the individual data points.

The second point to be noted from figure 5 is the decreasing yawing moment with increasing Mach number and angle of attack, which is mainly the result of the reduced lift-curve slope of the vertical tail with increased Mach number and the increased interference effects of the wing and fuselage flow fields on the vertical tail with increased angle of attack. This condition may result in directional instability (negative C_{n_β}), and therein lies the purpose of investigating various directional-stability-improvement devices.

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The third point to be noted from figure 5 is the flattening out of the pitching-moment curves in the vicinity of the origin for $M = 2.98$ and 4.01 when plotted against α. This effect is magnified with increasing Mach number and is an indication of neutral longitudinal stability. Since the total normal force remains unaffected, it appears that a slight reduction in the normal force contributed by the tail due to the interference effects of the wing and fuselage flow fields combined with the long tail moment arm is sufficient to produce a noticeable effect on the pitching moment.

Flight and wind-tunnel directional stability.- Figure 6 presents data showing the decreasing directional stability of the basic (no fixes) X-1E airplane with increasing Mach number which were taken from the results of flight and wind-tunnel tests. The flight results consist of unpublished preliminary test data from the High-Speed Flight Station taken at random angles of attack from 2.8° to 8.36° and random Reynolds numbers of 4.45×10^{6} to 9.30×10^{6} for supersonic Mach numbers from 1.25 to 2.13. The wind-tunnel results consist of test data from reference 1 obtained in the Langley 9-inch supersonic tunnel for Reynolds numbers of 0.36×10^{6} to 0.57×10^{6} and Mach numbers of 1.62 to 2.62 and from the tests of the present investigation obtained in the Langley high Mach number jet for Reynolds numbers of 1.25×10^{6} to 2.08×10^{6} and Mach numbers of 2.37 to 4.01. The wind-tunnel data from both sources are presented for angles of attack of 3° and 6°.

It may be seen from figure 6 that if the flight-test data were extrapolated to the Mach numbers of the present wind-tunnel tests, the present test data would be somewhat higher than the extrapolated flight data. A similar comparison of wind-tunnel and flight data was made in reference 9 for another airplane at $M = 1.4$ in which the comparison showed the same trend as the present data; that is, the wind-tunnel results were higher than flight results. In reference 9, much of this difference was accounted for by correcting for the vertical-tail flexibility effects and the air-intake effects of the full-scale airplane. Even though the appropriate information is not available to correct the present wind-tunnel data, it might reasonably be assumed that such a correction would have the effect of reducing the level of the wind-tunnel data, thereby causing the data of the present tests to more closely approximate the data and the hypothetical extrapolation of the data of the full-scale flight tests at the present Mach numbers.

The reasons for the discrepancy between that portion of the wind-tunnel data of the present tests which overlaps that of reference 1 is unknown. The only basic difference between the two tests besides having been made in different wind tunnels was that an internal strain-gage balance was used to measure the forces and moments of the present tests and an external mechanical balance was used to measure the forces for the tests of reference 1.

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Airplane With Stability-Improvement Devices

General results.- The results of the tests in which the various stability-improvement devices were employed are shown in figures 7 to 15 for the three Mach numbers. Comparison of the curves of these figures with those of figure 5 reveals that, in general, the fin arrangements result in increases in normal force, pitching moment, side force, and yawing moment, with a reduction only in rolling moment. A comparison of the strake data in the same manner shows that, in general, the strakes produce an increase in the normal force, decreases in pitching and rolling moments, and essentially no effect on yawing moment or side force. The remaining discussion will be limited in scope to comments concerning the slopes of the experimental data curves rather than the data points.

Directional stability characteristics.- Figures 16 and 17 show a comparison of the variation of C_{n_β} with angle of attack and Mach number, respectively, for the airplane with and without the various directional-stability-improvement devices. The fixed fins provide a maximum increment in C_{n_β} of approximately 0.001, and with several exceptions for the single ventral fin provide positive, though limited, directional stability throughout the tests. The jettisonable fins, on the other hand, provide incremental C_{n_β} ranging up to 0.0027, with a resultant C_{n_β} generally greater than 0.001. Figure 16 shows that the fin-produced C_{n_β} for the configurations and Mach numbers of the present investigation is relatively unaffected by changes in angle of attack. The data of reference 4, however, indicate a large increase in C_{n_β} for a 45° swept-wing supersonic airplane having four very low-aspect-ratio fins of X-arrangement by changing the angle of attack from 0° to 15°.

This difference in the effects of angle of attack on C_{n_β} for the two tests is probably a result of the difference in fin span; the fins of reference 4, being very short, are subject to shielding by the fuselage at low angles while those of the present test were much longer in span and, consequently, were exposed to the stream flow at all angles.

All configurations with directional-stability-improvement devices in figure 17 show increased effectiveness in C_{n_β} with increasing Mach number at $\alpha = 12^\circ$. Somewhat the same trend is shown for all finned configurations in figure 16 at angles of attack greater than 8°. The higher Mach numbers and angles of attack lead to greater efficiency of the fins probably because of higher q fields at the base of the airplane.

Figure 18 presents ΔC_{n_β}, which is the incremental directional-stability parameter attributable to the fins, plotted against the sum of the lateral projection of the individual fin areas. An interesting point may be observed in figure 18; that is, the establishment of the trend that ΔC_{n_β} is roughly proportional to fin area. Two interesting departures from this trend may be observed: The first is that the jettisonable fins (filled symbols in fig. 18) provide from two to four times the ΔC_{n_β} produced by the fixed fins with only two to two and one-half times the area. (See, for example, the two four-finned configurations in fig. 18(a).) This result is due to unequal percentages of fin area being buried in the fuselage wake and boundary layer for the two fin types. The second departure shows the three-finned configurations usually to be less effective in producing C_{n_β} than those with two fins and are the only multifinned configurations not producing ΔC_{n_β} roughly proportional to the number of fins. This condition is apparently a result of the fins being too closely spaced and thereby inducing fin-to-fin interactions.

The upper and lower fins are shown in reference 4 to provide approximately equal contributions to the total incremental C_{n_β}, while in the present test the upper fins produced only about one-third of ΔC_{n_β}. The tail arrangements for the configurations of the two tests are quite different, making the fin-tail interactions quite different, and therefore the data are not directly comparable.

The 15° wedged jettisonable fin produced a somewhat higher stabilizing influence than did the flat-plate fin as would be expected from reference 5 (see figs. 16 and 17), but the increased drag anticipated from a fin with such a section would make its use unfeasible.

It has already been mentioned that the strakes were used with good results to increase the directional stability of aircraft configurations at a lower supersonic Mach number (ref. 6) and at subsonic Mach numbers (refs. 7 and 8). Strake performance, however, is so dependent upon Mach number and various geometric parameters, such as fuselage forebody length and fineness ratio, type of strake fairing at nose of fuselage, vertical location of strakes, span of strakes, angle of attack, and arrangement of the vertical tail, that comparisons between data of different tests are quite difficult. For this reason, discussion of the strakes will be limited to the data of the present tests. As shown in figures 16 and 17, the strakes appear to have negligible effect on C_{n_β} at $M = 2.37$ and 2.98, but in figures 16(c) and 17(c) at $M = 4.01$ and $\alpha = 0^\circ$ it may be seen that the strakes produce a small increase in C_{n_β} (ranging to 0.0006). It is possible that angles of attack greater than those of the present test and changes in geometry from those of the present test might increase the yield in C_{n_β} with the use of strakes at these and higher Mach numbers, but such speculation is beyond the scope of this discussion.

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<u>Longitudinal stability effects</u>.- A comparison is presented in figure 19 of the margin of static longitudinal stability for the airplane with and without the various stability-improvement devices. It may be seen for all Mach numbers in figure 19 that the fins generally provide an increase in the static margin, which is a real advantage at Mach number 4.01 for which the airplane has neutral longitudinal stability without the fins. The maximum increase in the static margin of 30 percent wing $\bar{c}$ was provided by the jettisonable, X-fin arrangement.

The use of the strakes, as might be expected from geometric considerations, reduces the static margin for all Mach numbers and results in longitudinal instability at $M = 4.01$.

<u>Effect on dihedral parameter</u>.- Figure 20 presents the effective dihedral parameter C_{l_β} for the airplane with and without the various directional-stability-improvement devices. For the most part, the fins reduce the negative C_{l_β}, which indicates a reduction in the effective dihedral, with a very large reduction at $M = 4.01$. At no time does the reduction result in an adverse (positive) rolling-moment parameter.

For the three Mach numbers of this investigation the strakes show a reversing trend; that is, the use of strakes results generally in an increase in negative C_{l_β} at $M = 2.37$, a slight decrease at $M = 2.98$, and a very large decrease in negative C_{l_β} at $M = 4.01$ resulting in positive C_{l_β} or adverse rolling moment for one port strake.

CONCLUSIONS

A wind-tunnel investigation of a 1/56-scale model of the X-1E research airplane in the Langley high Mach number jet at Mach numbers of 2.37, 2.98, and 4.01 with and without various directional-stability-improvement devices to investigate and improve the stability characteristics has resulted in the following conclusions:

1. The basic airplane becomes statically unstable directionally near Mach number 3 and longitudinally near Mach number 4.

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2. The fixed, shorter span fins produced, with several exceptions for the single ventral fin, small increases in the directional stability parameter C_{n_β} (generally less than 0.001) for all Mach numbers and angles of attack.

3. The jettisonable, longer span fins produced increments in C_{n_β} from two to four times those for the fixed fins with only two to two and one-half times the area, despite the fact that the incremental C_{n_β} is roughly proportional to the fin area.

4. The three-finned configurations are the only multifinned arrangements not producing C_{n_β} proportional to the number of fins, probably the result of close fin spacing and subsequent fin-to-fin interactions.

5. The four-jettisonable-fin configuration produced an increase in the margin of longitudinal stability $\partial C_m/\partial C_N$ equal to 30 percent of the wing mean aerodynamic chord; the other fin arrangements produced somewhat smaller stabilizing effects.

6. All fin arrangements reduced the effective dihedral parameter but never resulted in adverse rolling moment.

7. The strakes produced a destabilizing pitching moment at all Mach numbers that resulted in longitudinal instability at $M = 4.01$ without providing any significant improvement to the directional stability at any Mach number.

Langley Research Center,
National Aeronautics and Space Administration,
Langley Field, Va., March 3, 1959.

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TABLE I -EXPERIMENTAL RESULTS FOR CONFIGURATIONS HAVING FIXED FINS

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n	M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
(a) No fixes								(b) One fixed ventral fin							
2.37	-1	-9	-.3543	.1287	.0024	.0150	-.0018	2.37	-1	-9	-.3395	.1214	.0015	.0135	-.0018
2.37	-1	-6	-.2252	.0943	.0022	.0130	-.0009	2.37	-1	-6	-.2140	.0904	.0014	.0126	-.0010
2.37	-1	-3	-.1018	.0641	.0025	.0124	-.0001	2.37	-1	-3	-.0958	.0603	.0017	.0121	-.0005
2.37	-1	0	.0300	.0236	.0021	.0133	.0003	2.37	-1	0	.0289	.0203	.0012	.0119	.0001
2.37	-1	3	.1579	-.0133	.0021	.0123	.0006	2.37	-1	3	.1542	-.0140	.0016	.0115	.0002
2.37	-1	6	.2910	-.0486	.0022	.0112	.0008	2.37	-1	6	.2832	-.0500	.0021	.0109	.0004
2.37	-1	9	.4265	-.0850	.0028	.0104	.0009	2.37	-1	9	.4146	-.0857	.0023	.0102	.0005
2.37	-1	12	.5723	-.1203	.0028	.0096	.0013	2.37	-1	12	.5537	-.1199	.0023	.0094	.0009
2.37	0	-9	-.3500	.1303	-.0003	-.0014	.0029	2.37	0	-9	-.3373	.1238	-.0003	-.0014	.0023
2.37	0	-6	-.2235	.1004	-.0008	-.0011	.0029	2.37	0	-6	-.2141	.0932	-.0003	-.0012	.0023
2.37	0	-3	-.1005	.0674	-.0005	-.0009	.0028	2.37	0	-3	-.0924	.0633	-.0008	-.0011	.0020
2.37	0	0	.0307	.0254	-.0001	-.0002	.0029	2.37	0	0	.0312	.0238	-.0005	-.0005	.0020
2.37	0	3	.1616	-.0111	-.0001	-.0001	.0025	2.37	0	3	.1568	-.0117	-.0004	-.0008	.0017
2.37	0	6	.2930	-.0474	.0004	-.0018	.0026	2.37	0	6	.2810	-.0478	.0000	-.0031	.0019
2.37	0	9	.4301	-.0853	.0002	-.0031	.0024	2.37	0	9	.4124	-.0836	.0002	-.0043	.0020
2.37	0	12	.5730	-.1203	.0003	-.0032	.0020	2.37	0	12	.5545	-.1199	-.0001	-.0043	.0017
2.37	1	-9	-.3503	.1303	-.0018	-.0195	.0059	2.37	1	-9	-.3350	.1235	-.0021	-.0182	.0047
2.37	1	-6	-.2215	.1005	-.0022	-.0177	.0050	2.37	1	-6	-.2122	.0920	-.0025	-.0165	.0039
2.37	1	-3	-.0982	.0655	-.0023	-.0159	.0043	2.37	1	-3	-.0943	.0624	-.0025	-.0162	.0033
2.37	1	0	.0334	.0215	-.0031	-.0141	.0037	2.37	1	0	.0357	.0220	-.0021	-.0139	.0032
2.37	1	3	.1621	-.0159	-.0023	-.0138	.0034	2.37	1	3	.1587	-.0145	-.0022	-.0145	.0031
2.37	1	6	.2949	-.0526	-.0023	-.0155	.0035	2.37	1	6	.2845	-.0516	-.0025	-.0162	.0032
2.37	1	9	.4336	-.0900	-.0029	-.0179	.0034	2.37	1	9	.4184	-.0879	-.0028	-.0185	.0034
2.37	1	12	.5796	-.1281	-.0034	-.0191	.0031	2.37	1	12	.5600	-.1254	-.0032	-.0207	.0030
2.37	3	-9	-.3408	.1226	-.0047	-.0590	.0107	2.37	3	-9	-.3366	.1195	-.0062	-.0576	.0099
2.37	3	-6	-.2150	.0925	-.0045	-.0523	.0086	2.37	3	-6	-.2109	.0881	-.0053	-.0530	.0082
2.37	3	-3	-.0956	.0619	-.0045	-.0468	.0069	2.37	3	-3	-.0933	.0568	-.0053	-.0480	.0066
2.37	3	0	.0308	.0215	-.0040	-.0422	.0057	2.37	3	0	.0346	.0166	-.0052	-.0439	.0055
2.37	3	3	.1566	-.0138	-.0040	-.0404	.0050	2.37	3	3	.1612	-.0186	-.0051	-.0436	.0049
2.37	3	6	.2877	-.0495	-.0046	-.0421	.0048	2.37	3	6	.2906	-.0555	-.0053	-.0447	.0048
2.37	3	9	.4209	-.0863	-.0051	-.0441	.0042	2.37	3	9	.4263	-.0927	-.0063	-.0479	.0043
2.37	3	12	.5595	-.1161	-.0054	-.0451	.0039	2.37	3	12	.5629	-.1221	-.0066	-.0493	.0039
2.37	5	-9	-.3411	.1282	-.0089	-.0942	.0192	2.37	5	-9	-.3360	.1228	-.0092	-.0947	.0183
2.37	5	-6	-.2183	.0989	-.0083	-.0854	.0160	2.37	5	-6	-.2141	.0926	-.0087	-.0876	.0153
2.37	5	-3	-.0937	.0652	-.0081	-.0769	.0127	2.37	5	-3	-.0917	.0603	-.0085	-.0798	.0124
2.37	5	0	.0323	.0267	-.0083	-.0707	.0102	2.37	5	0	.0344	.0198	-.0084	-.0744	.0103
2.37	5	3	.1585	-.0107	-.0078	-.0695	.0086	2.37	5	3	.1620	-.0168	-.0086	-.0731	.0090
2.37	5	6	.2905	-.0477	-.0084	-.0721	.0076	2.37	5	6	.2924	-.0538	-.0088	-.0759	.0080
2.37	5	9	.4192	-.0840	-.0086	-.0737	.0063	2.37	5	9	.4216	-.0910	-.0094	-.0793	.0072
2.37	5	12	.5646	-.1142	-.0091	-.0751	.0052	2.37	5	12	.5644	-.1208	-.0104	-.0809	.0057
(c) Two fixed ventral fins								(d) Three fixed ventral fins							
2.37	-1	-9	-.3493	.1401	.0015	.0122	-.0023	2.37	-1	-9	-.3500	.1361	.0015	.0131	-.0026
2.37	-1	-6	-.2216	.1023	.0015	.0120	-.0020	2.37	-1	-6	-.2218	.0993	.0014	.0119	-.0016
2.37	-1	-3	-.0994	.0646	.0017	.0115	-.0012	2.37	-1	-3	-.0995	.0615	.0017	.0115	-.0011
2.37	-1	0	.0325	.0142	.0013	.0130	-.0008	2.37	-1	0	.0326	.0123	.0012	.0125	-.0009
2.37	-1	3	.1616	-.0343	.0008	.0112	-.0008	2.37	-1	3	.1616	-.0362	.0012	.0116	-.0008
2.37	-1	6	.2949	-.0872	.0013	.0110	-.0010	2.37	-1	6	.2943	-.0857	.0017	.0109	-.0008
2.37	-1	9	.4379	-.1447	.0019	.0111	-.0009	2.37	-1	9	.4350	-.1425	.0018	.0110	-.0009
2.37	0	-9	-.3480	.1419	-.0003	-.0046	.0028	2.37	0	-9	-.3460	.1369	-.0003	-.0055	.0027
2.37	0	-6	-.2233	.1038	-.0004	-.0038	.0027	2.37	0	-6	-.2214	.1001	-.0004	-.0048	.0024
2.37	0	-3	-.0999	.0658	-.0005	-.0038	.0024	2.37	0	-3	-.0981	.0628	-.0009	-.0038	.0023
2.37	0	0	.0315	.0144	-.0010	-.0015	.0021	2.37	0	0	.0334	.0131	-.0009	-.0015	.0023
2.37	0	3	.1610	-.0342	-.0002	-.0035	.0015	2.37	0	3	.1632	-.0349	-.0005	-.0024	.0015
2.37	0	6	.2931	-.0854	-.0002	-.0038	.0014	2.37	0	6	.2987	-.0859	-.0001	-.0036	.0014
2.37	0	9	.4378	-.1446	-.0007	-.0050	.0011	2.37	0	9	.4396	-.1427	-.0003	-.0044	.0012
2.37	1	-9	-.3475	.1418	-.0015	-.0250	.0070	2.37	1	-9	-.3467	.1365	-.0015	-.0250	.0066
2.37	1	-6	-.2219	.1031	-.0023	-.0227	.0060	2.37	1	-6	-.2186	.1002	-.0022	-.0221	.0058
2.37	1	-3	-.0981	.0654	-.0019	-.0199	.0050	2.37	1	-3	-.0981	.0622	-.0019	-.0190	.0049
2.37	1	0	.0362	.0130	-.0019	-.0162	.0044	2.37	1	0	.0362	.0112	-.0023	-.0161	.0040
2.37	1	3	.1636	-.0349	-.0016	-.0168	.0038	2.37	1	3	.1656	-.0361	-.0019	-.0177	.0038
2.37	1	6	.2975	-.0866	-.0019	-.0181	.0035	2.37	1	6	.2998	-.0880	-.0023	-.0185	.0035
2.37	1	9	.4409	-.1449	-.0022	-.0196	.0032	2.37	1	9	.4408	-.1442	-.0026	-.0191	.0032
2.37	3	-9	-.3491	.1392	-.0049	-.0662	.0138	2.37	3	-9	-.3511	.1362	-.0050	-.0668	.0139
2.37	3	-6	-.2240	.1032	-.0044	-.0608	.0115	2.37	3	-6	-.2223	.1002	-.0044	-.0593	.0113
2.37	3	-3	-.1007	.0646	-.0047	-.0532	.0090	2.37	3	-3	-.1007	.0628	-.0047	-.0533	.0088
2.37	3	0	.0310	.0133	-.0042	-.0480	.0070	2.37	3	0	.0329	.0120	-.0046	-.0475	.0073
2.37	3	3	.1619	-.0361	-.0038	-.0472	.0063	2.37	3	3	.1619	-.0361	-.0042	-.0462	.0061
2.37	3	6	.2994	-.0886	-.0044	-.0487	.0056	2.37	3	6	.2969	-.0884	-.0049	-.0487	.0059
2.37	3	9	.4431	-.1466	-.0054	-.0496	.0051	2.37	3	9	.4393	-.1442	-.0058	-.0494	.0051
2.37	5	-9	-.3528	.1464	-.0084	-.1049	.0228	2.37	5	-9	-.3497	.1424	-.0083	-.1046	.0222
2.37	5	-6	-.2266	.1104	-.0078	-.0956	.0195	2.37	5	-6	-.2233	.1075	-.0077	-.0957	.0189
2.37	5	-3	-.1009	.0704	-.0076	-.0866	.0156	2.37	5	-3	-.1009	.0680	-.0080	-.0860	.0152
2.37	5	0	.0327	.0191	-.0078	-.0805	.0127	2.37	5	0	.0308	.0184	-.0074	-.0792	.0124
2.37	5	3	.1625	-.0313	-.0073	-.0781	.0110	2.37	5	3	.1622	-.0319	-.0066	-.0776	.0110
2.37	5	6	.3005	-.0843	-.0076	-.0810	.0101	2.37	5	6	.3005	-.0837	-.0083	-.0799	.0098
2.37	5	9	.4374	-.1401	-.0085	-.0821	.0086	2.37	5	9	.4403	-.1391	-.0089	-.0817	.0088

TABLE I -EXPERIMENTAL RESULTS FOR CONFIGURATIONS HAVING FIXED FINS – Continued

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n	M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
(e) Four fixed fins in X arrangement								(f) No fixes							
2.37	-1	-9	-.3635	.1688	.0016	.0133	-.0026	2.98	-1	-9	-.2677	.0685	.0018	.0136	-.0020
2.37	-1	-6	-.2306	.1181	.0014	.0131	-.0018	2.98	-1	-6	-.1652	.0463	.0022	.0121	-.0011
2.37	-1	-3	-.1031	.0670	.0020	.0128	-.0013	2.98	-1	-3	-.0741	.0350	.0016	.0118	-.0006
2.37	-1	0	.0308	.0135	.0012	.0134	-.0007	2.98	-1	0	.0194	.0256	.0015	.0113	.0002
7.37	-1	3	.1597	-.0319	.0020	.0115	-.0004	2.98	-1	3	.1173	.0038	.0023	.0122	.0005
2.37	-1	6	.2928	-.0779	.0021	.0119	-.0004	2.98	-1	6	.2248	-.0271	.0019	.0118	.0006
2.37	-1	9	.4339	-.1336	.0022	.0114	.0000	2.98	-1	9	.3322	-.0560	.0015	.0112	.0009
								2.98	-1	12	.4461	-.0846	.0009	.0112	.0010
								2.98	-1	15	.5775	-.1195	.0015	.0116	.0003
2.37	0	-9	-.3573	.1712	-.0001	-.0043	.0024	2.98	0	-9	-.2651	.0703	.0004	-.0006	.0016
2.37	0	-6	-.2318	.1223	.0000	-.0030	.0023	2.98	0	-6	-.1640	.0482	.0008	-.0007	.0014
2.37	0	-3	-.0999	.0702	-.0008	-.0028	.0021	2.98	0	-3	-.0721	.0375	.0002	.0000	.0013
2.37	0	0	.0352	.0157	-.0001	-.0014	.0019	2.98	0	0	.0198	.0276	.0006	.0005	.0012
2.37	0	3	.1616	-.0293	-.0001	-.0025	.0016	2.98	0	3	.1181	.0051	.0010	.0010	.0011
2.37	0	6	.2922	-.0752	.0003	-.0032	.0016	2.98	0	6	.2237	-.0266	.0005	.0005	.0010
2.37	0	9	.4346	-.1318	.0002	-.0039	.0013	2.98	0	9	.3301	-.0547	.0002	.0000	.0008
								2.98	0	12	.4439	-.0835	.0000	-.0000	.0009
								2.98	0	15	.5781	-.1195	.0002	.0005	.0001
2.37	1	-9	-.3572	.1704	-.0013	-.0241	.0062	2.98	1	-9	-.2647	.0699	-.0015	-.0176	.0037
2.37	1	-6	-.2294	.1199	-.0022	-.0228	.0058	2.98	1	-6	-.1637	.0479	-.0015	-.0156	.0033
2.37	1	-3	-.1001	.0685	-.0019	-.0194	.0047	2.98	1	-3	-.0698	.0368	-.0011	-.0144	.0027
2.37	1	0	.0379	.0130	-.0022	-.0165	.0042	2.98	1	0	.0214	.0269	-.0016	-.0118	.0022
2.37	1	3	.1635	-.0317	-.0019	-.0167	.0036	2.98	1	3	.1201	.0044	-.0017	-.0107	.0018
2.37	1	6	.2979	-.0792	-.0018	-.0188	.0035	2.98	1	6	.2268	-.0275	-.0016	-.0112	.0013
2.37	1	9	.4390	-.1367	-.0024	-.0182	.0030	2.98	1	9	.3333	-.0558	-.0020	-.0107	.0013
								2.98	1	12	.4497	-.0854	-.0022	-.0117	.0012
								2.98	1	15	.5818	-.1212	-.0021	-.0124	.0007
2.37	3	-9	-.3599	.1598	-.0053	-.0677	.0141	2.98	3	-9	-.2669	.0701	-.0041	-.0531	.0084
2.37	3	-6	-.2285	.1112	-.0048	-.0610	.0120	2.98	3	-6	-.1659	.0484	-.0032	-.0486	.0068
2.37	3	-3	-.1007	.0621	-.0048	-.0538	.0096	2.98	3	-3	-.0709	.0375	-.0035	-.0436	.0053
2.37	3	0	.0369	.0077	-.0046	-.0486	.0075	2.98	3	0	.0221	.0266	-.0035	-.0388	.0037
2.37	3	3	.1642	-.0393	-.0046	-.0477	.0062	2.98	3	3	.1217	.0050	-.0038	-.0355	.0027
2.37	3	6	.2971	-.0872	-.0048	-.0491	.0055	2.98	3	6	.2269	-.0257	-.0034	-.0343	.0018
2.37	3	9	.4393	-.1435	-.0058	-.0501	.0050	2.98	3	9	.3364	-.0543	-.0032	-.0352	.0011
								2.98	3	12	.4525	-.0841	-.0038	-.0359	.0005
								2.98	3	15	.5882	-.1216	-.0036	-.0386	.0002
2.37	5	-9	-.3594	.1617	-.0087	-.1052	.0233	2.98	5	-9	-.2653	.0733	-.0067	-.0861	.0151
2.37	5	-6	-.2290	.1150	-.0082	-.0978	.0202	2.98	5	-6	-.1644	.0536	-.0065	-.0794	.0120
2.37	5	-3	-.1006	.0653	-.0081	-.0879	.0162	2.98	5	-3	-.0725	.0410	-.0061	-.0720	.0097
2.37	5	0	.0330	.0141	-.0079	-.0810	.0134	2.98	5	0	.0233	.0285	-.0063	-.0660	.0072
2.37	5	3	.1646	-.0344	-.0077	-.0781	.0109	2.98	5	3	.1225	.0049	-.0067	-.0615	.0051
2.37	5	6	.3012	-.0832	-.0080	-.0816	.0100	2.98	5	6	.2274	-.0239	-.0061	-.0613	.0035
2.37	5	9	.4384	-.1354	-.0089	-.0836	.0089	2.98	5	9	.3347	-.0511	-.0060	-.0624	.0023
								2.98	5	12	.4509	-.0795	-.0056	-.0641	.0014
								2.98	5	15	.5961	-.1207	-.0066	-.0678	.0011

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n	M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
(g) One fixed ventral fin								(h) Two fixed ventral fins.							
2.98	-1	-9	-.2588	.0687	.0020	.0157	-.0012	2.98	-1	-9	-.2712	.0800	.0011	.0147	-.0023
2.98	-1	-6	-.1590	.0486	.0019	.0141	-.0010	2.98	-1	-6	-.1686	.0552	.0014	.0143	-.0019
2.98	-1	-3	-.0642	.0385	.0018	.0122	-.0003	2.98	-1	-3	-.0731	.0377	.0017	.0129	-.0010
2.98	-1	0	.0256	.0292	.0021	.0116	.0001	2.98	-1	0	.0214	.0210	.0011	.0135	-.0004
2.98	-1	3	.1260	.0073	.0025	.0112	.0002	2.98	-1	3	.1227	-.0094	.0019	.0129	.0000
2.98	-1	6	.2282	-.0239	.0024	.0094	.0005	2.98	-1	6	.2333	-.0525	.0018	.0117	.0003
2.98	-1	9	.3392	-.0528	.0021	.0084	.0009	2.98	-1	9	.3462	-.0900	.0019	.0111	.0004
2.98	-1	12	.4586	-.0816	.0020	.0059	.0010	2.98	-1	12	.4658	-.1294	.0017	.0109	.0006
2.98	-1	15	.5881	-.1167	.0020	.0056	.0008	2.98	-1	15	.6061	-.1812	.0014	.0106	.0000
2.98	0	-9	-.2570	.0729	.0006	.0009	.0021	2.98	0	-9	-.2697	.0818	-.0004	-.0000	.0014
2.98	0	-6	-.1592	.0512	.0005	.0007	.0020	2.98	0	-6	-.1694	.0576	-.0001	-.0002	.0013
2.98	0	-3	-.0655	.0411	.0008	.0003	.0017	2.98	0	-3	-.0712	.0402	-.0006	.0001	.0015
2.98	0	0	.0251	.0304	.0011	.0002	.0018	2.98	0	0	.0240	.0235	-.0002	.0007	.0016
2.98	0	3	.1252	.0085	.0015	-.0003	.0014	2.98	0	3	.1234	-.0077	.0005	.0015	.0013
2.98	0	6	.2306	-.0234	.0015	-.0024	.0013	2.98	0	6	.2336	-.0507	.0004	-.0016	.0013
2.98	0	9	.3378	-.0517	.0015	-.0047	.0016	2.98	0	9	.3465	-.0889	.0005	-.0023	.0012
2.98	0	12	.4523	-.0798	.0013	-.0051	.0015	2.98	0	12	.4641	-.1283	.0007	-.0025	.0012
2.98	0	15	.5903	-.1175	.0011	-.0071	.0009	2.98	0	15	.6067	-.1799	.0005	-.0022	.0008
2.98	1	-9	-.2538	.0720	-.0008	-.0152	.0038	2.98	1	-9	-.2689	.0813	-.0011	-.0193	.0047
2.98	1	-6	-.1558	.0511	-.0009	-.0149	.0033	2.98	1	-6	-.1659	.0547	-.0015	-.0178	.0038
2.98	1	-3	-.0590	.0404	-.0009	-.0135	.0030	2.98	1	-3	-.0708	.0374	-.0012	-.0161	.0029
2.98	1	0	.0297	.0298	-.0010	-.0121	.0025	2.98	1	0	.0226	.0195	-.0013	-.0130	.0024
2.98	1	3	.1304	.0065	-.0007	-.0126	.0022	2.98	1	3	.1249	-.0111	-.0013	-.0124	.0016
2.98	1	6	.2348	-.0250	-.0003	-.0144	.0023	2.98	1	6	.2372	-.0559	-.0014	-.0125	.0016
2.98	1	9	.3444	-.0522	-.0006	-.0160	.0025	2.98	1	9	.3512	-.0951	-.0013	-.0141	.0011
2.98	1	12	.4617	-.0834	-.0012	-.0195	.0028	2.98	1	12	.4692	-.1356	-.0015	-.0148	.0013
2.98	1	15	.5929	-.1195	-.0012	-.0214	.0026	2.98	1	15	.6092	-.1877	-.0014	-.0168	.0009
2.98	3	-9	-.2617	.0671	-.0048	-.0503	.0078	2.98	3	-9	-.2734	.0813	-.0038	-.0570	.0107
2.98	3	-6	-.1606	.0467	-.0043	-.0463	.0061	2.98	3	-6	-.1684	.0563	-.0029	-.0515	.0093
2.98	3	-3	-.0682	.0363	-.0039	-.0436	.0053	2.98	3	-3	-.0731	.0407	-.0029	-.0466	.0073
2.98	3	0	.0253	.0253	-.0039	-.0399	.0040	2.98	3	0	.0223	.0216	-.0028	-.0418	.0058
2.98	3	3	.1265	.0023	-.0038	-.0382	.0030	2.98	3	3	.1256	-.0092	-.0028	-.0386	.0047
2.98	3	6	.2327	-.0286	-.0034	-.0386	.0024	2.98	3	6	.2378	-.0514	-.0024	-.0397	.0040
2.98	3	9	.3418	-.0607	-.0033	-.0422	.0023	2.98	3	9	.3530	-.0914	-.0022	-.0401	.0032
2.98	3	12	.4632	-.0865	-.0033	-.0444	.0019	2.98	3	12	.4747	-.1353	-.0024	-.0423	.0029
2.98	3	15	.5925	-.1242	-.0033	-.0484	.0017	2.98	3	15	.6175	-.1877	-.0027	-.0452	.0025
2.98	5	-9	-.2613	.0719	-.0074	-.0833	.0139	2.98	5	-9	-.2739	.0876	-.0061	-.0904	.0180
2.98	5	-6	-.1626	.0528	-.0069	-.0783	.0114	2.98	5	-6	-.1700	.0630	-.0064	-.0847	.0154
2.98	5	-3	-.0679	.0408	-.0068	-.0717	.0092	2.98	5	-3	-.0747	.0468	-.0058	-.0761	.0126
2.98	5	0	.0266	.0274	-.0067	-.0673	.0071	2.98	5	0	.0246	.0264	-.0057	-.0706	.0098
2.98	5	3	.1265	.0029	-.0067	-.0649	.0057	2.98	5	3	.1273	-.0066	-.0061	-.0678	.0079
2.98	5	6	.2329	-.0254	-.0062	-.0674	.0045	2.98	5	6	.2379	-.0462	-.0052	-.0677	.0065
2.98	5	9	.3443	-.0559	-.0056	-.0694	.0040	2.98	5	9	.3476	-.0863	-.0047	-.0699	.0053
2.98	5	12	.4580	-.0822	-.0054	-.0738	.0034	2.98	5	12	.4728	-.1300	-.0043	-.0717	.0044
2.98	5	15	.6025	-.1243	-.0060	-.0798	.0035	2.98	5	15	.6224	-.1860	-.0045	-.0765	.0043

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TABLE I.- EXPERIMENTAL RESULTS FOR CONFIGURATIONS HAVING FIXED FINS – Continued

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n	M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
(i) Three fixed ventral fins.								(j) Four fixed fins in X arrangement							
2.98	-1	-9	-.2683	.0782	.0020	.0138	-.0027	2.98	-1	-9	-.2749	.1016	.0017	.0169	-.0030
2.98	-1	-6	-.1687	.0539	.0018	.0132	-.0021	2.98	-1	-6	-.1742	.0722	.0020	.0158	-.0031
2.98	-1	-3	-.0732	.0365	.0021	.0118	-.0010	2.98	-1	-3	-.0745	.0447	.0018	.0141	-.0019
2.98	-1	0	.0216	.0191	.0015	.0119	-.0007	2.98	-1	0	.0245	.0199	.0017	.0137	-.0013
2.98	-1	3	.1250	-.0114	.0023	.0129	-.0004	2.98	-1	3	.1290	-.0153	.0024	.0131	-.0010
2.98	-1	6	.2348	-.0558	.0031	.0122	-.0002	2.98	-1	6	.2377	-.0563	.0032	.0108	-.0008
2.98	-1	9	.3457	-.0941	.0027	.0120	.0000	2.98	-1	9	.3486	-.0926	.0028	.0091	.0000
2.98	-1	12	.4630	-.1328	.0021	.0129	-.0001	2.98	-1	12	.4659	-.1286	.0030	.0084	.0001
2.98	-1	15	.6025	-.1831	.0026	.0119	.0000	2.98	-1	15	.6018	-.1671	.0031	.0064	.0005
2.98	0	-9	-.2670	.0823	.0008	-.0016	.0032	2.98	0	-9	-.2733	.1011	.0005	.0004	.0027
2.98	0	-6	-.1685	.0587	.0007	-.0013	.0029	2.98	0	-6	-.1741	.0789	.0008	.0003	.0027
2.98	0	-3	-.0722	.0407	.0006	-.0012	.0027	2.98	0	-3	-.0725	.0508	.0003	-.0005	.0026
2.98	0	0	.0230	.0240	.0005	-.0006	.0026	2.98	0	0	.0250	.0268	.0011	.0001	.0020
2.98	0	3	.1258	-.0078	.0013	-.0001	.0022	2.98	0	3	.1309	-.0097	.0018	-.0005	.0017
2.98	0	6	.2362	-.0516	.0017	-.0008	.0018	2.98	0	6	.2402	-.0515	.0018	-.0032	.0016
2.98	0	9	.3448	-.0904	.0013	-.0015	.0015	2.98	0	9	.3482	-.0884	.0018	-.0045	.0017
2.98	0	12	.4634	-.1311	.0015	-.0017	.0014	2.98	0	12	.4659	-.1252	.0020	-.0062	.0017
2.98	0	15	.6032	-.1838	.0012	-.0009	.0004	2.98	0	15	.6025	-.1672	.0017	-.0070	.0015
2.98	1	-9	-.2681	.0825	.0001	-.0194	.0061	2.98	1	-9	-.2728	.1021	-.0010	-.0182	.0062
2.98	1	-6	-.1648	.0570	.0001	-.0174	.0057	2.98	1	-6	-.1715	.0773	-.0002	-.0174	.0058
2.98	1	-3	-.0708	.0391	-.0013	-.0151	.0048	2.98	1	-3	-.0720	.0499	-.0008	-.0156	.0049
2.98	1	0	.0246	.0226	-.0005	-.0136	.0044	2.98	1	0	.0256	.0246	.0000	-.0141	.0045
2.98	1	3	.1277	-.0107	-.0005	-.0120	.0036	2.98	1	3	.1330	-.0127	-.0001	-.0146	.0039
2.98	1	6	.2384	-.0545	-.0005	-.0126	.0030	2.98	1	6	.2418	-.0546	-.0001	-.0158	.0035
2.98	1	9	.3493	-.0937	-.0005	-.0134	.0027	2.98	1	9	.3526	-.0937	-.0001	-.0176	.0032
2.98	1	12	.4667	-.1353	-.0008	-.0147	.0025	2.98	1	12	.4718	-.1308	-.0003	-.0215	.0038
2.98	1	15	.6073	-.1885	-.0011	-.0159	.0014	2.98	1	15	.6094	-.1760	-.0006	-.0234	.0032
2.98	3	-9	-.2686	.0783	-.0043	-.0570	.0115	2.98	3	-9	-.2769	.1022	-.0046	-.0581	.0119
2.98	3	-6	-.1689	.0538	-.0038	-.0526	.0095	2.98	3	-6	-.1733	.0705	-.0038	-.0542	.0101
2.98	3	-3	-.0722	.0382	-.0037	-.0477	.0074	2.98	3	-3	-.0734	.0449	-.0041	-.0487	.0079
2.98	3	0	.0246	.0197	-.0037	-.0428	.0057	2.98	3	0	.0268	.0184	-.0041	-.0449	.0064
2.98	3	3	.1281	-.0132	-.0037	-.0396	.0044	2.98	3	3	.1316	-.0187	-.0037	-.0429	.0053
2.98	3	6	.2403	-.0554	-.0032	-.0396	.0035	2.98	3	6	.2430	-.0602	-.0032	-.0438	.0038
2.98	3	9	.3516	-.0949	-.0027	-.0407	.0029	2.98	3	9	.3561	-.0971	-.0027	-.0454	.0029
2.98	3	12	.4742	-.1394	-.0029	-.0428	.0027	2.98	3	12	.4750	-.1365	-.0030	-.0503	.0036
								2.98	3	15	.6161	-.1810	-.0028	-.0538	.0037
2.98	5	-9	-.2722	.0868	-.0060	-.0928	.0177	2.98	5	-9	-.2775	.1085	-.0068	-.0924	.0184
2.98	5	-6	-.1709	.0630	-.0059	-.0857	.0149	2.98	5	-6	-.1724	.0759	-.0067	-.0857	.0157
2.98	5	-3	-.0746	.0455	-.0062	-.0786	.0122	2.98	5	-3	-.0728	.0510	-.0067	-.0792	.0132
2.98	5	0	.0237	.0238	-.0061	-.0716	.0094	2.98	5	0	.0280	.0218	-.0062	-.0745	.0109
2.98	5	3	.1296	-.0099	-.0061	-.0678	.0075	2.98	5	3	.1334	-.0147	-.0065	-.0711	.0083
2.98	5	6	.2392	-.0502	-.0052	-.0682	.0060	2.98	5	6	.2464	-.0536	-.0056	-.0730	.0064
2.98	5	9	.3521	-.0904	-.0050	-.0703	.0048	2.98	5	9	.3576	-.0946	-.0051	-.0746	.0053
2.98	5	12	.4689	-.1344	-.0049	-.0715	.0041	2.98	5	12	.4737	-.1327	-.0045	-.0779	.0048
								2.98	5	15	.6221	-.1762	-.0059	-.0857	.0055
(k) No fixes								(l) One fixed ventral fin							
4.01	-1	-9	-.2123	.0372	.0035	.0073	-.0009	4.01	-1	-9	-.2079	.0353	.0009	.0058	-.0015
4.01	-1	-6	-.1336	.0193	.0032	.0058	-.0011	4.01	-1	-6	-.1296	.0182	.0014	.0057	-.0016
4.01	-1	-3	-.0605	.0125	.0041	.0063	-.0011	4.01	-1	-3	-.0568	.0114	.0015	.0058	-.0017
4.01	-1	0	.0124	.0113	.0039	.0070	-.0004	4.01	-1	0	.0141	.0101	.0016	.0083	-.0009
4.01	-1	3	.0890	.0107	.0041	.0080	.0005	4.01	-1	3	.0924	.0071	.0011	.0080	-.0003
4.01	-1	6	.1718	-.0008	.0047	.0081	.0015	4.01	-1	6	.1748	-.0007	.0014	.0091	.0009
4.01	-1	9	.2695	-.0329	.0047	.0088	.0019	4.01	-1	9	.2723	-.0339	.0010	.0099	.0012
4.01	-1	12	.3667	-.0452	.0049	.0086	.0029	4.01	-1	12	.3674	-.0455	.0003	.0084	.0019
4.01	-1	15	.4882	-.0703	.0027	.0057	.0024	4.01	-1	15	.4909	-.0713	-.0006	.0057	.0021
4.01	0	-9	-.2095	.0401	.0011	-.0056	.0009	4.01	0	-9	-.2090	.0406	.0007	-.0051	.0012
4.01	0	-6	-.1303	.0222	.0008	-.0057	.0006	4.01	0	-6	-.1301	.0228	.0005	-.0038	.0006
4.01	0	-3	-.0587	.0136	.0006	-.0037	.0002	4.01	0	-3	-.0550	.0142	.0006	-.0031	.0004
4.01	0	0	.0145	.0118	.0007	-.0022	.0004	4.01	0	0	.0144	.0130	.0004	-.0017	.0006
4.01	0	3	.0877	.0119	.0006	-.0016	.0007	4.01	0	3	.0910	.0125	.0003	-.0009	.0007
4.01	0	6	.1705	.0005	.0035	-.0026	.0009	4.01	0	6	.1734	.0011	.0002	-.0002	.0010
4.01	0	9	.2701	-.0334	.0043	-.0051	.0012	4.01	0	9	.2694	-.0333	.0001	-.0038	.0011
4.01	0	12	.3635	-.0462	.0025	-.0040	.0009	4.01	0	12	.3650	-.0454	-.0009	-.0045	.0009
4.01	0	15	.4888	-.0719	.0005	-.0058	.0005	4.01	0	15	.4882	-.0712	-.0014	-.0056	.0006
4.01	1	-9	-.2109	.0398	.0001	-.0185	.0029	4.01	1	-9	-.2087	.0403	-.0002	-.0179	.0032
4.01	1	-6	-.1301	.0219	.0003	-.0158	.0026	4.01	1	-6	-.1298	.0218	-.0009	-.0162	.0030
4.01	1	-3	-.0549	.0134	.0024	-.0149	.0019	4.01	1	-3	-.0547	.0140	-.0007	-.0141	.0022
4.01	1	0	.0168	.0123	-.0005	-.0135	.0016	4.01	1	0	.0186	.0117	-.0009	-.0134	.0017
4.01	1	3	.0905	.0119	-.0006	-.0119	.0009	4.01	1	3	.0902	.0118	-.0006	-.0119	.0014
4.01	1	6	.1737	.0012	.0001	-.0116	.0003	4.01	1	6	.1752	-.0001	-.0007	-.0110	.0009
4.01	1	9	.2727	-.0336	.0024	-.0138	.0003	4.01	1	9	.2741	-.0335	-.0015	-.0154	.0010
4.01	1	12	.3717	-.0464	-.0016	-.0150	-.0007	4.01	1	12	.3695	-.0477	-.0021	-.0166	.0002
4.01	1	15	.4913	-.0770	.0012	-.0159	-.0003	4.01	1	15	.4909	-.0782	-.0028	-.0181	.0007
4.01	3	-9	-.2104	.0355	-.0042	-.0472	.0067	4.01	3	-9	-.2082	.0336	-.0026	-.0462	.0062
4.01	3	-6	-.1301	.0179	-.0039	-.0440	.0051	4.01	3	-6	-.1281	.0178	-.0027	-.0430	.0052
4.01	3	-3	-.0553	.0120	-.0040	-.0408	.0037	4.01	3	-3	-.0535	.0126	-.0028	-.0403	.0041
4.01	3	0	.0175	.0117	-.0045	-.0376	.0022	4.01	3	0	.0193	.0122	-.0029	-.0376	.0027
4.01	3	3	.0924	.0119	-.0045	-.0353	.0007	4.01	3	3	.0941	.0112	-.0030	-.0359	.0016
4.01	3	6	.1771	-.0024	-.0049	-.0348	-.0001	4.01	3	6	.1786	-.0031	-.0030	-.0359	.0007
4.01	3	9	.2734	-.0368	-.0054	-.0362	-.0006	4.01	3	9	.2769	-.0369	-.0035	-.0389	.0009
4.01	3	12	.3717	-.0539	-.0052	-.0361	-.0010	4.01	3	12	.3748	-.0551	-.0037	-.0402	.0009
4.01	3	15	.4919	-.0829	-.0059	-.0370	-.0005	4.01	3	15	.4951	-.0841	-.0036	-.0414	.0017
4.01	5	-9	-.2112	.0406	-.0057	-.0751	.0107	4.01	5	-9	-.2099	.0406	-.0045	-.0739	.0116
4.01	5	-6	-.1322	.0274	-.0061	-.0695	.0082	4.01	5	-6	-.1288	.0279	-.0042	-.0683	.0096
4.01	5	-3	-.0568	.0196	-.0062	-.0643	.0059	4.01	5	-3	-.0551	.0213	-.0043	-.0641	.0075
4.01	5	0	.0184	.0178	-.0062	-.0606	.0039	4.01	5	0	.0202	.0182	-.0047	-.0609	.0059
4.01	5	3	.0937	.0149	-.0063	-.0591	.0025	4.01	5	3	.0957	.0160	-.0048	-.0592	.0050
4.01	5	6	.1786	-.0013	-.0071	-.0572	.0020	4.01	5	6	.1770	-.0015	-.0054	-.0598	.0045
4.01	5	9	.2695	-.0321	-.0072	-.0588	.0014	4.01	5	9	.2737	-.0341	-.0054	-.0628	.0043
4.01	5	12	.3659	-.0504	-.0078	-.0599	.0007	4.01	5	12	.3715	-.0517	-.0052	-.0635	.0037
4.01	5	15	.4952	-.0797	-.0074	-.0623	-.0010	4.01	5	15	.5010	-.0828	-.0056	-.0689	.0023

TABLE I -EXPERIMENTAL RESULTS FOR CONFIGURATIONS HAVING FIXED FINS – Concluded

(m) Two fixed ventral fins

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
4.01	-1	-9	-.2141	.0448	.0013	.0100	-.0027
4.01	-1	-6	-.1337	.0251	.0018	.0094	-.0024
4.01	-1	-3	-.0571	.0133	.0015	.0087	-.0018
4.01	-1	0	.0160	.0066	.0013	.0093	-.0015
4.01	-1	3	.0962	.0029	.0015	.0109	-.0004
4.01	-1	6	.1807	-.0147	.0021	.0104	.0008
4.01	-1	9	.2819	-.0523	.0017	.0107	.0014
4.01	-1	12	.3758	-.0714	.0013	.0098	.0022
4.01	-1	15	.5022	-.1065	.0007	.0078	.0024
4.01	0	-9	-.2120	.0506	.0004	-.0027	.0015
4.01	0	-6	-.1326	.0314	.0005	-.0019	.0011
4.01	0	-3	-.0572	.0184	.0002	-.0013	.0011
4.01	0	0	.0181	.0117	.0004	-.0007	.0012
4.01	0	3	.0934	.0050	.0006	-.0002	.0015
4.01	0	6	.1763	-.0106	.0008	-.0010	.0014
4.01	0	9	.2783	-.0513	.0008	-.0036	.0018
4.01	0	12	.3772	-.0726	.0002	-.0026	.0015
4.01	0	15	.5028	-.1081	-.0001	-.0054	.0012
4.01	1	-9	-.2118	.0502	.0002	-.0157	.0039
4.01	1	-6	-.1326	.0292	-.0001	-.0154	.0039
4.01	1	-3	-.0570	.0176	-.0007	-.0143	.0032
4.01	1	0	.0187	.0091	-.0006	-.0127	.0028
4.01	1	3	.0927	.0037	-.0007	-.0069	.0025
4.01	1	6	.1789	-.0133	-.0005	-.0115	.0022
4.01	1	9	.2816	-.0534	-.0009	-.0146	.0020
4.01	1	12	.3805	-.0755	-.0016	-.0171	.0016
4.01	1	15	.5075	-.1168	-.0016	-.0184	.0017
4.01	3	-9	-.2136	.0407	-.0020	-.0479	.0083
4.01	3	-6	-.1300	.0213	-.0024	-.0446	.0069
4.01	3	-3	-.0553	.0124	-.0022	-.0416	.0054
4.01	3	0	.0212	.0065	-.0023	-.0379	.0041
4.01	3	3	.0979	.0019	-.0020	-.0362	.0030
4.01	3	6	.1864	-.0179	-.0016	-.0368	.0022
4.01	3	9	.2867	-.0578	-.0016	-.0384	.0018
4.01	3	12	.3899	-.0846	-.0022	-.0384	.0019
4.01	3	15	.5147	-.1258	-.0026	-.0411	.0026
4.01	5	-9	-.2114	.0498	-.0039	-.0768	.0144
4.01	5	-6	-.1305	.0357	-.0035	-.0712	.0121
4.01	5	-3	-.0551	.0242	-.0036	-.0657	.0094
4.01	5	0	.0221	.0169	-.0033	-.0625	.0075
4.01	5	3	.0994	.0086	-.0034	-.0603	.0063
4.01	5	6	.1878	-.0137	-.0034	-.0608	.0059
4.01	5	9	.2830	-.0531	-.0040	-.0640	.0057
4.01	5	12	.3832	-.0799	-.0042	-.0655	.0053
4.01	5	15	.5162	-.1238	-.0039	-.0683	.0035

(n) Three fixed ventral fins

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
4.01	-1	-9	-.2174	.0441	.0013	.0102	-.0025
4.01	-1	-6	-.1353	.0231	.0014	.0088	-.0021
4.01	-1	-3	-.0588	.0126	.0015	.0091	-.0016
4.01	-1	0	.0159	.0064	.0012	.0106	-.0009
4.01	-1	3	.0927	.0028	.0014	.0112	.0001
4.01	-1	6	.1774	-.0137	.0020	.0107	.0013
4.01	-1	9	.2786	-.0524	.0016	.0110	.0016
4.01	-1	12	.3782	-.0727	.0014	.0103	.0025
4.01	-1	15	.5059	-.1071	.0004	.0070	.0026
4.01	0	-9	-.2105	.0506	.0004	-.0012	.0016
4.01	0	-6	-.1309	.0320	.0005	-.0014	.0015
4.01	0	-3	-.0573	.0178	.0002	-.0004	.0014
4.01	0	0	.0182	.0117	.0004	-.0002	.0015
4.01	0	3	.0936	.0050	.0002	.0003	.0020
4.01	0	6	.1781	-.0113	.0008	-.0005	.0019
4.01	0	9	.2801	-.0520	.0004	-.0017	.0021
4.01	0	12	.3777	-.0733	-.0002	-.0031	.0017
4.01	0	15	.5069	-.1088	-.0004	-.0053	.0015
4.01	1	-9	-.2122	.0496	-.0003	-.0166	.0045
4.01	1	-6	-.1312	.0287	-.0005	-.0149	.0039
4.01	1	-3	-.0535	.0170	-.0007	-.0128	.0035
4.01	1	0	.0206	.0091	-.0005	-.0118	.0032
4.01	1	3	.0970	.0031	-.0007	-.0112	.0027
4.01	1	6	.1815	-.0115	-.0004	-.0115	.0023
4.01	1	9	.2841	-.0536	-.0005	-.0142	.0023
4.01	1	12	.3872	-.0750	-.0015	-.0166	.0021
4.01	1	15	.5116	-.1167	-.0016	-.0192	.0027
4.01	3	-9	-.2155	.0377	-.0016	-.0490	.0074
4.01	3	-6	-.1338	.0202	-.0017	-.0434	.0061
4.01	3	-3	-.0572	.0119	-.0018	-.0403	.0049
4.01	3	0	.0194	.0077	-.0019	-.0371	.0040
4.01	3	3	.0961	.0031	-.0020	-.0354	.0029
4.01	3	6	.1846	-.0173	-.0016	-.0360	.0023
4.01	3	9	.2847	-.0571	-.0025	-.0379	.0021
4.01	3	12	.3860	-.0840	-.0031	-.0384	.0022
4.01	3	15	.5147	-.1247	-.0026	-.0399	.0032
4.01	5	-9	-.2140	.0497	-.0039	-.0747	.0143
4.01	5	-6	-.1326	.0345	-.0039	-.0695	.0121
4.01	5	-3	-.0570	.0248	-.0040	-.0639	.0096
4.01	5	0	.0202	.0168	-.0041	-.0602	.0078
4.01	5	3	.0976	.0085	-.0042	-.0590	.0068
4.01	5	6	.1844	-.0132	-.0043	-.0596	.0063
4.01	5	9	.2815	-.0532	-.0044	-.0619	.0061
4.01	5	12	.3830	-.0799	-.0050	-.0642	.0060
4.01	5	15	.5163	-.1244	-.0043	-.0681	.0044

(o) Four fixed fins in X arrangement

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
4.01	-1	-9	-.2214	.0581	.0013	.0079	-.0022
4.01	-1	-6	-.1393	.0342	.0018	.0073	-.0020
4.01	-1	-3	-.0626	.0195	.0015	.0076	-.0023
4.01	-1	0	.0159	.0084	.0017	.0088	-.0014
4.01	-1	3	.0926	-.0002	.0014	.0112	-.0004
4.01	-1	6	.1826	-.0202	.0021	.0109	.0008
4.01	-1	9	.2800	-.0541	.0009	.0097	.0013
4.01	-1	12	.3796	-.0694	.0007	.0106	.0017
4.01	-1	15	.5077	-.1051	-.0007	.0074	.0020
4.01	0	-9	-.2196	.0643	.0000	-.0037	.0008
4.01	0	-6	-.1382	.0407	.0005	-.0034	.0007
4.01	0	-3	-.0591	.0247	.0007	-.0022	.0006
4.01	0	0	.0163	.0124	.0004	-.0011	.0006
4.01	0	3	.0936	.0027	.0006	-.0011	.0010
4.01	0	6	.1781	-.0155	.0008	-.0005	.0013
4.01	0	9	.2799	-.0512	.0004	-.0039	.0015
4.01	0	12	.3769	-.0688	-.0006	-.0034	.0014
4.01	0	15	.5066	-.1081	-.0012	-.0057	.0015
4.01	1	-9	-.2193	.0638	-.0002	-.0182	.0041
4.01	1	-6	-.1366	.0337	-.0009	-.0173	.0031
4.01	1	-3	-.0608	.0227	-.0007	-.0167	.0027
4.01	1	0	.0188	.0092	-.0013	-.0140	.0022
4.01	1	3	.0971	.0001	-.0011	-.0130	.0021
4.01	1	6	.1833	-.0188	-.0012	-.0132	.0012
4.01	1	9	.2821	-.0553	-.0017	-.0154	.0014
4.01	1	12	.3829	-.0748	-.0023	-.0172	.0007
4.01	1	15	.5078	-.1137	-.0027	-.0191	.0014
4.01	3	-9	-.2175	.0541	-.0031	-.0516	.0093
4.01	3	-6	-.1353	.0317	-.0032	-.0474	.0070
4.01	3	-3	-.0589	.0179	-.0034	-.0434	.0057
4.01	3	0	.0214	.0077	-.0035	-.0421	.0045
4.01	3	3	.0982	-.0024	-.0036	-.0395	.0034
4.01	3	6	.1883	-.0258	-.0036	-.0395	.0027
4.01	3	9	.2864	-.0625	-.0040	-.0406	.0022
4.01	3	12	.3844	-.0846	-.0047	-.0417	.0024
4.01	3	15	.5109	-.1233	-.0042	-.0440	.0032
4.01	5	-9	-.2165	.0608	-.0043	-.0810	.0150
4.01	5	-6	-.1355	.0418	-.0044	-.0773	.0125
4.01	5	-3	-.0585	.0267	-.0044	-.0713	.0096
4.01	5	0	.0224	.0132	-.0048	-.0674	.0071
4.01	5	3	.1013	.0018	-.0046	-.0638	.0062
4.01	5	6	.1882	-.0223	-.0055	-.0646	.0065
4.01	5	9	.2827	-.0622	-.0052	-.0658	.0057
4.01	5	12	.3790	-.0810	-.0055	-.0688	.0059
4.01	5	15	.5125	-.1213	-.0056	-.0736	.0047

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TABLE II -EXPERIMENTAL RESULTS FOR CONFIGURATIONS HAVING JETTISONABLE FINS

(a) One jettisonable ventral fin

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
2.37	-1	-9	-.3376	.1172	.0015	.0140	-.0022
2.37	-1	-6	-.2139	.0868	.0014	.0135	-.0016
2.37	-1	-3	-.0937	.0560	.0017	.0117	-.0014
2.37	-1	0	.0326	.0180	.0013	.0117	-.0011
2.37	-1	3	.1558	-.0188	.0017	.0107	-.0007
2.37	-1	6	.2852	-.0561	.0018	.0102	-.0007
2.37	-1	9	.4166	-.0918	.0016	.0095	-.0004
2.37	-1	12	.5499	-.1161	.0016	.0083	-.0001
2.37	0	-9	-.3342	.1166	-.0003	-.0027	.0022
2.37	0	-6	-.2119	.0871	-.0003	-.0025	.0020
2.37	0	-3	-.0950	.0583	-.0009	-.0032	.0020
2.37	0	0	.0335	.0183	-.0001	-.0029	.0022
2.37	0	3	.1577	-.0187	-.0001	-.0034	.0019
2.37	0	6	.2856	-.0554	.0000	-.0050	.0017
2.37	0	9	.4192	-.0925	-.0002	-.0071	.0019
2.37	0	12	.5520	-.1177	.0002	-.0063	.0016
2.37	1	-9	-.3358	.1176	-.0022	-.0208	.0052
2.37	1	-6	-.2119	.0869	-.0022	-.0196	.0049
2.37	1	-3	-.0911	.0571	-.0022	-.0188	.0043
2.37	1	0	.0363	.0170	-.0019	-.0172	.0041
2.37	1	3	.1590	-.0186	-.0015	-.0174	.0039
2.37	1	6	.2883	-.0555	-.0023	-.0191	.0039
2.37	1	9	.4239	-.0935	-.0025	-.0209	.0040
2.37	1	12	.5601	-.1230	-.0025	-.0232	.0037
2.37	3	-9	-.3377	.1173	-.0052	-.0608	.0115
2.37	3	-6	-.2134	.0864	-.0047	-.0568	.0106
2.37	3	-3	-.0918	.0557	-.0044	-.0523	.0089
2.37	3	0	.0348	.0164	-.0045	-.0475	.0076
2.37	3	3	.1621	-.0207	-.0045	-.0471	.0070
2.37	3	6	.2922	-.0584	-.0047	-.0492	.0068
2.37	3	9	.4274	-.0957	-.0052	-.0513	.0066
2.37	3	12	.5611	-.1172	-.0056	-.0538	.0062
2.37	5	-9	-.3359	.1215	-.0086	-.0992	.0208
2.37	5	-6	-.2135	.0901	-.0113	-.0938	.0188
2.37	5	-3	-.0916	.0581	-.0080	-.0861	.0158
2.37	5	0	.0348	.0185	-.0075	-.0810	.0139
2.37	5	3	.1632	-.0195	-.0077	-.0799	.0123
2.37	5	6	.2952	-.0571	-.0079	-.0826	.0116
2.37	5	9	.4256	-.0945	-.0085	-.0853	.0106
2.37	5	12	.5646	-.1163	-.0090	-.0883	.0099

(b) One 15° wedge jettisonable fin

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
2.37	-1	-9	-.3375	.1196	.0011	.0144	-.0020
2.37	-1	-6	-.2151	.0902	.0014	.0144	-.0018
2.37	-1	-3	-.0953	.0601	.0017	.0130	-.0013
2.37	-1	0	.0304	.0190	.0013	.0134	-.0007
2.37	-1	3	.1570	-.0206	.0017	.0121	-.0006
2.37	-1	6	.2878	-.0608	.0018	.0106	-.0002
2.37	-1	9	.4186	-.0977	.0016	.0103	.0000
2.37	-1	12	.5463	-.1123	.0020	.0091	.0004
2.37	0	-9	-.3372	.1198	-.0004	-.0034	.0033
2.37	0	-6	-.2136	.0910	-.0004	-.0026	.0030
2.37	0	-3	-.0957	.0605	-.0005	-.0038	.0030
2.37	0	0	.0331	.0180	-.0005	-.0025	.0028
2.37	0	3	.1602	-.0205	-.0001	-.0029	.0025
2.37	0	6	.2854	-.0601	-.0001	-.0056	.0027
2.37	0	9	.4205	-.0996	-.0002	-.0072	.0026
2.37	0	12	.5454	-.1168	.0001	-.0075	.0023
2.37	1	-9	-.3343	.1192	-.0019	-.0226	.0070
2.37	1	-6	-.2108	.0892	-.0019	-.0214	.0068
2.37	1	-3	-.0934	.0590	-.0023	-.0197	.0061
2.37	1	0	.0361	.0160	-.0019	-.0177	.0057
2.37	1	3	.1620	-.0231	-.0020	-.0189	.0054
2.37	1	6	.2907	-.0625	-.0023	-.0205	.0053
2.37	1	9	.4237	-.1018	-.0021	-.0228	.0053
2.37	1	12	.5501	-.1221	-.0030	-.0251	.0050
2.37	3	-9	-.3351	.1193	-.0048	-.0650	.0137
2.37	3	-6	-.2119	.0882	-.0044	-.0617	.0130
2.37	3	-3	-.0935	.0567	-.0044	-.0568	.0113
2.37	3	0	.0369	.0157	-.0039	-.0522	.0098
2.37	3	3	.1660	-.0232	-.0041	-.0502	.0007
2.37	3	6	.2937	-.0639	-.0045	-.0533	.0084
2.37	3	9	.4316	-.1044	-.0050	-.0555	.0079
2.37	3	12	.5622	-.1199	-.0057	-.0570	.0072
2.37	5	-9	-.3344	.1214	-.0084	-.1042	.0235
2.37	5	-6	-.2137	.0916	-.0079	-.0986	.0218
2.37	5	-3	-.0914	.0587	-.0074	-.0913	.0193
2.37	5	0	.0388	.0185	-.0072	-.0870	.0168
2.37	5	3	.1653	-.0207	-.0067	-.0852	.0149
2.37	5	6	.2960	-.0602	-.0077	-.0885	.0138
2.37	5	9	.4286	-.1003	-.0082	-.0913	.0128
2.37	5	12	.5627	-.1174	-.0088	-.0936	.0116

(c) Two jettisonable ventral fins

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
2.37	-1	-9	-.3612	.1680	.0012	.0146	-.0035
2.37	-1	-6	-.2314	.1174	.0011	.0132	-.0026
2.37	-1	-3	-.1033	.0667	.0002	.0131	-.0022
2.37	-1	0	.0328	.0025	.0008	.0145	-.0019
2.37	-1	3	.1693	-.0615	.0008	.0121	-.0019
2.37	-1	6	.3107	-.1307	.0008	.0123	-.0018
2.37	-1	9	.4529	-.1862	.0017	.0107	-.0013
2.37	0	-9	-.3618	.1670	-.0004	.0060	.0024
2.37	0	-6	-.2326	.1189	-.0012	-.0040	.0028
2.37	0	-3	-.1022	.0687	-.0013	-.0043	.0022
2.37	0	0	.0357	.0038	-.0010	-.0025	.0020
2.37	0	3	.1723	-.0609	-.0003	-.0031	.0014
2.37	0	6	.3113	-.1287	-.0003	-.0040	.0013
2.37	0	9	.4536	-.1922	-.0002	-.0061	.0012
2.37	1	-9	-.3621	.1670	-.0012	-.0257	.0082
2.37	1	-6	-.2311	.1188	-.0023	-.0235	.0069
2.37	1	-3	-.1025	.0675	-.0016	-.0212	.0059
2.37	1	0	.0385	.0016	-.0020	-.0188	.0051
2.37	1	3	.1732	-.0614	-.0018	-.0192	.0047
2.37	1	6	.3143	-.1315	-.0018	-.0207	.0042
2.37	1	9	.4633	-.2006	-.0016	-.0214	.0039
2.37	3	-9	-.3610	.1665	-.0042	-.0706	.0168
2.37	3	-6	-.2298	.1194	-.0034	-.0648	.0144
2.37	3	-3	-.1010	.0684	-.0037	-.0590	.0122
2.37	3	0	.0390	.0026	-.0032	-.0529	.0100
2.37	3	3	.1951	-.0617	-.0029	-.0520	.0091
2.37	3	6	.3189	-.1286	-.0036	-.0542	.0086
2.37	3	9	.4640	-.1919	-.0041	-.0540	.0072
2.37	5	-9	-.3635	.1738	-.0074	-.1113	.0275
2.37	5	-6	-.2376	.1264	-.0070	-.1045	.0245
2.37	5	-3	-.1033	.0752	-.0064	-.0950	.0211
2.37	5	0	.0371	.0116	-.0062	-.0880	.0182
2.37	5	3	.1752	-.0526	-.0061	-.0869	.0164
2.37	5	6	.3197	-.1214	-.0064	-.0902	.0148
2.37	5	9	.4630	-.1875	-.0066	-.0904	.0126

(d) Three jettisonable ventral fins

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
2.37	-1	-9	-.3578	.1584	.0012	.0144	-.0028
2.37	-1	-6	-.2291	.1104	.0010	.0137	-.0021
2.37	-1	-3	-.1013	.0592	.0013	.0143	-.0018
2.37	-1	0	.0366	-.0056	.0012	.0148	-.0015
2.37	-1	3	.1728	-.0683	.0011	.0134	-.0014
2.37	-1	6	.3168	-.1363	.0012	.0138	-.0018
2.37	-1	9	.4419	-.1646	.0014	.0133	-.0014
2.37	0	-9	-.3569	.1604	-.0007	-.0048	.0024
2.37	0	-6	-.2251	.1125	-.0007	-.0028	.0022
2.37	0	-3	-.0999	.0621	-.0009	-.0029	.0019
2.37	0	0	.0393	-.0030	-.0010	-.0019	.0015
2.37	0	3	.1749	-.0674	-.0002	-.0025	.0011
2.37	0	6	.3166	-.1353	-.0002	-.0028	.0007
2.37	0	9	.4516	-.1814	.0004	-.0034	.0007
2.37	1	-9	-.3564	.1596	-.0014	-.0247	.0068
2.37	1	-6	-.2253	.1117	-.0022	-.0218	.0059
2.37	1	-3	-.0978	.0608	-.0020	-.0209	.0050
2.37	1	0	.0423	-.0066	-.0020	-.0172	.0045
2.37	1	3	.1811	-.0707	-.0020	-.0192	.0039
2.37	1	6	.3188	-.1389	-.0021	-.0193	.0037
2.37	1	9	.4583	-.1889	-.0026	-.0193	.0031
2.37	3	-9	-.3577	.1592	-.0046	-.0689	.0159
2.37	3	-6	-.2265	.1114	-.0041	-.0639	.0140
2.37	3	-3	-.0969	.0590	-.0041	-.0578	.0116
2.37	3	0	.0410	-.0061	-.0041	-.0528	.0100
2.37	3	3	.1818	-.0704	-.0036	-.0519	.0087
2.37	3	6	.3246	-.1395	-.0039	-.0533	.0081
2.37	3	9	.4590	-.1840	-.0044	-.0522	.0065
2.37	5	-9	-.3613	.1665	-.0070	-.1098	.0267
2.37	5	-6	-.2290	.1209	-.0068	-.1024	.0238
2.37	5	-3	-.0990	.0674	-.0071	-.0934	.0201
2.37	5	0	.0428	.0022	-.0062	-.0882	.0176
2.37	5	3	.1796	-.0621	-.0061	-.0870	.0155
2.37	5	6	.3271	-.1339	-.0067	-.0895	.0139
2.37	5	9	.4612	-.1837	-.0072	-.0877	.0110

TABLE II -EXPERIMENTAL RESULTS FOR CONFIGURATIONS HAVING JETTISONABLE FINS - Continued

(e) Four jettisonable fins in X arrangement.

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
2.37	-1	-9	-.3752	.1925	.0016	.0138	-.0028
2.37	-1	-6	-.2475	.1622	.0021	.0157	-.0033
2.37	-1	-3	-.1109	.0939	.0023	.0163	-.0032
2.37	-1	0	.0304	.0175	.0018	.0164	-.0026
2.37	-1	3	.1680	-.0524	.0024	.0159	-.0023
2.37	-1	6	.3110	-.1282	.0020	.0152	-.0020
2.37	-1	9	.4603	-.1940	.0026	.0137	-.0016
2.37	0	-9	-.3790	.1975	.0005	-.0061	.0023
2.37	0	-6	-.2440	.1642	.0005	-.0032	.0038
2.37	0	-3	-.1094	.0960	-.0001	-.0030	.0036
2.37	0	0	.0350	.0192	.0003	-.0006	.0032
2.37	0	3	.1718	-.0503	.0002	-.0016	.0024
2.37	0	6	.3151	-.1262	.0006	-.0035	.0024
2.37	0	9	.4630	-.1925	.0012	-.0040	.0018
2.37	1	-9	-.3793	.1983	-.0011	-.0283	.0077
2.37	1	-6	-.2461	.1622	-.0011	-.0246	.0087
2.37	1	-3	-.1112	.0947	-.0012	-.0231	.0076
2.37	1	0	.0362	.0145	-.0020	-.0202	.0070
2.37	1	3	.1734	-.0565	-.0018	-.0211	.0064
2.37	1	6	.3181	-.1312	-.0017	-.0220	.0059
2.37	1	9	.4682	-.2035	-.0015	-.0216	.0044
2.37	3	-6	-.2480	.1602	-.0046	-.0692	.0170
2.37	3	-3	-.1123	.0923	-.0051	-.0635	.0154
2.37	3	0	.0316	.0153	-.0047	-.0580	.0139
2.37	3	3	.1725	-.0557	-.0042	-.0568	.0126
2.37	3	6	.3187	-.1314	-.0045	-.0595	.0115
2.37	3	9	.4633	-.1965	-.0046	-.0568	.0093
2.37	5	-6	-.2523	.1636	-.0079	-.1090	.0286
2.37	5	-3	-.1116	.0962	-.0074	-.1016	.0261
2.37	5	0	.0316	.0216	-.0069	-.0965	.0233
2.37	5	3	.1714	-.0506	-.0069	-.0943	.0210
2.37	5	6	.3173	-.1252	-.0071	-.0970	.0193
2.37	5	9	.4618	-.1869	-.0079	-.0968	.0169

(f) One jettisonable ventral fin

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
2.98	-1	-9	-.2608	.0644	.0015	.0160	-.0020
2.98	-1	-6	-.1608	.0440	.0019	.0150	-.0017
2.98	-1	-3	-.0661	.0332	.0018	.0131	-.0009
2.98	-1	0	.0246	.0232	.0021	.0121	-.0005
2.98	-1	3	.1218	.0020	.0024	.0115	-.0002
2.98	-1	6	.2300	-.0312	.0015	.0100	.0001
2.98	-1	9	.3393	-.0593	.0021	.0089	.0001
2.98	-1	12	.4535	-.0873	.0019	.0074	.0002
2.98	-1	15	.5864	-.1237	.0016	.0067	.0000
2.98	0	-9	-.2588	.0673	.0005	.0007	.0012
2.98	0	-6	-.1604	.0463	.0000	.0001	.0014
2.98	0	-3	-.0672	.0357	.0003	.0002	.0012
2.98	0	0	.0241	.0257	.0007	-.0009	.0011
2.98	0	3	.1218	.0031	.0001	-.0009	.0010
2.98	0	6	.2288	-.0293	.0010	-.0035	.0011
2.98	0	9	.3392	-.0576	.0011	-.0046	.0014
2.98	0	12	.4524	-.0863	.0009	-.0057	.0013
2.98	0	15	.5882	-.1231	.0007	-.0077	.0009
2.98	1	-9	-.2588	.0669	-.0010	-.0154	.0037
2.98	1	-6	-.1564	.0462	-.0014	-.0154	.0033
2.98	1	-3	-.0669	.0356	-.0015	-.0149	.0028
2.98	1	0	.0257	.0250	-.0016	-.0138	.0023
2.98	1	3	.1251	.0010	-.0008	-.0139	.0021
2.98	1	6	.2341	-.0317	-.0008	-.0159	.0021
2.98	1	9	.3454	-.0608	-.0007	-.0181	.0024
2.98	1	12	.4627	-.0903	-.0017	-.0212	.0028
2.98	1	15	.5921	-.1256	-.0013	-.0231	.0025
2.98	3	-9	-.2589	.0655	-.0045	-.0523	.0091
2.98	3	-6	-.1589	.0457	-.0041	-.0499	.0084
2.98	3	-3	-.0659	.0341	-.0036	-.0468	.0073
2.98	3	0	.0285	.0237	-.0036	-.0436	.0062
2.98	3	3	.1286	-.0005	-.0035	-.0415	.0050
2.98	3	6	.2355	-.0313	-.0031	-.0430	.0046
2.98	3	9	.3456	-.0607	-.0026	-.0467	.0049
2.98	3	12	.4708	-.0919	-.0030	-.0497	.0051
2.98	3	15	.6002	-.1303	-.0026	-.0544	.0052
2.98	5	-9	-.2638	.0701	-.0068	-.0873	.0156
2.98	5	-6	-.1615	.0504	-.0067	-.0833	.0139
2.98	5	-3	-.0663	.0382	-.0061	-.0778	.0117
2.98	5	0	.0278	.0238	-.0065	-.0734	.0097
2.98	5	3	.1284	-.0005	-.0060	-.0712	.0079
2.98	5	6	.2370	-.0306	-.0046	-.0741	.0070
2.98	5	9	.3456	-.0593	-.0049	-.0777	.0065
2.98	5	12	.4613	-.0890	-.0051	-.0813	.0064
2.98	5	15	.6095	-.1330	-.0052	-.0903	.0071

(g) One 15° wedge jettisonable fin

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
2.98	-1	-9	-.2663	.0672	.0019	.0152	-.0026
2.98	-1	-6	-.1653	.0473	.0018	.0148	-.0024
2.98	-1	-3	-.0731	.0358	.0013	.0140	-.0016
2.98	-1	0	.0203	.0258	.0016	.0130	-.0007
2.98	-1	3	.1214	.0026	.0020	.0140	.0001
2.98	-1	6	.2284	-.0325	.0019	.0140	.0003
2.98	-1	9	.3368	-.0640	.0016	.0144	.0005
2.98	-1	12	.4540	-.0946	.0014	.0144	.0006
2.98	-1	15	.5899	-.1345	.0020	.0140	.0008
2.98	0	-9	-.2648	.0723	.0004	.0005	.0026
2.98	0	-6	-.1652	.0513	.0007	.0003	.0027
2.98	0	-3	-.0722	.0407	.0002	.0005	.0026
2.98	0	0	.0209	.0301	.0006	.0005	.0026
2.98	0	3	.1213	.0049	.0009	.0009	.0027
2.98	0	6	.2294	-.0308	.0009	.0004	.0025
2.98	0	9	.3372	-.0617	.0010	.0002	.0025
2.98	0	12	.4516	-.0925	.0003	-.0004	.0028
2.98	0	15	.5901	-.1334	.0014	-.0002	.0026
2.98	1	-9	-.2643	.0719	-.0007	-.0172	.0054
2.98	1	-6	-.1619	.0497	-.0012	-.0167	.0055
2.98	1	-3	-.0698	.0378	-.0013	-.0157	.0050
2.98	1	0	.0226	.0266	-.0013	-.0141	.0048
2.98	1	3	.1215	.0013	-.0014	-.0132	.0047
2.98	1	6	.2314	-.0360	-.0014	-.0133	.0046
2.98	1	9	.3413	-.0677	-.0018	-.0150	.0049
2.98	1	12	.4579	-.0987	-.0020	-.0174	.0053
2.98	1	15	.5963	-.1393	-.0018	-.0182	.0048
2.98	3	-9	-.2667	.0652	-.0038	-.0566	.0097
2.98	3	-6	-.1648	.0445	-.0039	-.0542	.0097
2.98	3	-3	-.0712	.0321	-.0038	-.0505	.0085
2.98	3	0	.0237	.0216	-.0042	-.0467	.0075
2.98	3	3	.1254	-.0027	-.0042	-.0435	.0062
2.98	3	6	.2318	-.0364	-.0042	-.0436	.0059
2.98	3	9	.3424	-.0666	-.0032	-.0459	.0060
2.98	3	12	.4629	-.1007	-.0034	-.0486	.0063
2.98	3	15	.6023	-.1439	-.0033	-.0527	.0065
2.98	5	-9	-.2679	.0699	-.0065	-.0907	.0173
2.98	5	-6	-.1642	.0492	-.0065	-.0882	.0165
2.98	5	-3	-.0707	.0363	-.0061	-.0820	.0150
2.98	5	0	.0251	.0224	-.0060	-.0771	.0131
2.98	5	3	.1252	-.0021	-.0067	-.0737	.0112
2.98	5	6	.2342	-.0331	-.0058	-.0748	.0101
2.98	5	9	.3433	-.0633	-.0053	-.0787	.0100
2.98	5	12	.4610	-.0953	-.0055	-.0825	.0102
2.98	5	15	.6087	-.1419	-.0062	-.0901	.0112

(h) Two jettisonable ventral fins

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
2.98	-1	-9	-.2788	.0968	.0007	.0157	-.0026
2.98	-1	-6	-.1751	.0647	.0010	.0147	-.0026
2.98	-1	-3	-.0742	.0392	.0005	.0130	-.0015
2.98	-1	0	.0237	.0126	.0012	.0136	-.0015
2.98	-1	3	.1305	-.0280	.0014	.0125	-.0011
2.98	-1	6	.2447	-.0819	.0014	.0114	-.0011
2.98	-1	9	.3601	-.1282	.0014	.0111	-.0008
2.98	-1	12	.4857	-.1786	.0012	.0105	-.0011
2.98	0	-9	-.2792	.0997	.0001	-.0018	.0013
2.98	0	-6	-.1733	.0679	.0000	-.0012	.0015
2.98	0	-3	-.0746	.0418	-.0002	-.0010	.0010
2.98	0	0	.0222	.0156	.0001	-.0000	.0012
2.98	0	3	.1295	-.0265	.0000	-.0011	.0010
2.98	0	6	.2442	-.0812	-.0001	-.0028	.0009
2.98	0	9	.3585	-.1274	.0003	-.0041	.0008
2.98	0	12	.4827	-.1769	.0005	-.0049	.0008
2.98	1	-9	-.2772	.0991	-.0011	-.0211	.0047
2.98	1	-6	-.1736	.0667	-.0016	-.0201	.0051
2.98	1	-3	-.0732	.0402	-.0012	-.0173	.0036
2.98	1	0	.0260	.0133	-.0009	-.0157	.0035
2.98	1	3	.1329	-.0289	-.0010	-.0152	.0030
2.98	1	6	.2479	-.0826	-.0011	-.0170	.0030
2.98	1	9	.3617	-.1299	-.0007	-.0180	.0029
2.98	1	12	.4867	-.1793	-.0010	-.0199	.0033
2.98	3	-9	-.2794	.0973	-.0022	-.0615	.0127
2.98	3	-6	-.1769	.0649	-.0027	-.0571	.0115
2.98	3	-3	-.0753	.0400	-.0023	-.0523	.0099
2.98	3	0	.0258	.0128	-.0018	-.0480	.0082
2.98	3	3	.1339	-.0282	-.0018	-.0454	.0071
2.98	3	6	.2495	-.0798	-.0014	-.0460	.0061
2.98	3	9	.3669	-.1292	-.0009	-.0484	.0060
2.98	3	12	.4954	-.1818	-.0011	-.0513	.0064
2.98	5	-9	-.2808	.1037	-.0050	-.0963	.0218
2.98	5	-6	-.1759	.0722	-.0049	-.0912	.0191
2.98	5	-3	-.0756	.0467	-.0044	-.0834	.0164
2.98	5	0	.0271	.0175	-.0044	-.0791	.0142
2.98	5	3	.1355	-.0256	-.0044	-.0766	.0126
2.98	5	6	.2508	-.0739	-.0039	-.0782	.0114
2.98	5	9	.3646	-.1233	-.0034	-.0810	.0102
2.98	5	12	.4930	-.1765	-.0027	-.0840	.0099

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TABLE II -EXPERIMENTAL RESULTS FOR CONFIGURATIONS HAVING JETTISONABLE FINS - Continued

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n	M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
(i) Three jettisonable ventral fins								(j) Four jettisonable fins in X arrangement							
2.98	-1	-9	-.2767	.0911	.0016	.0167	-.0038	2.98	-1	-9	-.3055	.1639	.0015	.0182	-.0038
2.98	-1	-6	-.1720	.0589	.0015	.0168	-.0034	2.98	-1	-6	-.1962	.1234	.0013	.0166	-.0034
2.98	-1	-3	-.0721	.0326	.0017	.0150	-.0021	2.98	-1	-3	-.0902	.0813	.0019	.0149	-.0027
2.98	-1	0	.0279	.0038	.0011	.0151	-.0012	2.98	-1	0	.0180	.0354	.0013	.0158	-.0022
2.98	-1	3	.1346	-.0387	.0022	.0139	-.0008	2.98	-1	3	.1319	-.0217	.0020	.0153	-.0020
2.98	-1	6	.2500	-.0934	.0022	.0127	-.0006	2.98	-1	6	.2509	-.0835	.0019	.0147	-.0016
2.98	-1	9	.3664	-.1397	.0022	.0130	-.0004	2.98	-1	9	.3661	-.1344	.0023	.0138	-.0013
2.98	-1	12	.4881	-.1858	.0020	.0127	-.0005	2.98	-1	12	.4921	-.1892	.0025	.0135	-.0016
2.98	0	-9	-.2742	.0927	.0001	.0009	.0009	2.98	0	-9	-.3041	.1679	.0002	-.0012	.0032
2.98	0	-6	-.1707	.0605	.0000	.0009	.0007	2.98	0	-6	-.1965	.1288	.0005	-.0006	.0031
2.98	0	-3	-.0702	.0336	-.0006	.0012	.0008	2.98	0	-3	-.0921	.0867	-.0005	-.0012	.0031
2.98	0	0	.0254	.0062	.0001	.0010	.0007	2.98	0	0	.0165	.0408	.0002	-.0005	.0025
2.98	0	3	.1348	-.0365	.0008	.0005	.0008	2.98	0	3	.1310	-.0179	.0004	-.0011	.0025
2.98	0	6	.2490	-.0911	.0007	-.0013	.0007	2.98	0	6	.2470	-.0776	.0008	-.0029	.0022
2.98	0	9	.3648	-.1381	.0008	-.0020	.0006	2.98	0	9	.3646	-.1305	.0012	-.0038	.0021
2.98	0	12	.4897	-.1902	.0010	-.0024	.0008	2.98	0	12	.4888	-.1848	.0014	-.0035	.0016
2.98	1	-9	-.2742	.0927	-.0011	-.0184	.0046	2.98	1	-9	-.3040	.1661	-.0010	-.0220	.0078
2.98	1	-6	-.1701	.0593	-.0016	-.0174	.0041	2.98	1	-6	-.1941	.1263	-.0019	-.0202	.0075
2.98	1	-3	-.0708	.0320	-.0008	-.0152	.0033	2.98	1	-3	-.0906	.0836	-.0013	-.0191	.0069
2.98	1	0	.0292	.0026	-.0009	-.0136	.0031	2.98	1	0	.0173	.0376	-.0014	-.0179	.0066
2.98	1	3	.1379	-.0402	-.0010	-.0130	.0025	2.98	1	3	.1342	-.0236	-.0015	-.0179	.0058
2.98	1	6	.2519	-.0951	-.0011	-.0149	.0027	2.98	1	6	.2516	-.0829	-.0007	-.0187	.0049
2.98	1	9	.3685	-.1417	-.0011	-.0157	.0025	2.98	1	9	.3685	-.1367	-.0007	-.0201	.0046
2.98	1	12	.4948	-.1962	-.0009	-.0182	.0025	2.98	1	12	.4934	-.1911	-.0010	-.0222	.0048
2.98	3	-9	-.2770	.0913	-.0039	-.0587	.0114	2.98	3	-9	-.3046	.1597	-.0039	-.0662	.0160
2.98	3	-6	-.1724	.0588	-.0039	-.0557	.0105	2.98	3	-6	-.1974	.1202	-.0036	-.0623	.0150
2.98	3	-3	-.0729	.0326	-.0043	-.0503	.0086	2.98	3	-3	-.0897	.0795	-.0036	-.0574	.0130
2.98	3	0	.0280	.0035	-.0039	-.0461	.0072	2.98	3	0	.0175	.0338	-.0032	-.0532	.0115
2.98	3	3	.1357	-.0387	-.0035	-.0440	.0059	2.98	3	3	.1340	-.0250	-.0033	-.0513	.0105
2.98	3	6	.2524	-.0929	-.0026	-.0442	.0049	2.98	3	6	.2538	-.0845	-.0024	-.0504	.0091
2.98	3	9	.3717	-.1430	-.0029	-.0458	.0044	2.98	3	9	.3696	-.1370	-.0023	-.0523	.0085
2.98	3	12	.4988	-.1992	-.0027	-.0489	.0042	2.98	3	12	.4988	-.1944	-.0022	-.0571	.0089
2.98	5	-9	-.2801	.0999	-.0062	-.0942	.0198	2.98	5	-9	-.3054	.1663	-.0063	-.1041	.0252
2.98	5	-6	-.1737	.0676	-.0061	-.0889	.0177	2.98	5	-6	-.1965	.1234	-.0062	-.0980	.0224
2.98	5	-3	-.0745	.0407	-.0057	-.0823	.0154	2.98	5	-3	-.0909	.0819	-.0063	-.0912	.0206
2.98	5	0	.0304	.0089	-.0055	-.0773	.0127	2.98	5	0	.0211	.0342	-.0063	-.0874	.0186
2.98	5	3	.1378	-.0349	-.0056	-.0758	.0109	2.98	5	3	.1346	-.0222	-.0063	-.0844	.0163
2.98	5	6	.2538	-.0871	-.0051	-.0773	.0095	2.98	5	6	.2550	-.0804	-.0049	-.0862	.0144
2.98	5	9	.3706	-.1373	-.0046	-.0796	.0084	2.98	5	9	.3723	-.1351	-.0045	-.0882	.0135
2.98	5	12	.4972	-.1952	-.0040	-.0831	.0080	2.98	5	12	.4951	-.1882	-.0039	-.0909	.0130
(k) One jettisonable ventral fin								(l) One 15° wedge jettisonable fin							
4.01	-1	-9	-.2086	.0349	.0013	.0086	-.0020	4.01	-1	-9	-.2084	.0325	.0005	.0087	-.0023
4.01	-1	-6	-.1301	.0177	.0010	.0076	-.0021	4.01	-1	-6	-.1299	.0154	.0010	.0090	-.0028
4.01	-1	-3	-.0552	.0109	.0012	.0083	-.0018	4.01	-1	-3	-.0533	.0079	.0008	.0075	-.0021
4.01	-1	0	.0159	.0089	.0009	.0088	-.0010	4.01	-1	0	.0178	.0060	.0005	.0099	-.0015
4.01	-1	3	.0908	.0090	.0007	.0095	-.0002	4.01	-1	3	.0927	.0041	.0007	.0109	-.0005
4.01	-1	6	.1752	-.0025	.0010	.0101	.0009	4.01	-1	6	.1771	-.0086	.0006	.0116	.0003
4.01	-1	9	.2729	-.0352	.0010	.0113	.0012	4.01	-1	9	.2764	-.0418	.0006	.0109	.0005
4.01	-1	12	.3682	-.0469	-.0001	.0107	.0021	4.01	-1	12	.3759	-.0553	-.0003	.0110	.0012
4.01	-1	15	.4926	-.0715	-.0002	.0066	.0022	4.01	-1	15	.4962	-.0855	-.0011	.0076	.0017
4.01	0	-9	-.2066	.0390	.0000	-.0020	.0009	4.01	0	-9	-.2095	.0371	.0003	-.0032	.0007
4.01	0	-6	-.1291	.0223	.0001	-.0028	.0006	4.01	0	-6	-.1285	.0203	.0001	-.0023	.0007
4.01	0	-3	-.0553	.0142	-.0001	-.0021	.0005	4.01	0	-3	-.0551	.0129	.0002	-.0022	.0007
4.01	0	0	.0182	.0124	-.0003	-.0010	.0007	4.01	0	0	.0163	.0099	.0000	-.0016	.0008
4.01	0	3	.0917	.0112	-.0002	-.0005	.0013	4.01	0	3	.0913	.0069	-.0002	-.0011	.0014
4.01	0	6	.1743	.0011	.0001	-.0003	.0013	4.01	0	6	.1758	-.0063	.0001	-.0018	.0015
4.01	0	9	.2744	-.0335	-.0003	-.0032	.0016	4.01	0	9	.2757	-.0414	-.0003	-.0038	.0017
4.01	0	12	.3696	-.0462	-.0005	-.0041	.0013	4.01	0	12	.3693	-.0566	-.0010	-.0052	.0015
4.01	0	15	.4915	-.0739	-.0015	-.0063	.0014	4.01	0	15	.4970	-.0867	-.0015	-.0083	.0017
4.01	1	-9	-.2064	.0381	-.0005	-.0131	.0028	4.01	1	-9	-.2073	.0367	-.0002	-.0155	.0031
4.01	1	-6	-.1272	.0208	-.0008	-.0142	.0027	4.01	1	-6	-.1266	.0188	-.0005	-.0147	.0028
4.01	1	-3	-.0533	.0135	-.0011	-.0141	.0023	4.01	1	-3	-.0530	.0103	-.0007	-.0141	.0028
4.01	1	0	.0206	.0111	-.0016	-.0124	.0020	4.01	1	0	.0206	.0079	-.0009	-.0135	.0026
4.01	1	3	.0930	.0100	-.0014	-.0115	.0020	4.01	1	3	.0927	.0049	-.0008	-.0145	.0025
4.01	1	6	.1791	-.0008	-.0011	-.0131	.0017	4.01	1	6	.1779	-.0083	-.0008	-.0141	.0020
4.01	1	9	.2781	-.0347	-.0016	-.0152	.0016	4.01	1	9	.2789	-.0449	-.0012	-.0176	.0021
4.01	1	12	.3755	-.0486	-.0018	-.0177	.0015	4.01	1	12	.3763	-.0597	-.0019	-.0200	.0022
4.01	1	15	.4988	-.0799	-.0022	-.0204	.0022	4.01	1	15	.4981	-.0928	-.0022	-.0237	.0031
4.01	3	-9	-.2113	.0305	-.0019	-.0492	.0063	4.01	3	-9	-.2064	.0323	-.0027	-.0486	.0079
4.01	3	-6	-.1277	.0147	-.0020	-.0454	.0057	4.01	3	-6	-.1262	.0158	-.0021	-.0469	.0070
4.01	3	-3	-.0550	.0088	-.0022	-.0429	.0051	4.01	3	-3	-.0533	.0093	-.0023	-.0454	.0064
4.01	3	0	.0194	.0089	-.0023	-.0398	.0043	4.01	3	0	.0196	.0082	-.0024	-.0424	.0054
4.01	3	3	.0922	.0085	-.0020	-.0377	.0034	4.01	3	3	.0962	.0061	-.0024	-.0411	.0043
4.01	3	6	.1784	-.0051	-.0024	-.0382	.0030	4.01	3	6	.1845	-.0100	-.0025	-.0411	.0040
4.01	3	9	.2765	-.0394	-.0029	-.0408	.0034	4.01	3	9	.2807	-.0456	-.0030	-.0448	.0045
4.01	3	12	.3723	-.0577	-.0035	-.0414	.0037	4.01	3	12	.3767	-.0645	-.0033	-.0464	.0050
4.01	3	15	.4942	-.0866	-.0031	-.0428	.0050	4.01	3	15	.4992	-.0977	-.0032	-.0503	.0065
4.01	5	-9	-.2072	.0430	-.0042	-.0741	.0136	4.01	5	-9	-.2088	.0400	-.0046	-.0780	.0133
4.01	5	-6	-.1300	.0295	-.0043	-.0700	.0116	4.01	5	-6	-.1299	.0259	-.0044	-.0749	.0123
4.01	5	-3	-.0549	.0227	-.0040	-.0661	.0099	4.01	5	-3	-.0546	.0184	-.0045	-.0704	.0108
4.01	5	0	.0202	.0192	-.0041	-.0619	.0083	4.01	5	0	.0223	.0155	-.0042	-.0677	.0098
4.01	5	3	.0953	.0176	-.0042	-.0607	.0077	4.01	5	3	.0958	.0114	-.0044	-.0677	.0094
4.01	5	6	.1803	-.0016	-.0047	-.0638	.0075	4.01	5	6	.1826	-.0071	-.0049	-.0699	.0097
4.01	5	9	.2729	-.0341	-.0052	-.0647	.0081	4.01	5	9	.2789	-.0414	-.0046	-.0717	.0103
4.01	5	12	.3690	-.0517	-.0051	-.0695	.0081	4.01	5	12	.3735	-.0615	-.0049	-.0768	.0107
4.01	5	15	.4781	-.0788	-.0052	-.0733	.0080	4.01	5	15	.5028	-.0948	-.0047	-.0817	.0098

TABLE II - EXPERIMENTAL RESULTS FOR CONFIGURATIONS HAVING JETTISONABLE FINS - Concluded

(m) Two jettisonable ventral fins.

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
4.01	-1	-9	-.2200	.0595	.0010	.0099	-.0026
4.01	-1	-6	-.1358	.0313	.0015	.0094	-.0026
4.01	-1	-3	-.0589	.0139	.0015	.0091	-.0019
4.01	-1	0	.0179	.0010	.0016	.0101	-.0011
4.01	-1	3	.0986	-.0100	.0018	.0103	-.0002
4.01	-1	6	.1851	-.0326	.0020	.0107	.0010
4.01	-1	9	.2883	-.0776	.0015	.0113	.0015
4.01	-1	12	.3920	-.1052	.0009	.0106	.0022
4.01	-1	15	.5246	-.1527	.0007	.0061	.0022
4.01	0	-9	-.2201	.0654	.0008	-.0029	.0020
4.01	0	-6	-.1367	.0394	.0009	-.0025	.0017
4.01	0	-3	-.0591	.0202	.0005	-.0014	.0018
4.01	0	0	.0202	.0054	.0007	-.0022	.0020
4.01	0	3	.0994	-.0073	.0009	-.0017	.0022
4.01	0	6	.1845	-.0299	.0007	-.0026	.0024
4.01	0	9	.2884	-.0768	.0010	-.0049	.0027
4.01	0	12	.3923	-.1056	.0008	-.0059	.0025
4.01	0	15	.5254	-.1557	.0002	-.0080	.0025
4.01	1	-9	-.2175	.0649	.0005	-.0177	.0052
4.01	1	-6	-.1346	.0365	.0002	-.0179	.0053
4.01	1	-3	-.0569	.0181	-.0004	-.0173	.0043
4.01	1	0	.0227	.0027	.0001	-.0158	.0043
4.01	1	3	.0989	-.0095	.0003	-.0139	.0041
4.01	1	6	.1886	-.0302	.0002	-.0146	.0038
4.01	1	9	.2905	-.0790	.0000	-.0176	.0040
4.01	1	12	.3966	-.1090	-.0006	-.0206	.0038
4.01	1	15	.5296	-.1642	-.0010	-.0239	.0051
4.01	3	-9	-.2177	.0522	-.0005	-.0505	.0096
4.01	3	-6	-.1337	.0273	-.0014	-.0472	.0081
4.01	3	-3	-.0571	.0110	-.0012	-.0438	.0069
4.01	3	0	.0215	-.0011	-.0006	-.0408	.0060
4.01	3	3	.1022	-.0118	-.0010	-.0395	.0049
4.01	3	6	.1909	-.0365	-.0003	-.0413	.0043
4.01	3	9	.2949	-.0843	-.0008	-.0439	.0045
4.01	3	12	.3965	-.1185	-.0015	-.0448	.0049
4.01	3	15	.5279	-.1686	-.0008	-.0500	.0064
4.01	5	-9	-.2183	.0611	-.0032	-.0799	.0170
4.01	5	-6	-.1348	.0395	-.0034	-.0752	.0150
4.01	5	-3	-.0533	.0221	-.0027	-.0711	.0127
4.01	5	0	.0244	.0075	-.0028	-.0680	.0108
4.01	5	3	.1020	-.0070	-.0026	-.0660	.0098
4.01	5	6	.1946	-.0367	-.0023	-.0681	.0095
4.01	5	9	.2922	-.0817	-.0029	-.0711	.0101
4.01	5	12	.3963	-.1171	-.0028	-.0749	.0102
4.01	5	15	.5317	-.1658	-.0021	-.0790	.0088

(n) Three jettisonable ventral fins

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
4.01	-1	-9	-.2181	.0517	.0006	.0105	-.0035
4.01	-1	-6	-.1355	.0265	.0007	.0090	-.0033
4.01	-1	-3	-.0570	.0067	.0008	.0097	-.0027
4.01	-1	0	.0217	-.0093	.0009	.0103	-.0019
4.01	-1	3	.1023	-.0221	.0006	.0109	-.0010
4.01	-1	6	.1903	-.0465	.0008	.0114	.0002
4.01	-1	9	.2937	-.0920	.0008	.0120	.0003
4.01	-1	12	.3969	-.1225	.0005	.0118	.0005
4.01	0	-9	-.2188	.0579	.0004	-.0024	.0004
4.01	0	-6	-.1339	.0309	.0005	-.0019	-.0001
4.01	0	-3	-.0550	.0093	.0006	-.0013	.0003
4.01	0	0	.0239	-.0060	.0004	.0003	.0005
4.01	0	3	.1027	-.0200	.0001	.0004	.0007
4.01	0	6	.1874	-.0436	.0003	-.0005	.0009
4.01	0	9	.2926	-.0921	-.0001	-.0022	.0010
4.01	0	12	.3995	-.1249	-.0007	-.0026	.0006
4.01	1	-9	-.2183	.0568	.0001	-.0168	.0034
4.01	1	-6	-.1337	.0291	-.0005	-.0149	.0032
4.01	1	-3	-.0547	.0078	-.0008	-.0142	.0025
4.01	1	0	.0208	-.0070	-.0011	-.0127	.0027
4.01	1	3	.1020	-.0203	-.0008	-.0126	.0022
4.01	1	6	.1890	-.0439	-.0006	-.0138	.0018
4.01	1	9	.2952	-.0922	-.0010	-.0164	.0020
4.01	1	12	.4003	-.1250	-.0012	-.0190	.0016
4.01	3	-9	-.2175	.0480	-.0020	-.0494	.0089
4.01	3	-6	-.1298	.0212	-.0021	-.0470	.0076
4.01	3	-3	-.0514	.0062	-.0023	-.0439	.0066
4.01	3	0	.0271	-.0065	-.0020	-.0419	.0055
4.01	3	3	.1061	-.0215	-.0018	-.0408	.0045
4.01	3	6	.1985	-.0504	-.0019	-.0433	.0039
4.01	3	9	.3025	-.0982	-.0019	-.0465	.0040
4.01	3	12	.4078	-.1361	-.0019	-.0493	.0043
4.01	5	-9	-.2163	.0562	-.0039	-.0783	.0154
4.01	5	-6	-.1327	.0352	-.0036	-.0740	.0133
4.01	5	-3	-.0531	.0172	-.0034	-.0699	.0114
4.01	5	0	.0264	.0026	-.0031	-.0687	.0099
4.01	5	3	.1076	-.0131	-.0029	-.0685	.0091
4.01	5	6	.1989	-.0434	-.0034	-.0702	.0091
4.01	5	9	.3012	-.0924	-.0032	-.0755	.0096
4.01	5	12	.4044	-.1299	-.0035	-.0800	.0098

(o) Four jettisonable fins in X arrangement

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
4.01	-1	-9	-.2422	.1078	.0012	.0118	-.0036
4.01	-1	-6	-.1544	.0711	.0016	.0120	-.0037
4.01	-1	-3	-.0722	.0434	.0016	.0109	-.0029
4.01	-1	0	.0119	.0183	.0014	.0127	-.0023
4.01	-1	3	.0963	-.0055	.0015	.0128	-.0015
4.01	-1	6	.1881	-.0403	.0017	.0133	-.0003
4.01	-1	9	.2896	-.0846	.0020	.0133	.0004
4.01	-1	12	.3987	-.1214	.0010	.0122	.0010
4.01	-1	15	.5296	-.1666	.0007	.0070	.0017
4.01	0	-9	-.2381	.1141	.0006	-.0021	.0017
4.01	0	-6	-.1527	.0766	.0002	-.0022	.0019
4.01	0	-3	-.0709	.0487	-.0001	-.0019	.0016
4.01	0	0	.0125	.0215	.0004	-.0008	.0016
4.01	0	3	.0975	-.0036	.0005	-.0016	.0019
4.01	0	6	.1883	-.0384	.0007	-.0011	.0022
4.01	0	9	.2885	-.0829	.0006	-.0049	.0022
4.01	0	12	.3958	-.1208	-.0001	-.0070	.0025
4.01	0	15	.5306	-.1684	.0001	-.0105	.0027
4.01	1	-9	-.2396	.1089	.0002	-.0199	.0040
4.01	1	-6	-.1516	.0716	-.0001	-.0203	.0037
4.01	1	-3	-.0712	.0424	.0000	-.0182	.0030
4.01	1	0	.0130	.0157	.0002	-.0161	.0029
4.01	1	3	.0956	-.0092	.0007	-.0156	.0028
4.01	1	6	.1896	-.0418	.0006	-.0161	.0021
4.01	1	9	.2929	-.0897	.0005	-.0194	.0027
4.01	1	12	.4024	-.1282	-.0001	-.0229	.0031
4.01	1	15	.5292	-.1708	-.0005	-.0255	.0042
4.01	3	-9	-.2389	.1130	-.0012	-.0526	.0147
4.01	3	-6	-.1538	.0770	-.0019	-.0493	.0123
4.01	3	-3	-.0709	.0501	-.0013	-.0462	.0106
4.01	3	0	.0139	.0262	-.0018	-.0439	.0092
4.01	3	3	.0968	-.0004	-.0012	-.0452	.0082
4.01	3	6	.1914	-.0392	-.0014	-.0475	.0080
4.01	3	9	.2955	-.0864	-.0018	-.0502	.0076
4.01	3	12	.3972	-.1272	-.0027	-.0542	.0091
4.01	3	15	.5290	-.1670	-.0021	-.0552	.0093
4.01	5	-9	-.2358	.1055	-.0037	-.0905	.0190
4.01	5	-6	-.1501	.0728	-.0035	-.0871	.0171
4.01	5	-3	-.0675	.0464	-.0036	-.0802	.0141
4.01	5	0	.0188	.0203	-.0036	-.0748	.0124
4.01	5	3	.1057	-.0064	-.0034	-.0719	.0113
4.01	5	6	.1786	-.0437	-.0036	-.0748	.0120
4.01	5	9	.3020	-.0945	-.0030	-.0762	.0122
4.01	5	12	.4144	-.1330	-.0038	-.0830	.0136
4.01	5	15	.5334	-.1622	-.0036	-.0876	.0133

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TABLE III - EXPERIMENTAL RESULTS FOR CONFIGURATIONS HAVING STRAKES

(a) One starboard strake

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
2.37	-1	-9	-.3551	.1078	.0016	.0217	-.0024
2.37	-1	-6	-.2189	.0796	.0022	.0196	-.0012
2.37	-1	-3	-.0996	.0560	.0026	.0168	-.0002
2.37	-1	0	.0351	.0233	.0029	.0132	.0004
2.37	-1	3	.1596	-.0106	.0026	.0106	.0007
2.37	-1	6	.2931	-.0400	.0033	.0070	.0009
2.37	-1	9	.4268	-.0643	.0034	.0024	.0007
2.37	-1	12	.5496	-.0928	.0037	-.0030	-.0003
2.37	0	-9	-.3489	.1090	.0006	.0025	.0025
2.37	0	-6	-.2169	.0836	.0005	.0019	.0029
2.37	0	-3	-.0961	.0614	.0002	.0006	.0027
2.37	0	0	.0367	.0257	.0000	-.0016	.0027
2.37	0	3	.1637	-.0061	-.0002	-.0037	.0023
2.37	0	6	.2942	-.0351	-.0007	-.0076	.0023
2.37	0	9	.4273	-.0630	-.0010	-.0121	.0018
2.37	0	12	.5705	-.0911	-.0011	-.0160	.0005
2.37	1	-9	-.3543	.1122	-.0009	-.0156	.0056
2.37	1	-6	-.2200	.0842	-.0006	-.0149	.0053
2.37	1	-3	-.0971	.0602	-.0012	-.0150	.0047
2.37	1	0	.0384	.0230	-.0013	-.0158	.0042
2.37	1	3	.1667	-.0097	-.0019	-.0174	.0038
2.37	1	6	.2956	-.0403	-.0025	-.0227	.0037
2.37	1	9	.4283	-.0657	-.0033	-.0273	.0036
2.37	1	12	.5777	-.0955	-.0037	-.0319	.0020
2.37	3	-9	-.3577	.1047	-.0046	-.0510	.0101
2.37	3	-6	-.2255	.0810	-.0051	-.0481	.0100
2.37	3	-3	-.1028	.0558	-.0047	-.0457	.0064
2.37	3	0	.0316	.0187	-.0052	-.0440	.0050
2.37	3	3	.1643	-.0118	-.0056	-.0443	.0044
2.37	3	6	.2970	-.0426	-.0064	-.0496	.0041
2.37	3	9	.4312	-.0704	-.0072	-.0542	.0036
2.37	3	12	.6025	-.1063	-.0087	-.0605	.0017
2.37	5	-9	-.3636	.1154	-.0084	-.0924	.0188
2.37	5	-6	-.2260	.0891	-.0086	-.0847	.0153
2.37	5	-3	-.0976	.0618	-.0086	-.0796	.0121
2.37	5	0	.0346	.0264	-.0090	-.0759	.0094
2.37	5	3	.1624	-.0058	-.0091	-.0763	.0081
2.37	5	6	.3020	-.0388	-.0102	-.0804	.0070
2.37	5	9	.4337	-.0686	-.0110	-.0847	.0058
2.37	5	12	.6383	-.1080	-.0130	-.0931	.0041

(b) One port strake

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
2.37	-1	-9	-.3531	.1004	.0001	.0256	-.0027
2.37	-1	-6	-.2186	.0764	.0007	.0208	-.0023
2.37	-1	-3	-.0969	.0533	.0012	.0166	-.0017
2.37	-1	0	.0355	.0190	.0014	.0136	-.0009
2.37	-1	3	.1627	-.0108	.0011	.0096	-.0006
2.37	-1	6	.2953	-.0392	.0019	.0075	-.0003
2.37	-1	9	.4209	-.0637	.0017	.0045	.0002
2.37	-1	12	.5723	-.0921	.0020	-.0001	.0020
2.37	0	-9	-.3484	.1031	-.0020	.0070	.0015
2.37	0	-6	-.2134	.0786	-.0021	.0030	.0011
2.37	0	-3	-.0952	.0568	-.0013	.0007	.0009
2.37	0	0	.0353	.0207	-.0012	-.0023	.0008
2.37	0	3	.1630	-.0082	-.0006	-.0058	.0008
2.37	0	6	.2959	-.0380	-.0006	-.0083	.0010
2.37	0	9	.4220	-.0632	-.0008	-.0099	.0013
2.37	0	12	.5766	-.0921	.0000	-.0136	.0026
2.37	1	-9	-.3543	.1052	-.0032	-.0104	.0051
2.37	1	-6	-.2186	.0792	-.0032	-.0135	.0036
2.37	1	-3	-.0960	.0549	-.0031	-.0150	.0032
2.37	1	0	.0351	.0192	-.0034	-.0175	.0026
2.37	1	3	.1651	-.0107	-.0031	-.0196	.0023
2.37	1	6	.2927	-.0387	-.0034	-.0225	.0026
2.37	1	9	.4328	-.0682	-.0025	-.0266	.0028
2.37	1	12	.5802	-.0973	-.0032	-.0299	.0041
2.37	3	-9	-.3526	.1062	-.0052	-.0458	.0102
2.37	3	-6	-.2170	.0795	-.0051	-.0438	.0072
2.37	3	-3	-.0961	.0558	-.0045	-.0435	.0057
2.37	3	0	.0387	.0192	-.0046	-.0439	.0045
2.37	3	3	.1671	-.0099	-.0039	-.0447	.0039
2.37	3	6	.2993	-.0406	-.0040	-.0483	.0041
2.37	3	9	.4332	-.0685	-.0051	-.0515	.0042
2.37	3	12	.6013	-.0999	-.0056	-.0541	.0044
2.37	5	-9	-.3645	.1150	-.0091	-.0834	.0185
2.37	5	-6	-.2256	.0881	-.0093	-.0799	.0146
2.37	5	-3	-.0948	.0593	-.0089	-.0774	.0115
2.37	5	0	.0362	.0242	-.0089	-.0753	.0090
2.37	5	3	.1687	-.0059	-.0081	-.0742	.0073
2.37	5	6	.3051	-.0386	-.0088	-.0786	.0066
2.37	5	9	.4394	-.0679	-.0083	-.0809	.0059
2.37	5	12	.6211	-.0968	-.0096	-.0832	.0057

(c) Both strakes

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
2.37	-1	-9	-.3648	.0816	.0016	.0255	-.0030
2.37	-1	-6	-.2221	.0671	.0017	.0216	-.0022
2.37	-1	-3	-.0994	.0472	.0011	.0174	-.0015
2.37	-1	0	.0351	.0176	.0013	.0138	-.0007
2.37	-1	3	.1630	-.0057	.0012	.0104	-.0003
2.37	-1	6	.2987	-.0283	.0016	.0064	.0002
2.37	-1	9	.4326	-.0452	.0013	.0030	.0003
2.37	-1	12	.5840	-.0610	.0015	-.0028	.0001
2.37	0	-9	-.3567	.0853	-.0008	.0084	.0019
2.37	0	-6	-.2227	.0692	-.0009	.0060	.0016
2.37	0	-3	-.0978	.0526	-.0010	.0031	.0015
2.37	0	0	.0368	.0212	-.0011	-.0009	.0013
2.37	0	3	.1657	-.0024	-.0009	-.0035	.0015
2.37	0	6	.2966	-.0258	-.0013	-.0072	.0013
2.37	0	9	.4322	-.0432	-.0007	-.0113	.0012
2.37	0	12	.5856	-.0602	-.0009	-.0162	.0011
2.37	1	-9	-.3624	.0857	-.0024	-.0087	.0050
2.37	1	-6	-.2272	.0697	-.0027	-.0108	.0045
2.37	1	-3	-.1005	.0519	-.0025	-.0129	.0041
2.37	1	0	.0367	.0198	-.0030	-.0146	.0038
2.37	1	3	.1668	-.0053	-.0031	-.0187	.0034
2.37	1	6	.3012	-.0283	-.0035	-.0226	.0036
2.37	1	9	.4352	-.0466	-.0038	-.0272	.0036
2.37	1	12	.5913	-.0653	-.0044	-.0322	.0035
2.37	3	-9	-.3614	.0838	-.0048	-.0478	.0105
2.37	3	-6	-.2226	.0668	-.0050	-.0448	.0082
2.37	3	-3	-.1006	.0483	-.0051	-.0439	.0062
2.37	3	0	.0335	.0174	-.0051	-.0441	.0047
2.37	3	3	.1664	-.0075	-.0048	-.0464	.0043
2.37	3	6	.2994	-.0296	-.0055	-.0492	.0041
2.37	3	9	.4323	-.0496	-.0066	-.0526	.0041
2.37	3	12	.6045	-.0702	-.0073	-.0573	.0036
2.37	5	-9	-.3607	.0950	-.0085	-.0839	.0187
2.37	5	-6	-.2236	.0763	-.0083	-.0809	.0149
2.37	5	-3	-.0952	.0528	-.0086	-.0776	.0118
2.37	5	0	.0365	.0232	-.0090	-.0759	.0094
2.37	5	3	.1644	-.0028	-.0086	-.0750	.0077
2.37	5	6	.3034	-.0275	-.0093	-.0788	.0070
2.37	5	9	.4352	-.0502	-.0104	-.0812	.0063
2.37	5	12	.6404	-.0726	-.0119	-.0875	.0058

TABLE III - EXPERIMENTAL RESULTS FOR CONFIGURATIONS HAVING STRAKES - Continued

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n	M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
(d) One starboard strake								(e) One port strake							
2.98	-1	-9	-.2824	.0559	.0027	.0207	-.0033	2.98	-1	-9	-.2812	.0571	.0005	.0229	-.0023
2.98	-1	-6	-.1756	.0380	.0027	.0190	-.0018	2.98	-1	-6	-.1731	.0398	.0015	.0190	-.0020
2.98	-1	-3	-.0811	.0313	.0022	.0151	-.0010	2.98	-1	-3	-.0781	.0333	.0019	.0151	-.0014
2.98	-1	0	.0182	.0276	.0023	.0124	.0001	2.98	-1	0	.0192	.0282	.0024	.0130	-.0006
2.98	-1	3	.1119	.0106	.0018	.0118	.0009	2.98	-1	3	.1117	.0132	.0027	.0098	-.0002
2.98	-1	6	.2219	-.0149	.0020	.0067	.0012	2.98	-1	6	.2197	-.0109	.0033	.0078	.0004
2.98	-1	9	.3316	-.0342	.0010	.0017	.0012	2.98	-1	9	.3304	-.0303	.0031	.0052	.0011
2.98	-1	12	.4473	-.0537	.0010	-.0025	.0007	2.98	-1	12	.4457	-.0502	.0027	.0287	.0031
2.98	-1	15	.5901	-.0807	.0020	-.0073	-.0008	2.98	-1	15	.5838	-.0794	.0028	-.0004	.0045
2.98	0	-9	-.2846	.0606	-.0010	.0070	.0014	2.98	0	-9	-.2811	.0613	-.0014	.0070	.0019
2.98	0	-6	-.1721	.0433	-.0004	.0061	.0018	2.98	0	-6	-.1707	.0438	-.0012	.0036	.0016
2.98	0	-3	-.0792	.0373	-.3334	.0038	.0018	2.98	0	-3	-.0811	.0378	-.0012	.0019	.0014
2.98	0	0	.0189	.0328	-.0003	.0012	.0019	2.98	0	0	.0177	.0326	-.0007	-.0002	.0010
2.98	0	3	.1122	.0169	.0001	-.0010	.0021	2.98	0	3	.1117	.0174	-.0003	-.0018	.0011
2.98	0	6	.2271	-.0114	-.0001	-.0052	.0023	2.98	0	6	.2202	-.0075	.0007	-.0038	.0013
2.98	0	9	.3318	-.0303	.0001	-.0101	.0020	2.98	0	9	.3281	-.0283	.0009	-.0058	.0017
2.98	0	12	.4486	-.0511	-.0003	-.0137	.0008	2.98	0	12	.4412	-.0471	.0012	-.0095	.0031
2.98	0	15	.5908	-.0822	.0003	-.0180	-.0008	2.98	0	15	.5823	-.0782	.0015	-.0126	.0047
2.98	1	-9	-.2822	.0611	-.0012	-.0066	.0037	2.98	1	-9	-.2814	.0616	-.0025	-.0096	.0043
2.98	1	-6	-.1732	.0437	-.0018	-.0074	.0038	2.98	1	-6	-.1695	.0435	-.0022	-.0110	.0035
2.98	1	-3	-.0811	.0377	-.0023	-.0091	.0034	2.98	1	-3	-.0787	.0368	-.0018	-.0123	.0030
2.98	1	0	.0176	.0312	-.0026	-.0102	.0033	2.98	1	0	.0183	.0316	-.0017	-.0142	.0024
2.98	1	3	.1148	.0145	-.0021	-.0109	.0032	2.98	1	3	.1149	.0164	-.0012	-.0155	.0023
2.98	1	6	.2241	-.0114	-.0024	-.0153	.0029	2.98	1	6	.2197	-.0115	-.0011	-.0167	.0022
2.98	1	9	.3363	-.0325	-.0022	-.0201	.0029	2.98	1	9	.3304	-.0322	-.0009	-.0178	.0026
2.98	1	12	.4537	-.0527	-.0021	-.0259	.0022	2.98	1	12	.4451	-.0520	-.0010	-.0220	.0042
2.98	1	15	.6004	-.0827	-.0015	-.0315	.0008	2.98	1	15	.5922	-.0814	-.0015	-.0258	.0059
2.98	3	-9	-.2870	.0536	-.0034	-.0372	.0079	2.98	3	-9	-.2838	.0594	-.0051	-.0442	.0096
2.98	3	-6	-.1746	.0365	-.0035	-.0363	.0067	2.98	3	-6	-.1737	.0404	-.0043	-.0421	.0075
2.98	3	-3	-.0801	.0305	-.0038	-.0345	.0053	2.98	3	-3	-.0811	.0331	-.0034	-.0420	.0059
2.98	3	0	.0168	.0245	-.0040	-.0323	.0041	2.98	3	0	.0173	.0270	-.0036	-.0409	.0045
2.98	3	3	.1168	.0078	-.0039	-.0332	.0029	2.98	3	3	.1151	.0097	-.0031	-.0395	.0031
2.98	3	6	.2241	-.0161	-.0042	-.0364	.0024	2.98	3	6	.2233	-.0152	-.0024	-.0403	.0026
2.98	3	9	.3402	-.0390	-.0038	-.0405	.0018	2.98	3	9	.3362	-.0354	-.0021	-.0415	.0024
2.98	3	12	.4592	-.0592	-.0041	-.0463	.0009	2.98	3	12	.4498	-.0558	-.0022	-.0439	.0033
2.98	3	15	.6195	-.0929	-.0046	-.0523	-.0009	2.98	3	15	.6040	-.0847	-.0029	-.0490	.0051
2.98	5	-9	-.2897	.0613	-.0060	-.0662	.0151	2.98	5	-9	-.2913	.0672	-.0078	-.0784	.0152
2.98	5	-6	-.1789	.0459	-.0056	-.0628	.0124	2.98	5	-6	-.1759	.0492	-.0073	-.0767	.0121
2.98	5	-3	-.0831	.0395	-.0063	-.0626	.0100	2.98	5	-3	-.0778	.0399	-.0066	-.0735	.0095
2.98	5	0	.0202	.0302	-.0064	-.0585	.0075	2.98	5	0	.0194	.0313	-.0064	-.0711	.0072
2.98	5	3	.1198	.0119	-.0067	-.0565	.0057	2.98	5	3	.1192	.0131	-.0062	-.0678	.0051
2.98	5	6	.2316	-.0117	-.0063	-.0591	.0038	2.98	5	6	.2295	-.0095	-.0050	-.0691	.0039
2.98	5	9	.3451	-.0329	-.0060	-.0642	.0028	2.98	5	9	.3352	-.0298	-.0048	-.0692	.0033
2.98	5	12	.4593	-.0522	-.0064	-.0711	.0021	2.98	5	12	.4581	-.0522	-.0043	-.0723	.0037
2.98	5	15	.6594	-.0975	-.0074	-.0795	.0003	2.98	5	15	.6408	-.0906	-.0057	-.0763	.0051

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
(f) Both strakes							
2.98	-1	-9	-.2902	.0379	.0010	.0197	-.0028
2.98	-1	-6	-.1776	.0269	.0008	.0179	-.0019
2.98	-1	-3	-.0844	.0277	.0009	.0157	-.0013
2.98	-1	0	.0180	.0273	.0011	.0120	-.0006
2.98	-1	3	.1117	.0178	.0015	.0093	.0000
2.98	-1	6	.2197	-.0022	.0013	.0060	.0007
2.98	-1	9	.3348	-.0146	.0009	.0028	.0013
2.98	-1	12	.4507	-.0255	.0014	-.0010	.0017
2.98	-1	15	.5970	-.0471	.0020	-.0052	.0016
2.98	0	-9	-.2853	.0425	-.0013	.0069	.0016
2.98	0	-6	-.1769	.0320	-.0006	.0046	.0016
2.98	0	-3	-.0799	.0313	-.0005	.0033	.0014
2.98	0	0	.0176	.0324	-.0007	.0008	.0015
2.98	0	3	.1125	.0220	-.0002	-.0019	.0016
2.98	0	6	.2232	.0020	-.0004	-.0042	.0016
2.98	0	9	.3332	-.0105	.0000	-.0072	.0019
2.98	0	12	.4501	-.0222	-.0003	-.0104	.0018
2.98	0	15	.5987	-.0485	.0003	-.0154	.0020
2.98	1	-9	-.2848	.0416	-.0023	-.0075	.0037
2.98	1	-6	-.1737	.0303	-.0015	-.0089	.0030
2.98	1	-3	-.0778	.0297	-.0018	-.0096	.0026
2.98	1	0	.0202	.0306	-.0020	-.0110	.0022
2.98	1	3	.1135	.0201	-.0020	-.0126	.0020
2.98	1	6	.2245	-.0006	-.0021	-.0155	.0020
2.98	1	9	.3373	-.0138	-.0022	-.0179	.0021
2.98	1	12	.4520	-.0255	-.0025	-.0221	.0023
2.98	1	15	.6019	-.0505	-.0028	-.0267	.0030
2.98	3	-9	-.2954	.0372	-.0041	-.0363	.0079
2.98	3	-6	-.1800	.0289	-.0032	-.0355	.0060
2.98	3	-3	-.0837	.0282	-.0030	-.0352	.0048
2.98	3	0	.0154	.0275	-.0027	-.0351	.0036
2.98	3	3	.1178	.0156	-.0033	-.0341	.0024
2.98	3	6	.2247	-.0012	-.0030	-.0353	.0018
2.98	3	9	.3411	-.0158	-.0033	-.0376	.0012
2.98	3	12	.4567	-.0274	-.0042	-.0414	.0019
2.98	3	15	.6230	-.0509	-.0045	-.0469	.0023
2.98	5	-9	-.2951	.0441	-.0079	-.0654	.0143
2.98	5	-6	-.1814	.0346	-.0074	-.0649	.0119
2.98	5	-3	-.0819	.0328	-.0075	-.0632	.0093
2.98	5	0	.0188	.0297	-.0080	-.0610	.0068
2.98	5	3	.1209	.0157	-.0077	-.0591	.0050
2.98	5	6	.2328	.0013	-.0068	-.0595	.0034
2.98	5	9	.3409	-.0115	-.0069	-.0612	.0030
2.98	5	12	.4665	-.0237	-.0066	-.0658	.0032
2.98	5	15	.6547	-.0556	-.0090	-.0686	.0022

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TABLE III - EXPERIMENTAL RESULTS FOR CONFIGURATIONS HAVING STRAKES - Concluded

(g) One starboard strake

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
4.01	-1	-9	-.2261	.0262	.0015	.0117	-.0018
4.01	-1	-6	-.1366	.0116	.0015	.0127	-.0014
4.01	-1	-3	-.0618	.0110	.0010	.0120	-.0011
4.01	-1	0	.0167	.0149	.0005	.0129	.0000
4.01	-1	3	.0951	.0226	.0009	.0113	.0008
4.01	-1	6	.1847	.0151	.0005	.0072	.0022
4.01	-1	9	.2821	-.0070	.0010	.0035	.0022
4.01	-1	12	.3808	-.0142	.0002	-.0009	.0019
4.01	-1	15	.5029	-.0359	.0002	-.0067	.0007
4.01	0	-9	-.2276	.0297	.0009	.0008	.0013
4.01	0	-6	-.1340	.0150	-.0001	.0008	.0012
4.01	0	-3	-.0607	.0144	.0001	.0019	.0014
4.01	0	0	.0180	.0182	.0004	.0009	.0017
4.01	0	3	.0948	.0252	.0000	-.0005	.0020
4.01	0	6	.1847	.0183	-.0010	-.0044	.0022
4.01	0	9	.2822	-.0034	-.0001	-.0099	.0014
4.01	0	12	.3812	-.0108	.0011	-.0140	-.0002
4.01	0	15	.5063	-.0349	-.0004	-.0189	-.0012
4.01	1	-9	-.2250	.0295	.0000	-.0122	.0036
4.01	1	-6	-.1367	.0140	-.0004	-.0112	.0032
4.01	1	-3	-.0595	.0141	-.0012	-.0115	.0028
4.01	1	0	.0176	.0166	-.0005	-.0125	.0025
4.01	1	3	.0968	.0223	-.0024	-.0123	.0021
4.01	1	6	.1835	.0165	-.0027	-.0165	.0019
4.01	1	9	.2838	-.0084	-.0025	-.0206	.0011
4.01	1	12	.3838	-.0166	-.0024	-.0246	-.0012
4.01	1	15	.5117	-.0445	-.0024	-.0316	-.0019
4.01	3	-9	-.2278	.0218	-.0015	-.0386	.0062
4.01	3	-6	-.1383	.0101	-.0015	-.0376	.0055
4.01	3	-3	-.0635	.0106	-.0019	-.0354	.0040
4.01	3	0	.0165	.0154	.0047	-.0355	.0028
4.01	3	3	.0951	.0221	.0029	-.0329	.0017
4.01	3	6	.1871	.0108	.0020	-.0363	.0009
4.01	3	9	.2829	-.0158	.0009	-.0405	.0003
4.01	3	12	.3860	-.0261	-.0002	-.0439	-.0003
4.01	3	15	.5298	-.0442	-.0010	-.0516	-.0001
4.01	5	-9	-.2321	.0268	.0026	-.0689	.0129
4.01	5	-6	-.1413	.0177	.0036	-.0660	.0105
4.01	5	-3	-.0618	.0179	.0036	-.0616	.0087
4.01	5	0	.0175	.0212	.0041	-.0595	.0068
4.01	5	3	.0984	.0249	.0027	-.0583	.0053
4.01	5	6	.1907	.0116	.0040	-.0606	.0045
4.01	5	9	.2854	-.0095	.0045	-.0655	.0044
4.01	5	12	.3902	-.0183	.0043	-.0696	.0023
4.01	5	15	.5491	-.0492	.0042	-.0787	-.0006

(h) One port strake

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
4.01	-1	-9	-.2262	.0212	-.0008	.0170	-.0017
4.01	-1	-6	-.1392	.0084	-.0001	.0143	-.0017
4.01	-1	-3	-.0636	.0073	-.0002	.0121	-.0016
4.01	-1	0	.0147	.0130	.0001	.0101	-.0005
4.01	-1	3	.0931	.0194	.0008	.0081	.0003
4.01	-1	6	.1828	.0150	.0009	.0087	.0014
4.01	-1	9	.2802	-.0069	.0010	.0063	.0027
4.01	-1	12	.3788	-.0128	.0009	.0038	.0042
4.01	-1	15	.5116	-.0328	.0002	.0004	.0047
4.01	0	-9	-.2238	.0254	-.0017	.0056	.0008
4.01	0	-6	-.1340	.0118	-.0017	.0024	.0004
4.01	0	-3	-.0607	.0112	-.0014	.0002	.0003
4.01	0	0	.0180	.0144	-.0011	-.0008	.0008
4.01	0	3	.0911	.0220	-.0008	-.0030	.0007
4.01	0	6	.1810	.0181	.0001	-.0032	.0007
4.01	0	9	.2805	-.0034	-.0001	-.0060	.0015
4.01	0	12	.3796	-.0111	-.0002	-.0088	.0025
4.01	0	15	.5095	-.0354	-.0006	-.0109	.0033
4.01	1	-9	-.2249	.0258	-.0019	-.0087	.0035
4.01	1	-6	-.1368	.0115	-.0023	-.0105	.0025
4.01	1	-3	-.0615	.0097	-.0024	-.0128	.0021
4.01	1	0	.0177	.0122	-.0024	-.0142	.0016
4.01	1	3	.0934	.0179	-.0024	-.0145	.0010
4.01	1	6	.1827	.0108	-.0019	-.0155	.0005
4.01	1	9	.2821	-.0116	-.0022	-.0183	.0010
4.01	1	12	.3818	-.0208	-.0023	-.0205	.0015
4.01	1	15	.5161	-.0424	-.0020	-.0220	.0035
4.01	3	-9	-.2297	.0220	-.0035	-.0379	.0072
4.01	3	-6	-.1401	.0076	-.0038	-.0373	.0052
4.01	3	-3	-.0618	.0081	-.0034	-.0382	.0035
4.01	3	0	.0166	.0129	-.0037	-.0385	.0020
4.01	3	3	.0933	.0164	-.0028	-.0369	.0005
4.01	3	6	.1834	.0069	-.0031	-.0383	-.0001
4.01	3	9	.2774	-.0171	-.0034	-.0385	.0003
4.01	3	12	.3841	-.0302	-.0034	-.0411	.0013
4.01	3	15	.5257	-.0509	-.0029	-.0448	.0035
4.01	5	-9	-.2307	.0319	-.0050	-.0681	.0110
4.01	5	-6	-.1424	.0192	-.0048	-.0665	.0081
4.01	5	-3	-.0614	.0163	-.0051	-.0649	.0058
4.01	5	0	.0158	.0183	-.0046	-.0624	.0041
4.01	5	3	.0965	.0219	-.0041	-.0614	.0027
4.01	5	6	.1869	.0075	-.0048	-.0615	.0026
4.01	5	9	.2832	-.0116	-.0047	-.0646	.0028
4.01	5	12	.3868	-.0237	-.0047	-.0650	.0028
4.01	5	15	.5539	-.0586	-.0044	-.0701	.0028

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(i) Both strakes

M	β, deg	α, deg	C_N	C_m	C_l	C_Y	C_n
4.01	-1	-9	-.2364	.0059	.0008	.0146	-.0020
4.01	-1	-6	-.1417	-.0014	.0006	.0124	-.0021
4.01	-1	-3	-.0634	.0036	.0013	.0119	-.0017
4.01	-1	0	.0147	.0123	.0009	.0096	-.0006
4.01	-1	3	.0948	.0256	.0013	.0090	.0002
4.01	-1	6	.1879	.0243	.0007	.0068	.0014
4.01	-1	9	.2852	.0115	.0017	.0036	.0020
4.01	-1	12	.3877	.0112	.0017	-.0001	.0027
4.01	-1	15	.5208	-.0083	.0015	-.0045	.0021
4.01	0	-9	-.2315	.0105	.0004	.0031	.0006
4.01	0	-6	-.1414	.0025	.0004	.0013	.0004
4.01	0	-3	-.0644	.0056	.0007	.0005	.0004
4.01	0	0	.0162	.0139	.0004	-.0009	.0009
4.01	0	3	.0949	.0264	.0001	-.0027	.0009
4.01	0	6	.1867	.0250	.0006	-.0053	.0012
4.01	0	9	.2860	.0139	.0009	-.0083	.0011
4.01	0	12	.3903	.0141	.0007	-.0118	.0009
4.01	0	15	.5205	-.0079	.0004	-.0167	.0007
4.01	1	-9	-.2344	.0102	-.0003	-.0093	.0031
4.01	1	-6	-.1443	.0009	-.0002	-.0111	.0027
4.01	1	-3	-.0651	.0028	-.0006	-.0120	.0022
4.01	1	0	.0196	.0129	-.0004	-.0130	.0016
4.01	1	3	.0973	.0230	-.0008	-.0138	.0012
4.01	1	6	.1866	.0233	-.0010	-.0156	.0007
4.01	1	9	.2860	.0065	-.0012	-.0201	.0006
4.01	1	12	.3959	.0049	-.0010	-.0238	.0002
4.01	1	15	.5289	-.0163	-.0018	-.0279	.0009
4.01	3	-9	-.2325	.0035	-.0030	-.0384	.0066
4.01	3	-6	-.1400	-.0023	-.0027	-.0380	.0049
4.01	3	-3	-.0617	.0032	-.0027	-.0374	.0035
4.01	3	0	.0184	.0123	-.0029	-.0391	.0019
4.01	3	3	.1005	.0196	-.0027	-.0375	.0005
4.01	3	6	.1959	.0157	-.0028	-.0382	.0001
4.01	3	9	.2898	.0003	-.0038	-.0414	.0000
4.01	3	12	.3945	-.0043	-.0030	-.0437	.0004
4.01	3	15	.5435	-.0220	-.0041	-.0504	.0017
4.01	5	-9	-.2359	.0095	-.0045	-.0659	.0106
4.01	5	-6	-.1439	.0049	-.0042	-.0643	.0082
4.01	5	-3	-.0595	.0108	-.0040	-.0639	.0063
4.01	5	0	.0176	.0178	-.0043	-.0635	.0047
4.01	5	3	.1003	.0246	-.0045	-.0602	.0035
4.01	5	6	.1974	.0163	-.0057	-.0611	.0030
4.01	5	9	.2977	.0042	-.0055	-.0644	.0034
4.01	5	12	.4078	.0007	-.0052	-.0666	.0027
4.01	5	15	.5777	-.0266	-.0058	-.0719	.0006

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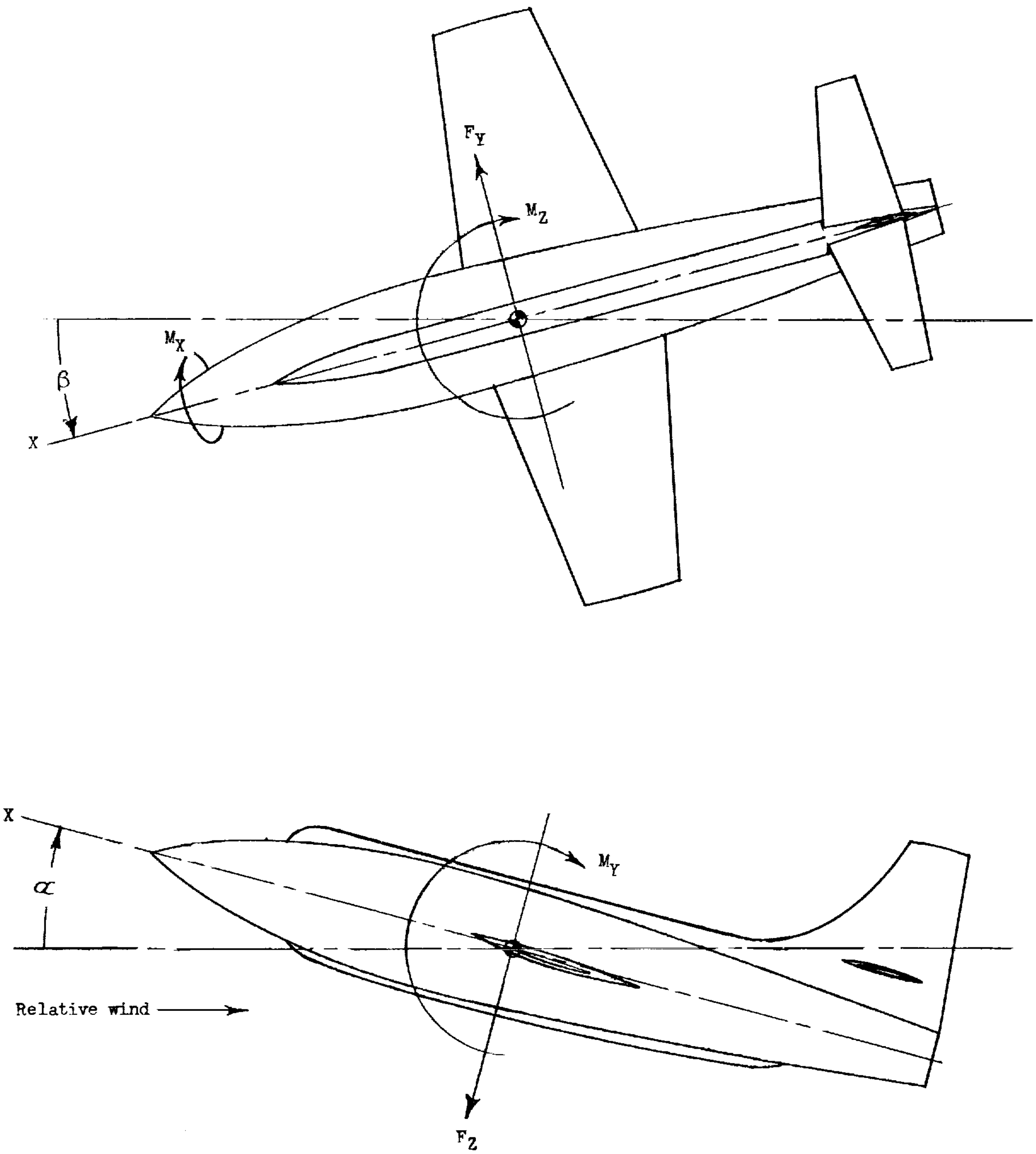


Figure 1.- System of body axes with arrows indicating positive direction of angles, forces, and moments.

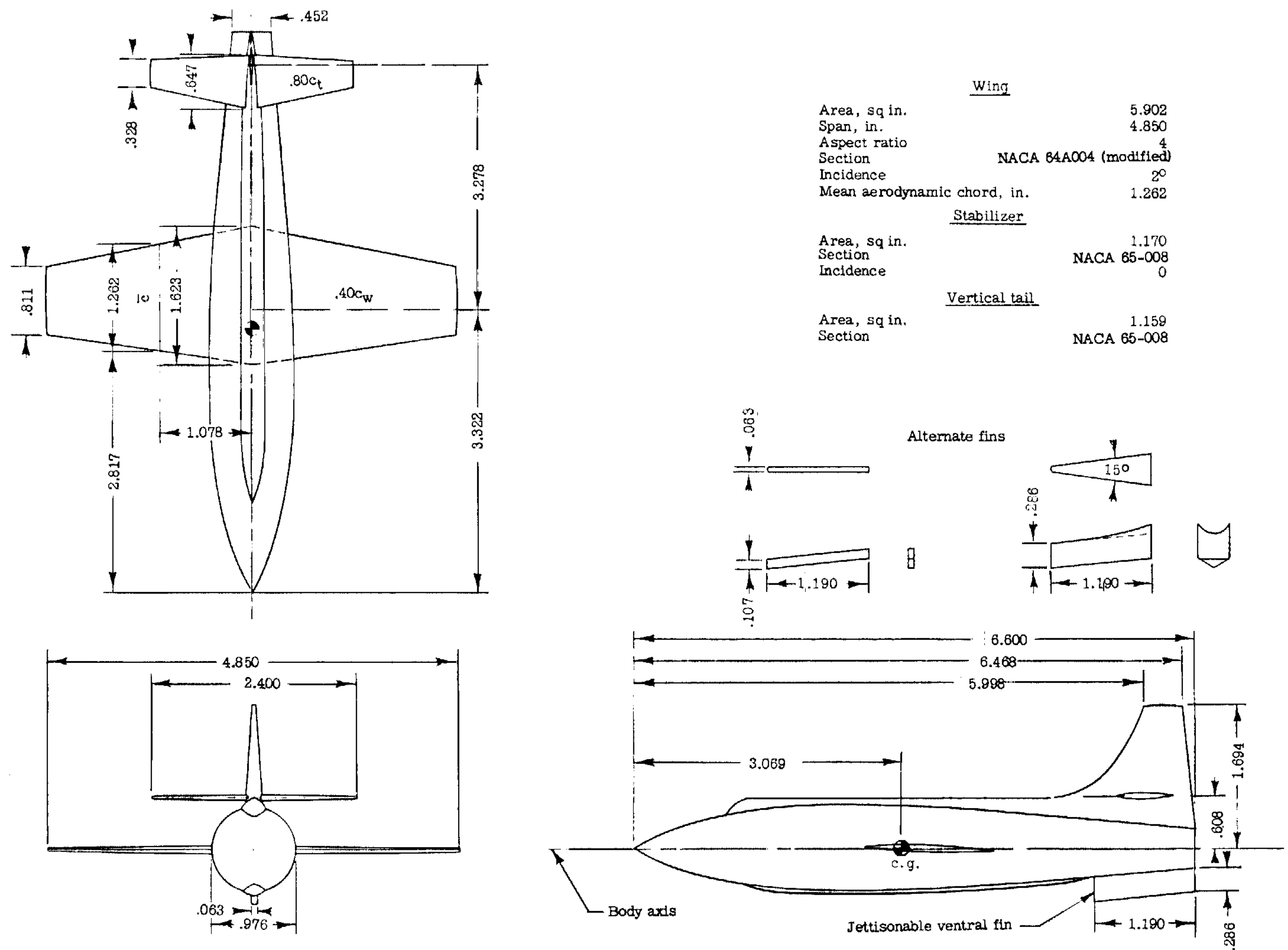
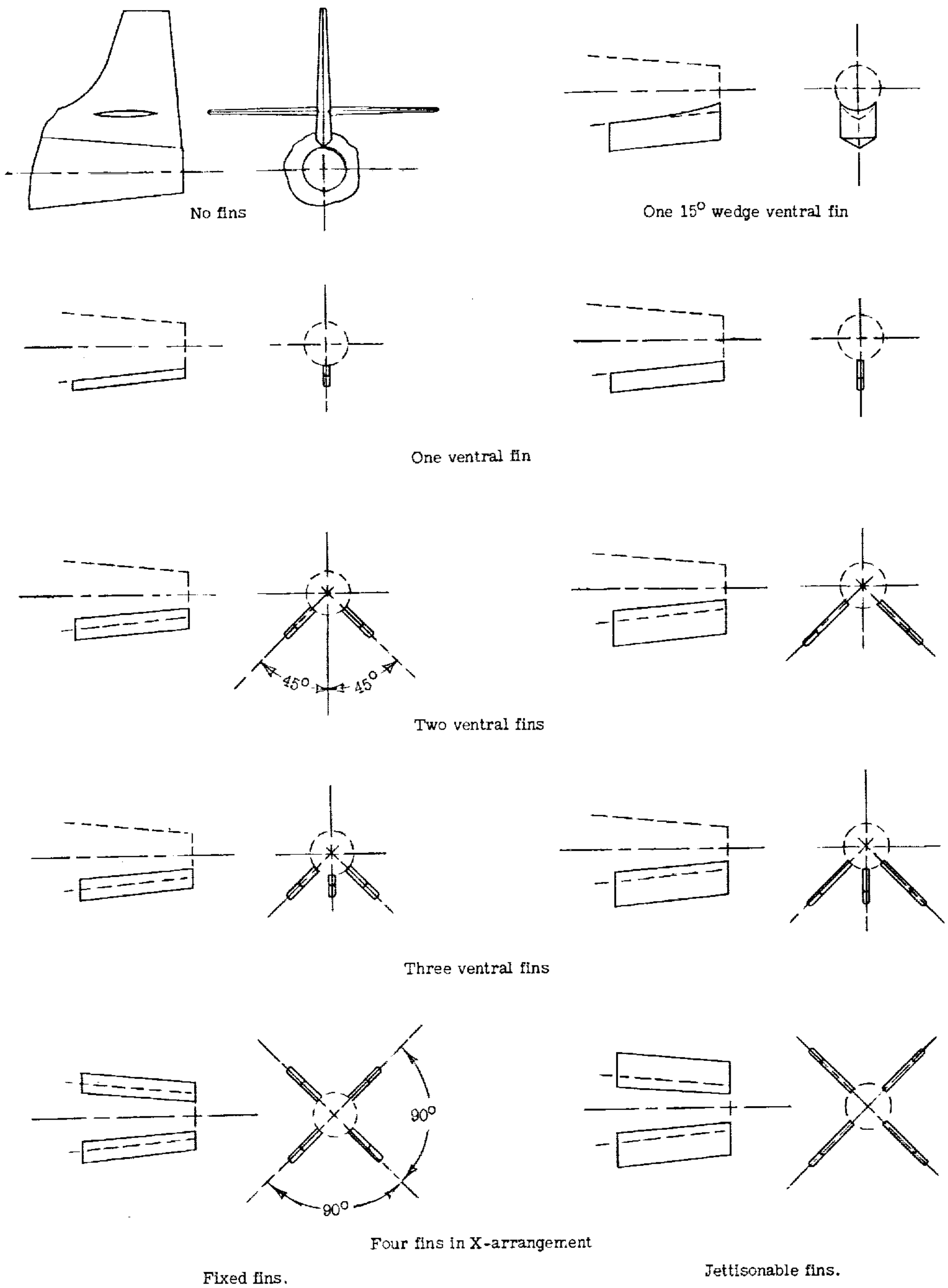


Figure 2.- Three-view drawing of 1/56-scale model of the X-1E airplane showing a jettisonable ventral fin. All dimensions are in inches.



(a) Various fin arrangements.

Figure 3.- Various directional-stability-improvement devices used in tests of the X-1E airplane.

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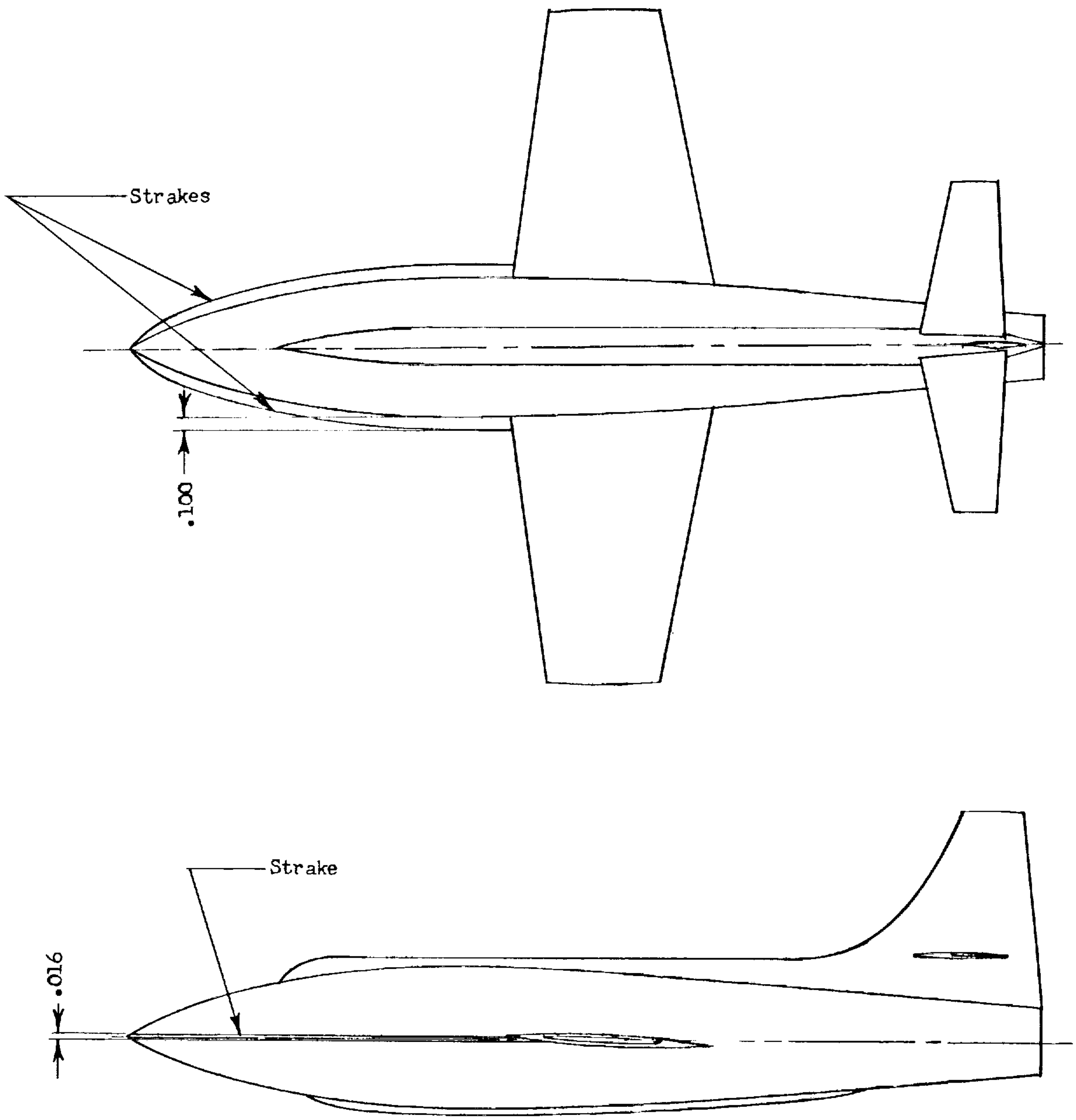

(b) Strakes.

Figure 3.- Concluded.

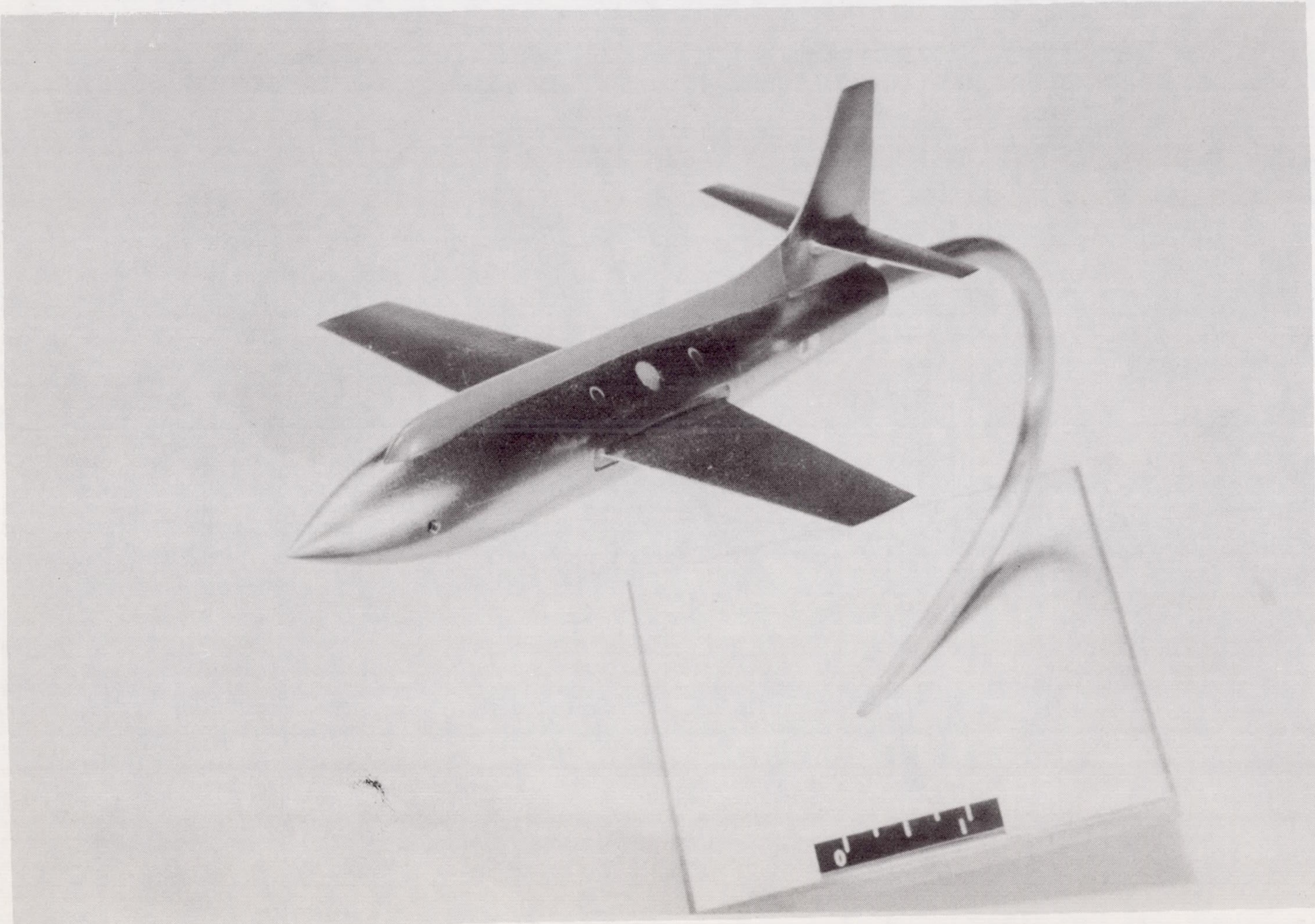

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Figure 4.- Photograph of 1/56-scale model of the X-1E airplane used in present wind-tunnel tests.

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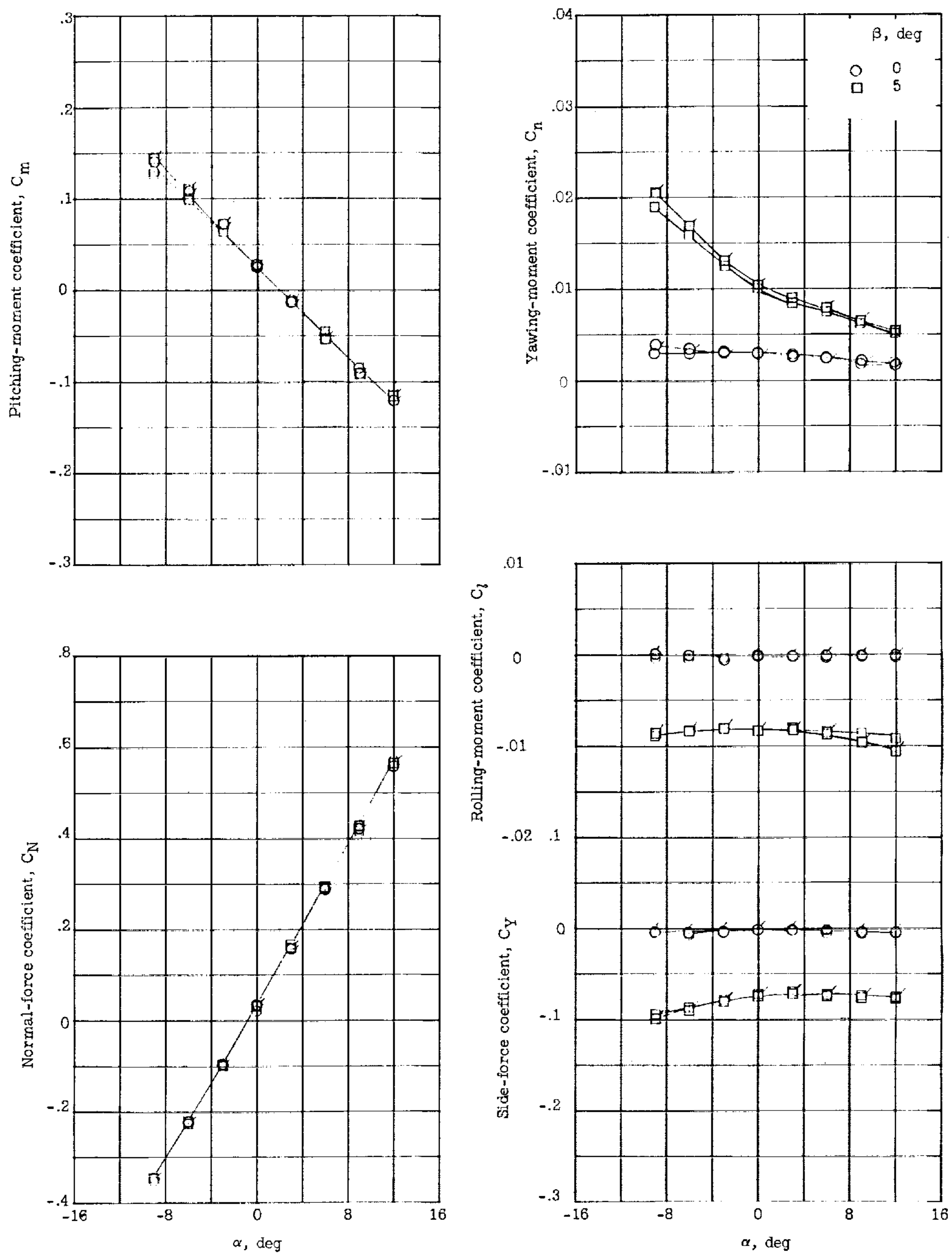
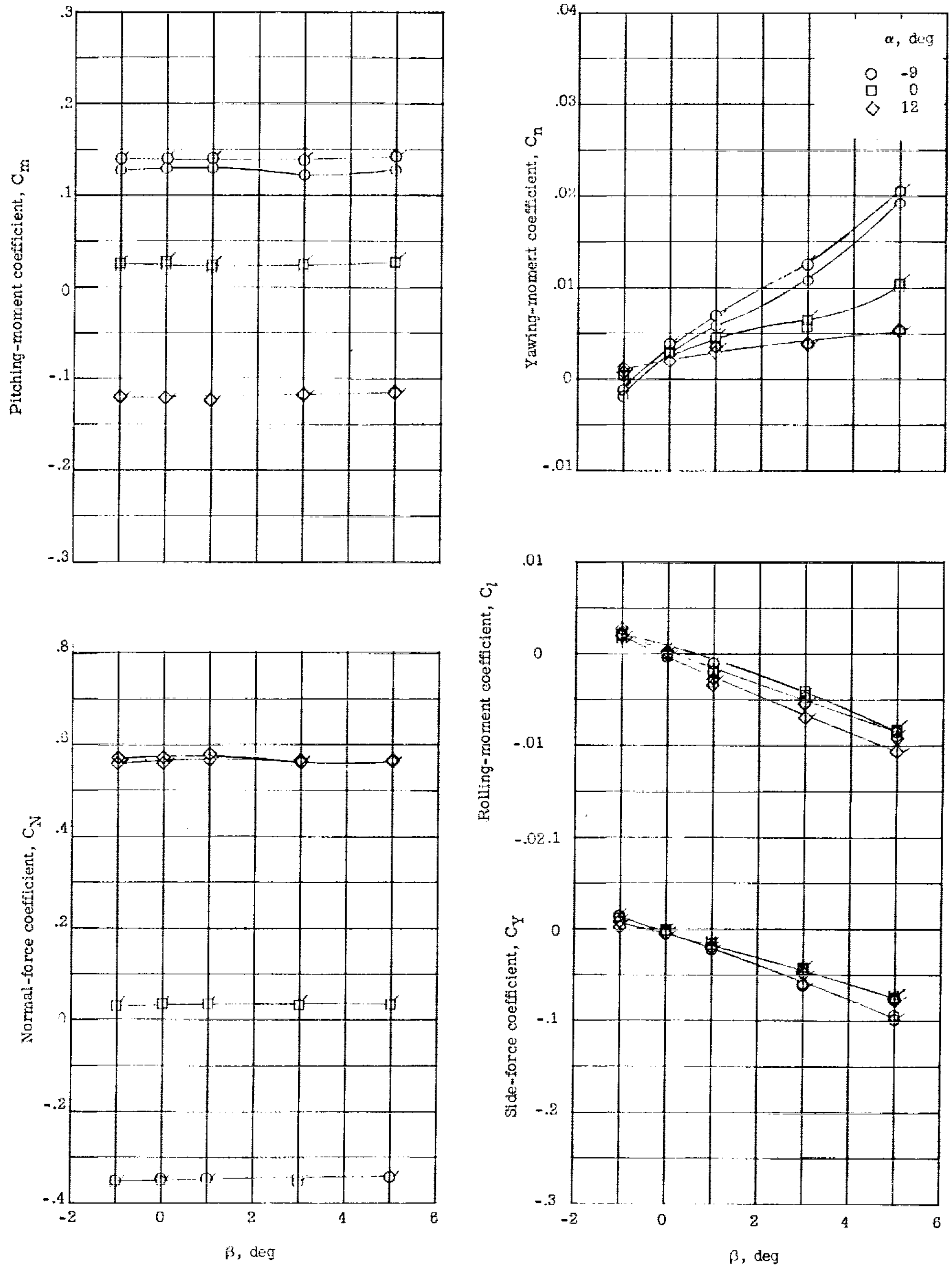


(a) M = 2.37.

Figure 5.- Aerodynamic characteristics of the X-1E airplane with and without fixed boundary-layer transition with no stability-improvement devices. Flagged symbols indicate fixed boundary-layer transition data.



(a) Concluded.

Figure 5.- Continued.

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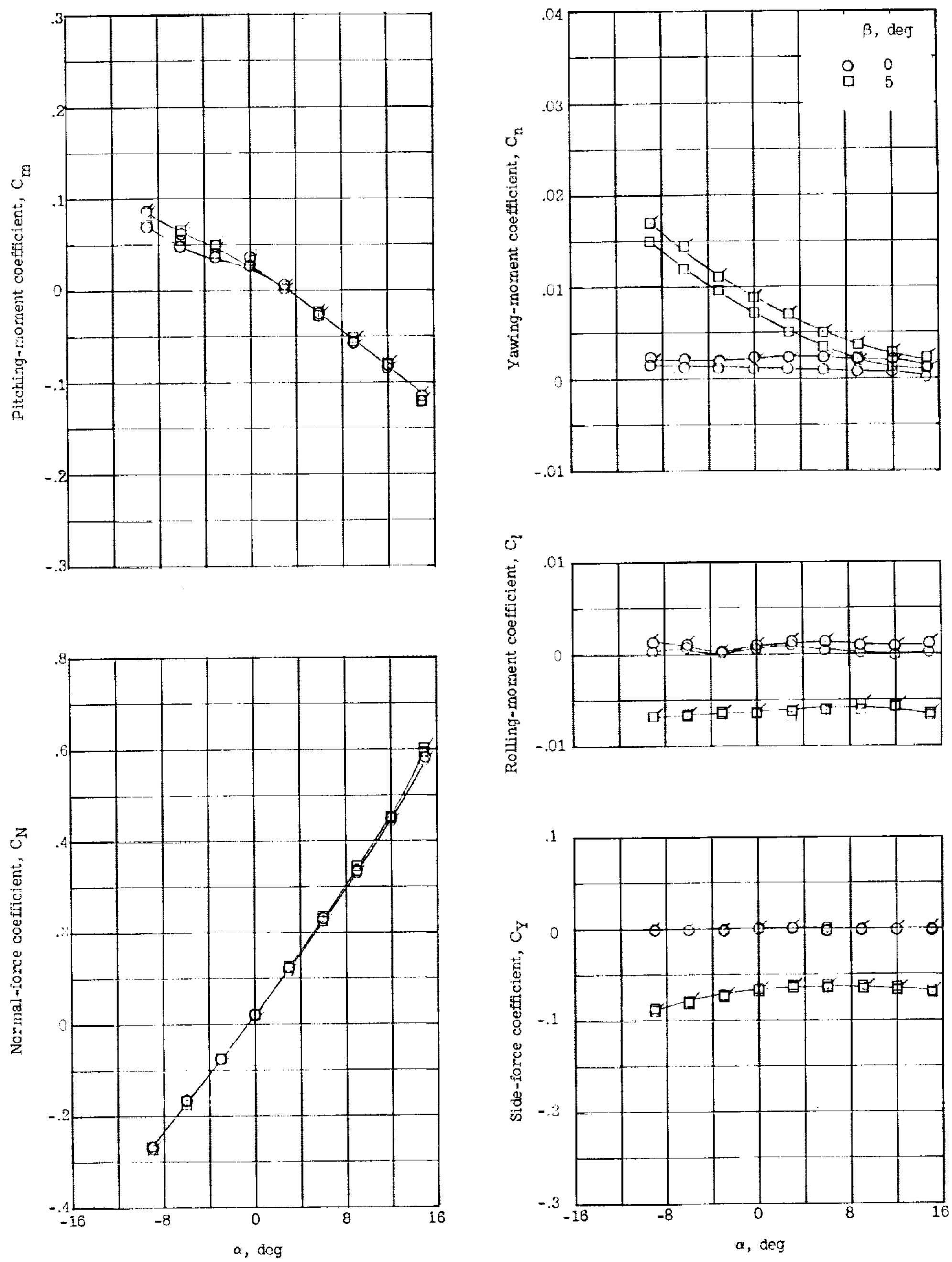
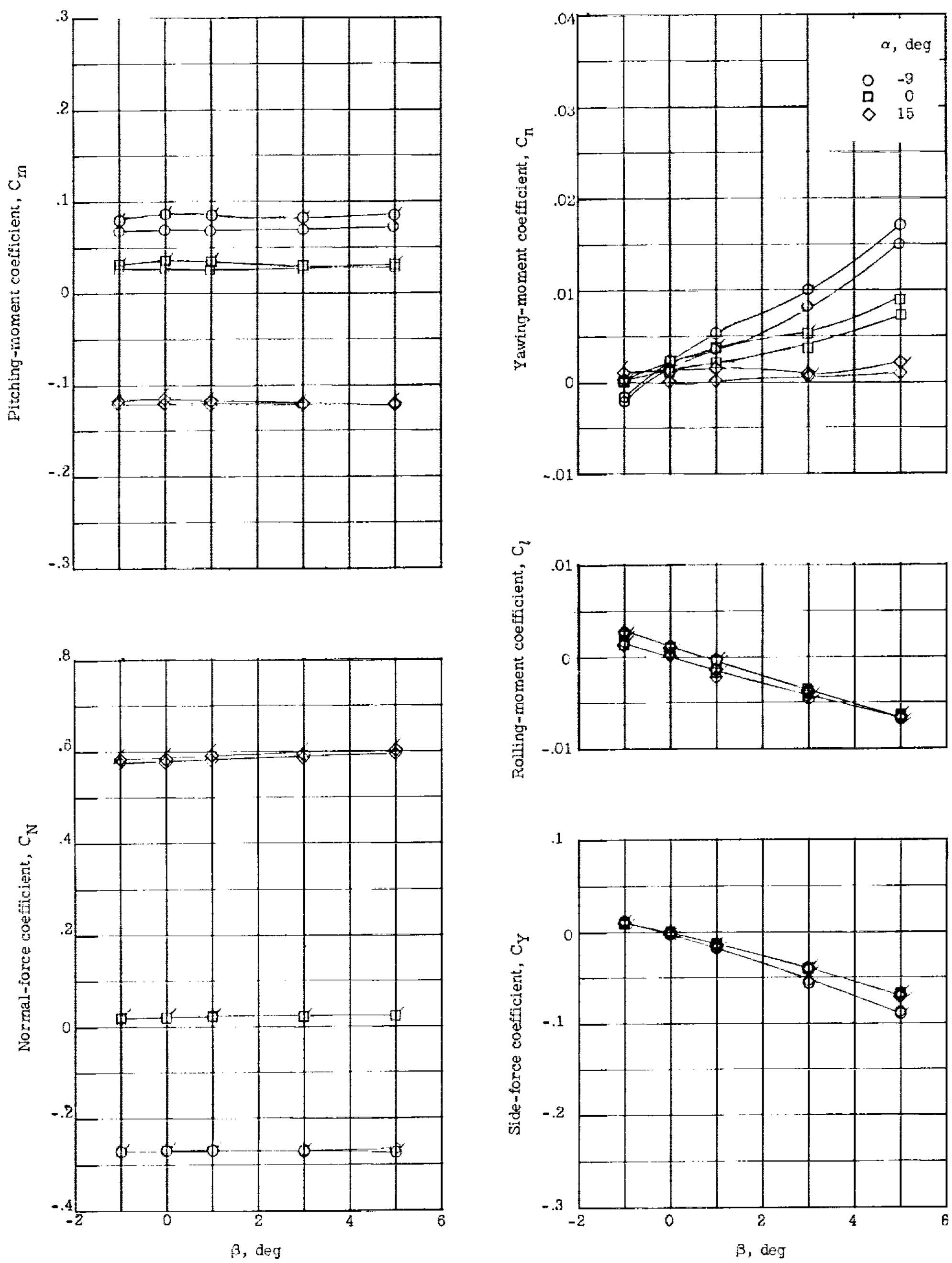


(b) M = 2.98.

Figure 5.- Continued.



(b) Concluded.

Figure 5.- Continued.

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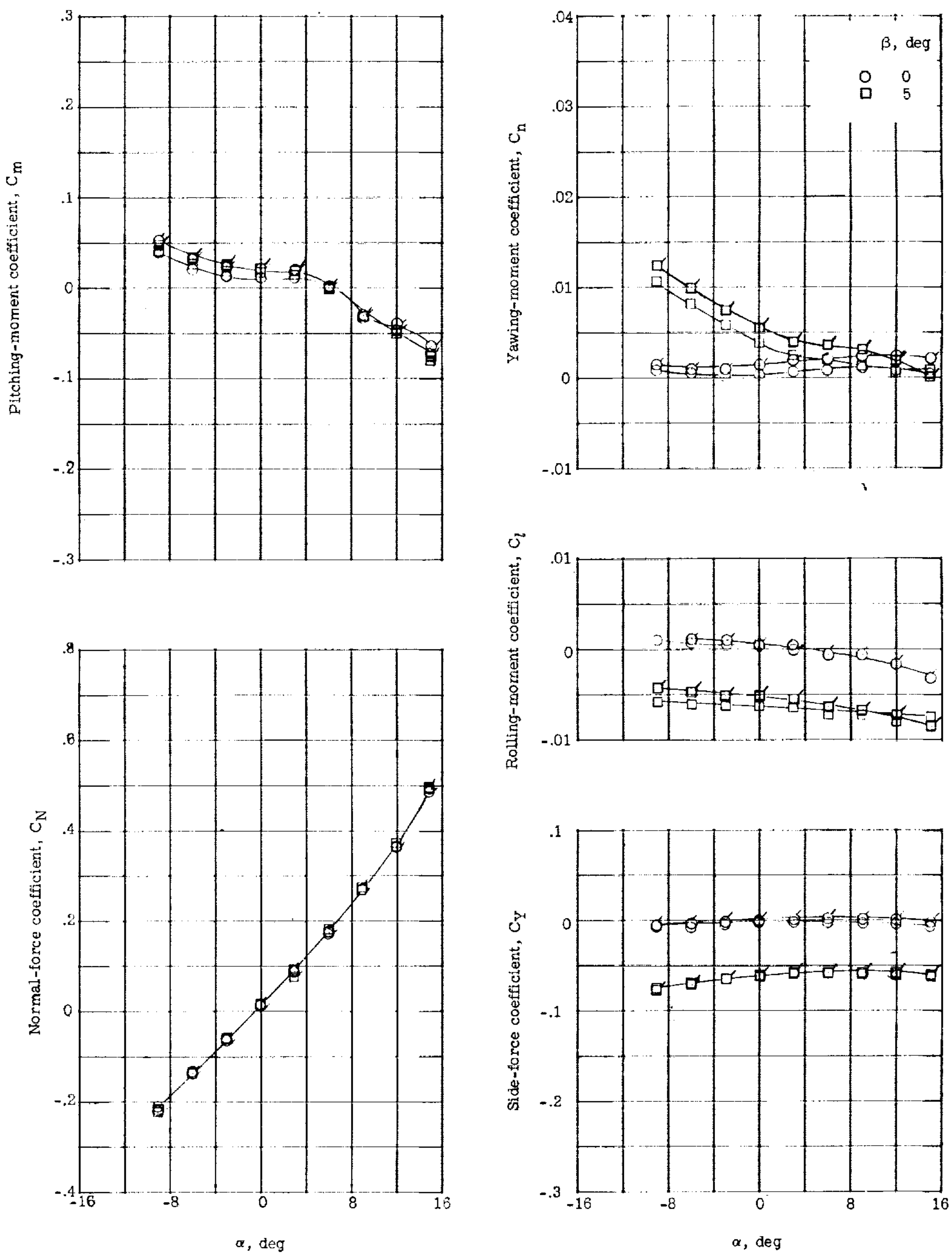
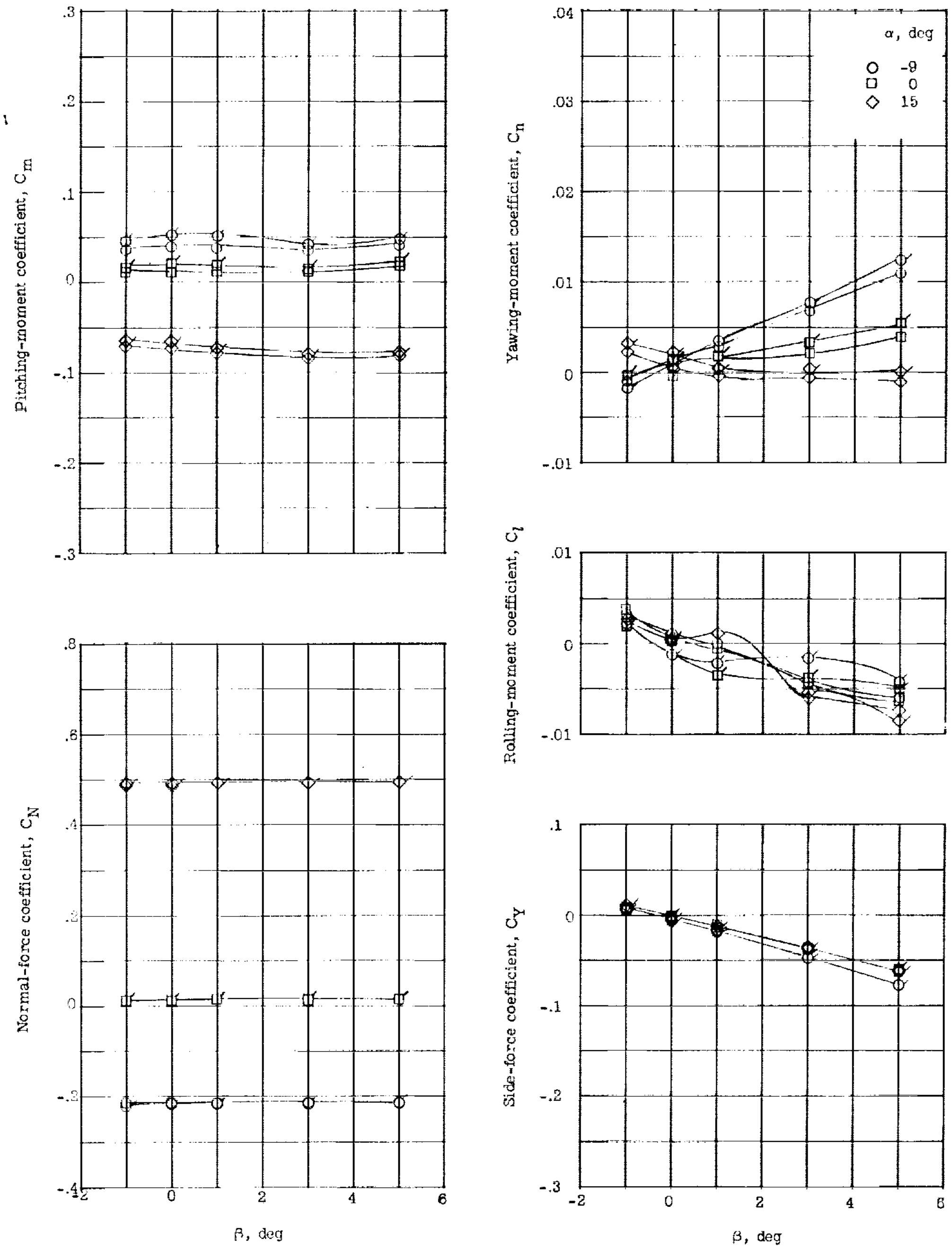


(c) M = 4.01.

Figure 5.- Continued.



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(c) Concluded.

Figure 5.- Concluded.

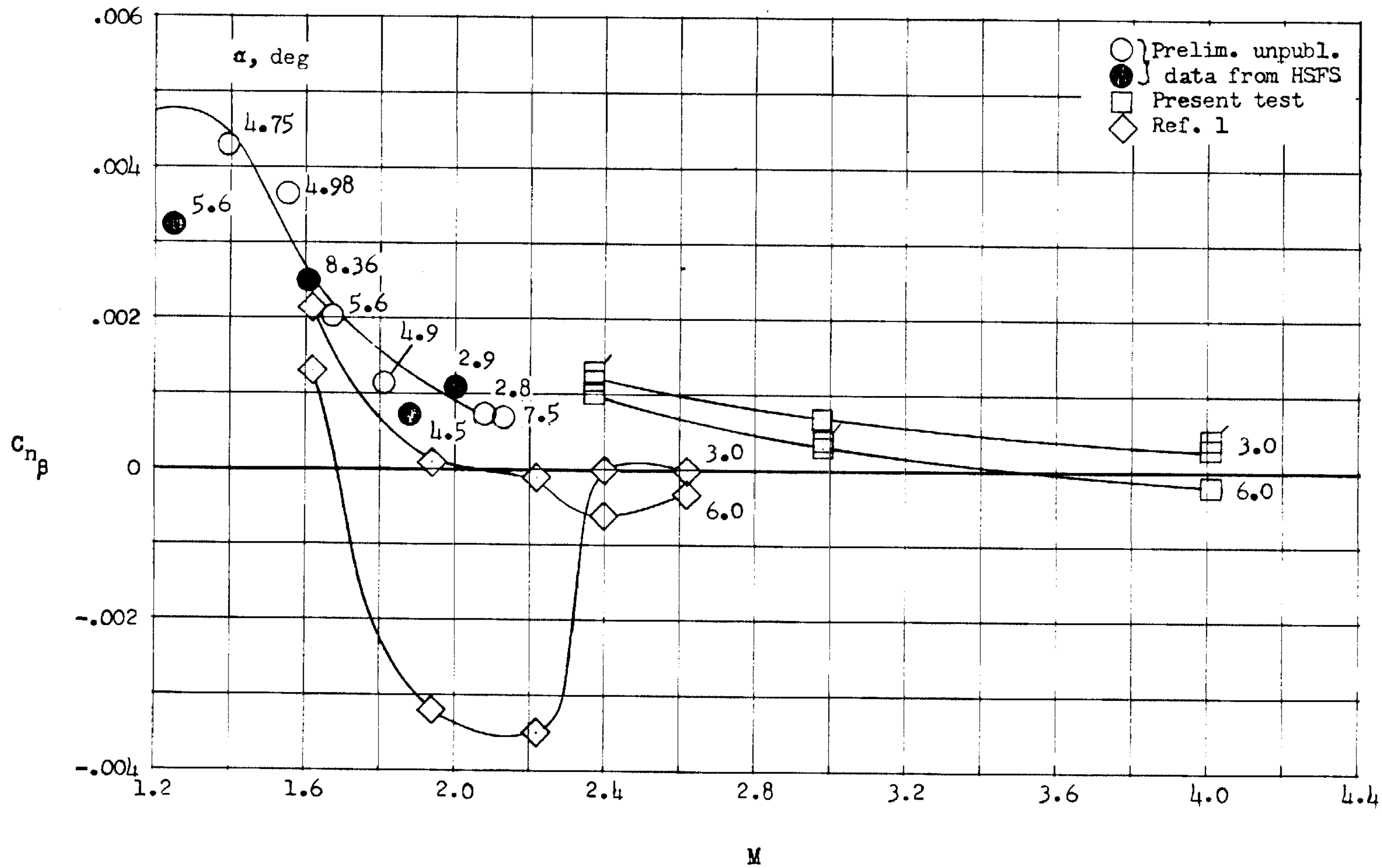
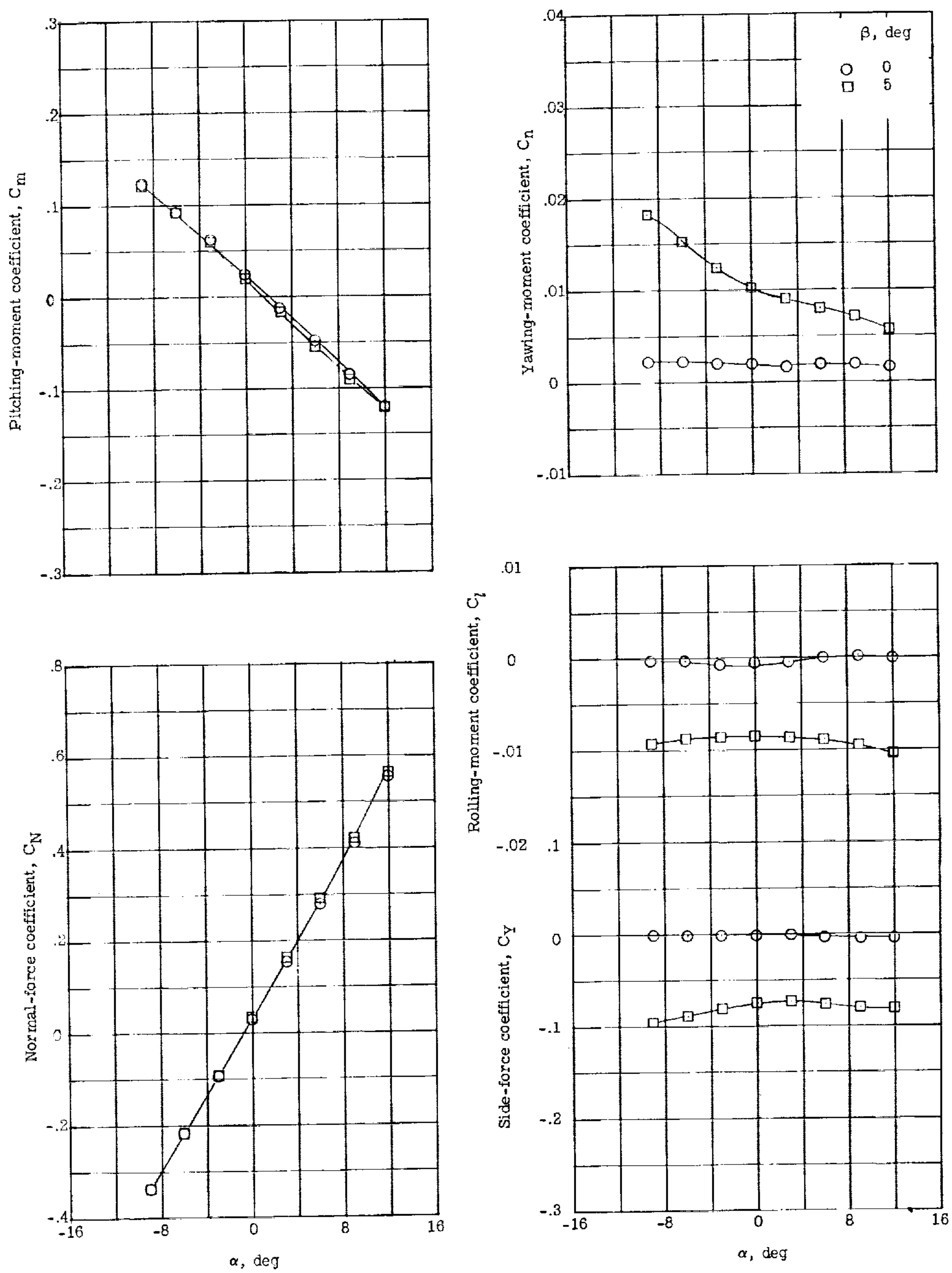


Figure 6.- Directional stability for the X-1E airplane with no directional-stability-improvement devices. Filled symbols represent power-off flight-test data.



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(a) One fixed ventral fin.

Figure 7.- Aerodynamic characteristics of the X-1E airplane having fixed-fin arrangements at $M = 2.37$.

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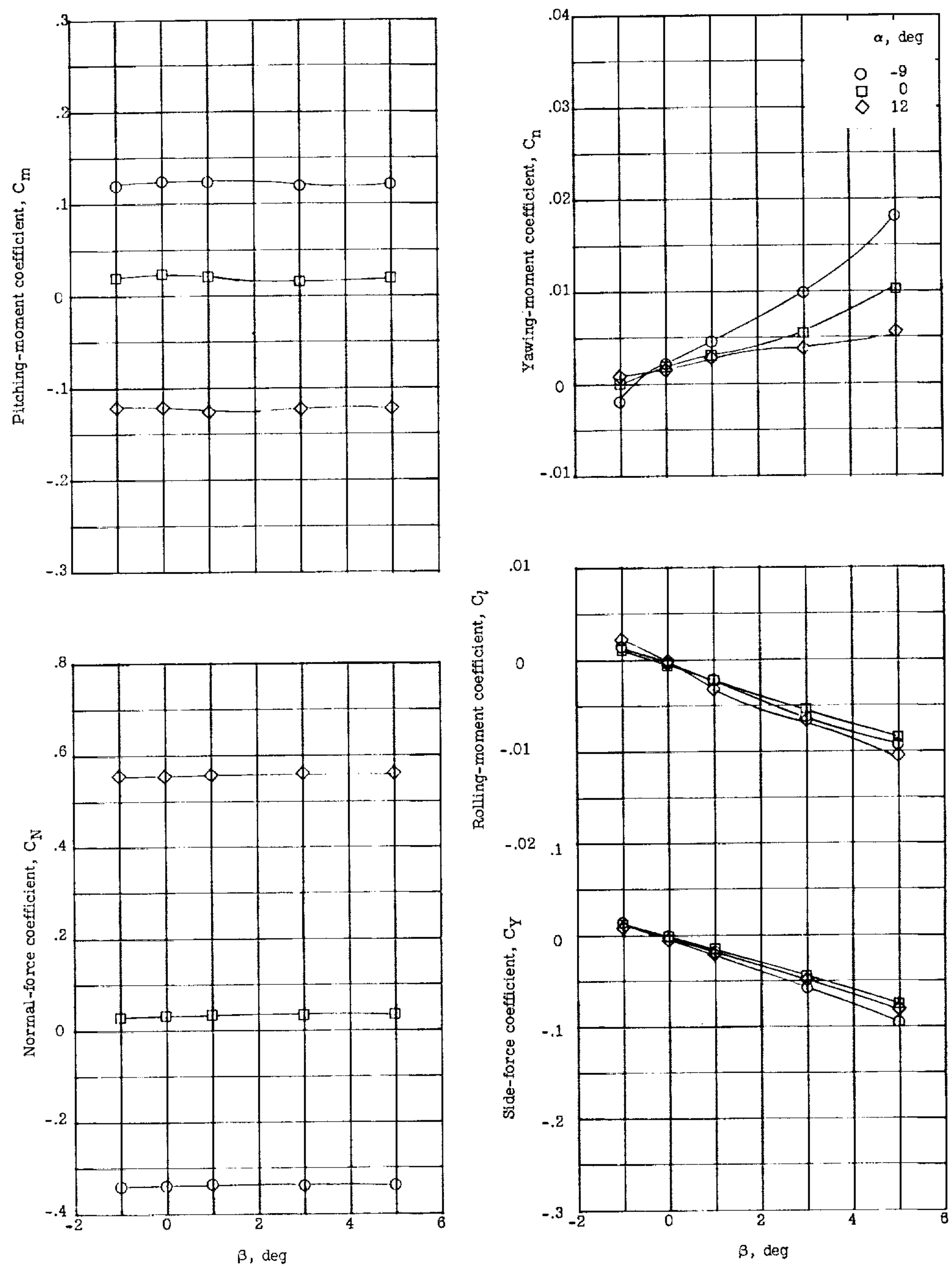
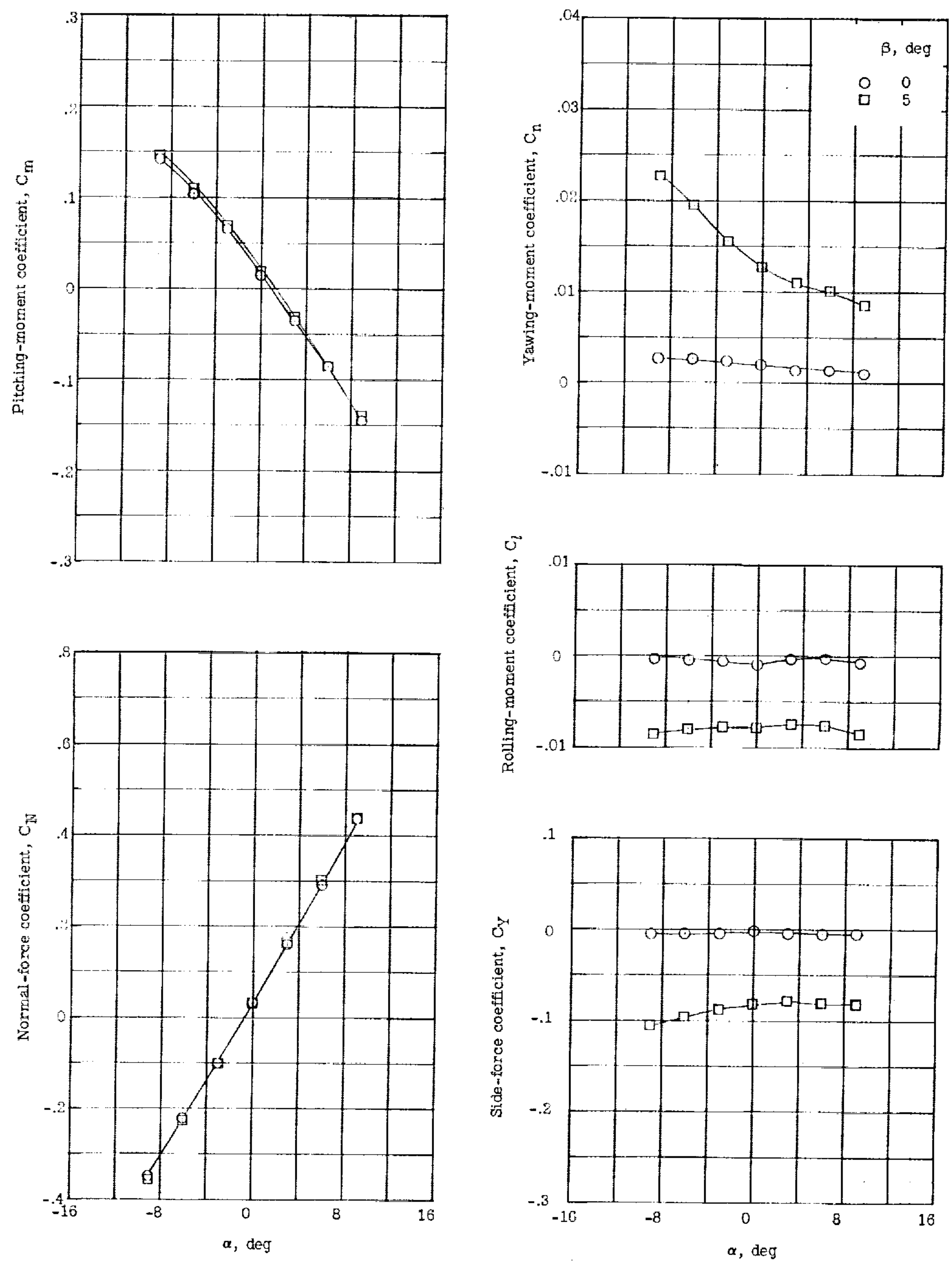


(a) Concluded.

Figure 7.- Continued.



(b) Two fixed ventral fins.

Figure 7.- Continued.

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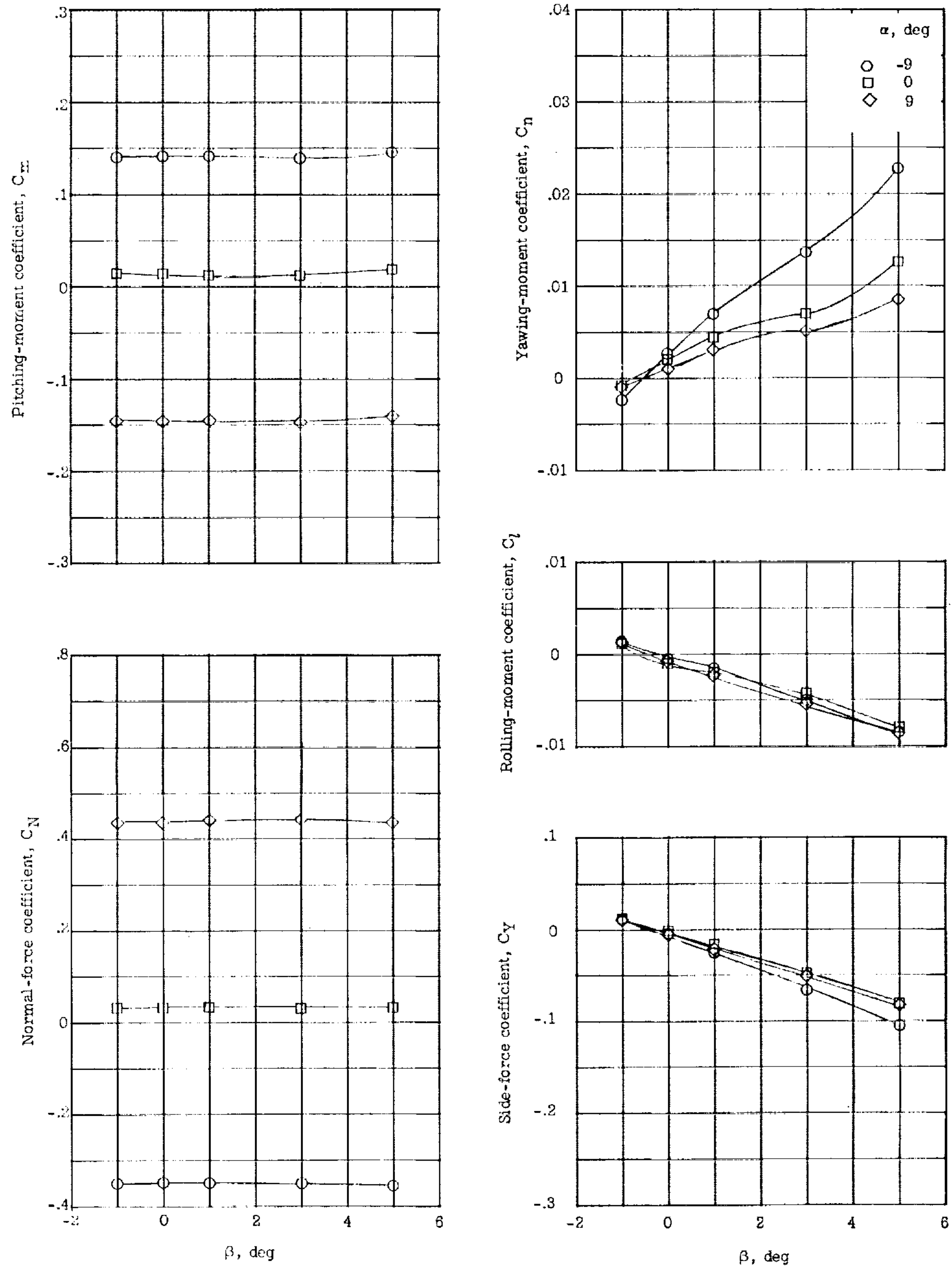
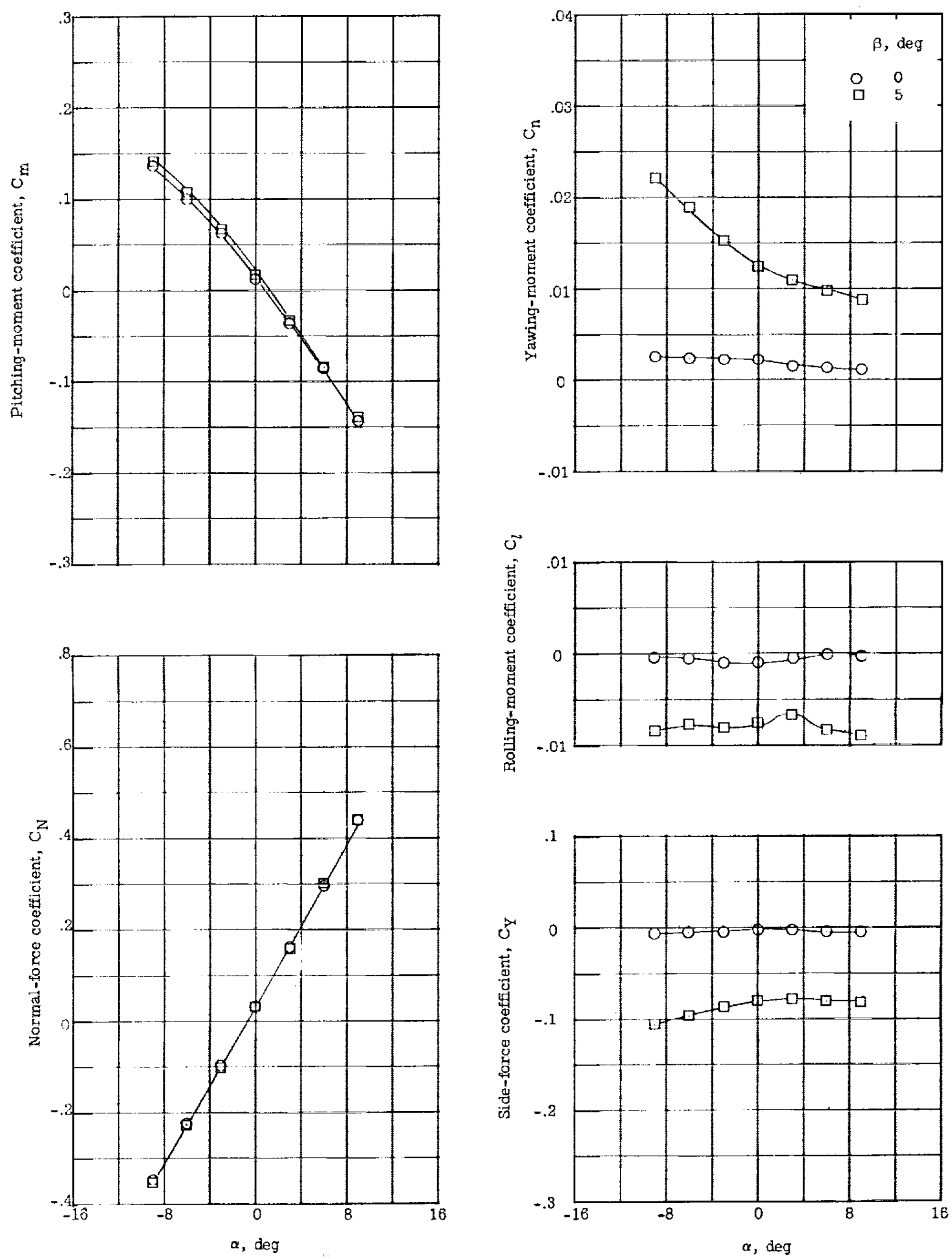


(b) Concluded.

Figure 7.- Continued.



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(c) Three fixed ventral fins.

Figure 7.- Continued.

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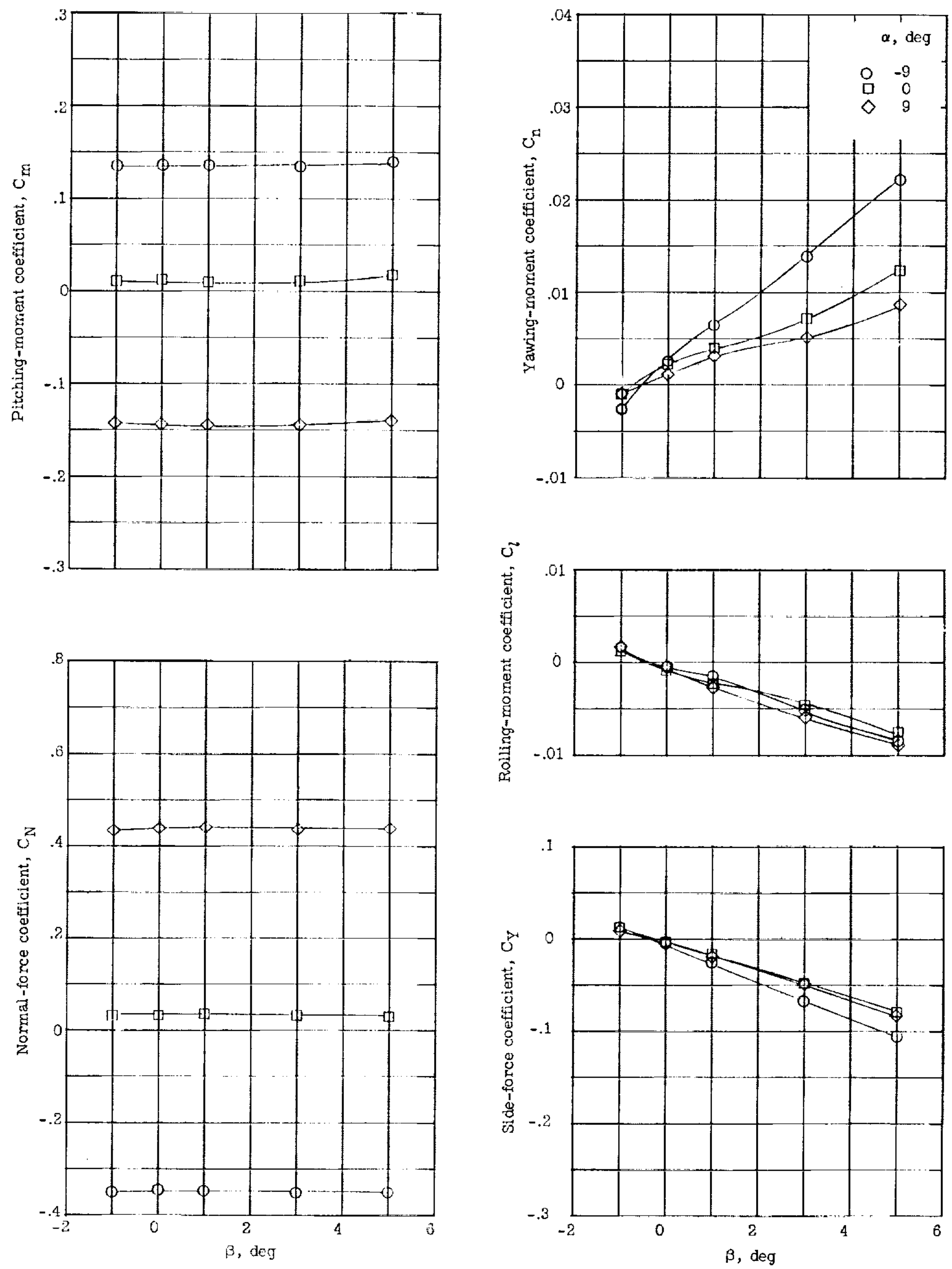
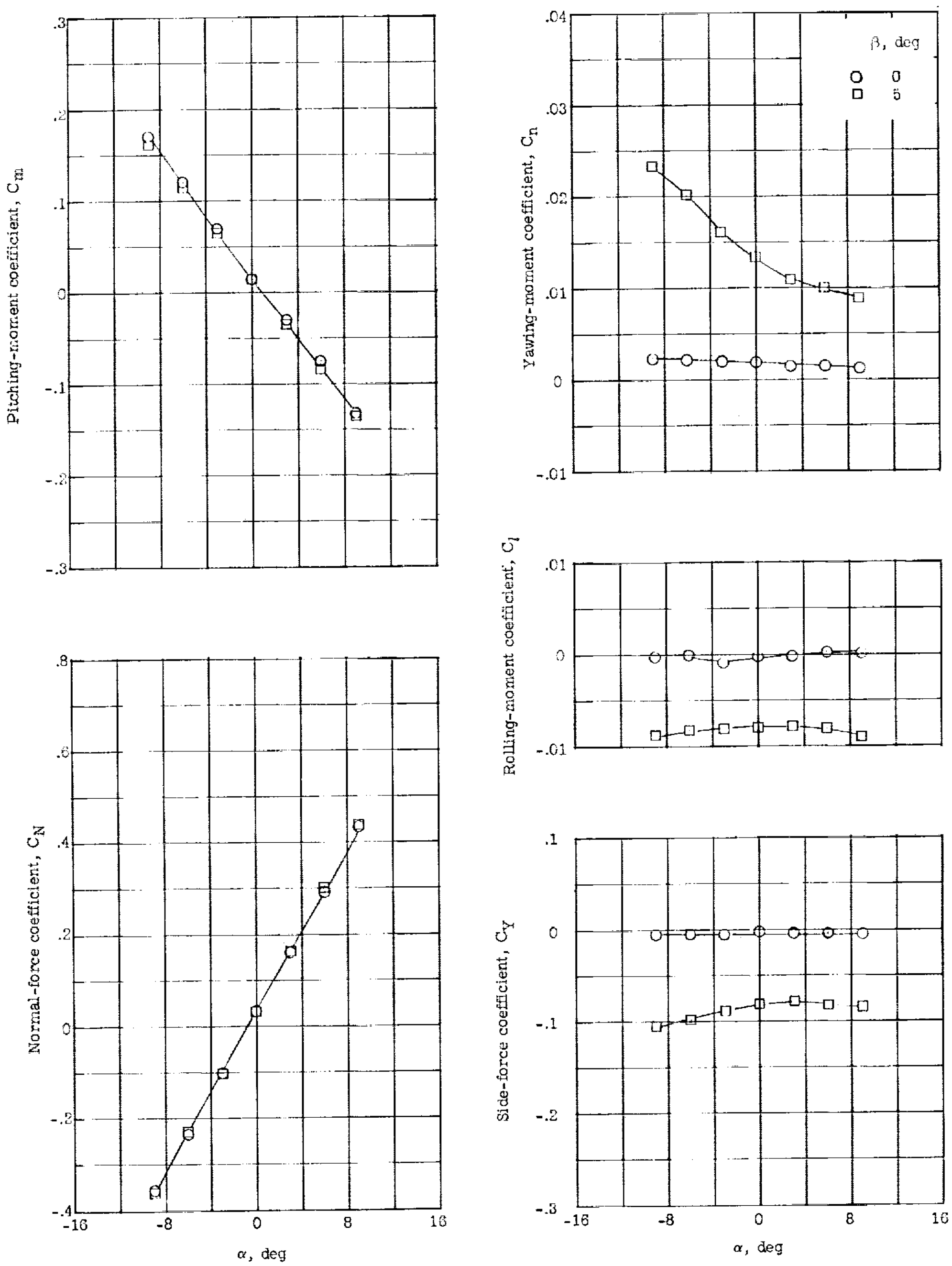


(c) Concluded.

Figure 7.- Continued.



(d) Four fixed fins in X-arrangement.

Figure 7.- Continued.

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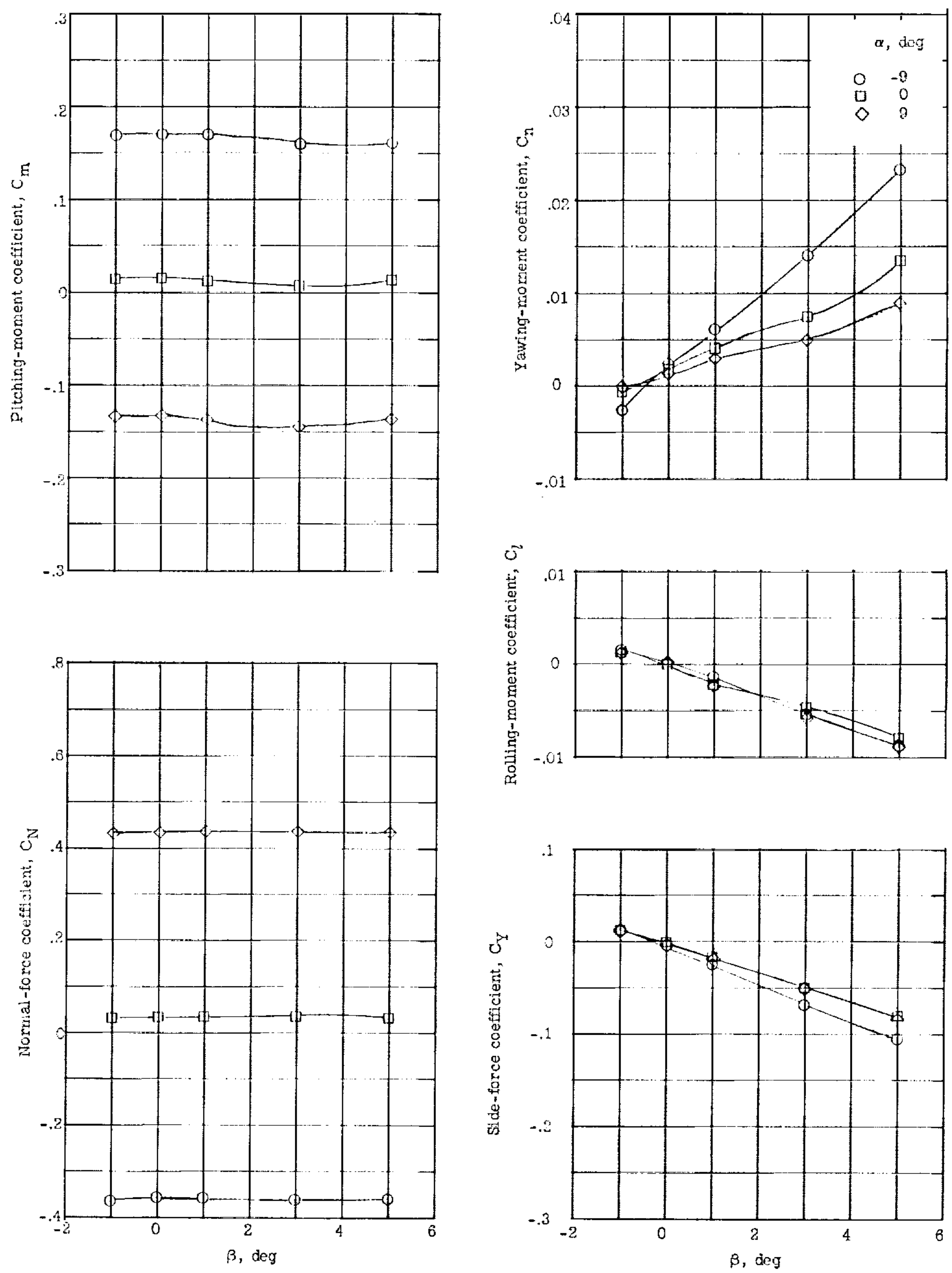
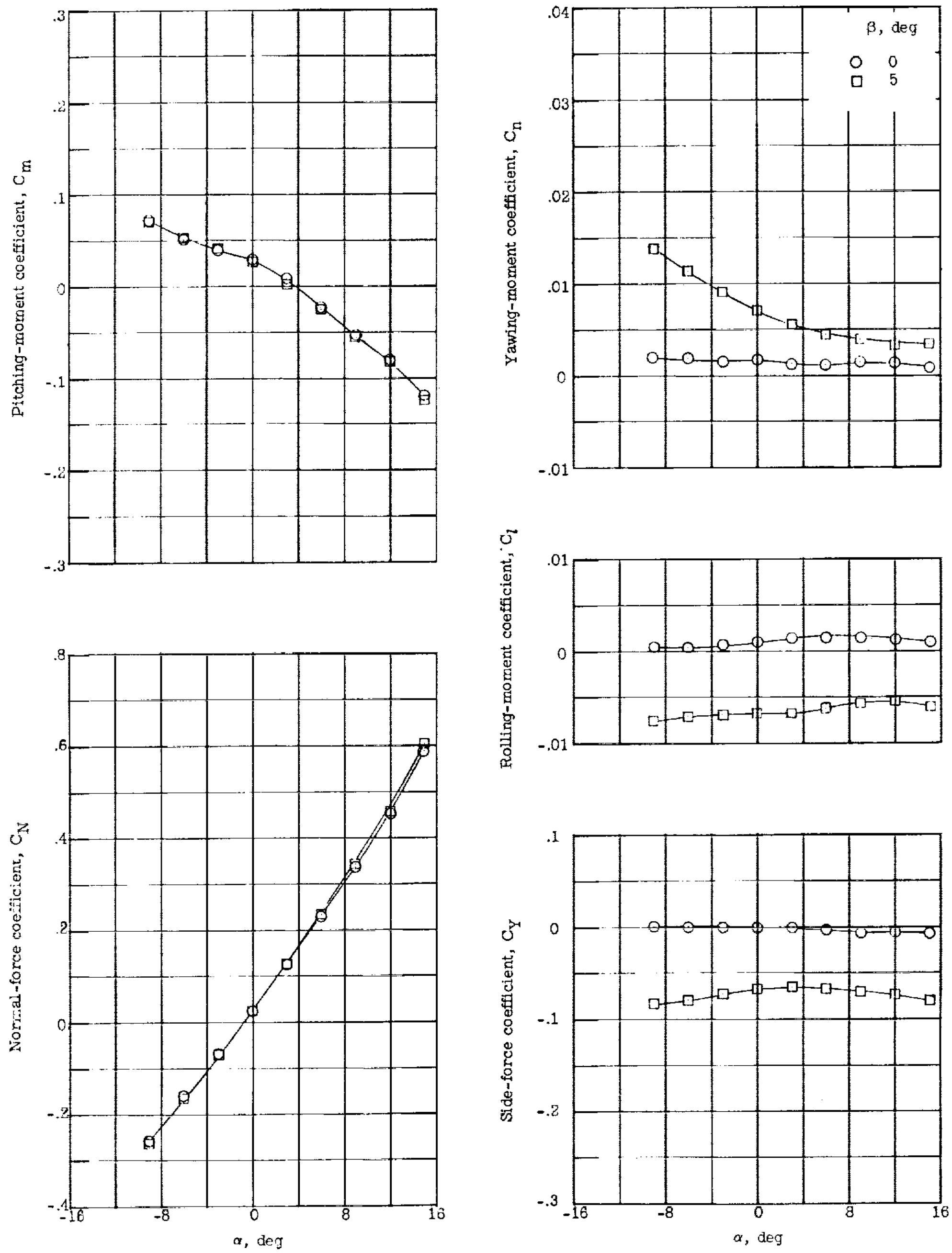


(d) Concluded.

Figure 7.- Concluded.



(a) One fixed ventral fin.

Figure 8.- Aerodynamic characteristics of the X-1E airplane having fixed-fin arrangements at M = 2.98.

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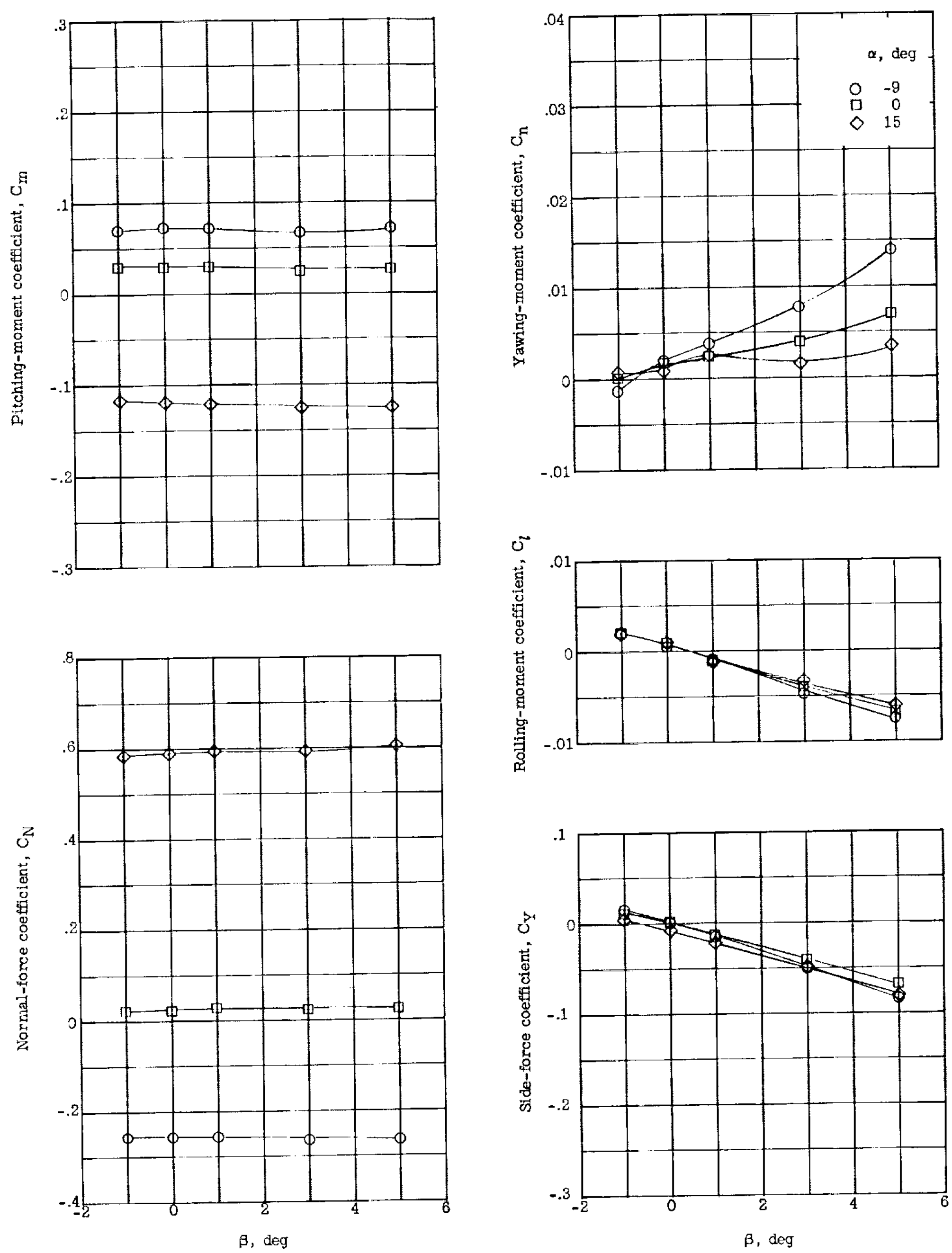
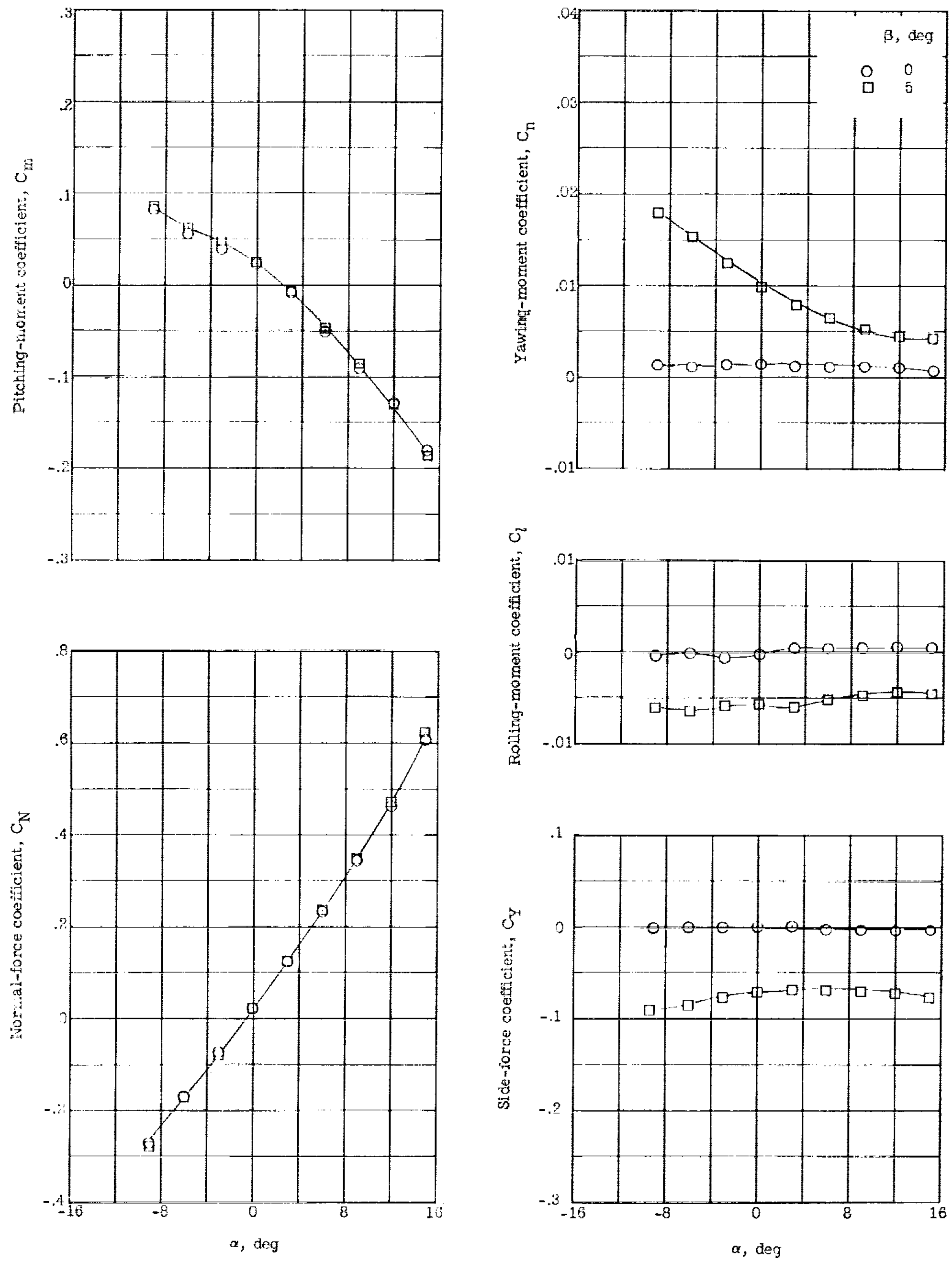


(a) Concluded.

Figure 8.- Continued.



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(b) Two fixed ventral fins.

Figure 8.- Continued.

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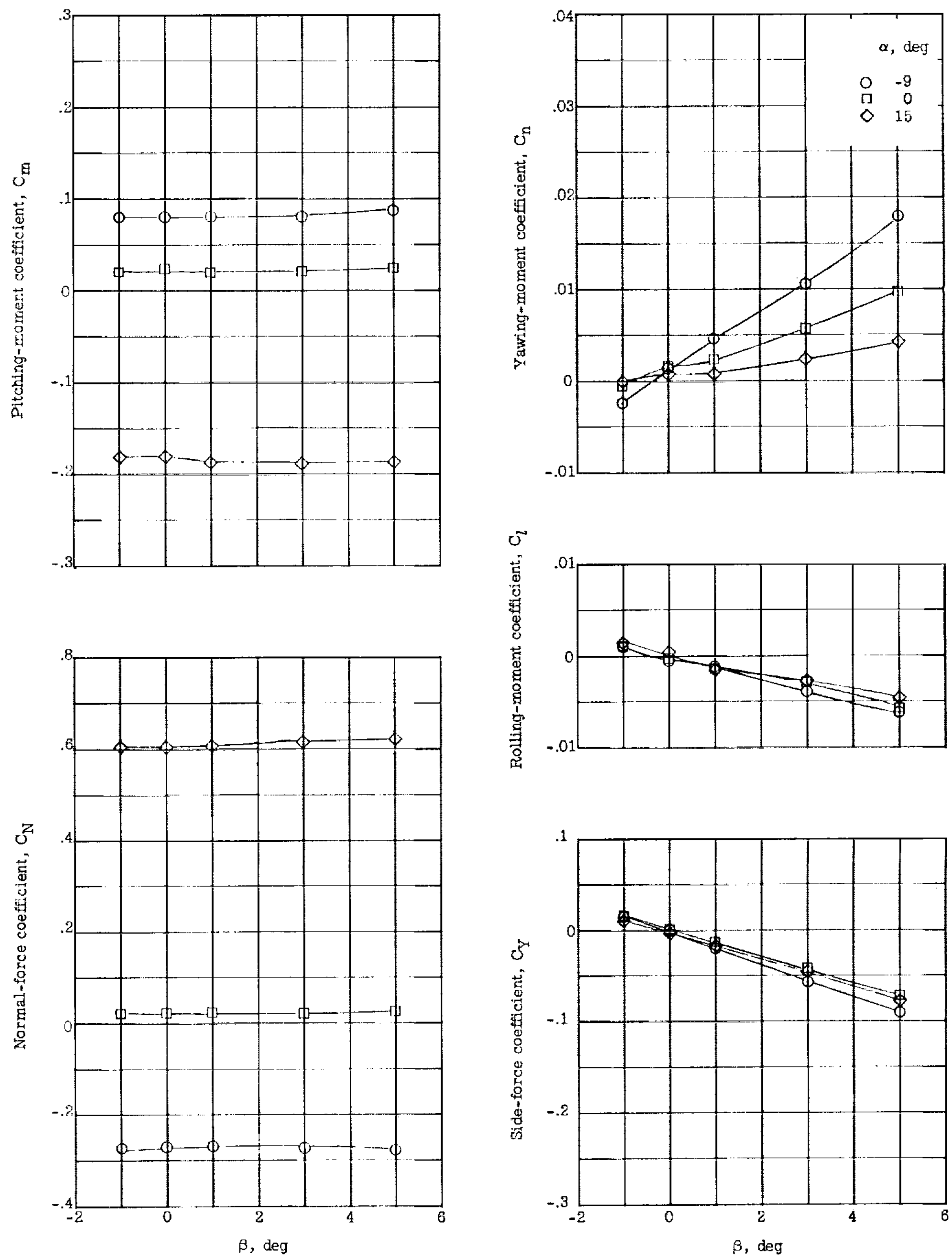
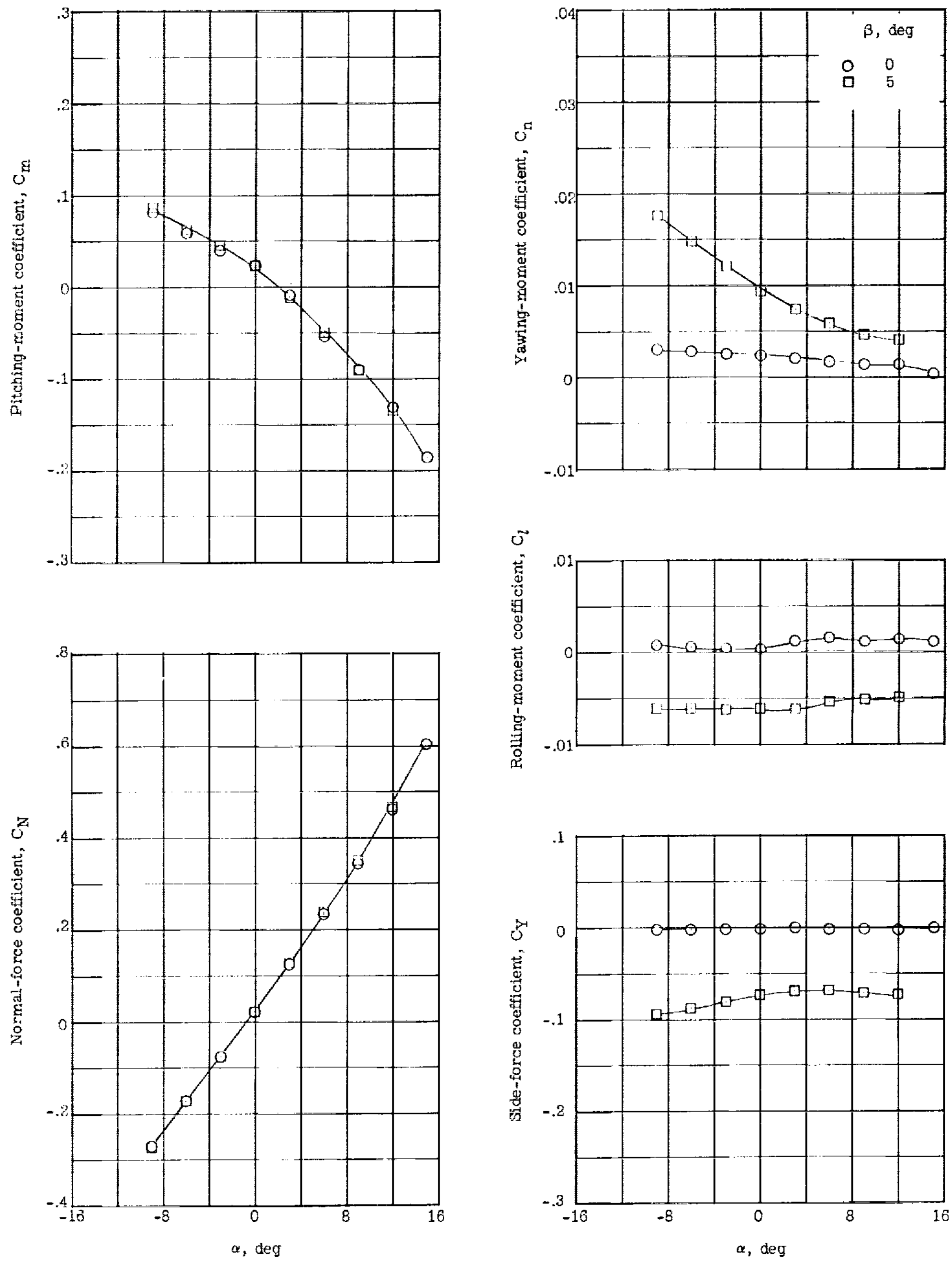


(b) Concluded.

Figure 8.- Continued.



(c) Three fixed ventral fins.

Figure 8.- Continued.

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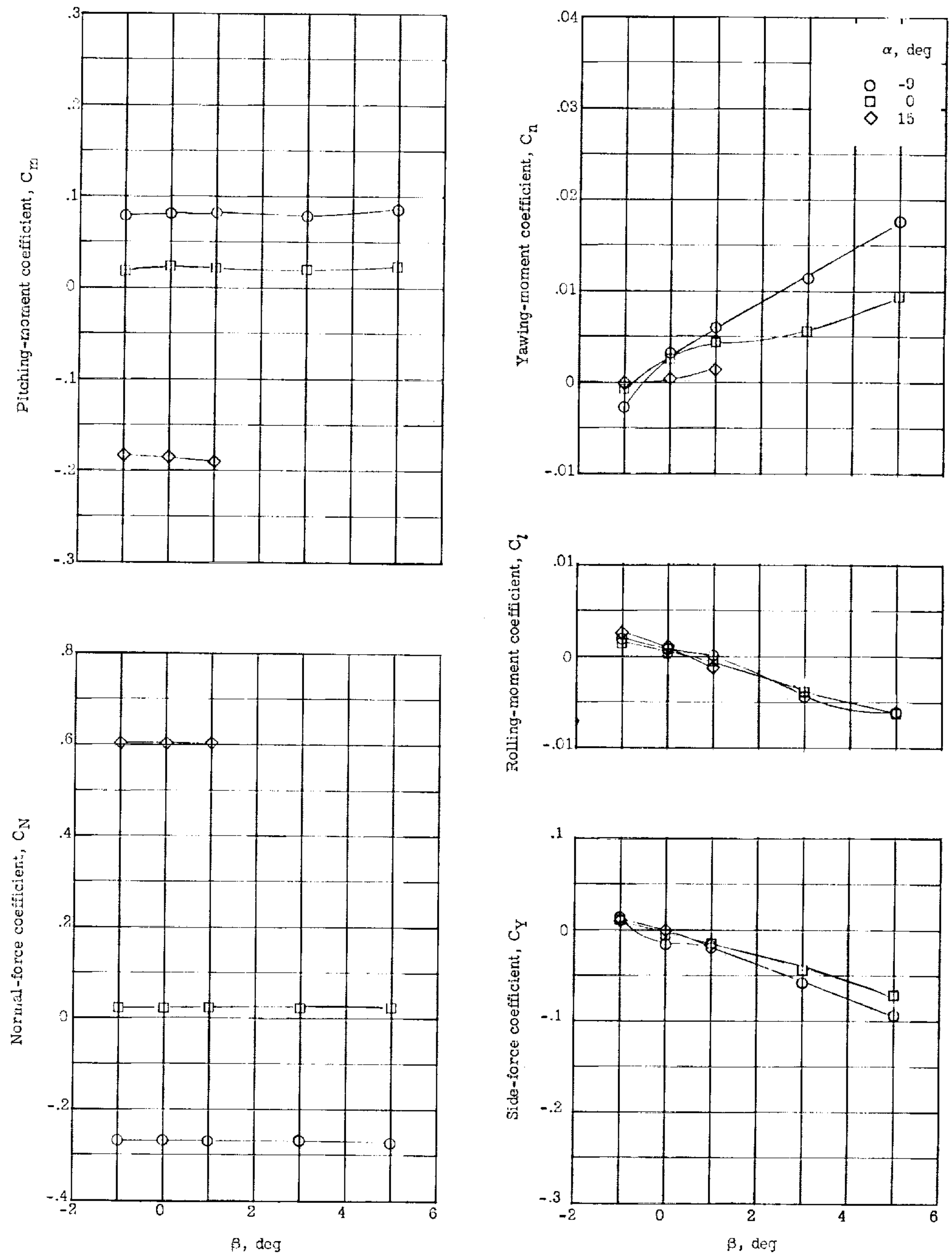
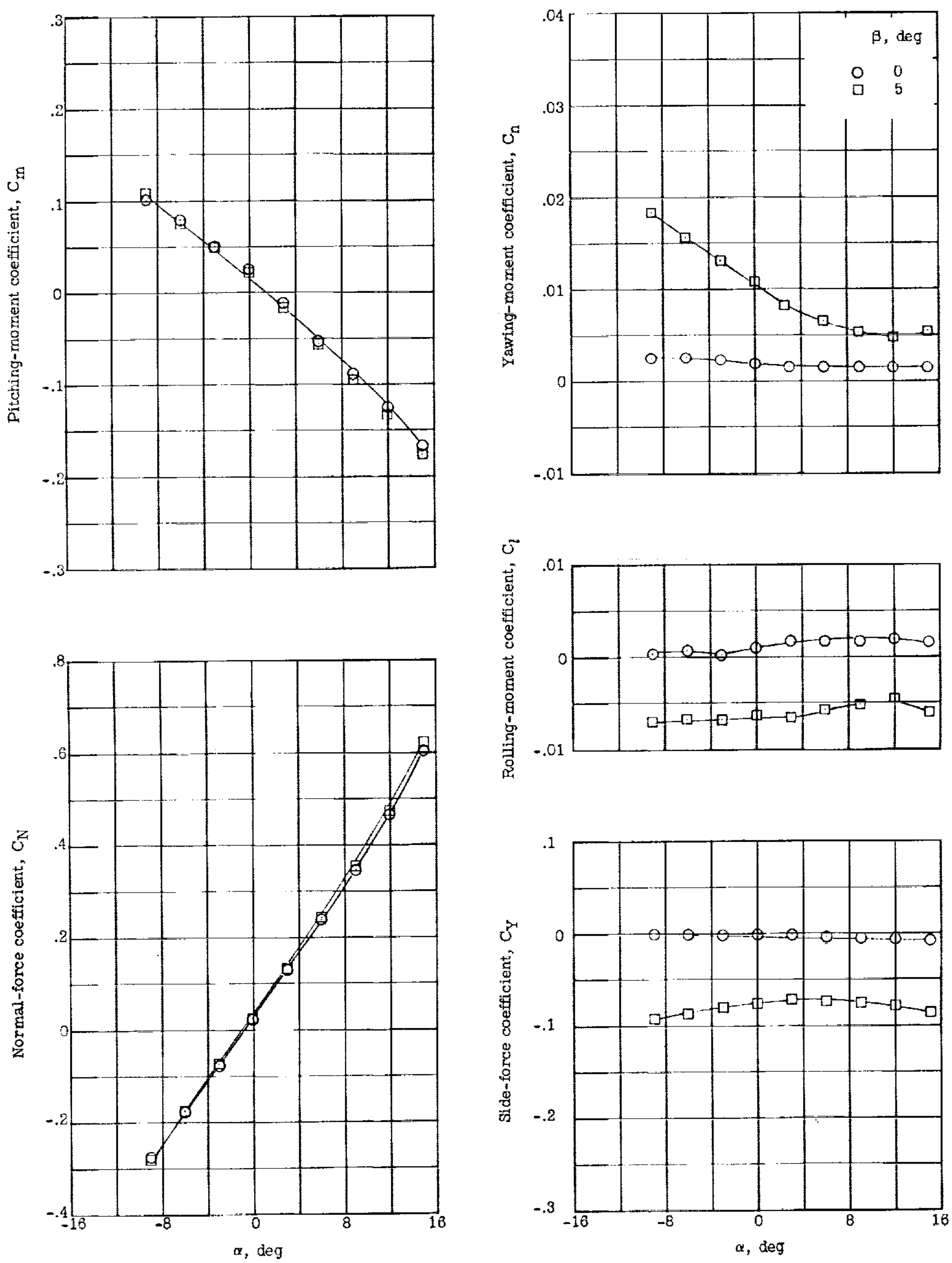


(c) Concluded.

Figure 8.- Continued.



(d) Four fixed fins in X-arrangement.

Figure 8.- Continued.

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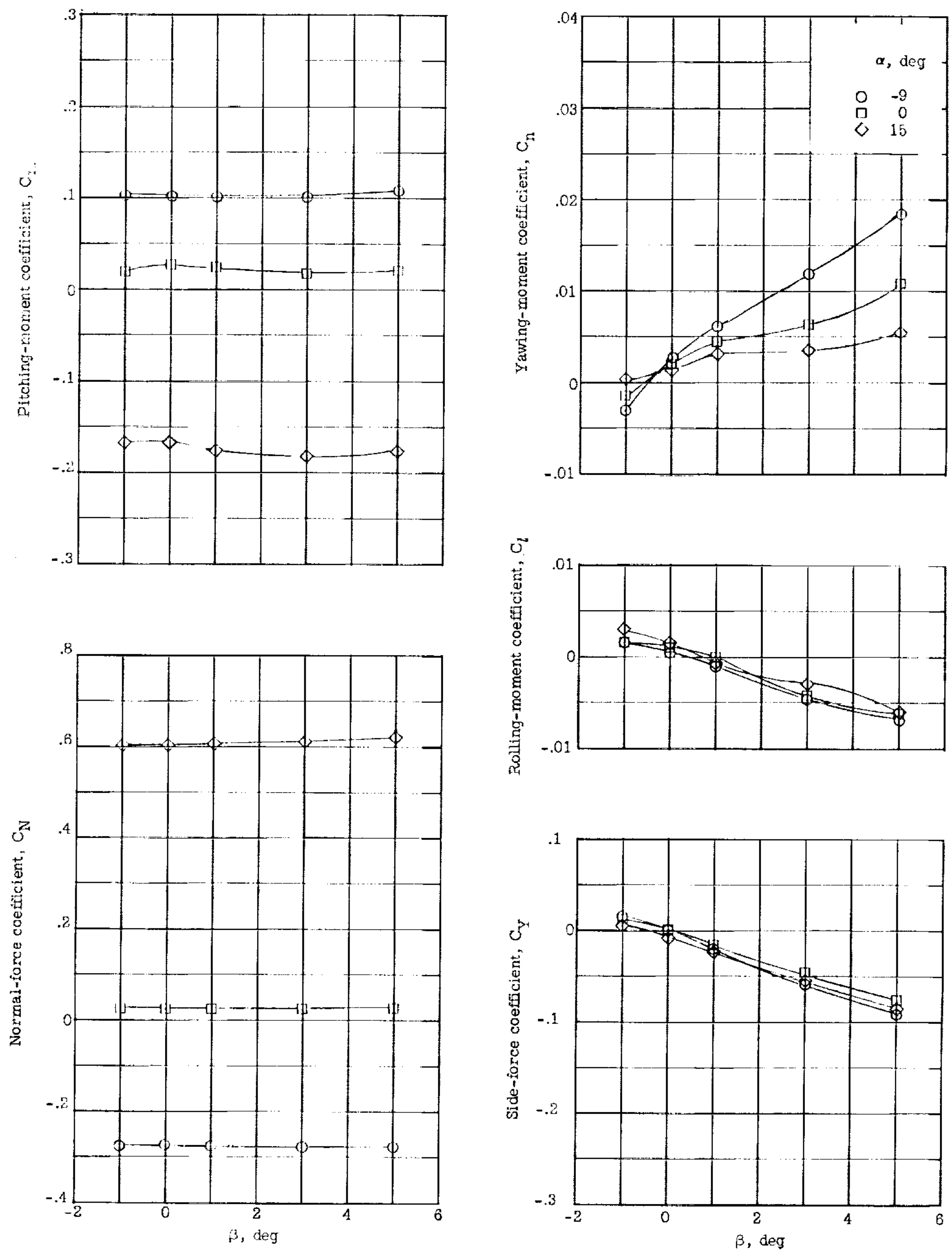
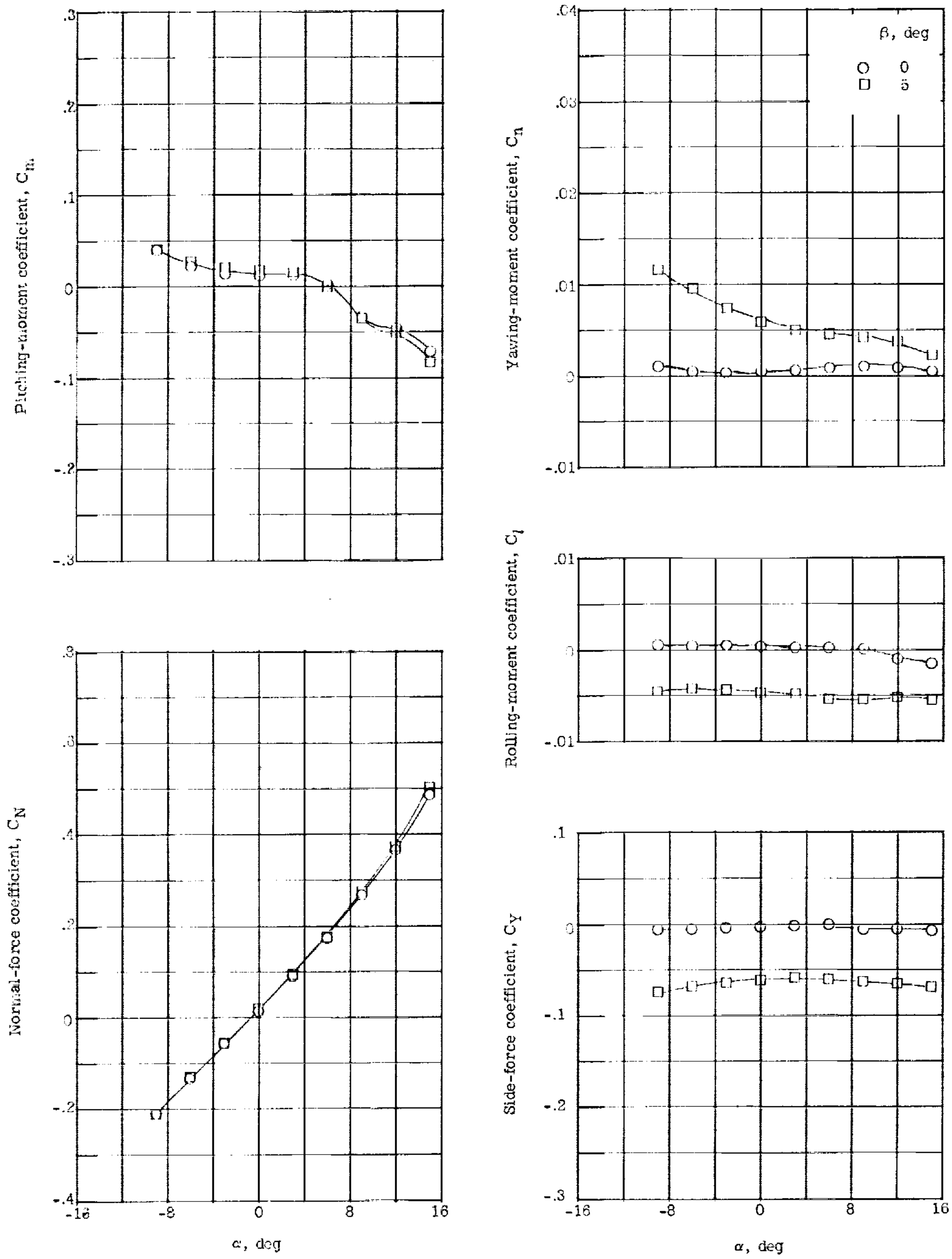


(d) Concluded.

Figure 8.- Concluded.

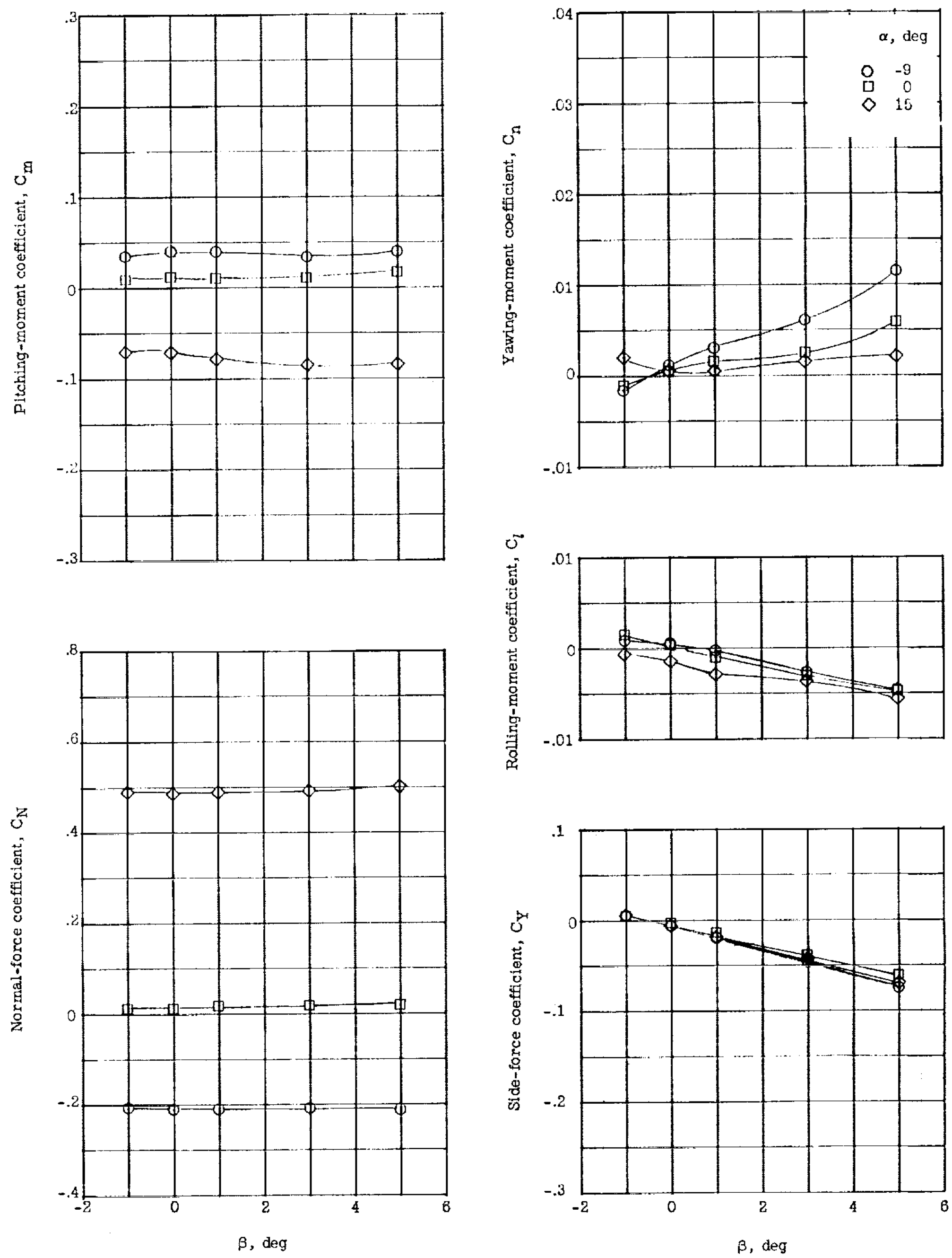


L-188

(a) One fixed ventral fin.

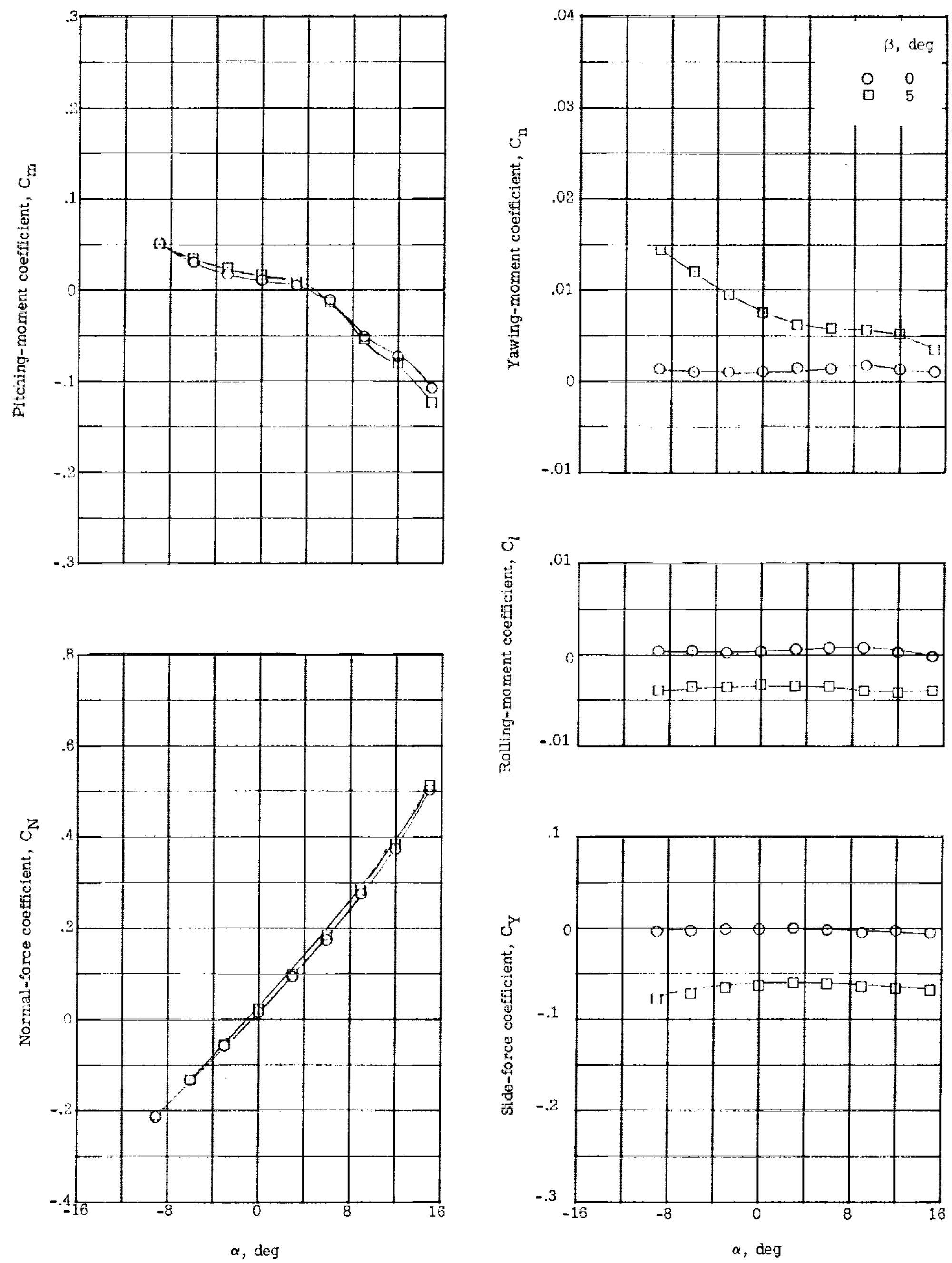
Figure 9.- Aerodynamic characteristics of the X-1E airplane having fixed-fin arrangements at M = 4.01.

L-188



(a) Concluded.

Figure 9.- Continued.

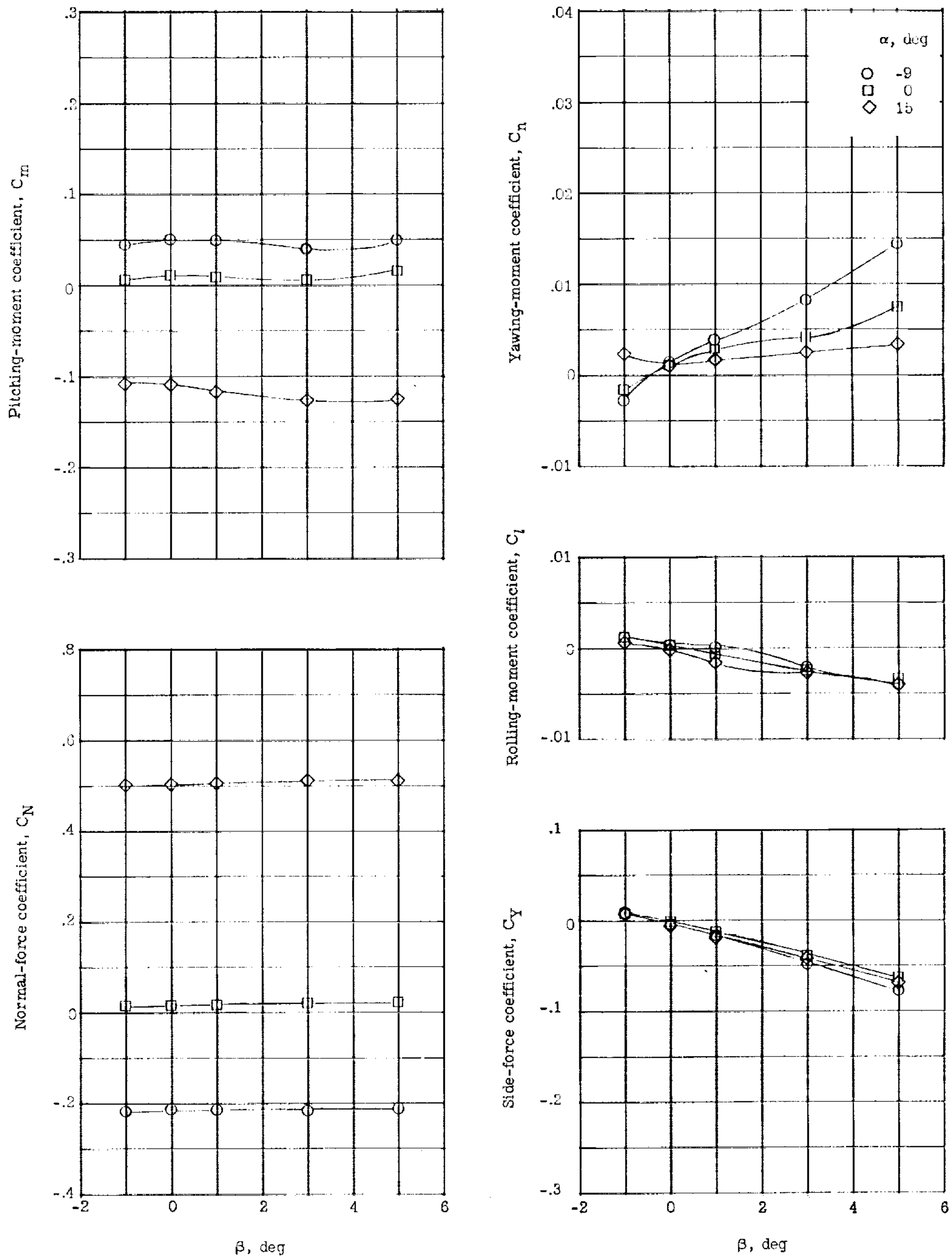


(b) Two fixed ventral fins.

Figure 9.- Continued.

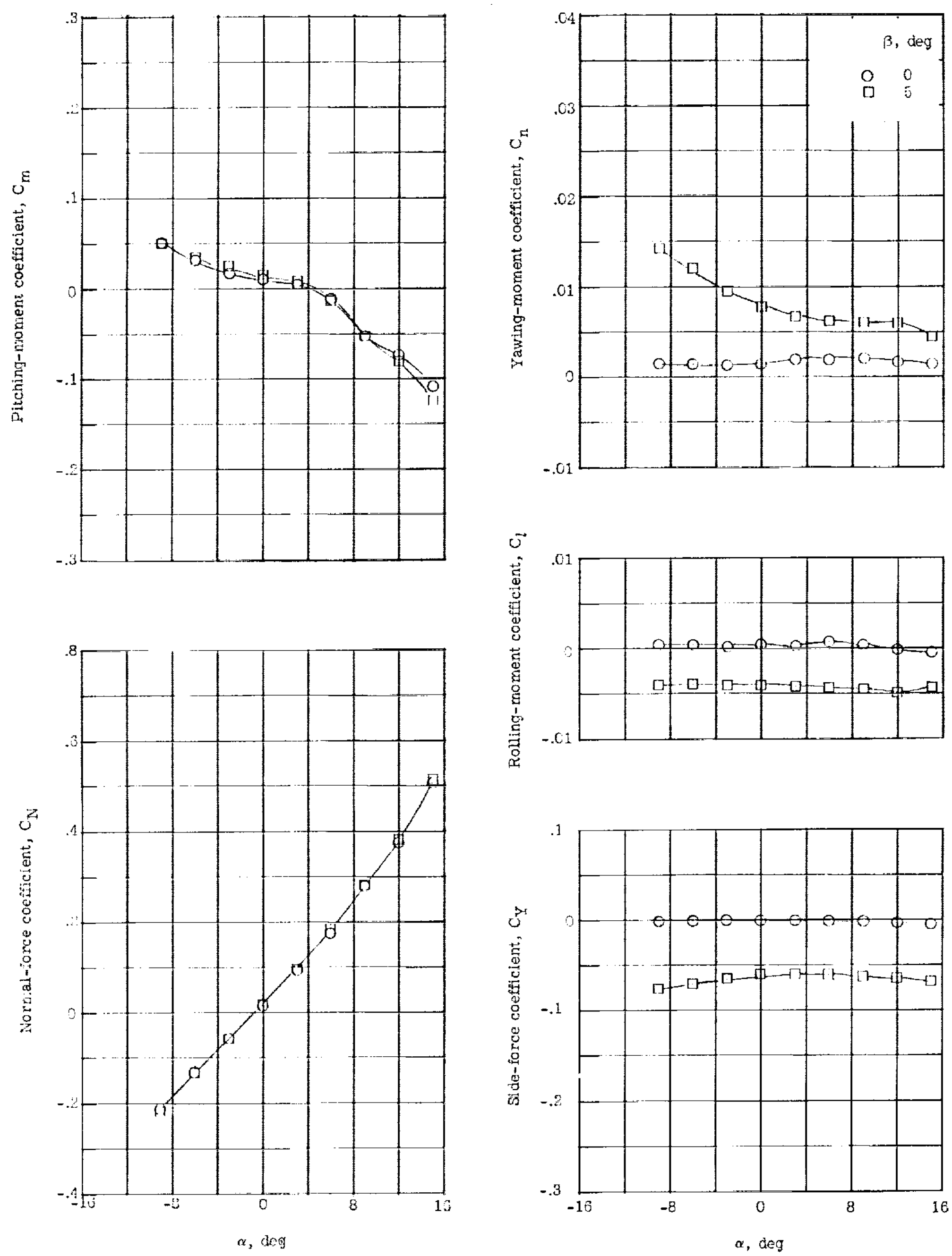
L-188

L-188



(b) Concluded.

Figure 9.- Continued.

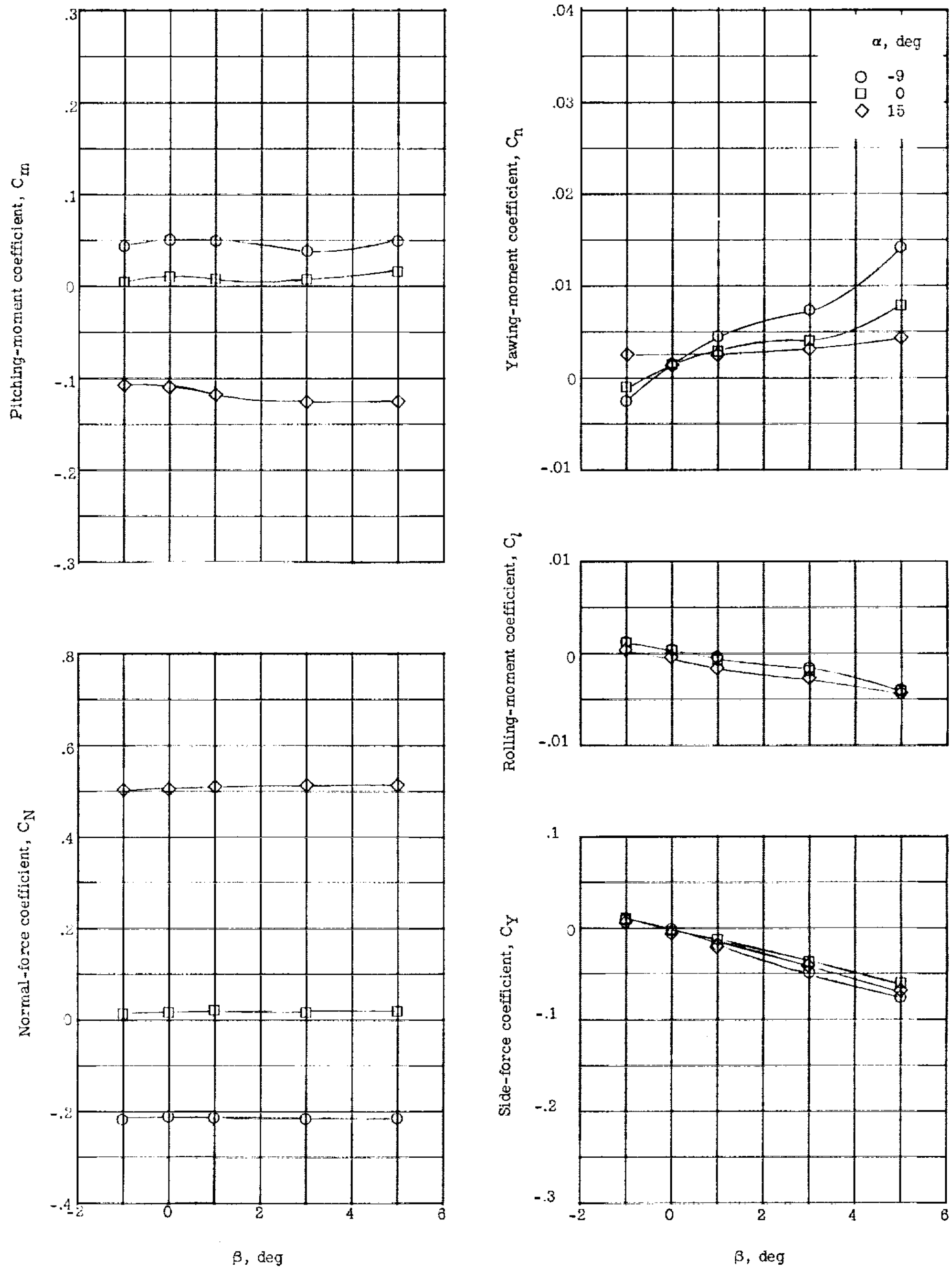


L-188

(c) Three fixed ventral fins.

Figure 9.- Continued.

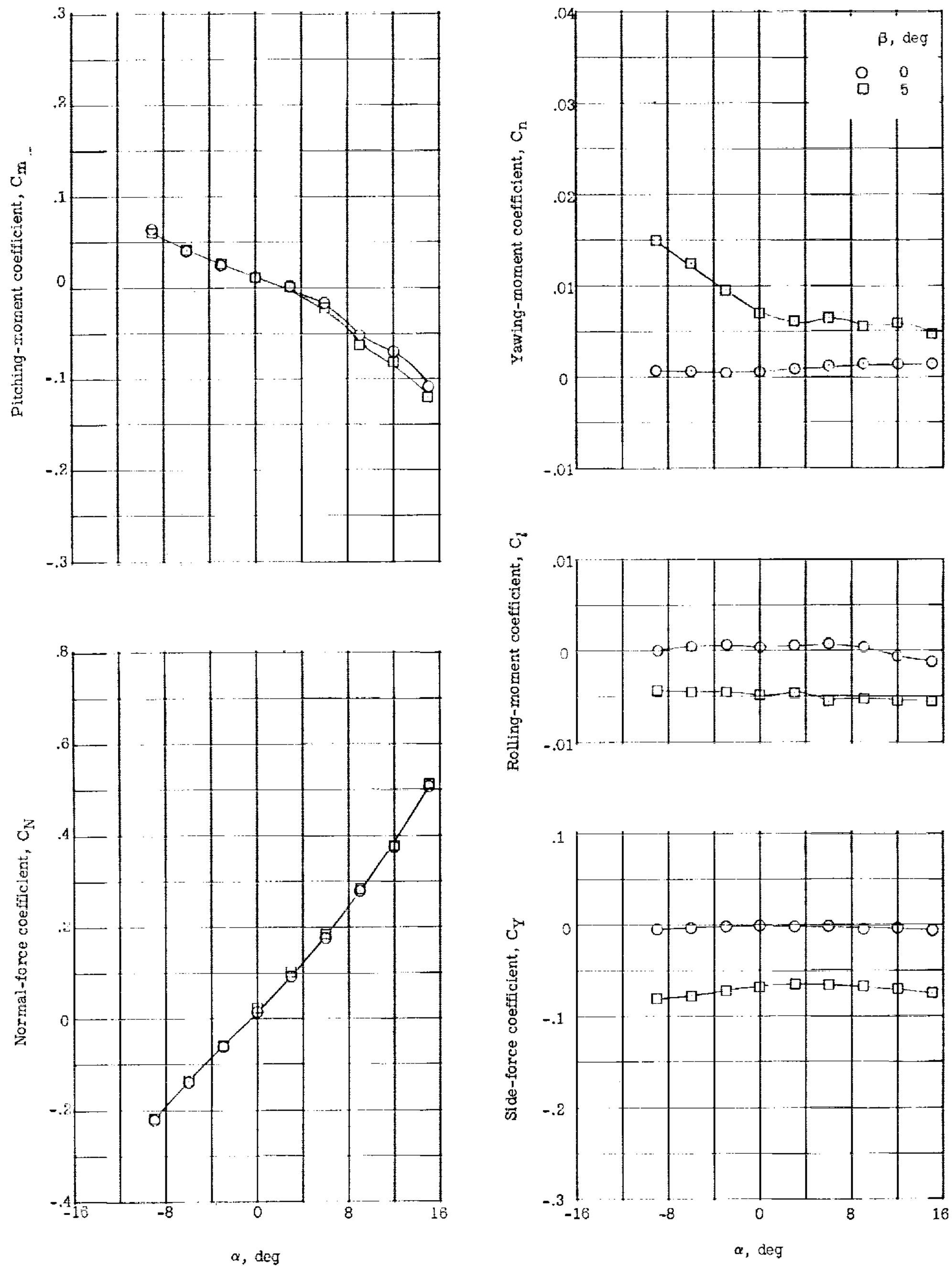
L-188



(c) Concluded.

Figure 9.- Continued.

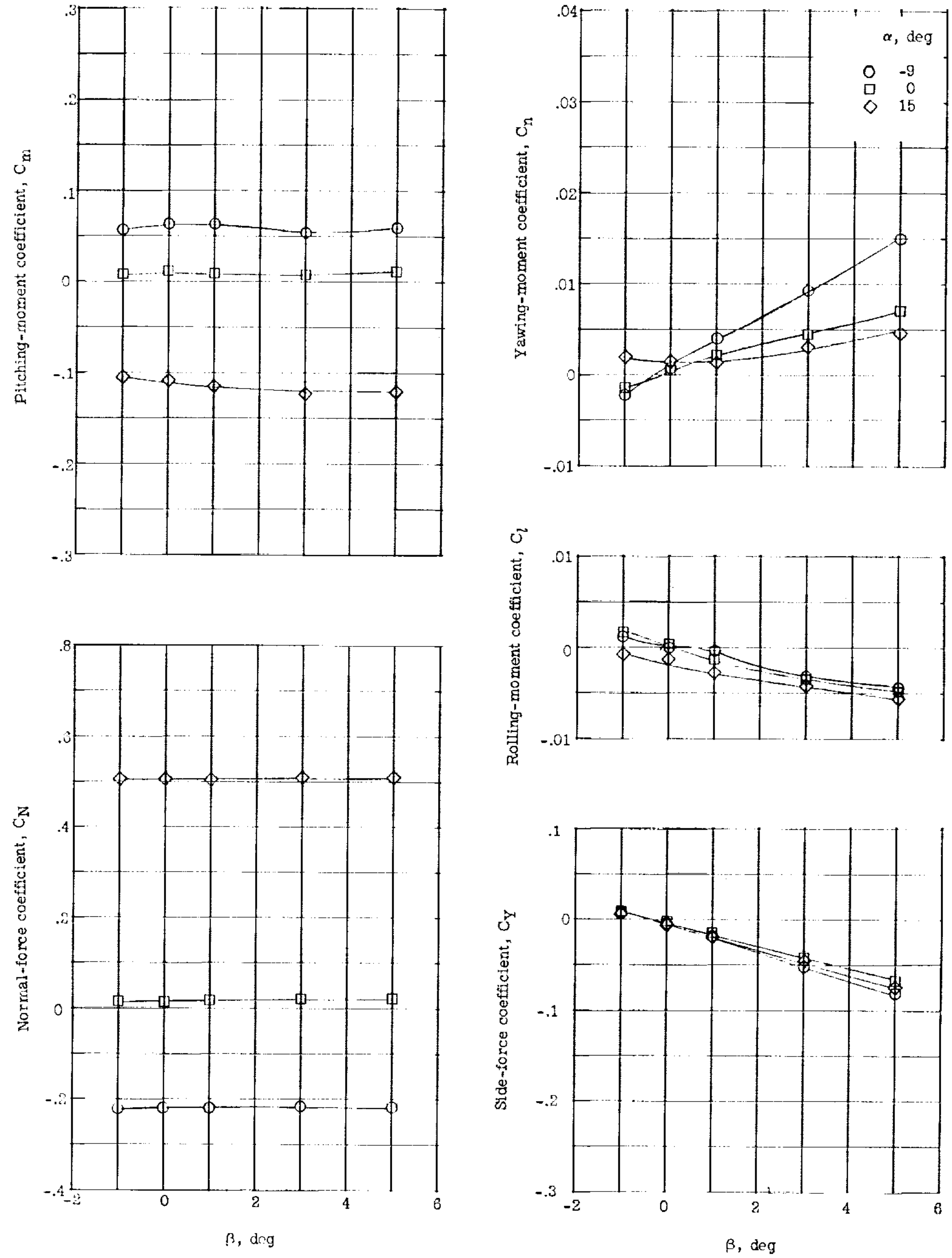
L-188



(d) Four fixed fins in X-arrangement.

Figure 9.- Continued.

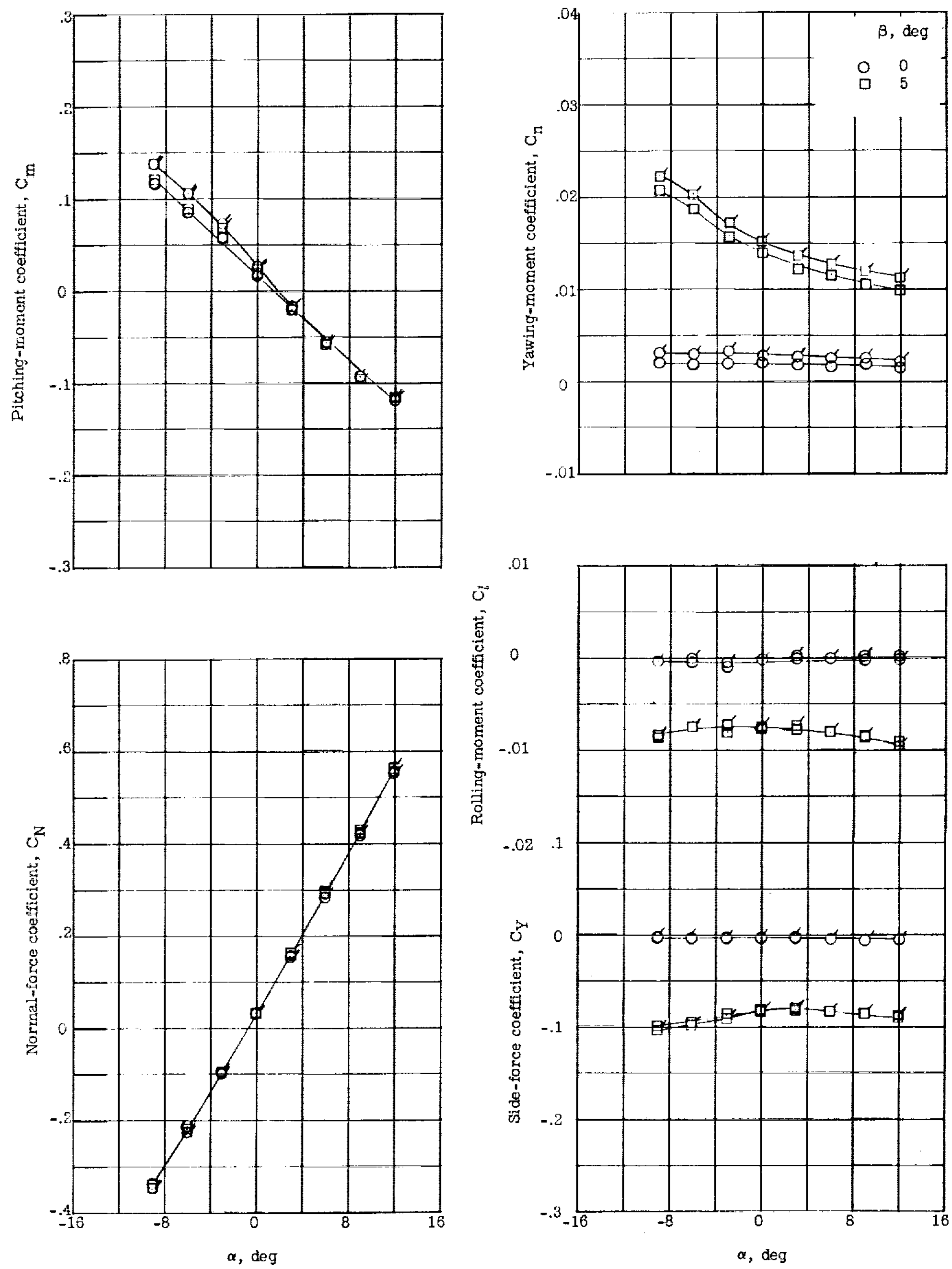
L-188



(d) Concluded.

Figure 9.- Concluded.

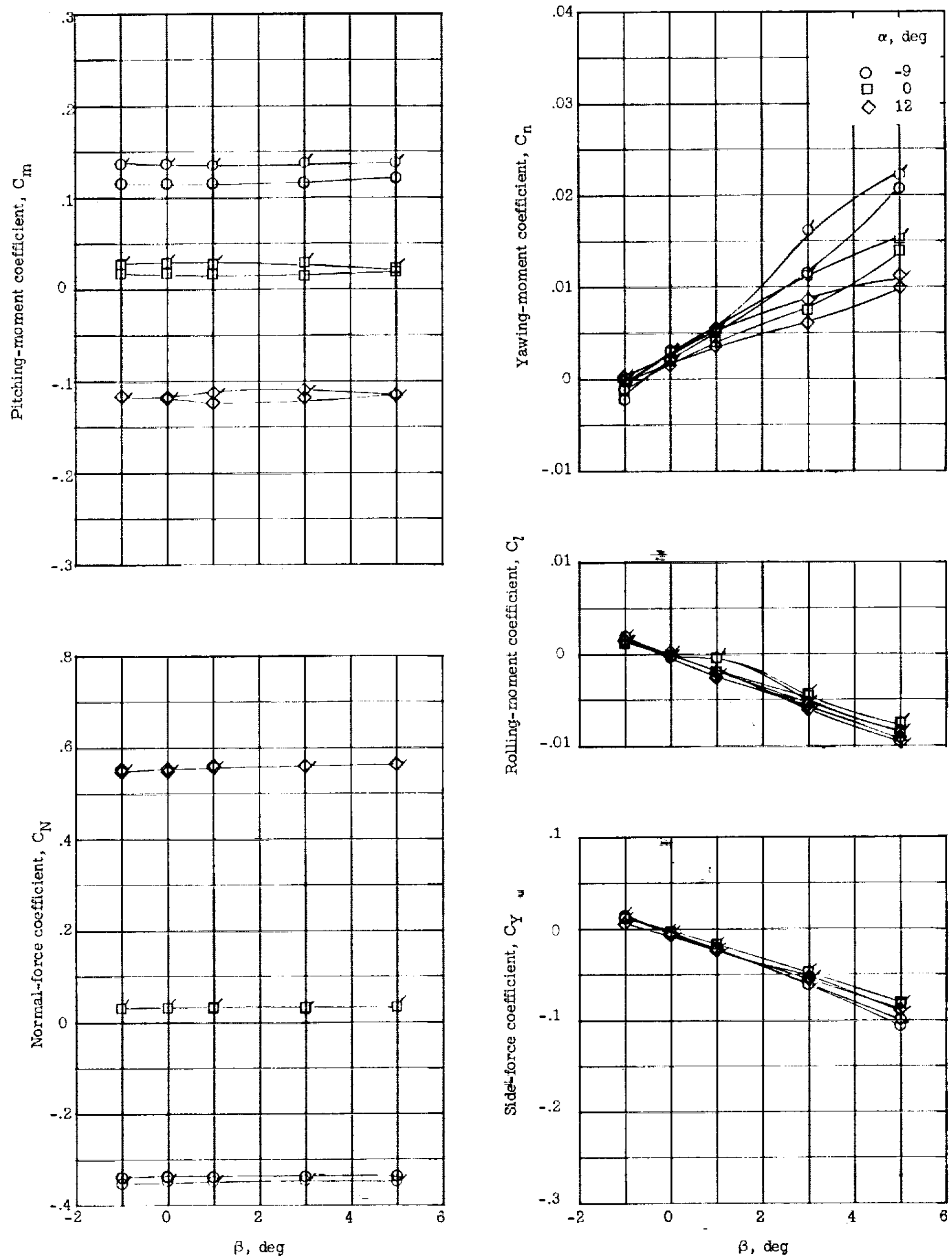
L-188



(a) One jettisonable ventral fin.

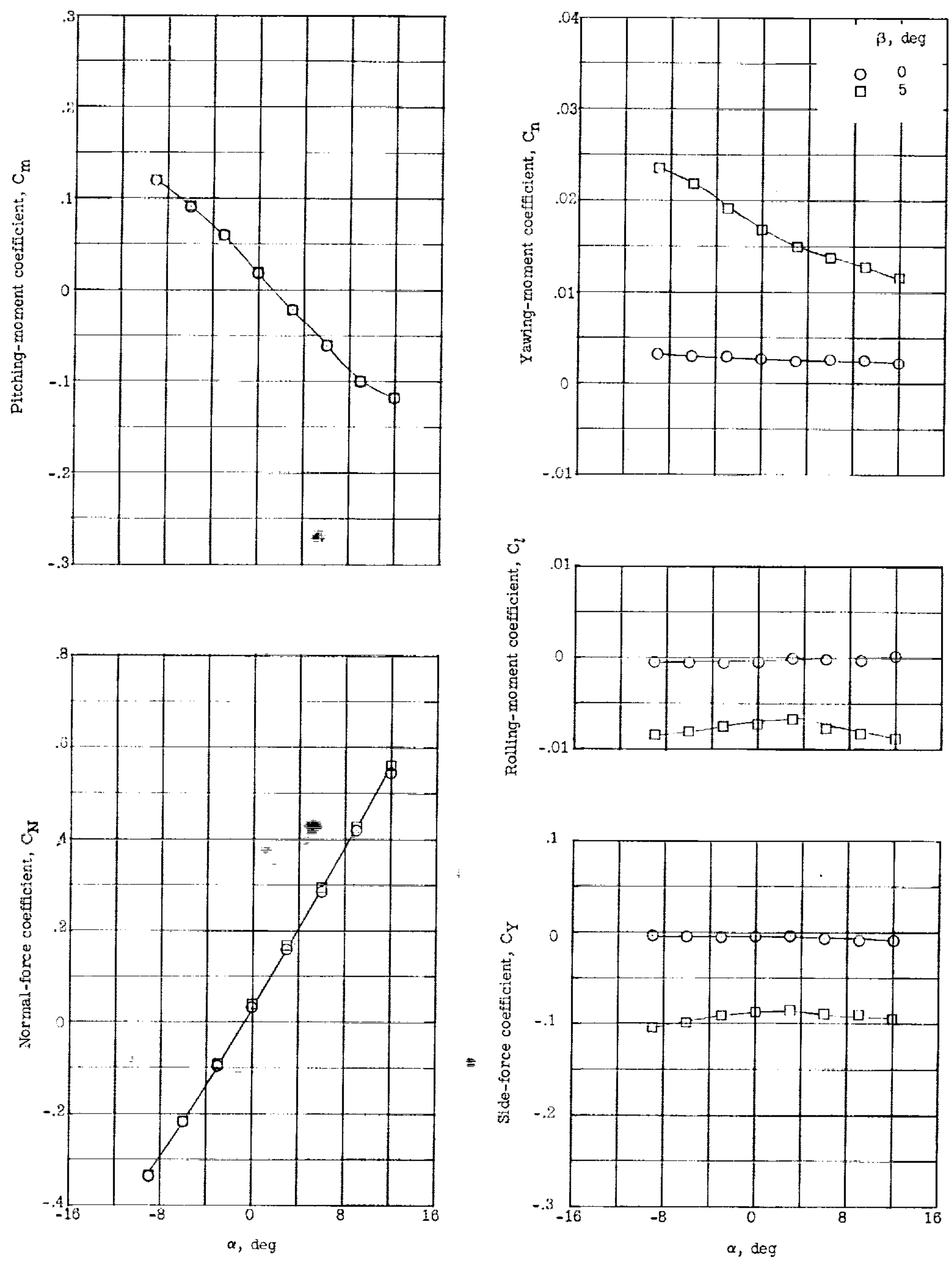
Figure 10.- Aerodynamic characteristics of the X-1E airplane having jettisonable-fin arrangements at $M = 2.37$. Flagged symbols indicate fixed boundary-layer transition data.

L-188



(a) Concluded.

Figure 10.- Continued.

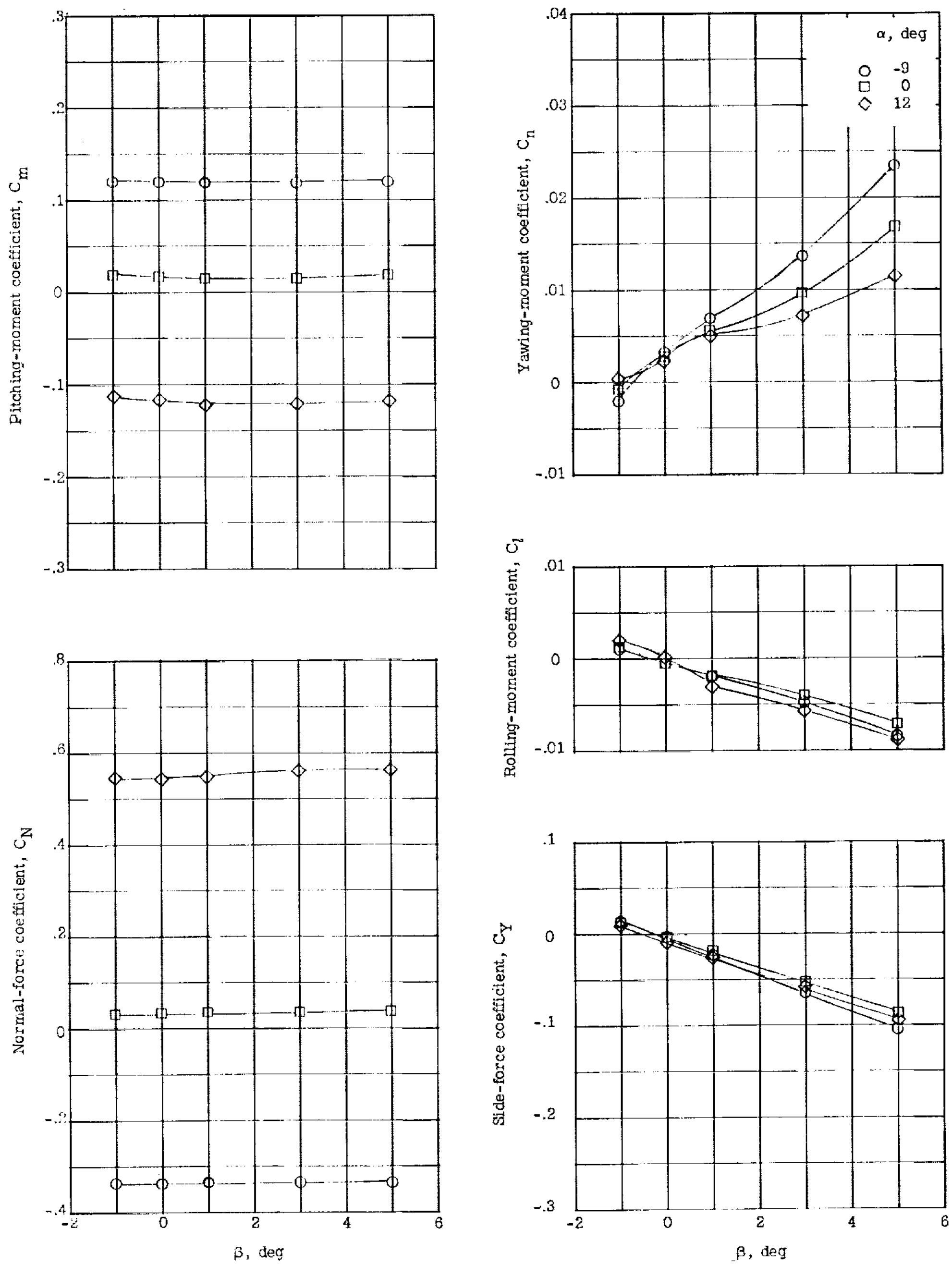


(b) One 15° wedge jettisonable fin.

Figure 10.- Continued.

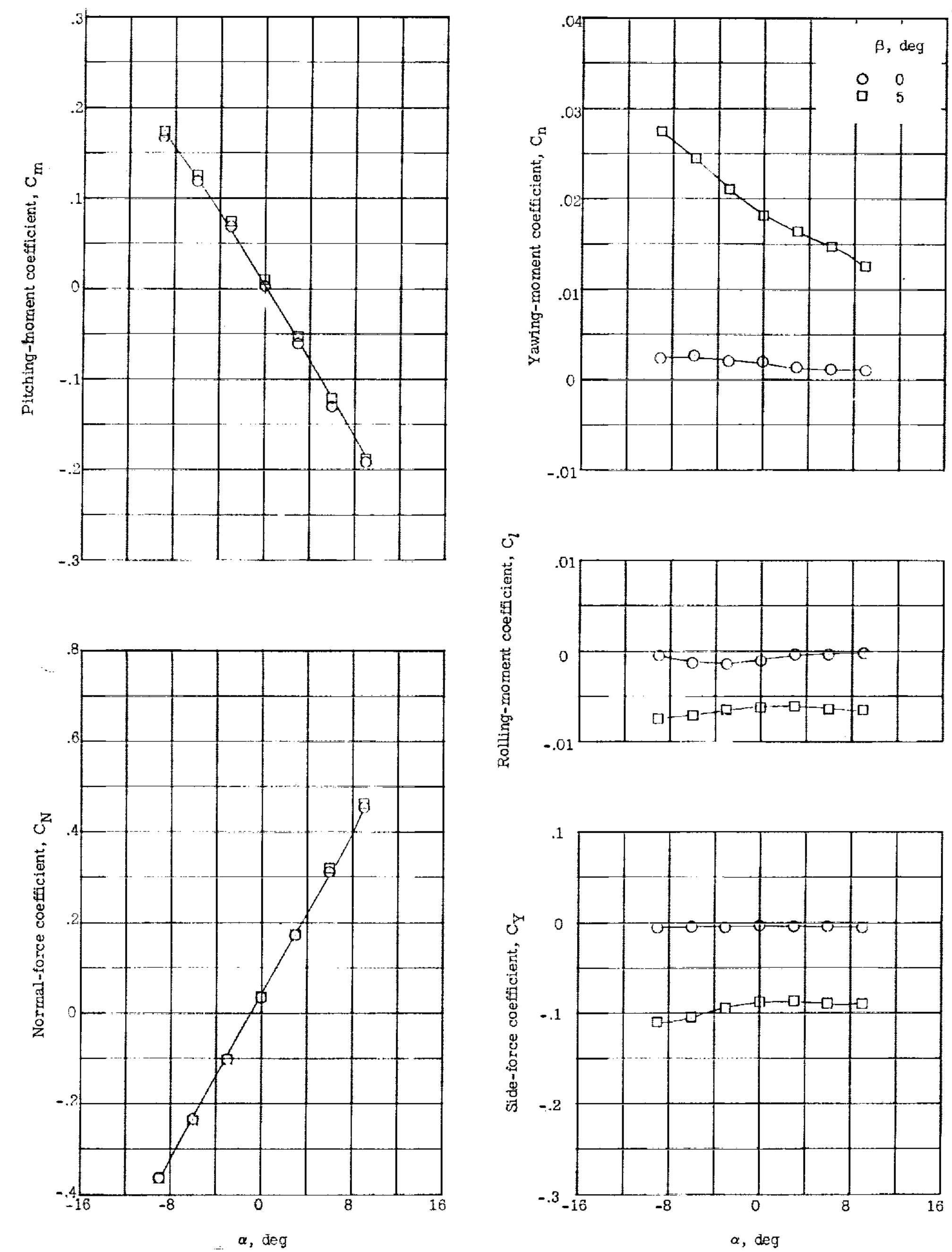
L-188

L-188



(b) Concluded.

Figure 10.- Continued.

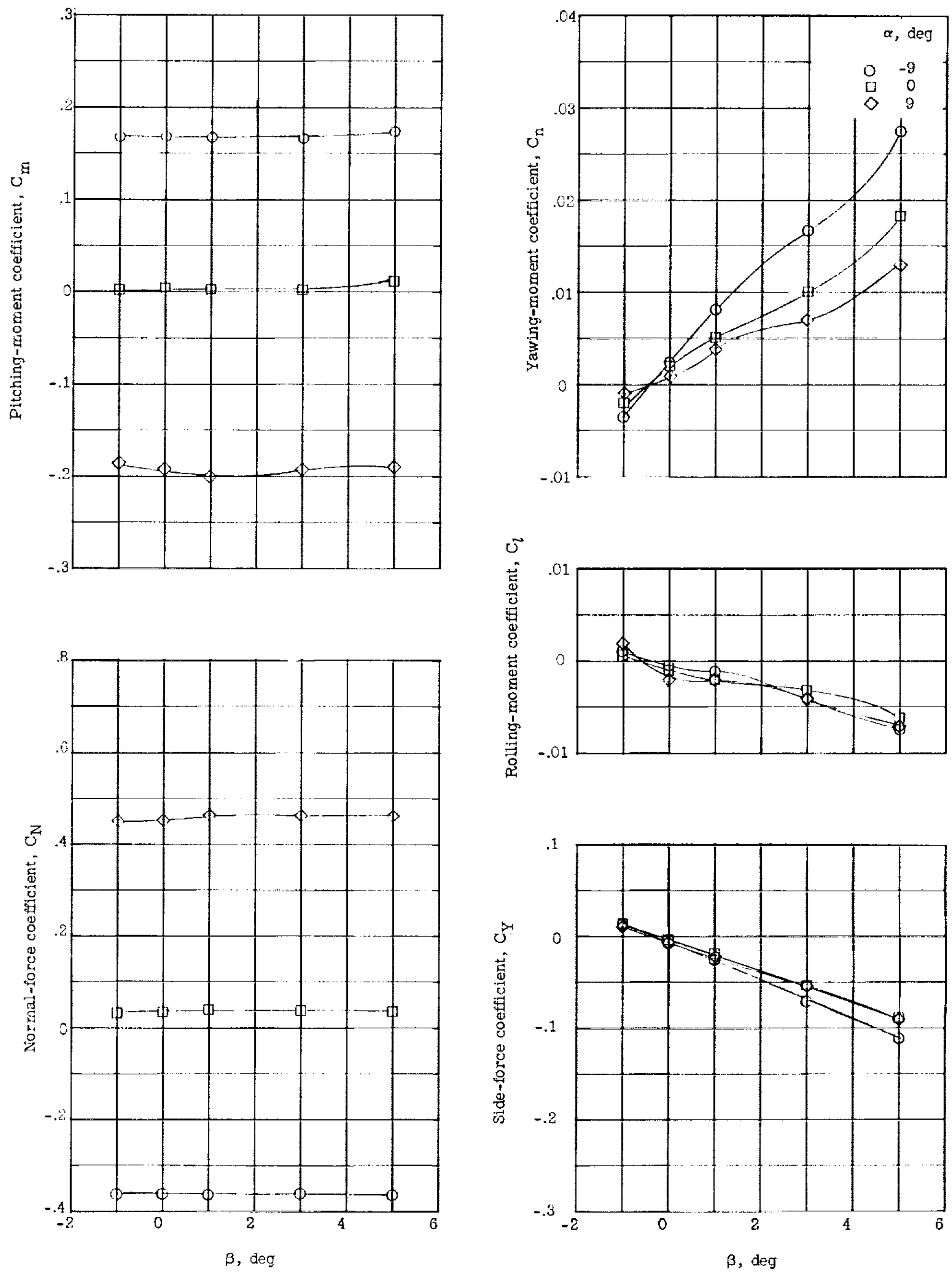


(c) Two jettisonable ventral fins.

Figure 10.- Continued.

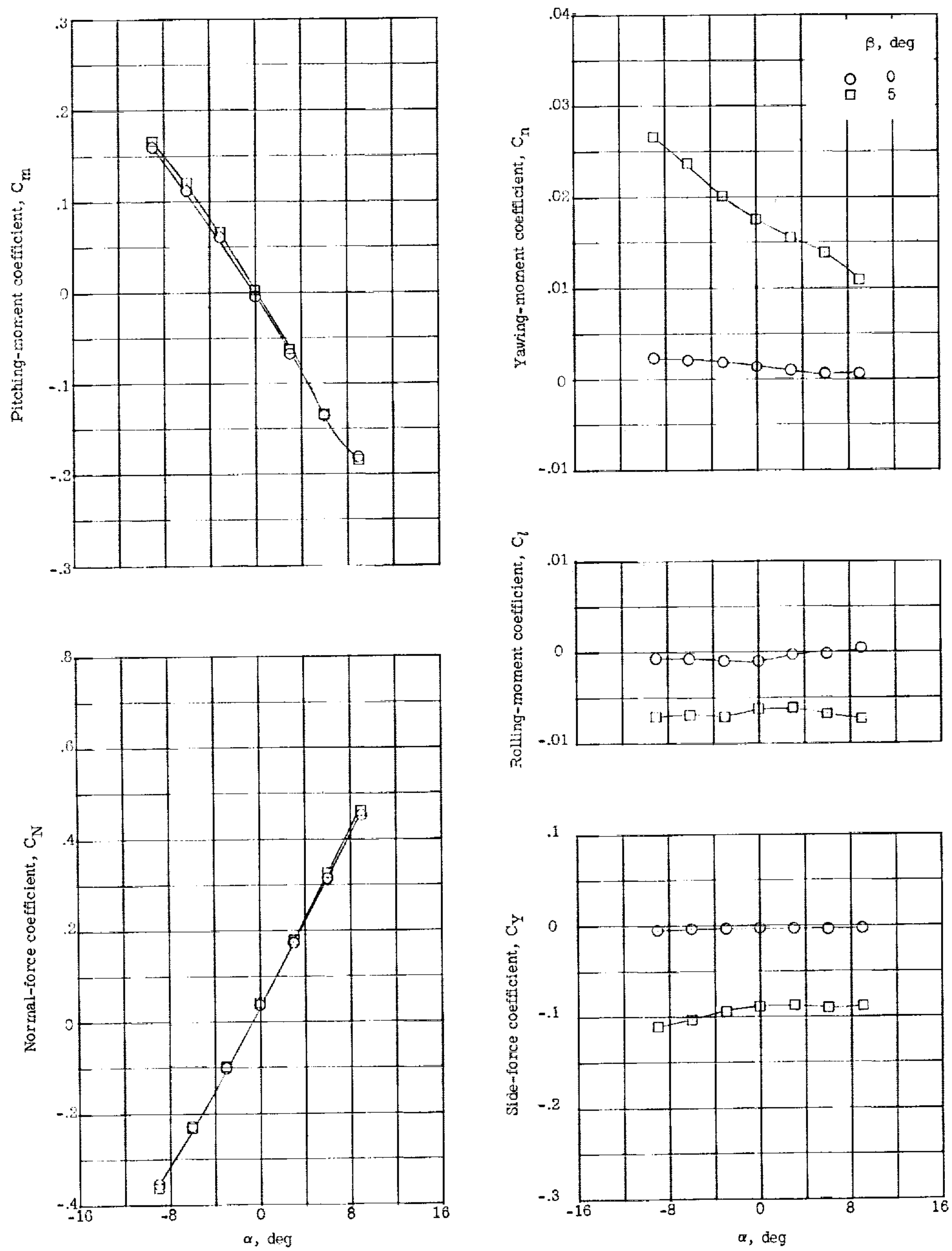
L-188

L-188



(c) Concluded.

Figure 10.- Continued.

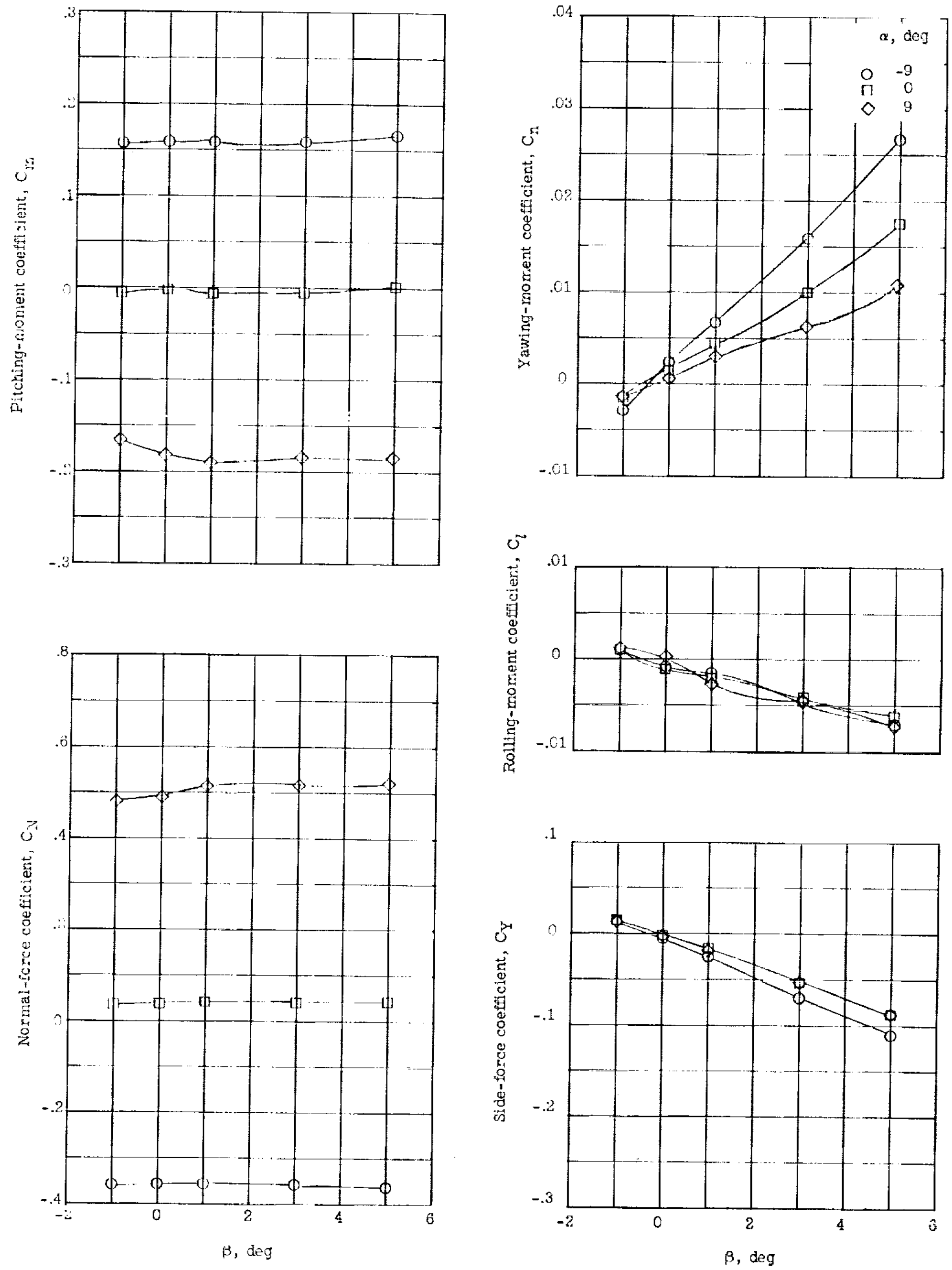


(d) Three jettisonable ventral fins.

Figure 10.- Continued.

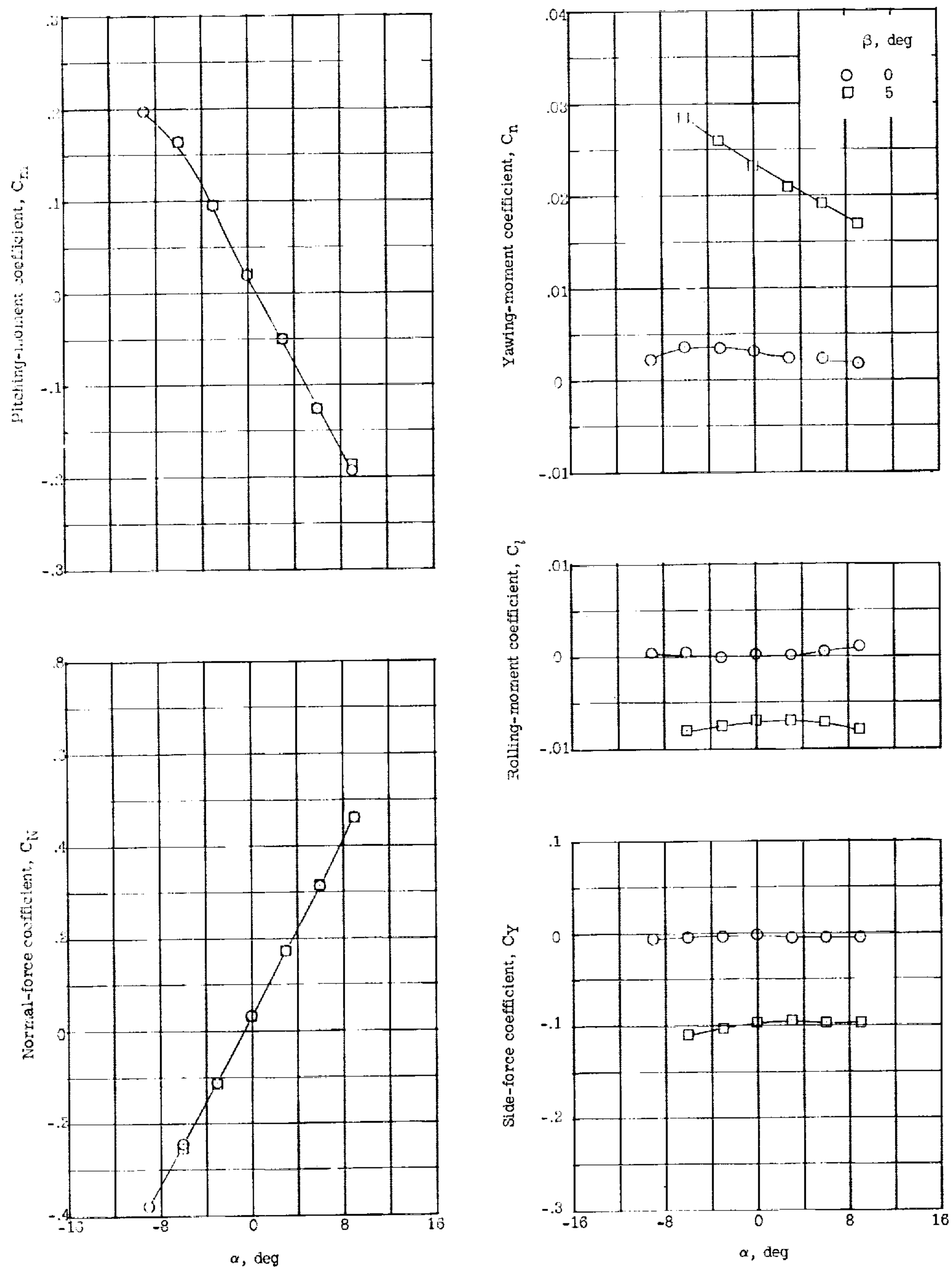
L-188

L-188



(d) Concluded.

Figure 10.- Continued.

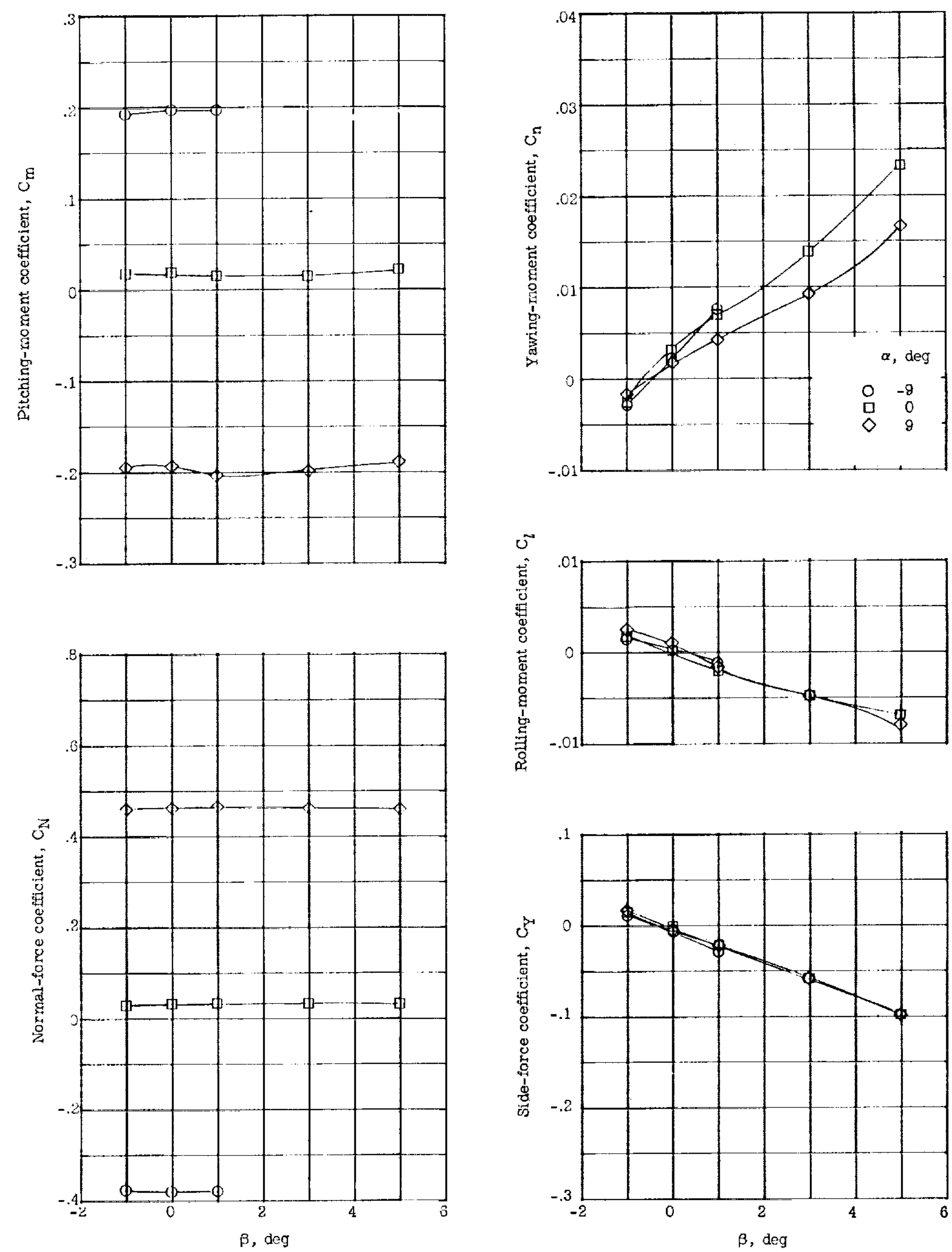


(e) Four jettisonable fins in X-arrangement.

Figure 10.- Continued.

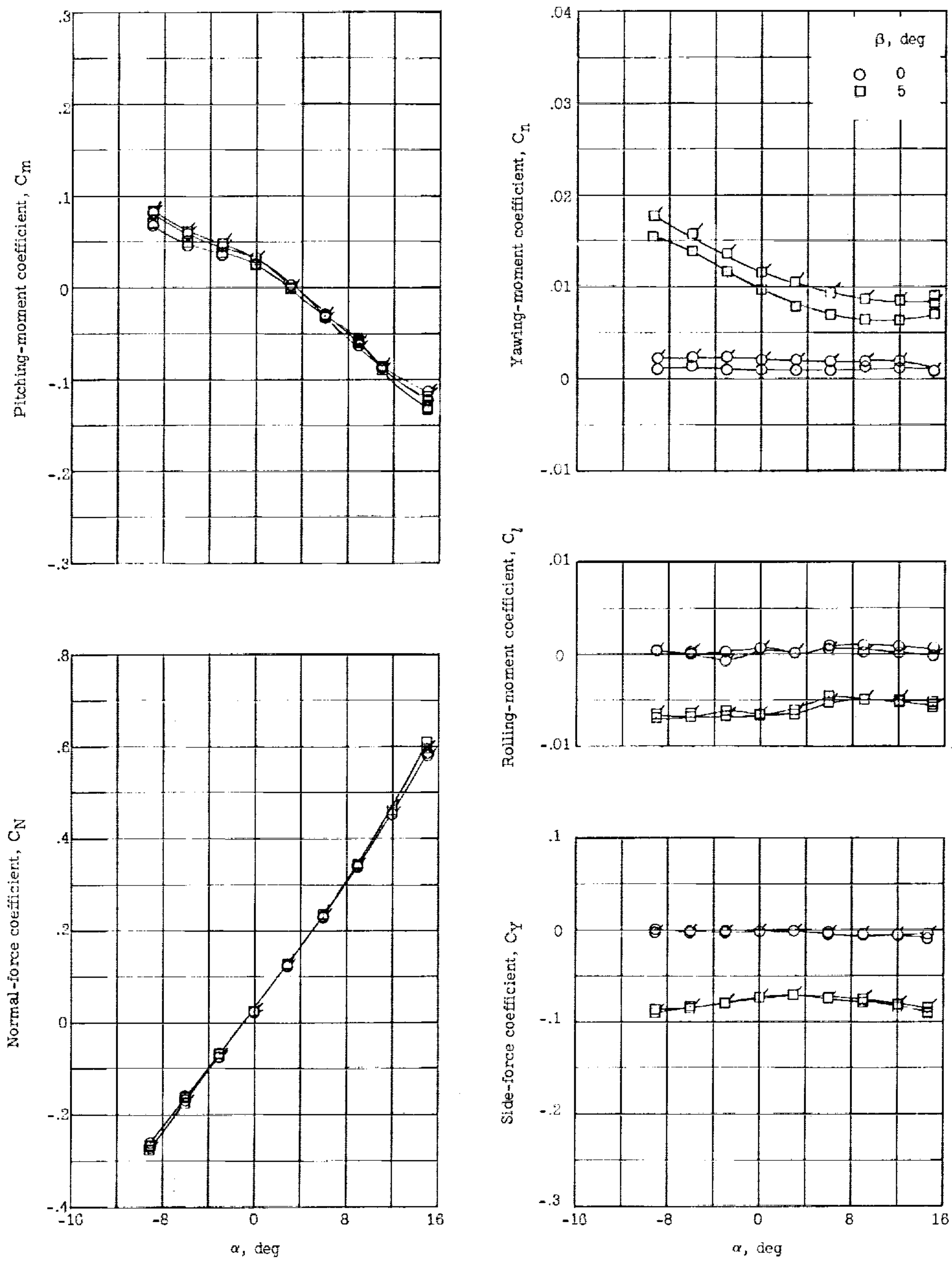
L-188

L-188



(e) Concluded.

Figure 10.- Concluded.

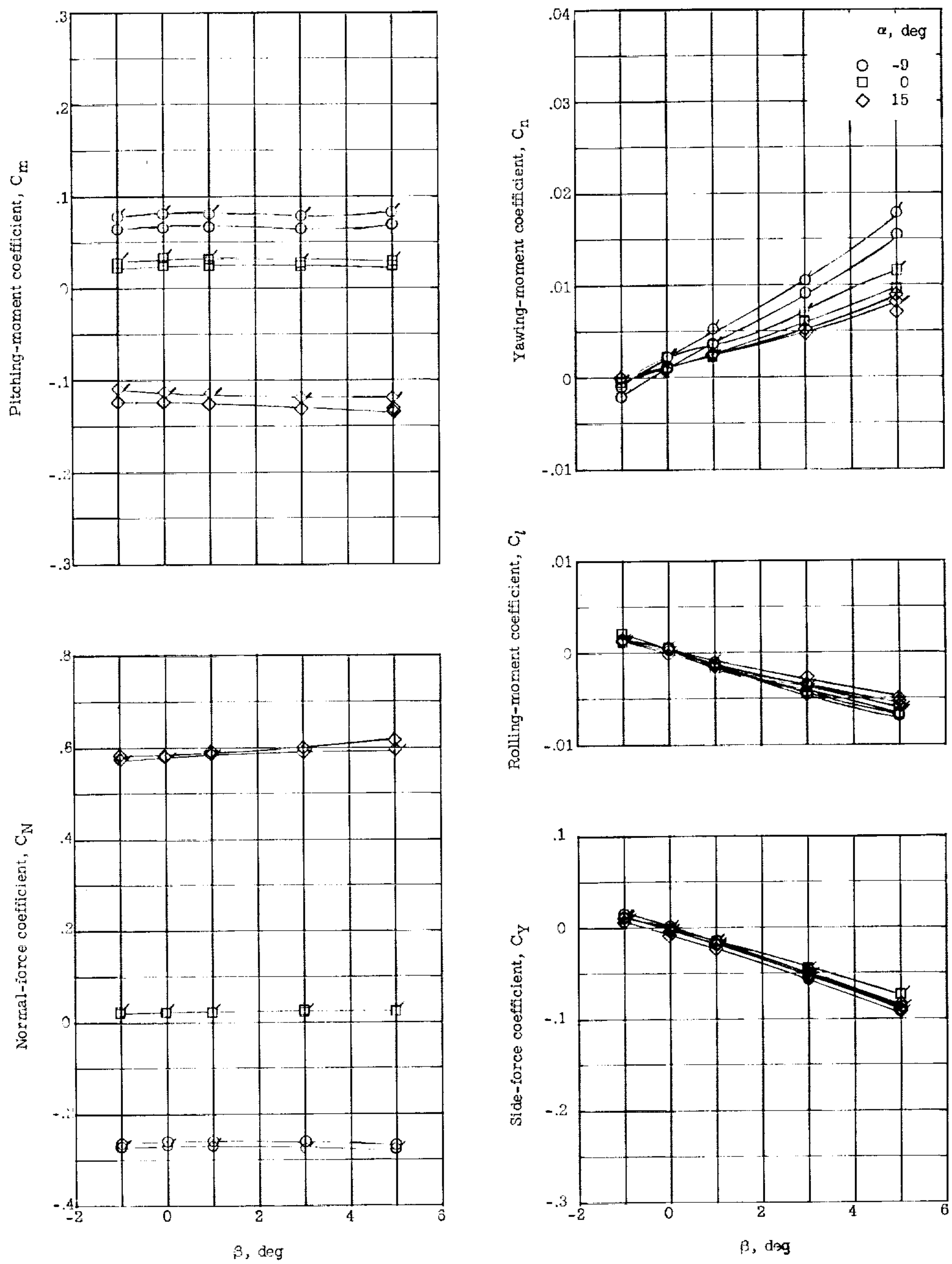


(a) One jettisonable ventral fin.

Figure 11.- Aerodynamic characteristics of the X-1E airplane having jettisonable-fin arrangements at M = 2.98. Flagged symbols indicate fixed boundary-layer transition data.

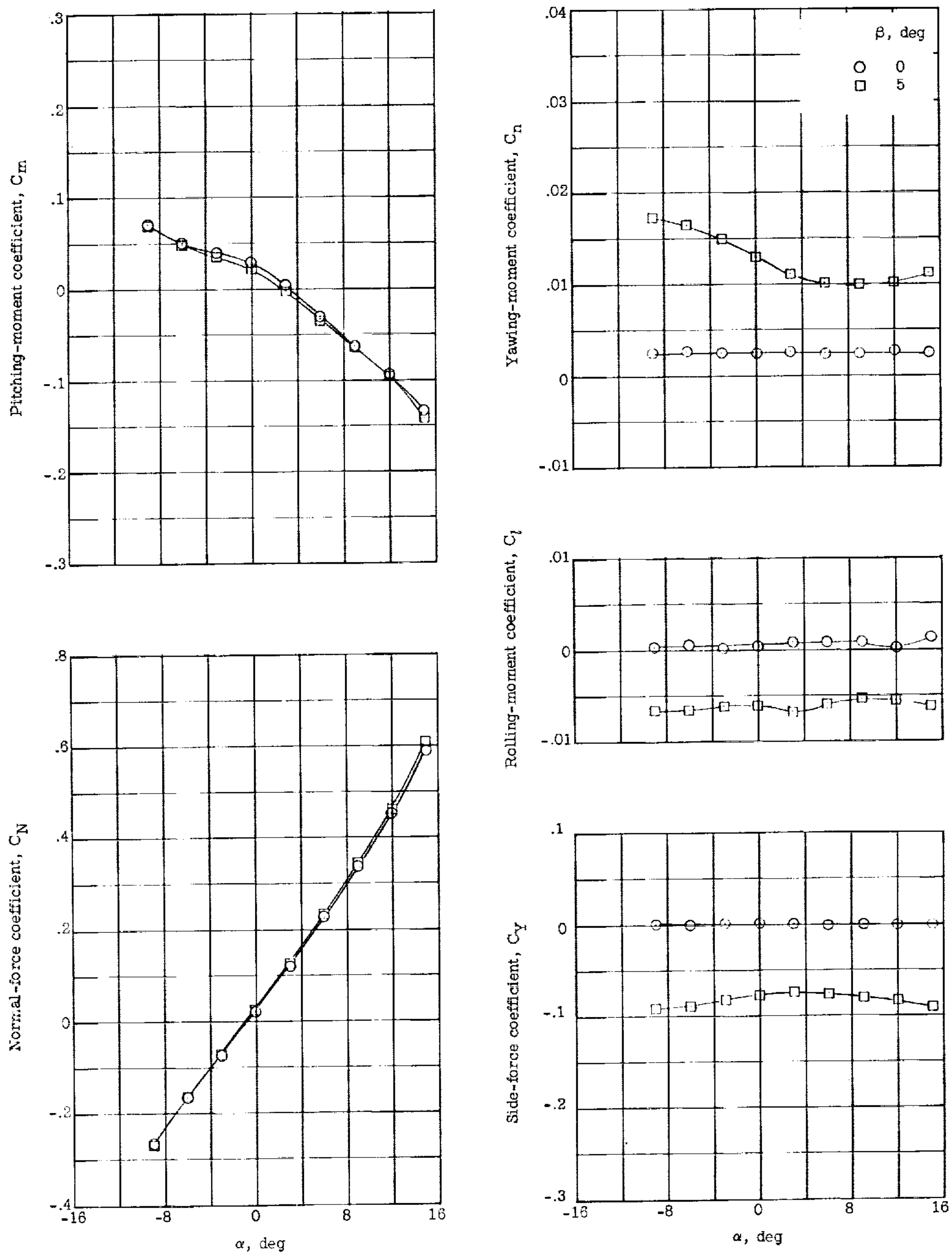
L-188

L-188



(a) Concluded.

Figure 11.- Continued.

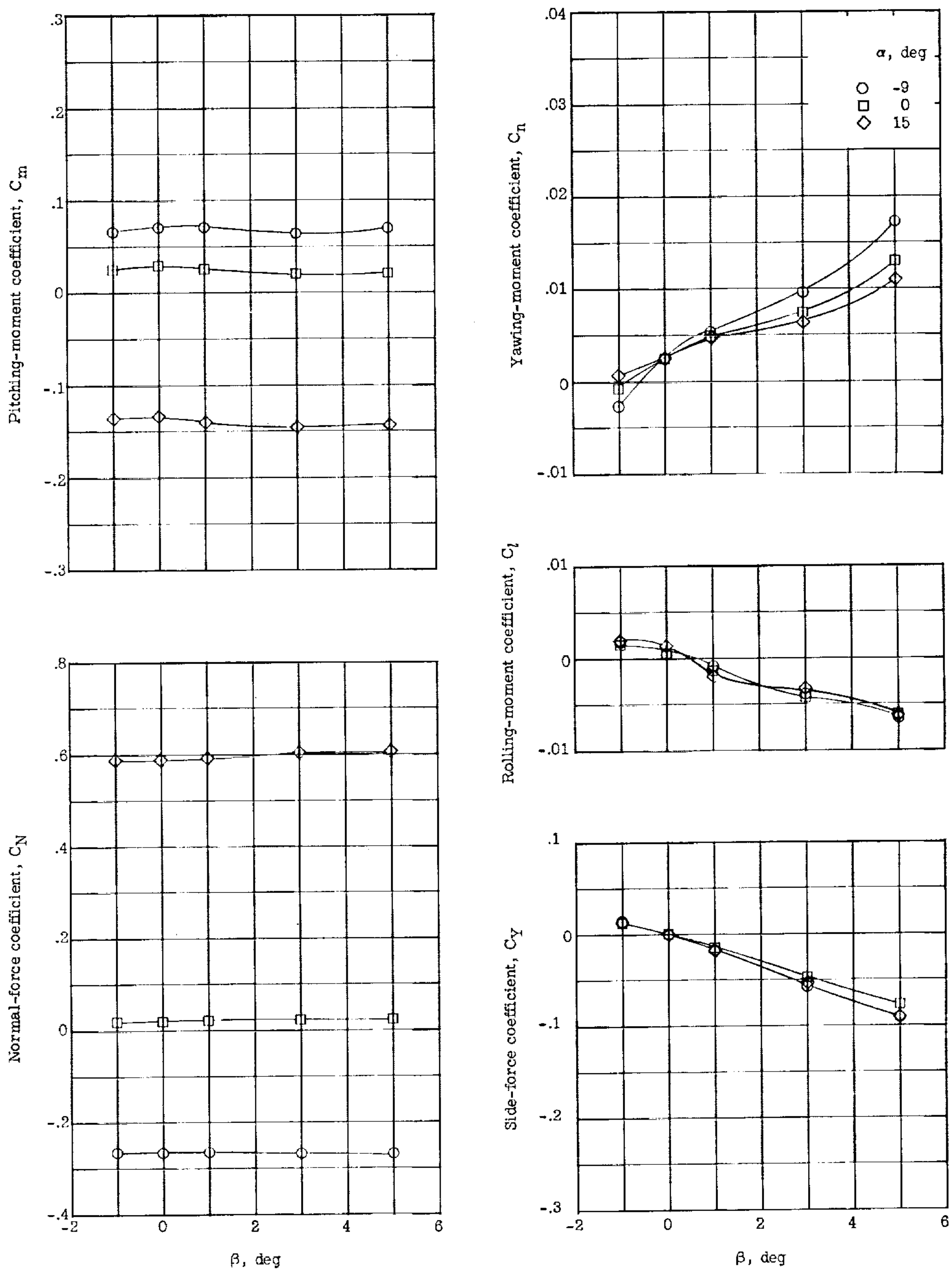


L-188

(b) One 15° wedge jettisonable ventral fin.

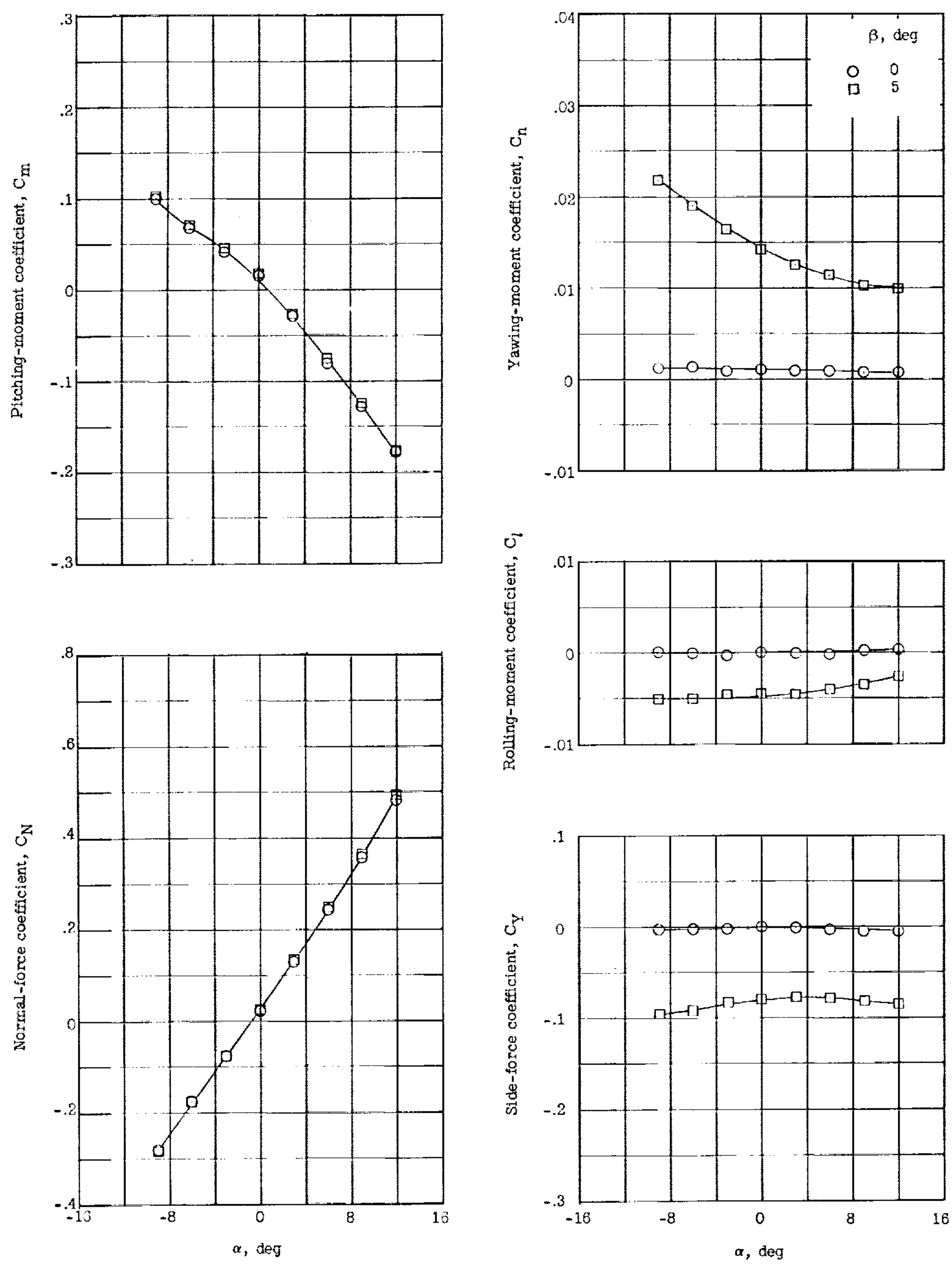
Figure 11.- Continued.

L-188



(b) Concluded.

Figure 11.- Continued.

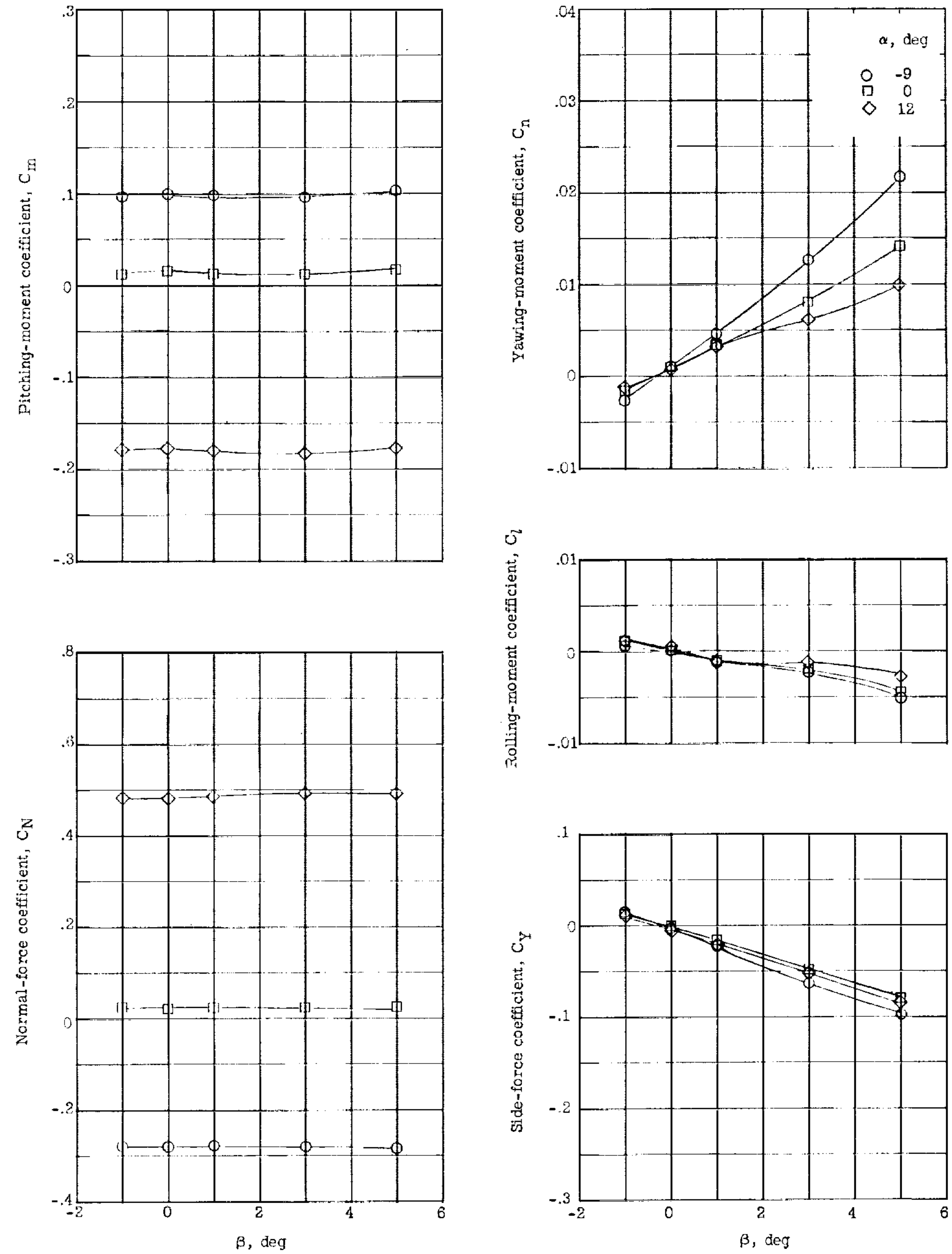


(c) Two jettisonable ventral fins.

Figure 11.- Continued.

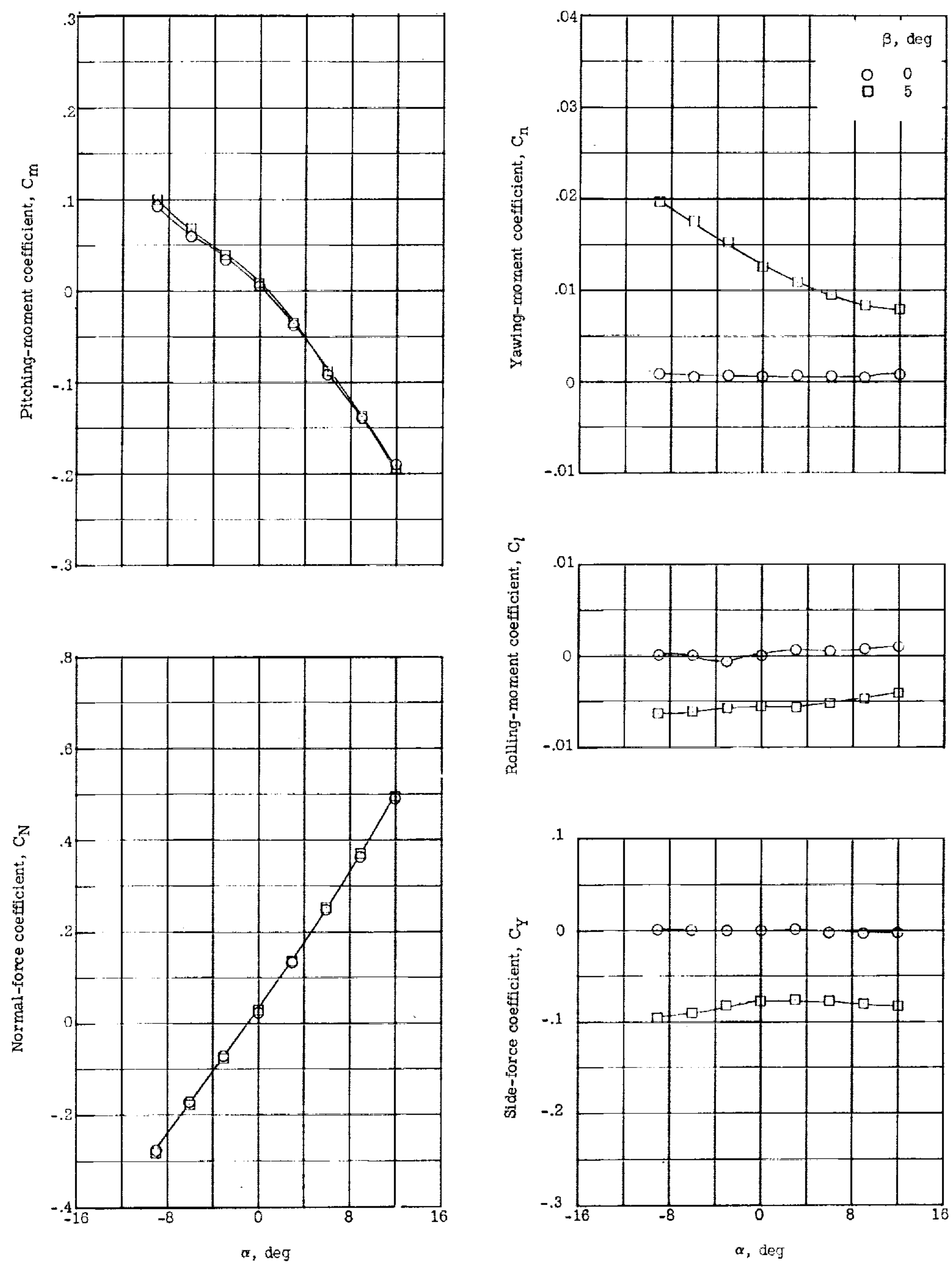
L-188

L-188



(c) Concluded.

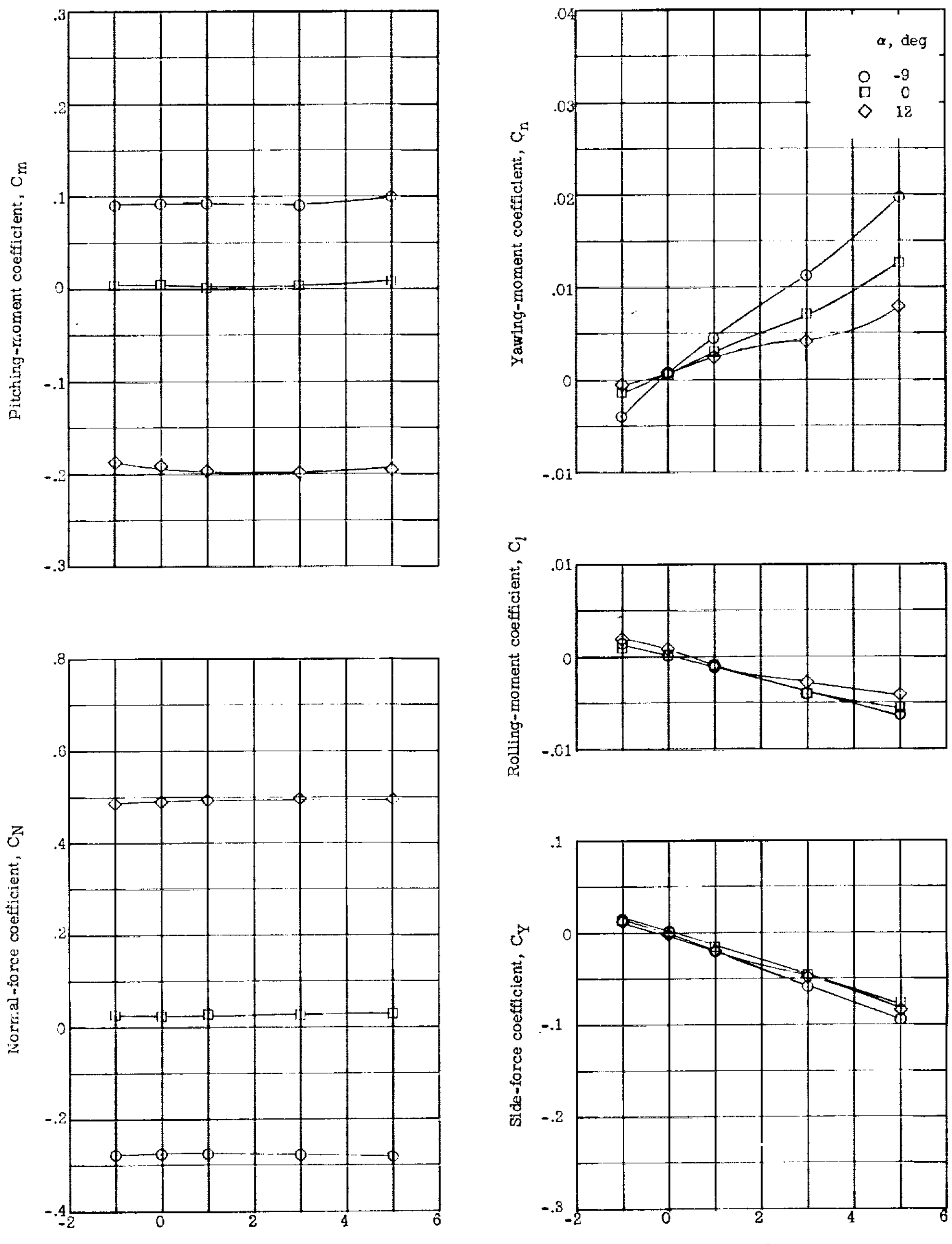
Figure 11.- Continued.



(d) Three jettisonable ventral fins.

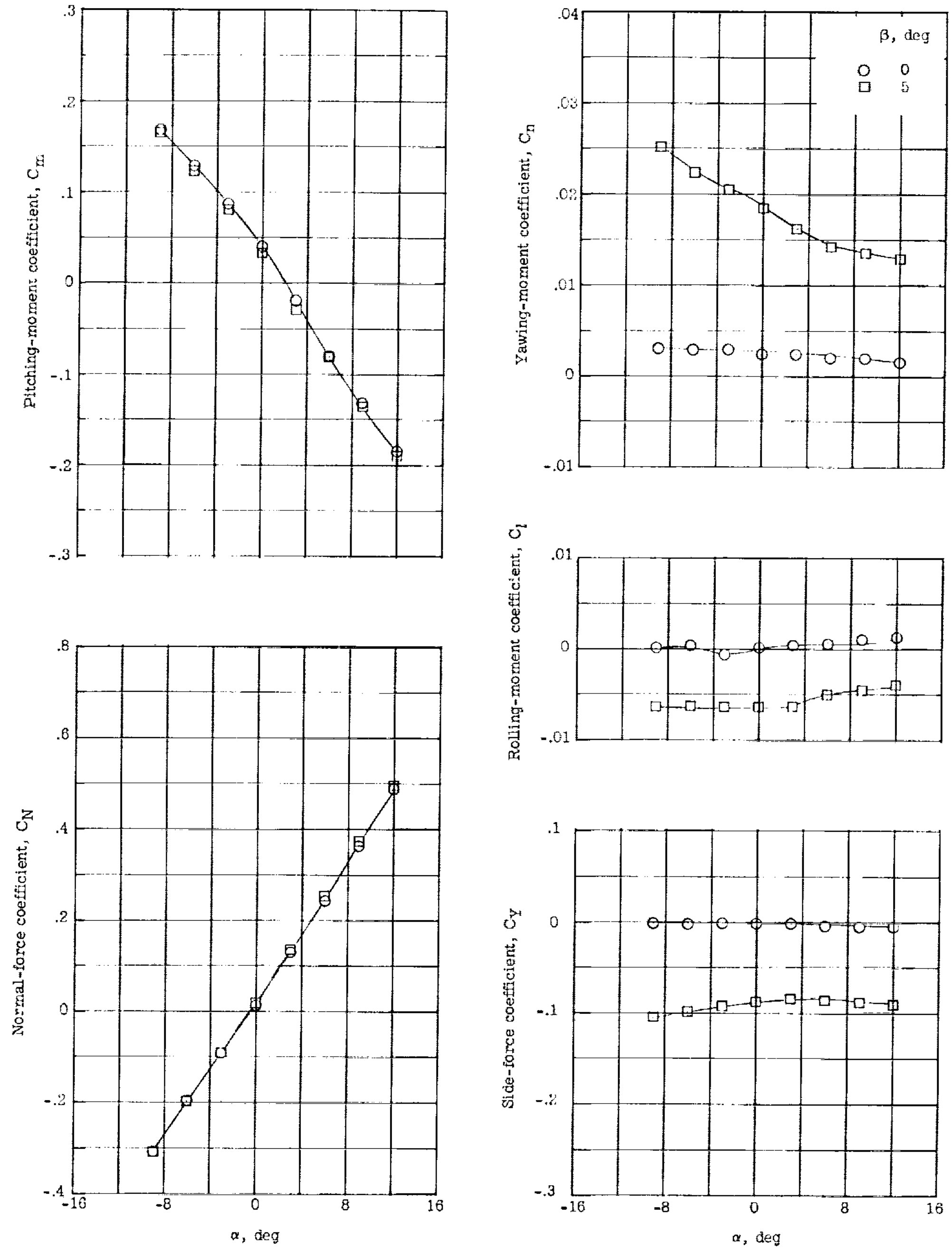
Figure 11.- Continued.

L-188



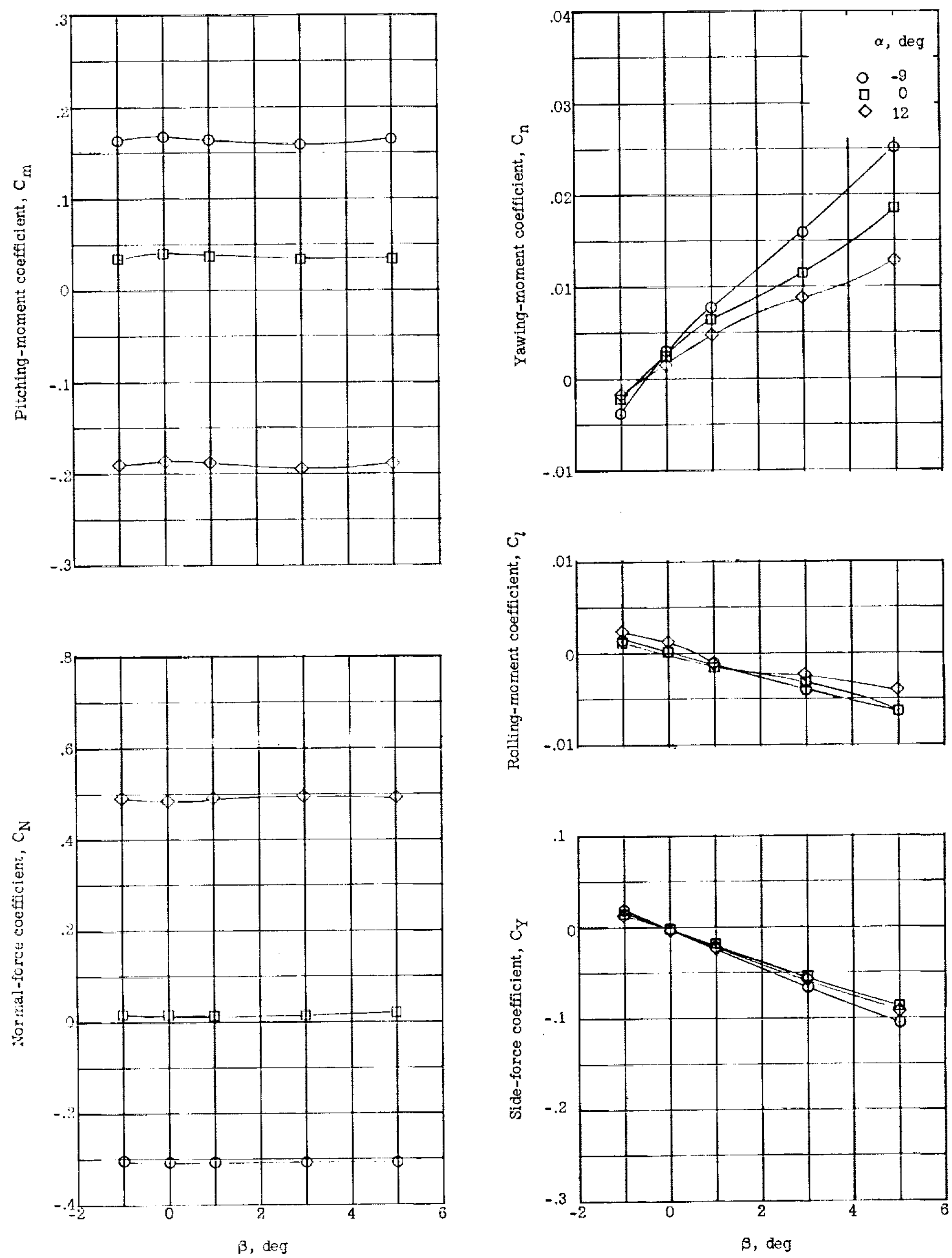
(d) Concluded.

Figure 11.- Continued.



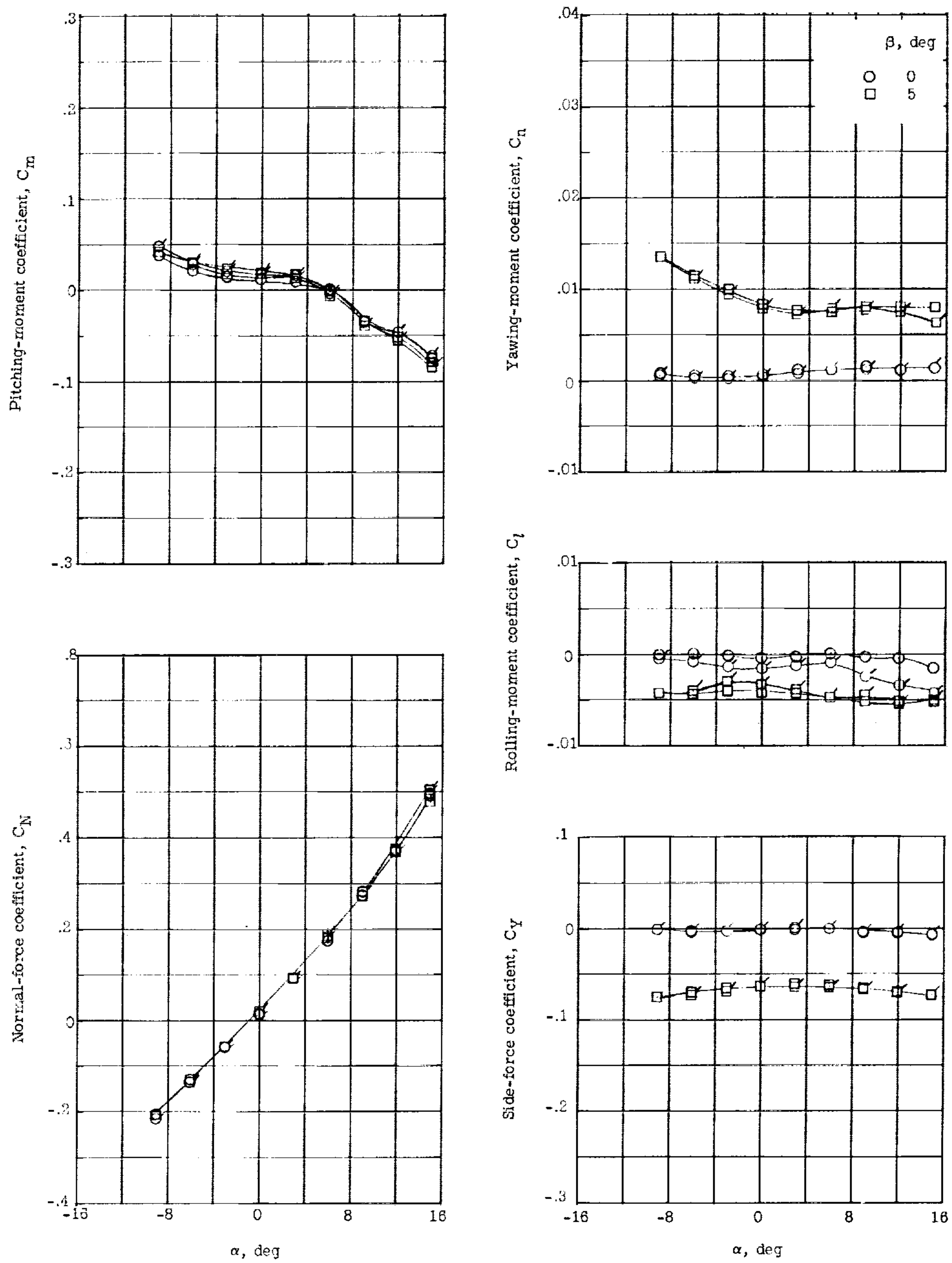
(e) Four jettisonable fins in X-arrangement.

Figure 11.- Continued.



(e) Concluded.

Figure 11.- Concluded.

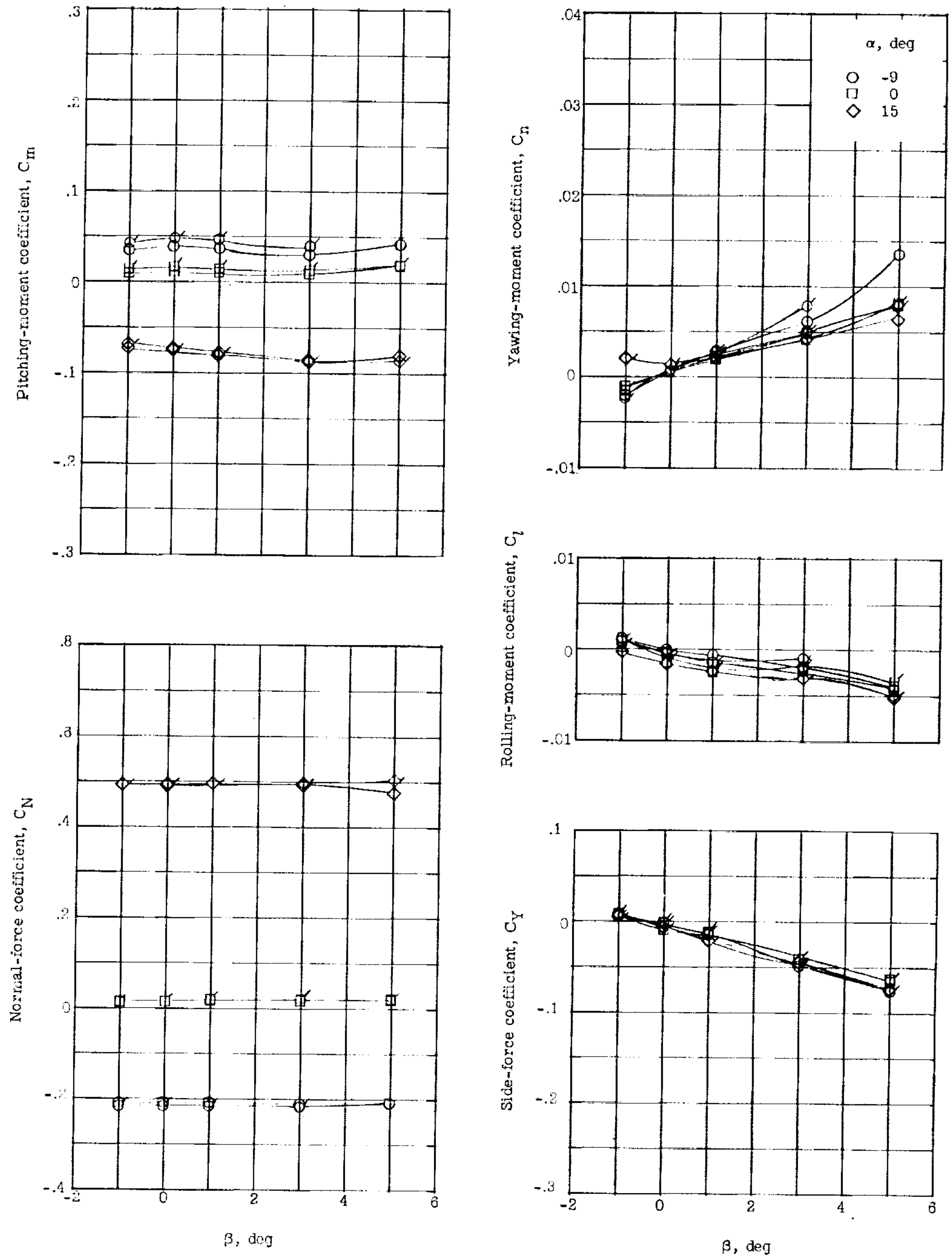


L-188

(a) One jettisonable ventral fin.

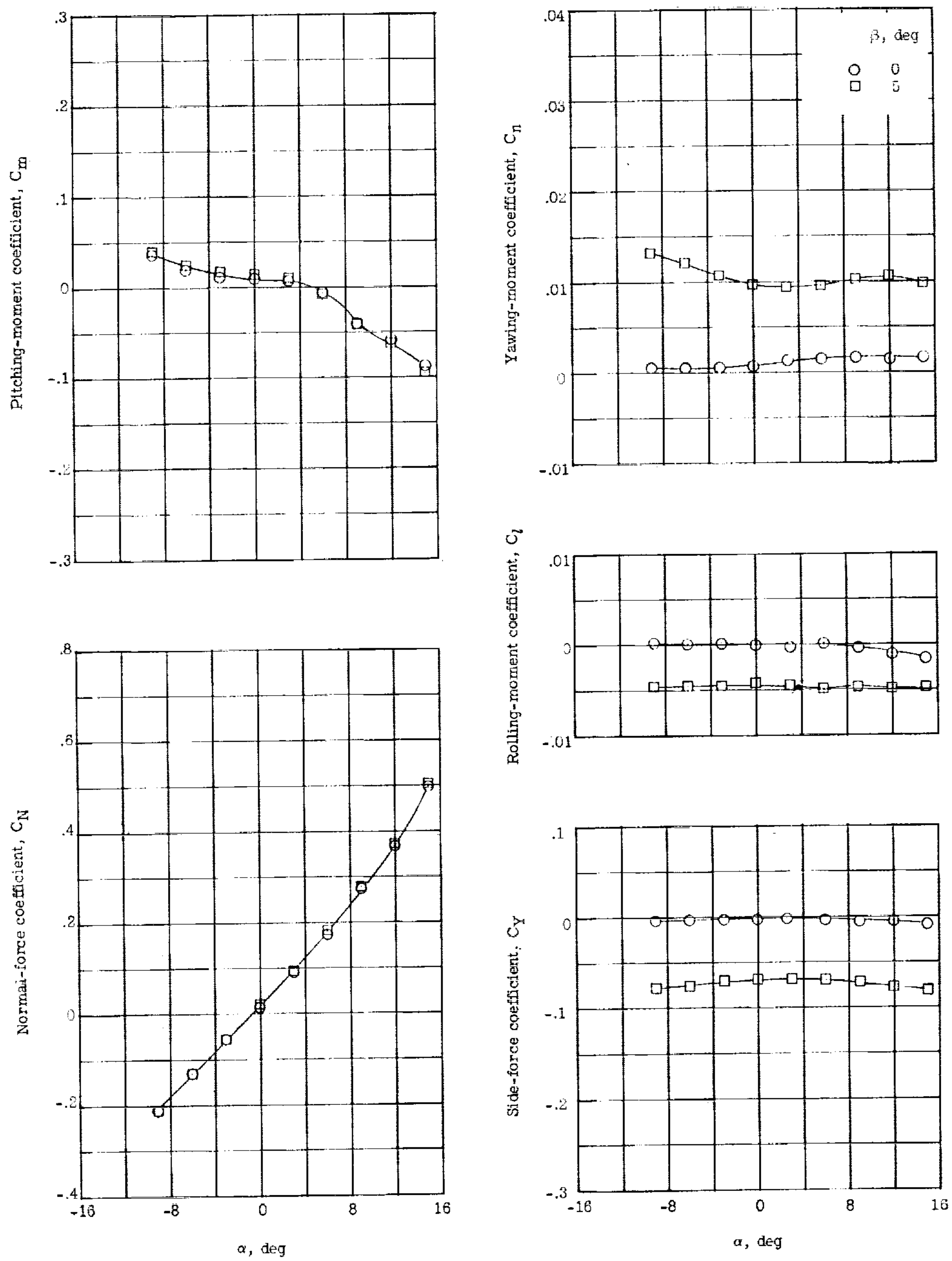
Figure 12.- Aerodynamic characteristics of the X-1E airplane having jettisonable-fin arrangements at M = 4.01. Flagged symbols indicate fixed boundary-layer transition data.

L-188



(a) Concluded.

Figure 12.- Continued.

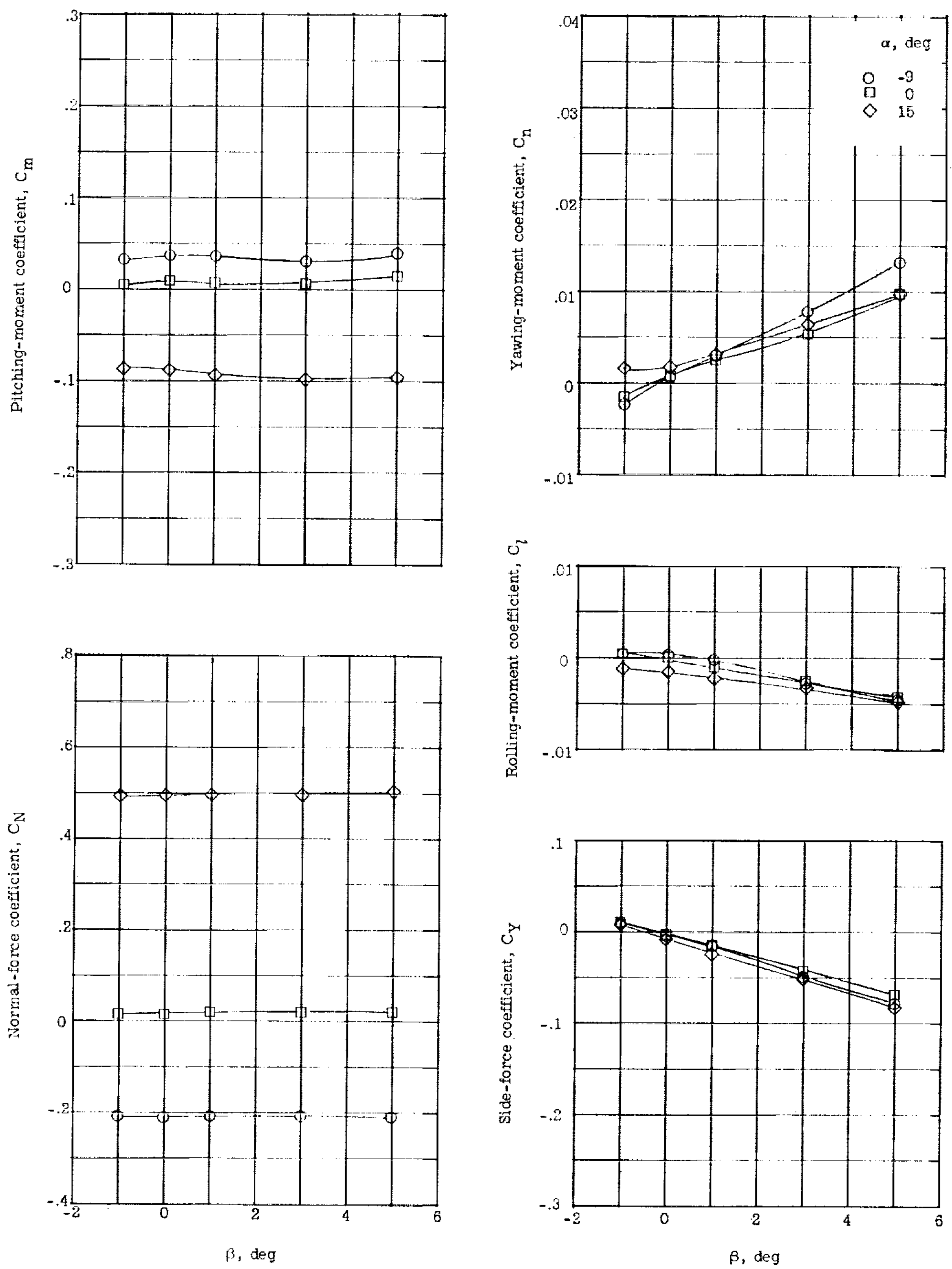


(b) One 15° wedge jettisonable ventral fin.

Figure 12.- Continued.

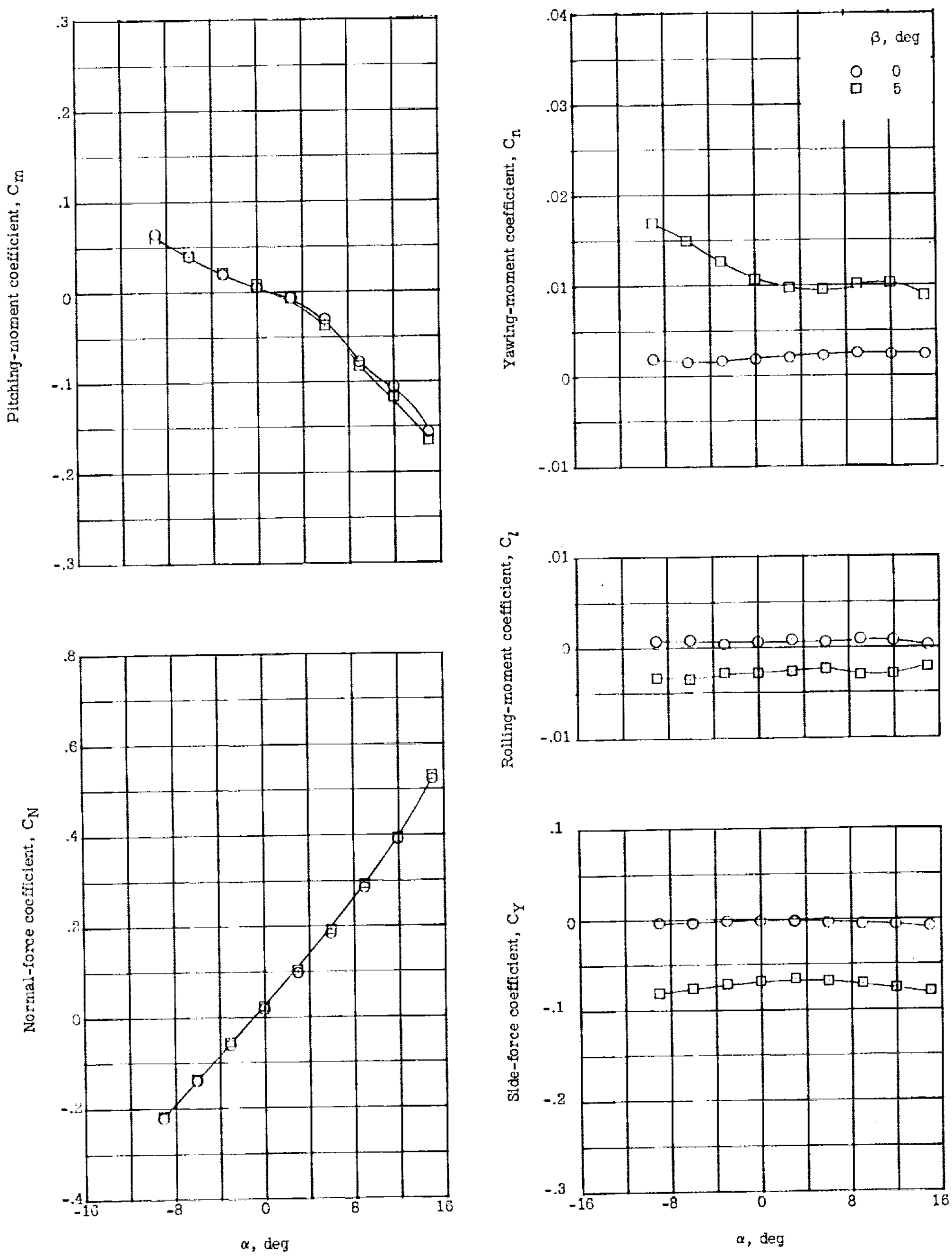
L-188

L-188



(b) Concluded.

Figure 12.- Continued.

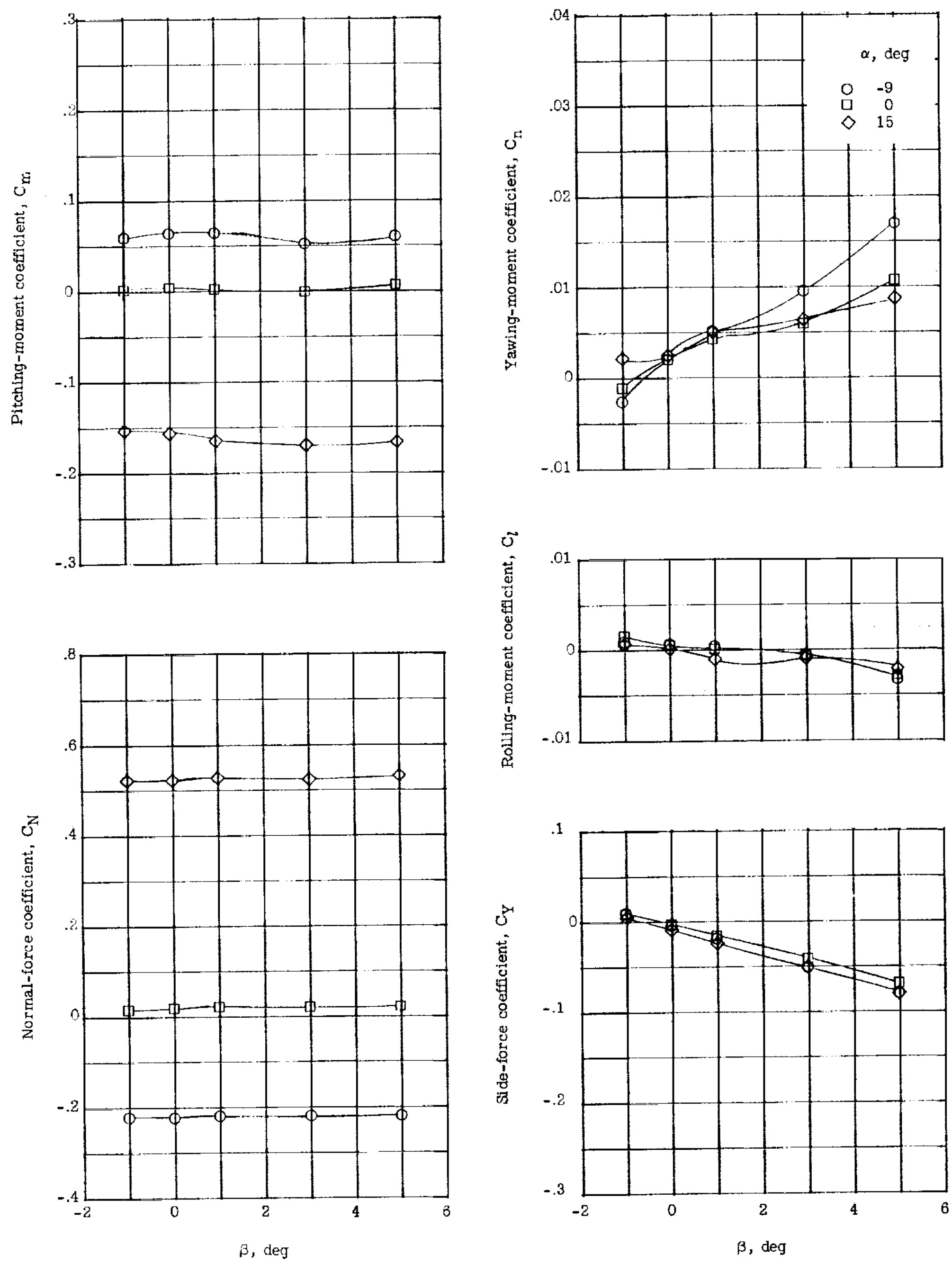


L-188

(c) Two jettisonable ventral fins.

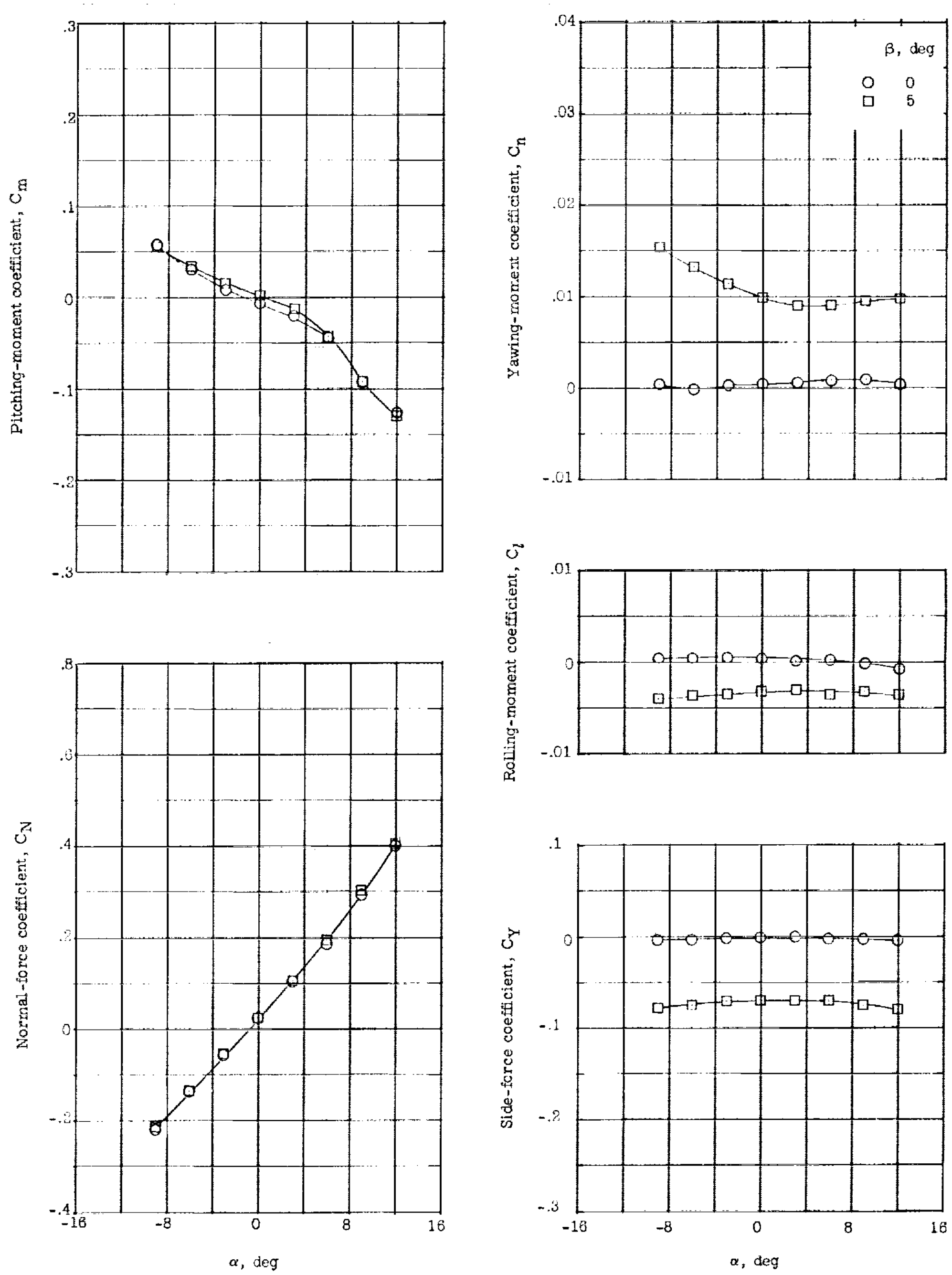
Figure 12.- Continued.

L-188



(c) Concluded.

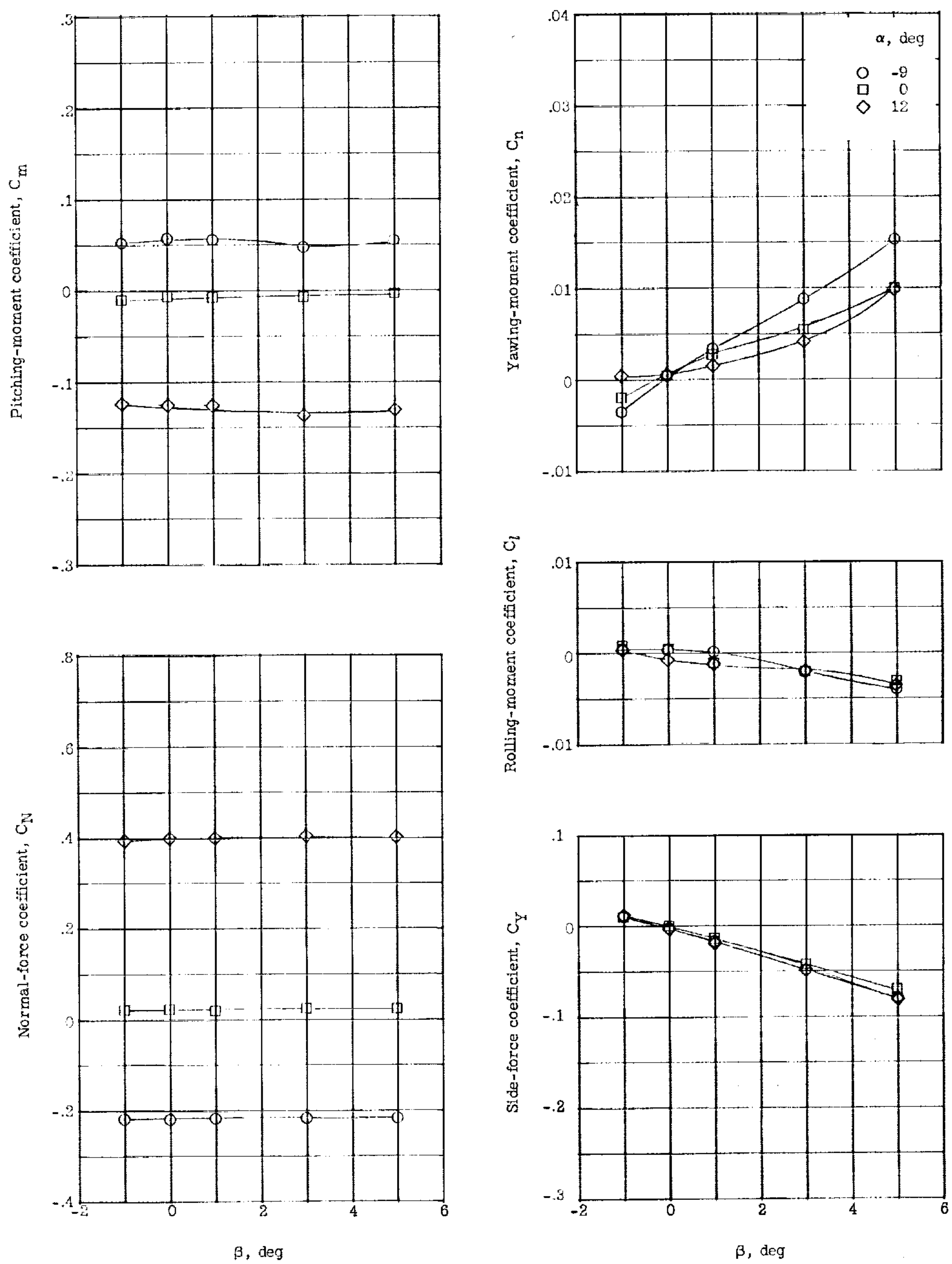
Figure 12.- Continued.



(d) Three jettisonable ventral fins.

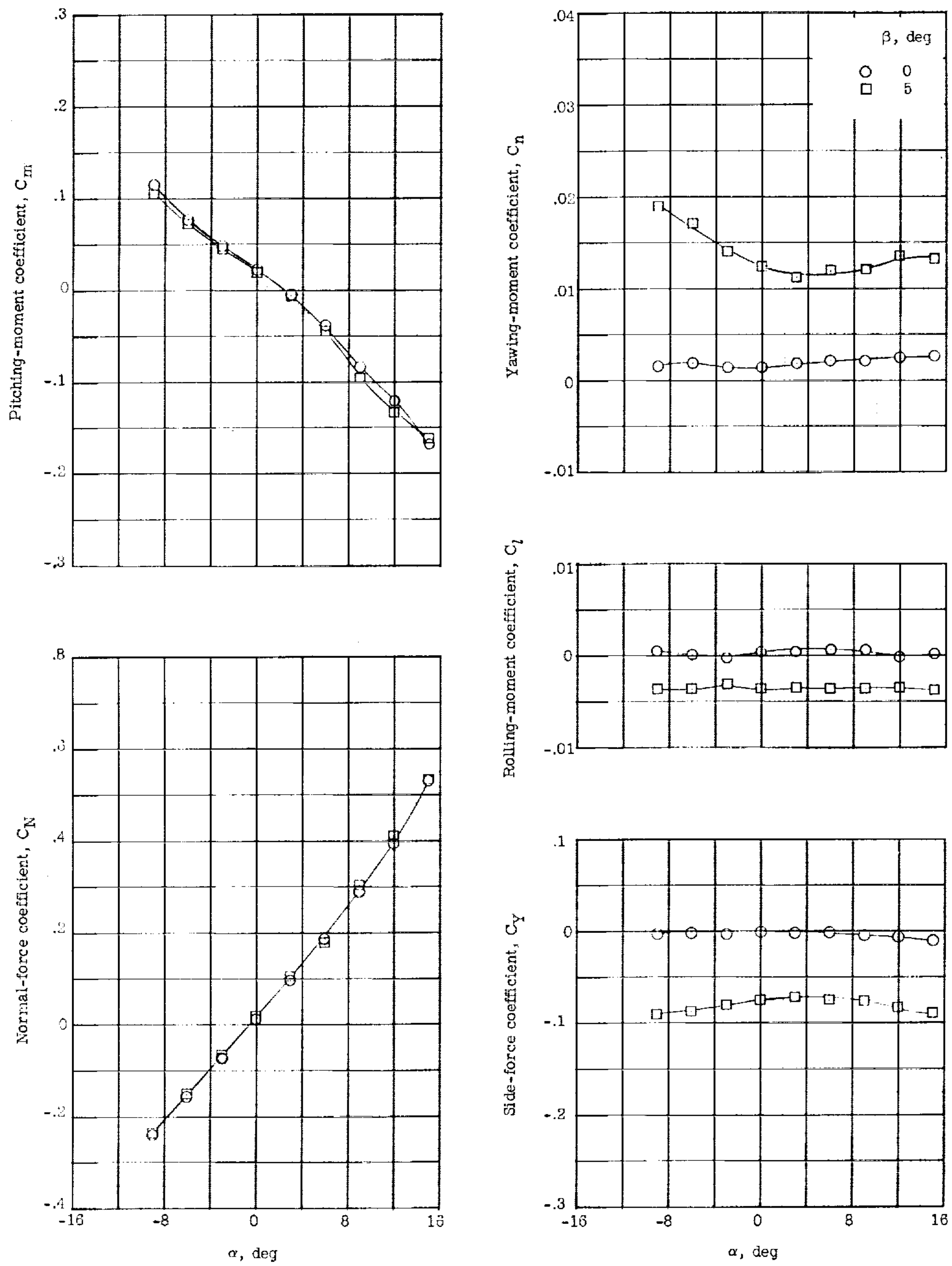
Figure 12.- Continued.

L-188



(d) Concluded.

Figure 12.- Continued.



(e) Four jettisonable fins in X-arrangement.

Figure 12.- Continued.

L-138

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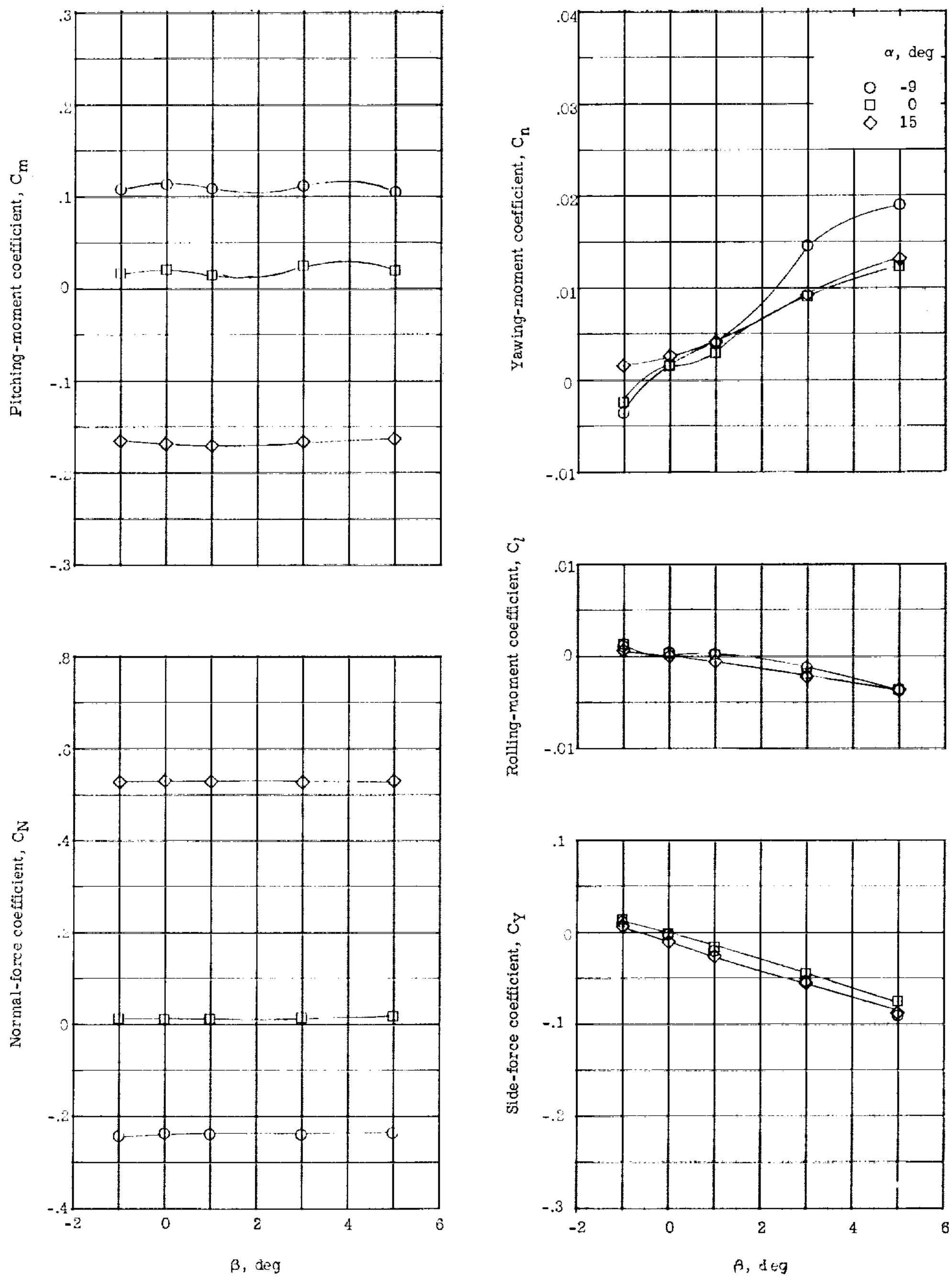
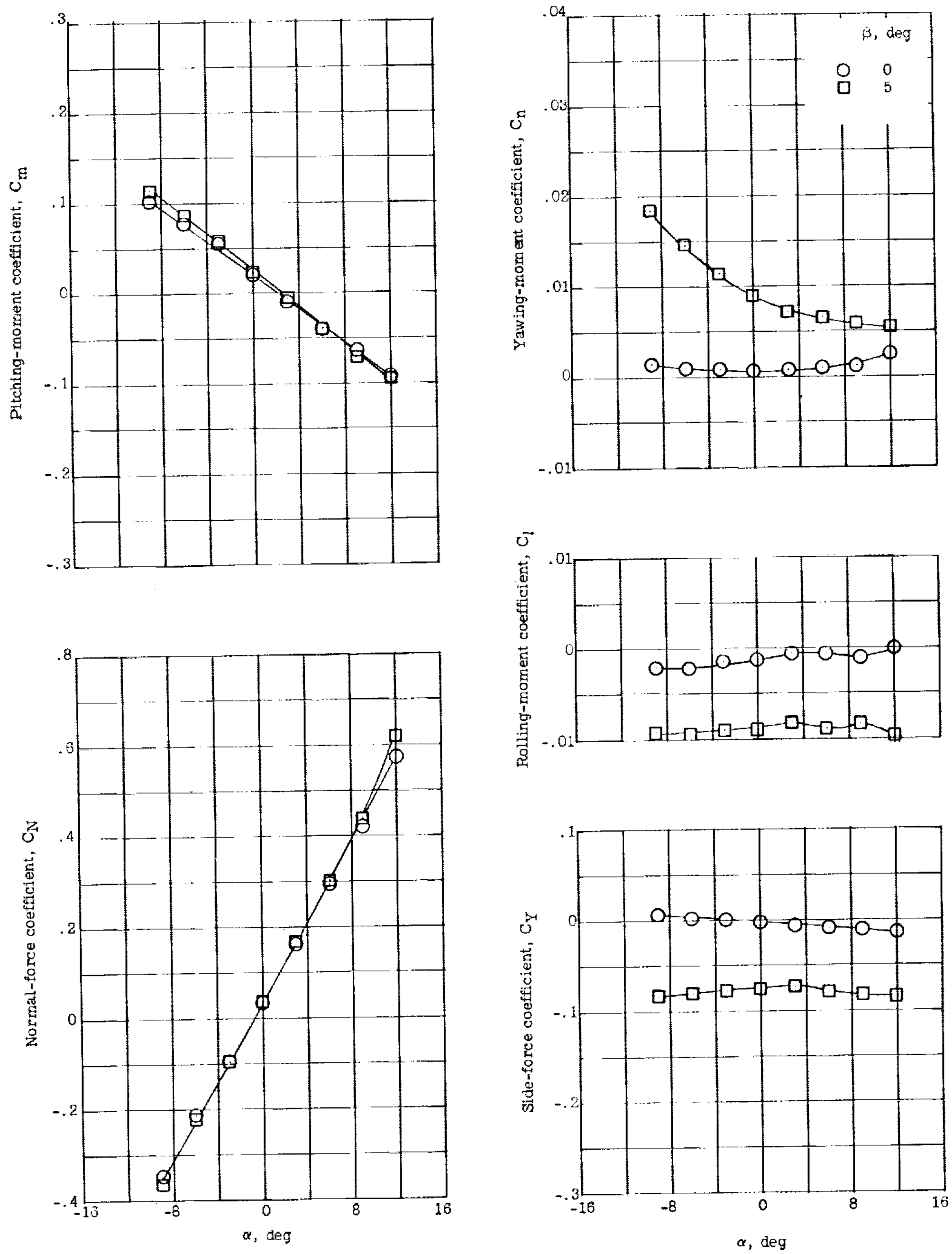


(e) Concluded.

Figure 12.- Concluded.

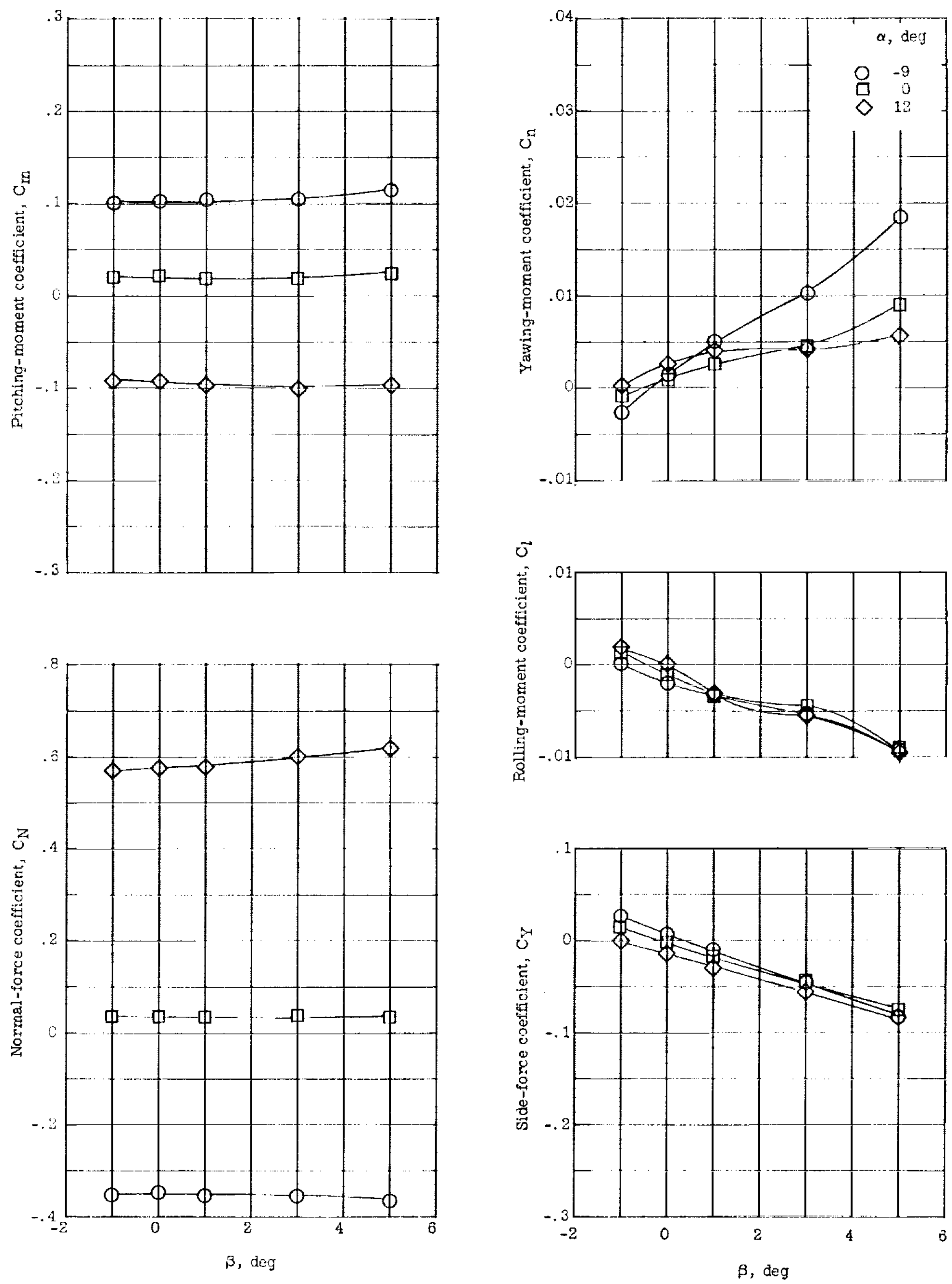


(a) One port strake.

Figure 13.- Aerodynamic characteristics of the X-1E airplane with strakes at $M = 2.37$.

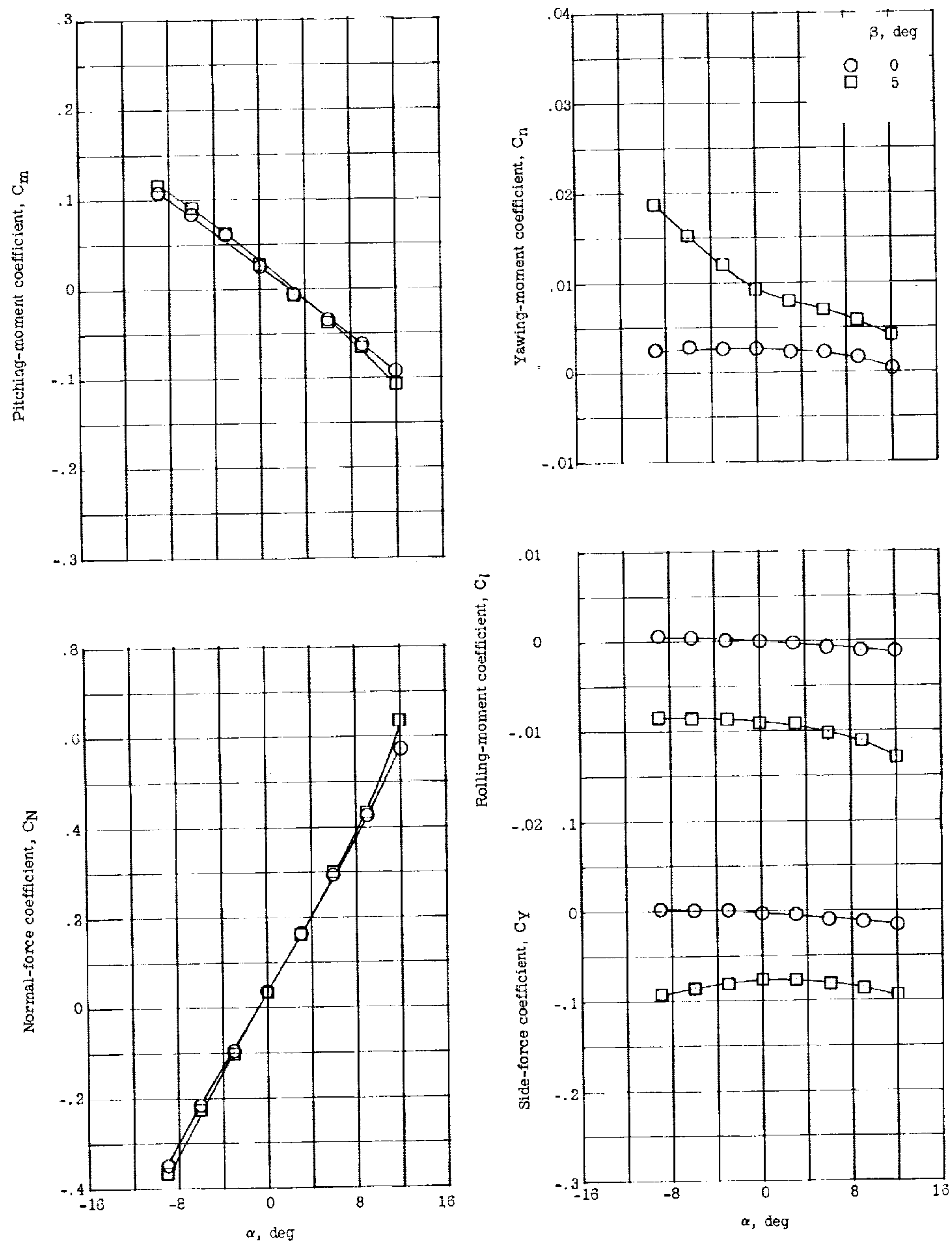
L-188

L-188



(a) Concluded.

Figure 13.- Continued.

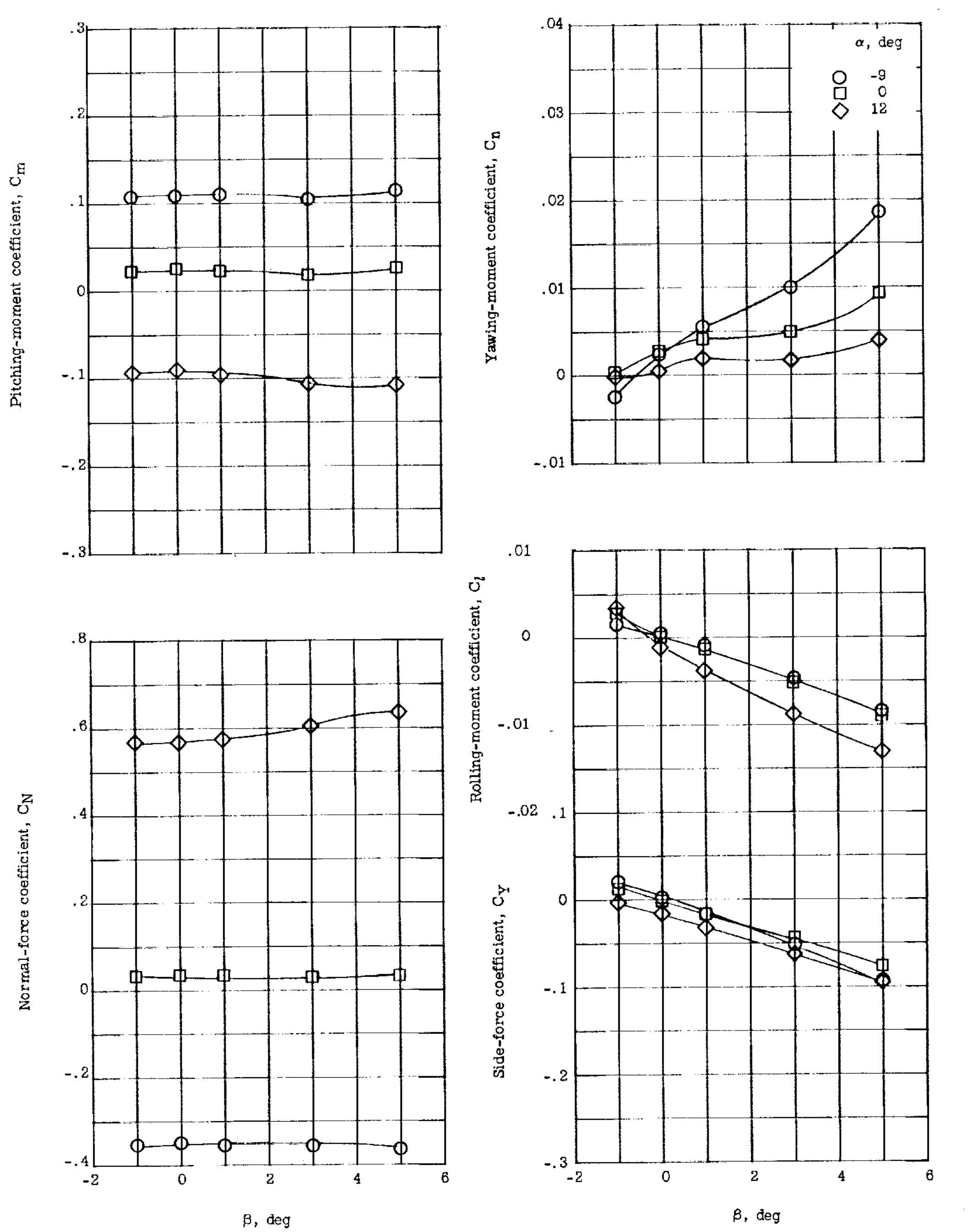


L-188

(b) One starboard strake.

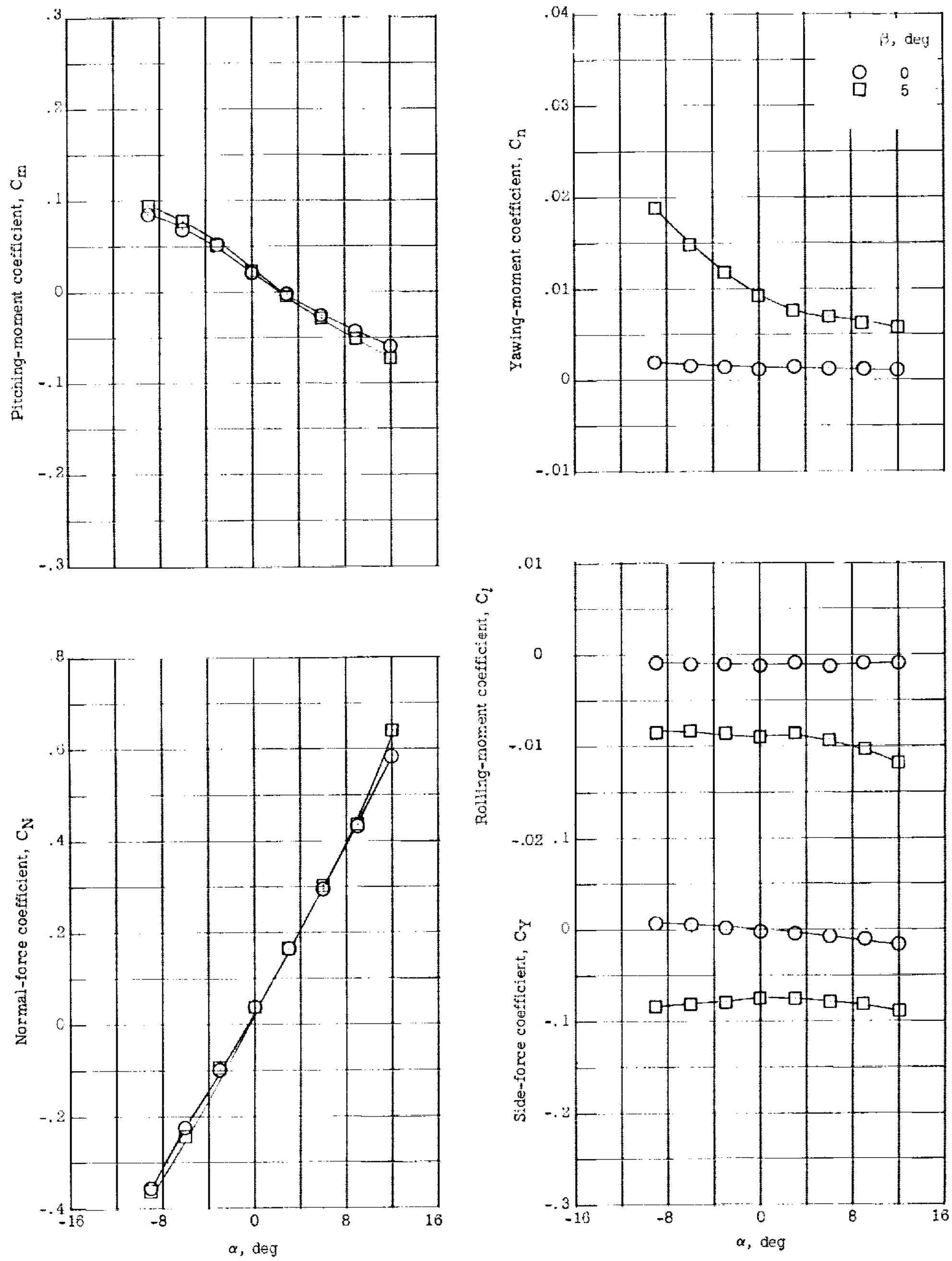
Figure 13.- Continued.

L-188



(b) Concluded.

Figure 13.- Continued.

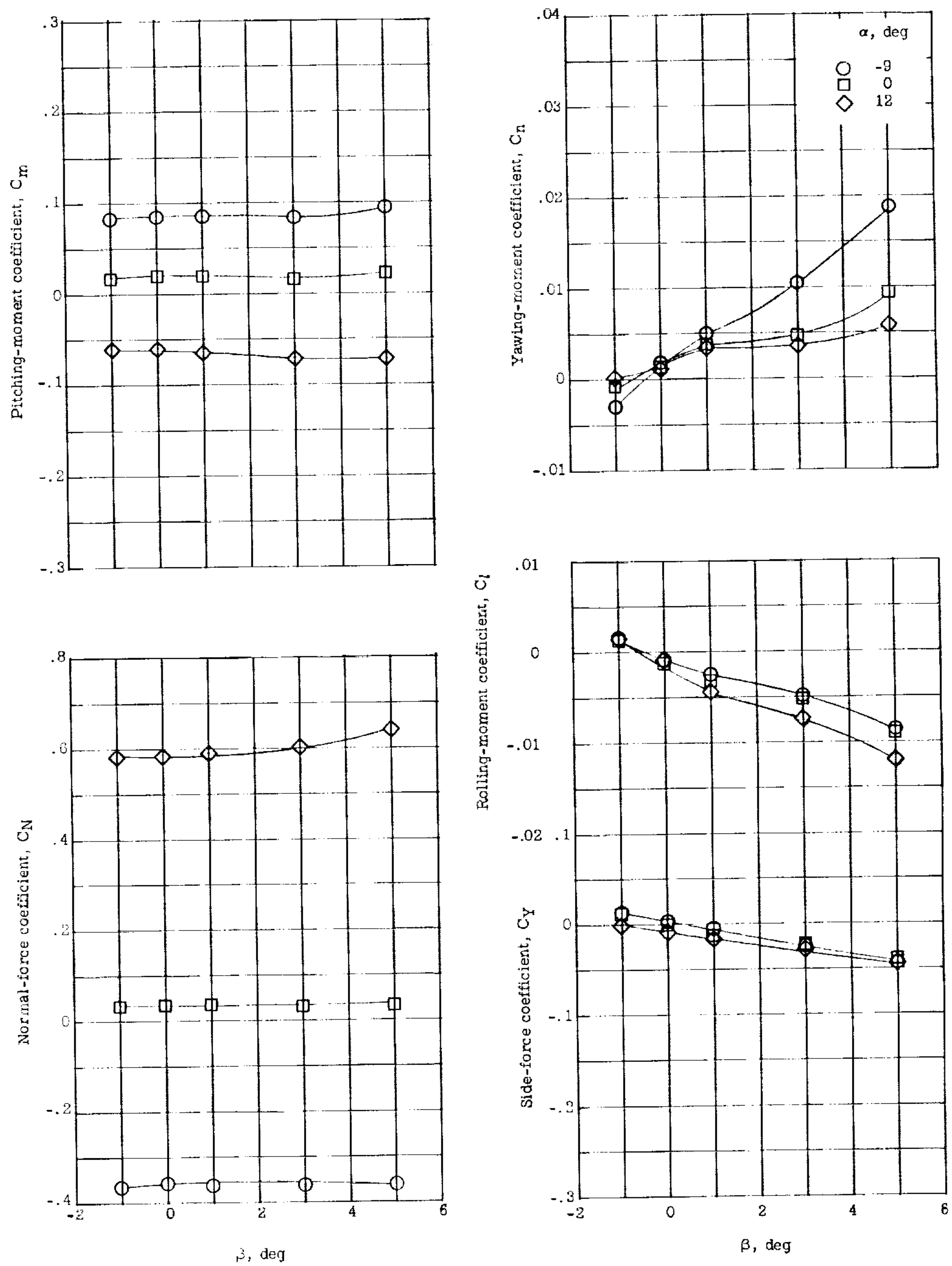


L-188

(c) Both strakes.

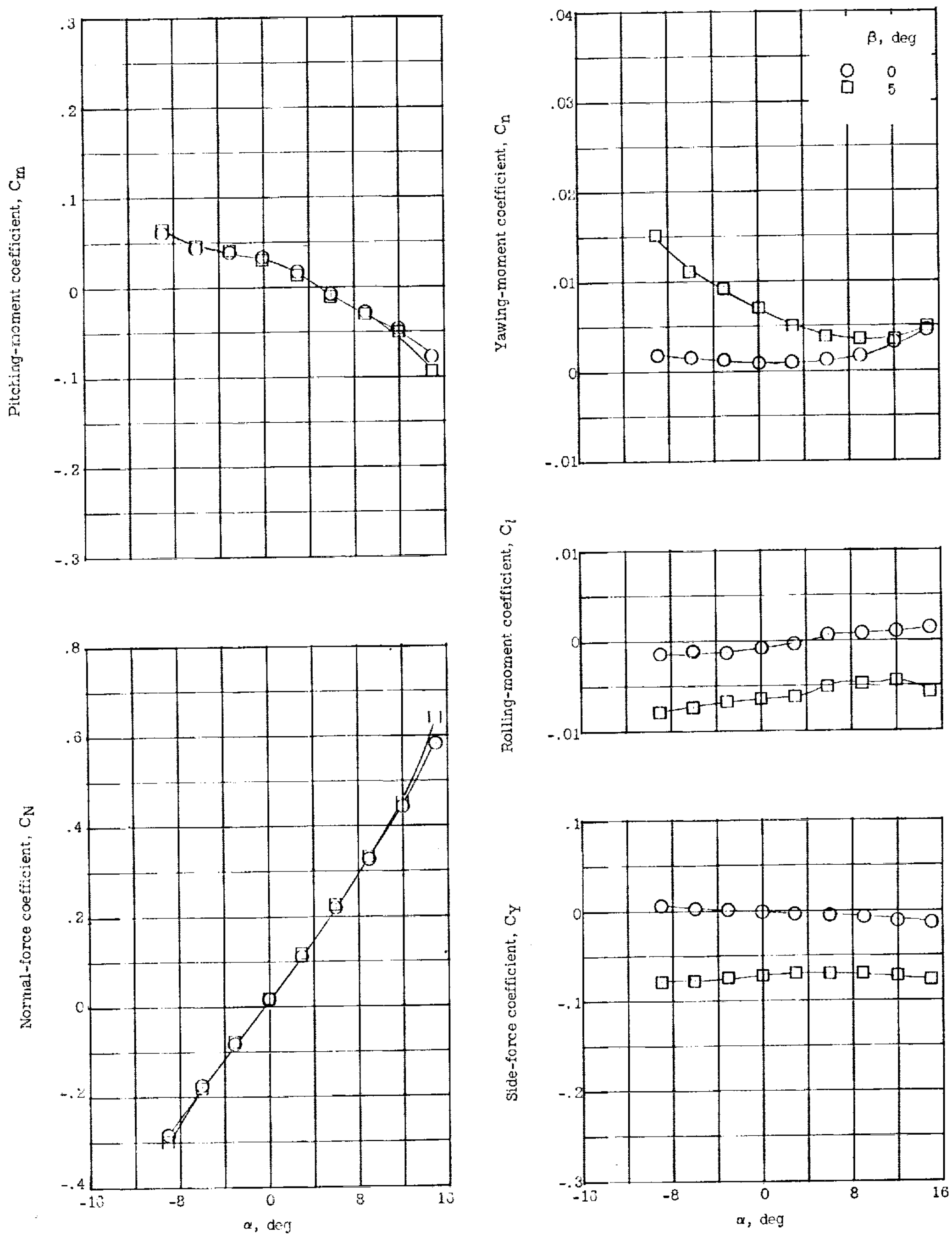
Figure 13.- Continued.

L-188



(c) Concluded.

Figure 13.- Concluded.

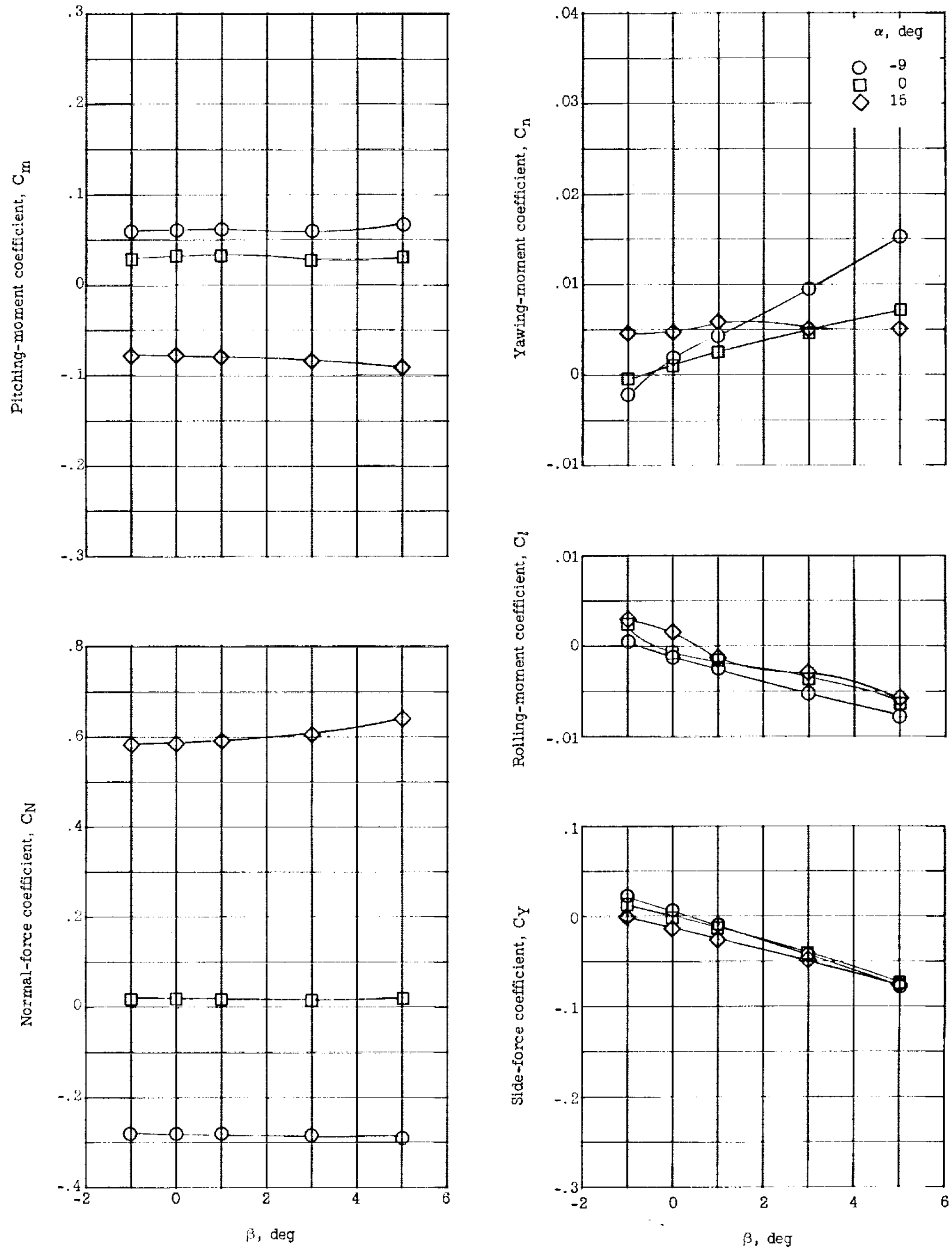


L-188

(a) One port strake.

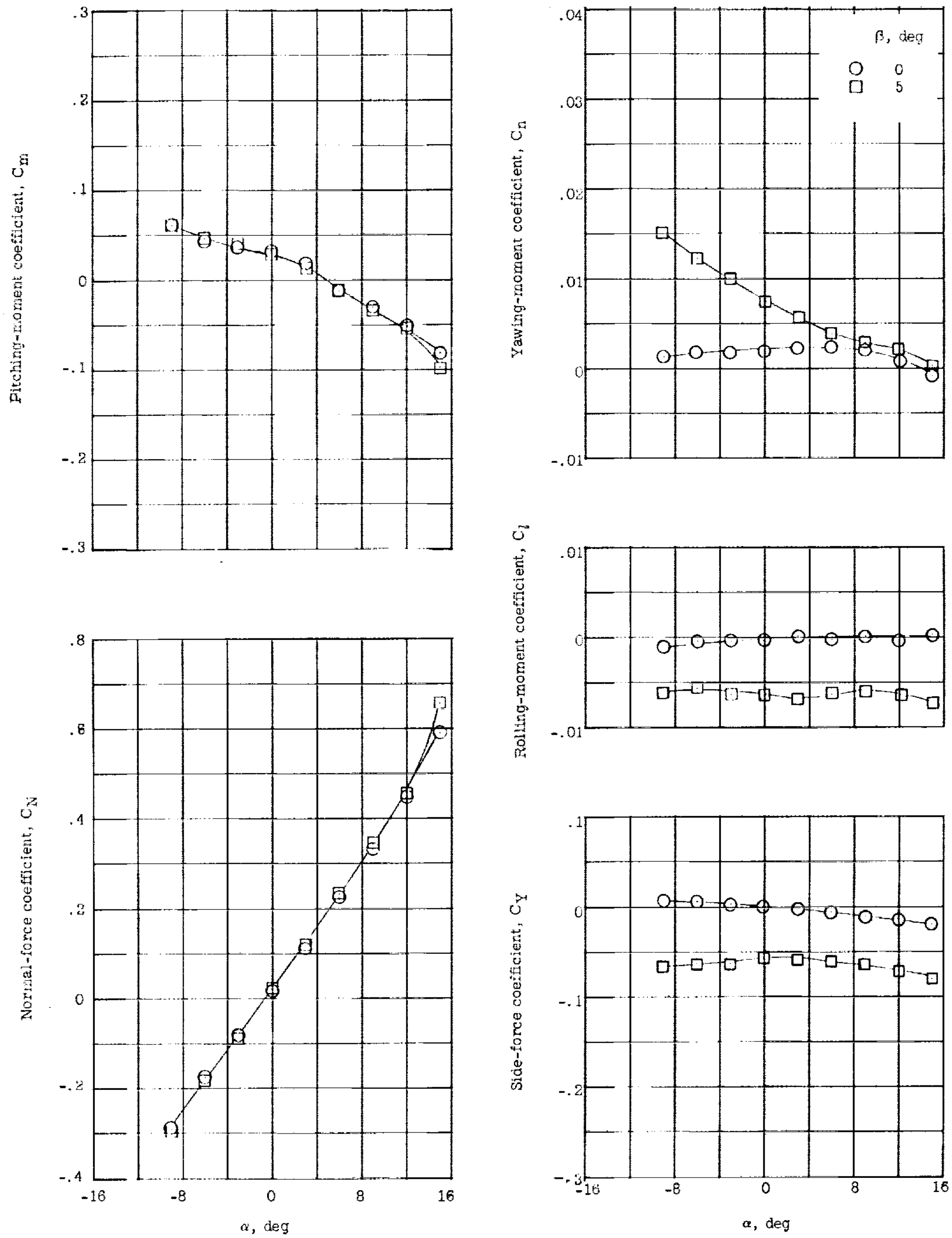
Figure 14.- Aerodynamic characteristics of the X-1E airplane with strakes at M = 2.98.

L-188



(a) Concluded.

Figure 14.- Continued.

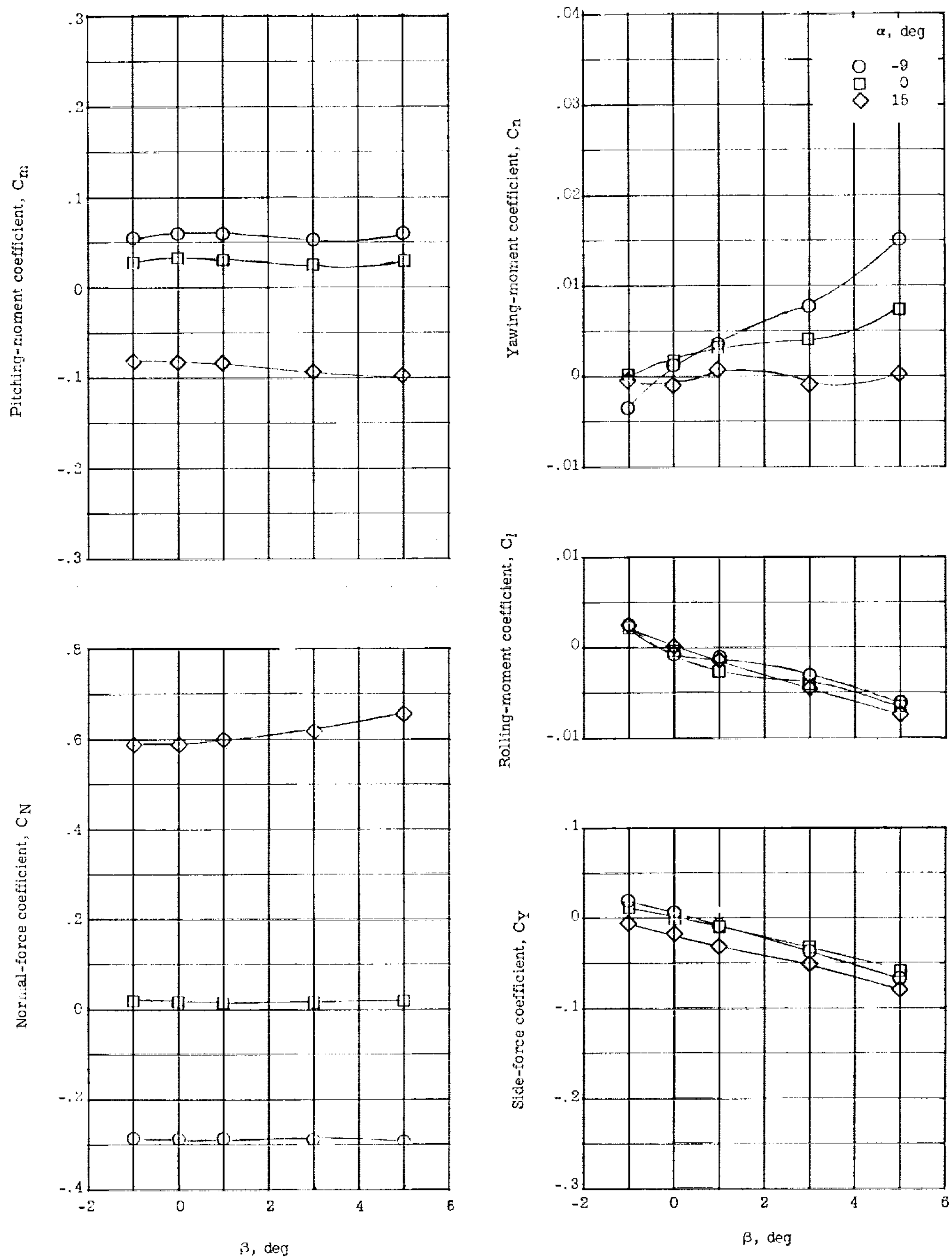


L-188

(b) One starboard strake.

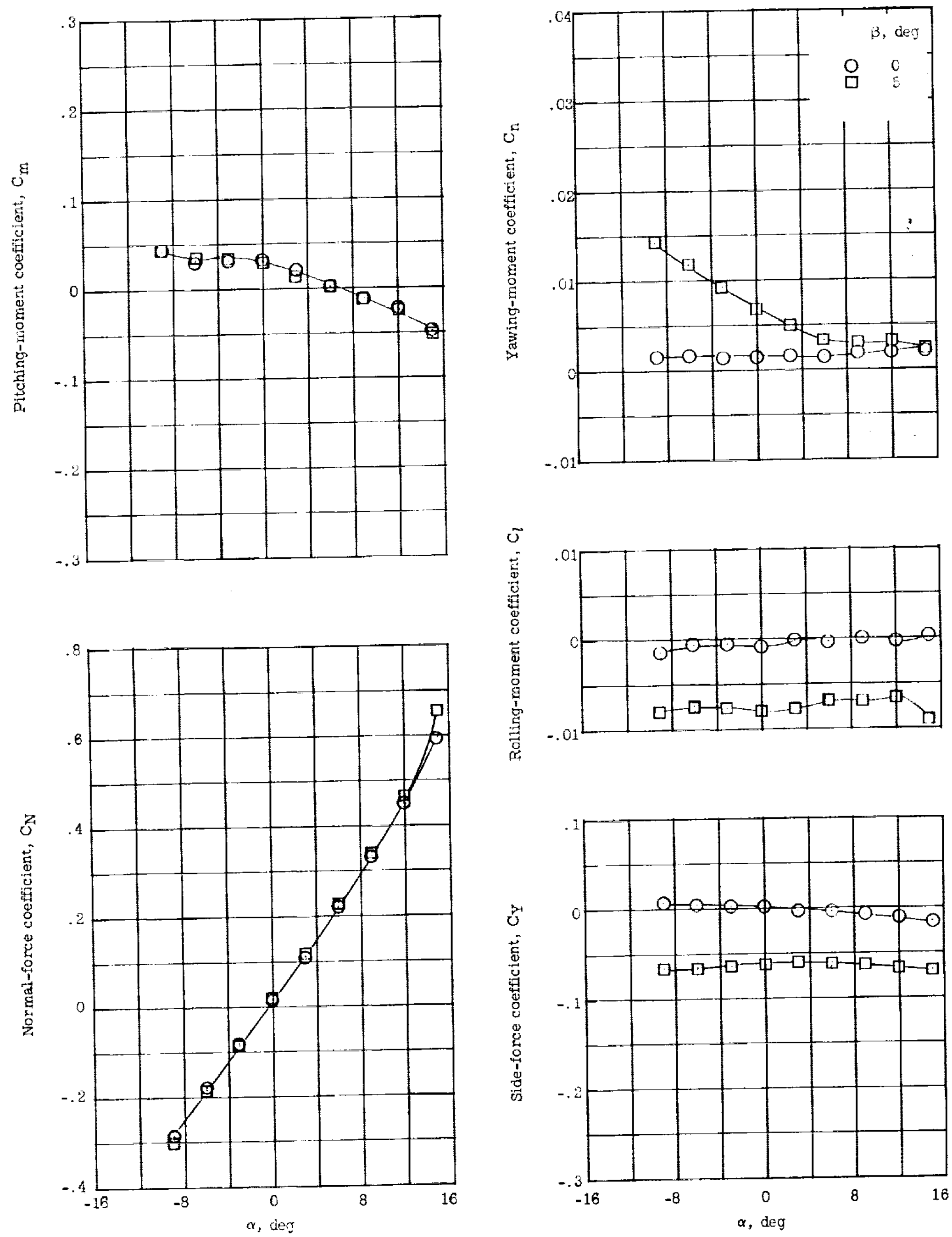
Figure 14.- Continued.

L-188



(b) Concluded.

Figure 14.- Continued.

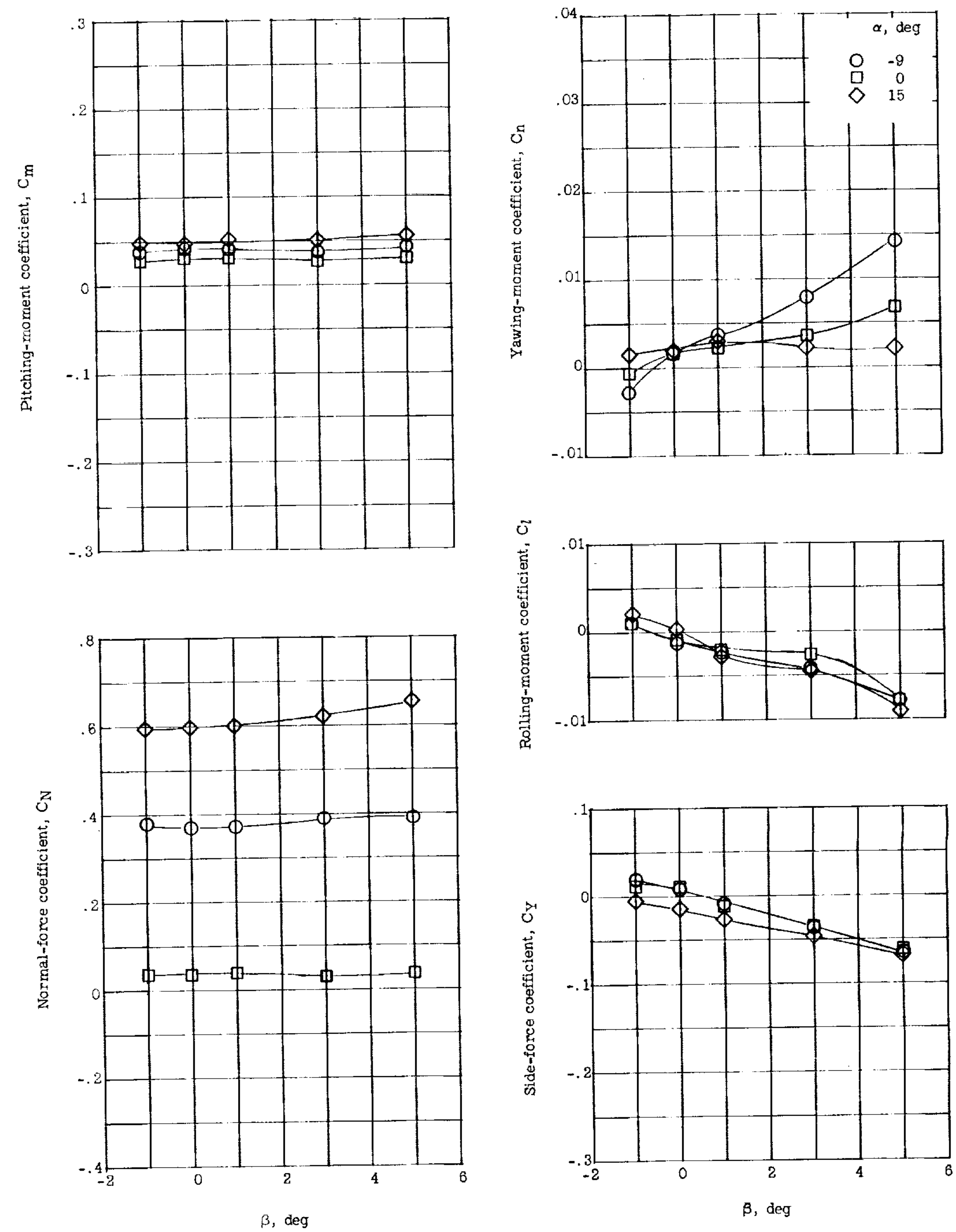


(c) Both strakes.

Figure 14.- Continued.

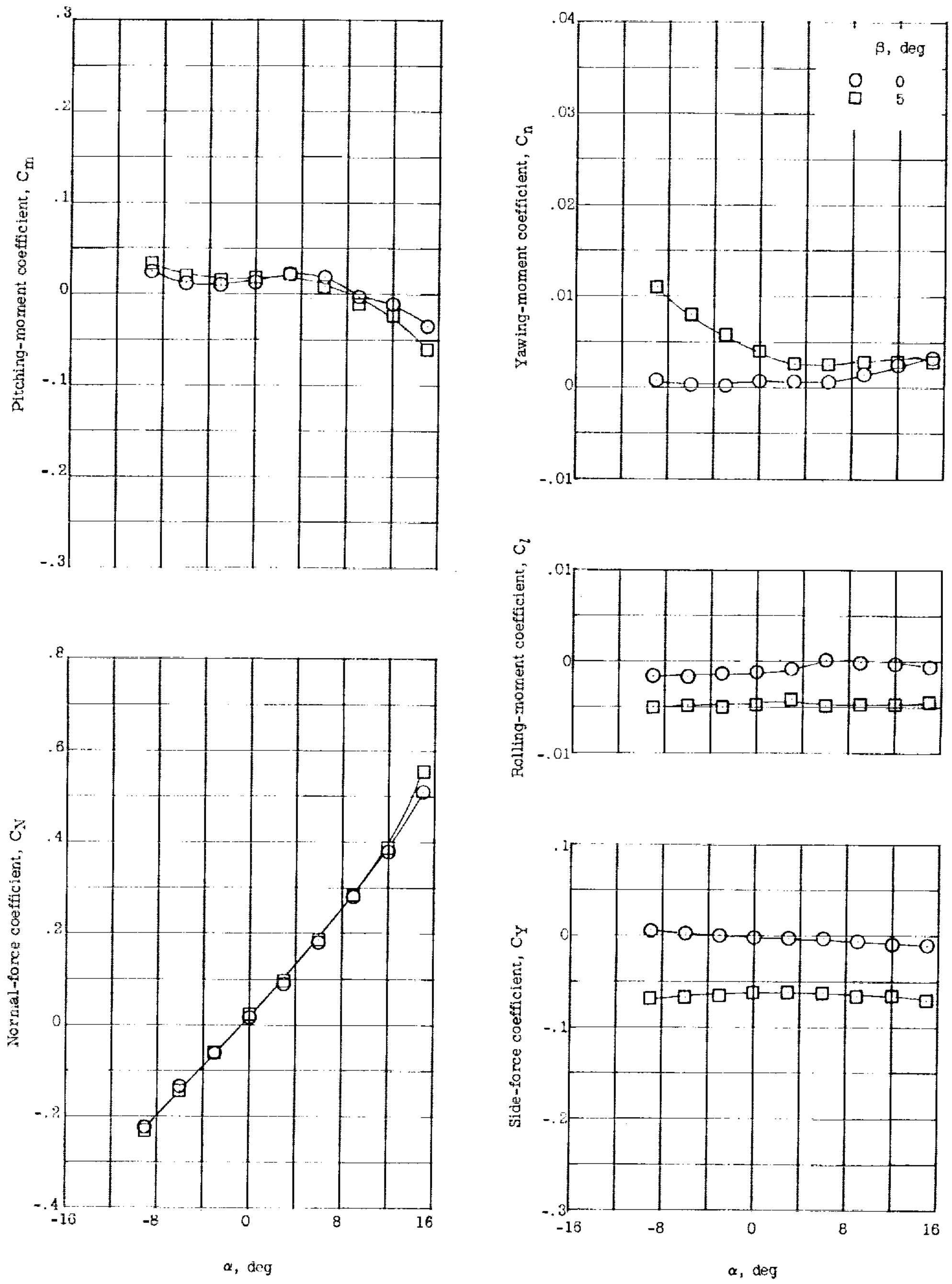
L-188

L-188



(c) Concluded.

Figure 14.- Concluded.

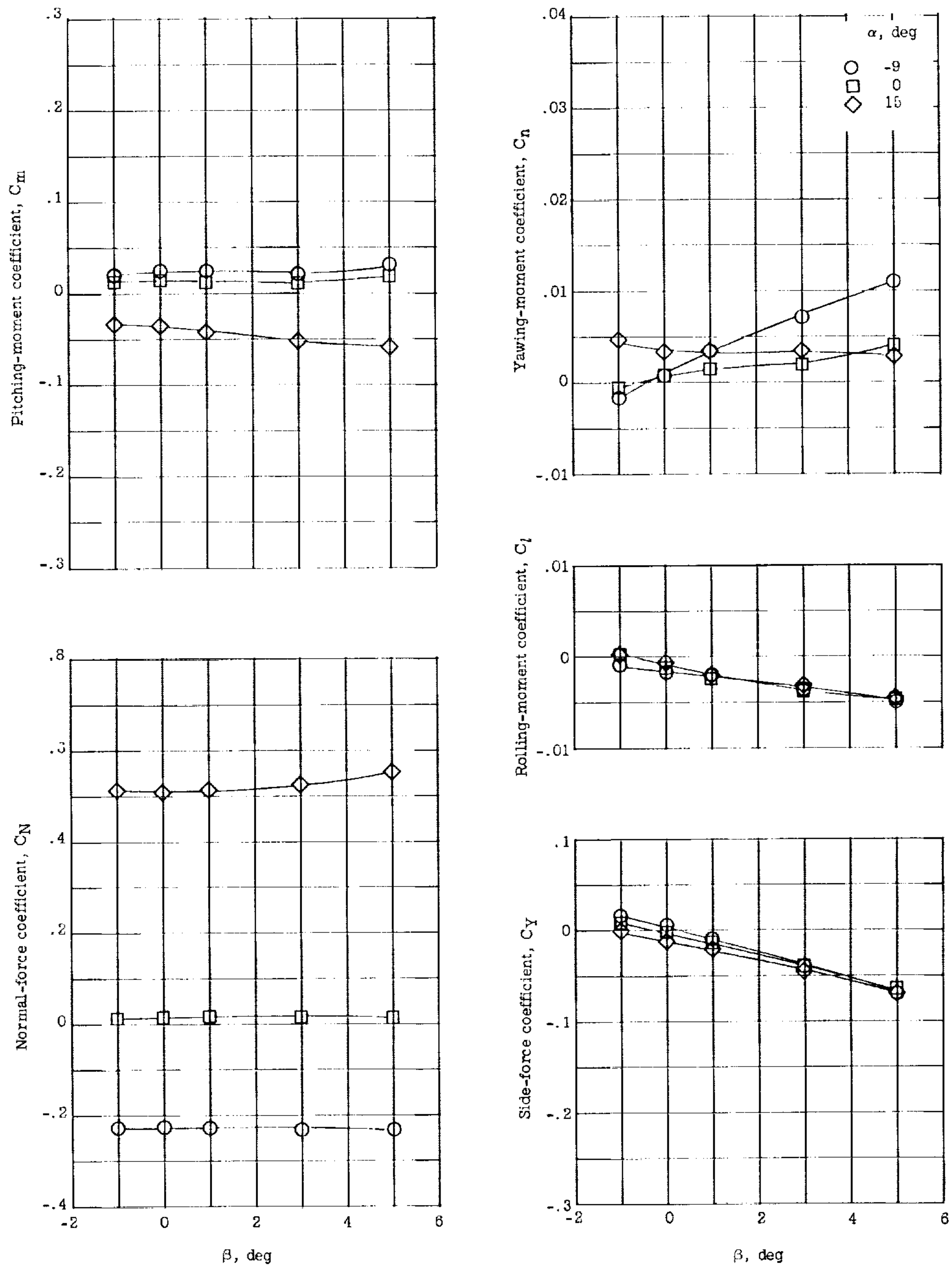


(a) One port strake.

Figure 15.- Aerodynamic characteristics of the X-1E airplane with strakes at $M = 4.01$.

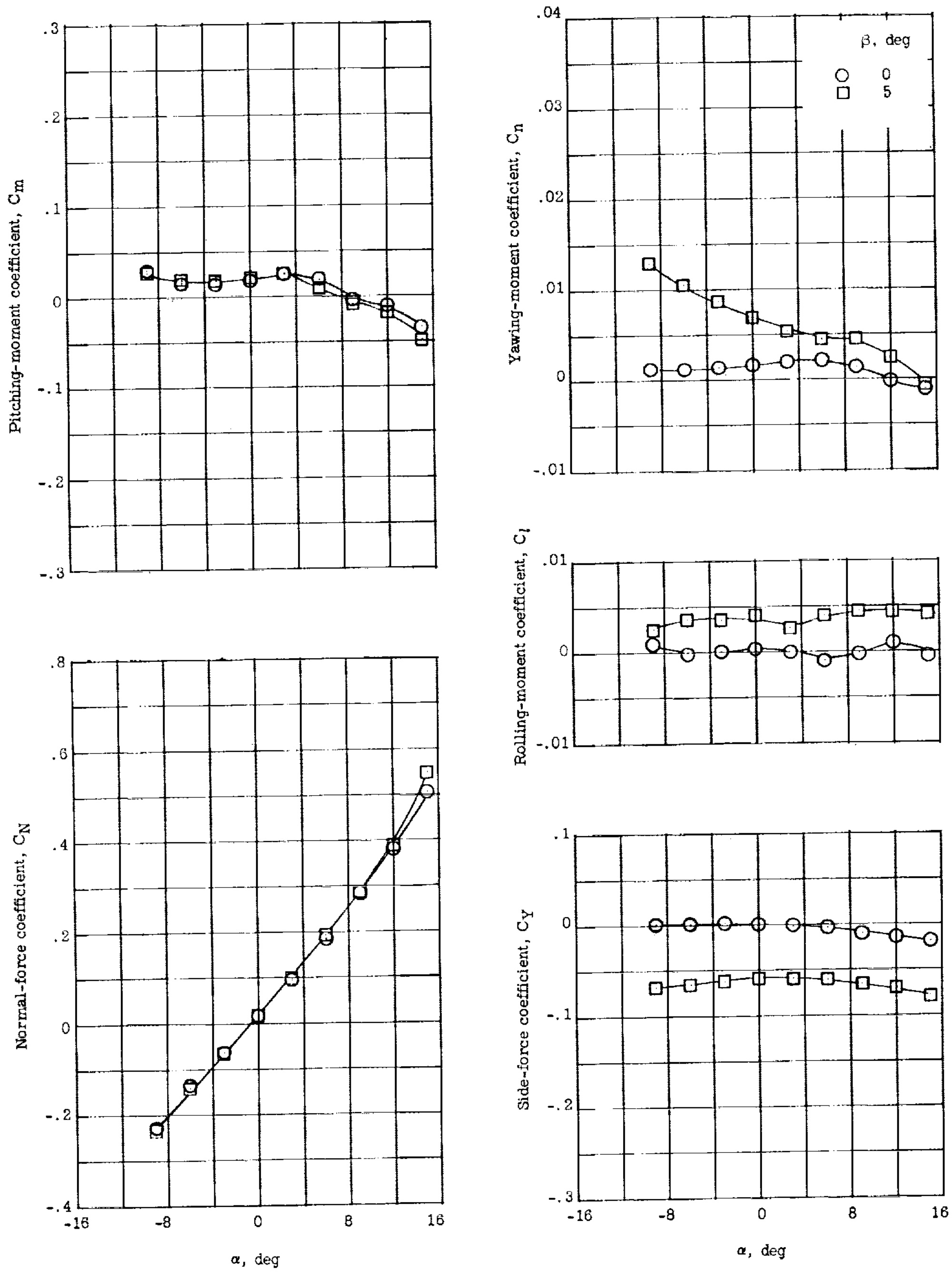
L-188

L-188



(a) Concluded.

Figure 15.- Continued.

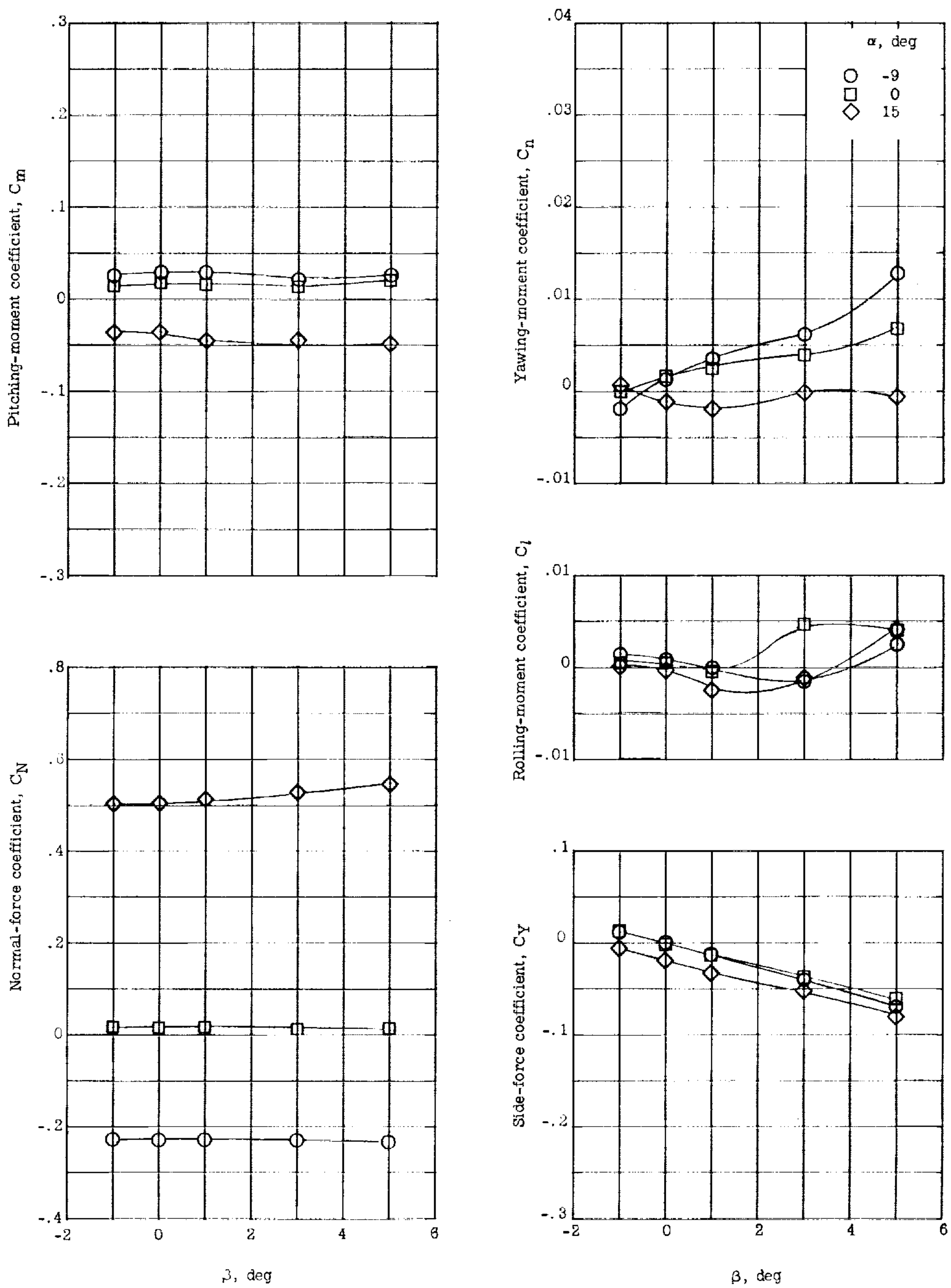


(b) One starboard strake.

Figure 15.- Continued.

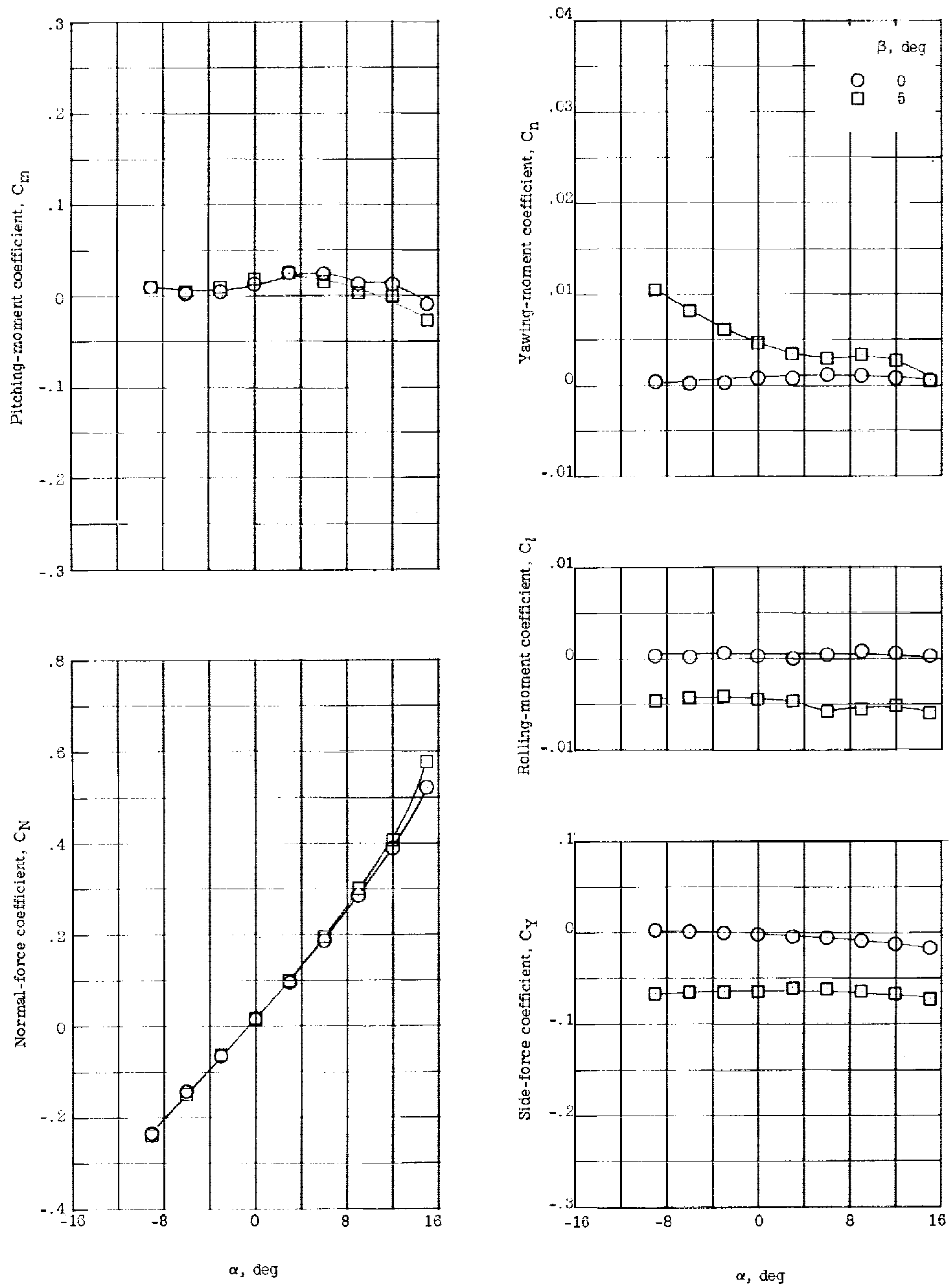
L-188

L-188



(b) Concluded.

Figure 15.- Continued.

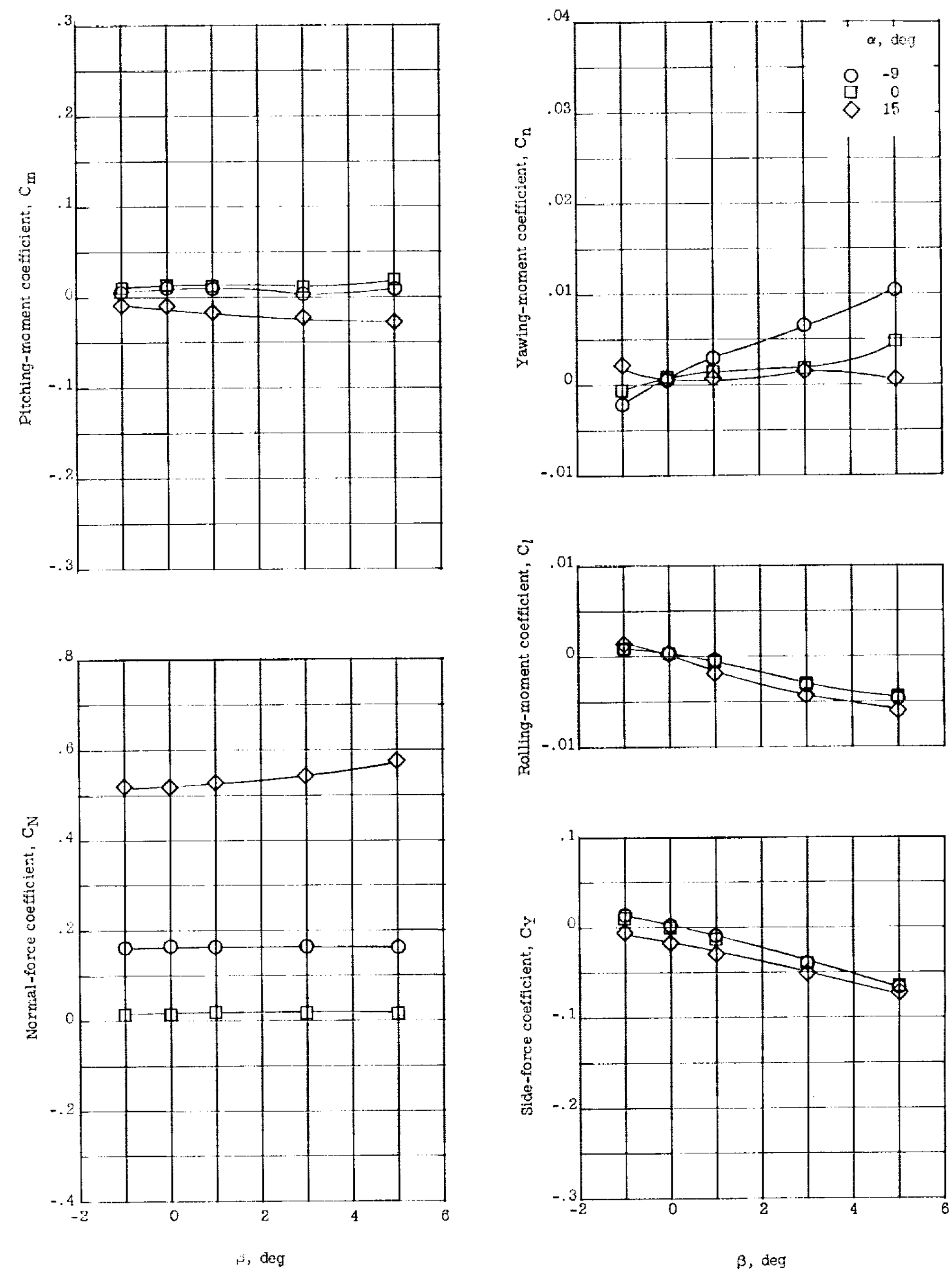


(c) Both strakes.

Figure 15.- Continued.

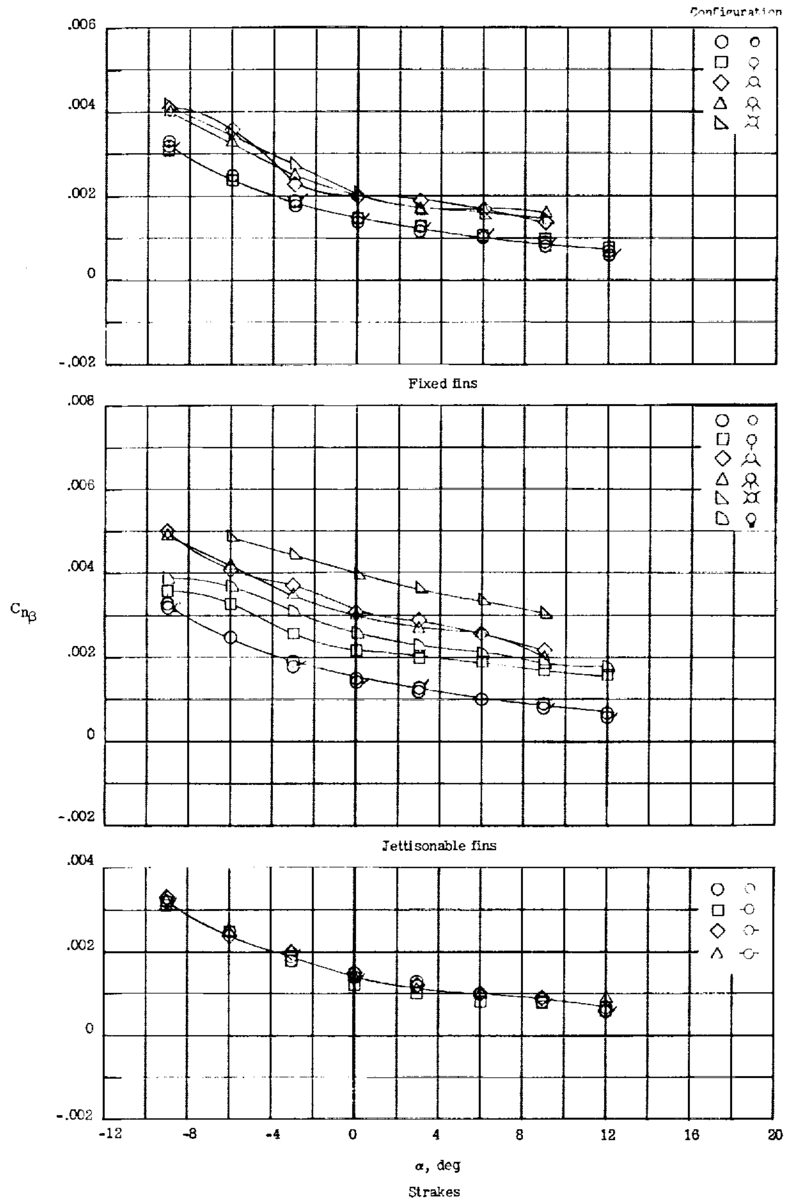
L-188

L-188



(c) Concluded.

Figure 15.- Concluded.

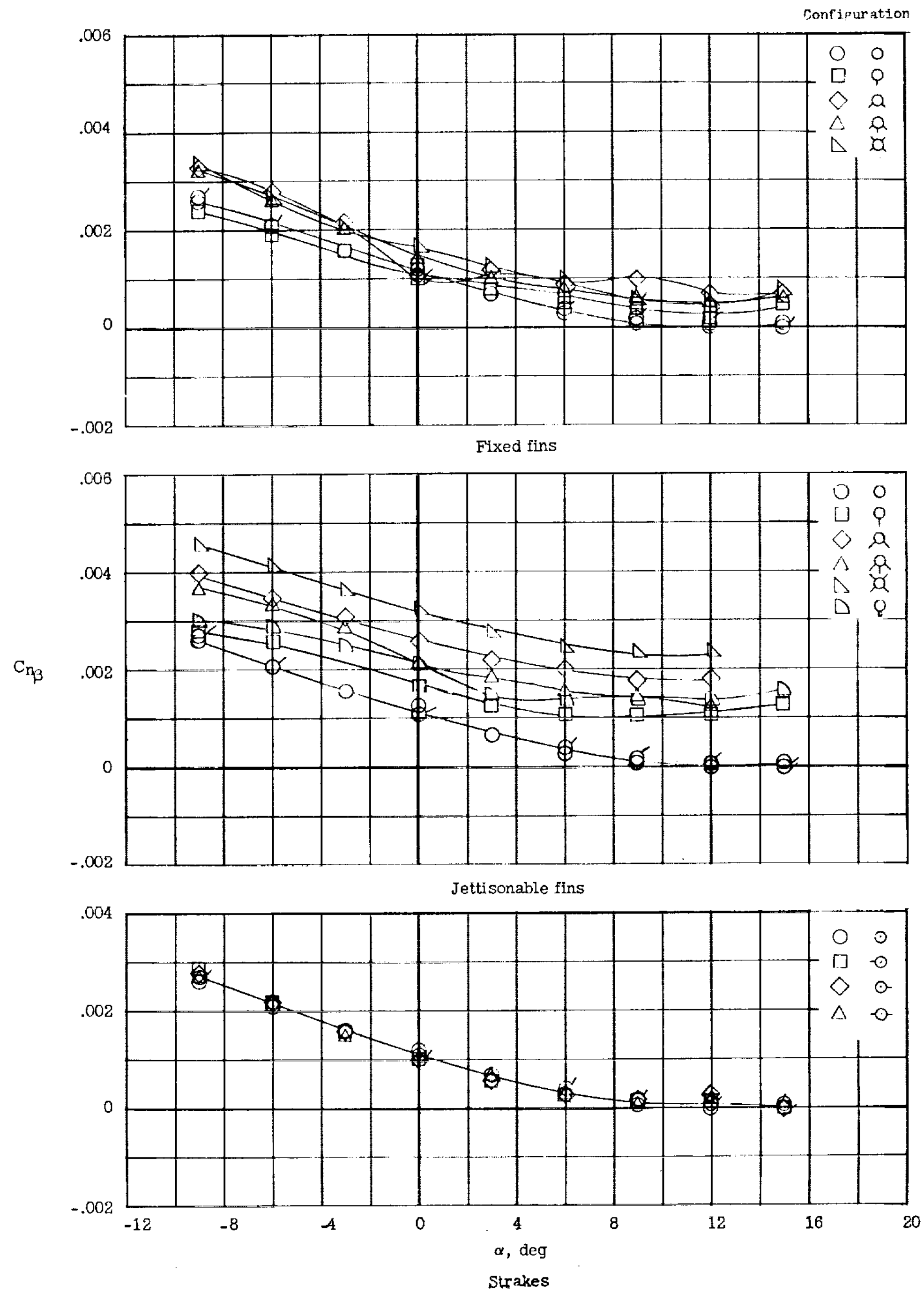


(a) M = 2.37.

Figure 16.- Comparison of the directional stability parameter C_{n_β} for a 1/56-scale model of the X-1E airplane with and without various directional-stability-improvement devices. Flagged symbols indicate check points.

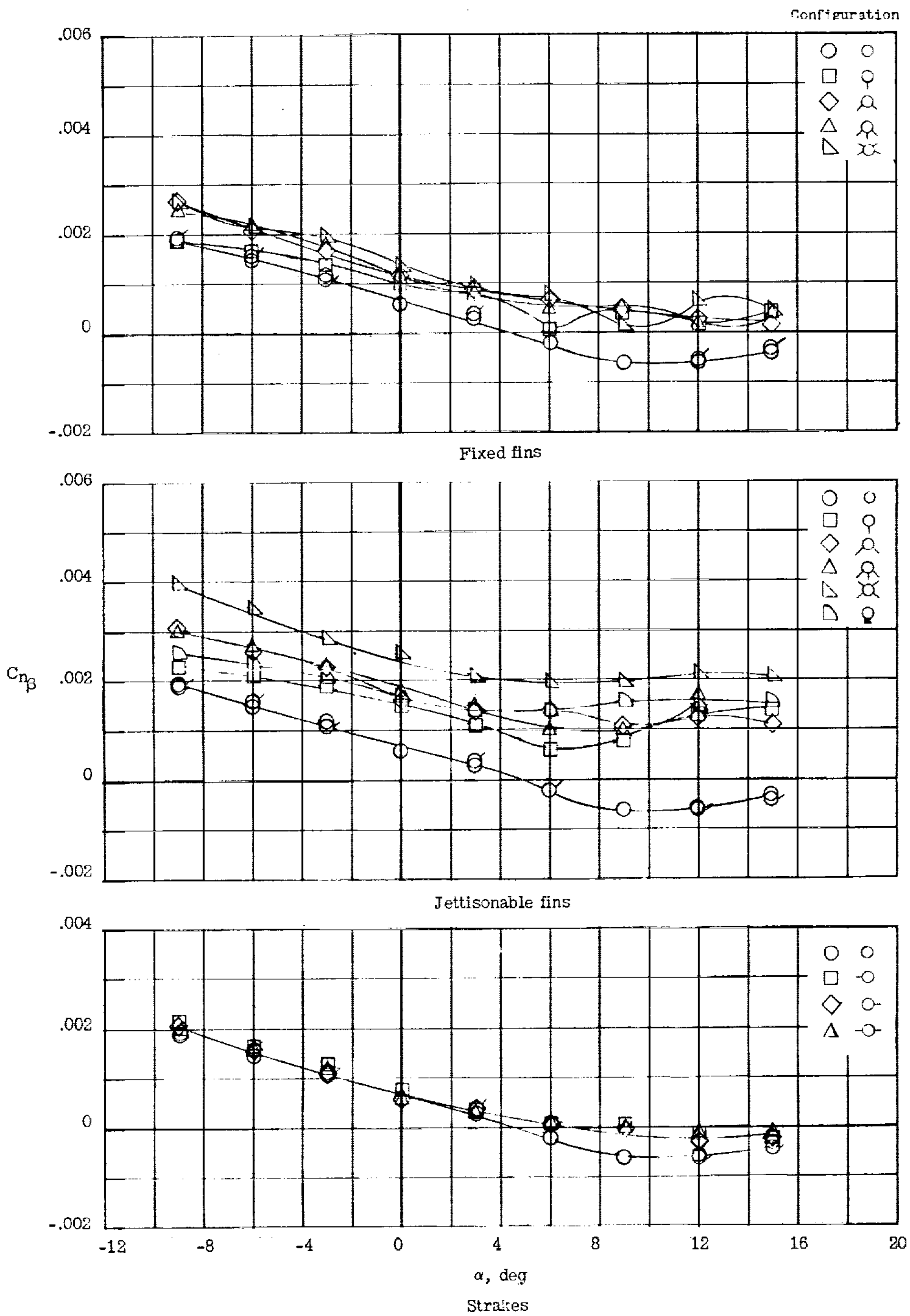
L-188

L-188



(b) M = 2.98.

Figure 16.- Continued.

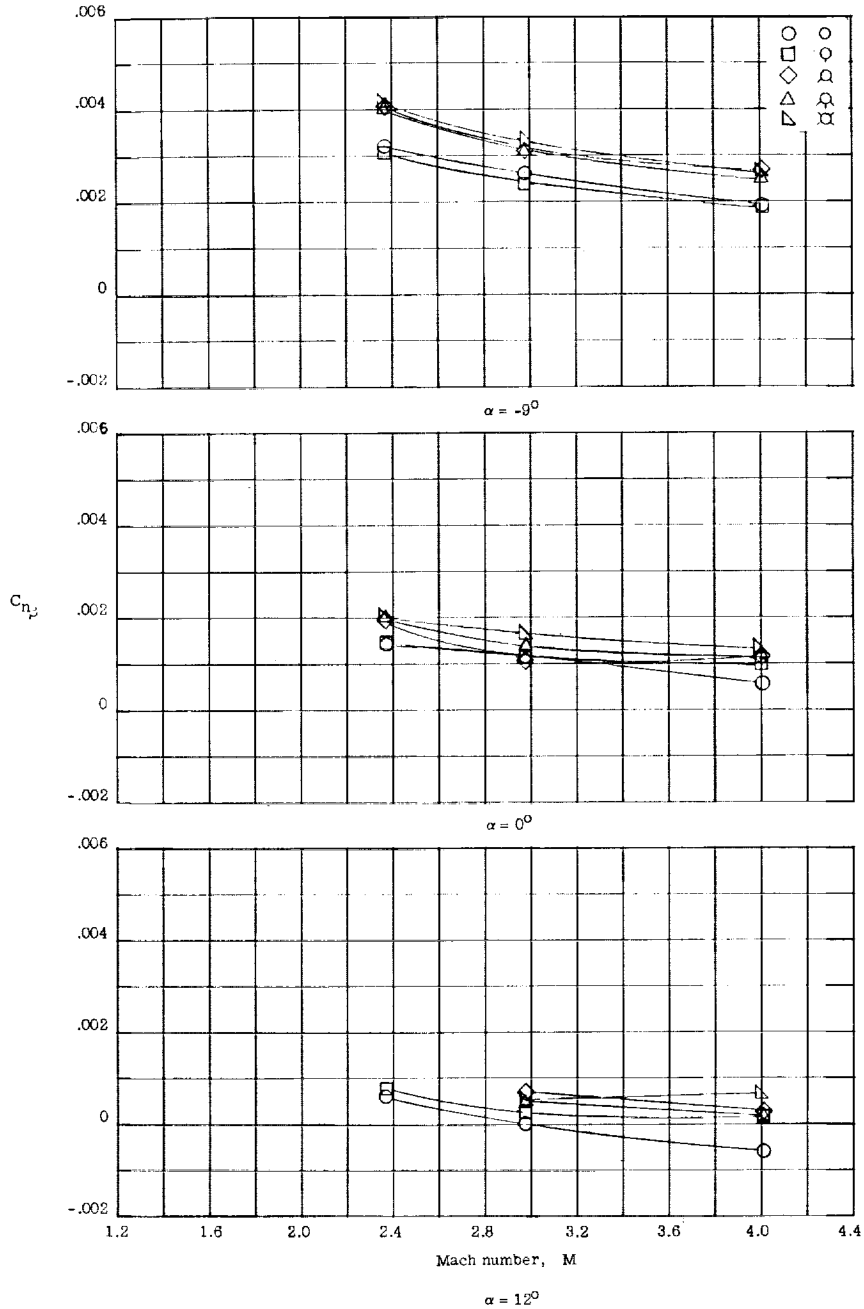


(c) M = 4.01.

Figure 16.- Concluded.

L-188

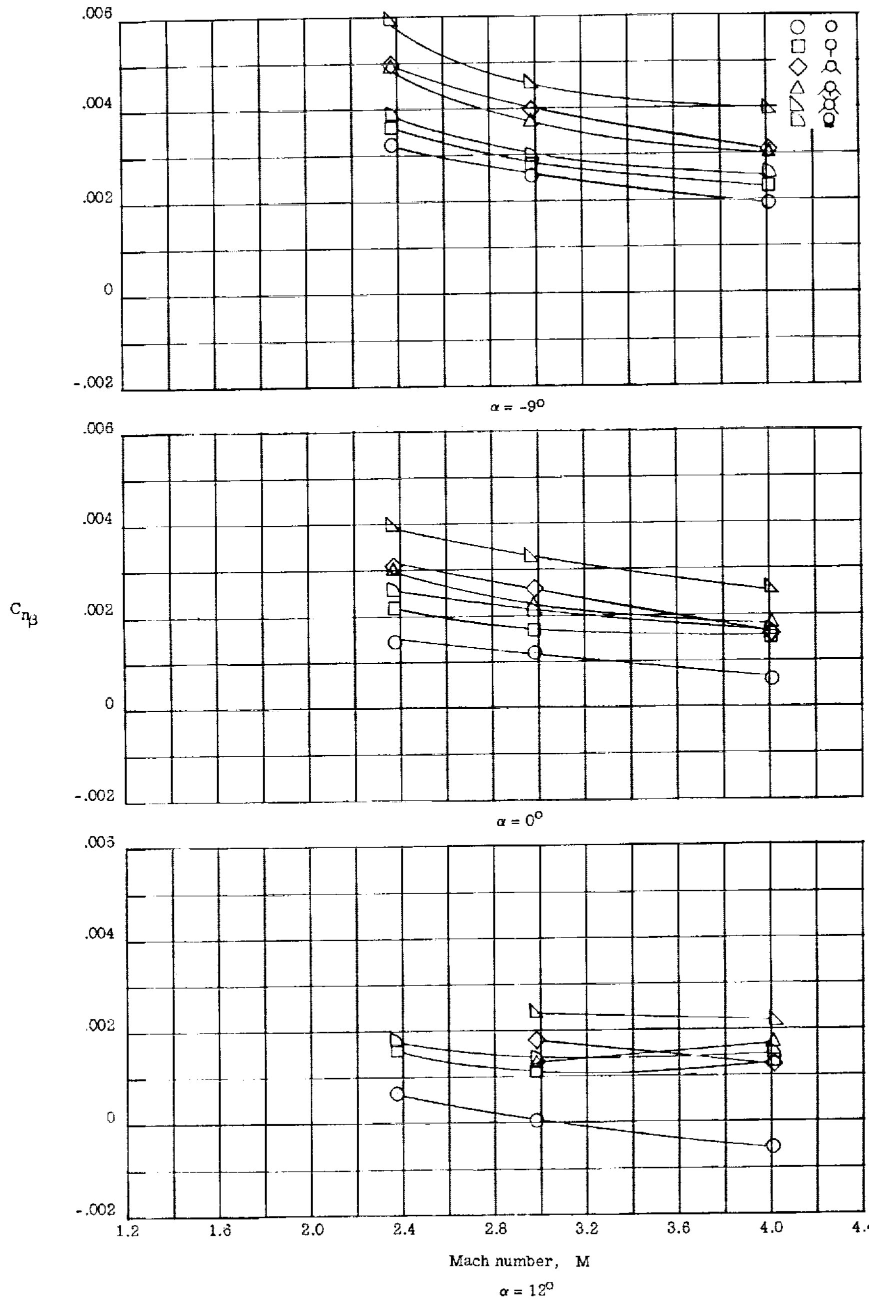
L-188



(a) Fixed fins.

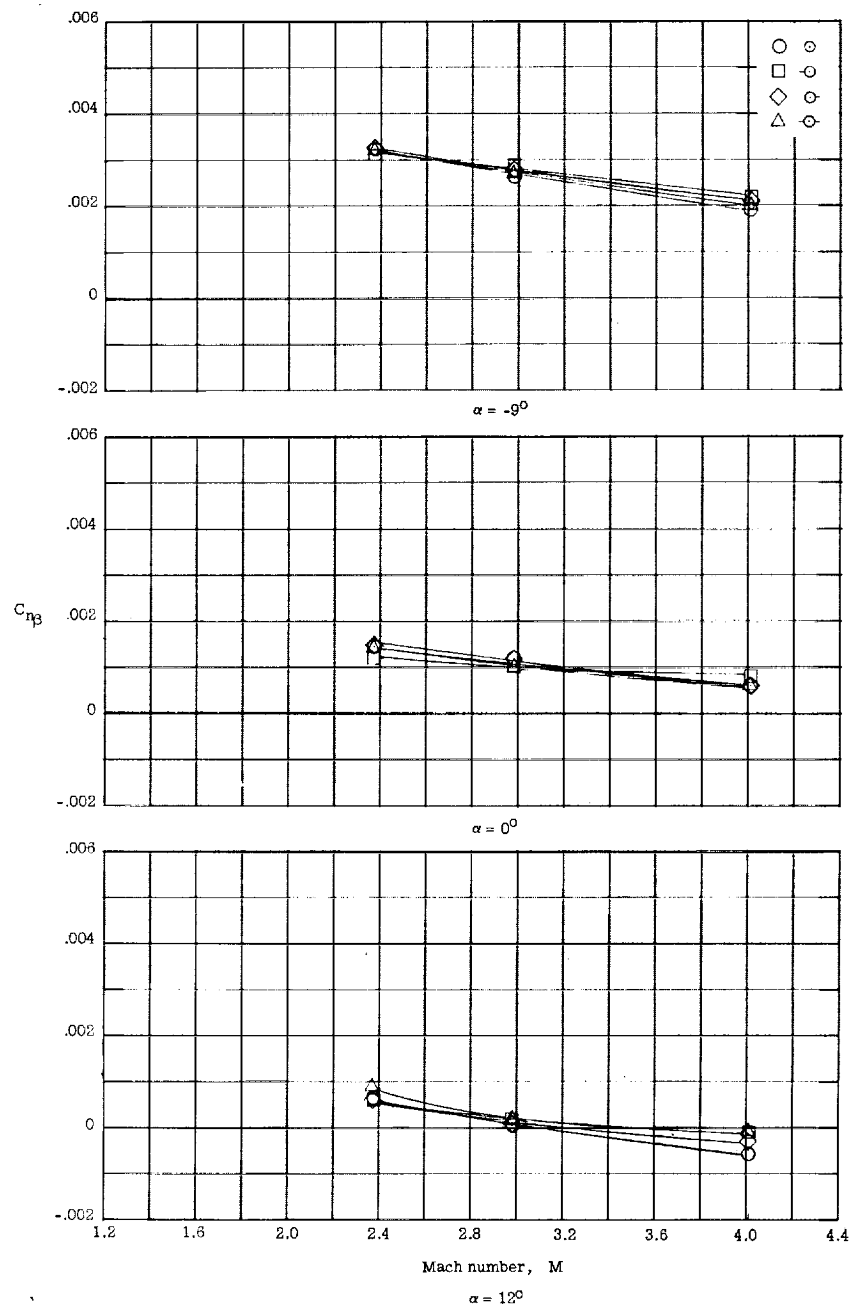
Figure 17.- Comparison of the directional stability parameter C_{n_β} for a 1/56-scale model of the X-1E airplane with and without various directional-stability-improvement devices.

L-188



(b) Jettisonable fins.

Figure 17.- Continued.



(c) Strakes.

Figure 17.- Concluded.

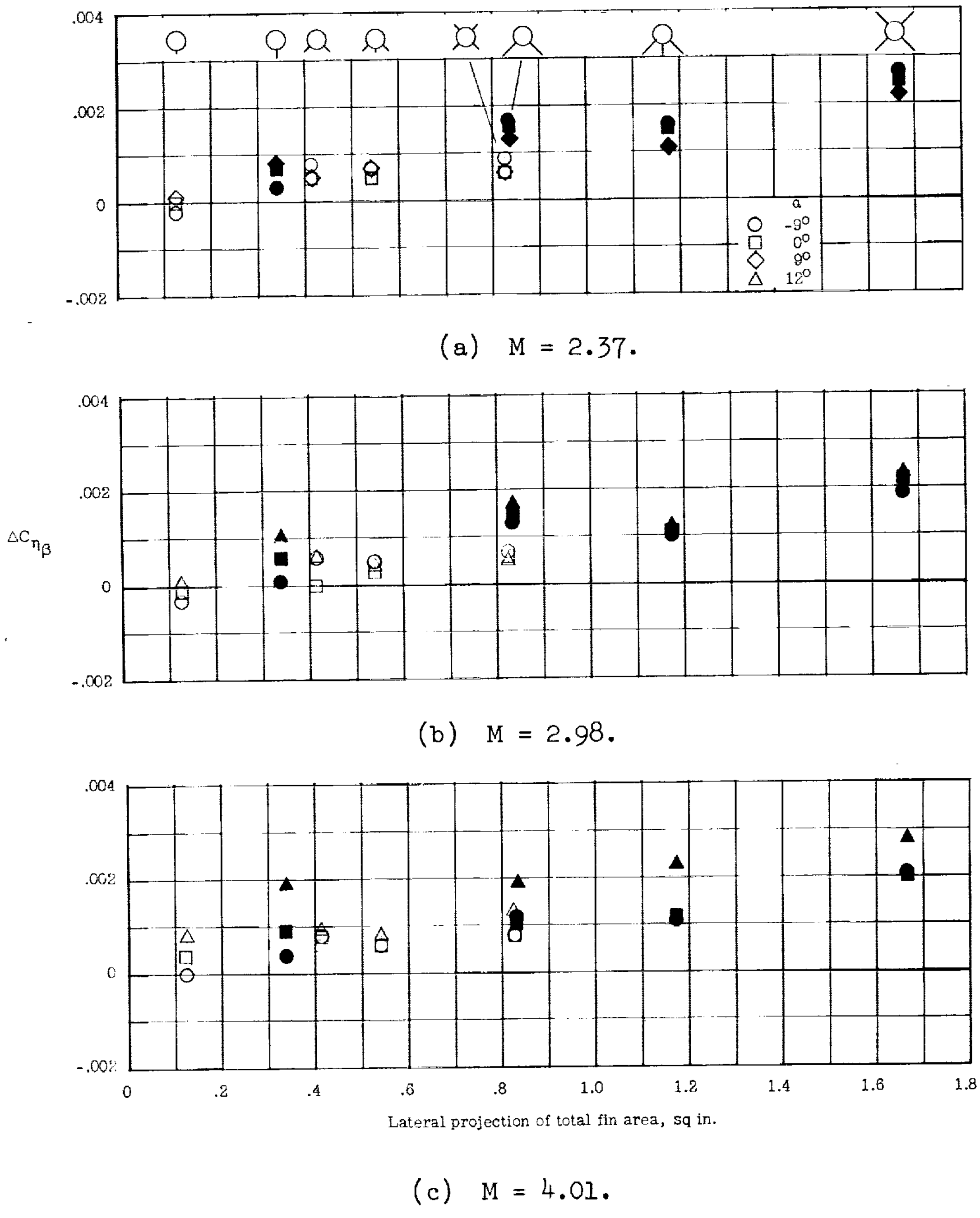


Figure 18.- Incremental directional stability parameter produced by the various fin arrangements as a function of total laterally projected fin area. Filled symbols represent jettisonable fins.

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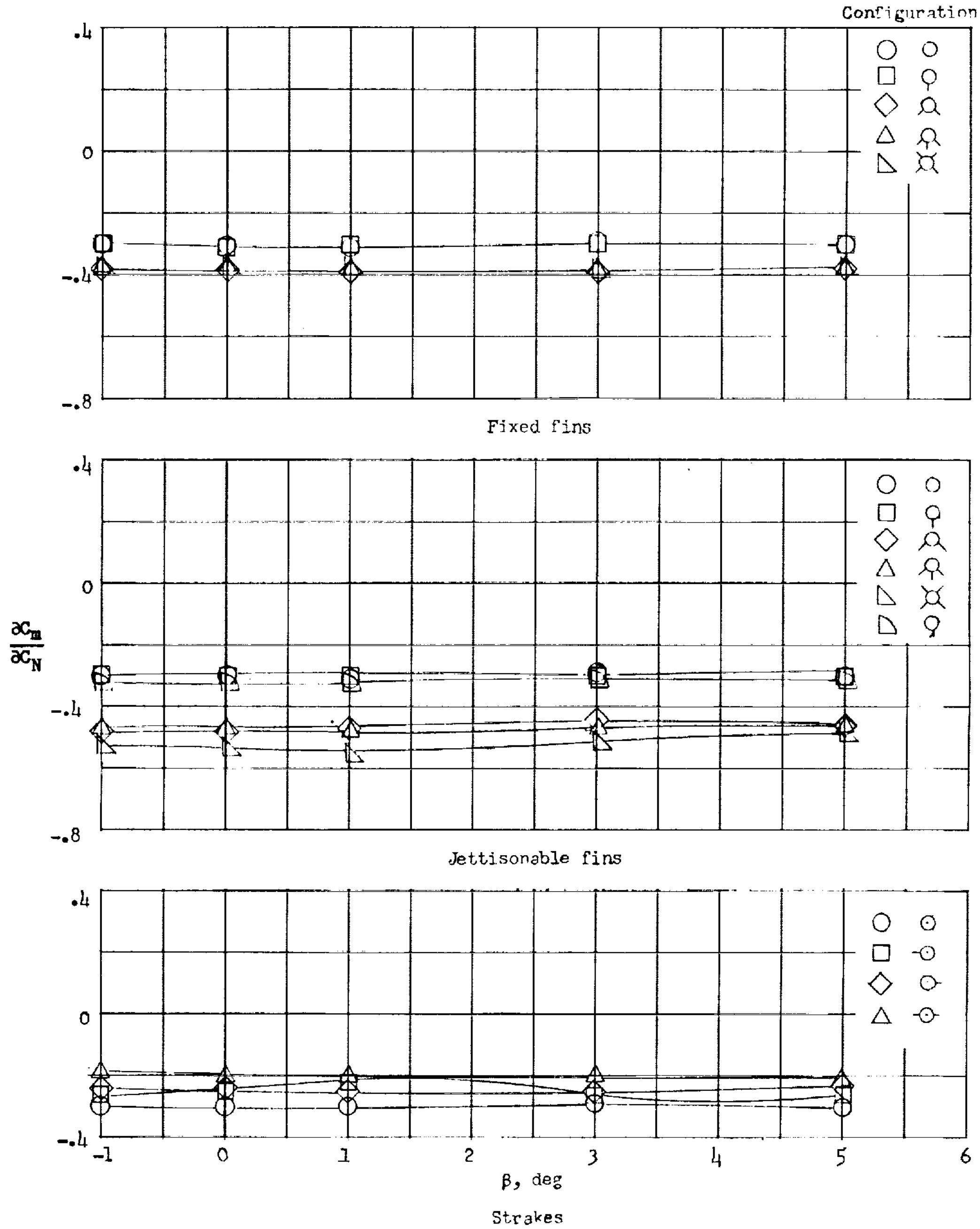
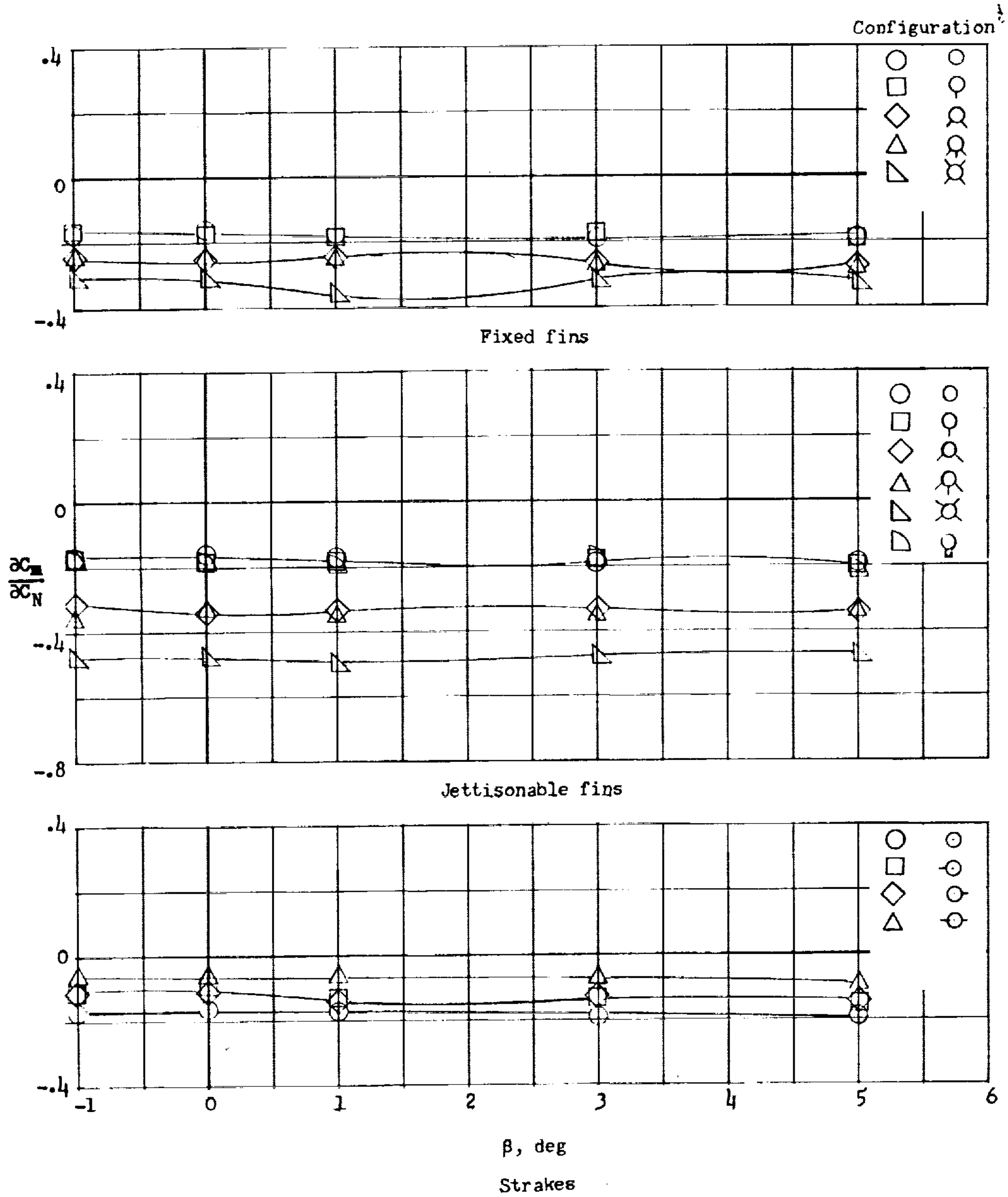


(a) M = 2.37.

Figure 19.- Comparison of the margin of static longitudinal stability parameter $\partial C_m/\partial C_N$ for a 1/56-scale model of the X-1E airplane with and without various directional-stability-improvement devices.



(b) M = 2.98.

Figure 19.- Continued.

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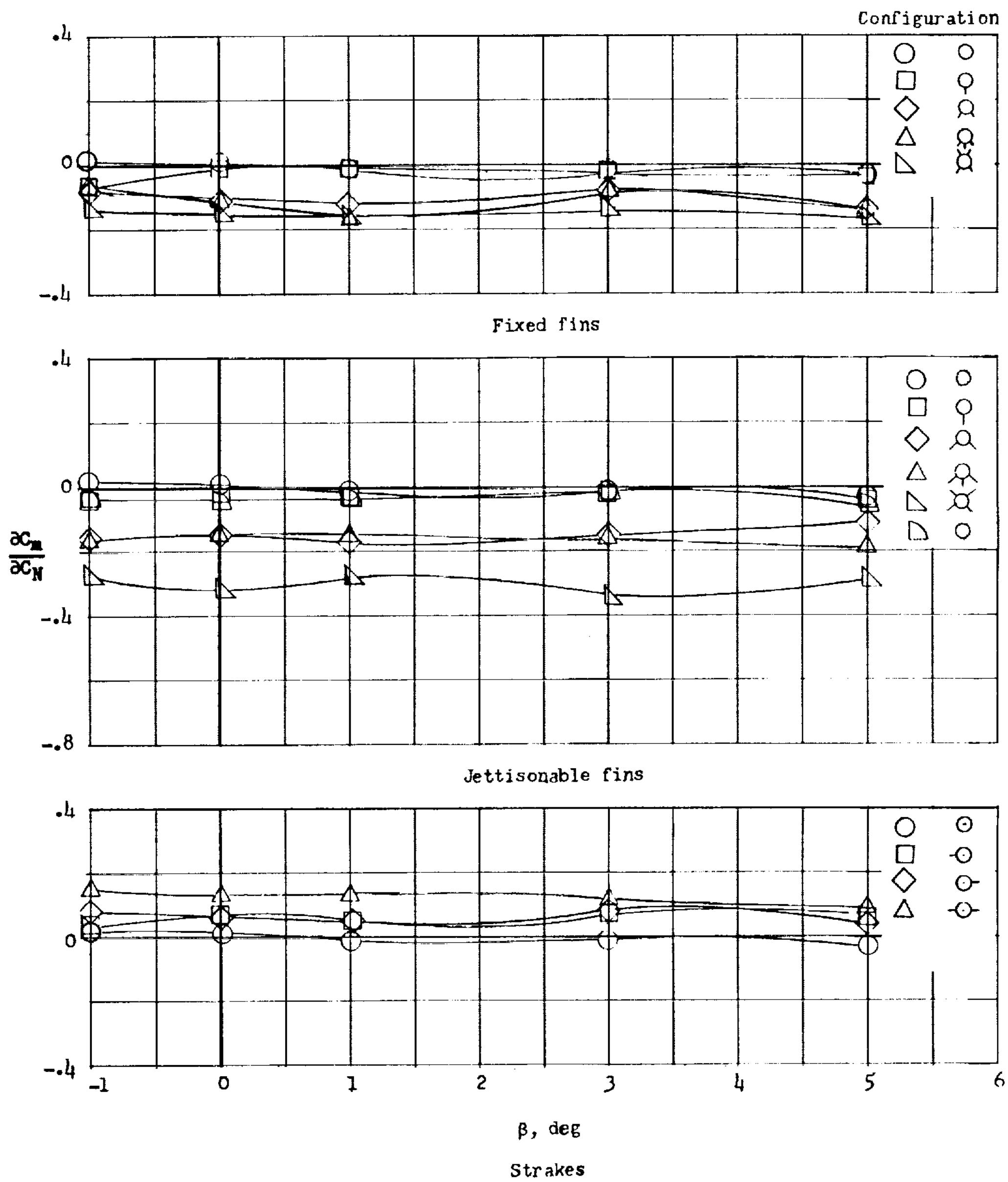
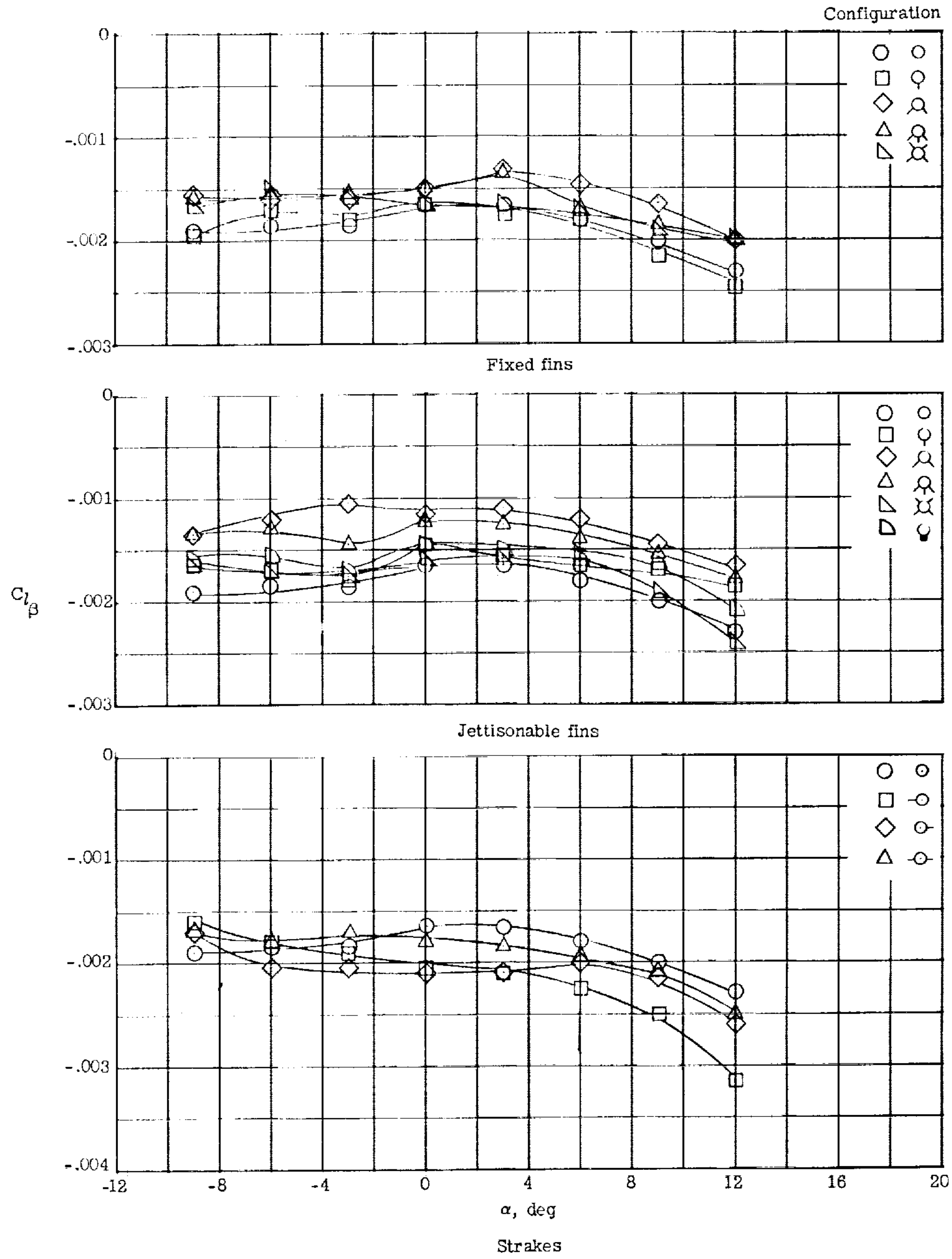


(c) M = 4.01.

Figure 19.- Concluded.



(a) M = 2.37.

Figure 20.- Comparison of the effective dihedral parameter C_{l_β} for a 1/56-scale model of the X-1E airplane with and without various directional-stability-improvement devices.

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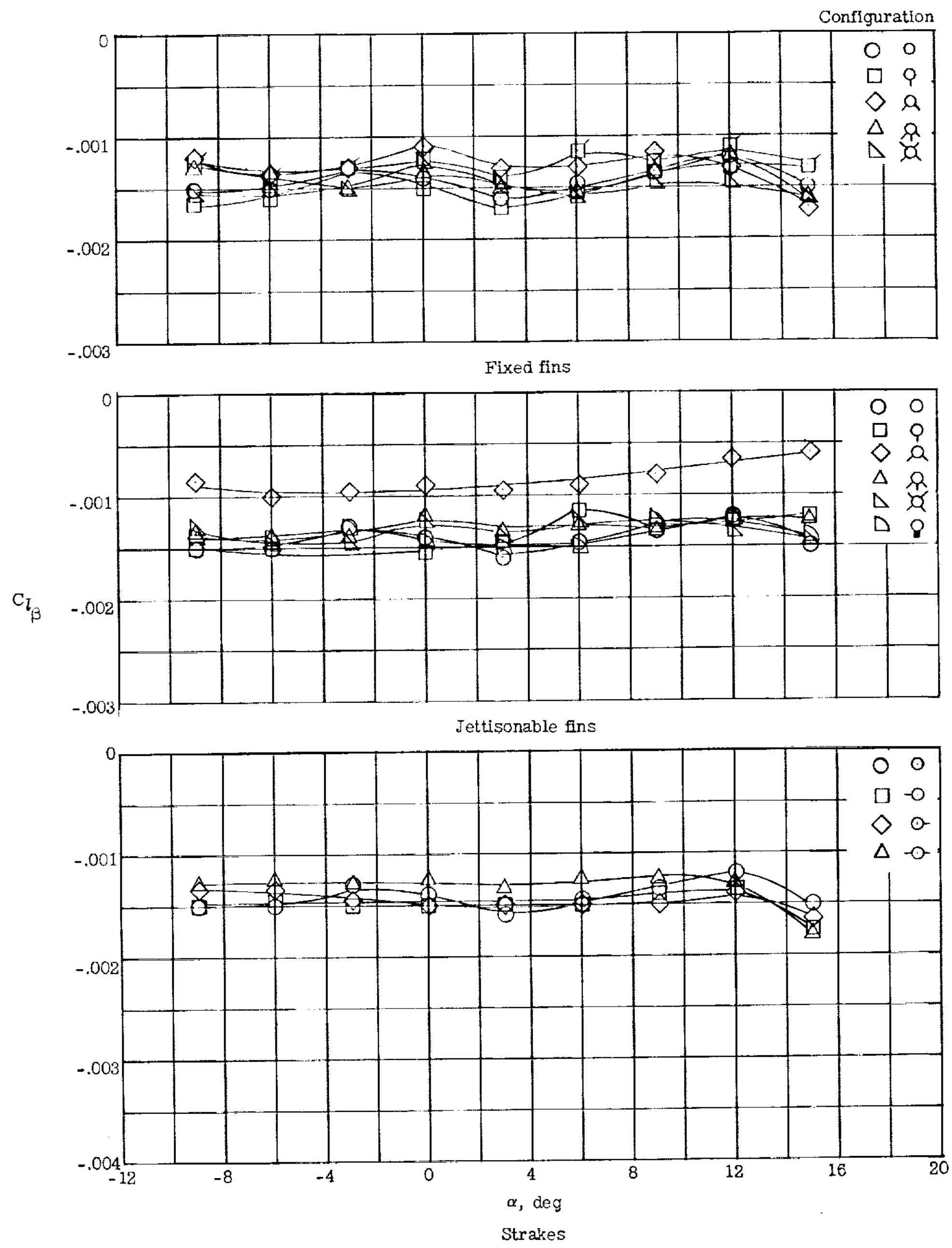
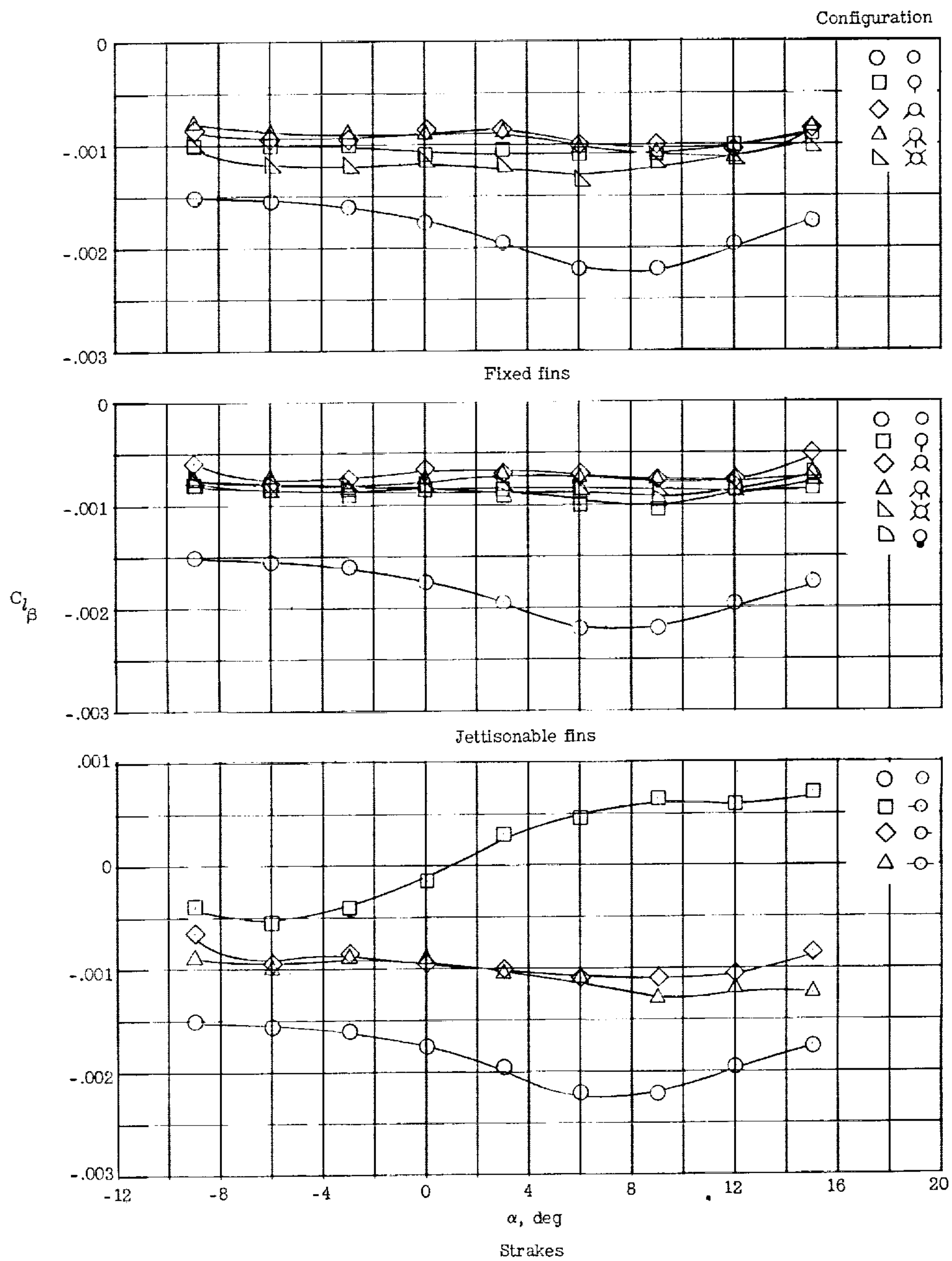


(b) M = 2.98.

Figure 20.- Continued.



(c) M = 4.01.

Figure 20.- Concluded.

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