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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

TECHNICAL MEMORANDUM X-35

# EFFECTS OF VERTICAL-TAIL SIZE AND A VENTRAL FIN ON THE STATIC LATERAL AND DIRECTIONAL STABILITY DERIVATIVES OF A 0.048-SCALE MODEL OF A HORIZONTAL-ATTITUDE VTOL AIRPLANE AT TRANSONIC SPEEDS*

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## SUMMARY

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An investigation was made of the effects of vertical-tail size and a ventral fin on the static lateral and directional stability derivatives of a 0.048-scale model of a horizontal-attitude vertical-take-off-and-landing (VTOL) airplane. The model was tested at Mach numbers from 0.6 to 1.2, with angles of attack up to 25° and angles of sideslip of 0°, -3.25°, and -6.50°.

The results indicated that the addition of the small vertical tail resulted in a directionally stable configuration for angles of attack up to at least 11°. Use of a vertical tail with a 33-percent greater exposed area increased the directional-stability contribution of the vertical tail by approximately 15 to 20 percent throughout most of the Mach number range. The effective dihedral was generally positive for the configuration with the large vertical tail. The addition of a ventral fin to the configuration produced no noticeable change in the lateral and directional derivatives. At an angle of attack of 0°, the directional-stability contribution of the horizontal tail was generally from 39 to 49 percent of the stability contribution of the small vertical tail. This directional-stability contribution decreased with increasing angle of attack. The -30° dihedral angle of the horizontal tail produced a large negative increment in the effective dihedral. A rapid increase in pitching-moment coefficient with increasing angle of sideslip was produced by the combined effects of horizontal-tail negative dihedral, high wing position, and low horizontal-tail position.




*Title, Unclassified.

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## [redacted] INTRODUCTION

An investigation has been conducted at transonic speeds in the Langley 8-foot transonic pressure tunnel to determine the effects of horizontal-tail negative dihedral, vertical-tail size, and ventral fins on the aerodynamic characteristics of a horizontal-attitude vertical-take-off-and-landing (VTOL) airplane. This model was tested at Mach numbers ranging from 0.6 to 1.2 and angles of attack up to $25^{\circ}$. The longitudinal-stability characteristics, including the effects of horizontal-tail negative-dihedral angle, were reported in reference 1. This previous study indicated that the horizontal tail with a dihedral angle of $-30^{\circ}$ yielded the most desirable longitudinal-stability results. Therefore, this horizontal tail was chosen for the lateral-stability investigation. The results of the lateral-stability investigation, including the effects of vertical-tail size and a ventral fin, are reported herein. The average test Reynolds number based on the mean aerodynamic chord varied from $1.42 \times 10^{6}$ to $1.90 \times 10^{6}$ over the Mach number range.

## SYMBOLS

| | |
|---|---|
| $b$ | wing span, in. |
| $C_D'$ | drag coefficient, $F_D'/qS$ |
| $C_{D,i}$ | internal drag coefficient (along body axis), $\dfrac{\text{Internal drag}}{qS}$ |
| $C_L$ | lift coefficient, $F_L/qS$ |
| $C_l$ | rolling-moment coefficient, $M_X/qSb$ |
| $C_{l_\beta}$ | rolling moment due to sideslip, $\dfrac{\partial C_l}{\partial \beta}$, per deg |
| $-C_{l_\beta}$ | effective dihedral parameter |
| $C_m$ | pitching-moment coefficient, $M_Y/qS$ |
| $C_n$ | yawing-moment coefficient, $M_Z/qSb$ |
| $C_{n_\beta}$ | static directional-stability parameter, $\dfrac{\partial C_n}{\partial \beta}$, per deg |

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| | |
|---|---|
| $C_{p,b}$ | base pressure coefficient, $\frac{p_b - p_\infty}{q}$ |
| $C_Y$ | side-force coefficient, $F_Y/qS$ |
| $C_{Y_\beta}$ | side-force derivative, $\frac{\partial C_Y}{\partial \beta}$, per deg |
| $\bar{c}_t$ | mean aerodynamic chord of exposed tail, in. |
| $\bar{c}_w$ | mean aerodynamic chord of wing, in. |
| $F_D'$ | drag, lb |
| $F_L$ | lift, lb |
| $F_Y$ | side force, lb |
| M | free-stream Mach number |
| $M_X$ | moment about X stability axis, in-lb |
| $M_Y$ | moment about Y stability axis, in-lb |
| $M_Z$ | moment about Z stability axis, in-lb |
| $p_b$ | static pressure at model base, lb/sq ft |
| $p_\infty$ | free-stream static pressure, lb/sq ft |
| q | free-stream dynamic pressure, lb/sq ft |
| R | Reynolds number based on wing mean aerodynamic chord |
| S | total wing area, sq ft |
| $t_{max}$ | maximum thickness of wing section, in. |
| w | mass flow through model |
| $w_\infty$ | mass flow through a free-stream tube of same area as inlet |
| X,Y,Z | stability axes (fig. 2) |

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$\alpha$ angle of attack of wing chord plane, deg

$\beta$ angle of sideslip of body reference line, deg

Model components:

$B_2$ fuselage

$F_2$ ventral fin

$H_{30}$ horizontal tail with $-30^{\circ}$ dihedral angle

N wingtip engine nacelles

$V_1$ small vertical tail

$V_2$ large vertical tail

W wing

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## APPARATUS AND TESTS

### Tunnel

The tests were conducted in the Langley 8-foot transonic pressure tunnel, which is a rectangular, slotted-throat, single-return tunnel designed to yield aerodynamic data at transonic speeds. During this investigation, the tunnel was operated at a stagnation pressure of approximately 1 atmosphere. To minimize humidity effects the dewpoint of the tunnel air was kept constant at approximately $0^{\circ}$ F and the stagnation temperature was automatically kept at $121^{\circ}$ F. Details of the test section have been presented in reference 2.

### Model

The model used in this investigation was 0.048 scale. Dimensional details of the model are presented in figure 1 and table I.

The wing, which was mounted high on the fuselage, was unswept along the 50-percent-chord line. It had an aspect ratio of 2.42 and a taper ratio of 0.433. The streamwise airfoil sections were modified NACA 65A005 with blunt trailing edges. The thickness of the trailing edges was 30 percent of the maximum thickness of the local airfoil section.

The fuselage, which had a fineness ratio of 10.4, was designed according to the supersonic area-rule concept and was partially indented to allow for the wing, nacelles, and tail surfaces in order to give a favorable area distribution at a Mach number of 1.4.

Two ram-type inlets with boundary-layer diverter plates were mounted on the sides of the fuselage beneath the wing. The air taken into these inlets was exhausted at the base of the model.



A large engine nacelle was mounted on each wingtip. These nacelles had a fineness ratio of 4.47, based on the total cross-sectional area, including that of the entering stream tube.

Two geometrically similar vertical tails, differing only in size, and one ventral fin were tested. All these vertical surfaces were swept back along the quarter-chord line at approximately $50^{\circ}$. The all-movable horizontal tail was set at a dihedral angle of $-30^{\circ}$. Details of the various tail arrangements are presented in figure 1(b).

## Measurements and Accuracy

Model forces and moments were measured by a six-component internal strain-gage balance and converted to coefficients of lift, drag, pitching moment, rolling moment, yawing moment, and lateral force in the stability-axis system. (See fig. 2.) The origin of the axis system was a center-of-gravity location at 33 percent of the wing mean aerodynamic chord and 14.15 percent of the mean aerodynamic chord below the wing chord line. Accuracies of the coefficients are estimated to be within the following limits:

| | |
|---|---|
| $C_L$ | ±0.02 |
| $C_D'$ | ±0.004 |
| $C_m$ | ±0.01 |
| $C_l$ | ±0.001 |
| $C_n$ | ±0.002 |
| $C_Y$ | ±0.008 |

The angles of attack were determined to within $\pm 0.15^{\circ}$ by a pendulum-type inclinometer located in the sting support and from a calibration of the deflection of the sting and balance with respect to model load. Angles of sideslip were set by means of couplings. A calibration of sting and balance deflection with respect to model load indicated that the angles of sideslip varied by about a quarter of a degree from the mean values used in this paper. Rakes of static- and total-pressure tubes located at the base of the fuselage and at the base of each nacelle were used to determine the internal drag and mass-flow ratios. The internal-drag coefficients are estimated to be accurate to within ±0.001. Base pressure coefficients were obtained from static-pressure orifices located at the base of the fuselage, at the base of each nacelle, and in the balance chamber. The accuracy of the base pressure coefficients is estimated to be ±0.05.

## Tests

The model was tested at Mach numbers from 0.6 to 1.2, with angles of attack from approximately $-2^{\circ}$ to approximately $25^{\circ}$ and angles of sideslip of approximately $0^{\circ}$, $-3.25^{\circ}$, and $-6.50^{\circ}$. Configuration $WB_2NH_{30}V_1$ was also tested through the Mach number range at angles of sideslip from $2^{\circ}$ to $-15^{\circ}$ and an average angle of attack of $3.25^{\circ}$. The actual angles of attack varied by about $\pm 0.4^{\circ}$ from the average value. During these tests, the average Reynolds number varied from $1.42 \times 10^6$ to $1.90 \times 10^6$. (See fig. 3.)

All tests were run with transition fixed. The 0.10-inch transition strips, which consisted of grains of carborundum (approximately 0.012 inch in diameter) at an estimated density of 40 grains per inch, were located at the 10-percent-chord line on all aerodynamic surfaces and at 10 percent of the fuselage and nacelle lengths.

## Corrections

Subsonic boundary interference was negligible and no corrections for this interference have been applied. The effects of supersonic boundary-reflected disturbances were reduced by testing the model several inches from the center line of the tunnel. No corrections for sting interference have been applied. The drag data have been adjusted to an assumed condition of free-stream static pressure acting over the model base by use of the base pressure coefficients presented in figure 4. The drag data have not been corrected for internal drag. The internal-drag coefficients are presented in figure 5.

# RESULTS

The mass-flow ratios for the fuselage and nacelles are presented in figure 6 as a function of Mach number. The six force and moment coefficients are presented as a function of angle of attack throughout the Mach number and sideslip-angle ranges for the various model configurations in tables II to VI. In figure 7, the force and moment coefficients are presented as a function of angle of sideslip throughout the Mach number range at an angle of attack of approximately 3.25° for model configuration $WB_2NH_{30}V_1$. The effects of vertical-tail size, a ventral fin, and the horizontal tail on the lateral-stability derivatives of the model are presented in figures 8, 9, and 10, respectively.

## DISCUSSION OF RESULTS

The variation of rolling-moment coefficient with angle of sideslip was generally linear for $\beta$ less than 4° for an angle of attack of about 3.25°. (See fig. 7(b).) The yawing-moment and side-force coefficients varied linearly with angle of sideslip for $\beta$ less than 8°. The lateral and directional coefficients were therefore assumed to vary linearly with angle of sideslip up to $\beta = 4^\circ$ for all configurations tested through the angle-of-attack range. Lateral and directional derivatives were then obtained by dividing the coefficients for $\beta \approx -3.25^\circ$ (see tables II to VI) by the angle of sideslip. Since there is no proof of linearity of the data throughout the entire angle-of-attack range, the reader should exercise some caution in interpreting the lateral and directional derivatives presented. In particular, care should be exercised with those derivatives at the higher angles of attack.

### Effects of Vertical-Tail Size

The configuration with the vertical tail off $\left(WB_2NH_{30}\right)$ was directionally unstable $\left(C_{n_\beta}\ \text{negative}\right)$ throughout the Mach number and angle-of-attack ranges of the investigation. (See fig. 8(a).) The addition of the small vertical tail $V_1$ resulted in a directionally stable configuration for angles of attack up to at least 11°. Substitution of the large tail $V_2$ (which had approximately 33 percent more exposed area) for the small tail increased the stability of the configuration by about 15 to 20 percent except at $M = 1.13$, where the increase was about 45 percent. As the angle of attack increased, the vertical tail became less effective in producing yawing moment.

The effective dihedral parameter for the configuration without the vertical tail was slightly negative $\left(C_{l_\beta}\ \text{positive}\right)$ at angles of attack near zero. (See fig. 8(b).) Addition of the vertical tail contributed a small stabilizing component to the effective dihedral of the model. The effective dihedral was ge[redacted]positive for the configuration with the large vertical tail throu[redacted] of attack and Mach number ranges of the investigation, with the exception of angles of attack near zero at $M = 0.95$, 1.00, and 1.05.

The variation of the lateral-force derivatives with angle of attack for the three configurations (fig. 8(c)) illustrates the decrease in vertical-tail effectiveness with increasing angle of attack.

## Effects of the Ventral Fin

The addition of the ventral fin to configuration $WB_2NH_{30}V_1$ produced no noticeable change in the lateral and directional stability characteristics. (See fig. 9.) An inspection of the side-force coefficients listed in tables II and VI for the model with and without the ventral fin reveals also that the ventral fin was virtually ineffective in producing side force. Apparently, the ineffectiveness of the ventral fin was caused by a combination of factors, two of which might have been the partial blanketing of the fin by the horizontal tail and the low aspect ratio (0.357) of the ventral fin. L 4 2 4

## Effects of the Horizontal Tail

Because of the large amount of negative dihedral, the horizontal tail had a significant effect on the lateral and directional stability characteristics of the model. (See fig. 10.) At an angle of attack of 0°, the directional stability $C_{n_\beta}$ contribution of the horizontal tail was generally from 39 to 49 percent of the stability contribution of the small vertical tail. As the angle of attack increased, the stability contribution of the horizontal tail decreased until it became nearly ineffective at angles of attack near 20°. For the Mach numbers of 1.00, 1.05, and 1.13, the horizontal tail was actually destabilizing at angles of attack near 20°.

The horizontal tail produced a large negative increment in the effective dihedral $-C_{l_\beta}$ $\left(\text{positive increment in } C_{l_\beta}\right)$. This effect, which attenuated with increasing angle of attack, was produced by the large negative geometric dihedral of the horizontal tail.

The contribution of the horizontal tail to the side-force derivative decreased with increasing angle of attack throughout the Mach number range.

The lift coefficient for configuration $WB_2NH_{30}V_1$ at an angle of attack of approximately 3.25° decreased slightly with increasing angle of sideslip at all Mach numbers tested. (See fig. 7(a).) The effect of increasing sideslip on the drag coefficient was small.

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The pitching-moment coefficient increased rapidly with increasing angle of sideslip. The largest contributing factor to this trim change was the horizontal tail. The effective angle of attack of the windward tail panel decreased rapidly with increasing angle of sideslip because of the large amount of negative dihedral of the horizontal tail. Conversely, the effective angle of attack of the tail panel on the leeward side of the fuselage increased with increasing angle of sideslip. However, the leeward tail panel is partially shielded by the fuselage and its contribution to the total lift is less than the contribution of the windward tail panel. The net result is a decrease in lift on the horizontal tail surfaces with increasing angle of sideslip and, because of the large moment arm, a large increase in positive pitching moment. This effect of the horizontal tail is illustrated by a comparison of the pitching-moment coefficients for $\beta \approx -3.25^{\circ}$ and $-6.50^{\circ}$ for configurations $WB_2NH_{30}$ and $WB_2N$ (tables IV and V).

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A smaller increase in positive pitching-moment coefficient with increasing angle of sideslip is also evident for the tail-off configuration (see table V). This effect was a result of the high wing location and was previously noted in reference 3. Reference 3 also indicates that a low horizontal-tail location will produce a small increase in positive pitching moment with increasing angle of sideslip.

## SUMMARY OF RESULTS

An investigation to determine the lateral and directional stability derivatives, including the effects of vertical-tail size and a ventral fin, of a 0.048-scale model of a horizontal-attitude vertical-take-off-and-landing (VTOL) airplane at transonic speeds has led to the following results:

1. The addition of a small vertical tail resulted in a directionally stable configuration $C_{n_\beta}$ positive for angles of attack up to at least $11^{\circ}$. Use of a tail with a 33-percent larger exposed area increased the directional-stability contribution of the vertical tail by 15 to 20 percent throughout most of the Mach number range of the investigation. The effective dihedral $-C_{l_\beta}$ was generally positive for the configuration with the large vertical tail.

2. The addition of a ventral fin to the configuration produced no noticeable change in the lateral and directional stability characteristics of the model.

3. At an angle of attack of $0^\circ$, the directional-stability contribution of the horizontal tail was generally from 39 to 49 percent of the stability contribution of the small vertical tail. This directional-stability contribution decreased with increasing angle of attack.

4. The $-30^\circ$ dihedral angle of the horizontal tail produced a large negative increment in the effective dihedral of the configuration.

5. The $-30^\circ$ dihedral angle of the horizontal tail produced a rapid increase in pitching-moment coefficient with increasing angle of sideslip throughout the Mach number range at an angle of attack of approximately $3.25^\circ$.

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Langley Research Center,
National Aeronautics and Space Administration,
Langley Field, Va., April 13, 1959.

REFERENCES

1. Olstad, Walter B.: Aerodynamic Characteristics in Pitch, Including Effects of Horizontal-Tail Negative Dihedral Angle, of a 0.048-Scale Model of a Horizontal-Attitude VTOL Airplane at Transonic Speeds. NASA TM X-11, 1960.

2. Mugler, John P., Jr.: Transonic Wind-Tunnel Investigation of the Aerodynamic Loading Characteristics of a $60^\circ$ Delta Wing in the Presence of a Body With and Without Indentation. NACA RM L55G11, 1955.

3. Robinson, Ross B.: Effects of Vertical Location of the Wing and Horizontal Tail on the Static Lateral and Directional Stability of a Trapezoidal-Wing Airplane Model at Mach Numbers of 1.41 and 2.01. NACA RM L58C18, 1958.

TABLE I

MODEL DIMENSIONS

| | |
|---|---|
| **Center-of-gravity location:** | |
| Longitudinal | Station 16.644 in., $0.33\bar{c}_w$ |
| Vertical | 0.766 in. below $\bar{c}_w$ |
| **Wing:** | |
| Airfoil section | 65A005 modified (trailing-edge thickness, $0.3t_{max}$) |
| Total area (measured between nacelle center lines), sq ft | 0.447 |
| Span (measured between nacelle center lines), in. | 12.456 |
| Mean aerodynamic chord, $\bar{c}_w$, in. | 5.424 |
| Aspect ratio | 2.42 |
| Taper ratio | 0.433 |
| Sweep of quarter-chord line, deg | 9.3 |
| Incidence, deg | 0 |
| Dihedral, deg | 0 |
| Distance of $\bar{c}_w$ above body reference line, in. | 1.056 |
| **Horizontal tail:** | |
| Airfoil section | NACA 65A004 |
| Area of exposed tail, sq ft | 0.1212 |
| Span of exposed tail, in. | 6.528 |
| Mean aerodynamic chord of exposed tail, $\bar{c}_t$ | 2.772 |
| Aspect ratio of exposed tail | 2.44 |
| Taper ratio of exposed tail | 0.497 |
| Sweep of quarter-chord line, deg | 29.6 |
| Incidence, deg | 0 |
| Dihedral, deg | -30 |
| Tail length, in. | 12.370 |
| Distance of $\bar{c}_t$ below body reference line, in. | 0.163 |

| Vertical tails: | $V_1$ | $V_2$ |
|---|---|---|
| Airfoil section | NACA 65A004 | NACA 65A004 |
| Area of exposed tail, sq ft | 0.0638 | 0.0851 |
| Span of exposed tail, in. | 3.264 | 3.820 |
| Aspect ratio of exposed tail | 1.16 | 1.19 |
| Taper ratio of exposed tail | 0.408 | 0.397 |
| Sweepback of quarter-chord line, deg | 47.55 | 47.55 |

| | |
|---|---|
| **Ventral fin:** | |
| Airfoil section | NACA 65A004 |
| Area of exposed fin, sq ft | 0.0178 |
| Span of exposed fin, in. | 1.078 |
| Aspect ratio | 0.357 |
| Taper ratio | 0.620 |
| Sweepback of quarter-chord line, deg | 49.00 |

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TABLE II.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2NH_{30}V_1$

(a) $\beta = 0^{\circ}$

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ | α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | M = 0.60 | | | | | | | M = 0.80 | | | |
| -0.01 | -0.058 | 0.0562 | 0.0829 | 0.0006 | 0.0012 | -0.0124 | 0.04 | -0.041 | 0.0564 | 0.0950 | 0.0000 | 0.0021 | -0.0066 |
| -2.28 | -.249 | .0638 | .0892 | .0002 | .0018 | -.0084 | -2.49 | -.280 | .0652 | .0930 | .0000 | .0026 | -.0056 |
| 2.26 | .135 | .0575 | .0707 | .0005 | .0010 | -.0096 | 2.55 | .196 | .0595 | .0862 | .0004 | .0016 | -.0065 |
| 4.52 | .327 | .0701 | .0488 | .0010 | .0011 | -.0110 | 5.02 | .447 | .0847 | .0577 | .0006 | .0015 | -.0080 |
| 6.80 | .522 | .1045 | .0208 | .0014 | .0004 | -.0136 | 7.42 | .631 | .1301 | -.0026 | .0014 | .0020 | -.0081 |
| 9.01 | .688 | .1536 | -.0407 | .0027 | .0015 | -.0106 | 9.56 | .740 | .1782 | -.0859 | .0022 | .0029 | -.0075 |
| 11.09 | .785 | .2042 | -.1282 | .0028 | .0009 | -.0117 | 11.69 | .838 | .2304 | -.1745 | .0012 | .0029 | -.0097 |
| 13.16 | .876 | .2589 | -.2162 | .0009 | .0016 | -.0121 | 13.83 | .925 | .2896 | -.2654 | .0013 | .0036 | -.0093 |
| 15.24 | .948 | .3154 | -.2953 | .0023 | .0009 | -.0080 | 15.94 | 1.010 | .3510 | -.3440 | .0033 | .0002 | -.0037 |
| 17.30 | 1.004 | .3722 | -.3631 | .0031 | .0010 | -.0098 | 18.12 | 1.113 | .4266 | -.4084 | .0038 | .0000 | -.0044 |
| 19.41 | 1.077 | .4372 | -.4115 | .0040 | -.0029 | -.0075 | 20.34 | 1.216 | .5123 | -.4693 | .0070 | -.0097 | .0026 |
| 21.50 | 1.165 | .5148 | -.4551 | .0095 | -.0169 | .0107 | 22.58 | 1.321 | .6091 | -.5159 | .0144 | -.0294 | .0206 |
| -.01 | -.062 | .0568 | .0807 | .0003 | .0012 | -.0125 | .05 | -.036 | .0553 | .0947 | .0001 | .0024 | -.0094 |
| | | | M = 0.90 | | | | | | | M = 0.95 | | | |
| 0.11 | -0.017 | 0.0572 | 0.1088 | 0.0001 | 0.0026 | -0.0084 | 0.11 | -0.018 | 0.0668 | 0.1057 | 0.0000 | 0.0029 | -0.0096 |
| -2.72 | -.332 | .0720 | .0991 | .0001 | .0024 | -.0067 | -2.82 | -.374 | .0839 | .1229 | .0000 | .0028 | -.0076 |
| 2.89 | .302 | .0705 | .0990 | .0004 | .0011 | -.0085 | 2.99 | .332 | .0852 | .0833 | .0002 | .0018 | -.0079 |
| 5.62 | .620 | .1159 | .0525 | .0004 | .0018 | -.0084 | 5.76 | .649 | .1346 | .0254 | -.0001 | .0014 | -.0084 |
| 7.82 | .724 | .1576 | -.0192 | .0033 | .0030 | -.0063 | 8.40 | .932 | .2061 | -.0689 | .0003 | .0024 | -.0091 |
| 10.01 | .843 | .2093 | -.1172 | .0024 | .0025 | -.0069 | 10.88 | 1.168 | .2922 | -.1595 | .0009 | .0027 | -.0101 |
| 12.21 | .967 | .2731 | -.2168 | .0009 | .0041 | -.0121 | 13.13 | 1.276 | .3694 | -.2393 | -.0003 | .0056 | -.0132 |
| 14.43 | 1.085 | .3462 | -.3108 | .0017 | .0032 | -.0085 | 15.23 | 1.342 | .4392 | -.3321 | .0021 | .0049 | -.0152 |
| 16.63 | 1.194 | .4258 | -.3977 | .0044 | -.0045 | -.0014 | 17.38 | 1.418 | .5186 | -.4201 | .0018 | .0050 | -.0145 |
| 18.82 | 1.296 | .5109 | -.4780 | .0056 | -.0095 | .0049 | 19.57 | 1.511 | .6134 | -.5039 | .0017 | .0033 | -.0126 |
| 21.12 | 1.412 | .6139 | -.5563 | .0105 | -.0213 | .0174 | 21.82 | 1.616 | .7224 | -.5881 | .0027 | .0012 | -.0096 |
| 23.37 | 1.510 | .7194 | -.6087 | -.0032 | .0179 | -.0305 | 24.10 | 1.719 | .8421 | -.6585 | .0011 | .0065 | -.0181 |
| .11 | -.016 | .0572 | .1078 | .0000 | .0026 | -.0085 | .13 | -.011 | .0662 | .1041 | .0000 | .0025 | -.0080 |

[redacted]

TABLE II.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2NH_{30}V_1$ - Continued

(a) $\beta = 0^o$ - Concluded

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ | α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | M = 1.00 | | | | | | | M = 1.05 | | | |
| 0.05 | -0.032 | 0.0787 | 0.0877 | 0.0000 | 0.0028 | -0.0078 | 0.05 | -0.039 | 0.0918 | 0.0883 | -0.0003 | 0.0015 | -0.0069 |
| -2.86 | -.363 | .0959 | .1044 | .0000 | .0032 | -.0061 | -2.85 | -.356 | .1079 | .1213 | -.0002 | .0019 | -.0055 |
| 2.93 | .303 | .0960 | .0532 | .0002 | .0025 | -.0074 | 2.93 | .288 | .1070 | .0391 | -.0001 | .0012 | -.0063 |
| 5.69 | .626 | .1459 | -.0209 | -.0004 | .0022 | -.0084 | 5.67 | .596 | .1508 | -.0248 | -.0006 | .0005 | -.0066 |
| 8.37 | .908 | .2188 | -.1188 | .0003 | .0029 | -.0084 | 8.36 | .869 | .2175 | -.1120 | -.0001 | .0022 | -.0077 |
| 10.90 | 1.148 | .3070 | -.2309 | .0007 | .0026 | -.0085 | 10.91 | 1.106 | .3030 | -.2272 | .0005 | .0017 | -.0069 |
| 13.23 | 1.294 | .3917 | -.3329 | -.0030 | .0084 | -.0206 | 13.20 | 1.245 | .3832 | -.3331 | -.0025 | .0072 | -.0174 |
| 15.49 | 1.441 | .4878 | -.4685 | .0008 | .0046 | -.0151 | 15.50 | 1.395 | .4796 | -.4663 | .0005 | .0038 | -.0126 |
| 17.84 | 1.609 | .6044 | -.6155 | .0016 | .0036 | -.0147 | 17.85 | 1.561 | .5942 | -.6081 | .0011 | .0034 | -.0103 |
| 20.11 | 1.704 | .7086 | -.6562 | .0026 | .0045 | -.0173 | 20.16 | 1.693 | .7112 | -.7280 | .0025 | .0006 | -.0154 |
| 22.37 | 1.797 | .8239 | -.7471 | .0019 | .0044 | -.0145 | 21.10 | 1.735 | .7574 | -.7499 | .0093 | .0063 | -.0253 |
| .05 | -.034 | .0776 | .0901 | -.0001 | .0028 | -.0075 | .02 | -.043 | .0912 | .0893 | -.0003 | .0024 | -.0065 |
| | | | M = 1.13 | | | | | | | M = 1.20 | | | |
| 0.04 | -0.048 | 0.0926 | 0.0976 | -0.0008 | 0.0011 | -0.0010 | 0.06 | -0.029 | 0.0961 | 0.0923 | -0.0002 | 0.0077 | 0.0139 |
| -2.82 | -.332 | .1076 | .1379 | -.0009 | .0015 | .0006 | .03 | -.044 | .0969 | .0912 | .0004 | .0066 | .0030 |
| 2.78 | .238 | .1052 | .0406 | -.0008 | .0011 | -.0023 | .01 | -.044 | .0970 | .0920 | .0004 | .0066 | .0031 |
| 5.53 | .527 | .1432 | -.0410 | -.0012 | .0022 | -.0041 | -2.75 | -.316 | .1118 | .1378 | .0001 | .0060 | .0014 |
| 8.24 | .790 | .2048 | -.1301 | -.0007 | .0031 | -.0041 | 2.79 | .233 | .1100 | .0281 | .0005 | .0066 | -.0045 |
| 10.79 | 1.014 | .2827 | -.2212 | .0006 | .0031 | -.0014 | 5.50 | .498 | .1454 | -.0487 | .0001 | .0074 | -.0054 |
| 13.13 | 1.157 | .3566 | -.3018 | -.0004 | .0026 | -.0038 | 8.14 | .741 | .2022 | -.1298 | .0009 | .0081 | -.0045 |
| 15.42 | 1.291 | .4423 | -.4001 | .0004 | .0023 | -.0044 | 10.67 | .950 | .2732 | -.2153 | .0019 | .0078 | -.0031 |
| 17.84 | 1.465 | .5561 | -.5296 | .0012 | .0025 | -.0060 | 13.09 | 1.107 | .3475 | -.3002 | .0015 | .0071 | -.0050 |
| 20.25 | 1.618 | .6799 | -.6387 | .0022 | .0035 | -.0047 | 15.41 | 1.244 | .4305 | -.3957 | .0012 | .0054 | -.0005 |
| 22.62 | 1.723 | .7974 | -.6660 | .0040 | .0067 | -.0084 | 17.81 | 1.412 | .5389 | -.5153 | .0020 | .0037 | .0001 |
| .01 | -.056 | .0920 | .0981 | -.0007 | .0015 | -.0006 | 20.25 | 1.569 | .6617 | -.6213 | .0015 | .0036 | .0009 |
| | | | | | | | 21.71 | 1.664 | .7443 | -.6874 | .0017 | .0048 | -.0025 |
| | | | | | | | -.02 | -.056 | .0969 | .0950 | .0003 | .0061 | .0001 |

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TABLE II.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2NH_{30}V_1$ - Continued

(b) $\beta \approx -3.25^o$

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ | α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M = 0.60 | | | | | | | M = 0.80 | | | | | | |
| 0.04 | -0.036 | 0.0538 | 0.0844 | 0.0001 | -0.0257 | 0.0668 | 0.12 | -0.016 | 0.0533 | 0.0981 | -0.0003 | -0.0301 | 0.0775 |
| -2.22 | -.238 | .0615 | .0943 | -.0007 | -.0256 | .0645 | -2.34 | -.259 | .0618 | .1002 | -.0013 | -.0307 | .0799 |
| 2.29 | .157 | .0563 | .0703 | .0009 | -.0265 | .0620 | 2.54 | .212 | .0585 | .0853 | .0007 | -.0291 | .0759 |
| 4.48 | .343 | .0689 | .0551 | .0021 | -.0238 | .0614 | 4.94 | .454 | .0830 | .0644 | .0026 | -.0261 | .0752 |
| 6.77 | .548 | .1045 | .0198 | .0025 | -.0205 | .0623 | 7.27 | .659 | .1284 | .0010 | .0015 | -.0220 | .0724 |
| 8.92 | .715 | .1547 | -.0472 | .0037 | -.0174 | .0611 | 9.35 | .763 | .1773 | -.0895 | .0032 | -.0159 | .0732 |
| 13.00 | .888 | .2571 | -.2207 | .0060 | -.0039 | .0587 | 13.48 | .943 | .2867 | -.2762 | .0024 | .0096 | .0530 |
| 17.15 | 1.034 | .3755 | -.3732 | .0075 | .0059 | .0587 | 17.76 | 1.146 | .4285 | -.4183 | .0078 | .0112 | .0714 |
| 18.66 | 1.103 | .4285 | -.4119 | .0121 | .0048 | .0702 | 19.38 | 1.224 | .4906 | -.4553 | .0111 | .0107 | .0793 |
| .03 | -.045 | .0541 | .0849 | .0000 | -.0257 | .0672 | .11 | -.018 | .0530 | .0988 | -.0004 | -.0301 | .0783 |
| M = 0.90 | | | | | | | M = 0.95 | | | | | | |
| 0.18 | 0.006 | 0.0543 | 0.1134 | -0.0006 | -0.0339 | 0.0829 | 0.24 | 0.022 | 0.0619 | 0.1079 | -0.0028 | -0.0367 | 0.0858 |
| -2.47 | -.294 | .0661 | .1073 | -.0025 | -.0346 | .0895 | -2.59 | -.350 | .0773 | .1216 | -.0030 | -.0399 | .0972 |
| 2.83 | .302 | .0677 | .0964 | .0008 | -.0316 | .0836 | 2.91 | .349 | .0814 | .0818 | -.0001 | -.0308 | .0825 |
| 5.32 | .581 | .1073 | .0560 | .0081 | -.0281 | .0863 | 5.48 | .653 | .1277 | .0200 | .0019 | -.0258 | .0847 |
| 7.51 | .710 | .1488 | -.0126 | .0043 | -.0220 | .0831 | 7.99 | .934 | .1987 | -.0611 | .0019 | -.0179 | .0823 |
| 9.70 | .857 | .2039 | -.1074 | .0031 | -.0117 | .0770 | 10.43 | 1.180 | .2823 | -.1622 | .0028 | -.0056 | .0735 |
| 13.92 | 1.083 | .3329 | -.3078 | .0022 | .0169 | .0543 | 14.45 | 1.312 | .4077 | -.3374 | .0051 | .0127 | .0625 |
| 18.22 | 1.299 | .4944 | -.4753 | .0056 | .0221 | .0721 | 18.75 | 1.509 | .5844 | -.5029 | -.0001 | .0318 | .0622 |
| 20.03 | 1.395 | .5747 | -.5295 | .0083 | .0162 | .0855 | 20.54 | 1.590 | .6672 | -.5590 | -.0008 | .0355 | .0645 |
| .17 | .002 | .0543 | .1142 | -.0005 | -.0341 | .0851 | .23 | .015 | .0616 | .1066 | -.0024 | -.0364 | .0878 |

TABLE II.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2NH_{30}V_1$ - Continued

(b) $\beta \approx -3.25^{\circ}$ - Concluded

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ | α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M = 1.00 | | | | | | | M = 1.05 | | | | | | |
| 0.13 | -0.026 | 0.0740 | 0.0983 | -0.0018 | -0.0382 | 0.0909 | 0.13 | -0.034 | 0.0893 | 0.1058 | -0.0025 | -0.0463 | 0.1053 |
| -2.63 | -.360 | .0909 | .1215 | -.0023 | -.0419 | .1000 | -2.57 | -.349 | .1044 | .1400 | -.0025 | -.0494 | .1132 |
| 2.84 | .304 | .0900 | .0665 | -.0009 | -.0323 | .0868 | 2.82 | .291 | .1049 | .0517 | -.0011 | -.0395 | .0989 |
| 5.45 | .620 | .1367 | .0041 | .0011 | -.0279 | .0854 | 5.43 | .606 | .1473 | -.0230 | .0010 | -.0304 | .0925 |
| 7.97 | .905 | .2066 | -.0975 | .0012 | -.0208 | .0842 | 7.94 | .879 | .2125 | -.1126 | .0016 | -.0190 | .0849 |
| 10.36 | 1.143 | .2905 | -.2011 | .0022 | -.0110 | .0787 | 10.32 | 1.115 | .2917 | -.2243 | .0007 | -.0140 | .0797 |
| 14.76 | 1.443 | .4647 | -.4059 | .0093 | .0178 | .0511 | 14.69 | 1.423 | .4636 | -.4680 | .0026 | .0097 | .0576 |
| 19.18 | 1.704 | .6736 | -.6085 | .0033 | .0207 | .0629 | 19.09 | 1.714 | .6808 | -.7212 | .0099 | .0274 | .0508 |
| 20.92 | 1.780 | .7609 | -.6654 | .0014 | .0272 | .0638 | 20.88 | 1.798 | .7723 | -.7782 | .0044 | .0307 | .0510 |
| .09 | -.024 | .0732 | .0987 | -.0018 | -.0385 | .0928 | .12 | -.039 | .0893 | .1052 | -.0025 | -.0465 | .1014 |
| M = 1.13 | | | | | | | M = 1.20 | | | | | | |
| 0.08 | -0.049 | 0.0904 | 0.1077 | -0.0028 | -0.0418 | 0.1047 | 0.09 | -0.049 | 0.0946 | 0.1026 | -0.0005 | -0.0320 | 0.1044 |
| -2.54 | -.332 | .1052 | .1475 | -.0020 | -.0442 | .1097 | -2.56 | -.328 | .1095 | .1507 | -.0008 | -.0341 | .1105 |
| 2.74 | .243 | .1038 | .0504 | -.0011 | -.0351 | .0980 | 2.71 | .230 | .1073 | .0409 | .0013 | -.0251 | .0994 |
| 5.27 | .516 | .1382 | -.0254 | -.0003 | -.0275 | .0945 | 5.23 | .491 | .1408 | -.0324 | .0015 | -.0171 | .0946 |
| 7.79 | .783 | .1964 | -.1153 | -.0002 | -.0180 | .0902 | 7.73 | .736 | .1950 | -.1161 | .0021 | -.0094 | .0910 |
| 10.19 | 1.002 | .2669 | -.2084 | .0010 | -.0114 | .0905 | 10.10 | .945 | .2599 | -.2022 | .0043 | -.0045 | .0951 |
| 14.67 | 1.314 | .4272 | -.4016 | .0037 | .0132 | .0750 | 14.66 | 1.271 | .4174 | -.3980 | .0042 | .0145 | .0889 |
| 19.19 | 1.633 | .6465 | -.6336 | .0101 | .0351 | .0598 | 19.18 | 1.601 | .6352 | -.6306 | .0053 | .0272 | .0898 |
| 21.19 | 1.740 | .7490 | -.6927 | .0124 | .0475 | .0595 | 20.66 | 1.686 | .7116 | -.6877 | .0056 | .0336 | .0892 |
| .11 | -.047 | .0906 | .1080 | -.0028 | -.0416 | .1028 | .08 | -.057 | .0951 | .1045 | -.0008 | -.0323 | .1048 |

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TABLE II.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2NH_{30}V_1$ - Continued

(c) $\beta \approx -6.50^{\circ}$

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ | α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l'$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M = 0.60 | | | | | | | M = 0.80 | | | | | | |
| 0.05 | -0.048 | 0.0494 | 0.1043 | 0.0022 | -0.0596 | 0.1707 | 0.15 | -0.018 | 0.0493 | 0.1212 | 0.0021 | -0.0672 | 0.1843 |
| -2.22 | -.241 | .0581 | .1108 | .0004 | -.0630 | .1759 | -2.36 | -.261 | .0593 | .1193 | -.0005 | -.0723 | .1919 |
| 2.31 | .142 | .0512 | .0893 | .0043 | -.0570 | .1704 | 2.57 | .207 | .0547 | .1120 | .0045 | -.0630 | .1836 |
| 4.53 | .340 | .0664 | .0625 | .0058 | -.0524 | .1683 | 4.99 | .458 | .0801 | .0779 | .0070 | -.0567 | .1815 |
| 6.75 | .533 | .1002 | .0169 | .0057 | -.0463 | .1652 | 7.26 | .650 | .1246 | .0065 | .0054 | -.0470 | .1768 |
| 8.93 | .705 | .1520 | -.0532 | .0065 | -.0372 | .1609 | 9.33 | .735 | .1708 | -.0863 | .0083 | -.0328 | .1742 |
| 13.10 | .898 | .2574 | -.2199 | .0085 | -.0058 | .1506 | 13.54 | .944 | .2836 | -.2813 | .0066 | .0174 | .1446 |
| 17.24 | 1.052 | .3795 | -.3738 | .0057 | .0258 | .1365 | 17.83 | 1.165 | .4315 | -.4247 | .0053 | .0414 | .1506 |
| 21.38 | 1.191 | .5174 | -.4596 | .0103 | .0377 | .1550 | 22.14 | 1.357 | .6059 | -.5198 | .0059 | .0601 | .1686 |
| .02 | -.052 | .0501 | .1053 | .0023 | -.0604 | .1708 | .13 | -.023 | .0494 | .1227 | .0021 | -.0682 | .1845 |
| M = 0.90 | | | | | | | M = 0.95 | | | | | | |
| 0.28 | 0.018 | 0.0507 | 0.1479 | 0.0006 | -0.0748 | 0.1993 | 0.36 | 0.054 | 0.0597 | 0.1360 | -0.0031 | -0.0837 | 0.2073 |
| -2.42 | -.290 | .0624 | .1453 | -.0029 | -.0816 | .2062 | -2.49 | -.330 | .0724 | .1606 | -.0035 | -.0914 | .2195 |
| 2.90 | .314 | .0655 | .1286 | .0054 | -.0664 | .1954 | 3.02 | .369 | .0808 | .1004 | .0026 | -.0714 | .2033 |
| 5.35 | .579 | .1047 | .0759 | .0137 | -.0566 | .2004 | 5.60 | .672 | .1282 | .0395 | .0057 | -.0558 | .2004 |
| 7.68 | .763 | .1549 | .0078 | .0170 | -.0445 | .1994 | 8.05 | .927 | .1947 | -.0363 | .0058 | -.0381 | .1950 |
| 9.75 | .861 | .2021 | -.0999 | .0072 | -.0244 | .1840 | 10.40 | 1.142 | .2742 | -.1249 | .0124 | -.0204 | .1887 |
| 11.91 | .964 | .2608 | -.2053 | .0094 | .0038 | .1659 | 14.61 | 1.368 | .4223 | -.3540 | .0053 | .0330 | .1506 |
| 18.35 | 1.335 | .5034 | -.4957 | -.0006 | .0702 | .1416 | 18.86 | 1.514 | .5854 | -.5057 | .0068 | .0791 | .1379 |
| 22.65 | 1.519 | .6931 | -.5946 | .0054 | .0736 | .1785 | 23.10 | 1.680 | .7831 | -.6349 | .0039 | .0735 | .1881 |
| .27 | .009 | .0510 | .1476 | .0007 | -.0757 | .1994 | .35 | .052 | .0599 | .1358 | -.0028 | -.0849 | .2093 |

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TABLE II.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2NH_{30}V_1$ - Concluded

(c) $\beta \approx -6.50^{\circ}$ - Concluded

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ | α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M = 1.00 | | | | | | | M = 1.05 | | | | | | |
| 0.26 | -0.001 | 0.0712 | 0.1394 | -0.0013 | -0.0832 | 0.2126 | 0.24 | -0.016 | 0.0855 | 0.1437 | -0.0014 | -0.0908 | 0.2223 |
| -2.53 | -.346 | .0858 | .1676 | -.0013 | -.0897 | .2219 | -2.53 | -.343 | .0994 | .1739 | -.0013 | -.0968 | .2295 |
| 2.97 | .326 | .0896 | .0978 | .0025 | -.0707 | .2074 | 2.92 | .299 | .1025 | .0862 | .0017 | -.0813 | .2170 |
| 5.55 | .631 | .1365 | .0332 | .0051 | -.0574 | .2074 | 5.50 | .599 | .1452 | .0131 | .0040 | -.0646 | .2143 |
| 8.05 | .899 | .2043 | -.0595 | .0063 | -.0387 | .1993 | 8.00 | .876 | .2097 | -.0965 | .0034 | -.0478 | .2037 |
| 10.42 | 1.137 | .2885 | -.1691 | .0086 | -.0188 | .1868 | 10.38 | 1.114 | .2898 | -.2119 | .0021 | -.0341 | .1957 |
| 14.88 | 1.467 | .4705 | -.4104 | .0101 | .0243 | .1608 | 14.78 | 1.443 | .4680 | -.4775 | .0037 | .0173 | .1589 |
| 19.23 | 1.724 | .6806 | -.6398 | .0095 | .0707 | .1407 | 19.18 | 1.722 | .6842 | -.7291 | .0099 | .0675 | .1392 |
| 23.06 | 1.892 | .8791 | -.7726 | .0136 | .0873 | .1670 | 21.38 | 1.837 | .8008 | -.8251 | .0162 | .0851 | .1441 |
| .22 | -.009 | .0713 | .1382 | -.0014 | -.0835 | .2150 | .24 | -.016 | .0856 | .1429 | -.0014 | -.0918 | .2201 |
| M = 1.13 | | | | | | | M = 1.20 | | | | | | |
| 0.23 | -0.028 | 0.0886 | 0.1433 | -0.0006 | -0.0793 | 0.2198 | 0.21 | -0.030 | 0.0941 | 0.1336 | 0.0014 | -0.0696 | 0.2198 |
| -2.45 | -.316 | .1009 | .1779 | -.0004 | -.0851 | .2262 | -2.45 | -.309 | .1058 | .1846 | .0019 | -.0787 | .2282 |
| 2.87 | .258 | .1029 | .0874 | .0012 | -.0699 | .2192 | 2.82 | .239 | .1076 | .0742 | .0020 | -.0584 | .2150 |
| 5.41 | .533 | .1405 | .0138 | .0031 | -.0573 | .2181 | 5.33 | .495 | .1424 | .0009 | .0039 | -.0463 | .2140 |
| 7.92 | .796 | .1988 | -.0785 | .0043 | -.0429 | .2181 | 7.86 | .746 | .1975 | -.0870 | .0059 | -.0336 | .2173 |
| 10.30 | 1.011 | .2683 | -.1773 | .0054 | -.0273 | .2159 | 10.25 | .956 | .2630 | -.1881 | .0059 | -.0216 | .2196 |
| 14.90 | 1.375 | .4424 | -.4057 | .0065 | .0088 | .1900 | 14.89 | 1.328 | .4339 | -.3970 | .0065 | .0026 | .2179 |
| 19.30 | 1.644 | .6506 | -.6191 | .0165 | .0750 | .1397 | 19.47 | 1.626 | .6528 | -.6306 | .0100 | .0218 | -.3774 |
| 21.22 | 1.753 | .7522 | -.6967 | .0209 | .0878 | .1395 | 20.45 | 1.684 | .7046 | -.6714 | .0119 | .0299 | -.3786 |
| .19 | -.040 | .0884 | .1448 | -.0009 | -.0805 | .2190 | .19 | -.032 | .0940 | .1348 | .0015 | -.0692 | .2188 |

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TABLE III.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2NH_{30}V_2$

(a) $\beta = 0^{\circ}$

| $\alpha$, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ | $\alpha$, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M = 0.60 | | | | | | | M = 0.80 | | | | | | |
| -0.01 | -0.046 | 0.0549 | 0.0828 | 0.0005 | 0.0038 | -0.0201 | 0.04 | -0.028 | 0.0549 | 0.0934 | 0.0002 | 0.0042 | -0.0147 |
| -2.30 | -.245 | .0627 | .0879 | .0003 | .0045 | -.0159 | -2.53 | -.274 | .0646 | .0913 | .0002 | .0047 | -.0134 |
| 2.26 | .147 | .0574 | .0690 | .0009 | .0028 | -.0176 | 2.52 | .198 | .0592 | .0842 | .0004 | .0033 | -.0142 |
| 4.55 | .343 | .0709 | .0493 | .0013 | .0030 | -.0189 | 5.04 | .454 | .0851 | .0597 | .0009 | .0032 | -.0130 |
| 6.82 | .535 | .1051 | .0176 | .0013 | .0034 | -.0176 | 7.39 | .642 | .1306 | -.0045 | .0023 | .0034 | -.0163 |
| 8.99 | .700 | .1539 | -.0390 | .0030 | .0028 | -.0145 | 9.53 | .745 | .1782 | -.0863 | .0020 | .0040 | -.0153 |
| 11.11 | .797 | .2059 | -.1282 | .0028 | .0022 | -.0157 | 11.70 | .851 | .2331 | -.1736 | .0016 | .0035 | -.0152 |
| 13.16 | .884 | .2593 | -.2120 | .0015 | .0036 | -.0155 | 13.81 | .936 | .2905 | -.2648 | .0023 | .0037 | -.0124 |
| 15.25 | .955 | .3162 | -.2911 | .0027 | .0035 | -.0189 | 15.95 | 1.023 | .3541 | -.3431 | .0041 | .0001 | -.0095 |
| 17.27 | 1.009 | .3714 | -.3625 | .0036 | .0014 | -.0137 | 18.14 | 1.120 | .4285 | -.4059 | .0037 | -.0004 | -.0097 |
| 19.40 | 1.085 | .4379 | -.4087 | .0046 | -.0017 | -.0111 | 20.37 | 1.229 | .5169 | -.4705 | .0070 | -.0095 | -.0031 |
| 21.52 | 1.180 | .5198 | -.4559 | .0101 | -.0158 | .0063 | 22.58 | 1.331 | .6122 | -.5153 | .0147 | -.0277 | .0154 |
| -.02 | -.054 | .0560 | .0800 | .0005 | .0038 | -.0201 | .02 | -.033 | .0552 | .0927 | .0004 | .0042 | -.0146 |
| M = 0.90 | | | | | | | M = 0.95 | | | | | | |
| 0.13 | -0.007 | 0.0567 | 0.1062 | 0.0003 | 0.0039 | -0.0111 | 0.10 | -0.011 | 0.0659 | 0.1021 | 0.0003 | 0.0040 | -0.0122 |
| -2.71 | -.315 | .0701 | .0956 | .0001 | .0045 | -.0096 | -2.82 | -.365 | .0822 | .1168 | -.0002 | .0048 | -.0103 |
| 2.81 | .288 | .0688 | .0977 | .0004 | .0032 | -.0122 | 2.97 | .332 | .0842 | .0796 | .0004 | .0030 | -.0103 |
| 5.60 | .621 | .1150 | .0546 | .0008 | .0034 | -.0126 | 5.70 | .647 | .1319 | .0233 | -.0001 | .0025 | -.0127 |
| 7.79 | .728 | .1566 | -.0195 | .0037 | .0033 | -.0088 | 8.36 | .941 | .2056 | -.0721 | .0006 | .0026 | -.0119 |
| 9.98 | .851 | .2098 | -.1167 | .0027 | .0035 | -.0116 | 10.95 | 1.195 | .2987 | -.1624 | .0015 | .0028 | -.0138 |
| 12.22 | .971 | .2722 | -.2120 | .0022 | .0035 | -.0099 | 13.16 | 1.290 | .3730 | -.2423 | .0011 | .0043 | -.0146 |
| 14.42 | 1.093 | .3464 | -.3044 | .0038 | .0012 | -.0091 | 15.25 | 1.359 | .4436 | -.3337 | .0021 | .0045 | -.0140 |
| 16.63 | 1.193 | .4244 | -.3955 | .0051 | -.0038 | -.0035 | 17.41 | 1.434 | .5234 | -.4179 | .0012 | .0046 | -.0172 |
| 18.84 | 1.302 | .5122 | -.4786 | .0061 | -.0099 | .0021 | 19.58 | 1.527 | .6185 | -.5028 | .0021 | .0034 | -.0153 |
| 21.10 | 1.410 | .6109 | -.5535 | .0092 | -.0169 | .0100 | 21.85 | 1.623 | .7251 | -.5855 | .0026 | .0011 | -.0118 |
| 23.33 | 1.503 | .7132 | -.6026 | -.0023 | .0186 | -.0295 | 24.10 | 1.720 | .8411 | -.6576 | .0017 | .0055 | -.0206 |
| .07 | -.016 | .0568 | .1057 | .0003 | .0042 | -.0130 | .07 | -.016 | .0658 | .1015 | .0001 | .0040 | -.0121 |

[redacted]

TABLE III.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2NH_{30}V_2$ - Continued

(a) $\beta = 0^{\circ}$ - Concluded

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ | α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M = 1.00 | | | | | | | M = 1.05 | | | | | | |
| 0.04 | -0.029 | 0.0783 | 0.0836 | 0.0003 | 0.0042 | -0.0122 | 0.03 | -0.035 | 0.0913 | 0.0887 | 0.0000 | 0.0039 | -0.0086 |
| -2.88 | -.362 | .0955 | .1025 | .0002 | .0049 | -.0121 | -2.81 | -.341 | .1067 | .1223 | -.0001 | .0045 | -.0095 |
| 2.93 | .311 | .0952 | .0535 | .0007 | .0035 | -.0117 | 2.87 | .283 | .1065 | .0375 | .0004 | .0030 | -.0100 |
| 5.70 | .626 | .1443 | -.0175 | .0003 | .0031 | -.0121 | 5.65 | .600 | .1513 | -.0310 | .0000 | .0019 | -.0092 |
| 8.35 | .908 | .2175 | -.1171 | .0007 | .0034 | -.0144 | 8.36 | .874 | .2187 | -.1119 | .0003 | .0027 | -.0099 |
| 10.89 | 1.152 | .3069 | -.2302 | .0011 | .0026 | -.0128 | 10.92 | 1.114 | .3049 | -.2268 | .0012 | .0030 | -.0090 |
| 13.23 | 1.302 | .3938 | -.3359 | -.0026 | .0085 | -.0233 | 13.22 | 1.256 | .3863 | -.3371 | -.0022 | .0083 | -.0201 |
| 15.49 | 1.446 | .4890 | -.4657 | .0009 | .0053 | -.0170 | 15.50 | 1.403 | .4812 | -.4684 | .0012 | .0055 | -.0148 |
| 17.82 | 1.606 | .6026 | -.5964 | -.0016 | .0016 | -.0147 | 17.85 | 1.564 | .5953 | -.6090 | .0015 | .0053 | -.0122 |
| 20.10 | 1.708 | .7089 | -.6501 | .0027 | .0042 | -.0210 | 20.15 | 1.695 | .7115 | -.7277 | .0031 | .0023 | -.0191 |
| 22.38 | 1.806 | .8270 | -.7426 | .0026 | .0038 | -.0188 | 20.82 | 1.724 | .7440 | -.7346 | .0057 | .0032 | -.0214 |
| 23.02 | 1.830 | .8609 | -.7698 | .0018 | .0040 | -.0185 | .01 | -.039 | .0910 | .0898 | .0000 | .0038 | -.0104 |
| -.01 | -.046 | .0783 | .0819 | .0002 | .0047 | -.0117 | | | | | | | |
| M = 1.13 | | | | | | | M = 1.20 | | | | | | |
| 0.03 | -0.046 | 0.0922 | 0.0969 | -0.0007 | 0.0037 | -0.0026 | 0.05 | -0.033 | 0.0963 | 0.0926 | -0.0001 | 0.0092 | 0.0033 |
| -2.84 | -.332 | .1075 | .1369 | -.0009 | .0034 | -.0048 | -2.77 | -.310 | .1111 | .1390 | -.0005 | .0090 | .0019 |
| 2.78 | .238 | .1050 | .0412 | -.0004 | .0032 | -.0057 | 2.80 | .238 | .1096 | .0296 | .0003 | .0086 | -.0023 |
| 5.51 | .519 | .1425 | -.0384 | -.0006 | .0032 | -.0072 | 5.50 | .506 | .1465 | -.0458 | .0005 | .0096 | -.0033 |
| 8.21 | .795 | .2054 | -.1316 | -.0008 | .0038 | -.0062 | 8.12 | .747 | .2027 | -.1288 | .0010 | .0096 | -.0045 |
| 10.76 | 1.019 | .2826 | -.2218 | .0009 | .0037 | -.0035 | 10.69 | .960 | .2760 | -.2167 | .0023 | .0092 | -.0018 |
| 13.13 | 1.162 | .3571 | -.3024 | -.0005 | .0032 | -.0078 | 13.10 | 1.113 | .3497 | -.2998 | .0009 | .0094 | -.0068 |
| 15.44 | 1.300 | .4451 | -.4025 | .0008 | .0041 | -.0066 | 15.45 | 1.261 | .4359 | -.3982 | .0030 | .0032 | .0045 |
| 17.84 | 1.470 | .5580 | -.5302 | .0017 | .0038 | -.0079 | 17.84 | 1.420 | .5418 | -.5160 | .0023 | .0054 | -.0005 |
| 20.23 | 1.620 | .6799 | -.6400 | .0024 | .0039 | -.0087 | 20.27 | 1.574 | .6638 | -.6230 | .0024 | .0055 | .0001 |
| 22.40 | 1.721 | .7888 | -.6692 | .0049 | .0079 | -.0103 | 21.92 | 1.679 | .7569 | -.6960 | .0024 | .0063 | -.0027 |
| -.01 | -.054 | .0919 | .0981 | -.0006 | .0039 | -.0059 | -.02 | -.052 | .0962 | .0933 | -.0001 | .0086 | -.0014 |

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TABLE III.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2NH_{30}V_2$ - Continued

(b) $\beta \approx -3.25^{\circ}$

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|
| M = 0.60 | | | | | | |
| 0.02 | -0.036 | 0.0560 | 0.0834 | 0.0010 | -0.0315 | 0.0773 |
| -2.24 | -.234 | .0641 | .0923 | .0003 | -.0319 | .0786 |
| 2.28 | .154 | .0593 | .0670 | .0015 | -.0320 | .0764 |
| 4.49 | .348 | .0728 | .0512 | .0029 | -.0287 | .0755 |
| 6.73 | .537 | .1052 | .0184 | .0033 | -.0272 | .0729 |
| 8.92 | .712 | .1559 | -.0492 | .0037 | -.0232 | .0717 |
| 13.00 | .891 | .2554 | -.2207 | .0060 | -.0098 | .0693 |
| 17.13 | 1.047 | .3710 | -.3771 | .0075 | .0027 | .0730 |
| 18.69 | 1.105 | .4180 | -.4110 | .0111 | .0015 | .0778 |
| M = 0.90 | | | | | | |
| 0.19 | 0.009 | 0.0610 | 0.1114 | 0.0010 | -0.0418 | 0.0942 |
| -2.45 | -.295 | .0738 | .1067 | -.0007 | -.0426 | .0972 |
| 2.80 | .300 | .0740 | .0956 | .0024 | -.0398 | .0913 |
| 5.29 | .581 | .1128 | .0532 | .0098 | -.0358 | .0961 |
| 7.51 | .715 | .1542 | -.0150 | .0057 | -.0303 | .0927 |
| 9.71 | .861 | .2066 | -.1056 | .0050 | -.0208 | .0892 |
| 13.90 | 1.082 | .3279 | -.3077 | .0025 | .0107 | .0628 |
| 18.22 | 1.311 | .4821 | -.4766 | .0033 | .0260 | .0719 |
| 20.09 | 1.402 | .5570 | -.5315 | .0082 | .0173 | .0916 |
| .20 | .011 | .0612 | .1126 | .0012 | -.0417 | .0942 |

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|
| M = 0.80 | | | | | | |
| 0.13 | -0.016 | 0.0584 | 0.0952 | 0.0013 | -0.0366 | 0.0864 |
| -2.35 | -.259 | .0671 | .0973 | .0003 | -.0371 | .0889 |
| 2.54 | .218 | .0634 | .0842 | .0020 | -.0358 | .0847 |
| 4.93 | .449 | .0864 | .0640 | .0037 | -.0317 | .0821 |
| 7.23 | .652 | .1306 | .0034 | .0024 | -.0286 | .0821 |
| 9.32 | .763 | .1790 | -.0931 | .0034 | -.0224 | .0822 |
| 13.48 | .944 | .2820 | -.2744 | .0025 | .0021 | .0648 |
| 17.74 | 1.145 | .4152 | -.4165 | .0080 | .0098 | .0770 |
| 19.44 | 1.229 | .4774 | -.4559 | .0114 | .0087 | .0843 |
| .10 | -.024 | .0584 | .0951 | .0011 | -.0368 | .0841 |
| M = 0.95 | | | | | | |
| 0.22 | 0.025 | 0.0702 | 0.1059 | -0.0007 | -0.0445 | 0.0969 |
| -2.56 | -.339 | .0856 | .1200 | -.0009 | -.0473 | .1061 |
| 2.93 | .351 | .0891 | .0805 | .0018 | -.0387 | .0939 |
| 5.48 | .653 | .1342 | .0181 | .0033 | -.0339 | .0940 |
| 7.97 | .931 | .2015 | -.0603 | .0025 | -.0257 | .0901 |
| 10.38 | 1.172 | .2842 | -.1611 | .0032 | -.0141 | .0837 |
| 14.44 | 1.312 | .4070 | -.3395 | .0031 | .0066 | .0666 |
| 18.76 | 1.512 | .5700 | -.4997 | .0001 | .0282 | .0672 |
| 20.63 | 1.595 | .6488 | -.5603 | -.0010 | .0352 | .0680 |
| .23 | .031 | .0702 | .1051 | -.0009 | -.0450 | .0965 |

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TABLE III.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2NH_{30}V_2$ - Continued

(b) $\beta \approx -3.25^{\circ}$ - Concluded

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ | α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M = 1.00 | | | | | | | M = 1.05 | | | | | | |
| 0.13 | -0.026 | 0.0855 | 0.0960 | -0.0001 | -0.0471 | 0.1015 | 0.10 | -0.034 | 0.0702 | 0.1059 | -0.0004 | -0.0533 | 0.1138 |
| -2.57 | -.346 | .1025 | .1232 | -.0003 | -.0506 | .1105 | -2.59 | -.347 | .0884 | .1381 | .0000 | -.0556 | .1196 |
| 2.84 | .305 | .1022 | .0658 | .0008 | -.0411 | .0976 | 2.81 | .290 | .0865 | .0513 | .0009 | -.0467 | .1074 |
| 5.43 | .611 | .1454 | .0052 | .0021 | -.0358 | .0970 | 5.42 | .607 | .1315 | -.0212 | .0024 | -.0370 | .1014 |
| 7.91 | .897 | .2106 | -.0974 | .0021 | -.0280 | .0936 | 7.93 | .883 | .1940 | -.1119 | .0026 | -.0255 | .0898 |
| 10.33 | 1.143 | .2906 | -.2043 | .0021 | -.0210 | .0913 | 10.34 | 1.123 | .2688 | -.2258 | .0015 | -.0212 | .0880 |
| 14.75 | 1.444 | .4568 | -.4083 | .0093 | .0113 | .0603 | 14.69 | 1.428 | .4315 | -.4654 | .0031 | .0061 | .0635 |
| 19.13 | 1.707 | .6497 | -.6089 | .0036 | .0162 | .0686 | 19.07 | 1.718 | .6413 | -.7169 | .0101 | .0264 | .0537 |
| 20.99 | 1.788 | .7333 | -.6757 | .0013 | .0230 | .0685 | 20.97 | 1.814 | .7363 | -.7815 | .0046 | .0297 | .0527 |
| .13 | -.024 | .0852 | .0972 | .0000 | -.0465 | .1037 | .10 | -.034 | .0715 | .1041 | -.0003 | -.0536 | .1096 |
| M = 1.13 | | | | | | | M = 1.20 | | | | | | |
| 0.09 | -0.045 | 0.0756 | 0.1092 | -0.0009 | -0.0492 | 0.1140 | 0.09 | -0.050 | 0.0776 | 0.1034 | 0.0012 | -0.0379 | 0.1144 |
| -2.54 | -.325 | .0902 | .1489 | .0001 | -.0518 | .1195 | -2.57 | -.331 | .0914 | .1522 | .0016 | -.0401 | .1187 |
| 2.71 | .241 | .0885 | .0521 | .0008 | -.0430 | .1101 | 2.70 | .228 | .0889 | .0418 | .0026 | -.0312 | .1077 |
| 5.27 | .517 | .1221 | -.0253 | .0012 | -.0346 | .1045 | 5.23 | .494 | .1209 | -.0319 | .0027 | -.0232 | .1026 |
| 7.79 | .793 | .1797 | -.1177 | .0008 | -.0252 | .0998 | 7.72 | .740 | .1719 | -.1136 | .0028 | -.0151 | .0995 |
| 10.19 | 1.015 | .2499 | -.2092 | .0023 | -.0185 | .1021 | 10.12 | .955 | .2375 | -.2006 | .0051 | -.0104 | .1032 |
| 14.68 | 1.321 | .4031 | -.4003 | .0047 | .0086 | .0819 | 14.66 | 1.278 | .3898 | -.3918 | .0054 | .0112 | .0963 |
| 19.19 | 1.646 | .6215 | -.6362 | .0103 | .0341 | .0634 | 19.18 | 1.615 | .6011 | -.6290 | .0062 | .0267 | .0919 |
| 21.18 | 1.753 | .7237 | -.6934 | .0127 | .0473 | .0617 | 20.94 | 1.719 | .6911 | -.6973 | .0068 | .0369 | .0886 |
| .09 | -.047 | .0757 | .1080 | -.0010 | -.0489 | .1121 | .08 | -.057 | .0774 | .1054 | .0011 | -.0385 | .1111 |

TABLE III.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2NH_{30}V_2$ - Continued

(c) $\beta \approx -6.50^{\circ}$

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|
| M = 0.60 | | | | | | |
| 0.03 | -0.039 | 0.0525 | 0.0982 | 0.0051 | -0.0800 | 0.1854 |
| -2.25 | -.236 | .0612 | .1041 | .0044 | -.0834 | .1888 |
| 2.30 | .150 | .0554 | .0848 | .0063 | -.0767 | .1845 |
| 4.52 | .347 | .0713 | .0581 | .0070 | -.0730 | .1823 |
| 6.77 | .544 | .1043 | .0117 | .0061 | -.0668 | .1789 |
| 8.96 | .711 | .1545 | -.0587 | .0053 | -.0577 | .1748 |
| 13.12 | .911 | .2595 | -.2192 | .0075 | -.0222 | .1577 |
| 17.24 | 1.063 | .3752 | -.3749 | .0031 | .0158 | .1373 |
| 21.39 | 1.204 | .5080 | -.4572 | .0082 | .0323 | .1532 |
| .05 | -.039 | .0534 | .0998 | .0056 | -.0808 | .1853 |
| M = 0.90 | | | | | | |
| 0.25 | 0.004 | 0.0560 | 0.1410 | 0.0040 | -0.0984 | 0.2167 |
| -2.46 | -.303 | .0685 | .1364 | .0017 | -.1036 | .2226 |
| 2.85 | .289 | .0697 | .1242 | .0072 | -.0901 | .2135 |
| 5.35 | .571 | .1087 | .0722 | .0144 | -.0800 | .2157 |
| 7.63 | .743 | .1558 | .0062 | .0155 | -.0652 | .2116 |
| 9.74 | .859 | .2031 | -.1005 | .0071 | -.0440 | .1954 |
| 13.96 | 1.087 | .3273 | -.3239 | .0039 | .0235 | .1451 |
| 18.34 | 1.340 | .4904 | -.4927 | -.0017 | .0633 | .1443 |
| 22.65 | 1.529 | .6673 | -.5980 | .0031 | .0748 | .1781 |
| .23 | -.003 | .0562 | .1410 | .0040 | -.0988 | .2169 |

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|
| M = 0.80 | | | | | | |
| 0.14 | -0.023 | 0.0537 | 0.1158 | 0.0053 | -0.0888 | 0.2035 |
| -2.36 | -.262 | .0628 | .1121 | .0036 | -.0924 | .2065 |
| 2.53 | .204 | .0586 | .1059 | .0069 | -.0845 | .1990 |
| 4.99 | .459 | .0851 | .0738 | .0085 | -.0798 | .1965 |
| 7.27 | .653 | .1287 | .0063 | .0059 | -.0698 | .1923 |
| 9.39 | .749 | .1762 | -.0860 | .0093 | -.0519 | .1898 |
| 13.51 | .942 | .2796 | -.2841 | .0039 | .0044 | .1467 |
| 17.82 | 1.160 | .4193 | -.4246 | .0038 | .0328 | .1511 |
| 22.13 | 1.367 | .5877 | -.5197 | .0020 | .0598 | .1683 |
| .14 | -.023 | .0531 | .1158 | .0055 | -.0904 | .2032 |
| M = 0.95 | | | | | | |
| 0.29 | 0.032 | 0.0658 | 0.1330 | 0.0004 | -0.1093 | 0.2282 |
| -2.59 | -.358 | .0813 | .1581 | .0015 | -.1147 | .2388 |
| 2.99 | .354 | .0856 | .1004 | .0051 | -.0973 | .2218 |
| 5.54 | .657 | .1331 | .0386 | .0073 | -.0810 | .2191 |
| 8.06 | .929 | .2016 | -.0392 | .0068 | -.0601 | .2090 |
| 10.47 | 1.164 | .2843 | -.1320 | .0079 | -.0358 | .1972 |
| 14.61 | 1.364 | .4210 | -.3543 | .0031 | .0150 | .1616 |
| 18.85 | 1.519 | .5747 | -.5066 | .0049 | .0712 | .1399 |
| 23.08 | 1.695 | .7592 | -.6424 | .0026 | .0774 | .1855 |
| .30 | .036 | .0653 | .1337 | .0004 | -.1098 | .2281 |

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TABLE III.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2NH_{30}V_2$ - Concluded

(c) $\beta \approx -6.50^{\circ}$ - Concluded

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ | α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M = 1.00 | | | | | | | M = 1.05 | | | | | | |
| 0.23 | -0.014 | 0.0797 | 0.1375 | 0.0022 | -0.1073 | 0.2325 | 0.22 | -0.024 | 0.0641 | 0.1406 | 0.0033 | -0.1117 | 0.2392 |
| -2.54 | -.356 | .0953 | .1642 | .0038 | -.1129 | .2415 | -2.56 | -.352 | .0802 | .1698 | .0045 | -.1166 | .2464 |
| 2.91 | .307 | .0979 | .0997 | .0046 | -.0958 | .2276 | 2.91 | .297 | .0832 | .0848 | .0050 | -.1024 | .2338 |
| 5.54 | .623 | .1450 | .0333 | .0063 | -.0827 | .2269 | 5.50 | .602 | .1287 | .0121 | .0064 | -.0843 | .2292 |
| 8.04 | .897 | .2095 | -.0754 | .0056 | -.0646 | .2149 | 7.99 | .873 | .1908 | -.0950 | .0049 | -.0661 | .2175 |
| 10.41 | 1.137 | .2878 | -.1820 | .0087 | -.0385 | .2013 | 10.38 | 1.117 | .2667 | -.2102 | .0030 | -.0511 | .2094 |
| 14.87 | 1.467 | .4615 | -.4151 | .0085 | .0061 | .1725 | 14.84 | 1.452 | .4407 | -.4712 | .0032 | .0037 | .1697 |
| 19.19 | 1.733 | .6600 | -.6521 | .0093 | .0592 | .1464 | 19.17 | 1.738 | .6500 | -.7272 | .0094 | .0566 | .1480 |
| 22.68 | 1.890 | .8265 | -.7688 | .0131 | .0891 | .1618 | .16 | -.031 | .0648 | .1412 | .0032 | -.1113 | .2375 |
| .22 | -.016 | .0796 | .1364 | .0022 | -.1069 | .2326 | | | | | | | |
| M = 1.13 | | | | | | | M = 1.20 | | | | | | |
| 0.19 | -0.036 | 0.0727 | 0.1418 | 0.0039 | -0.1008 | 0.2415 | 0.21 | -0.031 | 0.0726 | 0.1324 | 0.0065 | -0.0928 | 0.2414 |
| -2.47 | -.320 | .0865 | .1753 | .0056 | -.1068 | .2475 | -2.47 | -.314 | .0856 | .1844 | .0080 | -.1013 | .2491 |
| 2.85 | .253 | .0879 | .0846 | .0044 | -.0922 | .2387 | 2.78 | .233 | .0857 | .0750 | .0058 | -.0820 | .2363 |
| 5.39 | .530 | .1242 | .0114 | .0052 | -.0784 | .2360 | 5.33 | .496 | .1203 | .0032 | .0061 | -.0692 | .2356 |
| 7.97 | .795 | .1830 | -.0767 | .0057 | -.0620 | .2346 | 7.84 | .744 | .1730 | -.0835 | .0072 | -.0545 | .2361 |
| 10.31 | 1.011 | .2521 | -.1732 | .0058 | -.0451 | .2293 | 10.19 | .956 | .2368 | -.1812 | .0066 | -.0412 | .2335 |
| 14.91 | 1.375 | .4202 | -.3953 | .0067 | -.0064 | .2006 | 14.84 | 1.317 | .4005 | -.3887 | .0048 | -.0109 | .2272 |
| 19.33 | 1.647 | .6263 | -.6157 | .0148 | .0662 | .1532 | 19.51 | 1.622 | .6157 | -.6267 | .0088 | -.0241 | -.9310 |
| 21.08 | 1.748 | .7167 | -.6936 | .0200 | .0874 | .1533 | 20.58 | 1.695 | .6703 | -.6687 | .0111 | .0262 | -.3712 |
| .14 | -.044 | .0734 | .1414 | .0038 | -.1006 | .2380 | .17 | -.036 | .0723 | .1336 | .0058 | -.0900 | .2387 |

[redacted]

TABLE IV.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2NH_{30}$

(a) $\beta \approx -3.25^\circ$

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ | α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M = 0.60 | | | | | | | M = 0.80 | | | | | | |
| 0.03 | -0.049 | 0.0504 | 0.0893 | -0.0036 | 0.0086 | 0.0403 | 0.11 | -0.027 | 0.0507 | 0.1026 | -0.0036 | 0.0064 | 0.0447 |
| -2.22 | -.239 | .0585 | .0961 | -.0050 | .0087 | .0406 | -2.35 | -.266 | .0602 | .1032 | -.0062 | .0058 | .0488 |
| 2.30 | .150 | .0530 | .0724 | -.0014 | .0081 | .0382 | 2.50 | .203 | .0555 | .0886 | -.0009 | .0059 | .0415 |
| 4.49 | .341 | .0665 | .0578 | .0011 | .0076 | .0373 | 4.96 | .454 | .0811 | .0667 | .0023 | .0080 | .0434 |
| 6.72 | .535 | .1002 | .0238 | .0030 | .0101 | .0386 | 7.25 | .658 | .1267 | .0069 | .0026 | .0100 | .0433 |
| 8.90 | .707 | .1510 | -.0430 | .0052 | .0116 | .0371 | 9.32 | .758 | .1738 | -.0836 | .0048 | .0127 | .0464 |
| 13.00 | .898 | .2567 | -.2212 | .0083 | .0173 | .0400 | 13.47 | .951 | .2859 | -.2791 | .0054 | .0272 | .0436 |
| 17.13 | 1.050 | .3784 | -.3799 | .0099 | .0162 | .0604 | 17.75 | 1.150 | .4282 | -.4214 | .0097 | .0189 | .0684 |
| 18.68 | 1.111 | .4299 | -.4168 | .0139 | .0148 | .0648 | 19.34 | 1.228 | .4901 | -.4608 | .0133 | .0178 | .0760 |
| .03 | -.049 | .0511 | .0876 | -.0032 | .0075 | .0360 | .07 | -.038 | .0508 | .1030 | -.0038 | .0069 | .0426 |
| M = 0.90 | | | | | | | M = 0.95 | | | | | | |
| 0.16 | -0.011 | 0.0522 | 0.1195 | -0.0038 | 0.0067 | 0.0465 | 0.16 | -0.004 | 0.0617 | 0.1184 | -0.0057 | 0.0068 | 0.0449 |
| -2.47 | -.309 | .0652 | .1132 | -.0076 | .0047 | .0505 | -2.59 | -.367 | .0779 | .1357 | -.0078 | .0023 | .0533 |
| 2.79 | .291 | .0647 | .1025 | -.0004 | .0070 | .0462 | 2.90 | .338 | .0803 | .0876 | -.0010 | .0119 | .0417 |
| 5.29 | .571 | .1041 | .0588 | .0084 | .0072 | .0533 | 5.47 | .646 | .1257 | .0260 | .0027 | .0126 | .0480 |
| 7.52 | .716 | .1485 | -.0064 | .0079 | .0106 | .0514 | 7.96 | .930 | .1956 | -.0627 | .0040 | .0149 | .0505 |
| 9.70 | .862 | .2026 | -.1019 | .0065 | .0160 | .0538 | 10.36 | 1.179 | .2801 | -.1643 | .0055 | .0201 | .0491 |
| 13.87 | 1.081 | .3299 | -.3130 | .0040 | .0324 | .0422 | 14.53 | 1.344 | .4183 | -.3488 | .0054 | .0305 | .0482 |
| 18.22 | 1.312 | .4972 | -.4823 | .0064 | .0288 | .0697 | 18.77 | 1.529 | .5919 | -.5143 | .0013 | .0358 | .0605 |
| 19.97 | 1.401 | .5746 | -.5359 | .0086 | .0222 | .0838 | 20.58 | 1.614 | .6776 | -.5753 | -.0005 | .0359 | .0661 |
| .18 | -.011 | .0522 | .1197 | -.0040 | .0062 | .0465 | .20 | -.006 | .0608 | .1189 | -.0055 | .0077 | .0452 |

[redacted]

TABLE IV.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2NH_{30}$ - Continued

(a) $\beta \approx -3.25^{\circ}$ - Concluded

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ | α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M = 1.00 | | | | | | | M = 1.05 | | | | | | |
| 0.09 | -0.047 | 0.0726 | 0.1105 | -0.0052 | 0.0065 | 0.0484 | 0.10 | -0.047 | 0.0859 | 0.1075 | -0.0068 | 0.0017 | 0.0602 |
| -2.57 | -.367 | .0892 | .1377 | -.0075 | .0031 | .0567 | -2.60 | -.355 | .1018 | .1384 | -.0093 | -.0033 | .0686 |
| 2.84 | .294 | .0884 | .0763 | -.0019 | .0112 | .0445 | 2.79 | .284 | .1012 | .0502 | -.0032 | .0073 | .0523 |
| 5.41 | .610 | .1339 | .0091 | .0020 | .0122 | .0489 | 5.38 | .597 | .1435 | -.0259 | .0007 | .0106 | .0548 |
| 7.90 | .895 | .2040 | -.0983 | .0035 | .0143 | .0505 | 7.90 | .873 | .2088 | -.1114 | .0030 | .0140 | .0520 |
| 10.32 | 1.143 | .2872 | -.2008 | .0062 | .0199 | .0480 | 10.31 | 1.115 | .2894 | -.2268 | .0031 | .0141 | .0551 |
| 14.72 | 1.446 | .4631 | -.4125 | .0099 | .0319 | .0399 | 14.65 | 1.417 | .4584 | -.4685 | .0030 | .0236 | .0471 |
| 19.12 | 1.709 | .6736 | -.6303 | .0061 | .0316 | .0556 | 19.04 | 1.705 | .6740 | -.7146 | .0104 | .0319 | .0488 |
| 20.98 | 1.791 | .7665 | -.6966 | .0032 | .0316 | .0622 | 19.57 | 1.741 | .7027 | -.7403 | .0103 | .0341 | .0471 |
| .15 | -.032 | .0712 | .1110 | -.0050 | .0070 | .0501 | .10 | -.051 | .0853 | .1085 | -.0067 | .0012 | .0583 |
| M = 1.13 | | | | | | | M = 1.20 | | | | | | |
| 0.09 | -0.053 | 0.0874 | 0.1075 | -0.0076 | 0.0046 | 0.0609 | 0.03 | -0.054 | 0.0919 | 0.0960 | -0.0049 | 0.0082 | 0.0696 |
| -2.57 | -.336 | .1027 | .1475 | -.0090 | .0028 | .0661 | -2.58 | -.331 | .1070 | .1459 | -.0066 | .0085 | .0743 |
| 2.69 | .236 | .1002 | .0450 | -.0036 | .0086 | .0573 | 2.65 | .225 | .1040 | .0309 | -.0014 | .0113 | .0673 |
| 5.25 | .515 | .1353 | -.0333 | -.0008 | .0109 | .0599 | 5.22 | .490 | .1383 | -.0409 | .0006 | .0147 | .0670 |
| 7.76 | .786 | .1939 | -.1221 | .0007 | .0144 | .0603 | 7.72 | .739 | .1930 | -.1220 | .0020 | .0168 | .0719 |
| 10.18 | 1.007 | .2653 | -.2134 | .0030 | .0149 | .0673 | 10.12 | .955 | .2609 | -.2091 | .0052 | .0166 | .0801 |
| 14.68 | 1.314 | .4249 | -.4054 | .0044 | .0248 | .0685 | 14.71 | 1.296 | .4239 | -.4142 | .0000 | .0267 | .0808 |
| 19.16 | 1.635 | .6444 | -.6356 | .0093 | .0350 | .0644 | 19.19 | 1.609 | .6368 | -.6383 | .0034 | .0237 | .1011 |
| 21.21 | 1.744 | .7498 | -.6949 | .0094 | .0380 | .0716 | 20.24 | 1.674 | .6913 | -.6783 | .0032 | .0247 | .0999 |
| .09 | -.053 | .0873 | .1063 | -.0076 | .0049 | .0591 | .03 | -.064 | .0917 | .0992 | -.0048 | .0082 | .0683 |

[redacted]

TABLE IV.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2NH_{30}$ - Continued

(b) $\beta \approx -6.50^\circ$

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ | α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M = 1.00 | | | | | | | M = 1.05 | | | | | | |
| 0.24 | -0.013 | 0.0703 | 0.1516 | -0.0087 | 0.0104 | 0.1237 | 0.26 | -0.010 | 0.0844 | 0.1429 | -0.0105 | 0.0016 | 0.1335 |
| -2.53 | -.353 | .0849 | .1804 | -.0133 | .0019 | .1347 | -2.54 | -.341 | .0973 | .1718 | -.0149 | -.0070 | .1463 |
| 3.00 | .329 | .0894 | .1061 | .0002 | .0231 | .1186 | 2.95 | .310 | .1022 | .0844 | -.0025 | .0135 | .1293 |
| 5.58 | .641 | .1371 | .0312 | .0064 | .0286 | .1267 | 5.55 | .615 | .1460 | .0146 | .0043 | .0233 | .1359 |
| 8.09 | .921 | .2073 | -.0738 | .0100 | .0346 | .1310 | 8.03 | .894 | .2108 | -.1049 | .0062 | .0275 | .1377 |
| 10.47 | 1.155 | .2914 | -.1777 | .0141 | .0415 | .1349 | 10.43 | 1.134 | .2928 | -.2279 | .0059 | .0286 | .1422 |
| 14.95 | 1.490 | .4768 | -.4208 | .0141 | .0558 | .1360 | 14.87 | 1.468 | .4746 | -.4912 | .0059 | .0455 | .1423 |
| 19.29 | 1.752 | .6907 | -.6652 | .0116 | .0746 | .1512 | 19.23 | 1.749 | .6934 | -.7436 | .0070 | .0625 | .1627 |
| 22.04 | 1.875 | .8343 | -.7469 | .0056 | .0672 | .1899 | 20.74 | 1.826 | .7732 | -.8126 | .0096 | .0659 | .1766 |
| .26 | .001 | .0700 | .1517 | -.0089 | .0109 | .1253 | .25 | -.014 | .0843 | .1397 | -.0103 | .0020 | .1353 |
| M = 1.13 | | | | | | | M = 1.20 | | | | | | |
| 0.21 | -0.029 | 0.0871 | 0.1392 | -0.0102 | 0.0085 | 0.1335 | 0.20 | -0.023 | 0.0931 | 0.1165 | -0.0079 | 0.0126 | 0.1442 |
| -2.47 | -.312 | .0992 | .1689 | -.0142 | .0028 | .1412 | -2.47 | -.304 | .1049 | .1728 | -.0120 | .0066 | .1492 |
| 2.88 | .266 | .1022 | .0814 | -.0039 | .0158 | .1329 | 2.83 | .245 | .1068 | .0642 | -.0037 | .0188 | .1413 |
| 5.43 | .541 | .1402 | .0080 | .0018 | .0235 | .1406 | 5.35 | .498 | .1429 | -.0123 | .0088 | -.0051 | -.3154 |
| 7.95 | .803 | .1985 | -.0816 | .0062 | .0291 | .1502 | 7.88 | .756 | .1975 | -.0943 | .0059 | .0294 | .1579 |
| 10.36 | 1.018 | .2692 | -.1762 | .0083 | .0313 | .1588 | 10.28 | .970 | .2645 | -.1887 | .0079 | .0299 | .1709 |
| 15.00 | 1.384 | .4448 | -.3991 | .0091 | .0341 | .1694 | 14.92 | 1.332 | .4334 | -.3969 | .0049 | .0289 | .1908 |
| 19.39 | 1.653 | .6544 | -.6105 | .0091 | .0565 | .1746 | 19.43 | 1.640 | .6532 | -.6204 | .0041 | .0401 | .2112 |
| 20.79 | 1.734 | .7292 | -.6728 | .0105 | .0603 | .1861 | 20.28 | 1.687 | .6972 | -.6531 | .0053 | .0424 | .2171 |
| .25 | -.023 | .0871 | .1386 | -.0100 | .0082 | .1344 | .16 | -.031 | .0928 | .1246 | -.0080 | .0125 | .1428 |

TABLE IV.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2NH_{30}$ - Concluded

(b) $\beta \approx -6.50^{\circ}$ - Concluded

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ | α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M = 0.60 | | | | | | | M = 0.80 | | | | | | |
| 0.05 | -0.036 | 0.0485 | 0.0967 | -0.0061 | 0.0090 | 0.0866 | 0.13 | -0.012 | 0.0487 | 0.1131 | -0.0060 | 0.0087 | 0.0969 |
| -2.21 | -.234 | .0567 | .1069 | -.0107 | .0053 | .0915 | -2.34 | -.255 | .0577 | .1184 | -.0121 | .0035 | .1016 |
| 2.29 | .152 | .0511 | .0835 | -.0007 | .0118 | .0850 | 2.59 | .212 | .0545 | .1044 | -.0001 | .0122 | .0918 |
| 4.54 | .343 | .0666 | .0647 | .0031 | .0127 | .0836 | 4.99 | .451 | .0796 | .0783 | .0055 | .0152 | .0959 |
| 6.79 | .546 | .1007 | .0185 | .0052 | .0161 | .0872 | 7.29 | .652 | .1241 | .0120 | .0067 | .0183 | .0977 |
| 8.95 | .712 | .1512 | -.0508 | .0071 | .0177 | .0895 | 9.40 | .760 | .1740 | -.0809 | .0097 | .0247 | .1058 |
| 13.11 | .907 | .2578 | -.2201 | .0119 | .0275 | .1010 | 13.54 | .943 | .2824 | -.2858 | .0076 | .0423 | .1061 |
| 17.24 | 1.068 | .3832 | -.3839 | .0067 | .0344 | .1152 | 17.87 | 1.162 | .4305 | -.4305 | .0056 | .0442 | .1352 |
| 21.39 | 1.200 | .5200 | -.4636 | .0146 | .0262 | .1519 | 22.15 | 1.352 | .6038 | -.5277 | -.0005 | .0502 | .1712 |
| .03 | -.052 | .0489 | .0960 | -.0062 | .0099 | .0873 | .10 | -.023 | .0484 | .1137 | -.0064 | .0085 | .0949 |
| M = 0.90 | | | | | | | M = 0.95 | | | | | | |
| 0.27 | 0.018 | 0.0503 | 0.1411 | -0.0068 | 0.0080 | 0.1046 | 0.36 | 0.049 | 0.0575 | 0.1385 | -0.0110 | 0.0096 | 0.1103 |
| -2.40 | -.288 | .0615 | .1430 | -.0147 | .0013 | .1120 | -2.45 | -.319 | .0694 | .1616 | -.0164 | -.0014 | .1274 |
| 2.89 | .310 | .0651 | .1226 | .0017 | .0142 | .1017 | 3.08 | .378 | .0807 | .1018 | -.0003 | .0218 | .1103 |
| 5.39 | .585 | .1054 | .0727 | .0136 | .0169 | .1170 | 5.62 | .676 | .1279 | .0372 | .0064 | .0272 | .1188 |
| 7.68 | .758 | .1530 | .0114 | .0205 | .0207 | .1264 | 8.11 | .943 | .1966 | -.0437 | .0090 | .0334 | .1248 |
| 9.79 | .869 | .2030 | -.0919 | .0129 | .0302 | .1198 | 10.51 | 1.179 | .2817 | -.1373 | .0127 | .0414 | .1285 |
| 14.00 | 1.091 | .3310 | -.3224 | .0081 | .0568 | .1133 | 14.73 | 1.399 | .4334 | -.3633 | .0085 | .0603 | .1265 |
| 18.37 | 1.339 | .5047 | -.5002 | -.0022 | .0671 | .1393 | 18.92 | 1.530 | .5917 | -.5229 | .0031 | .0721 | .1456 |
| 22.66 | 1.519 | .6928 | -.6073 | -.0015 | .0594 | .1880 | 23.13 | 1.687 | .7871 | -.6568 | -.0022 | .0597 | .2033 |
| .26 | .008 | .0501 | .1415 | -.0071 | .0080 | .1044 | .37 | .053 | .0587 | .1394 | -.0104 | .0106 | .1057 |

TABLE V.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2N$

(a) $\beta \approx -3.25^{\circ}$

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|
| M = 0.60 | | | | | | |
| 0.00 | 0.004 | 0.0476 | 0.0052 | 0.0026 | 0.0228 | 0.0312 |
| -2.30 | -.178 | .0537 | -.0314 | .0004 | .0231 | .0308 |
| 2.26 | .171 | .0508 | .0428 | .0053 | .0223 | .0280 |
| 4.51 | .336 | .0638 | .0790 | .0080 | .0215 | .0246 |
| 6.76 | .502 | .0950 | .1070 | .0100 | .0219 | .0293 |
| 8.96 | .641 | .1408 | .1115 | .0119 | .0218 | .0281 |
| 13.14 | .743 | .2233 | .1070 | .0121 | .0228 | .0432 |
| 17.31 | .833 | .3164 | .0847 | .0131 | .0175 | .0667 |
| 18.70 | .871 | .3509 | .0885 | .0175 | .0146 | .0718 |
| -.02 | -.004 | .0485 | .0056 | .0026 | .0218 | .0275 |
| M = 0.90 | | | | | | |
| 0.12 | 0.077 | 0.0496 | 0.0007 | 0.0029 | 0.0227 | 0.0328 |
| -2.52 | -.205 | .0579 | -.0502 | .0001 | .0241 | .0320 |
| 2.79 | .338 | .0641 | .0389 | .0069 | .0229 | .0309 |
| 5.36 | .605 | .1058 | .0489 | .0191 | .0245 | .0382 |
| 7.62 | .697 | .1455 | .0660 | .0146 | .0249 | .0398 |
| 9.78 | .789 | .1912 | .0623 | .0119 | .0255 | .0457 |
| 14.11 | .931 | .2979 | .0423 | .0034 | .0344 | .0461 |
| 18.58 | 1.080 | .4296 | .0328 | .0062 | .0319 | .0718 |
| 20.28 | 1.146 | .4899 | .0289 | .0115 | .0231 | .0883 |
| .13 | .072 | .0493 | .0010 | .0030 | .0232 | .0331 |

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|
| M = 0.88 | | | | | | |
| 0.05 | 0.032 | 0.0432 | 0.0014 | 0.0026 | 0.0201 | 0.0279 |
| -2.47 | -.169 | .0491 | -.0409 | .0001 | .0202 | .0269 |
| 2.50 | .211 | .0481 | .0437 | .0054 | .0197 | .0269 |
| 4.96 | .410 | .0708 | .0760 | .0089 | .0199 | .0272 |
| 7.31 | .557 | .1083 | .0861 | .0087 | .0203 | .0276 |
| 9.45 | .612 | .1464 | .0788 | .0111 | .0212 | .0362 |
| 13.69 | .708 | .2249 | .0652 | .0059 | .0266 | .0378 |
| 18.03 | .829 | .3245 | .0634 | .0120 | .0185 | .0670 |
| 19.54 | .881 | .3662 | .0648 | .0154 | .0153 | .0706 |
| .04 | .027 | .0429 | .0007 | .0024 | .0201 | .0281 |
| M = 0.95 | | | | | | |
| 0.15 | 0.107 | 0.0574 | -0.0335 | 0.0006 | 0.0235 | 0.0295 |
| -2.69 | -.265 | .0692 | -.0339 | .0001 | .0246 | .0347 |
| 2.87 | .409 | .0797 | -.0196 | .0043 | .0230 | .0320 |
| 5.50 | .689 | .1272 | -.0150 | .0085 | .0247 | .0388 |
| 8.00 | .926 | .1931 | -.0207 | .0102 | .0257 | .0422 |
| 10.46 | 1.127 | .2719 | -.0290 | .0097 | .0268 | .0470 |
| 14.76 | 1.187 | .3826 | .0019 | .0057 | .0325 | .0536 |
| 19.19 | 1.302 | .5263 | .0084 | .0016 | .0355 | .0697 |
| 20.91 | 1.352 | .5906 | .0050 | -.0007 | .0387 | .0702 |
| .18 | .109 | .0570 | -.0341 | .0008 | .0236 | .0316 |

TABLE V.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2N$ - Continued

(a) $\beta \approx -3.25^{\circ}$ - Concluded

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ | α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M = 1.00 | | | | | | | M = 1.05 | | | | | | |
| 0.03 | 0.045 | 0.0678 | -0.0203 | 0.0021 | 0.0267 | 0.0320 | 0.06 | 0.035 | 0.0796 | -0.0071 | 0.0023 | 0.0255 | 0.0403 |
| -2.72 | -.278 | .0810 | -.0267 | .0010 | .0270 | .0331 | -2.72 | -.276 | .0921 | -.0108 | .0010 | .0263 | .0418 |
| 2.79 | .358 | .0870 | -.0148 | .0047 | .0259 | .0307 | 2.79 | .332 | .0977 | -.0063 | .0050 | .0251 | .0386 |
| 5.44 | .640 | .1329 | -.0081 | .0086 | .0262 | .0367 | 5.45 | .612 | .1398 | -.0111 | .0081 | .0249 | .0429 |
| 8.02 | .880 | .1990 | -.0139 | .0099 | .0259 | .0413 | 8.06 | .854 | .2034 | -.0207 | .0094 | .0249 | .0464 |
| 10.52 | 1.078 | .2770 | -.0209 | .0099 | .0261 | .0474 | 10.54 | 1.050 | .2779 | -.0314 | .0098 | .0244 | .0495 |
| 15.13 | 1.286 | .4307 | -.0066 | .0054 | .0269 | .0537 | 15.10 | 1.249 | .4261 | -.0238 | .0050 | .0240 | .0548 |
| 19.71 | 1.466 | .6114 | -.0041 | .0037 | .0283 | .0669 | 19.72 | 1.439 | .6091 | -.0272 | .0037 | .0241 | .0675 |
| .04 | .048 | .0666 | -.0216 | .0022 | .0264 | .0338 | .04 | .030 | .0795 | -.0086 | .0022 | .0256 | .0362 |
| M = 1.13 | | | | | | | M = 1.20 | | | | | | |
| 0.04 | 0.015 | 0.0805 | 0.0055 | 0.0011 | 0.0264 | 0.0447 | 0.02 | 0.002 | 0.0853 | 0.0127 | 0.0028 | 0.0274 | 0.0575 |
| -2.67 | -.258 | .0924 | .0038 | -.0003 | .0276 | .0436 | -2.65 | -.255 | .0971 | .0151 | .0011 | .0301 | .0551 |
| 2.68 | .272 | .0955 | .0072 | .0047 | .0268 | .0441 | 2.69 | .253 | .0997 | .0120 | .0062 | .0281 | .0550 |
| 5.33 | .522 | .1311 | .0068 | .0074 | .0266 | .0474 | 5.29 | .485 | .1331 | .0121 | .0078 | .0290 | .0591 |
| 7.94 | .756 | .1882 | .0027 | .0094 | .0272 | .0530 | 7.85 | .701 | .1850 | .0096 | .0102 | .0297 | .0652 |
| 10.42 | .949 | .2552 | -.0161 | .0119 | .0264 | .0639 | 10.36 | .892 | .2487 | -.0166 | .0139 | .0275 | .0779 |
| 15.15 | 1.192 | .4043 | -.0034 | .0014 | .0309 | .0619 | 15.18 | 1.157 | .3973 | -.0052 | .0085 | .0279 | .0915 |
| 19.04 | 1.358 | .5512 | -.0001 | .0044 | .0273 | .0779 | 19.86 | 1.371 | .5799 | -.0108 | .0046 | .0225 | .1082 |
| .00 | .011 | .0807 | .0032 | .0010 | .0273 | .0427 | .02 | .002 | .0856 | .0125 | .0030 | .0277 | .0535 |

[redacted]

TABLE V.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2N$ - Continued

(b) $\beta \approx -6.50^{\circ}$

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ | α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M = 0.60 | | | | | | | M = 0.80 | | | | | | |
| 0.02 | 0.000 | 0.0462 | 0.0147 | 0.0082 | 0.0448 | 0.0539 | 0.06 | 0.027 | 0.0462 | 0.0112 | 0.0088 | 0.0462 | 0.0633 |
| -2.29 | -.177 | .0517 | -.0208 | .0033 | .0454 | .0577 | -2.48 | -.192 | .0528 | -.0327 | .0028 | .0450 | .0626 |
| 2.29 | .161 | .0490 | .0481 | .0133 | .0441 | .0541 | 2.53 | .231 | .0529 | .0530 | .0148 | .0458 | .0613 |
| 4.54 | .329 | .0630 | .0830 | .0179 | .0427 | .0578 | 5.03 | .452 | .0779 | .0924 | .0211 | .0455 | .0692 |
| 6.78 | .497 | .0935 | .1079 | .0207 | .0442 | .0615 | 7.36 | .609 | .1177 | .1006 | .0224 | .0448 | .0745 |
| 9.04 | .635 | .1400 | .1125 | .0223 | .0435 | .0689 | 9.51 | .673 | .1610 | .0875 | .0267 | .0459 | .0884 |
| 13.21 | .756 | .2252 | .1015 | .0233 | .0434 | .0902 | 13.78 | .786 | .2490 | .0674 | .0150 | .0521 | .1014 |
| 17.43 | .853 | .3204 | .0857 | .0131 | .0443 | .1135 | 18.15 | .941 | .3652 | .0654 | .0118 | .0526 | .1345 |
| 21.60 | .932 | .4202 | .0931 | .0212 | .0329 | .1528 | 22.50 | 1.090 | .5055 | .0661 | .0042 | .0573 | .1716 |
| -.01 | -.004 | .0463 | .0156 | .0082 | .0456 | .0542 | .09 | .024 | .0460 | .0129 | .0092 | .0466 | .0611 |
| M = 0.90 | | | | | | | M = 0.95 | | | | | | |
| 0.14 | 0.067 | 0.0475 | 0.0114 | 0.0097 | 0.0477 | 0.0663 | 0.19 | 0.109 | 0.0554 | -0.0268 | 0.0057 | 0.0488 | 0.0676 |
| -2.57 | -.214 | .0559 | -.0391 | .0023 | .0468 | .0682 | -2.64 | -.257 | .0650 | -.0246 | .0016 | .0465 | .0749 |
| 2.79 | .332 | .0630 | .0491 | .0176 | .0492 | .0702 | 2.90 | .417 | .0786 | -.0172 | .0131 | .0502 | .0776 |
| 5.37 | .585 | .1027 | .0585 | .0300 | .0485 | .0847 | 5.54 | .687 | .1258 | -.0116 | .0184 | .0496 | .0886 |
| 7.73 | .737 | .1492 | .0699 | .0371 | .0483 | .1017 | 8.10 | .922 | .1922 | -.0145 | .0200 | .0507 | .0990 |
| 9.90 | .794 | .1903 | .0662 | .0247 | .0491 | .1020 | 10.57 | 1.121 | .2716 | -.0228 | .0213 | .0521 | .1101 |
| 14.25 | .933 | .2979 | .0331 | .0111 | .0613 | .1146 | 14.95 | 1.236 | .3965 | -.0071 | .0086 | .0618 | .1204 |
| 18.69 | 1.103 | .4348 | .0156 | .0013 | .0714 | .1396 | 19.05 | 1.292 | .5158 | -.0107 | .0021 | .0742 | .1429 |
| 23.12 | 1.240 | .5908 | .0203 | .0005 | .0660 | .1937 | 23.64 | 1.410 | .6886 | .0047 | .0024 | .0656 | .2007 |
| .13 | .064 | .0474 | .0111 | .0097 | .0482 | .0665 | .20 | .115 | .0552 | -.0257 | .0055 | .0489 | .0696 |

TABLE V.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2N$ - Concluded

(b) $\beta \approx -6.50^{\circ}$ - Concluded

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ | α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M = 1.00 | | | | | | | M = 1.05 | | | | | | |
| 0.11 | 0.056 | 0.0647 | -0.0110 | 0.0083 | 0.0533 | 0.0725 | 0.12 | 0.039 | 0.0769 | 0.0025 | 0.0083 | 0.0496 | 0.0811 |
| -2.71 | -.276 | .0770 | -.0126 | .0042 | .0519 | .0787 | -2.72 | -.280 | .0884 | .0026 | .0042 | .0493 | .0836 |
| 2.87 | .367 | .0858 | -.0089 | .0145 | .0544 | .0769 | 2.85 | .338 | .0963 | -.0004 | .0146 | .0507 | .0848 |
| 5.52 | .640 | .1329 | -.0040 | .0192 | .0531 | .0909 | 5.48 | .610 | .1387 | -.0060 | .0187 | .0506 | .0971 |
| 8.13 | .874 | .1968 | -.0050 | .0205 | .0519 | .1022 | 8.12 | .846 | .2010 | -.0108 | .0195 | .0475 | .1069 |
| 10.59 | 1.072 | .2756 | -.0115 | .0205 | .0512 | .1145 | 10.58 | 1.040 | .2748 | -.0224 | .0197 | .0451 | .1157 |
| 15.28 | 1.300 | .4343 | -.0118 | .0115 | .0522 | .1342 | 15.25 | 1.265 | .4312 | -.0283 | .0106 | .0477 | .1341 |
| 19.82 | 1.473 | .6143 | -.0213 | .0029 | .0621 | .1582 | 19.88 | 1.454 | .6164 | -.0403 | .0029 | .0538 | .1630 |
| 21.19 | 1.523 | .6734 | -.0206 | .0042 | .0638 | .1726 | 22.05 | 1.529 | .7100 | -.0469 | .0036 | .0537 | .1900 |
| .09 | .056 | .0641 | -.0127 | .0081 | .0534 | .0744 | .13 | .043 | .0762 | .0015 | .0085 | .0496 | .0808 |
| M = 1.13 | | | | | | | M = 1.20 | | | | | | |
| 0.07 | 0.021 | 0.0795 | 0.0139 | 0.0077 | 0.0537 | 0.0915 | 0.10 | 0.018 | 0.0856 | 0.0211 | 0.0092 | 0.0545 | 0.1024 |
| -2.66 | -.257 | .0902 | .0192 | .0030 | .0528 | .0916 | -2.61 | -.246 | .0957 | .0286 | .0046 | .0543 | .1008 |
| 2.80 | .286 | .0955 | .0154 | .0139 | .0535 | .0940 | 2.81 | .267 | .1009 | .0207 | .0137 | .0555 | .1052 |
| 5.43 | .536 | .1333 | .0174 | .0192 | .0553 | .1070 | 5.37 | .491 | .1352 | .0222 | .0184 | .0571 | .1152 |
| 8.04 | .769 | .1901 | -.0045 | .0225 | .0535 | .1217 | 7.99 | .710 | .1877 | .0169 | .0227 | .0559 | .1312 |
| 10.52 | .949 | .2555 | -.0041 | .0236 | .0511 | .1369 | 10.46 | .893 | .2496 | -.0113 | .0246 | .0510 | .1475 |
| 15.34 | 1.212 | .4080 | .0124 | .0188 | .0429 | .1576 | 15.31 | 1.164 | .3982 | .0012 | .0200 | .0406 | .1806 |
| 18.87 | 1.352 | .5410 | .0107 | .0080 | .0484 | .1734 | 17.92 | 1.299 | .5004 | -.0026 | .0121 | .0414 | .1891 |
| .09 | .023 | .0795 | .0125 | .0078 | .0534 | .0875 | .14 | .024 | .0856 | .0220 | .0092 | .0540 | .1004 |

[redacted]

TABLE VI.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2NH_{30}F_2V_1$

(a) $\beta = 0^{\circ}$

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ | α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M = 0.60 | | | | | | | M = 0.80 | | | | | | |
| -0.02 | -0.046 | 0.0537 | 0.0869 | 0.0004 | 0.0052 | -0.0119 | 0.06 | -0.023 | 0.0538 | 0.0973 | 0.0000 | 0.0044 | -0.0120 |
| -2.30 | -.239 | .0617 | .0915 | .0001 | .0058 | -.0080 | -2.51 | -.266 | .0633 | .0970 | .0000 | .0051 | -.0081 |
| 2.26 | .151 | .0557 | .0767 | .0009 | .0047 | -.0129 | 2.53 | .205 | .0582 | .0923 | .0006 | .0040 | -.0111 |
| 4.49 | .341 | .0689 | .0574 | .0013 | .0044 | -.0101 | 4.99 | .447 | .0825 | .0664 | .0002 | .0035 | -.0119 |
| 6.77 | .534 | .1019 | .0239 | .0019 | .0037 | -.0131 | 7.39 | .652 | .1280 | .0086 | .0010 | .0049 | -.0122 |
| 8.96 | .697 | .1510 | -.0353 | .0024 | .0037 | -.0137 | 9.50 | .740 | .1761 | -.0850 | .0025 | .0043 | -.0096 |
| 13.11 | .867 | .2538 | -.2118 | .0030 | .0028 | -.0111 | 13.75 | .925 | .2858 | -.2618 | -.0005 | .0087 | -.0149 |
| 17.24 | 1.008 | .3694 | -.3562 | .0032 | .0020 | -.0086 | 18.06 | 1.108 | .4223 | -.4019 | .0035 | .0002 | -.0029 |
| 21.51 | 1.181 | .5191 | -.4485 | .0099 | -.0160 | .0155 | 22.54 | 1.320 | .6062 | -.5065 | .0133 | -.0269 | .0207 |
| -.04 | -.050 | .0538 | .0830 | .0003 | .0054 | -.0082 | .03 | -.028 | .0535 | .0976 | -.0001 | .0052 | -.0090 |
| M = 0.90 | | | | | | | M = 0.95 | | | | | | |
| 0.13 | 0.010 | 0.0558 | 0.1113 | 0.0001 | 0.0048 | -0.0112 | 0.17 | 0.023 | 0.0658 | 0.1014 | -0.0002 | 0.0049 | -0.0113 |
| -2.63 | -.289 | .0680 | .1034 | .0000 | .0054 | -.0099 | -2.76 | -.338 | .0818 | .1237 | -.0009 | .0058 | -.0084 |
| 2.83 | .302 | .0683 | .1011 | .0005 | .0042 | -.0123 | 2.98 | .350 | .0840 | .0825 | .0003 | .0043 | -.0104 |
| 5.53 | .612 | .1121 | .0579 | .0003 | .0040 | -.0116 | 5.69 | .654 | .1316 | .0284 | -.0001 | .0039 | -.0121 |
| 7.73 | .717 | .1543 | -.0181 | .0025 | .0045 | -.0076 | 8.31 | .934 | .2024 | -.0644 | .0001 | .0033 | -.0104 |
| 9.95 | .848 | .2061 | -.1035 | .0008 | .0068 | -.0112 | 10.81 | 1.160 | .2876 | -.1536 | .0007 | .0046 | -.0106 |
| 14.32 | 1.065 | .3360 | -.2977 | .0002 | .0072 | -.0140 | 15.11 | 1.322 | .4276 | -.3240 | .0026 | .0052 | -.0110 |
| 18.73 | 1.278 | .5003 | -.4661 | .0044 | -.0064 | .0017 | 19.49 | 1.497 | .6041 | -.4895 | .0010 | .0055 | -.0137 |
| 23.25 | 1.480 | .7013 | -.5889 | -.0115 | .0382 | -.0521 | 23.99 | 1.697 | .8263 | -.6455 | -.0008 | .0116 | -.0263 |
| .10 | .003 | .0561 | .1103 | -.0001 | .0048 | -.0110 | .16 | .018 | .0660 | .1007 | -.0002 | .0051 | -.0090 |

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TABLE VI.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2NH_{30}F_2V_1$ - Continued

(a) $\beta \approx 0^{\circ}$ - Concluded

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ | α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M = 1.00 | | | | | | | M = 1.05 | | | | | | |
| 0.08 | -0.008 | 0.0773 | 0.0883 | -0.0003 | 0.0049 | -0.0084 | 0.06 | -0.021 | 0.0951 | 0.0989 | -0.0004 | 0.0035 | -0.0083 |
| -2.79 | -.333 | .0920 | .1125 | -.0010 | .0053 | -.0060 | -2.80 | -.333 | .1112 | .1279 | -.0005 | .0044 | -.0054 |
| 2.89 | .314 | .0948 | .0557 | .0000 | .0041 | -.0093 | 2.88 | .288 | .1105 | .0525 | .0000 | .0036 | -.0086 |
| 5.68 | .628 | .1440 | -.0100 | -.0004 | .0039 | -.0090 | 5.64 | .596 | .1562 | -.0115 | .0000 | .0028 | -.0088 |
| 8.30 | .899 | .2123 | -.1025 | .0002 | .0038 | -.0101 | 8.31 | .863 | .2247 | -.0988 | .0000 | .0038 | -.0096 |
| 10.82 | 1.132 | .2981 | -.2096 | .0006 | .0041 | -.0112 | 10.83 | 1.090 | .3083 | -.2072 | .0005 | .0040 | -.0114 |
| 15.43 | 1.436 | .4812 | -.4458 | .0000 | .0071 | -.0175 | 15.45 | 1.387 | .4872 | -.4503 | .0001 | .0072 | -.0152 |
| 20.00 | 1.682 | .6942 | -.6316 | .0015 | .0060 | -.0166 | 20.02 | 1.666 | .7099 | -.7115 | .0014 | .0032 | -.0169 |
| 23.53 | 1.831 | .8757 | -.7696 | .0008 | .0050 | -.0174 | 21.76 | 1.738 | .7950 | -.7450 | .0011 | .0049 | -.0215 |
| .08 | -.008 | .0767 | .0909 | -.0003 | .0053 | -.0080 | .05 | -.023 | .0947 | .0995 | -.0004 | .0045 | -.0060 |
| M = 1.13 | | | | | | | M = 1.20 | | | | | | |
| 0.02 | -0.040 | 0.0916 | 0.1066 | -0.0015 | 0.0031 | 0.0000 | 0.07 | -0.025 | 0.0956 | 0.0954 | -0.0005 | 0.0095 | 0.0070 |
| -2.76 | -.313 | .1053 | .1436 | -.0015 | .0033 | .0007 | -2.74 | -.295 | .1084 | .1390 | -.0010 | .0091 | .0086 |
| 2.79 | .241 | .1044 | .0524 | -.0007 | .0031 | -.0028 | 2.79 | .248 | .1092 | .0381 | -.0002 | .0092 | .0002 |
| 5.50 | .520 | .1409 | -.0252 | -.0006 | .0039 | -.0038 | 5.49 | .506 | .1445 | -.0373 | .0001 | .0110 | -.0019 |
| 8.18 | .789 | .2019 | -.1165 | -.0008 | .0044 | -.0041 | 8.11 | .746 | .2003 | -.1177 | .0010 | .0110 | -.0027 |
| 10.70 | .996 | .2748 | -.1946 | -.0047 | .0061 | -.0037 | 10.64 | .947 | .2703 | -.1960 | .0017 | .0115 | -.0019 |
| 15.37 | 1.286 | .4361 | -.3862 | .0000 | .0051 | -.0072 | 15.38 | 1.234 | .4249 | -.3686 | .0019 | .0078 | .0014 |
| 20.13 | 1.598 | .6657 | -.6276 | .0016 | .0049 | -.0072 | 20.16 | 1.559 | .6522 | -.6015 | .0020 | .0063 | .0005 |
| 22.82 | 1.728 | .8024 | -.6660 | .0024 | .0066 | -.0076 | 21.79 | 1.666 | .7445 | -.6782 | .0023 | .0066 | -.0028 |
| .02 | -.040 | .0920 | .1050 | -.0011 | .0039 | -.0001 | .02 | -.039 | .0959 | .0967 | -.0004 | .0091 | .0003 |

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TABLE VI.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2NH_{30}F_2V_1$ - Continued

(b) $\beta \approx -3.25^{\circ}$

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ | α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M = 0.60 | | | | | | | M = 0.80 | | | | | | |
| 0.10 | -0.004 | 0.0519 | 0.0864 | -0.0006 | -0.0273 | 0.0697 | 0.14 | 0.006 | 0.0523 | 0.1005 | -0.0007 | -0.0308 | 0.0771 |
| -2.20 | -.206 | .0580 | .0947 | -.0014 | -.0269 | .0711 | -2.32 | -.235 | .0597 | .0997 | -.0018 | -.0307 | .0818 |
| 2.33 | .186 | .0551 | .0700 | .0000 | -.0279 | .0649 | 2.57 | .235 | .0584 | .0865 | .0005 | -.0297 | .0779 |
| 4.55 | .376 | .0706 | .0570 | .0011 | -.0262 | .0642 | 4.99 | .479 | .0846 | .0650 | .0021 | -.0272 | .0770 |
| 6.75 | .570 | .1050 | .0231 | .0019 | -.0226 | .0656 | 7.26 | .674 | .1289 | .0042 | .0012 | -.0230 | .0749 |
| 8.96 | .741 | .1574 | -.0452 | .0025 | -.0191 | .0605 | 9.37 | .768 | .1781 | -.0914 | .0029 | -.0168 | .0756 |
| 13.05 | .914 | .2621 | -.2192 | .0049 | -.0055 | .0581 | 13.50 | .960 | .2896 | -.2759 | .0009 | .0094 | .0529 |
| 17.18 | 1.068 | .3853 | -.3725 | .0062 | .0048 | .0616 | 17.78 | 1.159 | .4319 | -.4131 | .0068 | .0099 | .0743 |
| 18.67 | 1.129 | .4357 | -.4059 | .0102 | .0037 | .0703 | 19.33 | 1.233 | .4914 | -.4521 | .0100 | .0088 | .0795 |
| .07 | -.016 | .0527 | .0861 | -.0005 | -.0275 | .0662 | .16 | .003 | .0520 | .1012 | -.0005 | -.0308 | .0772 |
| M = 0.90 | | | | | | | M = 1.00 | | | | | | |
| 0.20 | 0.014 | 0.0533 | 0.1148 | -0.0008 | -0.0345 | 0.0829 | 0.15 | -0.005 | 0.0734 | 0.0973 | -0.0017 | -0.0376 | 0.0903 |
| -2.40 | -.280 | .0646 | .1049 | -.0028 | -.0357 | .0888 | -2.61 | -.339 | .0890 | .1094 | -.0019 | -.0421 | .1002 |
| 2.84 | .317 | .0680 | .1017 | .0010 | -.0319 | .0815 | 2.87 | .322 | .0908 | .0691 | -.0004 | -.0314 | .0847 |
| 5.35 | .600 | .1087 | .0540 | .0083 | -.0295 | .0878 | 5.47 | .633 | .1369 | .0032 | .0012 | -.0282 | .0893 |
| 7.57 | .732 | .1526 | -.0108 | .0038 | -.0231 | .0828 | 8.02 | .916 | .2082 | -.0885 | .0012 | -.0221 | .0848 |
| 9.73 | .869 | .2056 | -.1058 | .0024 | -.0131 | .0772 | 10.38 | 1.153 | .2918 | -.1979 | .0004 | -.0126 | .0771 |
| 13.94 | 1.090 | .3349 | -.3107 | .0001 | .0183 | .0529 | 14.80 | 1.456 | .4686 | -.4032 | .0078 | .0151 | .0510 |
| 18.24 | 1.317 | .5000 | -.4762 | .0040 | .0218 | .0727 | 19.17 | 1.712 | .6758 | -.6056 | .0016 | .0187 | .0633 |
| 19.90 | 1.401 | .5718 | -.5220 | .0066 | .0166 | .0880 | 20.91 | 1.785 | .7618 | -.6628 | .0002 | .0233 | .0657 |
| .23 | .016 | .0536 | .1152 | -.0009 | -.0347 | .0867 | .21 | .004 | .0725 | .0978 | -.0015 | -.0379 | .0920 |

TABLE VI.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2NH_{30}F_2V_1$ - Continued

(b) $\beta \approx -3.25^{\circ}$ - Concluded

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|
| M = 1.05 | | | | | | |
| 0.14 | -0.022 | 0.0892 | 0.1128 | -0.0023 | -0.0471 | 0.1062 |
| -2.54 | -.334 | .1035 | .1454 | -.0022 | -.0500 | .1117 |
| 2.83 | .300 | .1055 | .0592 | -.0012 | -.0414 | .0996 |
| 5.48 | .625 | .1491 | -.0129 | .0003 | -.0316 | .0932 |
| 7.99 | .892 | .2158 | -.0979 | .0013 | -.0211 | .0861 |
| 10.38 | 1.124 | .2948 | -.2149 | -.0006 | -.0138 | .0790 |
| 14.73 | 1.435 | .4673 | -.4664 | .0018 | .0085 | .0577 |
| 19.11 | 1.725 | .6846 | -.7213 | .0081 | .0263 | .0508 |
| 20.88 | 1.810 | .7758 | -.7791 | .0038 | .0305 | .0507 |
| .16 | -.018 | .0895 | .1136 | -.0023 | -.0474 | .1035 |
| M = 1.20 | | | | | | |
| 0.14 | -0.024 | 0.0956 | 0.0975 | 0.0009 | -0.0291 | 0.1022 |
| -2.48 | -.305 | .1080 | .1492 | .0003 | -.0312 | .1069 |
| 2.74 | .248 | .1087 | .0388 | .0018 | -.0246 | .0995 |
| 5.25 | .502 | .1426 | -.0312 | .0021 | -.0178 | .0935 |
| 7.75 | .752 | .1970 | -.1130 | .0025 | -.0103 | .0919 |
| 10.14 | .957 | .2627 | -.1957 | .0039 | -.0054 | .0981 |
| 14.69 | 1.282 | .4208 | -.3787 | .0034 | .0111 | .0924 |
| 19.24 | 1.612 | .6405 | -.6227 | .0036 | .0244 | .0943 |
| 21.23 | 1.731 | .7469 | -.7022 | .0041 | .0330 | .0904 |
| .10 | -.036 | .0950 | .0989 | .0008 | -.0300 | .1000 |

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|
| M = 1.13 | | | | | | |
| 0.17 | -0.024 | 0.0905 | 0.1112 | -0.0023 | -0.0418 | 0.1025 |
| -2.53 | -.313 | .1041 | .1502 | -.0017 | -.0430 | .1079 |
| 2.78 | .260 | .1050 | .0529 | -.0009 | -.0367 | .0996 |
| 5.31 | .531 | .1405 | -.0209 | -.0007 | -.0302 | .0961 |
| 7.82 | .801 | .1999 | -.1099 | -.0005 | -.0207 | .0918 |
| 10.23 | 1.011 | .2690 | -.1953 | -.0005 | -.0140 | .0914 |
| 14.70 | 1.323 | .4302 | -.3949 | .0023 | .0102 | .0788 |
| 19.20 | 1.648 | .6510 | -.6373 | .0077 | .0320 | .0642 |
| 21.21 | 1.752 | .7535 | -.6924 | .0101 | .0458 | .0646 |
| .16 | -.031 | .0903 | .1117 | -.0023 | -.0418 | .1041 |

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TABLE VI.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2NH_{30}F_2V_1$ - Continued

(c) $\beta \approx -6.50^o$

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ | α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | M = 0.60 | | | | | | | M = 0.80 | | | |
| 0.07 | -0.023 | 0.0478 | 0.1026 | 0.0020 | -0.0652 | 0.1816 | 0.16 | -0.015 | 0.0495 | 0.1118 | 0.0170 | -0.1150 | -0.4768 |
| -2.19 | -.218 | .0550 | .1140 | .0004 | -.0680 | .1827 | -2.29 | -.245 | .0573 | .1230 | -.0005 | -.0763 | .1988 |
| 2.34 | .168 | .0504 | .0875 | .0040 | -.0625 | .1812 | 2.63 | .227 | .0546 | .1108 | .0046 | -.0679 | .1924 |
| 4.58 | .363 | .0670 | .0648 | .0054 | -.0585 | .1795 | 5.00 | .470 | .0807 | .0802 | .0066 | -.0630 | .1909 |
| 6.80 | .562 | .1025 | .0195 | .0047 | -.0523 | .1764 | 7.31 | .664 | .1267 | .0090 | .0041 | -.0532 | .1864 |
| 8.97 | .722 | .1540 | -.0512 | .0044 | -.0429 | .1727 | 9.36 | .751 | .1743 | -.0886 | .0086 | -.0377 | .1858 |
| 13.14 | .920 | .2628 | -.2219 | .0048 | -.0081 | .1549 | 13.54 | .954 | .2860 | -.2819 | .0043 | .0146 | .1495 |
| 17.30 | 1.083 | .3885 | -.3691 | .0026 | .0223 | .1447 | 17.90 | 1.184 | .4390 | -.4220 | .0022 | .0376 | .1582 |
| 21.43 | 1.226 | .5317 | -.4566 | .0063 | .0357 | .1634 | 22.17 | 1.373 | .6134 | -.5169 | .0011 | .0571 | .1797 |
| .09 | -.023 | .0481 | .1027 | .0023 | -.0661 | .1816 | .18 | -.004 | .0484 | .1198 | .0022 | -.0726 | .1942 |
| | | | M = 0.90 | | | | | | | M = 0.95 | | | |
| 0.31 | 0.026 | 0.0508 | 0.1436 | 0.0011 | -0.0789 | 0.2075 | 0.38 | 0.065 | 0.0602 | 0.1304 | -0.0015 | -0.0874 | 0.2152 |
| -2.36 | -.274 | .0611 | .1427 | -.0026 | -.0849 | .2145 | -2.41 | -.306 | .0709 | .1535 | -.0029 | -.0970 | .2286 |
| 2.92 | .321 | .0659 | .1253 | .0055 | -.0714 | .2038 | 3.06 | .388 | .0827 | .0994 | .0036 | -.0745 | .2115 |
| 5.38 | .586 | .1051 | .0742 | .0137 | -.0617 | .2093 | 5.61 | .680 | .1298 | .0427 | .0061 | -.0601 | .2075 |
| 7.70 | .767 | .1549 | .0103 | .0162 | -.0499 | .2090 | 8.08 | .941 | .1969 | -.0319 | .0060 | -.0425 | .2020 |
| 9.77 | .875 | .2041 | -.0967 | .0064 | -.0292 | .1908 | 10.45 | 1.175 | .2815 | -.1287 | .0075 | -.0218 | .1914 |
| 14.00 | 1.089 | .3330 | -.3245 | .0068 | -.0041 | -.4439 | 14.68 | 1.388 | .4295 | -.3485 | .0028 | .0279 | .1574 |
| 18.36 | 1.346 | .5081 | -.4866 | -.0025 | .0654 | .1513 | 18.89 | 1.529 | .5920 | -.4970 | .0046 | .0744 | .1473 |
| 22.64 | 1.527 | .6961 | -.5896 | .0003 | .0708 | .1919 | 23.10 | 1.696 | .7905 | -.6338 | -.0009 | .0719 | .2010 |
| .29 | .019 | .0505 | .1445 | .0012 | -.0798 | .2077 | .36 | .058 | .0604 | .1313 | -.0018 | -.0883 | .2154 |

[redacted]

TABLE VI.- BASIC AERODYNAMIC CHARACTERISTICS OF

MODEL CONFIGURATION $WB_2NH_{30}F_2V_1$ - Concluded

(c) $\beta \approx -6.50^\circ$ - Concluded

| α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ | α, deg | $C_L$ | $C_D'$ | $C_m$ | $C_l$ | $C_n$ | $C_Y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M = 1.00 | | | | | | | M = 1.05 | | | | | | |
| 0.27 | 0.013 | 0.0721 | 0.1330 | 0.0001 | -0.0864 | 0.2202 | 0.28 | 0.010 | 0.0868 | 0.1336 | 0.0013 | -0.0940 | 0.2308 |
| -2.43 | -.315 | .0847 | .1560 | -.0005 | -.0928 | .2284 | -2.41 | -.306 | .0976 | .1693 | .0008 | -.1001 | .2381 |
| 2.99 | .344 | .0912 | .0960 | .0040 | -.0743 | .2132 | 3.00 | .329 | .1060 | .0846 | .0034 | -.0861 | .2262 |
| 5.58 | .641 | .1379 | .0322 | .0058 | -.0630 | .2135 | 5.56 | .625 | .1497 | .0170 | .0043 | -.0716 | .2242 |
| 8.06 | .908 | .2063 | -.0569 | .0051 | -.0465 | .2100 | 8.05 | .889 | .2136 | -.0806 | .0026 | -.0551 | .2155 |
| 10.43 | 1.142 | .2905 | -.1596 | .0076 | -.0249 | .1965 | 10.33 | 1.116 | .2904 | -.1921 | .0005 | -.0412 | .2065 |
| 14.89 | 1.476 | .4737 | -.4073 | .0075 | .0176 | .1719 | 14.82 | 1.457 | .4734 | -.4686 | .0018 | .0107 | .1722 |
| 19.23 | 1.734 | .6838 | -.6418 | .0071 | .0655 | .1515 | 19.19 | 1.732 | .6891 | -.7202 | .0061 | .0598 | .1527 |
| 23.49 | 1.906 | .9027 | -.7735 | .0055 | .0775 | .1946 | .30 | .010 | .0866 | .1327 | .0012 | -.0938 | .2287 |
| .29 | .022 | .0716 | .1316 | .0003 | -.0863 | .2218 | | | | | | | |
| M = 1.13 | | | | | | | M = 1.20 | | | | | | |
| 0.28 | -0.003 | 0.0896 | 0.1308 | 0.0021 | -0.0824 | 0.2268 | 0.01 | -0.038 | 0.0951 | 0.1279 | 0.0045 | -0.0719 | 0.2312 |
| -2.39 | -.293 | .1007 | .1694 | .0020 | -.0877 | .2339 | -2.34 | -.282 | .1055 | .1750 | .0043 | -.0783 | .2352 |
| 2.91 | .278 | .1055 | .0770 | .0036 | -.0731 | .2248 | 2.85 | .262 | .1101 | .0591 | .0057 | -.0587 | .2217 |
| 5.45 | .553 | .1443 | .0073 | .0049 | -.0619 | .2240 | 5.37 | .522 | .1468 | -.0099 | .0069 | -.0483 | .2228 |
| 7.97 | .809 | .2024 | -.0792 | .0049 | -.0497 | .2286 | 7.86 | .764 | .2013 | -.0958 | .0082 | -.0373 | .2269 |
| 10.36 | 1.022 | .2731 | -.1732 | .0041 | -.0349 | .2253 | 10.25 | .973 | .2678 | -.1919 | .0071 | -.0276 | .2295 |
| 14.98 | 1.392 | .4505 | -.3925 | .0038 | -.0029 | .2067 | 14.89 | 1.332 | .4365 | -.3976 | .0042 | -.0055 | .2291 |
| 19.39 | 1.659 | .6590 | -.6155 | .0119 | .0675 | .1542 | 19.42 | 1.642 | .6578 | -.6121 | .0057 | .0496 | .1981 |
| .28 | -.005 | .0890 | .1302 | .0021 | -.0818 | .2264 | .26 | -.009 | .0950 | .1208 | .0043 | -.0701 | .2261 |



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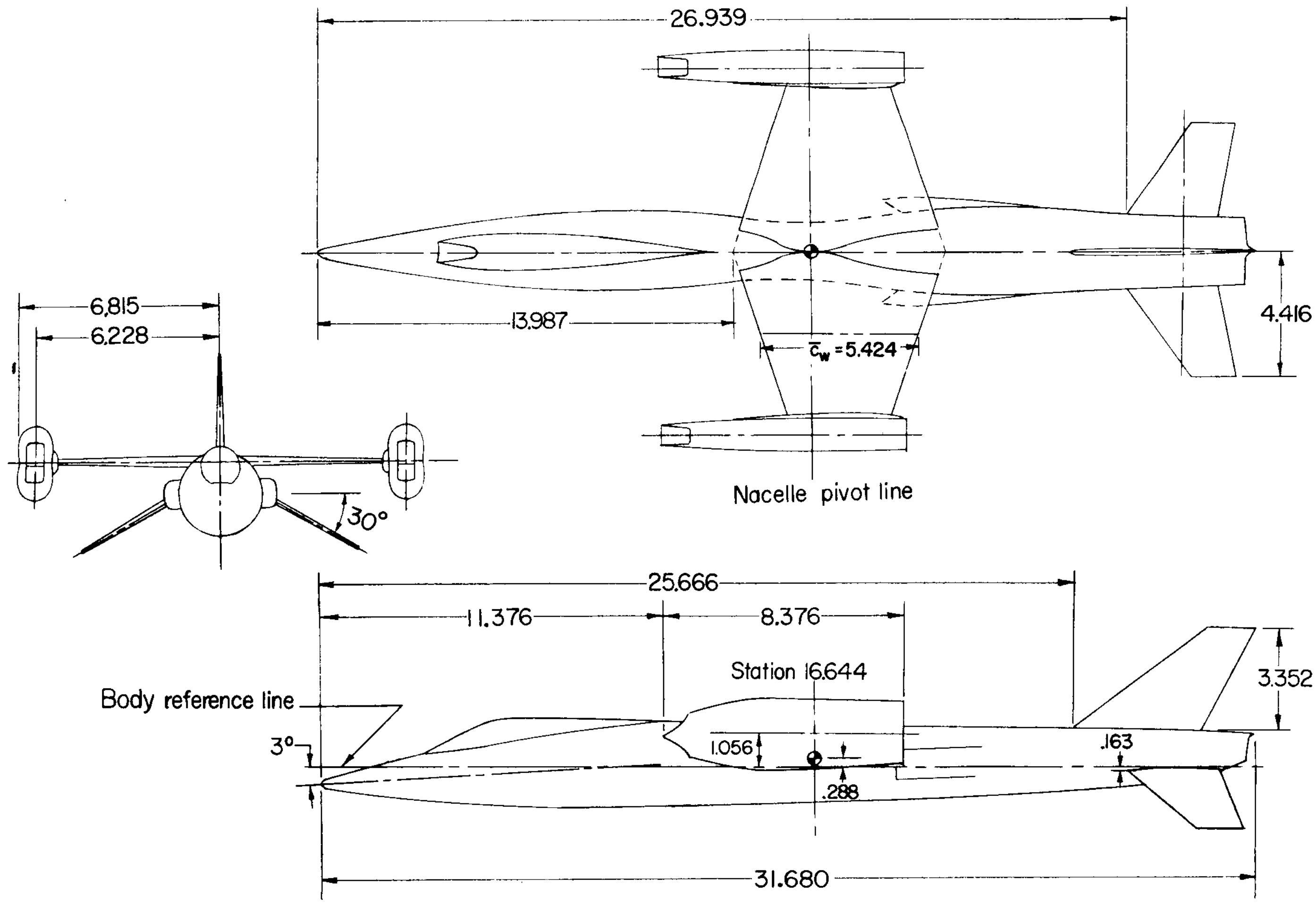


(a) Complete model.

Figure 1.- Drawings of the 0.048-scale model of a horizontal-attitude VTOL airplane. All dimensions are in inches unless otherwise noted.

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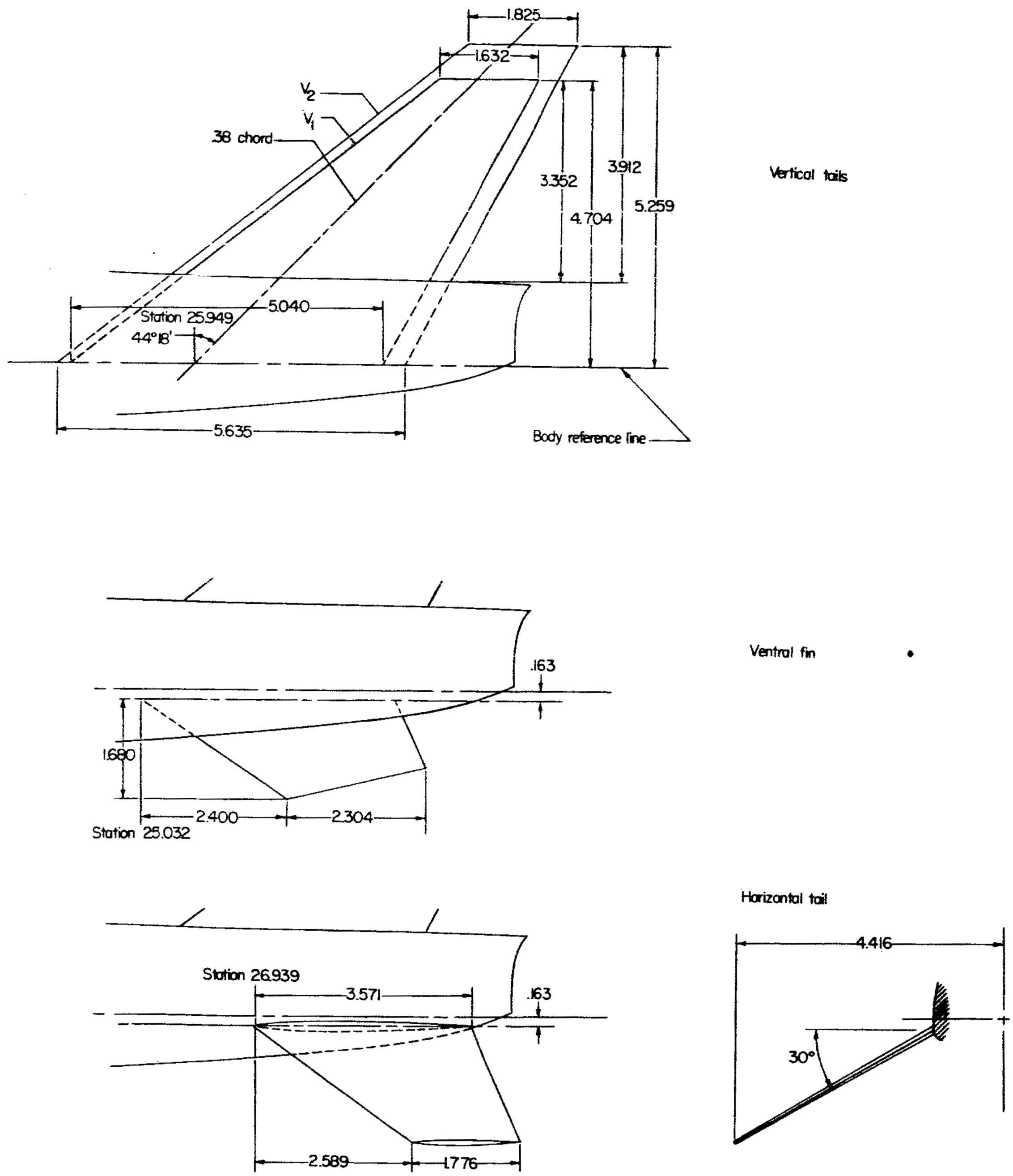


(b) Tail arrangements.

Figure 1.- Concluded.

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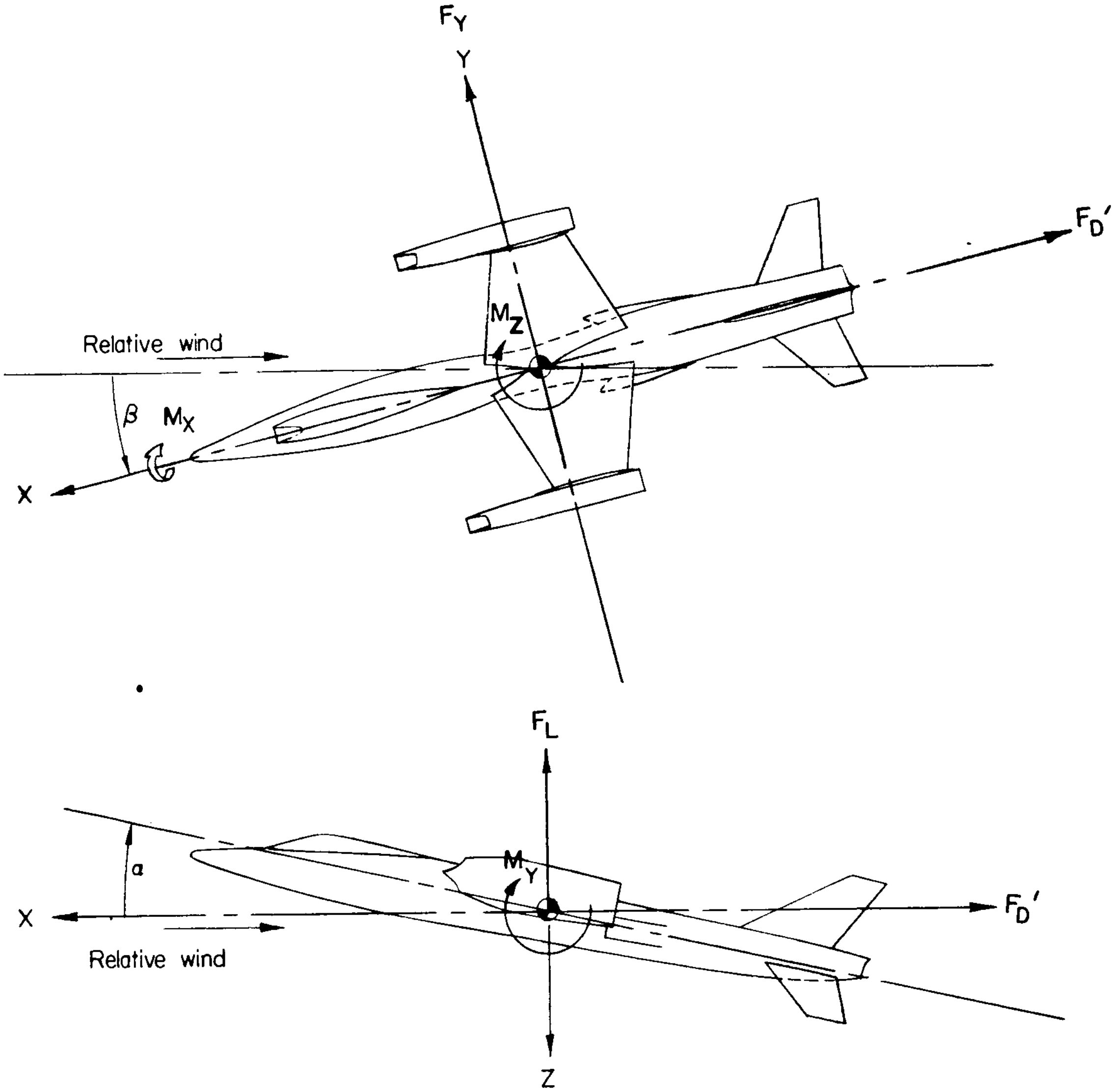


Figure 2.- System of stability axes. Arrows indicate positive directions.

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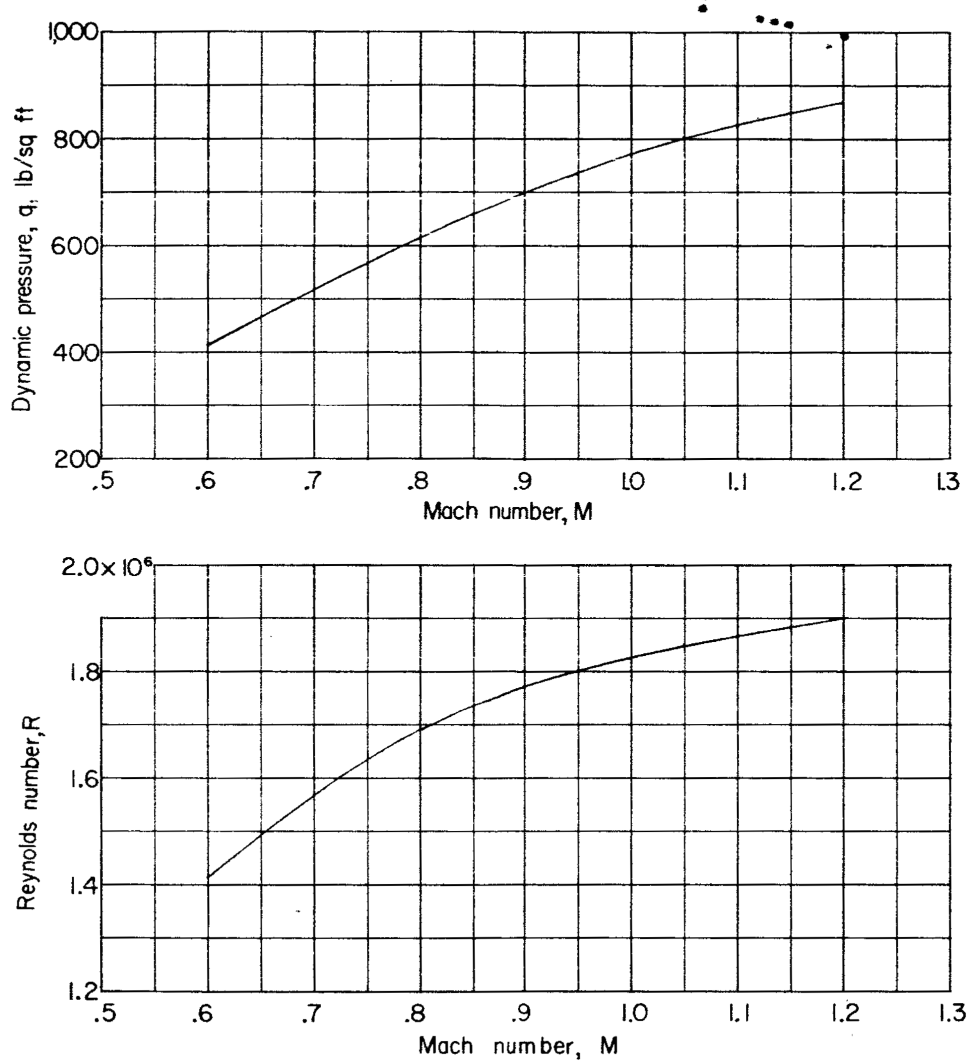


Figure 3.- Variation with Mach number of the average test dynamic pressure and Reynolds number based on the wing mean aerodynamic chord.

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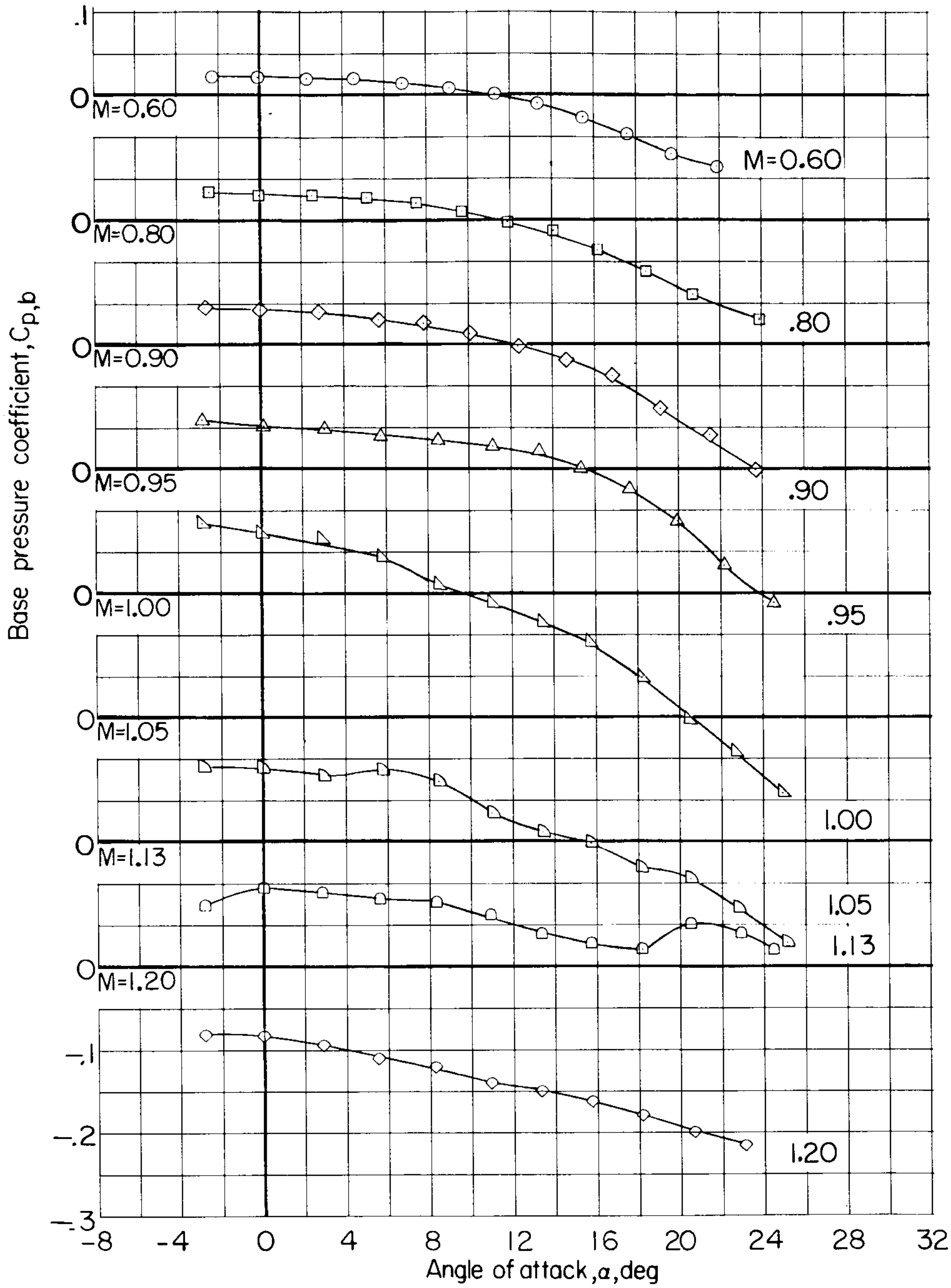


(a) Base of fuselage.

Figure 4.- Variation of base pressure coefficients with angle of attack.

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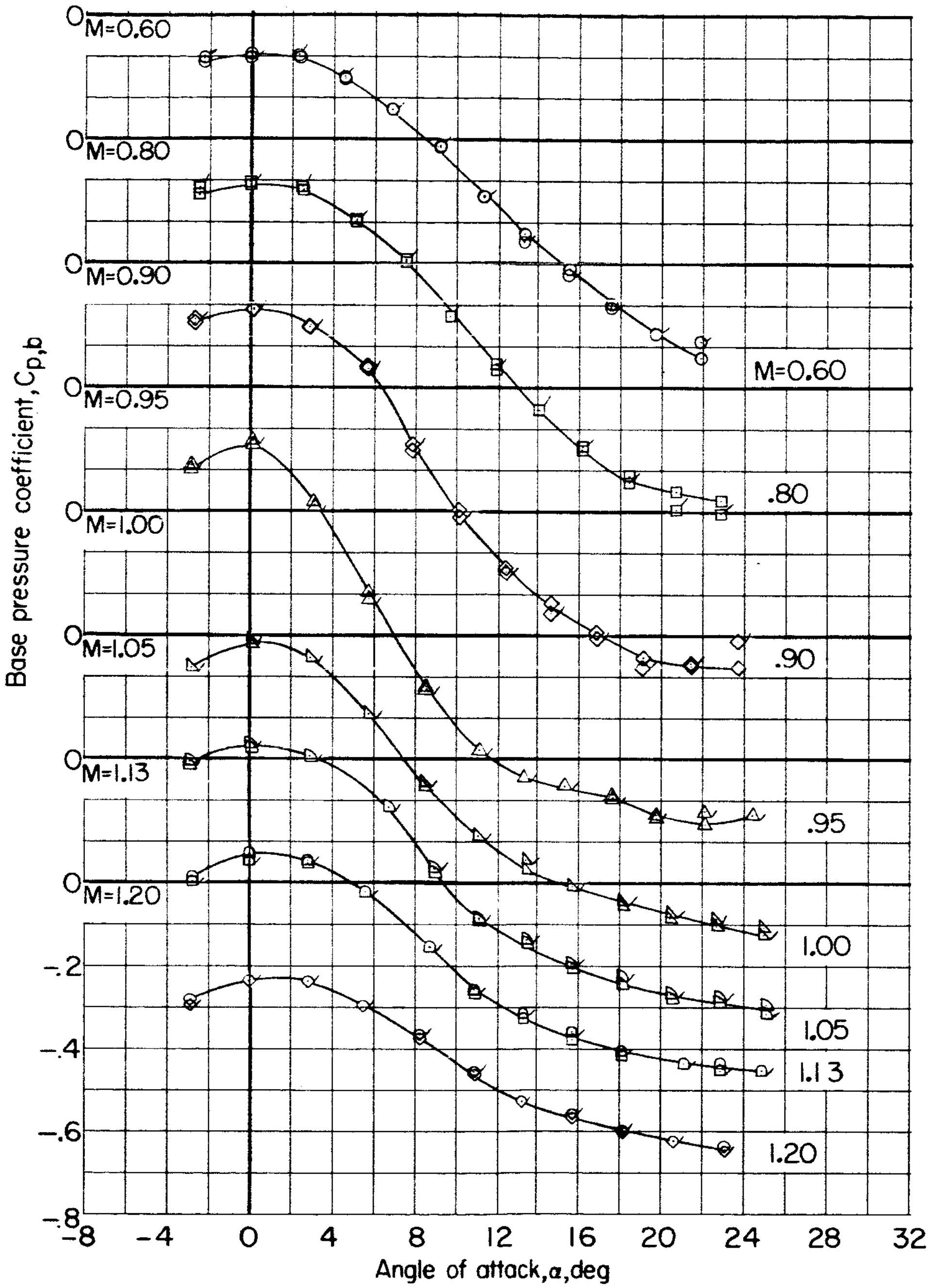


(b) Base of wing-tip nacelles. Plain symbols indicate values for starboard nacelle and flagged symbols indicate values for port nacelle.

Figure 4.- Concluded.

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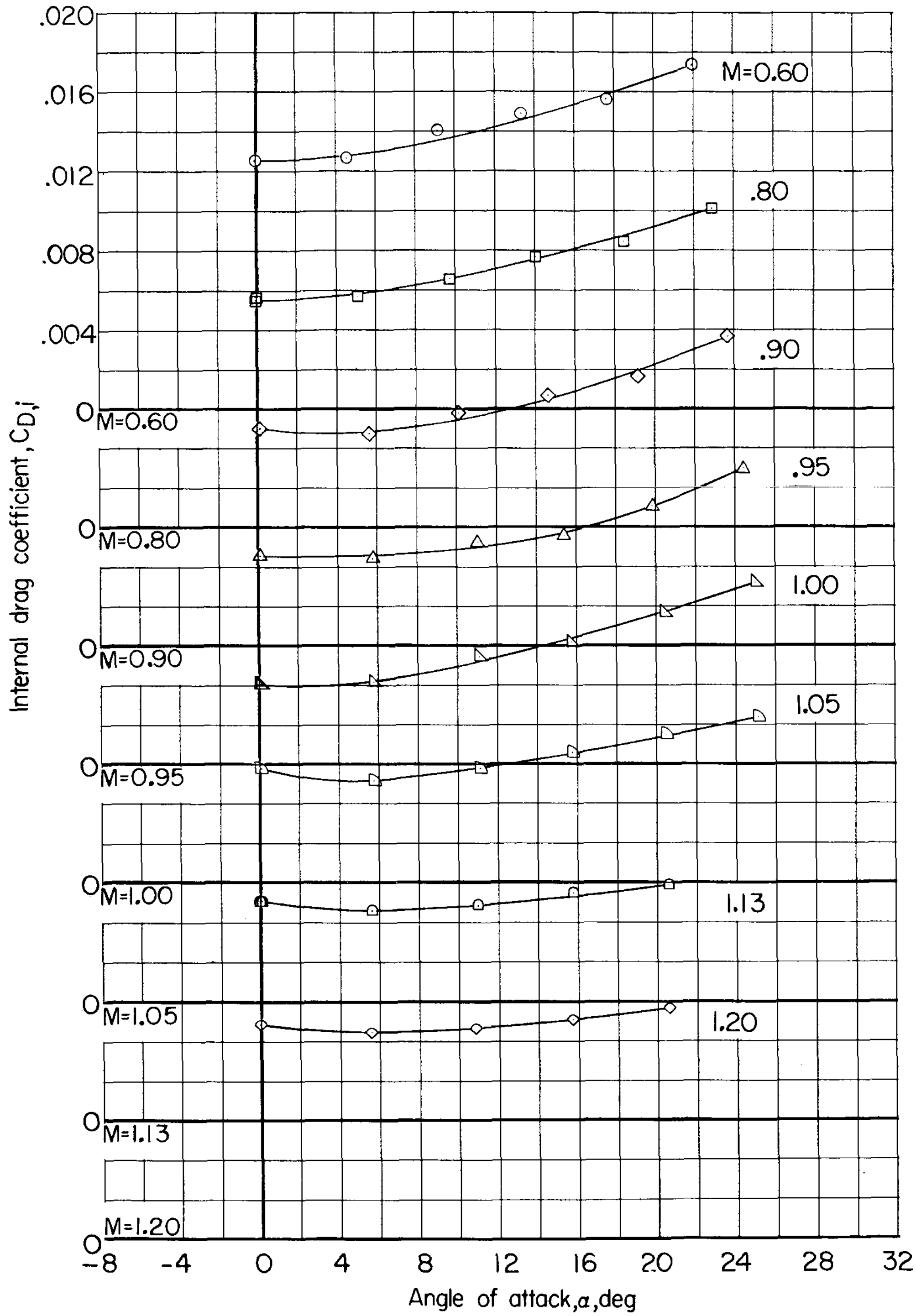


Figure 5.- Variation of internal drag coefficient with angle of attack.

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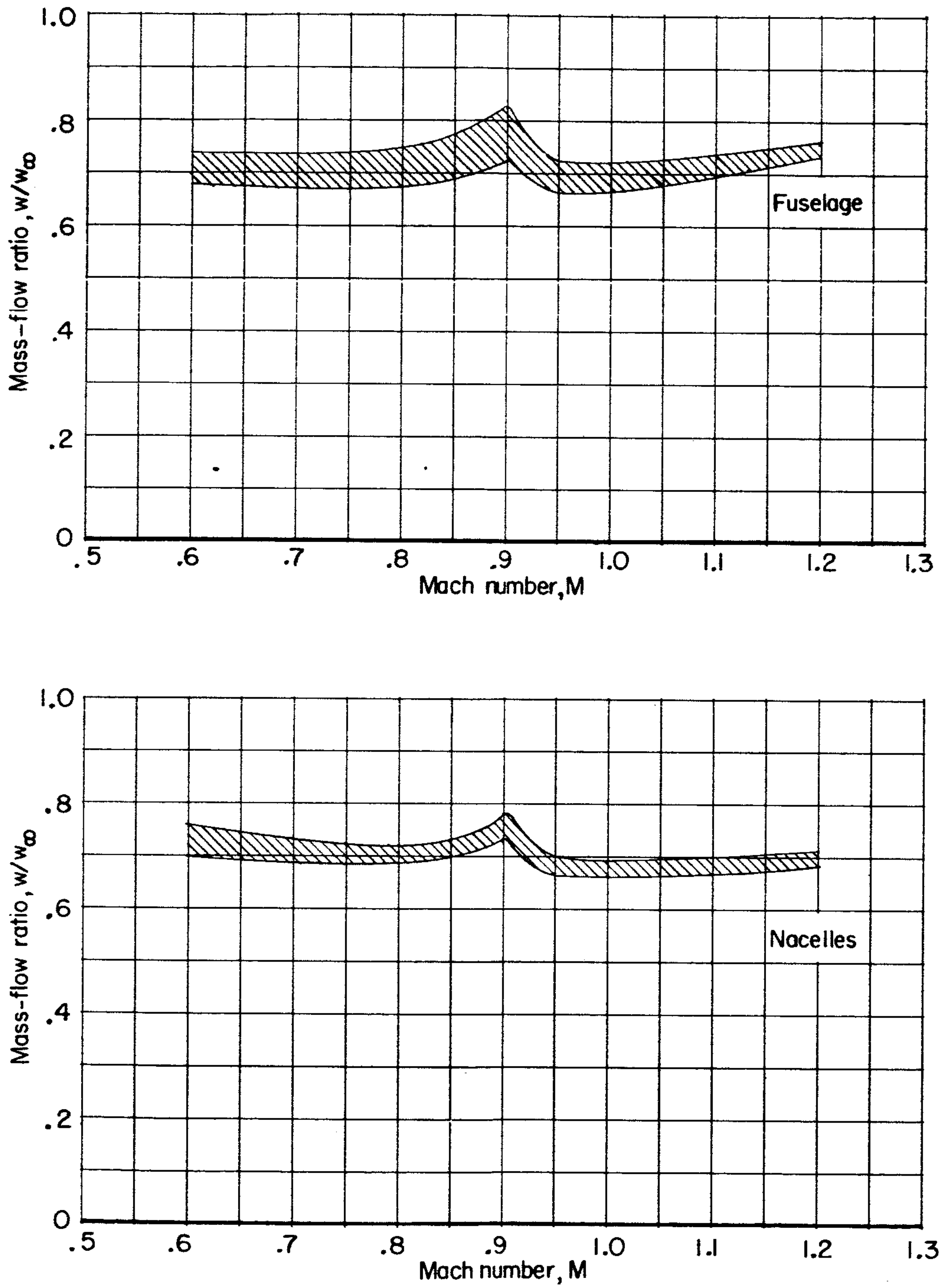


Figure 6.- Variation with Mach number of the range of mass-flow ratio for the various model configurations.

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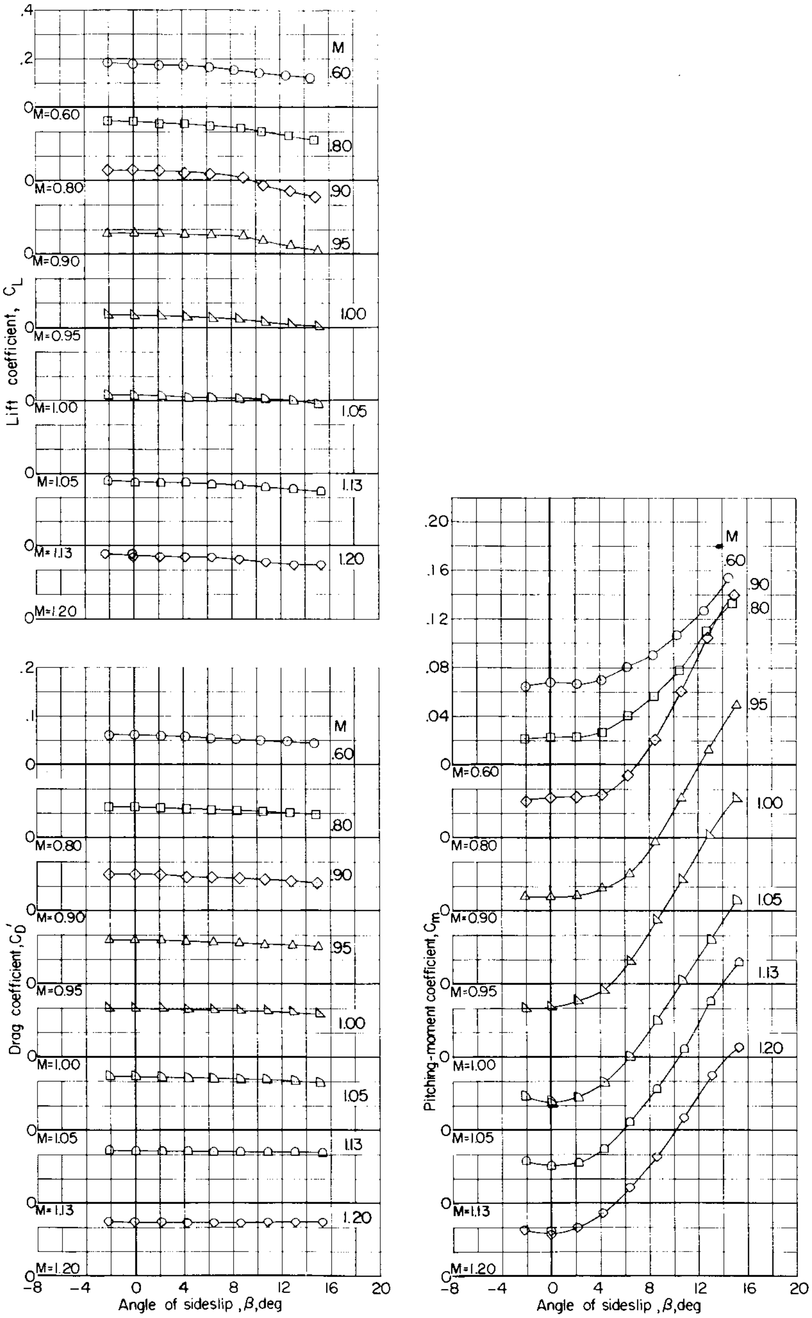


(a) Variation with angle of sideslip of lift, drag, and pitching-moment coefficients.

Figure 7.- Aerodynamic characteristics of the model. Configuration $WB_2NH_{30}V_1$; $\alpha \approx 3.25^\circ$.

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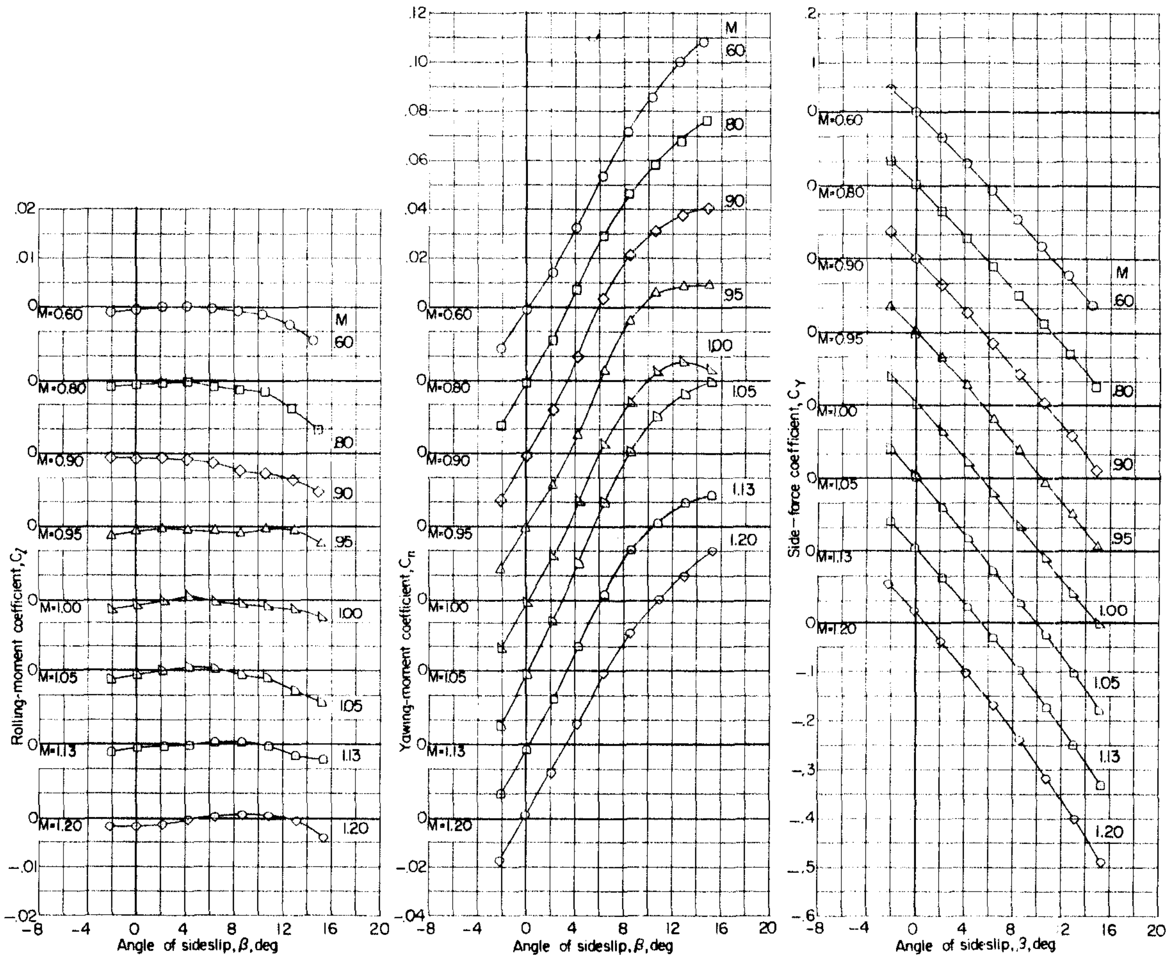


(b) Variation with angle of sideslip of rolling-moment, yawing-moment, and side-force coefficients.

Figure 7.- Concluded.

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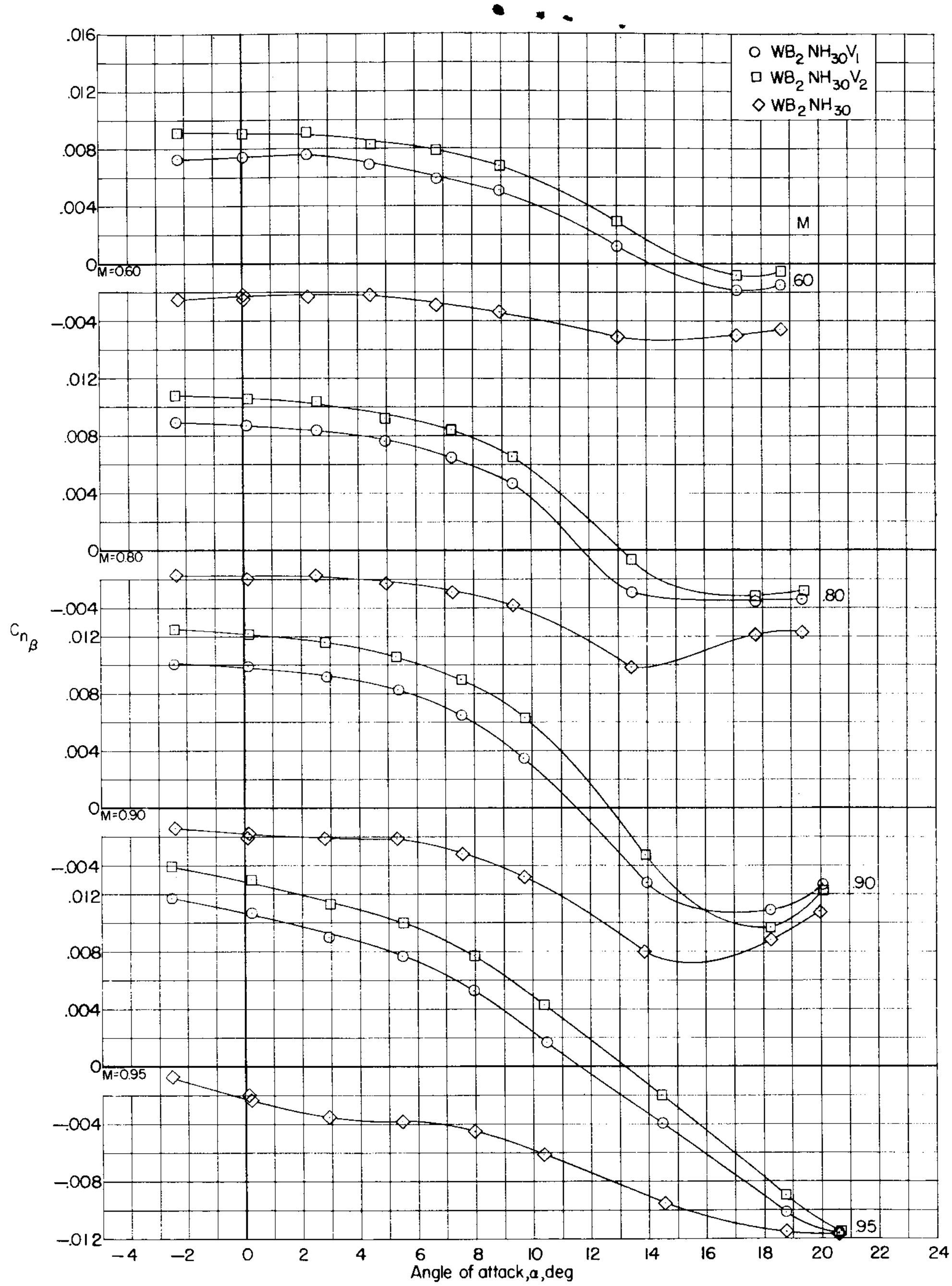


(a) Variation with angle of attack of yawing moment due to sideslip.

Figure 8.- Effect of vertical-tail size on the lateral-stability derivatives of the model. $\beta = \pm 3.25^{\circ}$.

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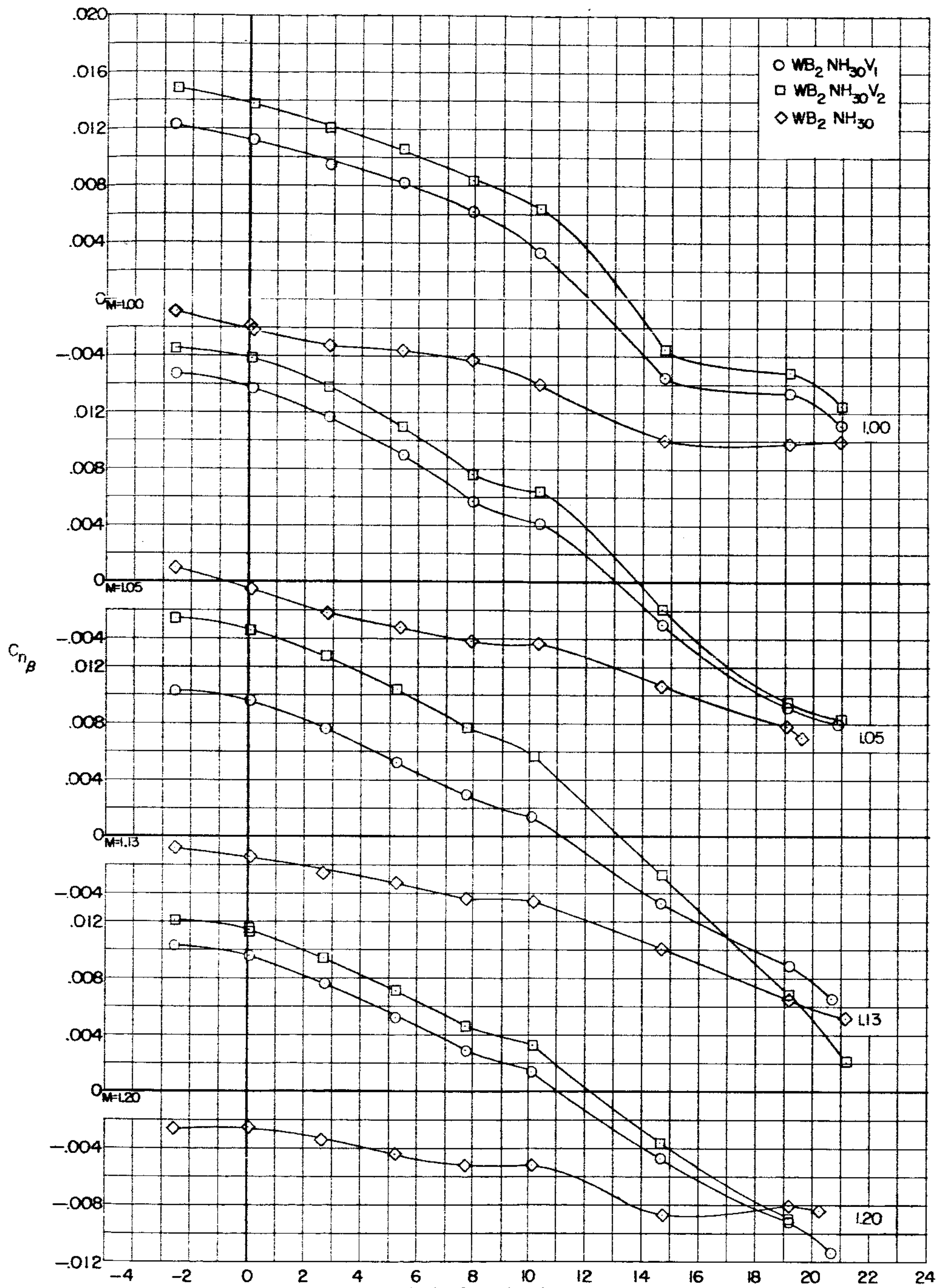


(a) Concluded.

Figure 8.- Continued.

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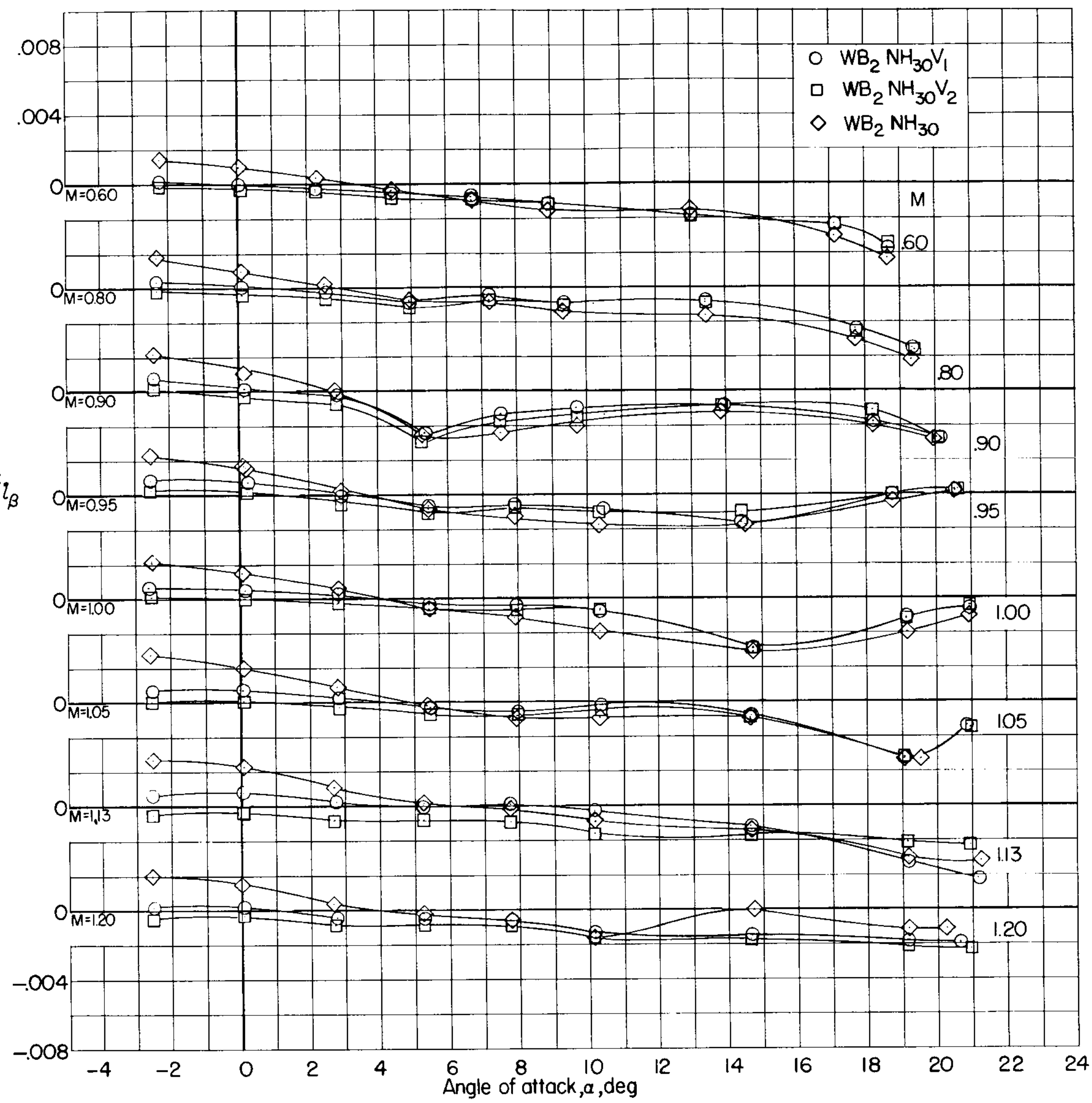


(b) Variation with angle of attack of rolling moment due to sideslip.

Figure 8.- Continued.

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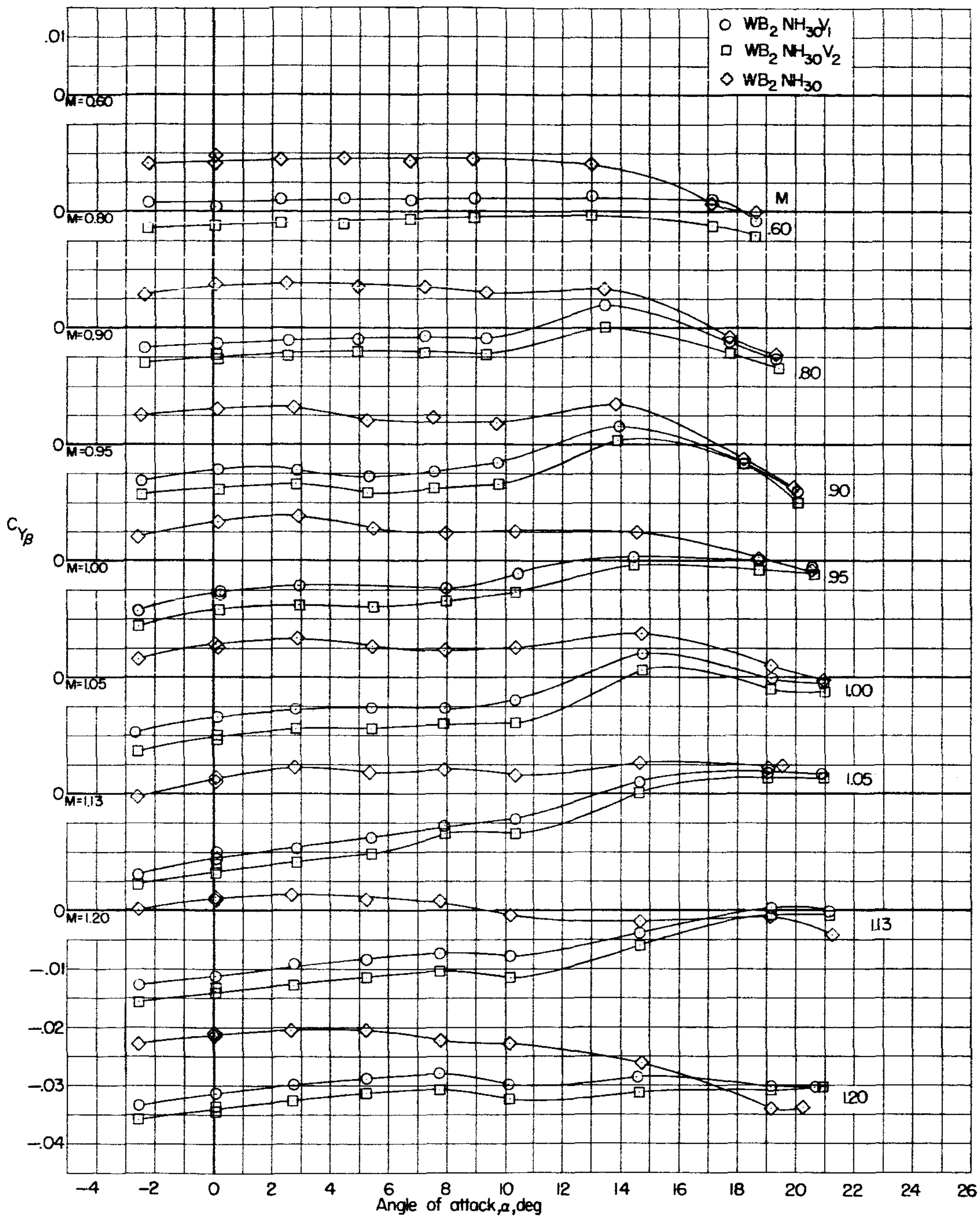


(c) Variation with angle of attack of side force due to sideslip.

Figure 8.- Concluded.

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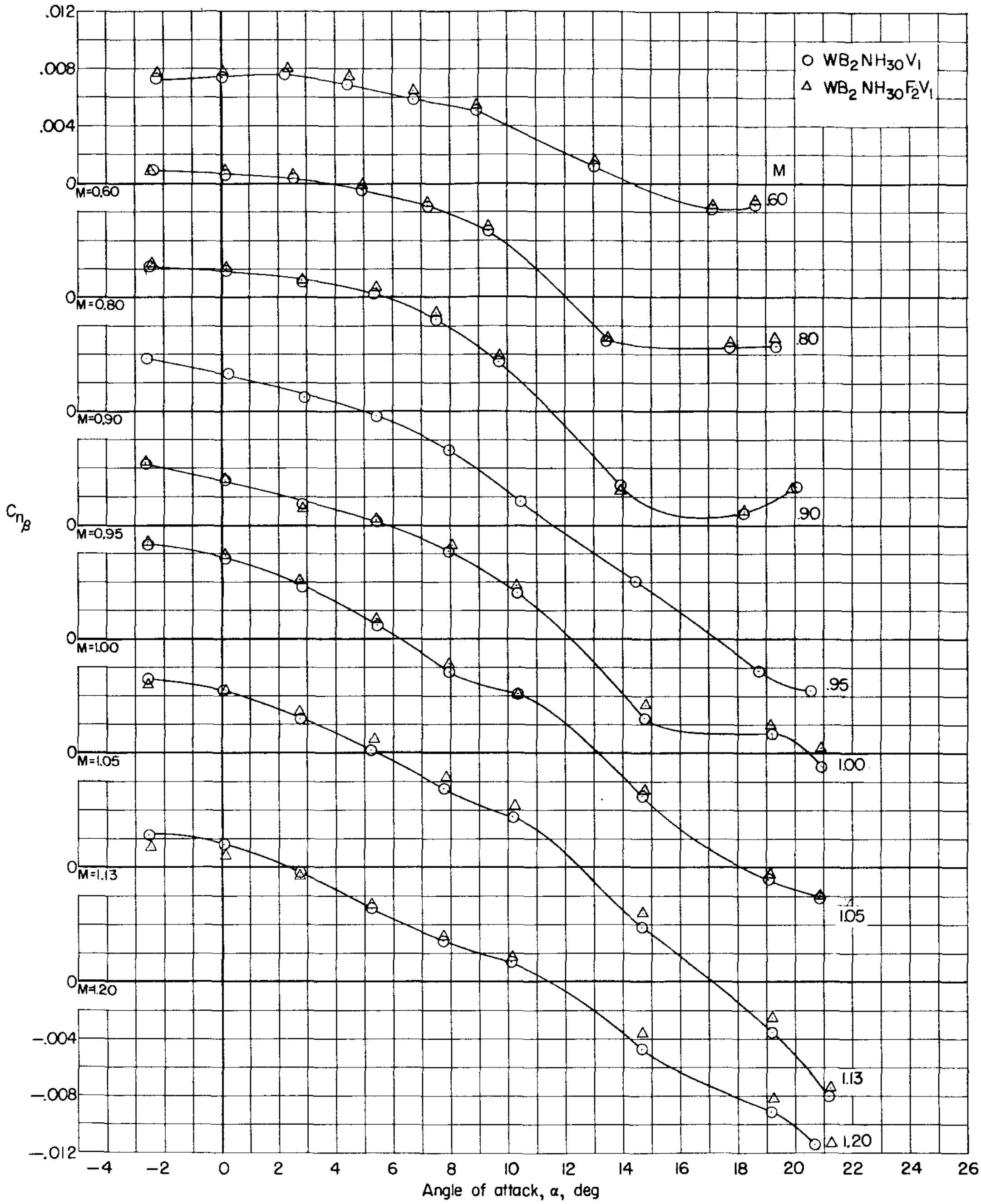


(a) Variation with angle of attack of yawing moment due to sideslip.

Figure 9.- Effect of the ventral fin on the lateral-stability derivatives of the model. $\beta = \pm 3.25^{\circ}$.

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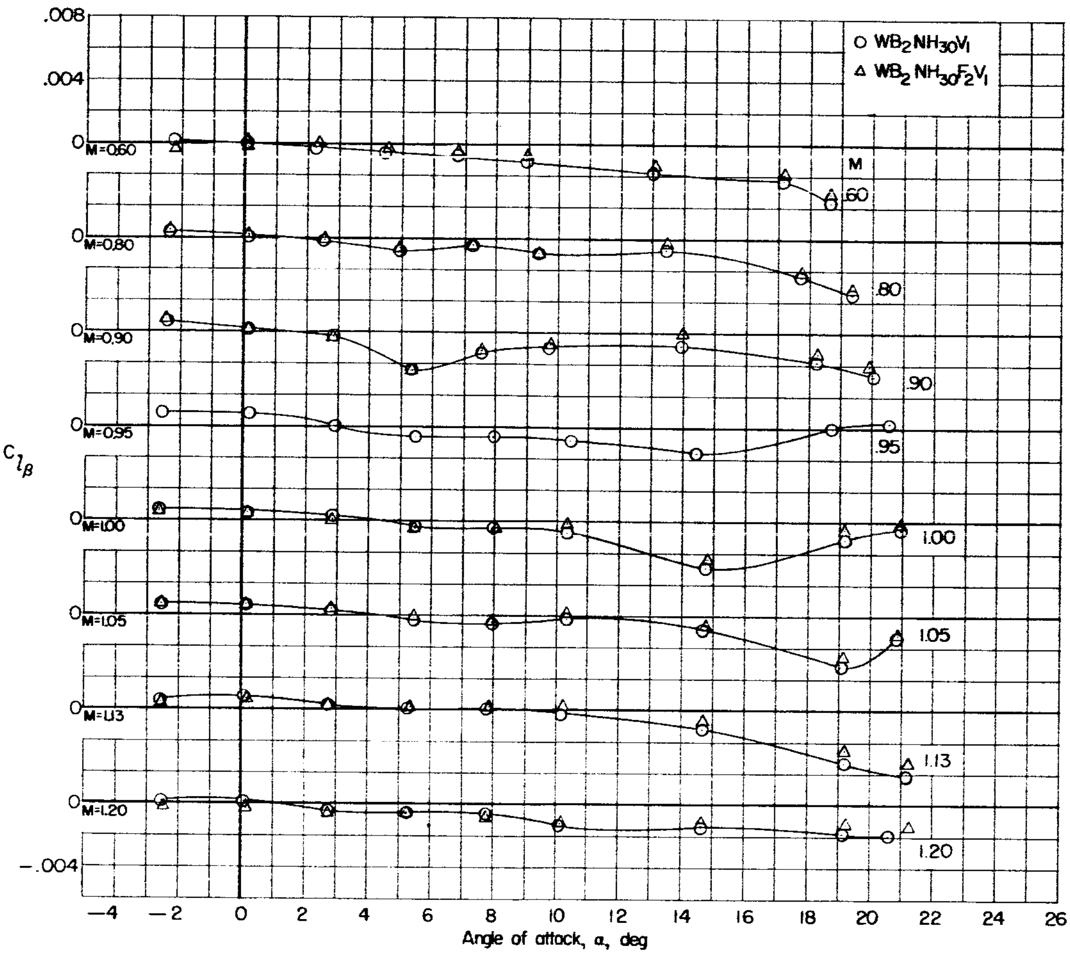


(b) Variation with angle of attack of rolling moment due to sideslip.

Figure 9.- Continued.

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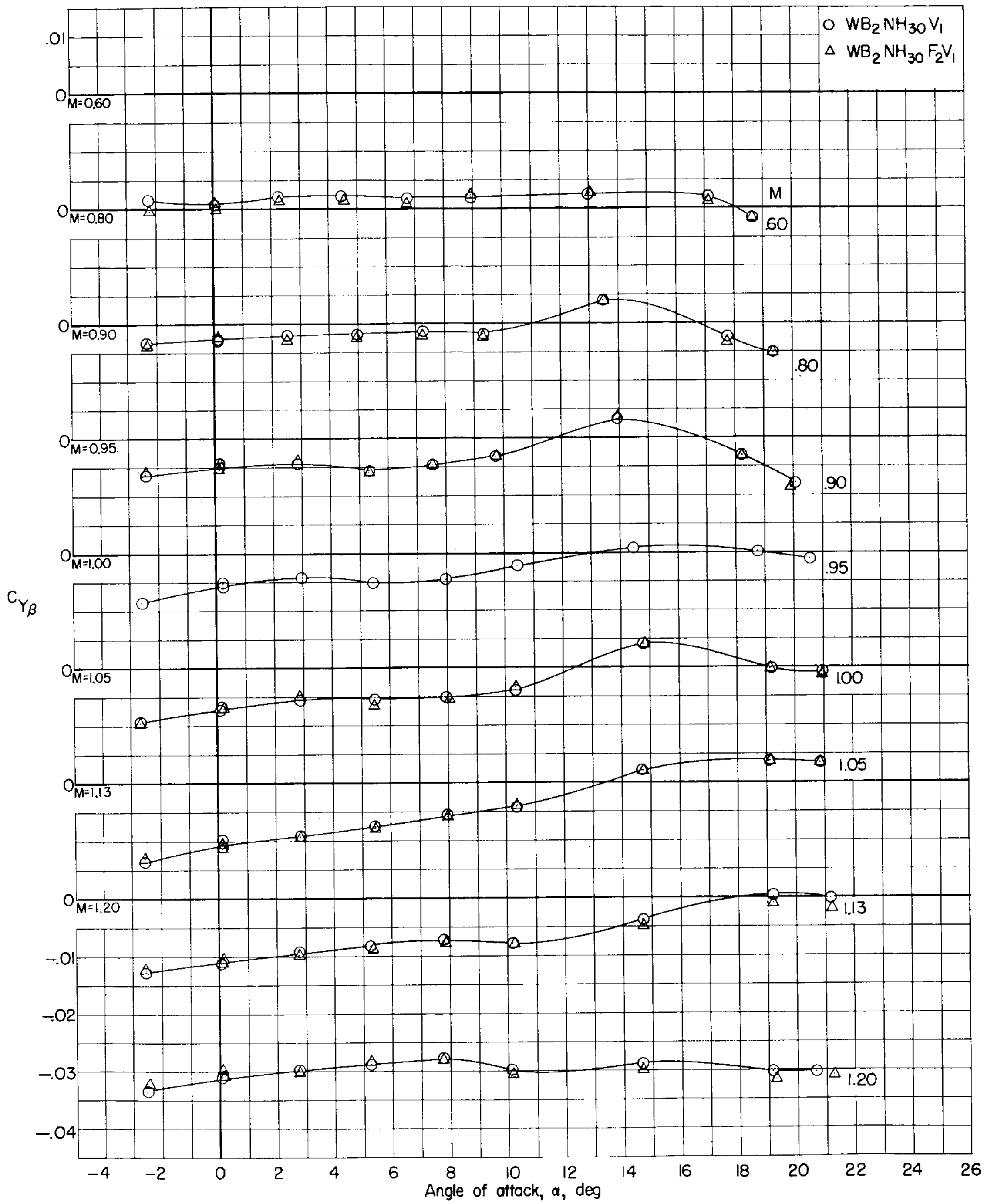


(c) Variation with angle of attack of side force due to sideslip.

Figure 9.- Concluded.

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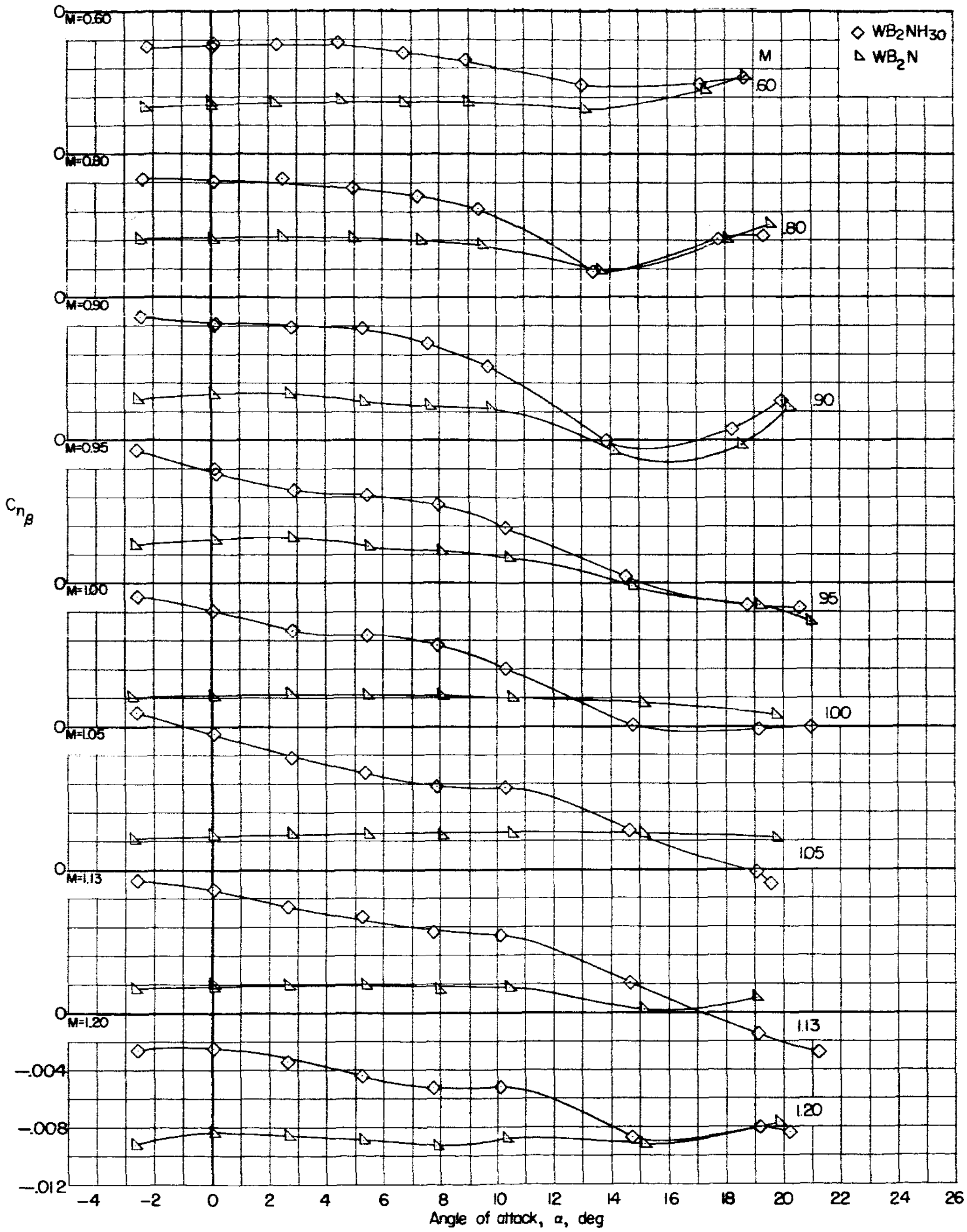


(a) Variation with angle of attack of yawing moment due to sideslip.

Figure 10.- Effect of the horizontal tail on the lateral-stability derivatives of the model. $\beta = \pm 3.25^{\circ}$.

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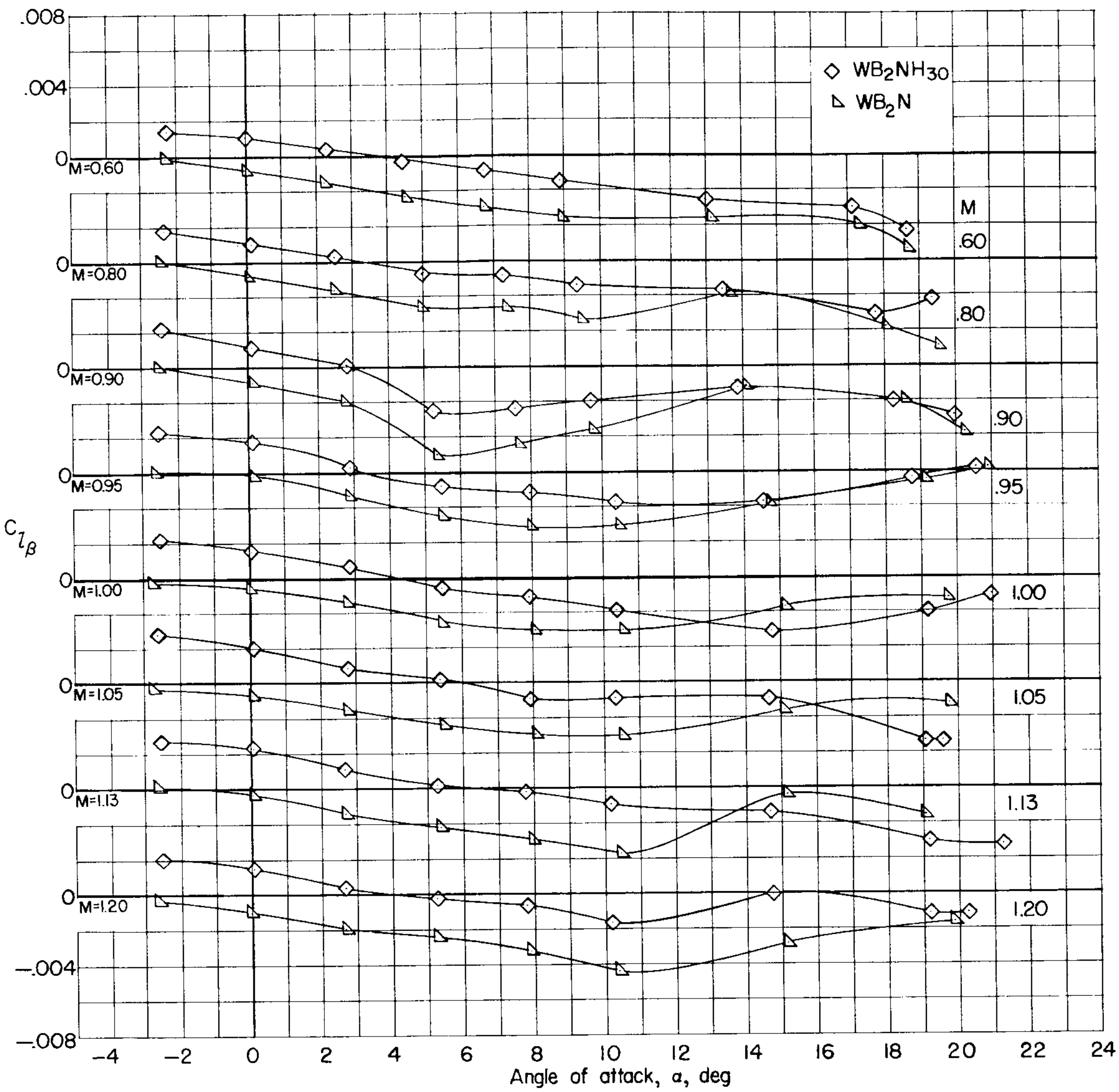


(b) Variation with angle of attack of rolling moment due to sideslip.

Figure 10.- Continued.

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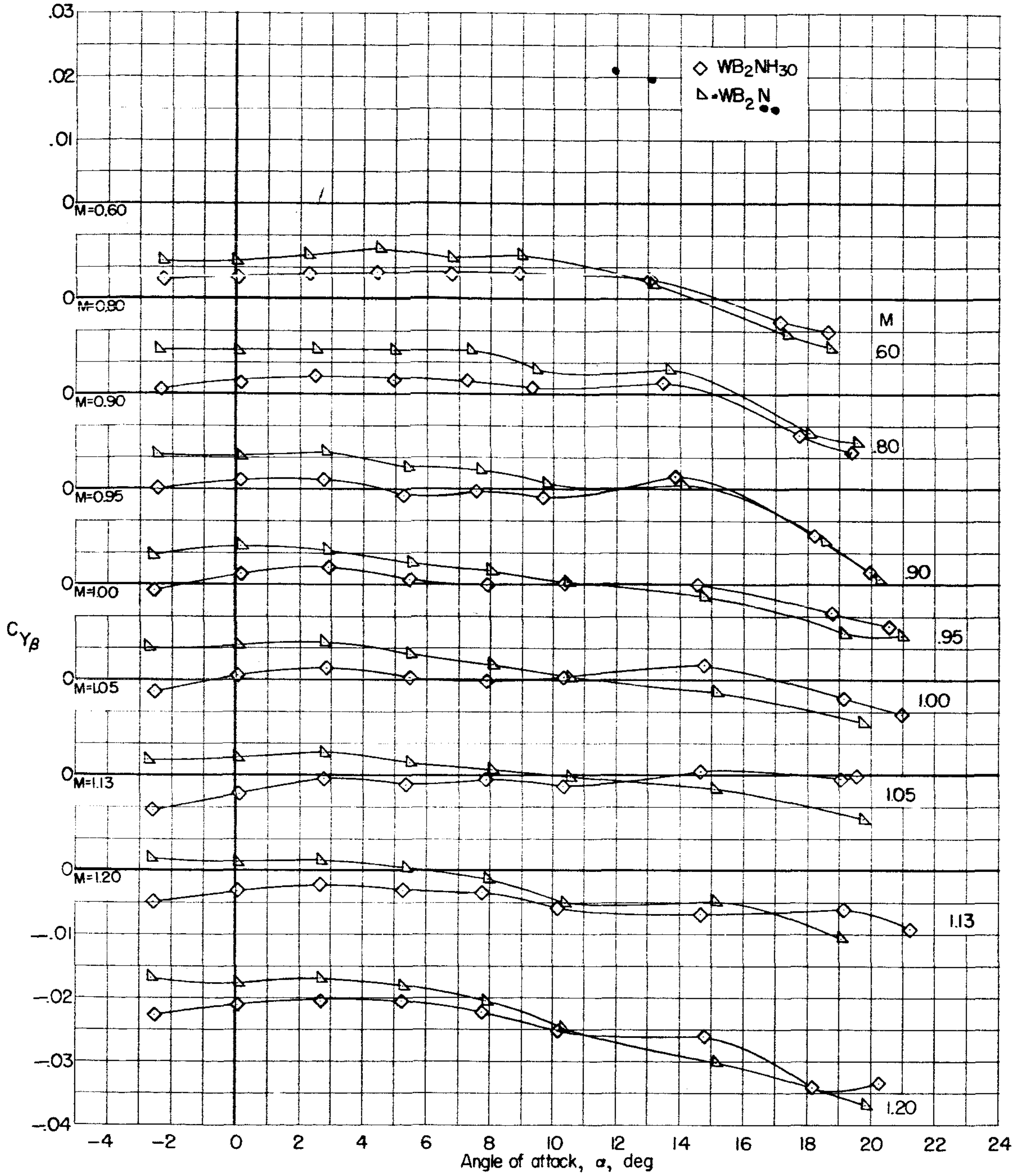


(c) Variation with angle of attack of side force due to sideslip.

Figure 10.- Concluded.