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ESTIMATED AERODYNAMIC CHARACTERISTICS

FOR

DESIGN OF THE

F-86E AIRPLANE
NORTH AMERICAN AVIATION, INC.

ENGINEERING DEPARTMENT

ESTIMATED
AERODYNAMIC CHARACTERISTICS

FOR

DESIGN OF THE

F-86E AIRPLANE

PREPARED BY

Aerodynamics Group - Basic Data

APPROVED BY

J. O. Beerer
Chief Technical Engineer
Date 12-26-50

REVISIONS

DATE | REV. BY | PAGES AFFECTED | REMARKS
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INTRODUCTION

This report is a compilation of aerodynamic data for design of the F-86E airplane. The aerodynamic coefficients presented herein are based on wind tunnel tests conducted in the North American Aerodynamics Laboratory 7.75 x 11 foot low speed wind tunnel and in the high speed Southern California Cooperative Wind Tunnel. NACA experimental results are also utilized.

This report was prepared by F. T. Gardner and H. T. Downey under the supervision of W. E. Swanson.
SUMMARY

Estimated aerodynamic characteristics of the F-86E airplane have been compiled herein for the purpose of furnishing a resume of design data. This report is in effect an appendix* to the aerodynamic report on the F-86A airplane since the principal difference between the F-86A and the F-86E which affects the aerodynamic characteristics is the incorporation of an all-movable horizontal tail.

The major portion of the information presented has been divided into sections of airplane longitudinal, lateral, and directional characteristics; the final sections are composed of fuel tank force data and slat load characteristics. Included in the longitudinal section are tail-off and tail-on lift and pitching moment, stabilizer and elevator effectiveness, stabilizer and elevator hinge moments, the effect of speed brakes, and the effect on airplane drag and pitching moment of the external under-wing fuel tanks. Lateral characteristics include the effect of aileron on lift, pitching moment and rolling moment. Aileron hinge moments and panel rolling moment complete the lateral section. The directional section consists of rudder hinge moment as a function of angle of yaw.

* For convenience the data of the F-86A airplane report (NA-48-814), which is applicable to both the F-86A and F-86E airplanes, have been reproduced herein such that the complete airplane characteristics of the F-86E are available in this one report.
DISCUSSION

GENERAL

The aerodynamic characteristics in this report have been presented as airplane coefficients which are defined by the nomenclature of Table II and by the dimensional data of Table I. This report is effectively an appendix to the aerodynamic characteristics report on the F-86A airplane, reference (a), since the principal aerodynamic difference between the F-86A and the F-86E is due to the difference in horizontal tails. The F-86E stabilizer serves as the primary longitudinal control and is operated by motion of the control column. The elevator is connected to the stabilizer by differential linkage so that the net effect is an all-moving horizontal tail. The F-86A stabilizer, however, is used only as a trimming device with the elevator acting in the conventional manner as the primary longitudinal control.

The data in this report are applicable only to a rigid airplane; therefore suitable modifications must be applied to include aero-elastic effects.

LONGITUDINAL CHARACTERISTICS

1. Tail-Off Lift, Drag, and Pitching Moment

Tail-off lift and pitching moment coefficients, slats closed, are presented in figure 4 for a Mach number range of M = 0.20 to 1.20. The effect of slats on lift and pitching moment is shown in figures 5 and 6 for the configurations of wing plus fuselage and wing in the presence of the fuselage. The tail-off drag polar, clean configuration, appears in figure 7 for M = 0.20 to M = 1.20. Figure 8 presents the drag of the fuselage in the presence of the wing, from which CDW(B) can be calculated since CDW(B) = CDW+B - CDW(W).

All tail-off data as listed above are reproduced from reference (a).

2. Tail-On Lift and Pitching Moment

Figure 9 presents tail-on lift and pitching moment for the Mach range of M = 0.20 to 1.20. These data are also reproduced from reference (a).

Pitching moment coefficients are taken about a center of gravity located at fuselage station 188.52.
DISCUSSION

LONGITUDINAL CHARACTERISTICS

2. Tail-On Lift and Pitching Moment (Cont.)

(.25 M.A.C.), water plane -12.23, and buttock plane zero. It should be noted that tail-on pitching moment data are for a stabilizer setting of +1 °.

Estimated limit trim lift coefficients versus Mach number for slat closed and open and for abrupt and gradual stalls are shown in figure 10. In figures 4 through 7 and 9 the limit lift coefficients for which data are shown are not correct for Mach numbers less than .60. The revised limit trim lift coefficients shown in figure 10 were used in the design of the airplane primarily because they were predicated upon flight test data of references (u) and (v).

3. Horizontal Tail Data

In addition to the difference already noted (General Discussion), the F-86E horizontal tail is designed with the elevator hinge line at the 72% chord element instead of the 67% chord element as it was for F-86A elevator. Moving the hinge line aft 5% of the horizontal tail chord reduced the elevator area but the nose of the elevator remained at essentially the same horizontal tail element thus the F-86E has an aerodynamic balance of the overhanging type. The static horn balance that was located near the tip of the horizontal tail has been removed and a new static balance, distributed internally along the nose of the aerodynamic balance, has been added. The trailing edge strip that was installed on the F-86A elevator has been removed from the F-86E. Figure 11 presents the rate of change of the elevator hinge moment coefficient with stabilizer deflection, \( \frac{dCH_s}{d\alpha} \), versus Mach number. The variation of stabilizer hinge moment with elevator deflection, \( CH_s(\alpha) \), is shown in figures 12 and 13. The rate of change of stabilizer hinge moment with stabilizer deflection, \( \frac{dCH_s}{dS_s} \), versus Mach number appears in figure 14. Figures 15 through 18 present the variation of stabilizer hinge moment with elevator deflection, \( CH_s(S_s) \). The data of figures 11 through 18 are based on references (e), (f), and (g).

Stabilizer effectiveness, figure 19, is based on references (e), (g), (l), and (m). Elevator effectiveness in the form of increments of airplane pitching moment at constant angles of attack due to elevator deflection, appears in figures...
DISCUSSION

LONGITUDINAL CHARACTERISTICS

3. Horizontal Tail Data (Cont.)

20 through 22. These data are predicated on references (e), (g), (l), and (p). Figure 23 presents the stabilizer-elevator gearing curve. Inasmuch as the effectiveness of an allmovable horizontal tail is such that it requires a high degree of accuracy in manufacture and rigging that is difficult to produce, a tolerance of ±1° elevator deflection is shown.

4. Speed Brake Effects

Increments in airplane pitching moment and drag due to deflection of the fuselage speed brakes, figures 24 through 27, are reproduced from the F-86A report, reference (a). It should be noted that the maximum speed brake deflection for the F-86E is 50° (see table I).

5. External Wing Fuel Tank Effects

Figure 28 presents the estimated increment in drag of the airplane due to one 120 gallon external wing fuel tank with fin for zero airplane angle of attack. The variation of dCm/dCL with Mach number is shown in figure 29. These data have resulted from an analysis of references (c), (d), (e), (r), (s), and (w). The location of the under-wing tank is at Futtock Plane 90.5.

LATERAL CHARACTERISTICS

Increments in lift, pitching moment, and rolling moment due to aileron deflection will be found in figures 31 through 44. Longitudinal and lateral center of pressure locations of the increment of wing load due to aileron deflection versus Mach number are presented in figure 30. The data of reference (b), (i), (l), and (m) were utilized in deriving the above information.

Aileron hinge moments, figures 45 and 46, are based on the data of references (i), (m), (q), and (a-2).

Panel rolling moment as a function of airplane angle of attack for the two configurations of wing plus fuselage and wing in the presence of the fuselage are reproduced from reference (a). Slats closed data appear in figure 47, while slats free data are given in figure 48.
DISCUSSION

LATERAL CHARACTERISTICS (Cont.)

For convenience, the average pressure coefficients measured in the aileron paddle balance chamber are included in this report in figures 49 through 52. These data are based on the information of references (1), (n), (o), (p), (q), (t), and (x).

DIRECTIONAL CHARACTERISTICS

The variation of rudder hinge moment due to both yaw and rudder deflection are presented at various Mach numbers in figures 53 and 54. Figure 55 presents the increment in rudder hinge moment due to angle of attack, throughout the range of yaw angles. These data are based on references (g) and (h).

TANK CHARACTERISTICS

Yaw data for the 120 gallon external wing fuel tank with large fin, located at Buttock Plane 99.5, are presented in figures 56 through 58. Tank normal force coefficient, CN, and CN x C.P. versus angle of yaw for various angles of attack and Mach numbers will be found in Figure 56.

Tank side force coefficient and the corresponding center of pressure versus angle of yaw for various airplane angles of attack and Mach number are presented in Figure 57. Figure 58 presents tank support fairing side force section data.

All tank data are predicated on the data of reference (j), (y), and (z).

SLAT LOAD CHARACTERISTICS

A table of retracted slat load characteristics at various Mach numbers and angles of attack is presented in figure 59. Included in this figure is a complete definition of the forces and moment arms involved.

The slat opening force coefficient, Cs, versus angle of attack for various Mach numbers is presented in figure 60.

All slat data are based on the tunnel tests of reference (k).
REFERENCES


(c) NA-49-737 "Revised Performance Calculations for the Model F-86A Airplane", Appendix I, dated 31 October 1949

(d) NA-49-1045 "Estimated Aerodynamic Characteristics for Design of F-45 Airplane", dated 21 November 1949

(e) NA-46-852 "Wind Tunnel Tests of a 0.23-Scale Model of the XP-86 Airplane with a 5 Aspect Ratio Sweptback Wing", dated 11 November 1946

(f) NA-48-969 "Wind Tunnel Tests of an 0.23-Scale Model of the XP-86 Airplane to Determine the Slats Open Flying Qualities", dated 15 October 1946

(g) NA-47-1043 "Wind Tunnel Tests to Determine the Low Speed Flying Qualities of a 0.20-Scale High Speed Model of the XP-86 Airplane", dated 26 October 1947

(h) NA-48-351 "Wind Tunnel Tests of a 0.20-Scale Model of the F-86B Airplane with an Enlarged Horizontal Tail and Revised Speed Brakes", dated 17 March 1948

(i) NA-49-467 "Wind Tunnel Tests to Determine the Stability and Fuselage Pressure Distribution of a 0.20-Scale Model of the F-93A Airplane"

(j) NA-49-1027 "Wind Tunnel Tests of a 1/3-Scale Semi-Span Model of the F-86A Airplane to Determine Force and Pressure Characteristics for Three 120 Gallon Wing Fuel Tanks", dated 16 November 1949
**REFERENCES**


(l) CWT-38  "Preliminary Report on High Speed Wind Tunnel Tests on a 0.20-Scale Half Model of the P-86B Airplane", dated 20 January 1948 through 1 March 1948


(n) CWT-54  "Preliminary Report on Additional High Speed Wind Tunnel Tests of an 0.08-Scale Model of the North American XAJ-l Airplane", dated 6 August 1948

(o) CWT-98  "Report on Wind Tunnel Tests at High Speeds and High Reynolds Numbers of a 0,115-Scale Reflection-Plane Model of the North American XA2J-1, Phase 1 Airplane", dated 26 April 1949

(p) CWT-110  "Report on Wind Tunnel Tests at High Speeds and High Reynolds Numbers of a 1/5-Scale Reflection-Plane Model Incorporating Various Components of the North American F-86 and YF-93 Airplane", dated 12 August 1949

(q) CWT-130  "Report on Wind Tunnel Tests at High Speeds of a 1/5-Scale Reflection-Plane Model of the North American F-86 and YF-93 Airplane", dated 12 August 1949

(r) RM-L9J19  "The Effect of Tip Tanks on the Rolling Characteristics at High Subsonic Mach Numbers of a Wing Having an Aspect Ratio of 3 with a Quarter-Chord Line Swept Back 35°", dated 17 January 1950

(s) RM-L9K25  "Experimental Investigation of Various External-Store Configurations on a Model of a Tailless Airplane with a Sweptback Wing", dated 19 January 1950
REFERENCES (Cont.)

(t) RM-L8H06  "Pressure Distributions Over a Wing-Fuselage Model at Mach Numbers of .4 to .99 and at 1.2", dated 3 November 1948

(u) RM-A8130  "The Effect of Change of Angle of Attack on the Maximum Lift Coefficient of a Pursuit Airplane", dated 6 May 1949

(v) CMR-A5G06 (NACA)  "Effect of Mach and Reynolds Numbers on Maximum Lift Coefficient in Gradual and Abrupt Stalls", dated July 1945


(x) NACA-PC #5.36/5 "High Speed Wind Tunnel Tests of a 1/4 Scale Model of the XP-81 Airplane -- Aileron Hinge Moment and Balance Pressures", dated 25 January 1945

(y) TW-1194 (NACA)  "Force and Pressure Distribution Measurements on Eight Fuselages"

(z) Archives Report No. 66/120 (German Report)  "Three Component Measurements on 15 Cm. Shell Shapes 1 and 5"

(a-1) NA-50-928  "Aerodynamic Dimensional Data for the F-86E Airplane (N.A.A. Model Designation NA-170)", dated 30 August 1950

(a-2) Flight Test Data, Flight 19, F-86A, No. 49-1067
TABLE I

AERODYNAMIC DIMENSIONAL DATA*

<table>
<thead>
<tr>
<th>WING DATA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$S_w$</td>
<td>Total wing area (includes flaps, slats, and 49.92 ft.$^2$ covered by the fuselage)</td>
</tr>
<tr>
<td>$b_w$</td>
<td>Span (horizontal)</td>
</tr>
<tr>
<td>$AR_w$</td>
<td>Aspect ratio</td>
</tr>
<tr>
<td>$\lambda_w$</td>
<td>Taper ratio $\frac{1}{1.949}$</td>
</tr>
<tr>
<td>$\Gamma_w$</td>
<td>Dihedral angle</td>
</tr>
<tr>
<td>$\bar{c}_w$</td>
<td>Mean aerodynamic chord (wing sta.98.71)</td>
</tr>
<tr>
<td></td>
<td>Fuselage sta. of .25 $\bar{c}_w$ (W.F.-25.63)</td>
</tr>
<tr>
<td>$\varphi_w$</td>
<td>Sweepback of the 25% element(aerodynamic)</td>
</tr>
<tr>
<td>$i_r$</td>
<td>Incidence of the root chord (sta.0)</td>
</tr>
<tr>
<td>$i_t$</td>
<td>Incidence of the tip chord (sta.220.8)</td>
</tr>
<tr>
<td>Root airfoil(normal to 25% element)</td>
<td>NACA 0012-64 (modified)</td>
</tr>
<tr>
<td>Tip airfoil(normal to 25% element)</td>
<td>NACA 0011-64 (modified)</td>
</tr>
</tbody>
</table>

* From Reference (a-l)
### TABLE I (Cont.)
### AERODYNAMIC DIMENSIONAL DATA

**AILERON DATA** (Data for one aileron)

<table>
<thead>
<tr>
<th>Type</th>
<th>Flat Sided</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S_a$</td>
<td>16.36 ft²</td>
</tr>
<tr>
<td>$S_a \tau_a$</td>
<td>26.49 ft²</td>
</tr>
<tr>
<td>$c_a/c_w$</td>
<td>0.3081</td>
</tr>
<tr>
<td>$\delta_{a_{max}}$</td>
<td>15° up, 15° down</td>
</tr>
</tbody>
</table>

**LEADING EDGE SLAT DATA** (for one side only)

| $S_{sl}$ | Area, projected into wing ref. plane | 17.72 ft² |
| $b_{sl}$ | Span (Wing Sta. 54.09 to 209.33)     | 155.24 in. |
| $C_{sl}$ | Chord (constant)                      | 16.43 in.  |
| $\delta_{sl}$ | Deflection                             | 15°00'    |

**HORIZONTAL TAIL**

<table>
<thead>
<tr>
<th>Type</th>
<th>Stabilizer adjustable from cockpit control column; elevator connected to stabilizer by differential linkage</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S_H$</td>
<td>Total area (including 1.20 ft² covered by vertical tail)</td>
</tr>
<tr>
<td>$b_H$</td>
<td>Span</td>
</tr>
<tr>
<td>$\text{AR}_H$</td>
<td>Aspect ratio</td>
</tr>
<tr>
<td>$\lambda_H$</td>
<td>Taper ratio</td>
</tr>
</tbody>
</table>
TABLE I (Cont.)
AERODYNAMIC DIMENSIONAL DATA

<table>
<thead>
<tr>
<th>HORIZONTAL TAIL (Cont.)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Gamma_H$ Dihedral angle</td>
<td>10°</td>
</tr>
<tr>
<td>$\overline{C}_H$ Mean aerodynamic chord (H.T.Sta.33.54)</td>
<td>34.71 in.</td>
</tr>
<tr>
<td>$F_{\text{H}}$ Fuselage station of .25 $\overline{C}_H$(W.P.20.70)</td>
<td>406.01</td>
</tr>
<tr>
<td>$\psi_H$ Sweepback of the 25% element</td>
<td>34°35'20&quot;</td>
</tr>
<tr>
<td>$S_{\text{H}}$ Ratio horizontal tail area to wing area</td>
<td>.1225</td>
</tr>
<tr>
<td>$S_{\text{H}}/S_W$ Airfoil Sections (Root and Tip, parallel to $\xi$)</td>
<td>NACA 0010-64</td>
</tr>
<tr>
<td>$\delta_e$ Deflection of stabilizer with respect to the fuselage reference plane</td>
<td>10° down, 6° up</td>
</tr>
<tr>
<td>$S_e$ Area (excluding balance area forward of the hinge line)</td>
<td>8.62 ft²</td>
</tr>
<tr>
<td>$S_e\delta_e$ Area moment (normal to hinge line)</td>
<td>6.07 ft³</td>
</tr>
<tr>
<td>$c_e/c_H$ Ratio of elevator chord to horizontal tail chord</td>
<td>.2800</td>
</tr>
<tr>
<td>$\delta_e$ Deflection maximum (measured with respect to horizontal stabilizer chord plane and normal to elevator hinge line)</td>
<td>20°54' up, 8°20' down</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VERTICAL TAIL DATA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$S_V$ Area (including .92 ft² blanketed by the fuselage and excluding 3.96 ft² dorsal fin)</td>
<td>33.44 ft²</td>
</tr>
<tr>
<td>$AR_V$ Aspect ratio</td>
<td>1.74</td>
</tr>
<tr>
<td>$\lambda_V$ Taper ratio</td>
<td>.362</td>
</tr>
<tr>
<td>$\tau_V$ Mean aerodynamic chord (V.T.Sta.37.87)</td>
<td>55.99 in.</td>
</tr>
<tr>
<td>Fuselage station of 25 $c_V$(W.P.54.59)</td>
<td>385.78</td>
</tr>
<tr>
<td>$\psi_V$ Sweepback of 25% element</td>
<td>35°</td>
</tr>
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TABLE I (Cont.)

AERODYNAMIC DIMENSIONAL DATA

<table>
<thead>
<tr>
<th>VERTICAL TAIL DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airfoil (parallel to fuselage reference planes, constant) NACA 0011(10) -64 modified</td>
</tr>
<tr>
<td>$S_r$ Area (including tab but excluding rudder balance forward of hinge line)</td>
</tr>
<tr>
<td>$S_r r$ Area moment</td>
</tr>
<tr>
<td>$\delta_r$ Deflection, maximum</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SPEED BRAKE DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\varepsilon_{j,\text{max}}$ Speed brake deflection, maximum</td>
</tr>
<tr>
<td>$S_j$ Area (surface area of one brake)</td>
</tr>
</tbody>
</table>
TABLE II

NOMENCLATURE

GENERAL NOMENCLATURE

\[ M \] Free stream Mach number = \( \frac{V}{a} \)
\[ V \] Average free stream velocity, ft./sec.
\[ a \] Velocity of sound in air, ft./sec.
\[ \alpha \] Angle of attack of fuselage reference line relative to the free air stream, degrees
\[ \psi \] Angle of yaw of plane of symmetry relative to the free air stream, degrees
\[ q \] Incompressible dynamic pressure of free stream = \( \frac{\rho v^2}{2} \)
\[ \rho \] Mass density of air, slugs/ft\(^3\)
\[ \frac{P}{q} \] Difference between local static pressure and free stream static pressure divided by free stream incompressible dynamic pressure
\[ S \] Wing area projected in wing reference plane, ft\(^2\)
\[ S_\text{aft} \] Area of movable surface aft of hinge line, ft\(^2\)
\[ c \] Mean aerodynamic chord, in.
\[ c_\text{aft} \] Mean aerodynamic chord of movable surface, in.
\[ b \] Wing span, ft.

AIRPLANE NOMENCLATURE

\[ W \] Wing
\[ B \] Fuselage
\[ S \] Slats
\[ S_f \] Slats free
\[ W(B) \] Wing in the presence of fuselage, slats retracted
\[ B(W) \] Fuselage in presence of wing, slats retracted
\[ H \] Horizontal tail
\[ V \] Vertical tail
TABLE II

NOMENCLATURE (Cont.)

AIRPLANE COEFFICIENTS

- $C_L = \frac{Lift}{qS}$: Lift coefficient
- $C_D = \frac{Drag}{qS}$: Drag coefficient
- $C_m = \frac{Pitching Moment}{qS_b}$: Pitching coefficient

- $C_{l} = \frac{Panel Rolling Moment}{qS_b}$: Panel rolling moment coefficient (due to lift on one wing only)
- $C_{l} = \frac{Airplane Rolling Moment}{qS_b}$: Airplane rolling moment coefficient due to deflection of one aileron
- $C_y = \frac{Side Force}{qS}$: Side force coefficient

MOVABLE SURFACES

- $C_H = \text{Hinge moment, where subscript (without parenthesis) denotes movable surface} = \frac{Hinge Moment}{qS_{aft}\text{aft}}$
- $C_{He}(\delta_e) = \text{Elevator hinge moment coefficient versus } C_L \text{ for various elevator angles}$
- $C_{HS}(\delta_e) = \text{Stabilizer hinge moment coefficient versus } C_L \text{ for various elevator angles}$
- $\delta(\text{ )= Angular deflection in plane normal to axis of rotation, where subscript indicates movable surfac}$

TANK COEFFICIENTS

- $C_N = \frac{Normal Force}{q Splan view}$: Normal force coefficient based on tank planview area
- $C_{7f} = \frac{Support Fairing Section Side Force Coefficient}{q Sfairing}$: Support fairing section side force coefficient
- $C_Y = \frac{Tank Side Force Coefficient}{q Splanview}$: Tank side force coefficient
TABLE II

NOMENCLATURE (Cont.)

SUBSCRIPTS

a = Aileron

e = Elevator

s = Stabilizer

r = Rudder
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SIGN CONVENTION FOR FLIGHT CONDITIONS

Directions, angles, surface deflections, and coefficients are positive as shown.
SIGN CONVENTION
YAW CONDITION

\[ +\psi \]

\[ +V \]

\[ +C_n \]

\[ \delta_n \]

\[ +\gamma \]
Fig. 4

Basic Tail-Off Configuration - Slats Closed

Cm & Cq Variation with C2 & M
EFFECT OF THE FUSELAGE ON THE PITCHING MOMENT DATA
Slats Open and Closed

- Wing plus fuselage, slats closed
- Wing in presence of fuselage, slats open
- Wing in presence of fuselage, slats closed

Note: Slats unlocked data are not shown for Mach numbers above M = 0.85. It is assumed that the slats will not open above M = 0.85.
BASIC TAIL-OFF CONFIGURATION
SLATS CLOSED
$C_D$ VS. $C_L$ VS. $M$
Drag Coef of Fuselage in Presence of Wing, \( C_{D_{\text{fus}}}(M) \), vs. Mach Number

Tail-Off, Slats Retracted, \( C_{\alpha} = 0 \)

Note: This curve is presented for use in determining the drag characteristics of the wing in presence of fuselage, \( C_{D_{\text{fus}}} \). Having complete drag characteristics of the basic tail off configuration, \( C_{D_{\text{basic}}} \), it is possible to find \( C_{D_{\text{fus}}} \) for any configuration as follows:

\[
C_{D_{fus}}(M) = C_{D_{\text{fus}}}(M) - C_{D_{\text{basic}}}(M)
\]
Basic Tail-On Configuration - Slats Closed,
$C_m$ & $C_A$ Variation with $C_l$ & $M$.

$C_m = 1.0^\circ$, $C_A = 0^\circ$

Mach Number
F-86A, F-86D, F-86E
ESTIMATED LIMIT TRIM LIFT COEFFICIENT
SLAT TRACK "B" (LOW POSITION SLAT)

- Slat retracted
- Slat open

Gradual stall
Abrupt stall

Mach number range from 0 to 120

North American Aviation, Inc.
### Estimated Aerodynamic Characteristics

**Model No. F-86E**

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<th>Scale Factor</th>
<th>1:12</th>
<th>1:10</th>
<th>1:7</th>
<th>1:5</th>
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<tr>
<td>Elevator Angle</td>
<td>0°</td>
<td>0.4°</td>
<td>1.2°</td>
<td>2.0°</td>
</tr>
<tr>
<td>Loran Acceleration</td>
<td>0</td>
<td>0.3</td>
<td>0.7</td>
<td>1.2</td>
</tr>
<tr>
<td>Loran Deceleration</td>
<td>0</td>
<td>0.3</td>
<td>0.7</td>
<td>1.2</td>
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**Fig. 11**

**Fig. 12**

**Fig. 13**
VARIATION OF ELEVATOR HINGE MOMENT WITH ELEVATOR DEFLECTION

HINGE LINE AT 72% ELEMENT
SLATS OPEN: $\delta_x = 0$
$\frac{1}{8}\delta_x = 1.83\text{ ft}^2$

$\delta_x$ vs. Elevator Deflection

$C_m$ vs. Elevator Deflection

$\alpha$ vs. Elevator Deflection

$\text{N.A. 60}$

$\text{N.A. 80}$

$\text{N.A. 85}$
NORTH AMERICAN AVIATION, INC.

ESTIMATED AERODYNAMIC CHARACTERISTICS

VARIATION OF ELEVATOR HINGE MOMENT WITH ELEVATOR DEFLECTION

HINGE LINE AT 72% ELEMENT
SLATS OPEN, 22° DEF.

\( C_{h}(\theta) \)

\( M = 0.95 \)

\( M = 1.00 \)

\( M = 1.05 \)

\( M = 1.20 \)
VARIATION OF STABILIZER HINGE MOMENT WITH ELEVATOR DEFORMATION

ELEVATOR HINGE LINE AT 72% HANDT
SLATS FOLDED, \( \delta = 0 \)
\( C_{L} = 0.100 \text{ ft}^{2} \)

\[ \frac{\text{SLEA AVG}}{\text{SLEA AVG}} = 1 = 0.621 \quad \text{/} \]
\[ \text{SLEA AVG} = 2 = 0.423 \]

\( C_{L} \) vs. \( \delta \)

\( C_{L}(\delta) \)

\( M = 1.0 \)

\( C_{L} \) vs. \( \alpha \)

\( C_{L}(\alpha) \)

\( \alpha \) vs. \( \delta \)

\( \alpha \) vs. \( C_{L} \)
Estimated Aerodynamic Characteristics

Fig. 24

Effect of Speed Brakes on Pitching Moment

Tail On
Tail Off

S\text{\textsubscript{\text{\textsuperscript{\textdegree}}}} = 50°
F-86E

Estimated Increment of Drag Coefficient Due to One 120 Gal. External Fuel Tank with Fin

\[ \Delta C_{D, \text{tank}} = \frac{\Delta D}{S} \]

where: \( \Delta D \) = Drag Increment

\( S \) = Wind Area = 288 sq. ft.

\( \Delta C_{D, \text{tank}} \):

\begin{align*}
\Delta C_{D, \text{tank}} & = 0.064 \\
\Delta C_{D, \text{tank}} & = 0.046 \\
\Delta C_{D, \text{tank}} & = 0.022 \\
\end{align*}

\( \alpha = 0^\circ \)

Mach No.

\begin{align*}
0 & \quad 4 \\
5 & \quad 6 \\
7 & \quad 8 \\
9 & \quad 10 \\
10 & \quad 11 \\
\end{align*}
Estimated Variation of $\Delta C_m$ with Mach No. due to 120 Gallon External Fuel Tanks with Fins

$\Delta C_m = \frac{\Delta M}{S \cdot L}$

Where:
- $\Delta M$ = Moment increment due to two tanks
- $S$ = Wing area
- $L$ = Wing MAC

$\Delta C_m_{tank} = 0$
Estimate Aerodynamic Characteristics

Model No. F-86E

Date: 9-15-49

Prepared by: HTD & GP
Checked by: WES

NORTH AMERICAN AVIATION, INC.

Report No. NA-50-1277
Estimated Aerodynamics

Figure 34: Increment in Lift Coefficient
Due to Allison O.D. Engines
(One Allison)
Estimated increment of lift coefficient due to aileron deflection (one aileron).
Estimated Increment of Lift Coefficient Due to Aileron Deflection (One Aileron)
Implement of Moment Due to Alleron Deflection

(Make Adjustment)
ABRUPT STALL
CANDID STALL

NOTE: THESE DATA APPLY TO YESSA, F-660, AND TO THOSE F-86A AIRPLANES HAVING SHORT CHORD ALERONS.

$\alpha = 0^\circ$

**Fig. 45**

**Estimated Short Chord Aileron Hinge Moment Coefficients**

Based on Flight 19 of F-86A, 12-16-47, G一组
represents X = 0.15, and NAAL 102
Slat transition, 6 + 9. Samurai and abrasive stall
$C_l/C_m = 2.722$, $C_l/C_n = 0.906$, $S_p = 2680$ ft.
The variation of rolling moment due to lift with angle of attack. (lift on left wing only)

Wing plus fuselage, slats closed, $\alpha = 0^\circ$

Wing in the presence of the fuselage, slats closed, $\alpha = 0^\circ$
Figure 2: Variation of rudder hinge moment due to rudder deflection at various Mach numbers.
VARIATION OF INCREASMENT IN RUDDER MUSCLE MOMENT DUE TO $C_m$ WITH YAW.

Note: Increment assumed constant with Mach no.

$C_m$ vs $\theta$
120 Gal External Fuel Tank with Large Fin

NORMAL FORCE COEFFICIENT AND CENTER OF PRESSURE

\( C_n \) = \( \frac{N}{W} \) \( \text{ANGLE: N = NORMAL FORCE, POSITIVE UP} \)
\( S_{e} \) = PLAN VIEW AREA OF TANK \( \approx 160 \text{ sq ft} \)
\( C_{a} \) = LOCATION OF CENTER OF PRESSURE FROM 45\% TANK STA IN TANK LENGTHS (EQUATION = EQUATION)
\( \psi \) = ANGLE OF VANE, \( \alpha \) = AIRPLANE ANGLE OF ATTACK

![Diagram with graph showing data points and curves for various M values: M=0.95, M=1.0, M=1.05]
NOTICE - WHEN GOVERNMENT OR OTHER DRAWINGS, SPECIFICATIONS OR OTHER DATA ARE USED FOR ANY PURPOSE OTHER THAN IN CONNECTION WITH A DEFINITELY RELATED GOVERNMENT PROCUREMENT OPERATION, THE U.S. GOVERNMENT THEREBY INCURS NO RESPONSIBILITY, NOR ANY OBLIGATION WHATSOEVER, AND THE FACT THAT THE GOVERNMENT MAY HAVE FORMULATED, FURNISHED, OR IN ANY WAY SUPPLIED THE SAID DRAWINGS, SPECIFICATIONS, OR OTHER DATA IS NOT TO BE REGARDED BY IMPLICATION OR OTHERWISE AS IN ANY MANNER LICENSING THE HOLDER OR ANY OTHER PERSON OR CORPORATION, OR CONVEYING ANY RIGHTS OR PERMISSION TO MANUFACTURE, USE OR SELL ANY PATENTED INVENTION THAT MAY IN ANY WAY BE RELATED THERETO.

UNCLASSIFIED
MEMORANDUM FOR DTIC/OCQ (ZENA ROGERS)
8725 JOHN J. KINGMAN ROAD, SUITE 0944
FORT BELVOIR VA 22060-6218

FROM: AFMC CSO/SCOC
4225 Logistics Avenue, Room S132
Wright-Patterson AFB OH 45433-5714

SUBJECT: Technical Reports Cleared for Public Release

References: (a) HQ AFMC/PAX Memo, 26 Nov 01, Security and Policy Review, AFMC 01-242 (Atch 1)
(b) HQ AFMC/PAX Memo, 19 Dec 01, Security and Policy Review, AFMC 01-275 (Atch 2)
(c) HQ AFMC/PAX Memo, 17 Jan 02, Security and Policy Review, AFMC 02-005 (Atch 3)

1. Technical reports submitted in the attached references listed above are cleared for public release in accordance with AFI 35-101, 26 Jul 01, Public Affairs Policies and Procedures, Chapter 15 (Cases AFMC 01-242, AFMC 01-275, & AFMC 02-005).

2. Please direct further questions to Lezora U. Nobles, AFMC CSO/SCOC, DSN 787-8583.

LEZORA U. NOBLES
AFMC STINFO Assistant
Directorate of Communications and Information

Attachments:
1. HQ AFMC/PAX Memo, 26 Nov 01
2. HQ AFMC/PAX Memo, 19 Dec 01
3. HQ AFMC/PAX Memo, 17 Jan 02

cc:
HQ AFMC/HO (Dr. William Elliott)
MEMORANDUM FOR HQ AFMC/HO

FROM: HQ AFMC/PAX

SUBJECT: Security and Policy Review, AFMC 02-005

1. The reports listed in your attached letter were submitted for security and policy review IAW AFI 35-101, Chapter 15. They have been cleared for public release.

2. If you have any questions, please call me at 77828. Thanks.

JAMES A. MORROW
Security and Policy Review
Office of Public Affairs

Attachment:
Your Ltr 14 January 2002
MEMORANDUM FOR: HQ AFMC/PAX
Attn: Jim Morrow

FROM: HQ AFMC/HO

SUBJECT: Releasability Reviews

1. Please conduct public releasability reviews for the following attached Defense Technical Information Center (DTIC) reports:


   c. *Phase IV Performance Test of the F-86F-40 Airplane Equipped with 6x3-inch Leading Edge Slats and 12-inch Extensions on the Wing Tips, May 1956*; DTIC No. AD-096 084.


   h. *Operational Suitability Test of the F-86F Airplane, 4 May 1953*; DTIC No. AD-017 568.


2. These attachments have been requested by Dr. Kenneth P. Werrell, a private researcher.

3. The AFMC/HO point of contact for these reviews is Dr. William Elliott, who may be reached at extension 77476.

John D. Weber
Command Historian

10 Attachments:

a. DTIC No. AD-B804 069
b. DTIC No. AD- 020 375
c. DTIC No. AD- 096 084
d. DTIC No. AD- 118 703
e. DTIC No. AD- 118 707
f. DTIC No. AD- 223 596
g. DTIC No. AD- 095 757
h. DTIC No. AD- 017 568
i. DTIC No. AD- 069 271
j. DTIC No. AD- 019 725