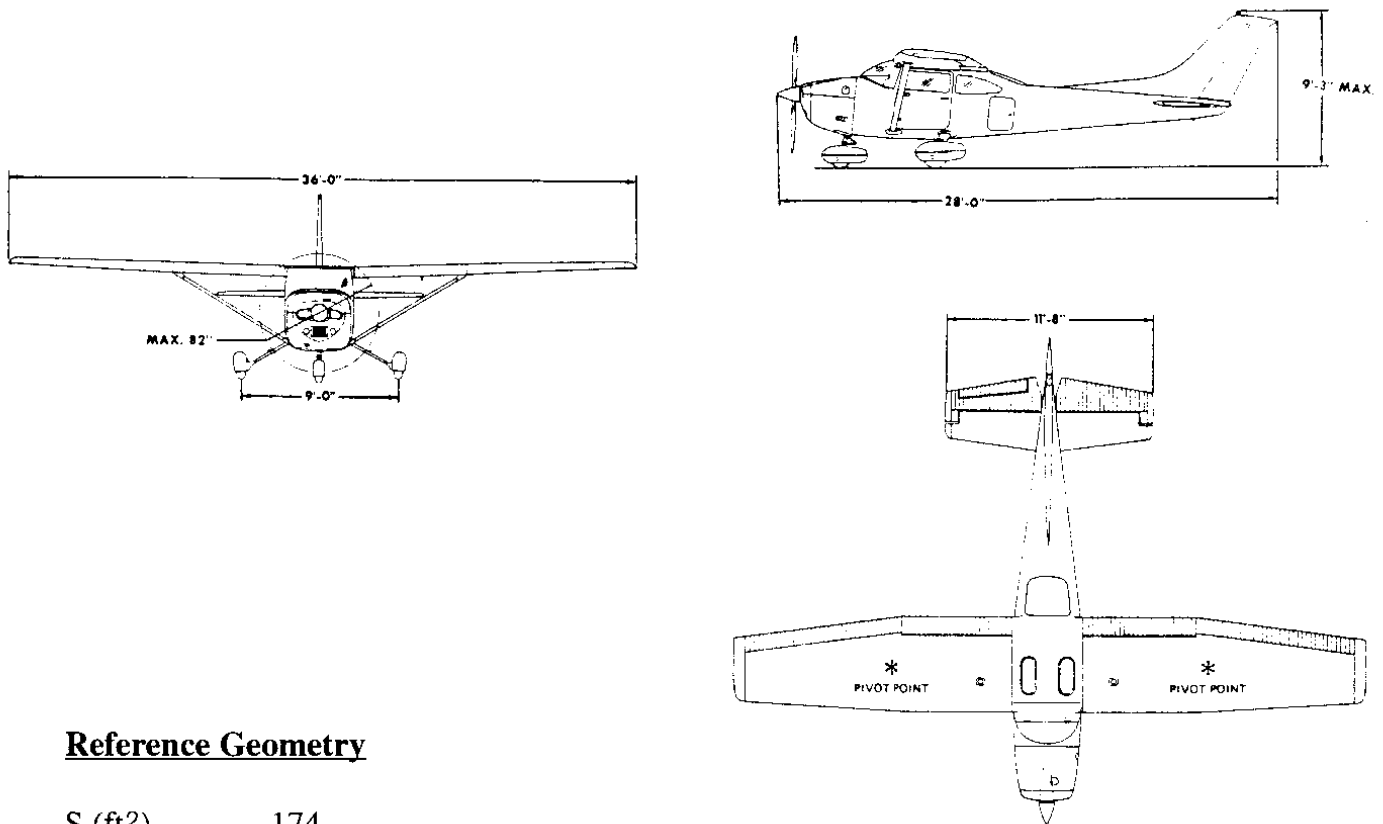


APPENDIX B: AIRPLANE DATA

The purpose of this appendix is to present geometric, mass, inertial, stability, control and (where available) hingemoment data for a range of airplanes and flight conditions. The airplanes are identified as Airplanes A through J:

Airplane A	is representative of a small, single piston-engine general aviation airplane such as the Cessna 182 (See Table B1: Pages 480–486)
Airplane B	is representative of a small, twin piston-engine general aviation airplane such as the Cessna 310 (See Table B2: Pages 487–493)
Airplane C	is representative of a small, single jet-engine, military training airplane such as the SIAI-Marchetti S-211 (See Table B3: Pages 494–500)
Airplane D	is representative of a small, twin jet-engine, military training airplane such as the Cessna T-37A (See Table B4: Pages 501–507)
Airplane E	is representative of a small, regional, twin-turboprop commuter airplane such as the Beech 99 (See Table B5: Pages 508–514)
Airplane F	is representative of a corporate four piston-engine airplane such as the Cessna 620 (See Table B6: Pages 515–521)
Airplane G	is representative of a corporate twin jet-engine airplane such as the Learjet 24 (See Table B7: Pages 522–528)
Airplane H	is representative of a single jet-engine interceptor fighter airplane such as the Lockheed F-104 (See Table B8: Pages 529–535)
Airplane I	is representative of a twin jet-engine fighter/attack airplane such as the McDonnell F-4 (See Table B9: Pages 536–542)
Airplane J	is representative of a large four jet-engine commercial transport airplane such as the Boeing 747-200 (See Table B10: Pages 543–549)

Tables B1–B10 also include examples of the open loop, longitudinal and lateral-directional, modes and transfer functions of these airplanes.

Table B1 Stability and Control Derivatives for Airplane A (Pages 480–486)**Three-view****Reference Geometry**

S (ft ²)	174
$\bar{c}$ (ft)	4.9
b (ft)	36.0

Flight Condition Data

	Climb	Cruise	Approach
Altitude, h (ft)	0	5,000	0
Mach Number, M	0.120	0.201	0.096
TAS, U_1 (ft/sec)	133.5	220.1	107.1
Dynamic pressure, $\bar{q}$ (lbs/ft ²)	21.2	49.6	13.6
C.G. location, fraction $\bar{c}$	26.4	26.4	26.4
Angle of attack, α_1 (deg)	5.4	0	4

Mass Data

W (lbs)	2,650	2,650	2,650
I_{xx_B} (slugft ²)	948	948	948
I_{yy_B} (slugft ²)	1,346	1,346	1,346
I_{zz_B} (slugft ²)	1,967	1,967	1,967
I_{xz_B} (slugft ²)	0	0	0

Table B1 (Continued) Stability and Control Derivatives for Airplane A (Pages 480–486)

<u>Flight Condition</u>	Climb	Cruise	Approach
<u>Steady State Coefficients</u>			
C_{L_1}	0.719	0.307	1.120
C_{D_1}	0.057	0.032	0.132
$C_{T_{x_1}}$	0.057	0.032	0.132
C_{m_1}	0	0	0
$C_{m_{T_1}}$	0	0	0
<u>Longitudinal Coefficients and Stability Derivatives (Stability Axes, Dimensionless)</u>			
C_{D_0}	0.0270	0.0270	0.0605
C_{D_u}	0	0	0
C_{D_α}	0.380	0.121	0.547
$C_{T_{x_u}}$	-0.171	-0.096	-0.396
C_{L_0}	0.307	0.307	0.807
C_{L_u}	0	0	0
C_{L_α}	4.41	4.41	4.41
$C_{L_{\dot{\alpha}}}$	1.7	1.7	1.7
C_{L_q}	3.9	3.9	3.9
C_{m_0}	0.04	0.04	0.09
C_{m_u}	0	0	0
C_{m_α}	-0.650	-0.613	-0.611
$C_{m_{\dot{\alpha}}}$	-5.57	-7.27	-5.40
C_{m_q}	-15.2	-12.4	-11.4
$C_{m_{T_u}}$	0	0	0
$C_{m_{T_\alpha}}$	0	0	0
<u>Longitudinal Control and Hinge Moment Derivatives (Stability Axes, 1/rad)</u>			
$C_{D_{\delta_e}}$	0	0	0
$C_{L_{\delta_e}}$	0.43	0.43	0.43
$C_{m_{\delta_e}}$	-1.369	-1.122	-1.029
$C_{D_{i_h}}$	not applicable		
$C_{L_{i_h}}$	not applicable		
$C_{m_{i_h}}$	not applicable		

Table B1 (Continued) Stability and Control Derivatives for Airplane A (Pages 480–486)

Flight Condition	Climb	Cruise	Approach
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Longitudinal Control and Hinge Moment Derivatives: Cont'd (Stability Axes, 1/rad)

C_{h_α}	-0.0545	-0.0584	-0.0549
$C_{h_{\delta_c}}$	-0.594	-0.585	-0.594

Lateral-Directional Stability Derivatives (Stability Axes, Dimensionless)

C_{l_β}	-0.0895	-0.0923	-0.0969
C_{l_p}	-0.487	-0.484	-0.494
C_{l_r}	0.1869	0.0798	0.2039
C_{y_β}	-0.404	-0.393	-0.303
C_{y_p}	-0.145	-0.075	-0.213
C_{y_r}	0.267	0.214	0.201
C_{n_β}	0.0907	0.0587	0.0701
$C_{n_{T_\beta}}$	0	0	0
C_{n_p}	-0.0649	-0.0278	-0.0960
C_{n_r}	-0.1199	-0.0937	-0.1151

Lateral-Directional Control and Hinge Moment Derivatives (Stability Axes, Dimensionless)

$C_{l_{\delta_a}}$	0.229	0.229	0.229
$C_{l_{\delta_r}}$	0.0147	0.0147	0.0147
$C_{y_{\delta_a}}$	0	0	0
$C_{y_{\delta_r}}$	0.187	0.187	0.187
$C_{n_{\delta_a}}$	-0.0504	-0.0216	-0.0786
$C_{n_{\delta_r}}$	-0.0805	-0.0645	-0.0604
$C_{h_{\alpha_a}}$	???	???	???
$C_{h_{\delta_a}}$	-0.369	-0.363	-0.369
$C_{h_{\beta_r}}$	0.0819	0.0819	0.0819
$C_{h_{\delta_r}}$	-0.579	-0.567	-0.579

Table B1 (Continued) Stability and Control Derivatives for Airplane A (Pages 480-486)**Longitudinal Transfer Function Data**

Altitude	=	5000 ft	M_1	=	0.201
U_1	=	130.39 kts	n	=	1.00 g
W_current	=	2650.0 lb	q_bar	=	49.60 psf
S_w	=	174.00 ft^2	(W/S)_TO	=	15.23 psf
Theta_1	=	0.00 deg	X_u	=	-0.0304 1/s
C_bar	=	4.90 ft	X_T_u	=	-0.0152 1/s
I_yy_B	=	1346 slgft2	X_a	=	19.4588 ft/s^2
C_m_1	=	0.0000	Z_u	=	-0.2919 1/s
C_m_u	=	0.0000	Z_a	=	-464.7095 ft/s^2
C_m_a	=	-0.6130 1/rad	Z_a_dot	=	-1.9799 ft/s
C_m_a_dot	=	-7.2700 1/rad	Z_q	=	-4.5422 ft/s
C_m_q	=	-12.4000 1/rad	M_u	=	0.0000 1/ft/s
C_m_T_1	=	0.0000	M_T_u	=	0.0000 1/ft/s
C_m_T_u	=	0.0000	M_a	=	-19.2591 1/s^2
C_m_T_a	=	0.0000	M_T_a	=	0.0000 1/s^2
C_L_1	=	0.3070	M_a_dot	=	-2.5428 1/s
C_L_u	=	0.0000	M_q	=	-4.3370 1/s
C_L_a	=	4.4100 1/rad			
C_L_a_dot	=	1.7000 1/rad			
C_L_q	=	3.9000 1/rad			
C_D_1	=	0.0320	w_n_SP	=	5.2707 rad/s
C_D_a	=	0.1210 1/rad	z_SP	=	0.8442
C_D_u	=	0.0000	w_n_P	=	0.1711 rad/s
C_T_X_1	=	0.0320	z_P	=	0.1289
C_T_X_u	=	-0.0960	X_del_e	=	0.0000 ft/s^2
C_L_d_e	=	0.4300 1/rad	Z_del_e	=	-44.9854 ft/s^2
C_D_d_e	=	0.0000 1/rad	M_del_e	=	-35.2508 1/s^2
C_m_d_e	=	-1.1220 1/rad			

POLYNOMIAL ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

$$\begin{aligned}
 & - 44.9854 S^3 - 7794.8686 S^2 - 355.6293 S - 330.5164 \\
 & + 222.0551 S^4 + 1985.9525 S^3 + 6262.2861 S^2 + 329.8825 S + 180.5762
 \end{aligned}$$

FACTORED ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

$$\begin{aligned}
 & -44.9854 (S + 173.2302) (S^2 + 0.0454 S + 0.0424) \\
 & 222.0551 (S^2 + 8.8994 S + 27.7798) (S^2 + 0.0441 S + 0.0293)
 \end{aligned}$$

$$\text{ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = -1.830343$$

POLYNOMIAL SPEED TO ELEVATOR TRANSFER FUNCTION

$$\begin{aligned}
 & - 875.3615 S^2 + 96137.8071 S + 498397.2852 \\
 & + 222.0551 S^4 + 1985.9525 S^3 + 6262.2861 S^2 + 329.8825 S + 180.5762
 \end{aligned}$$

Table B1 (Continued) Stability and Control Derivatives for Airplane A (Pages 480-486)

FACTORED SPEED TO ELEVATOR TRANSFER FUNCTION

$$-875.3615 (S - 114.7866)(S + 4.9602)$$

$$222.0551 (S^2 + 8.8994 S + 27.7798)(S^2 + 0.0441 S + 0.0293)$$

$$\text{SPEED TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = 2760.037863$$

POLYNOMIAL PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION

$$- 7713.2340 S^2 - 15867.0001 S - 908.2451$$

$$+ 222.0551 S^4 + 1985.9525 S^3 + 6262.2861 S^2 + 329.8825 S + 180.5762$$

FACTORED PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION

$$-7713.2340 (S + 1.9982)(S + 0.0589)$$

$$222.0551 (S^2 + 8.8994 S + 27.7798)(S^2 + 0.0441 S + 0.0293)$$

$$\text{PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = -5.029704$$

Lateral-Directional Transfer Function Data

W _{current} =	2650.0 lb	(W/S) _{TO} =	15.23 psf
Altitude =	5000 ft	q _{bar} =	49.60 psf
S _w =	174.00 ft ²	I _{xx_S} =	948 slgft ²
U ₁ =	130.39 kts	I _{zz_S} =	1967 slgft ²
Theta ₁ =	0.00 deg	I _{xz_S} =	0 slgft ²
Alpha =	0.00 deg	Y _B =	-41.1146 ft/s ²
b _w =	36.00 ft	Y _p =	-0.6417 ft/s
I _{xx_B} =	948 slgft ²	Y _r =	1.8311 ft/s
I _{zz_B} =	1967 slgft ²	L _B =	-30.2497 1/s ²
I _{xz_B} =	0 slgft ²	L _p =	-12.9738 1/s
C _{l_B} =	-0.0923 1/rad	L _r =	2.1391 1/s
C _{l_p} =	-0.4840 1/rad	N _B =	9.2717 1/s ²
C _{l_r} =	0.0798 1/rad	N _{T_B} =	0.0000 1/s ²
C _{n_B} =	0.0587 1/rad	N _p =	-0.3591 1/s
C _{n_T_B} =	0.0000	N _r =	-1.2105 1/s
C _{n_p} =	-0.0278 1/rad	w _{n_D} =	3.2448 rad/s
C _{n_r} =	-0.0937 1/rad	z _D =	0.2066
C _{y_B} =	-0.3930 1/rad	TC _{SPIRAL} =	55.922 s
C _{y_p} =	-0.0750 1/rad	TC _{ROLL} =	0.077 s
C _{y_r} =	0.2140 1/rad	TC ₁ =	0.077 s
C _{l_d_a} =	0.2290 1/rad	TC ₂ =	55.922 s
C _{l_d_r} =	0.0147 1/rad	Y _{del_a} =	0.0000 ft/s ²
C _{n_d_a} =	-0.0216 1/rad	Y _{del_r} =	19.5634 ft/s ²
C _{n_d_r} =	-0.0645 1/rad	L _{del_a} =	75.0507 1/s ²
C _{y_d_a} =	0.0000 1/rad	L _{del_r} =	4.8177 1/s ²
C _{y_d_r} =	0.1870 1/rad	N _{del_a} =	-3.4117 1/s ²
		N _{del_r} =	-10.1879 1/s ²

Table B1 (Continued) Stability and Control Derivatives for Airplane A (Pages 480–486)

POLYNOMIAL SIDESLIP TO AILERON TRANSFER FUNCTION

$$+ 696.4302 S^3 + 17900.0258 S^2 + 2683.9498 S$$

$$+ 220.0752 S^5 + 3162.7190 S^4 + 6212.5579 S^3 + 30261.6885 S^2 + 539.1737 S$$

FACTORED SIDESLIP TO AILERON TRANSFER FUNCTION

$$696.4302 \quad S(S + 25.5517)(S + 0.1508)$$

$$220.0752 \quad S(S + 13.0127)(S + 0.0179)(S^2 + 1.3405 S + 10.5287)$$

$$\text{SIDESLIP TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = 4.977895$$

POLYNOMIAL SIDESLIP TO RUDDER TRANSFER FUNCTION

$$+ 19.5634 S^4 + 2497.8410 S^3 + 29711.2702 S^2 - 512.7145 S$$

$$+ 220.0752 S^5 + 3162.7190 S^4 + 6212.5579 S^3 + 30261.6885 S^2 + 539.1737 S$$

FACTORED SIDESLIP TO RUDDER TRANSFER FUNCTION

$$19.5634 \quad S(S - 0.0172)(S + 114.4019)(S + 13.2945)$$

$$220.0752 \quad S(S + 13.0127)(S + 0.0179)(S^2 + 1.3405 S + 10.5287)$$

$$\text{SIDESLIP TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = -0.950926$$

POLYNOMIAL ROLL TO AILERON TRANSFER FUNCTION

$$+ 16516.7989 S^3 + 21473.1354 S^2 + 132776.7201 S$$

$$+ 220.0752 S^5 + 3162.7190 S^4 + 6212.5579 S^3 + 30261.6885 S^2 + 539.1737 S$$

FACTORED ROLL TO AILERON TRANSFER FUNCTION

$$16516.7989 \quad S(S^2 + 1.3001 S + 8.0389)$$

$$220.0752 \quad S(S + 13.0127)(S + 0.0179)(S^2 + 1.3405 S + 10.5287)$$

$$\text{ROLL TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = 246.259658$$

Table B1 (Continued) Stability and Control Derivatives for Airplane A (Pages 480–486)

POLYNOMIAL ROLL TO RUDDER TRANSFER FUNCTION

$$+ 1060.2487 S^3 - 3906.2643 S^2 - 58494.3958 S$$

$$+ 220.0752 S^5 + 3162.7190 S^4 + 6212.5579 S^3 + 30261.6885 S^2 + 539.1737 S$$

FACTORED ROLL TO RUDDER TRANSFER FUNCTION

$$1060.2487 \quad S(S - 9.4949)(S + 5.8106)$$

$$220.0752 \quad S(S + 13.0127)(S + 0.0179)(S^2 + 1.3405 S + 10.5287)$$

$$\text{ROLL TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = -108.488972$$

POLYNOMIAL HEADING TO AILERON TRANSFER FUNCTION

$$- 750.8413 S^3 - 15813.4284 S^2 - 3308.3966 S + 19037.9166$$

$$+ 220.0752 S^5 + 3162.7190 S^4 + 6212.5579 S^3 + 30261.6885 S^2 + 539.1737 S$$

FACTORED HEADING TO AILERON TRANSFER FUNCTION

$$-750.8413 \quad (S - 0.9773)(S + 20.7903)(S + 1.2479)$$

$$220.0752 \quad S(S + 13.0127)(S + 0.0179)(S^2 + 1.3405 S + 10.5287)$$

$$\text{HEADING TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = 35.309434$$

POLYNOMIAL HEADING TO RUDDER TRANSFER FUNCTION

$$- 2242.0954 S^3 - 29706.6792 S^2 - 2770.5323 S - 8464.9288$$

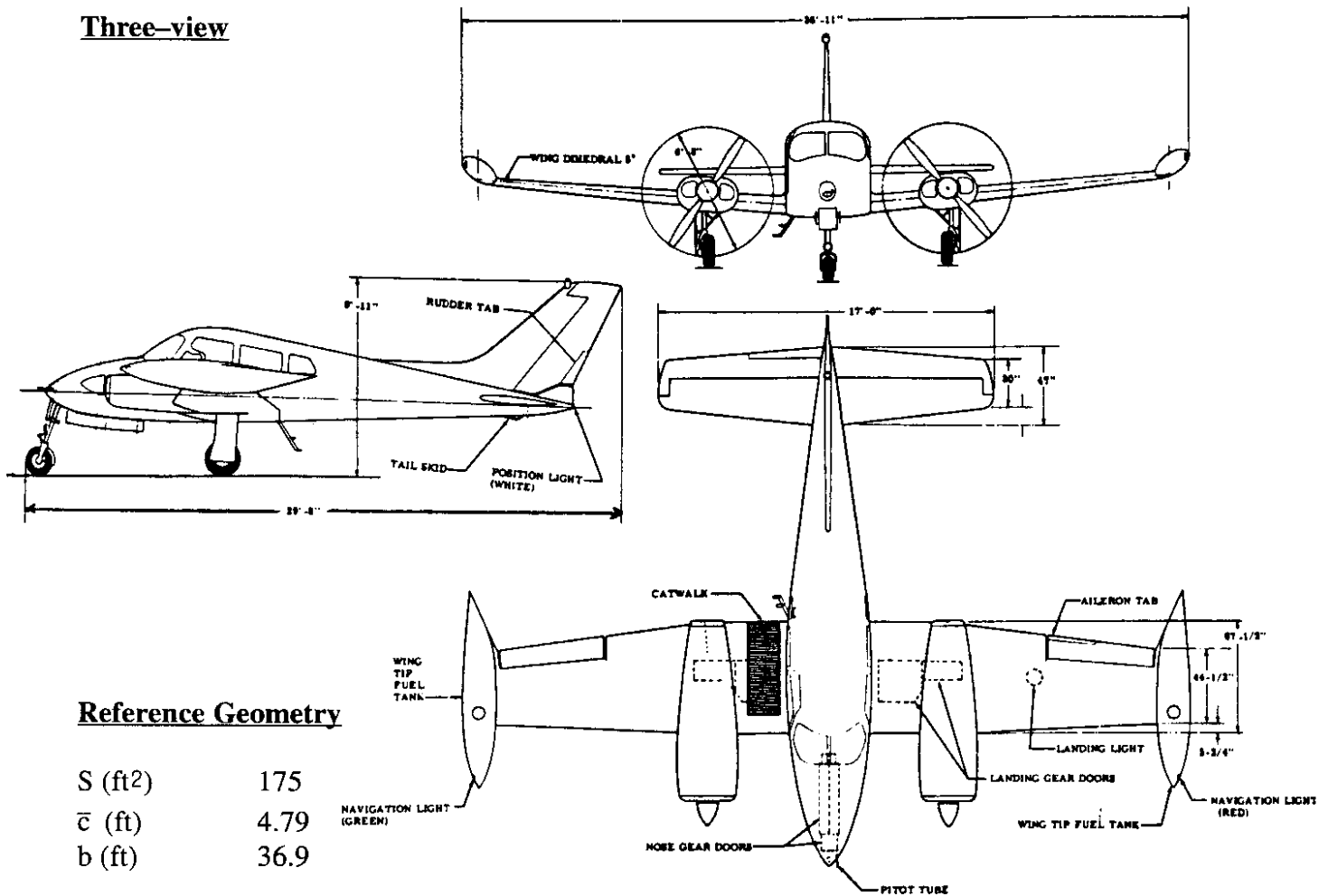
$$+ 220.0752 S^5 + 3162.7190 S^4 + 6212.5579 S^3 + 30261.6885 S^2 + 539.1737 S$$

FACTORED HEADING TO RUDDER TRANSFER FUNCTION

$$-2242.0954 \quad (S + 13.1775)(S^2 + 0.0720 S + 0.2865)$$

$$220.0752 \quad S(S + 13.0127)(S + 0.0179)(S^2 + 1.3405 S + 10.5287)$$

$$\text{HEADING TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = -15.699819$$

Table B2 Stability and Control Derivatives for Airplane B (Pages 487–493)**Three-view****Reference Geometry**

S (ft ²)	175
$\bar{c}$ (ft)	4.79
b (ft)	36.9

Flight Condition Data

	Climb	Cruise	Approach
Altitude, h (ft)	0	8,000	0
Mach Number, M	0.160	0.288	0.124
TAS, U_1 (ft/sec)	179.0	312.5	137.9
Dynamic pressure, $\bar{q}$ (lbs/ft ²)	38.1	91.2	22.6
C.G. location, fraction $\bar{c}$	33.0	33.0	33.0
Angle of attack, α_1 (deg)	5	0	6.6

Mass Data

W (lbs)	4,600	4,600	4,600
I_{xx_B} (slugft ²)	8,884	8,884	8,884
I_{yy_B} (slugft ²)	1,939	1,939	1,939
I_{zz_B} (slugft ²)	11,001	11,001	11,001
I_{xz_B} (slugft ²)	0	0	0

Table B2 (Continued) Stability and Control Derivatives for Airplane B (Pages 487–493)

Flight Condition	Climb	Cruise	Approach
<u>Steady State Coefficients</u>			
C_{L_1}	0.690	0.288	1.163
C_{D_1}	0.0540	0.0310	0.1710
$C_{T_{x_1}}$	0.0540	0.0310	0.1710
C_{m_1}	0	0	0
$C_{m_{T_1}}$	0	0	0
<u>Longitudinal Coefficients and Stability Derivatives (Stability Axes, Dimensionless)</u>			
C_{D_0}	0.0290	0.0290	0.0974
C_{D_v}	0	0	0
C_{D_α}	0.362	0.160	0.650
$C_{T_{x_u}}$	−0.162	−0.093	−0.513
C_{L_0}	0.288	0.288	0.640
C_{L_u}	0	0	0
C_{L_α}	4.58	4.58	4.58
$C_{L_{\dot{\alpha}}}$	4.5	5.3	4.1
C_{L_q}	8.8	9.7	8.4
C_{m_0}	0.07	0.07	0.10
C_{m_u}	0	0	0
C_{m_α}	−0.339	−0.137	−0.619
$C_{m_{\dot{\alpha}}}$	−14.8	−12.7	−11.4
C_{m_q}	−29.2	−26.3	−25.1
$C_{m_{T_u}}$	0	0	0
$C_{m_{T_\alpha}}$	0	0	0
<u>Longitudinal Control and Hinge Moment Derivatives (Stability Axes, 1/rad)</u>			
$C_{D_{\delta_e}}$	0	0	0
$C_{L_{\delta_e}}$	0.90	0.81	0.77
$C_{m_{\delta_e}}$	−2.53	−2.26	−2.16
$C_{D_{i_h}}$	not applicable		
$C_{L_{i_h}}$	not applicable		
$C_{m_{i_h}}$	not applicable		

Table B2 (Continued) Stability and Control Derivatives for Airplane B (Pages 487–493)

Flight Condition	Climb	Cruise	Approach
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Longitudinal Control and Hinge Moment Derivatives: Cont'd (Stability Axes, 1/rad)

C_{h_α}	−0.0826	−0.0863	−0.0925
$C_{h_{\delta_e}}$	−0.742	−0.742	−0.742

Lateral–Directional Stability Derivatives (Stability Axes, Dimensionless)

C_{l_β}	−0.0923	−0.1096	−0.0965
C_{l_p}	−0.552	−0.551	−0.566
C_{l_r}	0.1746	0.0729	0.2433
C_{y_β}	−0.610	−0.698	−0.577
C_{y_p}	−0.2093	−0.1410	−0.2897
C_{y_r}	0.356	0.355	0.355
C_{n_β}	0.1552	0.1444	0.1683
$C_{n_{T_\beta}}$	0	0	0
C_{n_p}	−0.0615	−0.0257	−0.1021
C_{n_r}	−0.1561	−0.1495	−0.1947

Lateral–Directional Control and Hinge Moment Derivatives (Stability Axes, Dimensionless)

$C_{l_{\delta_a}}$	0.1720	0.1720	0.1720
$C_{l_{\delta_r}}$	0.0192	0.0192	0.0192
$C_{y_{\delta_a}}$	0	0	0
$C_{y_{\delta_r}}$	0.230	0.230	0.230
$C_{n_{\delta_a}}$	−0.0402	−0.0168	−0.0676
$C_{n_{\delta_r}}$	−0.1152	−0.1152	−0.1152
$C_{h_{\alpha_a}}$	???	???	???
$C_{h_{\delta_a}}$	−0.481	−0.453	−0.481
$C_{h_{\beta_r}}$	0.0722	0.0722	0.0722
$C_{h_{\delta_r}}$	−0.602	−0.590	−0.602

Table B2 (Continued) Stability and Control Derivatives for Airplane B (Pages 487–493)**Longitudinal Transfer Function Data**

Altitude	=	0 ft	M ₁	=	0.160
U ₁	=	106.04 kts	n	=	1.00 g
W _{current}	=	4600.0 lb	q _{bar}	=	38.07 psf
S _w	=	175.00 ft ²	(W/S) _{TO}	=	26.29 psf
Theta ₁	=	5.00 deg	X _u	=	-0.0281 1/s
C _{bar}	=	4.79 ft	X _{T_u}	=	-0.0141 1/s
I _{yy_B}	=	1939 slgft ²	X _a	=	15.2843 ft/s ²
C _{m_1}	=	0.0000	Z _u	=	-0.3593 1/s
C _{m_u}	=	0.0000	Z _a	=	-215.9370 ft/s ²
C _{m_a}	=	-0.3390 1/rad	Z _{a_dot}	=	-2.8060 ft/s
C _{m_a_dot}	=	-14.8000 1/rad	Z _q	=	-5.4873 ft/s
C _{m_q}	=	-29.2000 1/rad	M _u	=	0.0000 1/ft/s
C _{m_T_1}	=	0.0000	M _{T_u}	=	0.0000 1/ft/s
C _{m_T_u}	=	0.0000	M _a	=	-5.5793 1/s ²
C _{m_T_a}	=	0.0000	M _{T_a}	=	0.0000 1/s ²
C _{L_1}	=	0.6900	M _{a_dot}	=	-3.2595 1/s
C _{L_u}	=	0.0000	M _q	=	-6.4308 1/s
C _{L_a}	=	4.5800 1/rad			
C _{L_a_dot}	=	4.5000 1/rad	w _{n_3} osc	=	0.1647 rad/s
C _{L_q}	=	8.8000 1/rad	z _{3rd} osc	=	0.1338
C _{D_1}	=	0.0540	TC ₁	=	0.107 s
C _{D_a}	=	0.3620 1/rad	TC ₂	=	0.725 s
C _{D_u}	=	0.0000	X _{del_e}	=	0.0000 ft/s ²
C _{T_X_1}	=	0.0540	Z _{del_e}	=	-41.9386 ft/s ²
C _{T_X_u}	=	-0.1620	M _{del_e}	=	-41.6392 1/s ²
C _{L_d_e}	=	0.9000 1/rad			
C _{D_d_e}	=	0.0000 1/rad			
C _{m_d_e}	=	-2.5300 1/rad			

POLYNOMIAL ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

$$- 41.9386 S^3 - 7495.5567 S^2 - 199.3076 S - 474.5850$$

$$+ 181.7858 S^4 + 1958.1258 S^3 + 2435.2386 S^2 + 156.2160 S + 63.5906$$

FACTORED ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

$$-41.9386 (S + 178.7008)(S^2 + 0.0262 S + 0.0633)$$

$$181.7858 (S + 9.3480)(S + 1.3796)(S^2 + 0.0441 S + 0.0271)$$

$$\text{ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = -7.463127$$

POLYNOMIAL SPEED TO ELEVATOR TRANSFER FUNCTION

$$- 641.0008 S^2 + 123693.0423 S + 282474.6952$$

$$+ 181.7858 S^4 + 1958.1258 S^3 + 2435.2386 S^2 + 156.2160 S + 63.5906$$

Table B2 (Continued) Stability and Control Derivatives for Airplane B (Pages 487–493)

FACTORED SPEED TO ELEVATOR TRANSFER FUNCTION

$$-641.0008 (S - 195.2259)(S + 2.2573)$$

$$181.7858 (S + 9.3480)(S + 1.3796)(S^2 + 0.0441 S + 0.0271)$$

$$\text{SPEED TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = 4442.079652$$

POLYNOMIAL PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION

$$-7432.7155 S^2 - 9070.9460 S - 598.0300$$

$$+ 181.7858 S^4 + 1958.1258 S^3 + 2435.2386 S^2 + 156.2160 S + 63.5906$$

FACTORED PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION

$$-7432.7155 (S + 1.1505)(S + 0.0699)$$

$$181.7858 (S + 9.3480)(S + 1.3796)(S^2 + 0.0441 S + 0.0271)$$

$$\text{PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = -9.404371$$

Lateral–Directional Transfer Function Data

W _{current} =	4600.0 lb	(W/S) _{TO} =	26.29 psf
Altitude =	0 ft	q _{bar} =	38.07 psf
S _w =	175.00 ft ²	I _{xx} _S =	8900 slgft ²
U ₁ =	106.04 kts	I _{zz} _S =	10985 slgft ²
Theta ₁ =	5.00 deg	I _{xz} _S =	-184 slgft ²
Alpha =	5.00 deg	Y _B =	-28.4250 ft/s ²
b _w =	36.90 ft	Y _p =	-1.0054 ft/s
I _{xx} _B =	8884 slgft ²	Y _r =	1.7101 ft/s
I _{zz} _B =	11001 slgft ²	L _B =	-2.5495 1/s ²
I _{xz} _B =	0 slgft ²	L _p =	-1.5718 1/s
C _l _B =	-0.0923 1/rad	L _r =	0.4972 1/s
C _l _p =	-0.5520 1/rad	N _B =	3.4733 1/s ²
C _l _r =	0.1746 1/rad	N _T _B =	0.0000 1/s ²
C _n _B =	0.1552 1/rad	N _p =	-0.1419 1/s
C _n _T _B =	0.0000	N _r =	-0.3601 1/s
C _n _p =	-0.0615 1/rad	w _n _D =	1.9400 rad/s
C _n _r =	-0.1561 1/rad	z _D =	0.1050
C _y _B =	-0.6100 1/rad	TC _{SPIRAL} =	-44.476 s
C _y _p =	-0.2093 1/rad	TC _{ROLL} =	0.584 s
C _y _r =	0.3560 1/rad	TC ₁ =	0.584 s
C _l _d _a =	0.1720 1/rad	TC ₂ =	-44.476 s
C _l _d _r =	0.0192 1/rad	Y _{del} _a =	0.0000 ft/s ²
C _n _d _a =	-0.0402 1/rad	Y _{del} _r =	10.7176 ft/s ²
C _n _d _r =	-0.1152 1/rad	L _{del} _a =	4.7510 1/s ²
C _y _d _a =	0.0000 1/rad	L _{del} _r =	0.5303 1/s ²
C _y _d _r =	0.2300 1/rad	N _{del} _a =	-0.8997 1/s ²
		N _{del} _r =	-2.5781 1/s ²

Table B2 (Continued) Stability and Control Derivatives for Airplane B (Pages 487-493)

POLYNOMIAL SIDESLIP TO AILERON TRANSFER FUNCTION

$$+ 168.7800 S^3 + 521.7640 S^2 + 40.5023 S$$

$$+ 178.9180 S^5 + 375.1483 S^4 + 789.6410 S^3 + 1134.8049 S^2 - 25.9185 S$$

FACTORED SIDESLIP TO AILERON TRANSFER FUNCTION

$$168.7800 \quad S(S + 3.0117)(S + 0.0797)$$

$$178.9180 \quad S(S - 0.0225)(S + 1.7119)(S^2 + 0.4074 S + 3.7637)$$

$$\text{SIDESLIP TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = -1.562683$$

POLYNOMIAL SIDESLIP TO RUDDER TRANSFER FUNCTION

$$+ 10.7139 S^4 + 478.7750 S^3 + 758.2996 S^2 - 34.9602 S$$

$$+ 178.9180 S^5 + 375.1483 S^4 + 789.6410 S^3 + 1134.8049 S^2 - 25.9185 S$$

FACTORED SIDESLIP TO RUDDER TRANSFER FUNCTION

$$10.7139 \quad S(S - 0.0448)(S + 43.0410)(S + 1.6910)$$

$$178.9180 \quad S(S - 0.0225)(S + 1.7119)(S^2 + 0.4074 S + 3.7637)$$

$$\text{SIDESLIP TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = 1.348853$$

POLYNOMIAL ROLL TO AILERON TRANSFER FUNCTION

$$+ 853.6582 S^3 + 361.7453 S^2 + 2554.5759 S$$

$$+ 178.9180 S^5 + 375.1483 S^4 + 789.6410 S^3 + 1134.8049 S^2 - 25.9185 S$$

FACTORED ROLL TO AILERON TRANSFER FUNCTION

$$853.6582 \quad S(S^2 + 0.4238 S + 2.9925)$$

$$178.9180 \quad S(S - 0.0225)(S + 1.7119)(S^2 + 0.4074 S + 3.7637)$$

$$\text{ROLL TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = -98.562052$$

Table B2 (Continued) Stability and Control Derivatives for Airplane B (Pages 487–493)

POLYNOMIAL ROLL TO RUDDER TRANSFER FUNCTION

$$+ 104.4505 S^3 - 206.7270 S^2 - 860.9920 S$$

$$+ 178.9180 S^5 + 375.1483 S^4 + 789.6410 S^3 + 1134.8049 S^2 - 25.9185 S$$

FACTORED ROLL TO RUDDER TRANSFER FUNCTION

$$104.4505 \quad S(S - 4.0264)(S + 2.0472)$$

$$178.9180 \quad S(S - 0.0225)(S + 1.7119)(S^2 + 0.4074 S + 3.7637)$$

$$\text{ROLL TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = 33.219266$$

POLYNOMIAL HEADING TO AILERON TRANSFER FUNCTION

$$- 175.2497 S^3 - 401.5655 S^2 - 73.6397 S + 455.3900$$

$$+ 178.9180 S^5 + 375.1483 S^4 + 789.6410 S^3 + 1134.8049 S^2 - 25.9185 S$$

FACTORED HEADING TO AILERON TRANSFER FUNCTION

$$-175.2497 \quad (S - 0.8456)(S^2 + 3.1370 S + 3.0729)$$

$$178.9180 \quad S(S - 0.0225)(S + 1.7119)(S^2 + 0.4074 S + 3.7637)$$

$$\text{HEADING TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = -17.570107$$

POLYNOMIAL HEADING TO RUDDER TRANSFER FUNCTION

$$- 463.0227 S^3 - 774.5867 S^2 - 50.1800 S - 151.6343$$

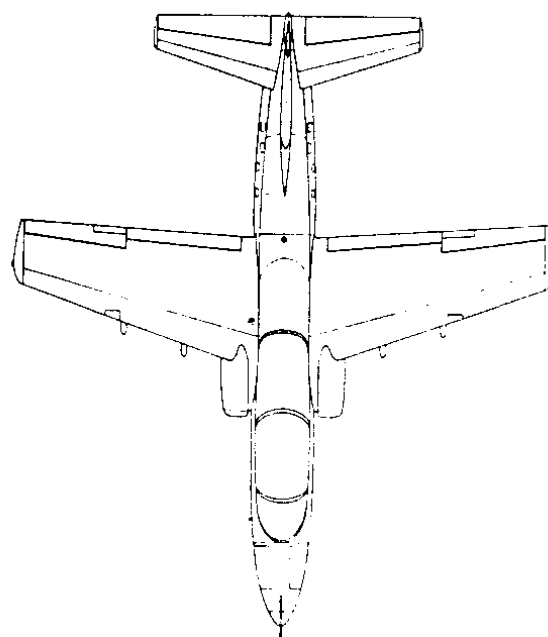
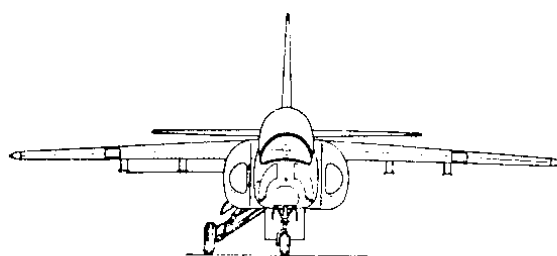
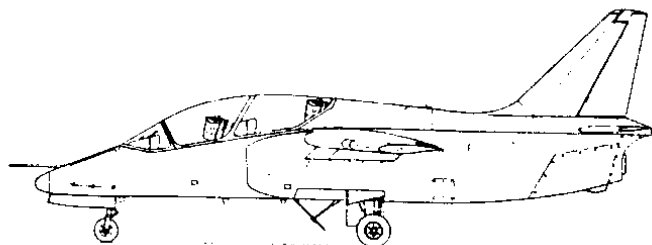
$$+ 178.9180 S^5 + 375.1483 S^4 + 789.6410 S^3 + 1134.8049 S^2 - 25.9185 S$$

FACTORED HEADING TO RUDDER TRANSFER FUNCTION

$$-463.0227 \quad (S + 1.7205)(S^2 + -0.0476 S + 0.1903)$$

$$178.9180 \quad S(S - 0.0225)(S + 1.7119)(S^2 + 0.4074 S + 3.7637)$$

$$\text{HEADING TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = 5.850439$$

Table B3 **Stability and Control Derivatives for Airplane C (Pages 494–500)****Three-view****Reference Geometry**

S (ft ²)	136
$\bar{c}$ (ft)	5.4
b (ft)	26.3

Flight Condition Data

	Approach	Cruise 1	Cruise 2
Altitude, h (ft)	0	25,000	35,000
Mach Number, M	0.111	0.600	0.600
TAS, U_1 (ft/sec)	124	610	584
Dynamic pressure, $\bar{q}$ (lbs/ft ²)	18.2	198.0	125.7
C.G. location, fraction $\bar{c}$	0.25	0.25	0.25
Angle of attack, α_1 (deg)	8	0	0.9

Mass Data

W (lbs)	3,500	4,000	4,000
I_{xx_B} (slugft ²)	750	800	800
I_{yy_B} (slugft ²)	4,600	4,800	4,800
I_{zz_B} (slugft ²)	5,000	5,200	5,200
I_{xz_B} (slugft ²)	200	200	200

Table B3 (Continued) Stability and Control Derivatives for Airplane C (Pages 494–500)

Flight Condition	Approach	Cruise 1	Cruise 2
<u>Steady State Coefficients</u>			
C_{L_1}	1.414	0.149	0.234
C_{D_1}	0.2100	0.0220	0.0250
$C_{T_{x_1}}$	0.2100	0.0220	0.0250
C_{m_1}	0	0	0
$C_{m_{T_1}}$	0	0	0
<u>Longitudinal Coefficients and Stability Derivatives (Stability Axes, Dimensionless)</u>			
C_{D_0}	0.0900	0.0205	0.0205
C_{D_u}	0	0.05	0.05
C_{D_α}	1.14	0.12	0.17
$C_{T_{x_u}}$	−0.45	−0.05	−0.055
C_{L_0}	0.65	0.149	0.149
C_{L_u}	0.071	0.084	0.132
C_{L_α}	5.0	5.5	5.5
$C_{L_{\dot{\alpha}}}$	3.0	4.2	4.2
C_{L_q}	9.0	10.0	10.0
C_{m_0}	−0.07	−0.08	−0.08
C_{m_u}	0	0	0
C_{m_α}	−0.60	−0.24	−0.24
$C_{m_{\dot{\alpha}}}$	−7.0	−9.6	−9.6
C_{m_q}	−15.7	−17.7	−17.7
$C_{m_{T_u}}$	0	0	0
$C_{m_{T_\alpha}}$	0	0	0
<u>Longitudinal Control and Hinge Moment Derivatives (Stability Axes, 1/rad)</u>			
$C_{D_{\delta_c}}$	0	0	0
$C_{L_{\delta_c}}$	0.39	0.38	0.35
$C_{m_{\delta_c}}$	−0.90	−0.88	−0.82
$C_{D_{i_h}}$	0	0	0
$C_{L_{i_h}}$	1.0	0.99	0.99
$C_{m_{i_h}}$	−2.3	−2.3	−2.3

Table B3 (Continued) Stability and Control Derivatives for Airplane C (Pages 494–500)

Flight Condition	Approach	Cruise 1	Cruise 2
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Longitudinal Control and Hinge Moment Derivatives: Cont'd (Stability Axes, 1/rad)

C_{h_α}	-0.22	-0.22	-0.22
$C_{h_{\delta_e}}$	-0.504	-0.504	-0.504

Lateral-Directional Stability Derivatives (Stability Axes, Dimensionless)

C_{l_β}	-0.140	-0.110	-0.110
C_{l_p}	-0.350	-0.390	-0.390
C_{l_r}	0.560	0.280	0.310
C_{y_β}	-0.94	-1.00	-1.00
C_{y_p}	-0.010	-0.140	-0.120
C_{y_r}	0.590	0.610	0.620
C_{n_β}	0.160	0.170	0.170
$C_{n_{T_\beta}}$	0	0	0
C_{n_p}	-0.030	0.090	0.080
C_{n_r}	-0.310	-0.260	-0.260

Lateral-Directional Control and Hinge Moment Derivatives (Stability Axes, Dimensionless)

$C_{l_{\delta_a}}$	0.110	0.100	0.100
$C_{l_{\delta_r}}$	0.030	0.050	0.050
$C_{y_{\delta_a}}$	0	0	0
$C_{y_{\delta_r}}$	0.260	0.0280	0.0280
$C_{n_{\delta_a}}$	-0.030	-0.003	-0.005
$C_{n_{\delta_r}}$	-0.110	-0.120	-0.120
$C_{h_{\delta_a}}$	-0.143	-0.143	-0.143
$C_{h_{\delta_r}}$	-0.500	-0.500	-0.500
$C_{h_{\beta_r}}$	0.25	0.25	0.25
$C_{h_{\delta_r}}$	-0.380	-0.380	-0.380

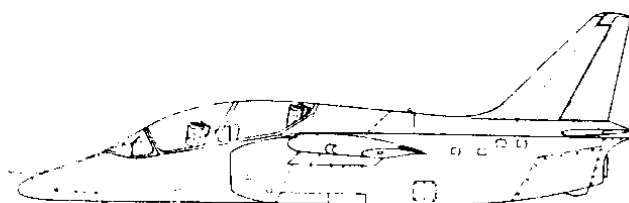


Table B3 (Continued) Stability and Control Derivatives for Airplane C (Pages 494–500)

Longitudinal Transfer Function Data

Altitude	=	0 ft	M ₁	=	0.111
U ₁	=	73.46 kts	n	=	1.00 g
W _{current}	=	3500.0 lb	q _{bar}	=	18.27 psf
S _w	=	136.00 ft ²	(W/S) _{TO}	=	25.74 psf
Theta ₁	=	8.00 deg	X _u	=	-0.0774 1/s
C _{bar}	=	5.40 ft	X _{T_u}	=	-0.0055 1/s
I _{yy_B}	=	4600 slgft ²	X _a	=	6.2582 ft/s ²
C _{m_1}	=	0.0000	Z _u	=	-0.5340 1/s
C _{m_u}	=	0.0000	Z _a	=	-118.9972 ft/s ²
C _{m_a}	=	-0.6000 1/rad	Z _{a_dot}	=	-1.4921 ft/s
C _{m_a_dot}	=	-7.0000 1/rad	Z _q	=	-4.4764 ft/s
C _{m_q}	=	-15.7000 1/rad	M _u	=	0.0000 1/ft/s
C _{m_T_1}	=	0.0000	M _{T_u}	=	0.0000 1/ft/s
C _{m_T_u}	=	0.0000	M _a	=	-1.7500 1/s ²
C _{m_T_a}	=	0.0000	M _{T_a}	=	0.0000 1/s ²
C _{L_1}	=	1.4140	M _{a_dot}	=	-0.4446 1/s
C _{L_u}	=	0.0710	M _q	=	-0.9972 1/s
C _{L_a}	=	5.0000 1/rad			
C _{L_a_dot}	=	3.0000 1/rad	w _{n_SP}	=	1.6452 rad/s
C _{L_q}	=	9.0000 1/rad	z _{SP}	=	0.7418
C _{D_1}	=	0.2100	w _{n_P}	=	0.2929 rad/s
C _{D_a}	=	1.1400 1/rad	z _P	=	0.0191
C _{D_u}	=	0.0000	X _{del_e}	=	0.0000 ft/s ²
C _{T_X_1}	=	0.2100	Z _{del_e}	=	-8.9077 ft/s ²
C _{T_X_u}	=	-0.4500	M _{del_e}	=	-2.6251 1/s ²
C _{L_d_e}	=	0.3900 1/rad			
C _{D_d_e}	=	0.0000 1/rad			
C _{m_d_e}	=	-0.9000 1/rad			

POLYNOMIAL ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

$$\begin{aligned}
 & - 8.9077 S^3 - 323.3421 S^2 - 14.9885 S - 43.6912 \\
 & \text{-----} \\
 & + 125.4782 S^4 + 307.6638 S^3 + 353.8063 S^2 + 30.0714 S + 29.1274
 \end{aligned}$$

FACTORED ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

$$\begin{aligned}
 & -8.9077 (S + 36.2566)(S^2 + 0.0427 S + 0.1353) \\
 & \text{-----} \\
 & 125.4782 (S^2 + 2.4407 S + 2.7066)(S^2 + 0.0112 S + 0.0858)
 \end{aligned}$$

ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION K_{gain} = -1.500000

POLYNOMIAL SPEED TO ELEVATOR TRANSFER FUNCTION

$$\begin{aligned}
 & - 55.7460 S^2 + 8349.5123 S + 9529.4560 \\
 & \text{-----} \\
 & + 125.4782 S^4 + 307.6638 S^3 + 353.8063 S^2 + 30.0714 S + 29.1274
 \end{aligned}$$

Table B3 (Continued) Stability and Control Derivatives for Airplane C (Pages 494–500)

FACTORED SPEED TO ELEVATOR TRANSFER FUNCTION

$$-55.7460 (S - 150.9107)(S + 1.1328)$$

$$125.4782 (S^2 + 2.4407 S + 2.7066)(S^2 + 0.0112 S + 0.0858)$$

$$\text{SPEED TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = 327.164213$$

POLYNOMIAL PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION

$$-325.4282 S^2 - 323.7640 S - 33.3761$$

$$+ 125.4782 S^4 + 307.6638 S^3 + 353.8063 S^2 + 30.0714 S + 29.1274$$

FACTORED PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION

$$-325.4282 (S + 0.8781)(S + 0.1168)$$

$$125.4782 (S^2 + 2.4407 S + 2.7066)(S^2 + 0.0112 S + 0.0858)$$

$$\text{PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = -1.145864$$

Lateral-Directional Transfer Function Data

W _{current} =	3500.0 lb	(W/S) _{TO} =	25.74 psf
Altitude =	0 ft	q _{bar} =	18.27 psf
S _w =	136.00 ft ²	I _{xx_S} =	777 slgft ²
U ₁ =	73.46 kts	I _{zz_S} =	4973 slgft ²
Theta ₁ =	8.00 deg	I _{xz_S} =	-393 slgft ²
Alpha =	8.00 deg	Y _B =	-21.4697 ft/s ²
b _w =	26.30 ft	Y _p =	-0.0242 ft/s
I _{xx_B} =	750 slgft ²	Y _r =	1.4292 ft/s
I _{zz_B} =	5000 slgft ²	L _B =	-11.7711 1/s ²
I _{xz_B} =	200 slgft ²	L _p =	-3.1211 1/s
C _{l_B} =	-0.1400 1/rad	L _r =	4.9938 1/s
C _{l_p} =	-0.3500 1/rad	N _B =	2.1025 1/s ²
C _{l_r} =	0.5600 1/rad	N _{T_B} =	0.0000 1/s ²
C _{n_B} =	0.1600 1/rad	N _p =	-0.0418 1/s
C _{n_T_B} =	0.0000	N _r =	-0.4320 1/s
C _{n_p} =	-0.0300 1/rad	w _{n_D} =	1.7980 rad/s
C _{n_r} =	-0.3100 1/rad	z _D =	0.2118
C _{y_B} =	-0.9400 1/rad	TC _{SPIRAL} =	-8.089 s
C _{y_p} =	-0.0100 1/rad	TC _{ROLL} =	0.276 s
C _{y_r} =	0.5900 1/rad	TC ₁ =	0.276 s
C _{l_d_a} =	0.1100 1/rad	TC ₂ =	-8.089 s
C _{l_d_r} =	0.0300 1/rad	Y _{del_a} =	0.0000 ft/s ²
C _{n_d_a} =	-0.0300 1/rad	Y _{del_r} =	5.9384 ft/s ²
C _{n_d_r} =	-0.1100 1/rad	L _{del_a} =	9.2487 1/s ²
C _{y_d_a} =	0.0000 1/rad	L _{del_r} =	2.5224 1/s ²
C _{y_d_r} =	0.2600 1/rad	N _{del_a} =	-0.3942 1/s ²
		N _{del_r} =	-1.4455 1/s ²

Table B3 (Continued) Stability and Control Derivatives for Airplane C (Pages 494–500)

POLYNOMIAL SIDESLIP TO AILERON TRANSFER FUNCTION

$$\frac{+ 137.7740 S^3 + 499.1699 S^2 + 64.5896 S}{+ 119.0192 S^5 + 507.5201 S^4 + 648.9080 S^3 + 1307.0734 S^2 - 172.4879 S}$$

FACTORED SIDESLIP TO AILERON TRANSFER FUNCTION

$$\frac{137.7740 \quad S(S + 3.4887)(S + 0.1344)}{119.0192 \quad S(S - 0.1236)(S + 3.6262)(S^2 + 0.7616 S + 3.2329)}$$

$$\text{SIDESLIP TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = -0.374459$$

POLYNOMIAL SIDESLIP TO RUDDER TRANSFER FUNCTION

$$\frac{+ 5.7005 S^4 + 224.8549 S^3 + 678.9163 S^2 - 195.2623 S}{+ 119.0192 S^5 + 507.5201 S^4 + 648.9080 S^3 + 1307.0734 S^2 - 172.4879 S}$$

FACTORED SIDESLIP TO RUDDER TRANSFER FUNCTION

$$\frac{5.7005 \quad S(S - 0.2643)(S + 36.1210)(S + 3.5877)}{119.0192 \quad S(S - 0.1236)(S + 3.6262)(S^2 + 0.7616 S + 3.2329)}$$

$$\text{SIDESLIP TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = 1.132035$$

POLYNOMIAL ROLL TO AILERON TRANSFER FUNCTION

$$\frac{+ 1171.4603 S^3 + 454.2025 S^2 + 1857.9873 S}{+ 119.0192 S^5 + 507.5201 S^4 + 648.9080 S^3 + 1307.0734 S^2 - 172.4879 S}$$

FACTORED ROLL TO AILERON TRANSFER FUNCTION

$$\frac{1171.4603 \quad S(S^2 + 0.3877 S + 1.5860)}{119.0192 \quad S(S - 0.1236)(S + 3.6262)(S^2 + 0.7616 S + 3.2329)}$$

$$\text{ROLL TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = -10.771696$$

Table B3 (Continued) Stability and Control Derivatives for Airplane C (Pages 494–500)

POLYNOMIAL ROLL TO RUDDER TRANSFER FUNCTION

$$+ 403.4749 S^3 - 766.2161 S^2 - 1534.7513 S$$

$$+ 119.0192 S^5 + 507.5201 S^4 + 648.9080 S^3 + 1307.0734 S^2 - 172.4879 S$$

FACTORED ROLL TO RUDDER TRANSFER FUNCTION

$$403.4749 \quad S(S - 3.1187)(S + 1.2197)$$

$$119.0192 \quad S(S - 0.1236)(S + 3.6262)(S^2 + 0.7616 S + 3.2329)$$

$$\text{ROLL TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = 8.897733$$

POLYNOMIAL HEADING TO AILERON TRANSFER FUNCTION

$$- 139.6122 S^3 - 224.6739 S^2 - 35.0775 S + 471.7029$$

$$+ 119.0192 S^5 + 507.5201 S^4 + 648.9080 S^3 + 1307.0734 S^2 - 172.4879 S$$

FACTORED HEADING TO AILERON TRANSFER FUNCTION

$$-139.6122 \quad (S - 1.0759)(S^2 + 2.6852 S + 3.1403)$$

$$119.0192 \quad S(S - 0.1236)(S + 3.6262)(S^2 + 0.7616 S + 3.2329)$$

$$\text{HEADING TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = -2.734701$$

POLYNOMIAL HEADING TO RUDDER TRANSFER FUNCTION

$$- 203.9638 S^3 - 589.7395 S^2 - 56.9493 S - 373.1381$$

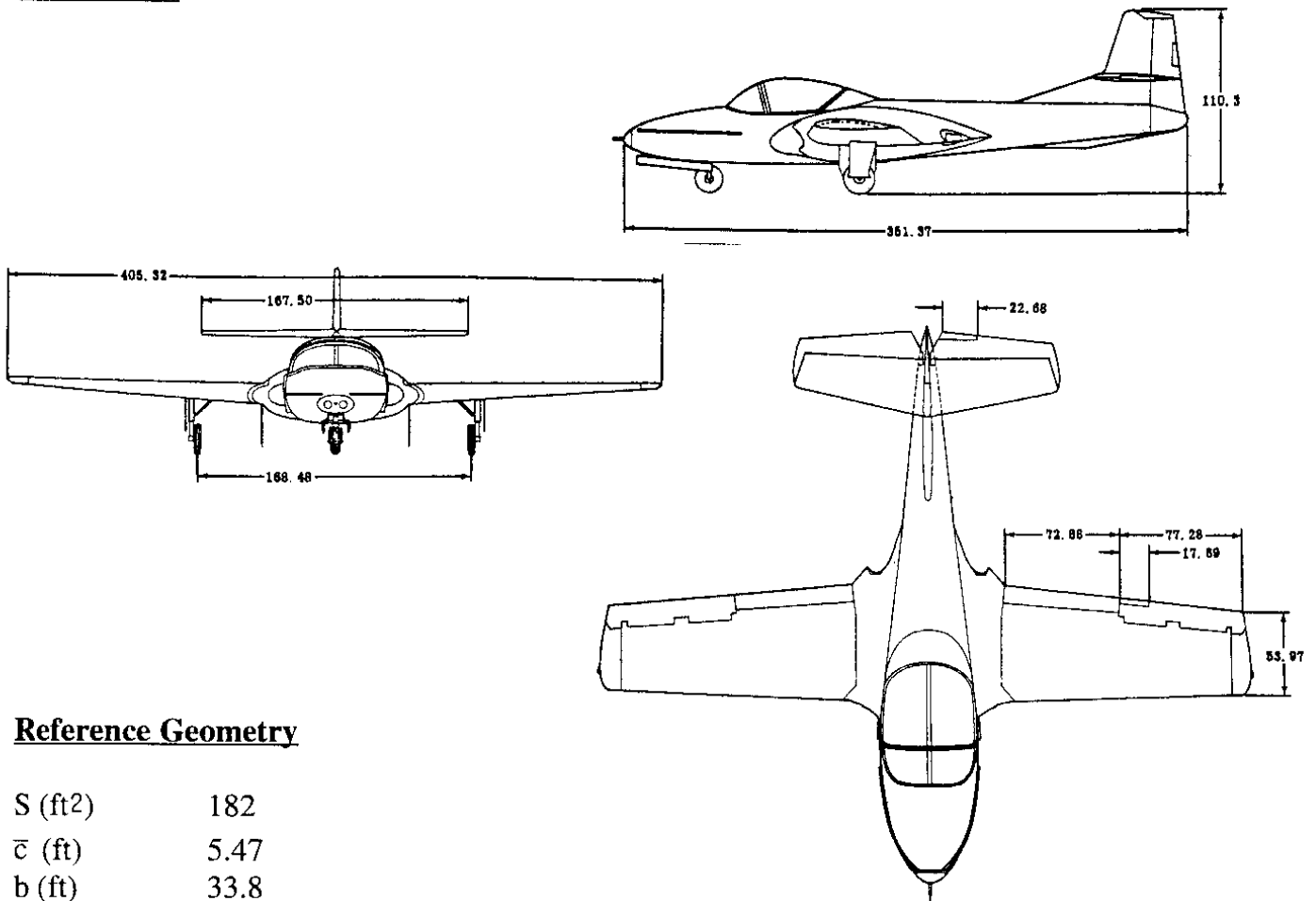
$$+ 119.0192 S^5 + 507.5201 S^4 + 648.9080 S^3 + 1307.0734 S^2 - 172.4879 S$$

FACTORED HEADING TO RUDDER TRANSFER FUNCTION

$$-203.9638 \quad (S + 3.0014)(S^2 + -0.1100 S + 0.6095)$$

$$119.0192 \quad S(S - 0.1236)(S + 3.6262)(S^2 + 0.7616 S + 3.2329)$$

$$\text{HEADING TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = 2.163271$$

Table B4 Stability and Control Derivatives for Airplane D (Pages 501–507)**Three-view****Reference Geometry**

S (ft ²)	182
$\bar{c}$ (ft)	5.47
b (ft)	33.8

Flight Condition Data

	Climb	Cruise	Approach
Altitude, h (ft)	0	30,000	0
Mach Number, M	0.313	0.459	0.143
TAS, U_1 (ft/sec)	349	456	160
Dynamic pressure, $\bar{q}$ (lbs/ft ²)	144.9	92.7	30.4
C.G. location, fraction $\bar{c}$	27.0	27.0	27.0
Angle of attack, α_1 (deg)	0.7	2	4.2

Mass Data

W (lbs)	6,360	6,360	6,360
I_{xx_B} (slugft ²)	7,985	7,985	7,985
I_{yy_B} (slugft ²)	3,326	3,326	3,326
I_{zz_B} (slugft ²)	11,183	11,183	11,183
I_{xz_B} (slugft ²)	0	0	0

Table B4 (Continued) Stability and Control Derivatives for Airplane D (Pages 501–507)

Flight Condition	Climb	Cruise	Approach
<u>Steady State Coefficients</u>			
C_{L_1}	0.241	0.378	1.150
C_{D_1}	0.0220	0.0300	0.1580
$C_{T_{x_1}}$	0.0220	0.0300	0.1580
C_{m_1}	0	0	0
$C_{m_{T_1}}$	0	0	0
<u>Longitudinal Coefficients and Stability Derivatives (Stability Axes, Dimensionless)</u>			
C_{D_0}	0.0200	0.0200	0.0689
C_{D_u}	0	0	0
C_{D_α}	0.130	0.250	0.682
$C_{T_{x_u}}$	−0.05	−0.07	−0.40
C_{L_0}	0.19	0.20	0.81
C_{L_u}	0	0	0
C_{L_α}	4.81	5.15	4.64
$C_{L_{\dot{\alpha}}}$	1.8	2.0	1.8
C_{L_q}	3.7	4.1	3.7
C_{m_0}	0.025	0.025	0.10
C_{m_u}	0	0	0
C_{m_α}	−0.668	−0.700	−0.631
$C_{m_{\dot{\alpha}}}$	−6.64	−6.95	−6.84
C_{m_q}	−14.3	−14.9	−14.0
$C_{m_{T_u}}$	0	0	0
$C_{m_{T_\alpha}}$	0	0	0
<u>Longitudinal Control and Hinge Moment Derivatives (Stability Axes, 1/rad)</u>			
$C_{D_{\delta_e}}$	0	0	0
$C_{L_{\delta_e}}$	0.4	0.5	0.4
$C_{m_{\delta_e}}$	−1.07	−1.12	−1.05
$C_{D_{i_h}}$	not applicable		
$C_{L_{i_h}}$	not applicable		
$C_{m_{i_h}}$	not applicable		

Table B4 (Continued) Stability and Control Derivatives for Airplane D (Pages 501–507)

Flight Condition	Climb	Cruise	Approach
-------------------------	--------------	---------------	-----------------

Longitudinal Control and Hinge Moment Derivatives: Cont'd (Stability Axes, 1/rad)

C_{h_a}	-0.00784	-0.00775	-0.00739
$C_{h_{\delta_e}}$	-0.347	-0.497	-0.347

Lateral-Directional Stability Derivatives (Stability Axes, Dimensionless)

C_{l_β}	-0.0851	-0.0944	-0.0822
C_{l_p}	-0.440	-0.442	-0.458
C_{l_r}	0.0590	0.0926	0.2540
C_{y_β}	-0.361	-0.346	-0.303
C_{y_p}	-0.0635	-0.0827	-0.1908
C_{y_r}	0.314	0.300	0.263
C_{n_β}	0.1052	0.1106	0.1095
$C_{n_{T_\beta}}$	0	0	0
C_{n_p}	-0.0154	-0.0243	-0.0768
C_{n_r}	-0.1433	-0.1390	-0.1613

Lateral-Directional Control and Hinge Moment Derivatives (Stability Axes, Dimensionless)

$C_{l_{\delta_a}}$	0.1788	0.1810	0.1788
$C_{l_{\delta_r}}$	0.015	0.015	0.015
$C_{y_{\delta_a}}$	0	0	0
$C_{y_{\delta_r}}$	0.2	0.2	0.2
$C_{n_{\delta_a}}$	-0.0160	-0.0254	-0.0760
$C_{n_{\delta_r}}$	-0.0365	-0.0365	-0.0365
$C_{h_{\delta_a}}$	???	???	???
$C_{h_{\delta_r}}$	-0.226	-0.226	-0.226
$C_{h_{\beta_r}}$	0.1146	0.1146	0.1146
$C_{h_{\delta_r}}$	-0.372	-0.372	-0.372



Table B4 (Continued) Stability and Control Derivatives for Airplane D (Pages 501-507)**Longitudinal Transfer Function Data**

Altitude	=	30000 ft	M ₁	=	0.458
U ₁	=	270.14 kts	n	=	1.00 g
W _{current}	=	6360.0 lb	q _{bar}	=	92.58 psf
S _w	=	182.00 ft ²	(W/S) _{TO}	=	34.95 psf
Theta ₁	=	2.00 deg	X _u	=	-0.0111 1/s
C _{bar}	=	5.47 ft	X _{T_u}	=	-0.0019 1/s
I _{yy_B}	=	3326 slgft ²	X _a	=	10.8087 ft/s ²
C _{m_1}	=	0.0000	Z _u	=	-0.1400 1/s
C _{m_u}	=	0.0000	Z _a	=	-437.4153 ft/s ²
C _{m_a}	=	-0.7000 1/rad	Z _{a_dot}	=	-1.0131 ft/s
C _{m_a_dot}	=	-6.9500 1/rad	Z _q	=	-2.0768 ft/s
C _{m_q}	=	-14.9000 1/rad	M _u	=	0.0000 1/ft/s
C _{m_T_1}	=	0.0000	M _{T_u}	=	0.0000 1/ft/s
C _{m_T_u}	=	0.0000	M _a	=	-19.3979 1/s ²
C _{m_T_a}	=	0.0000	M _{T_a}	=	0.0000 1/s ²
C _{L_1}	=	0.3780	M _{a_dot}	=	-1.1553 1/s
C _{L_u}	=	0.0000	M _q	=	-2.4768 1/s
C _{L_a}	=	5.1500 1/rad	w _{n_SP}	=	4.6523 rad/s
C _{L_a_dot}	=	2.0000 1/rad	z _{SP}	=	0.4927
C _{L_q}	=	4.1000 1/rad	w _{n_P}	=	0.0934 rad/s
C _{D_1}	=	0.0300	z _P	=	0.0526
C _{D_a}	=	0.2500 1/rad	X _{del_e}	=	0.0000 ft/s ²
C _{D_u}	=	0.0000	Z _{del_e}	=	-42.2216 ft/s ²
C _{T_X_1}	=	0.0300	M _{del_e}	=	-31.0366 1/s ²
C _{T_X_u}	=	-0.0700			
C _{L_d_e}	=	0.5000 1/rad			
C _{D_d_e}	=	0.0000 1/rad			
C _{m_d_e}	=	-1.1200 1/rad			

POLYNOMIAL ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

$$\begin{aligned}
 & - 42.2216 S^3 - 14191.7548 S^2 - 149.4537 S - 137.9759 \\
 & + 456.9617 S^4 + 2099.4660 S^3 + 9914.8881 S^2 + 115.4904 S + 86.2350
 \end{aligned}$$

FACTORED ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

$$\begin{aligned}
 & -42.2216 (S + 336.1153)(S^2 + 0.0105 S + 0.0097) \\
 & 456.9617 (S^2 + 4.5846 S + 21.6436)(S^2 + 0.0098 S + 0.0087)
 \end{aligned}$$

$$\text{ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = -1.600000$$

POLYNOMIAL SPEED TO ELEVATOR TRANSFER FUNCTION

$$\begin{aligned}
 & - 456.3609 S^2 + 296829.8192 S + 406732.2497 \\
 & + 456.9617 S^4 + 2099.4660 S^3 + 9914.8881 S^2 + 115.4904 S + 86.2350
 \end{aligned}$$

Table B4 (Continued) Stability and Control Derivatives for Airplane D (Pages 501–507)

FACTORED SPEED TO ELEVATOR TRANSFER FUNCTION

$$-456.3609 (S - 651.7952)(S + 1.3674)$$

$$456.9617 (S^2 + 4.5846 S + 21.6436)(S^2 + 0.0098 S + 0.0087)$$

$$\text{SPEED TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = 4716.558886$$

POLYNOMIAL PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION

$$-14133.7557 S^2 - 12940.1035 S - 212.3526$$

$$+ 456.9617 S^4 + 2099.4660 S^3 + 9914.8881 S^2 + 115.4904 S + 86.2350$$

FACTORED PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION

$$-14133.7557 (S + 0.8988)(S + 0.0167)$$

$$456.9617 (S^2 + 4.5846 S + 21.6436)(S^2 + 0.0098 S + 0.0087)$$

$$\text{PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = -2.462488$$

Lateral–Directional Transfer Function Data

W _{current} =	6360.0 lb	(W/S) _{TO} =	34.95 psf
Altitude =	30000 ft	q _{bar} =	92.58 psf
S _w =	182.00 ft ²	I _{xx_S} =	7989 slgft ²
U ₁ =	270.14 kts	I _{zz_S} =	11179 slgft ²
Theta ₁ =	2.00 deg	I _{xz_S} =	-112 slgft ²
Alpha =	2.00 deg	Y _B =	-29.2173 ft/s ²
b _w =	33.80 ft	Y _p =	-0.2588 ft/s
I _{xx_B} =	7985 slgft ²	Y _r =	0.9390 ft/s
I _{zz_B} =	11183 slgft ²	L _B =	-6.7297 1/s ²
I _{xz_B} =	0 slgft ²	L _p =	-1.1679 1/s
C _{l_B} =	-0.0944 1/rad	L _r =	0.2447 1/s
C _{l_p} =	-0.4420 1/rad	N _B =	5.6345 1/s ²
C _{l_r} =	0.0926 1/rad	N _{T_B} =	0.0000 1/s ²
C _{n_B} =	0.1106 1/rad	N _p =	-0.0459 1/s
C _{n_T_B} =	0.0000	N _r =	-0.2625 1/s
C _{n_p} =	-0.0243 1/rad	w _{n_D} =	2.4092 rad/s
C _{n_r} =	-0.1390 1/rad	z _D =	0.0470
C _{y_B} =	-0.3460 1/rad	TC _{SPIRAL} =	271.310 s
C _{y_p} =	-0.0827 1/rad	TC _{ROLL} =	0.790 s
C _{y_r} =	0.3000 1/rad	TC ₁ =	0.790 s
C _{l_d_a} =	0.1810 1/rad	TC ₂ =	271.310 s
C _{l_d_r} =	0.0150 1/rad	Y _{del_a} =	0.0000 ft/s ²
C _{n_d_a} =	-0.0254 1/rad	Y _{del_r} =	16.8886 ft/s ²
C _{n_d_r} =	-0.0365 1/rad	L _{del_a} =	12.9033 1/s ²
C _{y_d_a} =	0.0000 1/rad	L _{del_r} =	1.0693 1/s ²
C _{y_d_r} =	0.2000 1/rad	N _{del_a} =	-1.2940 1/s ²
		N _{del_r} =	-1.8595 1/s ²

Table B4 (Continued) Stability and Control Derivatives for Airplane D (Pages 501–507)

POLYNOMIAL SIDESLIP TO AILERON TRANSFER FUNCTION

$$+ 644.0174 S^3 + 1367.8551 S^2 + 97.7970 S$$

$$+ 455.8852 S^5 + 682.2214 S^4 + 2779.2781 S^3 + 3360.8268 S^2 + 12.3497 S$$

FACTORED SIDESLIP TO AILERON TRANSFER FUNCTION

$$644.0174 \quad S(S + 2.0499)(S + 0.0741)$$

$$455.8852 \quad S(S + 1.2663)(S + 0.0037)(S^2 + 0.2265 S + 5.8041)$$

$$\text{SIDESLIP TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = 7.918973$$

POLYNOMIAL SIDESLIP TO RUDDER TRANSFER FUNCTION

$$+ 16.8863 S^4 + 874.8441 S^3 + 1050.7889 S^2 - 5.5526 S$$

$$+ 455.8852 S^5 + 682.2214 S^4 + 2779.2781 S^3 + 3360.8268 S^2 + 12.3497 S$$

FACTORED SIDESLIP TO RUDDER TRANSFER FUNCTION

$$16.8863 \quad S(S - 0.0053)(S + 50.5775)(S + 1.2357)$$

$$455.8852 \quad S(S + 1.2663)(S + 0.0037)(S^2 + 0.2265 S + 5.8041)$$

$$\text{SIDESLIP TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = -0.449612$$

POLYNOMIAL ROLL TO AILERON TRANSFER FUNCTION

$$+ 5891.4614 S^3 + 1777.3570 S^2 + 29208.1767 S$$

$$+ 455.8852 S^5 + 682.2214 S^4 + 2779.2781 S^3 + 3360.8268 S^2 + 12.3497 S$$

FACTORED ROLL TO AILERON TRANSFER FUNCTION

$$5891.4614 \quad S(S^2 + 0.3017 S + 4.9577)$$

$$455.8852 \quad S(S + 1.2663)(S + 0.0037)(S^2 + 0.2265 S + 5.8041)$$

$$\text{ROLL TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = 2365.091648$$

Table B4 (Continued) Stability and Control Derivatives for Airplane D (Pages 501–507)

POLYNOMIAL ROLL TO RUDDER TRANSFER FUNCTION

$$+ 499.3974 S^3 - 162.4592 S^2 - 2964.0008 S$$

$$+ 455.8852 S^5 + 682.2214 S^4 + 2779.2781 S^3 + 3360.8268 S^2 + 12.3497 S$$

FACTORED ROLL TO RUDDER TRANSFER FUNCTION

$$499.3974 \quad S(S - 2.6043)(S + 2.2790)$$

$$455.8852 \quad S(S + 1.2663)(S + 0.0037)(S^2 + 0.2265 S + 5.8041)$$

$$\text{ROLL TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = -240.005862$$

POLYNOMIAL HEADING TO AILERON TRANSFER FUNCTION

$$- 648.6980 S^3 - 1000.5959 S^2 - 78.0196 S + 2038.5145$$

$$+ 455.8852 S^5 + 682.2214 S^4 + 2779.2781 S^3 + 3360.8268 S^2 + 12.3497 S$$

FACTORED HEADING TO AILERON TRANSFER FUNCTION

$$-648.6980 \quad (S - 1.0733)(S^2 + 2.6158 S + 2.9278)$$

$$455.8852 \quad S(S + 1.2663)(S + 0.0037)(S^2 + 0.2265 S + 5.8041)$$

$$\text{HEADING TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = 165.065891$$

POLYNOMIAL HEADING TO RUDDER TRANSFER FUNCTION

$$- 852.6958 S^3 - 970.9207 S^2 + 53.1470 S - 206.6877$$

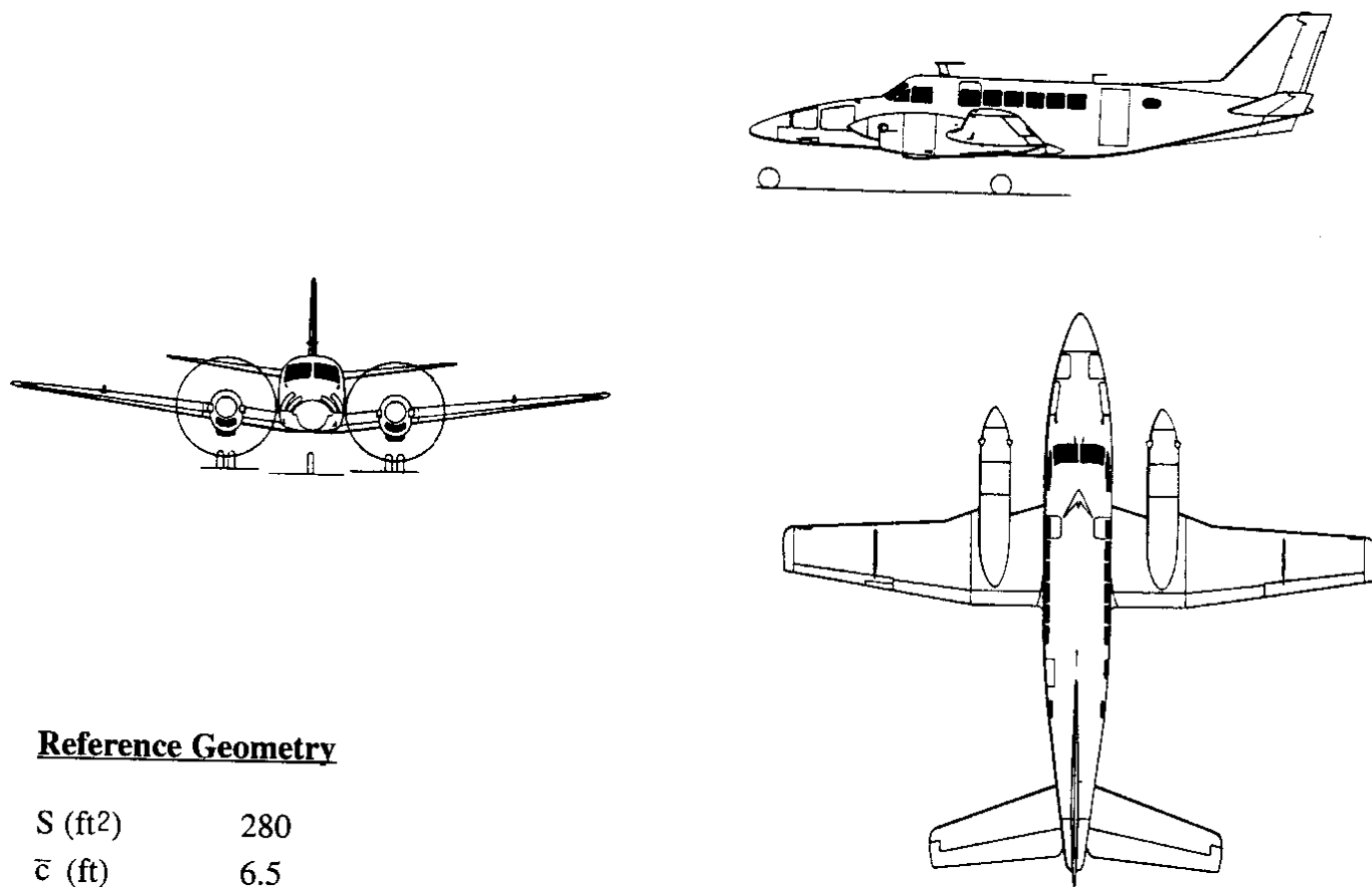
$$+ 455.8852 S^5 + 682.2214 S^4 + 2779.2781 S^3 + 3360.8268 S^2 + 12.3497 S$$

FACTORED HEADING TO RUDDER TRANSFER FUNCTION

$$-852.6958 \quad (S + 1.3240)(S^2 + -0.1854 S + 0.1831)$$

$$455.8852 \quad S(S + 1.2663)(S + 0.0037)(S^2 + 0.2265 S + 5.8041)$$

$$\text{HEADING TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = -16.736246$$

Table B5 Stability and Control Derivatives for Airplane E (Pages 508–514)**Three-view****Reference Geometry**

S (ft ²)	280
$\bar{c}$ (ft)	6.5
b (ft)	46

Flight Condition Data

	Approach	Cruise (low)	Cruise (high)
Altitude, h (ft)	0	5,000	20,000
Mach Number, M	0.152	0.310	0.434
TAS, U_1 (ft/sec)	170	340	450
Dynamic pressure, $\bar{q}$ (lbs/ft ²)	34.2	118.3	128.2
C.G. location, fraction $\bar{c}$	0.16	0.16	0.16
Angle of attack, α_1 (deg)	3.5	0	1.1

Mass Data

W (lbs)	11,000	7,000	11,000
I_{xx_B} (slugft ²)	15,189	10,085	15,189
I_{yy_B} (slugft ²)	20,250	15,148	20,250
I_{zz_B} (slugft ²)	34,141	23,046	34,141
I_{xz_B} (slugft ²)	4,371	1,600	4,371

Table B5 (Continued) Stability and Control Derivatives for Airplane E (Pages 508–514)

Flight Condition	Approach	Cruise (low)	Cruise (high)
<u>Steady State Coefficients</u>			
C_{L_1}	1.15	0.211	0.306
C_{D_1}	0.162	0.0298	0.0298
$C_{T_{x_1}}$	0.162	0.0298	0.0298
C_{m_1}	0	0	0
$C_{m_{T_1}}$	0	0	0
<u>Longitudinal Coefficients and Stability Derivatives (Stability Axes, Dimensionless)</u>			
C_{D_0}	0.0969	0.0270	0.0270
C_{D_u}	0	0	0
C_{D_α}	0.933	0.131	0.131
$C_{T_{x_u}}$	-0.324	-0.0596	-0.0596
C_{L_0}	0.760	0.201	0.201
C_{L_u}	0.027	0.020	0.020
C_{L_α}	6.24	5.48	5.48
$C_{L_{\dot{\alpha}}}$	2.7	2.5	2.5
C_{L_q}	8.1	8.1	8.1
C_{m_0}	0.10	0.05	0.05
C_{m_u}	0	0	0
C_{m_α}	-2.08	-1.89	-1.89
$C_{m_{\dot{\alpha}}}$	-9.1	-9.1	-9.1
C_{m_q}	-34.0	-34.0	-34.0
$C_{m_{T_u}}$	0	0	0
$C_{m_{T_\alpha}}$	0	0	0
<u>Longitudinal Control and Hinge Moment Derivatives (Stability Axes, 1/rad)</u>			
$C_{D_{\delta_e}}$	0	0	0
$C_{L_{\delta_e}}$	0.58	0.60	0.60
$C_{m_{\delta_e}}$	-1.9	-2.0	-2.0
$C_{D_{i_h}}$	0	0	0
$C_{L_{i_h}}$	1.3	1.35	1.35
$C_{m_{i_h}}$	-3.9	-4.1	-4.1

Table B5 (Continued) Stability and Control Derivatives for Airplane E (Pages 508–514)

Flight Condition	Approach	Cruise (low)	Cruise (high)
<u>Longitudinal Control and Hinge Moment Derivatives: Cont'd (Stability Axes, 1/rad)</u>			
C_{h_α}	???	???	???
$C_{h_{\delta_e}}$	???	???	???
<u>Lateral–Directional Stability Derivatives (Stability Axes, Dimensionless)</u>			
C_{l_β}	–0.13	–0.13	–0.13
C_{l_p}	–0.50	–0.50	–0.50
C_{l_r}	0.06	0.14	0.14
C_{y_β}	–0.59	–0.59	–0.59
C_{y_p}	–0.21	–0.19	–0.19
C_{y_r}	0.39	0.39	0.39
C_{n_β}	0.120	0.080	0.080
$C_{n_{T_\beta}}$	0	0	0
C_{n_p}	–0.005	0.019	0.019
C_{n_r}	–0.204	–0.197	–0.197
<u>Lateral–Directional Control and Hinge Moment Derivatives (Stability Axes, Dimensionless)</u>			
$C_{l_{\delta_a}}$	0.156	0.156	0.156
$C_{l_{\delta_r}}$	0.0087	0.0109	0.0106
$C_{y_{\delta_a}}$	0	0	0
$C_{y_{\delta_r}}$	0.144	0.148	0.144
$C_{n_{\delta_a}}$	–0.0012	–0.0012	–0.0012
$C_{n_{\delta_r}}$	–0.0763	–0.0772	–0.0758
$C_{h_{\alpha_a}}$	???	???	???
$C_{h_{\delta_a}}$	???	???	???
$C_{h_{\beta_r}}$	???	???	???
$C_{h_{\delta_r}}$	???	???	???

Table B5 (Continued) Stability and Control Derivatives for Airplane E (Pages 508–514)**Longitudinal Transfer Function Data**

Altitude	=	20000 ft	M ₁	=	0.434
U ₁	=	266.59 kts	n	=	1.00 g
W _{current}	=	11000.0 lb	q _{bar}	=	128.28 psf
S _w	=	280.00 ft ²	(w/S) _{TO}	=	39.29 psf
Theta ₁	=	1.10 deg	X _u	=	-0.0138 1/s
C _{bar}	=	6.50 ft	X _{T_u}	=	0.0000 1/s
I _{yy_B}	=	20250 slgft ²	X _a	=	18.2703 ft/s ²
C _{m_1}	=	0.0000	Z _u	=	-0.1466 1/s
C _{m_u}	=	0.0000	Z _a	=	-575.2323 ft/s ²
C _{m_a}	=	-1.8900 1/rad	Z _{a_dot}	=	-1.8852 ft/s
C _{m_a_dot}	=	-9.1000 1/rad	Z _q	=	-6.1082 ft/s
C _{m_q}	=	-34.0000 1/rad	M _u	=	0.0000 1/ft/s
C _{m_T_1}	=	0.0000	M _{T_u}	=	0.0000 1/ft/s
C _{m_T_u}	=	0.0000	M _a	=	-21.7904 1/s ²
C _{m_T_a}	=	0.0000	M _{T_a}	=	0.0000 1/s ²
C _{L_1}	=	0.3060	M _{a_dot}	=	-0.7578 1/s
C _{L_u}	=	0.0200	M _q	=	-2.8314 1/s
C _{L_a}	=	5.4800 1/rad	w _{n_SP}	=	5.0015 rad/s
C _{L_a_dot}	=	2.5000 1/rad	z _{SP}	=	0.4849
C _{L_q}	=	8.1000 1/rad	w _{n_P}	=	0.0950 rad/s
C _{D_1}	=	0.0298	z _P	=	0.0625
C _{D_a}	=	0.1310 1/rad	X _{del_e}	=	0.0000 ft/s ²
C _{D_u}	=	0.0000	Z _{del_e}	=	-62.6410 ft/s ²
C _{T_X_1}	=	0.0298	M _{del_e}	=	-23.0586 1/s ²
C _{T_X_u}	=	-0.0596			
C _{L_d_e}	=	0.6000 1/rad			
C _{D_d_e}	=	0.0000 1/rad			
C _{m_d_e}	=	-2.0000 1/rad			

POLYNOMIAL ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

$$- 62.6410 S^3 - 10412.5899 S^2 - 129.8301 S - 107.8977$$

$$+ 451.8346 S^4 + 2197.1573 S^3 + 11332.6989 S^2 + 154.0270 S + 101.9633$$

FACTORED ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

$$-62.6410 (S + 166.2140)(S^2 + 0.0124 S + 0.0104)$$

$$451.8346 (S^2 + 4.8509 S + 25.0149)(S^2 + 0.0119 S + 0.0090)$$

$$\text{ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = -1.058201$$

POLYNOMIAL SPEED TO ELEVATOR TRANSFER FUNCTION

$$- 1144.4693 S^2 + 141313.7394 S + 380639.6108$$

$$+ 451.8346 S^4 + 2197.1573 S^3 + 11332.6989 S^2 + 154.0270 S + 101.9633$$

Table B5 (Continued) Stability and Control Derivatives for Airplane E (Pages 508–514)

FACTORED SPEED TO ELEVATOR TRANSFER FUNCTION

$$-1144.4693 (S - 126.1126)(S + 2.6373)$$

$$451.8346 (S^2 + 4.8509 S + 25.0149)(S^2 + 0.0119 S + 0.0090)$$

$$\text{SPEED TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = 3733.103383$$

POLYNOMIAL PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION

$$-10371.2086 S^2 - 12042.5102 S - 226.3310$$

$$+ 451.8346 S^4 + 2197.1573 S^3 + 11332.6989 S^2 + 154.0270 S + 101.9633$$

FACTORED PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION

$$-10371.2086 (S + 1.1420)(S + 0.0191)$$

$$451.8346 (S^2 + 4.8509 S + 25.0149)(S^2 + 0.0119 S + 0.0090)$$

$$\text{PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = -2.219730$$

Lateral–Directional Transfer Function Data

W _{current} =	11000.0 lb	(W/S) _{TO} =	39.29 psf
Altitude =	20000 ft	q _{bar} =	128.28 psf
S _w =	280.00 ft ²	I _{xx} _S =	15028 slgft ²
U ₁ =	266.59 kts	I _{zz} _S =	34302 slgft ²
Theta ₁ =	1.10 deg	I _{xz} _S =	4004 slgft ²
Alpha =	1.10 deg	Y _B =	-61.5970 ft/s ²
b _w =	46.00 ft	Y _p =	-1.0140 ft/s
I _{xx} _B =	15189 slgft ²	Y _r =	2.0813 ft/s
I _{zz} _B =	34141 slgft ²	L _B =	-14.2925 1/s ²
I _{xz} _B =	4371 slgft ²	L _p =	-2.8100 1/s
C _l _B =	-0.1300 1/rad	L _r =	0.7868 1/s
C _l _p =	-0.5000 1/rad	N _B =	3.8534 1/s ²
C _l _r =	0.1400 1/rad	N _T _B =	0.0000 1/s ²
C _n _B =	0.0800 1/rad	N _p =	0.0468 1/s
C _n _T _B =	0.0000	N _r =	-0.4850 1/s
C _n _p =	0.0190 1/rad	w _n _D =	1.8740 rad/s
C _n _r =	-0.1970 1/rad	z _D =	0.0356
C _y _B =	-0.5900 1/rad	TC _{SPIRAL} =	40.169 s
C _y _p =	-0.1900 1/rad	TC _{ROLL} =	0.306 s
C _y _r =	0.3900 1/rad	TC ₁ =	0.306 s
C _l _d _a =	0.1560 1/rad	TC ₂ =	40.169 s
C _l _d _r =	0.0106 1/rad	Y _{del} _a =	0.0000 ft/s ²
C _n _d _a =	-0.0012 1/rad	Y _{del} _r =	15.0338 ft/s ²
C _n _d _r =	-0.0758 1/rad	L _{del} _a =	17.1510 1/s ²
C _y _d _a =	0.0000 1/rad	L _{del} _r =	1.1654 1/s ²
C _y _d _r =	0.1440 1/rad	N _{del} _a =	-0.0578 1/s ²
		N _{del} _r =	-3.6511 1/s ²

Table B5 (Continued) Stability and Control Derivatives for Airplane E (Pages 508–514)

POLYNOMIAL SIDESLIP TO AILERON TRANSFER FUNCTION

$$\frac{-888.1303 S^3 + 252.7854 S^2 + 264.4851 S}{+435.9557 S^5 + 1495.3368 S^4 + 1758.4115 S^3 + 5051.8377 S^2 + 124.6967 S}$$

FACTORED SIDESLIP TO AILERON TRANSFER FUNCTION

$$\frac{-888.1303 S(S - 0.7063)(S + 0.4216)}{435.9557 S(S + 3.2716)(S + 0.0249)(S^2 + 0.1335 S + 3.5119)}$$

$$\text{SIDESLIP TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = 2.121027$$

POLYNOMIAL SIDESLIP TO RUDDER TRANSFER FUNCTION

$$\frac{+14.5663 S^4 + 1622.0629 S^3 + 4598.9072 S^2 - 73.7606 S}{+435.9557 S^5 + 1495.3368 S^4 + 1758.4115 S^3 + 5051.8377 S^2 + 124.6967 S}$$

FACTORED SIDESLIP TO RUDDER TRANSFER FUNCTION

$$\frac{14.5663 S(S - 0.0159)(S + 108.4456)(S + 2.9277)}{435.9557 S(S + 3.2716)(S + 0.0249)(S^2 + 0.1335 S + 3.5119)}$$

$$\text{SIDESLIP TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = -0.591520$$

POLYNOMIAL ROLL TO AILERON TRANSFER FUNCTION

$$\frac{+7710.1719 S^3 + 4778.2179 S^2 + 29739.2664 S}{+435.9557 S^5 + 1495.3368 S^4 + 1758.4115 S^3 + 5051.8377 S^2 + 124.6967 S}$$

FACTORED ROLL TO AILERON TRANSFER FUNCTION

$$\frac{7710.1719 S(S^2 + 0.6197 S + 3.8571)}{435.9557 S(S + 3.2716)(S + 0.0249)(S^2 + 0.1335 S + 3.5119)}$$

$$\text{ROLL TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = 238.492770$$

Table B5 (Continued) Stability and Control Derivatives for Airplane E (Pages 508–514)

POLYNOMIAL ROLL TO RUDDER TRANSFER FUNCTION

$$+ 86.6662 S^3 - 1225.7765 S^2 - 21560.8896 S$$

$$+ 435.9557 S^5 + 1495.3368 S^4 + 1758.4115 S^3 + 5051.8377 S^2 + 124.6967 S$$

FACTORED ROLL TO RUDDER TRANSFER FUNCTION

$$86.6662 \quad S(S - 24.3574)(S + 10.2138)$$

$$435.9557 \quad S(S + 3.2716)(S + 0.0249)(S^2 + 0.1335 S + 3.5119)$$

$$\text{ROLL TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = -172.906628$$

POLYNOMIAL HEADING TO AILERON TRANSFER FUNCTION

$$+ 874.8018 S^3 + 407.6949 S^2 - 26.7579 S + 2086.3085$$

$$+ 435.9557 S^5 + 1495.3368 S^4 + 1758.4115 S^3 + 5051.8377 S^2 + 124.6967 S$$

FACTORED HEADING TO AILERON TRANSFER FUNCTION

$$874.8018 \quad (S + 1.5193)(S^2 + -1.0533 S + 1.5697)$$

$$435.9557 \quad S(S + 3.2716)(S + 0.0249)(S^2 + 0.1335 S + 3.5119)$$

$$\text{HEADING TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = 16.731062$$

POLYNOMIAL HEADING TO RUDDER TRANSFER FUNCTION

$$- 1581.6056 S^3 - 4775.3808 S^2 - 427.5017 S - 1524.6101$$

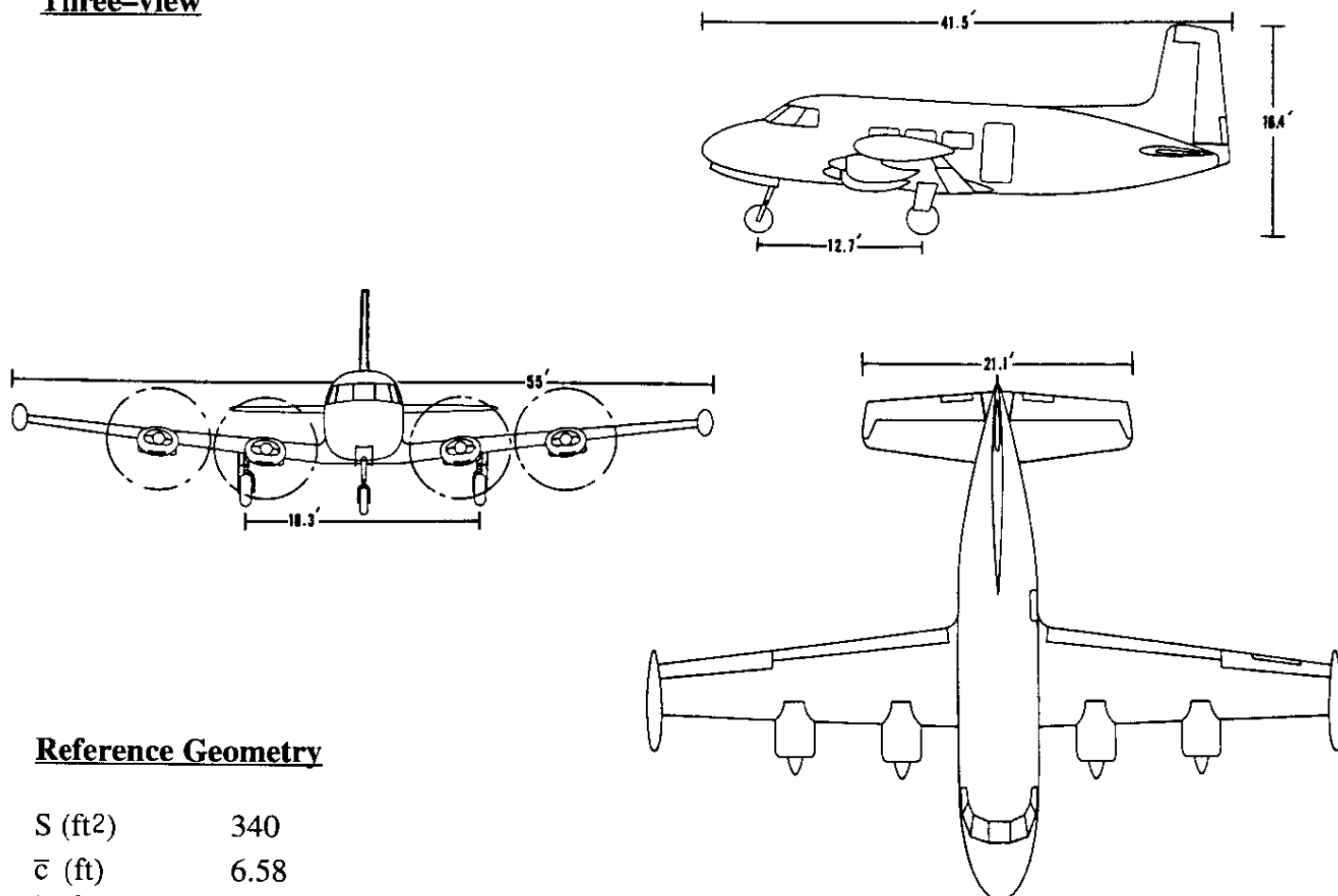
$$+ 435.9557 S^5 + 1495.3368 S^4 + 1758.4115 S^3 + 5051.8377 S^2 + 124.6967 S$$

FACTORED HEADING TO RUDDER TRANSFER FUNCTION

$$-1581.6056 \quad (S + 3.0349)(S^2 + -0.0156 S + 0.3176)$$

$$435.9557 \quad S(S + 3.2716)(S + 0.0249)(S^2 + 0.1335 S + 3.5119)$$

$$\text{HEADING TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = -12.226545$$

Table B6 Stability and Control Derivatives for Airplane F (Pages 515–521)**Three-view****Reference Geometry**

S (ft ²)	340
$\bar{c}$ (ft)	6.58
b (ft)	55.1

Flight Condition Data

	Climb	Cruise	Approach
Altitude, h (ft)	0	18,000	0
Mach Number, M	0.181	0.351	0.170
TAS, U_1 (ft/sec)	202.4	366.8	189.2
Dynamic pressure, $\bar{q}$ (lbs/ft ²)	48.7	91.1	42.6
C.G. location, fraction $\bar{c}$	0.25	0.25	0.25
Angle of attack, α_1 (deg)	5	0	6

Mass Data

W (lbs)	15,000	15,000	15,000
I_{xx_B} (slugft ²)	64,811	64,811	64,811
I_{yy_B} (slugft ²)	17,300	17,300	17,300
I_{zz_B} (slugft ²)	64,543	64,543	64,543
I_{xz_B} (slugft ²)	0	0	0

Table B6 (Continued) Stability and Control Derivatives for Airplane F (Pages 515–521)

Flight Condition	Climb	Cruise	Approach
<u>Steady State Coefficients</u>			
C_{L_1}	0.903	0.484	1.038
C_{D_1}	0.0750	0.0420	0.1140
$C_{T_{x_1}}$	0.0750	0.0420	0.1140
C_{m_1}	0	0	0
$C_{m_{T_1}}$	0	0	0
<u>Longitudinal Coefficients and Stability Derivatives (Stability Axes, Dimensionless)</u>			
C_{D_0}	0.0408	0.0322	0.0628
C_{D_u}	0	0	0
C_{D_α}	0.527	0.269	0.475
$C_{T_{x_u}}$	-0.225	-0.126	-0.342
C_{L_0}	0.43	0.48	0.48
C_{L_u}	0	0	0
C_{L_α}	5.38	5.55	5.38
$C_{L_{\dot{\alpha}}}$	3.3	2.7	2.7
C_{L_q}	8.0	7.5	7.6
C_{m_0}	0.06	0.06	0.09
C_{m_u}	0	0	0
C_{m_α}	-1.06	-1.18	-1.00
$C_{m_{\dot{\alpha}}}$	-10.3	-8.17	-8.68
C_{m_q}	-24.7	-22.4	-22.8
$C_{m_{T_u}}$	0	0	0
$C_{m_{T_\alpha}}$	0	0	0
<u>Longitudinal Control and Hinge Moment Derivatives (Stability Axes, 1/rad)</u>			
$C_{D_{\delta_e}}$	0	0	0
$C_{L_{\delta_e}}$	0.63	0.58	0.59
$C_{m_{\delta_e}}$	-1.90	-1.73	-1.75
$C_{D_{i_h}}$	not applicable		
$C_{L_{i_h}}$	not applicable		
$C_{m_{i_h}}$	not applicable		

Table B6 (Continued) Stability and Control Derivatives for Airplane F (Pages 515–521)

Flight Condition	Climb	Cruise	Approach
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Longitudinal Control and Hinge Moment Derivatives: Cont'd (Stability Axes, 1/rad)

C_{h_α}	0	0	0
$C_{h_{\delta_e}}$	-0.178	-0.212	-0.212

Lateral-Directional Stability Derivatives (Stability Axes, Dimensionless)

C_{l_β}	-0.1080	-0.1381	-0.1172
C_{l_p}	-0.570	-0.566	-0.576
C_{l_r}	0.2176	0.1166	0.2307
C_{y_β}	-0.886	-0.883	-0.907
C_{y_p}	-0.315	-0.227	-0.343
C_{y_r}	0.448	0.448	0.447
C_{n_β}	0.1848	0.1739	0.1871
$C_{n_{T_\beta}}$	0	0	0
C_{n_p}	-0.0924	-0.0501	-0.1026
C_{n_r}	-0.208	-0.200	-0.224

Lateral-Directional Control and Hinge Moment Derivatives (Stability Axes, Dimensionless)

$C_{l_{\delta_a}}$	0.1776	0.1776	0.1776
$C_{l_{\delta_r}}$	0.0200	0.0200	0.0200
$C_{y_{\delta_a}}$	0	0	0
$C_{y_{\delta_r}}$	0.20	0.20	0.20
$C_{n_{\delta_a}}$	-0.0367	-0.0194	-0.0417
$C_{n_{\delta_r}}$	-0.1054	-0.1054	-0.1054
$C_{h_{\alpha_a}}$	???	???	???
$C_{h_{\delta_a}}$	-0.462	-0.376	-0.462
$C_{h_{\beta_r}}$	0.0602	0.0602	0.0602
$C_{h_{\delta_r}}$	-0.588	-0.537	-0.588

Table B6 (Continued) Stability and Control Derivatives for Airplane F (Pages 515-521)**Longitudinal Transfer Function Data**

Altitude	=	0 ft	M_1	=	0.169
U_1	=	112.09 kts	n	=	1.00 g
W_current	=	15000.0 lb	q_bar	=	42.53 psf
S_w	=	340.00 ft^2	(W/S)_TO	=	44.12 psf
Theta_1	=	6.00 deg	X_u	=	-0.0374 1/s
C_bar	=	6.58 ft	X_T_u	=	-0.0187 1/s
I_yy_B	=	17300 slgft2	X_a	=	17.4632 ft/s^2
C_m_1	=	0.0000	Z_u	=	-0.3404 1/s
C_m_u	=	0.0000	Z_a	=	-170.4133 ft/s^2
C_m_a	=	-1.0000 1/rad	Z_a_dot	=	-1.4565 ft/s
C_m_a.dot	=	-8.6800 1/rad	Z_q	=	-4.0997 ft/s
C_m_q	=	-22.8000 1/rad	M_u	=	0.0000 1/ft/s
C_m_T_1	=	0.0000	M_T_u	=	0.0000 1/ft/s
C_m_T_u	=	0.0000	M_a	=	-5.5002 1/s^2
C_m_T_a	=	0.0000	M_T_a	=	0.0000 1/s^2
C_L_1	=	1.0380	M_a_dot	=	-0.8303 1/s
C_L_u	=	0.0000	M_q	=	-2.1809 1/s
C_L_a	=	5.3800 1/rad	w_n_SP	=	2.7097 rad/s
C_L_a.dot	=	2.7000 1/rad	z_SP	=	0.7199
C_L_q	=	7.6000 1/rad	w_n_P	=	0.2051 rad/s
C_D_1	=	0.1140	z_P	=	0.0871
C_D_a	=	0.4750 1/rad	X_del_e	=	0.0000 ft/s^2
C_D_u	=	0.0000	Z_del_e	=	-18.3007 ft/s^2
C_T_X_1	=	0.1140	M_del_e	=	-9.6254 1/s^2
C_T_X_u	=	-0.3420			
C_L_d_e	=	0.5900 1/rad			
C_D_d_e	=	0.0000 1/rad			
C_m_d_e	=	-1.7500 1/rad			

POLYNOMIAL ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

$$- 18.3007 S^3 - 1822.3980 S^2 - 69.7621 S - 103.0202$$

$$+ 190.6352 S^4 + 750.5300 S^3 + 1434.2726 S^2 + 81.2760 S + 58.8687$$

FACTORED ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

$$-18.3007 (S + 99.5433)(S^2 + 0.0377 S + 0.0566)$$

$$190.6352 (S^2 + 3.9013 S + 7.3422)(S^2 + 0.0357 S + 0.0421)$$

$$\text{ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = -1.750000$$

POLYNOMIAL SPEED TO ELEVATOR TRANSFER FUNCTION

$$- 319.5876 S^2 + 26420.8184 S + 49830.2577$$

$$+ 190.6352 S^4 + 750.5300 S^3 + 1434.2726 S^2 + 81.2760 S + 58.8687$$

Table B6 (Continued) Stability and Control Derivatives for Airplane F (Pages 515–521)

FACTORED SPEED TO ELEVATOR TRANSFER FUNCTION

$$-319.5876 (S - 84.5164)(S + 1.8449)$$

$$190.6352 (S^2 + 3.9013 S + 7.3422)(S^2 + 0.0357 S + 0.0421)$$

$$\text{SPEED TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = 846.464416$$

POLYNOMIAL PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION

$$-1819.7453 S^2 - 1641.6803 S - 143.5503$$

$$+ 190.6352 S^4 + 750.5300 S^3 + 1434.2726 S^2 + 81.2760 S + 58.8687$$

FACTORED PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION

$$-1819.7453 (S + 0.8040)(S + 0.0981)$$

$$190.6352 (S^2 + 3.9013 S + 7.3422)(S^2 + 0.0357 S + 0.0421)$$

$$\text{PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = -2.438483$$

Lateral-Directional Transfer Function Data

W _{current} =	15000.0 lb	(W/S) _{TO} =	44.12 psf
Altitude =	0 ft	q _{bar} =	42.53 psf
S _w =	340.00 ft ²	I _{xx_S} =	64808 slgft ²
U ₁ =	112.09 kts	I _{zz_S} =	64546 slgft ²
Theta ₁ =	6.00 deg	I _{xz_S} =	28 slgft ²
Alpha =	6.00 deg	Y _B =	-28.1334 ft/s ²
b _w =	55.10 ft	Y _p =	-1.5494 ft/s
I _{xx_B} =	64811 slgft ²	Y _r =	2.0192 ft/s
I _{zz_B} =	64543 slgft ²	L _B =	-1.4410 1/s ²
I _{xz_B} =	0 slgft ²	L _p =	-1.0313 1/s
C _{l_B} =	-0.1172 1/rad	L _r =	0.4131 1/s
C _{l_p} =	-0.5760 1/rad	N _B =	2.3097 1/s ²
C _{l_r} =	0.2307 1/rad	N _{T_B} =	0.0000 1/s ²
C _{n_B} =	0.1871 1/rad	N _p =	-0.1845 1/s
C _{n_T_B} =	0.0000	N _r =	-0.4027 1/s
C _{n_p} =	-0.1026 1/rad	w _{n_D} =	1.5875 rad/s
C _{n_r} =	-0.2240 1/rad	z _D =	0.1298
C _{y_B} =	-0.9070 1/rad	TC_SPIRAL =	-47.494 s
C _{y_p} =	-0.3430 1/rad	TC_ROLL =	0.839 s
C _{y_r} =	0.4470 1/rad	TC ₁ =	0.839 s
C _{l_d_a} =	0.1776 1/rad	TC ₂ =	-47.494 s
C _{l_d_r} =	0.0200 1/rad	Y _{del_a} =	0.0000 ft/s ²
C _{n_d_a} =	-0.0417 1/rad	Y _{del_r} =	6.2036 ft/s ²
C _{n_d_r} =	-0.1054 1/rad	L _{del_a} =	2.1836 1/s ²
C _{y_d_a} =	0.0000 1/rad	L _{del_r} =	0.2459 1/s ²
C _{y_d_r} =	0.2000 1/rad	N _{del_a} =	-0.5148 1/s ²
		N _{del_r} =	-1.3011 1/s ²

Table B6 (Continued) Stability and Control Derivatives for Airplane F (Pages 515–521)

POLYNOMIAL SIDESLIP TO AILERON TRANSFER FUNCTION

$$+ 92.7863 S^3 + 243.5732 S^2 + 21.3324 S$$

$$+ 189.1787 S^5 + 299.4014 S^4 + 563.2602 S^3 + 556.0521 S^2 - 11.9605 S$$

FACTORED SIDESLIP TO AILERON TRANSFER FUNCTION

$$92.7863 \quad S(S + 2.5344)(S + 0.0907)$$

$$189.1787 \quad S(S - 0.0211)(S + 1.1915)(S^2 + 0.4122 S + 2.5201)$$

SIDESLIP TO AILERON TRANSFER FUNCTION $K_{\text{gain}} = -1.783567$

POLYNOMIAL SIDESLIP TO RUDDER TRANSFER FUNCTION

$$+ 6.2036 S^4 + 252.0165 S^3 + 271.2165 S^2 - 14.0290 S$$

$$+ 189.1787 S^5 + 299.4014 S^4 + 563.2602 S^3 + 556.0521 S^2 - 11.9605 S$$

FACTORED SIDESLIP TO RUDDER TRANSFER FUNCTION

$$6.2036 \quad S(S - 0.0495)(S + 39.5163)(S + 1.1573)$$

$$189.1787 \quad S(S - 0.0211)(S + 1.1915)(S^2 + 0.4122 S + 2.5201)$$

SIDESLIP TO RUDDER TRANSFER FUNCTION $K_{\text{gain}} = 1.172940$

POLYNOMIAL ROLL TO AILERON TRANSFER FUNCTION

$$+ 413.0424 S^3 + 187.5472 S^2 + 823.8478 S$$

$$+ 189.1787 S^5 + 299.4014 S^4 + 563.2602 S^3 + 556.0521 S^2 - 11.9605 S$$

FACTORED ROLL TO AILERON TRANSFER FUNCTION

$$413.0424 \quad S(S^2 + 0.4541 S + 1.9946)$$

$$189.1787 \quad S(S - 0.0211)(S + 1.1915)(S^2 + 0.4122 S + 2.5201)$$

ROLL TO AILERON TRANSFER FUNCTION $K_{\text{gain}} = -68.880671$

Table B6 (Continued) Stability and Control Derivatives for Airplane F (Pages 515–521)

POLYNOMIAL ROLL TO RUDDER TRANSFER FUNCTION

$$+ 46.4127 S^3 - 84.9735 S^2 - 254.6216 S$$

$$+ 189.1787 S^5 + 299.4014 S^4 + 563.2602 S^3 + 556.0521 S^2 - 11.9605 S$$

FACTORED ROLL TO RUDDER TRANSFER FUNCTION

$$46.4127 \quad S(S - 3.4302)(S + 1.5993)$$

$$189.1787 \quad S(S - 0.0211)(S + 1.1915)(S^2 + 0.4122 S + 2.5201)$$

$$\text{ROLL TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = 21.288527$$

POLYNOMIAL HEADING TO AILERON TRANSFER FUNCTION

$$- 97.2067 S^3 - 191.0852 S^2 - 32.9320 S + 137.6426$$

$$+ 189.1787 S^5 + 299.4014 S^4 + 563.2602 S^3 + 556.0521 S^2 - 11.9605 S$$

FACTORED HEADING TO AILERON TRANSFER FUNCTION

$$-97.2067 \quad (S - 0.6713)(S^2 + 2.6371 S + 2.1092)$$

$$189.1787 \quad S(S - 0.0211)(S + 1.1915)(S^2 + 0.4122 S + 2.5201)$$

$$\text{HEADING TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = -11.508088$$

POLYNOMIAL HEADING TO RUDDER TRANSFER FUNCTION

$$- 246.1281 S^3 - 284.7168 S^2 - 20.5770 S - 41.8190$$

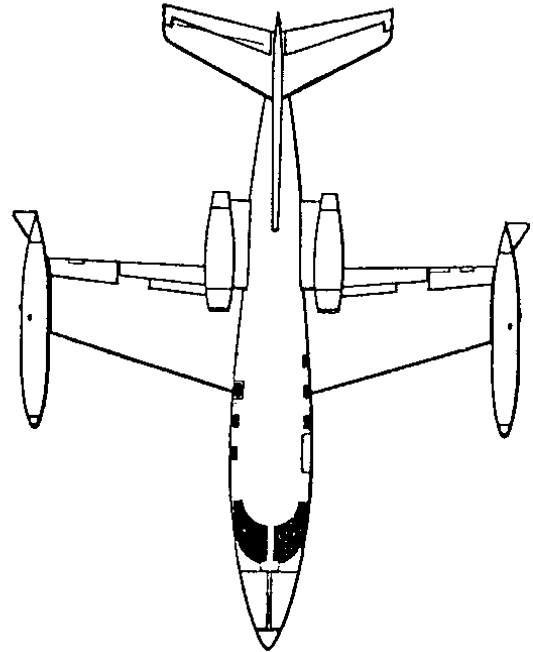
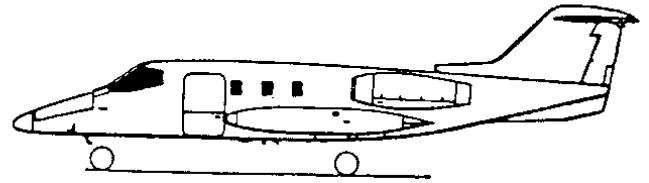
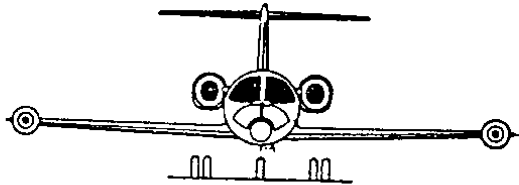
$$+ 189.1787 S^5 + 299.4014 S^4 + 563.2602 S^3 + 556.0521 S^2 - 11.9605 S$$

FACTORED HEADING TO RUDDER TRANSFER FUNCTION

$$-246.1281 \quad (S + 1.2045)(S^2 + -0.0477 S + 0.1411)$$

$$189.1787 \quad S(S - 0.0211)(S + 1.1915)(S^2 + 0.4122 S + 2.5201)$$

$$\text{HEADING TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = 3.496427$$

Table B7 **Stability and Control Derivatives for Airplane G (Pages 522–528)****Three-view****Reference Geometry**

S (ft ²)	230
$\bar{c}$ (ft)	7.0
b (ft)	34.0

Flight Condition Data

	Approach	Cruise (Max Wht)	Cruise(Low Wht)
Altitude, h (ft)	0	40,000	40,000
Mach Number, M	0.152	0.7	0.7
TAS, U_1 (ft/sec)	170	677	677
Dynamic pressure, $\bar{q}$ (lbs/ft ²)	34.3	134.6	134.6
C.G. location, fraction $\bar{c}$	0.32	0.32	0.32
Angle of attack, α_1 (deg)	5.0	2.7	1.5

Mass Data

W (lbs)	13,000	13,000	9,000
I_{xx_B} (slugft ²)	28,000	28,000	6,000
I_{yy_B} (slugft ²)	18,800	18,800	17,800
I_{zz_B} (slugft ²)	47,000	47,000	25,000
I_{xz_B} (slugft ²)	1,300	1,300	1,400

Table B7 (Continued) Stability and Control Derivatives for Airplane G (Pages 522–528)

<u>Flight Condition</u>	Approach	Cruise (Max Wht)	Cruise(Low Wht)
<u>Steady State Coefficients</u>			
C_{L_1}	1.64	0.41	0.28
C_{D_1}	0.2560	0.0335	0.0279
$C_{T_{x_1}}$	0.2560	0.0335	0.0279
C_{m_1}	0	0	0
$C_{m_{T_1}}$	0	0	0
<u>Longitudinal Coefficients and Stability Derivatives (Stability Axes, Dimensionless)</u>			
C_{D_0}	0.0431	0.0216	0.0216
C_{D_u}	0	0.104	0.104
C_{D_α}	1.06	0.30	0.22
$C_{T_{xu}}$	-0.60	-0.07	-0.07
C_{L_0}	1.2	0.13	0.13
C_{L_u}	0.04	0.40	0.28
C_{L_α}	5.04	5.84	5.84
$C_{L_{\dot{\alpha}}}$	1.6	2.2	2.2
C_{L_q}	4.1	4.7	4.7
C_{m_0}	0.047	0.050	0.050
C_{m_u}	-0.01	0.050	0.070
C_{m_α}	-0.66	-0.64	-0.64
$C_{m_{\dot{\alpha}}}$	-5.0	-6.7	-6.7
C_{m_q}	-13.5	-15.5	-15.5
$C_{m_{T_u}}$	0.006	-0.003	-0.003
$C_{m_{T_\alpha}}$	0	0	0
<u>Longitudinal Control and Hinge Moment Derivatives (Stability Axes, 1/rad)</u>			
$C_{D_{\delta_e}}$	0	0	0
$C_{L_{\delta_e}}$	0.40	0.46	0.46
$C_{m_{\delta_e}}$	-0.98	-1.24	-1.24
$C_{D_{i_h}}$	0	0	0
$C_{L_{i_h}}$	0.85	0.94	0.94
$C_{m_{i_h}}$	-2.1	-2.5	-2.5

Table B7 (Continued) Stability and Control Derivatives for Airplane G (Pages 522–528)

Flight Condition	Approach	Cruise (Max Wht)	Cruise(Low Wht)
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Longitudinal Control and Hinge Moment Derivatives: Cont'd (Stability Axes, 1/rad)

$C_{h_{\alpha}}$	-0.105	-0.132	-0.132
$C_{h_{\delta_c}}$	-0.378	-0.476	-0.476

Lateral-Directional Stability Derivatives (Stability Axes, Dimensionless)

$C_{l_{\beta}}$	-0.173	-0.110	-0.100
C_{l_p}	-0.390	-0.450	-0.450
C_{l_r}	0.450	0.160	0.140
$C_{y_{\beta}}$	-0.730	-0.730	-0.730
C_{y_p}	0	0	0
C_{y_r}	0.400	0.400	0.400
$C_{n_{\beta}}$	0.150	0.127	0.124
$C_{n_{r_{\beta}}}$	0	0	0
C_{n_p}	-0.130	-0.008	-0.022
C_{n_r}	-0.260	-0.200	-0.200

Lateral-Directional Control and Hinge Moment Derivatives (Stability Axes, Dimensionless)

$C_{l_{\delta_a}}$	0.149	0.178	0.178
$C_{l_{\delta_r}}$	0.014	0.019	0.021
$C_{y_{\delta_a}}$	0	0	0
$C_{y_{\delta_r}}$	0.140	0.140	0.140
$C_{n_{\delta_a}}$	-0.050	-0.020	-0.020
$C_{n_{\delta_r}}$	-0.074	-0.074	-0.074
$C_{h_{\alpha_a}}$	???	???	???
$C_{h_{\delta_a}}$	???	???	???
$C_{h_{\beta_r}}$	???	???	???
$C_{h_{\delta_r}}$	???	???	???

Table B7 (Continued) Stability and Control Derivatives for Airplane G (Pages 522-528)**Longitudinal Transfer Function Data**

Altitude	=	0 ft	M_1	=	0.152
U_1	=	100.71 kts	n	=	1.00 g
W_current	=	13000.0 lb	q_bar	=	34.34 psf
S_w	=	230.00 ft^2	(W/S)_TO	=	56.52 psf
Theta_1	=	5.00 deg	X_u	=	-0.0589 1/s
C_bar	=	7.00 ft	X_T_u	=	-0.0101 1/s
I_yy_B	=	18800 slgft2	X_a	=	11.3367 ft/s^2
C_m_1	=	0.0000	Z_u	=	-0.3818 1/s
C_m_u	=	-0.0100	Z_a	=	-103.5160 ft/s^2
C_m_a	=	-0.6600 1/rad	Z_a_dot	=	-0.6439 ft/s
C_m_a.dot	=	-5.0000 1/rad	Z_q	=	-1.6501 ft/s
C_m_q	=	-13.5000 1/rad	M_u	=	-0.0002 1/ft/s
C_m_T_1	=	0.0000	M_T_u	=	0.0001 1/ft/s
C_m_T_u	=	0.0060	M_a	=	-1.9408 1/s^2
C_m_T_a	=	0.0000	M_T_a	=	0.0000 1/s^2
C_L_1	=	1.6400	M_a_dot	=	-0.3027 1/s
C_L_u	=	0.0400	M_q	=	-0.8174 1/s
C_L_a	=	5.0400 1/rad			
C_L_a.dot	=	1.6000 1/rad	w_n_SP	=	1.5616 rad/s
C_L_q	=	4.1000 1/rad	z_SP	=	0.5636
C_D_1	=	0.2560	w_n_P	=	0.2358 rad/s
C_D_a	=	1.0600 1/rad	z_P	=	0.0671
C_D_u	=	0.0000	X_del_e	=	0.0000 ft/s^2
C_T_X_1	=	0.2560	Z_del_e	=	-7.8184 ft/s^2
C_T_X_u	=	-0.6000	M_del_e	=	-2.8818 1/s^2
C_L_d_e	=	0.4000 1/rad			
C_D_d_e	=	0.0000 1/rad			
C_m_d_e	=	-0.9800 1/rad			

POLYNOMIAL ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

$$- 7.8184 S^3 - 492.0217 S^2 - 25.8286 S - 34.6877$$

$$+ 170.6233 S^4 + 305.7196 S^3 + 435.0697 S^2 + 29.8732 S + 23.1410$$

FACTORED ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

$$-7.8184 (S + 62.8796) (S^2 + 0.0514 S + 0.0706)$$

$$170.6233 (S^2 + 1.7601 S + 2.4386) (S^2 + 0.0317 S + 0.0556)$$

$$\text{ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = -1.498972$$

POLYNOMIAL SPEED TO ELEVATOR TRANSFER FUNCTION

$$- 88.6353 S^2 + 10112.1693 S + 9166.6414$$

$$+ 170.6233 S^4 + 305.7196 S^3 + 435.0697 S^2 + 29.8732 S + 23.1410$$

Table B7 (Continued) Stability and Control Derivatives for Airplane G (Pages 522-528)

FACTORED SPEED TO ELEVATOR TRANSFER FUNCTION

$$-88.6353 (S - 114.9868)(S + 0.8994)$$

$$170.6233 (S^2 + 1.7601 S + 2.4386)(S^2 + 0.0317 S + 0.0556)$$

SPEED TO ELEVATOR TRANSFER FUNCTION $K_{\text{gain}} = 396.120995$

POLYNOMIAL PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION

$$-489.3354 S^2 - 316.8998 S - 32.0013$$

$$+ 170.6233 S^4 + 305.7196 S^3 + 435.0697 S^2 + 29.8732 S + 23.1410$$

FACTORED PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION

$$-489.3354 (S + 0.5224)(S + 0.1252)$$

$$170.6233 (S^2 + 1.7601 S + 2.4386)(S^2 + 0.0317 S + 0.0556)$$

PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION $K_{\text{gain}} = -1.382884$ **Lateral-Directional Transfer Function Data**

W _{current} =	13000.0 lb	(W/S) _{TO} =	56.52 psf
Altitude =	0 ft	q _{bar} =	34.34 psf
S _w =	230.00 ft ²	I _{xx_S} =	27919 slgft ²
U ₁ =	100.71 kts	I _{zz_S} =	47081 slgft ²
Theta ₁ =	5.00 deg	I _{xz_S} =	-369 slgft ²
Alpha =	5.00 deg	Y _B =	-14.2686 ft/s ²
b _w =	34.00 ft	Y _P =	0.0000 ft/s
I _{xx_B} =	28000 slgft ²	Y _r =	0.7819 ft/s
I _{zz_B} =	47000 slgft ²	L _B =	-1.6639 1/s ²
I _{xz_B} =	1300 slgft ²	L _p =	-0.3751 1/s
C _{l_B} =	-0.1730 1/rad	L _r =	0.4329 1/s
C _{l_p} =	-0.3900 1/rad	N _B =	0.8555 1/s ²
C _{l_r} =	0.4500 1/rad	N _{T_B} =	0.0000 1/s ²
C _{n_B} =	0.1500 1/rad	N _p =	-0.0742 1/s
C _{n_T_B} =	0.0000	N _r =	-0.1483 1/s
C _{n_p} =	-0.1300 1/rad	w _{n_D} =	1.0413 rad/s
C _{n_r} =	-0.2600 1/rad	z _D =	-0.0453
C _{y_B} =	-0.7300 1/rad	TC _{SPIRAL} =	-34.137 s
C _{y_p} =	0.0000 1/rad	TC _{ROLL} =	1.363 s
C _{y_r} =	0.4000 1/rad	Y _{del_a} =	0.0000 ft/s ²
C _{l_d_a} =	0.1490 1/rad	Y _{del_r} =	2.7364 ft/s ²
C _{l_d_r} =	0.0140 1/rad	L _{del_a} =	1.4331 1/s ²
C _{n_d_a} =	-0.0500 1/rad	L _{del_r} =	0.1347 1/s ²
C _{n_d_r} =	-0.0740 1/rad	N _{del_a} =	-0.2852 1/s ²
C _{y_d_a} =	0.0000 1/rad	N _{del_r} =	-0.4220 1/s ²
C _{y_d_r} =	0.1400 1/rad		

Table B7 (Continued) Stability and Control Derivatives for Airplane G (Pages 522–528)

POLYNOMIAL SIDESLIP TO AILERON TRANSFER FUNCTION

$$+ 50.1518 S^3 + 82.1337 S^2 + 2.8556 S$$

$$+ 169.9617 S^5 + 103.6534 S^4 + 169.3730 S^3 + 130.1231 S^2 - 3.9599 S$$

FACTORED SIDESLIP TO AILERON TRANSFER FUNCTION

$$50.1518 \quad S(S + 1.6022)(S + 0.0355)$$

$$169.9617 \quad S(S - 0.0293)(S + 0.7334)(S^2 + -0.0943 S + 1.0844)$$

$$\text{SIDESLIP TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = -0.721137$$

POLYNOMIAL SIDESLIP TO RUDDER TRANSFER FUNCTION

$$+ 2.7362 S^4 + 73.0267 S^3 + 33.2130 S^2 - 5.2154 S$$

$$+ 169.9617 S^5 + 103.6534 S^4 + 169.3730 S^3 + 130.1231 S^2 - 3.9599 S$$

FACTORED SIDESLIP TO RUDDER TRANSFER FUNCTION

$$2.7362 \quad S(S - 0.1234)(S + 26.2238)(S + 0.5890)$$

$$169.9617 \quad S(S - 0.0293)(S + 0.7334)(S^2 + -0.0943 S + 1.0844)$$

$$\text{SIDESLIP TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = 1.317052$$

POLYNOMIAL BANK ANGLE TO AILERON TRANSFER FUNCTION

$$+ 244.2348 S^3 + 35.6460 S^2 + 128.4237 S$$

$$+ 169.9617 S^5 + 103.6534 S^4 + 169.3730 S^3 + 130.1231 S^2 - 3.9599 S$$

FACTORED BANK ANGLE TO AILERON TRANSFER FUNCTION

$$244.2348 \quad S(S^2 + 0.1459 S + 0.5258)$$

$$169.9617 \quad S(S - 0.0293)(S + 0.7334)(S^2 + -0.0943 S + 1.0844)$$

$$\text{BANK ANGLE TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = -32.431294$$

Table B7 (Continued) Stability and Control Derivatives for Airplane G (Pages 522-528)

POLYNOMIAL BANK ANGLE TO RUDDER TRANSFER FUNCTION

$$+ 23.8372 S^3 - 30.2418 S^2 - 101.3111 S$$

$$+ 169.9617 S^5 + 103.6534 S^4 + 169.3730 S^3 + 130.1231 S^2 - 3.9599 S$$

FACTORED BANK ANGLE TO RUDDER TRANSFER FUNCTION

$$23.8372 \quad S(S - 2.7913)(S + 1.5226)$$

$$169.9617 \quad S(S - 0.0293)(S + 0.7334)(S^2 + -0.0943 S + 1.0844)$$

$$\text{BANK ANGLE TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = 25.584449$$

POLYNOMIAL HEADING TO AILERON TRANSFER FUNCTION

$$- 50.3835 S^3 - 40.4765 S^2 - 3.0427 S + 24.0869$$

$$+ 169.9617 S^5 + 103.6534 S^4 + 169.3730 S^3 + 130.1231 S^2 - 3.9599 S$$

FACTORED HEADING TO AILERON TRANSFER FUNCTION

$$-50.3835 \quad (S - 0.5687)(S^2 + 1.3721 S + 0.8407)$$

$$169.9617 \quad S(S - 0.0293)(S + 0.7334)(S^2 + -0.0943 S + 1.0844)$$

$$\text{HEADING TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = -6.082742$$

POLYNOMIAL HEADING TO RUDDER TRANSFER FUNCTION

$$- 71.9185 S^3 - 32.2701 S^2 - 1.1857 S - 18.8159$$

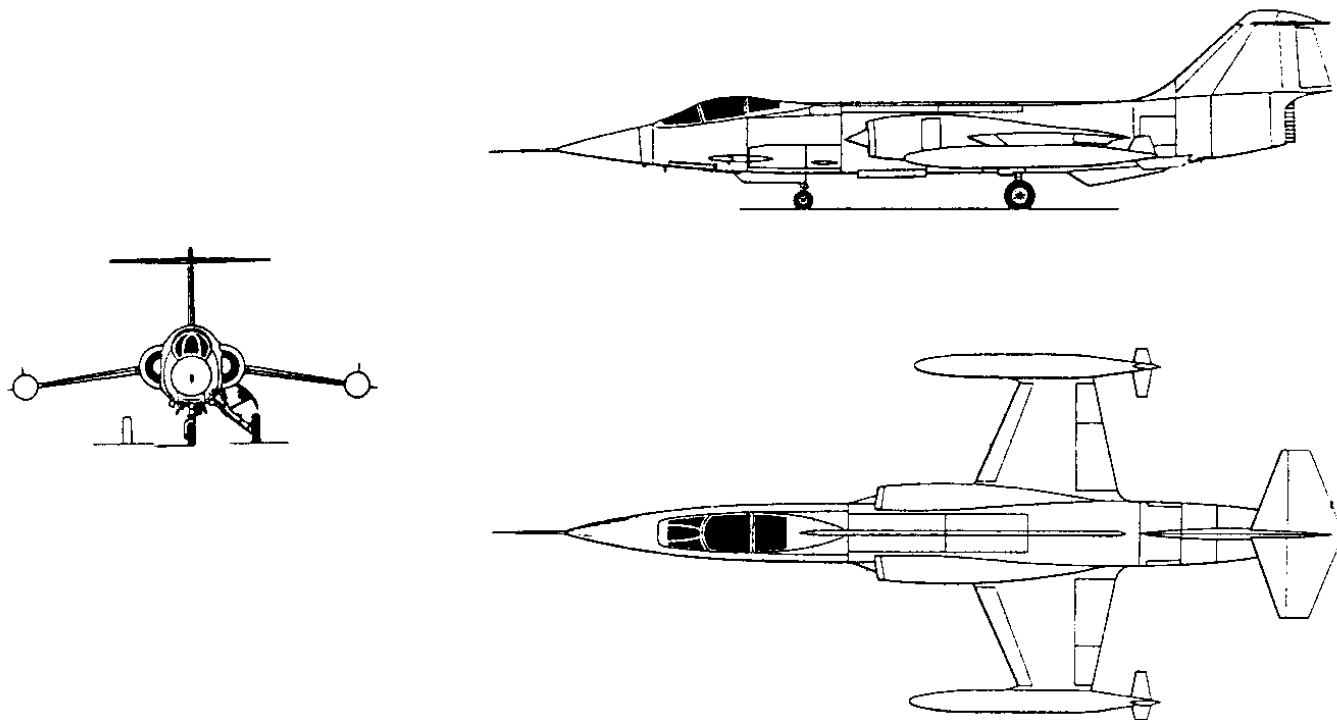
$$+ 169.9617 S^5 + 103.6534 S^4 + 169.3730 S^3 + 130.1231 S^2 - 3.9599 S$$

FACTORED HEADING TO RUDDER TRANSFER FUNCTION

$$-71.9185 \quad (S + 0.8188)(S^2 + -0.3701 S + 0.3195)$$

$$169.9617 \quad S(S - 0.0293)(S + 0.7334)(S^2 + -0.0943 S + 1.0844)$$

$$\text{HEADING TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = 4.751643$$

Table B8 Stability and Control Derivatives for Airplane H (Pages 529–535)**Three-view****Reference Geometry**

S (ft ²)	196
$\bar{c}$ (ft)	9.6
b (ft)	21.9

Flight Condition Data

	Approach	Cruise
Altitude, h (ft)	0	55,000
Mach Number, M	0.257	1.800
TAS, U_1 (ft/sec)	287	1,742
Dynamic pressure, $\bar{q}$ (lbs/ft ²)	97.8	434.5
C.G. location, fraction $\bar{c}$	0.07	0.07
Angle of attack, α_1 (deg)	10	2

Mass Data

W (lbs)	16,300	16,300
I_{xx_B} (slugft ²)	3,600	3,600
I_{yy_B} (slugft ²)	59,000	59,000
I_{zz_B} (slugft ²)	60,000	60,000
I_{xz_B} (slugft ²)	0	0

Table B8 (Continued) Stability and Control Derivatives for Airplane H (Pages 529–535)

<u>Flight Condition</u>	Approach	Cruise
<u>Steady State Coefficients</u>		
C_{L_1}	0.850	0.191
C_{D_1}	0.2634	0.0553
$C_{T_{x_1}}$	0.2634	0.0553
C_{m_1}	0	0
$C_{m_{T_1}}$	0	0
<u>Longitudinal Coefficients and Stability Derivatives (Stability Axes, Dimensionless)</u>		
C_{D_0}	0.1189	0.0480
C_{D_u}	0	–0.060
C_{D_α}	0.455	0.384
$C_{T_{x_u}}$	–0.50	–0.13
C_{L_0}	0.240	0.122
C_{L_u}	0	–0.20
C_{L_α}	3.440	2.005
$C_{L_{\dot{\alpha}}}$	0.66	0.82
C_{L_q}	2.30	1.90
C_{m_0}	0.03	–0.028
C_{m_u}	0	0
C_{m_α}	–0.644	–1.308
$C_{m_{\dot{\alpha}}}$	–1.640	–2.050
C_{m_q}	–5.84	–4.83
$C_{m_{T_u}}$	0	0
$C_{m_{T_\alpha}}$	0	0
<u>Longitudinal Control and Hinge Moment Derivatives (Stability Axes, 1/rad)</u>		
$C_{D_{\delta_e}}$	not applicable	
$C_{L_{\delta_e}}$	not applicable	
$C_{m_{\delta_e}}$	not applicable	
$C_{D_{i_h}}$	0	0
$C_{L_{i_h}}$	0.684	0.523
$C_{m_{i_h}}$	–1.60	–1.31

Table B8 (Continued) Stability and Control Derivatives for Airplane H (Pages 529–535)

Flight Condition	Approach	Cruise
<u>Longitudinal Control and Hinge Moment Derivatives: Cont'd (Stability Axes, 1/rad)</u>		
C_{h_α}	not applicable	
$C_{h_{\delta_e}}$	not applicable	
<u>Lateral–Directional Stability Derivatives (Stability Axes, Dimensionless)</u>		
C_{l_β}	–0.175	–0.093
C_{l_p}	–0.285	–0.272
C_{l_r}	0.265	0.154
C_{y_β}	–1.180	–1.045
C_{y_p}	0	0
C_{y_r}	0	0
C_{n_β}	0.507	0.242
$C_{n_{T_\beta}}$	0	0
C_{n_p}	–0.144	–0.093
C_{n_r}	–0.753	–0.649
<u>Lateral–Directional Control and Hinge Moment Derivatives (Stability Axes, Dimensionless)</u>		
$C_{l_{\delta_a}}$	0.0392	0.0173
$C_{l_{\delta_r}}$	0.0448	0.0079
$C_{y_{\delta_a}}$	0	0
$C_{y_{\delta_r}}$	0.329	0.087
$C_{n_{\delta_a}}$	0.0042	0.0025
$C_{n_{\delta_r}}$	–0.1645	–0.0435
$C_{h_{\delta_a}}$	???	???
$C_{h_{\delta_r}}$	???	???
$C_{h_{\beta_r}}$	???	???
$C_{h_{\delta_r}}$	???	???

Table B8 (Continued) Stability and Control Derivatives for Airplane H (Pages 529–535)**Longitudinal Transfer Function Data**

Altitude	=	0 ft	M_1	=	0.257
U_1	=	170.02 kts	n	=	1.00 g
W_current	=	16300.0 lb	q_bar	=	97.87 psf
S_w	=	196.00 ft^2	(W/S)_TO	=	83.16 psf
Theta_1	=	10.00 deg	X_u	=	-0.0695 1/s
C_bar	=	9.60 ft	X_T_u	=	0.0035 1/s
I_yy_B	=	59000 slgft2	X_a	=	14.9560 ft/s^2
C_m_1	=	0.0000	Z_u	=	-0.2243 1/s
C_m_u	=	0.0000	Z_a	=	-140.2225 ft/s^2
C_m_a	=	-0.6440 1/rad	Z_a_dot	=	-0.4180 ft/s
C_m_a.dot	=	-1.6400 1/rad	Z_q	=	-1.4566 ft/s
C_m_q	=	-5.8400 1/rad	M_u	=	0.0000 1/ft/s
C_m_T_1	=	0.0000	M_T_u	=	0.0000 1/ft/s
C_m_T_u	=	0.0000	M_a	=	-2.0100 1/s^2
C_m_T_a	=	0.0000	M_T_a	=	0.0000 1/s^2
C_L_1	=	0.8500	M_a_dot	=	-0.0856 1/s
C_L_u	=	0.0000	M_q	=	-0.3049 1/s
C_L_a	=	3.4400 1/rad			
C_L_a.dot	=	0.6600 1/rad	w_n_SP	=	1.4679 rad/s
C_L_q	=	2.3000 1/rad	z_SP	=	0.3075
C_D_1	=	0.2634	w_n_P	=	0.1479 rad/s
C_D_a	=	0.4550 1/rad	z_P	=	0.1385
C_D_u	=	0.0000	X_del_e	=	0.0000 ft/s^2
C_T_X_1	=	0.2634	Z_del_e	=	-25.8984 ft/s^2
C_T_X_u	=	-0.5000	M_del_e	=	-4.9939 1/s^2
C_L_d_e	=	0.6840 1/rad			
C_D_d_e	=	0.0000 1/rad			
C_m_d_e	=	-1.6000 1/rad			

POLYNOMIAL ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

$$- 25.8984 S^3 - 1435.4151 S^2 - 66.6826 S - 33.6512$$

$$+ 287.3857 S^4 + 271.2473 S^3 + 636.1609 S^2 + 31.0502 S + 13.5446$$

FACTORED ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

$$-25.8984 (S + 55.3788)(S^2 + 0.0461 S + 0.0235)$$

$$287.3857 (S^2 + 0.9029 S + 2.1547)(S^2 + 0.0410 S + 0.0219)$$

$$\text{ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = -2.484472$$

POLYNOMIAL SPEED TO ELEVATOR TRANSFER FUNCTION

$$- 387.3356 S^2 + 23961.0113 S + 20955.5903$$

$$+ 287.3857 S^4 + 271.2473 S^3 + 636.1609 S^2 + 31.0502 S + 13.5446$$

Table B8 (Continued) Stability and Control Derivatives for Airplane H (Pages 529–535)

FACTORED SPEED TO ELEVATOR TRANSFER FUNCTION

$$-387.3356 (S - 62.7237)(S + 0.8625)$$

$$287.3857 (S^2 + 0.9029 S + 2.1547)(S^2 + 0.0410 S + 0.0219)$$

$$\text{SPEED TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = 1547.154040$$

POLYNOMIAL PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION

$$-1432.9547 S^2 - 742.7324 S - 59.5152$$

$$+ 287.3857 S^4 + 271.2473 S^3 + 636.1609 S^2 + 31.0502 S + 13.5446$$

FACTORED PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION

$$-1432.9547 (S + 0.4193)(S + 0.0991)$$

$$287.3857 (S^2 + 0.9029 S + 2.1547)(S^2 + 0.0410 S + 0.0219)$$

$$\text{PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = -4.394013$$

Lateral-Directional Transfer Function Data

W _{current} =	16300.0 lb	(W/S) _{TO} =	83.16 psf
Altitude =	0 ft	q _{bar} =	97.87 psf
S _w =	196.00 ft ²	I _{xx} _S =	5301 slgft ²
U ₁ =	170.02 kts	I _{zz} _S =	58299 slgft ²
Theta ₁ =	10.00 deg	I _{xz} _S =	-9645 slgft ²
Alpha =	10.00 deg	Y _B =	-44.6786 ft/s ²
b _w =	21.90 ft	Y _p =	0.0000 ft/s
I _{xx} _B =	3600 slgft ²	Y _r =	0.0000 ft/s
I _{zz} _B =	60000 slgft ²	L _B =	-13.8692 1/s ²
I _{xz} _B =	0 slgft ²	L _p =	-0.8619 1/s
C _l _B =	-0.1750 1/rad	L _r =	0.8014 1/s
C _l _p =	-0.2850 1/rad	N _B =	3.6533 1/s ²
C _l _r =	0.2650 1/rad	N _T _B =	0.0000 1/s ²
C _n _B =	0.5070 1/rad	N _p =	-0.0396 1/s
C _n _T _B =	0.0000	N _r =	-0.2070 1/s
C _n _p =	-0.1440 1/rad	w _n _D =	2.8810 rad/s
C _n _r =	-0.7530 1/rad	z _D =	0.1281
C _y _B =	-1.1800 1/rad	TC _{SPIRAL} =	-966.957 s
C _y _p =	0.0000 1/rad	TC _{ROLL} =	0.967 s
C _y _r =	0.0000 1/rad	TC ₁ =	0.967 s
C _l _d _a =	0.0392 1/rad	TC ₂ =	-966.957 s
C _l _d _r =	0.0448 1/rad	Y _{del} _a =	0.0000 ft/s ²
C _n _d _a =	0.0042 1/rad	Y _{del} _r =	12.4570 ft/s ²
C _n _d _r =	-0.1645 1/rad	L _{del} _a =	3.1067 1/s ²
C _y _d _a =	0.0000 1/rad	L _{del} _r =	3.5505 1/s ²
C _y _d _r =	0.3290 1/rad	N _{del} _a =	0.0303 1/s ²
		N _{del} _r =	-1.1853 1/s ²

Table B8 (Continued) Stability and Control Derivatives for Airplane H (Pages 529-535)

POLYNOMIAL SIDESLIP TO AILERON TRANSFER FUNCTION

$$+ 138.8075 S^3 + 124.5049 S^2 + 21.1488 S$$

$$+ 200.5823 S^5 + 355.3425 S^4 + 1817.6079 S^3 + 1720.6151 S^2 - 1.7814 S$$

FACTORED SIDESLIP TO AILERON TRANSFER FUNCTION

$$138.8075 \quad S(S + 0.6693)(S + 0.2276)$$

$$200.5823 \quad S(S - 0.0010)(S + 1.0346)(S^2 + 0.7380 S + 8.3000)$$

$$\text{SIDESLIP TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = -11.872326$$

POLYNOMIAL SIDESLIP TO RUDDER TRANSFER FUNCTION

$$+ 8.7071 S^4 + 522.7889 S^3 + 516.9667 S^2 - 6.8065 S$$

$$+ 200.5823 S^5 + 355.3425 S^4 + 1817.6079 S^3 + 1720.6151 S^2 - 1.7814 S$$

FACTORED SIDESLIP TO RUDDER TRANSFER FUNCTION

$$8.7071 \quad S(S - 0.0130)(S + 59.0359)(S + 1.0189)$$

$$200.5823 \quad S(S - 0.0010)(S + 1.0346)(S^2 + 0.7380 S + 8.3000)$$

$$\text{SIDESLIP TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = 3.820969$$

POLYNOMIAL ROLL TO AILERON TRANSFER FUNCTION

$$+ 875.7196 S^3 + 327.8840 S^2 + 3407.2931 S$$

$$+ 200.5823 S^5 + 355.3425 S^4 + 1817.6079 S^3 + 1720.6151 S^2 - 1.7814 S$$

FACTORED ROLL TO AILERON TRANSFER FUNCTION

$$875.7196 \quad S(S^2 + 0.3744 S + 3.8908)$$

$$200.5823 \quad S(S - 0.0010)(S + 1.0346)(S^2 + 0.7380 S + 8.3000)$$

$$\text{ROLL TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = -1912.752646$$

Table B8 (Continued) Stability and Control Derivatives for Airplane H (Pages 529–535)

POLYNOMIAL ROLL TO RUDDER TRANSFER FUNCTION

$$+ 1637.8237 S^3 - 62.2256 S^2 - 1004.2890 S$$

$$+ 200.5823 S^5 + 355.3425 S^4 + 1817.6079 S^3 + 1720.6151 S^2 - 1.7814 S$$

FACTORED ROLL TO RUDDER TRANSFER FUNCTION

$$1637.8237 S(S - 0.8023)(S + 0.7643)$$

$$200.5823 S(S - 0.0010)(S + 1.0346)(S^2 + 0.7380 S + 8.3000)$$

$$\text{ROLL TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = 563.777878$$

POLYNOMIAL HEADING TO AILERON TRANSFER FUNCTION

$$- 138.8075 S^3 - 49.4245 S^2 - 4.3303 S + 372.9196$$

$$+ 200.5823 S^5 + 355.3425 S^4 + 1817.6079 S^3 + 1720.6151 S^2 - 1.7814 S$$

FACTORED HEADING TO AILERON TRANSFER FUNCTION

$$-138.8075 (S - 1.2742)(S^2 + 1.6303 S + 2.1085)$$

$$200.5823 S(S - 0.0010)(S + 1.0346)(S^2 + 0.7380 S + 8.3000)$$

$$\text{HEADING TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = -209.345936$$

POLYNOMIAL HEADING TO RUDDER TRANSFER FUNCTION

$$- 508.7194 S^3 - 338.6218 S^2 - 5.8614 S - 109.9050$$

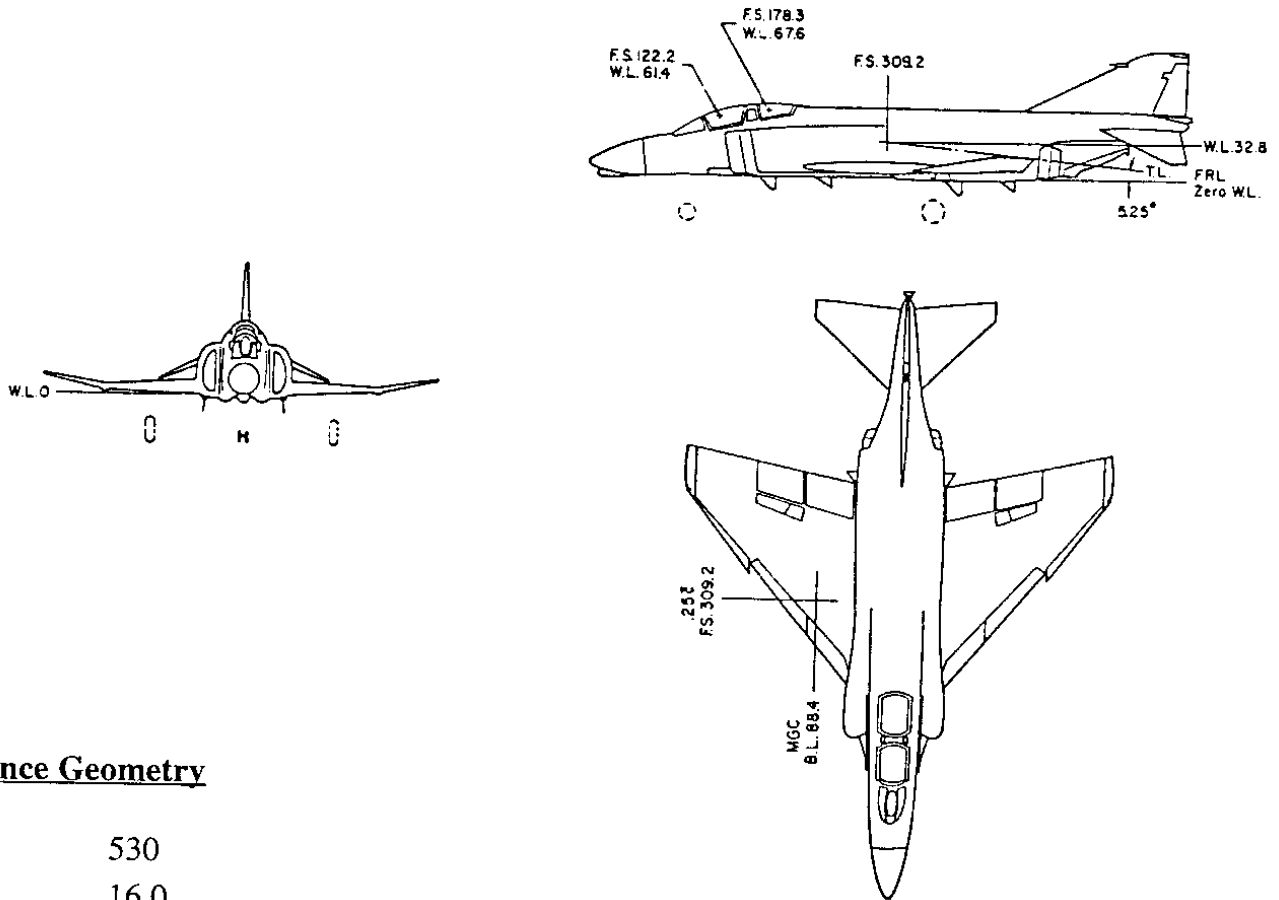
$$+ 200.5823 S^5 + 355.3425 S^4 + 1817.6079 S^3 + 1720.6151 S^2 - 1.7814 S$$

FACTORED HEADING TO RUDDER TRANSFER FUNCTION

$$-508.7194 (S + 0.9125)(S^2 + -0.2468 S + 0.2368)$$

$$200.5823 S(S - 0.0010)(S + 1.0346)(S^2 + 0.7380 S + 8.3000)$$

$$\text{HEADING TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = 61.697394$$

Table B9 Stability and Control Derivatives for Airplane I (Pages 536–542)**Three-view****Reference Geometry**

S (ft ²)	530
$\bar{c}$ (ft)	16.0
b (ft)	38.7

Flight Condition Data

	Approach	Cruise (M<1)	Cruise (M>1)
Altitude, h (ft)	0	35,000	55,000
Mach Number, M	0.206	0.900	1.800
TAS, U_1 (ft/sec)	230	876	1,742
Dynamic pressure, $\bar{q}$ (lbs/ft ²)	62.9	283.2	434.5
C.G. location, fraction $\bar{c}$	0.29	0.29	0.29
Angle of attack, α_1 (deg)	11.7	2.6	3.3

Mass Data

W (lbs)	33,200	39,000	39,000
I_{xx_B} (slugft ²)	23,700	25,000	25,000
I_{yy_B} (slugft ²)	117,500	122,200	122,200
I_{zz_B} (slugft ²)	133,700	139,800	139,800
I_{xz_B} (slugft ²)	1,600	2,200	2,200

Table B9 (Continued) Stability and Control Derivatives for Airplane I (Pages 536–542)

<u>Flight Condition</u>	Approach	Cruise (M<1)	Cruise (M>1)
<u>Steady State Coefficients</u>			
C_{L_1}	1.0	0.26	0.17
C_{D_1}	0.2000	0.0300	0.0480
$C_{T_{x_1}}$	0.2000	0.0300	0.0480
C_{m_1}	0	0	0
$C_{m_{T_1}}$	0	0	0
<u>Longitudinal Coefficients and Stability Derivatives (Stability Axes, Dimensionless)</u>			
C_{D_0}	0.0269	0.0205	0.0439
C_{D_u}	0	0.027	-0.054
C_{D_α}	0.555	0.300	0.400
$C_{T_{x_u}}$	-0.4500	-0.064	-0.1000
C_{L_0}	0.430	0.100	0.010
C_{L_u}	0	0.270	-0.180
C_{L_α}	2.80	3.75	2.80
$C_{L_{\dot{\alpha}}}$	0.63	0.86	0.17
C_{L_q}	1.33	1.80	1.30
C_{m_0}	+0.020	+0.025	-0.025
C_{m_u}	0	-0.117	+0.054
C_{m_α}	-0.098	-0.400	-0.780
$C_{m_{\dot{\alpha}}}$	-0.950	-1.300	-0.250
C_{m_q}	-2.00	-2.70	-2.00
$C_{m_{T_u}}$	0	0	0
$C_{m_{T_\alpha}}$	0	0	0
<u>Longitudinal Control and Hinge Moment Derivatives (Stability Axes, 1/rad)</u>			
$C_{D_{\delta_e}}$	not applicable		
$C_{L_{\delta_c}}$	not applicable		
$C_{m_{\delta_e}}$	not applicable		
$C_{D_{i_h}}$	-0.14	-0.10	-0.15
$C_{L_{i_h}}$	0.24	0.40	0.25
$C_{m_{i_h}}$	-0.322	-0.580	-0.380

Table B9 (Continued) Stability and Control Derivatives for Airplane I (Pages 536–542)

Flight Condition	Approach	Cruise (M<1)	Cruise (M>1)
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Longitudinal Control and Hinge Moment Derivatives: Cont'd (Stability Axes, 1/rad)

$C_{h_{\alpha}}$	not applicable		
$C_{h_{\delta_e}}$	not applicable		

Lateral–Directional Stability Derivatives (Stability Axes, Dimensionless)

$C_{l_{\beta}}$	–0.156	–0.080	–0.025
C_{l_p}	–0.272	–0.240	–0.200
C_{l_r}	0.205	0.070	0.040
$C_{y_{\beta}}$	–0.655	–0.680	–0.700
C_{y_p}	0	0	0
C_{y_r}	0	0	0
$C_{n_{\beta}}$	0.199	0.125	0.090
$C_{n_{T_{\beta}}}$	0	0	0
C_{n_p}	0.013	–0.036	0
C_{n_r}	–0.320	–0.270	–0.260

Lateral–Directional Control and Hinge Moment Derivatives (Stability Axes, Dimensionless)

$C_{l_{\delta_a}}$	0.0570	0.0420	0.0150
$C_{l_{\delta_r}}$	0.0009	0.0060	0.0030
$C_{y_{\delta_a}}$	–0.0355	–0.0160	–0.010
$C_{y_{\delta_r}}$	0.124	0.095	0.050
$C_{n_{\delta_a}}$	0.0041	–0.0010	–0.0009
$C_{n_{\delta_r}}$	–0.072	–0.066	–0.025
$C_{h_{\alpha_a}}$	???	???	???
$C_{h_{\delta_a}}$	???	???	???
$C_{h_{\beta_r}}$	???	???	???
$C_{h_{\delta_r}}$	???	???	???

Table B9 (Continued) Stability and Control Derivatives for Airplane I (Pages 536–542)**Longitudinal Transfer Function Data**

Altitude	=	35000 ft	M_1	=	0.900
U_1	=	518.96 kts	n	=	1.00 g
W_current	=	39000.0 lb	q_bar	=	283.17 psf
S_w	=	530.00 ft^2	(W/S)_TO	=	73.58 psf
Theta_1	=	2.60 deg	X_u	=	-0.0122 1/s
C_bar	=	16.00 ft	X_T_u	=	-0.0006 1/s
I_yy_B	=	122200 slgft^2	X_a	=	-4.8986 ft/s^2
C_m_l	=	0.0000	Z_u	=	-0.1105 1/s
C_m_u	=	-0.1170	Z_a	=	-462.9218 ft/s^2
C_m_a	=	-0.4000 1/rad	Z_a_dot	=	-0.9619 ft/s
C_m_a.dot	=	-1.3000 1/rad	Z_q	=	-2.0134 ft/s
C_m_q	=	-2.7000 1/rad	M_u	=	-0.0026 1/ft/s
C_m_T_l	=	0.0000	M_T_u	=	0.0000 1/ft/s
C_m_T_u	=	0.0000	M_a	=	-7.8602 1/s^2
C_m_T_a	=	0.0000	M_T_a	=	0.0000 1/s^2
C_L_l	=	0.2600	M_a_dot	=	-0.2333 1/s
C_L_u	=	0.2700	M_q	=	-0.4846 1/s
C_L_a	=	3.7500 1/rad			
C_L_a.dot	=	0.8600 1/rad	w_n_3 osc	=	2.8472 rad/s
C_L_q	=	1.8000 1/rad	z_3rd osc	=	0.2210
C_D_l	=	0.0300	TC_1	=	25.389 s
C_D_a	=	0.3000 1/rad	TC_2	=	-25.100 s
C_D_u	=	0.0270	X_del_e	=	12.2466 ft/s^2
C_T_X_l	=	0.0300	Z_del_e	=	-48.9864 ft/s^2
C_T_X_u	=	-0.0640	M_del_e	=	-11.3973 1/s^2
C_L_d_e	=	0.4000 1/rad			
C_D_d_e	=	-0.1000 1/rad			
C_m_d_e	=	-0.5800 1/rad			

POLYNOMIAL ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

$$\begin{aligned}
 & - 48.9864 S^3 - 9985.6978 S^2 - 139.3202 S - 35.6784 \\
 & + 876.8633 S^4 + 1102.8926 S^3 + 7106.2935 S^2 - 4.9526 S - 11.1541
 \end{aligned}$$

FACTORED ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

$$\begin{aligned}
 & -48.9864 (S + 203.8323) (S^2 + 0.0139 S + 0.0036) \\
 & 876.8633 (S - 0.0398) (S + 0.0394) (S^2 + 1.2582 S + 8.1064)
 \end{aligned}$$

$$\text{ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = 3.198674$$

POLYNOMIAL SPEED TO ELEVATOR TRANSFER FUNCTION

$$\begin{aligned}
 & + 10738.6016 S^3 + 13610.0294 S^2 + 453125.8259 S + 155272.0233 \\
 & + 876.8633 S^4 + 1102.8926 S^3 + 7106.2935 S^2 - 4.9526 S - 11.1541
 \end{aligned}$$

Table B9 (Continued) Stability and Control Derivatives for Airplane I (Pages 536–542)

FACTORED SPEED TO ELEVATOR TRANSFER FUNCTION

$$10738.6016 (S + 0.3453)(S^2 + 0.9221 S + 41.8776)$$

$$876.8633 (S - 0.0398)(S + 0.0394)(S^2 + 1.2582 S + 8.1064)$$

$$\text{SPEED TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = -13920.616547$$

POLYNOMIAL PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION

$$-9982.4646 S^2 - 5045.9068 S - 60.9416$$

$$+ 876.8633 S^4 + 1102.8926 S^3 + 7106.2935 S^2 - 4.9526 S - 11.1541$$

FACTORED PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION

$$-9982.4646 (S + 0.4931)(S + 0.0124)$$

$$876.8633 (S - 0.0398)(S + 0.0394)(S^2 + 1.2582 S + 8.1064)$$

$$\text{PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = 5.463602$$

Lateral-Directional Transfer Function Data

W _{current} =	39000.0 lb	(W/S) _{TO} =	73.58 psf
Altitude =	35000 ft	q _{bar} =	283.17 psf
S _w =	530.00 ft ²	I _{xx_S} =	25037 slgft ²
U ₁ =	518.96 kts	I _{zz_S} =	139763 slgft ²
Theta ₁ =	2.60 deg	I _{xz_S} =	-3011 slgft ²
Alpha =	2.60 deg	Y _B =	-83.2769 ft/s ²
b _w =	38.70 ft	Y _p =	0.0000 ft/s
I _{xx_B} =	25000 slgft ²	Y _r =	0.0000 ft/s
I _{zz_B} =	139800 slgft ²	L _B =	-18.5587 1/s ²
I _{xz_B} =	2200 slgft ²	L _p =	-1.2300 1/s
C _{l_B} =	-0.0800 1/rad	L _r =	0.3587 1/s
C _{l_p} =	-0.2400 1/rad	N _B =	5.1946 1/s ²
C _{l_r} =	0.0700 1/rad	N _{T_B} =	0.0000 1/s ²
C _{n_B} =	0.1250 1/rad	N _p =	-0.0331 1/s
C _{n_T_B} =	0.0000	N _r =	-0.2479 1/s
C _{n_p} =	-0.0360 1/rad	w _{n_D} =	2.3956 rad/s
C _{n_r} =	-0.2700 1/rad	z _D =	0.0482
C _{y_B} =	-0.6800 1/rad	TC _{SPIRAL} =	77.022 s
C _{y_p} =	0.0000 1/rad	TC _{ROLL} =	0.748 s
C _{y_r} =	0.0000 1/rad	TC ₁ =	0.748 s
C _{l_d_a} =	0.0420 1/rad	TC ₂ =	77.022 s
C _{l_d_r} =	0.0060 1/rad	Y _{del_a} =	-1.9595 ft/s ²
C _{n_d_a} =	-0.0010 1/rad	Y _{del_r} =	11.6343 ft/s ²
C _{n_d_r} =	-0.0660 1/rad	L _{del_a} =	9.7433 1/s ²
C _{y_d_a} =	-0.0160 1/rad	L _{del_r} =	1.3919 1/s ²
C _{y_d_r} =	0.0950 1/rad	N _{del_a} =	-0.0416 1/s ²
		N _{del_r} =	-2.7428 1/s ²

Table B9 (Continued) Stability and Control Derivatives for Airplane I (Pages 536-542)

POLYNOMIAL SIDESLIP TO AILERON TRANSFER FUNCTION

$$- 1.9544 S^4 + 217.3759 S^3 + 636.1162 S^2 + 76.3060 S$$

$$+ 873.6315 S^5 + 1380.7964 S^4 + 5301.0394 S^3 + 6769.8305 S^2 + 87.0037 S$$

FACTORED SIDESLIP TO AILERON TRANSFER FUNCTION

$$-1.9544 \quad S(S - 114.0811)(S + 2.7307)(S + 0.1253)$$

$$873.6315 \quad S(S + 1.3366)(S + 0.0130)(S^2 + 0.2309 S + 5.7388)$$

$$\text{SIDESLIP TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = 0.877043$$

POLYNOMIAL SIDESLIP TO RUDDER TRANSFER FUNCTION

$$+ 11.6041 S^4 + 2445.8956 S^3 + 3053.5834 S^2 - 20.3121 S$$

$$+ 873.6315 S^5 + 1380.7964 S^4 + 5301.0394 S^3 + 6769.8305 S^2 + 87.0037 S$$

FACTORED SIDESLIP TO RUDDER TRANSFER FUNCTION

$$11.6041 \quad S(S - 0.0066)(S + 209.5221)(S + 1.2626)$$

$$873.6315 \quad S(S + 1.3366)(S + 0.0130)(S^2 + 0.2309 S + 5.7388)$$

$$\text{SIDESLIP TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = -0.233463$$

POLYNOMIAL ROLL TO AILERON TRANSFER FUNCTION

$$+ 8538.5611 S^3 + 2951.7568 S^2 + 43861.6068 S$$

$$+ 873.6315 S^5 + 1380.7964 S^4 + 5301.0394 S^3 + 6769.8305 S^2 + 87.0037 S$$

FACTORED ROLL TO AILERON TRANSFER FUNCTION

$$8538.5611 \quad S(S^2 + 0.3457 S + 5.1369)$$

$$873.6315 \quad S(S + 1.3366)(S + 0.0130)(S^2 + 0.2309 S + 5.7388)$$

$$\text{ROLL TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = 504.134977$$

Table B9 (Continued) Stability and Control Derivatives for Airplane I (Pages 536–542)

POLYNOMIAL ROLL TO RUDDER TRANSFER FUNCTION

$$+ 1508.1220 S^3 - 639.4342 S^2 - 38337.1395 S$$

$$+ 873.6315 S^5 + 1380.7964 S^4 + 5301.0394 S^3 + 6769.8305 S^2 + 87.0037 S$$

FACTORED ROLL TO RUDDER TRANSFER FUNCTION

$$1508.1220 \quad S(S - 5.2583)(S + 4.8343)$$

$$873.6315 \quad S(S + 1.3366)(S + 0.0130)(S^2 + 0.2309 S + 5.7388)$$

$$\text{ROLL TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = -440.638051$$

POLYNOMIAL HEADING TO AILERON TRANSFER FUNCTION

$$- 220.2790 S^3 - 358.7315 S^2 - 44.7945 S + 1584.5260$$

$$+ 873.6315 S^5 + 1380.7964 S^4 + 5301.0394 S^3 + 6769.8305 S^2 + 87.0037 S$$

FACTORED HEADING TO AILERON TRANSFER FUNCTION

$$-220.2790 \quad (S - 1.4872)(S^2 + 3.1157 S + 4.8369)$$

$$873.6315 \quad S(S + 1.3366)(S + 0.0130)(S^2 + 0.2309 S + 5.7388)$$

$$\text{HEADING TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = 18.212169$$

POLYNOMIAL HEADING TO RUDDER TRANSFER FUNCTION

$$- 2428.6583 S^3 - 3160.9790 S^2 - 203.2968 S - 1388.3758$$

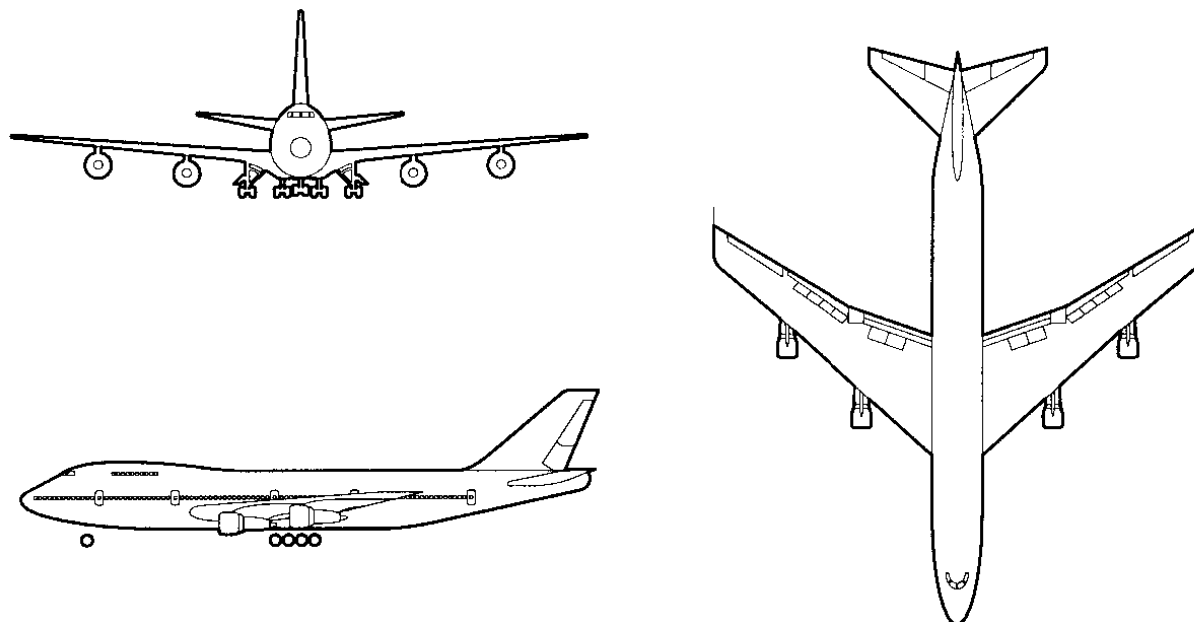
$$+ 873.6315 S^5 + 1380.7964 S^4 + 5301.0394 S^3 + 6769.8305 S^2 + 87.0037 S$$

FACTORED HEADING TO RUDDER TRANSFER FUNCTION

$$-2428.6583 \quad (S + 1.4998)(S^2 + -0.1983 S + 0.3811)$$

$$873.6315 \quad S(S + 1.3366)(S + 0.0130)(S^2 + 0.2309 S + 5.7388)$$

$$\text{HEADING TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = -15.957664$$

Table B10 Stability and Control Derivatives for Airplane J (Pages 543–549)**Three-view****Reference Geometry**

S (ft ²)	5,500
$\bar{c}$ (ft)	27.3
b (ft)	196

Flight Condition Data

	Approach	Cruise (low)	Cruise (high)
Altitude, h (ft)	0	20,000	40,000
Mach Number, M	0.198	0.650	0.900
TAS, U_1 (ft/sec)	221	673	871
Dynamic pressure, $\bar{q}$ (lbs/ft ²)	58.0	287.2	222.8
C.G. location, fraction $\bar{c}$	0.25	0.25	0.25
Angle of attack, α_1 (deg)	8.5	2.5	2.4

Mass Data

W (lbs)	564,000	636,636	636,636
I_{xx_B} (slugft ²)	13,700,000	18,200,000	18,200,000
I_{yy_B} (slugft ²)	30,500,000	33,100,000	33,100,000
I_{zz_B} (slugft ²)	43,100,000	49,700,000	49,700,000
I_{xz_B} (slugft ²)	830,000	970,000	970,000

Table B10 (Continued) Stability and Control Derivatives for Airplane J (Pages 543–549)

<u>Flight Condition</u>	Approach	Cruise (low)	Cruise (high)
<u>Steady State Coefficients</u>			
C_{L_1}	1.76	0.40	0.52
C_{D_1}	0.2630	0.0250	0.0450
$C_{T_{x_1}}$	0.2630	0.0250	0.0450
C_{m_1}	0	0	0
$C_{m_{T_1}}$	0	0	0
<u>Longitudinal Coefficients and Stability Derivatives (Stability Axes, Dimensionless)</u>			
C_{D_0}	0.0751	0.0164	0.0305
C_{D_u}	0	0	0.22
C_{D_α}	1.13	0.20	0.50
$C_{T_{x_u}}$	−0.5523	−0.055	−0.950
C_{L_0}	0.92	0.21	0.29
C_{L_u}	−0.22	0.13	−0.23
C_{L_α}	5.67	4.4	5.5
$C_{L_{\dot{\alpha}}}$	6.7	7.0	8.0
C_{L_q}	5.65	6.6	7.8
C_{m_0}	0	0	0
C_{m_u}	0.071	0.013	−0.09
C_{m_α}	−1.45	−1.00	−1.60
$C_{m_{\dot{\alpha}}}$	−3.3	−4.0	−9.0
C_{m_q}	−21.4	−20.5	−25.5
$C_{m_{\tau_u}}$	0	0	0
$C_{m_{\tau_{\dot{\alpha}}}}$	0	0	0
<u>Longitudinal Control and Hinge Moment Derivatives (Stability Axes, 1/rad)</u>			
$C_{D_{\delta_e}}$	0	0	0
$C_{L_{\delta_e}}$	0.36	0.32	0.30
$C_{m_{\delta_e}}$	−1.40	−1.30	−1.20
$C_{D_{i_h}}$	0	0	0
$C_{L_{i_h}}$	0.75	0.70	0.65
$C_{m_{i_h}}$	−3.0	−2.7	−2.5

Table B10 (Continued) Stability and Control Derivatives for Airplane J (Pages 543–549)

<u>Flight Condition</u>	<u>Approach</u>	<u>Cruise (low)</u>	<u>Cruise (high)</u>
<u>Longitudinal Control and Hinge Moment Derivatives: Cont'd (Stability Axes, 1/rad)</u>			
$C_{h_{\alpha}}$	???	???	???
$C_{h_{\delta_e}}$	???	???	???
<u>Lateral-Directional Stability Derivatives (Stability Axes, Dimensionless)</u>			
$C_{l_{\beta}}$	-0.281	-0.160	-0.095
C_{l_p}	-0.502	-0.340	-0.320
C_{l_r}	0.195	0.130	0.200
$C_{y_{\beta}}$	-1.08	-0.90	-0.90
C_{y_p}	0	0	0
C_{y_r}	0	0	0
$C_{n_{\beta}}$	0.184	0.160	0.210
$C_{n_{T_{\beta}}}$	0	0	0
C_{n_p}	-0.222	-0.026	0.020
C_{n_r}	-0.360	-0.280	-0.330
<u>Lateral-Directional Control and Hinge Moment Derivatives (Stability Axes, Dimensionless)</u>			
$C_{l_{\delta_a}}$	0.053	0.013	0.014
$C_{l_{\delta_r}}$	0	0.008	0.005
$C_{y_{\delta_a}}$	0	0	0
$C_{y_{\delta_r}}$	0.179	0.120	0.060
$C_{n_{\delta_a}}$	0.0083	0.0018	-0.0028
$C_{n_{\delta_r}}$	-0.113	-0.100	-0.095
$C_{h_{\alpha_a}}$	???	???	???
$C_{h_{\delta_a}}$	???	???	???
$C_{h_{\beta_r}}$	???	???	???
$C_{h_{\delta_r}}$	???	???	???

Table B10 (Continued) Stability and Control Derivatives for Airplane J (Pages 543-549)**Longitudinal Transfer Function Data**

Altitude	=	40000 ft	M ₁	=	0.900
U ₁	=	516.00 kts	n	=	1.00 g
W _{current}	=	636636.0 lb	q _{bar}	=	222.72 psf
S _w	=	5500.00 ft ²	(W/S) _{TO}	=	115.75 psf
Theta ₁	=	2.40 deg	X _u	=	-0.0218 1/s
C _{bar}	=	27.30 ft	X _{T_u}	=	-0.0604 1/s
I _{yy_B}	=	33100000 slgft ²	X _a	=	1.2227 ft/s ²
C _{m_u}	=	0.0000	Z _u	=	-0.0569 1/s
C _{m_u}	=	-0.0900	Z _a	=	-339.0036 ft/s ²
C _{m_a}	=	-1.6000 1/rad	Z _{a_dot}	=	-7.6658 ft/s
C _{m_a_dot}	=	-9.0000 1/rad	Z _q	=	-7.4741 ft/s
C _{m_q}	=	-25.5000 1/rad	M _u	=	-0.0001 1/ft/s
C _{m_T_1}	=	0.0000	M _{T_u}	=	0.0000 1/ft/s
C _{m_T_u}	=	0.0000	M _a	=	-1.6165 1/s ²
C _{m_T_a}	=	0.0000	M _{T_a}	=	0.0000 1/s ²
C _{L_1}	=	0.5200	M _{a_dot}	=	-0.1425 1/s
C _{L_u}	=	-0.2300	M _q	=	-0.4038 1/s
C _{L_a}	=	5.5000 1/rad	w _{n_SP}	=	1.3215 rad/s
C _{L_a_dot}	=	8.0000 1/rad	z _{SP}	=	0.3532
C _{L_q}	=	7.8000 1/rad	TC ₁	=	16.340 s
C _{D_1}	=	0.0450	TC ₂	=	58.050 s
C _{D_a}	=	0.5000 1/rad	X _{del_e}	=	0.0000 ft/s ²
C _{D_u}	=	0.2200	Z _{del_e}	=	-18.3410 ft/s ²
C _{T_X_1}	=	0.0450	M _{del_e}	=	-1.2124 1/s ²
C _{T_X_u}	=	-0.9500			
C _{L_d_e}	=	0.3000 1/rad			
C _{D_d_e}	=	0.0000 1/rad			
C _{m_d_e}	=	-1.2000 1/rad			

POLYNOMIAL ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

$$- 18.3410 S^3 - 1055.6956 S^2 - 84.9709 S - 1.9952$$

$$+ 878.5677 S^4 + 888.9681 S^3 + 1599.5636 S^2 + 121.1943 S + 1.6175$$

FACTORED ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

$$-18.3410 (S + 57.4786)(S^2 + 0.0806 S + 0.0019)$$

$$878.5677 (S + 0.0612)(S + 0.0172)(S^2 + 0.9334 S + 1.7464)$$

$$\text{ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = -1.233487$$

POLYNOMIAL SPEED TO ELEVATOR TRANSFER FUNCTION

$$- 22.4263 S^2 + 32442.6029 S + 12108.4240$$

$$+ 878.5677 S^4 + 888.9681 S^3 + 1599.5636 S^2 + 121.1943 S + 1.6175$$

Table B10 (Continued) Stability and Control Derivatives for Airplane J (Pages 543-549)

FACTORED SPEED TO ELEVATOR TRANSFER FUNCTION

$$-22.4263 (S - 1447.0080)(S + 0.3731)$$

$$878.5677 (S + 0.0612)(S + 0.0172)(S^2 + 0.9334 S + 1.7464)$$

$$\text{SPEED TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = 7485.685023$$

POLYNOMIAL PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION

$$-1062.5244 S^2 - 468.6144 S - 31.4031$$

$$+ 878.5677 S^4 + 888.9681 S^3 + 1599.5636 S^2 + 121.1943 S + 1.6175$$

FACTORED PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION

$$-1062.5244 (S + 0.3586)(S + 0.0824)$$

$$878.5677 (S + 0.0612)(S + 0.0172)(S^2 + 0.9334 S + 1.7464)$$

$$\text{PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION } K_{\text{gain}} = -19.414087$$

Lateral-Directional Transfer Function Data

W _{current} =	636636.0 lb	(W/S) _{TO} =	115.75 psf
Altitude =	40000 ft	q _{bar} =	222.72 psf
S _w =	5500.00 ft ²	I _{xx_S} =	18174070 slgft ²
U ₁ =	516.00 kts	I _{zz_S} =	49725930 slgft ²
Theta ₁ =	2.40 deg	I _{xz_S} =	-351328 slgft ²
Alpha =	2.40 deg	Y _B =	-55.0231 ft/s ²
b _w =	196.00 ft	Y _p =	0.0000 ft/s
I _{xx_B} =	18200000 slgft ²	Y _r =	0.0000 ft/s
I _{zz_B} =	49700000 slgft ²	L _B =	-2.1137 1/s ²
I _{xz_B} =	970000 slgft ²	L _p =	-0.5054 1/s
C _{l_B} =	-0.1600 1/rad	L _r =	0.1932 1/s
C _{l_p} =	-0.3400 1/rad	N _B =	0.7725 1/s ²
C _{l_r} =	0.1300 1/rad	N _{T_B} =	0.0000 1/s ²
C _{n_B} =	0.1600 1/rad	N _p =	-0.0141 1/s
C _{n_T_B} =	0.0000	N _r =	-0.1521 1/s
C _{n_p} =	-0.0260 1/rad	w _{n_D} =	0.9112 rad/s
C _{n_r} =	-0.2800 1/rad	z _D =	0.0643
C _{y_B} =	-0.9000 1/rad	TC _{SPIRAL} =	78.264 s
C _{y_p} =	0.0000 1/rad	TC _{ROLL} =	1.689 s
C _{y_r} =	0.0000 1/rad	TC ₁ =	1.689 s
C _{l_d_a} =	0.0130 1/rad	TC ₂ =	78.264 s
C _{l_d_r} =	0.0080 1/rad	Y _{del_a} =	0.0000 ft/s ²
C _{n_d_a} =	0.0018 1/rad	Y _{del_r} =	7.3364 ft/s ²
C _{n_d_r} =	-0.1000 1/rad	L _{del_a} =	0.1717 1/s ²
C _{y_d_a} =	0.0000 1/rad	L _{del_r} =	0.1057 1/s ²
C _{y_d_r} =	0.1200 1/rad	N _{del_a} =	0.0087 1/s ²
		N _{del_r} =	-0.4828 1/s ²

Table B10 (Continued) Stability and Control Derivatives for Airplane J (Pages 543–549)

POLYNOMIAL SIDESLIP TO AILERON TRANSFER FUNCTION

$$- 6.5121 S^3 + 3.7340 S^2 + 0.8827 S$$

$$+ 870.7830 S^5 + 628.6269 S^4 + 791.3719 S^3 + 438.0016 S^2 + 5.4686 S$$

FACTORED SIDESLIP TO AILERON TRANSFER FUNCTION

$$-6.5121 \quad S(S - 0.7533)(S + 0.1799)$$

$$870.7830 \quad S(S + 0.5919)(S + 0.0128)(S^2 + 0.1172 S + 0.8304)$$

$$\text{SIDESLIP TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = \quad 0.161417$$

POLYNOMIAL SIDESLIP TO RUDDER TRANSFER FUNCTION

$$+ 7.3354 S^4 + 425.9739 S^3 + 218.0615 S^2 - 2.4517 S$$

$$+ 870.7830 S^5 + 628.6269 S^4 + 791.3719 S^3 + 438.0016 S^2 + 5.4686 S$$

FACTORED SIDESLIP TO RUDDER TRANSFER FUNCTION

$$7.3354 \quad S(S - 0.0110)(S + 57.5543)(S + 0.5276)$$

$$870.7830 \quad S(S + 0.5919)(S + 0.0128)(S^2 + 0.1172 S + 0.8304)$$

$$\text{SIDESLIP TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = \quad -0.448333$$

POLYNOMIAL ROLL TO AILERON TRANSFER FUNCTION

$$+ 149.4192 S^3 + 33.6557 S^2 + 133.0699 S$$

$$+ 870.7830 S^5 + 628.6269 S^4 + 791.3719 S^3 + 438.0016 S^2 + 5.4686 S$$

FACTORED ROLL TO AILERON TRANSFER FUNCTION

$$149.4192 \quad S(S^2 + 0.2252 S + 0.8906)$$

$$870.7830 \quad S(S + 0.5919)(S + 0.0128)(S^2 + 0.1172 S + 0.8304)$$

$$\text{ROLL TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = \quad 24.333635$$

Table B10 (Continued) Stability and Control Derivatives for Airplane J (Pages 543–549)

POLYNOMIAL ROLL TO RUDDER TRANSFER FUNCTION

$$+ 100.1689 S^3 - 76.5459 S^2 - 823.1939 S$$

$$+ 870.7830 S^5 + 628.6269 S^4 + 791.3719 S^3 + 438.0016 S^2 + 5.4686 S$$

FACTORED ROLL TO RUDDER TRANSFER FUNCTION

$$100.1689 \quad S(S - 3.2742)(S + 2.5100)$$

$$870.7830 \quad S(S + 0.5919)(S + 0.0128)(S^2 + 0.1172 S + 0.8304)$$

$$\text{ROLL TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = -150.532188$$

POLYNOMIAL HEADING TO AILERON TRANSFER FUNCTION

$$+ 6.5121 S^3 + 2.1241 S^2 + 0.1082 S + 4.7950$$

$$+ 870.7830 S^5 + 628.6269 S^4 + 791.3719 S^3 + 438.0016 S^2 + 5.4686 S$$

FACTORED HEADING TO AILERON TRANSFER FUNCTION

$$6.5121 \quad (S + 1.0190)(S^2 + -0.6928 S + 0.7226)$$

$$870.7830 \quad S(S + 0.5919)(S + 0.0128)(S^2 + 0.1172 S + 0.8304)$$

$$\text{HEADING TO AILERON TRANSFER FUNCTION } K_{\text{gain}} = 0.876826$$

POLYNOMIAL HEADING TO RUDDER TRANSFER FUNCTION

$$- 421.1418 S^3 - 234.6564 S^2 - 10.4259 S - 29.8066$$

$$+ 870.7830 S^5 + 628.6269 S^4 + 791.3719 S^3 + 438.0016 S^2 + 5.4686 S$$

FACTORED HEADING TO RUDDER TRANSFER FUNCTION

$$-421.1418 \quad (S + 0.6756)(S^2 + -0.1184 S + 0.1048)$$

$$870.7830 \quad S(S + 0.5919)(S + 0.0128)(S^2 + 0.1172 S + 0.8304)$$

$$\text{HEADING TO RUDDER TRANSFER FUNCTION } K_{\text{gain}} = -5.450543$$