APPENDIX B: AIRPLANE DATA

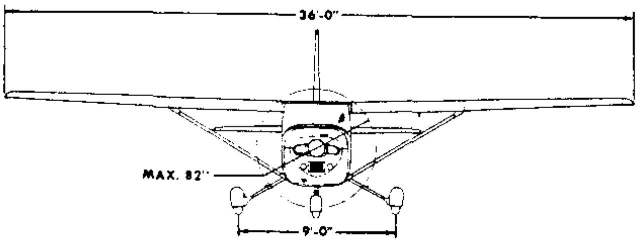
The purpose of this appendix is to present geometric, mass, inertial, stability, control and (where available) hingemoment data for a range of airplanes and flight conditions. The airplanes are identified as Airplanes A through J:

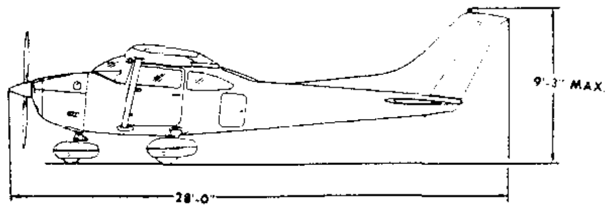
Airplane A	is representative of a small, single piston–engine general aviation airplane such as the Cessna 182 (See Table B1: Pages 480–486)
Airplane B	is representative of a small, twin piston–engine general aviation airplane such as the Cessna 310 (See Table B2: Pages 487–493)
Airplane C	is representative 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 representaive 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)

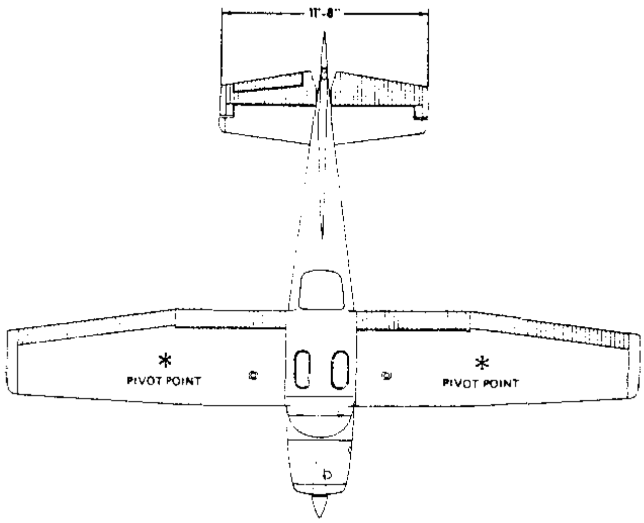
Tables B1–B10 also include examples of the open loop, longitudinal and lateral–directional, modes and transfer functions of these airplanes.

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

	Climb	Cruise	Approach
W (lbs)	2,650	2,650	2,650
I_{xx_B} (slugft2)	948	948	948
I_{yy_B} (slugft2)	1,346	1,346	1,346
I_{zz_B} (slugft2)	1,967	1,967	1,967
I_{xz_B} (slugft2)	0	0	0

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

Flight Condition	Climb	Cruise	Approach
Steady State Coefficients			
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
Longitudinal Coefficients and Stability Derivatives (Stability Axes, Dimensionless)			
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
Longitudinal Control and Hinge Moment Derivatives (Stability Axes, 1/rad)			
$C_{D_{\delta_e}}$	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
Longitudinal Control and Hinge Moment Derivatives: Cont'd (Stability Axes, 1/rad)			
C_{h_α}	-0.0545	-0.0584	-0.0549
$C_{h_{\delta_e}}$	-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					
C_D_a	=	0.1210	1/rad	w_n_SP	=	5.2707	rad/s
C_D_u	=	0.0000		z_SP	=	0.8442	
C_T_X_1	=	0.0320		w_n_P	=	0.1711	rad/s
C_T_X_u	=	-0.0960		z_P	=	0.1289	
C_L_d_e	=	0.4300	1/rad	X_del_e	=	0.0000	ft/s^2
C_D_d_e	=	0.0000	1/rad	Z_del_e	=	-44.9854	ft/s^2
C_m_d_e	=	-1.1220	1/rad	M_del_e	=	-35.2508	1/s^2

```
POLYNOMIAL ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

 - 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


FACTORED ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

-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)


 ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION K_gain =   -1.830343


POLYNOMIAL SPEED TO ELEVATOR TRANSFER FUNCTION

 - 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
```

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)


 SPEED TO ELEVATOR TRANSFER FUNCTION K_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)

 PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION K_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	slgft2
U_1	=	130.39	kts	I_zz_S	=	1967	slgft2
Theta_1	=	0.00	deg	I_xz_S	=	0	slgft2
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	slgft2	Y_r	=	1.8311	ft/s
I_zz_B	=	1967	slgft2	L_B	=	-30.2497	1/s^2
I_xz_B	=	0	slgft2	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)**

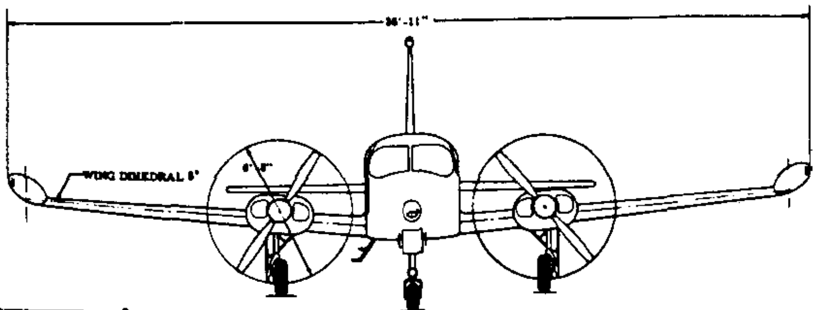
```
POLYNOMIAL SIDESLIP TO AILERON TRANSFER FUNCTION

 + 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   S(S + 25.5517)(S + 0.1508)
--------------------------------------------------------------------------------
220.0752   S(S + 13.0127)(S + 0.0179)(S^2 + 1.3405 S + 10.5287)


 SIDESLIP TO AILERON TRANSFER FUNCTION K_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   S(S - 0.0172)(S + 114.4019)(S + 13.2945)
--------------------------------------------------------------------------------
220.0752   S(S + 13.0127)(S + 0.0179)(S^2 + 1.3405 S + 10.5287)


 SIDESLIP TO RUDDER TRANSFER FUNCTION K_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   S(S^2 + 1.3001 S + 8.0389)
--------------------------------------------------------------------------------

220.0752   S(S + 13.0127)(S + 0.0179)(S^2 + 1.3405 S + 10.5287)


 ROLL TO AILERON TRANSFER FUNCTION K_gain =  246.259658
```

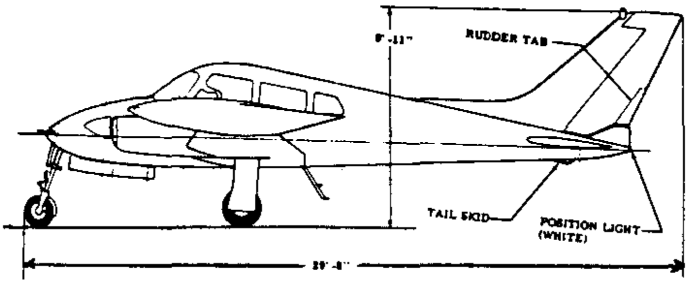
Table B1 (Continued) Stability and Control Derivatives for Airplane A (Pages 480–486)

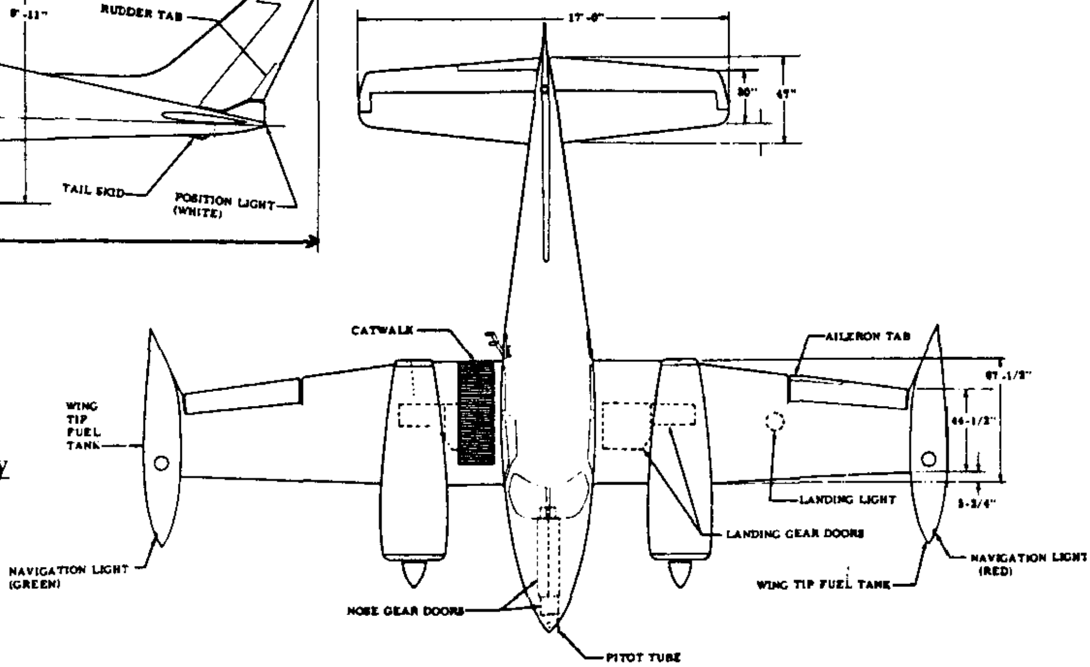
```
POLYNOMIAL ROLL TO RUDDER TRANSFER FUNCTION

 + 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   S(S - 9.4949)(S + 5.8106)
--------------------------------------------------------------------------------
220.0752   S(S + 13.0127)(S + 0.0179)(S^2 + 1.3405 S + 10.5287)


 ROLL TO RUDDER TRANSFER FUNCTION K_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   (S - 0.9773)(S + 20.7903)(S + 1.2479)
--------------------------------------------------------------------------------
220.0752   S(S + 13.0127)(S + 0.0179)(S^2 + 1.3405 S + 10.5287)


 HEADING TO AILERON TRANSFER FUNCTION K_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   (S + 13.1775)(S^2 + 0.0720 S + 0.2865)
--------------------------------------------------------------------------------
220.0752   S(S + 13.0127)(S + 0.0179)(S^2 + 1.3405 S + 10.5287)


 HEADING TO RUDDER TRANSFER FUNCTION K_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} (slugft2)	8,884	8,884	8,884
I_{yy_B} (slugft2)	1,939	1,939	1,939
I_{zz_B} (slugft2)	11,001	11,001	11,001
I_{xz_B} (slugft2)	0	0	0

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

Flight Condition	Climb	Cruise	Approach
Steady State Coefficients			
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
Longitudinal Coefficients and Stability Derivatives (Stability Axes, Dimensionless)			
C_{D_0}	0.0290	0.0290	0.0974
C_{D_u}	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
Longitudinal Control and Hinge Moment Derivatives (Stability Axes, 1/rad)			
$C_{D_{\delta_e}}$	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
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 slgft2       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)


 ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION K_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)


 SPEED TO ELEVATOR TRANSFER FUNCTION K_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)


 PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION K_gain =   -9.404371
```

Lateral–Directional Transfer Function Data

```
W_current  =      4600.0 lb
Altitude   =           0 ft
S_w        =      175.00 ft^2
U_1        =      106.04 kts
Theta_1    =        5.00 deg
Alpha      =        5.00 deg
b_w        =       36.90 ft
I_xx_B     =        8884 slgft2
I_zz_B     =       11001 slgft2
I_xz_B     =           0 slgft2
C_l_B      =     -0.0923 1/rad
C_l_p      =     -0.5520 1/rad
C_l_r      =      0.1746 1/rad
C_n_B      =      0.1552 1/rad
C_n_T_B    =      0.0000
C_n_p      =     -0.0615 1/rad
C_n_r      =     -0.1561 1/rad
C_y_B      =     -0.6100 1/rad
C_y_p      =     -0.2093 1/rad
C_y_r      =      0.3560 1/rad
C_l_d_a    =      0.1720 1/rad
C_l_d_r    =      0.0192 1/rad
C_n_d_a    =     -0.0402 1/rad
C_n_d_r    =     -0.1152 1/rad
C_y_d_a    =      0.0000 1/rad
C_y_d_r    =      0.2300 1/rad

(W/S)_TO   =       26.29 psf
q_bar      =       38.07 psf
I_xx_S     =        8900 slgft2
I_zz_S     =       10985 slgft2
I_xz_S     =        -184 slgft2
Y_B        =    -28.4250 ft/s^2
Y_p        =     -1.0054 ft/s
Y_r        =      1.7101 ft/s
L_B        =     -2.5495 1/s^2
L_p        =     -1.5718 1/s
L_r        =      0.4972 1/s
N_B        =      3.4733 1/s^2
N_T_B      =      0.0000 1/s^2
N_p        =     -0.1419 1/s
N_r        =     -0.3601 1/s
w_n_D      =      1.9400 rad/s
z_D        =      0.1050
TC_SPIRAL  =     -44.476 s
TC_ROLL    =       0.584 s

TC_1       =       0.584 s
TC_2       =     -44.476 s
Y_del_a    =      0.0000 ft/s^2
Y_del_r    =     10.7176 ft/s^2
L_del_a    =      4.7510 1/s^2
L_del_r    =      0.5303 1/s^2
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)

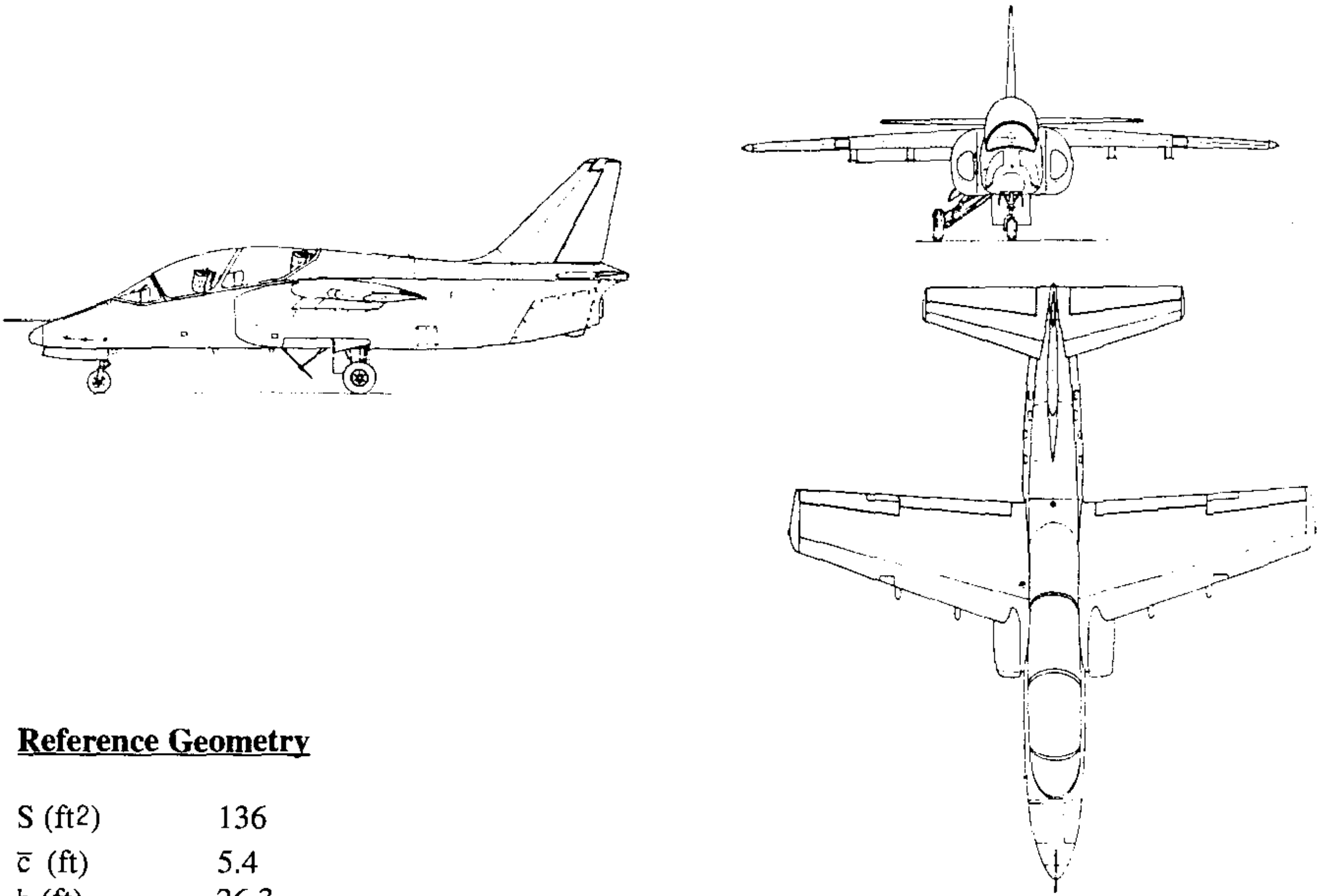
```
POLYNOMIAL SIDESLIP TO AILERON TRANSFER FUNCTION

 + 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   S(S + 3.0117)(S + 0.0797)
-----------------------------------------------------------------------------
178.9180   S(S - 0.0225)(S + 1.7119)(S^2 + 0.4074 S + 3.7637)


 SIDESLIP TO AILERON TRANSFER FUNCTION K_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   S(S - 0.0448)(S + 43.0410)(S + 1.6910)
-----------------------------------------------------------------------------
178.9180   S(S - 0.0225)(S + 1.7119)(S^2 + 0.4074 S + 3.7637)


 SIDESLIP TO RUDDER TRANSFER FUNCTION K_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   S(S^2 + 0.4238 S + 2.9925)
-----------------------------------------------------------------------------
178.9180   S(S - 0.0225)(S + 1.7119)(S^2 + 0.4074 S + 3.7637)


 ROLL TO AILERON TRANSFER FUNCTION K_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   S(S - 4.0264)(S + 2.0472)
-------------------------------------------------------------------------------
178.9180   S(S - 0.0225)(S + 1.7119)(S^2 + 0.4074 S + 3.7637)


 ROLL TO RUDDER TRANSFER FUNCTION K_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   (S - 0.8456)(S^2 + 3.1370 S + 3.0729)
-------------------------------------------------------------------------------
178.9180   S(S - 0.0225)(S + 1.7119)(S^2 + 0.4074 S + 3.7637)


 HEADING TO AILERON TRANSFER FUNCTION K_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   (S + 1.7205)(S^2 + -0.0476 S + 0.1903)
-------------------------------------------------------------------------------
178.9180   S(S - 0.0225)(S + 1.7119)(S^2 + 0.4074 S + 3.7637)


 HEADING TO RUDDER TRANSFER FUNCTION K_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} (slugft2)	750	800	800
I_{yy_B} (slugft2)	4,600	4,800	4,800
I_{zz_B} (slugft2)	5,000	5,200	5,200
I_{xz_B} (slugft2)	200	200	200

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

Flight Condition	Approach	Cruise 1	Cruise 2
Steady State Coefficients			
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
Longitudinal Coefficients and Stability Derivatives (Stability Axes, Dimensionless)			
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
Longitudinal Control and Hinge Moment Derivatives (Stability Axes, 1/rad)			
$C_{D_{\delta_e}}$	0	0	0
$C_{L_{\delta_e}}$	0.39	0.38	0.35
$C_{m_{\delta_e}}$	–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
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
$C_{h_{\alpha_a}}$	–0.143	–0.143	–0.143
$C_{h_{\delta_a}}$	–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

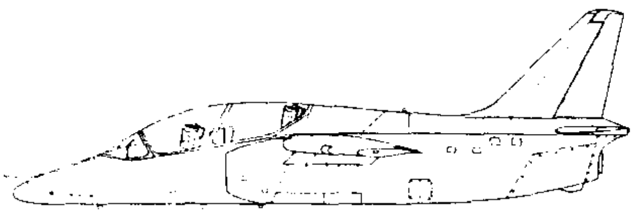


Table B3 (Continued) Stability and Control Derivatives for Airplane C (Pages 494–500)

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	slgft2	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

 - 8.9077 S^3 - 323.3421 S^2 - 14.9885 S - 43.6912
-------------------------------------------------------------------------------
 + 125.4782 S^4 + 307.6638 S^3 + 353.8063 S^2 + 30.0714 S + 29.1274


FACTORED ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

-8.9077   (S + 36.2566)(S^2 + 0.0427 S + 0.1353)
-------------------------------------------------------------------------------
125.4782  (S^2 + 2.4407 S + 2.7066)(S^2 + 0.0112 S + 0.0858)


 ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION K_gain =   -1.500000


POLYNOMIAL SPEED TO ELEVATOR TRANSFER FUNCTION

 - 55.7460 S^2 + 8349.5123 S + 9529.4560
-------------------------------------------------------------------------------
 + 125.4782 S^4 + 307.6638 S^3 + 353.8063 S^2 + 30.0714 S + 29.1274
```

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)


 SPEED TO ELEVATOR TRANSFER FUNCTION K_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)


 PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION K_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	slgft2
U_1	=	73.46	kts	I_zz_S	=	4973	slgft2
Theta_1	=	8.00	deg	I_xz_S	=	-393	slgft2
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	slgft2	Y_r	=	1.4292	ft/s
I_zz_B	=	5000	slgft2	L_B	=	-11.7711	1/s^2
I_xz_B	=	200	slgft2	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)

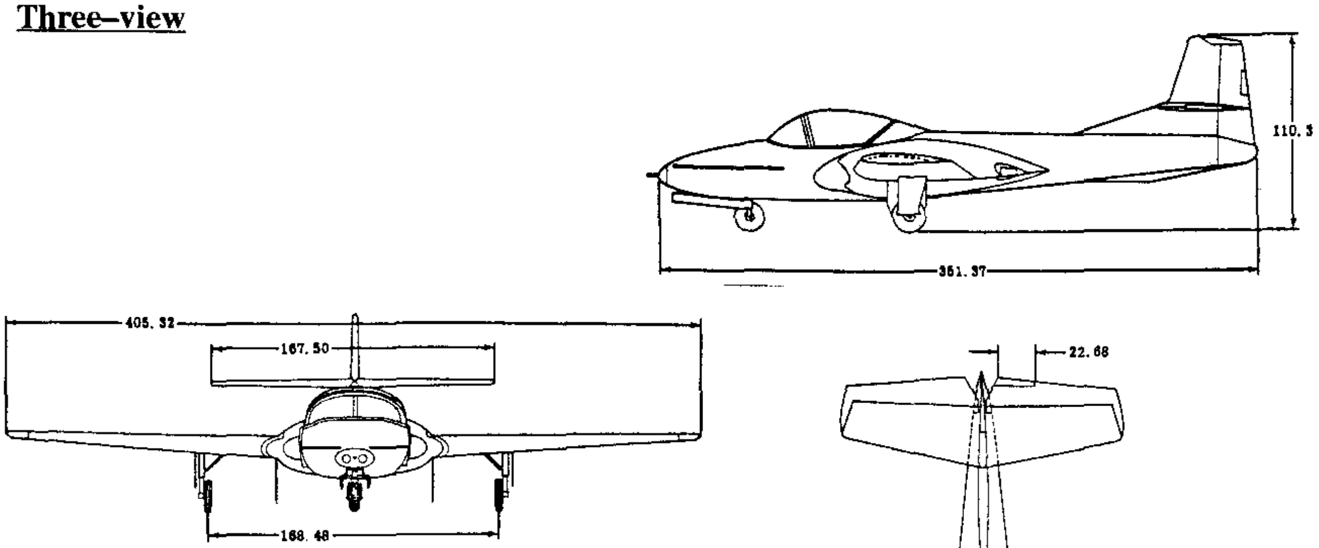
```
POLYNOMIAL SIDESLIP TO AILERON TRANSFER FUNCTION

 + 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

137.7740   S(S + 3.4887)(S + 0.1344)
--------------------------------------------------------------------------------
119.0192   S(S - 0.1236)(S + 3.6262)(S^2 + 0.7616 S + 3.2329)


 SIDESLIP TO AILERON TRANSFER FUNCTION K_gain =   -0.374459


POLYNOMIAL SIDESLIP TO RUDDER TRANSFER FUNCTION

 + 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

5.7005   S(S - 0.2643)(S + 36.1210)(S + 3.5877)
--------------------------------------------------------------------------------
119.0192   S(S - 0.1236)(S + 3.6262)(S^2 + 0.7616 S + 3.2329)


 SIDESLIP TO RUDDER TRANSFER FUNCTION K_gain =    1.132035


POLYNOMIAL ROLL TO AILERON TRANSFER FUNCTION

 + 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

1171.4603   S(S^2 + 0.3877 S + 1.5860)
--------------------------------------------------------------------------------
119.0192   S(S - 0.1236)(S + 3.6262)(S^2 + 0.7616 S + 3.2329)


 ROLL TO AILERON TRANSFER FUNCTION K_gain =  -10.771696
```

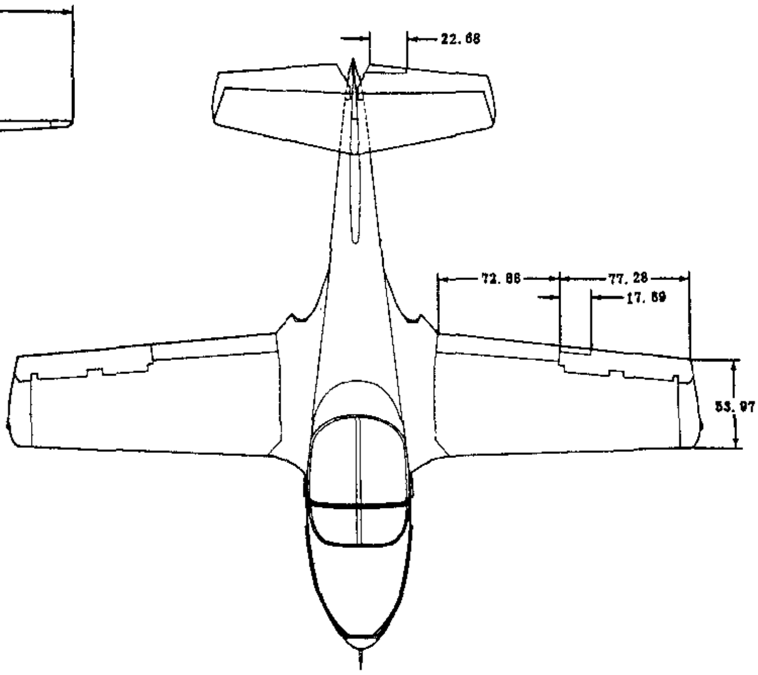
Table B3 (Continued) Stability and Control Derivatives for Airplane C (Pages 494–500)

```
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   S(S - 3.1187)(S + 1.2197)
--------------------------------------------------------------------------------
119.0192   S(S - 0.1236)(S + 3.6262)(S^2 + 0.7616 S + 3.2329)


 ROLL TO RUDDER TRANSFER FUNCTION K_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  (S - 1.0759)(S^2 + 2.6852 S + 3.1403)
--------------------------------------------------------------------------------
119.0192   S(S - 0.1236)(S + 3.6262)(S^2 + 0.7616 S + 3.2329)


 HEADING TO AILERON TRANSFER FUNCTION K_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  (S + 3.0014)(S^2 + -0.1100 S + 0.6095)
--------------------------------------------------------------------------------
119.0192   S(S - 0.1236)(S + 3.6262)(S^2 + 0.7616 S + 3.2329)

 HEADING TO RUDDER TRANSFER FUNCTION K_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} (slugft2)	7,985	7,985	7,985
I_{yy_B} (slugft2)	3,326	3,326	3,326
I_{zz_B} (slugft2)	11,183	11,183	11,183
I_{xz_B} (slugft2)	0	0	0

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

Flight Condition	Climb	Cruise	Approach
Steady State Coefficients			
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
Longitudinal Coefficients and Stability Derivatives (Stability Axes, Dimensionless)			
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
Longitudinal Control and Hinge Moment Derivatives (Stability Axes, 1/rad)			
$C_{D_{\delta_e}}$	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_α}	–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
$C_{h_{\alpha_a}}$	???	???	???
$C_{h_{\delta_a}}$	–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

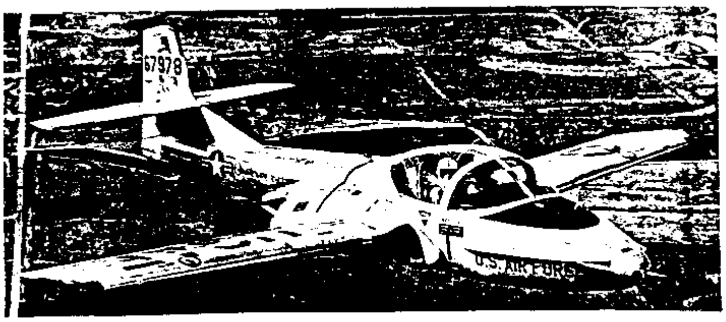


Table B4 (Continued) Stability and Control Derivatives for Airplane D (Pages 501–507)

Longitudinal Transfer Function Data

```
Altitude   =      30000 ft
U_1        =     270.14 kts
W_current  =     6360.0 lb
S_w        =     182.00 ft^2
Theta_1    =       2.00 deg
C_bar      =       5.47 ft
I_yy_B     =       3326 slgft2
C_m_1      =     0.0000
C_m_u      =     0.0000
C_m_a      =    -0.7000 1/rad
C_m_a.dot  =    -6.9500 1/rad
C_m_q      =   -14.9000 1/rad
C_m_T_1    =     0.0000
C_m_T_u    =     0.0000
C_m_T_a    =     0.0000
C_L_1      =     0.3780
C_L_u      =     0.0000
C_L_a      =     5.1500 1/rad
C_L_a.dot  =     2.0000 1/rad
C_L_q      =     4.1000 1/rad
C_D_1      =     0.0300
C_D_a      =     0.2500 1/rad
C_D_u      =     0.0000
C_T_X_1    =     0.0300
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
```

```
M_1        =       0.458
n          =        1.00 g
q_bar      =       92.58 psf
(W/S)_TO   =       34.95 psf
X_u        =     -0.0111 1/s
X_T_u      =     -0.0019 1/s
X_a        =     10.8087 ft/s^2
Z_u        =     -0.1400 1/s
Z_a        =   -437.4153 ft/s^2
Z_a_dot    =     -1.0131 ft/s
Z_q        =     -2.0768 ft/s
M_u        =      0.0000 1/ft/s
M_T_u      =      0.0000 1/ft/s
M_a        =    -19.3979 1/s^2
M_T_a      =      0.0000 1/s^2
M_a_dot    =     -1.1553 1/s
M_q        =     -2.4768 1/s

w_n_SP     =      4.6523 rad/s
z_SP       =      0.4927
w_n_P      =      0.0934 rad/s
z_P        =      0.0526
X_del_e    =      0.0000 ft/s^2
Z_del_e    =    -42.2216 ft/s^2
M_del_e    =    -31.0366 1/s^2
```

```
POLYNOMIAL ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

 - 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


FACTORED ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

-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)


 ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION K_gain =   -1.600000


POLYNOMIAL SPEED TO ELEVATOR TRANSFER FUNCTION

 - 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
```

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)
```

SPEED TO ELEVATOR TRANSFER FUNCTION K_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)
```

PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION K_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	slgft2
U_1	=	270.14	kts	I_zz_S	=	11179	slgft2
Theta_1	=	2.00	deg	I_xz_S	=	-112	slgft2
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	slgft2	Y_r	=	0.9390	ft/s
I_zz_B	=	11183	slgft2	L_B	=	-6.7297	1/s^2
I_xz_B	=	0	slgft2	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)

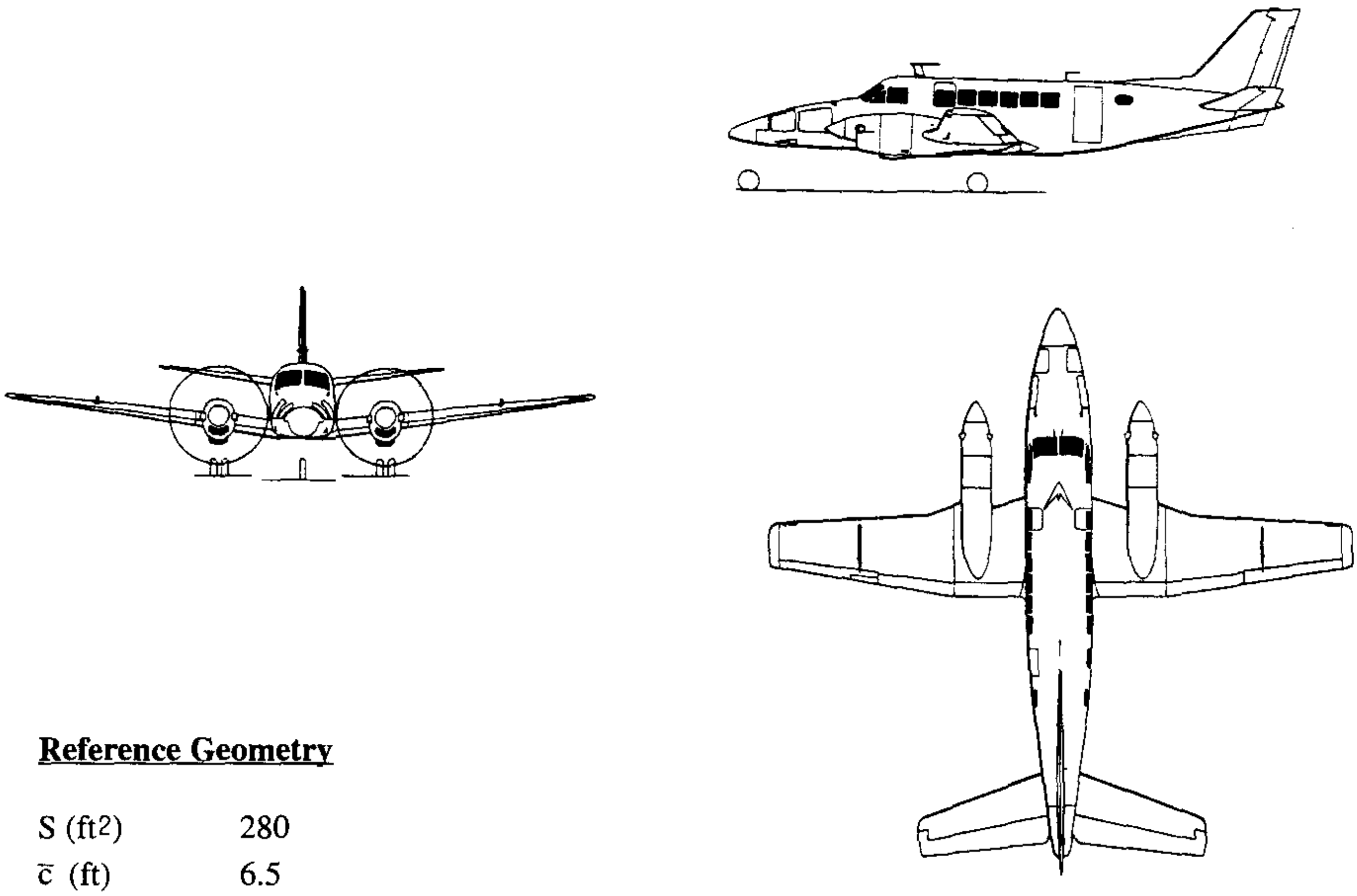
```
POLYNOMIAL SIDESLIP TO AILERON TRANSFER FUNCTION

 + 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   S(S + 2.0499)(S + 0.0741)
-------------------------------------------------------------------------------
455.8852   S(S + 1.2663)(S + 0.0037)(S^2 + 0.2265 S + 5.8041)


 SIDESLIP TO AILERON TRANSFER FUNCTION K_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   S(S - 0.0053)(S + 50.5775)(S + 1.2357)
-------------------------------------------------------------------------------
455.8852   S(S + 1.2663)(S + 0.0037)(S^2 + 0.2265 S + 5.8041)


 SIDESLIP TO RUDDER TRANSFER FUNCTION K_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   S(S^2 + 0.3017 S + 4.9577)
-------------------------------------------------------------------------------

455.8852   S(S + 1.2663)(S + 0.0037)(S^2 + 0.2265 S + 5.8041)


 ROLL TO AILERON TRANSFER FUNCTION K_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   S(S - 2.6043)(S + 2.2790)
--------------------------------------------------------------------------------
455.8852   S(S + 1.2663)(S + 0.0037)(S^2 + 0.2265 S + 5.8041)


 ROLL TO RUDDER TRANSFER FUNCTION K_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  (S - 1.0733)(S^2 + 2.6158 S + 2.9278)
--------------------------------------------------------------------------------
455.8852   S(S + 1.2663)(S + 0.0037)(S^2 + 0.2265 S + 5.8041)


 HEADING TO AILERON TRANSFER FUNCTION K_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  (S + 1.3240)(S^2 + -0.1854 S + 0.1831)
--------------------------------------------------------------------------------
455.8852   S(S + 1.2663)(S + 0.0037)(S^2 + 0.2265 S + 5.8041)


 HEADING TO RUDDER TRANSFER FUNCTION K_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/ft2)	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} (slugft2)	15,189	10,085	15,189
I_{yy_B} (slugft2)	20,250	15,148	20,250
I_{zz_B} (slugft2)	34,141	23,046	34,141
I_{xz_B} (slugft2)	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)
Steady State Coefficients			
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
Longitudinal Coefficients and Stability Derivatives (Stability Axes, Dimensionless)			
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
Longitudinal Control and Hinge Moment Derivatives (Stability Axes, 1/rad)			
$C_{D_{\delta_e}}$	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)
Longitudinal Control and Hinge Moment Derivatives: Cont'd (Stability Axes, 1/rad)			
$C_{h_{\alpha}}$	???	???	???
$C_{h_{\delta_e}}$	???	???	???
Lateral–Directional Stability Derivatives (Stability Axes, Dimensionless)			
$C_{l_{\beta}}$	–0.13	–0.13	–0.13
C_{l_p}	–0.50	–0.50	–0.50
C_{l_r}	0.06	0.14	0.14
$C_{y_{\beta}}$	–0.59	–0.59	–0.59
C_{y_p}	–0.21	–0.19	–0.19
C_{y_r}	0.39	0.39	0.39
$C_{n_{\beta}}$	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
Lateral–Directional Control and Hinge Moment Derivatives (Stability Axes, Dimensionless)			
$C_{l_{\delta_a}}$	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	slgft2	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				
C_L_a.dot	=	2.5000	1/rad	w_n_SP	=	5.0015	rad/s
C_L_q	=	8.1000	1/rad	z_SP	=	0.4849	
C_D_1	=	0.0298		w_n_P	=	0.0950	rad/s
C_D_a	=	0.1310	1/rad	z_P	=	0.0625	
C_D_u	=	0.0000		X_del_e	=	0.0000	ft/s^2
C_T_X_1	=	0.0298		Z_del_e	=	-62.6410	ft/s^2
C_T_X_u	=	-0.0596		M_del_e	=	-23.0586	1/s^2
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)


 ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION K_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)


 SPEED TO ELEVATOR TRANSFER FUNCTION K_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)

 PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION K_gain =   -2.219730
```

Lateral-Directional Transfer Function Data

W_current	=	11000.0	lb
Altitude	=	20000	ft
S_w	=	280.00	ft^2
U_1	=	266.59	kts
Theta_1	=	1.10	deg
Alpha	=	1.10	deg
b_w	=	46.00	ft
I_xx_B	=	15189	slgft2
I_zz_B	=	34141	slgft2
I_xz_B	=	4371	slgft2
C_l_B	=	-0.1300	1/rad
C_l_p	=	-0.5000	1/rad
C_l_r	=	0.1400	1/rad
C_n_B	=	0.0800	1/rad
C_n_T_B	=	0.0000	
C_n_p	=	0.0190	1/rad
C_n_r	=	-0.1970	1/rad
C_y_B	=	-0.5900	1/rad
C_y_p	=	-0.1900	1/rad
C_y_r	=	0.3900	1/rad
C_l_d_a	=	0.1560	1/rad
C_l_d_r	=	0.0106	1/rad
C_n_d_a	=	-0.0012	1/rad
C_n_d_r	=	-0.0758	1/rad
C_y_d_a	=	0.0000	1/rad
C_y_d_r	=	0.1440	1/rad

(W/S)_TO	=	39.29	psf
q_bar	=	128.28	psf
I_xx_S	=	15028	slgft2
I_zz_S	=	34302	slgft2
I_xz_S	=	4004	slgft2
Y_B	=	-61.5970	ft/s^2
Y_p	=	-1.0140	ft/s
Y_r	=	2.0813	ft/s
L_B	=	14.2925	1/s^2
L_p	=	-2.8100	1/s
L_r	=	0.7868	1/s
N_B	=	3.8534	1/s^2
N_T_B	=	0.0000	1/s^2
N_p	=	0.0468	1/s
N_r	=	-0.4850	1/s
w_n_D	=	1.8740	rad/s
z_D	=	0.0356	
TC_SPIRAL	=	40.169	s
TC_ROLL	=	0.306	s
TC_1	=	0.306	s
TC_2	=	40.169	s
Y_del_a	=	0.0000	ft/s^2
Y_del_r	=	15.0338	ft/s^2
L_del_a	=	17.1510	1/s^2
L_del_r	=	1.1654	1/s^2
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)

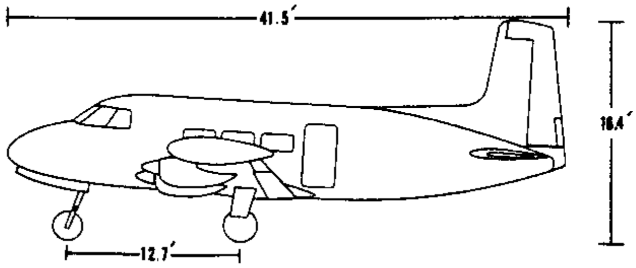
```
POLYNOMIAL SIDESLIP TO AILERON TRANSFER FUNCTION

 - 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

-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)


 SIDESLIP TO AILERON TRANSFER FUNCTION K_gain =    2.121027


POLYNOMIAL SIDESLIP TO RUDDER TRANSFER FUNCTION

 + 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

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)


 SIDESLIP TO RUDDER TRANSFER FUNCTION K_gain =   -0.591520


POLYNOMIAL ROLL TO AILERON TRANSFER FUNCTION

 + 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

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)


 ROLL TO AILERON TRANSFER FUNCTION K_gain =  238.492770
```

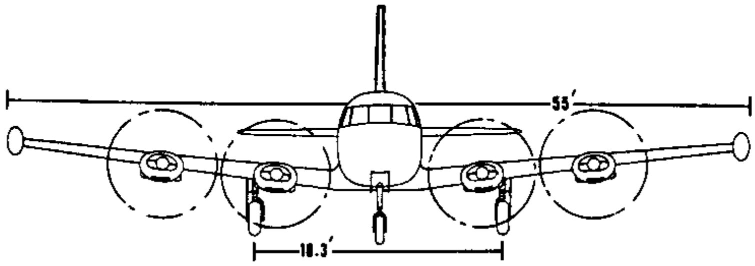
Table B5 (Continued) Stability and Control Derivatives for Airplane E (Pages 508–514)

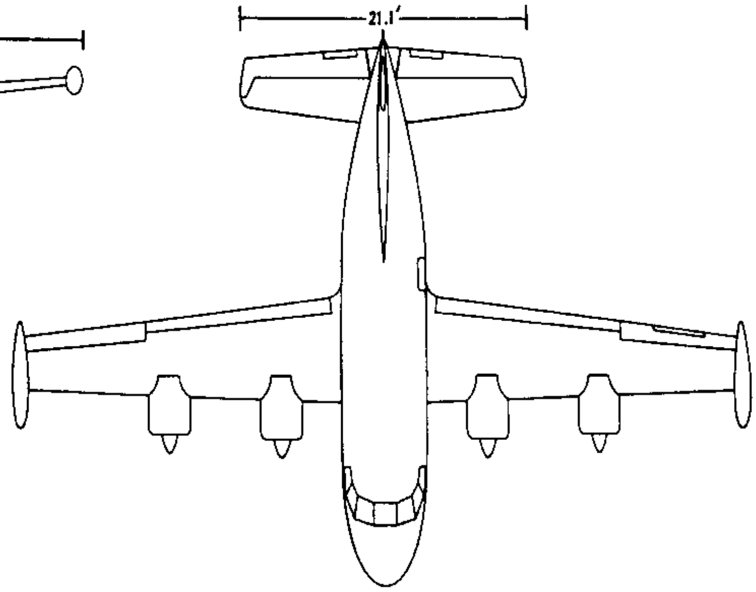
```
POLYNOMIAL ROLL TO RUDDER TRANSFER FUNCTION

 + 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   S(S - 24.3574)(S + 10.2138)
-------------------------------------------------------------------------------
435.9557   S(S + 3.2716)(S + 0.0249)(S^2 + 0.1335 S + 3.5119)


 ROLL TO RUDDER TRANSFER FUNCTION K_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   (S + 1.5193)(S^2 + -1.0533 S + 1.5697)
-------------------------------------------------------------------------------
435.9557   S(S + 3.2716)(S + 0.0249)(S^2 + 0.1335 S + 3.5119)


 HEADING TO AILERON TRANSFER FUNCTION K_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   (S + 3.0349)(S^2 + -0.0156 S + 0.3176)
-------------------------------------------------------------------------------
435.9557   S(S + 3.2716)(S + 0.0249)(S^2 + 0.1335 S + 3.5119)


 HEADING TO RUDDER TRANSFER FUNCTION K_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} (slugft2)	64,811	64,811	64,811
I_{yy_B} (slugft2)	17,300	17,300	17,300
I_{zz_B} (slugft2)	64,543	64,543	64,543
I_{xz_B} (slugft2)	0	0	0

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

Flight Condition	Climb	Cruise	Approach
Steady State Coefficients			
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
Longitudinal Coefficients and Stability Derivatives (Stability Axes, Dimensionless)			
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
Longitudinal Control and Hinge Moment Derivatives (Stability Axes, 1/rad)			
$C_{D_{\delta_e}}$	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
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				
C_L_a.dot	=	2.7000	1/rad	w_n_SP	=	2.7097	rad/s
C_L_q	=	7.6000	1/rad	z_SP	=	0.7199	
C_D_1	=	0.1140		w_n_P	=	0.2051	rad/s
C_D_a	=	0.4750	1/rad	z_P	=	0.0871	
C_D_u	=	0.0000		X_del_e	=	0.0000	ft/s^2
C_T_X_1	=	0.1140		Z_del_e	=	-18.3007	ft/s^2
C_T_X_u	=	-0.3420		M_del_e	=	-9.6254	1/s^2
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)


 ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION K_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)
```

SPEED TO ELEVATOR TRANSFER FUNCTION K_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)
```

PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION K_gain = -2.438483

Lateral–Directional Transfer Function Data

W_current	=	15000.0	lb
Altitude	=	0	ft
S_w	=	340.00	ft^2
U_1	=	112.09	kts
Theta_1	=	6.00	deg
Alpha	=	6.00	deg
b_w	=	55.10	ft
I_xx_B	=	64811	slgft2
I_zz_B	=	64543	slgft2
I_xz_B	=	0	slgft2
C_l_B	=	-0.1172	1/rad
C_l_p	=	-0.5760	1/rad
C_l_r	=	0.2307	1/rad
C_n_B	=	0.1871	1/rad
C_n_T_B	=	0.0000	
C_n_p	=	-0.1026	1/rad
C_n_r	=	-0.2240	1/rad
C_y_B	=	-0.9070	1/rad
C_y_p	=	-0.3430	1/rad
C_y_r	=	0.4470	1/rad
C_l_d_a	=	0.1776	1/rad
C_l_d_r	=	0.0200	1/rad
C_n_d_a	=	-0.0417	1/rad
C_n_d_r	=	-0.1054	1/rad
C_y_d_a	=	0.0000	1/rad
C_y_d_r	=	0.2000	1/rad

(W/S)_TO	=	44.12	psf
q_bar	=	42.53	psf
I_xx_S	=	64808	slgft2
I_zz_S	=	64546	slgft2
I_xz_S	=	28	slgft2
Y_B	=	-28.1334	ft/s^2
Y_p	=	-1.5494	ft/s
Y_r	=	2.0192	ft/s
L_B	=	-1.4410	1/s^2
L_p	=	-1.0313	1/s
L_r	=	0.4131	1/s
N_B	=	2.3097	1/s^2
N_T_B	=	0.0000	1/s^2
N_p	=	-0.1845	1/s
N_r	=	-0.4027	1/s
w_n_D	=	1.5875	rad/s
z_D	=	0.1298	
TC_SPIRAL	=	-47.494	s
TC_ROLL	=	0.839	s
TC_1	=	0.839	s
TC_2	=	-47.494	s
Y_del_a	=	0.0000	ft/s^2
Y_del_r	=	6.2036	ft/s^2
L_del_a	=	2.1836	1/s^2
L_del_r	=	0.2459	1/s^2
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)

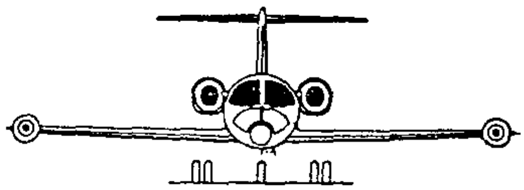
```
POLYNOMIAL SIDESLIP TO AILERON TRANSFER FUNCTION

 + 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   S(S + 2.5344)(S + 0.0907)
---------------------------------------------------------------------------------
189.1787   S(S - 0.0211)(S + 1.1915)(S^2 + 0.4122 S + 2.5201)


 SIDESLIP TO AILERON TRANSFER FUNCTION K_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   S(S - 0.0495)(S + 39.5163)(S + 1.1573)
---------------------------------------------------------------------------------
189.1787   S(S - 0.0211)(S + 1.1915)(S^2 + 0.4122 S + 2.5201)


 SIDESLIP TO RUDDER TRANSFER FUNCTION K_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   S(S^2 + 0.4541 S + 1.9946)
---------------------------------------------------------------------------------

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


 ROLL TO AILERON TRANSFER FUNCTION K_gain =  -68.880671
```

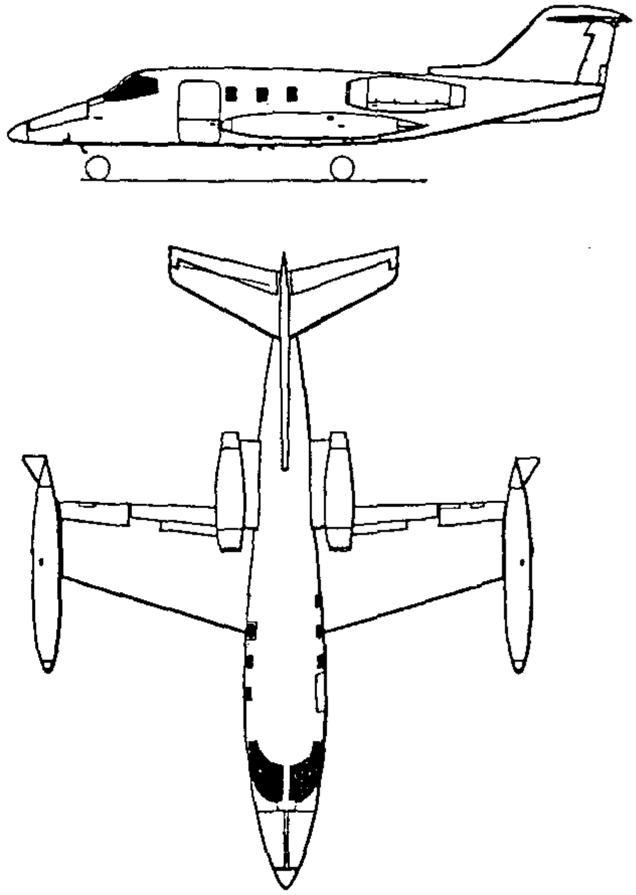
Table B6 (Continued) **Stability and Control Derivatives for Airplane F (Pages 515–521)**

```
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   S(S - 3.4302)(S + 1.5993)
--------------------------------------------------------------------------------
189.1787   S(S - 0.0211)(S + 1.1915)(S^2 + 0.4122 S + 2.5201)


 ROLL TO RUDDER TRANSFER FUNCTION K_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  (S - 0.6713)(S^2 + 2.6371 S + 2.1092)
--------------------------------------------------------------------------------
189.1787   S(S - 0.0211)(S + 1.1915)(S^2 + 0.4122 S + 2.5201)


 HEADING TO AILERON TRANSFER FUNCTION K_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  (S + 1.2045)(S^2 + -0.0477 S + 0.1411)
--------------------------------------------------------------------------------
189.1787   S(S - 0.0211)(S + 1.1915)(S^2 + 0.4122 S + 2.5201)


 HEADING TO RUDDER TRANSFER FUNCTION K_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)

Flight Condition	Approach	Cruise (Max Wht)	Cruise(Low Wht)
Steady State Coefficients			
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
Longitudinal Coefficients and Stability Derivatives (Stability Axes, Dimensionless)			
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
$C_{T_{x_u}}$	–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
Longitudinal Control and Hinge Moment Derivatives (Stability Axes, 1/rad)			
$C_{D_{\delta_e}}$	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)
Longitudinal Control and Hinge Moment Derivatives: Cont'd (Stability Axes, 1/rad)			
C_{h_α}	–0.105	–0.132	–0.132
$C_{h_{\delta_e}}$	–0.378	–0.476	–0.476
Lateral–Directional Stability Derivatives (Stability Axes, Dimensionless)			
C_{l_β}	–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_β}	–0.730	–0.730	–0.730
C_{y_p}	0	0	0
C_{y_r}	0.400	0.400	0.400
C_{n_β}	0.150	0.127	0.124
$C_{n_{T_\beta}}$	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)
```

ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION K_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_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_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	slgft2
U_1	=	100.71	kts	I_zz_S	=	47081	slgft2
Theta_1	=	5.00	deg	I_xz_S	=	-369	slgft2
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	slgft2	Y_r	=	0.7819	ft/s
I_zz_B	=	47000	slgft2	L_B	=	-1.6639	1/s^2
I_xz_B	=	1300	slgft2	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)

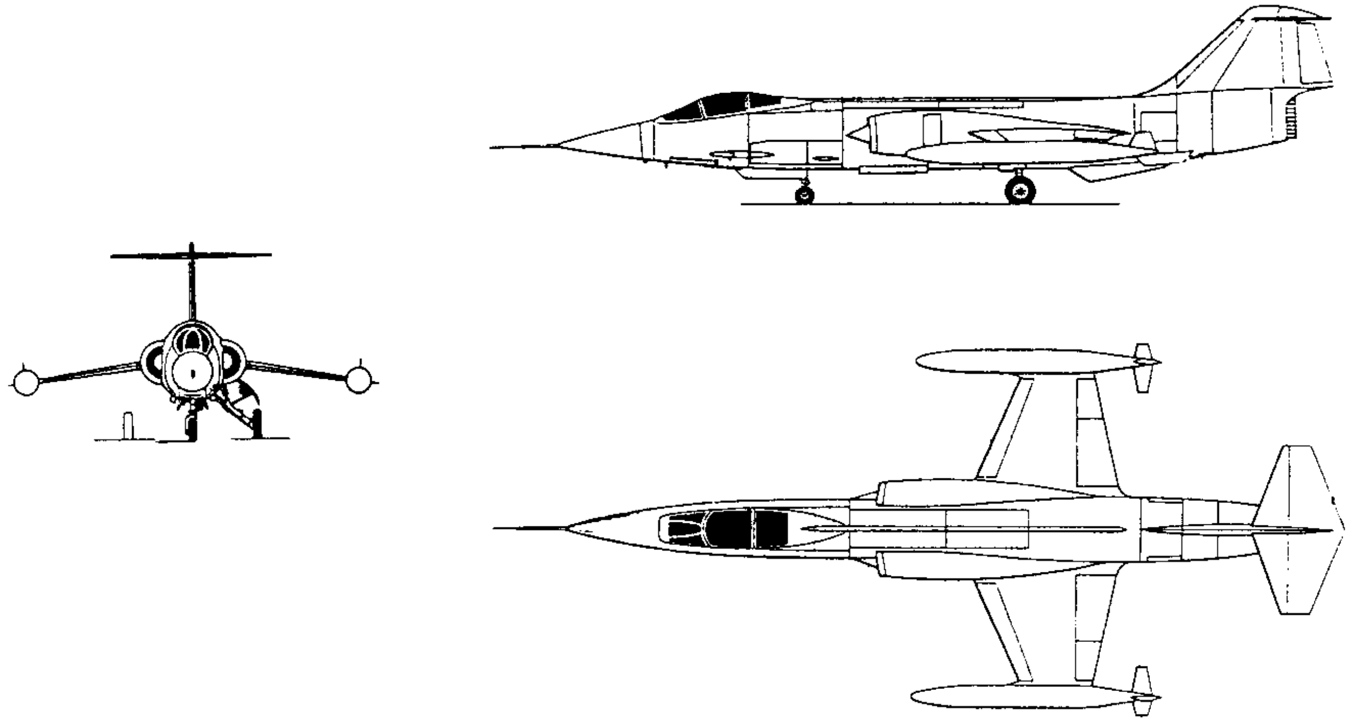
```
POLYNOMIAL SIDESLIP TO AILERON TRANSFER FUNCTION

 + 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   S(S + 1.6022)(S + 0.0355)
----------------------------------------------------------------------------------
169.9617   S(S - 0.0293)(S + 0.7334)(S^2 + -0.0943 S + 1.0844)


 SIDESLIP TO AILERON TRANSFER FUNCTION K_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   S(S - 0.1234)(S + 26.2238)(S + 0.5890)
----------------------------------------------------------------------------------
169.9617   S(S - 0.0293)(S + 0.7334)(S^2 + -0.0943 S + 1.0844)


 SIDESLIP TO RUDDER TRANSFER FUNCTION K_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   S(S^2 + 0.1459 S + 0.5258)
----------------------------------------------------------------------------------
169.9617   S(S - 0.0293)(S + 0.7334)(S^2 + -0.0943 S + 1.0844)


 BANK ANGLE TO AILERON TRANSFER FUNCTION K_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   S(S - 2.7913)(S + 1.5226)
--------------------------------------------------------------------------------
169.9617   S(S - 0.0293)(S + 0.7334)(S^2 + -0.0943 S + 1.0844)


 BANK ANGLE TO RUDDER TRANSFER FUNCTION K_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  (S - 0.5687)(S^2 + 1.3721 S + 0.8407)
--------------------------------------------------------------------------------
169.9617   S(S - 0.0293)(S + 0.7334)(S^2 + -0.0943 S + 1.0844)


 HEADING TO AILERON TRANSFER FUNCTION K_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  (S + 0.8188)(S^2 + -0.3701 S + 0.3195)
--------------------------------------------------------------------------------
169.9617   S(S - 0.0293)(S + 0.7334)(S^2 + -0.0943 S + 1.0844)


 HEADING TO RUDDER TRANSFER FUNCTION K_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} (slugft2)	3,600	3,600
I_{yy_B} (slugft2)	59,000	59,000
I_{zz_B} (slugft2)	60,000	60,000
I_{xz_B} (slugft2)	0	0

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

Flight Condition	Approach	Cruise
Steady State Coefficients		
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
Longitudinal Coefficients and Stability Derivatives (Stability Axes, Dimensionless)		
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
Longitudinal Control and Hinge Moment Derivatives (Stability Axes, 1/rad)		
$C_{D_{\delta_e}}$	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
Longitudinal Control and Hinge Moment Derivatives: Cont'd (Stability Axes, 1/rad)		
C_{h_α}	not applicable	
$C_{h_{\delta_e}}$	not applicable	
Lateral–Directional Stability Derivatives (Stability Axes, Dimensionless)		
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
Lateral–Directional Control and Hinge Moment Derivatives (Stability Axes, Dimensionless)		
$C_{l_{\delta_a}}$	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
$C_{h_{\alpha_a}}$	???	???
$C_{h_{\delta_a}}$	???	???
$C_{h_{\beta_r}}$	???	???
$C_{h_{\delta_r}}$	???	???

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)


 ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION K_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)


 SPEED TO ELEVATOR TRANSFER FUNCTION K_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)

 PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION K_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	slgft2
U_1	=	170.02	kts	I_zz_S	=	58299	slgft2
Theta_1	=	10.00	deg	I_xz_S	=	-9645	slgft2
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	slgft2	Y_r	=	0.0000	ft/s
I_zz_B	=	60000	slgft2	L_B	=	-13.8692	1/s^2
I_xz_B	=	0	slgft2	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)

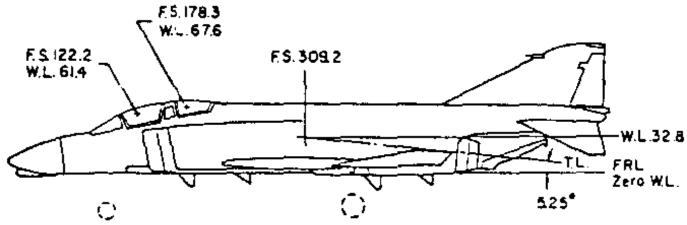
```
POLYNOMIAL SIDESLIP TO AILERON TRANSFER FUNCTION

 + 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   S(S + 0.6693)(S + 0.2276)
--------------------------------------------------------------------------------
200.5823   S(S - 0.0010)(S + 1.0346)(S^2 + 0.7380 S + 8.3000)


 SIDESLIP TO AILERON TRANSFER FUNCTION K_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   S(S - 0.0130)(S + 59.0359)(S + 1.0189)
--------------------------------------------------------------------------------
200.5823   S(S - 0.0010)(S + 1.0346)(S^2 + 0.7380 S + 8.3000)


 SIDESLIP TO RUDDER TRANSFER FUNCTION K_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   S(S^2 + 0.3744 S + 3.8908)
--------------------------------------------------------------------------------

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


 ROLL TO AILERON TRANSFER FUNCTION K_gain =-1912.752646
```

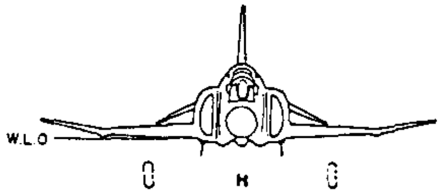
Table B8 (Continued) **Stability and Control Derivatives for Airplane H (Pages 529–535)**

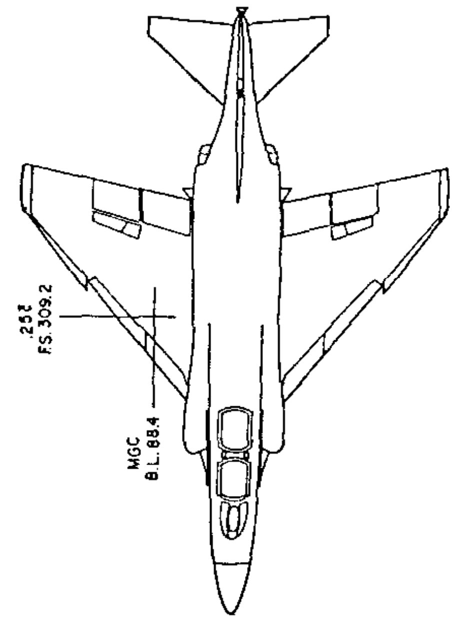
```
POLYNOMIAL ROLL TO RUDDER TRANSFER FUNCTION

 + 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)


 ROLL TO RUDDER TRANSFER FUNCTION K_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)


 HEADING TO AILERON TRANSFER FUNCTION K_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)


 HEADING TO RUDDER TRANSFER FUNCTION K_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)**

Flight Condition	Approach	Cruise (M<1)	Cruise (M>1)
Steady State Coefficients			
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
Longitudinal Coefficients and Stability Derivatives (Stability Axes, Dimensionless)			
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
Longitudinal Control and Hinge Moment Derivatives (Stability Axes, 1/rad)			
$C_{D_{\delta_e}}$	not applicable		
$C_{L_{\delta_e}}$	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)
Longitudinal Control and Hinge Moment Derivatives: Cont'd (Stability Axes, 1/rad)			
C_{h_α}	not applicable		
$C_{h_{\delta_e}}$	not applicable		
Lateral–Directional Stability Derivatives (Stability Axes, Dimensionless)			
C_{l_β}	–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_β}	–0.655	–0.680	–0.700
C_{y_p}	0	0	0
C_{y_r}	0	0	0
C_{n_β}	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 slgft2	X_a	=	-4.8986 ft/s^2
C_m_1	=	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_1	=	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_1	=	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_1	=	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_1	=	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

 - 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


FACTORED ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION

-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)


 ANGLE OF ATTACK TO ELEVATOR TRANSFER FUNCTION K_gain =    3.198674


POLYNOMIAL SPEED TO ELEVATOR TRANSFER FUNCTION

 + 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
```

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 + C.0394)(S^2 + 1.2582 S + 8.1064)


 SPEED TO ELEVATOR TRANSFER FUNCTION K_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)

 PITCH ATTITUDE TO ELEVATOR TRANSFER FUNCTION K_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	slgft2
U_1	=	518.96	kts	I_zz_S	=	139763	slgft2
Theta_1	=	2.60	deg	I_xz_S	=	-3011	slgft2
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	slgft2	Y_r	=	0.0000	ft/s
I_zz_B	=	139800	slgft2	L_B	=	-18.5587	1/s^2
I_xz_B	=	2200	slgft2	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)

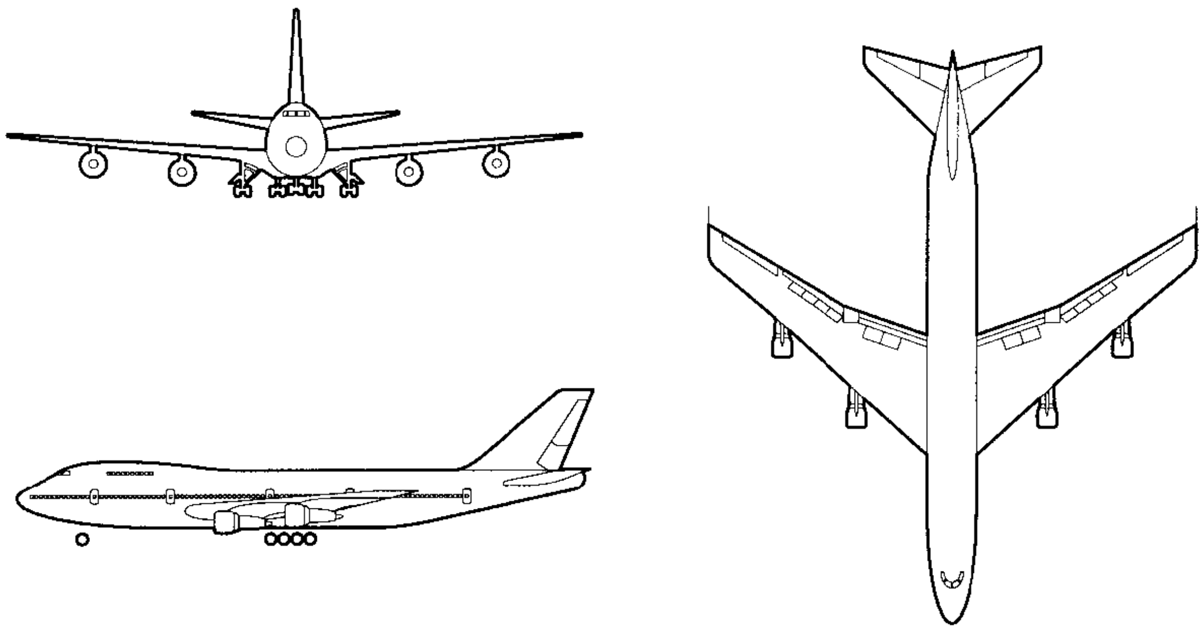
```
POLYNOMIAL SIDESLIP TO AILERON TRANSFER FUNCTION

 - 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    S(S - 114.0811)(S + 2.7307)(S + 0.1253)
--------------------------------------------------------------------------------
873.6315    S(S + 1.3366)(S + 0.0130)(S^2 + 0.2309 S + 5.7388)


 SIDESLIP TO AILERON TRANSFER FUNCTION K_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    S(S - 0.0066)(S + 209.5221)(S + 1.2626)
--------------------------------------------------------------------------------
873.6315    S(S + 1.3366)(S + 0.0130)(S^2 + 0.2309 S + 5.7388)


 SIDESLIP TO RUDDER TRANSFER FUNCTION K_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    S(S^2 + 0.3457 S + 5.1369)
--------------------------------------------------------------------------------

873.6315    S(S + 1.3366)(S + 0.0130)(S^2 + 0.2309 S + 5.7388)


 ROLL TO AILERON TRANSFER FUNCTION K_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   S(S - 5.2583)(S + 4.8343)
--------------------------------------------------------------------------------
873.6315   S(S + 1.3366)(S + 0.0130)(S^2 + 0.2309 S + 5.7388)

 ROLL TO RUDDER TRANSFER FUNCTION K_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   (S - 1.4872)(S^2 + 3.1157 S + 4.8369)
--------------------------------------------------------------------------------
873.6315   S(S + 1.3366)(S + 0.0130)(S^2 + 0.2309 S + 5.7388)

 HEADING TO AILERON TRANSFER FUNCTION K_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   (S + 1.4998)(S^2 + -0.1983 S + 0.3811)
--------------------------------------------------------------------------------
873.6315   S(S + 1.3366)(S + 0.0130)(S^2 + 0.2309 S + 5.7388)

 HEADING TO RUDDER TRANSFER FUNCTION K_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