Design, Analysis and Research Corporation (DARcorporation)

ERRATA: Airplane Aerodynamics and Performance

Year of Print, 1997
(Errata Revised May 4, 2018)

Please check the website www.darcorp.com for updated errata

cover & title page	'Warren S. Bellows Distinguished Professor' should be 'J.L. Constant Distinguished Professor'
page i, Line 25	Remove line
page i, Line 26	'Joulowski' should be 'Joukowski'
page ii, Line 2	'Joulowski' should be 'Joukowski'
page xxiii, Line 4	'$\sqrt{M^2 - 1}$' should be '$\sqrt{1 - M_\infty^2}$'
page xxiii, Line 14	'ft/sec ^or^ m/sec' should be 'ft/sec or m/sec'
page xxiii, Line 15	'ft/sec ^or^ m/sec' should be 'ft/sec or m/sec'
page 7, Equation (1.14)	Should read: $\frac{\rho}{\rho_1} = \left(\frac{P}{P_1}\right)\left(\frac{T_1}{T}\right) = \left(\frac{T}{T_1}\right)^{\left(-\frac{1}{aR}-1\right)}$
page 7, Equation (1.15)	Should read: $\frac{T}{T_O} = 1 + \frac{ah}{T_O} = 1 - 6.875\text{x}10^{-6} h$
page 22, Equation (2.40)	Should read: $V = \sqrt{\frac{2(p_t - p)}{\rho}} = V_e\sqrt{\frac{\rho_o}{\rho}} = \frac{V_e}{\sqrt{\sigma}}$
page 26, Equation (2.56)	Should read: $V_e = V_c - \Delta V_c$
page 34, Line 28	'$A = b / S^2$' should be '$A = b^2 / S$'
page 47, Equation (2.97)	'(2.97)' should be '(2.99)'
page 55, Line 8	Should read 'The derivation clearly establishes the fact that the lift and drag coefficients, c_l and c_d, are functions of α

	, R_N and M. By using a similar process a pitching moment coefficient, c_m, can be determined so that the sectional pitching moment can be computed from:'
page 55, Line 16	Should read 'This is because the span was taken to be unity.'
page 59, Line 6	Should read 'Numerical values for the parameter c_{m_o} are given in Table 3.1 for several types of airfoils.'
page 60, Equation (3.21)	'$\frac{\partial c_{m_x}}{\partial c_l}$' should be '$\frac{\partial c_{m_x}}{\partial \alpha}$'
page 61, Line 1	'Eqn (2.10)' should be 'Eqn (2.9)'
page 61, Line 4	'$c_p = 0$' should be '$c_p = 1.0$'
page 61, Figure 3.7	For the figure on the left, the pressure distribution on the lower surface should be pointing INTO the surface.
Page 61, Figure 3.7	For the 'c_p vs. x/c' curve, c_p is positive below x/c-axis and negative above x/c-axis.
page 61, Figure 3.8	'$\left(\frac{\Delta p}{q} = C_{p\,lower} - C_{p\,upper}\right)$' should be '$\left(\frac{\Delta p}{q} = c_{p\,lower} - c_{p\,upper}\right)$'
page 62, Equation (3.25b)	Should read: $c_x = \frac{X}{\bar{q}c} = \int_0^1 \left(c_{p_{\mathrm{upper}}} \frac{dz_{\mathrm{upper}}}{dx} - c_{p_{\mathrm{lower}}} \frac{dz_{\mathrm{lower}}}{dx} \right) d\left(\frac{x}{c}\right)$
page 63, Line 20	'$\sqrt{1-M_\infty}$' should be '$\sqrt{1-M_\infty^2}$'
page 64, Equation (3.34)	Should read: $c_p = \frac{c_{p_o}}{\sqrt{1-M_\infty^2} + \frac{c_{p_o} M_\infty^2}{2\left(\sqrt{1-M_\infty^2}+1\right)}}$
page 72, Table 3.2	'maximum thickness ratio' should be 'maximum thickness'

page 74, Line 22	Add the following line after Line 22: 7) Pitching Moment Characteristics (effect on trim drag)
page 74, Line 23	'six' should be 'seven'
page 80, Line 6	'looses' should be 'loses'
page 82, Line 13	Remove 'already'
page 86, Figure 3.27	Last Figure should be 'g' instead of 'f'
page 87, Line 9	'Figure 4.27c' should be 'Figure 3.27c'
page 87, Line 17	'Figure 4.27d' should be 'Figure 3.27d'
page 87, Line 19	'4.27e' should be 'Figure 3.27e'
page 87, Line 21	Remove second 'with'
page 91, Figure 3.31	Change vertical axis from 'c_l' to 'c_p'
page 92, Line 4	'C_p *upper*' should be 'c_p *upper*'
page 92, Line 32	'Problem 3.2' should be 'Problem 3.1'
page 104, Equation (4.33)	Should read: $a = \dfrac{2\pi A}{2 + \sqrt{\dfrac{A^2\beta^2}{\kappa^2}\left(1 + \dfrac{tan^2 \Lambda_{c/2}}{\beta^2}\right) + 4}}$
page 104, Equation (4.34)	Should read: $C_D = C_o + C_1 C_L + C_2 C_L^2 + \dots$
page 105, Figure 4.9	'$e = \dfrac{1}{\pi Ae}$' should be '$\dfrac{1}{\pi Ae}$'
page 108, Equation (4.38)	Should read: $\dfrac{x_{ac}}{\bar{c}} = \dfrac{x}{\bar{c}} - \dfrac{C_{m_x} - C_{m_{ac}}}{C_L \cos\alpha + C_D \sin\alpha}$
page 108, Equation (4.39)	Should read: $\dfrac{x_{ac}}{\bar{c}} \approx \dfrac{x}{\bar{c}} - \dfrac{C_{m_x} - C_{m_{ac}}}{C_L}$
page 108, Line 14	'appear' should be 'appears'

page 110, Line 3	‘FAR*23’ should be ‘FAR 23’
page 111, Figure 4.13	Change vertical axis label from ‘ C_L ’ to ‘ c_l ’
page 111, Figure 4.13	Symbols for λ=0.5 and λ=0.2 should be reversed
page 114, Equation (4.41)	Should read: $C_{L_{max}}(\Lambda) = \left\{C_{L_{max}}(\Lambda = 0)\right\} cos\,\Lambda$
page 114, Figure 4.17	Change vertical axis label from ‘ C_L ’ to ‘ c_l ’
page 116, Line 4	Should read ‘As seen in Figure 3.25, the maximum lift coefficient is increased by the use of slats or slots.’
page 117, Line 6	‘places’ should be ‘placed’
page 119, Figure 4.22	Right hand figure caption should read ‘b) Sweep Forward (negative): Λ_{LE} <0’
page 124, Equation (4.53)	Should read: $\dfrac{C_{L_\alpha}}{c_{l_\alpha}} = \dfrac{8.5}{2+\sqrt{8.5^2\left(1+\dfrac{\tan^2 21.3}{\left(1-0.2^2\right)}\right)+4}} = 0.748$
page 129, Line 18	Should read ‘… pure canard and three-surface airplanes can be found in Ref.4.10, pages 344-353 and…’
page 131, Line 24	Remove second ‘be’
page 133, Line 23	Should read ‘… from a windtunnel test of a wing with a wing area of 200 ft^2 for…’
page 134, Line 20	Should read ‘…coefficient of 1.34. Hint: use Eqns (4.33) and (4.54).’
page 138, Figure 5.1	‘Eqn 5.2’ should be ‘Eqn 5.4’
page 138, Line 14	‘Figure 5.2’ should be ‘Figure 5.1’
page 144, Figure 5.6b	‘S = 27.0 ft’ should be ‘b = 27.0 ft’
page 151, Figure 5.12	Change vertical axis label from ‘ C_L ’ to ‘ R_{LS} ’
page 187, Line 16	‘Eqn (5.27)’ should be ‘Eqn (5.34)’

page 187, Line 26	'Figure 5.11' should be 'Figure 5.13'
page 195, Line 4	'Eqn (5.3)' should be 'Eqn (5.4)'
page 195, Line 5	Should read:

$$C_{D_{at\,(C_L/C_D)_{\max}}} = 2C_{D_{\min}} + \frac{2C_{L_{min.drag}}^2}{\pi Ae} - \frac{2C_{L_{min.drag}}}{\pi Ae}\sqrt{\pi AeC_{D_{\min}} + C_{L_{min.drag}}^2}$$

page 196, Figure 5.46	Add 'Without Flap Deflection' to the chart on the left and 'With Deflected Flaps' to the chart on the right.
page 205, Figure 6.2b	Figure title should read: 'Example Applications of Turbo-Prop Engines in Airplanes'
page 214, Line 5	'778 ft-lb/sec' should be '778 ft-lb'
page 223, Equation (6.12a)	Should read: $s.f.c = 0.454\left(SHP_{t.o.}\right)^{-0.055}$
page 223, Equation (6.12b)	Should read: $s.f.c = 0.525\left(SHP_{t.o.}\right)^{-0.079}$
page 251, Line 1	Should read 'It should be expected that if large power ...'
page 253, Figure 6.42	'whereever' should be 'wherever'
page 289, Line 12	'thank' should be 'than'
page 316, Line 2	'Figure 7.18' should be 'Figure 7.26'
page 318, Line 1	'near field' should be 'far field'
page 319, Line 23	'110.5' should be '100.5'
page 326, Figure 7.29	Y_1 should be measured from the X-axis, not the lower surface.
page 327, Problem 7.5	'$V_s = \sqrt{1+\frac{S}{A}C_D}$ ' should be '$V_s = V\sqrt{1+\frac{S}{A}C_D}$ '
page 333, Line 5	Should read '...assumed that the airplane…'

page 335, Equation (8.10)	Should read: $-D - W\sin\gamma = 0$
page 341, Equation (8.30)	Should read: $RD_{\min} = \sqrt{\frac{W}{S}\frac{2}{\rho}\frac{1}{\left(C_L^3 / C_D^2\right)_{\max}}} = \sqrt{\frac{W}{S\rho}\frac{10.67}{\pi Ae}\sqrt{\frac{C_{D_o}}{3\pi Ae}}}$
page 359, Line 14	Should read '... Eqn (8.59) shows that at ...'
page 361, Figure 8.20	The horizontal axis of bottom-right chart should have a label 'Angle of Attack, α (deg)'
page 362, Figure 8.21	Title should read 'Determination of Maximum Level Mach Number for a Fighter'.
page 372, Line 1	Should read 'A jet-powered airplane, with a weight of 10,000 lb, has the …'
page 375, Equation (9.5)	'$\cos\gamma \approx 0$' should be '$\cos\gamma \approx 1$'
page 375, Equation (9.9)	Should read: $R.C. = \frac{(T-D)V}{W} - \frac{V}{g}\frac{dV}{dh}\frac{dh}{dt} = \frac{(T-D)V}{W} - \frac{V}{g}\frac{dV}{dh}R.C.$
page 380, Line 6	'shaded rectangles' should be 'blank cells'
page 383, Line 12	'Figure 9.5' should be 'Figure 9.6'
page 384, Line 2	'$\partial RC / \partial C_L$' should be '$\partial R.C. / \partial C_L$'
page 384, Line 11	'Figure 9.5' should be 'Figure 9.6'
page 384, Equation (9.34)	Should read: $C_{L_{\text{best climb angle}}} = \sqrt{C_{D_o}\pi Ae}$
page 387, Line 20	'trust-to-weight' should be 'thrust-to-weight'
page 389, Line 16	'actually' should be 'actual'
page 393, Figure 9.9	'W = 28,000 lbs' should be 'W = 40,000 lbs' and vice versa

page 394, Figure 9.10	‘ $S = 1,000\ ft^2$ ’ should be ‘ $S = 1,700\ ft^2$ ’
page 395, Line 19	Should read ‘This effect will be further discussed in Section 9.4.’
Page 399, Line 4	‘ $C_D / C_L^{3/2}$ ’ should be ‘ $C_L^{3/2} / C_D$ ’
page 400, Line 1	‘ $THP_{reqd} = DxV$ ’ should be ‘ $THP_{reqd} = DV$ ’
page 400, Line 2	Should read ‘… rate from: $R.C._{\max} = \left(THP_{av} - THP_{reqd}\right)/W$ ’
page 403, Equation (9.65)	Should read: $$RD = \frac{\left(D_{OEI} - T_{av_{OEI}}\right)V}{W} = \frac{THP_{reqd_{OEI}} - THP_{av_{OEI}}}{W}$$
page 404, Line 18	Should read ‘... weight, altitude, and thrust or ...’
page 404, Equation (9.68)	Should read: $ds = \int_{t_1}^{t_2} V \cos\gamma dt \approx V_{ave}\left(t_2 - t_1\right) = R_{CL}$
page 405, Line 1	Should read ‘... weight, altitude, and thrust or ...’
page 405, Line 4	‘in-practical’ should be ‘impractical’
page 409, Line 7	should read ‘…the time-to-climb can be evaluated…’
page 410, Line 6	‘ $H_{absolute}$ ’ should be ‘ $h_{absolute}$ ’
page 411, Line 9	‘Extended Twin Operations’ should be ‘Extended Range Twin Engine Operations’
page 412, Line 12	Should read ‘... power setting, and added drag ...’
page 412, Line 15	Should read ‘... power setting, and added drag ...’
page 412, Line 17	‘un-practical’ should be ‘impractical’
page 417, Figure 9.21	Horizontal axis should read ‘Speed, V’
page 421, Line 15	‘ $\frac{dU}{dh}$ ’ should be ‘ $\frac{\mathrm{d}V}{dh}$ ’

page 421, Equation (9.84) The factor of '0.567' is good for British units only

page 423, Equation (9.87) The factor of '-0.133' is good for British units only

page 423, Line 11 Should read '... the correction factor to the rate-of-climb, ...'

page 424, Line 8 Should read '... while also 'pulling up' perpendicular to the flight path, Eqn. (9.2) shows that the ...'

page 425, Line 19 Should read '... show the effect of one stopped engine ...'

page 433, Line 8 'W=10,000 lbs' should be 'W = 16,000 lbs'

page 433, Problem 9.7 The dynamic pressure for the maximum rate-of-climb should be:

$$\bar{q} = \frac{T}{6C_{D_o}S} + \sqrt{\left(\frac{T}{6C_{D_o}S}\right)^2 + \frac{W^2}{3S^2 C_{D_o}\pi e A}}$$

page 445, Equation (10.8) Should read:

$$S_G = \int_{\mp V_W}^{V_{LOF}} \frac{V \pm V_W}{a_g} dV = \int_{\mp V_W}^{V_{LOF}} \frac{V \pm V_W}{g\left\{\left(\frac{T}{W} - \mu_g\right) - \frac{\left(C_{D_g} - \mu_g C_{L_g}\right)\bar{q}}{W/S} - \phi\right\}} dV$$

page 447, Line 4 'wing' should be 'wind'

page 450, Line 6 'A=2.20' should be 'A =2.02'

page 450, Line 6 '$h/\bar{c} = 0.33$' should be '$h/\bar{c} = 0.329$'

page 456, Line 9 'hard-surfaces' should be 'hard-surface'

page 456, Equation (10.23) Should read: $S_{TO} = 8.134\left(TOP_{23}\right) + 0.0149\left(TOP_{23}\right)^2 \; in \; ft$

page 458, Line 10 Should read '… field-length distance, S_{TOFL}, from:'

page 458, Equation (10.24) Should read: $S_{TOFL} = 37.5 TOP_{25}$

page 459, Figure 10.20 Change vertical axis label from to ‘ S_{TOBFL} ’ to ‘ S_{TOFL} ’

page 460, Equation (10.26) Should read: $a_g = a_{g_{\mathrm{V=0}}} - \dfrac{\left(a_{g_{\mathrm{V=0}}} - a_{g_{V=V_R}}\right)V^2}{V_R^2}$

page 461, Equation (10.29) Should read:

$$S_{NGR} = \int_0^{V_R} \frac{VdV}{a_{g_{V=0}} - \dfrac{\left(a_{g_{V=0}} - a_{g_{V=V_R}}\right)V^2}{V_R^2}}$$

$$= \frac{1}{2}\int_0^{V_R^2} \frac{dV^2}{a_{g_{V=0}} - \dfrac{\left(a_{g_{V=0}} - a_{g_{V=V_R}}\right)V^2}{V_R^2}}$$

$$= \frac{V_R^2}{2a_{g_{ave}}}$$

page 461, Equation (10.31) Should read:

$$S_{NGR} = \int_{\mp \mathrm{V_W}}^{V_R} \frac{VdV}{a_{g_{V=0}} - \dfrac{\left(a_{g_{V=0}} - a_{g_{V=V_R}}\right)V^2}{V_R^2}} \pm V_w \int_{t=0}^{t=t_R} dt$$

page 462, Equation (10.32) Should read:

$$\frac{1}{2}\int_{\mp V_w^2}^{V_R^2} \frac{dV^2}{a_{g_{V=0}} - \dfrac{\left(a_{g_{V=0}} - a_{g_{V=V_R}}\right)V^2}{V_R^2}} = \frac{1}{2}\left(\frac{V_R^2 - V_w^2}{a_{g_{\text{ave with wind}}}}\right)$$

page 467, Equation (10.48) ‘ $\frac{1}{2}a_{g_{\text{ave at } V=V_{LOF}/\sqrt{2}}}$ ’ terms should be ‘ $\dfrac{1}{2a_{g_{\text{ave at } V=V_{LOF}/\sqrt{2}}}}$ ’

page 467, 2nd line of Equation (10.48)

left side of equation:	$\frac{1}{2a_{g_{ave\ at\ V=V_{LOF}/\sqrt{2}}}}\left[V_{LOF}^2 \pm 2V_w V_{LOV} - V_w^2 + 2V_w^2\right] =$
right side of equation:	$\frac{1}{2a_{g_{ave\ at\ V=V_{LOF}/\sqrt{2}}}}\left(V_{LOF} \pm V_w\right)^2 =$
page 468, Line 20	'32.2 seconds' should be '22.2 seconds'
page 471, Table 10.2	The last three steps should be Steps 32, 33 and 34
page 471, Table 10.2	Step 30: t_{NGR} = 15.4 sec
page 471, Table 10.2	Step 30: $T_{V=89\ fps}$ = 1,400 lbs
page 471, Table 10.2	Step 34: t_{TO} = 22.2 sec
page 477, Figure 10.27	For the Take-off Weight vs Balanced Field Length plot, the top curve is for Sea Level and the bottom curve is for an altitude of 8,000 ft.
page 479, Line 14	Should read '... 50 ft obstacle must be possible.'
page 479, Line 21	Should read '… stabilized at a speed of $V_A = 1.2V_{s_{approach}}$, must be determined.'
page 479, Line 26	Should read '… stabilized at a speed of $V_A = 1.2V_{s_{PA}}$, must be determined.'
page 479, Line 29	Should read 'Without braking, the wheels-to-ground friction coefficient must be assumed to be 0.025.'
page 490, Equation (10.90)	Should read: $\frac{W}{2g}\left(V_{FL}^2 - V_{TD}^2\right) + Wh_{flare} = \left(\overline{D-T}\right)_{TD} S_{LTR}$, where $\left(\overline{D-T}\right)_{TD}$ is the average retarding force during the flare.
page 490, Equation (10.91)	Should read: $$V_{TD} = \sqrt{\frac{W}{2g}\left(V_{FL}^2\right) + Wh_{flare} - \left(\overline{D-T}\right)_{TD} S_{LTR}}$$

page 490, Line 9	‘ $(\overline{T-D})_{TD}$ ’ should be ‘ $\left(\overline{D-T}\right)_{TD}$ ’
page 491, Equation (10.92)	Should read: $\left(D-T\right)_{TD} \approx +W\overline{\gamma}_A$
page 491, Equation (10.93)	Should read: $(D-T)_{TD} \approx D_{TD} \approx +W\left(\frac{C_D}{C_L}\right)_{TD}$
page 491, Equation (10.94)	Should read: $\left(\overline{D-T}\right)_{TD} = \frac{1}{2}W\left\{\overline{\gamma}_A + \left(\frac{C_D}{C_L}\right)_{TD}\right\}$
page 491, Line 8	‘ V_A ’ should be ‘ V_{S_L} ’
page 492, Line 8	Should read ‘… versus V as shown in Figure 10.35.’
page 493, Line 23	Should read ‘… to find the landing ground roll component, S_{LNGR}.’
page 494, Line 8	‘hard-surfaces’ should be ‘hard-surface’
page 494, Equation (10.100)	Should read: $S_{LG} = 0.265\left(V_{s_{approach}}\right)^2 \; in \; ft$
page 494, Line 11	Should read: ‘… airplane in the approach configuration in kts.’
page 496, Figure 10.38	‘FAR 23’ should be ‘FAR 25’
page 497, Figure 10.39	‘ $\frac{h_{creen}}{\overline{\gamma}_A}$ ’ should be ‘ $\frac{h_{screen}}{\overline{\gamma}_A}$ ’
page 509, Line 20	‘looses’ should be ‘loses’
page 510, Line 16	‘french’ should be ‘French’
page 513, Line 26	Should read ‘… one of many reasons why sizing the wing and engines of an airplane…’
page 517, Line 2	Should read ‘…maximum endurance occurs when flying…’
page 517, Figure 11.4	The dashed line represents the C_L versus C_L^3/C_D^2 curve whereas the dotted line represents the C_L versus C_L/C_D curve.

page 525, Equation (11.26)	Should read: $R_{max\ with\ wind} = 326\frac{\eta_p}{c_p}\frac{C_L}{C_D}\ln\frac{W_{begin}}{W_{end}} \pm 778\frac{V_w\eta_p}{c_p}...$
page 535, Line 2	‘looses’ should be ‘loses’
page 535, Line 20	‘french’ should be ‘French’
page 535, Line 21	‘from’ should be ‘form’
page 540, Line 7	‘has’ should be ‘as’
page 546, Line 19	‘begin’ should be ‘beginning’
page 547, Line 22	‘begin’ should be ‘beginning’
page 564, Table 11.4	Line 10 should read ‘…the mission time or 20 minutes at maximum endurance…’
page 569, Line 8	Should read ‘… the definition of the weight W_i : it is the airplane weight…’
page 572, Line 2	Should read ‘As indicated before, solutions for airplane take-off...’
page 576, Line 26	‘A’ should be ‘An’
page 583, Line 17	The footnote is on the next page.
page 590, Figure 12.8	The label “W=100,000 lbs” should be referenced to the middle curve.
page 597, Equation (12.29)	Should read: $n_{\lim} = 1 \pm \frac{K_g U_{de} V C_{L_\alpha}}{498(W_{FDGW}/S)}$
page 598, Line 19	Should read ‘There are two types of V-n diagrams for FAR25 certified airplanes: 1) the V-n maneuver diagram and 2) the V-n gust diagram.’
page 600, Line 5	‘Sub-sub-section 12.4.2.6’ should be ‘Sub-sub-section 12.4.2.7’
page 600, Line 6	‘Sub-sub-section 12.4.2.?’ should be ‘Sub-sub-section 12.4.2.5’

page 601, Line 2	Should read '$n_{lim_{pos}}$ may not be less than 2.5'.
page 604, Line 7	Should read '... to sustain speed in an n-g pull-up ...'.
page 604, Line 12	Should read '... to sustain speed in an n-g pull-up ...'.
page 612, Line 17	Should read '…it may be shown that this can be re-written as:'
page 620, Line 17	'Eqn (12.74)' should be 'Eqn (12.73)'
page 622, Line 5	Should read 'First, accelerate from M=0.5 to about ...'
page 624, Figure 12.27	The vertical and horizontal axis should be C_L and C_D respectively.
page 628, Problem 12.1	The lift-drag relationship is defined in Figures 5.2 and 5.3 instead of Figure 5.4.
page 690, Chart D5	Change vertical axis label from 'PNL' to 'ΔPNL'
page 691, Chart D6	Change vertical axis label from 'PNL' to 'ΔPNL'
page 692, Chart D7	Change vertical axis label from 'PNL' to 'ΔPNL'
page 693, Chart D8	Change vertical axis label from 'PNL' to 'ΔPNL'