Design, Analysis and Research Corporation (DARcorporation)

ERRATA: Airplane Aerodynamics and Performance

First Printing, 1997
(Errata Revised July 12, 2016)

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cover & title page	Dr. Lan is now a J.L. Constant Distinguished Professor instead of a Warren S. Bellows Distinguished Professor
page i	Section 2.5.6 does not exist.
page i, ii	Change “Joulowski” to “Joukowski”.
page xxiii	
2nd row	Factor in Prandtl-Glauert transformation, β, should be $\sqrt{1-M_\infty^2}$.
12th row	Remove errant carats from units of ΔV_i and ΔV_p .
page 7, Eqn (1.14)	Should read: $\frac{\rho}{\rho_1}=\left(\frac{P}{P_1}\right)\left(\frac{T_1}{T}\right)=\left(\frac{T}{T_1}\right)^{\left(-\frac{1}{aR}-1\right)}$.
Eqn (1.15)	Should read: $\frac{T}{T_O}=1+\frac{ah}{T_O}=1-6.875\text{x}10^{-6}h$.
page 22, Eqn (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, Eqn (2.56)	Should read: $V_e=V_c-\Delta V_c$
page 34, 5th line from bottom	Should read ‘$A = b^2/S$’.
page 47, Eqn (2.97)	Change (2.97) to (2.99).
page 55, 8th line from top	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:’

Last line — Should read 'This <u>is</u> because the span was taken to be unity.'

page 59, 7th line from bottom — Should read 'Numerical values for the parameter c_{m_o} are given in Table 3.1 for several types of <u>airfoils</u>.'

page 60, Eqn (3.21) — $\frac{\partial c_{m_X}}{\partial c_l}$ should be $\frac{\partial c_{m_X}}{\partial \alpha}$.

page 61, 1st line from top — Replace 'Eqn (2.10)' to 'Eqn (2.9)'.

4th line from top — Should read '$c_p = 1.0$'.

Fig 3.7 — For the figure on the left, the pressure distribution on the lower surface should be pointing INTO the surface.
For the 'c_p vs. x/c' curve, c_p is positive below x/c-axis and negative above x/c-axis.

page 61(cont.), Fig 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, Eqn 3.25b — $c_x = \frac{X}{\bar{q}c} = \int_0^1 \left(c_{p_{\text{lower}}} - c_{p_{\text{upper}}} \right) d\left(\frac{z}{c} \right)$ should be

$$c_x = \frac{X}{\bar{q}c} = \int_0^1 \left(c_{p_{\text{upper}}} \frac{dz_{\text{upper}}}{dx} - c_{p_{\text{lower}}} \frac{dz_{\text{lower}}}{dx} \right) d\left(\frac{x}{c} \right)$$

page 63, last line — The factor should be $\sqrt{1 - M_\infty^2}$.

page 64, Eqn (3.34) — Should be $c_p = \dfrac{c_{p_o}}{\sqrt{1 - M_\infty^2} + \dfrac{c_{p_o} M_\infty^2}{2\left(\sqrt{1 - M_\infty^2} + 1 \right)}}$

page 72, Table 3.2 — Replace all 'maximum thickness ratio' to 'maximum thickness'.

page 74 — In selection list, add the following line:
7) Pitching Moment Characteristics (effect on trim drag)

In paragraph following selection list, change "six" to "seven"

page 80, 6th line from top — 'looses' should be 'loses'.

page 82, last line	Eliminate ‘already’.
page 86, Fig 3.27	Last Figure should be ‘g’ instead of ‘f’
page 87	
9th line	Replace ‘Figure 4.27c’ with ‘Figure 3.27c’.
17th line	Replace ‘Figure 4.27d’ with ‘Figure 3.27d’.
19th line	Replace ‘4.27e’ with ‘Figure 3.27e’.
21st line	Eliminate the second ‘with’.
page 91, Fig 3.31	The vertical axis should be ‘c_p’ instead of ‘c_l’.
page 92,	
Problem 3.1	The title of the fourth column should be ‘c_p upper’.
Problem 3.2	‘Problem 3.2’ should be ‘Problem 3.1’.
page 104, Eqn (4.33)	Should be $a = \dfrac{2\pi A}{2 + \sqrt{\dfrac{A^2\beta^2}{\kappa^2}\left(1 + \dfrac{\tan^2 \Lambda_{c/2}}{\beta^2}\right) + 4}}$
Eqn (4.34)	Should read $C_D = C_o + C_1 C_L + C_2 C_L^2 + \ldots$
Page 105,Fig 4.9	$e = \dfrac{1}{\pi A e}$ is replaced with $\dfrac{1}{\pi A e}$ in both the Figure and the caption.
page 108,	
Eqn (4.38)	The first term on the right hand side should be $\dfrac{x}{\bar{c}}$.
Eqn (4.39)	The first term on the right hand side should be $\dfrac{x}{\bar{c}}$.
3rd line from bottom	‘appear’ should be ‘appears’.
page 110, Line 3	FAR*23 should be FAR 23
page 111, Fig 4.13	Change the vertical axis label from ‘C_L’ to ‘c_l’, the sectional lift coefficient. Symbols for λ=0.5 and λ=0.2 should be reversed.
page 114,	
Eqn (4.41)	Should be $C_{L_{max}}(\Lambda) = \left\{C_{L_{max}}(\Lambda = 0)\right\} \cos\Lambda$.

Fig 4.17 — The vertical axis should be named 'c_l', the sectional lift coefficient.

page 116, 4th line from top — Should read 'As seen in Figure 3.25, the maximum lift coefficient is increased by the use of slats or slots.

page 117 — 2nd line of Section 4.5.3.6, replace 'places' with 'placed'.

page 119, Fig 4.22 — *The sub-title of the figure on the right hand side should be:* 'b) Sweep Forward (negative): $\Lambda_{LE} < 0$'

page 124, Eqn (4.53) — Should be $\frac{C_{L_\alpha}}{c_{l_\alpha}} = \frac{8.5}{2 + \sqrt{8.5^2\left(1 + \frac{\tan^2 21.3}{\left(1 - 0.2^2\right)}\right) + 4}} = 0.748$.

page 129 — 8th line of Section 4.7.3. Remove ")" after 353.

page 131, 3rd line from bottom — Eliminate the extra 'be'.

page 133, Problem 4.4 — The wing area of the airplane is 200 ft^2.

page 134, Problem 4.8 — Last line should read 'Hint: use Eqns (4.33) and (4.54)'.

page 138, Fig 5.1 — On Right Hand Figure, equation should be Eqn 5.4. Also, in the first line of the last paragraph of this page, change Figure 5.2 to Figure 5.1.

page 144, Figure 5.6b — S = 27.0 ft, replace "S" with "b". b = 27.0 ft

page 151, Fig 5.12 — On figure, replace axis label C_L with R_{LS}

page 187 — Line following **Solution:**, change Eqn (5.27) to Eqn (5.34)

page 187, line 5 from bottom — Change (5.11) to (5.13).

page 195, Problem 5.3 — 'Eqn (5.3)' should be 'Eqn (5.4)'.

page 195, Problem 5.3 — the term $\frac{2C^2_{L_{\text{min drag}}}}{\pi Ae}$ replaces $\frac{2C_{L_{\text{min drag}}}}{\pi Ae}$

page 196, Fig 5.46	Add 'Without Flap Deflection' to the chart on the left and 'With Deflected Flaps' to the chart on the right.
page 205, Fig 6.2b	Figure title should read: 'Example Applications of Turbo-Prop Engines in Airplanes'.
page 214, 5th line from top	One BTU equals 778 ft-lbs~~/sec~~.
page 223, Eqn 6.12a and b	$s.f.c_{to}$ should be s.f.c
page 251, 1st line	Should read 'It should be expected that <u>if</u> large power ...'.
page 253, Fig 6.42	Change "whereever" to "wherever"
page 289, 4th line from bottom	*C*hange "thank" with "than"
page 316, 2nd line from top	Change (7.18) to (7.26)
page 318, 1st line	Change "near field" with "far field"
page 319, last line	Change "110.5" with "100.5"
page 326, Fig 7.29	Y_1 should be measured from the X-axis, not the lower surface.
page 327, Problem 7.5	$V_s = V\sqrt{1+\frac{S}{A}C_D}$
page 333	1st line of second paragraph, "...assumed that <u>the</u> airplane..."
page 335, Eqn (8.10)	Equation should equal zero.
page 341, Eqn (8.30)	Should be $RD_{\min} = \sqrt{\frac{W}{S}\frac{2}{\rho}\frac{1}{\left(C_L^3/C_D^2\right)_{\max}}} = \sqrt{\frac{W}{S\rho}\frac{10.67}{\pi Ae}\sqrt{\frac{C_{D_o}}{3\pi Ae}}}$
page 359	The line before *Eqn.(8.67)* should read '... Eqn (8.59) <u>shows</u> that at ...'
page 361, Fig 8.20	The horizontal axis of bottom-right chart should have a label 'Angle of Attack, α (deg)'

page 362, Fig 8.21	Title of the figure should be: 'Determination of Maximum Level Mach Number for a Fighter'.
page 372, Problem 8.12	Assume W = 10,000 lbs.
page 375, Eqn (9.5)	$\cos\gamma \approx 1$ replaces $\cos\gamma \approx 0$
page 375, Eqn (9.9)	Should be $R.C. = \frac{(T-D)V}{W} - \frac{V}{g}\frac{dV}{dh}\frac{dh}{dt} = \frac{(T-D)V}{W} - \frac{V}{g}\frac{dV}{dh} R.C.$
page 380, *6th line from the figure*	Replace 'shaded rectangles' with 'blank cells'.
page 383, *4th line above Sec.9.2.1.2*	'Figure 9.5' should be 'Figure 9.6'.
page 384, *2nd line from top*	Replace $\partial RC / \partial C_L$ with $\partial R.C./\partial C_L$.
3rd line after Eqn (9.31)	'Figure 9.5' should be 'Figure 9.6'.
Eqn (9.34)	$C_{L_{\text{best climb angle}}} = \sqrt{C_{D_o} \pi A e}$
page 387, *3rd line from bottom*	Replace 'trust-to-weight' with 'thrust-to-weight'.
page 389, *1st line after Eqn (9.42)*	'actually' should be 'actual'.
page 393, Fig 9.9	The label 'W = 28,000 lbs' on the right of the figure should be 'W = 40,000 lbs'; and vise versa.
page 394, Fig 9.10	The largest wing area in the figure should be 1,700 ft^2 instead of 1,000 ft^2.
page 395, *9th line from bottom*	Should read 'This effect will be further discussed in Section 9.4'.
Page 399, line 4	$C_L^{3/2}/C_D$ replaces $C_D/C_L^{3/2}$
page 400, *1st line from top*	$THP_{reqd} = DV$
2nd line from top	RC_{max} should be $R.C._{max}$.

page 403, Eqn (9.65) $$RD = \frac{\left(D_{OEI} - T_{av_{OEI}}\right)V}{W} = \frac{THP_{reqd_{OEI}} - THP_{av_{OEI}}}{W}$$

page 404,
3rd line from bottom Should read '... weight, altitude, and thrust or ...'.

page 404, Equation 9.68 integral limits should t_1 to t_2 instead of h_1 to h_2

page 405,
1st line from top Should read '... weight, altitude, and thrust or ...'
4th line from top 'in-practical' should be 'impractical'.

page 409, line 7 should read: "…the time-to-climb can be evaluated…"

page 410,
6th line from top '$H_{absolute}$' should be '$h_{absolute}$'.

page 411,
5th line from bottom ETOPS stands for 'Extended Range Twin Engine Operations'.

page 412,
4th line after Eqn (9.78) Should read '... power setting, and added drag ...'
7th line after Eqn (9.78) Should read '... power setting, and added drag ...'
9th line from bottom 'un-practical' should be 'impractical'.

page 417, Fig 9.21 The symbol for speed should be 'V'.

page 421,
1st line before Eqn (9.81) $\frac{dU}{dh}$ should be $\frac{\mathrm{d}V}{dh}$.
Eqn (9.84) The factor of '0.567' is good for British units only.

page 423,
Eqn (9.87) The factor of '-0.133' is good for British units only.
2nd line after Eqn (9.87) Should read '... the correction factor to the rate-of-climb, ...'

page 424,
4th line from bottom Should read '... while also 'pulling up' perpendicular to the flight path, Eqn.(9.2) shows that the ...'

page 425,
1st line of Section 9.6.2 Should read '... show the effect of one stopped engine ...'

page 433,
Problem 9.4 The weight, W, should be 16,000 lbs.

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

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

page 445, Eqn (10.8) Should be

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

page 447, 3rd line 2nd paragraph "wing" should be "wind"

page 450, Example 10.1 A =2.02 and $h/\bar{c} = 0.329$

page 456,
2nd line of Section 10.3.2.1 'hard-surfaces' should be 'hard-surface'.

Eqn (10.23) The resulted S_{TO} is in feet.

page 458, Section 10.3.2.2 Should begin with:
'The method predicts the total FAR 25 field-length distance, $\underline{S_{TOFL}}$, from:

$$S_{TOFL} = 37.5TOP_{25} \qquad (10.24)$$

where ....'

page 459, Fig 10.20 The label of the vertical axis should be 'S_{TOFL}'.

page 460, Eqn (10.26) Should be $a_g = a_{g_{V=0}} - \frac{\left(a_{g_{V=0}} - a_{g_{V=V_R}}\right)V^2}{V_R^2}$

page 461,
Eqn (10.29) Should read

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

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

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

Eqn (10.31)

Should read

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

page 462, Eqn (10.32)

Should read

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

page 467,Eqn (10.48)

replace the terms: $\frac{1}{2}a_{g_{\text{ave at } V=V_{LOF}/\sqrt{2}}}$ with

$$\frac{1}{2a_{g_{\text{ave at } V=V_{LOF}/\sqrt{2}}}}$$

page 467,
2nd line of equation 10.48

left side of equation: $$\frac{1}{2a_{g_{ave\ at\ V=V_{LOF}/\sqrt{2}}}}\left[V_{LOF}^2 \pm 2V_wV_{LOV} - V_w^2 + 2V_w^2\right] =$$

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,
8th line from bottom

The take-off time is predicted to be 22.2 seconds instead of 30.2 seconds.

page 471, Table 10.2 — The last three steps should be Steps 32, 33 and 34;
Step 30: t_{NGR} = 15.4 sec; $T_{V=89\ fps}$ = 1,400 lbs;
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,
2nd line above Section 10.4.2 — Should read '... 50 ft obstacle must be possible.'

4th line of Section 10.4.2 — Should read 'For USAF airplanes (Ref. 10.2), the landing distance from the 50ft obstacle, while stabilized at a speed of $V_A = 1.2V_{s_{approach}}$, must be determined.'

6th line from bottom — Should read 'For US Navy airplanes (Ref. 10.3), the landing distance from the 50 ft obstacle, while stabilized at a speed of $V_A = 1.2V_{s_{PA}}$, must be determined.'

2nd line from bottom — Should read 'Without braking, the wheels-to-ground friction coefficient must be assumed to be 0.025.'

page 490,

Eqn (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.

Eqn (10.91) — Should read $V_{TD} = \sqrt{\frac{W}{2g}\left(V_{FL}^2\right) + Wh_{flare} - \left(\overline{D-T}\right)_{TD} S_{LTR}}$.

3rd line from bottom — $(\overline{T-D})_{TD}$ should be $\left(\overline{D-T}\right)_{TD}$.

page 491, Eqn (10.92) — Should read $\left(D-T\right)_{TD} \approx +W\bar{\gamma}_A$.

page 491, Eqn (10.93) — Should read $(D-T)_{TD} \approx D_{TD} \approx +W\left(\frac{C_D}{C_L}\right)_{TD}$.

page 491, Eqn (10.94) — Should read $\left(\overline{D-T}\right)_{TD} = \frac{1}{2}W\left\{\bar{\gamma}_A + \left(\frac{C_D}{C_L}\right)_{TD}\right\}$.

page 491, Line before 10.6.1.3 — V_A should be V_{S_L} .

page 492, last line — Should read '... versus V as shown in Figure 10.35.'

page 493, last line	Should read: '...to find the landing ground roll component, S_{LNGR}.'
page 494, *2nd line of Section 10.6.2.1*	'hard-surfaces' should be 'hard-surface'.
Eqn (10.100)	$V_{s_{approach}}$ is in kts and S_{LG} is in feet.
page 496, Fig 10.38	The data are for FAR25 airplanes.
page 497, Fig 10.39	'h_{creen}' should be 'h_{screen}'.
page 509, *1st line of Section 11.1*	'looses should be 'loses'.
page 510, *3rd line after Eqn 11.5*	'french' should be 'French'.
page 513, *5th line from bottom,*	Insert 'the' between 'sizing' and 'wing'.
page 517, lines 1-2	Should read: "…maximum endurance occurs when flying…"
page 517, Fig 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, Eqn (11.26)	The 'c_j' in the second term on the right hand side should be 'c_p'.
page 535, *2nd line from top* *5th line from bottom* *4th line from bottom*	Replace 'looses' with 'loses'. 'french' should be 'French'. Replace 'from' with 'form'.
page 540, *2nd line below Fig 11.17*	Replace 'has' with 'as'.
page 546, *10th line from bottom*	Replace 'begin' with 'beginning'.
page 547, *6th line from bottom*	Replace 'begin' with 'beginning'.
page 564, Table 11.4 *10th line from the title*	Delete the repeated 'minutes'.

page 569, 8th line from bottom	Delete the repeated 'is'.
page 572, 1st line	Should read: 'As indicated before, solutions for airplane take-off...'
page 576, 2nd line from bottom	'A' should be 'An'.
page 583, 2nd line from bottom	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, Eqn (12.29)	Should be $n_{\lim} = 1 \pm \frac{K_g U_{de} V C_{L_\alpha}}{498\left(W_{FDGW}/S\right)}$.
page 598, 1st line of Section 12.4.2	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,	
5th line from top	'Sub-sub-section 12.4.2.6' should be 'Sub-sub-section 12.4.2.7'.
6th line from top	'Sub-sub-section 12.4.2.?' should be 'Sub-sub-section 12.4.2.5'.
page 601, 1st line after Eqn (12.40)	Should read '$n_{lim\,pos}$ may not be less than 2.5'.
page 604,	
7th line of Section 12.5.2	Should read '... to sustain speed in <u>an</u> n-g pull-up ...'.
5th line from bottom	Should read '... to sustain speed in <u>an</u> n-g pull-up ...'.
page 612, (14)-(15)	Between (14) and (15), replace "cab" with "can".
page 620, 3rd line after Eqn (12.74)	'Eqn (12.74)' should be 'Eqn (12.73)'.
page 622, 5th line from top	Should read 'First, accelerate <u>from</u> M=0.5 to about ...'
page 624, Fig 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	y-axis label should be: “ΔPNL” not “PNL”
page 691	y-axis label should be: “ΔPNL” not “PNL”
page 692	y-axis label should be: “ΔPNL” not “PNL”
page 693	y-axis label should be: “ΔPNL” not “PNL”