

ERRATA: Airplane Aerodynamics and Performance

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(Errata Revised March 07, 2011)

- 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 “Joukowski” 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:
$$\frac{\rho}{\rho_1} = \left(\frac{P}{P_1}\right)\left(\frac{T_1}{T}\right) = \left(\frac{T}{T_1}\right)^{\left(-\frac{1}{\gamma} - 1\right)}$$
.
- Eqn (1.15)* Should read:
$$\frac{T}{T_0} = 1 + \frac{ah}{T_0} = 1 - 6.875 \times 10^{-6} h$$
.
- 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 = b²/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 is because the span was taken to be unity.’
- page 59,
7th line from bottom* Should read ‘Numerical values for the parameter c_{m_0} are given in Table 3.1 for several types of airfoils.’

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
4th line from top
Fig 3.7

Replace 'Eqn (2.10)' to 'Eqn (2.9)'.
Should read ' $c_p = 1.0$ '.
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 $\left(\frac{\Delta p}{q} = c_{p_{lower}} - c_{p_{upper}} \right)$

last line

The factor should be $\sqrt{1 - M_\infty^2}$.

page 62, Eqn 3.25b

$$c_x = \frac{X}{qc} = \int_0^1 \left(c_{p_{lower}} - c_{p_{upper}} \right) d\left(\frac{z}{c} \right) \text{ should be}$$
$$c_x = \frac{X}{qc} = \int_0^1 \left(c_{p_{upper}} \frac{dz_{upper}}{dx} - c_{p_{lower}} \frac{dz_{lower}}{dx} \right) dx$$

page 64, Eqn (3.34)

Should be $c_p = \frac{c_{p_o}}{\sqrt{1 - M_\infty^2} + \frac{c_{p_o} M_\infty^2}{2(\sqrt{1 - M_\infty^2} + 1)}}$

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 87
9th line
17th line
19th line
21st line

Replace 'Figure 4.27c' with 'Figure 3.27c'.
Replace 'Figure 4.27d' with 'Figure 3.27d'.
Replace '4.27e' with 'Figure 3.27e'.
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
$$a = \frac{2\pi A}{2 + \sqrt{\frac{A^2 \beta^2}{\kappa^2} \left(1 + \frac{\tan^2 \Lambda_{c/2}}{\beta^2}\right)} + 4}$$

Page 105, Fig 4.9

$e = \frac{1}{\pi A e}$ is replaced with $\frac{1}{\pi A e}$ in both the Figure and the caption.

Eqn (4.34)

Should read $C_D = C_o + C_1 C_L + C_2 C_L^2 + \dots$

page 108,
3rd line from bottom

'appear' should be 'appears'.

Eqn (4.38)

The first term on the right hand side should be $\frac{x}{\bar{c}}$.

Eqn (4.39)

The first term on the right hand side should be $\frac{x}{\bar{c}}$.

page 111, Fig 4.13

Change the vertical axis label from 'C_L' to 'c_l', the sectional lift coefficient.

Symbols for $\lambda=0.5$ and $\lambda=0.2$ should be reversed.

page 114,
Eqn (4.41)
Fig 4.17

Should be $C_{L_{max}}(\Lambda) = \{C_{L_{max}}(\Lambda = 0)\} \cos \Lambda$.

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
$$\frac{C_{L_u}}{c_{l_u}} = \frac{8.5}{2 + \sqrt{8.5^2 \left(1 + \frac{\tan^2 21.3}{(1-0.2^2)}\right)} + 4} = 0.748$$

page 129

8th line of Section 4.7.3 should read: 'A detailed discussion of these trim effects on conventional, pure canard and three-surface

	airplanes <u>can be found in</u> Ref. 4.10,
<i>page 131, 3rd line from bottom</i>	Eliminate the extra 'be'.
<i>page 133, Problem 4.4</i>	The wing area of the airplane is 200 ft ² .
<i>page 134, Problem 4.8</i>	Last line should read 'Hint: use Eqns (4.33) and (4.54)'.
<i>page 138, Fig 5.1</i>	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.
<i>page 144, Figure 5.6b</i>	S = 27.0 ft, replace "S" with "b". b = 27.0 ft
<i>page 151, Fig 5.12</i>	On figure, replace axis label C _L with R _{LS}
<i>page 187</i>	Line following Solution: , change Eqn (5.27) to Eqn (5.34)
<i>page 187, line 5 from bottom</i>	Change (5.11) to (5.13).
<i>page 195, Problem 5.3</i>	'Eqn (5.3)' should be 'Eqn (5.4)'.
<i>page 195, Problem 5.3</i>	the term $\frac{2C_{L_{\min \text{ drag}}}^2}{\pi Ae}$ replaces $\frac{2C_{L_{\min \text{ drag}}}}{\pi Ae}$
<i>page 196, Fig 5.46</i>	Add 'Without Flap Deflection' to the chart on the left and 'With Deflected Flaps' to the chart on the right.
<i>page 205, Fig 6.2b</i>	Figure title should read: 'Example Applications of Turbo-Prop Engines in Airplanes'.
<i>page 214, 5th line from top</i>	One BTU equals 778 ft-lbs/see.
<i>page 251, 1st line</i>	Should read 'It should be expected that <u>if</u> large power ...'.
<i>page 253, Fig 6.42</i>	Change "whereever" to "wherever"
<i>page 289, 4th line from bottom</i>	Change "thank" with "than"
<i>page 316, 2nd line from top</i>	Change (7.18) to (7.26)
<i>page 318, 1st line</i>	Change "near field" with "far field"

<i>page 319, last line</i>	Change “110.5” with “100.5”
<i>page 327, Problem 7.5</i>	$V_s = V \sqrt{1 + \frac{S}{A} C_D}$
<i>page 333</i>	1st line of second paragraph, “...assumed that <u>the</u> airplane...”
<i>page 335, Eqn (8.10)</i>	Equation should equal zero.
<i>page 341, Eqn (8.30)</i>	Should be $RD_{\min} = \sqrt{\frac{W}{S} \frac{2}{\rho} \frac{1}{(C_L^3 / C_D^2)_{\max}}} = \sqrt{\frac{W}{S\rho} \frac{10.67}{\pi A e} \sqrt{\frac{C_{D_0}}{3\pi A e}}}$
<i>page 359</i>	The line before <i>Eqn.(8.67)</i> should read ‘... <i>Eqn (8.59)</i> <u>shows</u> that at ...’
<i>page 361, Fig 8.20</i>	The horizontal axis of bottom-right chart should have a label ‘Angle of Attack, α (deg)’
<i>page 362, Fig 8.21</i>	Title of the figure should be: ‘Determination of Maximum Level Mach Number for a Fighter’.
<i>page 372, Problem 8.12</i>	Assume $W = 10,000$ lbs.
<i>page 375, Eqn (9.5)</i>	$\cos \gamma \approx 1$ replaces $\cos \gamma \approx 0$
<i>page 375, Eqn (9.9)</i>	Should be $R.C. = \frac{(T-D)V}{W} - \frac{V}{g} \frac{dV}{dh} \frac{dh}{dt} = \frac{(T-D)V}{W} - \frac{V}{g} \frac{dV}{dh} R.C.$
<i>page 380, 6th line from the figure</i>	Replace ‘shaded rectangles’ with ‘blank cells’.
<i>page 383, 4th line above Sec.9.2.1.2</i>	‘Figure 9.5’ should be ‘Figure 9.6’.
<i>page 384, 2nd line from top 3rd line after Eqn (9.31) Eqn (9.34)</i>	Replace $\partial RC / \partial C_L$ with $\partial R.C. / \partial C_L$. ‘Figure 9.5’ should be ‘Figure 9.6’. $C_{L_{\text{best climb angle}}} = \sqrt{C_{D_0} \pi A e}$
<i>page 387, 3rd line from bottom</i>	Replace ‘trust-to-weight’ with ‘thrust-to-weight’.
<i>page 389, 1st line after Eqn (9.42)</i>	‘actually’ should be ‘actual’.

<i>page 393, Fig 9.9</i>	The label ‘W = 28,000 lbs’ on the right of the figure should be ‘W = 40,000 lbs’; and vice versa.
<i>page 394, Fig 9.10</i>	The largest wing area in the figure should be 1,700 ft ² instead of 1,000 ft ² .
<i>page 395, 9th line from bottom</i>	Should read ‘This effect will be further discussed in Section 9.4’.
<i>Page 399, line 4</i>	$C_L^{3/2}/C_D$ replaces $C_D/C_L^{3/2}$
<i>page 400, 1st line from top 2nd line from top</i>	THP _{reqd} = DV RC _{max} should be R.C. _{max} .
<i>page 403, Eqn (9.65)</i>	$RD = \frac{(D_{OEI} - T_{avOEI})V}{W} = \frac{THP_{reqdOEI} - THP_{avOEI}}{W}$
<i>page 404, 3rd line from bottom</i>	Should read ‘... weight, altitude, and thrust or ...’.
<i>page 404, Equation 9.68 page 405, 1st line from top 4th line from top</i>	integral limits should t ₁ to t ₂ instead of h ₁ to h ₂ Should read ‘... weight, altitude, and thrust or ...’ ‘in-practical’ should be ‘impractical’.
<i>page 409, line 7</i>	should read: “...the time-to-climb can be evaluated...”
<i>page 410, 6th line from top</i>	‘H _{absolute} ’ should be ‘h _{absolute} ’.
<i>page 411, 5th line from bottom</i>	ETOPS stands for ‘Extended Range Twin Engine Operations’.
<i>page 412, 4th line after Eqn (9.78) 7th line after Eqn (9.78) 9th line from bottom</i>	Should read ‘... power setting, <u>and</u> added drag ...’ Should read ‘... power setting, <u>and</u> added drag ...’ ‘un-practical’ should be ‘impractical’.
<i>page 417, Fig 9.21</i>	The symbol for speed should be ‘V’.
<i>page 421, 1st line before Eqn (9.81) Eqn (9.84)</i>	$\frac{dU}{dh}$ should be $\frac{dV}{dh}$. The factor of ‘0.567’ is good for British units only.
<i>page 423, Eqn (9.87) 2nd line after Eqn (9.87)</i>	The factor of ‘-0.133’ is good for British units only. Should read ‘... the correction factor <u>to</u> the rate-of-climb, ...’
<i>page 424,</i>	

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:

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

page 445, Eqn (10.8) Should be

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

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-surfaced’.

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, S_{TOFL} , from:

$$S_{TOFL} = 37.5TOP_{25} \tag{10.24}$$

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

$$\begin{aligned}
S_{NGR} &= \int_0^{V_R} \frac{VdV}{a_{gV=0} - \frac{(a_{gV=0} - a_{gV=V_R})V^2}{V_R^2}} \\
&= \frac{1}{2} \int_0^{V_R^2} \frac{dV^2}{a_{gV=0} - \frac{(a_{gV=0} - a_{gV=V_R})V^2}{V_R^2}} \\
&= \frac{V_R^2}{2a_{g_{ave}}}
\end{aligned}$$

Eqn (10.31)

Should read

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

page 462, Eqn (10.32)

Should read

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

page 467, Eqn (10.48)

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

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

page 467,

2nd line of equation 10.48

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

$$\text{right side of equation: } \frac{1}{2a_{g_{ave \text{ at } V=V_{LOF}/\sqrt{2}}}} (V_{LOF} \pm V_w)^2 =$$

page 468,

8th line from bottom

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

Eqn (10.94)

$$\text{Should read } (\overline{D-T})_{TD} = \frac{1}{2} W \left\{ \bar{\gamma}_A + \left(\frac{C_D}{C_L} \right)_{TD} \right\}$$

page 471, Table 10.2

The last three steps should be Steps 32, 33 and 34;

Step 30: $t_{NGR} = 15.4$ sec; $T_{V=89 \text{ fps}} = 1,400$ 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 $\frac{W}{2g} (V_{FL}^2 - V_{TD}^2) + Wh_{flare} = (\overline{D-T})_{TD} S_{LTR}$,

where $(\overline{D-T})_{TD}$ is the average retarding force during the flare.

Eqn (10.90)

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

3rd line from bottom

$(\overline{T-D})_{TD}$ should be $(\overline{D-T})_{TD}$.

page 491, Eqn (10.92)

Should read $(D-T)_{TD} \approx +W\bar{\gamma}_A$.

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 $(\overline{D-T})_{TD} = \frac{1}{2}W \left\{ \bar{\gamma}_A + \left(\frac{C_D}{C_L}\right)_{TD} \right\}$.

page 491, Line before 10.6.1.3

V_A should be V_{SL} .

page 491, Last line

Should read ‘... versus V as shown in Figure 10.35.’

page 491, 9th line from bottom Should read ‘... versus V as shown in Figure 10.35.’

page 491, last line,

Should read: ‘...to find the landing ground roll component, S_{LNGR} .’

page 494, 2 nd line of Section 10.6.2	‘hard-surfaces’ should be ‘hard-surfaced’.
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, 1 st line of Section 11.1	‘looses’ should be ‘loses’.
page 510, 3 rd line after Eqn 11.5	‘french’ should be ‘French’.
page 513, 5 th 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, 2 nd line from top 5 th line from bottom 4 th line from bottom	Replace ‘looses’ with ‘loses’. ‘french’ should be ‘French’. Replace ‘from’ with ‘form’.
page 540, 2 nd line below Fig 11.17	Replace ‘has’ with ‘as’.
page 546, 10 th line from bottom	Replace ‘begin’ with ‘beginning’.
page 547, 6 th line from bottom	Replace ‘begin’ with ‘beginning’.
page 564, Table 11.4 10 th line from the title	Delete the repeated ‘minutes’.
page 569, 8 th line from bottom	Delete the repeated ‘is’.
page 572, 1 st line	Should read: ‘As indicated before, solutions for airplane take-off...’

<i>page 576, 2nd line from bottom</i>	‘A’ should be ‘An’.
<i>page 583, 2nd line from bottom</i>	The footnote is on the next page.
<i>page 590, Figure 12.8</i>	The label “W=100,000 lbs” should be referenced to the middle curve.
<i>page 597, Eqn (12.29)</i>	Should be $n_{lim} = 1 \pm \frac{K_g U_{de} V C_{L\alpha}}{498(W_{FDGW}/S)}$.
<i>page 598, 1st line of Section 12.4.2</i>	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.’
<i>page 600, 5th line from top 6th line from top</i>	‘Sub-sub-section 12.4.2.6’ should be ‘Sub-sub-section 12.4.2.7’. ‘Sub-sub-section 12.4.2.?’ should be ‘Sub-sub-section 12.4.2.5’.
<i>page 601, 1st line after Eqn (12.40)</i>	Should read ‘ $n_{lim_{pos}}$ may not be less than 2.5’.
<i>page 604, 7th line of Section 12.5.2 5th line from bottom</i>	Should read ‘... to sustain speed in <u>an</u> n-g pull-up ...’. Should read ‘... to sustain speed in <u>an</u> n-g pull-up ...’.
<i>page 612, (14)-(15)</i>	Between (14) and (15), replace “cab” with “can”.
<i>page 620, 3rd line after Eqn (12.74)</i>	‘Eqn (12.74)’ should be ‘Eqn (12.73)’.
<i>page 622, 5th line from top</i>	Should read ‘First, accelerate <u>from</u> M=0.5 to about ...’
<i>page 624, Fig 12.27</i>	The vertical and horizontal axis should be C_L and C_D respectively.
<i>page 628, Problem 12.1</i>	The lift-drag relationship is defined in Figures 5.2 and 5.3 instead of Figure 5.4.
<i>page 690</i>	y-axis label should be: “ΔPNL” not “PNL”
<i>page 691</i>	y-axis label should be: “ΔPNL” not “PNL”
<i>page 692</i>	y-axis label should be: “ΔPNL” not “PNL”
<i>page 693</i>	y-axis label should be: “ΔPNL” not “PNL”

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