

## Known Typographical Errors in the First Edition, Second Printing of Basic Fluid Mechanics by D. C. Wilcox

These are all of the known typographical errors as of July 15, 2010.

1. Page 20, Problem 1.20: The units of  $\mathcal{R}$  and should be ft·lb/(slug·mole·°R) and those of  $\mathcal{M}$  should be slug/(slug·mole).
2. Page 20, Problem 1.21: The units of  $\mathcal{R}$  should be J/(kg·mole·K) and those of  $\mathcal{M}$  should be kg/(kg·mole).
3. Page 21, Problem 1.29: Change “Appealing to Equation (1.4)” to “Appealing to Equation (1.17)”.
4. Page 24, Problem 1.57: Change “Consider tape whose width” to “Consider tape whose width (out of the page)”.
5. Page 59, paragraph just below Equation (3.26), last line: Change “54.138” to “54.127”.
6. Page 92, Equation (4.15): Change “ $w\partial/\partial x$ ” to “ $w\partial/\partial z$ ”.
7. Page 151, Equation (6.6): Change the “+” to a “-” The correct equation is

$$p - \rho g z = \text{constant} = p_o$$

Also, the line just below the equation refers to Equation (3.10), which has a “+”. The difference occurs because  $z$  is positive upwards in Equation (3.10) and positive downwards in Equation (6.6).

8. Page 159, line just above Equation (6.37): Change “cross-sectional area” to “diameter”.
9. Page 160, Figure 6.9: Change “ $u_1$ ” and “ $u_2$ ” to “ $U_1$ ” and “ $U_2$ ”, respectively.
10. Page 163, Figure 6.10: Change “ $\phi$ ” to “45°”.
11. Page 163, Equations (6.55) and (6.60): Change “ $\phi$ ” to “45°”.
12. Page 163, Line below Equation (6.55): Change “ $\rho A \sin \phi$ ” to “ $\rho A \sin 45^\circ$ ”.
13. Page 164, Equations (6.61) and (6.62): Change “ $\phi$ ” to “45°”.
14. Page 164, Paragraph just below Equation (6.62): Delete the entire paragraph.
15. Page 170, Paragraph just above Equation (6.97), first line: Change “indicated integral” to “indicated integration”.
16. Page 194, Problem 6.84(b): Change “Compute  $D$ ” to “Compute  $F_D$ ”.

17. Page 195, Problems 6.86 and 6.87, first line below equation: Replace “Assuming fuel density,  $\rho_e$ , velocity,  $u_e$ , and exit area,  $A_e$ , are constant at the rocket exit plane, and that pressure at the rocket exit plane is negligibly small, determine” with “Fuel density,  $\rho_e$ , and velocity,  $u_e$ , are uniform at the rocket exit plane, which has area  $A_e$ . Also, pressure at the rocket exit plane is negligible. Determine”.
18. Page 195, Problem 6.87, first line: Replace “Klingons” with “Romulans”.
19. Page 203, Figure 7.1 Caption: Change “viscous force,  $\mathbf{F}_s$ ” to “surface force,  $\mathbf{F}_s$ ”.
20. Page 228, just above Equation (7.140): Replace “substitute Equations (7.137) and (7.138) into Equation (7.133)” with “combine Equations (7.133), (7.135) and (7.137), and let  $d_2/d_1 = \sqrt{2}$ ”. Also, the correct Equation (7.140) for  $h_L$  is

$$h_L = \left[ \hat{R}_1 + \hat{R}_2 \left( \frac{d_1}{d_2} \right)^4 \right] \bar{u}_1^2 = \left[ \hat{R}_1 + \frac{1}{4} \hat{R}_2 \right] U^2$$

21. Page 239, Equation (7.193): The dimensions of  $y$  are m, not m/sec. The correct equation is

$$\bar{u} = \frac{Q}{y^2} = \frac{5 \text{ m}^3/\text{sec}}{(2.61 \text{ m})^2} = 0.734 \frac{\text{m}}{\text{sec}}$$

22. Page 244, paragraph 4, line 2 [just above Equation (7.210)]: Change “ $Fr_2 = 2$ ” to “ $Fr_1 = 2$ ”.
23. Page 253, Problem 7.50: Add “ $L/D = 100$ ”.
24. Page 309, Equation (9.81): The quantity “ $r$ ” should not appear in the equation to the right. The correct equation is

$$\frac{d\Omega\tau}{dU} = 2\rho Q (V_j - 2U)$$

25. Page 332, Problem 10.12, last line: Replace “ft<sup>2</sup>/sec<sup>2</sup>” with “ft<sup>2</sup>/sec”.
26. Page 332, Problem 10.13, last line: Replace “m<sup>2</sup>/sec<sup>2</sup>” with “m<sup>2</sup>/sec”.
27. Page 332, Problem 10.14, third line below equation: Replace “ft<sup>2</sup>/sec<sup>2</sup>” with “ft<sup>2</sup>/sec”.
28. Page 332, Problem 10.15, fourth line below equation (twice): Replace “m<sup>2</sup>/sec<sup>2</sup>” with “m<sup>2</sup>/sec”.
29. Page 351, paragraph 4, line 1: Change “one the” to “the one”.
30. Page 392, paragraph 1, line 2: Change “ $v(0^+, y)$ ” to “ $v(0^-, y)$ ”.
31. Page 404, Problem 11.58: In the last line, change “ $U = u_o$ ” to “ $U = U_o$ ”.

32. Page 421, just below Equation (12.38): The strain-rate tensor does not vanish for the potential vortex. Thus, the entire paragraph should be replaced by the following.

“where  $\Gamma$  is the circulation. Reference to Equation(12.33) shows that the vorticity vector,  $\nabla \times \mathbf{u}$ , vanishes for this velocity field. Because the vorticity is zero, fluid particles experience no local rotation, but rather, always retain their original orientation. Figure 12.5(a) shows a fluid particle at several points as it moves on one of the circular streamlines of a potential-vortex flow.”

33. Page 421, just below Equation (12.39): The entire paragraph should be replaced by the following.

“Reference to Equation (12.31) shows that every component of the strain-rate tensor,  $[\mathbf{S}]$ , is zero for this velocity field. Correspondingly, fluid particles experience no volume or angular distortion and all of the fluid rotates as a unit similar to a solid body. We noted earlier (Section 4.3) that the motion in the core of a hurricane is well approximated as a rigid-body rotation. For this flow, the vorticity is”

34. Page 437, Sentence between Equations (12.125) and (12.126): Change “since  $\nabla \cdot \mathbf{u}$  for” to “since  $\nabla \cdot \mathbf{u} = 0$  for”.

35. Page 446, paragraph 2, line 4: Change “number if timesteps” to “number of timesteps”.

36. Page 456, Problem 12.52: Change “ $u(0) = 0, u'(h/2) = 0$ ” to “ $u(\pm h/2) = 0$ ”.

37. Page 476, Equation (13.90): The minus sign after the final equal sign should be omitted. The correct equation is

$$\frac{\partial u}{\partial y} = \frac{du}{d\eta} \frac{\partial \eta}{\partial y} = U \frac{dF}{d\eta} \left( \frac{1}{2\sqrt{\nu t}} \right) = \frac{U}{2\sqrt{\nu t}} \frac{dF}{d\eta}$$

38. Page 480, Equation (13.118): The second derivative should be with respect to  $y$ , not  $t$ . The correct equation is

$$\frac{\partial u}{\partial t} = \nu \frac{\partial^2 u}{\partial y^2}$$

39. Page 491, Equations (13.180) and (13.182): Change “ $\Delta t/(4\Delta x)$ ” to “ $U\Delta t/(4\Delta x)$ ”. It appears four times in each equation.

40. Page 491, Equation (13.183): Change “ $\Delta t/\Delta x$ ” to “ $U\Delta t/\Delta x$ ”. It appears in both the numerator and the denominator.

41. Page 492, Equation (13.184): Change “ $\Delta t/(2\Delta x)$ ” to “ $U\Delta t/(2\Delta x)$ ”. It appears in both the numerator and the denominator.

42. Page 492, Equations (13.187): Change “ $\Delta t/(4\Delta x)$ ” to “ $U\Delta t/(4\Delta x)$ ”. It appears in the equations for  $A_j$  and  $C_j$ .

43. Page 492, Equation (13.187): The minus sign ahead of the terms in square brackets in the equation for  $D_j$  be a plus sign. The correct equation is

$$D_j = -A_j u_{j-1}^n + \left[ B_j - 2 \frac{\nu \Delta t}{(\Delta x)^2} \right] u_j^n - C_j u_{j+1}^n$$

44. Page 516, Equation (14.35): The last term on the right-hand side should be multiplied by  $\nu$ . The correct equation is

$$\underbrace{u \frac{\partial u}{\partial x}}_{U^2/x} + \underbrace{v \frac{\partial u}{\partial y}}_{U^2/x} = \underbrace{-\frac{1}{\rho} \frac{\partial p}{\partial x}}_{P/\rho x} + \underbrace{\nu \frac{\partial^2 u}{\partial x^2}}_{\nu U/x^2} + \underbrace{\nu \frac{\partial^2 u}{\partial y^2}}_{\nu U/\delta^2}$$

45. Page 517, Equation (14.38): The last term on the right-hand side should be multiplied by  $\nu$ . The correct equation is

$$\underbrace{u \frac{\partial v}{\partial x}}_{U^2 \delta/x^2} + \underbrace{v \frac{\partial v}{\partial y}}_{U^2 \delta/x^2} = \underbrace{-\frac{1}{\rho} \frac{\partial p}{\partial y}}_{U^2/\delta} + \underbrace{\nu \frac{\partial^2 v}{\partial x^2}}_{\nu U \delta/x^3} + \underbrace{\nu \frac{\partial^2 v}{\partial y^2}}_{\nu U/x \delta}$$

46. Page 517, Unnumbered equation in Point 2: Replace “ $\partial u/\partial x$ ” with “ $\partial v/\partial x$ ”. The correct equation is

$$u \frac{\partial v}{\partial x} \sim v \frac{\partial v}{\partial y} \sim \nu \frac{\partial^2 v}{\partial y^2} \sim \frac{U^2 \delta}{x^2}$$

47. Page 601, last paragraph, last line: Change “ $[\boldsymbol{\tau}] = \mathbf{0}$ ” to “ $[\boldsymbol{\tau}] = [\mathbf{0}]$ ”.

48. Page 646, Problem 15.72, equation: In the first term, replace “ $\frac{1}{2} (u_{i+1}^n - u_{i-1}^n)$ ” with “ $\frac{1}{2} (u_{i+1}^n + u_{i-1}^n)$ ”. The correct equation is

$$\frac{u_i^{n+1} - \frac{1}{2} (u_{i+1}^n + u_{i-1}^n)}{\Delta t} + a \frac{u_{i+1}^n - u_{i-1}^n}{2\Delta x} = 0$$

49. Page 651, Table A.3: Change “deka” to “deca”.

50. Page 676: Equation (D.24): The equation actually defines  $-\nabla \times \mathbf{u}$ . Also, in the radial direction term, the denominator should have  $\sin \phi$  rather than  $\sin \theta$ . The correct equation is

$$\begin{aligned} \nabla \times \mathbf{u} &= \frac{\mathbf{e}_R}{R \sin \phi} \left[ \frac{\partial}{\partial \phi} (u_\theta \sin \phi) - \frac{\partial u_\phi}{\partial \theta} \right] \\ &+ \frac{\mathbf{e}_\theta}{R} \left[ \frac{\partial}{\partial R} (R u_\phi) - \frac{\partial u_R}{\partial \phi} \right] \\ &+ \frac{\mathbf{e}_\phi}{R \sin \phi} \left[ \frac{\partial u_R}{\partial \theta} - \frac{\partial}{\partial R} (R u_\theta \sin \phi) \right] \end{aligned}$$

51. Page 676: Equation (D.25): The first term on the second line of the equation should have  $R^2 \sin \phi$  in the denominator rather than  $R^2 \sin^2 \phi$ . The correct equation is

$$\begin{aligned}\nabla^2 \mathbf{u} &= \left[ \frac{1}{R^2} \frac{\partial}{\partial R} \left( R^2 \frac{\partial}{\partial R} \right) + \frac{1}{R^2 \sin^2 \phi} \frac{\partial^2}{\partial \theta^2} \right. \\ &\quad \left. + \frac{1}{R^2 \sin \phi} \frac{\partial}{\partial \phi} \left( \sin \phi \frac{\partial}{\partial \phi} \right) \right] (u_R \mathbf{e}_R + u_\theta \mathbf{e}_\theta + u_\phi \mathbf{e}_\phi)\end{aligned}$$

52. Page 717, Problem 1.21: Change  $\mathcal{M} = 44$  to  $\mathcal{M} = 44 \text{ kg}/(\text{kg-mole})$ .
53. Page 724, Problem 13.9: There is an extra factor of 2 just after the equal sign. The correct answer is

$$\psi = Uy \operatorname{erfc}(\eta) + 2U \sqrt{\nu t / \pi} (1 - e^{-\eta^2}) \quad \text{where} \quad \eta \equiv y / (2\sqrt{\nu t})$$

54. Page 731, Reynolds and Perkins reference: “(9177)” should be changed to “(1977)”.