

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

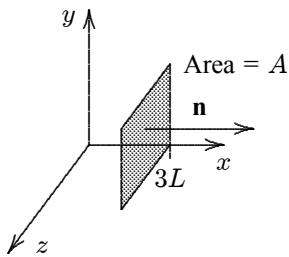
These are all of the known typographical errors as of April 17, 2011.

1. Page 8, Equation (1.10): Change the dimensions of  $R_{air}$  from  $J/(m \text{ kg}\cdot\text{K})$  to  $J/(\text{kg}\cdot\text{K})$ . The correct equation is

$$R_{air} = 287 \text{ J}/(\text{kg}\cdot\text{K}) \quad [1716 \text{ ft}\cdot\text{lb}/(\text{slug}\cdot^\circ\text{R})]$$

2. Page 9, Example 1.3: The units of  $\mathcal{R}$  should be  $J/(\text{kg}\cdot\text{mole}\cdot\text{K})$  and those of  $\mathcal{M}$  should be  $\text{kg}/(\text{kg}\cdot\text{mole})$ . Also, the value of the universal gas constant should be 8314, rather than 8310.
3. Page 10, Example 1.4, next to last sentence: Change “vaner inversely” to “varies inversely”.
4. Page 17, Example 1.8: Change “Consider tape whose width” to “Consider tape whose width (out of the page)”.
5. Page 23, Problem 1.18: The units of  $\mathcal{R}$  and should be  $\text{ft}\cdot\text{lb}/(\text{slug}\cdot\text{mole}\cdot^\circ\text{R})$  and those of  $\mathcal{M}$  should be  $\text{slug}/(\text{slug}\cdot\text{mole})$ .
6. Page 23, Problem 1.19: The units of  $\mathcal{R}$  and should be  $J/(\text{kg}\cdot\text{mole}\cdot\text{K})$  and those of  $\mathcal{M}$  should be  $\text{kg}/(\text{kg}\cdot\text{mole})$ .
7. Page 23, Problem 1.27: Change “Appealing to Equation (1.4)” to “Appealing to Equation (1.18)”.
8. Page 25, Problem 1.48: Change “for is given by” to “is given by”.
9. Page 29, Problems 1.69 and 1.70: Change the word “straw” to “tube” in parts (a) and (c).
10. Page 57, Problems 2.50 and 2.51: The force on the body,  $F$ , should be included as a dimensional quantity.
11. Page 69, Example 3.3, last line: Change “54.138” to “54.127”.
12. Page 73, Example 3.4, last line: Change “This, doubling” to “Thus, doubling”.
13. Page 78, next to last line: Change “CB and OB” to “CB and OD”.
14. Page 96, Problem 3.66, first line: Change “ $h = \frac{1}{5}h$ ” to “ $h = \frac{1}{5}H$ ”.
15. Page 107, Equation (4.15): Change “ $w\partial/\partial x$ ” to “ $w\partial/\partial z$ ”.

16. Page 133, Problem 4.52: The coordinate axes are mislabeled. Change  $y$  to  $x$ ,  $z$  to  $y$  and  $x$  to  $z$ . The figure should be as follows.



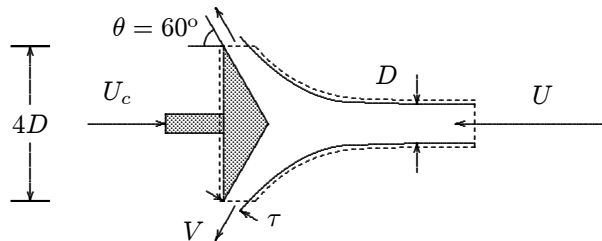
17. Page 135, paragraph 2, next to last line: Change “forms to Chapter 6” to “forms in Chapter 6”.
18. Page 155, Problem 5.12: Change “A unsteady” to “An unsteady”.
19. Page 156, Problem 5.23: Change “Finf” to “Find”.
20. Page 171, Equation (6.6): Change the “+” to a “-” The correct equation is

$$p - \rho gz = \text{constant} = p_a$$

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).

21. Page 177, Example 6.3, first line: Delete the first occurrence of the phrase “of cross-sectional area”.
22. Page 180, line just above Equation (6.37): Change “cross-sectional area” to “diameter”.
23. Page 182, Figure 6.9: Change “ $u_1$ ” and “ $u_2$ ” to “ $U_1$ ” and “ $U_2$ ”, respectively.
24. Page 185, Figure 6.10: Change “ $\phi$ ” to “ $45^\circ$ ”.
25. Page 186, Equations (6.55), (6.60), (6.61) and (6.62): Change “ $\phi$ ” to “ $45^\circ$ ”.
26. Page 186, Line below Equation (6.55): Change “ $\rho A \sin \phi$ ” to “ $\rho A \sin 45^\circ$ ”.
27. Page 187, First paragraph: Delete the entire paragraph.
28. Page 193, Paragraph just above Equation (6.97), first line: Change “indicated integral” to “indicated integration”.
29. Page 205, Problem 6.37, second line: Change “from the lower duct wall” to “from the upper duct wall”.

30. Page 206, Problems 6.39 and 6.40: Add the following sentence. “Use the control volume indicated in the figure.” The figure between the two problems should appear as shown below. The only change is the addition of the dashed lines depicting the control volume.



**Problems 6.39, 6.40**

31. Page 209, Problem 6.51: Change “ $\mathbf{F} = 3.02\pi\rho U^2 D^2 \mathbf{i}$ ” to “ $\mathbf{F} = 3.02\pi\rho U^2 d^2 \mathbf{i}$ ” (lower case  $d$  replaces upper case  $D$ ).
32. Page 211, Problem 6.59, line 3: Change “ $U_1, U_2, \alpha$ ” to “ $U_1, U_2, \beta$ ”.
33. Page 220, Problems 6.91 and 6.92, 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”.
34. Page 220, Problem 6.92, first line: Replace “Klingons” with “Romulans”.
35. Page 241, Figure 7.5, caption: Change “Fiction” to “Friction”.
36. Page 242, Example 7.7, next to last equation: The numerical values are inverted. The correct equation is

$$\frac{1}{\sqrt{f}} = 6.3245553 \quad \text{and} \quad -2 \log_{10} \left( \frac{k_s/D}{3.7} + \frac{2.51}{Re_D \sqrt{f}} \right) = 6.3195079$$

37. Page 254, just above Equation (7.111): Replace “substitute Equations (7.108) and (7.109) into Equation (7.104)” with “combine Equations (7.104), (7.106) and (7.108), and let  $d_2/d_1 = \sqrt{2}$ ”. Also, the correct Equation (7.111) for  $h_L$  is

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

38. Page 262, Example 7.11, last paragraph: Change “0.30 and 0.50” to “0.030 and 0.050”.
39. Page 266, next to last paragraph, first line: Change “the pebble advances” to “the point where the pebble strikes advances”.

40. Page 267, Example 7.13: The dimensions of  $y$  are m, not m/sec. The correct equation for  $\bar{u}$  is

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

41. Page 272, Example 7.15, line 1: Change “ $Fr_2 = 2$ ” to “ $Fr_1 = 2$ ”.
42. Page 276, Problem 7.18, line 1: Change “ $\dot{m} = 5 \text{ kg/sec}$ ” to “ $\dot{m} = 0.5 \text{ kg/sec}$ ”.
43. Page 277, Problem 7.31, line 4: The definition of the pressure coefficient,  $C_p$ , is incorrect. Change “ $C_p \equiv (p_2 - p_1)/(\frac{1}{2}\rho\bar{u}_1^2) = 0.45$ ” to “ $C_p \equiv (p_2 - p_1)/(\frac{1}{2}\rho\bar{u}_1^2) = 0.45$ ”.
44. Page 280, Problem 7.47: Add “ $L/D = 100$ ”.
45. Page 281, Problem 7.51, figure: Change “ $p_0 + \Delta p$ ” to “ $p_a + \Delta p$ ”.
46. Page 342, Equation (9.78): The quantity “ $r$ ” should not appear in the equation to the right. The correct equation is

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

47. Page 362, last paragraph, line 3: Replace “Equation (10.30)” with “Equation (10.29)”.
48. Page 362, paragraph 1, line 2: Change “form the pressure” to “from the pressure”.
49. Page 369, Problem 10.14, third line below equation: Replace “ft<sup>2</sup>/sec<sup>2</sup>” with “ft<sup>2</sup>/sec”.
50. Page 369, Problem 10.15, fourth line below equation (twice): Replace “m<sup>2</sup>/sec<sup>2</sup>” with “m<sup>2</sup>/sec”.
51. Page 369, Problem 10.16, last line: Replace “ft<sup>2</sup>/sec<sup>2</sup>” with “ft<sup>2</sup>/sec”.
52. Page 369, Problem 10.17, last line: Replace “m<sup>2</sup>/sec<sup>2</sup>” with “m<sup>2</sup>/sec”.
53. Page 387, paragraph 4, line 1: Change “one the” to “the one”.
54. Page 429, paragraph 1, line 2: Change “ $v(0^+, y)$ ” to “ $v(0^-, y)$ ”.
55. Page 441, Problem 11.58: In the last line, change “ $U = u_o$ ” to “ $U = U_o$ ”.
56. Page 458, Equation (12.37): Change “ $\partial w/\partial x$ ” to “ $\partial w/\partial z$ ”.
57. Page 459, 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.”

58. Page 459, 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,  $[S]$ , 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”

59. Page 475, Sentence between Equations (12.125) and (12.126): Change “since  $\nabla \cdot \mathbf{u}$  for” to “since  $\nabla \cdot \mathbf{u} = 0$  for”.

60. Page 484, paragraph 2, line 4: Change “number if timesteps” to “number of timesteps”.

61. Page 494, Problem 12.52: Change “ $u(0) = 0, u'(h/2) = 0$ ” to “ $u(\pm h/2) = 0$ ”.

62. Page 518, Equation (13.118): Change “ $\partial^2 u / \partial t^2$ ” to “ $\partial^2 u / \partial y^2$ ”.

63. Page 524, Equations (13.158) and (13.159): Change “ $p_a$ ” to “ $p_o$ ”.

64. Page 524, last line: Change “ $p_a$ ” to “ $p_o$ ”.

65. Page 526, Equations (13.171) and (13.173): Change “ $p_a$ ” to “ $p_o$ ”. It appears twice in Equation (13.173).

66. Page 527, Equation (13.174): Change “ $p_a$ ” to “ $p_o$ ”.

67. Page 529, 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.

68. Page 529, Equation (13.183): Change “ $\Delta t / \Delta x$ ” to “ $U\Delta t / \Delta x$ ”. It appears in both the numerator and the denominator.

69. Page 530, 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.

70. Page 530, 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  $C_j$ .

71. Page 530, Equation (13.187): Change the minus sign ahead of the terms in square brackets in the equation for  $D_j$  to a plus sign. The correct equation is

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

72. Page 537, Problem 13.20(b): Change “ $p_a$ ” to “ $p_o$ ”.

73. Page 541, Problem 13.31(c): Change “ $p_a$ ” to “ $p_o$ ”.

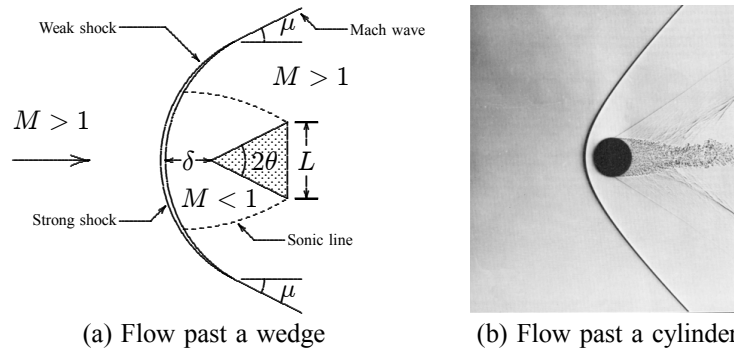
74. Page 544, Problem 13.42: Change “ $p_a$ ” to “ $p_o$ ”.

75. Page 555, Unnumbered equation in Point 2: Replace “ $\partial u/\partial x$ ” with “ $\partial v/\partial x$ ”. The correct equation is

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

76. Page 639, last paragraph, last line: Change “ $[\boldsymbol{\tau}] = \mathbf{0}$ ” to “ $[\boldsymbol{\tau}] = [\mathbf{0}]$ ”.

77. Page 651, Figure 15.14: In the line drawing for flow past a wedge, the sonic lines are drawn incorrectly. The corrected figure is as follows.



78. Page 684, 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

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

79. Page 693, Table B.3: Change “deka” to “deca”.

80. Page 718: Equation (E.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

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

81. Page 718: Equation (E.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

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

82. Page 759, Problem 1.7: Change “23.1 million molecules” to “231 million molecules”.
83. Page 759, Problem 1.19: Change “J/(kg·K)” to “J/(kg-mole·K)”.
84. Page 762, Problem 7.33: Change “10.16 m” to “13.42 m”.
85. Page 762, Problem 7.39: The number “1000” should be changed to “2000”. The correct answer is

$$h_p = \Delta z + 2000m^2/(\pi^2\rho^2gD^4)$$

86. Page 762, Problem 7.51: The number “0.42” should be changed to “0.33”. The correct answer is

$$\mathbf{R} = \pi\rho U^2 D^2 [0.33 \mathbf{i} - 0.5625 \mathbf{j}]$$

87. Page 762, Problem 7.71: Froude number is dimensionless. Change “ $Fr_1 = 0.034$  ft” to “ $Fr_1 = 0.034$ ”.
88. Page 763, Problems 8.21 and 8.23: The numbers are reversed. “8.21” should be “8.23” and “8.23” should be “8.21”.
89. Page 763, Problem 8.29: The answer is off by a factor of 10. Change “ $T_2 = 1947$  K” to “ $T_2 = 194.7$  K”.
90. Page 765, Problem 13.9: There is an extra factor of 2 just after the equal sign. The correct answer is

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

91. Page 773, Reynolds and Perkins reference: Change “(9177)” to “(1977)”.
92. Page 780, Navier-Stokes equation in spherical coordinates reference: “71” should be replaced by “718”.