

Errata Sheet for *Fluid Mechanics: Fundamentals and Applications* – Çengel and Cimbala

Latest update: 02-08-2007

This is a list of errors (and *enhancements*) in the textbook. If you find any additional errors in the book, or have suggestions for improvement, please contact **John M. Cimbala** at **814-863-2739** or **jmc6@psu.edu** to report it. [By way of acknowledgment, the person (other than the authors) who first reports an error is listed in brackets, unless requested otherwise.]

Note: First check the copyright page to see which printing you have. At the time of this writing, there have been *two* printings, and the third printing is coming shortly. The errors and enhancements are listed according to printing number in reverse chronological order to save you time. For example, all the errors and enhancements listed for the first printing have been fixed in the second printing; if you have the second printing, ignore all the corrections listed for the first printing. For each printing, we categorize the changes as *major errors*, *minor errors*, or *enhancements*:

- **Major errors** are important and significant (e.g., incorrect equations or numerical values) – *these must be changed*.
- **Minor errors** are spelling or typo errors and other minor changes – *these may be skipped without impacting understanding of the material*.
- **Enhancements** are changes that clarify something and/or help you to understand the material better (e.g., improvements to a figure or wording changes) – *these may be skipped since they are not really errors, but are useful changes that enhance understanding of the material*.

Corrections in the third printing (September 2006) – “3 4 5 6 7 8 9 0 DOW/DOW 0 9 8 7 6” on the copyright page. These errors were found *after* the deadline for the 3rd printing, and will be corrected in the 4th printing (date to be determined). Make these changes *only* if you have the 1st, 2nd, or 3rd printing of the book.

Major Errors in the Third Printing

- Pg. 47, Eq. 2-26: Change “ $\tan \beta$ ” to “ $\tan (d\beta)$ ”. [Jason DeGraw]
- Pg. 56, left column, first line of text above References: Change “droplet or bubble is” to “droplet or soap bubble, respectively, is”.
- Pg. 58, Prob. 2-10 table: Change the title of the first column from “z, km” to “r, km”.
- Pg. 94, Fig. 3-46a: Move the labels and arrows for *B* up, and move the labels and arrows for *G* down so that *B* is above *G* as in Fig. 3-44(a). [Junfeng Zhang]
- Pg. 189, first line: Change “Eq. 5-44” to “Eq. 5-43”. [Jason DeGraw]
- Pg. 190, third line above the new section: Change “free-stream value” to “free-stream velocity”. [Jason DeGraw]
- Pg. 257, Fig. 6-38: Reverse the direction of angular velocity, ω . [Milivoje Kostic]
- Pg. 261, Prob. 6-20: At the end, add “Assume the jet stream is perpendicular to the incoming liquid flow line”.
- Pg. 340, lines 2 and 6 of the last paragraph before new section: Change “laminar sublayer” to “viscous sublayer” (two occurrences). [Rustom Bhiladvala]
- Pg. 342, line 10 of the last bullet item: Change “laminar sublayer” to “viscous sublayer”. [Rustom Bhiladvala]
- Pg. 344, Fig. 8-30: The labels are mixed up: “2 in” is the dimension and “0.2 ft³/s water” is the flow rate. [Jason DeGraw]
- Pg. 371, line 3 of figure caption: Change “close-up view” to “cutaway view”. [Jason DeGraw]
- Pg. 371, lines 5 to 6 of figure caption: Remove “looking down the axis with flow into the page.”. [Jason DeGraw]
- Pg. 375, Fig. 8-69: Turn the pipe in the middle figure to the same orientation (same flow direction) as the left figure.
- Pg. 512, Fig. 10-77b: Move the dimension arrow for $\delta(x)$ up a bit to the *top* of the plate.
- Pg. 543, Eq. (1) of Example 10-15: Add a third (missing) measurement, namely “ $V = 10.0$ m/s”. [Jose Sinibaldi]
- Pg. 571, Fig. 11-17: Add an *x* axis label, namely, “Re”. [Jason DeGraw]
- Pg. 807, Prob. 14-36, 3rd line from end of problem: Change “m(Lpm)²” to “m/(Lpm)²”. [Alex Schwartz]

Minor Errors in the Third Printing

- Pg. 17, line 2 above Eq. 1-2: Change “from Newton’s” to “from an equation based on Newton’s”.
- Pg. 42, Eq. 2-9: Change the font for the v in c_v to the volume font, not the velocity font, i.e., change to c_v .
- Pg. 59, Prob. 2-35: Add at the end of the problem statement, “For simplicity, assume $\beta = \text{constant} = \beta$ at 40°C” [Rustom Bhiladvala]
- Pg. 149, Fig. 4-52: Add a pointer from the word “System” pointing to the dashed line around the left spray can. [Jason DeGraw]
- Pg. 190, 6 lines before the new section: Change “parallel the *z*-axis” to “parallel to the *z*-axis”. [Mohamed Elsari]
- Pg. 242, second and third equations on the page: Remove the arrow from *V* – it is a scalar (two occurrences).
- Pg. 249, sixth line on blackboard of Fig. 6-28: Add an arrow over the *M* – it is a vector. [Jason DeGraw]
- Pg. 251, Fig. 6-31: Remove the extraneous plus sign on the upper right part of the figure.
- Pg. 251, Eqs. 6-43 and 6-44: Change the font for *V* to that of volume, not velocity (two occurrences). [Jason DeGraw]
- Pg. 252, Eq. 6-46 and last equation in Fig. 6-33: Add an arrow over the *H* – it is a vector. [Jason DeGraw]

- Pg. 271, Fig. 7-5: Change “WATCHOUT” to “WATCH OUT” (two words, not one) on the sign. [Jason DeGraw]
- Pg. 291, Fig. 3: Make the **f** italic, i.e., change “**f**” to “*f*”.
- Pg. 345, last equation in the cluster of four equations near the bottom: Change “20 =” to “20 m =”.
- Pg. 346, last equation in the cluster of four equations near the bottom: Change “20 =” to “20 m =”.
- Pg. 352, lines 1 and 2: Change “convert” to “converts”.
- Pg. 352, line above Eq. 8-60: Change “the case of **sudden expansion** is” to “the case of a **sudden expansion** is”.
- Pg. 368, line 5: Change “head loss is small.” to “head loss is smaller.”. [Jason DeGraw]
- Pg. 484, line below Eq. 1: Change “with radius as” to “with radius (across streamlines) as”.
- Pg. 599, Reference 9: Change “J. Happel” to “J. Happel and H. Brenner”. Also change “Hydrocarbons” to “Hydrodynamics”. [Rustom Bhiladvala]
- Pg. 603, Fig. P11-35: The two horizontal cups are oriented wrong. Turn 90°. [Jason DeGraw]
- Pg. 616, 5th line below Eq. (b): Change the reference from “Çengel, 2002” to “Çengel and Boles, 2002”.
- Pg. 687, last line of first bullet item near the bottom of page: Change “flow energy” to “potential energy”.
- Pg. 697, line 3 of blue highlighted statement and line 4 of the figure caption for Fig. 13-21: Change “cross-section” to “cross-sectional area” (two occurrences on this page).
- Pg. 699, lines 2 to 3 below Eq. 13-46: Change “cross section” to “cross-sectional area”.
- Pg. 713, line after the equation for h_L , near the middle: Change “dissipation ratio is” to “dissipation ratio are”.
- Pg. 724, lines 3 to 4 of paragraph 2, left column: Change “cross section” to “cross-sectional area”.
- Back inside cover, entry for $\vec{\zeta}$, ζ : Change “magnitued” to “magnitude”.

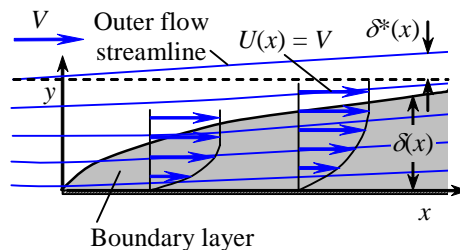
Enhancements to the Third Printing

- Pg. 239, line after Eq. 6-29: Change “on the body. This” to “on the body. We remind ourselves that \vec{V} in E. 6-29 is the fluid velocity relative to an inertial reference frame. This”. [Krishna Pillai]
- Pg. 266, Prob. 6-65, line 5: Change “10 m/s” to “10 m/s relative to the skater”.
- Pg. 264, Prob. 6-48E, last sentence: Change “the electric power” to “the maximum possible electric power”.
- Pg. 338, Fig. 8-24: Add this sentence at the end of the caption: “Note that $u(r)$ in the turbulent case is the *time-averaged* velocity component in the axial direction (the overbar on u has been dropped for simplicity)”. [Rustom Bhiladvala]
- Pg. 352, 2 lines above Eq. 8-60: Change “the conservation of mass, momentum, and energy equations” to “the equations of mass, momentum, and energy balance”.
- Pg. 484, line above Eq. 3: Change “coordinates reduces to” to “coordinates (see Eq. 9-62b without the viscous terms) reduces to”. [Cliff Moses]

Corrections in the **second printing (July 2005)** – “034567890 DOW/DOW 098765” on the copyright page. These were corrected in the 3rd printing (expected Aug. 2006). Make these changes *only* if you have the 1st or 2nd printing of the book.

Major Errors in the Second Printing

- Pg. 63, Problem 2-76E, line 2: Change “1408” to “140^o”. [Woonjean Park]
- Pg. 68, 2nd line below Eq. 3-5: Change “xz-plane” to “yz-plane”. [Woonjean Park]
- Pg. 107, Problem 3-47, line 2: Change “by a piston” to “by a 30-cm-diameter piston”.
- Pg. 108, Answer to problem 3-48: Change “5.0” to “1.34”. [Woonjean Park]
- Pg. 110, Problem 3-66, first line: Change “A 4-m-high” to “A 5-m-high”. [Tao Xing]
- Pg. 110, Figure P3-68E: Change the dimension “5 ft” to “8 ft” for consistency with the solutions manual. [Roscoe Ward]
- Pg. 111, Figure P3-82: Change the dimension “10 cm” to “9.5 cm” for consistency with the problem statement. [Tao Xing]
- Pg. 113, Problem 3-101, last line: Change “1030 kg/m” to “1030 kg/m³”. [Russ LaBarca]
- Pg. 231, Fig. 6-5: Add the subscript “body” to the label $d\vec{F}$ on the left. I.e., change “ $d\vec{F}$ ” to “ $d\vec{F}_{\text{body}}$ ”.
- Pg. 261, Answers to Prob. 6-27: Change “(a) 250 N, (b) 1.25 kW” to “(a) -167 N, (b) 833 W”. [Ted Thiede]
- Pg. 263, Prob. 6-37, 2nd line: Change “30 m/s” to “30 m/s relative to the ground”.
- Pg. 310, Answer to Problem 7-33: Change “ V/V_∞^2 ” to “ V^2/V_∞^2 ”. [Woonjean Park]
- Pg. 328, Eq. 8-14: Change “1” to “ r^2 ” in the numerator of the first term on the right side of the equation.
- Pg. 356, 3 lines below Eq. 8-62: Change “nearly 1” to “about 1.05”.
- Pg. 388, Answer to Problem 8-45: Change “93.8 m” to “10.8 m”. [Woonjean Park]
- Pg. 431, top middle term on right side of Eq. 9-63: Change “ ∂_r ” to “ ∂r ”, i.e., the r should *not* be a subscript.
- Pg. 466, Fig. P9-99: Change the lower vertical dimension from “ h_2 ” to “ h_1 ”. [Russ LaBarca]
- Pg. 468, answer to Problem 9-111: Change “ $\vec{V}P$ ” to “ $\vec{\nabla}P$ ”.
- Pg. 524, Figure 10-102: All the streamlines, a pointer line, and a dashed line are missing, as shown below. [Eric Paterson]



- Pg. 554, Prob. 10-48: In all three equations, ϕ should *not* be a subscript, i.e., change “ ∂_ϕ ” to “ $\partial\phi$ ” (3 places).
- Pg. 555, 3rd line of Problem 10-54: Change “ $(-ay + cx)$ ” to “ $(-ay + c)$ ”. [Ted Thiede]
- Pg. 603, Answer given for Problem 11-41: Change “186” to “135”. [Russ LaBarca]
- Pg. 620, Eq. 12-16: The division line is missing between the numerator dA and the denominator A . [Eric Paterson]
- Pg. 709, 2nd equation on the page – the equation for “ $y_c =$ ”: In the denominator, change “ (12 m^2) ” to “ $(12 \text{ m}^2)^2$ ”.
- Pg. 709, 2nd equation on the page and also on the first line of Discussion: Change the answer from “2.2 m” to “2.65 m”.
- Pg. 927, entry for **normal stress** (subset of **stress**): Change “shear” to “normal” in two places.

Minor Errors in the Second Printing

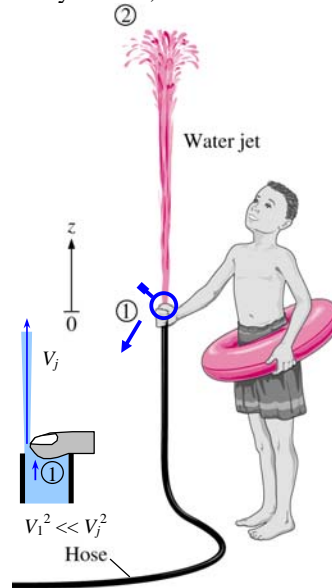
- Pg. ix, end of Chapter 4: Move the Summary entry up, just above the entry for the Application Spotlight. [Woonjean Park]
- Pg. xi, end of Chapter 10: Move the Summary and References entries up, just above the entry for the Application Spotlight. [Woonjean Park]
- Pg. xi, end of Chapter 11: Move the Summary and References entries up, just above the entry for the Application Spotlight. [Woonjean Park]
- Pg. 8, line 5 of second paragraph: Change “Osborn” to “Osborne”.
- Pg. 9, lines 1 and 5: Change “Theodore” to “Theodor” (two places). [Note – both spellings are commonly used, but “Theodore” is an Americanized version; the Hungarian name does not include the “e” at the end]
- Pg. 17, figure 1-28: Change “=” to “ \approx ” in three places.
- Pg. 42, Eq. 2-10 (twice), 3 lines below Eq. 2-10, Eq. 2-11, and 1 line below Eq. 2-11 (5 occurrences total): Change subscript “ave” to “avg”.
- Pg. 57, line 3 of second paragraph: Change “and ranging” to “and ranging” [“a” not italicized]. [Woonjean Park]
- Pg. 73, Figure 3-15: Extend the line for the lower limit of dimension h_2 to the right such that it nearly touches the interface between the oil (light blue) and the mercury (dark blue). Also extend the lower limit of dimension h_3 . [Woonjean Park]
- Pg. 85, first two equations in the Analysis (2 places): Change the subscript “ave” to “avg”. [Woonjean Park]
- Pg. 87, first two equations in the Analysis (2 places): Change the subscript “ave” to “avg”. [Woonjean Park]
- Pg. 89, Eq. 3-33 (2 places): Change the subscript “ave” to “avg”. [Woonjean Park]

- Pg. 102, second-to-last equation in the right column: Change the subscript “ave” to “avg”. [Woonjean Park]
- Pg. 109, Figure P3-52: Two corrections – (1) color the fluid in the line from the bottom of the tank to point A grey, the same color as the glycerin. (2) remove the grey piston-like shading at the top (it is open to the air). [Jim Brasseur]
- Pg. 112, Answer to Prob. 3-88: Change the subscript “ave” to “avg”. [Woonjean Park]
- Pg. 116, Problem 3-126E, line 2: Change “1026E” to “126E”. [Woonjean Park]
- Pg. 153, 3 places; Pg. 154, 11 places; Pg. 155, 3 places; Pg. 167, 1 place: Change “Leibnitz” to “Leibniz”. [Both spellings appear in the literature, but the one without the “t” is the proper spelling] [Clement Kleinstreuer]
- Nomenclature on back inside cover, page 2, left column, line 4 under the entry for k : Change “buckingham” to “Buckingham”. [Wonnam Lee]
- Nomenclature on inside back cover, page 2, middle column, line 11 from bottom under the entry for s : Change “submeerged” to “submerged”. [Wonnam Lee]
- Pg. 449, 4th line of **Assumptions**: Change “constant-pressure” to “constant pressure”, i.e., remove the hyphen.
- Pg. 687, two lines below Eq. 13-18: Change “of constant” to “of rectangular cross section and of constant”. [Jason DeGraw]
- Pg. 931 and throughout the Index: Remove entries for variables and units. In particular, remove the entry for A, atm, Bar, bhp, Btu, C, cd, Fr, ft, g , GM , $H_{available}$, $H_{pump, u}$, $H_{required}$, J, J/m^2 , K, kg, kgf, kgf/cm^2 , Kilogram-force per square centimeter, kJ, kPa, lbf, lbf/ft, lbf/in², lbm, m, m²/s, Ma, MPa, N, N·m, N·m/m², N/m, N/m², NPSH, $NPSH_{required}$, P^* , psi, R, R_{gas} , s, and $W_{water\ horsepower}$.
- Pg. 938: Remove all three entries for “ER”, i.e., “ER clutch, 60”, “ER effect, 60”, and “ER fluids, 60”.
- Pg. 948, entry for “Pressure prism”: Change the page numbers from “82” to “80,82”.
- Pg. 954, second column: Remove entry for “TT”.
- Pg. 956, third column: Remove all entries for the letter “X”.

Enhancements to the Second Printing

- Pg. 32, line 3 of Problem 1-18: Remove the word “upward”, since the direction of the acceleration is not given.
- Pg. 37, line 2 above Eq. 2-3: Change “is called **specific weight** and” to “is called **specific weight**, or **weight density**, and”.
- Pg. 40, line 14: Change “higher temperatures boils at higher pressures” to “higher pressure boils at higher temperature”. [Woonjean Park]
- Pg. 45, end of line 2 and beginning of line 3: Change “*density difference*, which is proportional” to “*density difference*, which is in turn proportional”. [Woonjean Park]
- Pg. 53, lines 1, 3, 5 from top, lines 1, 2, and 3 below Eq. 2-37, in Fig. 2-22b, and in the caption of Fig. 2-22b (8 occurrences total): Change “bubble” to “soap bubble” for clarity – we are not talking about air bubbles in water.
- Pg. 53, label to the left of Eq. 2-37: Change “Bubble” to “Soap bubble”.
- Pg. 53, line 4 below Eq. 2-37: Change “bubble consisting” to “existence”.
- Pg. 53, first line of first new paragraph below Eq. 2-37: Change “droplet (or bubble)” to “droplet of liquid in a gas (or a bubble of gas in a liquid)”.
- Pg. 66, 5th line above Eq. 3-1: Change “Pressures below atmospheric pressure are called” to “ P_{gage} can be positive or negative, but pressures below atmospheric pressure are sometimes called”. [Jim Brasseur]
- Pg. 66, 2nd line above Eq. 3-1: Delete “all positive quantities and are”. [Jim Brasseur]
- Pg. 68, Fig. 3-4: Add an arrow in the white space pointing down, and label it \vec{g} as in Fig. 3-48.
- Pg. 69, Fig. 3-6: Add an arrow in the white space pointing down, an label it \vec{g} as in Fig. 3-48.
- Pg. 69, Fig. 3-6: Remove the gray shading in the figure.
- Pg. 80, Figures 3-25 and 3-26 and Eq. 3-19 (3 places): Change the subscript “ave” to “avg”. [Woonjean Park]
- Pg. 80, Fig. 3-25: Change the label on the right from “Pressure prism of volume V ” to “Pressure prism”.
- Pg. 80, Fig. 3-25: Change the equation label on the bottom right from “ $V = \int dV = \int P dA = F_R$ ” to “ $F_R = \int P dA$ ”. [Woonjean Park]
- Pg. 82, line 4: Change the in-line equation from “ $V = \int P dA$ ” to “ $F_R = \int P dA$ ”.
- Pg. 83, Caption of Fig. 3-29, line 2: Change “form a volume” to “form a pressure prism”.
- Pg. 108, Figure P3-48: Extend the dimension for 22 cm vertically such that it is at the same elevation as the interface between the air (white) and fluid 1 (dark blue). [Woonjean Park]
- Pg. 113, Problem 3-102, last two lines: Change “pressure and its location” to “pressure difference and the location of the maximum pressure”. [Tao Xing]
- Pg. 118, Figure P3-134: Add small horizontal lines at the top and bottom of the dimension arrow for Δh . [Woonjean Park]
- Pg. 119, Problem 3-144, line 5: Change “the same.” to “the same, and the fluids meet at the axis of rotation.”.
- Pg. 119, Figure P3-144: Several errors: (1) Remove the gray and light blue shaded areas. (2) Move the short vertical line in the bottom tube (the interface between the left and right fluids) to the left such that it is coincident with the axis of rotation. (3) color the fluid on the left side gray (everything up to the short vertical line at its revised location). [Woonjean Park]
- Pg. 122, Right in the middle: Change “parcels of fluid” to “fluid particles”.

- Pg. 125, 4th line below Eq. 4-8: Change “time t , since the” to “time t . Why? Because the”.
- Pg. 177, line 6 of the section “Moving or...”: Change “ \vec{V}_{CV} ” to “ \vec{V}_{CS} ” (two occurrences).
- Pg. 177, line 7 of the section “Moving or...”: Change “control volume” to “control surface”.
- Pg. 187, Fig. 5-23: Add an arrow in the white space pointing down, and label it \vec{g} as in Fig. 3-48.
- Pg. 194, given info for Example 5-5: Change to: “Water is flowing from a garden hose (Fig. 5-38). A child places his thumb to cover most of the hose outlet, causing a thin jet of high-speed water to emerge. The pressure in the hose just upstream of his thumb is 400 kPa. If the hose is held upward, what is the maximum height that the jet could achieve?” [Jim Brasseur]
- Pg. 194, last line: Remove Assumption 2. Then, on Pg. 195, renumber Assumption 3 to 2, 4 to 3, and 5 to 4. [Jim Brasseur]
- Pg. 195, line 4 above the first equation on the page: Change “ V_1 ” to “ $V_1^2 \ll V_j^2$ and thus V_1 ”. [Jim Brasseur]
- Pg. 195, line 3, Assumption 5 (now Assumption 4): Change to “The irreversibilities that occur at the outlet of the hose due to the abrupt contraction are not taken into account”. [Jim Brasseur]
- Pg. 195, line 3 above the first equation on the page: Change “the hose” to “the elevation just below the hose”. [Jim Brasseur]
- Pg. 195, first equation on the page: Change the first “0” (upper right of blue arrow) to “ ≈ 0 ”. [Jim Brasseur]
- Pg. 195, Fig. 5-38: Add a magnifying glass around the boy’s hand, and add a zoomed-in inset diagram as sketched below:



- Pg. 195, Caption of Fig. 5-38: Add “Inset shows a magnified view of the hose outlet region.
- Pg. 195, Assumptions of Example 5-6: Add another one, “**3** Irreversible losses in the tap region are neglected.” [Jim Brasseur]
- Pg. 195, line 4 above the last equation on the page: Change “ V_1 ” to “ $V_1^2 \ll V_2^2$ and thus V_1 ”. [Jim Brasseur]
- Pg. 195, line 4 above the last equation on the page: Change “tank is large” to “tank is very large”. [Jim Brasseur]
- Pg. 195, last equation on the page: Change the first “0” (upper right of blue arrow) to “ ≈ 0 ”. [Jim Brasseur]
- Pg. 196, Add to end of Discussion: “From conservation of mass, $(V_1/V_2)^2 = (D_2/D_1)^4$. So, for example, if $D_2/D_1 = 0.1$, then $(V_1/V_2)^2 = 0.0001$, and our approximation that $V_1^2 \ll V_2^2$ is justified”. [Jim Brasseur]
- Pg. 196, second-to-last equation on the page: Change the first “0” (upper right of blue arrow) to “ ≈ 0 ”. [Jim Brasseur]
- Pg. 197, 4th line of Discussion: Change “surface. Also” to “surface, along with other irreversible losses, as discussed in detail in Chap. 8. Also”. [Jim Brasseur]
- Pg. 217, Problem 5-14, 2nd-to-last line: Change “the air” to “the average air” [Eric Stempo].
- Pg. 235, first line below Eq. 6-18: Move the entire sentence “Most...are steady” to the beginning of the paragraph.
- Pg. 235, Just below Eq. 6-18: Add “For a case in which a non-deforming control volume moves at constant velocity (an inertial reference frame), the first \vec{V} in Eq. 6-18 may *also* be taken relative to the moving control surface.”. [Bob Spall]
- Pg. 261, Prob. 6-27, 4th line: Change “rate of water is” to “rate of water through the stationary nozzle is”.
- Pg. 261, Prob. 6-27, 6th line: Change “applied on the” to “applied by the”.
- Pg. 464, 1st line of Problem 9-82: Change “forced between” to “forced to flow between”. [Woonjean Park]
- Pg. 469, Line 2 (of column 1): Change “function $\psi =$ ” to “function ψ as a”. [Woonjean Park]
- Pg. 679, Objective #1, 2nd line: Change “from flow” to “from pressurized flow”.
- Pg. 679, line 1 of 2nd paragraph: Change “driven by a” to “driven by gravity and/or a”. [David Hill]
- Pg. 680, line 1 of 2nd paragraph: Change “In an open” to “In a symmetric open”. [David Hill]
- Pg. 680, line 5 of 2nd paragraph: Move “, as shown in Fig. 13-2” to line 3 of the same paragraph, between “surface” and “(when”. [David Hill]
- Pg. 681, line 2: Change “slope and constant” to “slope, constant roughness, and constant”. [David Hill]
- Pg. 683, line 1: Change “*tranquil, critical, or rapid*” to “*subcritical, critical, or supercritical*”. [David Hill]

- Pg. 683, Eq. 13-6: Remove the second “=” sign and everything to the right of it. [David Hill]
- Pg. 683, line 2 below Eq. 13-6: Change “length, which is” to “length. L_c is”. [David Hill]
- Pg. 683, line 3 below Eq. 13-6: Change “channels.” to “channels, and $Fr = V / \sqrt{gy}$ ”. [David Hill]
- Pg. 691, Sec. 13-5, last sentence of first paragraph: Change to “constant height” to “constant wall height”.
- Pg. 693, last sentence before the section “Critical...”: Change the whole sentence to “Nevertheless, coefficient n is assumed to be independent of the size and shape of the channel—it varies only with surface roughness”. [David Hill]
- Pg. 694, last line before the example: Change “sections.” to “sections, as illustrated in Example 13.4”. [David Hill]
- Pg. 697, 5th line from bottom: Change “per unit cross-sectional area ($A_c = 1 \text{ m}^2$)” to “for a cross-sectional area of 1 m^2 .”
- Pg. 768, Fig. 14-56: Change “ η_{pump} ” to “ η_{fan} ” in two places. [Woonjean Park]
- Pg. 771, Fig. 14-60: Change “ η_{pump} ” to “ η_{fan} ” in two places. [Woonjean Park]
- Pg. 777, line 4: Change “*Assumptions* The pump” to “*Assumptions 1* The pump”. [Wonnam Lee]
- Pg. 813, Problem 14-88, line 3: Change “pump performance” to “fan performance”. [Woonjean Park]
- Pg. 813, Problem 14-89, line 1: Change “the pump specific” to “the specific”. [Woonjean Park]

Corrections in the first printing (January 2005) – “0234567890 DOW/DOW 0987654” on the copyright page. These have been corrected in the 2nd printing (July 2005). Make these changes *only* if you have the 1st printing of the book.

Major Errors in the First Printing

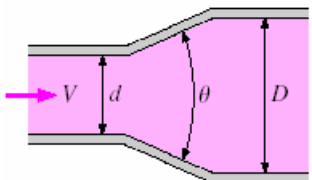
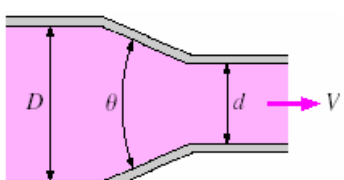
- Inside front cover, right side, last line of the section called “Some Physical Constants”: Change “154.37” to “1545.37”.
- Inside front cover, right side, third line from bottom: Change the units of density from “lb_f/ft³” to “lb_m/ft³”.
- Pg. 55, line 1 of Analysis: Change “Eq. 2-15” to “Eq. 2-38”. [Jeff King]
- Pg. 73, line 2: Change “ $\rho_1 \cong \rho_2$ ” to “ $\rho_1 \ll \rho_2$ ”. [Eric Paterson]
- Pg. 73, line 3: Change “ $P_1 - P_2 \rho_2 gh$ ” to “ $P_1 - P_2 \cong \rho_2 gh$ ”. [Eric Paterson]
- Pg. 113, Answer given for Problem 3-108E: Change “4.08 ft/s²” to “4.03 ft/s²”.
- Pg. 128, First equation of Analysis: Change “(15 – 0.8y)” to “(1.5 – 0.8y)”. [Erica Aversa]
- Pg. 196, 4 lines above the Solution in the problem statement of Example 5-7: Change “4 mm” to “5 mm”. [John Brossman]
- Pg. 224, Answer given for Problem 5-88: Change “200 kW” to “201 kW”.
- Pg. 256, 2nd equation of Analysis: Change “118 N” to “117.7 N”.
- Pg. 256, 4th line of text from the bottom: Change “118 N per m” to “117.7 N per m”.
- Pg. 257, top equation: Change the answer from “2.40 m” to “1.55 m”. Also, since it is not obvious where the 141.4 comes from, change the equation to the following:

$$L = \frac{\sqrt{2r_2 \dot{m} V_2}}{w} = \frac{\sqrt{2(2 \text{ m})(23.56 \text{ kg/s})(3 \text{ m/s}) \left(\frac{\text{N}}{\text{kg} \cdot \text{m/s}^2} \right)}}{117.7 \text{ N/m}} = 1.55 \text{ m}$$

- Pg. 265, Answers given for Problem 6-59: Change “30.2” to “30.3”, and change “0.0593” to “0.0595”.
- Pg. 311, Answer given for Problem 7-44: Change “20.0 rpm” to “19.9 rpm”.
- Pg. 350, footnote under the diagrams for pipe exits: Change “ $\alpha = 1$ ” to “ $\alpha \approx 1.05$ ”
- Pg. 350, the equation for the sudden expansion, near the middle of the page: Add a factor of α , i.e., the equation should be as follows, with the correction in red:

$$K_L = \alpha \left(1 - \frac{d^2}{D^2} \right)^2$$

- Pg. 350, bottom: The loss coefficients listed for the Expansion are actually those for the Contraction, and vice-versa. Also, the first angle for the contraction should be 30°, not 20°. The correct listing should be as follows:

<p>Expansion (for $\theta = 20^\circ$):</p> <p>$K_L = 0.30$ for $d/D = 0.2$</p> <p>$K_L = 0.25$ for $d/D = 0.4$</p> <p>$K_L = 0.15$ for $d/D = 0.6$</p> <p>$K_L = 0.10$ for $d/D = 0.8$</p>		<p>Contraction:</p> <p>$K_L = 0.02$ for $\theta = 30^\circ$</p> <p>$K_L = 0.04$ for $\theta = 45^\circ$</p> <p>$K_L = 0.07$ for $\theta = 60^\circ$</p>	
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- Pg. 352, Eq. 8-60: Add a factor of α , i.e., the equation should be as follows, with the correction in red:

$$K_L = \alpha \left(1 - \frac{A_{\text{small}}}{A_{\text{large}}} \right)^2$$

- Pg. 352, third line below Eq. 8-60: Change “ $K_L = 1$ ” to “ $K_L = \alpha$ ”.
- Pg. 353, line 2 of Example 8-6: Change “30° from the horizontal.” to “10° from the axis.”.
- Pg. 353, bottom line: Change “for gradual expansion of $\theta = 60^\circ$ total included angle is $K_L = 0.07$.” to “for a gradual expansion of total included angle $\theta = 20^\circ$ and diameter ratio $d/D = 6/9$ is $K_L = 0.133$ (by interpolation using Table 8-4).”
- Pg. 354, 3rd equation on the page: Change “0.07” to “0.133” and change “0.175” to “0.333”. The final form of the equation should be as follows, with the corrections in red:

$$h_L = K_L \frac{V_1^2}{2g} = (0.133) \frac{(7 \text{ m/s})^2}{2(9.81 \text{ m/s}^2)} = 0.333 \text{ m}$$

- Pg. 354, last equation on the page: Change “0.175” to “0.333”, change “1000 kg · m/s” to “1000 kg · m/s²” [Charlie Chacko], and change “169” to “168”. The final form of the equation should be as follows, with the corrections in red:

$$\begin{aligned}
P_2 &= P_1 + \rho \left\{ \frac{\alpha_1 V_1^2 - \alpha_2 V_2^2}{2} - gh_L \right\} = (150 \text{ kPa}) + (1000 \text{ kg/m}^3) \\
&\quad \times \left\{ \frac{1.06(7 \text{ m/s})^2 - 1.06(3.11 \text{ m/s})^2}{2} - (9.81 \text{ m/s}^2)(0.333 \text{ m}) \right\} \\
&\quad \times \left(\frac{1 \text{ kN}}{1000 \text{ kg} \cdot \text{m/s}^2} \right) \left(\frac{1 \text{ kPa}}{1 \text{ kN/m}^2} \right) \\
&= \mathbf{168 \text{ kPa}}
\end{aligned}$$

- Pg. 354, 3 lines above the Discussion: Change “169 kPa” to “168 kPa”.
- Pg. 387, answer given for Problem 8-37: Change “29” to “32.3”.
- Pg. 389, answer given for Problem 8-49: Change “743” to “734”.
- Pg. 389, Problem 8-61: Change the answers from “321 kPa, 28 kPa” to “322 kPa, 25 kPa”.
- Pg. 524, first equation on the page (in Step 5 of Example 10-10): Change “3600 ft” to “3600 s”.
- Pg. 557, answer given for Problem 10-75: Change “10.0 m/s” to “10.1 m/s”.
- Pg. 558, answer given for Problem 10-87: Change “3.75 cm” to “1.05 cm”.
- Pg. 575, the lower left entry in the table (the semitrailer): The drag coefficients are not given! Add the following: “Without fairing, $C_D = 0.96$ ” and “With fairing, $C_D = 0.76$ ”.
- Pg. 605, answer given for Problem 11-62E: Change “1320” to “1120”.
- Pg. 672, Problem 12-60E, answers: Change “539 K” to “539 R”.

Minor Errors in the First Printing

- Pg. 8, line 13: Change “Ecole Polytechnic and the Ecole Ponts et Chaussees” to “École Polytechnique and the École des Ponts et Chaussées”. [Véronique Larin]
- Pg. 11, line 3 above the section “Natural...”: Change “Osborn” to “Osborne”. [Woonjean Park]
- Pg. 21, line 1: change “453.6 gm” to “453.6 g”.
- Pg. 55, line 1 of Properties: Change “Table 2-3” to “Table 2-4”. [Jeff King]
- Pg. 219, Problem 5-44, line 3: Change “diameter D_o ” to “diameter D ”.
- Pg. 260, line 2 of Problem 6-9C: change “slow” to “flow”.
- Pg. 558, lines 4 and 5 of Problem 10-80: Change “dimension to the wind” to “dimension parallel to the wind” (2 occurrences).
- Pg. 624, in *Analysis*: Change “0.87337” to “0.8737” three times (a total of 3 occurrences).
- Pg. 627, first equation in *Analysis*: Change “ $(150 \text{ m/s}^2)^2$ ” to “ $(150 \text{ m/s})^2$ ”.
- Pg. 629, third equation in *Analysis*: Change to the following, with the changes in red:

$$\frac{T_2}{T_0} = 0.970\mathbf{1} \quad \frac{P_2}{P_0} = 0.899\mathbf{3} \quad \text{Ma}_2 = \mathbf{0.391}$$

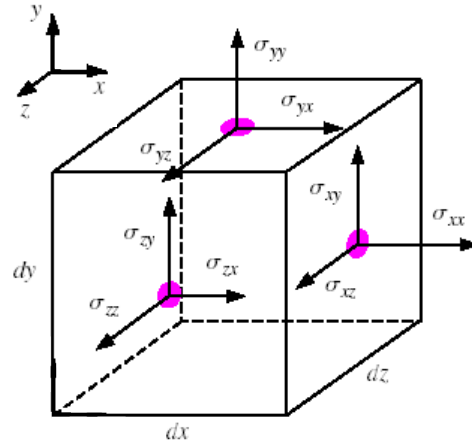
Note: the first number changes from “0.9703” to “0.9701”, the second number changes from “0.9000” to “0.8993”, and the last number should be bold and blue since it is an answer.

- Pg. 629, fourth equation in *Analysis*: Change “0.9703” to “0.9701”.
- Pg. 629, fifth equation in *Analysis*: Change “0.9000” to “0.8993”.
- Pg. 629, fifth equation in *Analysis*: Change the answer from “95.8 kPa” to “95.7 kPa”.
- Pg. 638, Figure 12-35: Change “ $\dot{m} = 2.858 \text{ kg/s}$ ” to “ $\dot{m} = 2.86 \text{ kg/s}$ ”.
- Pg. 640, line 2 of caption of Fig. 12-36: Change “Orbiter” to “orbiter” since it is not a proper name like “Columbia”.
- Pg. 641, last two lines of the caption of Figure 12-39: Change “ $\text{Ma}_{n,1}$ ” to “ $\text{Ma}_{1,n}$ ” and change “ $\text{Ma}_{n,2}$ ” to “ $\text{Ma}_{2,n}$ ”.
- Pg. 881, Problem 15-70, 4th line from the end of the problem statement: Change “velocity vectors” to “the velocity profile”.
- Pg. 922, entry for “head”: Change “[194]” to “[192]” in four places, namely, line 2, line 9, line 18, and line 21. [Frank Meeuwissen]
- Pg. 924, entry for “Navier-Stokes equation”: Change “[429, 474]” to “[429, 475]”. [Justin Prosser]
- Pg. 925, entry for “Poiseuille flow”: Change “[316, 332]” to “[316, 330]”.
- Pg. 925, entry for “Poiseuille flow”, line 3: Change “Pouiseuille” to “Poiseuille”. [Frank Meeuwissen]
- Pg. 933, entry for “Cavitation”: Change the page numbers from “40, 56” to “40, 55, 57”. [Zach Fuhrer]
- Pg. 950: Remove the duplicate entry for “Reynolds, Lord...”, and add the “8” to the entry for “Reynolds, Osborne”.
- Pg. 951, entry for “Sonar dome”: Change the page number from “56” to “57”. [Woonjean Park]
- Pg. 951, entry for “Sonoluminescence”: Change the page number from “56” to “57”. [Woonjean Park]

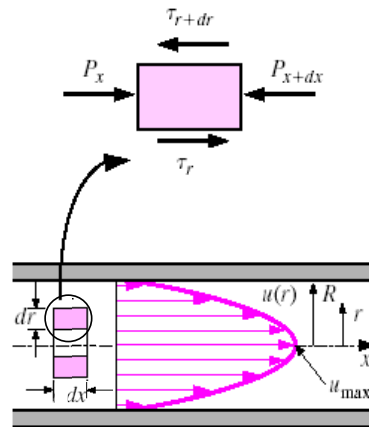
Enhancements to the First Printing

- Pg. xiii in Table of Contents: Capitalize main words in the titles for Tables A-13 through A-16 (for consistency).

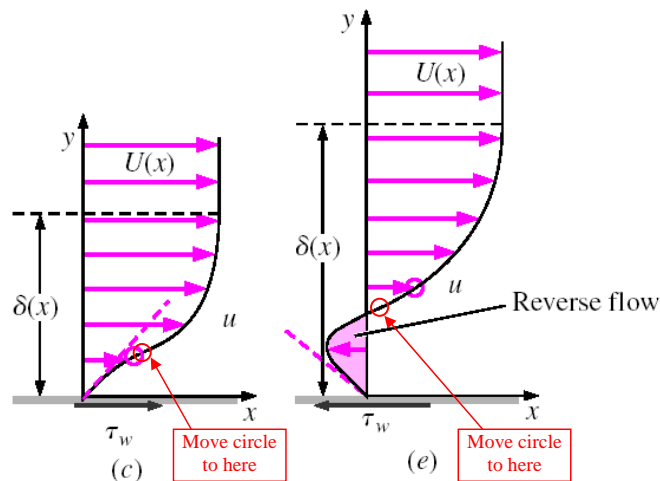
- Pg. 145, Equation 4-30: The equation should be colored blue, as in Eq. (4-32) on the next page.
- Pg. 233, Fig. 6-8: Move the x - y - z axis to the upper left portion of the figure, not touching the cube (there is nothing special about the origin location). It should look like this:



- Pg. 238, Equation 6-25: The color of both velocity vectors in that equation should be blue, not black. [Eric Paterson]
- Pg. 244, Fig. 6-24: Add a black arrow on the left side of the small control volume, and label it " F_R ".
- Pg. 327, Fig. 8-11: Increase the length of the two small squares so that they look like rectangles, not squares, and so that they have the same aspect ratio (length to width) as the bigger rectangle above them.
- Pg. 327, Fig. 8-11: Add a circle around the upper small rectangle so that it is clear that the upper free body diagram is a magnification of that top rectangular fluid element. Here is what the figure should look like:



- Pg. 342, Fig. 8-28: Add in the white space: "See Fig. A-12, p. 898, for a full-page Moody chart."
- Pg. 371, Figure 8-63: Change "(C)" to "(c)", i.e., make it lower case.
- Pg. 536, Figure 10-123: In parts (c) and (e), the blue circles representing the inflection points are not located properly. Move the one in part (c) to the right a little bit, and move the one for part (e) to the left – just to the right side of the y -axis. The changes are sketched below:



- Pg. 574, Table 11-2, second entry from the top left, i.e., the one labeled “Sphere...”: Under the drawing of the sphere, add “See Fig. 11-36 for C_D vs. Re for smooth and rough spheres.”
- Pg. 590, middle of page, last line of paragraph: Change “order of 100.” to “order of 100 for a two-dimensional airfoil.”
- Pg. 618, line 3 of *Properties*: Change “temperatures” to “temperature”.
- Pg. 658, 2 lines above Eq. 12-71: Change “is turbulent” to “is usually turbulent”.
- Pg. 664, top line: Change “a definite no” to “a definite *no*”.
- Pg. 673, Problem 12-88: Change “Calculate” to “Using EES (or other) software, calculate”.
- Pg. 810, Fig. P14-52: Add in the lower right portion of the figure “ $T = 25^\circ\text{C}$, $P = 1 \text{ atm}$ ”.
- Pg. 878, Problem 15-49, 5th line from the top of the page: Change “velocity vectors” to “streamlines”.