

Corrections to:  
**Turbulent Flows**

by

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There have been eleven printings of *Turbulent Flows*. Here, first the corrections to the ninth printing are given, then corrections to earlier printings.

Please report any further corrections to the author at `s.b.pope@cornell.edu`.

**Corrections that apply to the 9th 2012 printing.**

- p.128, Ex. 5.22: The RHS of the second equation should be “ $\frac{1}{4}\text{Ma}^2(\gamma - 1)$ ”.
- p.287, Ex.7.6: The text between Eqs. (7.70) and (7.71) should be replaced by:

“From this expression for  $\mathcal{P}$ , show that, at high Reynolds number, the peak production occurs close to the location  $\check{y}$  where the viscous and Reynolds stresses are equal. Show that  $\check{\mathcal{P}}$ , the production at  $\check{y}$  is”

**Corrections that apply to the 8th 2011 printing.**

- p.12, Eq.(2.5): “ $(U_k - u_k^{(i)})^n$ ” should be “ $(U_k - u_k^{(i)})$ ”.
- p.57, above Eq.(3.94): “Cauchy-Schwartz” should be “Cauchy-Schwarz”.
- p.59, Ex.3.16: “Cauchy-Schwartz” should be “Cauchy-Schwarz”.
- p.122, Ex.5.13: “Cauchy-Schwartz” should be “Cauchy-Schwarz”.
- p.124, Eqs.(5.122) and (5.123) should be:

$$2S_{ij}S_{ij} = \frac{\partial U_i}{\partial x_j} \frac{\partial U_i}{\partial x_j} + \frac{\partial U_i}{\partial x_j} \frac{\partial U_j}{\partial x_i} \quad (122)$$

$$2\Omega_{ij}\Omega_{ij} = \frac{\partial U_i}{\partial x_j} \frac{\partial U_i}{\partial x_j} - \frac{\partial U_i}{\partial x_j} \frac{\partial U_j}{\partial x_i} \quad (123)$$

- p.133, Eq.(5.164): “ $\overline{D}k$ ” should be “ $\overline{D}k$ ”.
- p.234, Eq.(6.251): in the middle part,  $\Gamma(\frac{3}{2})$  should be in the numerator, not the denominator.
- p.246, The second sentence of Section 6.5.8 should be “In these cases the shear-stress spectrum  $E_{12}(\kappa_1)$  is zero.”
- p.320, Eq.(7.199): “ $-\frac{2}{3}k \left( \frac{\partial \langle U_i \rangle}{\partial x_j} + \frac{\partial \langle U_j \rangle}{\partial x_i} \right)^n$ ” should be “ $-\frac{2}{3}k \left( \frac{\partial \langle U_i \rangle}{\partial x_j} + \frac{\partial \langle U_j \rangle}{\partial x_i} \right)$ ”.
- p.374, Ex.10.5: “Cauchy-Schwartz” should be “Cauchy-Schwarz”.
- p.534, Eq.(12.275): “ $\mathbf{U}(t)$ ” should be “ $\mathbf{U}^*(t)$ ”.
- p.551, last line: “ $\langle \Gamma \nabla^2 \phi^s \psi \rangle$ ” should be “ $\langle \Gamma \nabla^2 \phi^s | \psi \rangle$ ”
- p.567, Ex.13.5: the first line should be “Show that the second moment of the filter function (if it exists) is”
- p.576, Eq.(13.64): “ $H \left( \frac{1}{\Delta_{(i)}} \right)$ ” should be “ $\frac{1}{\Delta_{(i)}} H$ ”.
- p.623, last line: “Eq.(13.25)” should be “Eq.(13.258)”.
- p.627, Eq.(13.274): “ $\overline{\mathcal{S}}_{ij}$ ” should be “ $\overline{S}_{ij}$ ”.
- p.706, Eq.(H.24): on the left-hand side, the vertical line is much too big: the expression should be “ $\langle \nu \nabla^2 u_i | \mathbf{v} \rangle$ ”.
- p.725, line below Eq.(J.69): “ $e^{-isV_1}$ ” should be “ $e^{isV_1}$ ”.
- p.755: “Cauchy-Schwartz” should be “Cauchy-Schwarz”.

### Corrections that apply to earlier printings.

The corrections are listed here in the following order:

**Corrections that apply only to the 2005 printing.**

**Corrections that apply only to the 2003 printing.**

**Corrections that apply only to the 2001 printing.**

**Corrections that apply to all printings, 2000, 2001 and 2003.**

**Corrections that apply only to the 2000 and 2001 printings.**

**Corrections that apply only to the 2000 printing.**

Please report any further corrections to the author at pope@mae.cornell.edu.

**Corrections that apply only to the 2005 printing.**

- p.12, Eq.(2.5): “ $(U_k - u_k^{(i)})^n$ ” should be “ $(U_k - u_k^{(i)})$ ”.

**Corrections that apply only to the 2003 printing.**

- p.211, line below Eq.(6.126): “ $\langle u \rangle_{\mathcal{L}}$ ” should be “ $\langle \mathbf{u} \rangle_{\mathcal{L}}$ ”.

**Corrections that apply only to the 2001 printing.**

- p.23, last line: “ $\partial_{ij}$ ” should be “ $\delta_{ij}$ ”.
- Back cover, in review from JFM: “tubulence” should be “turbulence”.

**Corrections that apply to all printings, 2000, 2001 and 2003.**

- p.12, Eq.(2.5): “ $(u_k^{(i)} - U_k)$ ” should be “ $(U_k - u_k^{(i)})$ ”.
- p.51, Eq.(3.68): replace “.” by “,” and add “where the last expression applies for integer  $n$  and  $\alpha$ .”
- p.57, above Eq.(3.94): “Cauchy-Schwartz” should be “Cauchy-Schwarz”.
- p.59, Ex.3.16: “Cauchy-Schwartz” should be “Cauchy-Schwarz”.
- p.122, Ex.5.13: “Cauchy-Schwartz” should be “Cauchy-Schwarz”.
- p.124, Eqs.(5.122) and (5.123) should be:

$$2S_{ij}S_{ij} = \frac{\partial U_i}{\partial x_j} \frac{\partial U_i}{\partial x_j} + \frac{\partial U_i}{\partial x_j} \frac{\partial U_j}{\partial x_i} \quad (122)$$

$$2\Omega_{ij}\Omega_{ij} = \frac{\partial U_i}{\partial x_j} \frac{\partial U_i}{\partial x_j} - \frac{\partial U_i}{\partial x_j} \frac{\partial U_j}{\partial x_i} \quad (123)$$

- p.133, Eq.(5.164): “ $\frac{\bar{D}k}{Dt}$ ” should be “ $\frac{Dk}{Dt}$ ”.
- p.154, Eq.(5.257): “ $-S(\xi f + \dots)$ ” should be “ $-S(2\xi f + \dots)$ ”.
- p.167, line below Eq.(5.293) “Exercise 5.36” should be “Exercise 5.37”.
- p.213, Eq.(6.143): “ $\delta_{ij}$ ” should be “ $\delta_{jk}$ ”.
- p.234, Eq.(6.251): in the middle part,  $\Gamma(\frac{3}{2})$  should be in the numerator, not the denominator.
- p.246, The second sentence of Section 6.5.8 should be “In these cases the shear-stress spectrum  $E_{12}(\kappa_1)$  is zero.”
- p.320, Eq.(7.199): in place of “ $-\frac{4}{3}k \frac{\partial \langle U_i \rangle}{\partial x_j}$ ”, the first term on the right-hand side should be “ $-\frac{2}{3}k \left( \frac{\partial \langle U_i \rangle}{\partial x_j} + \frac{\partial \langle U_j \rangle}{\partial x_i} \right)$ ”.
- p.374, Ex.10.5: “Cauchy-Schwartz” should be “Cauchy-Schwarz”.
- p.379, Eq.(10.75): “ $C_\mu^{3/4}$ ” should be “ $C_\mu^{-3/4}$ ”.
- p.425, Eq.(11.133): “ $\varepsilon$ ” should be “ $\mathcal{P}$ ”.
- p.488, Ex.(12.19), penultimate line: “Eqs.(12.101) and (12.102)” should be “Eqs.(12.101) and (12.103)”.
- p.493, Eq.(12.121): “ $+\frac{1}{2}C_0$ ” should be “ $-\frac{1}{2}C_0$ ”.
- p.493, Eq.(12.122): “ $-\frac{1}{2}C_0$ ” should be “ $+\frac{1}{2}C_0$ ”.
- p.534, Eq.(12.275): “ $\mathbf{U}(t)$ ” should be “ $\mathbf{U}^*(t)$ ”.
- p.538, Eq.(12.288): “ $(2k^{1/2})$ ” should be “ $(2k)^{1/2}$ ”.
- p.548, Eq.(12.338): “ $b(\mathbf{x}, t)$ ” should be “ $b(\mathbf{x}, t)^2$ ”.
- p.548, Eq.(12.339): “ $b$ ” should be “ $b^2$ ”.
- p.549, Eq.(12.341): “ $b(\mathbf{x}, t)$ ” should be “ $b(\mathbf{x}, t)^2$ ”.
- p.551, last line: “ $\langle \Gamma \nabla^2 \phi^s \rangle$ ” should be “ $\langle \Gamma \nabla^2 \phi^s | \psi \rangle$ ”

- p.563, Table 13.2: in the equation defining the transfer function, “ $e^{i\kappa r}$ ” should be “ $e^{-i\kappa r}$ ”.
- p.567, Ex.13.5: the first line should be “Show that the second moment of the filter function (if it exists) is”
- p.568, Eq.(13.34): the right-hand side should be multiplied by the factor  $(1/\mathcal{L})$ .
- p.570, Eq.(13.39): on the first line, the right-hand side should be: “ $\langle \bar{u}(x+r)\bar{u}(x) \rangle$ ”.
- p.576, Eq.(13.64): on the right-hand side, within the product, the Heaviside function should be multiplied by the factor  $(1/\Delta_{(i)})$ .
- p.581, Eq.(13.94) should be:  $\bar{p} \equiv \bar{p} + \frac{2}{3}\rho k_r$ .
- p.582, first line: “Eq.(13.91)” should be “Eq.(13.89)”.
- p.605, Eq.(13.195): “ $\hat{u}_k(\boldsymbol{\kappa}, t)$ ” should be “ $\hat{u}_k(\boldsymbol{\kappa}', t)$ ”.
- p.607, Eq.(13.200), “ $H(\kappa_c - \boldsymbol{\kappa}'')$ ” should be “ $H(\kappa_c - \kappa'')$ ”.
- p.623, last line: “Eq.(13.248)” should be “Eq.(13.258)”.
- p.627, Eq.(13.274): “ $S_{ij}$ ” should be “ $\bar{S}_{ij}$ ”.
- p.675, Eq.(C.25): “ $g^m(a)$ ” should be “ $g^{(m)}(a)$ ”.
- p.686, Eq.(E.25): “ $\langle |c_n|^2 \rangle$ ” should be “ $\langle |c_n|^2 \rangle$ ”.
- p.703, line 6: “Eq.(12.4)” should be “Eq.(12.6)”.
- p.706, Eq.(H.24): on the left-hand side, “ $\langle \nu \nabla^2 u_i \rangle$ ” should be “ $\langle \nu \nabla^2 u_i | \mathbf{v} \rangle$ ”.
- p.706, Ex. H.5: “Eq.(H.18)” should be “Eq.(H.14)”.
- p.725, line below Eq.(J.69): “ $e^{-isV_1}$ ” should be “ $e^{isV_1}$ ”.
- p.755: “Cauchy-Schwartz” should be “Cauchy-Schwarz”.

**Corrections that apply only to the 2000 and 2001 printings.**

- p.xxviii: The definition of  $u_\tau$  should be  $\sqrt{\tau_w/\rho}$ .
- p.64: in item (iii) “ $\{\hat{u}_1, \hat{u}_2, \dots, \hat{u}_3\}$ ” should be “ $\{\hat{u}_1, \hat{u}_2, \dots, \hat{u}_D\}$ ”.
- p.76, line 22 “for the circumferential coordinate” should be “of the circumferential coordinate”.
- p.90, Ex. 4.5 (a): “ $a_{ij}$ ” should be “ $a_{ij}/k$ ”.
- p.91, Ex. 4.5 (e): “ $\langle u_i u_j \rangle$ ” should be “ $\langle u_i u_j \rangle/k$ ”.
- p.112: The four horizontal arrows towards the right of Fig. 5.14(b) are spurious and should be removed.
- p.122, Eq.(5.104): “ $\nu_T$ ” should be “ $\hat{\nu}_T$ ”.
- p.198, 2nd line of Eq.(6.55): “ $e_1$ ” should be “ $\mathbf{e}_1$ ”.
- p.203, Eq.(6.83): At the start of the equation “ $\frac{3}{r^5}$ ” should be “ $\frac{3}{r^4}$ ”.
- p.204, Eq.(6.87): At the start of the equation “ $\frac{3}{r^5}$ ” should be “ $\frac{3}{r^4}$ ”.
- p.211, Ex.6.16: The line below Eq.(6.126) should be: “For a periodic velocity field with  $\langle \mathbf{u} \rangle_{\mathcal{L}} = 0$ , show that  $\phi$  is uniform, and obtain a . . .”
- p.206, Eq.(6.97) should be:

$$a_1 + 3a_2 + 9a_3 + 10a_4 + 12a_5 = 0.$$

- p.238, Eq.(6.258): Instead of “ $4/3$ ”, the exponent should be “ $3/4$ ”.
- p.336, line 21: “(Reynolds-averaged Navier–Stokes)” should be “Reynolds-averaged Navier–Stokes”.
- p.394, Table 11.1: In the last column of the table, the entries in the fourth and fifth rows should be commuted. That is, the fourth entry should be “axi,  $\xi > 0$ ” and the fifth should be “axi,  $\xi < 0$ ”.
- p.394, Footnote 2: “none” should be “only one”.
- p.415, Table 11.2: the middle three entries in the last row (corresponding to axisymmetric contraction, axisymmetric expansion and plain strain) should be:

$$\sqrt{3}\mathcal{S}_\lambda \quad 2\sqrt{3}\mathcal{S}_\lambda \quad 2\mathcal{S}_\lambda.$$

- p.427, Table 11.4: under SSG, the second entry “ $C_3 = 0.8$ ” should be replaced by “ $C_3^* = 1.3$ ”.
- p.449 above Eq.(11.216): “sames” should be “same”
- p.586, Eq.(13.124) should be:  $\langle E_f \rangle \approx \langle E \rangle$ .
- p.586, line below Eq.(13.124):  $\langle \overline{E} \rangle$  should be  $\langle E_f \rangle$
- p.591, The right-hand side of Eq.(13.139) should be  $\ell_s \left(1 + \frac{\nu}{\nu_r}\right)^{1/2}$ .
- p.594, The right-hand side of Eq.(13.149) should be  $\ell_s \left(1 + \frac{\nu}{\nu_r}\right)^{1/2}$ .
- p.599, in Eq.(13.166): “ $y^+$ ” should be “ $-y^+$ ”
- p.623, Ex.(13.42): in the penultimate line “expansion;” should be “expansion,”.
- p.629, Below Eq.(13.282), “Lesieur and Métais (1998)” should be “Lesieur and Métais (1996)”.
- p.652, Eq.(A.52): “ $\mathbf{e}_k$ ” should be “ $\mathbf{e}_k$ ”.
- p.697, Eq.(G.9): “ $(-1)^{n+1}$ ” should be “ $(-1)^n$ ”.
- p.737, “Lesieur and Métais (1998)” should be “Lesieur and Métais (1996)”.
- p.742, The reference “Reynolds, O. (1894)” should be:  
Reynolds, O. (1895) “On the dynamical theory of incompressible viscous fluids and the determination of the criterion.” *Philos. Trans. R. Soc. London Ser. A* 186, 123-164.

### Corrections that apply only to the 2000 printing.

- In the paperback version the acknowledgement for the cover illustration has, unfortunately, been omitted. It should read:  
Vortex structure and dynamics in the near field of a coaxial jet (courtesy of W.J.A. Dahm, C.E. Frieler and G. Tryggvason)

- In the Author index, several page numbers are off by one or two pages.
- p. 7, l.4: “wing” should be “wings”
- p.23, below Eq.(2.71), add the parenthetic sentence:  
(For variable-density flow,  $S_{ij}$  is defined as  $S_{ij} \equiv \frac{1}{2}(\partial U_i/\partial x_j + \partial U_j/\partial x_i) - \frac{1}{3}\Delta\delta_{ij}$  . . )

- p. 374: Eq.(10.48) should be

$$\frac{|\langle uv \rangle|}{k} = \left( C_\mu \frac{\mathcal{P}}{\varepsilon} \right)^{1/2}$$

- p. 426, in items(ii) and (iii): “ $\mathcal{M}_{ijkl}$ ” should be “ $M_{ijkl}$ ”
- p. 427, l.10: “ $\mathcal{M}_{ijkl}$ ” should be “ $M_{ijkl}$ ”
- p. 426, in Ex.11.22: “ $\mathcal{M}_{ijkl}$ ” should be “ $M_{ijkl}$ ”
- p. 565, below Eq.(13.11): “transfer” should be “transform”
- p. 577, line above Eq.(13.67): “0.1” should be “0.2”
- p. 742: The reference to Porté-Agel *et al.*(2000) is: J. Fluid Mech. 415, 261–284.
- p. 749: In the Author index, the page numbers for the latter part of the book are incorrect. For page numbers 557-639 (i.e., Chapter 13) add 1 to the given page number. For page numbers greater than 641 (i.e., Appendices) add 2 to the given page number.
- p.750: under Gardiner, “861” should be “713”.

The following are minor corrections, of little consequence to the reader.

- Paperback first page, l. 15: “appendixes” should be “appendices”
- Paperback back cover, l.5: “appendixes” should be “appendices”
- Paperback back cover, l.13: “tur-bulent” should be “turbulent”
- p. 26, above Eq.(2.78): “(Eq.2.42)” should be “Eq.(2.42)”
- p. 751, under Launder, B. E.: “425, 426, 427, 428” should be “425–428”