RADIAL FLOW TURBOCOMPRESSORS

Design, Analysis and Applications,

by Michael Casey and Chris Robinson

Corrigenda: version 5.05.2022

The following list includes errors that have been identified by readers or by the authors so far. The list also includes some additional useful references that were not included in the book as they were unknown to the authors or appeared during the final copyediting stage when no further changes were allowed.

Introduction
Page xv, first sentence, second paragraph, “in in” should be “in”

Acknowledgements
Phillip Epple should be Professor Phillip Epple of the Coburg University of Applied Sciences. Fabian Dietmann appears twice!

Introduction to Radial Flow Turbocompressors
Page 15, section 1.4.2
Whittle’s dates are (1907-1996).

Page 30, section 1.6.7
The word “i.impeller” in the caption to figure 1.18 should be simply “impeller”.

Energy transfer
Page 47, section 2.2.3
paragraph 3: “In a turbine, rotor work …” should be “In a turbine rotor, work …”

Page 5, section 2.2.4
Near the end of the first paragraph “(2.4)” should be “(2.3)”.

Page 68, section 2.6.1,
Line 1, ‘equation, (2.23)’ should be ‘equation, (2.27)’

Equations of state
Page 93, section 3.3.1
Correction to equation 3.19

$$Z = \sqrt{Z_1 Z_{2s}}, \quad c_p = (h_{2s} - h_1)/(T_{2s} - T_1), \quad c_v = (u_{2s} - u_1)/(T_{2s} - T_1)$$
$$\kappa = \ln(p_{2s}/p_1)/\ln(v_1/v_{2s}), \qquad 3.19$$

Correction to equation 3.20

$$y_{12} = \int_1^2 v dp = \frac{n}{(n-1)} ZRT_1 \left[\left(\frac{p_2}{p_1} \right)^{\frac{n-1}{n}} - 1 \right], \quad \frac{n-1}{n} = \frac{(\kappa - 1)}{\kappa \eta_p}, \qquad 3.20$$

Page 103, section 3.6.1
Correction to equation 3.45

$$n_{pv} = \frac{\ln(p_2 / p_1)}{\ln(v_1 / v_2)} \qquad 3.45$$

Page 105, section 3.6.4
This section ends with the statement that a revised form of the estimation of the polytropic head and efficiency with a real gas has not yet become standard. In the meantime, after the final draft of the book was written, a good summary of the issues and their possible solution has been provided in the web by Huntington (2020). He states that in the next version of the ASME PTC10 code will probably include three of the methods described there, and highly recommends that the Sandberg and Colby (2013) method as the simplest satisfactory method.

Efficiency definitions for compressors
Page 119, section 4.4.1
paragraph 2, Line 5, ‘Section 2.5.7’ should be ‘Section 2.7.3’
paragraph 2, Line 7, ‘Section 2.5.8’ should be ‘Section 2.7.4’
paragraph 4, Last line, ‘Section 3.5.1’ should be ‘Section 3.5.2’

Page 134, section 4.8
Equation 4.69 should be

$$\frac{1}{\eta_p} = 1 - \frac{\Delta s}{\sum (\Delta s)_h} \qquad 4.69$$

For further details see the reference to Zweifel (1941), as given on page 751.

Fluid dynamics
Page 150, section 5.4.2
last but one sentence of paragraph 2, Figure 5.8 should be Figure 5.7.

Page 164, section 5.5.9,
In the second paragraph the reference should be “… (Schlichting and Gersten, 2006)”

Gas dynamics
Page 209, section 6.5.6
equation 6.34 should be

$$\dot{m}_{cor} = \frac{\dot{m}}{A \rho_t a_t} = \frac{A \rho a}{A \rho_t a_t} M \qquad 6.34$$

Aerodynamic loading
Page 230, section 7.44
The second line of equation 7.20 should be

$$\ln(\tan 2\theta) = -\ln\left(\frac{L}{W_1}\right) + \ln\left(\frac{W_2}{W_1} - 1\right) \qquad 7.20$$

Similarity

Page 259, section 8.4.4

Sutherland's law as written in equation 8.29 is not completely correct and should be corrected to

$$\mu = \mu_{ref}\left(\frac{T}{T_{ref}}\right)^{3/2}\frac{T_{ref}+S}{T+S} \qquad 8.29$$

Further details can be found by reference to more detailed fluid dynamic text books.

Page 273, section 8.6.4

Near middle of the last paragraph the bracket should read "…(as it does for all backswept impellers)."

Page 278, section 8.7.1

The middle line of equation 8.55 should be

$$\phi_{t1} = \phi_{t1B}\left[\left(\frac{\phi_{t1}}{\phi_{t1B}}\right)_{M1}\left(\frac{\phi_{t1}}{\phi_{t1B}}\right)_{M2}\left(\frac{\phi_{t1}}{\phi_{t1B}}\right)_{M3}\cdots\right] + \left[(\Delta\phi_{t1})_{A1} + (\Delta\phi_{t1})_{A2} + (\Delta\phi_{t1})_{A3} + \cdots\right] \qquad 8.55$$

Specific speed

Page 296, section 9.3.3

The reference for Figure 11 in the first paragraph of section 9.3.3 is meant to be a reference to Figure 11.18 on page 368.

Losses and Performance

Page 304, section 10.3.3

On the last line, the value of the dissipation coefficient that Denton recommends should be c_d=0.002

Page 318, section 10.5.1

During the final production stages of this book another good summary of the 1D loss models for centrifugal compressors was published in chapter 6 of Gambini and Vellini (2020).

Impeller Design

Page 353, section 11.4.3

Correction to equation 11.27 which should read as follows:

$$M_{u2} = \frac{M_{w1}}{(3.2\phi_{t1}/k)^{0.36} + 0.15M_{w1}(0.45 + \phi_{t1}/k)} \qquad 11.27$$

Page 371, section 11.6.6

In the first sentence of second paragraph "025" should be "0.25"

Page 400, section 11.12.3

In the last sentence of first paragraph, (5.39) should be (11.64)

Diffuser Design
Pages 434 to 436, section 12.11.1
The text captions relating to Figures 12.22 and 12 21 have been reversed.

Casing Component Design

Geometry definition
Page 466, section 16.1.2.
The first sentence should have a bullet point.

Throughflow code for Radial Compressors
Page 515, section 15.9.2
Equation 15.68, should be

$$\Delta\theta = (2\pi r - Zt_u) / Zr \qquad 15.68$$

Computational fluid dynamics

Compressor Instability and Control

Maps and Matching
Page 601, section 18.1.2.
The first sentence should have a bullet point.

Page 626, section 18.6.1
In Table 18.2, the units of the outlet pressure should be N/m^2
The outlet total temperature and the total pressure in the right-hand column should be calculated with

$$T_{t2} = T(h_{t2}, s_{t2}), \quad p_{t2} = p(h_{t2}, s_2)$$

Page 650, section 18.8.1
Figure 18 15 is courtesy of the Institute of Refrigeration, www.ior.org.

Structural integrity

Development and testing

References

Additional useful recent references:
Gambini, M. and Vellini M., (2020) *Turbomachinery, Fundamentals, Selection and Preliminary Design*. Springer, DOI: 10.1007/978-3-030-51299-6

Huntington, R.A., (2020) *Polytropic Calculation Wars are Over*, Researchgate.net, Oak Hill Turbo & Associates LLC, November 2020, DOI: 10.13140/RG.2.2.26600.90887