

ERRATA AND ADDITIONS FOR "ENGINEERING NOISE CONTROL"

4th Edn. First printing

April 23, 2018

- p24, Eq. 1.32 should not have the \pm symbol on the RHS
- p36, 3 lines from the bottom of the page, replace $\cos b$ with $\cos \beta$
- p68, In Equation (2.14), change K to C , where C is the viscous damping constant and define κ as the segment stiffness
- p118, 7 lines below heading 3.13.1.1, change "2008" to "2005".
- p120, In Equation (3.29), remove the "-" sign following the "=" sign
- p121, In Eq. (3.35), $P_1 P_2$ should be $p_{01} p_{02}$ and I_n should be I
- p122, 5 lines above Eq. 3.37, change " Jacobsen, 2008" to " Jacobsen and de Bree, 2005"
- p167, 180, replace "AS2107 - 1987" with "AS2107 - 2000"
- p195, Equation (5.33) should be:

$$Q_0 = 4\pi a^2 \left[\frac{A}{a^2} + \frac{jkA}{a} \right] e^{-jka} = 4\pi A (1 + jka) e^{-jka} \quad (5.33a,b)$$

- p196, Equation (5.36) should be:

$$\begin{aligned} p(\mathbf{r}, \theta, t) &= \frac{jk\rho c Q_0}{(1 + jka)} [-G(r_1, h, \omega) + G(r_2, -h, \omega)] e^{j(\omega t + ka)} \\ &= \frac{jk\rho c Q_0}{(1 + jka)} [-G(r - h \cos\theta, h, \omega) + G(r + h \cos\theta, -h, \omega)] e^{j(\omega t + ka)} \end{aligned} \quad (5.36a,b)$$

- p196 In Equations (5.37) and (5.38a), remove the minus sign that follows the equals sign
- p197 In Equations (5.42), (5.43) and (5.44), remove the minus sign that follows the equals sign
- p228, In Eq. 5.153, replace $2k_1$ with k
- p228, In Eq. 5.153, replace $(1-j)$ with $(1+j)$
- p229, In Eq. 5.155, replace $(1-j)$ with $(1+j)$
- p229, Replace Equation (5.157) and the two lines preceding it with:

where $g(w)$ is the scaled complementary error function, $\text{erfc}(\cdot)$ is the complementary error function (Abramowitz and Stegun, 1965), and w , which is given by Equation (5.153), is a complex number.

The calculation of $g(w)$ is a complicated process and the equations to follow can only be used in isolation if the real part of w is less than 0 and the imaginary part is greater than 0 (that is, w is in the second quadrant of the complex plane). So any calculation begins with adjusting the value of w to w_a so that the real part is less than 0 and the imaginary part is greater than 0. As w_a is complex, we can write, $w_a = w_r + jw_i = \text{Re}\{w_a\} + j \text{Im}\{w_a\}$. The calculation of $g(w_a)$ is then undertaken using Equations (5.156) to (5.159). If the original value of w did not need be adjusted to put w in the second quadrant of the complex plane, then $g(w) = g(w_a)$. If the original value of w before adjustment, was such that w was not in the second quadrant of the complex plane, then $g(w_a)$ must be adjusted to obtain $g(w)$, according to the following rules, with rule 1 applied first and rule 3 applied to the result after the application of rules 1 and 2.

1. If the imaginary part of w is less than 0, then $g(w_a)$ is replaced with $g(w) = 2\exp(-w_a^2) - g(w_a)$, where $g(w_a)$ is calculated using Equations (5.156) to (5.159);
2. If the imaginary part of w is greater than or equal to 0, then $g(w) = g(w_a)$;
3. If the product of the imaginary and real parts of w is greater than 0, then the sign of the imaginary part of $g(w_a)$ is changed (i.e., the complex conjugate of the $g(w)$ that was obtained using the preceding two rules is then the final $g(w)$).

For small w_r and w_i , where w_r is less than or equal to 3.9 and w_i is less than or equal to 3:

$$g(w_a) = g(w_r, jw_i) = K_1(w_i, w_r) + jK_2(w_i, w_r) \quad (5.157a)$$

where,

$$K_1(w_i, w_r) = \frac{hw_i}{\pi(w_r^2 + w_i^2)} + \left[\frac{2w_i h}{\pi} \sum_{n=1}^{\infty} \frac{e^{-n^2 h^2 (w_r^2 + w_i^2 + n^2 h^2)}}{(w_i^2 - w_r^2 + n^2 h^2)^2 + 4w_r^2 w_i^2} \right] - \frac{w_i}{\pi} E(h) \quad (5.157b)$$

$$\begin{aligned} &+P && \text{if } w_i < \pi/h \\ &+0.5P && \text{if } w_i = \pi/h \\ &+0 && \text{if } w_i > \pi/h \end{aligned}$$

$$K_2(w_i, w_r) = \frac{hw_r}{\pi(w_r^2 + w_i^2)} + \left[\frac{2w_r h}{\pi} \sum_{n=1}^{\infty} \frac{e^{-n^2 h^2 (w_r^2 + w_i^2 + n^2 h^2)}}{(w_i^2 - w_r^2 + n^2 h^2)^2 + 4w_r^2 w_i^2} \right] + \frac{w_r}{\pi} E(h) \quad (5.157c)$$

$$\begin{aligned} &-F && \text{if } w_i < \pi/h \\ &-0.5F && \text{if } w_i = \pi/h \\ &-0 && \text{if } w_i > \pi/h \end{aligned}$$

$$P = \frac{2}{\exp[w_r^2 + (2w_i\pi/h) - w_i^2]} \left[\frac{(A_1C_1 - B_1D_1)}{(C_1^2 + D_1^2)} \right] \quad (5.157d)$$

$$F = \frac{2}{\exp[w_r^2 + (2w_i\pi/h) - w_i^2]} \left[\frac{(A_1D_1 + B_1C_1)}{(C_1^2 + D_1^2)} \right] \quad (5.157e)$$

$$\begin{cases} A_1 = \cos(2w_r w_i) \\ B_1 = \sin(2w_r w_i) \\ C_1 = e^{-2w_i\pi/h} - \cos(2w_r\pi/h) \\ D_1 = \sin(2w_r\pi/h) \end{cases} \quad (5.157f)$$

The error bound can be estimated from:

$$E(h) \leq \frac{2\sqrt{\pi} e^{-(\pi^2/h^2)}}{(1 - e^{-(\pi^2/h^2)})} \quad (5.157g)$$

Note that h is a constant selected by the user. If $h=1$, then $E(h) \leq 2 \times 10^{-4}$ and only 3 or 4 terms are needed in the infinite sums included in the expressions for K_1 and K_2 . If h is reduced to 0.8, then $E(h) \leq 10^{-6}$ and 5 terms will be needed in the infinite sums included in the expressions for K_1 and K_2 . If h is reduced to 0.5, then $E(h) \leq 10^{-15}$ and 14 terms will be needed in the infinite sums included in the expressions for K_1 and K_2 . It is recommended that $h = 0.8$ be used.

p229, In Equations (5.158) and (5.159), replace $-jw$ with $+jw_a$ and replace w with w_a .

p229, 1 and 2 lines above Equation (5.158), replace 3 with 3.9 and 2 with 3.

p230, In Eq. 5.166, replace $2k$ with k

p230, In Eq. 5.166, replace $(1-j)$ with $(1+j)$

p231, Replace the paragraph beginning with ‘‘The effect of turbulence’’ (including Equation (5.167) and the 3 lines following it) with the following:

The effect of atmospheric turbulence on sound over an acoustically smooth surface has been investigated by Clifford (1983) and by Raspet (1995). The presence or absence of turbulence may be included by a generalisation of their results to give the following general expression for the mean square sound pressure at a receiver located at a direct distance, r , from the source for a spherically symmetric sound source having unit far field sound pressure at 1 m:

$$\langle p^2 \rangle_t = \frac{1}{r^2} + \frac{|R_s|^2}{(r_1+r_2)^2} + \frac{2|R_s|}{r(r_1+r_2)} T \cos[\alpha_s - k(r_1 + r_2 - r)] \quad (\text{Pa}^2)$$

where: $\alpha_s = \tan^{-1} \frac{\text{Im}\{R_s\}}{\text{Re}\{R_s\}}$

and where the sign of k has been changed here to reflect that positive time dependence is used in this book, whereas negative time dependence has been used by Clifford (1983) and by Raspet (1995).

p247, Replace Equation (5.195) with:

$$A_g = -10 \log_{10} \left[1 + \left(\frac{r}{r_1 + r_2} \right)^2 |R_s|^2 + \left(\frac{2r}{r_1 + r_2} \right) |R_s| T \cos[\alpha_s - k(r_1 + r_2 - r)] \right] \quad (\text{dB})$$

p248, 4 lines under Equation (5.197), Z_s should be Z_m

p250, line above Eq. 5.201, change (5.198) to (5.200)

p255, Table 5.9, column 2, change the heading from “slight” to “strong” and change the bottom entry from “D” to “C”.

p255, Table 5.9, column 4, change the heading from “strong” to “slight”

p255, Table 5.9, Footnote a , change “close to ground” to “10 m above the ground”

p258, 4 lines above Eq. 5.206, change “added” to “subtracted”

p274-6, the standards ISO 3743/2, ISO 3747 and ISO 3741 are not listed at the end of the book. The references are:

ISO 3741:2010, “Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Precision methods for reverberation test rooms.”

ISO 3743-1:2010, “Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Engineering methods for small movable sources in reverberant fields - Part 1: Comparison method for a hard-walled test room.”

ISO 3743-2:1994, “Acoustics - Determination of sound power levels of noise sources using sound pressure - Engineering methods for small, movable sources in reverberant fields - Part 2: Methods for special reverberation test rooms.”

ISO 3747:2010, “Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Engineering/survey methods for use in situ in a reverberant environment.”

p293, Equation (7.6), k^2 should be k_z^2

p358, Equation (8.12) should be

$$B = \frac{Eh^3}{12(1 - \nu^2)}$$

p364, fig 8.5, the horizontal part of the IIC 50 curve should extend down to 100 Hz

p364, 7 lines from the top of the page add “curvature of” immediately before “500”

p365, Equation (8.21), change the "+" sign to a "-" sign

p365, delete sentence beginning 4 lines above Eq. (8.21) and replace with “Both IIC and ISO specify a 1/3 octave band frequency range from 100 Hz to 3150 Hz inclusive.”

p367, In Equation (8.24), the last term in brackets should be multiplied by 2

p372, In Figure 8.8 caption change (= mh) to (= m/h)

p374, Equation 8.49 should be replaced with:

$$\begin{aligned} TL_{\max} &= 20\log_{10}\left(\frac{mc_L}{4\rho ch}\right) + 10\log_{10}\eta + 17 \\ &= 20\log_{10}\left(\frac{mc_L}{h}\right) + 10\log_{10}\eta - 47.4 \text{ dB (at } 20^\circ\text{C)} \end{aligned} \tag{8.49a,b}$$

p374, Replace “Lgunggren (1991)” with “Ljunggren (1991)”

p378, line 2, replace “8.39” with “8.38”

p397, The second term in brackets in Eq (8.76) is missing a minus sign - it should be $10^{-TL/10}$

p404, Line 3 of item 2 in the solution, change “27.1” to “33.7”

p413, 3 lines below Eq. (8.103), the reference to Eq (8.100) should be Eq. (8.101)

p422, Item 3, “ $N = (2/\ell)(2.5)$ ” should be “ $N = (2/\lambda)(2.5)$ ”

p422, Add the following to the end of item 3, “As there are 3 diffracted paths around the building for sound arriving at the rear wall, the power level on the rear wall should be increased by $10\log_{10}(3)=4.8$ dB, so the total power on the rear wall becomes 71.8 dB.”

p422, Two lines from the bottom, change 67 to 71.8 and change 79 to 80.

p423, Line 1, change 80 to 81

p423, first equation, change 80 to 81 and change 74 to 75

p431, Figure 8.21 is missing - see below.

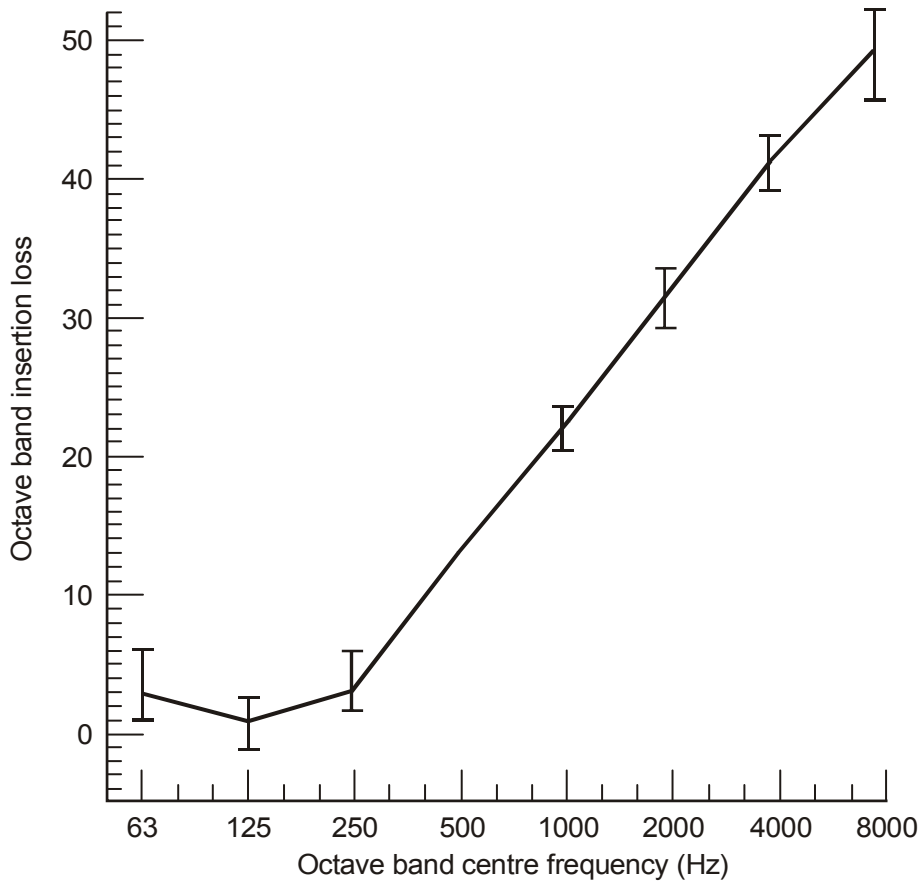


Figure 8.21 Typical pipe lagging insertion loss for 50 mm glass fibre, density 70-90 kg m⁻³, covered with a lead/aluminum jacket of 6 kg m⁻² surface density. The I symbols represent variations in measured values for three pipe diameters (75 mm, 150 mm and 360 mm).

p443, In Eq. (9.25), replace $(1 - M^2)$ with $(1 - M)^2$

p449, Following Eq. (9.46), add “In the presence of a mean flow of Mach number, M , in the duct, the RHS of Equations (9.45), (9.46) and (9.47) should be multiplied by $(1 - M)^2$.”

p449, Replace Equation (9.44) with the following equation, where S_V is the cross sectional area of the volume.

$$\omega_0 = c \sqrt{-\frac{3\ell_e S_V + \ell_V S}{2\ell_e^3 S_V} + \sqrt{\left(\frac{3\ell_e S_V + \ell_V S}{2\ell_e^3 S_V}\right)^2 + \frac{3S}{\ell_e^3 S_V \ell_V}}}$$

p454, Last term in Equation (9.65), replace A_T with (A_T/Z_s)

p456, After Eq. (9.75), add, "Note that in the presence of grazing flow of Mach number, M , Equations (9.69) to (9.75) can be used by substituting $(1 - M)\ell_e$ for ℓ_e in all places."

p467, 3rd line above Eq. (9.102), Change "Figure 9.11a" to "Figure 9.12a".

p471, 2nd and 5th lines from the top, change "undamping" to "nonlinear"

p473, In Eq. (9.124), the right hand side should be multiplied by the gas density.

p477, Top label in Figure 9.14, change "quadruple" to "quadrupole".

p478, Line 8 under heading 9.8, change "undamping" to "non-linear".

p482, line 21, change "height" to "width".

p487, Figure 9.20 legend should be

curve no	$\frac{\sigma}{\rho h}$
1	0.01
2	0.1
3	0.5
4	1

p488, Figure 9.21 legend should be

curve no	$\frac{\sigma}{\rho h}$
1	0.01
2	0.1
3	0.5
4	1

p490, bottom line, $2h/\ell$ should be $2h/\lambda$

p493, 4 and 9 lines from the bottom, $2h/\ell$ should be $2h/\lambda$

p494, Figure 9.23 caption should have the following sentence added. "Note that for a silencer with multiple baffles, S is the cross-sectional area of one airway, not the total silencer."

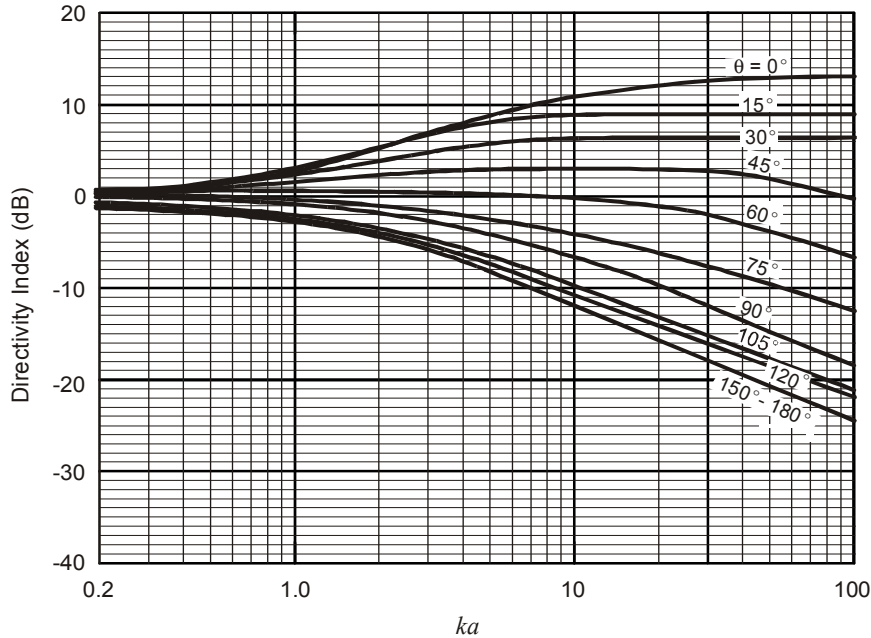
p497, 2 lines from the bottom of the page, change "doubled" to "double"

p498, 4th line under Section 9.11, change "9.5" to "9.6"

p499, To avoid confusion with the discussion on p501 (line 1), change f_0 to f_{0s} in three locations above Eq. (9.145)

p506, replace second sentence under the heading, “9.15 DIRECTIVITY OF EXHAUST DUCTS” with “To get the rectangular section data to collapse on to the ka axis for circular ducts, where $2a$ is the duct diameter, it was necessary to multiply the rectangular duct dimension ($2d$) in the direction of the observer by $4/\pi$ to get $2a$.”

p508, Figure 9.30 should be



Exhaust stack directivity index measured in the field vs ka where a is the stack radius. Curves fitted to data reported by Day and Bennett (2008).

p509, first line, change 2π to π

p510, Equation (5.170) should be:

$$w(\varphi) = \left(\frac{\sin(ks_d \sin(\varphi))}{ks_d \sin(\varphi)} \right)^2 (1 - \alpha_{st})^{(L/2d)\tan|\varphi|}$$

p519, The spring helix angle, α , can be included in Eq. 10.11 to give a more accurate result as follows (E is the modulus of elasticity):

$$k = \frac{d^4 \cos \alpha}{8 n_c D^3} \left[\frac{\cos^2 \alpha}{G} + \frac{2 \sin^2 \alpha}{E} \right]^{-1}$$

p528, 5 lines above Equation (10.36), change “Equation (10.10)” to “Equation (10.12)”

p531, Equation (10.45) should be:

$$M_f = j(k_f/\omega - \omega m_f)^{-1}$$

p536, 6 lines under the figure, change “undamping” to “nonlinear”

p539, Equation (10.53) has a square missing on the second term in the numerator. The correct equation is:

$$\frac{|y_1|}{|F|} = \frac{1}{k_1} \frac{\sqrt{\left(\frac{2\zeta_2\Omega m_1}{m_2}\right)^2 + \left(\Omega^2 - \frac{k_2 m_1}{k_1 m_2}\right)^2}}{\sqrt{\left(\frac{2\zeta_2\Omega m_1}{m_2}\right)^2 \left(\Omega^2 - 1 + \frac{m_2\Omega^2}{m_1}\right)^2 + \left[\frac{k_2}{k_1}\Omega^2 - (\Omega^2 - 1)\left(\Omega^2 - \frac{k_2 m_1}{k_1 m_2}\right)\right]^2}}$$

However, this equation is only valid for zero damping on the main mass, although it gives quite accurate results provided the damping is relatively small. The equation that includes damping on the main mass is Equation (10.42) in the third edition with the "d" removed from the denominator on the RHS. So if damping, ζ_1 , is included on the main mass, the above equation becomes:

$$|y_1| = \frac{|F|}{k_1} \left[(1 - \Omega^2 - r/q)^2 + (2\zeta_1\Omega + s/q)^2 \right]^{-1/2}$$

and

$$|y_2| = |y_1| \left[(a/q)^2 + (b/q)^2 \right]^{1/2}$$

where, $\Omega = \omega\sqrt{m_1/k_1}$, θ_1 and θ_2 are phase angles of the motion of the masses relative to the excitation force, $|F|$ is the amplitude of the excitation force and:

$$\begin{aligned} a &= (k_2/k_1)^2 + 4\zeta_2^2\Omega^2 - (m_2/m_1)(k_2/k_1)\Omega^2 \\ b &= -2\zeta_2(m_2/m_1)\Omega^3 \\ q &= \left(\frac{k_2}{k_1} - \frac{m_2\Omega^2}{m_1} \right)^2 + 4\zeta_2^2\Omega^2 \\ r &= (m_2/m_1)(k_2/k_1)^2\Omega^2 - (m_2/m_1)^2(k_2/k_1)\Omega^4 + 4\zeta_2^2(m_2/m_1)\Omega^4 \\ s &= 2\zeta_2(m_2/m_1)^2\Omega^5 \end{aligned}$$

p542, line 2, change Equation (10.57) to Equation (10.62)

p572, Figure 11.3 caption, although Heitner did use a similar figure to this, it was based on the earlier work published by Ingard so the correct reference should be "Ingard, 1959".

p585, Line following Equation (11.55), replace "A-weighted internal level" with "unweighted internal level".

p586, Line following Equation (11.59), replace "A-weighted internal level" with "unweighted internal level".

p643, In Equation (12.36), change ψ to φ

p644, In Equation (12.40), change φ to ψ

p644, In Equation (12.40) and in the text in 3 places following the equation, change (x_b, y_b) to (x_b, y_b, z_b)

p644, 2 lines below Equation (12.40), change φ to ψ

p652, Third line of footnote, ρ should be ρ_m

p652, Last line of footnote, in the equation for k_B , ω should be replaced with ω^2

p654, In Equation (12.61), m_p should be M_p

p654, 1st line under 12.3.2, change “equations” to “equation”

p657, In step 6, the equation reference should be 12.62

p657, In the example table, the column header σ (dB) should be $10 \log_{10} \sigma$ (dB)

p660, Eq. A.9 should be

$$F = -\nabla P_{tot} V = \rho_{tot} V \frac{dU_{tot}}{dt} \quad (\text{A.9a,b})$$

p669, 4 lines above Eq. C1, change “undamping” to “nonlinear”

p669, Equation C.1 could be written in a less ambiguous way as

$$R_1 = \rho \Delta PA / (\dot{m} \ell) = \Delta PA / (V_0 \ell)$$

p673, Two lines above Eq. C.9 (and 2 and 3 lines from the top of the page), replace “complex density” with “complex density (normalised with respect to the density of of the gas in the porous material)”.

p673, One and two lines above Eq. C.9 (and 3 lines from the top of the page), replace “complex compressibility” with “complex compressibility (normalised with respect to the compressibility of the gas in the porous material)”.

p684, Line under Eq. (C.50), add after “cavity” the following: “, the impedance, Z_L for a wave incident at angle, θ , is”

p684, Line above Eq. (C.52), change C.38 to C.49

p686 3 lines under Equation (C.55), change “9.22” to “9.25”

p715, Remove the 2009 reference for Jacobsen and de Bree