

Engineering Noise Control 5th edn.
Errata and Clarifications

January 27, 2019

p21, Figure 1.4, change the X on the axis labels to A .

p24, two lines under Figure 1.5, the expression, $e^{j\omega t + \beta}$ should be $e^{j(\omega t + \beta)}$.

p26, Equation (1.61), replace p_{RMS} with $p_{\text{RMS}}(\mathbf{r})$

p26, line immediately following Equation (1.61), replace “example” with “equation”

p26, Equation (1.63), replace p_{rms} with p_{RMS}

p43, In Table 1.2, band number 17, the 1/3-octave band centre frequency should be 50 Hz.

p71, Near the bottom of the page, items labelled 1 and 2 should be items (a) and (b).

p95, Line following Equation (2.54), change (2.45) to (2.54)

p95, Line above table 2.4 caption, change L to L_0

p95, Table 2.4 caption, change $N_{0,50}$ to N_{50} and change L to L_0

p95, Equation (2.55) should be $N_{50} = \frac{\log_{10}(\Theta + 1)}{\log_{10} 11} N_{50:\Theta=10}$

p118, Replace Table 2.14 with the following table

Table 2.14 Recommended ambient sound levels and reverberation times (average of the 500 Hz and 1000 Hz octave bands) for different areas of occupancy in buildings (space furnished but unoccupied, data mainly from AZ/NZS 2107 (2000))

Types of occupancy/activity	Recommended sound level (dBA)	Recommended reverberation time at 500 to 1000 Hz (sec)
Lecture rooms, assembly halls, tutorial rooms	30–35	0.72 for 50 m ³ to 1.0 for 10 000 m ³ varying linearly with log ₁₀ (room volume in m ³)
Audio-visual areas	35–45	0.6–0.8
Churches	30–35	—
Computer rooms (teaching)	40–45	0.4–0.6
Computer rooms (working)	45–50	0.4–0.6
Conference rooms, seminar rooms	35–40	0.6–0.7
Corridors and lobbies	45–50	0.6–0.8
Drama studios	25–30	10% to 20% higher than lecture rooms above
Libraries (reading)	40–45	0.4–0.6
Libraries (stack area)	45–50	0.6–0.8
Music studios and concert halls	30–35	1.05 for 50 m ³ to 1.6 for 5 000 m ³ , varying linearly with log ₁₀ (room volume in m ³)
Professional and admin. offices	35–40	0.6–0.8
Design offices, drafting offices	40–45	0.4–0.6
Executive offices	35–40	0.4–0.6
Open plan office areas	40–45	Low as possible
Reception areas	40–45	0.6–0.8
Hospitals, Doctors surgeries	40–45	0.4–0.7
Airport terminals	45–55	Low as possible
Restaurants	40–50	Low as possible
Hotel bar	45–50	0.6–1.0
Private house (sleeping)	30–35	0.4–0.5
Private house (recreation)	35–45	0.4–0.5

p128, 1 and 2 lines above Section 2.14, change 30 to 35, change the reference to ASHRAE (2015) and change the table reference to 2.16

p132, First dot point, remove the text, “(regulation usually)”

p138, Line following Equation (3.10), the correct units of dynamic viscosity are N-s/m².

p138, Equation (3.13) should be $C_c = V_c/(\gamma P)$

p150, 5 lines above dot point 1, replace “ $E_{A,T}$ ” with “ L_{AE} or SEL”

p150, 4 and 5 lines above dot point 1, replace “type II” with “Class 2”

p150, 9 lines above the bottom of the page, change “87” to “85”

Chapter 4, In numerous places , replace Q_{rms} with Q_{RMS}

p176, In Equations (4.18) and (4.21), replace hr with h/r

p177, In Equation (4.25), replace hr with h/r

p177, One and two lines above Equation (4.31), replace f with F in 3 places

p178, 8th line following Equation (4.32), replace D_{rms} with D_{RMS}

p182, In Equation (4.55), u_03 should be $u_0/3$

p182, In Equation (4.56), U^6c^3 should be U^6/c^3

p185, In Equation (4.71), $U(ch)$ should be $U/(ch)$

p186, In Equation (4.72), U^8c^5 should be U^8/c^5

p188, two lines under Equation (4.81), change $r_0 \cos \alpha$ to $r_0/\cos \alpha$

p190, Equation (4.85) should be $A = \frac{Q_0}{4\pi}$

p191, Change Equation (4.96) to $k = \omega/c = 2\pi f/c$

p193, In Equation (4.105), $(\alpha + \beta)2$ should be $(\alpha + \beta)/2$

p193, Equation (4.105) should be replaced with $r = \frac{(a/\lambda)^2 - n^2}{2n/\lambda}$

p193, In Equation (4.108), change $a^2\lambda$ to a^2/λ

p197, Line immediately above Equation (4.119), replace h with h_R

p198, Figure 4.15 caption, change “Equation (4.113)” to “Equation (4.121)” and “Equation (4.112)” to “Equation (4.120)”.

p205, third paragraph under heading 4.12, delete the last 2 lines

p219, Replace the first sentence in the second paragraph following Table 4.5, with “A more accurate method of determining Δ_1 is to measure the average sound pressure level on two imaginary test surfaces surrounding the machine, which correspond roughly to the shape of the machine.”

p226, 3 lines above section 5.2.2, change ωc_m to ω/c_m

p230, second line, change $k = \omega c$ to $k = \omega/c$

p230, line above Equation (5.18), change “Equation (5.13)” to “Equation (5.15)”.

p232, Replace Equation (5.34) with the following:

$$g(w_r, jw_i) = K_1(w_i, w_r) + jK_2(w_i, w_r)$$

p233, Delete the paragraph and dot points 1 and 2 following Equation (5.42) and replace with the following.

“The calculation of $g(w)$ in the preceding equations is only valid 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 $w_a = w_{ar} + jw_{ai} = \text{Re}\{w_a\} + j\text{Im}\{w_a\}$ so that the real part is less than 0 and the imaginary part is greater than 0. The calculation of $g(w_a)$ is then undertaken using Equations (5.33) to (5.42) by substituting w_a for w . If the original value of w did not need to 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 (5.33) to (5.42);
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 $g(w)$).

p234, Remove the paragraph following Equation (5.46) and items 1 and 2 that follow this paragraph. Replace with the following text.

“Unlike the first calculation method (Equations (5.34) to (5.42)), the preceding calculation method (Equations (5.43) to (5.46)) returns the correct value of $g(w)$ for values of w in any quadrant of the complex plane, without the need for different procedures that are dependent on which quadrant w is in.”

p234, At the beginning of the paragraph preceding Equation (5.47), replace $w = nh$ with $\text{Re}\{w\} = nh$.

p235, Delete the first paragraph.

p235, Second paragraph, replace $w = (n + \frac{1}{2})h$ with $\text{Re}\{w\} = (n + \frac{1}{2})h$.

p236, Delete the last sentence in the paragraph following Equation (5.58).

p239, In Equation (5.65), replace $d_{SR}D\alpha$ with $d_{SR}D/\alpha$

p246, 3rd line of the 3rd paragraph following Equation (5.84), change $d\mathbf{U}/dh$ to dc/dh

p247, Figure 5.3, vertical axis should be labelled, “Wind shear coefficient, ξ ”.

p247, Table 5.5 caption, change “empirical” to “wind shear”.

p249, Third line after Equation (5.89), replace “lower” with “higher”.

p250, In Equation (5.95), replace “ h_0/z_0 ” with “ $(h_0/z_0) + 1$ ”.

p251, Delete the text and equations beginning just below Equation (5.100) and ending immediately above Equation (5.118) on page 253, and replace with the following “An approximate expression may also be used to calculate R_B , as given in earlier Harmonoise documentation (Nota and van Leeuwen, 2004). That is:

$$\frac{1}{R_B} \approx \frac{8}{d_{SR}} \sqrt{\frac{B_M}{2\pi c}}$$

where d_{SR} is the distance from the source to the receiver (see Figure 5.5).

The radius of curvature is used in the Harmonoise propagation model to calculate the path lengths and propagation times for sound travelling from the source to the receiver over a propagation path that has been curved as a result of atmospheric wind gradients and temperature gradients. Taking into account the ray curvature also allows more accurate calculation of barrier attenuation as discussed in Section 5.3.7.3.

A more accurate means for calculating the radius of curvature of the sound ray involves using Figure 5.5 to obtain the following equation for ψ_S in terms of R_c ”

p253, Add the following text immediately after Equation (5.119).

“Equation (5.93) is then substituted into Equation (5.118) to obtain the following transcendental equation:

$$\psi_S = -\varphi + \arcsin \left[\left(\frac{\cos \psi_S}{c} \right) \left(\frac{A_m + B_m}{h + z_0} \right) \left(\frac{d}{2 \cos \varphi} \right) \right]$$

where z_0 is defined in Tables 5.6 and 5.7, and h is the mean height above the ground of a straight line drawn between the source and receiver (usually equal to $(h_S + h_R)/2$).

The preceding equation must be solved iteratively to obtain ψ_S . Once ψ_S is known, Equation (5.93) can be used to obtain R_c . The angle, ψ_R , may be calculated using

Equation (5.126).”

p255, Delete the first, third and fourth paragraphs, including Equation (5.120).

p256, Delete the last paragraph.

p257, Delete the first 4 lines under the figure caption and add the following immediately after Equation (5.125).

“To be able to calculate the angle, θ , it is necessary to determine the location, (d_0, X) , shown in Figures 5.5 to 5.9. From the figures: $d_0 = R_c \sin \psi_S$ and $X = R_c \cos \psi_S$ ”

p259, Include the following immediately before Section 5.3.4.5.

“Calculation of the location of the reflection point is needed in order to find the length of the reflected wave path from the source to the receiver. Calculation of this location requires the solution of a cubic equation and is discussed in Appendix D in the book, Wind Farm Noise by Hansen, Doolan and Hansen (ISBN 9781118826126). Once this location is found, the angle at which the reflected wave leaves the source and its path length can be found using the same techniques as for the direct wave. The path between the source and reflection point is analysed by treating the reflection point as a virtual receiver, while the path between the reflection point and the actual receiver is analysed by treating the reflection point as a virtual source.”

p262, In Equation (5.132), change R to R_c (radius of curvature of sound wave, which is negative by convention in a negative sonic gradient)

p269, In Equations (5.147) and (5.148), replace X_S with $\sqrt{X_S^2 + (Y_B - Y_S)^2}$ and replace X_R with $\sqrt{X_R^2 + (Y_B - Y_R)^2}$

p269, 4th line after Equation (5.148), change SQ’ to S’Q’

p279, Table 5.12 caption, change “Category 4” to “Category D”.

p282, First dot point, after the word, attenuation, add , A_{site}

p282, Second dot point, after the word, attenuation, add , A_h

p282, Paragraph beginning immediately above Equation (5.172), change “Table 5.13” to “Table 5.14” in two places

p284, First line, change m/s^2 to kg/m^2

p284, The coefficient, C_3 in Equation (5.180) is equal to 1 for single edge diffraction

(Figure 5.15). For double edge diffraction (Figure 5.20), C_3 is given by:

$$C_3 = \frac{1 + (5\lambda/e)^2}{1/3 + (5\lambda/e)^2}$$

p285, Immediately after Equation (5.186), add “where the dimension, e , is zero for single edge diffraction.

p285, Table 5.15, last line, replace the data with the following numbers:
0.02, 0.03, 0.04, 0.05, 0.06, 0.08, 0.09, 0.12

p285, bottom of page add the following text.

“5.6.5 Industrial Equipment Screening, A_{site}

In the absence of measured data, Table 5.16 may be used as a guide for estimating the attenuation through process equipment in an industrial facility. To calculate the number of metres, $r_1 + r_2$, of travel of the sound wave through the industrial facility, use the same approach as used in Section 5.6.4 for attenuation through vegetation (see Figure 5.25).

Table 1 Octave band attenuation, A_{site} , due to process equipment (after ISO9613)

	Octave band centre frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
A_{site} (dB/m)	0	0.015	0.025	0.025	0.02	0.02	0.015	0.015

5.6.6 Housing Screening, A_h

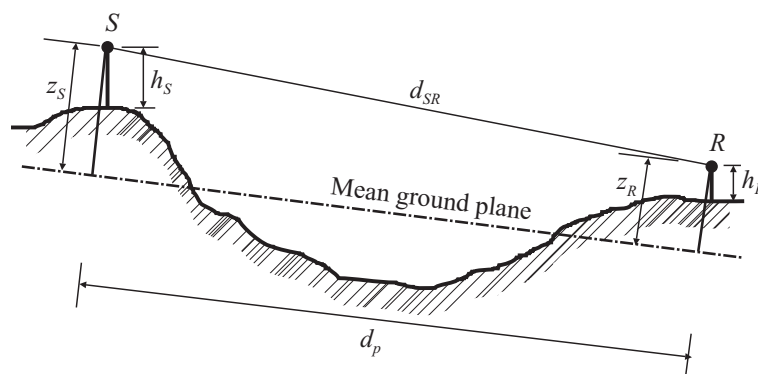
The attenuation due to propagation through rows of houses may be calculated using:

$A_h = 0.1B(r_1 + r_2) - 10 \log_{10} \left(1 - \frac{P}{100} \right)$ (dB), where $P \leq 90$ is the percentage of the lengths of the housing facades relative to the total length of the road, railway or industrial facility in the vicinity, B is the building density (total plan area of buildings divided by the total ground area (including the area covered by buildings). To calculate the number of metres, $r_1 + r_2$, of travel of the sound wave through the housing estate, use the same approach as used in Section 5.6.4 for attenuation through vegetation (see Figure 5.25). The second term on the RHS of the preceding equation is only used if there are well defined rows of houses. When A_h is included in the excess attenuation calculation, the ground effect for propagation through the region containing houses is set equal to zero. However, if the ground effect calculated in the absence of the houses is greater than A_h , then A_h is set equal to the ground effect calculated in the absence of the houses.”

p286, In Equation (5.187), r_S and r_R are defined in Figure 4.17, L_{min} is the minimum dimension (length of height) of the reflecting surface and θ is the angle between the incident sound ray and the normal to the reflecting surface (see Figure 4.17)

p287, In Equation (5.189), replace A_{gr} with A_g

p290, Replace Figure 5.26 with the following figure:



Source and receiver heights above the ground and the mean ground plane.

p291, Replace Equation (5.200) with $G_{\text{path}} = \frac{\sum_{i=1}^{\ell} G_i d_i}{\sum_{i=1}^{\ell} d_i}$

p291, Line immediately above Equation (5.201), replace “, and:” with “projected on the mean ground plane and d_p is the length between source and receiver of the mean ground plane:”

p291, Replace equation (5.201) with $d_p = \sqrt{(z_{mn} - z_{m1})^2 + (x_n - x_1)^2}$, where z_{m1} is the mean ground plane vertical coordinate at the source location, x_1 is the ground plane horizontal coordinate at the source location, z_{mn} is the mean ground plane vertical coordinate at the receiver location and x_n is the ground plane horizontal coordinate at the receiver location.

p291, In Equation (5.203), replace $A_{gr,H,\min}$ with $A_{g,H,\min}$

p291, Second line from bottom of page, replace A_{gr} , with A_g , in 4 places

p291, Bottom line, replace “LHS” with “RHS”

p294, Immediately following Equation (5.219), add “where in this particular equation, d_{SR} is the straight line distance between the source and receiver”

p296, 11 lines from the bottom of the page, replace Z_{PnR} with Z_{PR}

p300, In Equation (5.229), change $|p_t|$ to $|p_t|^2$

p302, Equation (5.237), change the constant, 0.1365, to 5.3888

p302, Change “Salomons and Janssen (2011)” to “Salomons et al. (2011)” (see new reference added to page 796 below)

p312, Item 5, change U_e to u_e

p313, To convert u_{tot} to dB, it is necessary to take the logarithm (base 10) of the RHS and multiply the result by 10

p328, 2 lines above Equation (6.42), delete “and (6.41)”

p367, line following Equation (7.10), replace z_n with z_i

p375, In Equation (7.24), change C_1 to C_I

p381, Figure 7.9(b), on the x -axis labels for points C and D, change f_{c1} to f_{c2}

p381, Figure 7.9 caption, second line, remove “ f_c ”,

p382, In Equation (7.51), remove “1+”

p422, In Equations (7.125) and (7.128), there should be an additional “(” following the “/” in the last term.

p434, In equations (8.31) and (8.32) and on the line between them “Re” should be in italics font as it represents the Reynolds number, not the real part of a complex number.

p437, 2 lines above Equation (8.43), remove the words, “or through the tube”

p441, line immediately following Equation (8.54), add “of the neck” after the word, “area”

p494, 7 lines under Equation (8.233), $2h/\ell$ should be $2h/\lambda$.

p503, Line above Equation (8.248), after the word “liner”, add “of length, L ”

p503, 2 lines above Equation (8.249), after the word “muffler”, add “of length, L ”

p503, Figure 8.41, in the figure and in the caption, replace d with ℓ in all places

p520, 2 lines from the bottom of the page, change 2π to π

p523, Equation (8.286) should be:

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

p529, 1 line and 6 lines above Equation (9.1), replace F with \hat{F}

p529, 4 lines above Equation (9.1), replace y_1 with \hat{y}_1

p530, Figure 9.1, replace F with \hat{F} and y_1 with \hat{y}_1

p531, In equation (9.8) and in the two lines immediately following it, and in Equation (9.9), change u_m to v_m

p532, line under Equation (9.16), replace F with \hat{F}

p556, Replace equation (9.77) with:

$$L_v = 20 \log_{10}(v/v_{\text{ref}}); \quad v_{\text{ref}} = 10^{-9} \text{ m/s}$$

p568, In the line above equation (10.2), change δP_t to ΔP_t

p587, 2 lines above equation (10.58), remove “Howe and”

p599, Equation (10.97) should be $L_W = N_R + 10 \log_{10} S + C$ and values of C for each octave band are listed in the following table

Values of the coefficient, C for transformer noise

Octave band centre frequency (Hz)	Octave band corrections (dB)		
	Location 1 ^a	Location 2 ^b	Location 3 ^c
31.5	−1	−1	−1
63	8	8	8
125	7	13	13
250	2	8	12
500	2	8	12
1000	−4	−1	6
2000	−9	−9	1
4000	−14	−14	−4
8000	−21	−21	−11

^aOutdoors, or indoors in a large mechanical room with a large amount of mechanical equipment.

^bIndoors in small rooms, or large rooms with only a small amount of other equipment.

^cAny critical location where a problem would result if the transformer should become noisy above its NEMA rating, following installation.

p601, The constant on the RHS of Equation (10.102) should be 74.9 and the constant on the RHS of Equation (10.103) should be 59.6

p601, Equations (10.102) and (10.103) can be used for turbines with output powers greater than 200 kW

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- p614, 4 lines from the bottom, change “track segment” to “train position”
- p614, line 5 under the heading, “Train Sound Power Levels”, delete the words “each track segment,”
- p615 In Equation (10.133), L_{24} is the total passing train length in a 24-hour period
- p615, In Equation (10.135) delete one of the two ΔL_c quantities on the RHS
- p615, Following the three lines immediately after Equation (10.134), add the following:
“The calculation requires that the train length be divided into small segments and the sound pressure level at the receiver is then calculated for each segment (taking into account the segment length - see Equation (10.135). The total sound pressure level at the receiver in each octave band, i , is then calculated by logarithmically summing the contributions from all train segments that contribute significantly to the total $L_{\max M, i}$ level. Also, the train position when undertaking the calculations for a particular receiver should be the one that results in the maximum overall $L_{A, \max M}$ level at the receiver. Each receiver will have a different train position that results in the maximum $L_{A, \max M}$ level.”
- p615, The track segment length is taken into account in Equation (10.135) by adding the term, $10 \log_{10}(L_{\text{track}})$ to the RHS, where L_{track} is the length of track in metres that is in the track segment under consideration
- p615, The train length is taken into account in Equation (10.136) by adding the term, $10 \log_{10}(L_{\text{train}})$ to the RHS, where L_{train} is the length of train in metres that is in the train segment under consideration
- p617, 1 line under the Geometrical Spreading heading, change “where $-A_{\text{div}}$ is” to “where A_{div} is”
- p617, 1 line under the Atmospheric Absorption heading, change “where $-A_a$ is” to “where A_a is”
- p617, 3 lines under the Ground Effect heading, change $\Delta L_g = A_g$ to $\Delta L_g = -A_g$
- p617, Line above Equation (10.137), delete the sentence, “The maximum sound pressure level, $L_{\max M, i}$, in each octave band, i , is calculated using:”
- p617, Equation (10.137) should be $\Delta h = d_1 d_2 / [16(d_1 + d_2)]$
- p618, In Equation (10.142), d_f is the distance from the facade to the receiver
- p620, In Equation (10.144), L is the length of the track section occupied by the idling train

- p620, Line above Equation (10.146), change “source line” to “source”
- p620, Line immediately following Equation (10.146), change “source line” to “source”
- p620, Last word in the paragraph following Equation (10.146), change “segment” to “section”.
- p620, 3 lines from the bottom, replace $L_{W,0,idling}$ with $L_{W,idling,i}$
- p622, first line, replace $L_{W,0,idling}$ with $L_{W,idling,i}$
- p622, Table 10.39, in heading change “Electric multiple input” to “Electric multiple unit”.
- p663, Equation (11.64), replace π with 2
- p727, second line following Equation (D.21), replace (D.9)–(D.14) with (D.15)–(D.20)
- p731, in Equation (D.26), replace $L_{D1} - L_{D2}$ with $L_{D2} - L_{D1}$
- p734, in Equation (D.41), add an “=” sign following $\frac{Z_N}{\rho c}$
- p735, in Equation (D.48), change φ to ϑ and add immediately after the equation, “where the angles are defined in Figure 7.8”
- p735, Line above Equation (D.51), replace Z_N with $Z_N/(\rho c)$
- p736, 2 lines from the bottom of the page, replace \bar{H} with H^M
- p737, Line immediately under Equation (D.58), replace the word, “factor” with “transfer function”
- p796, Add the following reference:
 Salomons, E., van Maercke, D., Defrance, J., and de Roo, F. (2011). The harmonoise sound propagation model. *Acta Acustica United with Acustica*, 97:62–74.