

Architectural Acoustics Third Printing Corrections

Acknowledgments The last paragraph reads:

Although I have tried to purge the document of errors, there are undoubtedly some that I have missed. I hope that these are few and do not cause undue confusion.

It should read:

Although I have tried to purge the document of errors, there are undoubtedly some that I have missed. Errors, in earlier printings, were pointed out by Michael Haberman at the University of Texas, Austin, Herb Kuntz, and Bob Celmer, at the University of Hartford. I hope that those that remain are few and do not cause undue confusion.

Page 23 The third paragraph, second line reads in part:

La Scalla

It should read:

La Scala

Page 23 The third paragraph, fifth line reads in part:

(Beranek, 1979)

It should read:

(Beranek, 2004)

Page 24 The caption for Fig. 1.15 reads:

FIGURE 1.15 Teatro Alla Scalla, Milan, Italy (Beranel, 1979)

It should read:

FIGURE 1.15 Teatro Alla Scala, Milan, Italy (Beranek, 2004)

Page 26 The caption for Fig. 1.16 reads:

FIGURE 1.16 Festspielhaus, Bayreuth, Germany (Beranek, 1979)

It should read:

FIGURE 1.16 Festspielhaus, Bayreuth, Germany (Beranek, 2004)

Page 26 The first paragraph, second line reads in part:

(Beranek, 1996)

It should read:

(Beranek, 2004)

Page 27 The caption for Fig. 1.17 reads:

FIGURE 1.17 Concert Hall, Stadt Casino, Basel, Switzerland (Beranek, 1979)

It should read:

FIGURE 1.17 Concert Hall, Stadt Casino, Basel, Switzerland (Beranek, 2004)

Page 27 The first paragraph, fifth line reads in part:

(Beranek, 1996)

It should read:

(Beranek, 2004)

Page 28 Add a line to the end of the first paragraph:

Neues Gewandhaus is no longer standing, having been destroyed during World War II.

Page 29 The caption for Fig. 1.19 reads:

FIGURE 1.19 Grosser Musikvereinssaal, Vienna, Austria (Beranek, 1979)

It should read:

FIGURE 1.19 Grosser Musikvereinssaal, Vienna, Austria (Beranek, 2004)

Page 30 The caption for Fig. 1.20 reads:

FIGURE 1.20 Concertgebouw, Amsterdam, Netherlands (Beranek, 1979)

It should read:

FIGURE 1.20 Concertgebouw, Amsterdam, Netherlands (Beranek, 2004)

Page 31 The last paragraph, sixth line reads in part:

(Beranek, 1979)

It should read:

(Beranek, 2004)

Page 32 The caption for Fig. 1.21 reads:

FIGURE 1.21 Symphony Hall, Boston, MA, USA (Beranek, 1979)

It should read:

FIGURE 1.21 Symphony Hall, Boston, MA, USA (Beranek, 2004)

Page 33 The caption for Fig. 1.22 reads:

FIGURE 1.22 Metropolitan Opera House, New York, NY, USA (Beranek, 1979)

It should read:

FIGURE 1.22 Metropolitan Opera House, New York, NY, USA (Beranek, 2004)

Page 34 The caption for Fig. 1.23 reads:

FIGURE 1.23 Carnegie Hall, New York, NY, USA (Beranek, 1979)

It should read:

FIGURE 1.23 Carnegie Hall, New York, NY, USA (Beranek, 2004)

Page 56 – Table 2.3

Current Text – The symbol ν in the book text is printed in two different fonts. We need to print it in one consistent font as below.

Table 2.3 Types of Vibrational Waves and their Velocities

Compressional			
Gas	Liquid	Infinite Solid	Solid Bar
$\sqrt{\frac{\gamma P}{\rho}}$	$\sqrt{\frac{B}{\rho}}$	$\sqrt{\frac{E(1-\nu)}{\rho(1+\nu)(1-2\nu)}}$	$\sqrt{\frac{E}{\rho}}$
Shear		Torsional	
String (Area S)	Solid	Bar	
$\sqrt{\frac{T}{S\rho}}$	$\sqrt{\frac{E}{2\rho(1+\nu)}}$	$\sqrt{\frac{E K_B}{2\rho I(1+\nu)}}$	
Bending		Rayleigh	
Rectangular Bar	Plate (Thickness – h)	Surface of a Solid	

$$\left[\frac{E h^2 \omega^2}{12 \rho} \right]^{1/4}$$

$$\left[\frac{E h^2 \omega^2}{12 \rho (1 - \nu^2)} \right]^{1/4}$$

$$0.385 \sqrt{\frac{E (2.6 + \nu)}{\rho (1 + \nu)}}$$

where **P** = equilibrium pressure (Pa)

atmospheric pressure = 1.01×10^5 Pa

γ = ratio of specific heats (about 1.4 for gases)

B = isentropic bulk modulus (Pa)

K_B = torsional stiffness (m^4)

I = moment of inertia (m^4)

ρ = mass density (kg/m^3)

E = Young's modulus of elasticity (N/m^2)

ν = Poisson's ratio $\cong 0.3$ for structural materials
and $\cong 0.5$ for rubber-like materials

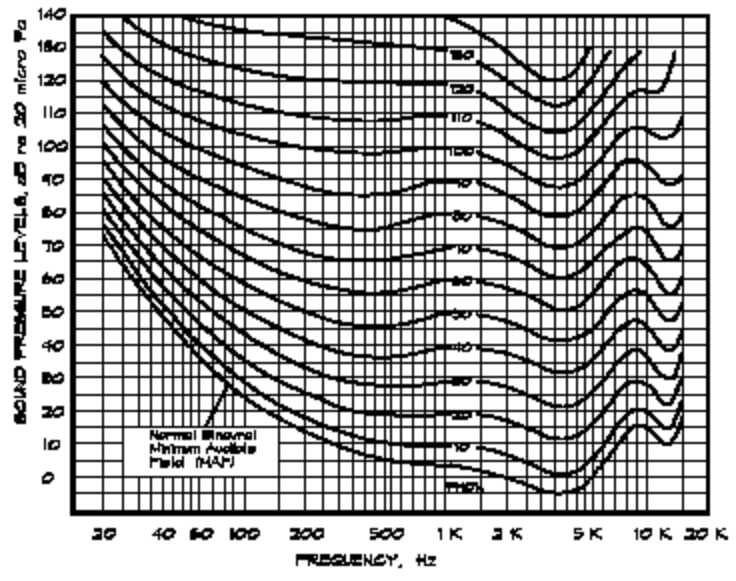
T = tension (N)

ω = angular frequency (rad/s)

Page 83 Figure 3.9

The left axis title has been changed from “micro N” to “micro Pa”. The citation was previously changed from (Fletcher and Munson, 1937) to (Robinson and Dadson, 1956):

FIGURE 3.9 Normal Loudness Contours for Pure Tones
(Robinson and Dadson, 1956)



Page 100 Equation 3.5 reads:

$$L_{eq} = 10 \log \frac{1}{T} \int_{t=0}^T 10^{0.1 L(t)}$$

It should read:

$$L_{eq} = 10 \log \frac{1}{T} \int_{t=0}^T 10^{0.1 L(t)} dt$$

Page 106 The current text reads:

The US Occupational Safety and Health Administration (OSHA) has set legal standards concerning noise exposure of workers in the workplace. The legal limit is 90 dBA (as measured using the slow meter response) for an 8-hour workday with a 5 dBA per time halving tradeoff. This means that a worker may be exposed to no more than 85 dBA for 16 hours, 90 dBA for 8 hours, 95 dBA for 4 hours, 100 dBA for 2 hours, 105 dBA for 1 hour, 110 dBA for 0.5 hours, or 115 dBA for any time.

It should read:

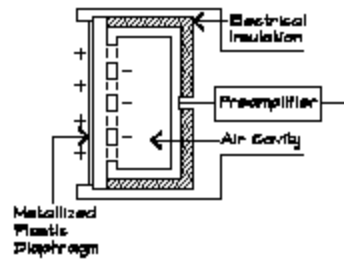
The US Occupational Safety and Health Administration (OSHA) has set legal standards concerning noise exposure of workers in the workplace. The legal limit is 90 dBA (as measured using the slow meter response) for an 8-hour workday with a 5 dBA per time halving tradeoff. This means that a worker may be exposed to no more than 85 dBA for 16 hours, 90 dBA for 8 hours, 95 dBA for 4 hours, 100 dBA for 2 hours, 105 dBA for 1 hour, 110 dBA for 0.5 hours, or 115 dBA for any time.

Page 117 Figure 4.3

The bottom left arrow label should be aligned as below:

FIGURE 4.3 Electret Condenser Microphone (Rowling, 1990)

A thin metallized plastic diaphragm is tightly stretched across a perforated backing plate. The holes in the back plate couple to an air cavity.



Page 136 Eq 4.10

The equation is shown as:

$$\text{TNI} = 4(L_{10} - L_{90}) + L_{90} - 30 \quad (\text{dBA}) \quad (4.10)$$

It should read as:

$$\text{TNI} = 4(L_{10} - L_{90}) + L_{90} - 30 \quad (4.10)$$

Page 179 Eq 5.19 reads:

$$f_{ro} = p^* \left\{ 24 + 40400 h \left[\frac{0.02 + h}{0.391 + h} \right] \right\} \quad (5.19)$$

where p^* = absolute pressure in standard atmospheres
 h = absolute humidity (% mole ratio)

$$= h_r \frac{10 \left[-6.8346 (T_0/T_k)^{1.261} + 4.6151 \right]}{p^*}$$

h_r = relative humidity (%)

It should read:

$$f_{ro} = p^* \left\{ 24 + 40400 h \left[\frac{0.02 + h}{0.391 + h} \right] \right\} \quad (5.19)$$

where p^* = ratio of ambient pressure to reference pressure, $p_0 = 1 \text{ atm} = 101.3 \text{ kPa}$
 h = absolute humidity (% mole ratio)

$$= \frac{h_r}{p^*} 10 \left[-6.8346 (T_{01}/T_k)^{1.261} + 4.6151 \right]$$

h_r = relative humidity (%)

$T_{01} = 273.16\text{K}$

Page 149 second to the last paragraph reads:

The modulation reduction factor varies from 0 for no reduction to 1 for 100% modulation reduction.

It should read:

The modulation reduction factor varies from 1 for no reduction to 0 for 100% modulation reduction.

Page 205 The text reads as:

In terms of the volume in Fig. 6.6, the change in the total pressure P is the acoustic pressure p and the change in volume is S dx.

It should read as:

In terms of the volume in Fig. 6.6, the change in the total pressure P is the acoustic pressure p and the change in volume is $S \frac{\partial \xi}{\partial x} dx$.

Page 207 Equation 6.33 reads:

$$\nabla^2 = \frac{1}{r^2} \frac{\partial}{\partial r} \left(r^2 \frac{\partial}{\partial r} \right) + \frac{1}{r^2 \sin \theta} \frac{\partial}{\partial \theta} \left(\sin \theta \frac{\partial}{\partial \theta} \right) + \frac{1}{r^2 \sin^2 \phi} \frac{\partial^2}{\partial \phi^2}$$

It should read as:

$$\nabla^2 = \frac{1}{r^2} \frac{\partial}{\partial r} \left(r^2 \frac{\partial}{\partial r} \right) + \frac{1}{r^2 \sin \theta} \frac{\partial}{\partial \theta} \left(\sin \theta \frac{\partial}{\partial \theta} \right) + \frac{1}{r^2 \sin^2 \theta} \frac{\partial^2}{\partial \phi^2}$$

Page 217 Equation 6.50 reads as:

$$R_{\theta} = \frac{1}{n} \left[\frac{\sin \left[\frac{n \pi d}{\lambda} \left(\sin \theta - \frac{c \tau}{d} \right) \right]}{\sin \left[\left(\frac{\pi d}{\lambda} \sin \theta - \frac{c \tau}{d} \right) \right]} \right]$$

It should read as:

$$R_{\theta} = \frac{1}{n} \left[\frac{\sin \left[\frac{n \pi d}{\lambda} \left(\sin \theta - \frac{c \tau}{d} \right) \right]}{\sin \left[\frac{\pi d}{\lambda} \left(\sin \theta - \frac{c \tau}{d} \right) \right]} \right]$$

Page 265 Eq. 7.79 reads as:

$$\mathbf{p}(x) = \mathbf{A} e^{j\omega t} e^{-j\mathbf{q}x} \quad (7.79)$$

where $\mathbf{q} = \delta + j\beta$ is the complex propagation constant within the absorbing material. It is much like the wave number in that its real part, δ , is close to ω/c . However, it has an imaginary part, β , which is the attenuation constant, in nepers/meter, of the sound passing through an absorber. To convert nepers per meter to dB/meter, multiply nepers by 8.69.

It should read as:

$$\mathbf{p}(x) = \mathbf{A} e^{j\omega t} e^{-\mathbf{q}x} \quad (7.79)$$

where $\mathbf{q} = \delta + j\beta$ is the complex propagation constant within the absorbing material. It has a real part, δ , which is the attenuation constant, in nepers/meter of the sound passing through an absorber. To convert nepers per meter to dB/meter, multiply nepers by 8.69. It also has an imaginary part, β , called the phase constant, which is much like the wave number and is close to ω/c .

Page 265 Eq. 7.80 reads as:

$$\mathbf{p} = \mathbf{A} e^{j\mathbf{q}x} + \mathbf{B} e^{-j\mathbf{q}x} \quad (7.80)$$

It should read as:

$$\mathbf{p} = \mathbf{A} e^{-\mathbf{q}x} + \mathbf{B} e^{\mathbf{q}x} \quad (7.80)$$

Page 265 Eq. 7.81 reads as:

$$\mathbf{u} = \frac{1}{z_w} \left[\mathbf{A} e^{j q x} - \mathbf{B} e^{-j q x} \right] \quad (7.81)$$

It should read as:

$$\mathbf{u} = \frac{1}{z_w} \left[\mathbf{A} e^{-q x} - \mathbf{B} e^{q x} \right] \quad (7.81)$$

Page 265 Eq. 7.86 reads as:

$$\mathbf{p}_1 = \mathbf{p}_2 \cos(\mathbf{q}d) - j z_w \mathbf{u}_2 \sin(\mathbf{q}d) \quad (7.86)$$

It should read as:

$$\mathbf{p}_1 = \mathbf{p}_2 \cosh(\mathbf{q}d) + z_w \mathbf{u}_2 \sinh(\mathbf{q}d) \quad (7.86)$$

Page 266 Eq. 7.87 reads as:

$$\mathbf{u}_1 = \left(\frac{-j}{z_w} \right) \mathbf{p}_2 \sin(\mathbf{q}d) + \mathbf{u}_2 \cos(\mathbf{q}d) \quad (7.87)$$

It should read as:

$$\mathbf{u}_1 = \left(\frac{\mathbf{p}_2}{z_w} \right) \sinh(\mathbf{q}d) + \mathbf{u}_2 \cosh(\mathbf{q}d) \quad (7.87)$$

Page 266 Eq. 7.94 reads as:

$$\delta \cong \frac{\omega}{c_0} \left[1 + 0.0978 (\rho_0 f / r_s)^{-0.700} \right] \quad (7.94)$$

$$\beta = \frac{\omega}{c_0} \left[0.189 (\rho_0 f / r_s)^{-0.595} \right] \quad (7.95)$$

where \mathbf{z}_w = complex characteristic impedance of the material

w = resistance or real part of the wave impedance

x = reactance or imaginary part of the wave impedance

\mathbf{q} = complex propagation constant

δ = real part of the propagation constant $\cong \omega/c_0$

β = imaginary part of the propagation constant
= attenuation (nepers/m)

$\rho_0 c_0$ = characteristic acoustic resistance of air (about 412 Ns/m³
– mks rayls)

r_s = specific flow resistance (mks rayls)

d = thickness of the material (m)

f = frequency (Hz)

j = $\sqrt{-1}$

It should read as:

$$\delta = \frac{\omega}{c_0} \left[0.189 (\rho_0 f / r_s)^{-0.595} \right] \quad (7.94)$$

$$\beta \cong \frac{\omega}{c_0} \left[1 + 0.0978 (\rho_0 f / r_s)^{-0.700} \right] \quad (7.95)$$

where \mathbf{z}_w = complex characteristic impedance of the material

w = resistance or real part of the wave impedance

x = reactance or imaginary part of the wave impedance

\mathbf{q} = complex propagation constant

δ = real part of the propagation constant

= attenuation (nepers/m)

β = imaginary part of the propagation constant $\cong \omega/c_0$

$\rho_0 c_0$ = characteristic acoustic resistance of air (about 412 Ns/m³
– mks rayls)

r_s = specific flow resistance (mks rayls)

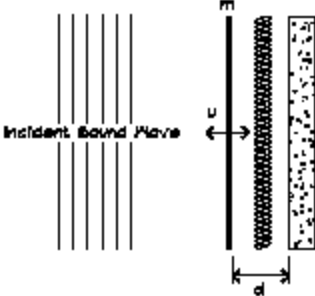
d = thickness of the material (m)

f = frequency (Hz)

j = $\sqrt{-1}$

Page 272 Figure 7.35 should show as:

FIGURE 7.35 Geometry of an Air Backed Panel Absorber



Page 273 Equation 7.102 reads as:

$$\alpha_n = \frac{4 r_f \rho_0 c_0}{\left(r_f + \rho_0 c_0\right)^2 + \left[(m/\omega)\left(\omega^2 - \omega_0^2\right)\right]^2} \quad (7.102)$$

It should read as:

$$\alpha_n = \frac{4 r_f \rho_0 c_0}{\left(r_f + \rho_0 c_0\right)^2 + \left[(m/\omega)\left(\omega^2 - \omega_r^2\right)\right]^2} \quad (7.102)$$

Page 277 Equation 7.113 reads as:

$$\omega_0 = \left(\frac{\rho_0 c_0^2}{m_c d}\right)^{\frac{1}{2}} \quad (7.113)$$

It should read as:

$$\omega_r = \left(\frac{\rho_0 c_0^2}{m_c d}\right)^{\frac{1}{2}} \quad (7.113)$$

Page 277 Equation 7.115 reads as:

$$\omega_0 = \left(\frac{\rho_0 c_0^2}{\rho_0 l V / S}\right)^{\frac{1}{2}} = c_0 \sqrt{\frac{S}{l V}} \quad (7.115)$$

It should read as:

$$\omega_r = \left(\frac{\rho_0 c_0^2}{\rho_0 l V / S}\right)^{\frac{1}{2}} = c_0 \sqrt{\frac{S}{l V}} \quad (7.115)$$

Page 278 Equation 7.117 reads as:

$$f_0 = \frac{c_0}{2\pi} \sqrt{\frac{\pi a^2}{(l_0 + 1.7 a) V}} \quad (7.117)$$

It should read as:

$$f_r = \frac{c_0}{2\pi} \sqrt{\frac{\pi a^2}{(l_0 + 1.7 a) V}} \quad (7.117)$$

Page 385 The first sentence after Fig. 11.4 reads:

time, $\tau = \frac{2m}{c}$, which is the time it takes for the amplitude of the envelope to fall to 1/e

It should read as:

time, $\tau = \frac{2m}{c}$, which is the time it takes for the amplitude of the envelope to fall to 1/e

Page 426 Figure 12.8 should read as:

FIGURE 12.8 Reference Contour for Calculating Impact Insulation Class and Other Ratings (ASTM E989, 1989)



Page 427 Figure 12.9 should read as:

FIGURE 12.9 Calculation of an IIC Rating



Page 459 Reference to Equation 13.1 reads:

where L_W = sound power level (dB re 10^{-12} Watts)

K_F = spectral constant which depends on the type of fan (dB)
shown in Fig. 13.8

Q_F = volume of air per time passing through the fan (cfm or L/s)

Q_{REF} = reference volume (1 for cfm or 0.472 for L/s)

It should read:

where L_W = sound power level (dB re 10^{-12} Watts)

K_F = spectral constant which depends on the type of fan
shown in Table 13.5 (dB)

Q_F = volume of air per time passing through the fan (cfm or L/s)

Q_{REF} = reference volume (1 for cfm or 0.472 for L/s)

Page 522 The sixth paragraph reads:

In wood construction the structures are light and stiff. The problem with wood floors for airborne noise isolation is usually in achieving sufficient mass. Lightweight-concrete fill weighs 110 to 115 lbs/cu ft (540 - 560 kg/sq m) and should be poured to a thickness of 1.5" (38 mm). A hard concrete fill (140 - 150 lbs/cu ft or 685 - 735 kg/sq m) is preferred, however the structural system must be designed to accommodate the additional weight.

It should read:

In wood construction the structures are light and stiff. The problem with wood floors for airborne noise isolation is usually in achieving sufficient mass. Lightweight-concrete fill weighs 110 to 115 lbs/cu ft (1760 - 1800 kg/cu m) and should be poured to a thickness of 1.5" (38 mm). A hard concrete fill (140 - 150 lbs/cu ft or 2240 - 2400 kg/cu m) is preferred, however the structural system must be designed to accommodate the additional weight.

Page 653 The second paragraph, first line reads in part:

(Beranek, 1979, 1996)

It should read:

(Beranek, 1979, 1996, 2004)

Page 658 The second paragraph, fifth line reads in part:

in Beranek's 1996 study

It should read:

In Beranek's 2004 study

Page 658 The third paragraph, second line reads in part:

In Beranek's (1996)

It should read:

In Beranek's (2004)

Page 658 The fourth paragraph, fifth line reads in part:

(Beranek, 1994)

It should read:

(Beranek, 2004)

Page 660 The first paragraph, second line reads in part:

(Beranek, 1996)

It should read:

(Beranek, 2004)

Page 660 The fourth paragraph, fifth line reads in part:

(Beranek, 1962)

It should read:

(Beranek, 2004)

Page 661 The second paragraph, seventh line reads in part:

(Beranek, 1996)

It should read:

(Beranek, 2004)

Page 664 The third paragraph, fifth line reads in part:

(Beranek, 1996)

It should read:

(Beranek, 2004)

Page 665 The fifth paragraph, last line reads in part:

(Beranek, 1996)

It should read:

(Beranek, 2004)

Page 666 The fourth paragraph, sixth line reads in part:

(Beranek, 1962, 1992, 1996)

It should read:

(Beranek, 1962, 1992, 1996, 2004)

Page 673 The second paragraph, sixth line reads in part:

(Beranek, 1996)

It should read:

(Beranek, 2004)

Page 674 The fourth paragraph, fifth line reads in part:

(Beranek, 1996)

It should read:

(Beranek, 2004)

Page 676 The first paragraph, fourth line reads in part:

(Beranek, 1996)

It should read:

(Beranek, 2004)

Page 731 Figure 20.20A title reads in part:

(Architect: Barton Meyers and Associates)

It should read:

(Architect: Barton Myers and Associates)

Page 733 Figure 20.21 title reads in part:

Sala Sao Paolo, Sao Paolo. Brazil – Longitudinal Section

It should read:

Sala Sao Paulo, Sao Paulo, Brazil – Longitudinal Section

Page 749 Last paragraph reads:

Figure 21.6 contains the results of later experiments that reexamined human reaction to a combination of delay and level, again using speech as the input signal.

It should read:

Figure 21.5 contains the results of later experiments that reexamined human reaction to a combination of delay and level, again using speech as the input signal.

Page 750 Third paragraph reads:

Figure 21.7 illustrates the differences; although there was forward temporal masking, the nearly horizontal shift in level with delay time measured by Haas was only observed in the case of music.

It should read:

Figure 21.6 illustrates the differences; although there was forward temporal masking, the nearly horizontal shift in level with delay time measured by Haas was only observed in the case of music.

Page 750 Paragraph 4 reads:

The audibility of reflections is also dependent on the reverberation time. Figure 21.8 shows the results of psychoacoustic studies by Nickson, Muncey, and Dubout, (1954).

It should read:

The audibility of reflections is also dependent on the reverberation time. Figure 21.7 shows the results of psychoacoustic studies by Nickson, Muncey, and Dubout, (1954).

Page 795 Paragraph 2 reads:

Figure 21.13 shows the relationships between the components, which are characterized in terms of their coefficients.

It should read:

Figure 22.13 shows the relationships between the components, which are characterized in terms of their coefficients.

Page 803 paragraph 2 reads:

Some programs (e.g., ODEON, Rindel, 2000), called hybrid models, use scattering coefficients in the normal way for the first two or three reflections, after which they abandon specular reflections and treat subsequent impacts as diffuse.

It should read:

Some programs (e.g., Naylor and Rindel, 1992, and ODEON, Naylor, 1993), called hybrid models, use scattering coefficients in the normal way for the first two or three reflections, after which they abandon specular reflections and treat subsequent impacts as diffuse.

Page 812 (References) reads:

Abby Road Studios (2002)

It should read:

Abbey Road Studios (2002)

Page 815 (References) reads:

Beranek (1996). Leo Beranek, *How They Sound, Concert and Opera Halls*. © 1996, Woodbury, NY: Acoustical Society of America.

Beranek (1998). Leo L. Beranek and Takayuki Hidaka, "Sound absorption in concert halls by seats, occupied and unoccupied, and by the hall's interior surfaces." Reprinted with permission from *J. Acoust. Soc. Am.*, vol. 104, no. 6. © 1998, Acoustical Society of America: Melville, NY, Dec.1998.

It should read:

Beranek (1996). Leo Beranek, *How They Sound, Concert and Opera Halls*. © 1996, Woodbury, NY: Acoustical Society of America.

Beranek (2004). Leo Beranek, *Concert Halls and Opera Houses: Music, Acoustics, and Architecture*, 2nd Ed., New York, NY: Springer-Verlag: 2004: Courtesy Leo Beranek.

Beranek (1998). Leo L. Beranek and Takayuki Hidaka, "Sound absorption in concert halls by seats, occupied and unoccupied, and by the hall's interior surfaces." Reprinted with permission from *J. Acoust. Soc. Am.*, vol. 104, no. 6. © 1998, Acoustical Society of America: Melville, NY, Dec.1998.

Page 823 (References) reads:

National Research Council Canada (1966). "Sound transmission loss of a Q-Floor assembly with floor tile, fireproofing and suspended ceiling system." rpt. 434-PY, Ottawa, CA: National Research Council, Nov. 1966.

Naylor (1993). G.M. Naylor, "ODEON - Another hybrid room acoustical model." *Applied Acoustics*, vol. 38 nos. 2-4, 1993.

It should read:

National Research Council Canada (1966). "Sound transmission loss of a Q-Floor assembly with floor tile, fireproofing and suspended ceiling system." rpt. 434-PY, Ottawa, CA: National Research Council, Nov. 1966.

Naylor (1993). G.M. Naylor, "ODEON - Another hybrid room acoustical model." *Applied Acoustics*, vol. 38 nos. 2-4, 1993.

Naylor and Rindel (1992). G.M. Naylor and J. H. Rindel, "Predicting Room Acoustical Behavior with the ODEON Computer Model." Presented as paper 3aAA3 at the 124th ASA meeting, New Orleans, November, 1992.

