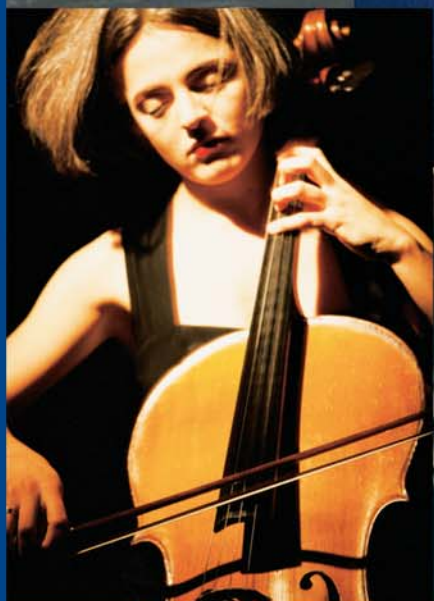


# Fitting Guide

Musicians Earplugs  
ER-9, ER-15, ER-25

Ready-Fit High Fidelity Earplugs  
ER-20

- *sound quality is clear and natural*
- *sound is not muffled*
- *noise fatigue is reduced*
- *fidelity is preserved*
- *just the right amount of sound reduction*



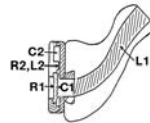
# History and Design of Flat Response Attenuators

ER-15 buttons have a diaphragm which functions as an acoustic compliance, while the volume of air in the sound bore of the custom earmold acts as an acoustic mass. The combination of the two produces a resonance at approximately 2700 Hz (as in the normal ear), which results in a smooth, flat attenuation.

## Musicians Earplugs

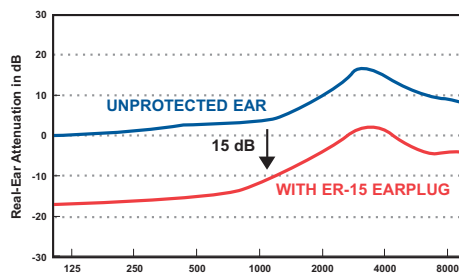
In the late 1970s Elmer Carlson, an engineer at Knowles Electronics, developed what we now call Musicians Earplugs. His design replicated the natural response of the ear canal so that sound heard with these earplugs would have the same quality as the original, just quieter.

In 1985, while consulting with the *Chicago Symphony Orchestra*, Mead Killion, Ph.D., president and founder of Etymotic Research, concluded that there was a real need for Carlson's earplugs.



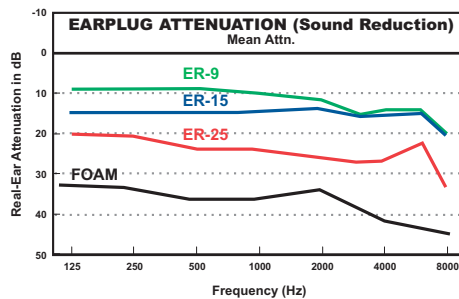
Schematic side view of the ER-15

C = compliance  
L = inductance  
R = resistance



Open ear response of the average ear measured in a diffuse field or reverberant room. The response of the ER-15 Musicians Earplug indicates a 15 dB reduction in eardrum sound pressure at each frequency.

## Mean Attenuation Characteristics of Musicians Earplugs



## ER-9

The ER-9 has reduced diaphragm stiffness for less attenuation.

## ER-25

The ER-25 has an increased diaphragm stiffness and an acoustic-mass channel molded into the button for more attenuation.

## Ready-Fit Earplugs

ER-20 High Fidelity Earplugs were developed to provide low-cost, one-size-fits-most high fidelity earplugs that can be used in a variety of noisy environments.

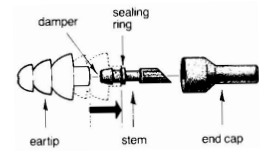
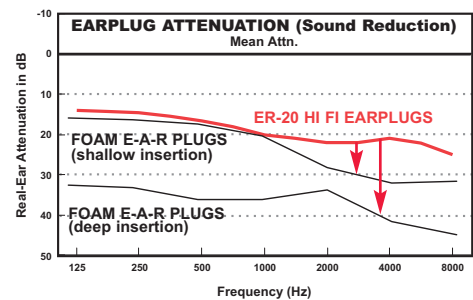


Diagram of the ER-20

The goal of the ER-20 design was the same as for Musicians Earplugs: to reduce noise but preserve sound quality; in effect, to turn down the noise but not muffle voices, environmental sounds or music.

ER-20s use a tuned resonator and acoustic resistor to give essentially equal sound reduction at all frequencies which preserves the fidelity of the original sound.



Lost high frequencies with conventional earplugs, compared to response of ER-20 High Fidelity Earplugs







# High Accuracy, Noise Isolating Earphones

**ER-4 MicroPro™ Reference Quality Earphones** are popular among audiophiles for personal listening (e.g. CD and MP3 players). ER-4 earphones are high fidelity transducers developed specifically to combine flat frequency response with isolation from external noise. They deliver transparent, reference quality sound and provide at least 20-25 dB of external noise exclusion at all frequencies, which allows listeners to hear the full dynamic range of recorded or live music at safe levels. Many stage performers and recording engineers use ER-4 earphones as in-ear monitors to monitor or isolate their own and others' instruments or voices from the rest of the band or mix.

**ER-6 Isolator™ Earphones** are a low-cost version of the ER-4 earphones, with a higher accuracy score than all other earphones and earbuds in their class. Sound Isolation is 15-20 dB. With a special adapter, ER-6 earphones can plug directly into your Musicians Earplugs.



# Colors of Clarity High Fidelity Earplugs

					
	ER-9 Musicians Earplug	ER-15 Musicians Earplug	ER-25 Musicians Earplug		
Description	Flat 9 dB sound reduction through the mid range. Same high frequency protection as the ER-15	Provides uniform 15 dB sound reduction across all frequencies	Provides 25 dB of relatively flat sound reduction across all frequencies		
Button colors*	Clear	Beige	Brown	Red	Blue
Interchangability	Identical dimensions. Change buttons for different listening conditions.				
Earmold styles					
	Standard	Partially countersunk	Countersunk		
Insertion	Moisten the mold for ease of insertion. Pull the ear outward and upward while easing the mold into the ear canal.				
Cleaning	Remove button from mold. Use water and mild soap on the mold only. Dry mold thoroughly before replacing button.				
Reasons to replace earplugs	Discoloration, shrinkage, cracking, hardening of earmold material, deterioration in performance.				

\* ER-9 buttons are not available in red or blue.

Etymotic Research manufactures and tests each button for proper resistance and compliance values before they are shipped to earmold laboratories. Earmold labs that are authorized by ER to make Musicians Earplugs are required to use an acoustic mass meter to verify that Musicians Earplugs have the correct volume of air in the sound bore to produce flat attenuation. Visit our website [www.etymotic.com](http://www.etymotic.com) for a list of authorized earmold labs.



## Recommended Earplugs for Music Professionals

Musicians practice and perform in a variety of different settings and they are exposed to high levels of sound, sometimes for long periods. They require different amounts of protection, depending on the sound levels they encounter during rehearsals and performances.

As designated by the number classification, ER-25s and ER-9s provide either more or less attenuation than ER-15s. Some musicians use one type of attenuator in one ear and one type in the other, depending on the source and location of the sound.

For more in-depth information regarding the clinical assessment of musicians, room acoustics, the physics of musical instruments, and environmental strategies used to reduce noise exposure for musicians, refer to: *Chasin, M. Musicians and the Prevention of Hearing Loss. Singular Publishing Group. 1996.*

	ER-9	ER-15	ER-25	ER-4	ER-20	Harmful Sound Comes From:
Small strings	●	●			●	Own instrument
Large strings	●	●			●	Brass section
Woodwinds		●			●	Brass section
Brass		●	●		●	Own instrument, other brass
Flutes		●			●	Percussion
Percussion		●	●		●	Own instruments, other percussion
Vocalists	●	●			●	Own voice, speakers, monitors
Acoustic guitar	●	●			●	Drums, speakers, monitors
Amplified instruments		●	●	●	●	Speakers, monitors
Marching bands		●			●	Multiple sources
Music teachers		●			●	Multiple sources
Recording engineers		●		●	●	Speakers, monitors
Sound crews		●		●	●	Speakers, monitors

## Frequently Asked Questions:

### What's wrong with conventional earplugs?

Conventional earplugs attenuate more in the high frequencies than in the low and mid frequencies, which makes music and voices unclear and unnatural. Deeply inserted foam earplugs can provide 30-40 dB of attenuation, although typically only a small amount of sound reduction is needed.

### How much protection is needed?

Noise-induced hearing loss is a function of exposure time, the average sound level and the peak level of very loud sounds. OSHA set industrial limits of 8 hours per day at 90 dBA. NIOSH recommends a maximum allowable exposure of 40 hours per week at 85 dBA.

#### Recommended Maximum Weekly Exposure (NIOSH, 1998)

Sound level (dB)	Exposure type	No protection	Using ER-20s
60	Conversation	SAFE	-
80-85	Noisy restaurant Vacuum cleaner Average factory	40 HRS.	SAFE
88	Circular saw Loud party Motorcycle	20 HRS.	SAFE
94	Subway Riding mower	5 HRS.	SAFE
97	Live band	2.5 HRS.	40 HRS.
100	Sporting event Chain saw Snowmobile	1.25 HRS.	20 HRS.
112	Blues bar/Rock concert	5 MINS.	1.25 HRS.
115	Ambulance siren	2.5 MINS.	36 MINS.
140	Jet engine Gun shot Firecracker	INSTANT LOSS	

Above 125 dB you are at risk for any period without maximum protection

#### Allowable Daily Exposure (OSHA and NIOSH)

Source Level (in dB)	OSHA	NIOSH
85	16	8
88		4
90	8	
92	6	
94		1
95	4	3/4
97	3	1/2
100	2	1/4
105	1	
110	1/2	
115	1/4	
120	1/8	

OSHA and NIOSH values listed above are given in *daily* exposure limits. According to the OSHA standard, a person can be exposed to a 95 dB environment for 4 hours before risking hearing damage. With 10 dB of protection that person can be exposed to 95 dB for 16 hours per day. NIOSH values are more conservative.

For maximum protection, foam earplugs, muffs or other hearing protection devices are recommended.

### What are the two greatest sources of error with Musicians Earplugs?

- 1) Earmold impressions that are not long enough (past the second bend)
- 2) Earmolds received from the earmold lab that are not long enough

### How can the occlusion effect be reduced?

Deep earmold impressions (past the second bend of the ear canal) are required because earmolds that do not seal deeply in the bony portion of the ear canal can create the occlusion effect. A shallow earmold can increase the occlusion effect by as much as 15-20 dB at low frequencies. Silicone impression material is recommended. Vented otoblocks decrease the likelihood of discomfort or damage to the ear during removal of deep impressions. If a remake is necessary because of the occlusion effect, it may be helpful for the person to vocalize "oo" or "ee" while the impression is setting. Open-jaw impressions are also an option.

### How can the occlusion effect be measured?

Etymotic Research produces a hand-held Occlusion Effect Meter which quickly quantifies the occlusion effect and earmold leakage. This information can reduce the need for remakes.



### What is NRR (Noise Reduction Rating)?

The EPA requires manufacturers to print a noise reduction rating (NRR) on all non-custom earplugs. The NRR for ER-20s is 12 dB, but actual clinical measurements of properly inserted ER-20s indicate that these earplugs provide almost equal sound reduction (20 dB) at all frequencies. The required formula used to determine NRR includes an adjustment for individual variability and for those persons who do not wear ear protection as instructed. Many investigators have found no consistent rank order correlation between the real-world NRRs and labeled NRRs. NRR is computed from laboratory data that are not representative of the values attained in the real world by actual users.



**RESEARCH AND PRODUCT DEVELOPMENT FOR THE EAR**  
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847-228-0006 www.etymotic.com

The ER family of earplugs is covered by three U.S. patents:  
4,852,683; 5,113,967; 5,887,070.  
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**Effective**  
for anyone who needs to  
hear accurately in a noisy  
environment...

### Aircraft

crew  
flight instructors  
passengers  
pilots



### Athletics

athletes  
coaches



### Construction

carpenters  
equipment operators  
road builders  
steel workers



### Emergency Vehicles

EMTs  
highway patrol  
firefighters



### Industrial

factory workers  
shop teachers  
students  
supervisors



### Leisure

concerts  
night clubs  
noisy restaurants  
sporting events



### Medical-Dental

dentists  
dental hygienists  
dental technicians  
surgeons



### Motor Sports

motorcyclists  
pit crews  
race car drivers



### Others

delivery drivers  
market traders  
night club staff  
truck drivers

