

SOUNDSOURCE™
NO.11-NA-US

So, What's the Story with Custom-Molded Earplugs?

Custom earplugs are sometimes portrayed as the ultimate hearing protection solution. They've been available for decades, but have not found wide acceptance in the industrial work environment. This observation begs the question: are they always the best hearing protection option? Let's take a practical look at custom earplugs.



Courtesy of The Council for Accreditation in Occupational Hearing Conservation, Hearing Conservation Manual 5th Edition.

Overview

Custom earplugs are made from impressions taken of an individual's ear canals. Impressions should be taken by an experienced professional—typically an audiologist—for safety and because accurate, high-quality impressions are critical for proper fit and noise attenuation[1].

Fit

Reports of more consistent repeat fittings with custom earplugs is not always supported by the evidence. Some studies show good results[2] while others do not[1]. As with any earplug, consistency of fit with custom earplugs still requires training and practice[2]. Custom earplugs are usually manufactured from acrylic, vinyl, or silicone. Acrylic is the cheapest material, but it is hard and brittle. Unlike acrylic, vinyl and silicone are somewhat yielding, but at often double the cost. Earplugs crafted from acrylic, vinyl, or silicone will not easily accommodate drastic changes in ear canal shape.

Honeywell
HOWARD LEIGHT

Foam earplugs remain pliable during their term of recommended use and adapt readily to jaw movement due to talking, chewing, or yawning, without creating a path for noise.

The fit of custom earplugs is also affected by changes to the wearer's physiology. Weight gain and loss, surgeries, and aging can cause changes to the skin, fat, cartilage, and connective tissue layers that give shape and support to the external ear. Earplug fit should be reassessed whenever such physiological changes occur.

Attenuation

When they fit properly, custom earplugs can provide Noise Reduction Ratings (NRRs) around 26 dB to 28 dB, but adequate attenuation is not always assured and there is often a high degree of variability[1]. If higher attenuation is required, there is no substitute for well-fit foam earplugs, which can deliver NRRs as high as 33 dB.

Regardless of the hearing protector, the published NRR is not a guaranteed attenuation value. In the case of custom earplugs, there is no practical way for the manufacturer to test the attenuation of that pair of earplugs before they leave the factory. For this reason, fit testing of custom earplugs with a tool like the VeriPRO field fit testing system is a necessity. VeriPRO can be used to verify the fit of any earplugs from any manufacturer, including custom earplugs. Fit testing is often the only opportunity a wearer of custom earplugs may have to know if their hearing will be adequately protected. If deficiencies in fit are revealed, custom earplugs must be remade.

Comfort

Custom earplugs can be very comfortable if the canal portion is not irritating, but the attenuation of a custom earplug depends on the depth of insertion into the ear canal[3]. Canal length cannot be increased once the earplug is manufactured; it must be correct at the time the impression is made. Deep-canal fittings can be uncomfortable with jaw movement. For this reason, vinyl and silicone materials are recommended for custom earplugs that will be worn for long periods. Physical alterations for comfort can be made to custom earplugs by the dispensing professional, but these usually require an office visit and can affect attenuation, which means fit testing must be repeated.

Hygiene

Because custom earplugs will be used repeatedly for months to years, they can collect and harbor toxins and grime from the work environment and pathogens from hands and ear canal secretions. Cleanliness and disinfection are required to mitigate common bacterial and fungal infections. It is important to follow care and maintenance requirements. Otherwise, disposable foam earplugs are recommended as they are the most hygienic hearing protection solution.

Cost

The high initial cost of custom earplugs may be offset to some degree by the longevity of the product. The long-term cost is dependent on the number of remakes, lost earplugs and employee turn-over rate. Custom earplugs can last for years, but their useful life varies due to work environment, the wearer’s physiology, personal hygiene, care of the earplugs, etc.

The following table illustrates the annual cost per worker of a pair of custom silicone earplugs with an average life span of three years. It assumes no changes in attenuation over the earplugs' life span and that Use and Care instructions are rigorously followed. This is compared with the costs and usage rates of popular non-custom disposable and reusable earplugs.

Earplug Type, Material, and Attenuation	Usage Rate	Unit Cost	Annual Cost/Worker
Custom-Molded (Silicone, NRR = 27 dB)	1 pair/3 years	$150.00/pair*	$50.00
LaserLite – Disposable (Roll-down foam, NRR = 32 dB)	10 pairs/week, 48 weeks/year	$0.10 - $0.15/pair†	$48.00 - $72.00
AirSoft – Reusable (TPE, w/stem, NRR = 27 dB)	2 pairs/month, 11 months/year	$0.65 - $0.90/pair†	$14.30 - $19.80

**Typical pricing from professional providers, including impressions and delivery (range = $110 - $200/pr.); current as of May, 2018.*
†Typical pricing from an online retailer; current as of May, 2018.

The data in the table demonstrate that custom earplugs may be cost-competitive with disposable foam earplugs, but their annual cost can be twice that of reusable, pre-molded earplugs. Nevertheless, their cost must be factored together with other requirements, like attenuation, comfort, fitting stability, environmental and personal hygiene, etc.

While custom earplugs may have a place in some Hearing Conservation Programs, they are just one of several available hearing protection options.

Sound Source is a periodic publication of the Hearing Conservation team of Honeywell Safety Products USA, Inc., addressing questions and topics relating to hearing conservation and hearing protection.

WARNING: This document does not provide important product warnings and instructions. Honeywell recommends all users of its products undergo thorough training and that all warnings and instructions provided with the products be thoroughly read and understood prior to use. It is necessary to assess hazards in the work environment and to match the appropriate personal protective equipment to particular hazards that may exist. At a minimum, a complete and thorough hazard assessment must be conducted to properly identify the appropriate personal protective equipment to be used in a particular work environment. FAILURE TO READ AND FOLLOW ALL PRODUCT WARNINGS AND INSTRUCTIONS AND TO PROPERLY PERFORM A HAZARD ASSESSMENT MAY RESULT IN SERIOUS PERSONAL INJURY.

---

[1] *Shanks, E. & Patel, J. (2009). Market surveillance of custom-moulded earplugs, Research Report RR727. Health and Safety Executive. (Available from Her Majesty's Stationery Office, St Clements House, 2-16 Colegate, Norwich NR3 1BQ, United Kingdom or hmsolicensing@cabinet-office.x.gsi.gov.uk).*
[2] *Casali, J.G. & Lee, K. (2017, February). Foam vs. Deep Custom-Molded Earplugs: A Comparison of Attenuation Achieved with Inexperienced-Subject-Fit and Trained-Subject-Fit, and Retention of Training Benefit after Extended Use. Paper presented at the annual meeting of the National Hearing Conservation Association, San Antonio, TX.*
[3] *Tufts, J.B., Chen, S., & Marshall, L. (2013). Attenuation as a function of the canal length of custom-molded earplugs: A pilot study. Journal of the Acoustical Society of America, Express Letters, 133(6), 446 - 451.*

Honeywell Safety Products USA, Inc.

900 Douglas Pike
Smithfield, RI 02917
www.honeywellsafety.com

© 2018 Honeywell Safety Products USA, Inc.

Honeywell
HOWARD LEIGHT