

# Design considerations for a dual hearing aid and hearing protection device for individuals with hearing loss

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## Context

**43%** of Canadians work in loud environments<sup>1</sup>

Among them, an increasing proportion suffers from noise-induced hearing loss (NIHL)

NIHL is responsible for difficulties in communication as well as in the perception and localization of sounds

## Existing solutions and their limitations

- Wearing both hearing protectors and hearing aids simultaneously → Lack of research on the effects, no consensus amongst professionals on how to use them<sup>2</sup>
- Active hearing protectors → No advantages in high noise environment, lack of data on the actual amplification and its risks for the user<sup>2</sup>

## Goal

To develop and validate a prototype of a protective hearing aid that can be used for research on the communication needs and the noise exposure of hearing-impaired workers in a loud environment.

## Design considerations

The device will consist of two earplugs, each instrumented with a loudspeaker and two microphones, such that a final prototype has the benefits of both hearing aids and hearing protection devices. Algorithms will be implemented into a connected platform. Some features should be particularly investigated as they need to:

### Hearing Aid Algorithm

- Be adapted to workers with low to severe hearing loss
- Maximize speech intelligibility with the right choice of prescription algorithm (NAL, FIG6,...)
- Include a prescription algorithm, volume control, user tilt and Automatic Gain Control input and output units.

### Wide Dynamic Range Compression

- Independently adapt compression features depending on the frequency range
- Include a particular number of bands chosen by finding a compromise between vowel recognition and consonant recognition<sup>3</sup>



### In-ear dosimetry

- Allow real time measurement of sound level in the protected ear canal
- Be adapted from attenuation measurements using F-MIRE method
- Help selecting the protecting tip providing the best acoustic seal through the sound level measurements
- Enable to monitor noise exposure and prevent overexposure

### Noise Reduction Algorithm

- Reduce background noise
- Minimize speech distortion
- Help evaluate the benefit of Active noise cancelling

## Expected outcomes

- Advise audiologists, OHS professionals and workers on feature choice depending on hearing diagnosis
- Familiarize hearing aid and hearing protection manufacturers on the needs of workers in loud environments
- Develop a method for noise dosimetry to assess the risks for hearing-impaired employees in noisy workplaces

## References

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