THE NEW CANADIAN STANDARD ASSOCIATION

STANDARD ON HEARING PROTECTORS:

CSA Z94.2 – Hearing Protection Devices

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Prepared by the **Subcommittee SC1** of the Occupational Hearing Conservation **Technical Committee Z1007**, under the jurisdiction of the **Strategic Steering Committee on Occupational Health and Safety**

The Committee comprises 16 members from different universities, manufacturing companies, users and institutions
- WHAT IS A STANDARD?
- Who writes/updates them?
- National and International Standards

CSA (Canadian Standard Association)
ANSI (American National Standards Institute)
ISO (International Association for Standardization)
Types of Standards:

- **A) Measurement Standards**
  - What to measure

- **B) Application Standards**
  - What to do with the results

- **C) Combination of both**
What to measure:

a) **Attenuation:** (difference of SLs at the threshold with and without protectors)

\[ SL_{\text{with}} - SL_{\text{No}} \]

At threshold

b) **Comfort:**
Un fortunately no standards so far.
Insertion loss **(not the same)**
(difference between levels inside and outside of the ATF).

\[
IL = SL_1 - SL_2
\]
S3.19-1974
Method for Measurement of Real-Ear Protection of Hearing Protectors and Physical Attenuation of Earmuffs;
[withdrawn, but still enforced by requirement of the United States hearing protector labeling regulation],

ANSI/ASA S12.6-1997 (R2008)
ISO 4869–1:1990
Acoustics — Hearing protectors — Part 1: Subjective method for the measurement of sound attenuation

Acoustics -- Hearing protectors -- Part 5: Method for estimation of noise reduction using fitting by inexperienced test subjects
Testing
- 125 – 8,000 Hz (narrow bands)
- Thresholds with and without protectors
- Three times
- 10 – 20 Subjects

Results
- Mean attenuation and std. deviation at each frequency
DIFFERENCES

S3.19-1974
Professional subjects

ANSI/ASA S12.6-1997

A

B

Trained-subject fit  Inexperienced-subject fit
USING THE DATA FROM THE MEASUREMENTS...

\[
\text{Attenuation} + \text{Std. deviation} = \text{dBA of the protected ear}
\]
ISO 4869-2/Cor1:2006: Estimation of A-weighted SPL when HP are worn.

3 Methods and 3 results: Single number
Three numbers
Seven numbers

Application Standards: What to do with the results?
ANSI/ASA S.12.68–2007: Method of Estimating Effective A–Weighted Sound Pressure Level When Hearing Protectors are worn

Same ingredients, different barman...

...and different results:

3 Methods and 3 results: Single number: $\text{NRS}_{Ax}$

Single number: $\text{NRS}_{Gx}$

Seven numbers: Octave bands
Single number $NRS_A$ and $NRS_G$

$L'_{Ax} = L_A - NRS_{Ax}$

Sound Level of the protected ear for protection performance $x$.

Two values of $x$: 20% and 80% of the population will experience $NRS_A =/>$ than the indicated.

New label by EPA will probably include both $NRS_A$: 20 AND 80
USA Environmental Protection Agency (EPA) 40 CFR Part 211

Noise Labeling Requirements for Hearing Protectors,”

\[ SL_{A \text{ (Prot. Ear)}} = SL_{C \text{ (Ambient)}} - \text{NRR} \]
NRR IS CALCULATED USING THE OLD S3.19-1974 Standard with Professional subjects
5 MINUTES REST!
Draft Standard

Z94.2 - Draft 19  7/23/2013

Hearing Protection Devices — Performance, Selection, Care, and Use


*Should be used with the CSA Z1007, Hearing Conservation Program Management*
What do we measure:

1. Attenuation
2. Earmuff force
3. Semi-inserts force
Testing
- 125 – 8,000 Hz (narrow bands)
- Thresholds with and without protectors
- Three times
- 10 – 20 Subjects

Results
- Mean attenuation and std. deviation at each frequency

Semi-reverb. Chamber
4 Speakers
TEST PROCEDURES

S3.19-1974
Professional subjects

ANSI/ASA S12.6-1997
Method B
Inexperienced-subject fit

NRR
CLASS

SNR(SF84),
Section 9.8: Noise Exposure Levels and Selection of Hearing Protection Devices

Three methods:

1. Classes: A, B and C

2. Single number:
   NRR and
   SNR(SF84) and

3. Octave-band computation
### Classes: A, B and C

<table>
<thead>
<tr>
<th>Frequency, Hz</th>
<th>Minimum attenuation, dB</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class A</td>
</tr>
<tr>
<td>125</td>
<td>10</td>
</tr>
<tr>
<td>250</td>
<td>18</td>
</tr>
<tr>
<td>500</td>
<td>26</td>
</tr>
<tr>
<td>1000</td>
<td>31</td>
</tr>
<tr>
<td>2000</td>
<td>33</td>
</tr>
<tr>
<td>3150</td>
<td>33</td>
</tr>
<tr>
<td>4000</td>
<td>31</td>
</tr>
<tr>
<td>6300</td>
<td>33</td>
</tr>
<tr>
<td>8000</td>
<td>33</td>
</tr>
</tbody>
</table>

Classes: A, B and C
# Use of Classes:

<table>
<thead>
<tr>
<th>$L_{ex,8}$ (dBA)</th>
<th>Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>$&lt; 87$</td>
<td>–</td>
</tr>
<tr>
<td>$&lt; 90$</td>
<td>C</td>
</tr>
<tr>
<td>$&lt; 95$</td>
<td>B or BL</td>
</tr>
<tr>
<td>$&lt; 105$</td>
<td>A or AL</td>
</tr>
<tr>
<td>$&lt; 110$</td>
<td>Dual *</td>
</tr>
<tr>
<td>$&gt; 110$</td>
<td>Dual +</td>
</tr>
</tbody>
</table>
Single number:

**NRR as per EPA**

Nose level of the protected ear \( \text{dBA} = \text{SL}_{\text{dBC}} - \text{NRR} \)

\[ = \text{SL}_{\text{dBA}} - \text{NRR} + 7 \]
Derating of the NRR (Table 2):

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Percentage of NRR Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earplugs</td>
<td>50 %</td>
</tr>
<tr>
<td>Earmuffs</td>
<td>70 %</td>
</tr>
<tr>
<td>Dual Protection</td>
<td>60 %</td>
</tr>
</tbody>
</table>
Examples:

1. $L_{eq}$ is 95 dBC. Earmuff NRR 26 dB,
   $L_{eqA} = 95 \text{ dBC} - 26 (0.7) = 95 - 18.2 = 76.8$,

2. $L_{eq}$ is 95 dBA. Earmuff NRR 26 dB,
   $L_{eqA} = 95 \text{ dBA} - (26 - 3) (0.7) = 95 - 16.1 = 78.9$,
# Single Number Rating Subject-Fit\textsubscript{84} (SNR (SF84))

<table>
<thead>
<tr>
<th>Octave-band centre frequency (Hz)</th>
<th>125</th>
<th>250</th>
<th>500</th>
<th>1000</th>
<th>2000</th>
<th>4000</th>
<th>8000</th>
<th>Overall level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pink noise with a level of 100 dBC</td>
<td>92.0</td>
<td>92.0</td>
<td>92.0</td>
<td>92.0</td>
<td>92.0</td>
<td>92.0</td>
<td>100.0 dBC*</td>
<td></td>
</tr>
<tr>
<td>A-weighting</td>
<td>–8.6</td>
<td>–3.2</td>
<td>0.0</td>
<td>1.2</td>
<td>1.0</td>
<td>-1.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A-weighted pink noise</td>
<td>75.9</td>
<td>83.4</td>
<td>88.8</td>
<td>92.0</td>
<td>93.2</td>
<td>93.0</td>
<td>90.9</td>
<td></td>
</tr>
<tr>
<td>Mean attenuation</td>
<td>10.0</td>
<td>14.4</td>
<td>19.6</td>
<td>22.8</td>
<td>29.6</td>
<td>38.8</td>
<td>34.1</td>
<td></td>
</tr>
<tr>
<td>Standard deviation</td>
<td>3.0</td>
<td>3.0</td>
<td>3.9</td>
<td>3.4</td>
<td>5.2</td>
<td>6.2</td>
<td>4.4</td>
<td></td>
</tr>
<tr>
<td>Assumed protection values (APV)</td>
<td>7.0</td>
<td>11.4</td>
<td>15.7</td>
<td>19.4</td>
<td>24.4</td>
<td>32.6</td>
<td>29.7</td>
<td></td>
</tr>
<tr>
<td>A-weighted pink noise – APV</td>
<td>68.9</td>
<td>72.0</td>
<td>73.1</td>
<td>72.6</td>
<td>68.8</td>
<td>60.4</td>
<td>61.2</td>
<td>78.6 dBA*</td>
</tr>
</tbody>
</table>

\[\text{SNR(SF}_{84}) = 100.0 \text{ dBC} - 78.6\]

\[= 21.4 \text{ dB}, \text{ which rounds to } 21 \text{ dB}\]
Example:

Leq is 95 dBC.
SNR (SF84) is 21 dB,

the predicted A-weighted Leq
95 dBC – 21 dB = 74 dBA
## Protection Outcome

<table>
<thead>
<tr>
<th>Resulting sound level</th>
<th>Protection outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>85 +</td>
<td>Insufficient</td>
</tr>
<tr>
<td>80 – 85</td>
<td>Acceptable</td>
</tr>
<tr>
<td>75 – 80</td>
<td>Good</td>
</tr>
<tr>
<td>70 – 75</td>
<td>Overprotection</td>
</tr>
</tbody>
</table>
Other issues dealt with in the Standard

1. **Extended work shift**

\[ \text{Lex},8 = \text{Leq} + 10 \cdot \log(T/8) \]
2. Specialized HPDs

- Active HPDs
  - Communication headsets
  - Active noise reduction headsets
  - Sound restoration headsets

- Passive HPDs
  - Flat or uniform attenuation
  - Frequency-sensitive devices
  - Adjustable-attenuation devices
  - Amplitude-sensitive devices
3. **Fit, care and use of HPDs**

4. **Implementation of hearing protection**

5. **Field Attenuation Estimation Systems (FAES)** (the new guy on the block!).

“What amount of protection is a given individual really getting from his/her HPD?”

ALSO GOOD FOR TRAINING AND FOLLOW-UP.
How do I know that what is advertised is for real? – False advertising.

A. Manufacturer’s Test Report and classification Form
B. CERTIFICATION

A process where the manufacturer has his product tested at a Certified Laboratory.

This is a long process that will be initiated after the Standard has been approved.

The goal is to allow for the inclusion of the statement Certified by the CSA in the packaging.
Thank you!
Any questions?