Why RWS with HIGH sound level?

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Industrial site

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DETECTION OF REVERSE ALARMS IN NOISY WORKPLACES

“Realistically, however, a vehicle can operate at various idling speeds and other engine regimes, with other noise sources in proximity of workers also contributing to the overall noisy background; hence, lower or higher alarm levels may be required depending on the situation.”

Background noise:

\[ \text{SPL}_{\text{site}} = 80-90 \text{ dBA} \] (see slide 4)

\[ \text{SPL}_{\text{Wheelloader@7m}} = 80-87 \text{ dBA} \]

RWS: SPL_{Truck RWS@7m} > 86 \text{ dBA} \Rightarrow SAE J994 Type B

SWL_{Wheelloader} = 105-112 \text{ dBA}
Calculate background sound level

Examples and assumptions:

- Ambient sound from the site (machines and vehicles far away): 80 dBA
- Sound from the wheel loader:  SWL= 105-112 dBA (Source Volvo CE)
  - at worker standing at 7 m:  SPL @ 7 m = SWL – 25 = 80-87 dBA
- Sound from the truck (idling):  SPL @ 7 m <60 dBA
- Estimated background sound at worker:  SPL_{worker} = {80}+{85}+{60} = 86 dBA  {addition in dB}
- Needed SPL_{RWS@7m} > SPL_{background worker} = 86 dBA => SWL_{RWS} > 101 dBA => Propose to mount SAE J994 Type B.

\[ L_W = L_p + 10 \log \left( \frac{Q}{4\pi \cdot r^2} \right) \]

Q = 2 for half spherical wave transmission

\[
SPL@r = 10 \log \frac{p^2}{p_{ref}^2} \quad \text{; } p^2 = D \frac{\rho_0 c \bar{W}}{4\pi r^2} \quad \text{; } SWL = 10 \log \frac{\bar{W}}{W_{ref}}
\]

\[
SPL@r = 10 \log D \frac{\rho_0 c \bar{W}}{4\pi r^2} - 20 \log p_{ref} = 10 \log \bar{W} - 10 \log r^2 + 10 \log D \frac{\rho_0 c}{4\pi} - 20 \log p_{ref} =
\]

\[
= SWL + 10 \log W_{ref} - 20 \log r - 20 \log p_{ref} + 10 \log D + 10 \log \frac{\rho_0 c}{4\pi} =
\]

\[
= SWL - 120 - 20 \log r + 94 + 10 \log D + 15 =
\]

\[
= SWL - 11 - 20 \log r + 10 \log D = SWL - 8 - 20 \log r; \text{ while } D=2.
\]

**SPL @ 7 m = SWL – 25** for r=7 m and D=2

**SPL @ 1 m = SWL – 8** for r=1 m and D=2

**SPL @ 1,2 m = SWL – 10** for r=1,2 m and D=2

r= distance to sound source; \(\bar{W}\) = time average Sound power; D = directionality (2 when half sphere); \(W_{ref} = 10^{-12} \text{ Watt}\);
\(p_{ref} = 2 \cdot 10^{-5} \text{ Pa}\); \(\rho \text{ } \rho_0 = 1.21 \text{ kg/liter}\); \(c = 331 \text{ m/s}\)
Typical industry site background noise

Several industrial sites worldwide, with heavy machines – stationary and moving – have very high background noise levels. Examples from Canada:

- Limestone plant: 80.5 dBA;
- Quicklime plant: 83.3 dBA;
- Sawmill plant #1: 85.9 dBA;
- Sawmill plant #2: 89.6 dBA.

**PAPER 1** - Vaillancourt, Nélisse, Laroche, Giguère, Boutin, Laferrière - Comparison of sound propagation and perception of three types of backup alarms with regards to worker safety

**PAPER 2** – *(FULL REPORT)* - Vaillancourt, Nélisse, Laroche, Giguère, Boutin, Laferrière - 2014 - Safety of Workers Behind Heavy Vehicles Assessment of Three Types of Reverse Alarm IRSST
Limit values related to typical alarms – Types defined in SAE J994

<table>
<thead>
<tr>
<th>Draft modes</th>
<th>min</th>
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<td>55</td>
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<tr>
<th>r - &quot;distance&quot; [m]</th>
<th>1m</th>
<th>1,2m</th>
<th>2m</th>
<th>7m</th>
<th>7,5m</th>
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<tr>
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| Type A - 112 dBA | 122 | 114 | 112 | 108 | 97 | 96 |
| Type B - 107 dBA | 117 | 109 | 107 | 103 | 92 | 91 |
| Type C - 97 dBA  | 107 | 99  | 97  | 93  | 82 | 81 |
| Type D           | 97  | 89  | 87  | 83  | 72 | 71 |
| Type E           | 87  | 79  | 77  | 73  | 62 | 61 |
| Type F [Other]   |     |     |     |     |    |    |
| Product tolerance |    |     |     |     | +/-4 |
Examples for Europe (UK) – Type C - 97 dB (A):

Unshielded SPL@7m = 82 dBA:


https://www.amazon.com/Yuesonic-Backup-Reversing-Connection-Vehicles/dp/B07TG8P832
Typical output levels according to Brigade:
82-107 dB(A)
Corresponds to SAE J994 type D to B.
"the background noise in a busy high street is about 65dB(A)"