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Why RWS with HIGH sound level?

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Industrial site

See discussions, stats, and author profiles for this publication at: https://www.researchgate.net/publication/283568753

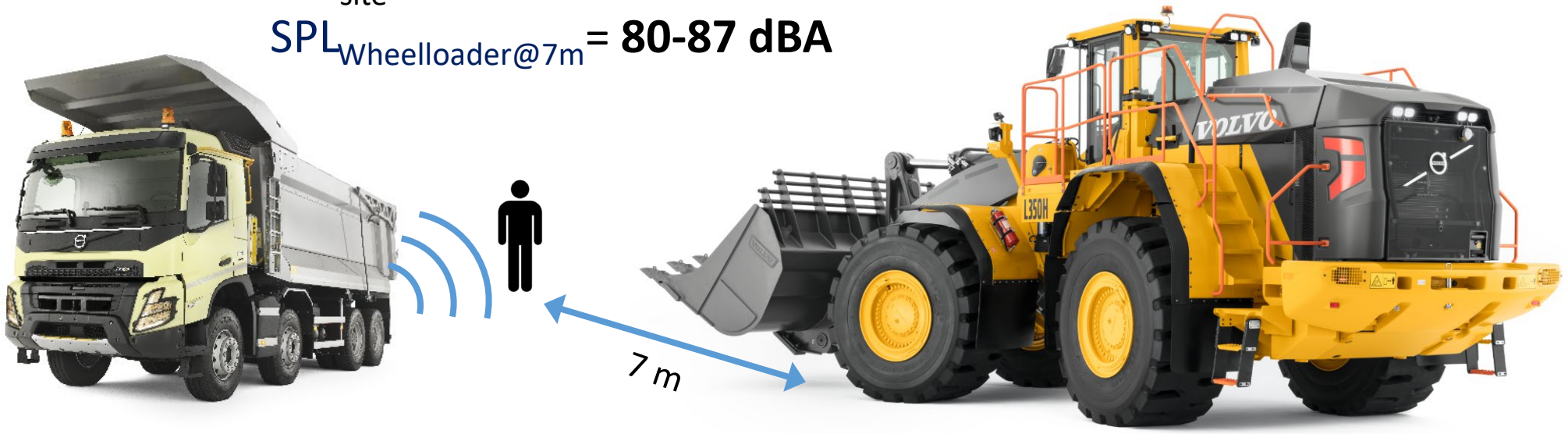
DETECTION OF REVERSE ALARMS IN NOISY WORKPLACES

"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:

SPL_{site} = 80-90 dBA (see slide 4)

$SPL_{Wheelloader@7m}$ = **80-87 dBA**



RWS: $SPL_{Truck\ RWS@7m}$ > **86 dBA => SAE J994 Type B**

$SWL_{Whelloader}$ = **105-112 dBA**

Calculate background sound level

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

Q = 2 for half spherical wave transmission

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 $SPL_{RWS@7m}$ > $SPL_{Back\ ground\ worker}$ = 86 dBA => SWL_{RWS} > 101 dBA => **Propose to mount SAE J994 Type B.**

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

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

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

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

$$= SWL - 11 - 20\log r + 10\log D = \textbf{\textit{SWL – 8 – 20 log r}}\textit{; while D=2.}$$

$\boldsymbol{SPL\ @\ 7\ m = SWL - 25}$ for r=7 m and D=2

$\boldsymbol{SPL\ @\ 1\ m = SWL - 8}$ for r=1 m and D=2

$\boldsymbol{SPL\ @\ 1,2\ m = SWL - 10}$ 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); $W_{ref} = 10^{-12}\ Watt$; $p_{ref} = 2 \cdot 10^{-5}\ Pa$; $\rho\quad \rho_0 = 1{,}21\ kg/liter$; $c = 331\ m/s$

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

Draft modes		min	max	**min**	**max**	min	max	**min**	**max**
Low mode	[dBA]	57	72	**55**	**70**	51	66	**40**	**55**
Normal mode	[dBA]	77	92	**75**	**90**	71	86	**60**	**75**
High mode	[dBA]	97	112	**95**	**110**	91	106	**80**	**95**
r - "distance" [m]		1 m		1,2 m		2 m		7 m	7,5 m
	SWL	Japanese standard		SAE J994				ISO 9533	PIEK
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					

New proposal

Examples for Europe (UK) –

Type C - 97 dB (A): Unshielded SPL@7m = 82 dBA:

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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)”

Ref. https://brigade-electronics.com/back-up-beeper-sound-decibels-and-the-basics-behind-reversing-alarm-sounds/