

Noise exposure in steel stud construction: Noise characterizations and tool limit guidance for commercial framers



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Objectives

- Obj. 1 Overview of major noise exposures of the trade
- Obj. 2 Noise dose
- Obj. 3 Octave band analysis
- Obj. 4 Recommendations to decrease noise exposure

Background



What the noise looks like

Chopsaw



What the noise looks like

Cordless Circular Saw



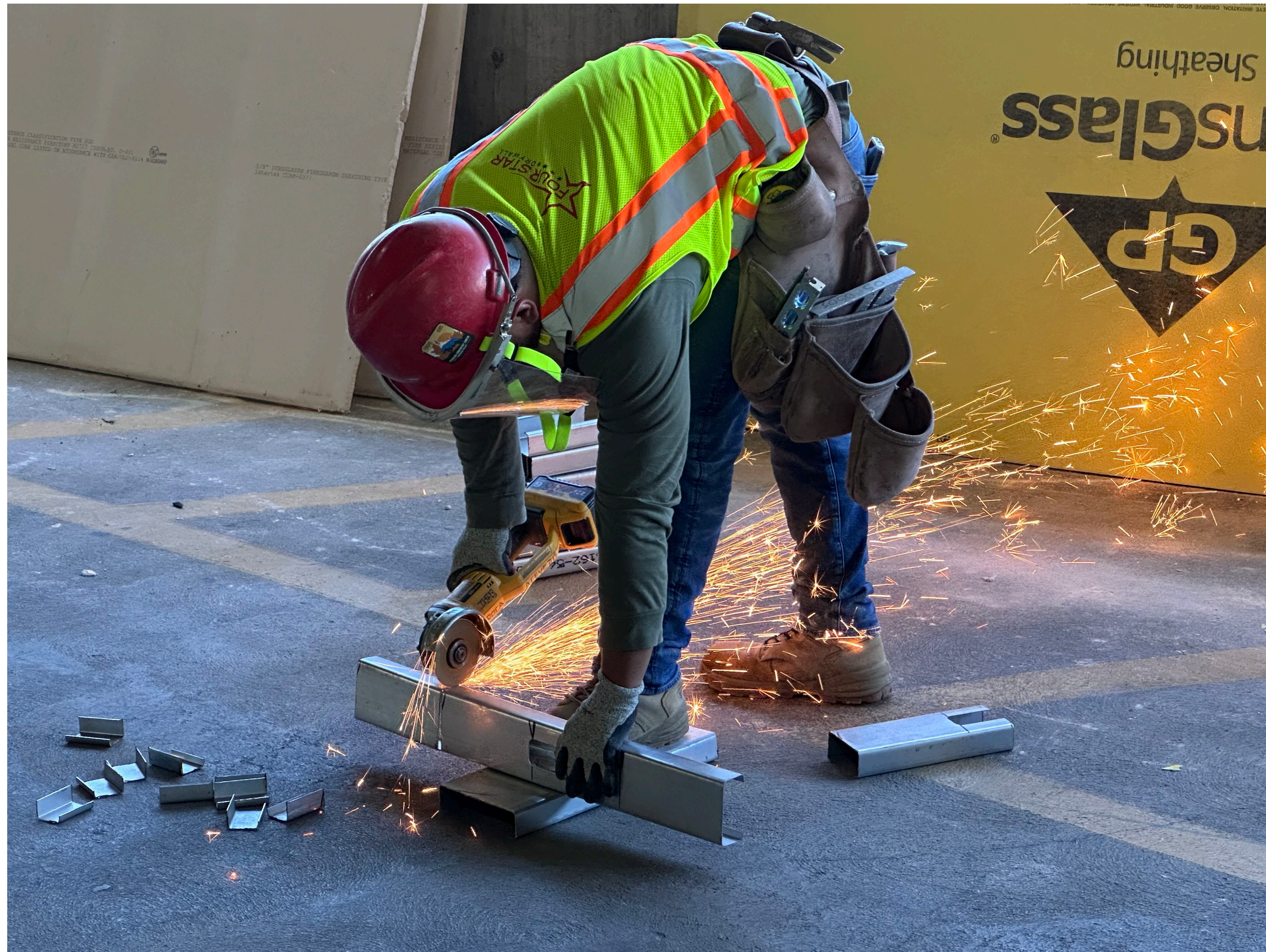
What the noise looks like

Cut-off Saw (aka demo saw)



What the noise looks like

Grinder



PAT (Powder Actuated Tool)



PAT Nailer
(aka shotgun)



Sampling Summery

- Personal dosimetry
- Number of samples collected - 1.4 million seconds sampled
- Observations of cutting times and styles



Saw Characterization Overview

All saws $L_{Aeq} = 107.2$ dB

Chopsaw



L_{Aeq} (dB) 106.3

L_{Cpeak} (dB) 118.9

Cordless Circular Saw



110.4

125.2

Cut-off Saw



105.9

118.3

Grinder

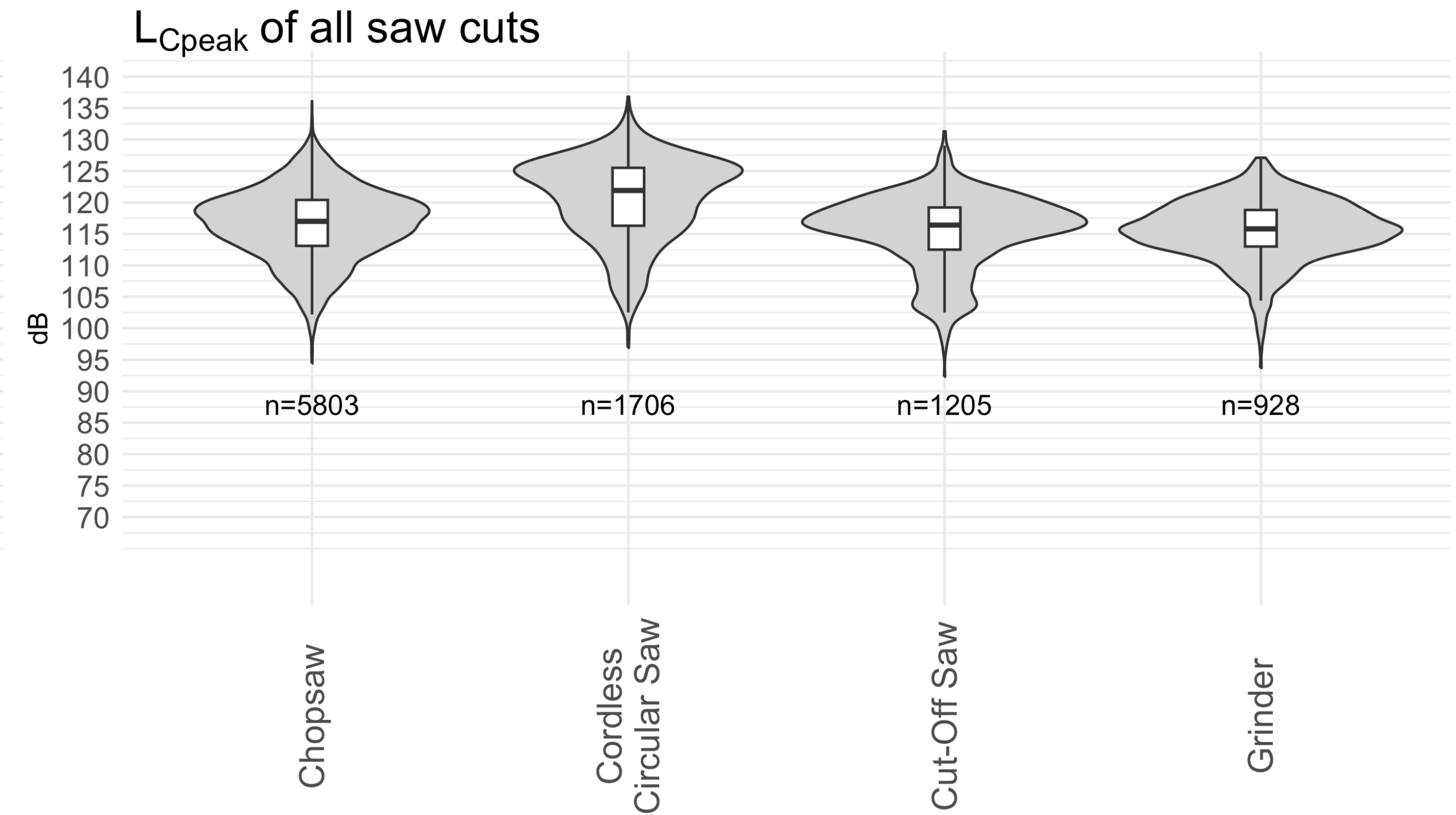
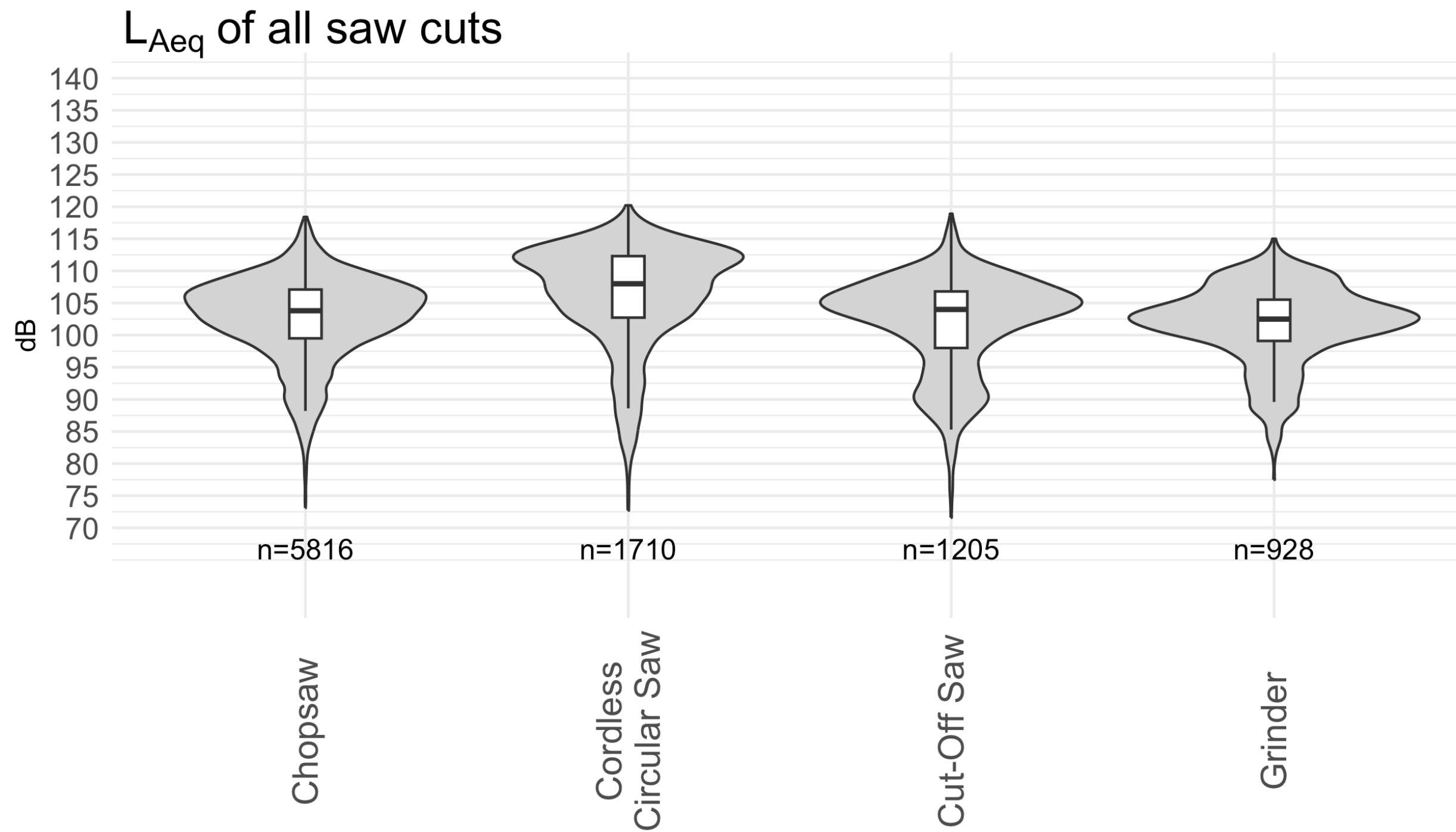


104.7

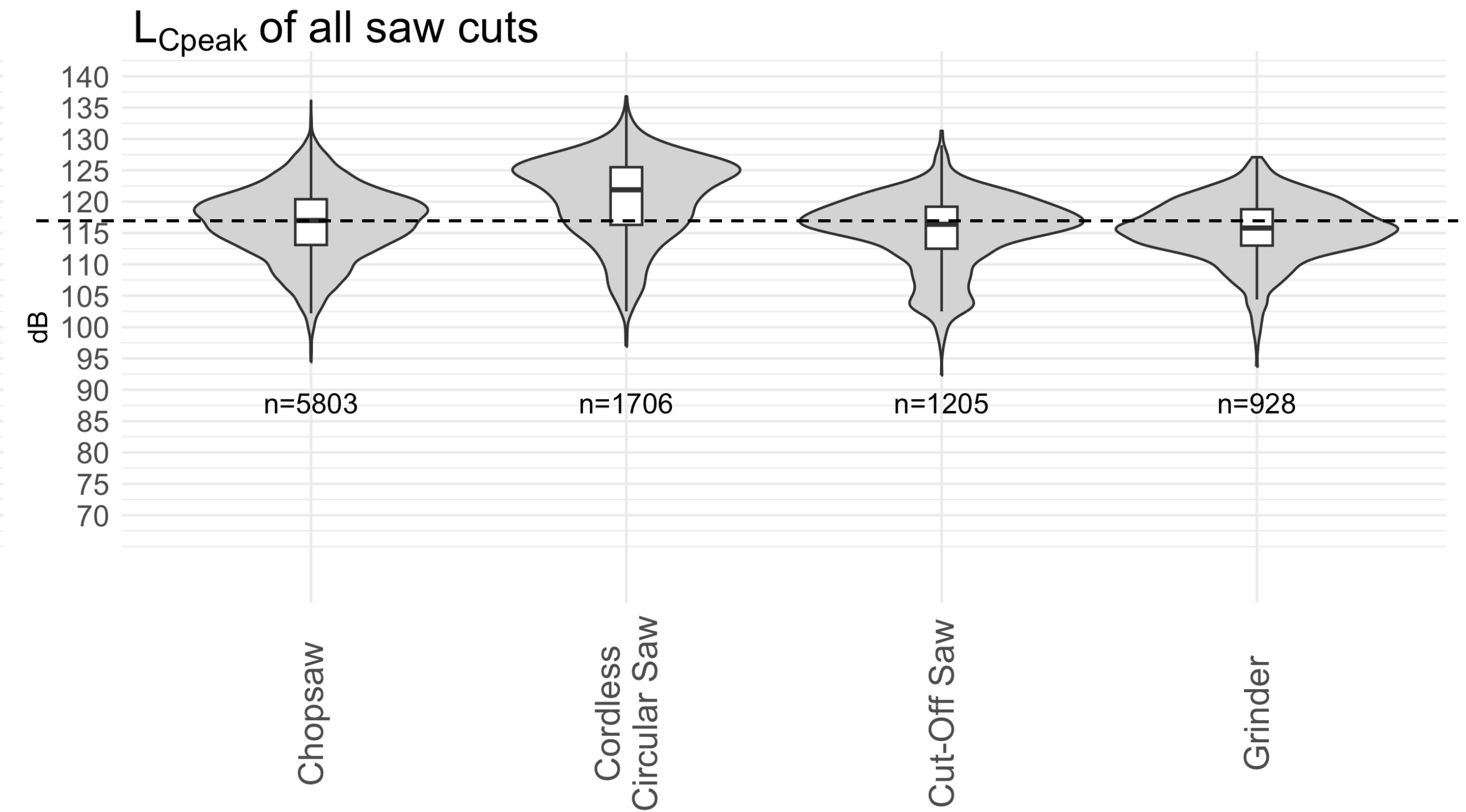
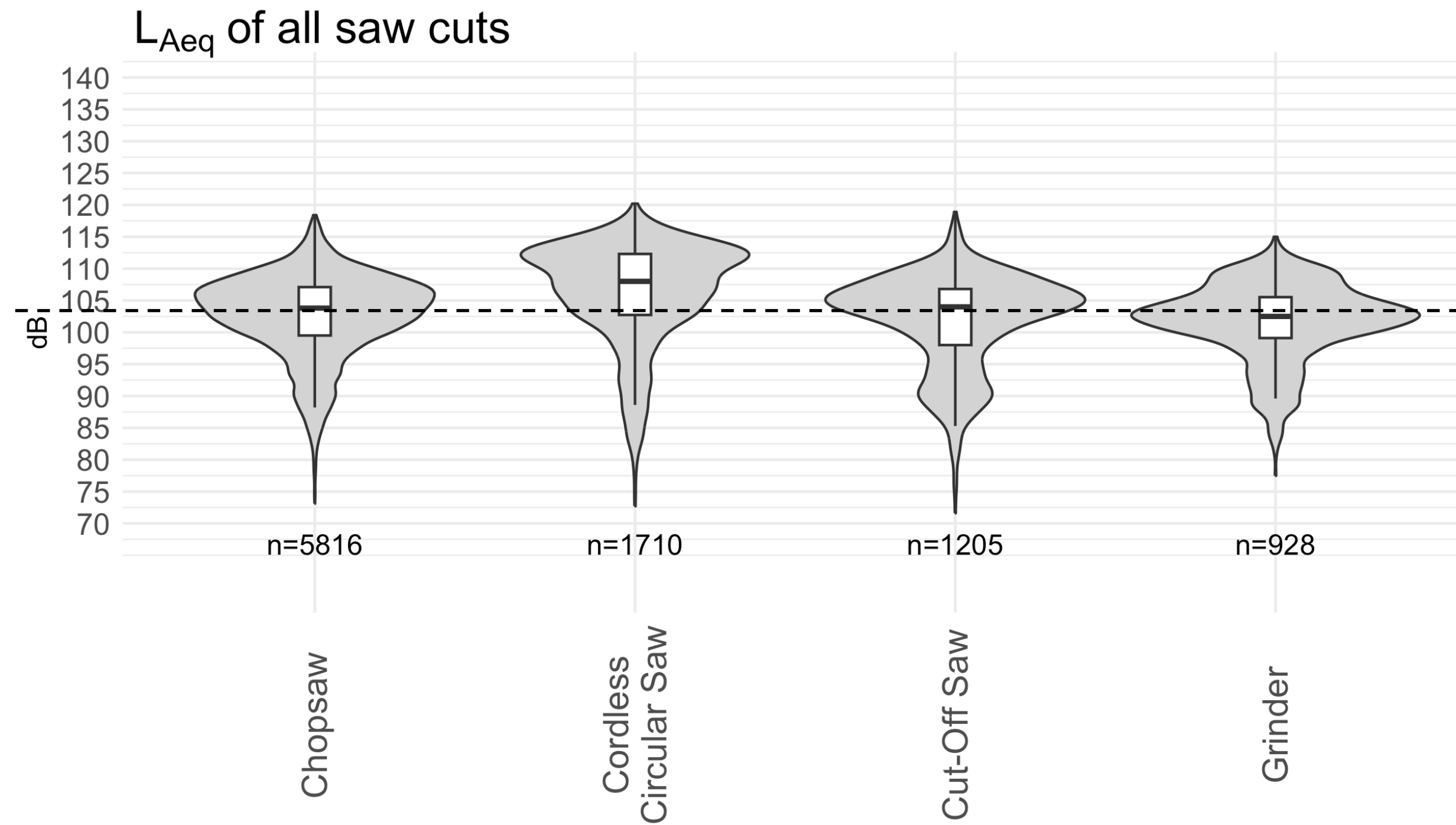
117.8

* Log-transformed means

Saw Characterization Overview



Saw Characterization Overview



PAT Nailer

Aka “shotgun” or “Ramset”



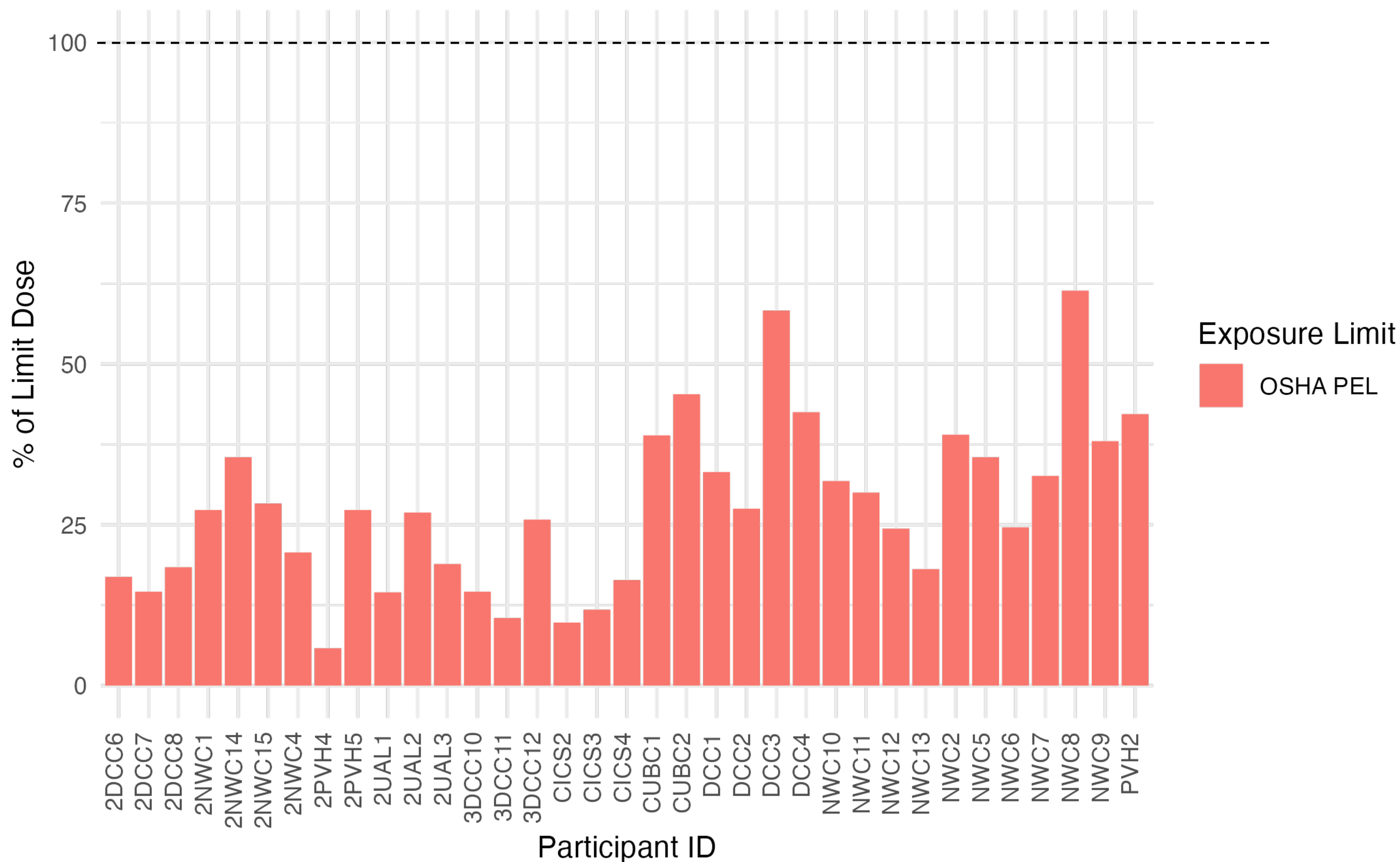
L_{Aeq} (dB) 108.4

L_{Cpeak} (dB) 138.1

* Log-transformed means

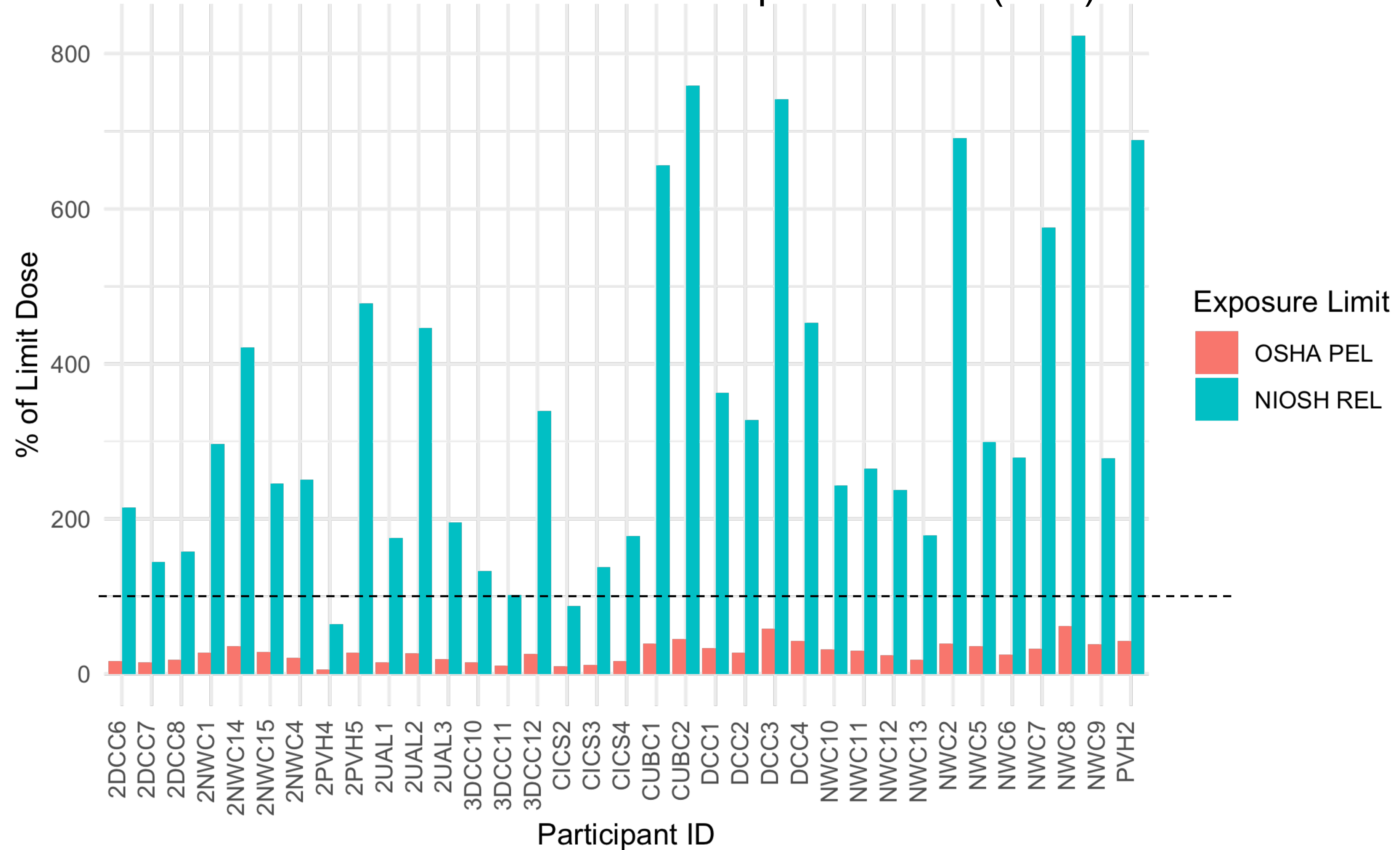
Noise dose results

OSHA Permissible Exposure Limit (PEL)



Noise dose results

NIOSH Recommended Exposure Limit (REL)

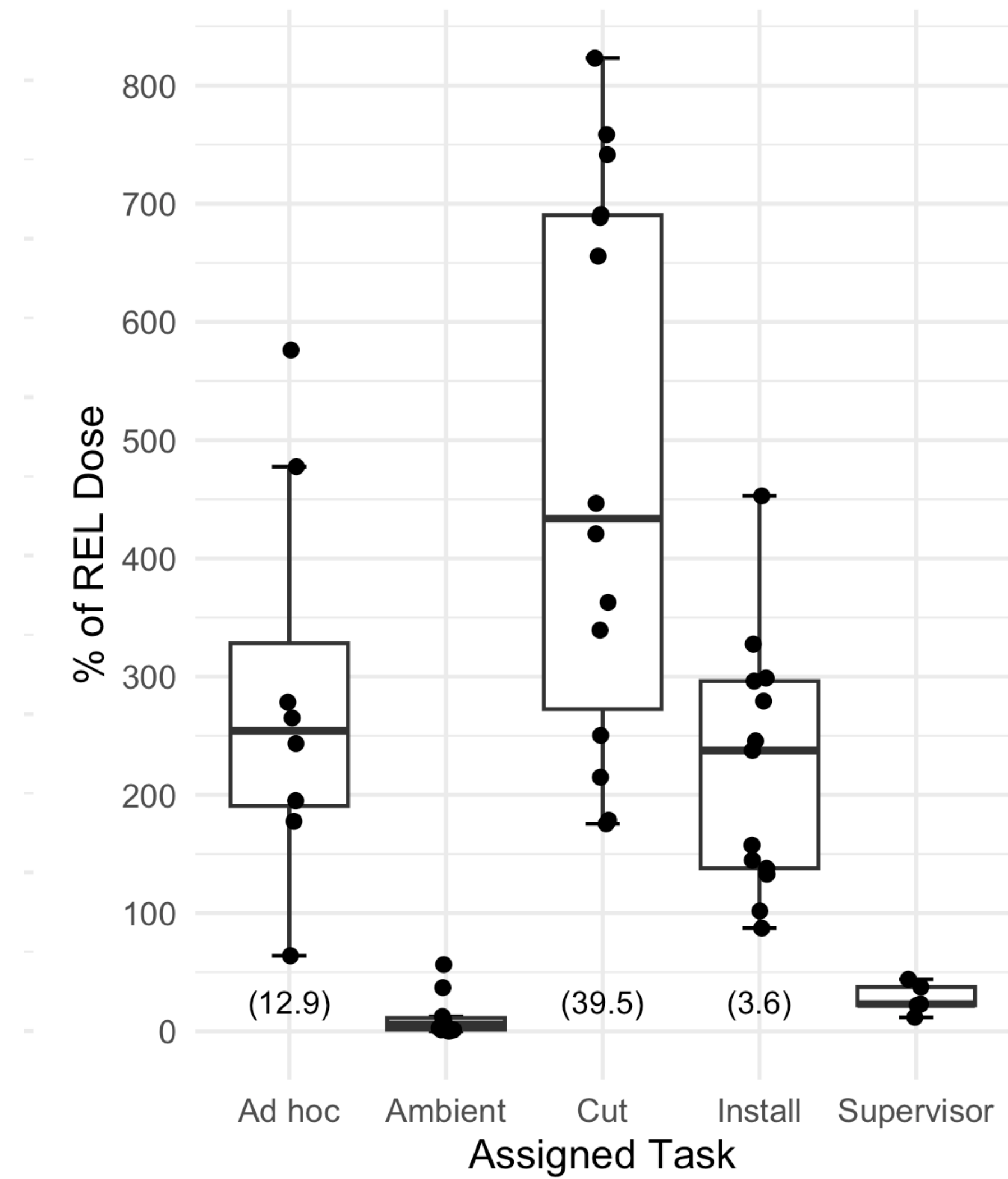


Task Assignments

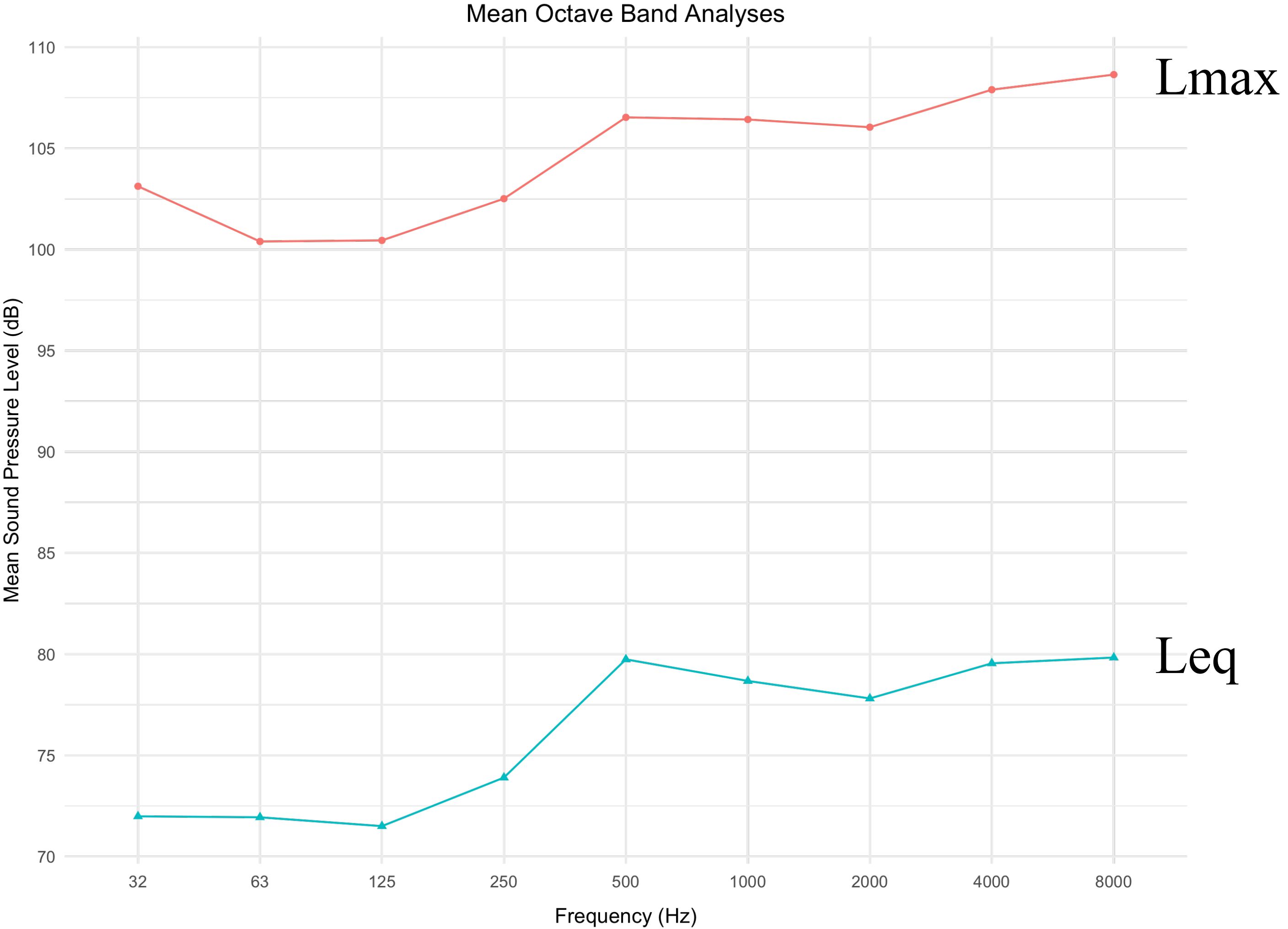
- Install vs. saw operator
- Numbers of cuts per day
 - 40/day for saw operators
 - 4/day for installers



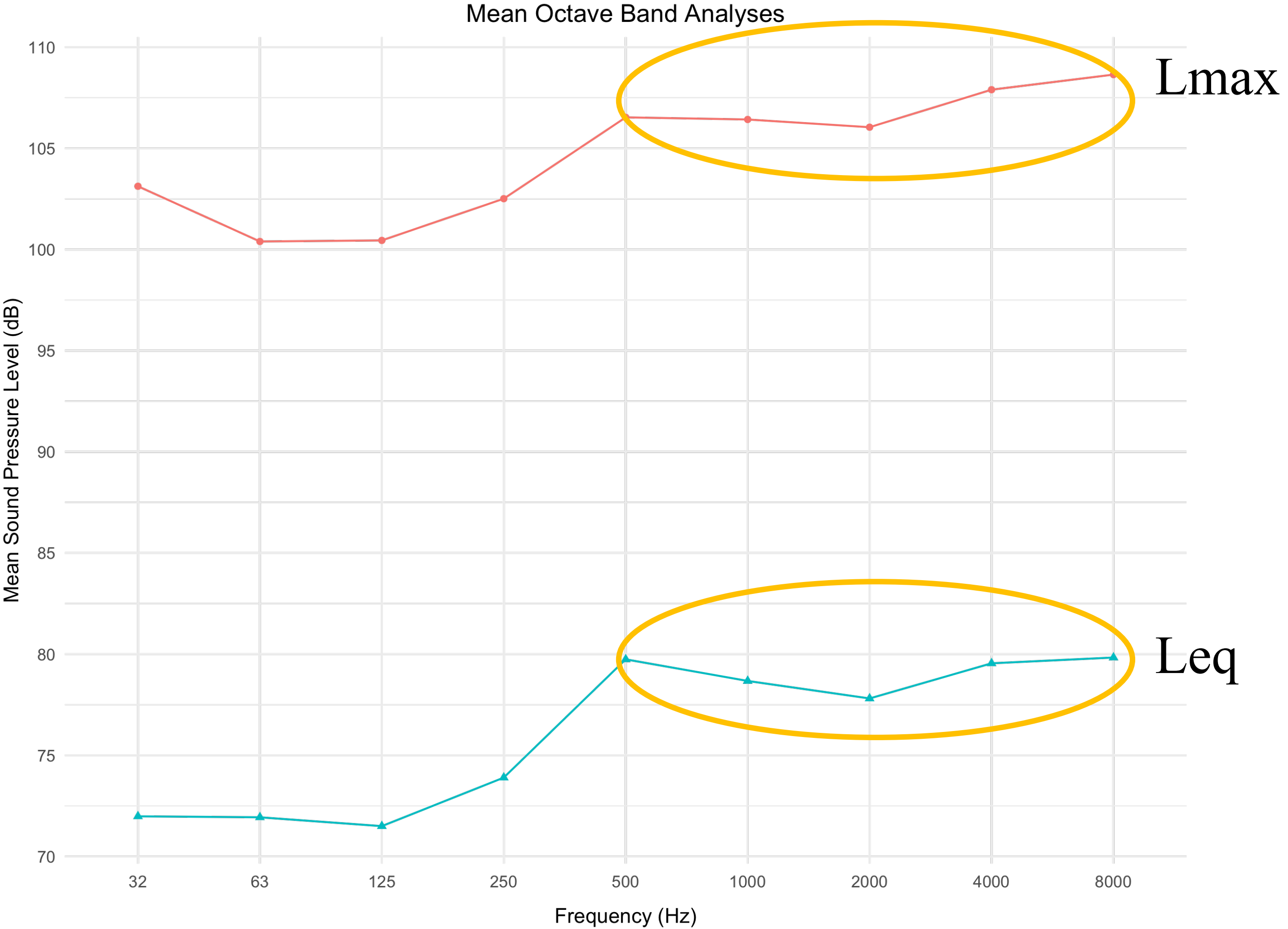
REL dose by Task Assignment



Octave Band Analysis



Octave Band Analysis



Saw Limit Recommendations

- NIOSH exposure duration equation
- L_{Aeq} for the saws

- $$T_{min} = \frac{480}{2(L-85)/3}$$



Saw Limit Recommendations

Stud/Saw Combination	L _{Aeq} (dB)	Mean cutting time (sec)	(Time allowed) ³	(Time allowed) ³	(Time allowed) ³
			Max # of cuts to REL no HPD	Max # of cuts with foam earplugs ¹	Max # of cuts with earmuffs ²
Any saw type:			(165 – 175 sec)	(1321 – 1403 sec)	(3525 – 3744 sec)
Any general stud size	107.0 – 107.3	12.8	13 – 14 cuts	103 - 110 cuts	275 - 293 cuts
Chopsaw:	106.1 – 106.4		(203 – 220 sec)	(1629 – 1756 sec)	(4348 – 4688 sec)
Any general studs (except 6" 97 mil; 152 mm/2.454 mm)		10.8	19-20 cuts	151 – 163 cuts	403 – 434 cuts
4" nominal (92 mm) studs		3.5	58-63 cuts	465 – 502 cuts	1242 – 1339 cuts
6" (152 mm) studs (except 97 mil; 2.454 mm)		15.7	13 – 14 cuts	104 – 112 cuts	277 - 299 cuts
6" 97 mil (152 mm/2.454 mm) studs		57.7	4 cuts	28 - 30 cuts	75 - 81 cuts
Cordless Circular Saw:	110.1 – 110.6		(77 – 86 sec)	(618 – 689 sec)	(1650 – 1838 sec)
Any general studs		7.2	11 – 12 cuts	86 - 96 cuts	229 - 255 cuts
Cut-off Saw:	105.5 – 106.2		(213 – 252 sec)	(1701 - 2014 sec)	(4542 - 5377 sec)
Any 54 mil (1.366 mm) studs		9.7	22 - 26 cuts	175 - 208 cuts	468 - 554 cuts
4" nominal (92 mm) studs ⁴		4.7	45 - 54 cuts	362 - 429 cuts	966 - 1144 cuts
Grinder:	104.4 – 105.0	23.2	(281 – 328 sec)	(2247 – 2621 sec)	(6000 – 6997 sec)



Note: For isolated tool use only.

¹with 9 dB of attenuation after derating 32 NRR foam earplugs per NIOSH guidelines
²with 13.25 dB of attenuation after derating 27 NRR hardhat-mounted earmuffs per NIOSH guidelines
³Time allowed calculated from Eq. 2
⁴Limited sampling data

Saw Limit Recommendations

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Saw Limit Recommendations



Saw	L _{Aeq} (dB)	(Time allowed) ³ No HPD	(Time allowed) ³ Foam earplugs ¹	(Time allowed) ³ Earmuffs ²
Any saw type		(165 – 175 sec)	(1321 – 1403 sec)	(3525 – 3744 sec)
Chopsaw	106.1 – 106.4	(203 – 220 sec)	(1629 – 1756 sec)	(4348 – 4688 sec)
Cordless Circular Saw	110.1 – 110.6	(77 – 86 sec)	(618 – 689 sec)	(1650 – 1838 sec)
Cut-off Saw	105.5 – 106.2	(213 – 252 sec)	(1701 - 2014 sec)	(4542 - 5377 sec)
Grinder	104.4 – 105.0	(281 – 328 sec)	(2247 – 2621 sec)	(6000 – 6997 sec)

¹with 9 dB of attenuation after derating 32 NRR foam earplugs per NIOSH guidelines

²with 13.25 dB of attenuation after derating 27 NRR hardhat-mounted earmuffs per NIOSH guidelines

³Time allowed calculated from Eq. 2

⁴Limited sampling data

	Mean (sec)	Range (sec)
Saw use per day	428.0	13 – 1105

Note: For isolated tool use only.

PAT Nailer Limit Recommendations



Note: For isolated tool use only.

$$N = 10^{(140 - PI)/10} \quad (5)$$

Mean (shots)	Range (shots)	L_{Cpeak} (dB)
40.1	7 – 114	138.1

PAT Shot Type	L_{Cpeak} (dB)	Max # of shots to REL (No HPD)	Max # of shots (foam earplugs) ¹	Max # of shots (earmuffs) ²	Max # of shots (double HPD) ³
Yellow or Red Cartridges	137.9 – 138.9	1.3 – 1.6	10-13	27-34	86-108
With extension pole⁴	134.0 – 135.5	3 - 4	23 - 31	60 - 83	190 - 263

¹with 9 dB of attenuation after derating 32 NRR foam earplugs per NIOSH guidelines

²with 13.25 dB of attenuation after derating 27 NRR hardhat-mounted earmuffs per NIOSH guidelines

³5-dB added to earmuff attenuation for double protectors per most-conservative NIOSH guidelines; as 18.25 of total attenuation

⁴Assumed shot at 7 ft (2.1 m) above hearing zone

⁵Murphy and Tubbs. (2007). Assessment of Noise Exposure for Indoor and Outdoor Firing Ranges

Overall Recommendations

- Further this research to develop more advanced models for recommendations
- Training needs to be tailored to workers in a language they understand
- Consider rotating workers through task assignments with less noise exposure
- Consider switching to hardhat-mounted earmuffs instead of earplugs



Acknowledgements



Colorado State University



Phase 2 Company



Questions??



Impact Driver



PAT Nailer and Impact Driver

Two other commonly-used tools

PAT Nailer



Impact Driver



L_{Aeq} (dB) 108.4

L_{cpeak} (dB) 138.1

98.5

117.6

* Log-transformed means

Impact Driver Limit Recommendations



$$T_{min} = \frac{480}{2^{(L-85)/3}}$$

Mean (sec)	Range (sec)	L _{Aeq} (dB)
387.4	16 – 877	98.5

Note: For isolated tool use only.

	L _{Aeq} (dB)	Average time above 90 dBA per screw driven	(Time Allowed)	(Time Allowed)
			Max # of screws to REL (No HPD)	With foam earplugs ¹
			(1215 – 1333 sec)	(9723 – 10664 sec)
Impact Driver	98.3 – 98.7	2.5 sec	486 – 533 screws	3889 – 4266 screws

¹with 9 dB of attenuation after derating 32 NRR foam earplugs per NIOSH guidelines