

VIBRATION IN THE ENVIRONMENT

Presented by Bob Rimrott

aercoustics
engineering limited

Acoustics
Noise
Vibration

Why are we here?

Because we have a facility that may have a vibration issue and aren't sure what to do

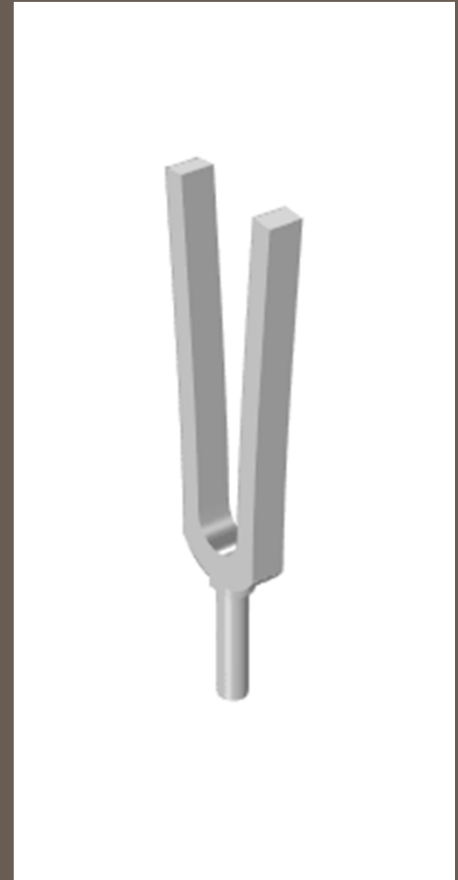
AGENDA

1. Understanding Vibration
2. Human Perception
3. Vibration Report
4. Measurement
5. Criteria
6. Conclusions

Understanding Vibration

Definition of “*Vibration*”:

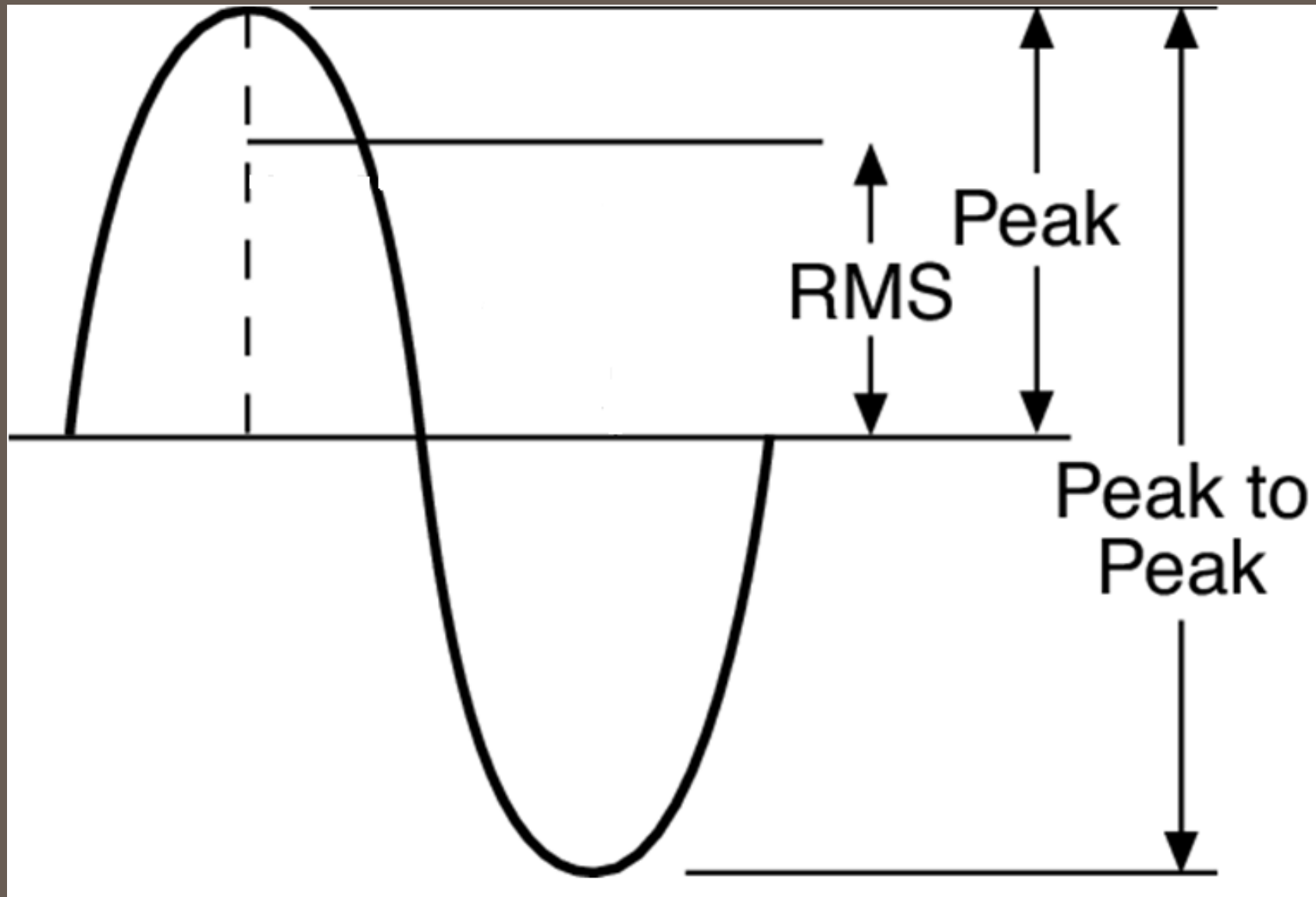
“the periodic motion of a rigid or elastic body forced from a position of equilibrium.”



Understanding Vibration

- Displacement (mm or micro-inches)
Easiest to visualize
- Velocity (mm/s or $\mu\text{in/s}$)
What most standards reference
- Acceleration (mm/s^2 or ‘%g’)
Easy to measure and related to forces

Understanding Vibration



CREST FACTOR: Ratio of Peak to RMS

Understanding Vibration

Unlike sound, there's no clearly standardized reference level, V_0

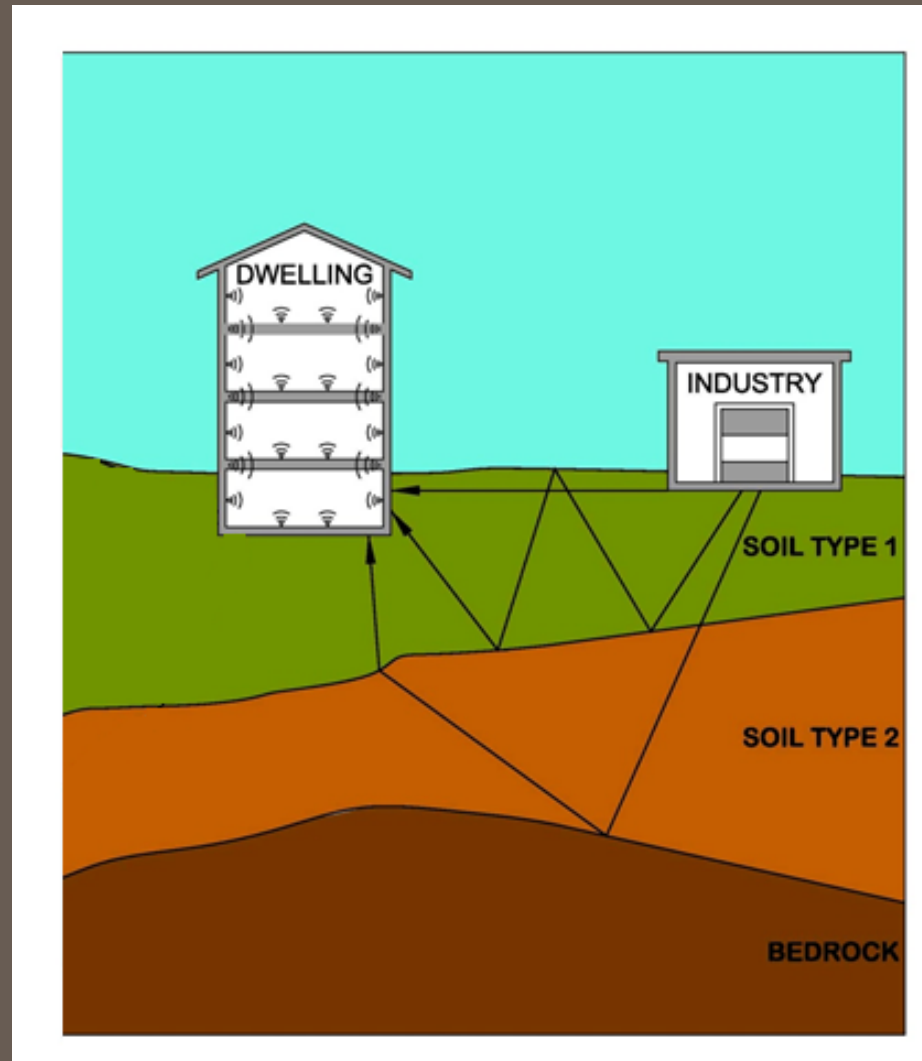
$$\text{Vibration (dB)} = 10 \log \left(\frac{V^2}{V_0^2} \right)$$

- Displacement
- Velocity
- Acceleration

Human Perception

Semantic Label	R.M.S. acceleration (mm/s ²) / (%g)		Semantic Label
	315	3.21%	
Very strong Perception	250	2.55%	
	200	2.04%	
	160	1.63%	Strong Perception
	125	1.27%	
	100	1.02%	
	80	0.82%	
Very clear Perception	63	0.64%	
	50	0.51%	
	40	0.41%	Clear Perception
	31.5	0.32%	
	25	0.25%	
Perception probable	20	0.20%	
	16	0.16%	
	12.5	0.13%	
	10	0.10%	Perception improbable
	8	0.08%	
	6.3	0.06%	
	5	0.05%	

Vibration Assessment Report



Vibration Assessment Report

- Introduction
- Facility Description
- *Vibration Source Summary*
- *Point of Reception Vibration Impact*
- *Vibration Assessment Summary*
- Conclusions

Vibration Source Summary Table

Table A4

Vibration Source Summary Table
(add columns or tables to address all receptors)

Source ID ¹	Source Description	Vibration Control Measures ²	Distance to R1 (metre)	Distance to R2 (metre)	Distance to R3 (metre)	Distance to R4 (metre)
A	Stamping press A	V	100	140	100	92
B	Stamping press B	V	120	146	80	90

Notes:

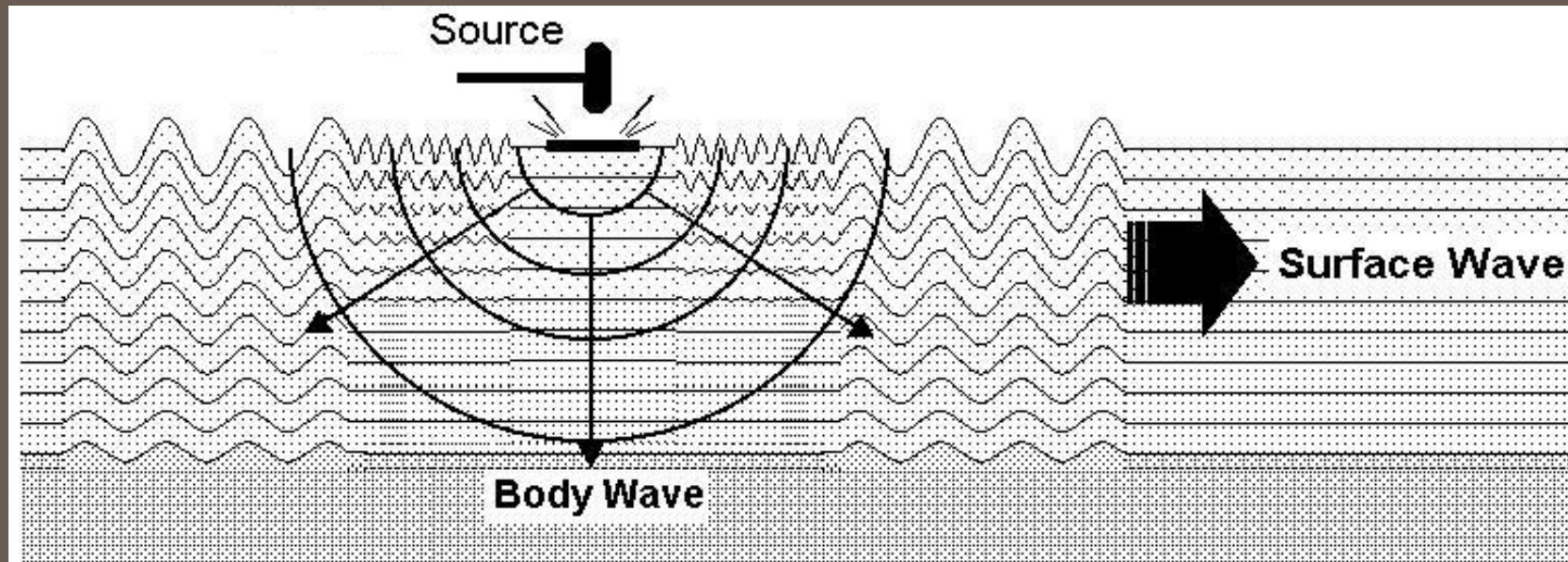
1. Wherever possible, the Source ID must be identical with that used in the ESDM report.
2. Vibration Control Measures
V: vibration isolation such as springs, pads, etc.
P: path interruption such as trench
O: other
U: uncontrolled

Vibration Generating Equipment

1. Stamping Plants
2. Rotating equipment (e.g. pumps)
3. Blasting (in Quarry's)

Measuring at the source is useful but measuring at the receptor gives best determination of compliance

Vibration Propagation



There's no 6 dB reduction per doubling of distance

Measurement



*At the
receptor, we
measure
inside.*

MOE Criteria

- Ontario Ministry of the Environment (MOE)
 - NPC-207 “Impulse Vibration in Residential Buildings”
 - NPC-119 “Blasting”

Industry Standard

- International Standards Organisation (ISO)
 - ISO 2631 “Evaluation of human exposure to whole-body vibration”

Criteria

TABLE 207-2

VIBRATION LIMITS FOR FREQUENT IMPULSES
(20 or More Impulses Reported in Observation Period)

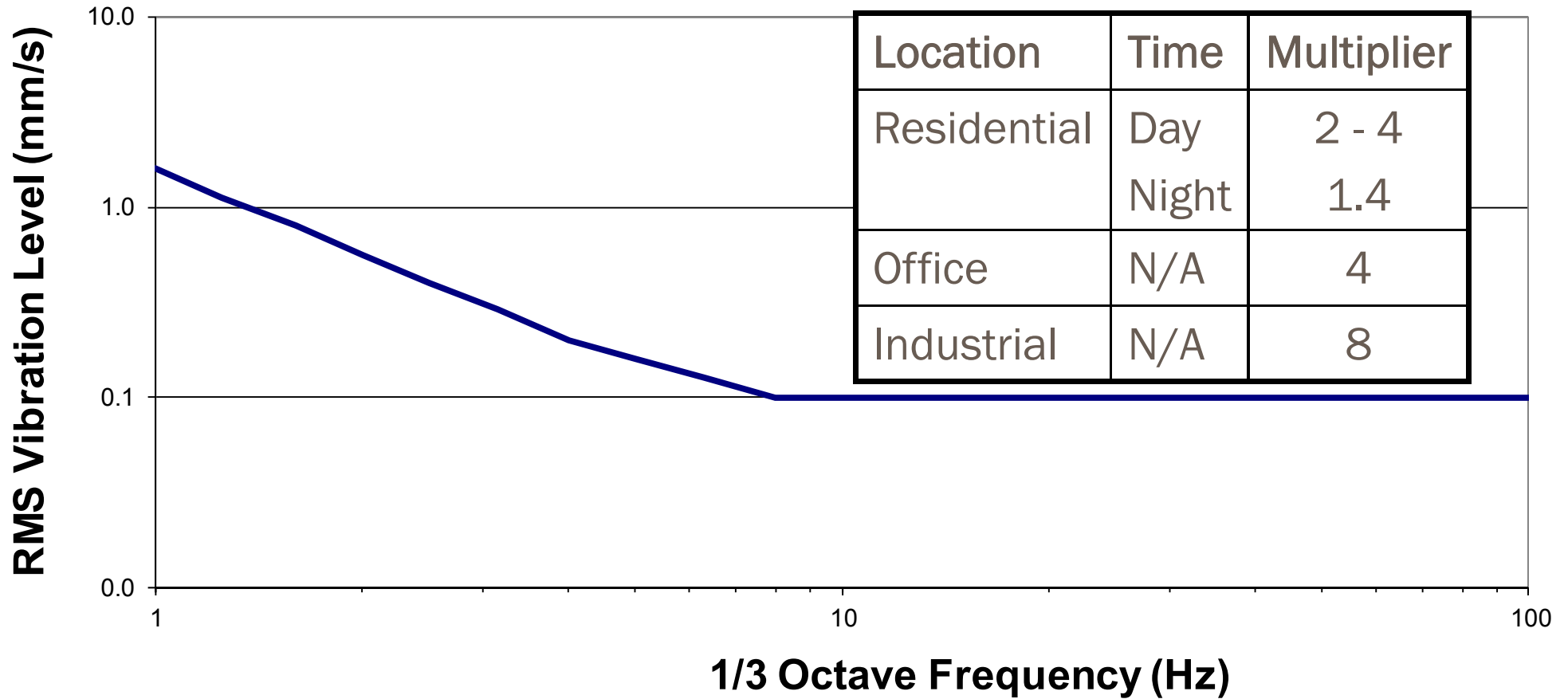
Applicable Clause	Observation Period Minutes	Limit on the Average Peak Vibration Velocity mm/s	
		Day-time 07:00-23:00	Night-time 23:00-07:00
4(4) (b)	20 minutes or less	0.30	0.30
4(4) (c) (i)	Less or equal to 60 minutes but more than 20 minutes	0.60	0.30
4(4) (c) (ii)	Less or equal to 120 minutes but more than 60 minutes	1.00	0.30

For infrequent events, the limit is 10 mm/s

Per NPC 207 (Draft)

Criteria

ISO Vibration Base Curve



Per ISO 2631 (1983)

Vibration Assessment Summary Table

Table A5
Vibration Assessment Summary Table

Receptor ID	Receptor Description	Vibration at Receptor (mm/s)	Verified by Vibration Audit (Yes/No)	Performance Limit (mm/s)	Compliance with Performance Limit ¹ (Yes/No)
R1	House to North	0.21	Yes	0.30	Yes
R2	House to East	0.17	Yes	0.30	Yes
R3	Nursing Home to South	0.22	Yes	0.30	Yes
R4	School to West	0.27	Yes	0.30	Yes

Structural Damage

Human perception is orders of magnitude below the onset of structural damage.

Vibration - Cautionary Limit

Subject to section 7, the peak particle velocity limit for vibration resulting from blasting operations in a mine or quarry is 1.00 cm/s.

Vibration - Peak Particle Velocity Limit

If the person in charge of a blasting operation carries out routine monitoring of the vibration the peak particle velocity limit for vibration resulting from blasting operations in a mine or quarry is 1.25 cm/s.

THANK YOU

Bob Rimrott

BobR@aercoustics.com

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