BUILDING VIBRATION STANDARDS Revision A

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Introduction

The purpose of this report is to give some recommended standards for building vibration. Note that the standards are derived from empirical data.

Each standard has a specific purpose. Here are some concerns:

1. Potential damage to the building
2. Health and well-being of the people occupying the building
3. Precision of optical microscopes, machining, and other operations

Some standards may attempt to address several purposes.

Furthermore, vibration standards are typically represented in terms of velocity.

Example I

Recommended limit values for traffic are given in Table 1, as taken from References 1 and 2. The peak value is taken from the velocity time history.

Table 1. Recommended Limit Values for Traffic

Type of building and foundation	Recommended vertical velocity Vmax [mm/sec]
Especially sensitive buildings and buildings of cultural and historic value	1
Newly-built buildings and/or foundations of a foot plate (spread footings)	2
Buildings on cohesion piles	3
Buildings on bearing piles or friction piles	5

Example II

Colin Gordon, Reference 3, has derived generic criterion curves, with an emphasis on semiconductor facilities, as shown in Table 2 and in Figure 1. The velocity is measured in one-third octave bands over the frequency range from 8 Hz to 100 Hz.

Table 2. Generic Vibration Criterion Curves

Criterion Curve	Max Level Velocity RMS (micrometers/sec)	Detail Size (microns)	Description of Use
Workshop (ISO)	800	N/A	Distinctly feelable vibration. Appropriate to workshops and nonsensitive areas.
Office (ISO)	400	N/A	Feelable vibration. Appropriate to offices and nonsensitive areas.
Residential Day (ISO)	200	75	Barely feelable vibration. Appropriate to sleep areas in most instances. Probably adequate for computer equipment, probe test equipment and low-power (to 20X) microscopes.
Theater (ISO)	100	25	Vibration not feelable. Suitable for sensitive sleep areas. Suitable in most instances for microscopes to 100X and for other equipment of low sensitivity.
VC-A	50	8	Adequate in most instances for optical microscopes to 400X, microbalances, optical balances, proximity and projection aligners, etc.
VC-B	25	3	An appropriate standard for optical microscopes to 1000X, inspection and lithography equipment (including steppers) to 3 micron line widths.
VC-C	12.5	1	A good standard for most lithography and inspection equipment to 1 micron detail size.
VC-D	6	0.3	Suitable in most instances for the most demanding equipment including electron microscopes (TEMs and SEMs) and E-Beam systems, operating to the limits of their capability.
VC-E	3	0.1	A difficult criterion to achieve in most instances. Assumed to be adequate for the most demanding of sensitive systems including long path, laser-based, small target systems and other systems requiring extraordinary dynamic stability.

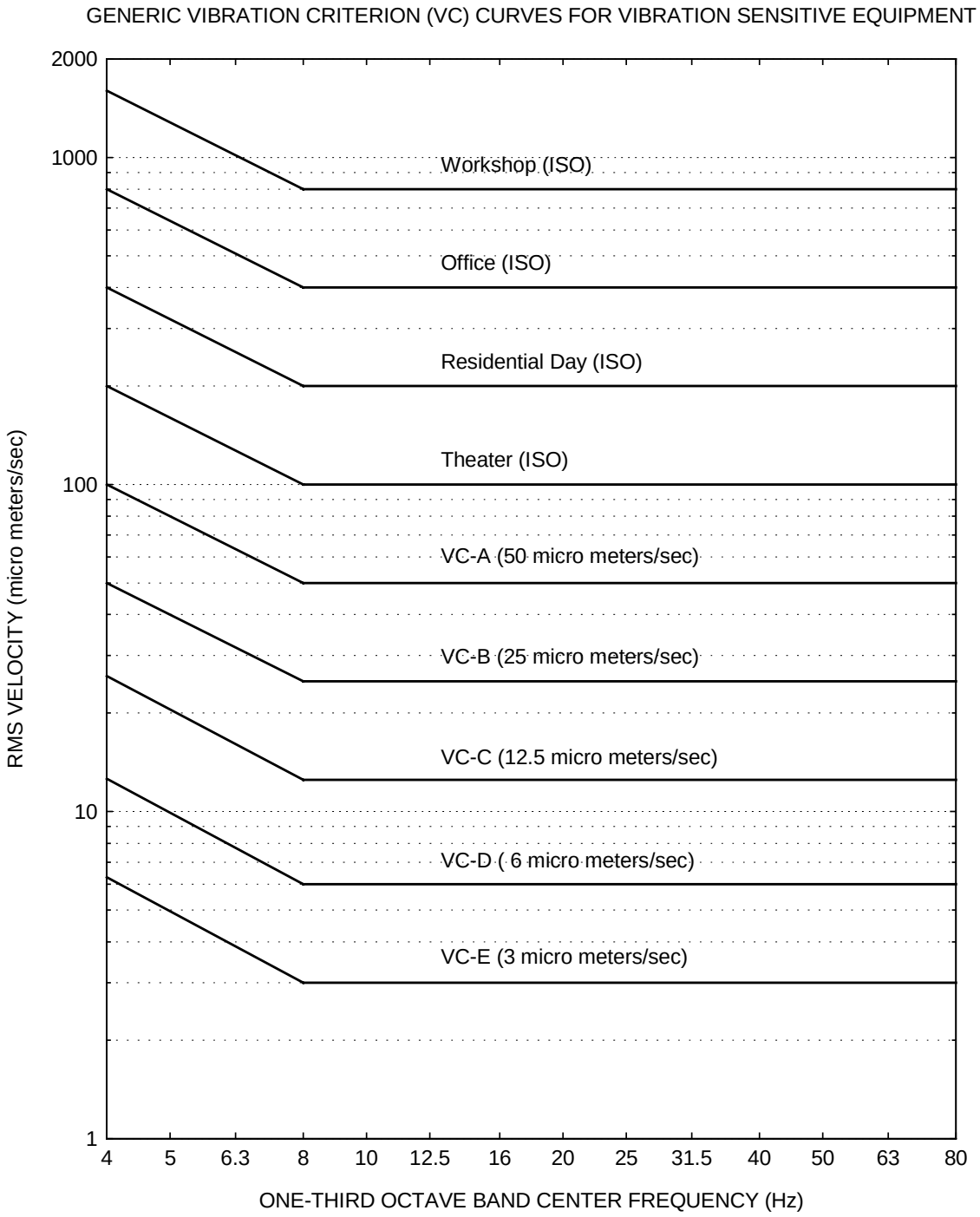
GENERIC VIBRATION CRITERION (VC) CURVES FOR VIBRATION SENSITIVE EQUIPMENT
RMS VELOCITY (micro meters/sec)
2000
1000
100
10
1
Workshop (ISO)
Office (ISO)
Residential Day (ISO)
Theater (ISO)
VC-A (50 micro meters/sec)
VC-B (25 micro meters/sec)
VC-C (12.5 micro meters/sec)
VC-D (6 micro meters/sec)
VC-E (3 micro meters/sec)
4
5
6.3
8
10
12.5
16
20
25
31.5
40
50
63
80
ONE-THIRD OCTAVE BAND CENTER FREQUENCY (Hz)

Figure 1.

Notes:

The detail size refers to the line widths for microelectronics fabrication, the particle (cell) size for medical and pharmaceutical research, etc. The values given take into account the observation that the vibration requirements of many items depend upon the detail size of the process.

Vibration Sources

The diagram in Figure 2 shows typical vibration sources for building excitation.

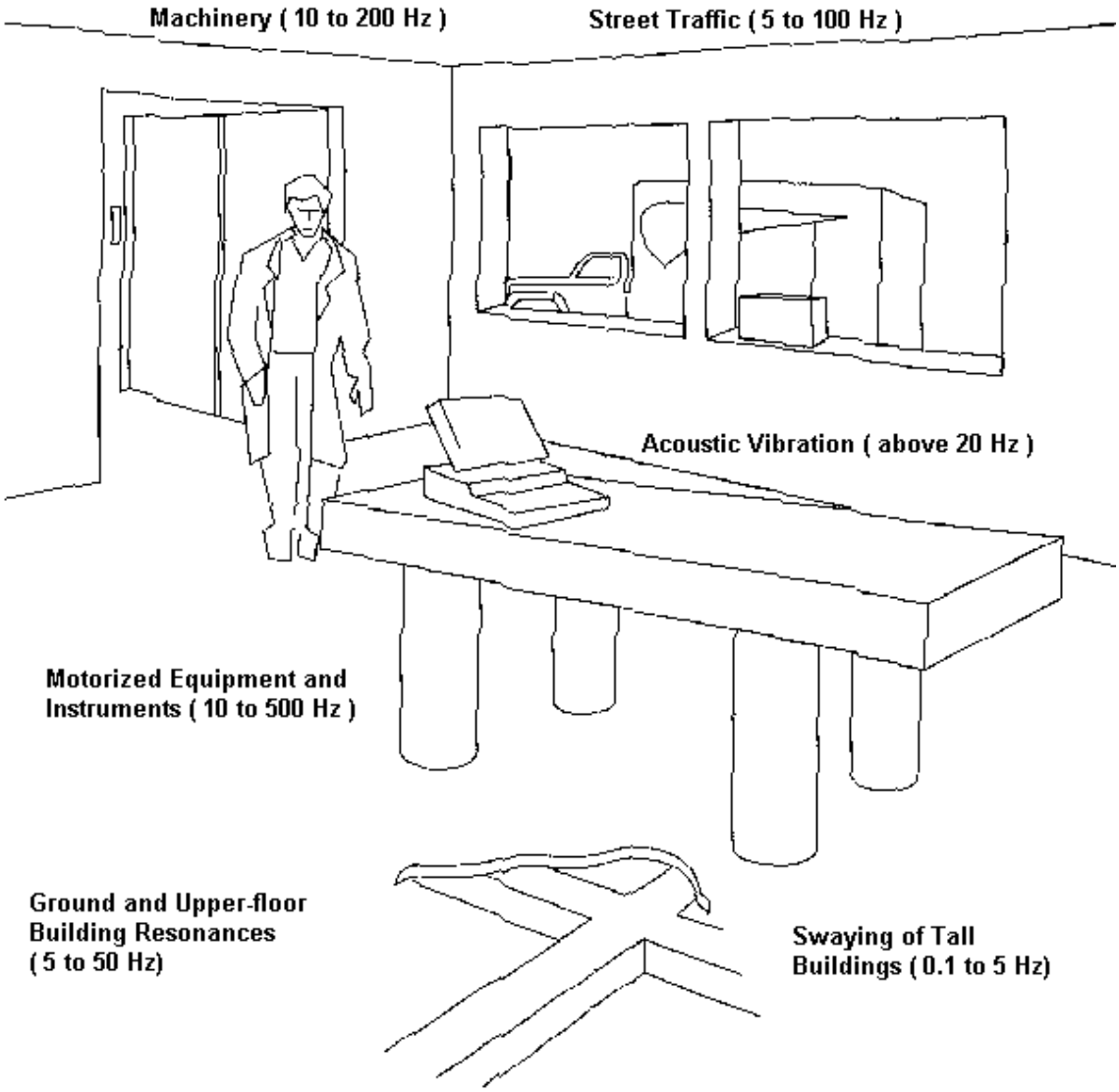

Figure 2. Building Vibration Sources (Courtesy of Newport Optics)

References

1. G. Bonde, et al, Criteria for Acceptable Traffic-Induced Vibrations, Institute of Technology, Uppsala University, UPTEC 81 42 R, TRAVI-K, 1981.

2. H. Bachmann, et al., Vibration Problems in Structures, Birkhauser Verlag, Berlin, 1995.

3. C. Gordon, Generic Vibration Criteria for Vibration-Sensitive Equipment, SPIE Proceedings Volume 1619, 1991.