

Appendix I:D. Ultrasonics

Applicability of OSHA's Noise Standard, 1910.95

OSHA's noise [1910.95](#) addresses airborne ultrasonic noise because of OSHA's criterion parameters.

- At 20 kilo-Hertz (kHz), an A-weighted sound pressure level is 10 decibels (dB) below an unweighted sound pressure level.
- At 50 kHz, an A-weighted sound pressure level is 25 dB below the corresponding unweighted level.
 - Example: If an A-weighted instrument is used to measure a 50 kHz, 110-dB tone, the instrument will indicate 85 dBA. (Note that the American National Standards Institute's (ANSI) S1.4-1976 or S1.4-1983 standard, which sets the performance and accuracy tolerances that all OSHA sound-level meters must meet, requires a Type II microphone accuracy of only ± 5 to 4 at frequencies above 10,000 Hz).

Health Effects and Threshold Limit Values (TLVs®)

- Research indicates that ultrasonic noise has little effect on general health unless there is direct body contact with a radiating ultrasonic source. Reported cases of headache and nausea associated with airborne ultrasonic exposures appear to have been caused by high levels of audible noise from source subharmonics.
- The American Conference of Governmental Industrial Hygienists (ACGIH®) has established permissible ultrasound exposure levels. These recommended limits (set at the middle frequencies of the one-third octave bands from 10 kHz to 50 kHz) are designed to prevent possible hearing loss caused by the subharmonics of the set frequencies, rather than the ultrasonic sound itself.
 - These TLVs® represent conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse effect on their ability to hear and understand normal speech. Previous TLVs® for frequencies in the 10 kHz to 20 kHz range, set to prevent subjective effects, are referenced in a cautionary note below (1). The 8-hour time-weighted average (TWA) values are an extension of the TLVs® for noise, which is an 8-hour TWA of 85 dBA for sound below 10 kHz. The ceiling values may be verified by using an integrating sound level meter with slow detection and 1/3 octave bands. All instrumentation should have adequate frequency response and should meet the specifications of ANSI S1.4-1983 and International Electrotechnical Commission (IEC) 804.
 - Measuring any source suspected of producing sound at levels exceeding the ACGIH® recommended limits requires the use of a precision sound level meter, equipped with a suitable microphone of adequate frequency response, and a portable third-octave filter set. Consult with the Assistant Regional Administrator for Technical Support for guidance.

TLVs® for Ultrasound			
	One-third Octave-Band Level		
	Measured in Air in dB re: 20 µ Pa; Head in Air		Measured in Water in dB re: 1 µ Pa; Head in Water
Mid-Frequency of Third-Octave Band (kHz)	Ceiling Values	8-Hour TWA	Ceiling Values
10	105 ^A	88 ^A	167
12.5	105 ^A	89 ^A	167
16	105 ^A	92 ^A	167
20	105 ^A	94 ^A	167
25	110 ^B	--	172
31.5	115 ^B	--	177
40	115 ^B	--	177
50	115 ^B	--	177
63	115 ^B	--	177
80	115 ^B	--	177
100	115 ^B	--	177
^A Subjective annoyance and discomfort may occur in some individuals at levels between 75 and 105 dB for the frequencies from 10 kHz to 20 kHz especially if they are tonal in nature. Hearing protection or engineering controls may be needed to prevent subjective effects. Tonal sounds in frequencies below 10 kHz might also need to be reduced to 80 dB.			
^B These values assume that human coupling with water or other substrate exists. These thresholds may be raised by 30 dB when there is no possibility that the ultrasound can couple with the body by touching water or some other medium. [When the ultrasound source directly contacts the body, the values in the table do not apply. The vibration level at the mastoid bone must be used.] Acceleration Values 15 dB above the reference of 1g rms should be avoided by reduction of exposure or isolation of the body from the coupling source. (g = acceleration due to the force of gravity, 9.80665 meters/second; rms = root-mean-square).			
Source: ACGIH® Worldwide. 2003 TLVs® and BEIs®: Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices, p.107.			

Controls

- High frequency noise is very directional and is relatively easily reflected or blocked by any type of barrier. The wavelength of a 16 kHz tone, for example, is about 3/4 inch, so a barrier of one to two inches higher than the source is generally sufficient to reflect noise of approximately the same frequency away from the nearby worker. Such barriers are inherent in some of the machines and surfaces themselves.
- High frequency audible noise is also easily absorbed by any of the so-called acoustical materials (for example, glass fiber or foam).