

### Sound Level Comparison Chart

Table of sound level dependence and the change of the respective ratio to subjective loudness (volume), objective sound pressure (voltage), and sound intensity (acoustic power).

**How many decibels (dB) level is double, half, or four times as loud?**

**How many dB to appear twice as loud? Here are all the different ratios?**

Level Change	Volume Loudness	Voltage Sound pressure	Acoustic Power Sound Intensity
+40 dB	16	100	10000
+30 dB	8	31.6	1000
+20 dB	4	10	100
<b>+10 dB</b>	2.0 = double	3.16 = $\sqrt{10}$	<b>10</b>
+6 dB	1.52 times	2.0 = double	4.0
+3 dB	1.23 times	1.414 times = $\sqrt{2}$	2.0 = double
----- ±0 dB -----	----- 1.0 -----	----- 1.0 -----	----- 1.0 -----
-3 dB	0.816 times	0.707 times	0.5 = half
-6 dB	0.660 times	0.5 = half	0.25
<b>-10 dB</b>	0.5 = half	0.316	0.1
-20 dB	0.25	0.100	0.01
-30 dB	0.125	0.0316	0.001
-40 dB	0.0625	0.0100	0.0001
<b>Log. quantity</b>	<b>Psycho quantity</b>	<b>Field quantity</b>	<b>Energy quantity</b>
<b>dB change</b>	<b>Loudness multipl.</b>	<b>Amplitude multiplier</b>	<b>Power multiplier</b>

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**Wrong expression****Correct version**

**Sound pressure falls inversely proportional to the square of the distance  $1/r^2$  from the sound source.**

**Sound pressure level decreases as the distance increases per doubling of distance from the source by (-)3 dB.**

**Sound intensity (energy) falls inversely proportional to the distance  $1/r$  from the sound source. wrong**

**Sound intensity level decreases inversely as the square of the distance increases per doubling of sound source with (-)3 dB per doubling. wrong**

**Sound pressure** falls inversely proportional to the distance  $1/r$  from the sound source.  
**That is the  $1/r$  law or distance law.**

**Sound pressure level** decreases by (-)6 dB per doubling of distance from the source to **1/2 (50 %)** of the sound pressure initial value.

**Sound intensity** (energy) falls inversely proportional to the square of the distance  $1/r^2$  from the sound source.

**Sound intensity level** decreases by (-)6 dB per doubling of distance from the source to **1/4 (25 %)** of the sound intensity initial value.

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## Permissible Exposure Time Guidelines – Sound Pressure Level - SPL

How long can a person endure a certain noise level before hearing impairment occurs?

Sound Pressure Level	Permissible Exposure Time
115 dB	0.46875 minutes (~30 sec)
112 dB	0.9375 minutes (~1 min)
109 dB	1.875 minutes (< 2 min)
106 dB	3.75 minutes (< 4 min)
103 dB	7.5 minutes
100 dB	15 minutes
97 dB	30 minutes
94 dB	1 hour
91 dB	2 hours
88 dB	4 hours
85 dB	8 hours
82 dB	16 hours

Accepted guidelines for recommended permissible exposure time for continuous time weighted average noise, according to **NIOSH-AINSI** and CDC.

For every 3 dB sound pressure level (SPL) over 85 dB, the permissible exposure time is cut in half – before damage to our hearing can occur.

NIOSH = National Institute for Occupational Safety and Health and  
 CDC = Centers for Disease Control and Prevention.  
 OSHA = Occupational Safety and Health Administration.

**This may not represent a worldwide view of the subject.**

Noise is an increasing public health problem and can have the following adverse health effects: hearing loss, sleep disturbances, cardiovascular and psychophysiological problems, performance reduction, annoyance responses, and adverse social behavior.

A person feels and judges sound events by exposure time, spectral composition, temporal structure, sound level, information content and subjective mental attitude.