

# Acoustic Terminology and Regulations

A reference guide to acoustic terminology,  
relevant regulations and standards

## Acoustic shock

ITU-T (The International Telecommunication Union – Telecommunication, part of UN) and ETSI (European Telecommunications Standards Institute) define an acoustic shock as:

*“Any temporary or permanent disturbance of the functioning of the ear, or of the nervous system, which may be caused to the user of a telephone earphone by a sudden sharp rise in the acoustic pressure produced by it.”*

All GN Netcom telecom headsets provide protection against permanent hearing damage with the built-in PeakStop that limits the maximum sound levels to 118 dB SPL (RMS). However, findings during the last couple of years indicate that in some cases, contact center agents have experienced discomfort, hypersensitivity to sound, and numbness as a result of sudden increases in sound levels below an RMS-value 118 dB RMS.

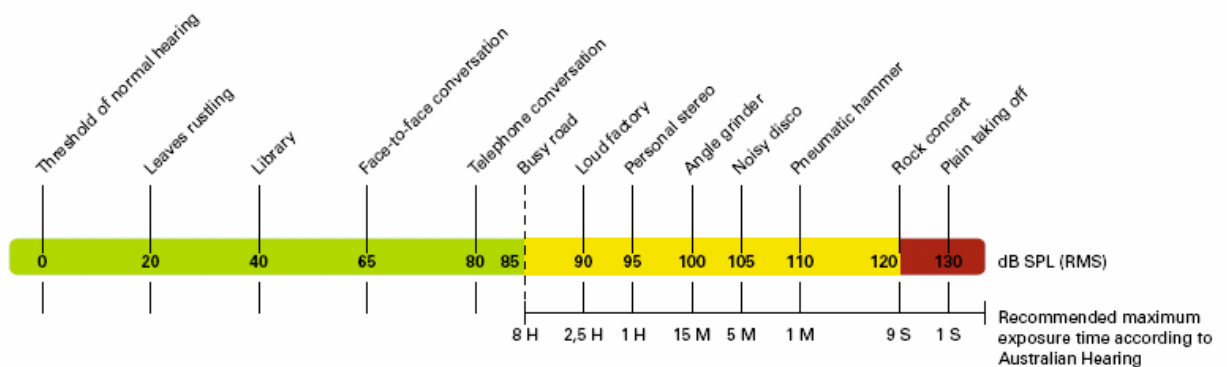
It is difficult to determine an absolute level below which acoustic shock is not experienced. This is because an acoustic shock not only is due to the loudness of the sound, but also to the nature and unexpectedness of the sound, the frequency level, and personal characteristics. A guideline from 2004 on prevention of acoustic shock from the Australian Communications Industry Forum (ACIF) suggests a frequency dependent limitation of loud sounds, resulting in a max RMS level of 102 dB SPL. The GN 8210 has been designed to comply with this guideline.

**dB or decibel.** One decibel is one tenth of a Bel, a unit named after the inventor of the telephone, Alexander Graham Bell. A difference of 1 dB between two sound levels is the smallest difference detectable by the human ear.

Decibel is a relative measure describing the ratio between two levels: 1) The level being measured, 2) A level of reference. To describe an absolute value, the level of reference must be known. For sound levels, the absolute level is referred to as dB SPL.

**dB SPL or Sound Pressure Level.** The level of reference for sound pressure level is the threshold of hearing for a 1kHz tone, equal to 0 dB SPL. The decibel scale is logarithmic, meaning that an increase of 6 dB actually equals twice the sound pressure. It is common to leave out the SPL definition when writing about decibel levels related to sound.

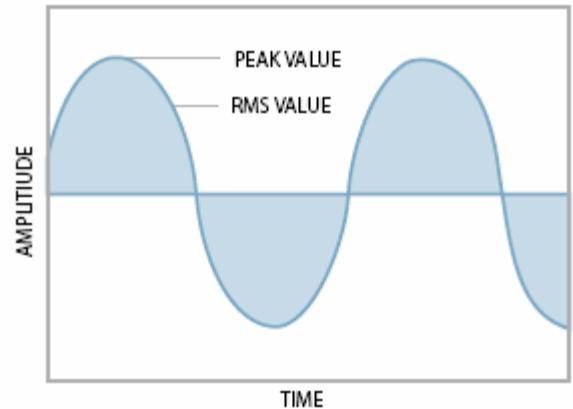
The below figure shows examples of dB levels from different sound sources and recommended time exposure.



**Frequency or Hz.** The number of wave cycles per second – 1 kHz or 1000 Hz is equal to 1000 cycles per second. As we move up in frequencies, we move up in pitch, like playing the keys of a piano from the base tones on the left to the treble tones on the right. A child is able to detect sounds between 20 Hz to 20,000 Hz, but as we age, we typically lose our ability to hear the highest pitch sounds. Speech typically lies between 100 up to 10000 Hz. Regular landline telephony only transmits frequencies between 300 to 3400 Hz, where most of the frequencies important to our understanding of speech lie.

**Peak value**

The absolute peak value is the maximum value that the sound waves reach. Internationally, 140 dB SPL is accepted as the agreed limit for absolute peak value that the ear should be exposed to. At a maximum peak value of 122 dB SPL, all GN Netcom telecom headsets are significantly below this limit.



**RMS value**

RMS value (Root Mean Square) is the actual energy within the signal. In many cases it is more relevant to look at the RMS value than the peak value. For headsets, the international agreed level for maximum RMS values is 118 dB SPL, which all GN Netcom telecom headsets meet. GN 8210 takes protection further to an RMS value of maximum 102 dB SPL.

**dB(A) or A-weighting** of the decibel level is the relationship between frequency and level. dB(A) is a standard for noise measurement that takes into account the human ear’s sensitivity to certain frequencies. The premise behind that at lower sounds, our ability to detect low or high frequency noise is reduced, so measurements should reflect this phenomenon. In general, we are most sensitive to sounds in the area between 3-4 kHz.

**Time weighted average exposure or LEQ levels**

This term usually does not concern high peaks or acoustic shock levels. Rather, LEQ mostly relates to exposure to lower noise levels (from e.g. machines on a factory floor), which - if the exposure time is long enough - can also affect your hearing. Even “self-induced” sounds from a rock concert or a noisy disco can be harmful. These types of noises are usually A-weighted and measured during an extended period of time to find the so-called time weighted average exposure or LEQ level. Time weighted average exposure is important in Noise-at-Work regulations and recommendations, where a maximum dB(A) level is measured over a working day (8 hours). These recommendations and regulations also affect contact centres, where operators are exposed to an average noise level through the headset during a day.

There are regional differences on the legal maximum LEQ level. In Europe, the coming regulation in 2006 states 87 dB(A) as the legal maximum level, with an upper action level at 85 dB(A) and a lower action level at 80 dB(A). In the US, OSHA’s legal limit is 90 dB(A), where as NIOSH recommends 85 dB(A). See more in the following pages.



# Regulations and Standards

An overview of relevant regulations, standards and guidelines

## Europe

	UK	Europe	Europe	Europe
<b>Institution</b>	Department of Trade and Industry	European Telecommunications Standards Institute	European Union	European Union
<b>Name of regulation</b>	Department of Trade and Industry Spec. 85/013	ETSI TBR 8	Council Directive 86/188/EEC of 12 May 1986 (CURRENT)	DIRECTIVE 2003/10/EC OF THE European PARLIAMT AND OF THE COUNCIL of 6 February 2003" (NEW)
<b>Website</b>	<a href="http://www.dti.gov.uk">www.dti.gov.uk</a>	<a href="http://www.etsi.org">www.etsi.org</a>	<a href="http://www.europa.eu.int">www.europa.eu.int</a>	<a href="http://www.europa.eu.int">www.europa.eu.int</a>
<b>Mandatory?</b>	Yes	No, but industry standard	Yes. Replaced by new regulation Feb 2006	Yes. Mandatory in all member states from February 2006
<b>Acoustic shock protection</b>				
<b>Absolute maximum peak level [dB SPL]</b>	-	-	-	<b>Exposure max limit: 140 dB</b> Upper action value: 137 dB Lower action value: 135 dB
<b>Maximum RMS value [dB SPL]</b>	118 dB SPL	118 dB SPL	-	-
<b>Noise exposure protection</b>				
<b>Time-weighted average exposure over 8 hrs (LEQ measurements) [dB(A) SPL]</b>	-	-	<b>Upper action value: 90 dB(A)</b> Lower action value: 85 dB(A)	<b>Exposure max limit: 87 dB(A)</b> Upper action value: 85 dB(A) Lower action value: 80 dB(A)

### Acoustic shock protection

140 dB SPL is the international accepted level for peak level protection, which is also incorporated in the EU legislation, among others. All GN Netcom headsets are well below at a maximum of 122 dB peak value.

An RMS value of 118 dB is the international level for headset protection, agreed to by leading authorities, such as ETSI. All GN Netcom telephone headsets are designed to comply with this limit. GN 8210 takes protection further to 102 dB.

### Noise exposure protection

By February 2006, no employees in the EU must be exposed to time-weighted average noise exposure above **87 dB(A)** during an 8 hour workday (measured when taking any hearing protection used into account). This does not relate to acoustic shock, but to a general noise exposure through the working day.

In the current regulation, the EU does not have a corresponding legal limit. Instead, the current EU regulation of 1986 operates with an upper action value of 90 dB(A), where the employer is required to take practical measures to reduce noise, and should this not be possible, hearing protection is mandatory.



February 15, 2006, this upper exposure value will be adjusted down to **85 dB(A)**, and thus becomes the value that – if exceeded – immediate action must be taken.

Furthermore, **80 dB(A)** is introduced as the lower action value (in the current regulation, this is 85 dB(A)). If noise exposure exceeds 80 dB(A), the employer should provide training and make hearing protection available to employees, if it is not possible to reduce noise.

The EU regulations apply to all work places, and thus also to contact centres. Contact centre operators are engaged in telephone conversation up to 8 hours per day, and although ambient room noise in the contact center can be quite high, the primary source of noise exposure is through the headset. This is because of the high telephone intensity of operators, but also due to the fact that ambient room noise will simply result in operators turning up the receive volume of their headset (most people require speech levels to be 10-15 dB above background noise for good intelligibility)<sup>1</sup>

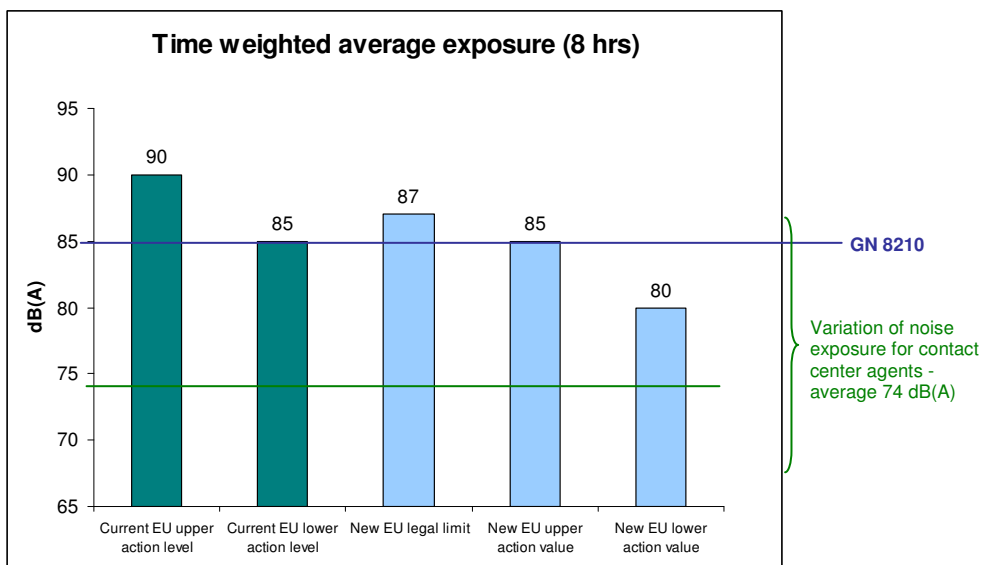
What does the new EU regulation mean to contact centres?

Most contact center operators are well below both the legal levels and action value levels. A study of 150 operators<sup>2</sup> in 15 different call centres in the UK showed that the average daily noise exposure level was 74 dB(A) for the 150 operators. The study also revealed that a some operators were in fact exposed to a volume level above the upper action value of 85 dB(A), as they preferred a high volume level for their telephone conversations.

Although they most likely do not exceed the legal maximum limit of 87 dB(A) in the future EU regulation, some operators are exposed to levels above the coming action values of 80 and 85 dB(A) – especially those in very noisy contact centres, who will be likely to turn up the volume.

Noise exposure between 80-85 dB(A) requires training on how to reduce noise levels (in contact centres this could be to encourage operators to turn down the volume via the volume control of the telephone or the headset amplifier).

However, for levels between 85 dB(A) and 87 dB(A), the new EU regulation actually states that immediate action must be taken, and hearing protection must be worn. Mandatory hearing protection is not feasible in a contact centre, so if employers wish to ensure that all operators are below the upper action value, suggested actions could be to reduce ambient room noise, to encourage employees to turn down headset volume, and to provide equipment designed especially for this purpose, such as GN Netcom’s digital amplifier, GN 8210.



<sup>1</sup> According to ACIF Guideline G616:2004, A2 (b)

<sup>2</sup> "Assessment of Noise Exposure of Call Centre Operators – Summary Report NV/01/123", December 2001

# Regulations and Standards

## North America & APAC

	US	US	US	Australia	Australia	Australia
<b>Institution</b>	Underwriters Laboratory Inc.	US Department of Labor	National Institute for Occupational Safety and Health (NIOSH)	Australian Communications Industry Forum	Australian Communications Industry Forum	Telstra communication
<b>Name of regulation</b>	UL 1459	Occupational Safety and Health Act 1970	Occupational Noise Exposure (Revised Criteria 1998)	AS/ACIF requirement S0004:2004	ACIF Guideline G616:2004	TT4 standard
<b>Website</b>	<a href="http://www.ul.com">www.ul.com</a>	<a href="http://www.osha.org">www.osha.org</a>	<a href="http://www.cdc.gov/niosh/98-126.html">www.cdc.gov/niosh/98-126.html</a>	<a href="http://www.acif.org.au">www.acif.org.au</a>	<a href="http://www.acif.org.au">www.acif.org.au</a>	-
<b>Mandatory?</b>	Yes	Yes. Mandatory since 1970	No. Recommendation	Yes	No - Guideline	No - industry standard. Certification required.
<b>Acoustic shock protection</b>						
<b>Absolute maximum peak level [dB SPL]</b>	-	140 dB SPL	140 dB SPL	128 dB SPL	-	103 dB SPL
<b>Maximum RMS value [dB SPL]</b>	118 dB SPL	-	-	118 dB SPL	102 dB SPL	<88 dB SPL (frequency dependent)
<b>Noise exposure protection</b>						
<b>Time-weighted average exposure / LEQ measurements (over 8 hours) [dB(A) SPL]</b>	-	90 dB(A)	85 dB(A)	-	-	-

### Acoustic shock protection

As in Europe, 140 dB SPL is the max peak value limit the ear should be exposed to. All GN Netcom headsets are well below at a maximum of 122 dB peak value. 118 dB RMS value is the international level for headset protection. All GN Netcom telephone headsets are designed to comply with this limit.

In Australia, both the Australian Communication Industry Forum and the telecommunication operator, Telstra, have issued a guidelines (the G616:2004), which – while not being mandatory – show the need for building further protection into headset equipment. Only very few products live up to these extremely strict standards requiring frequency dependent protection. One of the products on the market designed to comply with the ACIF Guidelines is GN Netcom's digital amplifier, the GN 8210, which complies with G616:2004 on all audio settings. TT4 is incorporated as a selectable audio mode in the Australian and European variants of GN 8210.

### ACIF Guideline G616:2004

The AS/ACIF G616:2004 specifies a new guideline for telecommunications equipment that provides a very strict protection against acoustic shock. According to the guideline, the maximum RMS sound pressure level of an acoustic protective device shall be less than the values specified in Table 1. The two columns in the table are



the so-called DRP (Drum Reference Point) and ERP (Ear Reference Point) levels and is the point where the sound level is measured. The difference in dB(A) is due to the physical characteristics of the ear, which results in the higher frequencies being perceived as louder by the eardrum (DRP) than the actually measured value at the outside of the ear (ERP). In order to live up the guideline, protective equipment must reduce the sound level depending on its frequencies. This protects the ear drum to a level of a maximum of 102 dB RMS across all frequencies. Only a digital amplifier can provide this protection and only if it is designed to the ACIF guideline, as is the GN 8210.

**Table 1: ACIF Acoustic shock protection**

Frequency (Hz)	Maximum RMS dB(A) SPL at DRP (Drum Reference Point)	Maximum RMS dB(A) SPL at ERP (Ear Reference Point)
410	102	102
516	102	101
649	102	101
818	102	101
972	102	101
1090	102	100
1223	102	100
1372	102	99
1540	102	98
1728	102	97
1939	102	96
2175	102	94
2441	102	93

**Noise exposure protection**

While 90 dB(A) is the legal limit for time weighted average exposure in the US, an 85 dB(A) limit is recommended by NIOSH, which is in line with the upper action value in the coming EU regulation. The GN 8210 ensures that users are in line with recommended standards. More information about time weighted average exposure for contact center agents can be found under the European legislation overview.

