WHITE PAPER

HP Poly Acoustic Safety

For use with general public

ACOUSTIC SAFETY 101: A TECHNICAL GUIDE FOR EVERYONE

An overview of the Poly role in shaping global acoustic safety standards and building products to meet them.

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I. INTRODUCTION: SORTING THROUGH A WORLD OF REGULATIONS

Like many aspects of the working world, a significant number of regulations govern the type and amount of noise we are exposed to. It is important to understand key government regulations in order to protect affected employees, and to best judge the efficacy of the technology chosen to do so. This white paper provides a simple, easy-to-understand explanation of the major acoustic safety regulations in force around the world, and an overview of technology developed by Poly to comply, or help users to comply, with regulations to safeguard auditory health.

A QUICK WORD ON MEASURING SOUND LEVELS

Most people are familiar with the word "decibel" (dB), the measure for sound pressure levels.

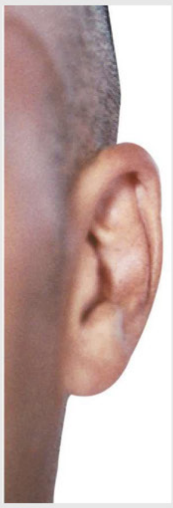
The mathematic formula for sound pressure level is:

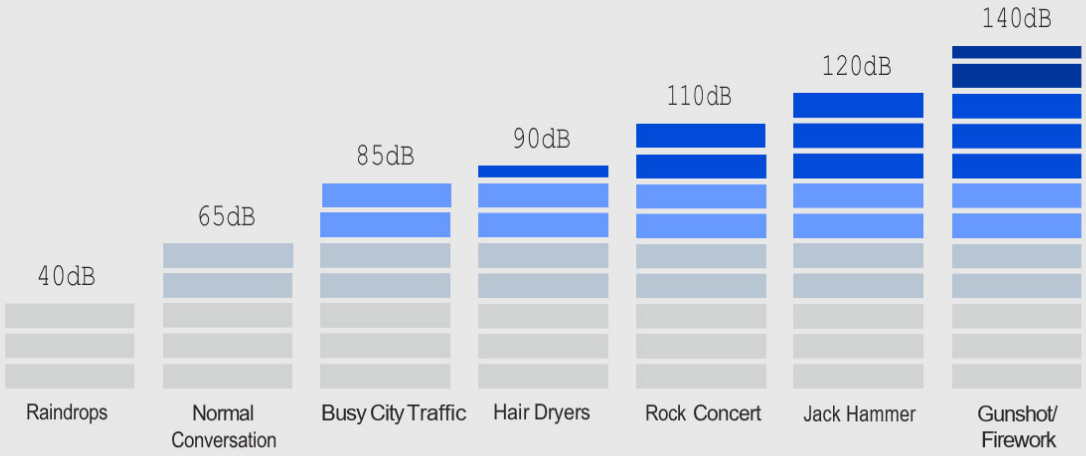
$$dBSPL = 20 \log_{10}\left(\frac{P}{P_{ref}}\right)$$

P is the effective pressure in Pascal
$\mathbf{P_{ref}}$ is the reference effective pressure in Pascal

FIGURE 1

DECIBEL LEVELS OF COMMON SOUNDS





The reference effective pressure is a threshold of hearing. It is the RMS (root mean square) sound pressure of the lowest audible sound of a 1,000 Hz tone, at $20*10^{-6}$ Pascal. As the equation shows, doubling the pressure, meaning two times P, increases 6 dBSPL. Figure 1 shows the decibel levels of some common sounds.

II. AN OVERVIEW OF KEY ACOUSTIC SAFETY REGULATIONS AND INDUSTRY STANDARDS

Most countries have acoustic safety regulations that govern how much noise the workers in their country or region can safely be exposed to. The regulations are more or less similar, but with subtle and notable differences. As an example, below is a comparison of the US and EU regulations:

US REGULATIONS: OSHA MANDATED NOISE MAXIMUMS

The Occupational Safety and Health Administration (OSHA) regulates employers' responsibilities to employees. OSHA Regulations 29 CFR 1910.95, Occupational Noise Exposure require employers to ensure that employee noise exposure does not exceed specified limits for three different noise measurements. These regulations pertain to:

- Impulse noise: The highest maximum noise level permitted relates to noise of very short duration. These noises are described in the regulations as "impact" or "impulsive" noise. Examples include gunshots and line noises such as clicks or pops. OSHA regulations limit impulse noise to 140 dBSPL, which can be measured with a sound meter equipped with a peak detector.
- Continuous noise: The regulations set a lower limit for noises that last longer than impulse noise (i.e., 500 milliseconds[1] or longer in duration) and may extend over seconds, minutes or hours. Continuous noise must not exceed 115 dBA.[2]
- Time-weighted average (TWA): OSHA also requires employers to limit the average of all levels of impulsive and continuous noise that employees are exposed to during an eight-hour workday.

Action level is 85 dBA. When noise exposure exceeds this level, OSHA requires employers to administer a hearing conservation program that includes annual hearing tests.

The exposure limit is 90 dBA. Employees shall not be exposed to average noise above this level.

1 Approximately half a second. By comparison, the blink of an eye is about 300 milliseconds.

2dBA stands for dB A-weighted sound pressure level. Its formal expression is dBSPL(A). The A-weighting relates to how human respond to noise, both from the viewpoint of hearing damage and annoyance.

IN EUROPEAN UNION: THE NOISE AT WORK DIRECTIVE

The EU's Noise at Work Directive establishes its rules for protecting hearing in the workplace. It addresses two sources of noise-induced hearing damage: acoustic shock and excessive noise exposure throughout a working day.

- Protection against acoustic shock from peak sound pressure: The Directive sets limits to three levels, summarized in Table 1.

  i. The lower exposure action level of peak sound pressure is 135 dB. When noise exposure exceeds this level, employers are required to assess the risk to workers' health, provide employees information and training, and make hearing protection device available to them.
  ii. The upper exposure action value is 137 dB. When noise exposure exceeds this level, employees are required to wear hearing protection devices.
  iii. The exposure limit value is 140 dB. Employees shall not be exposed to noise at or above this level.

- Protection against daily noise exposure: Similar to OSHA's time-weighted-average, the Directive also defines three levels of noise that an employee may typically be exposed to during an average day or week .

  i. The lower exposure action level is 80 dBA. See the preceding section for lower and upper exposure action levels.
  ii. The upper exposure action level is 85 dBA.
  iii. The exposure limit value of daily noise exposure is 87 dBA.

TABLE 1

COMPARING US AND EU REGULATIONS

REGULATION	US OSHA	EU NOISE AT WORK DIRECTIVE
Impulse noise/peak sound pressure	140 dB	140 dB exposure limit 137 dB upper action value 135 dB lower action value
CONTINUOUS NOISE	**115 dBA**	**NONE**
TWA/daily noise exposure	90 dBA exposure limit 85 dBA upper action value	87 dBA exposure limit 85 dBA upper action value 80 dBA lower action value

Note 1: Australian Communications Industry Forum (ACIF) published a recommendation guide, G616, intended to reduce acoustic startle from headset. It requires headset receive output to be <102 dBSPL at DRP. All Poly products with SoundGuard DIGITAL comply with G616, see the Poly product sheet on page 14 and 15 for detail.

Note 2: IEC 62368-1 and EN 50332 specify acoustic safety requirement for personal music player (PMP). It requires headphones multimedia headset receive output to be ≤100 dBA with 150 mV input for analog or -10 dBFS input for digital. All Poly multimedia products comply with PMP acoustic safety requirement. See the Poly product sheet on page 14 and 15 for detail.

DIFFERENCES BETWEEN US AND EU REGULATIONS

Table 1 summarizes the differences between the US OSHA and EU Noise at Work regulations.

There are two measurement differences between the US and EU requirements:

- Trading relation - By which reducing the duration of the daily noise exposure allows an increase in the exposure limit. In other words, reducing the exposure limit allows an increase in the exposure duration. The trading relation in the US is 5 dB and in EU is 3 dB. For instance:

  i. In the US, the action level is 85 dBA for eight hours, which is equivalent to 80 dBA for 16 hours or 90 dBA for four hours.

  ii. In the EU, the upper action value is 85 dBA for eight hours, which is equivalent to 82 dBA for 16 hours or 88 dBA for four hours.

- Threshold of measurement - In the US, only the continuous, intermittent and impulsive noise levels equal or higher than 80 dBA are integrated into the TWA calculation, but in the EU, there is no threshold. All noises with any levels are integrated into the daily noise exposure calculation.

Separately and together, the acoustic safety regulations outlined by the US, EU, as well as other countries and regions present a significant obligation for many types of employers. However, these regulations are based on so-called "open-field" noise[3] in workplaces such as factories, construction sites and other inherently loud locations. No government regulations specifically address sound that is emitted on or in the ear by headsets. The section below discusses how acoustic safety regulations can be interpreted by employers to protect workers who wear headsets on a daily or occasional basis.

3For more information, refer to ITU-T P.360, "Efficiency of devices for preventing the occurrence of excessive acoustic pressure by telephone receivers and assessment of daily noise exposure of telephone users."

INTERPRETING INDUSTRY STANDARDS FOR HEADSET USE

Telecom industry standards interpret “open field” regulatory requirements for headset use. The best-known standards are ITU-T P.360, UL 60950-1 and ETSI EG 202 518. These industry standards define the test methods and noise limit requirements as they relate to US and EU regulations.

HEADSET TESTING EQUIPMENT AND METHODOLOGIES

Among the many noise sources that are encountered in the workplace, telephony headsets are in a unique category. They generate sounds at or in the user’s ear rather than externally, as is the case with “open field” noise.

Through the years, few techniques were developed to measure noise exposure from headsets. The noise level of a headset is measured on a Head And Torso Simulator (HATS). HATS simulates the human auditory system with synthetic soft pinna, ear canal and eardrum. The measurement microphone in HATS measures the sound signal that would exist at a real person’s eardrum location, called the Drum (eardrum) Reference Point, or DRP[4].

FIGURE 2

A HEAD AND TORSO SIMULATOR (HATS)



Photo courtesy of Bruel and Kjaer.

4 For more information on reference point, refer to ITU-T P.58, "Head and torso simulator for telephonometry".

INTERPRETING NOISE REGULATIONS INTO HEADSET LIMITS

The human ear amplifies certain sounds more than others, making us more sensitive to hearing the human voice. So, for a particular sound, a measurement in the "open field" is very different than a measurement inside of a human ear, at DRP. The difference is called Head Related Transfer Function, or HRTF[5]. To compare an acoustic measurement on HATS, at DRP, to an "open field" regulatory acoustic safety requirement,the measurement result must be translated to the "open field" equivalent by correcting with the HRTF.

However, for simplicity and convenience, telecom industry standards have historically specified a long duration disturbance acoustic limit (similar to the continuous noise in OSHA) such as ITU-T P.360, UL 60950-1 and ETSI EG 202 518. The requirement is 118 dBA[6] at about the opening to the ear canal, called the Ear Reference Point, or ERP.

Acoustic startle is another sensitive and important concern for headset users, especially for contact centers agents. Startle signals may not be high enough to cause hearing damages, yet they startle users. They are annoying, stressful and certainly reduce headset listening comfort. Australian Communications

Industry Forum (ACIF) published a recommendation guide, G616, intended to reduce acoustic startle incidence from headsets. It requires the headset receive output to be <102 dBSPL at DRP. All Poly products with SoundGuard® DIGITAL comply with G616, see the Poly product sheet on page 14 and 15 for more details.

WHO (World Health Organization) estimates that 1.1 billion young people worldwide could be at risk of hearing loss due to unsafe listening practice. Regularly listening to music at high volume and for long duration poses a serious threat to one's hearing. IEC 62368-1 and EN 50332 specify acoustic safety requirements for personal music player (PMP). The requirements are in two parts: the player, e.g. mobile phones, and the listening device, e.g. multimedia headsets. The requirements limit the maximum electrical output from players and limit the maximum acoustic output from listening devices with the maximum signal from players. There are two levels of maximum output requirements from analog player, the level for an ordinary user is 27 mV, and the level for instructed user is 150 mV. There is only one maximum acoustic output requirement from listening device, it is ≤ 100 dBA with 150 mV input for analog or -10 dBFS input for digital. The test signal is the "program simulation noise" specified by EN 60268-1. All Poly multimedia products comply with PMP acoustic safety requirement, see the Poly product sheet on page 13 and 14 for detail.

THE BOTTOM LINE

A complex mix of HRTF, ERP and DRP based measurements explains the difference in the maximum "open field" noise levels noted in the US and EU regulations, and the lower maximum volumes incorporated into the Poly acoustic protection technologies described in Section III.

5 For more information on HRTF, refer to ITU-T P.57, "Artificial ears", ITU-T P.58 and IEEE Std 1652, "Free field acoustic reference to telephony measurements".

6 There are some old European standards that demand to meet 118 dBSPL without A-weighting.

III. POLY TECHNOLOGY FOR ACOUSTIC SAFETY

The human ear amplifies certain sounds more than others, making Since the company's founding in 1961, Poly has been a strong leader, participant and supporter of various global industry standards, particularly those pertaining to acoustic safety.

For example, Poly has:

- Led and drafted ITU-T P.360 and ETSI EG 202 518
- Helped create ISO 11904-1 and -2, IEC 62368-1, UL 60950-1 and UL 62368-1, and EN 50332-3
- Participated in the World Health Organization's "Make Listening Safe" campaign

Poly has a rich history in designing and manufacturing telecommunications headsets at the leading edge of listening comfort and safety. Poly products offer solutions that limit impulse and continuous noise exposure, TWA daily noise exposure and PMP acoustic safety. These products not only comply with acoustic safety regulations but also surpass standards with additional measures that bring greater acoustic comfort to the user, such as anti-acoustic startle.

Here are a few highlights of the many Poly innovations in acoustic safety and comfort:

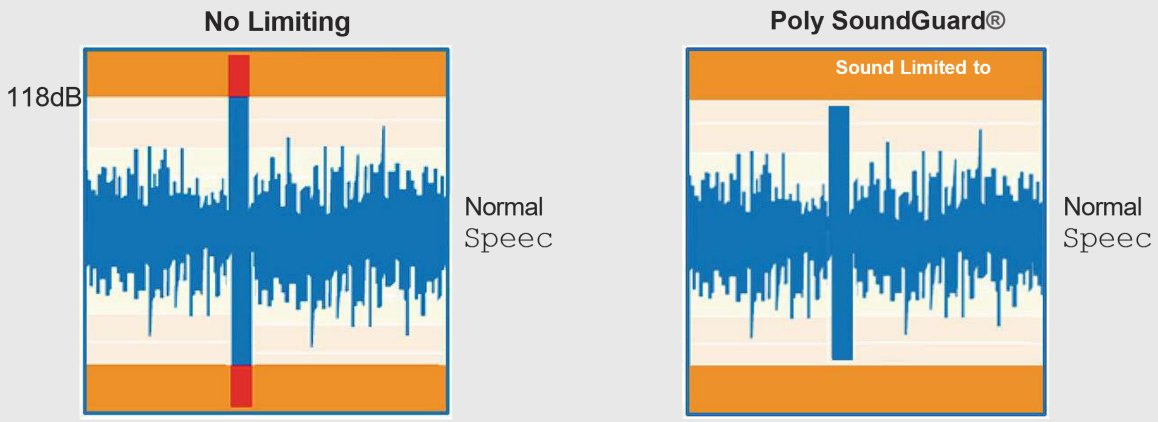
SoundGuard technology delivers a virtually instantaneous attack time to remove impulse and long duration disturbance noise levels that would exceed 118 dBA. Below is an example comparing the effect a loud tone-like noise in normal speech with and without SoundGuard technology. The diagram shows the loud noise is clipped to below 118 dBA while the speech signals remain intact.

To ensure 100 percent compliance while considering safety margins, product variations and measurement variations, the actual acoustic safety limits of most Poly headset products that contain SoundGuard technology are well below 118 dBA.

FIGURE 3

POLY SOUNDGUARD TECHNOLOGY

Poly SoundGuard technology keeps speech signals intact while limiting abrupt loud noises to below 118 dBA



One example of Poly headsets protected with SoundGuard technology is EncorePro HW720, shown on the right. For the full list of Poly headsets featuring SoundGuard technology, see the product sheet at the end of this paper.



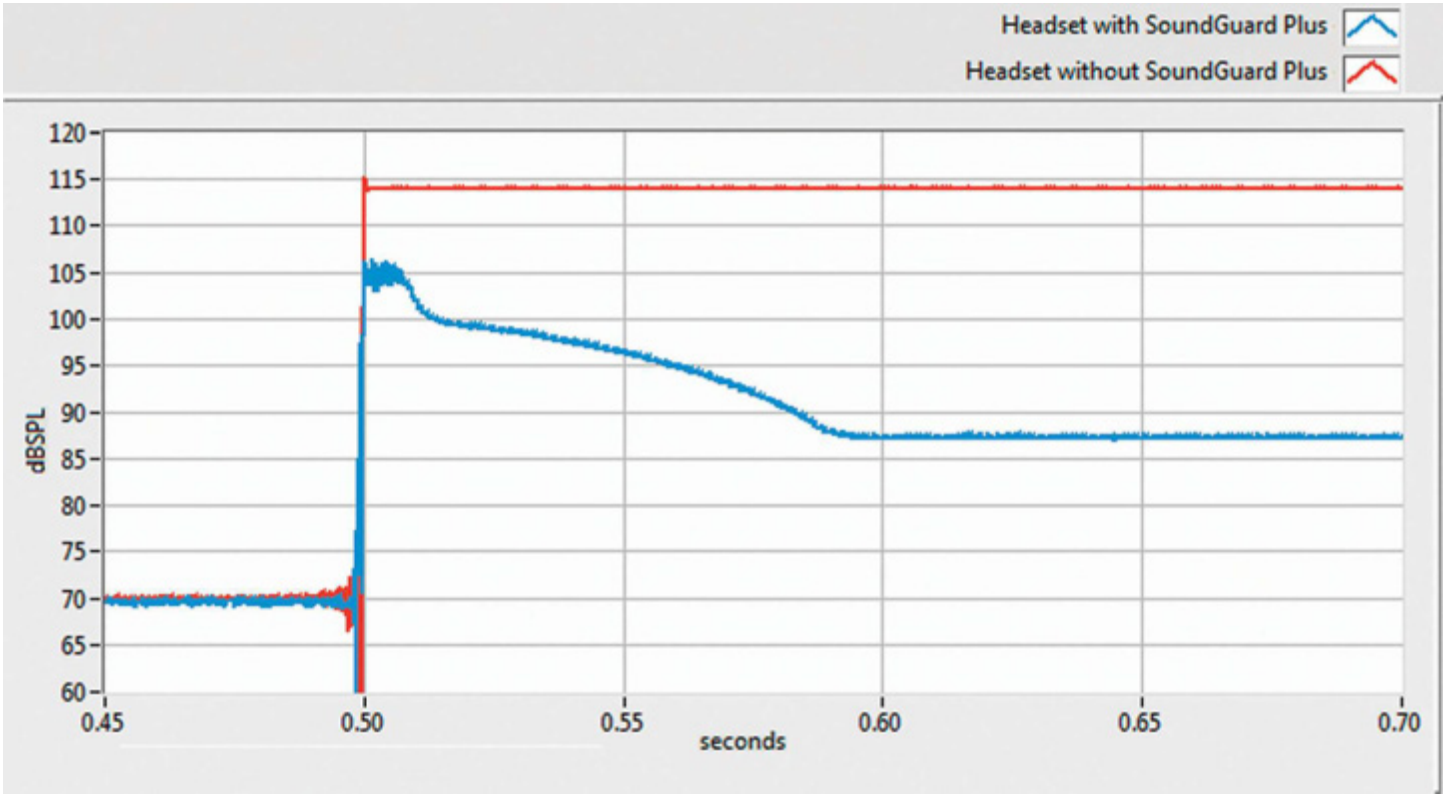
HP Poly Mission
625 USB Headset

SoundGuard Plus features multistage limiting technology. A Peak Limiter clips high unwanted impulsive signals, such as pops and clicks, as well as long-duration disturbance with a virtually instantaneous attack time of less than one millionth of a second. The clipping level varies from product to product due to the variation of the sensitivity of the headset driver. However, in all Poly headset products with SoundGuard Plus technology, the highest clip level ever measured is 106 dBSPL, which is much lower than the 140 dBSPL impulse and 118 dBA long-duration disturbance limit set by regulatory and industry standards.

If the incoming loud signal continues, a Linear Limiter further reduces the system gain to maintain a linear signal that is approximately 6 dB below (twice as quiet) the instantaneous clip level within a few milliseconds. If the incoming loud signal still persists, a Dynamic Level Adjust algorithm will continue to drop the signal level to 22 dB below the clipped level in less than 350 milliseconds.

Below is a comparison with SoundGuard Plus vs without SoundGuard Plus technology on a very loud signal in normal speech. The output shows that without SoundGuard Plus, the loud noise is clipped by SoundGuard technology to below 115 dB. With SoundGuard Plus, the loud signal is first clipped by the Peak Limiter algorithm to about 106 dBSPL instantaneously. When the loud signal continues, the Linear Limiter algorithm cuts the noise to 100 dBSPL in about 10 milliseconds. When the loud signal still continuous, the Dynamic Level Adjust algorithm further attenuates the noise level to about 87 dBSPL.

Simply put, SoundGuard Plus is an adaptive technology that quickly attenuates the loud noise while allowing the natural voice to remain unchanged, thus ensuring continuous clarity of communication.





Vista M22



DA85



HP Poly Focus 625

One example of Poly products feature SoundGuard Plus is Vista™ M22 as shown on the left. For the full list of Poly products featuring SoundGuard Plus technology, see the product sheet at the end of this paper.

SoundGuard DIGITAL's sophisticated algorithms provide additional acoustic protection above and beyond the impulse and long duration disturbance protection that Sound Guard and SoundGuard Plus provide. SoundGuard DIGITAL constantly monitors signal levels, making subtle adjustments when needed to prevent average daily noise exposure (TWA) from exceeding 85 dBA or 80 dBA (per the user's choice). Again, to ensure 100 percent compliance, and considering safety margin and products and measurements variations, the actual acoustic safety limits of most Poly headset products that contains SoundGuard DIGITAL technology are well below the 85 dBA or 80 dBA limit.

SoundGuard DIGITAL incorporates Poly's enhanced anti-startle technology that not only guarantees compliance to G616, noise level to be below 102 dBSPL at DRP both for impulse and continuous noises, it detects and controls one, the delta between the previous listen level and the startle noise level, two, the raising time of the startle noise, and three, the duration of the startle noise. SoundGuard DIGITAL is designed to protect user's hearing and improve listening comfort while maintaining natural sounding speech.

One example of Poly products featuring SoundGuard DIGITAL is the DA85 as shown on the left. For the full list of Poly products featuring SoundGuard DIGITAL, see the product sheet at the end of this paper.

Poly multimedia headset products that provide high-fidelity stereo listening experiences, including gaming headsets, are designed to meet IEC 62368-1. UL 62368-1 and EN 50332-1. -2 and -3 PMP acoustic safety requirements.

All Poly multimedia and gaming headsets feature PMP acoustic safety technology. One example is Voyager Surround 85 as shown on the left. For the full list of Poly headsets featuring PMP acoustic safety technology, see the product sheet at the end of this paper.

Lens Cloud is the management and reporting tool for enterprises to apply and monitor regional acoustic settings. Acoustic events such as G616 limiting or Poly enhanced anti-startle limiting can be monitored for changes and data provided to demonstrate to employees that any loud sudden sounds where limited to a safe and comfortable level by the supported Poly headset. For the full list of Poly headsets that support Lens Cloud see the product sheet at the end of this paper.

IV. SUMMARY

The acoustic safety regulations implemented by the US, EU and other countries all aim to protect workers from noise exposure despite subtle yet important differences in their definitions. These regulations are designed to address "open field" noise, which is distinctly different from sound that is emitted on or in the ear by headsets.

The telecom industry has interpreted "open field" regulatory requirements for headset use, defined test methods and noise limit requirements as they relate to regulations.

For more than 50 years Poly has been a strong leader, participant, and supporter of global acoustic safety. Poly is a leader in the global industry committees that create standards, and an active participant in acoustic health initiatives.

Correspondingly, Poly products incorporate leading-edge technologies that can instantaneously protect against impulsive noise, continuous noise and long-term daily noise exposures. These products meet acoustic safety regulations and surpass them with additional measures that bring greater listening comfort to the user. Key Poly innovations include:

SoundGuard technology removes impulse and continuous noise levels that would exceed 118 dBA, clipping the noises to below 118 dBA.

SoundGuard Plus is an adaptive technology that removes high unwanted impulsive noise, such as pops and clicks, as well as continuous noise, with an attack time of less than one millionth of a second while keeping the speech signals intact.

SoundGuard DIGITAL's sophisticated algorithms provide additional acoustic protection above and beyond SoundGuard and SoundGuard Plus by constantly monitoring signal levels and, making subtle adjustments when needed to prevent average daily noise exposure (TWA) from exceeding user-specified limits. SoundGuard DIGITAL also contains anti-startle algorithms that provides additional listening comfort while maintaining natural sounding speech.

For more information, visit www.**hp.com**

ABOUT HP COLLABORATION SOULTIONS

Combine headsets, video conferencing, phones and software to deliver secure and seamless collaboration experiences for every work environment.

Explore solutions designed to reduce frictions with AI-powered experiences that improve video, remove noise, and keep teams focused. Simplify deployment with one ecosystem and seamless compatibility across leading meeting platforms. Built with security in mind. Protect your organization with encrypted communications and centralized firmware management to reduce risk and strengthen control.

For more information, please visit www.**hp.com** or call (800) 544-4660.

	Sound-Guard	Sound-Guard Plus	SoundGuard Digital			Portable Music Player Acoustic Safety
	≤118dBA @ ERP	≤106dBA @ ERP	TWA/Daily Noise Exposure ≤80 or 85 dBA per user choice	Poly Enhanced Anti-Startle	G616 Limit-ing ≤102 dB @DRP	<100 dBA @ FF or DF
Contact Centre Headsets						
EncorePro 300, 500, and 700 series with DA75/85/85-M	●		● ●	● ● ●	● ● ●	
EncorePro 300,500, and 700 series with DM15/AP15	●	●	●	●	●	
EncorePro 300 USB Series	●		● ●		● ●	
EncorePro 500 and 700 USB Series	●		● ●	● ●	● ●	
Corded USB Headsets						
Blackwire 3200/3300 Series (in USB mode only)	●					
Blackwire 5200 Series (in USB mode only)	●		●* ●		●* ● ●	
Blackwire 710/720	●		●	● ●	●	
Blackwire 7225/8225	●		● ●	● ● ●	● ● ●	
HP Poly Mission 400 series	●		● ●	● ● ●	● ● ●	●
HP Poly Mission 600 series	●		● ●	● ● ●	● ● ●	●
HP Poly Mission 800 Series	●		● ●	● ● ●	● ● ●	●
Audio Processors (with EncorePro 300, 500, and 700 Series)						
MDA500/400 QD Series	●		● ●	● ● ●	● ● ●	
DM15/AP15	●		●	●	●	
M12/M22/P10/E10/DA55/DA60	●	●				
AL10	●		●			
DA70/DA80/DA90	●		● ●	● ● ●	● ● ●	
DA75/DA85/DA85-M	●		● ●	● ● ●	● ● ●	
CS Range						
CS510/CS520	●		●	●	●	
CS530/CS540	●					
Savi Range						
W410/W420/W710/W720/W740	●		●* ●	●* ●	●* ●	
W430/W440/W730/W740	●					

Savi 7210/7220	●		●	●	●	
Savi 7300/7400 Series	●		● ●	● ● ●	● ● ●	
Savi 8210/8220 Office/UC	●		● ●	● ● ●	● ● ●	
Savi 8240/8245 Office/UC	●		● ●	● ●	● ●	
Savi 8410/8420 Office	●		● ●	● ● ●	● ● ●	
Savi 8445 Office	●		● ●	● ●	● ●	
Voyager Range						
Voyager 3200 UC/Voyager 5200 Office/ UC	●					
Voyager 4200 Office/UC Series	●		●* ●		●* ●	●
Voyager 4300	●		●* ●		●* ●	●
Voyager 6200 UC	●		●* ●		●* ●	●
Voyager 8200 UC	●		●* ●		●* ●	●
Voyager Focus	●		●* ●		●* ●	●
Voyager Focus 2	●		●* ●		●* ●	●
Voyager Surround 80/85	●		●* ●		●* ●	●
Voyager Legend 50/30 UC	●		●* ●		●* ●	●
Voyager Free 60	●		●* ●		●* ●	●
Voyager Free 20	●					●
HP Poly Focus 6 series	●		●* ●		●* ● ●	●

Key
● Acoustic safety feature is included with product as standard
●* Acoustic safety feature is disabled by default - use Poly Lens or HP Poly Studio to enable
● Acoustic safety feature configurable via Poly Lens or HP Poly Studio and manageable via Poly Lens Cloud
● Acoustic safety data reported in Acoustic Event Reporting through Insights in Poly Lens Cloud

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