



Acoustic emission of IT Products and noise at workplaces

Hewlett-Packard is committed to producing products that are acceptable acoustically and that meet customer and regulatory requirements. This paper outlines:

- the basics of acoustic noise
- how computer noise is measured
- how HP reports its product noise emission values according to international standards
- how to compare noise emissions from different products
- how to relate the HP noise values to workplace noise criteria

In most areas of the work environment, the safety and health of workers can only be assured if the employer implements the legal requirements or accident prevention regulations from the employer's liability insurance association. In addition to direct hazards (like electric shock or mechanical hazards), indirect factors like stress and noise need to be avoided as well.

Noise at workplaces

Unwanted sound from whatever source is called noise. Most people at work are exposed to various sound sources (PC, printer, telephone, speech, street sound, air conditioners, etc.). If the noise level is too high, conversation may become difficult and distraction may occur. Therefore it is important to keep the overall noise level as low as possible at workplaces and also in private life.

Basics of acoustics:

- **A-weighted Sound Power Level (L_{WAd})** in Bel (B) is a logarithmic quantity of the rate of acoustic energy emitted by a product into the environment. Sound power level is independent of the environment. Note that "Bel" (B) is used for Sound Power Level of IT equipment to avoid confusion with the topic Sound Pressure Levels (see below). Sound power level is the primary descriptor of noise emissions from IT products. "A-weighting" represents the response of the human ear at moderate intensity levels, which reflects people's perception of loudness.



- **A-weighted Sound Pressure Level (L_{pAm})** in deciBel (dB) is a logarithmic quantity of the sound pressure at a specific location. The sound pressure level depends on the sound power level of a product, the distance from the source and the room in which the product is located. If "A-weighting" is used, deciBel is sometimes abbreviated "dB(A)" instead of "dB".



Acoustic values for IT products

HP products have been tested for acoustic emission in accordance with international standard ISO 7779 and the values are determined and declared according to ISO 9296. The noise emission values that HP reports are the declared A-weighted sound power level L_{WAd} in B (bels) and the declared A-weighted emission sound pressure level L_{pAm} in dB(A) for both operating and idle modes. (Note: 1B = 10 dB)

Declared A-weighted sound power level L_{WAd} is a statistical maximum value to account for both product variation and lab-to-lab variations and is typically about 0.3 - 0.4 bels greater than the average measured A-weighted sound power level, L_{WA}.

The declared A-weighted emission sound pressure level L_{pAm} is based on the measurement at the operator position, or if no operator position is defined, at the bystander positions with the product in an acoustical laboratory.

- **Operator position** is the position of a user who is required to operate a product. The position is specified by ISO 7779 as 0.25 m in front of the product (keyboard for PCs). The operator position is defined for PCs, workstation products, notebook computers.
- **Bystander position** is the position for products in which an operator is not needed or the product is remotely operated and is specified in ISO 7779 as 1.0m on each side of the product and 1.5 m high. Bystander positions are appropriate for printers, servers, switches.
- **Operating mode** is the condition of a product when performing its intended function(s), according to ISO 7779. E.g. a printer in printing mode or a PC in “process mode” i.e. displays info, accessing internal disk, fan spinning.
- **Idle Mode** is the condition in which the equipment being tested is energized but is not operating, according to ISO 7779. For most PCs and servers, typically no disk access but cooling fans are spinning and therefore noise exist. For some equipment (like printers without fan) idle mode could mean no noise exist (or it is inaudible).
- **Power saving mode** – a low energy mode in which the cooling fan(s) may be off and thus can be inaudible.



HP products and acoustic emissions

HP is aware of customer requirements for IT equipment and aims at decreasing the acoustic emissions from HP products as much as possible. One should realize that the higher performance of a product (e.g. faster microprocessor, printer with higher printing capacity) usually results in higher electrical power consumption. Most of this electrical power is converted into heat that needs to be brought out of the product components. Cooling fans are often used to cool the product. Of course, if more heat is generated, then the fans need to run faster thus generating more noise. So users of PCs, notebooks, and servers have three contradictory demands of their products: they want them to be powerful, to be quiet and to be reliable (by cooling the chips).

For many HP products there is an IT Eco Declaration available that includes the acoustic emission figures. These IT Eco Declarations can be found on Internet at: <http://www.hp.com/go/ted>

A general source of HP product information is always the HP Internet portal accessible at: <http://www.hp.com>

HP uses product innovations that reduce the product noise emission:

- **InstantOn Technology for HP Laser printers**

HPs Instant-on Technology uses cutting-edge fuser technology to produce the first page faster when a printer is coming out of power save mode so the print job is done sooner and the printer can be sent to power save mode again. In fact, the print job may even be finished before many competitive printers would have started printing.

Note, the noise of the fan and the printer engine reach its maximum during printing. In power save mode, the printer is very quiet. This feature also helps to reduce the total noise in the workplace.

- **Optimized HP processor technology**

Optimized coordinated processors along with primary and secondary chipsets in a computer allow for the reduction of power consumption. Less power consumption results in less heat inside the computer that leads to reduced fan speed, which lowers the computer noise.

- **Fan speed control to reduce fan noise**

Refined fan speed control has enabled HP to minimize the noise for typical environments and still meet the cooling requirements under adverse conditions. HP has improved the efficiency of the thermal solution – heat-sink (material, size, shape and design) along with efficient airflow management and fan design. These advances have permitted HP to minimize noise while maintaining cooling of the product without sacrificing reliability requirements.

Recommendations for customers comparing noise emission values

Whenever acoustic emissions are compared between competitive products, ensure that the same quantities are compared with the following recommendations:

- Insist that all product noise values are sound power level L_{WAd} and sound pressure level L_{pAm} measured according to ISO 7779 and determined according to ISO 9296.
- The primary metric for product comparison is sound power level (L_{WAd}) since that is the value that relates directly to the A-weighted sound pressure level in the room where the product is installed. Ensure that all values are declared values per ISO 9296. (Declared sound power levels L_{WAd} are about 0.3 B higher than average L_{WA} .)

- Product A-weighted emission sound pressure levels may be compared but are secondary to sound power levels ($L_{WA,d}$) and will underestimate room sound pressure levels.
- Sound Pressure Level $L_{pA,m}$ values can be compared only if they are measured at the same position (the same distance from the source). For example, if a notebook or PC $L_{pA,m}$ is improperly reported at the *Bystander Position* instead of the proper *Operator Position*, the $L_{pA,m}$ will be 6 – 8 dBA lower at the bystander position than the correct value at the operator position.

Further tips and reference data

- **Combining sources:** Two identical sound sources generate a total sound power level that is just 0.3 B (3 dB) higher than the single source, e.g. 2 PCs with an $L_{WA,d}$ of 4.0 B generate a combined sound power level of 4.3 B. Ten equal sources (such as ten servers in a cabinet) generate a total sound power level that is 1.0 B (10 dB) higher than one source and sounds twice as loud as one server.
- **Subjective impression of differences in sound levels:**
 - 1 dB (0.1 B) difference in two levels is barely noticeable
 - 3 dB (0.3 B) difference in two levels is noticeable
 - 10 dB (1.0 B) difference in two levels sounds twice as loud.
- **Typical A-weighted sound power level L_{WA} :**
 - 3.0 B = Soft whisper
 - 3.5 – 4.0 B = quiet notebook computer
 - 7.0 B = normal conversation
 - 10.0 B = automobile on highway
- **Typical A-weighted sound pressure level L_{pA}**
 - 0 dB = measurement value that will never be reached due to test equipment noise
 - 15 dB = threshold of typical hearing under quiet lab conditions
 - 20 dB = quiet recording studio
 - 25 – 35 dB = quiet PC at operator position
 - 30 dB = soft whisper at 1.5 meter distance
 - 55 dB = normal voice at 3 meter distance
 - 65 dB = normal conversation at 1 meter distance
 - 120 dB = threshold of human pain and risk of hearing damage

Requirements for acoustics in the workplace

Because working environments can be so different, the legal requirements are always related to a specific workplace in terms of the sound pressure level as received by the worker at his workplace from all sources of noise.

According to the EU frame Directive [89/391/EEC](#), it is the duty of the employers to ensure safety and health of workers at workplace. Underneath this frame directive, 18 sub-directives are listed. One of those is for workplace noise ([2003/10/EC](#)) that dictates the use of hearing protectors if the 8-hour average $L_{pAeq,8}$ measured in the workplace is above 85 dB. If the average sound pressure reaches 80 dB(A), hearing protectors need to be offered by the Employer.

It is the duty of each EU member state to implement this EU Directives into national law. As example, the EU Directive 2003/10/EC has been implemented in German law at March 2007 ([Noise-Vibration-Workplace-Regulation](#)) and replaces the German OSHA (Berufsgenossenschaft) accident protection regulation BGV-B3, that was used before and specified a more detailed and stringent workplace requirement. Following limits for an 8 hour average sound pressure workplace level $L_{pAeq,8}$ have been used in BGV-B3:

- 55 dB for predominant mental work
- 70 dB for predominant office work (i.e. typical office environment)
- 85 dB for all other activities

Note: Although these figures are not legally binding it will be kept in this file for reference and because business customers still stick to this requirements for workplace assessment. Again, **the primary concern for noise from IT equipment in an office is not from legal criteria, but from product acceptability, product quality, annoyance and activity interference.**

Assessment of a business related workplace

The employer is responsible to implement the legal requirements against noise. He must assess his workplaces and need to take action if the total A-weighted sound pressure level is too high for a specific workplace (e.g. a library or an office where software is developed). Therefore acoustic emission data for many IT products is requested from product suppliers in tenders and other customer requests.

A-weighted sound pressure levels in rooms may be determined from the product A-weighted sound power level $L_{WA,d}$, distance from the source, size of room, acoustical properties of the room, other noise sources in room, and background levels in room. For guidance refer to ECMA TR 27 or ISO 11690-3. The A-weighted emission sound pressure level $L_{pA,m}$ per ISO 7779 (i.e. measured in a acoustic chamber) will always be lower than the L_{pA} measured in a workplace (at the same distance from the product) due to room reflections and noises from other sources in the room.

Contact HP

If support by HP is needed, please contact your **local HP Sales office** offered at <http://www.hp.com>.

As mentioned above, acoustics emission figures are available at the HP *IT Eco Declarations* that are available via Internet at: <http://www.hp.com/go/tecd>

If specific questions appear by HP customers located in European Union member countries, do not hesitate to contact us with email address: techregshelp@hp.com