Sound power testing of heat pumps: while repeatable, reproducible, verifiable and cost-effective test conditions should reflect their average use in the EU and be common to all products.

Despite their undeniable energy efficiency benefits, like many other households’ appliances, heat pumps also generate sound. Heat pumps sound emission can be linked to their components’ operation (compressor, fans, circulators) and their installation.

Heat pumps are characterised by the sound power level of the unit. Sound can be characterized by different physical quantities. In this regard, it is important to differentiate sound power and sound pressure.

The sound power is a univocal descriptor of a sound source and it is an objective quantity independent of the environment in which the source is placed.

Instead, sound pressure is related to the directivity of the noise, the environment (e.g. reverberant field effect) and installation of the unit. It also depends on the location (distance / orientation) of the listener. Both are expressed in dB(A) but shall not be confused.

Today, it is possible to measure the sound power level of heat pumps with a method that is conventionally used. The tests for heat pumps are already described in EN 12102 series. The standards offer valid test methods and test procedures that are using generic acoustic test methods, such as reverberant room (EN ISO 3741 / 3743), free field (EN ISO 3744 / 3745) or sound intensity (EN ISO 9614) methods.

The Ecodesign and Energy labelling directives refer to the standard EN 12102. It is important to note that the Ecodesign and Energy labelling framework rely on sound power level. Sound pressure level cannot be included in the Ecodesign and Energy labelling frameworks, because the sound pressure results from the impact of the equipment with its environment and does not characterize performance of the product on its own. Sound pressure is dealt with at the Member States or local level with requirements generally defined as maximum outdoor sound pressure limits at the installation site, which are intimately related to the specificities of the given area. It is not possible to define maximum sound pressure levels as an ecodesign criteria to place heat pumps on the EU market.

Additionally, sound power level is the indicator used through the different Ecodesign and Energy labelling regulations (fridge freezer, ventilation, air conditioners, etc.). Introducing a new indicator will create further confusion for the end customers especially if this indicator will depend on the distance to the equipment.
The Ecodesign requirements on sound power level shall be defined for operating conditions of the heat pump that allow:

- a fair comparison between the units;
- repeatability, reproducibility and verification of the measurements;
- the use indifferently of the 3 acoustic test methods;
- a fair balance between the test required and resources required for the test both for market surveillances and manufacturers;
- **to declare the sound power level in relation to a heating capacity that is already declared for seasonal performance rating.**

These requirements should be representative of the use of the heat pump in average running conditions and common for all products. Thus, it is not possible to define test conditions leading to maximum sound power level for all units because the conditions to generate this level are related to specific settings for each individual unit.
Annex: Individual answers to VHK questions

1. Are you aware of the proposed max. noise requirement for air-to-water heat pumps in the Netherlands?

Yes, EHPA is in contact with the Dutch Heat Pump Association and is following the ongoing legislative process. According to the latest information, the Dutch authorities are aiming at adopting the new proposal by the beginning of July 2020, with an enter into force on 1st January 2021.

The Dutch proposal on sound includes sound pressure and excludes any provisions on test conditions. The Dutch authorities are proposing a maximum of sound pressure level of 35 dB at night, 40 dB during the day and 5db tonality for neighbouring homes.
It is expected that the legislation will limit the sound level of heat pumps at 40 dB(A) at the border of the neighbours’ property.

Although the proposal excludes requirements on sound power level and test conditions, the national authorities are also discussing the possibility to take into consideration test conditions to achieve the maximum sound power, which is not favoured by the heat pump industry.

2. Are you aware of noise requirements in other Member States, and how these values need to be assessed (which test method and which limit value applies?)

Yes, EHPA and EHI are aware that more and more communities and Member States are introducing maximum outdoor sound pressure limits at the installation site. Indoor sound is often regulated in national building code. Some of the national requirements also include provisions on the way to determine limit values. More details on national provisions are available here.

Differences among the Member States are given by limit values, relevant point of immission, additional sources and acceptance of setback. In this regard, the only element that can be included and be harmonized in a European standard is the sound power level of the unit.

3. Are you advocating for a single test method for assessing noise from (air-to-water) heat pumps, preferably applied in the context of Ecodesign information requirements?

Today, sound power tests for heat pumps are already described in EN 12102 series. The standards offer valid, reproducible, repeatable and verifiable test methods and test procedures which can be considered as a “single test method”.

Nevertheless, EHPA and EHI recognise that the current standards do not provide sufficiently well-defined and correct test conditions for sound power level measurement. In this regard, EHPA and EHI would support the improvement of current test standards by further working on well-defined test conditions. If new test conditions are developed, these should replace and not add up to the existing ones to prevent an increase of testing.
However, it is important to note that any agreement on new test conditions for sound power levels would require some time and should be mandated to EU standardisation bodies. EHPA and EHI members are willing to contribute to the development of these test conditions and test points via CEN/CENELEC dedicated working group CEN/TC 113 WG 09.

4. Would this single test method allow for provision of generic noise data, which can then be used to assess whether the unit can be applied in conformity with local conditions? (one test providing inputs for local calculations, whatever the local limit values may be).

As mentioned previously, a test method for sound power measurements already exists. Nevertheless, EHPA and EHI recognise the need for improving the representativeness of test conditions for measuring sound power levels.

As the conditions in which maximum sound power occurs, in reality, might be different from one unit to the other, are depending on heating capacity delivered and are not representative for the normal use of a heat pump, maximum sound power level information is not ready to be displayed according to the existing framework and test conditions. Indeed, it will require the definition and proofing of a harmonized testing procedures and conditions related to a heating capacity already declared for seasonal performance rating that expert agree is complex to define and, therefore, will require time. While EHPA and EHI are willing to contribute to the discussion, we also estimate that the current timeline of the revision and the setting of the technical meetings is not sufficient to address the issue comprehensively. Finally, EHPA and EHI maintain that only the sound power value defined at harmonized conditions representative of the normal use of the product and not extreme cases should remain the primary indicator for a fair comparison between products under Ecodesign and Energy labelling regulation.

Concerning sound pressure levels related measures, such measures cannot and should not be included in the Ecodesign framework since sound pressure is not a characteristic of the unit by itself and cannot be a prerequisite for placing a product on the EU market. Other elements related to the installation and the surroundings (see above) influence the sound emission, thus the sound pressure. Also, existing national legislation sets maximum sound requirements for determined areas, which takes into considerations the specificities of local environments. Therefore, there cannot be a European standard and requirement which would allow covering all sound pressure requirements and test conditions which would be intimately related to national, regional and local requirements and conditions.

5. Does your preferred test method take into account the tonality of the noise? If so, how? (which octave bands are measured?)

No, EHPA and EHI are not in favour of taking into account tonality under Ecodesign framework. Tonality is a relevant aspect only for psychoacoustics and for some markets in Europe, but not for the entire internal market. In this regard, tonality is a high-level sound value at specific frequency (pure tone) that can be identified on either sound power or sound pressure spectrums. It requires measurements done in narrow bands. No standard definition is available for tonality outside the psycho-acoustics field. There is no need to adapt the existing test protocol EN 12102-1 to require measurements in narrow band frequencies in order to identify the tonality.
6. What is the proposed capacity provided by the unit during the noise measurement (and for how long? 30 seconds or more? does it include cycling - if relevant?)

Acoustic experts working on IEA Heat Pump Technologies - Annex 51 "Acoustic signature of heat pumps" have started to look into the acoustic behaviour of air-to-water heat pumps in different operating conditions and settings (fan / compressor speeds).

EHPA and EHI call for reproducible, repeatable, verifiable, cost-effective and straightforward test conditions to be implemented. In this regard, it should be possible to use all acoustic measurement techniques for improved test conditions, noticing that acoustic measurements can last from 30s to several hours, depending on the acoustic measurement technique.

When developing test conditions, the following elements should be taken into account:

- test conditions should be the same for all units;
- test conditions should be representative of the normal average unit running conditions during the heating season; therefore, testing at very low temperature is not relevant for end users because it does not happen in certain EU countries or only occur very rarely;
- test conditions should lead to steady-state operation of the unit during the acoustic measurement; therefore, cycling should not be considered during test measurement;
- declaration of sound power level should be related to a heating capacity already declared for seasonal performance rating.

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About EHPA:

The European Heat Pump Association (EHPA) is a Brussels based industry association which aims at promoting awareness and proper deployment of heat pump technology in the European marketplace for residential, commercial and industrial applications.

EHPA provides technical and economic input to European, national and local authorities in legislative, regulatory and energy efficiency matters. All activities are aimed at overcoming market barriers and dissemination of information in order to speed up market development of heat pumps for heating, cooling and hot water production.

EHPA coordinates quality initiatives: including the HP KEYMARK, a Quality label for heat pumps and Certification standards for heat pump installers. The association compiles the annual heat pump statistics and organizes a number of events, among them an annual heat pump conference.

About EHI:

EHI, the Association of the European Heating Industry, represents 90% of the European market for heat and hot water generation, heating controls and heat emitters, 75% of the hydronic heat pump market, 80% of the biomass central heating market (pellets, wood) and 70% of the solar thermal market.

EHI Members produce advanced technologies for heating in buildings, including heating systems, burners, boilers, heat pumps, components and system integrators, radiators, surface heating & cooling and renewable energy systems. In doing so, we employ directly more than 125.000 people in Europe and invest more than 1 billion euros a year in energy efficiency.