

WHITE PAPER: **HEAT PUMPS & SOUND**

April 2020



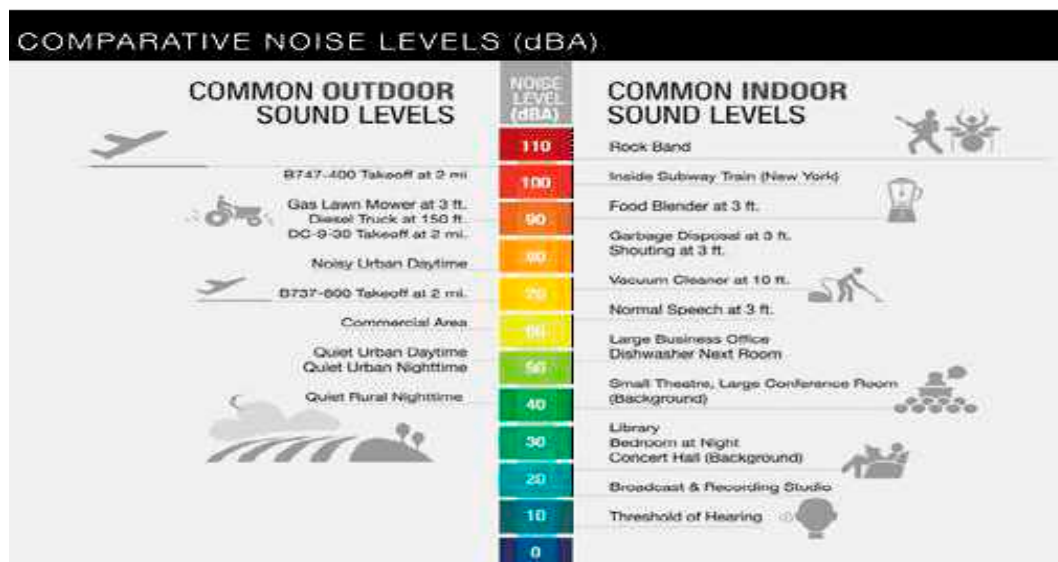
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1. INTRODUCTION

Every day the human's hearing is stimulated by a variety of surrounding sounds; these can be more or less pleasant. A sound is a wave where the energy is transmitted by pressure variations which can be detected by the human ear and can be measured. Instead, sound perception is subjective. People have different responses to loudness, sharpness, tonality and roughness. Even the person's cultural background, the visibility and/or the colour of the sound emitter, the surrounding environment can have an impact on the appreciation of the noise. If the sound is perceived as negative and unwanted, then it is considered a "noise".

Noise from traffic, industry and recreational activities is a growing problem. The recent exposure data from the European Environment Agency (EEA) demonstrate that more than 100 million European citizens are affected by high noise levels negatively impacting human health. The biggest problem is the loss of sleep. The World Health Organization recommends that for a good night's sleep, continuous background noise should stay below 30 decibels and individual noises should not exceed 45 decibels.



Source: [Fundamentals of Noise and Sound](#), Federal Aviation Administration

¹https://www.epd.gov.hk/epd/noise_education/web/ENG_EPd_HTML/m1/intro_1.html

²H. Hellgren, Presentation on Introduction to psychoacoustics, RISE, presentation given on 01/10/2019 during the EHPA's Sound Workshop

³L.Cao and J.Gross, Cultural Differences in Perceiving Sounds Generated by Others: Self Matters, Front Psychol, 2015, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4667006/>

⁴K. Koprowska, Subjective perception of noise exposure in relation to urban green space availability, Elsevier, 2018, <https://www.sciencedirect.com/science/article/pii/S1618866717304119>

⁵https://ec.europa.eu/environment/basics/health-wellbeing/noise/index_en.htm

⁶https://ec.europa.eu/info/events/noise-europe-2017-apr-24_en

⁷<https://www.euro.who.int/Noise>

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Acoustic is becoming more and more of a concern for the heat pump industry.

Due to the population's increased exposure to noise in the past years, sound issues have climbed up on the priority lists of local, national and the EU authorities. The rise of awareness on the negative consequences of noise has pushed policymakers to adopt measures to abate excessive sound levels. Such measures included limitations of noise from transport vehicles and certain types of equipment. Besides, urban planning regulations and obligations to inform the public about the impacts of noise pollution are also part of the process of tackling noise issues .

The main focus of European Union noise policy is on noise abatement through the use of mandatory technical standards for products. The most important legal tools consist of a set of directives establishing noise emission limits for particular products: motor vehicles, motorcycles, tyres, aeroplanes, household appliances and outdoor equipment .

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. In some cases, such sound may be an issue for end-users, who considers it noise.

Therefore, acoustic is becoming more and more of a concern for the heat pump industry. While industrial solutions to abate sound levels are being explored, other challenges related to the subjective perception of noise are still to be addressed. The complexity of sound issues requires a comprehensive approach that goes beyond technical solution and includes communication, training and legal actions.

Thanks to the impulse of some EHPA's members, the association held a workshop on sound issues, on 1st October 2019, at the Austrian Institute of Technology in Vienna. The Workshop provided a platform for manufacturers to discuss sound emissions from heat pumps and the answers needed for the public. Participants were also invited to brainstorm on potential actions to tackle sound-related issues.

Finally, as an annexe to this report, EHPA Secretariat put together a brief overview of the EU and national policy state of play on sound issues.

⁸ https://ec.europa.eu/environment/basics/health-wellbeing/noise/index_en.htm

⁹ SECTION 9 – NOISE LEGISLATION1030 Handbook on the Implementation of EC Environmental Legislation, p. 1030, <https://ec.europa.eu/environment/archives/enlarg/handbook/noise.pdf>



2. WORKSHOP FINDINGS

It is of general acknowledgement that heat pumps emit sound. Nevertheless, the challenge of reducing heat pumps' sound levels does not only rely on technological improvement. Indeed, other legal, communication and installation factors need to be taken into consideration to tackle, comprehensively, the noise made by a unit.



2.1. LEGAL & REGULATORY CONSIDERATIONS

Today, legal obligations and requirements on sound are defined, in parallel, on a European and on a national level.

On a European level, the EN 12102 series are the reference standard for heat pump acoustics. The standards offer valid test methods and test procedures to measure the sound power level of heat pumps.

The Ecodesign and Energy labelling directives set the basis for harmonized requirements on sound power level. For measurements, the texts refer to the standard EN 12102.

Nevertheless, the current regulations do not provide sufficiently well-defined and correct test conditions for sound power level measurement. In this regard, it would be necessary to further work 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.

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 on an EU level.

Finally, it would also be interesting to look into a definition of noise whilst **standardizing definitions for sound-related concepts** such as “night mode”, “day mode”, etc. Such standardization would provide stakeholders, market authorities and end-users with a common language. This would help to avoid ambiguous or misleading information on heat pumps acoustics.



2.2. INSTALLATION & COMMUNICATION CONSIDERATIONS

The **sound perception of a heat pump is intimately linked to the installation of the unit.** The location (city/countryside, outdoor/indoor, placement, etc.), the surrounding environment (closed-room, other buildings, etc.), the exposure and even its visibility play a key role on the noise perception. Inevitably, a wrongly or carelessly installed heat pump will emit more sound than expected, which will result in end-users being unsatisfied of the appliance's acoustic performance. Therefore, **the lack of knowledge, among installers, on how to install a heat pump from a sound perspective preempts any noise improvements.**

In this regard, installers should be provided with **a guide outlining installation and placement parameters** (where to install it, how to install it, the direction of the installation, etc.). Such a guide could be complemented by a **tool that could convert the metric issued by the manufacturers and provide the value for a specific location.** For example, the Austrian Institute of Technology is working on an application that provides installers with a 3D view on the sound of the unit and the impact of placement on sound emissions.

A good installation needs to be complemented by realistic and transparent marketing communication on the sound emitted by heat pumps. Indeed, it is important to note that there is a mismatch between real, measurable sound and perceived (also visual) noise. Specific care shall be taken on the characteristic of the sound: many complaints are not related to the overall level but to a disturbing single frequency noise. This could be covered by the declaration of tonality according to standards.

When it comes to sound levels, **manufacturers should communicate in the same way and use the same terminology to refer to the same acoustic performance.** Correct information and clear explanation on what levels of sound can be expected from a heat pump should be provided to the end-user.

Also, manufacturers should contribute to **raising the consumers' awareness of the benefits of heat pumps versus the sound of the unit.** Such communication should also put into perspective the perceived noise of a heat pump with other types of noises.

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2.3. CONSIDERATIONS ON THE LACK AND DISPARITY OF INFORMATION AMONG STAKEHOLDERS

Issues related to heat pumps acoustics come together with a clear disparity of information within the heat pump sector (research and development centres, components manufacturers, heat pump manufacturers, etc.) but also among the end-users and the EU/national authorities. Such disparity is the cause of a deepening **knowledge gap between the industry and the general public and the policymakers**. As a result, this gap creates a fragmented understanding of sound issues, false expectations and eventually, frustration at all levels.

Thus, there is a clear need for effective knowledge sharing between the industry and the general public. A **sound guide** issued by the heat pump industry could help to raise awareness and **improve the understanding of heat pump acoustics**.



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There is a clear need for effective knowledge sharing between the industry and the general public.

2.4. TECHNICAL CONSIDERATIONS

Overall **there is room for improvement when it comes to heat pumps acoustics, especially regarding components integration and interaction**. In this regard, collaboration and data sharing among stakeholders should be fostered and promoted.

The industry should look into what is perceived as noisy to improve the heat pump acoustic. Whether it is the vibration, the heat pumps itself or the (un)correct installation. When considering what originates the noise, transient acoustic should also be taken into consideration.

Lastly, research and development should look into improving the overall heat pump design, while also focusing on more specific technical aspects such as the turbine inflow, sensors and the overall cycle acoustic

3. CONCLUSIONS

Sound and noise issues are becoming more and more important for EU and national authorities, as well as for end-users. **More and more communities and Member States are introducing maximum outdoor sound pressure limits at the installation site.** Whereas, the **indoor sound is often regulated in national building codes.**

For this reason, the heat pump industry recognises that there is a need for rapid action to deliver on sound expectations and to provide the end-users as well as the policymakers, with an answer to the issue of acoustic. Indeed, **concerns on heat pump sound should not undermine the environmental and energy efficiency benefits that the technology is providing.**

More research & development complemented by better regulation will help the heat pump industry to deliver on sound expectations. Additionally, information dissemination via the development of a sound guide will help to tackle many aspects of the sound issue, while avoiding undermining the environmental and energy efficiency benefits of the heat pump technology.




The Brussels based European Heat Pump Association aisbl (EHPA) represents the majority of the European heat pump industry. It has currently 130 members from all parts of the industry's value chain: heat pump and component manufacturers, research institutes, universities, testing labs and energy agencies.

Its key goal is to promote awareness and proper deployment of heat pump technology in the European marketplace for residential, commercial and industrial applications. EHPA coordinates the European Quality label for heat pumps and the CEN Heat pump KEYMARK.

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HEAT PUMPS & SOUND

ANNEXE



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1. EU STATE OF PLAY (ECODESIGN & ENERGY LABELING)

1.1. INTRODUCTION

On EU level, **Ecodesign and Energy labelling Directives are among the pieces of legislation setting requirements on products.**

The EU Ecodesign Directive establishes a framework under which manufacturers of energy-using products are obliged to increase energy efficiency and reduce negative environmental impacts occurring throughout the product life cycle. It is complemented by the Energy Labelling Directive. These requirements are set for individual product groups called “Lots”.

Within this framework, requirements sound power levels tolerances for heat-pumps are included in:

- Lot 1 on Space and combination heaters
- Lot 2 on Water heaters
- Lot 10 on Room air conditioning appliances

The sound (or noise) that all types of space heating & cooling and domestic hot water heat pumps, produce is a relevant parameter as it influences the options for installation and seasonal efficiency. For these reasons there is an ecodesign requirement for noise emission of heat pumps (as well as a labelling information).

NB: it is important to note that the ecodesign and energy labelling framework only looks at sound power levels. Sound pressure levels are not included within the framework. This is due to the fact that sound power is the total acoustical capacity emitted by a sound source and is an absolute value. It is not affected by the environment or the location of the listener. Instead, sound pressure is affected by the sound power, the environment and the location of the listener and is what we hear. For this reason, more and more communities and Member States are introducing maximum outdoor sound pressure limits at the installation site.



1.2. LOT 1 ON SPACE & COMBINATION HEATERS

1.2.1. LEGISLATIVE & POLICY STATE OF PLAY

1.2.1.1. Ecodesign Regulation (EU) 813/2013/EC

Commission Regulation (EU) No 813/2013 of 2 August 2013 implementing Directive 2009/125/EC with regard to ecodesign requirements for space heaters and combination heaters introduced new, updates minimum energy efficiency requirements for space and combination heaters.

Within the initial considerations of the Regulation, it is clearly stated that:

- (5) “the environmental aspects of space heaters and combination heaters that have been identified as significant for the purposes of this Regulation are energy consumption in the use phase and (for heat pump heaters) sound power levels. (...)”.
- (14) the “ecodesign requirements should harmonise energy consumption, sound power level and nitrogen oxides emission requirements for space heaters and combination heaters throughout the Union, thus helping to make the internal market operate better and to improve the environmental performance of these products”.

The text also provides a definition of ‘standard rating conditions’, which means the operating conditions of heaters under average climate conditions for establishing (...) sound power level (article 2, §8). It specifies also that ‘sound power level’ refers to the A-weighted sound power level, indoors and/or outdoors, expressed in dB (article 2, §22).

Annex II to the regulation provides indications on the ecodesign requirements for sound power level.

From 26 September 2015, **the maximum sound power of heat pumps ranges from 60/65 dB (indoor/outdoor) if output < 6 kW to max. 80/88 dB for output > 30 kW.**

Within the same annex, Table 2 provides indications on information requirements for heat pump space heaters and heat pump combination heaters. Information requirements also apply as of 26 September 2015.

Rated heat output ≤ 6 kW		Rated heat output > 6 kW and ≤ 12 kW		Rated heat output > 12 kW and ≤ 30 kW		Rated heat output > 30 kW and ≤ 70 kW	
Sound power level (L_{WA}), indoors	Sound power level (L_{WA}), outdoors	Sound power level (L_{WA}), indoors	Sound power level (L_{WA}), outdoors	Sound power level (L_{WA}), indoors	Sound power level (L_{WA}), outdoors	Sound power level (L_{WA}), indoors	Sound power level (L_{WA}), outdoors
60 dB	65 dB	65 dB	70 dB	70 dB	78 dB	80 dB	88 dB

Item	Symbol	Value	Unit
Sound power level, indoors/outdoors	L_{WA}	x/x	dB

Annex III to the regulation looks at Measurements and Calculation.

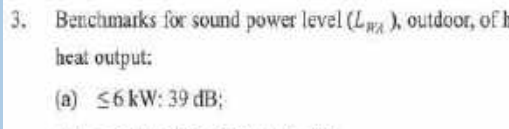

General conditions for measurements and calculations include:

- §2, (d) specifies that: For heaters equipped with supplementary heaters, the measurement and calculation of rated heat output, seasonal space heating energy efficiency, water heating energy efficiency, sound power level and emissions of nitrogen oxides shall take account of the supplementary heater.
- §2, (e) indicates that: Declared values for rated heat output, seasonal space heating energy efficiency, water heating energy efficiency, sound power level and emissions of nitrogen oxides shall be rounded to the nearest integer.

Specific requirements for seasonal space heating energy efficiency of heat pump space heaters and heat pump combination heaters: “For establishing the rated coefficient of performance COP_{rated} or rated primary energy ratio PER_{rated}, the sound power level or emissions of nitrogen oxides, the operating conditions shall be the standard rating conditions set out in Table 3 and the same declared capacity for heating shall be used (§4, (a))”.

Annex IV looks into verification procedure for market surveillance purposes and it is outlined that when performing the market surveillance checks referred to in Article 3(2) of Directive 2009/125/EC, the authorities of the Member States shall apply verification procedure for the requirements set out in Annex II. For heater models, they shall be considered to comply with the applicable requirements set out in Annex II to the Regulation if (...) the sound power level LWA is not more than 2dB higher than declared value of the unit. Also, if the average of the three units for the sound power level LWA is not more than 2 dB higher than the declared value of the unit.

Annex V to the Regulation shows the benchmarks for sound power levels.

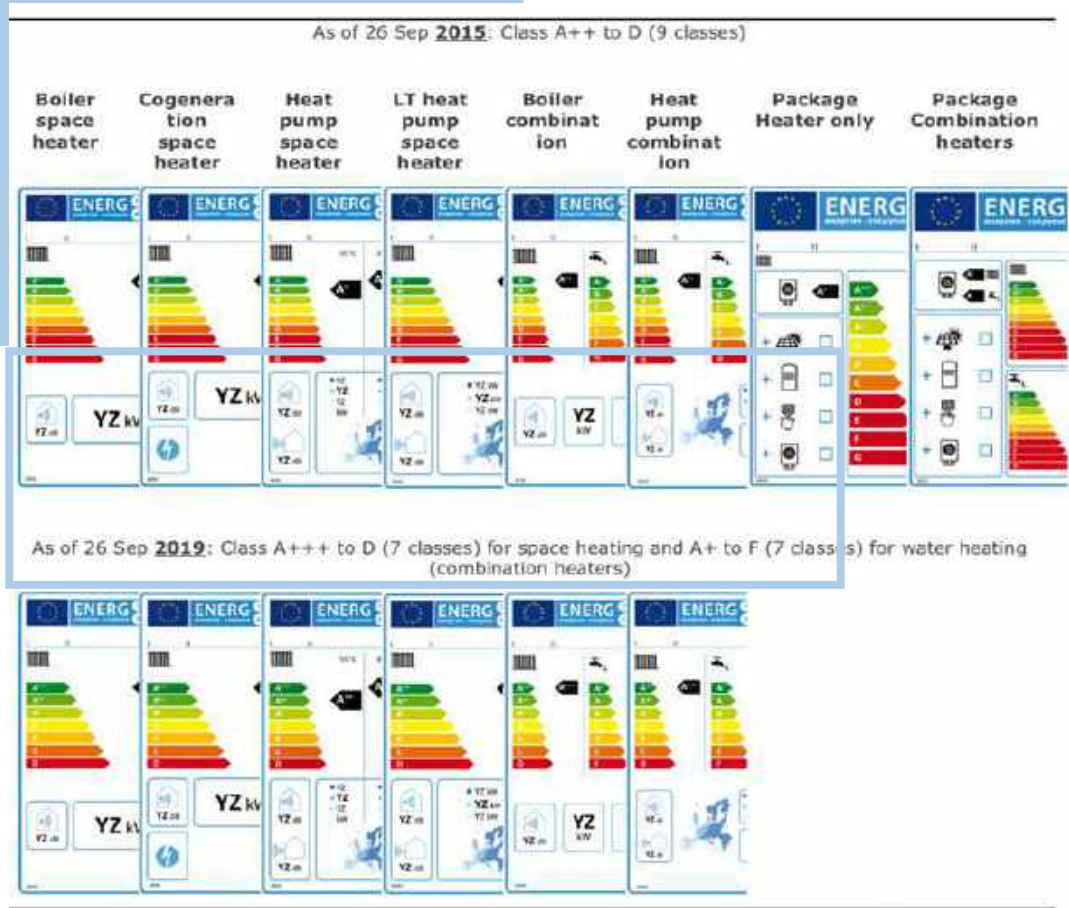
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3. Benchmarks for sound power level (L_{WA}), outdoor, of heat pump space heaters and of heat pump combination heaters with rated heat output:
- (a) ≤ 6 kW: 39 dB;
 - (b) > 6 kW and ≤ 12 kW: 40 dB;
 - (c) > 12 kW and ≤ 30 kW: 41 dB;
 - (d) > 30 kW and ≤ 70 kW: 67 dB.
- 

1.2.1.2. Energy labelling regulation (EU) no 811/2013/EC

Commission Delegated Regulation (EU) No 811/2013 of 18 February 2013 supplementing Directive 2010/30/EU describes the rules for the energy labelling of space heaters, combination heaters, packages of space heater, temperature control and solar device and packages of combination heater, temperature control and solar device. The scope of products of the labelling regulation is virtually the same as for Regulation (EU) 813/2013 but is limited to products with a maximum heat output ≤ 70 kW (for space heating).

The regulation indicates that **‘the sound power level of a heater can be an important consideration for end-users. Information on sound power levels should be included on the labels of space heaters and combination heaters’** (initial considerations (9)).

Therefore, a sound pictogram informing consumers on sound power levels must be included on the label. The labels (design, size, format) are described in Annex III.



Annex IV, point 1.1 indicates that the sound power level LWA, indoors, in dB, rounded to the nearest integer (for heat pump space heaters if applicable) should be provided as part of the information in the product fiche. The sound power level LWA, outdoors, in dB, rounded to the nearest integer should also be included of the product fiche.

Table 8 of Annex V details technical parameters for heat pump space heaters and heat pump combination heaters that should be included within the technical documentation. Sound power levels should be presented as follows:

Item	Symbol	Value	Unit
Sound power level, indoors/ outdoors	L_{WA}	x / x	dB

Sound power levels are also part of the information to be provided in cases where end-users cannot be expected to see the product displayed (Annex VI).

1.2.2 OPTIONS GOING FORWARD

(According to [Final Report on Lot 1](#) published on 2/10/2019)

Article 7 on review states the elements that need to be considered in a review. This also include: **“the appropriateness of setting stricter ecodesign requirements for the energy efficiency of boiler space heaters and boiler combination heaters, for the sound power level and for emissions of nitrogen oxides”**.

The report addresses sound power limits for heat pumps.

It states that the sound (or noise) that space heaters, and heat pumps in particular, produce is a relevant parameter as it influences the options for installation and seasonal efficiency. For these reasons there is an ecodesign requirement for sound power of heat pumps (and a labelling information parameter for all space heaters, including boilers).

Although the regulation clearly states the outdoor and system temperatures for measurement of noise of heat pumps, the capacity is not clearly defined. At one point, reference is made to the rated heat output but also to “the same declared capacity... [as used for energy efficiency calculation]”. This is not unambiguous.

It is even more complex if the difference between fixed speed heat pumps and inverter-driven heat pumps is considered: the fixed speed capacity is by definition its full load capacity, for the inverter driven it depends on the part load required and other possible control settings.

To solve this problem, a revised regulation shall clearly state the outdoor and indoor (system) conditions and at minimum require declaring the fan speed and compressor speed that is more representative of conditions when most sound is produced (e.g. by declaring fan speed or flow rate, and compressor speed at bivalent point). The test method and the exact conditions have to be decided with test institutes, industry and other stakeholders together. Stakeholders did indicate that the test should reflect operation in conditions that are expected to be most problematic for sound emissions (more on this in Task 1). In order to properly take into account tonality of the noise (to calculate the emissions on the basis of sound power provided) information per third-octave bands needs to be provided as well.

For space heaters that are known to emit very low noise, stakeholders have suggested a simple approach based on a declaration that the noise emissions (indoor, outdoor whichever are relevant) are below a certain threshold (avoiding the need for testing of these products).

1.3. LOT 2 ON WATER HEATERS

1.3.1. LEGISLATIVE & POLICY STATE OF PLAY

1.3.1.1. Ecodesign Regulation (EU) No 814/2013

Commission Regulation (EU) No 814/2013 of 2 August 2013 implementing Directive 2009/125/EC with regard to ecodesign requirements for water heaters and hot water storage tanks introduced new, updates minimum energy efficiency requirements for water heaters. The scope covers water heaters with a rated heat output of maximum 400 kW and hot water storage tanks with a maximum volume of 2,000 litres. Included are integrated packages of water heaters and solar devices.

Similarly to the Lot 1, the initial considerations (4) of the Ecodesign Regulation (EU) No 814/2013 outline that ‘The environmental aspects of water heaters that have been identified as significant for the purposes of this Regulation are energy consumption in the use phase and (for heat pump water heaters) sound power levels.’(4).

Therefore, ‘**ecodesign requirements should harmonise energy consumption, sound power level (...) thus helping to make the internal market operate better and to improve the environmental performance of these products**’ (12).

The regulation includes the same definition as for Lot 1 (cf. section on Ecodesign Regulation (EU) 813/2013/EC).

Annex II to the regulation specifies ecodesign requirements for sound power levels. From 26 September 2015, **the maximum sound power of heat pumps ranges from 60/65 dB (indoor/outdoor) if output < 6 kW to max. 80/88 dB for output > 30 kW and 70 kW.**

Rated heat output ≤ 6 kW		Rated heat output > 6 kW and ≤ 12 kW		Rated heat output > 12 kW and ≤ 30 kW		Rated heat output > 30 kW and ≤ 70 kW	
Sound power level (L _{WA}), indoors	Sound power level (L _{WA}), outdoors	Sound power level (L _{WA}), indoors	Sound power level (L _{WA}), outdoors	Sound power level (L _{WA}), indoors	Sound power level (L _{WA}), outdoors	Sound power level (L _{WA}), indoors	Sound power level (L _{WA}), outdoors
60 dB	65 dB	65 dB	70 dB	70 dB	78 dB	80 dB	88 dB

Annex III details measurements. For the purposes of compliance and verification of compliance with the requirements of this Regulation, measurements shall be made using harmonised standards the reference numbers of which have been published for this purpose in the Official Journal of the European Union, or using other reliable, accurate and reproducible methods that take into account the generally recognised state-of-the-art methods. They shall meet the conditions and technical parameters.

For heat pump water heaters, if applicable, technical parameters of water heaters include the sound power level L_{WA}, in dB, indoors and outdoors, rounded to the nearest integer.

Annex IV details calculations. Table 7 specifies applicable tolerances, including for sound power level L_{WA}, indoors and/or outdoors:

Measured parameter	Verification tolerance
Sound power level L _{WA} , indoors and/or outdoors	The measured value shall not be more than 2 dB higher than the rated value.

Annex VI shows the indicative benchmarks for water heating efficiency (35% for 3XS to 130% for 4XL), sound power levels and NOx emissions, being 35 mg/kWh (in terms of GCV) for boilers using gaseous fuels and 50 mg/kWh when using liquid fuels).

2. BENCHMARKS FOR SOUND POWER LEVEL (L_{WA}), OUTDOORS, OF HEAT PUMP WATER HEATERS WITH:

- (a) rated heat output ≤ 6 kW: 39 dB;
- (b) rated heat output > 6 kW and ≤ 12 kW: 40 dB;
- (c) rated heat output > 12 kW and ≤ 30 kW: 41 dB;
- (d) rated heat output > 30 kW and ≤ 70 kW: 67 dB.

1.3.1.2. Energy Labelling Regulation (EU) No 812/2013

Commission Delegated Regulation (EU) No 812/2013 of 18 February 2013 supplements Directive 2010/30/EU describes the rules for the energy labelling of water heaters, hot water storage tanks and packages of water heater and solar device. The scope of products of the labelling regulation is virtually the same as for Regulation (EU) No. 814/2013 but is limited to products with a maximum heat output ≤ 70 kW and storage tank volumes of 500 L.

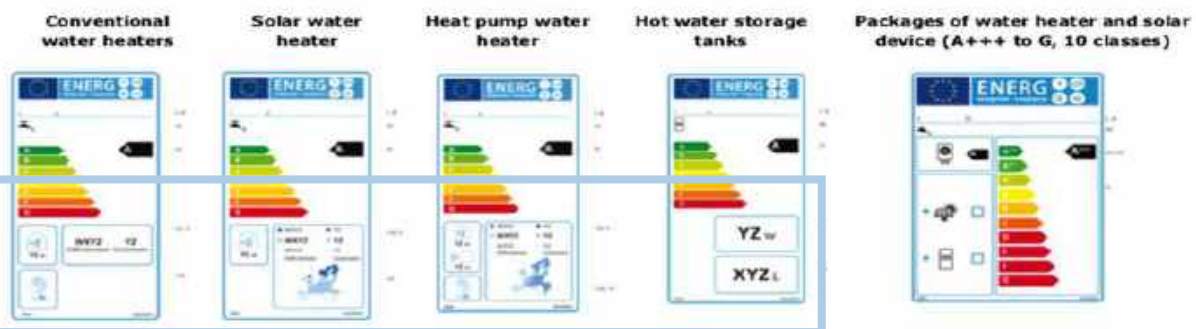
Initial considerations of the regulation outline that 'The sound power level of a water heater could be an important consideration for end-users. Information on sound power levels should be included on the labels of water heaters' (7).

The framework prescribes that a sound pictogram informing consumers on sound power levels is included on the label.

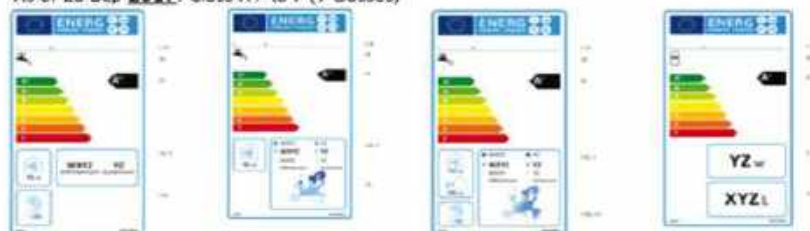
The labels (design, size, format) are described in Annex III:

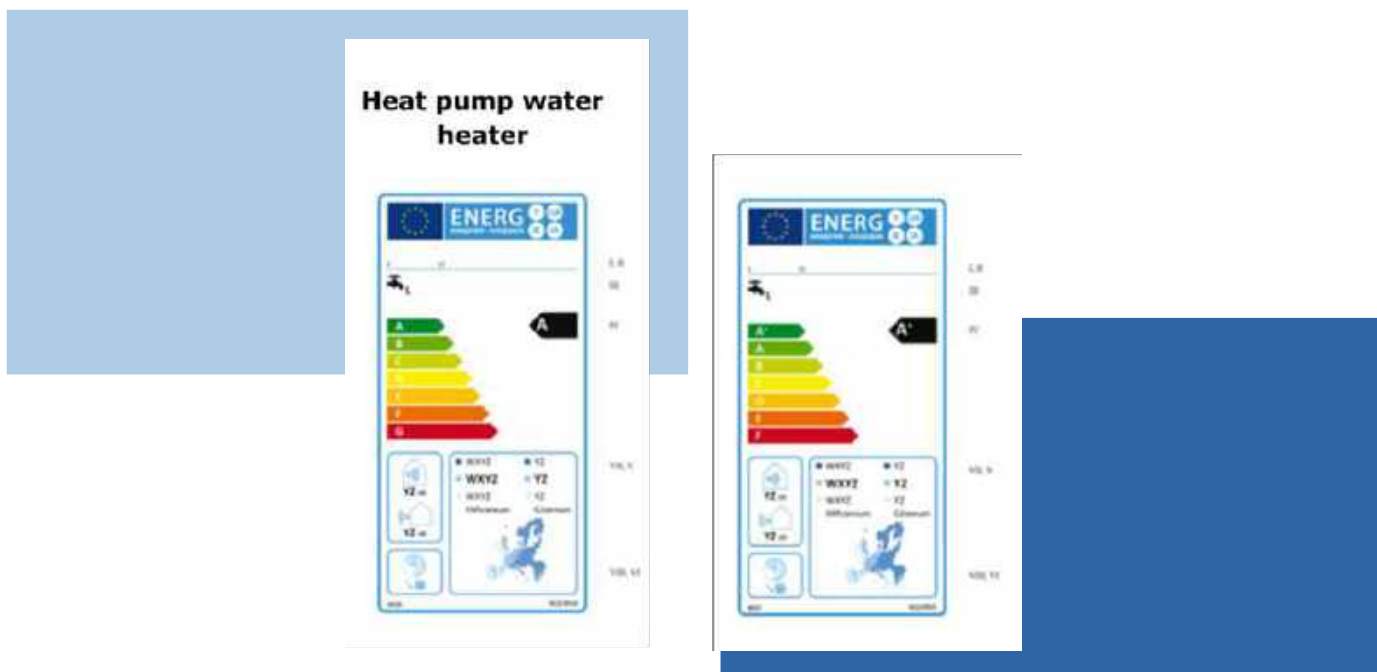
Figure 2. Energy labels for the various products in scope of Commission Delegated Regulation (EU) No. 812/2013

As of 26 Sep 2015: Class A to G (7 classes)



As of 26 Sep 2017: Class A+ to F (7 classes)





Annex IV on the product fiche specifies that ‘the sound power level LWA, indoors and outdoors, in dB, rounded to the nearest integer (for heat pump water heaters if applicable)’. The same prescriptions are given for the Information to be provided in cases where end-users cannot be expected to see the product displayed (Annex VI).

Annex VII on measurements indicates that ‘for the purposes of compliance and verification of compliance with the requirements of this Regulation, measurements shall be made using harmonised standards the reference numbers of which have been published for this purpose in the Official Journal of the European Union, or using other reliable, accurate and reproducible measurement methods that take into account the generally recognised state-of-the-art methods. They shall meet the conditions and technical parameters’. For water heaters, the technical parameters include sound levels (point 7 of Annex VII).

Last but not least, it is set that in terms of sound verification tolerances, the measured value shall not be more than 2 dB higher than the rated value (Annex IX).

1.3.2 OPTIONS GOING FORWARD

(According to [Final Report on Lot 2](#) published on 2/10/2019))

The report addresses sound power measurements.

Current description of assessment is unclear and not in conformity with known testing practice. By setting clearer test conditions, the sound power values will be more representative and give a lower administrative burden for industry and MSAs.



1.4. LOT 10 ON ROOM AIR CONDITIONING APPLIANCES

1.4.1. LEGISLATIVE & POLICY STATE OF PLAY

1.4.1.1. Ecodesign Regulation (EU) No 206/2012

The European Commission published Commission Regulation (EU) No 206/2012 implementing ecodesign requirement measures for air conditioners and comfort fans. The Regulation includes requirements for maximum sound power level for all air conditioner types in scope. The Regulation applies to electric mains-operated air conditioners with a rated capacity of ≤ 12 kW for cooling, or heating if the product has no cooling function, and comfort fans with an electric fan power input ≤ 125 W.

Initial considerations state that the main environmental aspects of the products covered, identified as significant for the purposes of this Regulation, are energy consumption in use phase and sound power level (4).

Annex I provides the ecodesign requirements and the definitions applicable for the purposes of the annexes.

The requirements for sound power level of air conditioners are dependent on the rated capacity. The requirements are shown in the table here below. It is to be noted that for ducted air conditioners, the sound power should be measured in-duct. In addition, these values are dependent on the rating conditions which refer to standard rating conditions in the Regulation. Requirements should be adapted if the sound power rating conditions vary in the future.

Table 5
Requirements for maximum sound power level

Rated capacity ≤ 6 kW		$6 <$ Rated capacity ≤ 12 kW	
Indoor sound power level in dB(A)	Outdoor sound power level in dB(A)	Indoor sound power level in dB(A)	Outdoor sound power level in dB(A)
60	65	65	70

Besides the above-mentioned requirements also requirements concerning product information are set out in the Annex I to the regulation:

Item	symbol	value	unit	Item	symbol	value	unit
fixed	Y/N			Sound power level (indoor/outdoor)	L_{WA}	x,x/x,x	dB(A)
staged	Y/N			Global warming potential	GWP	x	kgCO ₂ eq.
variable	Y/N			Rated air flow (indoor/outdoor)	—	x/x	m ³ /h
Contact details for obtaining more information	Name and address of the manufacturer or of its authorised representative.						

(*) For staged capacity units, two values divided by a slash (/) will be declared in each box in the section 'Declared capacity of the unit' and 'declared EER/COP' of the unit.

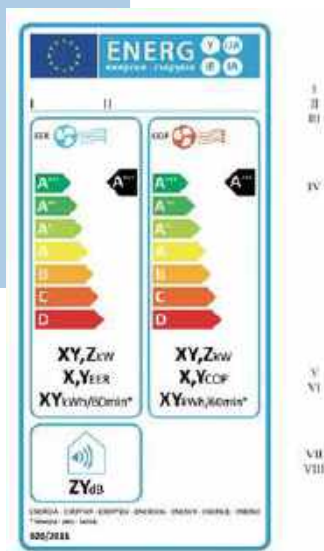
(**) If default $C_d = 0,25$ is chosen then (results from) cycling tests are not required. Otherwise either the heating or cooling cycling test value is required.

Annex III looks at the verification procedure for market surveillance purposes. Depending on the type of appliance the appliance, the air conditioner model shall be considered to comply with the requirements set out in this Regulation, as applicable, if the maximum sound power or the average maximum sound power level does not exceed more than 2 dB(A) of the declared value.

1.4.1.2. Energy Labelling (EU) No 626/2011

The framework prescribes that a sound pictogram informing consumers on sound power levels is included on the label (Annex II). See below an example of a label design.

Sound power level for indoor unit expressed in dB(A) re1 pW, rounded to the nearest integer.



Annex IV indicates that inside and outside sound power levels at standard rating conditions, on cooling and/or heating modes should be included as part of the information in the product fiche.

The regulation also prescribes that “Sound power levels expressed in dB(A) re1 pW, rounded to the nearest integer” are among the information to be provided in the cases where end-users cannot be expected to see the product displayed (Annex VI).

1.4.2 OPTIONS GOING FORWARD

(according to the latest proposal discussed at the Consultation Forum on 9th September 2019)

In the proposed revision of the Commission Regulation repealing Regulation No 2016/2012 with regard to ecodesign requirements for air conditioners and comfort fans indicates that from 1 January 2022, the sound power of air-to-air air conditioners, air-to-air heat pumps and comfort fans shall not be above the values in Table 6 (Annex II):

Table 6
Minimum sound power requirements

	Sound power level in dB(A)	
	Indoor	Outdoor
Air-to-air air conditioners and air-to-air heat pumps other than single and double duct air conditioners and heat pumps, with a rated capacity < 6 kW	60	65
Air-to-air air conditioners and air-to-air heat pumps other than single and double duct air conditioners and heat pumps, with a rated capacity ≥ 6 kW	65	70
Single and double duct air conditioners and heat pumps	65	-

Annex III looks at measurements and calculations and it is indicated that ‘for air-to-air heat pumps equipped with an electric supplementary heater, the measurement and calculation of the declared heating capacity, the seasonal space heating energy efficiency, sound power level shall take account of the electric supplementary heater’.

For sound power level of fixed air-to-air air conditioners and fixed air-to-air heat pumps, while establishing the sound power level, the operating conditioners shall be the standard rating conditions. The part load ratio in heating mode shall be the part load ratio of rating point C.

For sound power level of portable air-to-air air conditioners and portable air-to-air heat pumps, while establishing the sound power level, the operating conditioners shall be the standard rating conditions. The capacity during the test shall be the rated capacity.

In terms of the proposal for the energy labelling, the revision outlines that the sound power class of air-to-air air conditioners, air-to-air heat pumps and comfort fans (Annex II on Energy efficiency classes).

The sound power class of air-to-air air conditioners, air-to-air heat pumps and comfort fans shall be determined on the basis of their sound power as set out in Table 4.

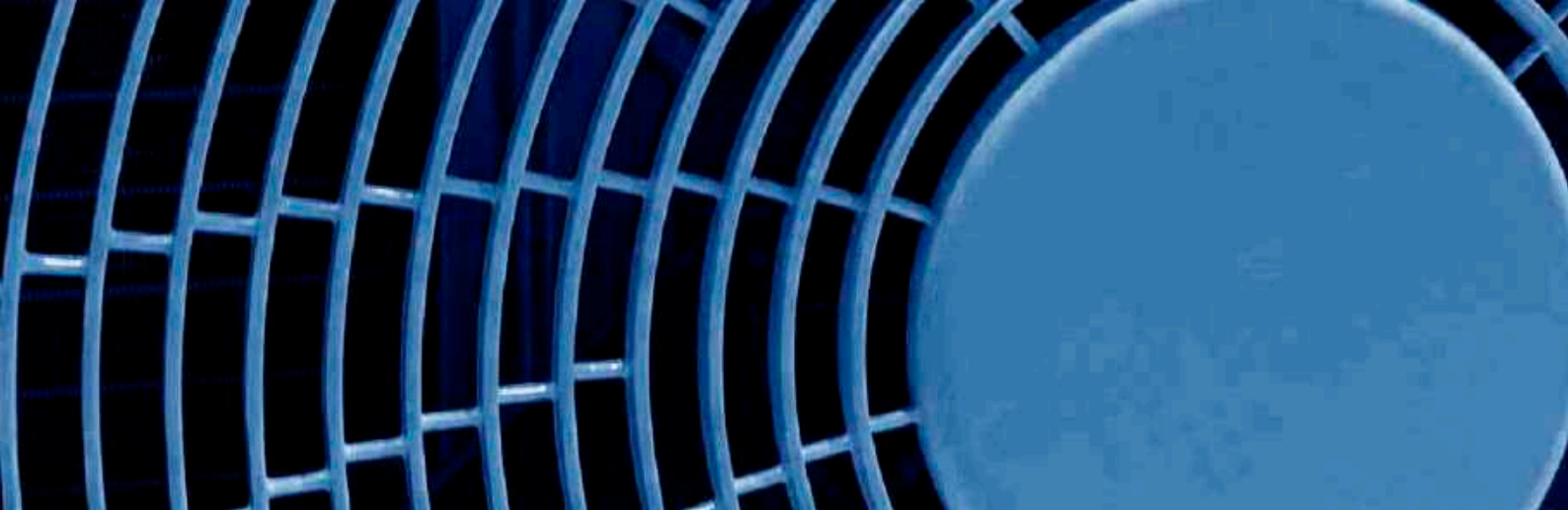
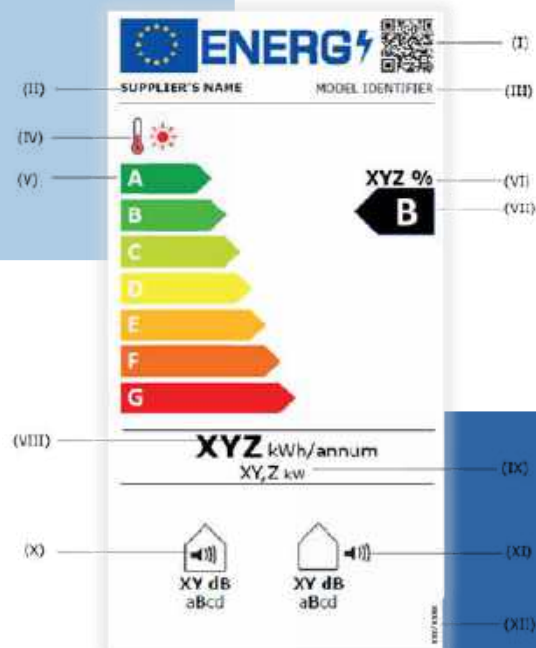


Table 4
Sound power classes of air-to-air air conditioners, air-to-air heat pumps and comfort fans

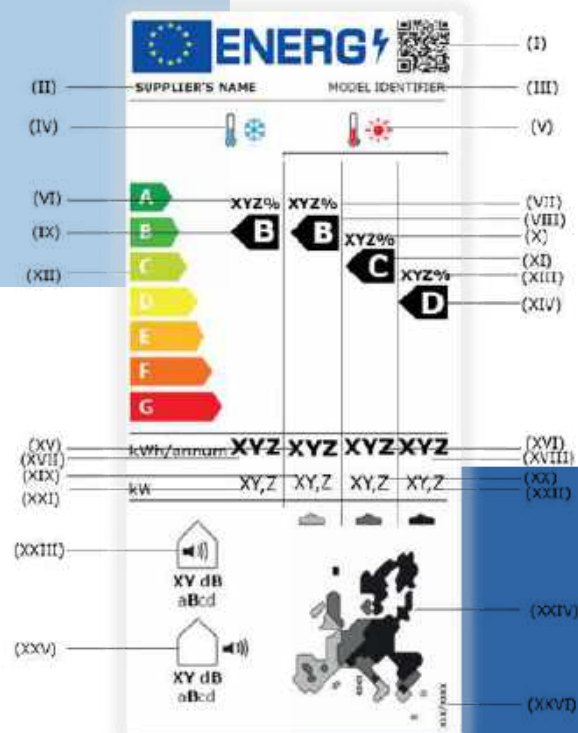
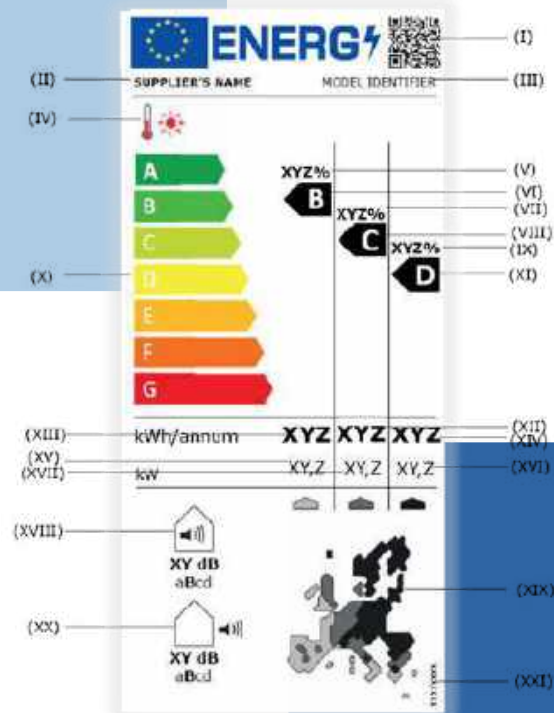
Energy Efficiency Class	Sound power (dB(A))
A	< 45
B	≥ 45 and < 55
C	≥ 55 and < 65
D	≥ 65

The sound power of air-to-air air conditioners, air-to-air heat pumps and comfort fans shall be determined in accordance with points 7 and 8 of Annex IV.

Accordingly, the energy label for portable heating only air-to-air heat pumps should display the indoor and the outdoor sound power expressed in dB(A) and rounded to the nearest integer, determined in accordance with Annex II, Table 4.



For heating only air-to-air heat pumps and other reversible air-to-air heat pumps the label layout is slightly different but the prescriptions for sound power levels are the same (see below).



Similarly, to the Annex III of the Regulation on ecodesign requirements, the Annex IV looks at measurements and calculation methods. It is specified that for air-to-air heat pumps equipped with an electric supplementary heater, the measurement and calculation of the declared heating capacity, the seasonal space heating energy efficiency, sound power level shall take account of the electric supplementary heater.

For sound power level of fixed air-to-air air conditioners and fixed air-to-air heat pumps, while establishing the sound power level, the operating conditioners shall be the standard rating conditions. The part load ratio in heating mode shall be the part load ratio of rating point C.

2. NATIONAL STATE OF PLAY

Sound pressure is affected by the sound power, the environment or the location of the listener and is what we hear. **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 codes. Most often indoor sound pressure from equipment that is installed close to or in habitable rooms should not exceed 30 dB.

This document identifies some of these Member States.

2.1 AUSTRIA

In Austria the noise from the (air-source) heat pump should not vastly exceed the background noise level, and criteria for distance, depending on installation circumstances, are provided. Maximum noise pressure levels vary per region, and limits may apply to the property border or the facade of the neighbouring property. A map of sound limits (at day and/or night) sets the outdoor sound power from all sources. When installing a heat pump, a neighbour has to clarify the accepted outdoor sound power level by a legal expert measuring the sound of the surroundings, on a case by case basis. This brings uncertainty for the acceptable sound power levels.

2.2 DENMARK

Hour period	Noise limit for		
	Cottage areas	Close to residential areas	Dwelling, houses, mixed housing and commercial open land
Weekends (18:00-22:00) Saturdays (07:00-14:00)	40 dB	45 dB	50-55 dB
Weekends (18:00-22:00) Saturdays (07:00-14:00) Sundays (07:00-22:00)	35 dB	40 dB	45 dB
Every day (22:00-07:00)	35 dB	35 dB	40 dB

2.3 FINLAND

Outdoors:

	Day time (07:00-22:00)	Night time (22:00-07:00)
Existing neighborhood, urban	55 dB	50 dB
New neighborhood, urban	55 dB	45 dB
Recreational area, non-urban	45 dB	40 dB

Indoors:

	Day time (07:00-22:00)	Night time (22:00-07:00)
Living areas	35 dB	30 dB

2.4 FRANCE

For indoor units, Article 5 of regulation of 30 June 1999 applies requiring the following sound pressure values:

- Living rooms : 30 dB(A)
- Kitchen : 50 dB(A)
- Opened kitchen on the living room 40 dB(A)

All values are related to the space heating unit when operating at the minimum capacity.

For outdoor units, the requirements given in the decree no 2006-1099 dated 31 of August 2006. These requirements are defined on the basis of noise emergence and not directly sound power level.

- 5 dB(A) during day time (from 7 am to 10 pm)
- 3 dB (A) during night time (from 10 pm to 7 am)

The values indicated for outdoor units are the maximum sound power level required by the NF PAC certification which a voluntary certification scheme. The requirements are very similar to those of the ErP requirements. Measurements are based on EN 12102-1.

2.5 GERMANY

In Germany there is no restriction on the sound power levels of heat pumps. However, the TA Lärm (Technical Instructions on Noise Protection) protects neighbours from too high immission levels. It specifies limit values to be observed at the relevant place of immission (0.5 m in front of the opened window of the room most in need of protection). For a residential area the maximum level is 35 dB(A) at night-time (from 22 to 6 h). Most frequent place of installation is the common living area with a nighttime limit of 40 dB(A).

In general, TA Lärm limits apply to the sum of the overall noise immissions from every source on site, not only to one single unit. In case the sound pressure resulting from the heat pumps is at least 6 dB(A) below the limit value, an accumulated forecast is not required.

Therefore, three ways of calculation can be taken: accounting all sources on site, a general discount of 6 dB(A) on limit value or sound pressure of heat pump only. The decision is taken by local authorities.

The Bundesverband Wärmepumpe (BWP) e.V. has drawn up a guideline that describes the subject matter well (in German) and there is also an online tool that can be used to calculate whether the limit values are being complied with.

Reference values of immission levels for the different areas according to "TA Lärm"

Area	Rating period	Rating level
Industrial area		70 dB(A)
Industrial estate	Day	65 dB(A)
	Night	50 dB(A)
Urban area	Day	63 dB(A)
	Night	45 dB(A)
Central area	Day	60 dB(A)
	Night	45 dB(A)
General residential area	Day	55 dB(A)
	Night	40 dB(A)
Pure residential area	Day	50 dB(A)
	Night	35 dB(A)

In Germany there is also a voluntary ecolabel scheme that looks at sound levels. The certification is the "Blue Angel RAL-UZ 204: Stationary air conditioners", which is not really relevant for heat pumps. The criteria are established by the German Federal Environment Agency and awarded by an independent Jury to products that are environmentally friendlier than others serving the same use. It is to assist consumers in their purchase decisions. The basic criteria for stationary air conditioners include requirements regarding e.g. SEER, SCOP and noise. The noise emissions of the devices must comply with the following requirements:

Die Geräuschemissionen der Geräte müssen nachfolgende Anforderungen erfüllen:

Nennleistung (P_{rated}) im Kühl- oder Heizbetrieb	Anforderungen an den Schallleistungspegel bei Nennleistung	
	Inneneinheiten	Außeneinheiten
$\leq 4,5 \text{ kW}$	$\leq 50 \text{ dB(A)}$	$\leq 58 \text{ dB(A)}$
$4,5 \text{ kW} < P_{rated} \leq 6 \text{ kW}$	$\leq 55 \text{ dB(A)}$	$\leq 62 \text{ dB(A)}$
$6 \text{ kW} < P_{rated} \leq 12 \text{ kW}$	$\leq 58 \text{ dB(A)}$	$\leq 68 \text{ dB(A)}$

Die Höhe der Geräuschemissionen muss in den Produktunterlagen dokumentiert sein.

2.6 ITALY

Territory classes	Reference periods	
	Day-period (06:00-22:00)	Night-period (22:00-06:00)
Class I	45 dB(A)	35 dB(A)
Class II	50 dB(A)	40 dB(A)
Class III	55 dB(A)	45 dB(A)
Class IV	60 dB(A)	50 dB(A)
Class V	65 dB(A)	55 dB(A)
Class VI	65 dB(A)	65 dB(A)

Class I- Protected areas where quiet is the main element (hospitals, schools, parks, country residential areas).

Class II- Areas devoted to residential settling with low inhabitant density (local traffic, no industries and only few commercial activities).

Class III- Mixed areas (local and passing traffic, mean inhabitant density, commercial activities, and offices but with no industries).

Class IV- Areas with high density, traffic, and commercial activities (near main roads, railways or ports- may be few small industries).

Class V- Mainly industrial areas.

Class VI- Only industrial areas; no dwellings.

2.7 THE NETHERLANDS

The Netherlands is considering a maximum sound pressure level of 35 dB for neighbouring homes. For an average heat pump in a dense area this means a reduction of 9 to 14dB(a) is needed.

Nevertheless, the legislation is not fixed yet. The Dutch Heat Pump Association expects that the legislation will limit the sound level of heat pumps at 40 dB(A) at the border of the neighbours' property.

Effectively, knowing that the average terraced house is 6 meters wide, it means 40 dB(A) at a distance of 3 meters when the heat pump is placed in the middle of the garden's width.

2.8 SPAIN

Type of acoustic area		Noise index		
		Day (07:00-19:00)	Evening (19:00-23:00)	Night (23:00-07:00)
E	Quiet areas (hospitals, schools).	50 dB(A)	50 dB(A)	40 dB(A)
A	Residential areas.	55 dB(A)	55 dB(A)	45 dB(A)
D	Nature and entertainment areas.	60 dB(A)	60 dB(A)	50 dB(A)
C	Entertainment areas.	63 dB(A)	63 dB(A)	53 dB(A)
b	Industrial areas.	65 dB(A)	65 dB(A)	55 dB(A)

The following tables show the requirements of different autonomous communities in Spain that have independent laws to control environmental noise:

Autonomous community	Emission limit values		
Andalusia	Area of acoustic sensitivity	Day (07:00-19:00)	Night (23:00-07:00)
	Silent areas	55 dB(A)	40 dB(A)
	Quite areas	55 dB(A)	45 dB(A)
	Tolerable noise areas	65 dB(A)	55 dB(A)
	Noisy areas	70 dB(A)	60 dB(A)
	Most noisy areas	75 dB(A)	65 dB(A)

Autonomous community	Emission limit values		
Castilla y Leon	Area of acoustic sensitivity	Day (07:00-19:00)	Night (23:00-07:00)
	Sanitary areas	45 dB(A)	35 dB(A)
	Residential areas	55 dB(A)	45 dB(A)
	Commercial areas	65 dB(A)	55 dB(A)
	Industrial and warehouses areas	70 dB(A)	55 dB(A)

Autonomous community	Emission limit values		
Extremadura	Area of acoustic sensitivity	Day (07:00-19:00)	Night (23:00-07:00)
	Sanitary areas	35 dB(A)	35 dB(A)
	Residential and commercial areas	60 dB(A)	45 dB(A)
	Industrial areas	70 dB(A)	55 dB(A)

Autonomous community	Emission limit values		
Madrid Community	Area of acoustic sensitivity	Day (07:00-19:00)	Night (23:00-07:00)
	Silent areas	50 dB(A)	40 dB(A)
	Quite areas	55 dB(A)	45 dB(A)
	Tolerable noise areas	65 dB(A)	55 dB(A)
	Noisy areas	70 dB(A)	60 dB(A)
	Most noisy areas	75 dB(A)	65 dB(A)

Autonomous community	Emission limit values		
Galicia	Area of acoustic sensitivity	Day (07:00-19:00)	Night (23:00-07:00)
	High sensitivity	35 dB(A)	35 dB(A)
	Moderate sensitivity	60 dB(A)	45 dB(A)
	Low sensitivity	70 dB(A)	55 dB(A)
	Service and other specific areas	75 dB(A)	75 dB(A)

2.9 SWEDEN

Outdoors:

Day time (06:00-18:00)	Evening (18:00-22:00)	Night (22:00-06:00)	Saturdays, Sundays and publ. holidays (06:00-18:00)
50 dB(A)	45 dB(A)	40 dB(A)	50 dB(A)

Source: Naturvårdsmiljö

The levels in the table above refer to the emission values at houses, preschools, schools and care facilities. They apply outdoors to the facade and to patios and other areas for outdoor activities in the vicinity of the home.

Indoors:

Max (burst of sound)	Equivalent (continuous noise)	Noise with tonality
45 dB(A)	30 dB(A)	25 dB(A)

Source: Folkhälsomyndigheten

The thresholds for both outdoors and indoors are recommended values and can form the basis for judging if the noise level from a heat pump is breaching the environmental code. activities in the vicinity of the home.

2.10 POLAND

In Poland, the indoor noise issues are specified in the Regulation of the Minister of Infrastructure and Construction on the technical conditions to be met by buildings and their location (Journal of Laws No. 75, item 690 of 2002, as amended) and the standard PN-B-02151-2: 2018-01.

The equivalent sound level of the noise penetrating into the building from all noise sources located outside this building may not exceed the values given below:

a) Living spaces in residential building, dormitory, hotel

- 40 dB (A) during the day
- 30 dB (A) at night

b) Kitchens and sanitary rooms

- 45 dB (A) during the day
- 40 dB (A) at night

c) Rooms in 2nd category and lower hotels

- 45 dB (A) during the day
- 35 dB (A) at night

Outdoor areas noise levels are specified in the announcement of the Minister of the Environment of October 15, 2013, regarding the publication of the Regulation of the Minister of the Environment on noise levels in the environment (see Table 10).

The values relate to the sound pressure level on the border of the construction plot (outside the area to which the owner/manager of this facility has a legal title), in accordance with the Environmental Protection Act (Journal of Laws 2013 item 1232).

No.	Designation of the area	Designation of the area D reference time interval equal to 8 least favorable hours of the day following successively	Designation of the area D reference time interval equal to 1 least favorable hour of the night
1	a. Protection zone A of the spa	45	40
	b. Hospital areas outside the city		
2	a. Areas of single-family housing	50	40
	b. Areas buildings associated with permanent or temporary stay of children and young people		
	c. Nursing home areas		
	d. Hospital areas in cities		
3	a. Areas of multi-family housing and collective housing	55	45
	b. Farm buildings		
	c. Recreation areas		
	d. Residential and service areas		
4	a. Areas in the downtown area of cities over 100,000 inhabitants	55	45

2.11 UK

In the UK the installation of an air source heat pump does not require prior permission if the requirements of MCS 20 are met: MCS20 means the maximum sound pressure one metre external to the centre point of any door or window to a habitable room of a neighbouring property as measured perpendicular to the plane of the door or window is maximum 42 dB(A).

The MCS20 describes the procedure which takes into account corrections of the unit sound power level for directivity, distance, barriers, background noise (40 dB(A)) and a correction for the higher value. The MCS Standard is industry lead in the UK.

Overall, the situation in the UK is a bit fragmented. The MCS Standard document is not required for the UK Domestic Renewable Heat Incentive scheme and does not currently apply universally. However, in practice, local planning authorities effectively demand the MCS Standard applies in order for the project to be awarded Permitted Development Rights.

2.12 EXAMPLE NON-EU COUNTRY: NORWAY

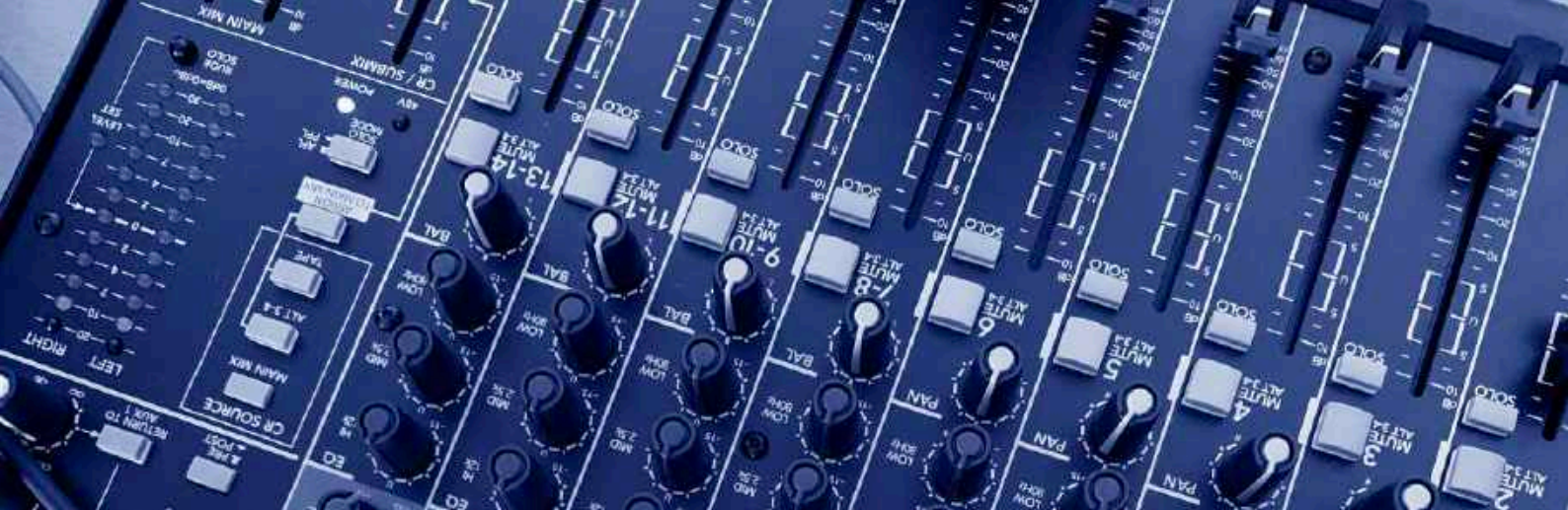
There is no sound legislation applying to heat pumps specifically. Requirements on noise can be found in Technical building regulations: § 13-9. Støy fra bygningstekniske installasjoner og utendørs lydkilder (Noise from building technical installations and outdoor sound sources)

Limit values for noise from technical installations are given in: Standards Norway (SN) NS 8175:2019 Lydforhold i bygninger- Lydklasser for ulike bygningstyper (Acoustic conditions in buildings- Sound classification of various types of buildings).

Grenseverdier for støy fra tekniske installasjoner (NS 8175,kl.C)

	Skoler	Boliger	Barnehager	Hotell	Helsebygg	Kontorer
Innendørs lydnivå fra kilder inne						
* fra næring- og servicevirksomhet	28 og 23	30 og 25*	30	30	28, 33, 38	33 og 28
L _{p,A,T}	30 og 25	32 og 27*	32	32	30, 35, 40	35 og 30
L _{p,A,max}						
Innendørs lydnivå fra kilder ute						
L _{p,A,24} og L _{p,A,T}	30	30	32	35	30, 30, 35	35
L _{p,A,max} Natt, kl. 23-07		45			30	
Grenseverdi for utemiljø, dag, kveld, natt						
L _{p,A,max}	40	35,40,45	40	45	40	45

Text in table above translated into English: Limit values for noise from technical installations



	Schools	Housing	Kindergarten	Hotel	Healthcare	Offices
Indoor sound level from sources inside	28 and 23 30 and 25	30 and 25 32 and 27	30 32	30 32	28, 33, 40 30, 35, 40	33 and 28 35 and 30
Indoor sound level from sources outside	30	30 45	32	35	30, 30, 35 30	35
Limit value for outdoor environment, day, evening, night	40	35, 40, 45	40	45	40	45

2.13 EXAMPLE NON-EU COUNTRY: SWITZERLAND

Sensitivity Level	Planning value	
	Day	Night
I	50 dB(A)	40 dB(A)
II	55 dB(A)	45 dB(A)
III	60 dB(A)	50 dB(A)
IV	65 dB(A)	55 dB(A)

Level I- Zones with high noise abatement requirements, notably in leisure zones.

Level II- Residential areas and areas for public buildings and installations.

Level III- is valid in zones in which operations emitting a certain level of noise are permitted (residential and industrial zones (mixed zones) and agricultural zones).

Level IV- Zones in which operations emitting a high level of noise are permitted (industrial zones).

3. CERTIFICATIONS LOOKING AT SOUND POWER LEVELS

Several certification schemes look into sound power levels:

- Eurovent Certita Certification (Europe)
- NF Heat Pumps (France)
- Heat Pump Keymark
- Quality label

4. FINAL REMARK

For more detailed information on EU and national legislation, as well as European standardization and certification on sound, readers are invited to look at the Annex 51, Task 1.2 on Regulations- Countries overview.

