

# IEA HPT Annex 51: Acoustic Signatures of Heat Pumps

## Overview Task 1 Acoustic Regulations of Heat Pumps



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- Available Documents
- Introduction
  - Basics about acoustics
  - Sound propagation
  - Psychoacoustics
- Measurement techniques
- Regulations

# Available Documents Task 1

## Documents

Introduction

Meas. techniques

Regulations

- Doc. 1.0 Introduction
- Doc. 1.1 Measurement Techniques
- Doc. 1.2 Regulations
- Doc. 1.3 Regulations (Synthesis)

<https://heatpumpingtechnologies.org/annex51/>

## Annex 51

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ANNEX 51

## Acoustic Signatures of Heat Pumps

Reduction of acoustic emissions is important to further increase the acceptance of heat pumps as air-to-water, water-to-air, air-to-air and brine-to-water (ground source) units. To increase this acceptance and minimize noise annoyance more focus has to be put on the acoustics emissions at steady state and transient behaviour of acoustic signatures during different operating conditions (e.g. icing, de- frosting, capacity control, cooling mode).

**The primary aim** with Annex 51 is to further increase the acceptance of heat pumps (as air-to-water, water-to-air, air-to-air and brine-to-water units ) for comfort purpose with respect to the noise and vibration emissions.

**A second focus** is placed on increasing knowledge at different levels (manufacturers, acoustic consultants, installers, legislators). To reach this goal, first different reasons to reduce sound emissions depending on countries (legislation), locations and applications have to be gathered and understood. The main influencing factors to the acoustic signature of these units will be identified. Collecting and combining research results in these fields on the different implementation levels (component, unit and application) will finally lead to directions for improved components, units and control strategies including guidelines, as well as training and inputs to future standards. The aim is to gather the knowledge and expertise of the participants on the different levels in order to forward this knowledge and establish recommendations and advices.

**Task 1** covers legislation, standards & regulations. Version 1 of the related documents is available for download. When IEA HPT Annex 51 finalizes, an updated version will be available here.

[IEA-HPT-Annex51-1.0-Introduction-V01](#)

[IEA-HPT-Annex51-1.1-Measurement-Techniques-V01](#)

[IEA-HPT-Annex51-1.2-Regulations-V01](#)

[IEA-HPT-Annex51-1.3-Regulations-Synthesis-V01](#)

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### Documents

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### Meas. techniques

### Regulations

ANNEX 51

## Acoustic Signatures of Heat Pumps

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[IEA-HPT-Annex51-1.3-Regulations-Synthesis-V01](#)

# Doc. 1.0 Introduction (1/4)

Documents

Introduction

Meas. techniques

Regulations

- Acoustics
  - What is acoustics and sound?
  - Main acoustic quantities
    - Sound power vs. sound power level
    - Sound pressure vs. sound pressure level
    - Sound intensity vs. sound intensity level

## Doc. 1.0 Introduction (2/4)

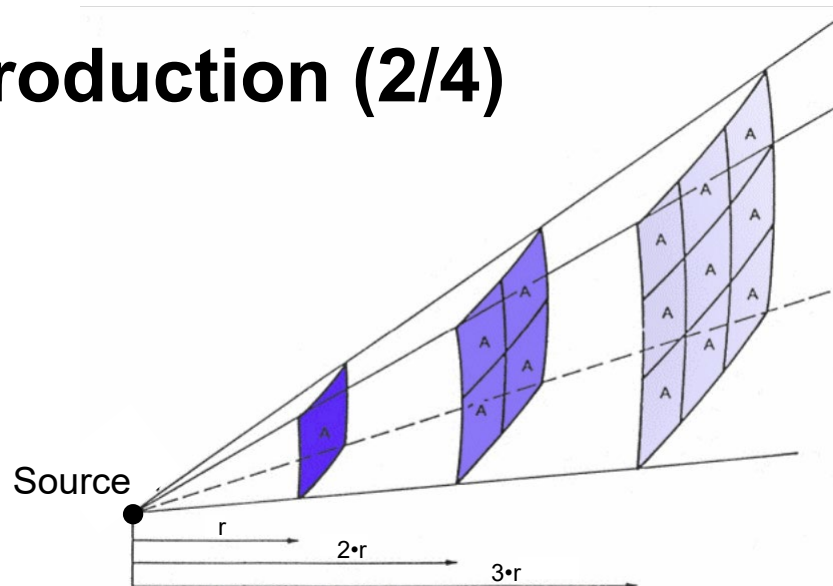
Documents

Introduction

Meas. techniques

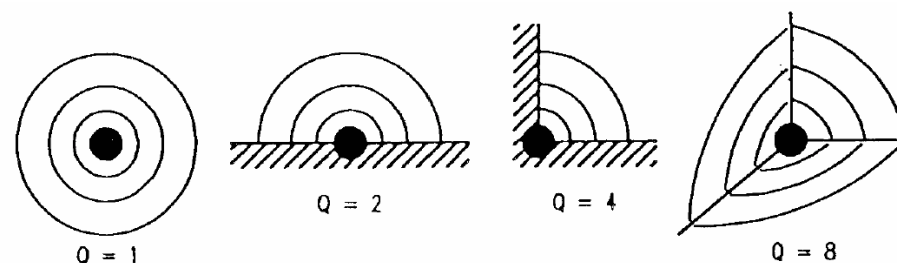
Regulations

- Sound propagation



(Illustration from Annex 51 Task Report: 1.0 Introduction)

- Directivity of sound



(Illustration from Annex 51 Task Report: 1.0 Introduction)

- Absorption, Reflection and transmission of sound waves

## Doc. 1.0 Introduction (3/4)

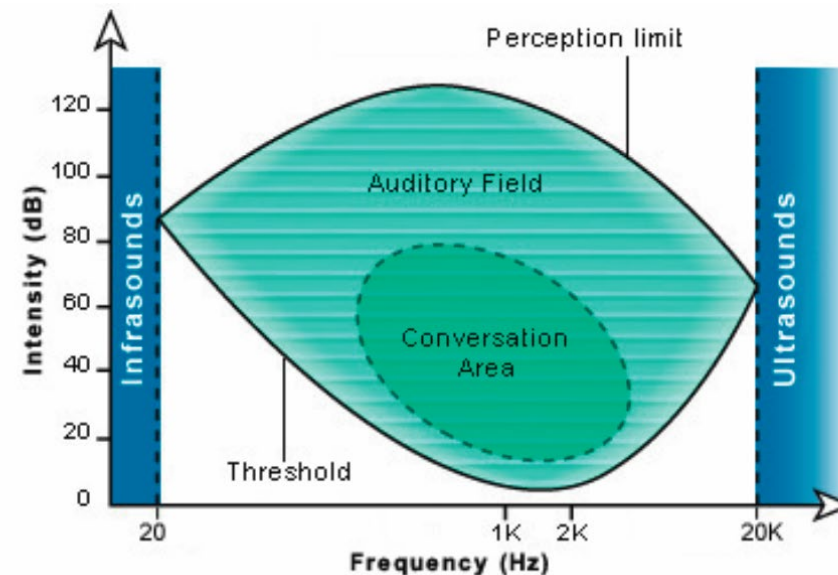
Documents

Introduction

Meas. techniques

Regulations

- Psychoacoustics
  - Main acoustic quantities do not correspond to human ears
  - Perception of hearing is depending on frequency and loudness



(Illustration from Annex 51 Task Report: 1.0 Introduction)



# Doc. 1.0 Introduction (4/4)

Documents

Introduction

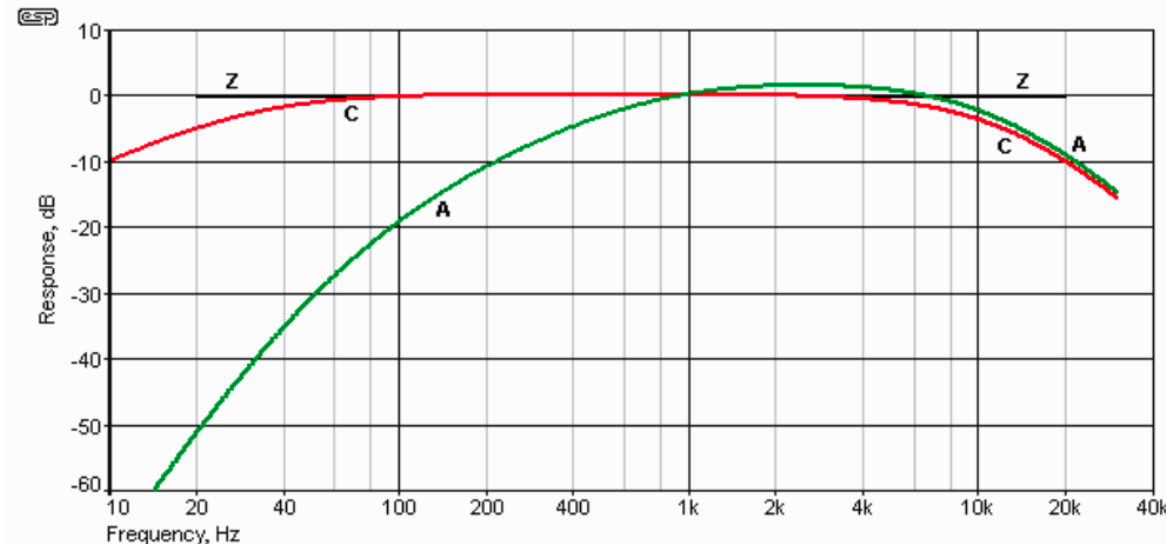
Meas. techniques

Regulations

## • Psychoacoustics

- Main acoustic quantities do not correspond to human ears
- Perception of hearing is depending on frequency and loudness

└─→ A-rated values



(Illustration from Annex 51 Task Report: 1.0 Introduction)

## Doc. 1.1 Measurement techniques

Documents

Introduction

Meas. techniques

Regulations

- Measurement instrument: Sound level meter
  - Microphone
  - Preamplifier
- Different categories/classes depending on precision
- Determination of
  - Sound pressure level (simple)
  - Sound power level (more elaborate)
  - Acoustic mapping and study of the directivity of the sources (microphone arrays)
  - Psychoacoustic investigations

## Doc. 1.2 Regulations (1/2)

Documents

Introduction

Meas. techniques

Regulations

- Overview of the regulations in
  - Austria
  - Denmark
  - Finland
  - France
  - Germany
  - Italy
  - Japan
  - Norway
  - Poland
  - South Korea
  - Sweden
  - Switzerland
  - Spain
  - United Kingdom
  - United States
- European Standards
- European Regulations on Noise
- Ecolabel

## Doc. 1.2 Regulations (2/2)

Documents

Introduction

Meas. techniques

Regulations

- Types of Regulations of noise immission
  - Laws
  - Guidelines (non-binding)
- All countries have different regulations
- In some countries different regulations in the federal provinces
- Noise immission limits depending on
  - Time of the day
  - Location (e.g. resting area, residential area, industrial area)
  - Limit between 25 and 45 dB(A) in the residential area

## Doc. 1.3 Regulations Synthesis

Documents

Introduction

Meas. techniques

Regulations

- Summary and comparison of the legislative situation in the investigated countries
- Questionnaire for the permanent revision and extension of the document

# Acknowledgements

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