

Test no. 1

Test procedure: Performance testing using standardized airways

Procedure according to: EN ISO 5801

Subject of test: Industrial fans, Air-handling equipment

Description: Measuring chamber with multi-nozzle wall equipped with Rosemount and Vaisala measuring devices. The range of airflow is 0-15 000 m³/h. Support fan for measurement of passive samples can be used.

- Determination of performance characteristics of radial and axial fans with free impellers or in spiral casing according to EN ISO 5801
- Determination of performance characteristics of AHU with integrated fans
- Determination of pressure drops of ducts, implemented duct elements and obstacles, etc.
- Determination of leakages (internal and external)

Determined parameters:

- External pressure of device and differential pressure on multi-nozzle wall for calculation of airflow
- Fan efficiency
- Fan power input
- Impeller speed

Scope of measurement:

- Volume airflow from 0 to 15 000 m³/h
- Static fan pressure from 0 to 3 kPa
- Maximal fan power input 10 kW (one-phase and three-phase fan motors)
- Fan speed control by frequency inverter, terminal voltage, or control voltage 0-10V
- Maximal impeller diameter up to 650 mm (bigger size possible after consultation)

Test no. 2

Test procedure: Performance testing of components/products for residential ventilation

Procedure according to: EN 13141-4, EN 13141-7, EN 13141-8

Subject of test: Fans used in residential ventilation systems, Mechanical supply and exhaust ventilation units (including heat recovery) for mechanical ventilation systems intended for single family dwellings, Performance testing of un-ducted mechanical supply and exhaust ventilation units (including heat recovery) for mechanical ventilation systems intended for a single room.

Description: Measuring chamber with multi-nozzle wall (0-15 000 m³/h), device for establishing of thermal and humidity efficiency (50-6 000 m³/h) and reverberation room are used for complete measurement. Measuring devices Rosemount, Vaisala, Ahlborn, Endress+Hauser and Brüel & Kjær are used.

Determined parameters:

- External pressure of fans or AHUs
- Airflow pressure curves
- Internal and external leakages (pressure method)
- Thermal and humidity efficiency on exhaust and supply air sides
- Sound power level
- Electric power input

Scope of measurement:

Determination of performance characteristics on the chamber with multi-nozzle wall:

- Volume airflow from 0 to 15 000 m³/h
- Static fan pressure from 0 to 3 kPa
- Maximal fan power input 10 kW (one-phase and three-phase fan motors)
- Fan speed control by frequency inverter, terminal voltage, or control voltage 0-10V
- Maximal impeller diameter up to 650 mm (bigger size possible after consultation)

Determination of thermodynamic characteristics:

- Volume airflow from 50 to 6000 m³/h
- Range of working temperatures at 6000 m³/h: 0 - 50°C
- Max. airflow to keep stabile temperature -15°C: 600 m³/h

Acoustic measurements

- Acoustic power levels in octave bands between 125 Hz and 8 kHz
- Size of reverberation room 7,10 m x 7,25 m x 2,90 m, size of the doors 1,30 m x 2,05 m
- Min. level of background: L_{WA} >22 dB

Test no. 3

Test procedure: Test procedures for establishing performance of air to air and flue gases heat recovery devices

Procedure according to: EN 308

Subject of test: Heat exchangers, Recuperators, Regenerators

Description: Measurement is realized on the stand for establishing of thermal and humidity efficiency in range of airflows from 50 to 6000 m³/h equipped with Ahlborn and Endress+Hauser devices.

Determined parameters:

- Determination of pressure drops of exhaust air and supply air sides
- Determination of leakages (internal and external)
- Determination of thermal and humidity efficiency

Scope of measurement:

- Measurement of thermal and humidity efficiency up to 6000 m³/h
- Working range of relative humidity 20 – 90 %
- Working range of air temperature at airflow 6000 m³/h: 0 - 50°C
- Airflow limit for cold climate tests (inlet of supply air -15°C) max. 600 m³/h

Test no. 4

Test procedure: Determination of sound power radiated into a duct by fans and other air-moving devices – In duct method

Procedure according to: EN ISO 5136

Subject of test: Fans, other air-moving devices

Description: Measurements of fans and other air-moving devices connected with the duct for determination of acoustic power radiated in the duct on exhaust or supply air sides. Method is not applicable for free fans (without duct). Measurement devices Brüel & Kjær are used.

Determined parameters:

- Fan sound power

Scope of measurement:

- Room or slightly higher temperature (standard is valid in temperature range from -50°C to 70°C)
- Diameter of duct in range from 0,15 m to 2 m
- Frequency band range of interest: one-third octave bands with middle frequency from 50 Hz to 10 kHz

Test no. 5

Test procedure: Measurement of sound power level of noise sources

Procedure according to: EN ISO 3741, EN ISO 3743-2, EN ISO 3744, EN ISO 3746, ISO 9614-2

Subject of test: Machinery and equipment, Air-handling devices, Noise sources

Description: Series of standards EN ISO 3740 to EN ISO 3746 describes methods for determination of acoustic powers of noise sources (machinery and equipment, small movable sources hand tools). Measurements in reverberation room, inner and outer space and *in situ* are included. Methods are suitable for all kinds of noises (stationary, unsteady, variable, single events).

Standard ISO 9614-2 describes determination of sound power levels of noise sources using sound intensity under less limited conditions than series EN ISO 3740 to EN ISO 3746. It is applicable for noise sources located in any environment, whose variability doesn't influence accuracy over acceptable limits and measuring probe is not exposed to flow of gas with unacceptable speed or instability. Acoustic power is function of environment and can vary from acoustic power of the same noise source measured under different conditions.

Measurement devices Brüel & Kjær are used.

It is possible to realize measurement in place of noise source production or at final installation.

Determined parameters:

- Level of acoustic power

Scope of measurement:

- Frequency band range of interest in reverberation room and inner space: one-third octave bands with middle frequency from 50 Hz to 10 kHz
- Frequency band range of interest in outer space: from 12,5 Hz to 20 kHz
- Size of reverberation room 7,10 m x 7,25 m x 2,90 m, size of the doors 1,30 m x 2,05 m
- Min. level of background: $L_{WA} > 22$ dB

Test no. 6

Test procedure: Mechanical performance of air handling units

Procedure according to: EN 1886 (chapters 5-9)

Subject of test: Air-handling units

Description: Standard describes complex measurement of mechanical performance (deflection of casing panels and frame), air leakages, filter bypass leakages (applicable for model boxes and real units), and thermal transmittance of casing, identification of thermal bridges and acoustic parameters (applicable only for model boxes). This standard is not applicable for fan coil units, units for residential buildings and units producing ventilation air mainly for a manufacturing process.

Determined parameters:

- Mechanical strength of casing (determination of max. relative deflection and classification of casing)
- Casing air leakage and classification, filter bypass leakage
- Thermal performance of casing (determination of thermal transmittance and thermal bridging factor, classification)
- Acoustic insulation of casing

Scope of measurement :

- Max. fan pressures +/- 2,5 kPa
- Size of room for thermal performance of casing: 7,10 m x 7,25 m x 2,90 m, doors 1,30 m x 2,05 m
- Frequency range: octave bands from 125 Hz to 8 kHz
- Min. level of background: $L_{WA} > 22$ dB

Test no. 7

Test procedure: Aerodynamic testing of dampers and valves

Procedure according to: EN 1751

Subject of test: Dampers and valves

Description: Testing involves determination of characteristics of dampers and valves including measurement of airflows, pressure drops, leakages of dampers, valves and their casings, thermal transfer characteristics and measurement of torque characteristics.

Determined parameters:

- Airflows and pressure drops
- Leakages (valves, dampers, casings)
- Structural stability
- Thermal transmittance through dampers and valves

Scope of measurement:

- Volume airflow from 0 to 15 000 m³/h
- Static pressure from 0 to 3 kPa

Test no. 8

Name of test procedure: Measurement of liquid flow by means of pressure differential devices inserted in circular cross-section conduits running full.

Procedure according to: EN ISO 5167-1

Subject of test: Machinery, Air-handling equipment, Ductwork products for air conveying

Description: Testing involves determination and calculation of airflows in ducts caused by pressure drops of inserted nozzles. It is measured by chamber with multi-nozzle wall and equipped with Rosemount and Vaisala measuring devices. The range of airflow is 0-15 000 m³/h. Support fan for measurement of passive samples can be used.

Determined parameters:

- Mass and volume flowrates

Scope of measurement:

- Volume airflow from 0 to 15 000 m³/h
- Subsonic, stable or slowly changeable flow in whole measured cross-section.
- The fluid is considered as single-phase.

Test no. 9

Test procedure: Determination of acoustic loss

Procedure according to: EN ISO 11546-2, EN ISO 11820, ISO 10847

Subject of test: Machine and equipment enclosures, Active and passive silencers, Outdoor noise barriers

Description: Measurement involves determination of sound insulation performance of enclosures, silencers and noise barriers *in situ*.

In case of sound insulation performance of enclosures, measurement is related to complete enclosure, not to its parts, and is applicable when there is relevant source of noise inside the enclosure (source of noise for which enclosure was designed). Where these methods are not applicable, artificial noise source can be used.

In case of silencers, their sound insulation performance is determined from decreasing of acoustic power level due to insert of silencer.

In case of outdoor barriers, acoustic loss of particular barrier under particular conditions is determined. It is not possible to compare performances of the same barrier in different locations.

Equipment Brüel & Kjær is used.

Determined parameters:

- Performance of enclosure via determination of sound power level with and without enclosure
- Transmission or insertion loss

Scope of measurement:

- **For enclosures:** frequency range at least from 100 Hz to 5 kHz in one-third octave bands and from 125 Hz to 4 kHz for octave bands. Ranges from 50 Hz to 10 kHz in one-third octave bands and from 63 Hz to 8 kHz in octave bands are preferred.
- **For silencers:** determination in octave bands with middle frequencies in range at least from 63 Hz to 4 kHz (and if possible or required, from 31,5 Hz to 8 kHz) or in one-third octave bands with middle frequencies in range at least from 50 Hz to 5 kHz (and if possible or required from 25 Hz do 10 kHz).
- **For noise barriers:** determination in octave bands with middle frequencies in range at least from 63 Hz do 4 kHz, in one-third octave bands with middle frequencies in range from 50 Hz to 5 kHz, in special case in octave band 8 kHz.
- Size of reverberation room 7,10 m x 7,25 m x 2,90 m, size of the doors 1,30 m x 2,05 m
- Min. level of background: $L_{WA} > 22$ dB