REHVA
Federation of European Heating, Ventilation and Air Conditioning Associations

CLIMA 2019
Built environment facing climate change
REHVA 13th HVAC World Congress
26 - 29 May, Bucharest, Romania

# Workshops at CLIMA 2019

## Workshop n. 17

## Advanced HVAC measurement technology and indoor air quality monitoring

Wednesday, 29 May, 10:30 - 13:00,

Meeting Room XXXXXX

### Workshop organizer(s)

**TESTO ROMANIA**

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**Additional information at:**
www.testo.ro

### Presenters

#### Chair(s)

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| Horațiu Bașa | Testo Romania |

#### Speakers

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| Raul Smoczer | Testo Romania |

### Scope

During the workshop we will discuss about two important topics

- Air flow measurements in ducts according to DIN EN 12599
- Comfort level measurement in the workplace

Considering the first topic it is well know that nowadays we spend most of the day in closed rooms. This is why heating, ventilation and air conditioning (HVAC) systems are installed which are intended to ensure pleasant ambient conditions indoors. Ventilation is of particular importance here. Firstly, it is not only used to provide fresh air, but also for extracting pollutants, for instance removing excess humidity from rooms.

Ensuring adequate air exchange and thus determining the volume flow is an important quality factor when it comes to commissioning and operating HVAC systems. The reliable determination of air velocity in ducts is one of the most challenging measurements which a ventilation and air conditioning technician has to carry out.

Importance of air velocity - In line with the motto: "The more, the merrier", HVAC systems are often operated with air volumes that are too high. This excessive requirement leads to increased operating costs. Energy expenditure for the fan rises, because a larger volume of air has to be moved through the system. However, costs are also incurred for conditioning the air (cooling, heating, humidifying or dehumidifying) and these can be reduced when the system is set correctly. In addition, a high air exchange often leads to draughts occurring in the room, making people feel uncomfortable. On the other hand, too low a volume flow can also be problematic. The people in the room have too little fresh air to breathe in. The indoor air is "stale", because the CO2 content in the room is too high. Low volume flows can also have negative impacts on the system's hygiene: there is the risk of germ formation in the system when movement of the humidified air in the ducts is too slow. A correctly set HVAC system therefore not only helps make the indoor climate comfortable, but also helps save costs.

Measurement of the correct air velocity - The key parameter for evaluating the functional capability of the HVAC system is the air volume flow. This is the product of flow velocity and duct area. Since, in practice, flow velocity in the duct cross-section is not the same, an individual point measurement does not suffice when it comes to determining the average air velocity. Disruptors, such as dampers, elbows and the like, have an influence on the velocity profile in the duct, which means a so-called grid measurement must be carried out at several locations in the duct. In order to meet quality requirements when it comes to determining volume flow, there are different standards all over the world dealing with the correct measurement of flow velocities. In addition to EN 12599, which is the leading standard in large parts of Europe, there are also EN 16211 and ASHRAE 111. What all methods have in common is that the measuring points are distributed over the duct cross-section according to the size of the duct in line with defined specifications, that a distinction is made between rectangular and round ducts and that the readings are averaged.

We will go into the correct measurement of volume flow according to EN 12599 and discuss about:

1. The right measuring location
2. The measurement method
3. Evaluation of the readings

The right measuring location - The decisive factor when it comes to meaningful measurements is selecting a suitable measuring point. This is already established by the system planner in the execution plan (project plan). The following criteria must be considered here:

- Air flow measuring points must be allowed for on all main ducts and on supply lines to rooms with high requirements.
- Minimum distances from disruptions must be adhered to: at least 6-times the hydraulic diameter downstream and 2-times the hydraulic diameter upstream
- The measuring points must be easily accessible and there must be enough space available for handling the measuring instrument.
- The flow must be free of any return flow or swirling

Air which flows through a duct does not have a uniform velocity. As a rule, the air in the middle flows faster than at the duct wall. There are greater resistances at the duct wall due to friction and these have to be overcome. A distinction is made between two basic flow profiles: laminar flow and turbulent flow.

Ideal flow profiles are almost exclusively found in very long ducts which run in a straight line and where there are no disruptions. For this reason, minimum distances from disruptions have to be adhered to.

The measurement method - The representative average flow value in the duct cross-section

must be established to determine the air volume flow. To do this, the measurement area is split into partial
areas and the velocity are determined at the central point of the partial areas. This method is called grid measurement. The method for dividing the duct cross-section into partial areas is different for rectangular and
round ducts.
DIN EN 12599 envisages the following two measurement methods:

- the trivial method for measurements in air ducts with a rectangular or square cross-section
- the centroidal axis method for measurements in ducts with a circular cross-section

Evaluation of the readings - There is a requirement in DIN EN 12599 for the accuracy of the air volume flow to be determined with a measurement uncertainty of ±10%. Here, the question that now has to be asked is how accurate was the measurement which has just been carried out. DIN EN 12599 also provides answers to this.

In addition to the uncertainty of the measuring instrument and the probe used, the irregularity of the flow profile is a crucial factor for determining the total error. Where there is a large profile irregularity, the required measurement uncertainty of ±10% can only be achieved with a number of measuring points that is just as large, but this is very time-consuming. The number of measuring points must therefore always be seen in connection with the distance from disruptions, because these are decisive when it comes to irregularity in the profile.

Considering the second topic of the workshop we will discuss also the importance of the comfort level measurement in the workplace

We know that several hundred million people all over the world work in offices. Many of them are dissatisfied with the ambient conditions where they work. The most common reasons are complaints about
thermal comfort and indoor air quality.
The complaints usually need to be investigated by a measuring technology technician. This person is faced with the challenge of objectively evaluating employees' thermal sensations in order to determine whether the complaints are justified and, where applicable, pinpoint their causes and eliminate them. From a business perspective alone, it goes without saying that the complaints need to be taken seriously, since employee performance directly relates to the ambient conditions in the workplace.
The aim of this workshop is to offer support to those responsible for the indoor climate and to identify possible ways of objectively evaluating subjective impressions about comfort level in the event of complaints.
As we all know thermal comfort plays a decisive role in influencing physical and mental capabilities. The human body's sensitivity to heat essentially depends on its thermal equilibrium (thermal balance). This thermal equilibrium is affected by physical activity and clothing, as well as ambient atmospheric parameters. These are:

• Air temperature
• Radiant temperature
• Air velocity (draught)
• Humidity

Thermal comfort occurs when a person feels thermally neutral. This happens when people find the ambient
parameters (temperature, humidity, draught and thermal radiation) in their surroundings pleasant. There is no requirement for warmer or colder, dryer or more humid indoor air. Thermal comfort also depends on the type of activity and clothing.

Reasons for using measuring technology for thermal evaluation in the workplace

Thermal comfort in the workplace is not an unnecessary luxury for employees, it is actually a basic requirement for performance and productivity. Which is why, from an economic perspective,

appropriate ambient conditions need to be created. As soon as an employee complains about the ambient conditions in the workplace, the employee's assertion about thermal discomfort has to be converted into an objective measurement result using appropriate measuring technology. This allows optimum evaluation of the situation. If the measurement results are all within the normal range, the measuring technology technician can immediately rule out any incorrect configuration of the HVAC system. Analysis of the employee's thermal discomfort must then be pursued on another level. There could be other reasons for the complaints, for example dissatisfaction with work, problems with colleagues, private issues or health complaints can all have an impact on how the thermal comfort level is perceived.

This workshop will also present the advantages of professional measuring technology together with all measurements that are necessary to evaluate the comfort level inside a building.

With an increasing number of fully air-conditioned workplaces in new buildings or buildings renovated to make them more energy-efficient, employee complaints about thermal discomfort at the workplace are also on the increase. Without the appropriate measuring technology, it is virtually impossible for air conditioning/in-house technicians to detect the difference between personal discomfort and real, negative indoor climate effects. However, this is absolutely essential in order to eliminate any possible negative impacts of the HVAC system for regulatory purposes. In this respect, simple and economical implementation of measurement methods is disproportionate to the risks which poorly or incorrectly configured ventilation and air conditioning technology in buildings can cause.

During the workshop we will also presents and test the latest measurement technology in the HVAC/R market and will demonstrate how SMART instrumentation is able to considerably reduce the commissioning time and costs for any HVAC/R technician.

With these measuring instruments and its extensive range of probes, technicians can record, analyze and document all the key parameters quickly and efficiently, so that they can take the appropriate corrective measures.

We will demonstrate why the communication between the measuring instruments and mobile devices is a huge benefit for any technician who wants to become more efficient.

## Audience

HVAC engineers and technicians.

## Expected results

Inform the participants about the latest technologies for air flow and comfort level measurement.

## Programme

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| **1 h** | Air flow measurements in ducts according to DIN EN 12599<br>Horatiu Basa, Testo Romania |
| **1 h** | Comfort level measurement in the workplace<br>Raul Smoczer, Testo Romania |
| **0.5h** | **Open discussion** |