



**Eurovent 6/17 – 2021**

# **Control systems for Air Handling Units**

**First Edition**

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## Document history

This Eurovent Industry Recommendation / Code of Good Practice supersedes all of its previous editions, which automatically become obsolete with the publication of this document.

## Modifications

This Eurovent publication was modified as against previous editions in the following manner:

Modifications as against	Key changes
1 <sup>st</sup> edition	Current document

## Preface

### In a nutshell

**This document provides recommendations on minimum functional requirements for control systems of Air Handling Units and clarifies the importance of controls in regard to energy consumption, safety, commissioning and maintenance aspects. It also explains the advantages of factory-supplied optimised systems and describes the legislative and normative framework of Air Handling Unit controls.**

## Authors

This document was published by Eurovent and was prepared in a joint effort by participants of the Product Group 'Air Handling Units' (PG-AHU), which represents a vast majority of manufacturers of these products active on the EMEA market. Particularly important contributions have been provided by Martin Wessbecher (editorial team leader), Martin Lenz, Pawel Szymanski, Andrius Tamasauskis and Orkun Yilmaz.

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## Important remarks

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## List of abbreviations

AHU	Air Handling Unit
API	Application Programming Interface
BACS	Building Automation and Control Systems
BMS	Building Management System
DCV	Demand Controlled Ventilation
EATR	Exhaust Air Transfer Ratio expressed in % (ratio between the exhaust air amount in supply air and supply air mass flow)
EMEA	Europe, the Middle East and Africa
EPB	Energy Performance of Buildings
EPBD	Energy Performance of Buildings Directive
ERC	Energy Recovery Component
HMI	Human-Machine Interface
I&C	Instrumentation and Control
IAQ	Indoor Air Quality
IEQ	Indoor Environmental Quality
LAN	Local Area Network
PG-AHU	Eurovent Product Group 'Air Handling Units'
PWM	Pulse-Width Modulation
VAV	Variable Air Volume
VOC	Volatile Organic Compounds

## 1. The essential importance of an Air Handling Unit control system

The primary role of the control system is to manage all functions of the Air Handling Unit (AHU) and other components of the ventilation system to provide optimal Indoor Environmental Quality (IEQ). From a ventilation and air conditioning perspective, the main indicators of IEQ include indoor temperature, indoor humidity and Indoor Air Quality (IAQ).

An equally important task is to ensure good IEQ at the lowest energy consumption. In general, it means proper adjustment of system components to the actual demand, considering their interoperability. Specifically, it involves accurate control of temperature, humidity and airflow – Demand Controlled Ventilation (DCV) in individual zones of the building, as well as stepless and optimised control of the components' output. More broadly, it also means effective communication with the power grid to optimise energy consumption on a wider scale.

Another significant feature of the control system is energy monitoring and logging, to enable analysis and adjustment of energy usage.

Finally, the control system must ensure safe operation and use of the equipment, as well as cyber security of the IT network. The latter involves compliance of the controllers with IT security protocols in accordance with relevant ISO and EU standards.

### 1.1 Factory-supplied AHU control system

To provide the most effective and energy-efficient control of the AHU operation, thorough expertise on AHU characteristics and other system elements is essential. HVAC equipment manufacturers are most knowledgeable in this regard. For this reason, using a factory-fitted smart control system for the AHU is the best option in most cases. Thus, the share of units delivered with integrated or co-supplied controls is constantly rising. Eurovent Market Intelligence statistics reflect this trend well. While in 2014 this share was approximately at 40%, in 2020 it reached already around 70%. In addition to most optimised operation, integrated and co-supplied systems can considerably facilitate commissioning, service and maintenance.

Nowadays, supplying an AHU along with integrated and factory-fitted controls is as self-evident as for other HVAC equipment (e.g. chillers) which in practice could not operate without the factory-built control system.

### 1.2 The way to reach the goal

To ensure that all the above-mentioned functions and benefits are provided, members of the Eurovent Product Group 'Air Handling Units' (PG-AHU) prepared a specification of minimum requirements that should be met by control systems of AHUs. These requirements are laid down in Chapter 2 and can serve as basis for planners, contractors and investors to verify that the control system meets the current standards.

The following chapters explain in detail the specifics of the system solution, clarify the key functionalities, and their impact on safety, commissioning and maintenance aspects. The last chapter provides references to the most relevant related legislation and standards.

## 2. Eurovent recommended minimum requirements for AHU control systems

The minimum specification of the AHU control system recommended by Eurovent includes:

Pos.	Requirement	Related sections
1	Communication with Building Management System (BMS) via analogue and/or digital signals	Paragraph 3.3
2	Management of ventilation air volume through DCV depending on IAQ determined by at least one sensor	Paragraph 3.1
3	Stepless speed control of fans	Paragraph 4.2
4	Monitoring contamination of air filters	Paragraph 4.1
5	Continuous control of heat recovery efficiency depending on the currently demanded supply air temperature	Paragraph 4.4
6	Monitoring core performance parameter and statuses, including: <ul style="list-style-type: none"> <li>- Malfunction of fans and heat recovery systems</li> <li>- Current temperatures, airflows and power consumption</li> </ul>	Paragraph 0 Paragraph 5.3

### 3. System solutions for high energy efficiency

High performance of individual AHU and system components in one duty point does not automatically mean optimal operation of the entire ventilation or air conditioning system. To maintain the designed level of IEQ at minimum energy consumption, operation of all AHU elements must be properly controlled with consideration of their interoperability. Synergies between other HVAC or technical building systems also need to be considered.

The controls and, in particular, their controller, can be seen as the brain of the system. All the coordination necessary to manage the components that comprise the system is performed by the controller. It receives feedback from sensors and components, analyses data and decides which functions to apply to meet the IEQ requirements with minimum energy consumption.

The following solutions should be considered when designing and selecting a control system to maximise energy efficiency.

#### 3.1 Demand Controlled Ventilation

Ensuring good IAQ requires supplying the adequate amount of outdoor air to premises. To optimise energy consumption at the same time and avoid excessive air renewal, the volume of delivered air must be adjusted to the current demand, i.e. a level of indoor emissions. To that end, the control system or the local controller monitors IAQ by means of sensors installed in the rooms and controls Variable Air Volume (VAV) terminals and speed of AHU fans accordingly. Depending on the application, the IAQ indicators may include:

- Concentration of CO<sub>2</sub> that correlates with the number of people in the room
- Concentration of Volatile Organic Compounds (VOC) and fine particles, which are usually caused either by human activities, released by materials or come from the outside
- Moisture, which is a good indicator of the need for fresh air in the kitchen and bathroom
- Presence detector

With DCV, smart communication between the control system in the individual rooms and the controls of an AHU is essential for high energy efficiency. It enables to adjust the fan speed exactly to the minimum depending on the positions of all VAV device dampers in the related rooms and thus minimise energy consumption.

### 3.2 Zone control

Heating, cooling and ventilation loads may considerably differ in various parts of the building. For this reason, individual zones in the building should be controlled separately. Nevertheless, smart communication between the zone controllers and AHU control system is crucial for optimisation of air handling at centralised level.

### 3.3 Interaction with other systems and devices

For the highest energy efficiency at the entire building scale, the interoperability between ventilation or air conditioning systems and other technical systems for heating and cooling must be optimised. This requires the integration of all control systems via the BMS to ensure that all devices (such as boilers and chillers, air curtains, fan heaters, or fan coils) are controlled in a coordinated and coherent manner.

In addition, the BMS has the advantage of grouping the status and main parameters of all the appliances connected to it in a single interface. It is therefore possible to view alarms, setpoints and take control of certain predefined parameters.

For easy on-site integration, standardised protocols and interfaces between the controls of the AHU, other devices and the BMS must be applied, as well as multiple sub-systems and components that should work with the BMS communication. An alternative for wired combination is working with radio communication.

### 3.4 Data and energy logging

Data logging brings the basis for optimisation of system operation depending on the real situation and the user behaviour in the building. It also facilitates the failure cause analysis and troubleshooting.

### 3.5 Controller display and mobile applications

The way the user can manage the operation of the system and be informed about it is also crucial. Normally, the control system display is used for this purpose. Its basic function should include at least:

- Changing the operation mode
- Setting a weekly calendar
- Information of the system status (including reading and acknowledging of alarms)

In addition to the traditional management via the interface display, it is possible to communicate directly or indirectly to the controller using a remote access. A direct connection can be made either wired directly to the controller, or with a wireless connection via a Local Area Network (LAN) type Wi-Fi for example.

An indirect connection implies that the controller is connected to the internet through a SIM card or an internet router and the user may have access to the system even by an application on their mobile phone or tablet. This has the advantage of making the system available 24/7. The data of the ventilation or air conditioning system is usually stored in the cloud. A cloud access offers many possibilities:



- Access to real-time data
- View previous data
- Compare several ventilation systems
- Be alert of status changes (alarm)
- Take control of the controller
- Ability to update software, controller firmware, as well as the different equipment that composes the ventilation system
- Analyse data for early detection of failures
- Save files related to the ventilation system

## 4. Control of AHU functions

The way how AHU components are controlled has a significant impact on energy consumption. Some of the vital control functions impacting energy efficiency include the following:

### 4.1 Air filter monitoring

During use, the filter becomes contaminated which causes a higher airflow resistance. If the fan capacity is not regulated, the amount of air supplied or extracted from the building will be reduced. The actual decline in air flow depends on the fan curve, however, for the difference between a clean filter and the maximum pressure drop, it can easily amount up to 40%. This obviously leads to the deterioration of IAQ. If the filter is not replaced after reaching the final pressure, the decline in air flow will be even higher.

In turn, when the capacity of a fan is regulated to compensate the higher filter resistance, the fan consumes more energy to deliver the same amount of air. Energy consumption may increase by more than 1,5 times.

To mitigate these effects, the contamination of air filters must be monitored to indicate the need for replacement.

According to Ecodesign requirements for ventilation units laid down in Regulation (EU) 1253/2014, filter monitoring is mandatory for products placed on the EU market. For non-residential ventilation units, the filter pollution warning system must have a pressure drop indicator for visual signalling or for triggering an alarm in the control system. In the latter case, each filter must be equipped with an air pressure device that sends a signal to the control system once the pressure drop in the filter exceeds its limits. The most common types of devices are the following:

- **Pressure relay:** It is a cheaper option than pressure transmitter. The relay activates when the pressure drop in the filter exceeds its limit. It is the most common device for filter pollution indication in non-residential ventilation units.
- **Pressure transmitter:** Pressure transmitter indicates a pressure drop in the filter, and therefore provides an actual pollution level to the control device.

Main advantages of pressure sensors:

- Lowers maintenance costs by extending the filters' service time
- Lowers energy costs by precisely indicating clogging
- Indicates filter pollution in a distant control device and therefore eliminates unnecessary checks

## 4.2 Control of airflow rate

To avoid fluctuations in the ventilation air volume due to filter contamination, the fan capacity should be stepless regulated by controlling its speed. This function is also necessary to adjust airflow supplied to the building to the current demand (e.g. depending on the number of people currently in the building). In addition, the stepless fan speed control facilitates adjustment of the airflow rate during commissioning of the system.

According to the Ecodesign requirements, non-residential ventilation units placed on the EU market must be equipped with multi-speed or variable-speed drive fans. However, the required use of fan speed control by the AHU control system is not specified.

## 4.3 Control of internal air leakage in Energy Recovery Components

Some types of Energy Recovery Components (ERC) are prone to the internal air leakage (EATR) which may result in the deterioration of IAQ and increased energy consumption. The issue concerns in particular rotary heat exchangers. In general, the leakage rate depends on the pressure difference between supply and exhaust air sides. Correct AHU design enables to achieve, at start-up, a pressure difference which eliminates or minimises the leakage. However, this pressure difference may vary during regular operation. The AHU control system should provide an optimal pressure difference under any operation conditions. For comprehensive information on proper measures, refer to the [Eurovent Recommendation 6/15 – 2021 – Air Leakages in Air Handling Units](#).

## 4.4 Frost protection of ERCs

Heat exchangers for thermal energy recovery are subject to freezing at low outdoor temperatures. Plate heat exchangers are most sensitive to icing-up at sub-zero temperatures. Freezing leads to the reduction of energy recovered from the extract air but also to a decrease in airflow and its misbalancing. In the worst case, physical damage to the exchanger may occur.

The main tasks of the intelligent frost protection systems are to:

- Identify the moment of freezing
- Protect the heat exchanger from freezing
- Minimise use of energy during defrosting

The crucial issue is to adequately identify the moment when freezing starts. The simplest method is to use an **outdoor air temperature sensor**. Usually, frost protection is activated when the outdoor air temperature drops below 0°C. The disadvantage of this method is that the actual freezing may start at a much lower temperature, for example at -5°C, especially when the humidity of extracted air is extremely low. Premature activation of frost protection means needless energy consumption for heating air without or with limited heat recovery.

Therefore, the following more advanced methods to determine the moment of freezing more precisely are used:

- Additional **exhaust air temperature sensor** near to or on the heat exchanger. It helps to determine when the temperature on the exhaust side of the heat exchanger drops below the required temperature. Since the downstream conditions of plate exchangers and rotors are far from uniform, it is crucial that the sensor are places in the correct (most critical) position to ensure proper functioning of the freeze protection. This is relevant for both plate and rotary

heat exchangers. For run around coil systems, the exhaust air condition downstream the cooling coil is homogeneous.

- **Extract air humidity sensor and exhaust air temperature sensor.** The algorithm of control system, considering the extracted air humidity and exhaust air temperature, can calculate the approximate freezing point.
- **Pressure drop measuring device** for the heat exchanger activates defrosting when the pressure in the heat exchanger drops. Usually, pressure relays are used for this purpose.

After identifying the moment of freezing, the control system of the ventilation unit takes certain automatic actions to prevent freezing. The most common measures are the following:

One method is to heat the outdoor air up to the freezing risk-free temperature with so-called **pre-heater**. The pre-heater can be an electric heater or a water/glycol coil with a circulation pump and a three-way control valve. The pre-heater can be in a duct or integrated into the device. Also, it can operate autonomously of the unit with its own controls. But such heaters cost up to twice as much as those controlled from the unit's own automation and prevent the use of other defrosting methods. The control system of a ventilation unit can control the pre-heater by on-off Pulse-Width Modulation (PWM), if electric, or 0-10 V signals. Control by 0-10 V signal is more fluent and allows to save up to 10% of energy. Considering that in Central Europe, the temperature can drop below -20°C, these savings are quite high.

Another method for defrosting is **using extract air**. The main motivation to use this method is that the energy cost of indoor heating is usually much lower than the cost of energy for the pre-heater. The second important issue is the high capacity of the pre-heater, as it must heat the air from very low outdoor temperatures to values around 0°C. Although it rarely operates at maximum power, it increases the power capacity requirement for all building. Various options may be used for this method:

- **Air flow misbalancing:** The idea of such defrosting is to increase warm airflow from the building (extracted air), and to reduce or shut down the airflow of the cold outdoor air. Thus, the air temperature on the exhaust side of the heat exchanger increases and the heat exchanger is defrosted. This mode works well when negative temperatures are temporary, for example, if the night-time temperature drops to -5°C, and the daytime temperature is above 0°C. As the temperature drops further, the defrost period extends, and the negative pressure indoors may rise.
- **Recirculation:** Recirculation is an efficient defrosting method. The principle is quite similar as for misbalancing, it will require a recirculation damper as an addition to the ventilation unit. During defrosting time, extracted air will circulate inside the unit to defrost the heat exchanger. An advantage in relation to misbalancing is that the negative pressure indoor does not occur. In turn, a disadvantage is that during the defrosting period, the fresh air supply is closed. Recirculation can also be used with an extract air CO<sub>2</sub> sensor, to apply recirculation at negative temperatures, if the CO<sub>2</sub> level is acceptable.

Freeze control methods specific to the ERC type include:

- **Plate heat exchangers**  
Defrosting by the by-pass damper. When using this option in the defrosting period, part or the

entire outdoor air flow goes through the by-pass directly to the supply air. At the same time, the warm extract air defrosts the heat exchanger. This method may require a more powerful after heater (more often a water heater). The main idea is to save on more expensive electrical energy for pre-heating and minimise the power capacity requirements for the ventilation equipment. Typically, plate heat exchangers are equipped with proportionally controlled face and by-pass dampers. The amount of bypassed outdoor is controlled in such a way that no more outdoor air is bypassed than needed to keep the exchanger ice free. In some cases, a 100% by-pass is used. Then all the outdoor air flows via the by-pass during the defrosting period. This method requires a high-capacity heater as it needs to increase sub-zero temperature air up to at least +16°C.

For colder climate zones, segmental by-pass damper is used. The main difference is that the heat exchanger by-pass damper has several segments on the heat exchanger instead of just one. During defrosting, only one segment of the heat exchanger is closed for defrosting, therefore only part of the air flows directly through the by-pass to the supplied air. As part of the outdoor air is heated in the heat exchanger, energy consumption for the supply air heating is much lower. Units with a segmental by-pass can operate without a pre-heater at very low temperatures (even -30°C).

- **Rotary heat exchangers**

Here a pre-heater can be used, or the efficiency of the rotor can be reduced by decreasing the rotor speed.

- **Run around coil systems**

Freeze control can be done with a pre-heater or by means of recirculation of return water from the cooling coil via a three-way control valve.

## 5. Safety aspects

The control system must provide safe operation of the AHU and the entire ventilation system. This primarily involves mechanical and fire safety.

### 5.1 Machinery Directive

The European Machinery Directive 2006/42/EC introduced a set of legal requirements establishing the safety objectives for manufacturers and distributors of mechanical equipment, regarding the safety of operators and maintenance personnel, equipment and the environment. Being a pre-requisite for marking the products with the CE mark, complying with the Machinery Directive is obligatory for any manufacturer or distributor that intends to sell their products in the EU.

There are some mechanical solutions to achieve these safety requirements. Supporting this, the controls of an AHU can also have a positive influence of safety aspects, such as:

- Stopping of the fans in case the door is opened
- Alarming in case of malfunction

## 5.2 Fire safety

There are various statutory requirements and regulations in different countries. Having an integrated control system allows the manufacturer to test all safety functions in the factory and ensure that they work properly, so that both the manufacturer and customer are sure about the safe operation of the subject unit on-site.

## 5.3 Component safety

The AHU control system must protect AHU components against damage due to extreme unacceptable operating conditions. These functions include in particular:

### 5.3.1 Frost protection of the water heater

Fluid in the water heater may freeze when the temperature drops below freezing point. Returned water temperature sensors may be used to indicate the moment of freezing. The drawback of this method is that only the mean (mixed) water return temperature can be measured. Waterflow in all coil circuits is however not equal, due to number of passes per circuit and manufacturing tolerances. Another method for protection is to use an airside frost protection thermostat (two-phase). With such a device it is possible to protect each coil circuit against freezing if the capillary is correctly mounted downstream the circuits of the coil.

If the measured temperature drops below the limit value, the airflow is automatically stopped. The algorithm also protects the heater at start-up during cold periods. Fans are switched on after the heater starts to operate at full capacity.

### 5.3.2 Protection of the electrical heater

Electrical heater is used to provide the required increase in supplied air temperature. If the airflow stops, the heater may increase the temperature locally, which may result in the melting of plastic parts, or even fire. Therefore, protection is provided in automatic mode to prevent it. The electrical heater has two protection modes: automatic and manual. When automatic protection is activated, the heater and its power circuit are disconnected, and cooling is ensured by an increased airflow. The fan speed is controlled according to the supply air temperature, i.e., if the supply air temperature drops below the minimum, the fan speed is reduced.

## 6. Cybersecurity

Cybersecurity is a topic which is often discussed and when a cyberattack happens, it is widely spread throughout the media. On the other side, there is no official standard that a controller must comply to. However, when a controller is connected to any kind of network, there are some aspects that should be considered:

- The communication to cloud services must be protected with state-of-the-art cryptography.
- Any remote operation executed on the control system must be authenticated and authorised. Any local operation, which is not intended for end user interaction, executed on the control system must be authenticated and authorised. End user interactions must be well defined and limited to harmless and nonessential actions for the control system.
- The above statement applies also for control systems with an embedded webserver, no matter if conducted programmatically via an Application Programming Interface (API) or by a human through a Human-Machine Interface (HMI).

- In case there is any sensitive information stored on the control system (e.g. passwords, keys, etc.), it must be stored encrypted.
- Any wireless connectivity, if the capability is present, must be turned off by default. Activation of such connectivity must require some local action (e.g. pressing a physical button on the controller, or a button on an HMI).
- For temporary connection such as commissioning and maintenance services, the wireless connectivity shall be automatically turned off after a configurable period of inactivity. In all cases, traffic over the wireless channel must be encrypted.

Compliance with points above is considered the bare minimum to ensure secure connection and operation of a control system. These and other requirements are described in the international series of standards IEC 62443 'Industrial communication networks – IT security for networks and systems', especially in the part 4-2 of the standard 'Technical security requirements for IACS components'.

## 7. Commissioning

Proper commissioning of the AHU with control system is crucial to its safe and efficient operation as expected on site. To achieve this, control system should have some specific features and some steps are recommended to be taken by the commissioner, both in the factory before shipment and during commissioning on site.

### 7.1 Benefits of factory-supplied AHU control system

In case of an AHU supplied with a control system by its manufacturer, order-specific parameters can be uploaded in the control unit at the factory. Then the AHU should be assembled and pass a full functional test and inspection, including all safety features before shipment. This should be documented with a signed document from the factory ensuring that the unit is tested for all its functions and operating modes.

Having all components and functions already pre-tested in the factory via a properly integrated controller will provide remarkable benefits for the customer and installer, as it will significantly reduce the installation time and will increase the confidence of all parties in better durability of the equipment in the field.

Controller can allow the commissioner to easily check on-site if all functions and operating modes work properly, preferably having a 'test mode' to facilitate this.

After on-site installation, the factory-set values for all parameters should be checked with respect to the control's documentation to validate if everything is right during start-up. Then the parameters can be adjusted accordingly for the project's specific requirements if any.

A commissioning protocol including data from factory settings and set values after start-up is recommended to be filled in and signed.

An integrated controller can be embedded with two separate memories; one for the manufacturer's 'factory settings' and another one for the 'commissioning settings', which would allow commissioner or service engineer to easily go back to one of these settings in case something goes wrong on site.

Besides all technical advantages addressed here, having an integrated control system in the AHU will also make life easier for the customer/commissioner by giving the opportunity to have a single contact

point for all equipment, rather than trying to keep a proper contact with the AHU manufacturer besides the BMS installer.

The below documents regarding installation and commissioning are recommended to be kept available either as hard copy annexed to the AHU's documentation, or available online and clearly addressed in the documentation if this is the case:

- Short description of the main components
- Function description including 'Flow Chart' (Schematic view of the components, sensors, etc. of the AHU)
- Wiring diagrams
- Operator's guide for the control panel
- Recommended commissioning protocol
- Report with data from final functional test in the factory

## 7.2 Accuracy of control parameters measurement

Accurate measurement of the actual parameter values has a huge impact on the quality of process control. This translates into both energy consumption and comfort conditions. There are several factors that affect this accuracy, including the appropriate placement and calibration of sensors and measuring devices, as well as their precision class and tolerance. Providing adequate measurement accuracy requires practical experience and testing. Therefore, applying factory-supplied and assembled systems that are replicable and comprehensively tested, normally results in a higher measurement accuracy compared to systems that are installed one-off on site by an external building automation contractor.

## 8. Service and maintenance

### 8.1 General aspects of maintenance

Maintenance and repair concerns owners and operators of AHUs and the Instrumentation and Control (I&C) systems they contain. Operators can be staff of the owner, the operator or companies in facility and building management. For companies and private individuals, there are inevitably extensive obligations and risks towards the public, the environment, the responsible authorities and employees.

If this is insufficiently or not at all perceived, increased energy consumption, plant downtimes and damage cannot be ruled out. If this occurs, legal and financial consequences are usually possible.

Taking timely and appropriate maintenance measures helps to eliminate or limit damage and liability risks, as well as providing considerable energy savings.

During and shortly after commissioning, the risk of failure due to material defects and manufacturing faults is quite high. These faults must be eliminated before the building is used.

Later failures are mainly caused by external influences, e.g. environmental stresses, impermissible loads, operating errors.

Regular inspection and maintenance are intended to prevent failure of plant components and to ensure:

- Maximum plant availability and high operational reliability
- Minimal energy consumption

- High convenience
- Long system life

As a rule, the installations concerned should be inspected before maintenance work is carried out. Interviewing the user helps to integrate his needs and observations into the maintenance measures. The results of an inspection then determine the scope of the maintenance tasks to be performed. This means that not all plant-specific maintenance activities have to be carried out at each maintenance date, but only those that have proven necessary after the inspection. The documentation of the maintenance work carried out and the running times of components helps to plan the next maintenance work independently of the personnel. An analysis of comparable systems can help to identify systematic failures and to carry out the next maintenance even more effectively.

## 8.2 Predictive maintenance

Regular monitoring of the system operation, which is a key element of so-called predictive maintenance, can prevent malfunctions of the AHU and system downtime due to component failures. Evaluation and analysis of recorded performance and running time of components can indicate abnormal functioning that potentially leads to failure well in advance. Unreasonable changes in energy consumption may identify anomalies. Access to data, ideally remote e.g. via cloud, is fundamental to implement predictive maintenance. To this end, communication between the control system and internal components of the AHU, such as damper and valve actuators, sensors, fans and drives is essential.

## 9. Standards and legislation

The major current European regulations and standards that specifically address HVAC control systems comprise:

### 9.1 Amended Energy Performance of Buildings Directive 2018/844

In Articles 14 and 15, the Directive obliges Member States to, by 2025, lay down requirements to equip air conditioning or combined air conditioning and ventilation systems with a rated output of over 290 kW in non-residential buildings with a control system capable inter alia of:

- Continuously monitoring, logging, analysing and allowing for adjusting energy use
- Allowing communication with connected technical building systems and other appliances inside the building and being interoperable with technical building systems across different types of proprietary technologies, devices and manufacturers

In turn, the residential buildings should be equipped with the functionality of continuous electronic monitoring that measures systems' efficiency and informs building owners or managers when it has fallen significantly and when system servicing is necessary, and effective control functionalities to ensure optimum generation, distribution, storage and use of energy.

Following Article 8, in 2020 the European Commission adopted delegated acts for establishing a voluntary common scheme for rating the smart readiness of buildings (SRI). The scheme aims at the assessment of a building (control system) capabilities to adapt its operation to the needs of the occupant and the grid and to improve its energy efficiency and overall performance.



The above mentioned EPBD provisions of Articles 14 and 15 are to be transposed at the level of the Member States to their national legislation. The SRI scheme is optional, which means that only some Member States may decide to implement it.

### **9.2 EN 16798-3:2018**

This standard provides general categories of the system capability for controlling IAQ by adjusting the air flow rate. The classification defines also to a certain extent, the degree of control of the thermodynamic properties in the room.

### **9.3 EN 15232-1: 2017**

Like the previous standard, EN 15232 is a part of the 'EPB set of standards' for the assessment of the energy performance of buildings. It broadly covers Building Automation and Control Systems (BACS) with in-depth look at the HVAC part. The standard defines BACS efficiency classes (A to D) with consideration of HVAC control system functions having an impact on the energy performance of buildings.

## About Eurovent

Eurovent is Europe's Industry Association for Indoor Climate (HVAC), Process Cooling, and Food Cold Chain Technologies. Its members from throughout Europe represent more than 1.000 organisations, the majority small and medium-sized manufacturers. Based on objective and verifiable data, these account for a combined annual turnover of more than 30bn EUR, employing around 150.000 people within the association's geographic area. This makes Eurovent one of the largest cross-regional industry committees of its kind. The organisation's activities are based on highly valued democratic decision-making principles, ensuring a level playing field for the entire industry independent from organisation sizes or membership fees.

## Our Member Associations

Our Member Associations are major national sector associations from Europe that represent manufacturers in the area of Indoor Climate (HVAC), Process Cooling, Food Cold Chain, and Industrial Ventilation technologies.

The more than 1.000 manufacturers within our network (Eurovent 'Affiliated Manufacturers' and 'Corresponding Members') are represented in Eurovent activities in a democratic and transparent manner.

→ For in-depth information and a list of all our members, visit [www.eurovent.eu](http://www.eurovent.eu)