REHVA
Federation of European Heating, Ventilation and Air Conditioning Associations

CLIMA 2025
Decarbonized, healthy and energy - conscious buildings in future climates

NVG
NORDIC VENTILATION GROUP
Scientific collaboration

TAL TECH

MODEL IEQ REGULATION ALIGNING WITH NEW PROVISIONS OF 2024 EPBD RECAST

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IEQ IN EPBD RECAST 2024

- EPBD recast 2024 introduced a concept of an **optimal Indoor Environmental Quality (IEQ)** to improve energy performance, resulting in comprehensive set of requirements for IEQ, not only in the design phase but also during operational life of building
- New requirement for **measuring and control devices for the monitoring and regulation of Indoor Air Quality** (IAQ) in non-residential buildings
- Ensuring IEQ standards and monitoring their compliance cost-effectively is very important and possible – addressed in many articles

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2024 EPBD RECAST INTRODUCED CLEAR DEFINITION FOR IEQ

Article 2(66) - 'indoor environmental quality'
means the result of an assessment of the conditions inside a building that **influence the health and wellbeing of its occupants**, based upon parameters such as those relating to the:

a) temperature,
b) humidity,
c) ventilation rate,
d) and presence of contaminants.

at least, **thermal comfort + IAQ**

- Member States will retain the competence for regulating indoor environmental quality, and they will need to define the indoor conditions (following the definition) to be maintained in buildings
- Member States can go beyond this definition and include other aspects in the transposition of the definition of IEQ, such as daylighting and acoustics (also in line with LEVEL(s))

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ADDRESSING IEQ IN THE DESIGN PHASE – NEW BUILDINGS AND MAJOR RENOVATION

Article 5(1) - Minimum energy performance requirements shall take account of **optimal indoor environmental quality**, in order to avoid possible negative effects such as inadequate ventilation, as well as local conditions and the designated function and the age of the building.

Article 7(6) - Member States shall address, in relation to new buildings, the issues of **optimal indoor environmental quality** […]

Article 8(3) - Member States shall address, in relation to buildings undergoing major renovation, the issues of **indoor environmental quality** […]

- Minimum requirements for indoor air quality and thermal comfort are to be set in the regulation for new buildings and major renovations, if not yet available
- EPBD guidance recommends EN 16798-1 **Category II** (medium occupant expectation)
- Besides ventilation, also air filtration requirements for outdoor air and control of indoor sources (materials, cooking…) can be recommended to control pollutant levels

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MEASURING AND CONTROL DEVICES FOR IAQ ARTICLE 13(5)

5. Member States shall require non-residential zero-emission buildings to be equipped with measuring and control devices for the monitoring and regulation of indoor air quality. In existing non-residential buildings, the installation of such devices shall be required, where technically and economically feasible, when a building undergoes a major renovation.
Member States may require the installation of such devices in residential buildings.

- **Mandatory in non-residential ZEBs** and, when technically and economically feasible, in non-residential existing undergoing major renovation
- These devices monitor and regulate the operation of the building and its technical systems to ensure that they operate optimally and provide the required IAQ
- Link with **demand-controlled ventilation**: mechanical and hybrid ventilation systems
- **CO_2** concentration can be continuously monitored as a proxy for ventilation which is an important factor for good IAQ
- **PM2.5** monitoring will ensure that outdoor air for ventilation is clean or adequately filtered and there are no significant indoor sources of PM

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EXAMPLE OF EVIDENCE BASED IEQ IMPLEMENTATION

- To help to implement new IEQ provisions in national regulation, REHVA and Nordic Ventilation Group experts have developed a model IEQ regulatory text
- Proposed text is expected to serve as an example of evidence based IEQ useful minimum implementation
- Could support harmonised national EPBD implementation

		Design	Monitoring	Inspections
Thermal Comfort	Operative temperature	X	(X)	
	Air temperature	(X)	X	X
	Air velocity	X		
	Relative humidity	X	X	
Indoor air quality	Ventilation Rate	X		X
	Carbon dioxide	X	X	
	PM2.5	X*	X*	
	Formaldehyde	X+		
	Nitrogen dioxide	X+		
	Radon	X+		
	Carbon Monoxide	X+		
Daylighting	Daylight provision	X		
	Illuminance	X		
	Glare probability	X		
Acoustics	Sound pressure	X		optional
	Sound reverberation time	X		

https://www.rehva.eu/fileadmin/user_upload/2024/IEQ_Guidance_2025.pdf

MODEL IEQ REGULATION

- All numeric values included serve as examples, following the **Commission guidance recommendation to use Category II** specified in EN 16798-1:2019 (medium occupant expectation), whose values ensure avoiding adverse health effects and comfort and well-being of occupants
- Limited to thermal comfort and IAQ, and noise of building services
- It is expected that a weather file for indoor climate and energy simulations already exist (for long term assessment of IEQ that is needed because of optimal IEQ and IAQ regulation)

- Model regulatory text is followed by explanatory report

https://www.rehva.eu/fileadmin/user_upload/2024/IEQ_Guidance_2025.pdf

IAQ AND VENTILATION

IAQ forms a main part of the document:

- Non-residential vs. residential
- Ventilation system (includes natural ventilation) – technology neutral
- Operation for optimal IAQ
- IAQ monitoring and regulation

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IAQ AND VENTILATION

- IAQ = source control + ventilation + filtration of outdoor air where relevant
- Minimum outdoor air ventilation requirements in residential/non-res
- Adresses PM2.5 so that ventilation with outdoor air filters is enough
- In zones where outdoor air intake is without filters, WHO PM2.5 limit value is required (when exceeded, openings must be closed or other measures applied)

4. Design values and requirements for indoor air quality

4.1 General

4.1.1 Indoor air quality shall be controlled by source control (pollutant sources), ventilation, and filtration of outdoor air where relevant.

4.1.2 Source control must be applied for pollutants emitted from building materials and interior design through the use of low polluting building materials[14], and with the use of local exhausts where relevant.

4.1.3 To maintain an acceptable level of pollutants in the indoor environment, minimum outdoor air ventilation requirements given in 4.2 and 4.3 shall be used to dimension the ventilation system.

4.1.4 To control the entry of outdoor particulate matter, outdoor air filters[15] in the ventilation system may be used. In zones where outdoor air intake without outdoor air filters is used, the particulate matter PM2.5 cannot be higher[16] than 10 µg/m^3.

[14] Low polluting building materials are defined in EN 16798-1:2019. Values for very low-polluting materials can be used only in the case of labelled/certified materials.

[15] For non-residential buildings filters are specified in EN 16798-3. Adequate filters protect both the occupants and the ventilation equipment.

[16] At a higher concentration, outdoor openings must be closed and IAQ maintained with other ventilation or air cleaning measures. WHO Global Air Quality Guidelines 2021 specify PM2.5 thresholds as an annual mean of 5-10 µg/m^3 and a 24-hour mean of 15-25 µg/m^3.

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MINIMUM VENTILATION REQUIREMENTS

- Refers to EN 16798-1:2019 Category II values
- In non-res. ventilation depends on number of people and floor area, i.e. dilutes emissions from people and building
- If other sources, more ventilation may be needed

- For residential buildings proposes room based values derived from Category II with common occupancy and room size assumptions
- Compliance with airflow rates may be assessed through CO_2 (and RH in residential)

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4.2 Ventilation in non-residential buildings

4.2.1 In indoor spaces where the criteria for indoor environments are set by human occupancy and where the production or process does not have a significant impact on the indoor environment, the required outdoor air ventilation rate shall be calculated as follows:

$$q_s = Nq_p + A_R q_B \quad (1)$$

where[17]

q_s design outdoor air ventilation rate, L/s (1 L/s = 3.6 m³/h)

N design value for the number of persons in the room,

q_p ventilation rate for occupancy per person, 7 L/(s person)

A_R room floor area, m²

q_B ventilation rate for emissions from building, default value 0.7 L/(s m²) assuming low polluting materials. When very low-polluting building materials (certified by national material emission control/labelling systems) are used, q_B = 0.35 L/(s m²).

4.2.2 In indoor spaces with other pollution sources, in addition to human occupancy and emissions from building, the sufficiency of ventilation rates provided by Equation 1 shall be checked and ventilation rates increased where relevant.

4.3 Ventilation in residential buildings

4.3.1 In residential buildings the total ventilation of a whole residence shall be at least 0.42 L/(s m²) [18]. Room specific minimum ventilation requirements are given in Table 2.

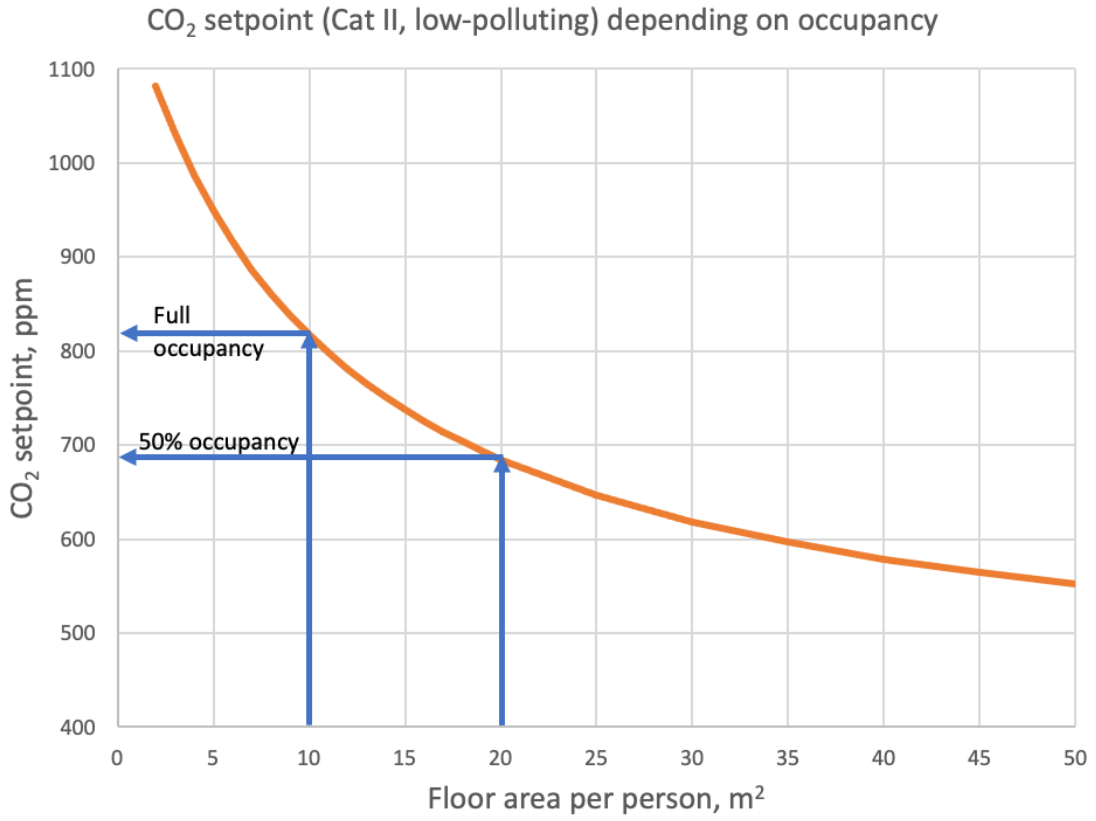
Table 2. Minimum design airflow rates in residences[19].

	Supply airflow rate L/s	Extract airflow rate L/s
Living rooms[1] >15 m²	8+0.27 L/(s·m²)	
Master bedroom and bedrooms >15 m²	14	
Living rooms and bedrooms 11-15 m²	12	
Bedrooms <11 m², 3rd and successive bedrooms in large apartments	8	
WC		10
Bathroom		15
Bathroom in one room apartment		10
Utility room		8
Wardrobe and storage room		6
Kitchen[2]		8
Kitchen[2], one room apartment		6
Kitchen[3], cooker hood in operation		25
Average airflow rate of a whole residence L/(s m²)	0.42	
Staircase of an apartment building, ACH	0.5	

[1] Transfer air from bedrooms can be used as a part of supply air but 12 L/s is minimum outdoor air rate
[2] Airflow rate in the kitchen when cooker hood is not in operation
[3] Fire regulations are to be followed

OPERATION FOR OPTIMAL IAQ

- Accepts CO_2 as a parameter to control IAQ
- Typical occupancy to calculate CO_2 setpoint (results in lower value than that at full load)
- Acceptable deviation in long term assessment <= 5% of occupied hours



5.2 Operation for optimal indoor air quality in non-residential buildings

5.2.1 Ventilation systems in non-residential buildings shall be controlled according to occupancy. Concentration of CO_2 can be used as a proxy for ventilation to operate ventilation system in between design and minimum ventilation rate.

5.2.2 Minimum ventilation rate shall be calculated with Equation 1 with no occupancy (n=0).

5.2.3 For CO_2 concentration setpoint[21] the total ventilation rate per person shall be calculated:

$$q_{sp} = \frac{q_s}{n} \quad (2)$$

where

q_{sp} total ventilation rate per person (L/(s person))

q_s design ventilation rate supplied by actual air distribution system, (L/s)

n number of the persons in the room corresponding to typical occupancy[22] (-)

5.2.4 CO_2 concentration setpoint above the outdoor CO_2 concentration shall be calculated from metabolic CO_2 generation and CO_2 volume balance:

$$C = \frac{q_{CO2}}{q_{sp}} \frac{1000}{3.6} \quad (3)$$

where

C CO_2 concentration setpoint value above the outdoor CO_2 concentration (ppm)

q_{CO2} CO_2 generation rate (L/(h person))

$\frac{1000}{3.6}$ 3600 and 10^6 are unit conversions from hour to second and litre to ppm

5.2.6 If ventilation is shut off for unoccupied periods, the system shall be switched on so that ventilation airflow volume corresponding to at least one volume of rooms will be delivered within 2 hours prior to occupation.

5.2.7 CO_2 setpoint values shall be used in the long-term assessment of CO_2 concentration with IAQ simulations. Acceptable deviation from these values shall be no more than 5% during occupancy hours.

ARTICLE 13(5) IMPLEMENTATION: MEASURING AND CONTROL DEVICES FOR IAQ

- Requires DCV and BACS:
  - Airflow rate control according to occupancy at relevant unit level
  - BACS that provide monitoring of IAQ and temperature
  - In major renovations to be followed as applicable
- In DCV with **outdoor air filters, CO_2 may be used as a parameter** for IAQ monitoring and regulation
- In zones where outdoor air intake without outdoor air filters is used, **additionally the particulate matter PM2.5** shall be used for IAQ monitoring and regulation

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6 IAQ monitoring and regulation equipment[24] in non-residential buildings

6.1 New non-residential buildings shall be equipped with measuring and control devices as a part of a demand-controlled ventilation (DCV) system for the monitoring and regulation of IAQ.

6.2 New non-residential buildings shall be equipped with building automation and control systems[25] which provide monitoring of IAQ and temperature in continuously occupied spaces.

6.3 In major renovations 6.1 and 6.2 shall be followed as applicable.

6.4 IAQ regulation shall be applied at least in spaces that are intended for three or more persons.

6.5 IAQ regulation is not needed in spaces where ventilation requirements are determined predominately by extract air flow rates.

6.6 DCV systems should use sensors that can reliably measure parameters that are used for IAQ monitoring and regulation.

6.7 In DCV systems equipped with adequate outdoor air filters, CO_2 may be used as a parameter for IAQ monitoring and regulation. In zones where outdoor air intake without outdoor air filters is used, additionally the particulate matter PM2.5 shall be used for IAQ monitoring and regulation[26].

6.8 Monitored IAQ parameters shall be made visible in rooms for users, provided both by readings and traffic light colour type of indicators. They should also be available at least with hourly resolution for last 12 months in building automation and control systems for long term performance assessment and maintenance support purposes.

[24] EPBD Article 13(5)

[25] EPBD Article 13(10). Note that article 13(9–12) provide other building automation and control requirements for systems performance and automatic lighting controls which can be addressed in energy regulation.

[26] When PM2.5 is reaching the setpoint, measures to control PM2.5 should be applied. These may include closing the outdoor openings, activating mechanical ventilation and/or air cleaning.

ZEB CAPACITY TO REACT TO EXTERNAL SIGNALS ARTICLE 11(1)

8 Capacity to react to external signals and adapt energy use, generation or storage[28]

8.1 A capacity to react to external signals shall be implemented so that thermal comfort and IAQ are not compromised. Acceptable deviations may be assessed as specified in 3.6, 5.2.7 and 5.3.2.

- Assumes that the capacity to react to external signals is addressed in energy regulation
- IAQ and thermal comfort shall not be compromised
- **Long term assessment needed to show that IAQ and thermal comfort will stay within acceptable range**

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EXPLANATORY REPORT

		Design	Monitoring	Inspections
Thermal Comfort	Operative temperature	X	(X)	
	Air temperature	X	X	X
	Air velocity	X		
	Relative humidity	X	X	
Indoor air quality	Ventilation Rate	X		X
	Carbon dioxide	X	X	
	PM2.5	X*	X*	
	Formaldehyde	X+		
	Nitrogen dioxide	X+		
	Radon	X+		
	Carbon Monoxide	X+		
Daylighting	Daylight provision	X		
	Illuminance	X		
	Glare probability	X		
Acoustics	Sound pressure	X		
	Sound reverberation time	X		

optional

- **Indicators and numerical ranges** (EN 16798-1) are provided for the requirements identified, for MS consideration.
- The table provides examples of relevant IEQ parameters when setting **design** requirements (Art. 7(6) and 8(3)), performing **monitoring** (Art. 13(5)), conducting **inspections** (Art. 23).
- Clarification where requirements are relevant:
  - * **$PM_{2.5}$**: filters or monitoring may be needed for polluted areas. Indoor pollution levels may also need to be considered.
  - + **NO_2, CO**: indoor parking areas, in case of indoor pollution sources, in polluted areas.

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GUIDELINES ON MEASURING AND CONTROL ARTICLE 13(5)

- **CO_2** concentration can be continuously monitored as a **proxy for ventilation** which is an important factor for good IAQ. **PM2.5** monitoring will ensure that outdoor air for ventilation is clean or adequately filtered and there are no significant indoor sources of PM.
- Low-cost sensors for routine IAQ monitoring are available for CO2, RH, fine particulate matter PM2.5, and CO that originate from combustion.
- It is recommended to specify at which **unit or zone level** or **space categories** it is relevant to require measuring and control of IAQ, as this not always needed.
- MSs may decide to introduce IAQ monitoring and regulating capabilities also for residential buildings and have flexibility about the type of equipment to install, the buildings to target, the parameters to monitor (e.g. CO2 levels in common areas, RH in 'wet rooms').

CONCLUSIONS

- EPBD IEQ/TBS guidance refers to **Category II** (medium occupant expectation) of EN 16798-1:2019 (expected publication Q2/Q3 2025)
- Measuring and control devices for the monitoring and regulation of IAQ will make **demand-controlled ventilation** (DCV) systems mandatory in new non-residential buildings – important to address **operation for optimal IAQ**
- In DCV with outdoor air filters, **CO_2** recommended as a parameter for IAQ monitoring and regulation
- In zones where outdoor air intake without outdoor air filters is used, additionally the particulate matter **PM2.5** recommended to be used for IAQ monitoring and regulation
- ZEB capacity to react to external signals and adapt stresses the importance of **long term assesment** to show that IAQ and thermal comfort will stay within accpetable range

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