



NTNU – Trondheim
Norwegian University of
Science and Technology



SCANVAC WEBINAR
COVID-19 and ventilation

Wednesday April 28th, 2021 at 14:00 (NO/DK/SE) 15:00 (FI)
Teams Live Event

Adapting REHVA COVID-19 guidelines to Norway

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SCANVAC Webinar on Covid-19 and Ventilation, 28.4.2021



REHVA guidance on HVAC operation in COVID-19 pandemic

- The REHVA COVID-19 guidance summarises advices/ recommendations on the operation and use of building service systems during COVID-19 pandemic.
- The current (4.1) version of the guidance was published on 15 April 2021 and overwrites all previous ones. (**November 17, August 3, April 3 and March 17**)

Principal updates compared to the previous version (4.0)

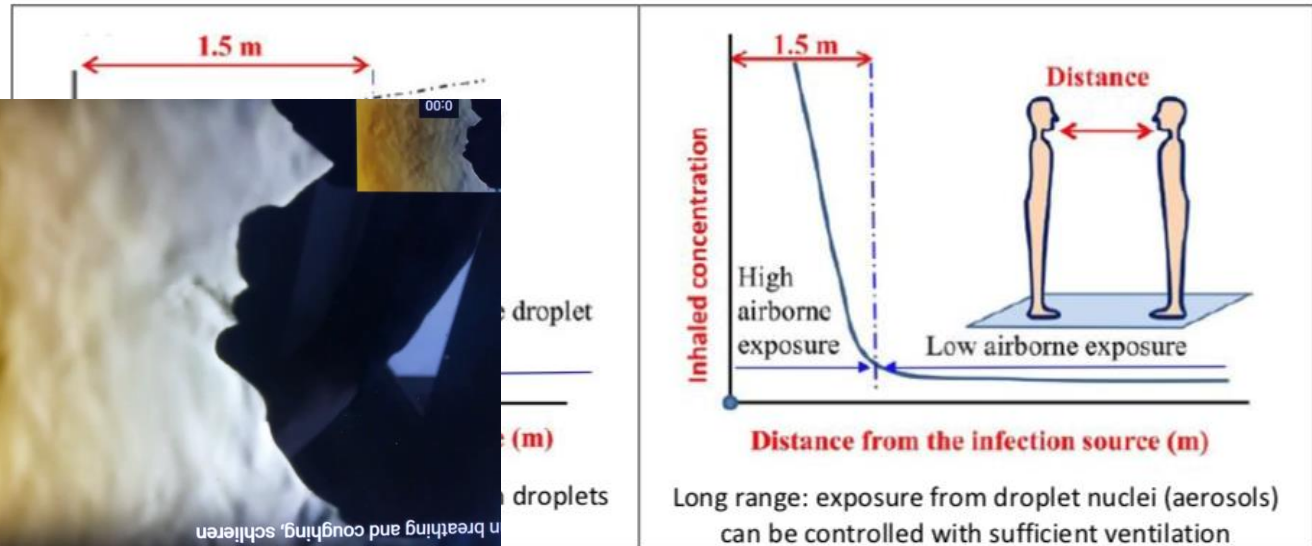
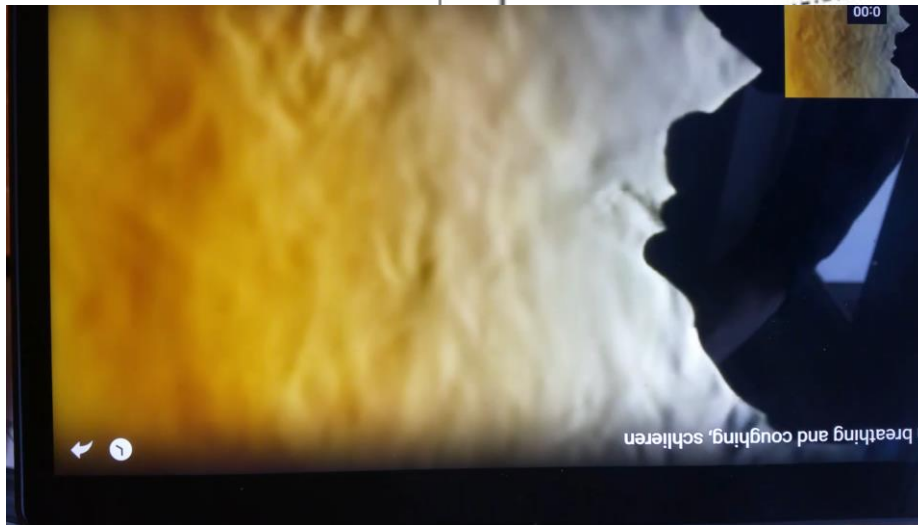
- Recommendation to operate mechanical ventilation systems in commercial buildings 1 hour before and after usage time, given that 3 volumes of outdoor air is provided at that time.
- Recommendation to change the CO₂ setpoint to 550 ppm in demand-controlled ventilation systems, in order to maintain the operation at nominal speed.
- In the heat recovery sections of the HVAC systems, plate heat exchangers and enthalpy plate exchangers with permeable membranes do not contribute to the virus transmission.



SARS-CoV-2 transmission routes

Short-range droplet transmission: an initial droplet velocity of 10 m/s larger droplets fall down within 1.5 m.

Long-range airborne transmission applies beyond 1.5 m distance for droplets < 50 μm

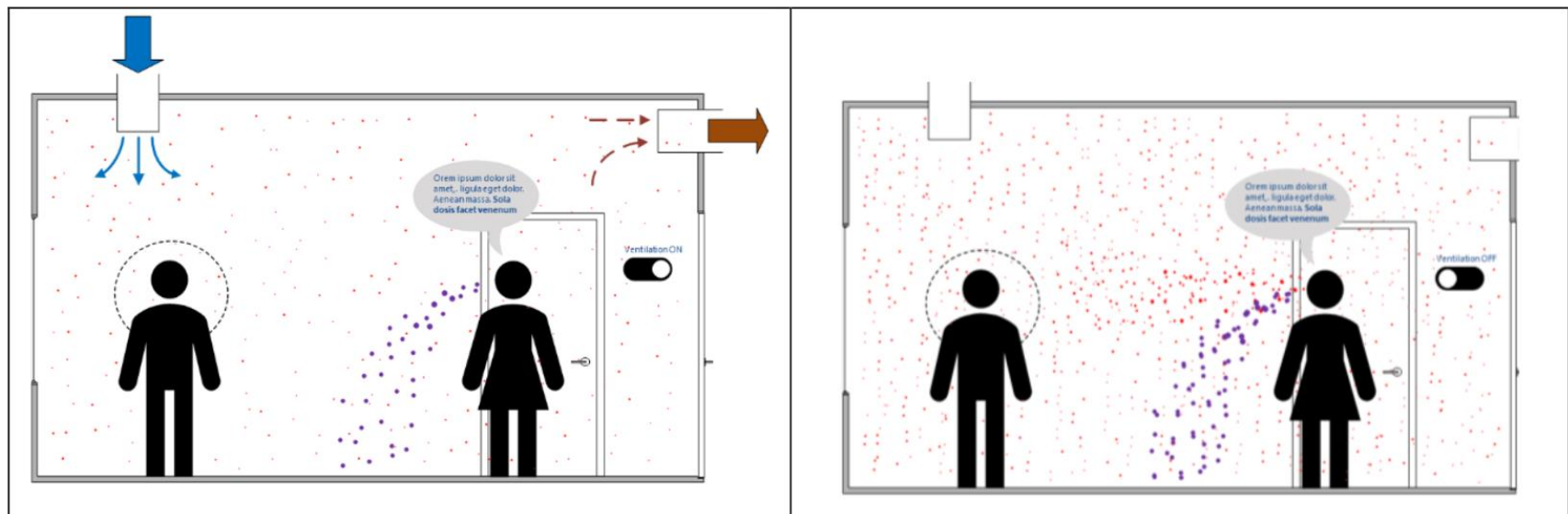


Long range: exposure from droplet nuclei (aerosols) can be controlled with sufficient ventilation
contact combined droplet and aerosol transmission (left) and long-range transmission (right). (Figure: courtesy L. Liu, Y. Li, P. V. Nielsen et al. xii)

- **Thermal plumes:**
- <http://www.healthyheating.com/Definitions/Schlieren-photography.htm>



REHVA COVID-19 guidance - effect of ventilation on virus spreading indoors



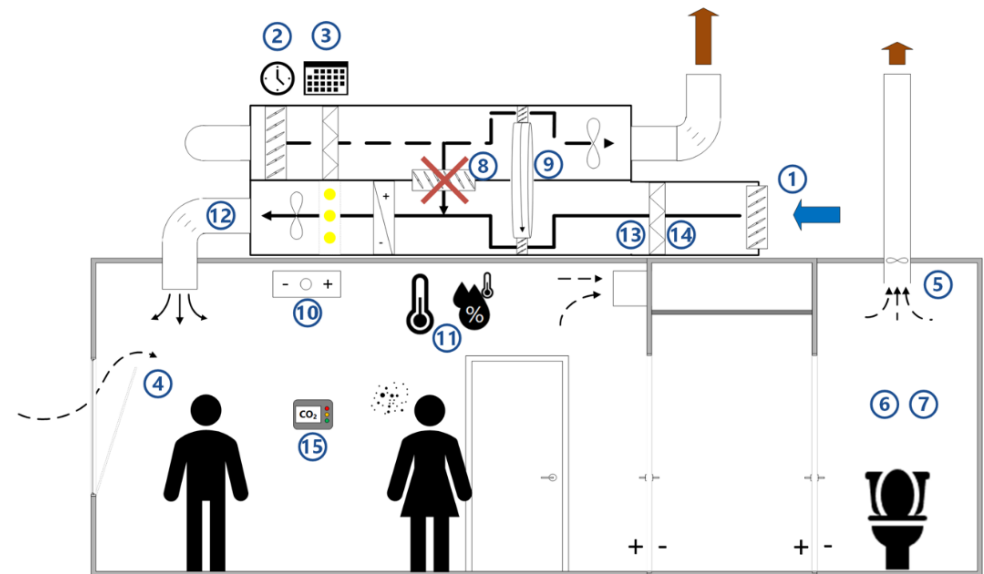
Left figure: ventilation system on, right figure: ventilation system off.

REHVA guidance on HVAC operation in COVID-19 pandemic



REHVA guidance on building services operation in COVID-19 pandemic

1. Ventilation rates
2. Ventilation operation times
3. Continuous operation of ventilator
4. Window opening
5. Toilet ventilation
6. Windows in toilets
7. Flushing toilets
8. Recirculation
9. Heat recovery equipment
10. Fan coils and induction units
11. Heating, cooling and possible humidification setpoints
12. Duct cleaning
13. Outdoor air and extract air filters
14. Maintenance works
15. IAQ monitoring





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Dissemination of REHVA COVID-19 guidance

- Translation of REHVA COVID-19 guidance in Norwegian
- An introduction article of REHVA COVID-19 guidance was published (25.3.2021) on VVS magazine by NemiTek

REHVA COVID-19 Veiledning 4.0

**Det er på tide å se på andre muligheter for
å redusere smittespredning i bygninger**

- NemiTek established a NemiTek COVID-19 work group to follow up and support REHVA COVID-19 Task force



SARS-CoV-2 transmission routes recognized in Norway

Infection with the SARS-CoV-2 virus occurs mainly following close contact (less than 1 meter) by exposure to droplets that contain viruses from the respiratory tract. (FHI-Norwegian Institute of Public Health, 21.2.2021)

- **Droplet transmission:** People with COVID-19 disease emit droplets and particles from their nose and mouth that contain SARS-CoV-2.
- **Direct contact:** Droplets / particles containing the virus from the respiratory tract land on nearby surfaces and are transmitted from there to the respiratory tract of another person.
- **Airborne transmission:** Tiny virus-containing droplets / particles from the nose and mouth of an infectious person can remain suspended in the air for a long time and move over longer distances.



Airborne transmission or not?

- For SARS-CoV-2, this amount (of infectious virus that may be enough to cause infection) is unknown, but modelling studies indicate that the amount of infectious virus to which they are exposed at distances of more than 1-2 metres will seldom be sufficient to cause infection.
- In some situations, however, it is possible that airborne transmission can occur, and cases have been reported where this may have been the mode of transmission.
- This happened in small rooms with poor ventilation ([*Inneklime og risiko for smitte av covid-19 - Råd om ventilasjon*](#)).
- However, airborne transmission is considered to be significant in some medical procedures performed in the healthcare service, so-called aerosol-generating procedures.

National regulations - Norwegian Labour Inspection Authority & Building Regulation



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Arbeidstilsynet Veiledning, best.nr. 444

DIREKTORATET FOR BYGGKVALITET

TEMA ▼ BYGGEREGLER ▼ BYGGSØK ▼ SENTRAL GODKJENNING ▼ NIREG

Du er her: Forside / BYGGEREGLER

Veiledning om
Klima og luftkvalitet på arbeidsplassen
Veiledning fra Arbeidstilsynet

Climate and air quality at work spaces

DIREKTORATET FOR BYGGKVALITET

TEMA ▼ BYGGEREGLER ▼ BYGGSØK ▼ SENTRAL GODKJENNING ▼ NIREG

Du er her: Forside / BYGGEREGLER

Byggeregler

Regulations on technical requirements for building works

Forskrift om tekniske krav til byggverk (Byggteknisk forskrift, building code) <http://www.dibk.no/BYGGEREGLER/>

<http://www.arbeidstilsynet.no/veiledning.html?tid=78036>



Norwegian ventilation requirements: TEK 17, July 1st 2017

§ 13-3. *Ventilation for public and office buildings*

1) In construction sectors, public and commercial buildings shall have minimum fresh air **26 m³ /hour per person (7.2 l/s)** with light activities....

Fresh air supply due to contamination from materials, products and installations must be minimum. 2.5 m³ / hour per m² floor area when the building or rooms are in use and minimum 0.7 m³/ hour per m² floor area when the building or rooms are not in use

- Office building: 15 m²/person, school buildings: 2 m²/person



Norwegian ventilation requirements

Climate and air quality at work spaces / Ventilation requirements assessed from three components related to pollution from:

- a. Number of persons
- b. Building, interior design and installations
- c. Work or process

a:7-10 l/s person, b:0.7-2 l/s.m²

Ventilation requirement: $V = a + b$ if $a + b > c$

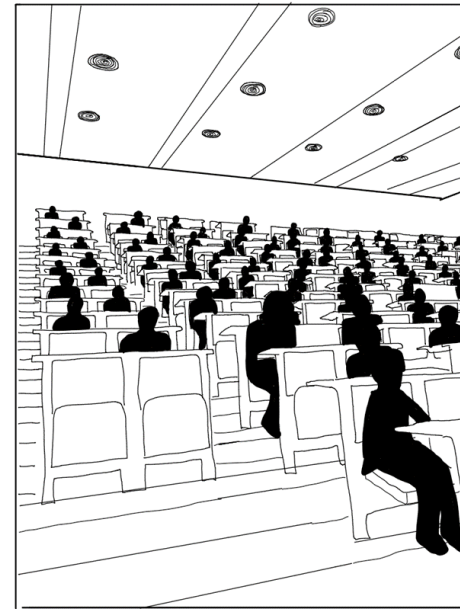
Ventilation requirement: $V = c$ if $a + b < c$



COVID-19 infection risk in a Norwegian lecture room



NTNU, lecture hall S2



Mathilde Ruud et al. Infection probability of COVID-19 in a large lecture room with mechanical ventilation. REHVA Journal 2/2021

- 131 students
- the supply airflow rate in S2 was 10.7 l/s per person
- the probability of infection in S2 is calculated to be 0.098%.



Adapting REHVA COVID-19 guidelines to Norway

REHVA COVID-19 guidelines:

Increase air supply and exhaust ventilation:

- ...extended operation time...
- ...in commercial buildings 1 hour before and after building usage time ...
- for DCV, change the CO₂ setpoint to 550 ppm ...
- during non occupied period, operate continuously at reduced speed
- to supply as much outside air as reasonably possible

Concerns

Should ventilation rates be increased during heating season?

Increasing ventilation in already well-ventilated rooms can potentially have a negative effect on the risk of infection....

However, ventilation can affect the spread of infection, for example by transferring air from one room to other rooms (overflow)...



Adapting REHVA COVID-19 guidelines to Norway

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Concerns

SARS-CoV-2 survives best at lower air temperatures and at low humidity, and our immune system is additionally adversely affected by increasing susceptibility to respiratory virus infection under such conditions.

Low humidity will be around 20% in winter and 30% in summer in Norway.

Humidity down to 10% is not uncommon in winter in buildings with balanced ventilation systems, and can make people more susceptible to respiratory virus infection.

Adapting REHVA COVID-19 guidelines to Norway

REHVA COVID-19 guidelines:

IAQ monitoring:

- ... it is recommended to install CO₂ sensors at the occupied zone
- ... especially in spaces that are often used for one hour or more by groups of people, such as classrooms, meeting rooms and restaurants...
- standalone CO₂ sensors or 'CO₂ traffic lights' can be used (800 ppm yellow/orange (warning) and 1000 ppm red (alarm))

Concerns

It is recommended that CO₂ levels should not exceed 1000 ppm in Norway.

How about other values than 800 ppm yellow/orange (warning) and 1000 ppm red (alarm)?

What are the infection risk with these CO₂ levels?

Can we determine the number of people sharing the same indoor environment according to CO₂ levels?



Adapting REHVA COVID-19 guidelines to Norway

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- standalone CO₂ sensors or 'CO₂ traffic lights' can be used

Concerns

The limit recommendation in relation to CO₂ must be balanced so that the humidity does not become too low (minimum around 20% humidity in winter and 30% humidity in summer) and adjusted if necessary.

It is a risk with low humidity since both the survival of the virus increases while our immune system is affected so that the susceptibility to infection is increased.

If the humidity drops to below 15% it may indicate that the ventilation rate is too high.



References

- *REHVA guidance on HVAC operation in COVID-19 pandemic*, <https://www.rehva.eu/activities/covid-19-guidance>
- <https://www.who.int/emergencies/diseases/novel-coronavirus-2019>
- *World Health Organization, 2020. Transmission of SARS-CoV-2: implications for infection prevention precautions: scientific brief, 09 July 2020 (No. WHO/2019-nCoV/Sci_Brief/Transmission_modes/2020.3). World Health Organization*
- *TEK 17*: <https://dibk.no/byggereglene/byggteknisk-forskrift-tek17/13/i/13-3/>
- *FHI-Norwegian Institute of Public Health* <https://www.fhi.no/en/op/novel-coronavirus-facts-advice/facts-and-knowledge-about-covid-19/facts-about-novel-coronavirus/?term=&h=1#transmission>
- https://www.fhi.no/contentassets/1af4c6e655014a738055c79b72396de8/inn-eklima-og-risiko-for-smitte-av-covid-19---rad-om-ventilasjon_27102020.pdf
- <https://nemitek.no/inneklima-korona-rehva/det-er-pa-tide-a-se-pa-andre-muligheter-for-a-redusere-smittespredning-i-bygninger/143991>