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From performance criteria to design values: REHVA residential ventilation GB 25 design procedure

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From evidence to ventilation design

- Health based ventilation rate 4 L/s pers recommended for the condition in which the only source of pollution are human occupation emitting bio-effluents (Carrer et al. 2018, HealthVent project) or 4.5 L/s pers by experiments to isolate bioeffluents (Zhang et al. 2018)
- 6-7 L/s pers (summary by Carrer et al. 2015) should apply in occupied rooms (bedrooms, living rooms), but the same amount of extract air is needed from wet rooms and kitchen (source control)
- Selection of air flow rates in dwellings has recently been updated in European and ISO standards (EN 15251, prEN 16798-1, ISO 17772-1:2017)

- In REHVA GB 25 prEN 16798-1 Category II values are followed: 7 L/s pers and 0.42 L/s m2
- **Default occupancy and transfer air assumptions are applied to end up with room based supply and extract airflow rates** (designers typically have no information about occupancy)

How much ventilation is needed?

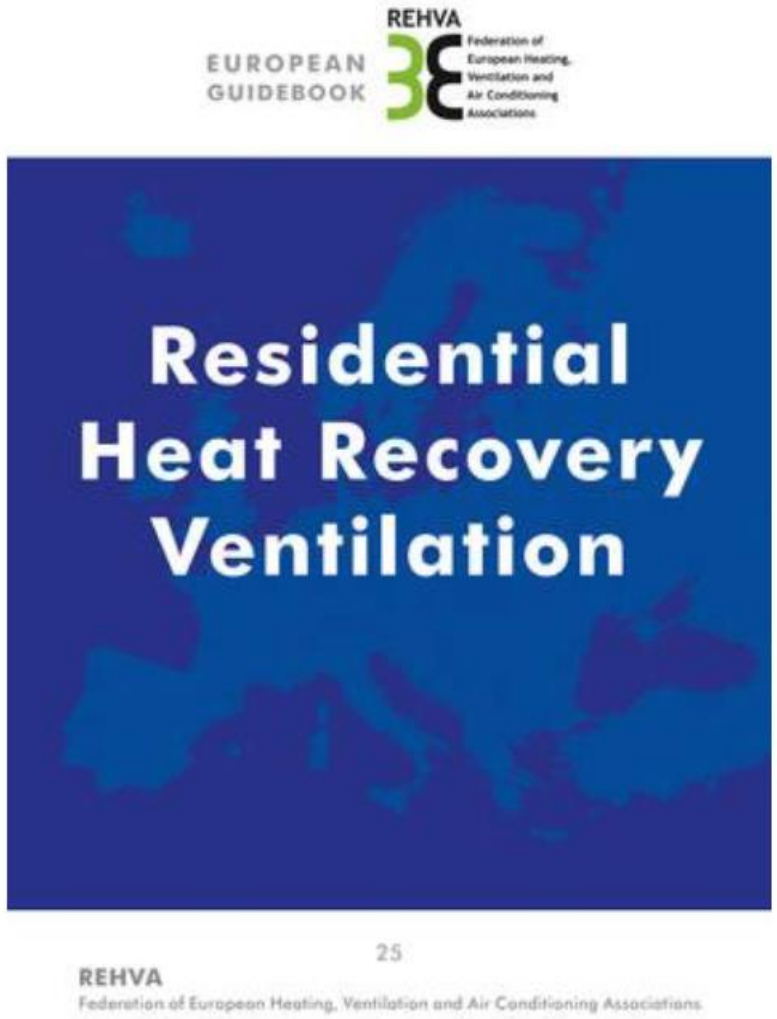
- No consensus in national regulation and guidelines
- FprEN 16798-1:2016 (EN 15251:2007) and ISO/DIS 17772-1 include new section for airflow rate selection in residences
- Further developed in this GB to be suitable for practical design

	Supply airflowrate L/s	Extract airflowrate L/s	Air velocity[1] m/s
Living rooms[2] >15 m^2	8+0.27 L/(s m^2)		0.10
Bedrooms >15 m^2	14		0.10
Living rooms and bedrooms 11-15 m^2	12		0.10
Bedrooms <11 m^2, 3rd and the following bedrooms in large apartments	8		0.10
WC		10	
Bathroom		15	
Bathroom in one room apartement		10	
Utility room		8	
Wardrobe and storage room		6	
Kitchen[3]		8	
Kitchen[3], one room apartement		6	
Kitchen, cooker hood in operation		25	
Average airflowrate of a whole residence L/(s m^2)		0.42	
Staircase of an apartement building, ACH		0.5	

[1]Maximum air velocity values apply at design airflow rate and supply air temperature in heating season conditions, in boost mode higher velocities may be accepted, see section 2.2.
[2]Transfer air from bedrooms may be reduced, 12 L/s is the minimum value
[3]Airflow rate in the kitchen when cooker hood is not in operation

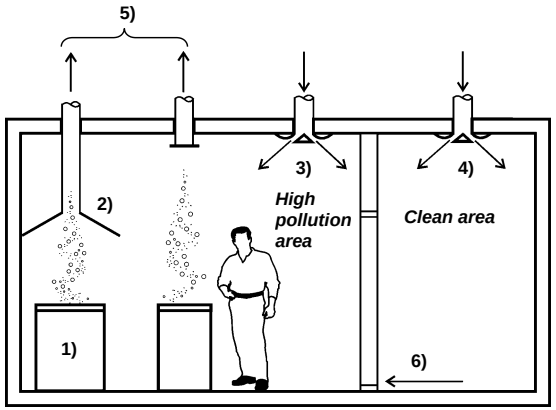
REHVA GB 25 (2018) Challenge of silent, clean and draft-free energy efficient ventilation

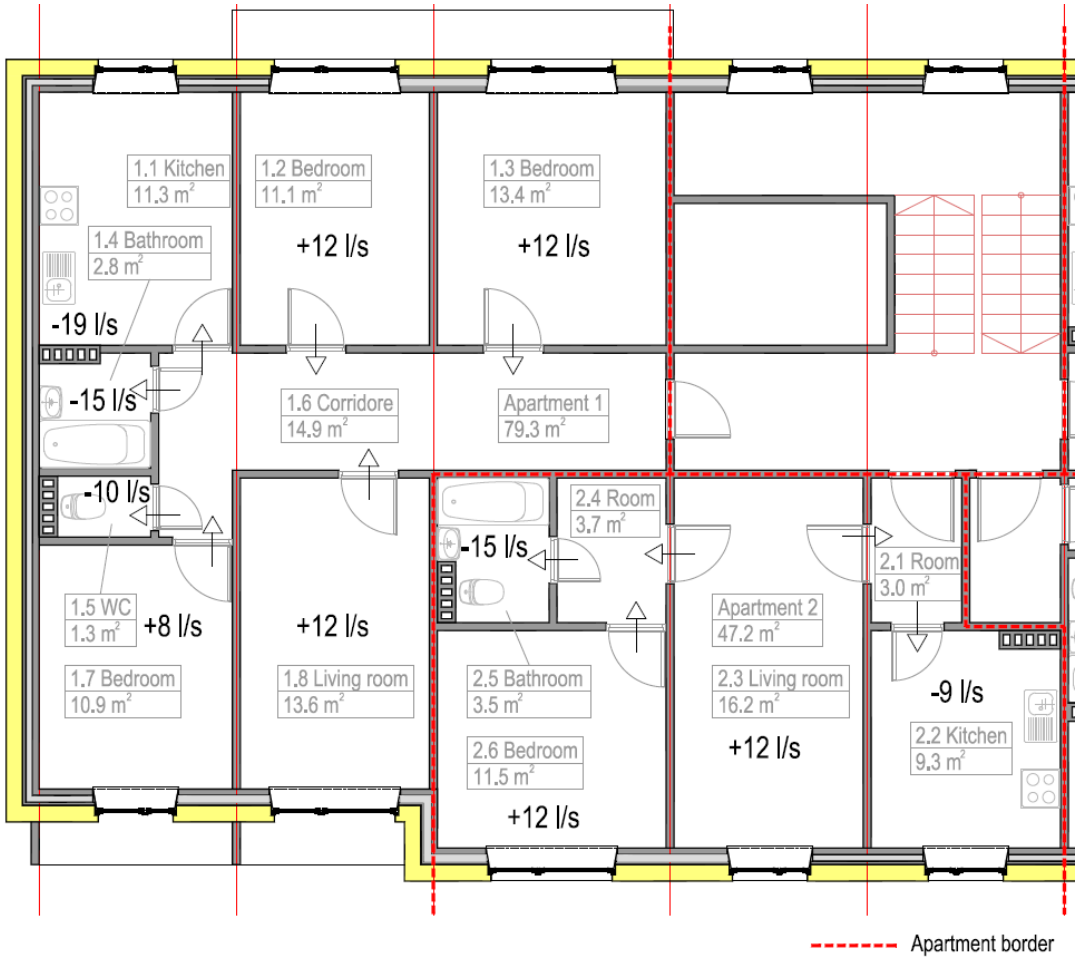
- Ventilation need – selection of airflow rates
- Ventilation system sizing – pressure drop and noise calculations
- Selection of ventilation units
- Ventilation system layouts:
  - New buildings
  - Renovation
- Commissioning and balancing
- Maintenance



Example: how to determine airflow rates and transfer air paths?

- The procedure for airflow sizing
- 1 L/s = 3.6 m^3/h





Example: one bedroom apartment

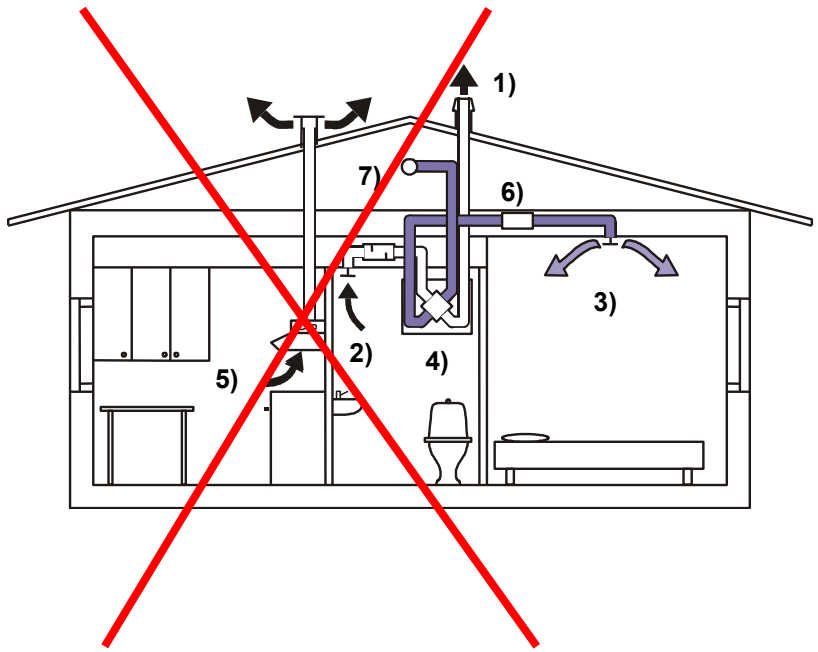
- Airflow rate calculation in one bedroom apartment. The determining airflow rate is marked with bold

Room	Area, m^2	Airflow rate, L/s (m^3/h)		
		Supply	Extract	General air change
2.1 Room	3.0	-	-	
2.2 Kitchen	9.3	-	8 (28.8)	
2.3 Living room	16.2	12 (43.2)	-	
2.4 Room	3.7	-	-	
2.5 Bathroom	3.5	-	15 (54.0)	
2.6 Bedroom	11.5	12 (43.2)	-	
Entire apartment	47.2	-	-	47.2·0.42=20 (72.0)
Total		**24 (86.4)**	23 (82.8)	20 (72.0)

- Total supply and extract airflow rates are almost equal and one extract airflow rate has be increased by 1 L/s to balance the ventilation
- The total design airflow rate of 24 L/s corresponds to 0.73 ach
- Cooker hood operation (25 L/s) another design task/operation mode

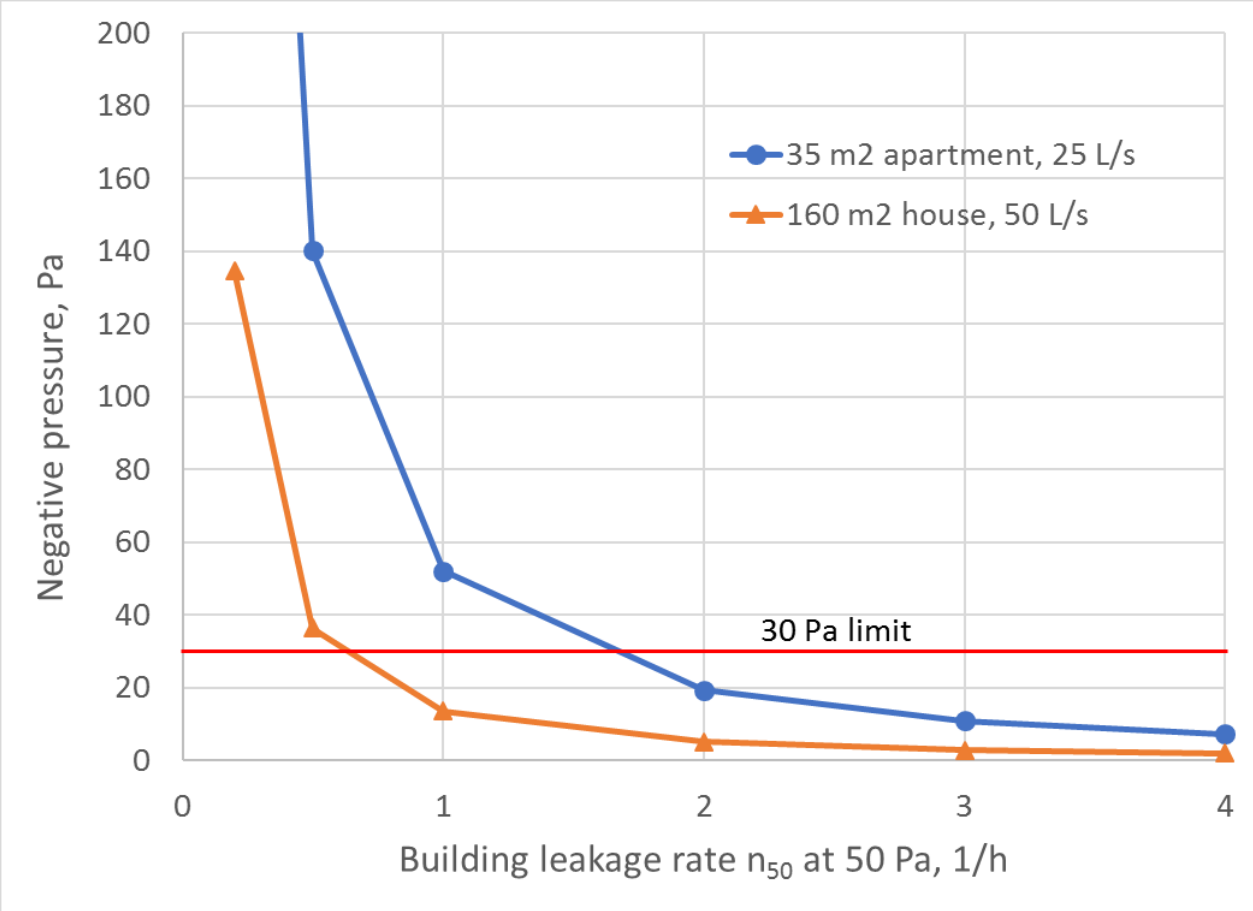
System issues - cooker hoods in modern buildings

- Separated cooker hoods can generate more than 100 Pa negative pressure in new airtight dwellings – it is preferable to connect the cooker hood to the ventilation unit in order to allow balanced operation
- If not compensated, then the maximum negative pressure during cooker hood operation should not exceed 30 Pa



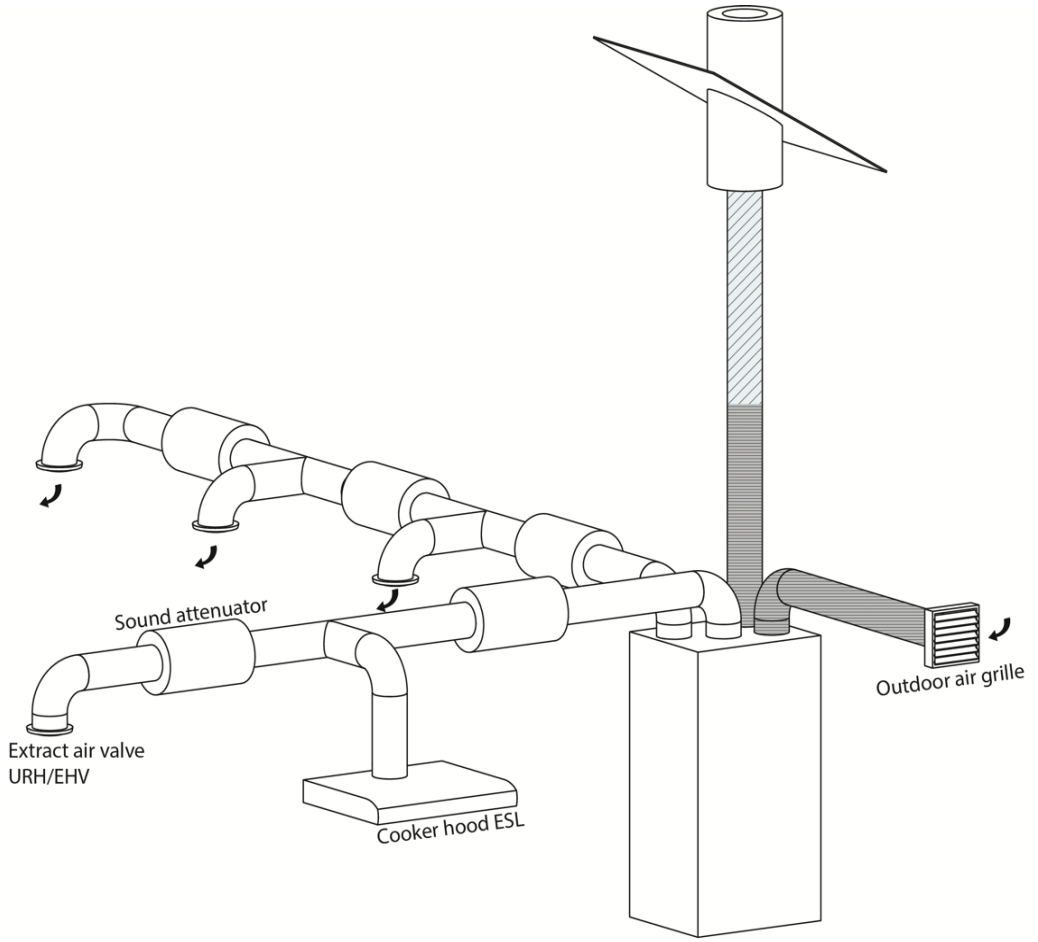
Airflow balance in airtight buildings

- Nearly zero energy buildings nZEB = airtight buildings with n_{50} < 1 1/h
- Special solutions needed for cooker hood and fireplace compensation

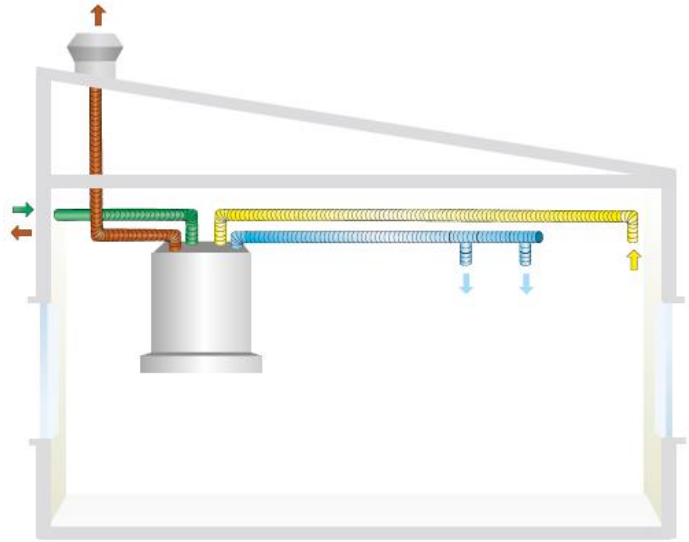


Typical single dwelling ventilation unit

- Plate heat exchanger: cooker hood extract is taken through the heat exchanger
- Rotary heat exchanger: and these units incorporate an extra duct connection for the cooker hood by-pass (i.e. connected after the heat exchanger)
- Outdoor air is taken directly from the facade, but exhaust is ducted to the roof



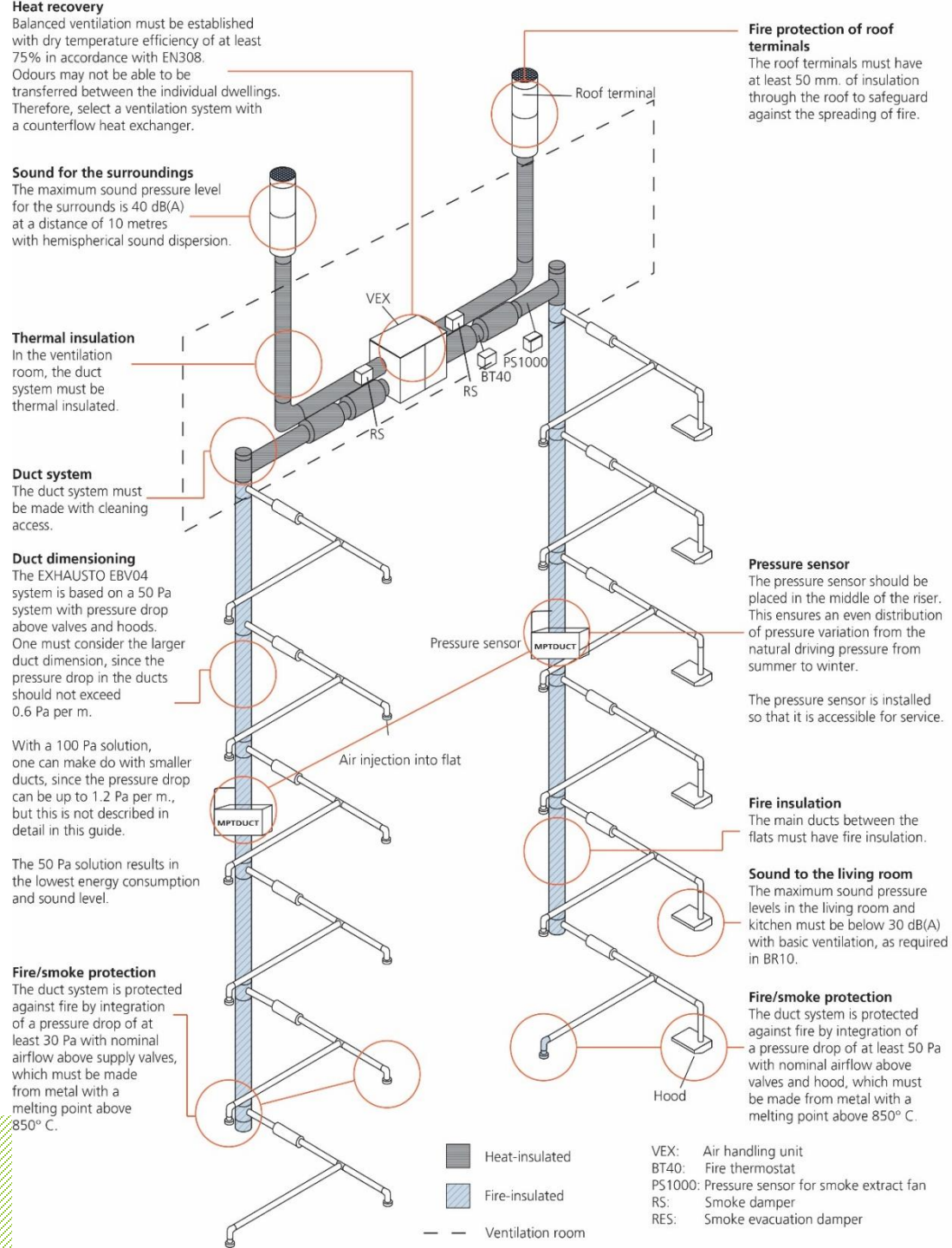
Single dwelling ventilation unit integrated with the cooker hood



- Brown arrow on the wall (optional) indicates that in some cases exhaust through the wall is possible where, particularly in that case, distances to windows and minimum velocity as well as compliance with local requirements is to be checked

Centralized system

- Plate heat exchangers are always used to avoid odour transfer in the heat recovery section
- Air handling unit serves cooker hoods and constant pressure is maintained halfway between that of the supply and extract air main ducts
- Opening the cooker hoods will increase extract airflow rate in the dwellings and the system increases the fan speed in order to keep constant static pressure in the main ducts



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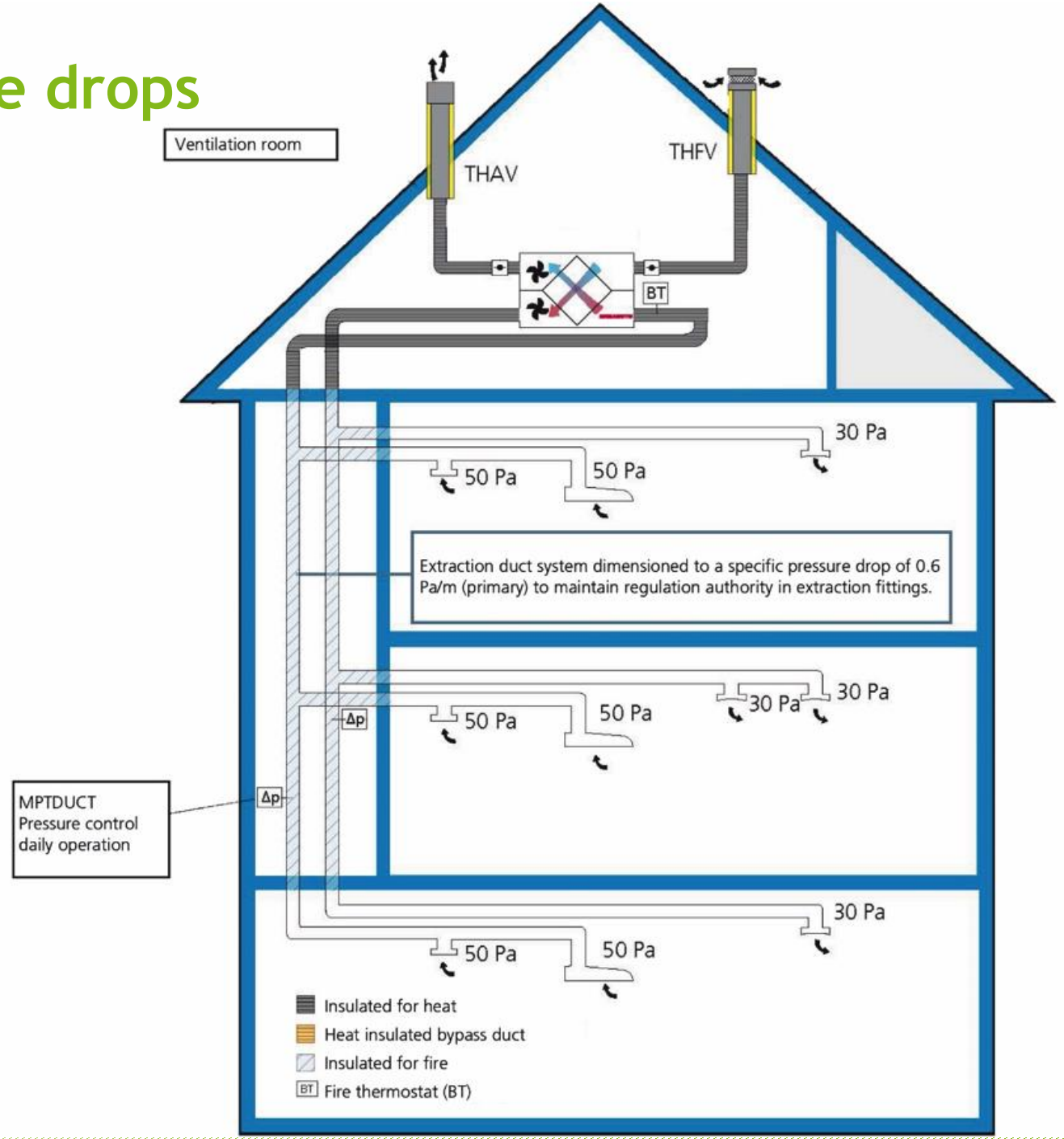
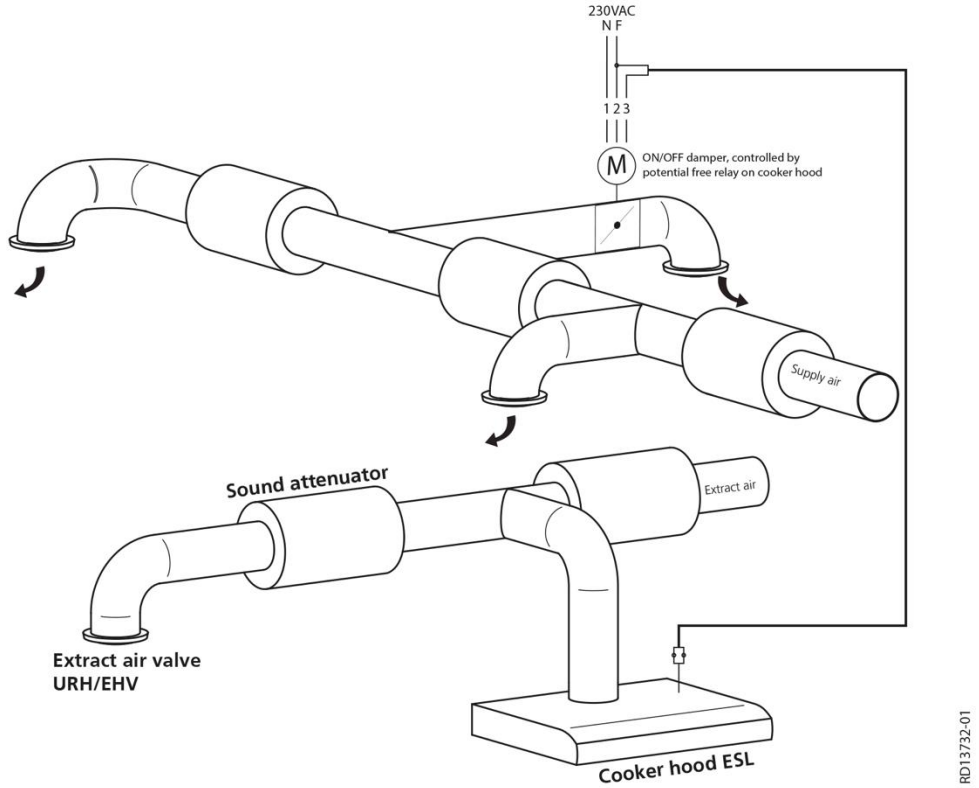
Typical pressure drops



Cooker hood operation



- In centralized system on/off damper and an additional supply air diffuser controlled with voltage signal
- General ventilation (min 8 L/s constant airflow) and boost (min 25 L/s) when the damper is opened

Conclusions

- Generally NZEB requirements provide new opportunities for dedicated ventilation systems as well as for research and harmonisation in order to ensure robust and reliable operation of ventilation satisfying high level health and comfort requirements of occupants
- REHVA GB No 25 has made a step forward from European and ISO standards prEN 16798-1:2018 and ISO 17772-1:2017 by developing a room-based airflow rate selection procedure providing L/s per room values for common residential rooms
- Main system solutions of single dwelling ventilation units and centralized ventilation provided both for new and renovated buildings