



DGENTR LOT 6: Task 1

V-systems, Standards & Legislation

ARMINES, BRE, VHK

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- ✓ Agreements at EU level
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- ✓ International



Performance definitions

1) Ventilation system

- ✓ Combination of appliances designed to supply interior spaces with outdoor air and to extract polluted indoor air

2) Ventilation effectiveness ϵ_v (EN 13779)

$$\epsilon_v = \frac{C_{ETA} - C_{SUP}}{C_{IDA} - C_{SUP}}$$

Pollution concentration (mg/m³)

C_{ETA} = in exhaust air

C_{SUP} = in supply air

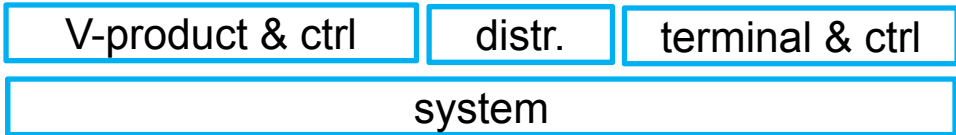
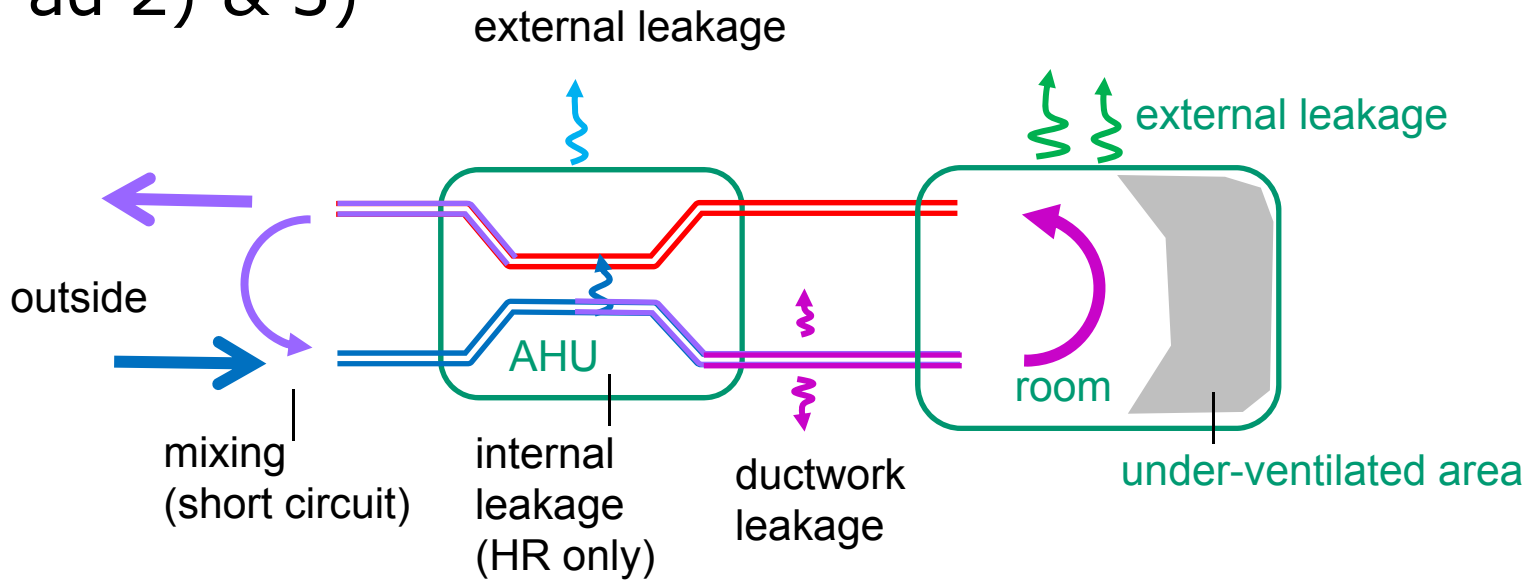
C_{IDA} = in indoor air

3) Flow rate Q (in m³/h or m³/s), at (external) pressure difference ΔP (in Pa)



Performance: ad 2) and 3)

ad 2) & 3)





Performance: leakage classes (res.)

EN 13141-7 (CHRV, residential)

EN 13141-8 (LHRV)

Cat. I HE (plate)
recuperative

Cat. II HE (rotary) regenerative

Pressure test method

Tracer methods

chamber

in-duct

internal
100 Pa

external
250 Pa

mixing

intern
250 Pa

extern
250 Pa

mix

intern
20 Pa

extern
50 Pa

A1	≤ 2%	≤ 2%
A2	≤ 5%	≤ 5%
A3	≤ 10%	≤ 10%
nc	>10%	>10%

B1	≤ 1%	C1	≤ 0,5%	≤ 2%
B2	≤ 2%	C2	≤ 2%	≤ 2%
B3	≤ 6%	C3	≤ 4%	≤ 2%
nc	>6%	nc	>4%	≤ 2%

U1	≤ 2%	≤ 2%	≤ 2%
U2	≤ 5%	≤ 5%	≤ 5%
U3	≤ 10%	≤ 10%	≤ 10%
U4	≤ 15%	≤ 15%	≤ 15%
U5	≤ 20%	≤ 20%	≤ 20%
U6	>20%	>20%	>20%



Performance definitions

4a) SPI , W/m³/s (EN 13142, residential)

Specific Power Input at 70% of design flow rate (20 °C, dry air, 101325 Pa, max. exhaust or supply air flow) and reference pressure drop, includes controls (incl. remote) and (if integrated) any heat pump.

$$SPI = PE/qv_{ref}$$

4b) SFP_E , W/m³/s (EN 13779, non-residential, for AHU)

Specific Fan Power at 100% design flow rate (20 °C, dry air, 101325 Pa) and reference pressure drop, relates only to fans

$$SFP_E = (P_{sfm} + P_{efm}) / q_{max}$$

reference pressure drop is average of the clean filter and recommended maximum (dirty filter) pressure drops. Also the pressure drops for other components (heat exchanger, cooling coil, humidifier) is the mean of start- and end values. Table with defaults provided.

Classes: SFP1 (≤500), SFP2 (≤750), SFP3 (≤1250), SFP4 (≤2000), SFP5 (≤3000), SFP6 (≤4500), SFP7



Performance definitions

5a) heat recovery rate, % (EN 13141, residential)

enthalpy method, at dry condition and balanced mass flow (1:1), if needed corrected for humidity ratio.

$$HR = \frac{Q_{out}}{Q_{in}} = \frac{T_{supply} - T_{outside}}{T_{exhaust} - T_{supply}}$$

5b) heat recovery rate, % (EN 13503, non-residential)

as 5a), but **subtracting** primary energy equivalent (at 0,6 and not 0,4 conversion!) of **fan power** needed for **internal pressure drop** over heat exchanger.

Classes: H1 (≥71%), H2 (≥64%), H3(≥55%), H4(≥45%), H5 (≥36%), H6

Ventilation systems

Standards

Legislation

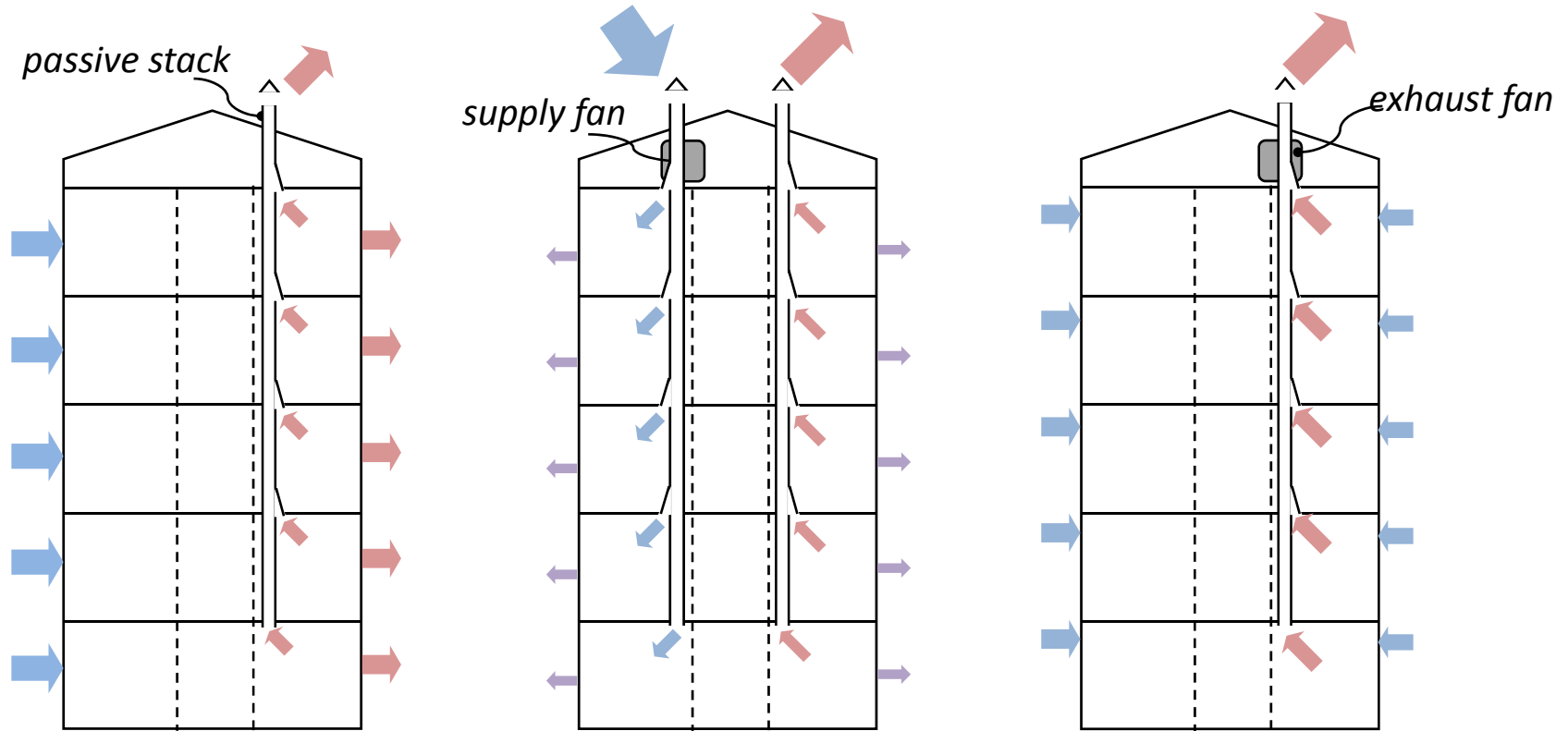


Performance definitions

- 6) Other: *noise, filter, filter bypass, humidity ratio, temperature ratio, NTPF (nom. temp performance factor)*



Ventilation basics: ABC



System A

Natural ventilation

System B

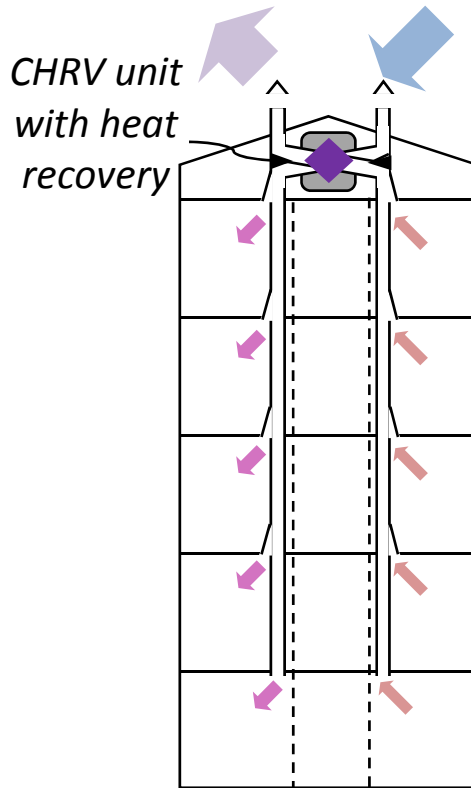
Supply ventilation

System C

Exhaust ventilation₉



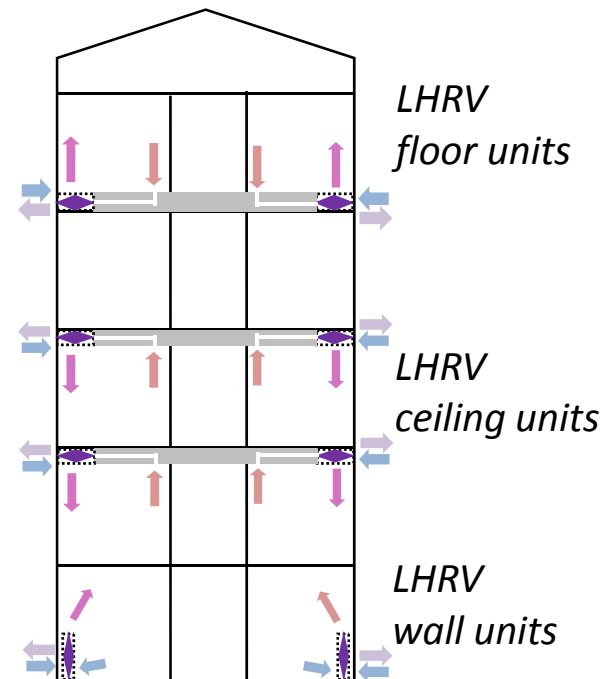
Ventilation basics: DE



*CHRV unit
with heat
recovery*

System D

Central Balanced
ventilation
possibly with HR



*LHRV
floor units*

*LHRV
ceiling units*

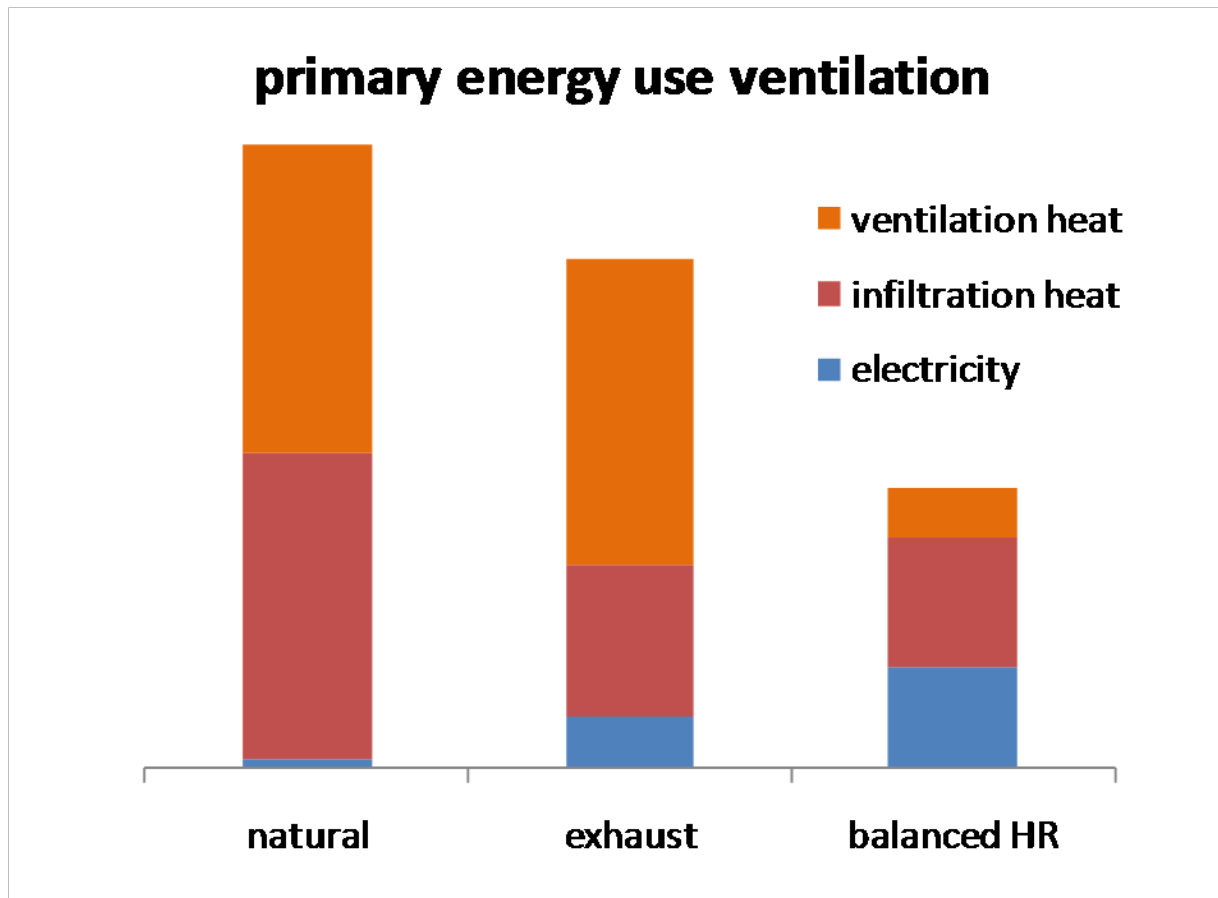
*LHRV
wall units*

System E

Local balanced heat
recovery ventilation
(floor, ceiling or wall units)

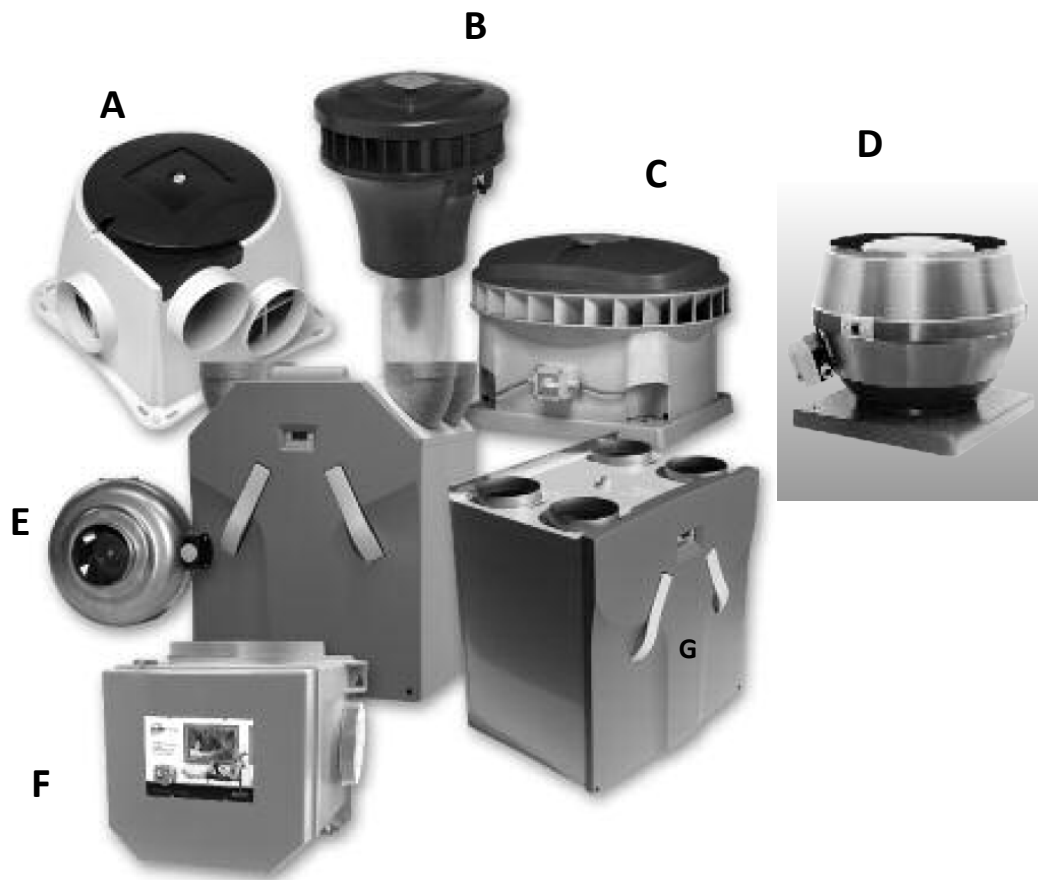


Ventilation basics & energy basics





Rooftop/ boxed (exhaust)



A/F. Boxed fans (exhaust) for central house ventilation (typical $250 \text{ m}^3/\text{h}$ @ 150 Pa).

B/C/D. Rooftop fans (exhaust) for central house, small office, school ventilation.

B=centrifugal (radial outlet);

C= centrifugal, diagonal outlet.

D=mixed flow with vertical outlet.

E. Duct fan.

G. Small central HR ventilation unit ($250\text{-}500 \text{ m}^3/\text{h}$).



LHRV/ CHRV (heat recovery)



LHRV fancoil integrated in floor or ceiling: with central heating & cooling + local ventilation ('Fassaden-belüftung', Schüco).



Larger CHRV unit, 1000-4000 m³/h.



Air Handling Units & HE Modules



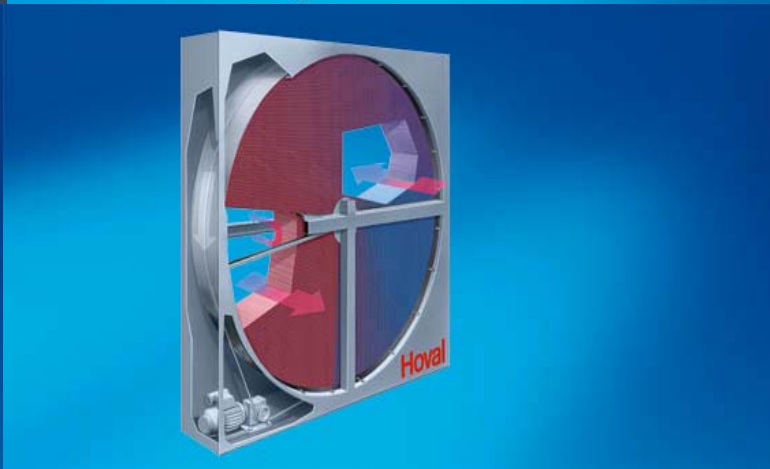
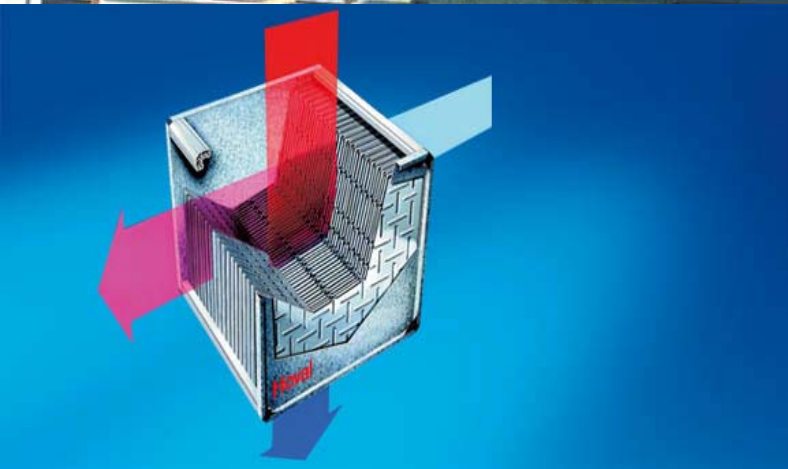
Upper left: Very large (100.000 m³/h) AHU with heat recovery (project Gemini/Kamen, Howatherm).

Upper right: Rooftop AHU with heat recovery (Hoval).

Below: Heat exchangers for waste heat recovery.

Below left: Cross-flow plate heat exchanger.

Below right: Rotary wheel (Hoval).

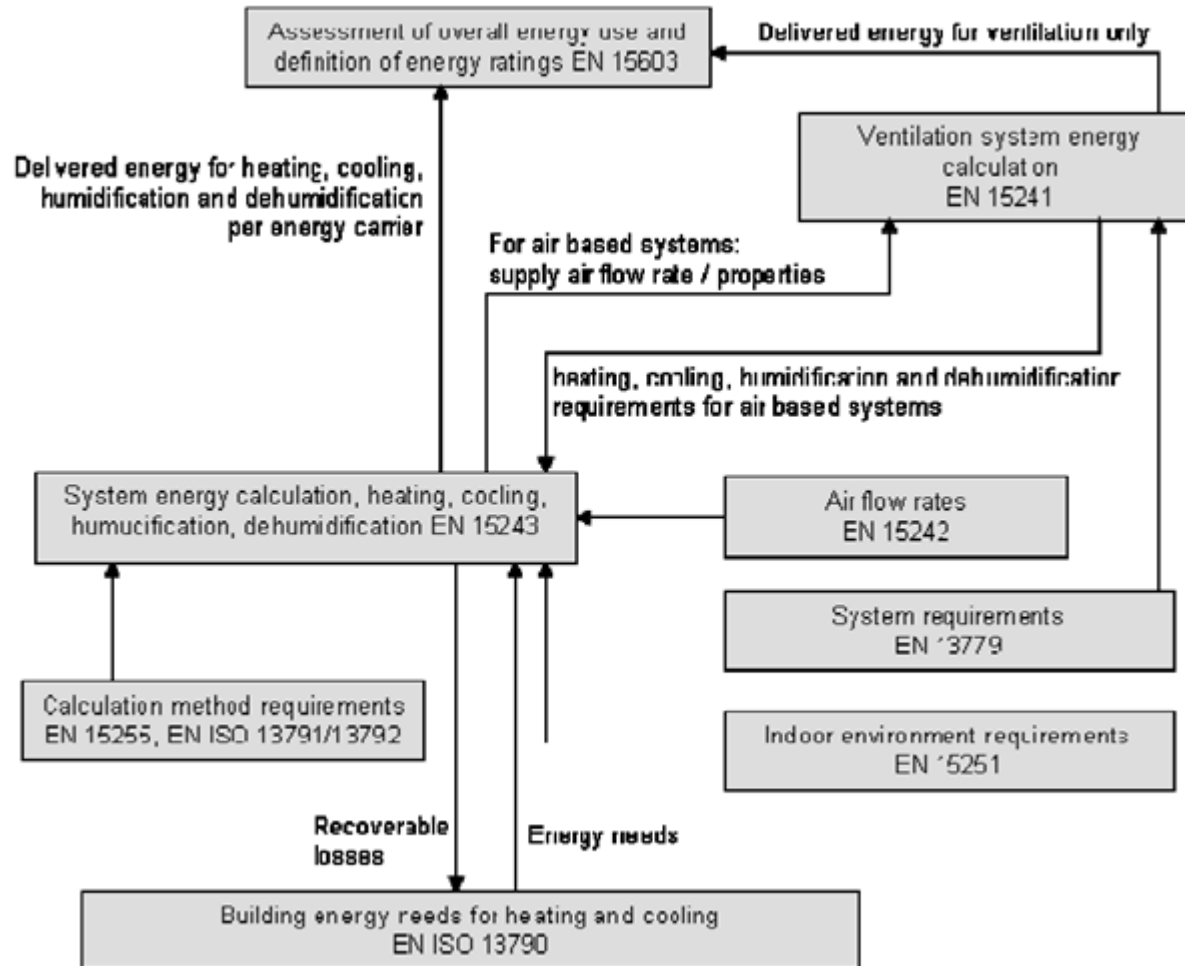




1) Directive 2010/31/EU of 19 May 2010 on the energy performance of buildings

- ✓ Minimum performance requirements shall be set for new, replacement and upgraded building technical systems installed in existing buildings. These are to cover energy performance, installation, sizing, adjustment and control.
- ✓ Ventilation specifically mentioned
- ✓ Indoor Air Quality may not suffer!
- ✓ Link with Ecodesign 2009/125/EC
- ✓ Entering into force at the end of 2012

EPBD standards





Ventilation Product Standards:

performance testing of components

RESIDENTIAL

- **EN 13141-1** / air transfer devices
- **EN 13141-2** / air terminal devices
- **EN 13141-4** / fans
- **EN 13141-5** / cowls & roof outlets
- **EN 13141-6** / exh. vent. system packages
- **EN 13141-7** / mech. supply & exh units + HR for dwellings
- **EN 13141-8** / mech. supply & exh units + HR for rooms
- **EN 13141-9** / ext. mounted RV-controlled air transf. device
- **EN 13141-10** / hum. controlled extract air terminal device
- **EN 13141-11** / positive pressure ventilation systems

NON-RESIDENTIAL

- **EN 1886** / Mech. performance air handling units
- **ISO 5801** / Industrial fans, performance testing
- **ISO 12248** / Ind.fans, tolerances& conversion methods
- **ISO 5221** / Methods for measuring air flow rates
- **ISO 5136** / Acoustics, induct radiated sound power level
- **ISO 3746** / Acoustics, casing radiated sound power level
- **EN 1751** / Aerodynamic testing of dampers & valves
- **EN 1216** / Performance testing heating/cooling coils
- **EN 779** / Determination of filtration performance
- **EN 308** / Performance testing air-to-air HR-devices



Ventilation Product Standards:

other

RESIDENTIAL

NON-RESIDENTIAL

Criteria for Indoor Environment	EN 15251 : 2007	
Design and dimensioning of ventilation systems	CEN/TR 14788 : 2006	EN 13779 : 2007
Determining performance criteria residential ventilation systems	EN 15665 : 2009	
Calculation Ventilation rates	EN 15242 : 2007 EN 13465 : 2004	
Calculation Ventilation energy	EN 15241 : 2007	
Rating and performance characteristics	prEN 13142 Rev V7 <i>on components/products for residential ventilation</i>	EN 13053 : 2006 <i>on air handling units</i>
Inspection of installed systems	EN 14134	EN 12599 : 2000 (for AC : 2002) (standard is under revision)



EU legislation

- 1) 89/106/EC : Construction Products (CPD)
- 2) 98/37/EC : Machinery
- 3) 2004/108/EC : Electromagnetic Compatibility (EMC)
- 4) 2006/95/EC : Low Voltage (LVD)
- 5) 2009/125/EC: Ecodesign of energy-related product (recast of 2005/32/EC)
- 6) 2010/30/EC: EU energy labeling (recast of 92/75/EC)
- 7) RoHS, WEEE: Hazardous Substances (RoHS)
- 8) Directives regarding health



EU legislation: Labelling and EuP

1) Existing measures

- ✓ Motors $>0,75$ kW

2) Coming measures

- ✓ Fans (for ventilation as component) > 125 W (ENER Lot 11)
- ✓ Residential ventilation <125 W (ENER Lot 10)

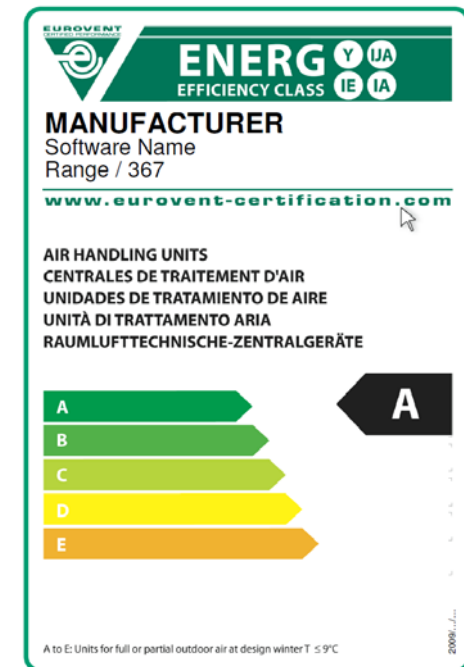
3) On going studies

- ✓ ENTR Lot 6 : This study (ventilation >125 W)



Industry voluntary certificate & label

- 1) No agreements
- 2) Eurovent Certification Company
 - Certification programs
 - ✓ Air handling units
 - ✓ Air to air plate and rotary heat exchangers
 - ✓ Air filters
- 3) Eurovent voluntary label →





RLT voluntary label AHU

Certified energy efficiency by TÜV SÜD




To guarantee the quality in energy labeling the association of AHU manufacturers in Germany is cooperating with the TÜV SÜD in Munich by certifying the energy efficiency of air handling units according to RLT-guideline 01.

*= TÜV SÜD is a world wide accepted German testing organisation





RLT voluntary label AHU

criteria / efficiency label			
Air velocity in the AHU cross section			
• without thermodyn. treatment	V4	V4	V5
• with heating	V3	V3	V4
• with additional functions	V2	V2	V3
Power consumption of the fan unit	0,90	0,95	1,0
Heat recovery device	H1	H2	H3

EN 13503 velocity classes m³/s: V1 ($\leq 1,6$), V2 ($\leq 1,8$), V3 (≤ 2), V4 ($\leq 2,2$), V5 ($\leq 2,5$), V6 ($\leq 2,8$), V7 ($\leq 3,2$), V8 ($\leq 3,6$)



Member States' legislation

Air distribution systems (mainly AHU)

- ✓ **Motor and drive efficiency**, full load : Motor EFF2 fans (Portugal), part load : SFP at 25 % flow = SFP at 100 % (UK), VSD above 1.1 kW (UK)
- ✓ **Airtight** ductworks and components (UK national rules and AHU leakage class 2, Poland)
- ✓ **Insulated ductworks** (Spain)
- ✓ **Specific fan power limits** with supp allowance for (HE, filters ...) (Germany, Ireland, Spain, UK)
- ✓ **Pressure drop** limitations (Spain - duct pressure loss, UK by subcomponent)
- ✓ **Filtration** (Spain - Prefilter mandatory F6, Max RH of 90 % for filters except fresh air)
- ✓ **Controls** (zone requirements, timer, variable supply air temperature)
- ✓ **Monitoring**



Member States' legislation: SFP

EXAMPLES MAX. SPECIFIC FAN POWER

		W/m³/s	
FR	RT2005/'07 (new+exist), res.	900	extract V (if >F5: 1440)
	RT2005/'07 (new+exist), non-res.	1080	balanced no-HR V, if filter F5-F9: 1620
BE	KB/ EPB	1250	[SFP3]
DE	EnEV 2009, if AHU>4000 m ³ /h	2000	[SFP4] for HEPA/HR:+value EN13779
ES	RITE, extract	750	
	RITE, airco	2000	
UK	NBSCG 2010, AHU with airco	1600-1800	non-res, new (1600-2200 existing)
	NBSCG 2010, other central V-sys	1400	(1800 existing)
	NBSCG 2010, zonal balanced V with HR	2000	
	NBSCG 2010, zonal extract V	600	



MS & US legislation: HR

EXAMPLES MANDATORY HEAT RECOVERY MEASURES

FIN	D2, 2003, all built & renov	HR mandatory, 30% at building level, 50% at product level, exceptions allowed
DE	EnEV 2009, >4000 m ³ /h	class H3 (EN 13053)
NL	EPC 2011, new built	HR and IAQ-control ca. standard (new built)
POL	>10.000 m ³ /h	HR mandatory
PT	airco system >80 kW	HR mandatory (eff.>50%) [free cooling required at > 10.000 m ³ /h]
UK	ECA (not mandatory)	HR wheel & heat pipe eff. >65, HR other >45-50%
US	ASHRAE 90.1-2007, fan >140 m ³	HR>50%



Scope proposal

ENER Lot 10
individual residential
<125 W per fan

small exhaust & natural
rooftop/boxed
LHRV
CHR
V

ENTR Lot 6
collective residential &
non-residential
>125 W per fan

small exhaust & natural
rooftop/boxed
LHRV
CHR
V
AHU

Lot 11: Fans >125 W
Reg. 640/2009: Motors >750 W

ENTR LOT 6
AC systems
>12 kW