Eurooppalaiset sisäilma- ja ilmanvaihtostandardiehdotukset

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FINVAC, puheenjohtaja

EPBD standardien uusinnan taustasta

- CEN standardeihin viitataan EPBD 2010 versioissa
- Komissiolta mandaatti 2007 standardien uusimiseksi CEN:lle
- Tarkoituksena yhtenäistää EU maissa EPBD direktiivin kansallista toimeenpanoa
- Edelliset, 2007 julkaistut monimutkaisia ja liian laajoja (noin 40 kpl)
- … ja joissa normatiivinen ja ohjeellinen teksti sekoitettu keskenään

Uudet EPBD standardit

- Suppeammat kuin edelliset
- Standardeissa normatiivinen teksti
- Standardein liittyvissä teknisissä raporteissa ohjeellinen ja selittävä teksti
- Molemmissa sama sisällysluettelo – käytettävä rinnan
- Tyhjät liitetaulukot (ei numeroarvoja), jotka täytetään kansallisella tasolla ja on tarkoitettu normatiivisiksi
- Liitteenä myös ei-normatiiviset ”default” numeroarvot
- Kaikki standardit ”valmiit” maaliskuussa 2016
- Tekniset raportit valmistuvat toukokuussa 2016
- Lopullinen äänestys alkoi lokakuussa 2016

Uusi sisäilmastandari korvaa vanhan EN15251:2007

- Standardi

FprEN 16798-1 Indoor environmental input parameters for the design and assessment of energy performance of buildings

- Tekninen raportti

FprEN 16798-2 TR Technical report. Guideline for using indoor environmental input parameters for the design and assessment of energy performance of buildings.

Vasemmalla Table B7 (normatiivinen) oikealla Table I4 (informatiivinen)

Category	Design ΔCO_2 concentration for occupied rooms (ppm above outdoors)	Design ΔCO_2 concentration for bedrooms (ppm above outdoors)
I		
II		
III		
IV		

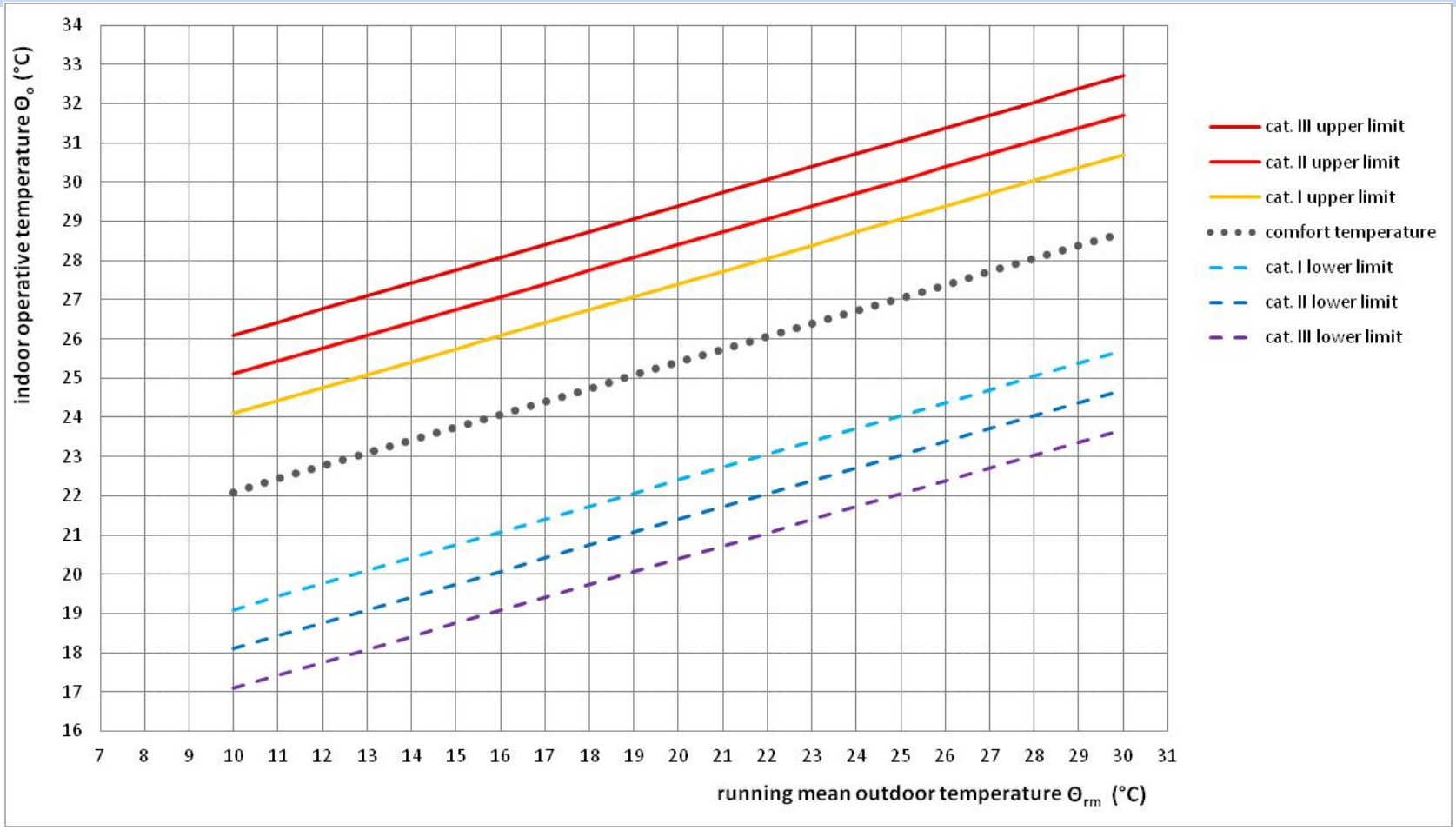
Category	Corresponding CO_2 concentration above outdoors in PPM for non-adapted persons
I	550 (10)
II	800 (7)
III	1350 (4)
IV	1350 (4)

Lämpöolot
Informative Tables H.2 and H.5

Rakennus/tilat yyppi	**Cat**	**Operatiivinen lämpötila, °C**				**Huone-lämpötila, °C**	**Operatiivinen lämpötila, °C**
		Minimi tämpötila talvella = tehomitoitus	Hyväksyttävä lämpötila-alue talvella	Maksimi tämpötila kesällä= tehomitoitus	Hyväksyttävä lämpötila-alue kesällä	2017 Suomen asetuksen suunnittelu lämpötila	Sisäilma-luokitus
Asuintilat	I	21,0	21,0 -25,0	25,5	23,5 - 25,5	20-25 20-27	20,0-26,0
	II	20,0	**20,0-25,0**	26,0	**23,0 - 26,0**		22,0-27,0
	III	18,0	18,0- 25,0	27,0	22,0 - 27,0		18… tumax+5
	IV	16,0	17,0-25,0	28,0	21,0 – 28,0		
Toimistot ja vastaavat tilat	I	21,0	21,0 – 23,0	25,5	23,5 - 25,5	21-25 20-27	20,0-26,0
	II	20,0	**20,0 – 24,0**	26,0	**23,0 - 26,0**		22,0-27,0
	III	19,0	19,0 – 25,0	27,0	22,0 - 27,0		18… tumax+5
	IV	18,0	17,0-25,0	28,0	21,0 –		

Ilmastoimattomien rakennusten sisälämpötila riippuu aikaisempien vuorokausien keskilämpötilasta

Alarajasuoria nostettu 1 oC ja jatkettu välille 10-16 oC



Ilman liikenopeuden jäähdyttävä vaikutus

Ilman nopeus 0.6 m/s	Ilman nopeus 0.9 m/s	Ilman nopeus 1.2 m/s
1.2°C	1.8°C	2.2°C

Ilman nopeutta voidaan käyttää jäähdytykseen silloin kun huoneen operatiivinen lämpötila on yli 25 oC

Hiilidioksidipitoisuus

Category	**Corresponding CO_2 concentration above outdoors in PPM for non-adapted persons (ulkoilmavirta l/s, hlö) CO2 tuotto 20 L/h,pers**			**Sisäilma - luokitus abs CO2**	**2017 asetus Delta CO2**
	2007 For energy calc	2017 Living rooms	2017 Bedrooms		**1450mg/m3 = 800 ppm vastaa noin 1200 ppm abs**
I	350	**550 (10)**	**380**	**750**	
II	500	**800 (7)**	**550**	**900**	
III	800	**1350 (4)**	**950**	**1200**	
IV	>800	**1350 (4)**	**950**		

Ilmanvaihdon henkilömäärästä riippuva komponentti

Category	Expected Percentage Dissatisfied	Airflow per non-adapted person l/(s.pers)
I	15	10
II	20	7
III	30	4
IV	40	2,5*

Materiaaliperäisen ilmanvaihdon suuruus

Category	Very low polluting building l/(s m^2)	Low polluting building l/(s m^2)	Non low-polluting building l/(s m^2)
I	0,5	1,0	2,0
II	0,35	0,7	1,4
III	0,2	0,4	0,8
IV	0,15	0,3	0,6
Minimum total ventilation rate for health	4 l/s person	4 l/s person	4 l/s person

Ihmisistä (käytöstä) ja materiaaleista syntyvään epäpuhtauskuormaan perustuva ilmanvaihto

Tarkoituksena edistää vähäpäästöisten materiaalien käyttöä lisätty luokka IV, muuten kuten EN 15251:2007

$$q_{tot} = n \times q_p + A \times q_B$$

Luokka	q_p (l/s,hlö)
I	10,0
II	7,0
III	4,0
IV	2,5

Luokka	q_B (l/s, m²)		
	Norm.	Vähäpäästöinen	Hyvin vähän pääst
I	2,0	1,0	0,5
II	1,4	0,7	0,35
III	0,8	0,4	0,2
IV	0,6	0,3	0,15

Asuntoilmanvaihto

- Kolme eri mitoitusvaihtoehtoa
- Kantaa ei ole otettu miten tehostus järjestetään jotta suuret alipaineet estetään
- Tarpeenmukaisuuden tarve todetaan mutta toteuttaminen ei ole esillä
- Keittiön tehostusilmanvaihto on liian pieni ym muita yksityiskohtia

Asuntoilmanvaihdon kolme mitoitustapaa

Category	Total ventilation including air infiltration (1)		Supply air flow per. person (2)	Supply air flow based on perceived IAQ for adapted persons (3)		Supply air (ulkoilmaa) flow Bed room level (l/s)		Exhaust air flow, l/s Depending on the number of main rooms (1,2,3,4,>5) Cat I: 1,4 x Cat II: 1,0 x Cat III: 0,7 x Cat IV: 0,5 x		
	l/s,m^2	Ach	l/s,per	q_p l/s, per	q_B l/s,m^2	Master bed-room l/s	Other bed-room l/s	Kit-chen	Bath-rooms	Toilets
I	0,49	0,7	10	3,5	0,25	20	10	20-40	14-21	14-21
II	0,42	0,6	7	2,5	0,15	14	8	20-40	10-15	10-15
III	0,35	0,5	4	1,5	0,1	8	4	14-28	7-10,5	7-10,5
IV *	0,23	0,4				5*	2,5*	10-20	5-7,5	5-7,5

Cat 4 olemassa oleville rakennuksille

Vähäpäästöisten materiaalien emissoiden kriteerit

Emission	Vähän epäpuhtauksia emittoiva materiaali puhtaille rakennuksille	Hyvin vähän epäpuhtauksia emittoiva materiaali erittäin puhtaille rakennuksille	Sisäilmaluokitus M1 kriteerit
Total VOCs TVOC (as in CEN/TS 16516)	< 1.000 µg/m³	< 300 µg/m³	< 200 µg/m³
Formaldehyde	< 100 µg/m³	< 30 µg/m³	< 50 µg/m³
Any C1A or C1B classified carcinogenic VOC	< 5 µg/m³	< 5 µg/m³	< 5 µg/m³
R value (as in CEN/TS 16516)	< 1.0	< 1.0	
Ammoniakki, NH3			< 30 µg/m³
Hajuttomuus			Hyväksyttävyys >0,1

Tavoitearvojen ja kuormien suuruudet tunneittain energialaskentaan mukana

- Tarpeen jotta simulointitulokset olivat yhteismitallisia
- Perustuu REHVA/FINVACin ehdotukseen
- Mukana mm
  - Asunnot (useita tyyppejä)
  - Toimistot
  - Päiväkodit
  - Ravintolat
- Nimelliskuormat, aikataulut, käyttöasteet ja käyttö tunneittain
- Suomessa YMn 2012 käynnistämä työ

Toimistot nimelliskuormat ja asetusarvot energiasimuloitteja varten

	Parameter	Office, landscaped	Value	Unit	Section-table
Operation time	Hour at day, START			hour	assumed
	Hour at day, END			hour	assumed
	Breaks, inside range			hours	assumed
	days/week			days	
	hours/day			hours	
	hours/year			hours	calculated
	Occupants			m^2/pers	assumed
	Occupants (Total)			W/m^2	Calculated
	Occupants (Dry)			W/m^2	calculated
	Appliances			W/m^2	assumed
	Lighting				
	Moisture production			g/(m^2, h)	calculated
	CO_2 production			l/(m^2, h)	calculated
	Min T,op in unoccupied hours			^oC	Assumed
	Max T,op in unoccupied hours			^oC	assumed
	Min T,op , heating/winter			^oC	Sec.7.2, table B1
	Max T,op , cooling/summer			^oC	Sec.7.2, table B1
	Ventilation rate (min.)			l/(s m^2)	Sec.6.3.2.2,
	Max CO_2 concentration (above outdoor)			ppm	Sec.6.3.2.3
	Min. relative humidity			%	Sec.7.4, table B2
	Max. relative humidity			%	Sec.7.4, table B2
	Lighting, illuminance in working areas			lux	Sec.7.5, table B4
	Domestic hot water use				

Työpistekohtaisen lämmityksen ja jäähdytyksen kriteerit prEN TR 16798-3 mukaan

Ominaisuus	**Vaatimus**
Lämpötilan (lämpöolojen) hallinta talvella	Työpisteessä operatiivinen lämpötilan säätönopeus on vähintään 0,5 K / minuutissa lämpötila-alueella 18-23 ° C.
Lämpötilan (lämpöolojen) hallinta kesällä	Työpisteessä operatiivinen lämpötilan säätönopeus on vähintään 0,5 K / minuutissa lämpötila-alueella 22-27 ° C.
Ilmanvaihtoilman (ulkoilman) määrä	Ilmanvaihtoilman (ulkoilmaa) määrän on oltava säädettävissä työpistekohtaisesti nollasta vähintään 7 l/s saakka.
Tuloilman latu	Ilmanpuhdistukseen liittyvissä vaatimuksissa viitataan standardin liitteeseen K, joka puuttellinen
Laitteen melutaso	Laitteen synnyttämä melutason tulee olla työpisteessä alle 35 dB(A)

Sisäilmaston arviointi lämpöolojen ja sisäilman laadun mukaan

Quality of indoor environment in % of time in four categories				
Percentage	5	7	68	20
Thermal Environment	IV	III	II	I
Percentage	7	7	76	10
Indoor Air Quality	IV	III	II	I

prEN 16798-3

Ventilation for non-residential buildings — Performance requirements for ventilation, air conditioning and room-conditioning systems

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Table 27 —Minimum filtration efficiency based on particle outdoor air quality

Outdoor air quality

	Supply air class			
	SUP 1	SUP 2	SUP 3	SUP 4
ODA (P) 1	88%[a]	80% [a]	80% [a]	80% [a]
ODA (P) 2	96% [a]	88% [a]	80% [a]	80% [a]
ODA (P) 3	99% [a]	96% [a]	92% [a]	80% [a]

[a] Combined average filtration efficiency over a single or multiple stage filtration in accordance to average filtration efficiency specified in EN 779

Table B.2 — Recommended minimum filter classes per filter section (definition of filter classes according to EN 779)
Outdoor air quality

	SUP 1	SUP 2	SUP 3	SUP 4
ODA 1	M5+F7	F7	F7	F7
ODA 2	F7 + F7	M5 + F7	F7	F7
ODA 3	F7 + F9	F7 + F7	M6 + F7	F7

ODA 1 applies where the World Health Organisation WHO (2005) guidelines and any National air
quality standards or regulations for outdoor air are fulfilled.
ODA 2 applies where pollutant concentrations exceed the WHO guidelines or any National air quality
standards or regulations for outdoor air by a factor of up to 1,5.
ODA 3 applies where pollutant concentrations exceed the WHO guidelines or any National air quality
standards or regulations for outdoor air by a factor greater than 1,5

Table 11 — Categories of design pressure conditions in the room, expressed as ventilation air flows

Category Description (situation with no wind and no stack effect)

PC 1 $q_{exhaust} > 1{,}15\ q_{supply}$
PC 2 $1{,}05\ q_{supply} < q_{exhaust} < 1{,}15\ q_{supply}$
PC 3 $0{,}95\ q_{supply} < q_{exhaust} < 1{,}05\ q_{supply}$
PC 4 $0{,}85\ q_{supply} < q_{exhaust} < 0{,}95\ q_{supply}$
PC 5 $q_{exhaust} < 0{,}85\ q_{supply}$

The choice of pressure level depends on the specific application. In some cases more than one level
of under- or overpressure is required to control the airflow between all areas of the building. In
addition to flow direction requirements, also other aspects may have to be taken into

account.

Table 12 — Classification of specific fan power

Category	P_{SFP} in (W/(m3/s)
SFP 0	< 300
SFP 1	≤ 500
SFP 2	≤ 750
SFP 3	≤1 250
SFP 4	≤2 000
SFP 5	≤ 3 000
SFP 6	≤ 4 500
SFP 7	> 4 500

The specific fan power P_{SFP} depends on the pressure drop, the efficiency of the fan and the design of

Table 13 — Extended P_{SFP} for additional components
Component P_{SFP} in (W/(m_3/s)

Additional mechanical filter stage[a]	+ 300
HEPA Filter according to EN 1822-3	+ 1 000
Gas Filter	+ 300
Heat recovery class H2 or H1[b]	+ 300

[a] a second filter (first filter min. F7 for supply or M5 for exhaust) is the
additional filter stage

[b] Class H2 or H1 according to EN 13053:2012

prEN 16798-4

Ventilation for non-residential buildings — Performance requirements for ventilation, air conditioning and room-conditioning systems

(Revision EN 13779) –Technical Report

Last update 25.4.2016

1.1.1 **Distance between intake and exhaust openings**

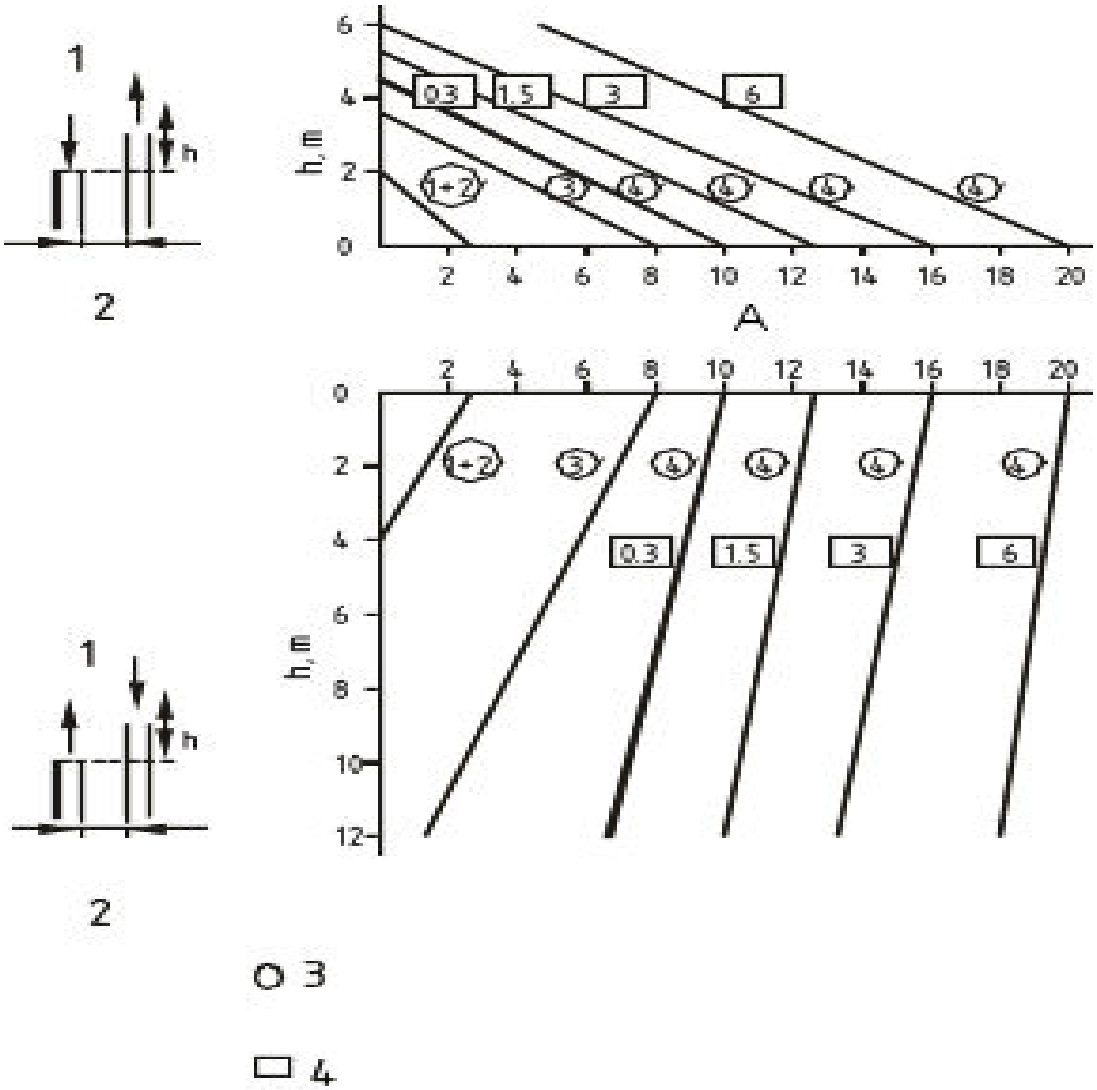


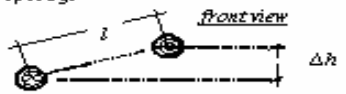
TABLE. Minimum distance between ventilation intake and exhausts

Legend:

α, β = angles of pitched roof or slant façade (angle between a straight and dotted line)

Δh = vertical height

l = length of line connecting the centers of the two openings

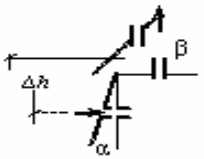


q_v = required capacity of ventilation exhaust in l/s

B = capacity of combustion device in kW

A shaft/box with ventilation exhaust
B with fine gas exhaust (gas fired boiler)
C with fine gas exhaust (other fuels combustion)

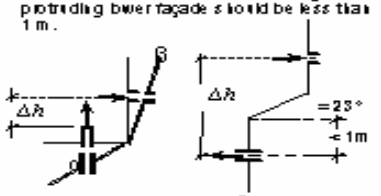
1.
Intake in façade below or equal to exhaust in adjacent (pitched) Rooftop. Intake in pitched roof (≤ 23°) below an exhaust in an adjacent roof with angle = 23°



$\alpha^* = \alpha \leq 15°$ AND $\alpha^* = \beta \leq 75°$ OR
$15° \leq \alpha \leq 67°$ AND $\alpha^* = \beta \leq 23°$

A.	$l + 2\ \Delta h \geq 0{,}308 * v\ q_v$
B.	$l + 2\ \Delta h \geq 0{,}613 * v\ B$
C.	$l + 3{,}38\ \Delta h \geq 2{,}051 * v\ B$

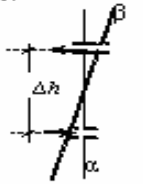
2.
Intake in façade above exhaust in adjacent (pitched) rooftop. Intake in façade above exhaust in lower part of the façade whereby the façade is divided by a roof-plane. The distance from exhaust to the roof-edge of the protruding lower façade should be less than 1 m.



$\alpha^* = \alpha \leq 15$ AND $\alpha^* = \beta \leq 15$

A.	$l + \Delta h \geq 0{,}308 * v\ q_v$
B.	$l + \Delta h \geq 0{,}613 * v\ B$
C.	$l + \Delta h \geq 3{,}050 * v\ B$

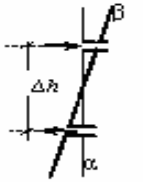
3.
Intake in a façade below or equal to exhaust in the façade.



$\alpha^* = \alpha \leq 15$ AND $\alpha^* = \beta \leq 15$

A.	$2l + \Delta h \geq 0{,}308 * v\ q_v$
B.	$l \geq 0{,}2 * v\ B$
C.	*not applicable*

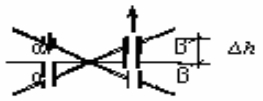
4.
Intake in a façade above exhaust in the façade.



$\alpha^* = \alpha \leq 15$ AND $\alpha^* = \beta \leq 15$

A.	$3{,}07\,l - \Delta h \geq 0{,}613 * v\ q_v$
B.	$1{,}54\,l - \Delta h \geq 0{,}308 * v\ B$
C.	*not applicable*

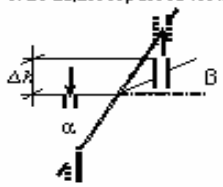
5.
Intake in a flat or slightly slant roof-plane below or equal to an exhaust in the same or an adjacent part of the roof, also flat or slightly slant (maximum pitch < 23°).



$\alpha^* = \alpha \leq 23$ AND $\alpha^* = \beta \leq 23$

A.	$l + \Delta h \geq 0{,}613 * v\ q_v$
B.	$l + \Delta h \geq 1{,}250 * ?\ B$
C.	$l + 2{,}954\ \Delta h \geq 3{,}090 * v\ B$

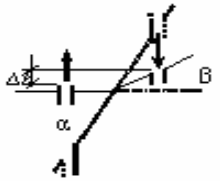
6.
Intake in roof below or equal to exhaust in the same or an adjacent pitched rooftop (≤ 23°)



$\alpha^* = \alpha \leq 75$ AND $23° = \beta \leq 75$

A	$l + 2\ \Delta h \geq 0{,}308 * v\ q_v$
B	$l + 2\ \Delta h \geq 0{,}613 * v\ B$
C	$l + 3{,}38\ \Delta h \geq 2{,}051 * v\ B$

7.
Intake in a pitched rooftop (≤ 23°) above exhaust in the same or an adjacent roof-plane



$\alpha^* = \alpha \leq 75$ AND $23° = \beta \leq 75$

A	$l + \Delta h \geq 0{,}613 * v\ q_v$
B	$l + \Delta h \geq 1{,}250 * v\ B$
C	$l + 2{,}954\ \Delta h \geq 3{,}090 * v\ B$

8.
Intake in a pitched roof-plane or façade, exhaust on the opposite roof plane where at least one of the roof planes has a pitch equal or more than 23°.

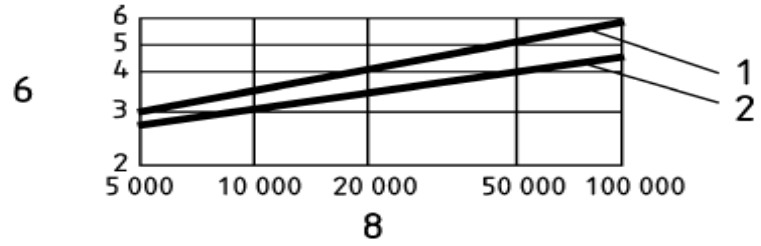
$23 = \alpha \leq 75$

A	$l + 2\ \Delta h \geq 0{,}308 * v\ q_v$
B	$l + 2\ \Delta h \geq 0{,}613 * ?\ B$
C	$l + 3{,}38\ \Delta h \geq 2{,}051 * v\ B$

REHVA Fed

Room height and floor area for plant rooms

6	room height in m
7	floor area in m^2
8	supply or extract airflow rate in $m^3.h^{-1}$



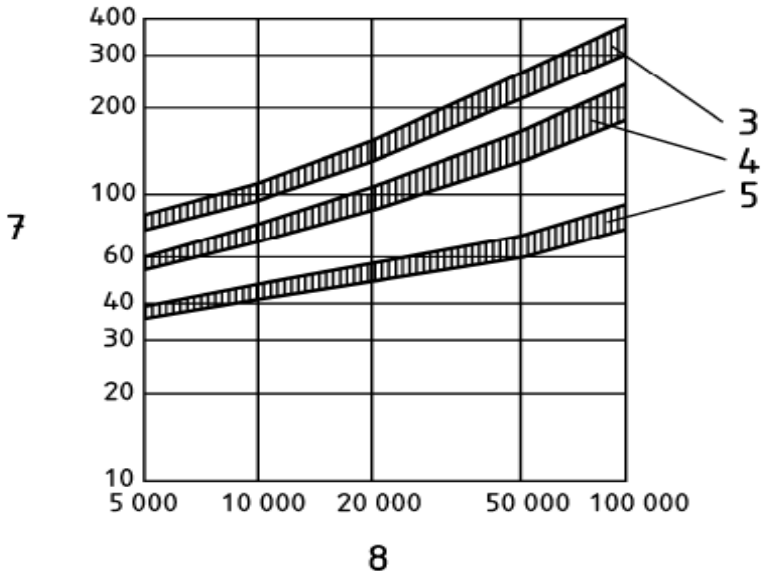


Table 5 — Classification of extract air (ETA) and exhaust air (EHA)

Category	Description	Examples
	Extract air with low pollution level	
ETA 1 EHA 1	Air from rooms where the main emission sources are the building materials and structures, and air from occupied rooms, where the main emission sources are human metabolism and building materials and structures. Rooms where smoking is allowed are excluded.	Offices, including integrated small storage rooms, spaces for public service, classrooms, stairways, corridors, meeting rooms, commercial spaces with no additional emission sources.
	Extract air with moderate pollution level	
ETA 2 EHA 2	Air from occupied rooms, which contains more impurities than category 1 from the same sources and/or also from human activities.	Lunchrooms, kitchens for preparing hot drinks, stores, storage spaces in office buildings, hotel rooms, dressing rooms.
	Extract air with high pollution level	
ETA 3 EHA 3	Air from rooms where emitted moisture, processes, chemicals tobacco smoke etc. substantially reduce the quality of the air.	Toilets and wash rooms, saunas, kitchens, copying plants, rooms specially designed for tobacco smokers.
	Extract air with very high pollution level	
ETA 4 EHA 4	Air which contains odours and impurities in significantly higher concentrations than those allowed for indoor air in occupied zones.	Exhaust hoods in professional use, grills and local kitchen exhausts, garages and drive tunnels, car parks, rooms for handling paints and solvents, rooms for unwashed laundry, rooms for foodstuff waste, central vacuum cleaning systems and heavily used smoking rooms.

Table 6 — Key air pollutants, example

Pollutant	averaging time	guideline value 2008/50/EC	guideline value WHO 2005
Gaseous Components			
Sulfure dioxide SO_2	10 minutes		500µg/m3
Sulfure dioxide SO_2	1 hr	350 µg/m^3 max 24 days exceeding	
Sulphur dioxide SO_2	24 h	125µg/m^3 max 3 days exceeding	20µg/m3
Ozone O_3	8 hour		100µg/m3
Nitrogen dioxide NO_2	1 year	40µg/m^3	40 µg/m^3
Nitrogen dioxide NO_2	1 h	200µg/m^3 max 18 days exceeding	200 µg/m^3
Benzene	1 Year	5µg/m^3	
Carbon monoxide CO	24 hours	10 mg/m^3	
Lead	1 Year	0.5µg/m^3	
Particles			
PM2,5	24 hour		25 µg/m^3
PM2,5	1 Year		10 µg/m^3
Particulate Matter PM_{10}	24 h	50 µg/m^3 max. 35 days exceeding	50 µg/m^3
Particulate Matter PM_{10}	1 year	40µg/m^3	20 µg/m^3

Table 7 — Summary of classification of outdoor air, examples

	Guideline value	*Stuttgart*	*London Traffic road*	*Madrid*
Gaseous Components				
SO_2	annual mean	5	2,53	8,79
	maximum 24 h EC ***125 µg/m3*** ***WHO 20µg/m3***	23	25,8	37
	Days over 125µg/m3 ***3 days*** *(EC)*	0	0	0
	Factor over guideline	**<1**	**<1**	**<1**
O_3	annual mean	63	31,2	31,5
	maximum 8 h (EC) ***120 µg/m³ (WHO)100***	178	85,50	105,7
	days over 120 *µg/m³*	31	YES	1
	Factor over guideline	**< 1,5**	**<1**	**<1**
NO_2	annual mean 40 *µg/m³*	80	**67**	60
	maximum 1 h *200 µg/m³*	**244**	**176**	**216**
	hours over 200 *µg/m³ 18 days max*	21	0	1
	Factor over guideline	**< 1,5**	**> 1,5**	**< 1,5**

Table 12 — Example of an LCC calculation for an F7-filter

LCC calculation	Cost (€)	%
Investment	80	4.5
Energy	1 364	78
Replacement	272	15.5
Disposal	34	2
Total LCC	1 750	100

Table 13 — — Criteria for air filters replacement

Filter stage/ class	Recommended final pressure loss	Hygiene interval	Factors affecting change
	First occurring between		
Only 1 filtration stage		Maximum 1 year	Spring and autumn – after pollen and spore seasons Highly polluted or dusty areas
1st filter stage		Maximum 1 year	
2nd Filter stage		2 years	
G1 — G4	150 Pa		
M5 — F7	200 Pa		
F8 — F9	300 Pa		

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Annex B
(informative)

Natural and Hybrid Ventilation