EUROPEAN DUCTWORK AIRTIGHTNESS CLASSES.

ON-GOING STANDARDIZATION WORK AND STATUS IN SWEDEN

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R&D manager Lindab
Tightvent Europe webinar, 25 January 2018

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The big perspective

Goals

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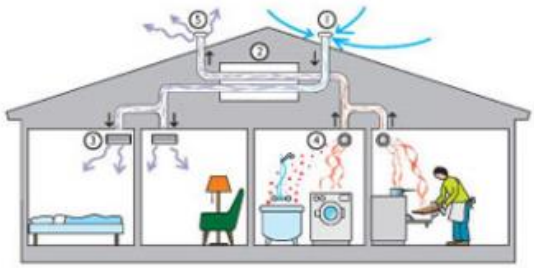
Research findings

Mechanical supply and exhausted ventilation with heat recovery



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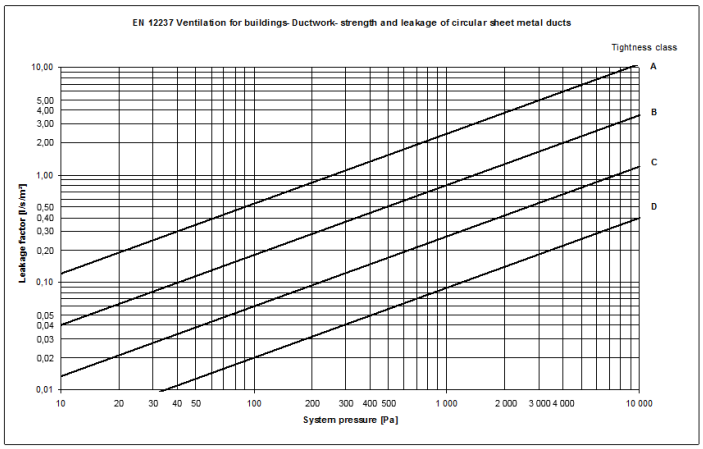
Airtightness in ventilation ducts what is it?

Airtightness diagram



Tightness class diagram

EN 14239 Surface area

Dimensions in millimetres

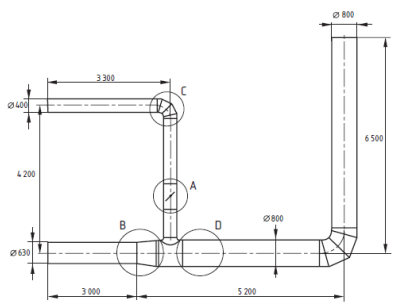


Figure 2 – Example of typical installation of ductwork with circular cross section

Table 1 – Example of calculation of duct surface area for circular ducts

Diameter mm	Duct surface area [a] per unit length m^2/m	Length m	Total duct surface area m^2
800	2,51	6,5 + 5,2	2,51 × 11,7 = 29,4
630	1,98	3,0	1,98 × 3,0 = 5,9
400	1,26	4,2 + 3,3	1,26 × 7,5 = 9,5
Total for installation shown in Figure 2			44,8

[a] From Table A.1

System test

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History

History

1960

* Wallin, O: „Täthetsförändringar hos ventilationskanaler" Tekniska meddelanden 139 från Instituionen för Uppvärmings-Ventilationsteknik, KTZ Stockholm.
Pettersson, F.: „Behövs en ändrad täthetsnorm för ventilationssystem" Tekniska meddelanden 164 från Institutionen för Uppvärmings- och Ventilationsteknik, KTH Stockholm.

SIS 827209

1972
1975

SVENSK STANDARD SIS 82 72 09
Utgåva 1
Sida 2

Ventilationskanaler av stålplåt
Hållfasthet och täthet

2.3 Läckflöde

Läckflödet (luftläckningen) q får vid av fabrikanten angiven täthetsklass A eller B – inte överstiga i tabell 2 angivna värden i l/s och m^2 mantelyta hos kanalen vid ett provtryck (övertryck) av 1 kPa. = 100 mm vp

Tabell 2

Täthetsklass	A	B
Högsta tillåtna läckflöde q i l/s och m^2 vid 1 kPa	2,4	0,8

Angivna värden på läckflödet q överensstämmer med motsvarande värden i VVS-AMA 72.

Eurovent 2/2

2.2 For normal ventilating and airconditioning installations, three classes of air tightness, A, B, and C have been chosen for which the upper limits of $f \cdot p_{sm}^{-0.65}$ are represented by:

1981

$$K_A = 0{,}027 \cdot 10^{-3} ms^{-1} \cdot Pa^{-0{,}65}$$

$$K_B = 0{,}009 \cdot 10^{-3} ms^{-1} \cdot Pa^{-0{,}65}$$

$$K_C = 0{,}003 \cdot 10^{-3} ms^{-1} \cdot Pa^{-0{,}65}$$

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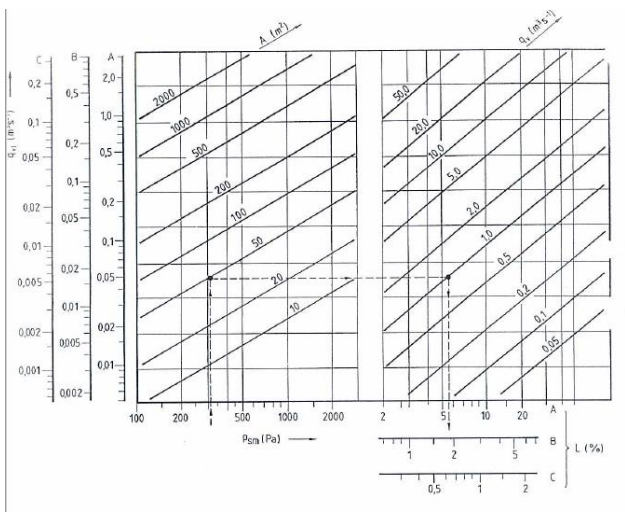
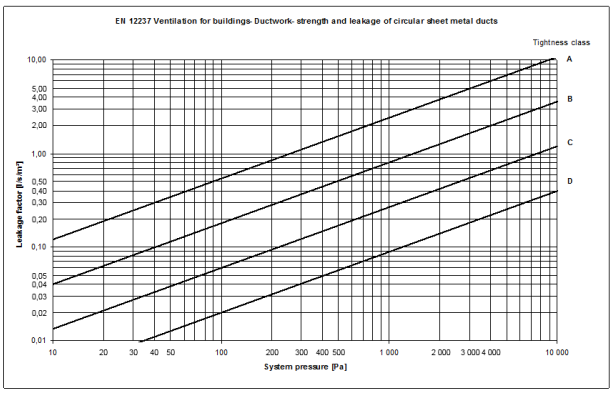
Eurovent 2/2



EN standards



Tightness class diagram

2003

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Third party certification

Swedish Type approval

Eurovent Certification

Requirements from other standards

EN 13779 Performance requirements (Old EPBD)

A.8.2 Selection of airtightness class

The minimum airtightness class is selected according to the following principles. However, a more strict class is applied in cases where the total area of the casing is exceptionally large in relation to the total airflow, where the pressure difference across the casing is exceptionally high, or when exceptional problems result from leakage because of the demands on air quality, risk of condensation or any other reason. EN 15242 gives methods to estimate the energy impact of air leakages and further advise on selection of aitightness classes for ductwork and air handling units.

The air leakage of enclosed air-handling units, and equipment rooms and chambers for fans and other assemblies should not exceed the leakage according to class A (corresponds class L3 for air handling units, EN 1886) in Figure A.3.

Class B is the general minimum requirement for air ducts, and also the minimum for all exhaust air ducts subject to overpressure inside the building, excluding plant rooms.

Class C is the recommended minimum class in many cases, especially if the pressure difference across the duct casing is high, or if any leakage can result in a hazard to the indoor air quality, control of pressure conditions or functioning of the system.

Class D is applied in special situations, and also applicable for cases described above for Class C, especially in installations with high hygiene requirements or with special attention to energy performance.

EN 16798-3 Performance requirements (New EPBD)

6.9.4 Leakages at air ducts

The classification and testing of airtightness of round ducts are defined in EN 12237, of rectangular ducts in EN 1507.

To reduce energy losses and to guarantee the planned air distribution, this value shall be minimum class B. Class C is recommended.

EN 15780 Cleanliness

F.3 Application of cleanliness levels - airtightness

The airtightness of the ductwork is also important for cleanliness. Leakages in unclean hollow spaces or suspended ceilings can have a big influence to the indoor air quality, especially for the advanced level. The minimum recommended tightness class related to these cleanliness levels can be expressed as follows, corresponding with the technical recommendations of EN 13779:2007, A.8.2,

Table F.3 — Recommended minimum tightness class

Level	Recommended minimum tightness class
Basic	B
Intermediate	C
Advanced	D

Table A.1 — Typical applications of cleanliness quality classes

Quality Class	Typical examples
Low	rooms with only intermittent occupancy e.g. storage rooms, technical rooms
Medium	offices, hotels, restaurants, schools, theatres, residential homes, shopping areas, exhibition buildings, sport buildings, general areas in hospitals and general working areas in industries
High	Laboratories, treatment areas in hospitals high quality offices

EN 12599 Handing over

Table 1 — Summary of tests, measurements and report to verify the quality of the systems

Required Steps	Purpose	Activities	Annexes
Step a Completeness checks	To ensure that the ventilating and air conditioning system has been installed entirely in accordance with contract	1. Comparison of equipment with the installation list 2. Compliance with technical rules (contract and official) 3. Accessibility 4. Cleanliness 5. Balancing 6. Air tightness 7. Documents necessary for operating	Annex A With more specified information on the activities 1 to 7

— air tightness of ducts according to EN 13779,

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EN 12599 Handing over

Table 2 — Functional measurements

Measurement at		Total System	Central System/Appliance				Duct work	Room					
Parameters		Additional cleanliness test	Current drawn and power by the motor [D.6]	air flow *) [D.1]	air temperature *) [D.3]	pressure drop across filter [D.7]	ductwork leakage test [D.8]	supply air flow [D.1]	exhaust air flow [D.1]	supply air temperature **) and air temperature in the room [D.3]	air humidity [D.4]	sound pressure level [D.5]	Indoor air velocity [D.2]
Ventilation System	(F) Z	2	1	1	0	1	2	1	2	0	0	2	0
	(F) H	2	1	1	1	1	2	1	2	2	0	2	2
	(F) C	2	1	1	1	1	2	1	2	2	2	2	2
	(F) M/D	2	1	1	1	1	2	1	2	2	1	2	2
Partial air conditioning system	(F) HC	2	1	1	1	1	2	1	2	1	2	2	2
	(F) HM/HD/ CM/CD	2	1	1	1	1	2	1	2	1	1	2	2
	(F) MD	2	1	1	1	1	2	1	2	2	1	2	2
	(F) HCM/M CD/CHD /HMD	2	1	1	1	1	2	1	2	1	1	2	2
Air conditioning system	(F) HCMD	2	1	1	1	1	2	1	2	1	1	2	2

*) Outdoor air, supply and exhaust air
**) Depending on control principles, if relevant

Explanations
0 measurement not necessary
1 to carry out in all cases
2 to carry out only in the case of contracted agreement

Different standards

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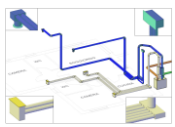
Airtightness Standards to the environment

Airtightness Standards Systems

	Dimensions	Strength and leakage
	EN 1506	EN12237
	EN 1505	EN 1507
	prEN 17192	prEN 17192

Differences

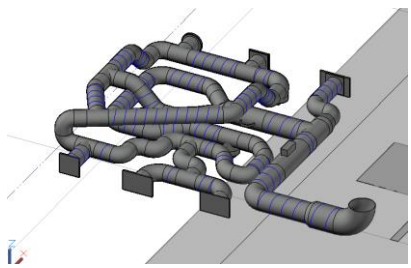
L/A ratio

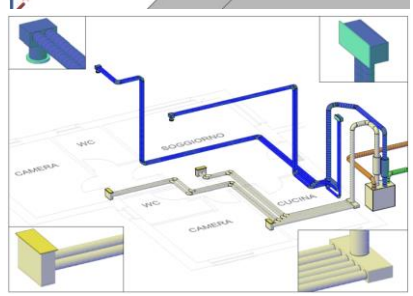
For rigid ductwork, L/As shall be:

$$1m^{-1} < \frac{L}{A_s} < 1{,}5m^{-1}$$

For semi-rigid ductwork, L/A shall be:

$$0{,}4m^{-1} < \frac{L}{A_s} < 0{,}6m^{-1}$$





Airtightness Standards Components

Dampers	EN 1751
Technical Components	EN 15727
Flexible ducts	EN 13180

Differences

Area calculation

7.2 Calculation of the total joint length (L)

The total joint length, in metres, for a product of circular cross-section is the sum of the joint perimeter of each connection (1 to n).

$$L = \pi \times (d_1 + d_2 + \ldots d_n) \quad (1)$$

The total joint length, in metres, for a product of rectangular cross-section is the sum of each joint perimeter.

$$L = 2 \times (a_1 + b_1 + a_2 + b_2 + \ldots a_n + b_n) \quad (2)$$

7.3 Calculation of the virtual product surface area (A_c)

The virtual product surface area A_c, in square metres, is:

$$A_c = L \times 0{,}5 \quad (3)$$

or

$$A_c = A_p \text{ (the product surface area)} \quad (4)$$

whichever is the larger.

Technical Components

C.3 Casing leakage

The range of case leakage performance has been related to the general ductwork leakage classes as follows:

The reference casing area is taken as the perimeter of the damper multiplied by an equivalent length of 1 m.

Figure C.2 gives for classes A, B and C the permitted maximum case leakage $q_{v,LCA}$ in $1 \cdot s^{-1} \cdot m^{-2}$ as a function of duct static pressure p_s in Pa.

Dampers

The leakage factor shall be determined by the air leakage rate divided by the surface area $\pi \cdot d_n \cdot L$ where L is the length of the reference test element and d_n is its nominal diameter.

Flexible ducts

Differences

Area calculation “1 meter duct”

Same theory in both EN 1751 and EN 15727

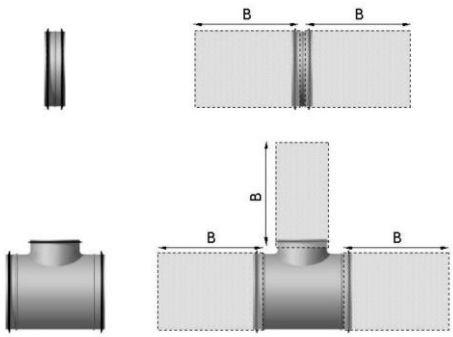


Figure 1. Virtual duct lengths B applied to circular slip-in joint and T-piece.

Airtightness Standards Air Handling Units

Air Handling Units	EN 1886

Table 4 — Casing air leakage classes of air handling units, 400 Pa negative test pressure

Leakage class of casing	Maximum leakage rate (f_{400}) $l \times s^{-1} \times m^{-2}$	Filter class (EN 779)
L3	1,32	G1 to F7
L2	0,44	F8 to F9
L1	0,15	superior to F9

Airtightness Standards in field at the handing over process

Handing over	EN 12599

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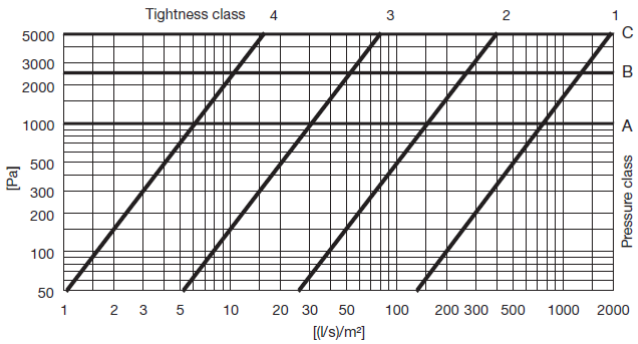
Airtightness through damper blade Standards

Airtightness Standards Through damper blade

Damper blades	EN 1751

Tightness past the closed damper blade and pressure classes



Pressure classification

Circular metallic duct classification

Table 2 – Ductwork Classification

Air tightness class	Static pressure limit (p_s) Pa		Air leakage limit (f_{max}) $m^3 \cdot s^{-1} m^{-2}$
	Positive	Negative	
A	500	500	$0{,}027 \cdot p_t^{0{,}65} \cdot 10^{-3}$
B	1 000	750	$0{,}009 \cdot p_t^{0{,}65} \cdot 10^{-3}$
C	2 000	750	$0{,}003 \cdot p_t^{0{,}65} \cdot 10^{-3}$
D [a]	2 000	750	$0{,}001 \cdot p_t^{0{,}65} \cdot 10^{-3}$
[a] Ductwork for special applications.			

Rectangular metallic duct classification

Table 1 — Ductwork classification

Air tightness class	Air leakage limit (f_{max}) $m^3 \cdot s^{-1} \cdot m^{-2}$	Static gauge pressure limits (ps) Pa			
		Negative at all pressure classes	Positive at pressure class		
			1	2	3
A	$0{,}027 \times p_{test}^{0{,}65} \times 10^{-3}$	200	400		
B	$0{,}009 \times p_{test}^{0{,}65} \times 10^{-3}$	500	400	1 000	2 000
C	$0{,}003 \times p_{test}^{0{,}65} \times 10^{-3}$	750	400	1 000	2 000
D [a]	$0{,}001 \times p_{test}^{0{,}65} \times 10^{-3}$	750	400	1 000	2 000
[a] Ductwork for special application.					

In field classification

D.8 Air leakage

D.8.1 Measuring method

The leakage measurements can be performed while the duct system is being installed.

As soon as a sufficiently large section of the air duct system has been installed, all openings are sealed off. A fan which is connected to the sealed duct system through an equipment for measuring is used to generate a test pressure difference above or below atmospheric pressure. The test pressure should be adjusted to one of the following values which should be chosen to be as near as possible to mean operating pressure of the system, preferably:

200 Pa, 400 Pa, or 1 000 Pa above atmospheric in case of supply air ducts or 200 Pa, 400 Pa or 750 Pa below atmospheric in case of exhaust air ducts.

If measurement equipment is used to verify tightness class A or B, it is possible that the above named pressure values could not be achieved at a greater ductwork surface area.

In this cases, the tightness class could be determine by a lower pressure, using the following formula to calculate the leakage airflow approximately:

New standards

New non metallic ducts

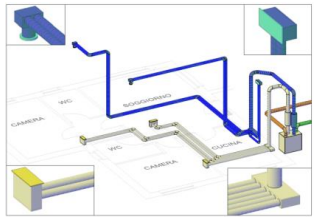
To small system

New shapes on ducts

New shapes on manifolds

Other criteria for pressure

L/A 1-1,5



solutions

To small system	at least 10 m2 or whole system
New shapes on ducts	measure the exact area
New shapes on manifolds	ad the whole surface of the cube or outline
Other criteria for pressure	Same idea as EN12599
L/A 0,4-0,6	Recommendation for supplier

US standards

Comparison European US classes

Generally, the air tightness classes are applied by European Union (EU) member countries as listed in Table 12-4. For the United States, ASHRAE originally developed "Air Leakage Class (C_L)" to predict air leakage from round, rectangular, flexible, and fibrous glass duct using data from research conducted in 1985 (RP-308). Today, ASHRAE is using air leakage classes in the same manner as European countries. Figure 12-5 shows the relationship of European air tightness classes and leakage classes. The equivalency between EU and ASHRAE leakage classes is noted on these figures; namely, A (C_L=19), B (C_L=6.4), C (C_L=2.1), and D (C_L=0.7).

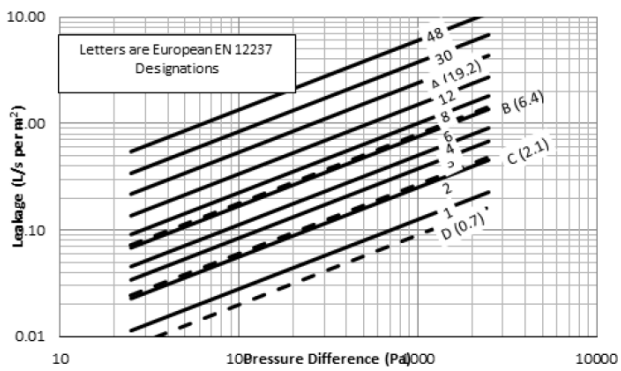


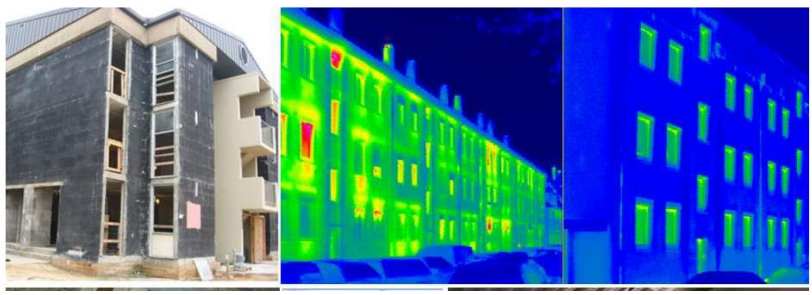
Figure 12-5. Relationship between European air tightness classes (dash lines) and ASHRAE leakage classes (solid lines) (SI units).

Source comparison

International Energy Agency

Deep Energy Retrofit

A Guide to Achieving Significant Energy Use Reduction with Major Renovation Projects
Annex 61, Subtask A



Sweden news

Study

ENERGIMYNDIGHETENS BESTÄLLARGRUPP FÖR ENERGIEFFEKTIVA FLERBOSTADSHUS

Tätning av ventilationskanaler

Förstudie inför teknikupphandling

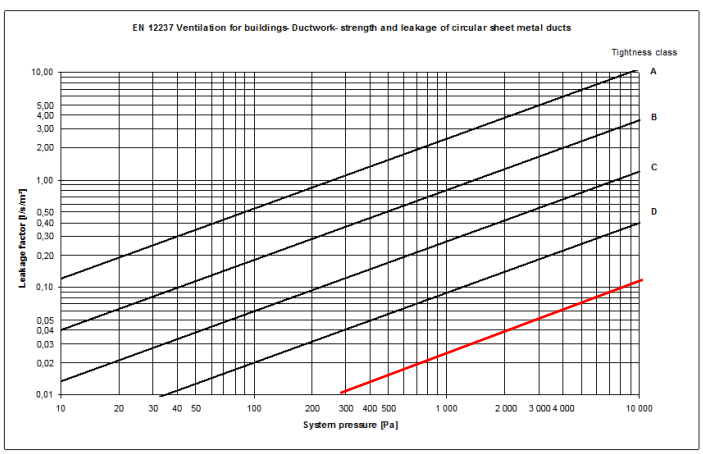
Upprättad av

Katarina Högdal, WSP Environmental

2014-12-12

http://www.bebostad.se/library/1867/foerstudie-kanaltaetning.pdf

Class E



Tightness class diagram

Class E

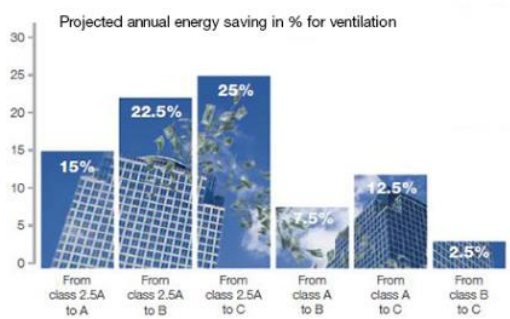
My wiev:

1. No demand from energy perspective.
2. Wet cleaning demand.
3. Problem with grease drips from factory processing.
4. Smell from garbage ventilation with over pressure.

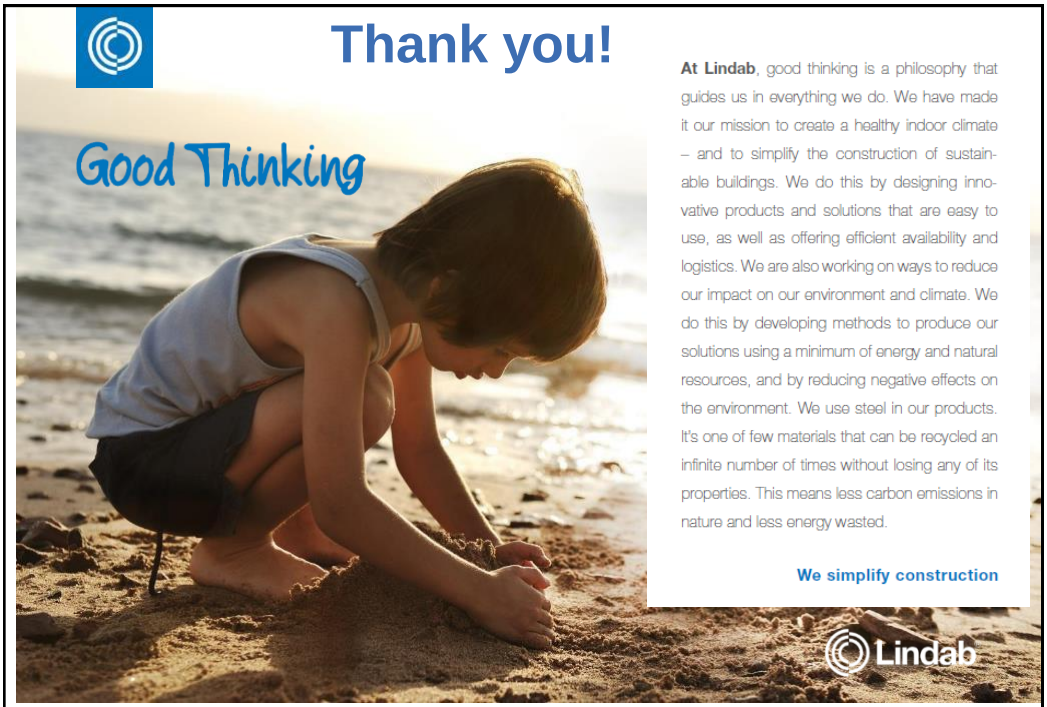
2-3 should be solved by airtight or downpipe principle
4 should be solved by airtight or negative pressure.

Lindab duct leaking calcylator

https://www.lindqst.com/ads/calcleak/default.aspx



Thank you!



At Lindab, good thinking is a philosophy that guides us in everything we do. We have made it our mission to create a healthy indoor climate – and to simplify the construction of sustainable buildings. We do this by designing innovative products and solutions that are easy to use, as well as offering efficient availability and logistics. We are also working on ways to reduce our impact on our environment and climate. We do this by developing methods to produce our solutions using a minimum of energy and natural resources, and by reducing negative effects on the environment. We use steel in our products. It's one of few materials that can be recycled an infinite number of times without losing any of its properties. This means less carbon emissions in nature and less energy wasted.

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