EUROPEAN DUCTWORK AIRTIGHTNESS CLASSES.
ON-GOING STANDARDIZATION WORK AND STATUS IN SWEDEN

Lars-Åke Mattsson:
Convener TC156 WG3 "Ducts"
R&D manager Lindab
Tightvent Europe webinar, 25 January 2018

The big perspective
Goals

Climate Action

2020 climate & energy package

- The 2020 package is a set of binding legislation to ensure the EU meets its climate and energy targets for the year 2020.
- The package includes:
  - 40% cut in greenhouse gas emissions from 1990 levels
  - 27% of EU energy from renewables
  - 27% improvement in energy efficiency

Research findings

TightVent Europe

About TightVent

Before 2020:
- EU countries will have to generalize thermal protection in new constructions and major renovations.

Build Tight Ventilate Right

Building and ductworks shrinkage will implicitly become a mandatory feature.

Energy efficient ventilation systems will need to be used.
Mechanical supply and exhausted ventilation with heat recovery

Airtightness in ventilation ducts what is it?
EN 14239 Surface area

<table>
<thead>
<tr>
<th>Diameter (mm)</th>
<th>Dust surface area² per unit length (m²/m)</th>
<th>Length (m)</th>
<th>Total dust surface area (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>0.54</td>
<td>6.56</td>
<td>6.56 x 0.54 = 3.66 m²</td>
</tr>
<tr>
<td>500</td>
<td>1.99</td>
<td>3.65</td>
<td>1.99 x 3.65 = 7.36 m²</td>
</tr>
<tr>
<td>400</td>
<td>1.83</td>
<td>4.20</td>
<td>1.83 x 4.20 = 7.61 m²</td>
</tr>
</tbody>
</table>

Total for installation shown in Figure 2 = 14.5 m²

Figure 2: Example of typical installation of ductwork with circular cross section
System test

History
History

1960


SIS 827209

1972

1975
2.2 For normal ventilating and air conditioning installations, three classes of air tightness, A, B, and C have been chosen for which the upper limits of $\gamma_{pm}^{-0.65}$ are represented by:

$$K_A = 0.027 \cdot 10^{-3} \text{ms}^{-1} \cdot \text{Pa}^{-0.65}$$

$$K_B = 0.009 \cdot 10^{-3} \text{ms}^{-1} \cdot \text{Pa}^{-0.65}$$

$$K_C = 0.003 \cdot 10^{-3} \text{ms}^{-1} \cdot \text{Pa}^{-0.65}$$
EN standards

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 advice on selection of airtightness 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 1686) 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.
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. Leaksages 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.6.2.

<table>
<thead>
<tr>
<th>Level</th>
<th>Recommended minimum tightness class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
<td>B</td>
</tr>
<tr>
<td>Intermediate</td>
<td>C</td>
</tr>
<tr>
<td>Advanced</td>
<td>D</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quality Class</th>
<th>Typical examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Rooms with only intermittent occupancy e.g. storage rooms, technical rooms</td>
</tr>
<tr>
<td>Medium</td>
<td>Offices, hotels, restaurants, schools, theatres, residential homes, shopping areas, exhibition buildings, sport buildings, general areas in hospitals and general working areas in industries</td>
</tr>
<tr>
<td>High</td>
<td>Laboratories, treatment areas in hospitals, high quality offices</td>
</tr>
</tbody>
</table>
EN 12599 Handing over

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

<table>
<thead>
<tr>
<th>Required Steps</th>
<th>Purpose</th>
<th>Activities</th>
<th>Annexes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic completeness checks</td>
<td>To ensure that the ventilating and air conditioning system has been installed entirely in accordance with contract</td>
<td>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</td>
<td>Annex A With more specified information on the activities 1 to 7</td>
</tr>
</tbody>
</table>

— air tightness of ducts according to EN 13779.

Table 2 — Functional measurements

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Total System</th>
<th>Central Supply/Exhaust</th>
<th>Test with</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ventilation system</td>
<td>DMC</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>DPH</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>DMC</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Fan coil</td>
<td>DMC</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>DMC</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Air conditioning system</td>
<td>DMC</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

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

Airtightness Standards to the environment
Airtightness Standards
Systems

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Strength and leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN 1506</td>
<td>EN12237</td>
</tr>
<tr>
<td>EN 1505</td>
<td>EN 1507</td>
</tr>
<tr>
<td>prEN 17192</td>
<td>prEN 17192</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Component</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dampers</td>
<td>EN 1751</td>
</tr>
<tr>
<td>Technical</td>
<td>EN 15727</td>
</tr>
<tr>
<td>Components</td>
<td></td>
</tr>
<tr>
<td>Flexible ducts</td>
<td>EN 13180</td>
</tr>
</tbody>
</table>

## Differences

### Area calculation

7.2 Calculation of the total joint length (2)

The total joint length, in metres, for a product of circular cross-section is the sum of the joint perimeter of each individual joint:

\[ L = \sum_{i=1}^{n} \left( \frac{d_i}{2} \right) \]

7.3 Calculation of the virtual product surface area (A_v)

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

\[ A_v = L \times 0.5 \]

\[ A_v = A_0 \text{ (the product surface area)} \]

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 outer pipe multiplied by an equivalent length of 1 m.

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

The leakage factor shall be determined by the air leakage rate divided by the surface area \( x \cdot d_i \cdot L \) where \( L \) is the length of the reference test element and \( d_i \) is its nominal diameter.
**Differences**

Area calculation “1 meter duct”

Same theory in both EN 1751 and EN 15727

---

**Airtightness Standards Air Handling Units**

<table>
<thead>
<tr>
<th>Air Handling Units</th>
<th>EN 1886</th>
</tr>
</thead>
</table>

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

<table>
<thead>
<tr>
<th>Leakage class of casing</th>
<th>Maximum leakage rate ( f_{400} ) ( 1 \times s^{-1} \times m^{-2} )</th>
<th>Filter class ( (EN 779) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>L3</td>
<td>1.32</td>
<td>G1 to F7</td>
</tr>
<tr>
<td>L2</td>
<td>0.44</td>
<td>F8 to F9</td>
</tr>
<tr>
<td>L1</td>
<td>0.15</td>
<td>superior to F9</td>
</tr>
</tbody>
</table>
### Airtightness Standards in field at the handing over process

| Handing over | EN 12599 |

### 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

<table>
<thead>
<tr>
<th>Air tightness class</th>
<th>Static pressure limit ($p_z$) Pa</th>
<th>Air leakage limit ($f_{max}$) $m^3 s^{-1} m^{-2}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive</td>
<td>Negative</td>
</tr>
<tr>
<td>A</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>B</td>
<td>1 000</td>
<td>750</td>
</tr>
<tr>
<td>C</td>
<td>2 000</td>
<td>750</td>
</tr>
<tr>
<td>D (^a)</td>
<td>2 000</td>
<td>750</td>
</tr>
</tbody>
</table>

\(^a\) Ductwork for special applications.

Rectangular metallic duct classification

Table 1 — Ductwork classification

<table>
<thead>
<tr>
<th>Air tightness class</th>
<th>Air leakage limit ($f_{max}$) $m^3 s^{-1} m^{-2}$</th>
<th>Static gauge pressure limits (ps) Pa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Negative at all pressure classes</td>
<td>Positive at pressure class</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>A</td>
<td>0.027 × $p_{new}^{1/3} \times 10^3$</td>
<td>200</td>
</tr>
<tr>
<td>B</td>
<td>0.009 × $p_{new}^{1/3} \times 10^3$</td>
<td>500</td>
</tr>
<tr>
<td>C</td>
<td>0.003 × $p_{new}^{1/3} \times 10^3$</td>
<td>750</td>
</tr>
<tr>
<td>D (^a)</td>
<td>0.001 × $p_{new}^{1/3} \times 10^3$</td>
<td>750</td>
</tr>
</tbody>
</table>

\(^a\) Ductwork for special applications.
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 close 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 determined 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) ($\mathrm{m}^3$/hr).
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
Tätning av ventilationskanaler
Förstudie inför teknikupphandling

Upprättat av
Katarina Högdal, WSP Environmental
2014-12-12


Class E

Tightness class diagram
Class E

My view:

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 calclulator

https://www.lindqst.com/ads/calcleak/default.aspx
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. We simplify construction.