Ventilation duct tightness

Ventilation ducts connect all the components of the ventilation system, ensuring proper air exchange in the building. Selecting proper duct material and diameter are crucial for the functioning of the whole system.

Duct tightness is an important issue to be considered when selecting and installing the ventilation system.

Market awareness of the issue of ventilation duct tightness is improving. Duct tightness tests are increasingly more frequent - unfortunately, they are sometimes conducted after the works had been finished which prevents making corrections.

Ventilations designs rarely specify installation tightness requirements. Most often the designers assume that the ducts are tight and design a 10% higher capacity installation to avoid any mistakes in its operation. However, tightness of the installation influences the capacity of the entire system and helps to reduce heat losses, this has a definite bearing on the comfort of the users. Additionally, lack of tightness increases energy consumption as the machines that ensure proper functioning of the installation - fans, recuperators or heaters have to process a higher amount of air than is required.

The issue of duct integrity has been addressed in the regulation of the Minister of infrastructure of 12.04.2002, on the technical conditions for buildings and their orientation. In accordance with Ordinance § 153 2. Duct cross-section is to be appropriate to the assumed air flow and their construction should be adequate to maintain the maximum air pressure and proper tightness of the installation, as per the Polish Standards for air duct integrity and durability.

Ventilation system tightness tests are conducted on the basis of the following standards: PN-EN-12237:2005 – for round ducts and fittings, and PN-EN-1507:2007 – for square ducts. Information about the duct tightness class is to be provided in the technical documentation for the ventilation system.

Based on the stipulations of the Polish construction standards, there are 4 classes of duct tightness:

1. **Class A** – the baseline for use in ventilating units, ventilators and other devices,
2. **Class B** – minimum value for ventilation ducts,
3. **Class C** – for ventilation ducts in high pressure installations,
4. **Class D** – for special purpose installations, especially intended for higher energy efficiency and hygiene standards.
Table 1.
Duct tightness class as per the standard PN-EN 12237:2005

<table>
<thead>
<tr>
<th>Duct tightness class</th>
<th>Static pressure boundary values ((P_s)) Pa</th>
<th>Leak index boundary value ((f_{\text{max}})) m(^3)s(^{-1})m(^{-2})</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Overpressure</td>
<td>Negative pressure</td>
</tr>
<tr>
<td>A</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>B</td>
<td>1000</td>
<td>750</td>
</tr>
<tr>
<td>C</td>
<td>2000</td>
<td>750</td>
</tr>
<tr>
<td>D(^a)</td>
<td>2000</td>
<td>750</td>
</tr>
</tbody>
</table>

\(^a\) Special purpose ducts

In Poland, Class B air ducts are used the most often, however due to the requirements of European Union standards, Class C and D ducts are used more and more frequently.

Installation tightness has a lot of influence on the operation of the entire system. Duct leakage reduces the amount of intake and outtake air, preventing proper air exchange in the facility. Duct leaks result in heat loss, which makes it difficult, and sometimes entirely prevents, to maintain the set air temperature. In system which are adjusted by controlling units, air duct leaks prevent accurate temperature and air flow setting.

Additionally, the pressure level in intake and outtake installations becomes irregular - it becomes impossible to balance the pressure within the installation, hence the actual air flow in the system will be different from the assumed value, disturbing the air exchange in the facility. The higher the pressure in the ventilation system, the more important it is to maintain the tightness of the installation.

Leakage raises running costs for the installation as the intake and outtake ventilators consume more energy. Moreover, air heating, cooling and moisturizing expenses rise, as some of the air is lost underground.

Duct tightness becomes a much more critical issue when the installation is fitter with a recuperator unit. Leaks lower the efficiency of the heat and moisture recovery, it also allows intake and outtake air to mix, resulting in contaminating the air supplied to the facility.

The causes of leaks may occur at the stage of design, production, assembly and operation of the ventilation system. They may result from improper system installation or maintenance. Therefore, it is required to pay particular attention to proper handling during each stage of the works.
The key element that influences the tightness of the ventilation ducts is the workmanship, in particular the technology used to install the seal. The seal is to be mechanically attached to the fitting, using only glue is insufficient. Mechanical fixing guarantees that the seal does not move as the installation components are fitted together.

When selecting ventilation ducts, it is important to note both the workmanship quality and the type of seal. Choosing high quality ducts with good parameters has a definite effect on installation tightness and eventually on the operation of the ventilation system. A very important issue is to use blind rivets during the installation of ducts and fittings instead of lap screws, and that the rivet holes are to be made alternately in subsequent duct sections so as to eliminate the possibility of leakage.

In Poland, Class D ducts certified by SITAC Swedish Institute for Technical Approval in Construction, are available on stock at Alnor Ventilation Systems. Duct tightness is attested by tests and analyses. More importantly, the tests were conducted on the full range of duct diameters - from 80 to 1 600 mm.

Alnor fittings are equipped with double-lip ethylene-propylene (EPDM) rubber seals. The seals are resistant to temperature fluctuations and are not damaged by the rough surface of the installation components. Factory-mounted seals mean the ventilation system remains tight even when the fittings are moved and rotated during installation for a proper fit.

The seals are mechanically fixed, which means no adhesive or sealing agents are required and the installation works can be conducted in any climatic conditions.

The issue of tightness of the ventilation system is to be taken into account as early as during the design stage. The designer should indicate the optimum means of connecting the ventilation ducts to maintain tightness as per the tightness class employed. Duct manufacturer should ensure high system component workmanship and material quality. The contractor is responsible for connection quality and must not allow any mechanical damage to compromise system tightness. Building administrator must not forget to inspect and maintain the installation. Good cooperation on each of the stages will yield proper results - a tight and well-functioning ventilation system which improves the comfort of the users of the facility.