

Promat

by etex



FIRE-RATED DUCTWORKS

An Introduction To Ventilation &
Smoke Extraction Ducting Systems

Fire-rated ductworks have a very important role within the fire safety system in buildings. We distinguish two main types: **smoke extraction ductworks** and **ventilation ductworks**.

Smoke extraction ducts play a crucial role in case of fire. Thanks to the activation of powerful smoke extraction fans (often installed on the roof), they capture smoke and toxic gasses and transport them outside of the building. This will ensure visibility and a safe escape for the people in the building.

Ventilation ducts guarantee a healthy air quality within the building in normal conditions. In case of fire, the fire-rated ducts will remain protect from the fire and dampers will seal off the duct at the source of the fire. This will prevent the fire from spreading through the building via the ventilation network.



Smoke extraction ductworks

Smoke extraction ducts remove smoke from buildings to enable emergency evacuation of the occupants, to prevent flash-over and to facilitate firefighting by the fire brigade.

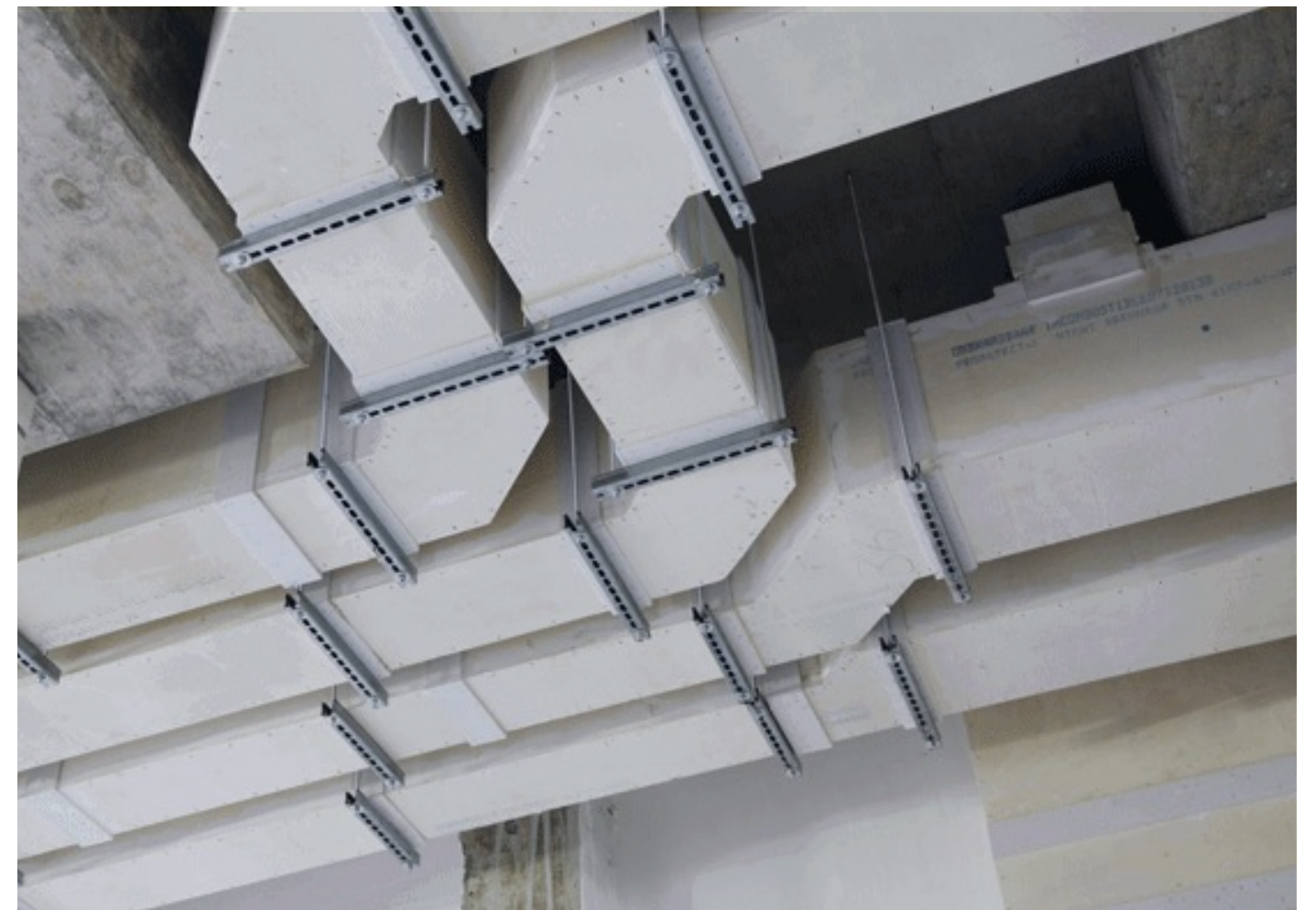
They are installed in large compartments, car parks, high-rise buildings and atriums in commercial, office and residential buildings. Car parks with low ceilings present dangerous zones because the smoke layer can fill the space very quickly and prevent evacuation.

High compartments (typically higher than 15 meters) are vulnerable to the spreading of smoke and present a challenge for fire protection engineers because of the decreased effectiveness of automatic sprinkler systems.

Fire-rated ductworks are required to conduct the smoke outside the building, using fan assisted systems (usually

installed on the roof). If a smoke extraction ductwork is fully contained within a fire compartment, it must at least be capable of resisting the anticipated smoke temperatures generated during the development of a fire. If the ductwork penetrates a fire resisting barrier (such as a fire-rated partition or ceiling), it must provide the same fire resistance as the barrier or partition.

To guarantee effective and fast smoke removal, it is necessary to make a detailed analysis of the room in question to study the expected fire propagation velocity in case of a fire. This is linked to the volume of the space, based on the floor surface area and the height. Promat experts can help you to make this analysis and will help you to design the correct ductworks to guarantee effective smoke extraction.



Fire-rated ventilation ductworks

Fire-rated ductworks are installed to guarantee the protective performance of a fire compartment. More precisely, fire-rated ventilation ducts avoid fire and heat to spread between two compartments..

A fire compartment prevents the fire from moving to another zone of the building by making sure that all the building materials used for floors, walls, ceiling and doors have the same fire classification and fire resistance rating.

Compartment walls and floors must have a specific fire resistance, which means that the performance criteria of load-bearing capacity (stability), integrity and insulation have been met for a duration of 30 to 240 minutes.

But even the best protected fire compartment becomes vulnerable if the services that run through it are not well protected. The HVAC system for the heating, cooling and comfort ventilation of is such a vulnerable service. If the ducts are not protected, fire will use the network of ducts to move across the building, even if fire compartments are in place.

It is therefore extremely important that, where compartmentation boundaries are penetrated by ducts, the fire separation criteria for the penetrated

partitions or ceilings are maintained. Fire-rated ducts will not become a conduit along which fires or hot smoke can spread to other areas.

The fire performance of a duct which penetrates a fire resisting or separating element requires careful consideration by specifiers. Typical metal sheet ducts fail to meet internationally accepted fire protection requirements. They heat and deform rapidly from the effects of fire. Under specific circumstances they can even accelerate the spread of flame and smoke.

The legal requirements to manage the risk of smoke spread in ventilations systems varies throughout Europe. In some countries smoke spread via the ventilation system is not considered to be a major problem. In other countries smoke dampers or fire and smoke dampers are required where the same ducting system supplies more than one fire compartment. Finally, there are countries where the regulations in addition to fire or smoke dampers also allows for a performance-based design, where software models are used to calculate the fire risk, based on the structure, the building materials used and the combustible material inside the building. Make sure to contact your local Promat expert to understand your local requirements and install the correct solution for your project.



What is the ideal PROMADUCT® system for my project?

Choosing the right fire-rated ductwork is often a challenge because of the complexity of the duct construction (passing through different fire compartments), the function of the system within the surrounding area and the fire conditions in case of an incident.

Promat offers a wide range of solutions for both ventilation and smoke extraction – for different operating pressures, sizes, orientations, configurations, and even for partial fire exposures. The solutions developed by our technical experts can meet any fire resistance requirement from 30 minutes (E – or EI 30) up to 120 minutes (E – EI 120), including smoke leakage (S). For special cases 240-minute integrity solutions are also available.

Traditionally, all ductwork used to be fabricated from steel. It required being encased in a fire protection system when passing through a compartment wall or floor without the aid of a fire damper, or when used as part of a smoke extraction system. Promat has developed a self-supporting 4-sided PROMADUCT® system that eliminates the need of a steel liner. Instead, it uses specially developed PROMATECT® boards, which match the leakage and air flow performance of steel ducts both for air ducts and smoke extraction ducts.

The main advantages:

- No steel sheet ducts required
- Single-layer construction
- Dimensionally stable and moisture resistant
- Easy to cut to size, ex-factory or on site
- Lightweight shaped sections
- Serviceable, smooth surface, robust
- Tested according to the most severe international standards
- Supporting hangers, supports and their fixings can be unprotected
- Available in large dimensions (maximum dimensions being all classified by authorized laboratories)
- With a roughness factor of the surface substantially identical to steel
- PROMATECT® calcium silicate boards have a CE marking for intended use Type 9: Technical services assemblies in buildings

The acoustic performances and the room temperature thermal insulation of Promat ductworks is excellent. If needed, it can be even improved by the use of additional layers of mineral wool or plasterboards.

PROMATECT® boards can also be used for cladding of existing steel ducts



How are our smoke extraction ducts tested?

Smoke extraction ducts can be tested according to different standards. The most common are the European Standard (EN 1366), the British Standard (BS 476) and, in some specific cases, the American Standard (UL).

Regarding Europe, the smoke extraction ducts are tested with fire from inside and outside.

Smoke control ducts can be distinguished as follows:

- **single compartment** smoke control ducts, which can be used in one fire compartment only and are tested according to EN 1366-9, under the 300 °C or 600 °C time/temperature curve. (The heating conditions and the furnace atmosphere shall conform to those specified in EN 1363-1 until 300 °C or 600 °C is reached. After this the temperature shall be maintained for the rest of the test.) Single compartment smoke control ducts are classified according to EN 13501-4 in Europe.
- **multi compartment** fire resistant smoke control ducts, which can be used in any number of fire compartments and are tested according to EN 1366-8, under the ISO 834 curve (EN 1363-1). These ducts are classified according to EN 13501-4 (as 'duct C').

These methods of testing are suitable only for ducts constructed from non-combustible materials (class A1 and A2-s1, d0).

The test method for multi-compartment fire-resistant smoke control ducts (EN 1366-8) is applicable to fire-resisting ducts that have already passed the appropriate period according to EN 1366-1 (Ducts A/500 Pa and B). For mono-compartment ducts, only the test according to EN 1366-9 is required.

The performance criteria are as follows:

- **Smoke leakage (S):** The duct shall not have a leakage exceeding 5 m³/h per 1 m² of internal surface area. This shall be related to the surface area of the duct from the perforated plate to the end of the duct by the inlet nozzles.
- **Integrity (E):** The integrity at the seal or penetration between the duct and the supporting construction shall be judged in accordance with EN 1363-1.
- **Insulation (I):** Test results from EN 1366-1 shall demonstrate the insulation performance of the duct.
- **Reduction in cross-section:** The internal dimensions (width and height for rectangular ducts, diameter for circular ducts) of the smoke extracting ductwork shall not decrease by more than 10% during the test.
- **Mechanical stability:** If the duct inside the furnace collapses, so that it can be judged as not being able to maintain its smoke extraction or fire resistance function, this shall be regarded as failure under the mechanical criterion.



How are our ventilation ductworks tested?

Ventilation ductworks can be tested according to different standards. The most common are the European Standard (EN 1366), the British Standard (BS 476) and, in some specific cases, the American Standard (UL).

In Europe, ventilation ducts are tested according to EN 1366-1 and classified according to EN 13501-3. The classification is completed by '(i → o)', '(o → i)', or '(i → o)' to indicate whether the element has been tested and fulfils the requirements with fire from the inside or outside only or from both sides.

In fact, the test is divided into two fire scenarios, fire from outside of the duct and fire from inside of the duct. One duct is needed for each scenario, and both scenarios have to be tested in the horizontal and the vertical direction. The standard heating curve described in EN 1363-1 (ISO 834) is used for both scenarios

The performance criteria are the following:

- **Integrity (E):** Integrity failure shall be deemed to have occurred if any of the following are observed:
 - Integrity failure occurs on the unexposed side as defined in EN 1363-1
 - The volume flow rate measured in duct A exceeds $15 \text{ m}^3 / (\text{m}^2 \text{ h})$, related to 20°C and 1013 mbar, related to the internal surface area of the duct inside the furnace.
- **Insulation (I):** Insulation failure shall be as defined in EN 1363-1: The duct no longer satisfies the Insulation criteria if the temperature rise on the unexposed side exceeds 180°C on any of the thermocouples or 140°C on average.
- **Smoke leakage (S):** Failure of this criterion shall have occurred if the flow rate in duct A during the test exceeds $10 \text{ m}^3 / (\text{m}^2 \text{ h})$, related to 20°C and 1013 mbar, related to the internal surface area of the duct inside the furnace.



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