

# White Paper on Pressure Level Categories for Smoke Control Dampers and their use in Buildings.

Frank Verlinden, Sr Product Manager @ Rf-t, July 2019

## Introduction and Scope

'AA'-classified Smoke Control Dampers ("SCD's") share the same type of activation, being 'automatic'. In contrast to 'MA' or 'HOT'-classified SCD's, they are only automatically controlled and designed to change the position of their damper blade just once in the case of a fire. There can, nevertheless, be significant differences between their other characteristics, which can have an impact on their suitability for different smoke control applications.

This white paper aims to clarify the relationship between pressure levels, leakage requirements and cycle testing for Smoke Control Dampers covered by the test standard EN1366-10, the classification standard EN13501-4 and the product standard EN12101-8.

It also relates pressure levels to an advised use in relation to the height of the building in which the SCD will be installed.

### 1) The relationship between pressure levels, the number of cycles and air and smoke tightness.

The test standard for Smoke Control Dampers, EN 1366-10:2011+A1:2017, makes the distinction between 3 different pressure levels which are applied during leakage and fire testing.

This is listed in Table 1:

**Table 1 — Differential pressures between inside and outside the duct for smoke extraction ductwork**

Pressure level	Operating differential pressure at ambient temperature Pa	Differential pressure for the fire test Pa
1	-500	-150
2	-1 000	-300
3	-1 500	-500

Pressure level 1 is the lowest category where a SCD can be submitted to, with a negative pressure of 500Pa during leakage tests and a negative pressure of 150Pa during fire testing.

Pressure level 3 is the highest category a SCD can achieve. The SCD is exposed to a negative pressure of 1.500Pa during leakage tests and -500Pa during fire tests.

Pressure level 2 sits in between with -1000Pa and -300Pa for leakage and fire tests.

Why is this important?

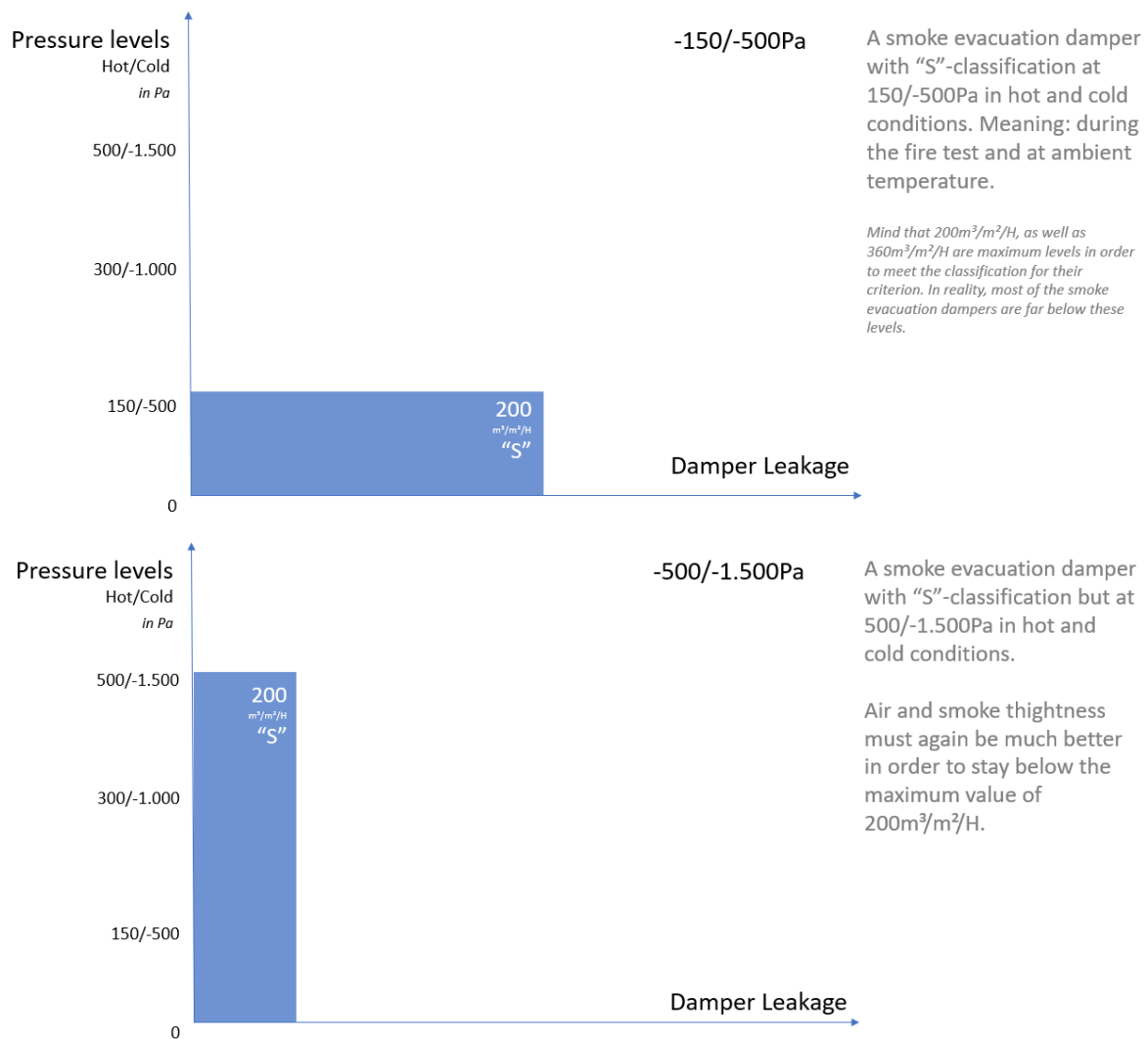
Pressure levels are directly related to the leakage requirements covered by the "E" and "S"-criteria, which are part of the fire classification of a SCD.

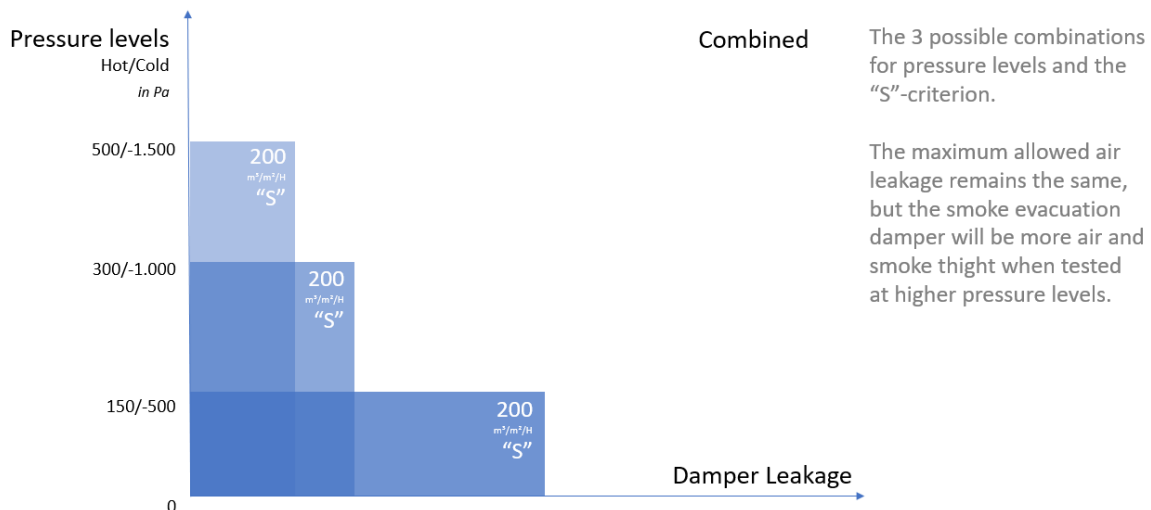
Example: **EI 90 (ved i <-> o) S 1500 C10.000 AA multi**

“E” relates, besides integrity, also to a maximum leakage threshold level of  $360\text{m}^3/\text{m}^2/\text{h}$ , irrespectively of a chosen pressure level. If the SCD also has a “S”-classification, that threshold level is lowered to  $200\text{m}^3/\text{m}^2/\text{h}$ .

‘1500’ in the classification above represents pressure level 3. If the SCD is tested at pressure level 1, the classification would indicate ‘500’. For pressure level 2, ‘1000’.

As shown in the graphs hereunder, for the same maximum air flow of  $200\text{m}^3/\text{m}^2/\text{h}$ , a SCD with ‘S’ classification which was tested under the conditions of pressure level 1 is allowed to have far more air leakage over its damper blade than a SCD tested according to pressure level 3. Again, SCD ‘s tested according to pressure level 2 sits in between.





So, a SCD with a '1500'-classification needs to be substantially more airtight than a SCD with a '500'-classification, for instance. In practice, this means that a '1500'-classified SCD will allow far less smoke to pass its closed damper blade than a '500'-classified SCD does, which increases the level of safety provided by the damper.

Pressure levels and air leakage also relate to the number of open/close cycles to which the damper was exposed before it is tested on leakage and before it is fire tested.

Fi: EI 90 (ved i <-> o) S 1500 C<sub>10.000</sub> AA multi

'C<sub>10.000</sub>' in the classification indicates the number of open/close cycles to which the damper was submitted before testing.

If it says "C<sub>10.000</sub>", the damper was cycle tested 10.000 times before the leakage and fire test. If the classification mentions "C<sub>300</sub>", the SCD was cycle tested 300 times before being tested. C<sub>10.000</sub> equals to approximately 15 days of continuous cycle testing. C<sub>300</sub> to roughly half a day. A full cycle may never exceed 120 seconds according to the test standard.

So, for the same leakage performance, a C<sub>10.000</sub>-classified SCD needs sealing with a significant higher abrasion resistance than a C<sub>300</sub>-classified SCD.

The number of cycles can be important in function of the frequency at which SCD's are tested on their readiness in a building. A C<sub>10.000</sub>-classified f.i., allows daily testing for almost 30 years. A C<sub>300</sub>-classified SCD allows for testing every 5 weeks over the same period of time. C<sub>10.000</sub> makes a SCD also suited for use in ventilation systems or night cooling. C<sub>300</sub> limits the use of a SCD for emergency purposes only.

**To conclude:**

**When compared, a SCD with an 'EI 90 (ved i <-> o) S 1500 C<sub>10.000</sub> AA multi'-classification assures a significant higher level of durability and air or smoke tightness than a SCD with an 'EI 90 (ved i <-> o) S 500 C<sub>300</sub> AA multi'-classification.**

**1) The relation between SCD's pressure levels and their use in buildings**

Pressure levels are directly linked to the air tightness of SCD's. They are important in function of the height of the building, when connected to vertical ducts for air supply and air release or smoke evacuation. The higher a building, the longer the ductwork, the more dampers connected per duct and the stronger the ventilators need to be to cope with sum of leakages and pressure losses. Stronger ventilators mean higher pressures applied to the SCD's close to the ventilators. The same applies for natural ventilation based on pressure differentials due to stack effects. This is where the pressure level classification of a SCD comes into play.

Although not specified by the European standards related to SCD's, it is generally accepted that the 3 pressure levels defined in EN1366-10 relate to 3 height categories for buildings. One can discuss the exact transition point between two levels, but the 3 categories defined hereafter can be considered as a realistic division of the height of a building and the suitable pressure class for SCD's to be used for each of them.

- low buildings (typically 10-15m): -150/-500Pa
- medium high buildings: (between 10-15 and 25-30m): -300/-1000Pa
- high buildings and high rises (higher than 25-30m): -500/-1500Pa

So, SCD's classified as '500' are fitted for the use in vertical ductwork of buildings no higher than 15m. SCD's classified as '1000' are suitable for buildings till approximately 30m. And SCD's with a '1500' classification can be used in all buildings, regardless their height as they can deal with very high pressure loads while still guaranteeing to remain below the maximum leakage threshold of  $200\text{m}^3/\text{m}^2/\text{h}$ .

**To conclude:**

**When compared, a SCD with an 'EI 90 (ved i <-> o) S 1500 C<sub>10.000</sub> AA multi'-classification assures its leakage rating at high pressures, which makes it suitable for use in SHEVS's\* and PDS's\*\*, regardless the height of a building. They include high buildings and high rises.**

**A SCD with, fi, an 'EI 90 (ved i <-> o) S 500 C<sub>300</sub> AA multi'-classification can maintain the same leakage rating only at lower pressures and is therefore deemed to be suitable for buildings up to maximum 15m high.**

### **3) General conclusions**

**Apart from their 'AA'-classification, SCD's can be designed or be suitable for different applications. In general, the higher the specifications, the more all-round a SCD can be applied in the field.**

**An 'AA'-classified SCD with '500' and 'C<sub>300</sub>' characteristics for its pressure level and cycling makes it suitable as an air supply and release or smoke release in SHEVS or PDS for low buildings not exceeding 15m. The durability of its drive, transmission and cold smoke seal allows for monthly testing.**

**'AA'-classified SCD's with '1500' and 'C<sub>10.000</sub>' classifications are more polyvalent. They can be installed in SHEVS's or PDS's in all buildings, regardless of their height. Their drive, transmission and cold seal design allow for daily testing or double use as a damper in a ventilation system.**

**Because of their high-pressure class, they feature also superior sealing against air and cold or hot smoke leakage in the case of fire.**

**'AA'-classified SCD's with '1000' pressure level end up in between both previous type of SCD's. They are less dependent from the height of a building than '500'-classified dampers but are however not advised for high buildings or high rises. Depending their classification for cycling, they might be suited for emergency use and limited testing only or be tested daily and be part of a combination of smoke control and comfort ventilation.**

\* SHEVS: Smoke and HEat Ventilation System

\*\* : PDS: Pressure Differential System