

The PDS function simulation

- takes structural, technical and atmospheric influences into account
- calculates volume flows, pressure differences, door opening forces and temperatures



Even the best planning can be ruined by adverse circumstances or unfavorable interactions. We want to check the safe function of the PDS using a simulation specifically tailored to the requirements of pressure differential systems in stairwells and fire service elevators.

The subject of the simulation is the calculation of volume flows and pressure differences under different atmospheric conditions.

The structural, technical and atmospheric influences on the function of the PDS are jointly evaluated computationally in a flow simulation.

As a result of the PDS functional simulation, the calculated data shows the protection goals achieved in terms of door opening force, door flow velocity and pressure differences.

Winter pressure maintenance - Fire floor: level 5 / Exhaust air path S2 / Outside door: temperatures and differential pressures

Temperature: Inside: 18°C Outside: -12°C Use: 20°C

Pressure Drop: dp 98 Pa

Exhaust air unit:

Supply Air	Stairwell	Lobby door:	Floor: Δp	Exhaust S2: Temp. // Δp	Use:	Floor Level:
Temp. // Δp // SA	Temp. // Δp			Temp. // Δp	Temp. // Δp	
3 °C 97 Pa	18 °C 97 Pa		80 Pa	18 °C 98 Pa	20 °C 66 Pa	27.OG
3 °C 94 Pa	18 °C 94 Pa		77 Pa	18 °C 94 Pa	20 °C 64 Pa	26.OG
3 °C 90 Pa	18 °C 90 Pa		74 Pa	18 °C 89 Pa	20 °C 61 Pa	25.OG
2 °C 87 Pa	18 °C 87 Pa		71 Pa	18 °C 86 Pa	20 °C 58 Pa	24.OG
2 °C 83 Pa	18 °C 83 Pa		68 Pa	18 °C 80 Pa	20 °C 55 Pa	23.OG
1 °C 80 Pa	18 °C 80 Pa		65 Pa	18 °C 77 Pa	20 °C 53 Pa	22.OG
1 °C 77 Pa	18 °C 77 Pa		62 Pa	18 °C 71 Pa	20 °C 50 Pa	21.OG
1 °C 73 Pa	17 °C 73 Pa		59 Pa	18 °C 62 Pa	20 °C 47 Pa	20.OG
0 °C 70 Pa	17 °C 70 Pa		56 Pa	18 °C 53 Pa	20 °C 45 Pa	19.OG
0 °C 66 Pa	17 °C 66 Pa		53 Pa	18 °C 44 Pa	20 °C 42 Pa	18.OG
-1 °C 63 Pa	17 °C 63 Pa		50 Pa	18 °C 35 Pa	20 °C 39 Pa	17.OG
-1 °C 60 Pa	17 °C 60 Pa		47 Pa	18 °C 26 Pa	20 °C 36 Pa	16.OG
-2 °C 57 Pa	17 °C 57 Pa		44 Pa	18 °C 17 Pa	20 °C 34 Pa	15.OG
-2 °C 54 Pa	16 °C 54 Pa		41 Pa	18 °C 8 Pa	20 °C 31 Pa	14.OG
-3 °C 50 Pa	16 °C 50 Pa		38 Pa	17 °C -1 Pa	20 °C 28 Pa	13.OG
-3 °C 47 Pa	15 °C 47 Pa		36 Pa	18 °C -5 Pa	20 °C 26 Pa	12.OG
-4 °C 36 Pa	15 °C 44 Pa		33 Pa	18 °C -5 Pa	20 °C 23 Pa	11.OG
-4 °C 35 Pa	14 °C 42 Pa		30 Pa	18 °C -5 Pa	20 °C 20 Pa	10.OG
-4 °C 34 Pa	13 °C 39 Pa		27 Pa	18 °C -5 Pa	20 °C 17 Pa	9.OG
-4 °C 33 Pa	12 °C 36 Pa		24 Pa	18 °C -5 Pa	20 °C 15 Pa	8.OG
-4 °C 33 Pa	11 °C 34 Pa		22 Pa	18 °C -5 Pa	20 °C 12 Pa	7.OG
-5 °C 32 Pa	10 °C 32 Pa		19 Pa	17 °C -5 Pa	20 °C 9 Pa	6.OG
-6 °C 32 Pa	8 °C 30 Pa	● 96 N	-1 Pa	8 °C -1 Pa	20 °C 7 Pa	5.OG
-6 °C 31 Pa	9 °C 28 Pa		15 Pa	18 °C -5 Pa	20 °C 4 Pa	4.OG
-7 °C 30 Pa	7 °C 26 Pa		12 Pa	18 °C -5 Pa	20 °C 1 Pa	3.OG
-8 °C 30 Pa	5 °C 24 Pa		10 Pa	18 °C -5 Pa	20 °C -1 Pa	2.OG
-9 °C 30 Pa	2 °C 22 Pa		8 Pa	18 °C -5 Pa	20 °C -4 Pa	1.OG
-9 °C 29 Pa	5 °C 21 Pa		8 Pa	18 °C -5 Pa	20 °C -7 Pa	EG
-10 °C 29 Pa	0 °C 19 Pa		4 Pa	18 °C -5 Pa	20 °C -10 Pa	1.UG
-11 °C 30 Pa	0 °C 18 Pa		1 Pa	18 °C -5 Pa	20 °C -12 Pa	2.UG
-12 °C 31 Pa	-8 °C 17 Pa		-1 Pa	18 °C -5 Pa	20 °C -15 Pa	3.UG

Specified Pressure Differential: Room to Atmosphere

Supply air: 13070 m³/h



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The art of handling air

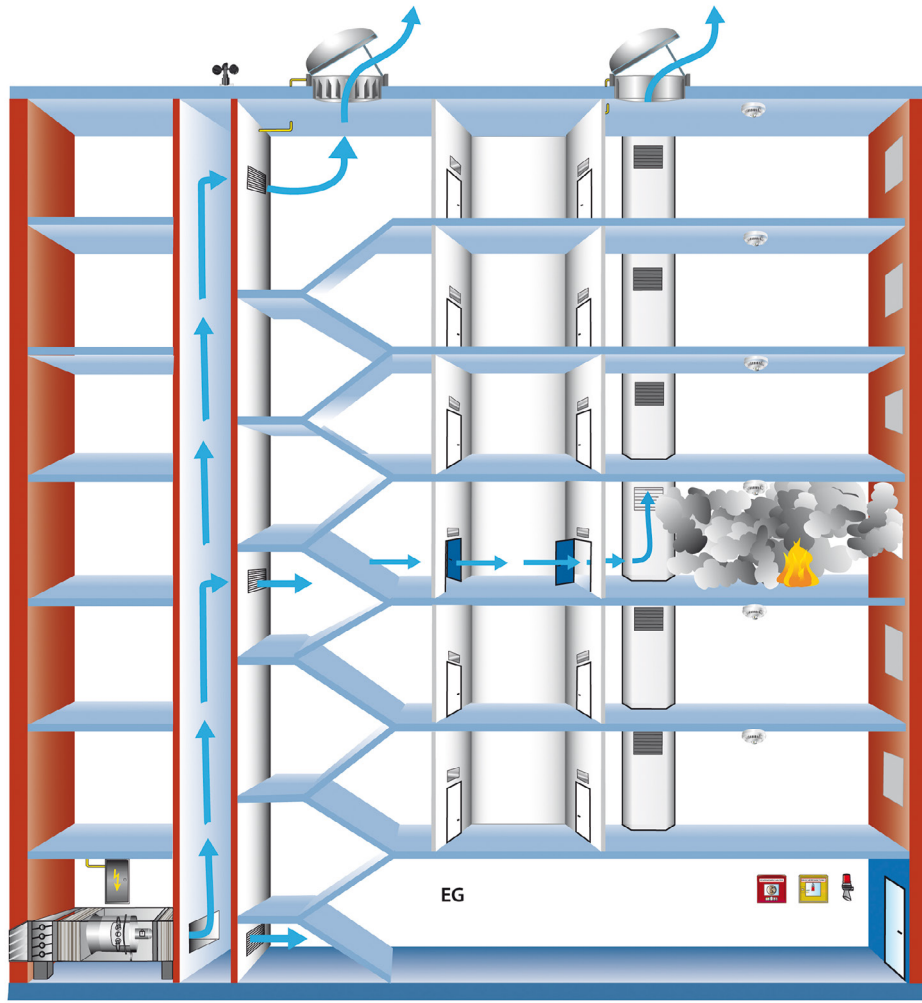
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The art of handling air

Pressure Differential Systems PDS

► Pressure Differential Systems ►►
►► we make it easy!



► Security through differential pressure! ►►
Keeping escape and rescue routes smoke-free

Smoke is prevented from entering into protected spaces via leakage paths through physical barriers (e.g. cracks around closed doors) or open doors by using pressure differentials, maintaining a positive pressure difference between the protected and unprotected space when doors are closed, or an airflow from the protected space to outside when escape doors are open.

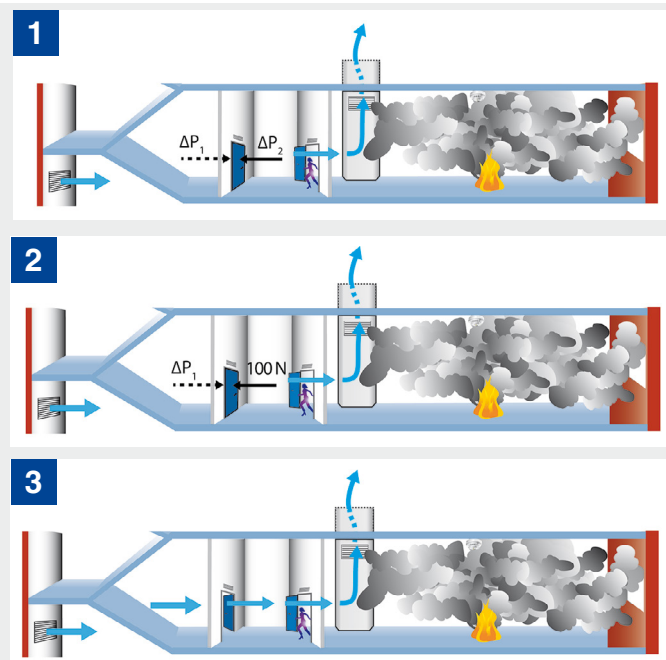
TR0X pressure differential system has undergone independent test accreditation by MPA Braunschweig, in accordance with EN 12101-0:2022 (Annex A) to verify initiation, activation and response times, operational reliability, smoke/hot gas extraction effectiveness, performance under fire condition and pressurisation performance. Our Pressure Differential System has achieved;

- | | |
|---|---|
| 1 | Initiation time: ≤ 60 s |
| 2 | Operation time: ≤ 120 s |
| 3 | Response time: ≤ 3 s |
| 4 | Supply air volume flow rate (V_{sa}): Up to 60,000m ³ /hr |
| 5 | Air release volume flow rate (V_{ar}): Up to 30,000m ³ /hr |
| 6 | Nominal pressure differential (ΔP_{nom}): Up to 50 Pa |

The operating principle

To prevent smoke ingress and to secure the escape route, The following operating/functional principles must be guaranteed:

- 1 Defined overpressure in the stairwell
- 2 Door opening forces less than 100N
- 3 Defined flow velocity in the door cross section
- 4 Automatically opening exhaust way on each storey



Pressure Differential System with active air release on the fire floor

To keep the area smoke free, Pressure Differential Systems (PDS) are equipped with a secured, i.e. automatically opening exhaust damper on each storey (e.g. via certified smoke control damper, type EK-JZ).

When a door to the stairwell is open, a controlled flow velocity through the door, at the rated speed according to the system design (1,0 - 2,0 m/s) must be secured.

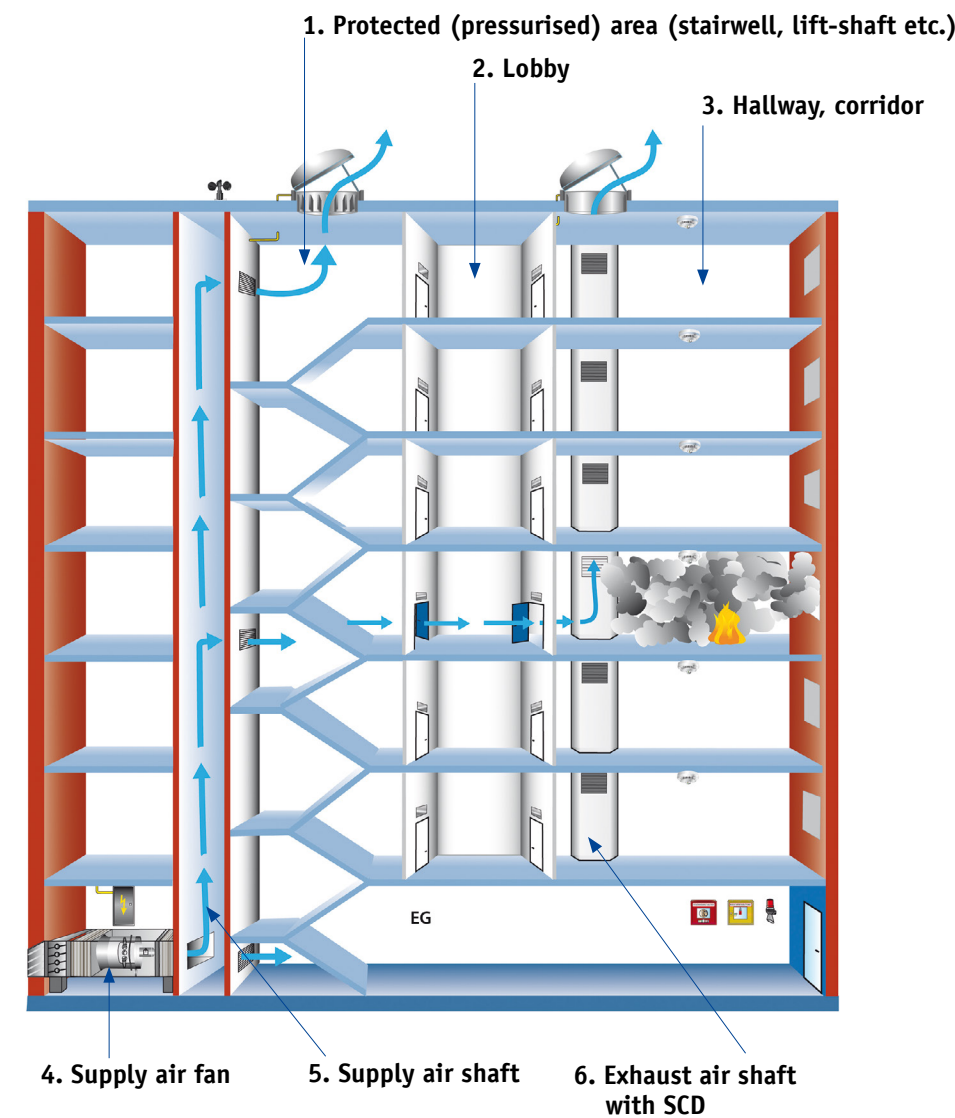
In contrast to passive air release methods, that rely on facade AOV's or natural smoke shafts that can be influenced due to environmental conditions, the active release PDS supply and exhaust fans work together to dynamically compensate for rapid changes in system demand.

By controlling the pressure on both sides of the door, the PDS can continuously monitor and adjust the supply and exhaust volume flows, maintaining closed door pressure and open door velocity on any storey.

A pressure cascade with overflow elements is also possible. A small amount of air exchange is possible in the lobby, even when all doors are closed.

- 1 Defined overpressure
- 2 Door opening force
- 3 Defined flow rate in the door cross section
- 4 Automatically opening exhaust damper on each storey

Pressure Differential System with active air release on the fire floor



1. Protected area

Task: The protected area must be secured from smoke ingress.

Solution: Introduce enough fresh air to replace current leaks.

Regulation: Active or passive, supply air fan with frequency converter.

2. Lobby

Depending on protection goals, the lobby can be protected (pressurised) or can be utilised for locating the exhaust air shaft (ventilated).

3. Hallway, corridor

The hallway connects the protected area(s) and the exhaust air path.

4. Supply air

Consisting of a supply air fan with louvre damper, if necessary with standby fan. Intake must be smoke-free.

5. Supply air shaft

Depending on the building geometry, a supply air shaft may be required to reduce the pressure loss in the stairwell. Supply air grilles every 3rd storey may be necessary for approx. >10 floors.

6. Exhaust air shaft with SCD

Task: The air that flows from the stairwell into the lobby or hallway must safely leave the building.

Solution: Dynamically balance the extract volume to match air flow from the stairwell.

Regulation: Active, exhaust fan with frequency converter.



Safety system pressure differential systems from TROX

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- | Step | Description |
|------|----------------------------------|
| 1. | Planning support: basics |
| 2. | Planning support: details |
| 3. | PDS function simulation |
| 4. | Smoke extraction dampers |
| 5. | Pressure relief |
| 6. | Fans |
| 7. | Switching and control system |
| 8. | Installation |
| 9. | Participation in expert approval |
| 10. | Regular maintenance |