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SMART SMARTCON

Aerodynamic Test Report

dated 16.09.2025

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The aerodynamic test rig was designed in accordance with GOST R EN 12238-2012, "Ventilation for buildings. Air terminal devices. Aerodynamic testing and rating for mixed flow application."

The test rig consists of a variable-speed fan, a measurement duct with a thermal anemometer and a flow-equalisation chamber. Figure 1 shows the rig layout.

The flow-equalisation chamber has a free cross-sectional area substantially greater than that of the diffuser slot and the flow straightener. This uniformly reduces air velocity and equalises the velocity profile across the section. Dynamic pressure becomes negligible, allowing total and static pressure to be treated as equal and ensuring accurate pressure loss measurements.

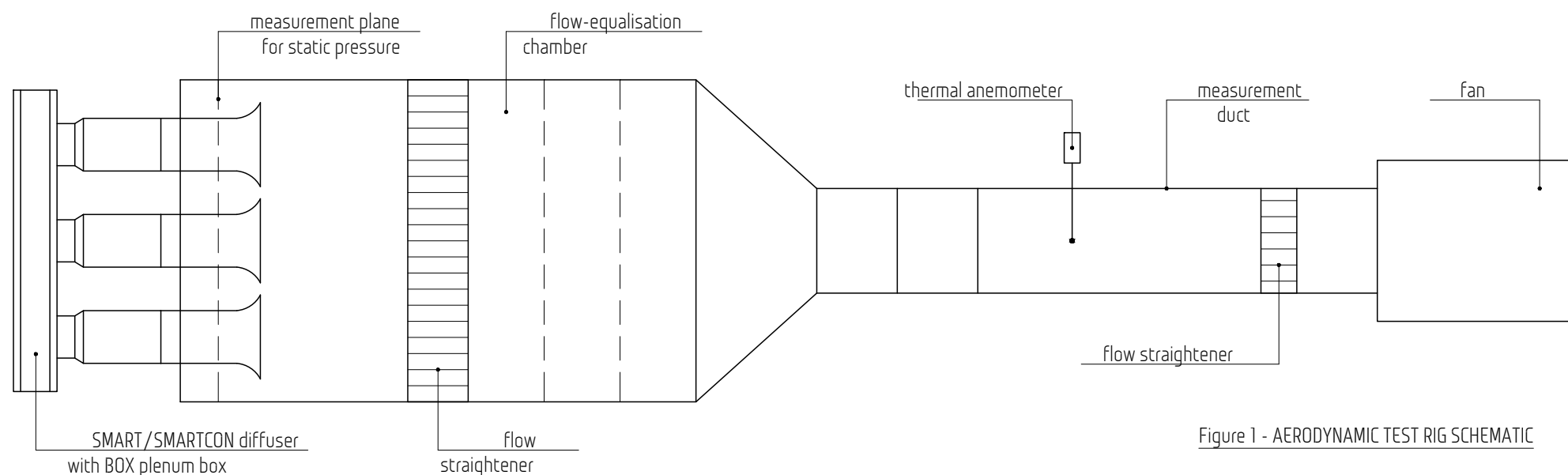


Figure 1 - AERODYNAMIC TEST RIG SCHEMATIC

Tests are performed on diffuser samples 1000 mm long.
The aerodynamic performance of diffusers with BOX plenum boxes in different versions (STD, FRNT, BOXZ) may vary by up to $\pm 10\%$.

Pressure loss is generally calculated as follows:

$$P_t = P_s + P_d$$

$$P_d = \frac{\rho}{2} \times \left(\frac{q_v}{A} \right)^2$$

Under the condition below, static and total pressure become equivalent, because dynamic pressure is negligible relative to static pressure:

$$\frac{q_v}{A} < \sqrt{\frac{P_s}{5 \times \rho}}$$

The total pressure loss equation then becomes:

$$\Delta P_t = P_s$$

During testing, the rig is set to a specified airflow. Once steady state is reached, the pressure difference and airflow are measured. Measurements are then repeated at other airflow values.

Measured parameters:

- q_v - airflow rate [m^3/h];
- ΔP_t - pressure loss [Pa];
- T_{meas} - air temperature [$^{\circ}\text{C}$];
- ϕ_{rel} - relative air humidity [%];
- B_{meas} - atmospheric pressure [Pa].

The test results are processed using the least-squares method to fit an averaged curve to the measured airflow and pressure loss points.

Table 1 - LIST OF MEASURING INSTRUMENTS

No.	Measured parameter	Measuring instrument (QR code: FGIS "Arshin")
1	Air velocity	TTM-2-01 T thermal anemometer 
2	Differential pressure	Testo 510i Smart Probe 

P_t - total pressure [Pa]; P_s - static pressure [Pa]; P_d - dynamic pressure [Pa];
 A - flow-equalisation chamber cross-sectional area [m^2]; ρ - air density [kg/m^3].

Table 2 - AERODYNAMIC PERFORMANCE OF DIFFUSERS SMART 10, 20, 30, 40, 50, 60, 70 (VERTICAL PLANE JET)

Test no.	SMART 10		SMART 20		SMART 30		SMART 40		SMART 50		SMART 60		SMART 70	
	q_v [m³/h]	ΔP_t [Pa]	q_v [m³/h]	ΔP_t [Pa]	q_v [m³/h]	ΔP_t [Pa]	q_v [m³/h]	ΔP_t [Pa]	q_v [m³/h]	ΔP_t [Pa]	q_v [m³/h]	ΔP_t [Pa]	q_v [m³/h]	ΔP_t [Pa]
1	39.8	1.0	72.4	1.2	108.7	1.9	143.5	2.3	180.5	2.4	212.1	2.4	251.4	2.5
2	54.9	3.1	109.6	4.0	162.8	4.8	219.5	5.9	274.8	5.8	325.0	5.6	377.2	5.6
3	73.4	6.3	145.1	7.7	213.0	8.8	283.5	10.2	363.8	10.4	425.7	9.9	499.4	10.1
4	89.3	9.6	184.2	12.8	265.8	14.2	371.0	18.2	450.4	16.2	541.0	16.4	639.8	17.1
5	109.8	14.6	219.1	18.4	319.0	20.9	427.2	24.7	538.4	23.5	647.4	23.9	759.8	24.5
6	126.8	19.3	256.7	25.4	379.2	30.1	500.4	34.8	629.5	32.4	738.4	31.5	884.9	33.8

Figure 2 - PRESSURE LOSS VERSUS AIRFLOW

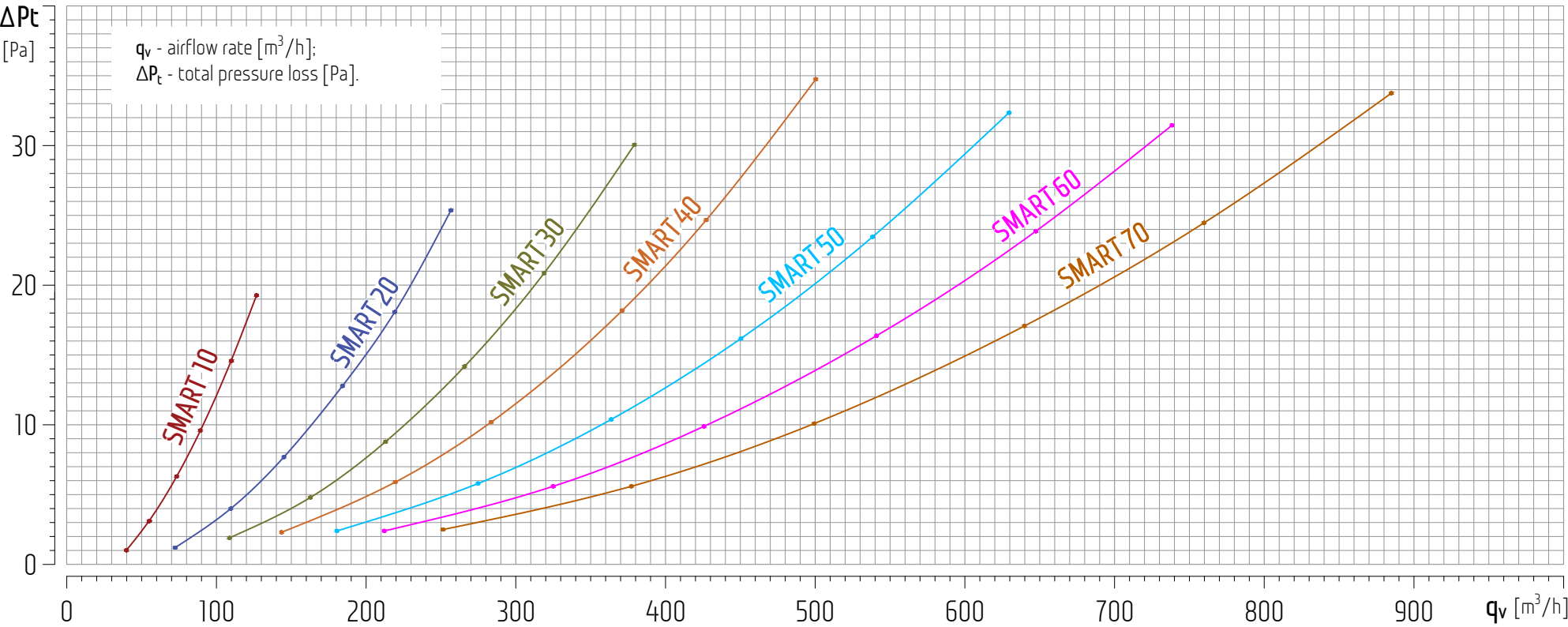
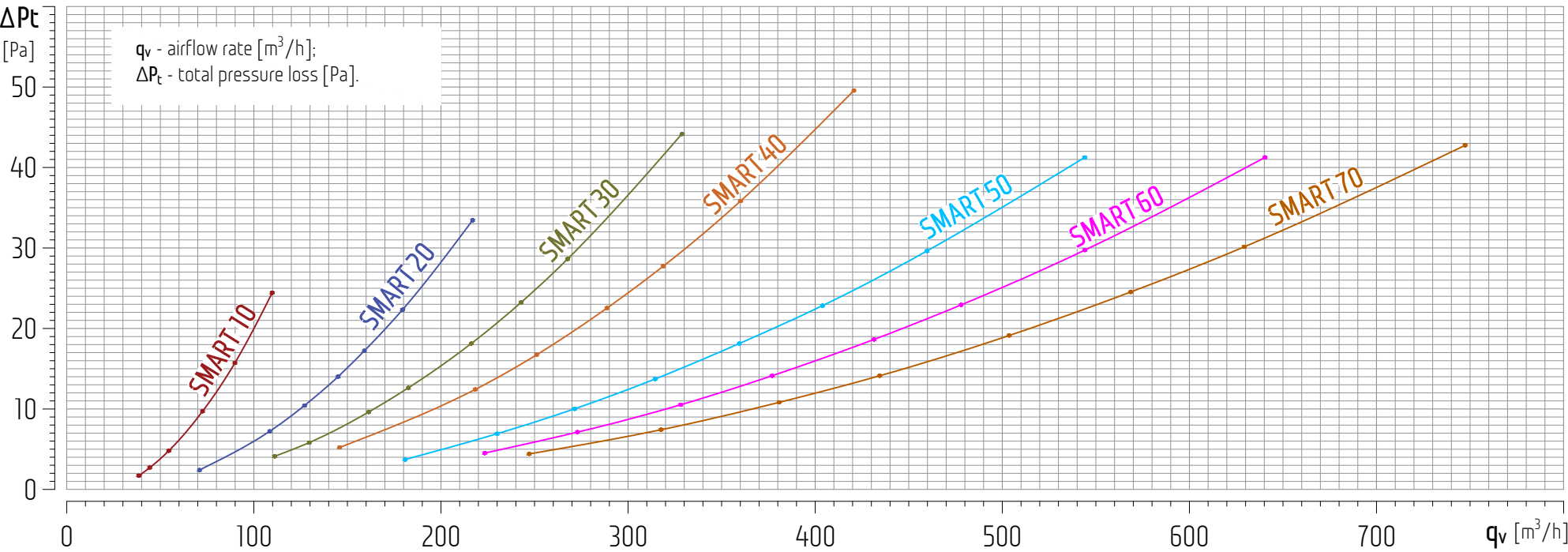
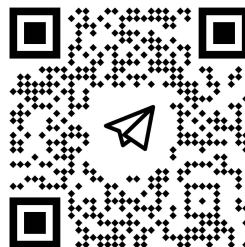
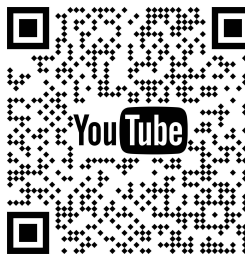
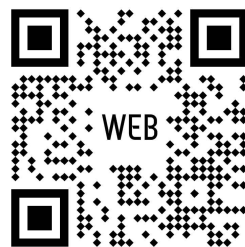


Table 3 - AERODYNAMIC PERFORMANCE OF DIFFUSERS SMART 10, 20, 30, 40, 50, 60, 70 (HORIZONTAL CEILING-ATTACHED PLANE JET)

Test no.	SMART 10		SMART 20		SMART 30		SMART 40		SMART 50		SMART 60		SMART 70	
	q _v [m³/h]	ΔP _t [Pa]	q _v [m³/h]	ΔP _t [Pa]	q _v [m³/h]	ΔP _t [Pa]	q _v [m³/h]	ΔP _t [Pa]	q _v [m³/h]	ΔP _t [Pa]	q _v [m³/h]	ΔP _t [Pa]	q _v [m³/h]	ΔP _t [Pa]
1	38.6	1.7	70.9	2.4	111.1	4.1	145.8	5.2	180.8	3.7	223.3	4.5	247.1	4.4
2	44.4	2.7	108.4	7.2	129.5	5.8	218.2	12.4	229.8	6.9	272.8	7.1	317.5	7.4
3	54.6	4.8	127.0	10.4	161.3	9.6	251.0	16.7	271.3	10.0	328.0	10.5	380.6	10.8
4	72.6	9.7	145.0	14.0	182.5	12.6	288.6	22.5	314.3	13.7	376.8	14.1	434.3	14.1
5	89.8	15.7	159.0	17.2	216.1	18.1	318.7	27.7	359.3	18.1	432.3	18.7	503.5	19.1
6	109.8	24.4	179.4	22.3	242.7	23.2	360.0	35.8	403.7	22.8	477.8	22.9	568.4	24.5
7			216.8	33.4	267.6	28.6	420.5	49.5	459.6	29.6	543.9	29.7	629.0	30.1
8					328.6	44.1			543.8	41.2	640.1	41.2	747.0	42.7

Figure 3 - PRESSURE LOSS VERSUS AIRFLOW





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