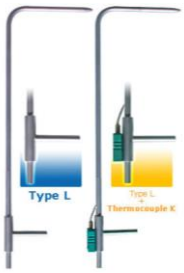
COMPARATIVE ANALYSIS OF METHODS FOR MEASURING THE AIR VELOCITY AND FLOW IN MECHANICAL VENTILATION SYSTEMS







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Measurements methods

1. Direct air measurement methods

1.1 Pitot static tube (Prandtl Tube) traverse in the supply duct (method 1)

1.2 Measurement using the effective area A_k was based on Standard EN 12238 (method 2)

1.3 Measurement at the air terminal (method 3)

1.4 Airflow measuring elements (method 4)

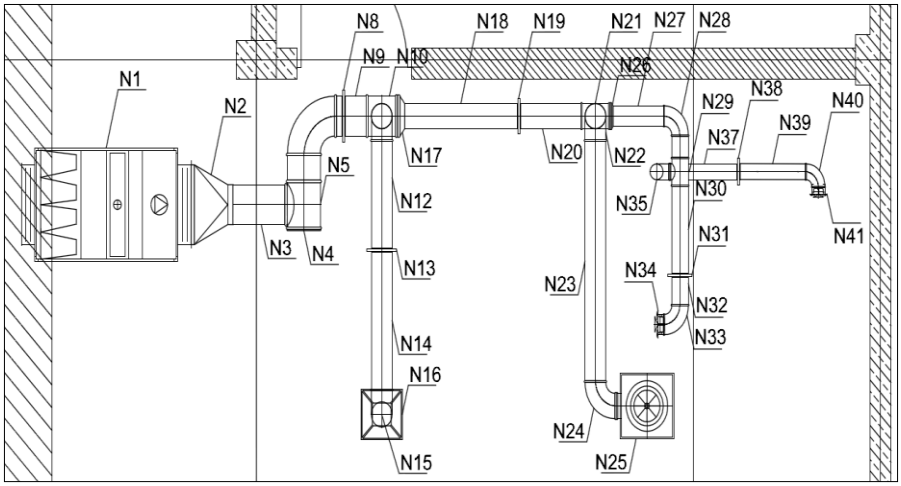
2. Direct air measurement methods using an attachment on the intake

2.1 Airflow hoods (method 5)

3. Indirect air measurement methods

3.1 Assessment damper characteristic (method 6)

Scheme of experimental setup



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Scheme of experimental setup

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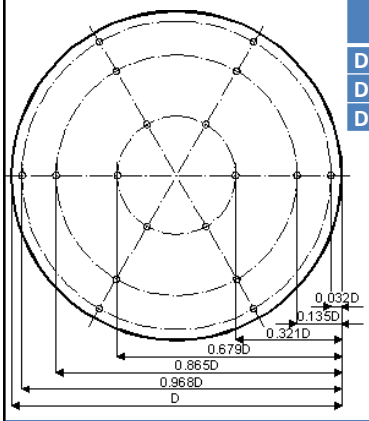
Summary of measurement methods for specific ATDs

ATDs	N41	N34	N25	N15
Method 1	x	x	x	x
Method 2	x	x	x	x
Method 3	-	-	x	-
Method 4	-	-	-	x
Method 5	x	x	x	x
Method 6	x	x	-	-

Method 1

Pitot static tube (Prandtl Tube) traverse in the supply duct



Diameter	Number of points i					
	1	2	3	4	5	6
	Distance from the duct wall y_i (mm)					
DN 125	5.5	18.3	37.0	88.0	106.7	119.5
DN 160	7.0	23.4	47.3	112.7	136.6	153.0
DN 200	8.7	29.3	59.2	140.8	170.7	191.3

$$V = A \cdot 1.291 \cdot \sqrt{(p_d)},\ m/s$$

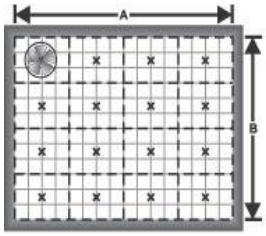
where:

p_d – value of the dynamic pressure, Pa,

A – cross section area, m^2.

Method 2

Measurement using the effective area A_k was based on Standard EN 12238



$$q_v = v_k \cdot A_k$$

where:

A_k – effective area of air terminal devices, (m^2);

v_k – average air velocity (m/s).

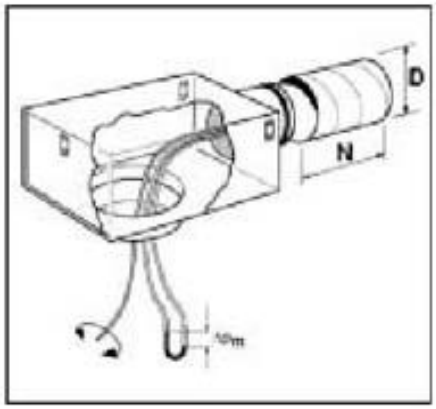
$$V_k = (\Sigma\, v_{ki}) / n$$

Effective area of air terminal devices

Air terminal devices	N41	N34	N25	N15
Effective area of ATD A_k (m^2)	0.00628	0.008038	0.055223	0.066248

Method 3

Measurement at the air terminal

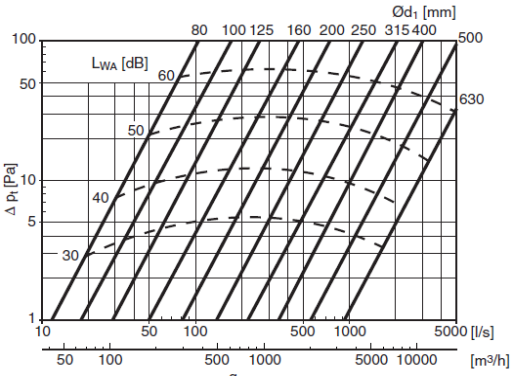


The coefficient k for the plenum for supply is 27.7.

Plenum box PER-250-200 (Systemair)

Method 4

Airflow measuring elements



Flow meter FMU (Lindab)

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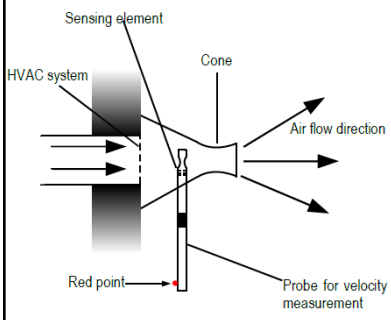

Method 5

Airflow hoods

model K25
200x200 mm,

model K80
350x350 mm

V = 10 to 400 $m^3 h^{-1}$;

model K120 -
450x450 mm.

V = 50 to 1200 $m^3 h^{-1}$.

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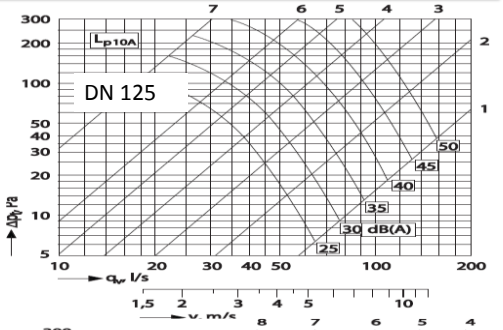
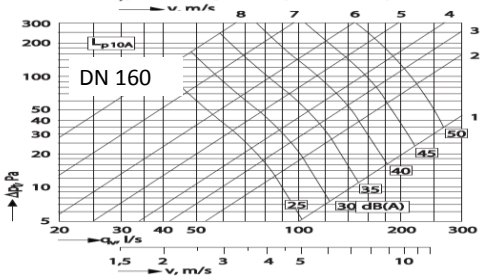
Method 6

Assessment damper characteristic

IRIS damper

Pressure calibrator KAL 84





COMPARATIVE ANALYSIS OF METHODS FOR MEASURING THE AIR VELOCITY AND FLOW IN MECHANICAL VENTILATION SYSTEMS

Air terminal devices			N41			N34		
Position of damper			5	3	1	9	5	1
Method 1	Prandtl tube	dp [Pa]	11.57	33.8	54.5	3.48	10.78	14.23
		V [m³/h]	**194.0**	**331.6**	**421.5**	**174.3**	**306.8**	**352.5**
Method 2	Free area	w [m/s]	7.9	9.4	11.5	5.5	7.3	8.2
		V [m³/h]	**178.6**	**212.5**	**259.9**	**159.2**	**211.3**	**237.3**
Method 3	Plenum box	dp [Pa]	-			-		
		V [m³/h]						
Method 4	Air flow meter	dp [Pa]	-			-		
		V [m³/h]						
Method 5	K25	w [m/s]	9.32	11.38	12.06	6.62	8.95	9.88
		V [m³/h]	**189.7**	**231.6**	**245.5**	**134.7**	**182.2**	**201**
	K80	w [m/s]	9.84	12.05	12.96	6.95	9.53	10.66
		V [m³/h]	**200.2**	**245.2**	**263.7**	**141.4**	**193.9**	**216.9**
	K120	w [m/s]	1.65	2.85	4.41	1.21	2.29	2.7
		V [m³/h]	**222.7**	**384.8**	**595.4**	**163.4**	**309.2**	**364.5**
Method 6	IRIS 125	dp [Pa]	198.6	102.7	18.8	-		
		V [m³/h]	**218.1**	**315.8**	**390.2**			
	IRIS 160	dp [Pa]	-			120.59	49.49	8.8
		V [m³/h]				**162.1**	**226.1**	**266.6**

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COMPARATIVE ANALYSIS OF METHODS FOR MEASURING THE AIR VELOCITY AND FLOW IN MECHANICAL VENTILATION SYSTEMS

Air terminal devices			N25			N16		
Position of damper			10%	50%	100%	30%	60%	100%
Method 1	Prandtl tube	dp [Pa]	4.78	16.45	22.95	4.31	17.9	23
		V [m³/h]	**319.2**	**592.4**	**699.4**	**303.1**	**617.9**	**701.3**
Method 2	Free area	w [m/s]	1.5	3.1	3.6	1.4	2.5	2.8
		V [m³/h]	**298.2**	**616.3**	**715.7**	**333.9**	**596.2**	**667.8**
Method 3	Plenum box	dp [Pa]	16.84	32.78	51.9	-		
		V [m³/h]	**409.2**	**570.9**	**718.4**			
Method 4	Air flow meter	dp [Pa]	-			12.53	28.5	30.7
		V [m³/h]				**374.6**	**565**	**586.3**
Method 5	K25	w [m/s]	-			-		
		V [m³/h]						
	K80	w [m/s]	9.24	13.86	14.48	11.76	13.38	13.58
		V [m³/h]	**188.1**	**282.1**	**294.7**	**239.3**	**272.3**	**275.9**
	K120	w [m/s]	1.68	4.71	5.27	2.82	4.74	5.42
		V [m³/h]	**226.8**	**635.4**	**711.9**	**380.2**	**639.7**	**731.6**
Method 6	IRIS 125	dp [Pa]	-			-		
		V [m³/h]						
	IRIS 160	dp [Pa]	-			-		
		V [m³/h]						

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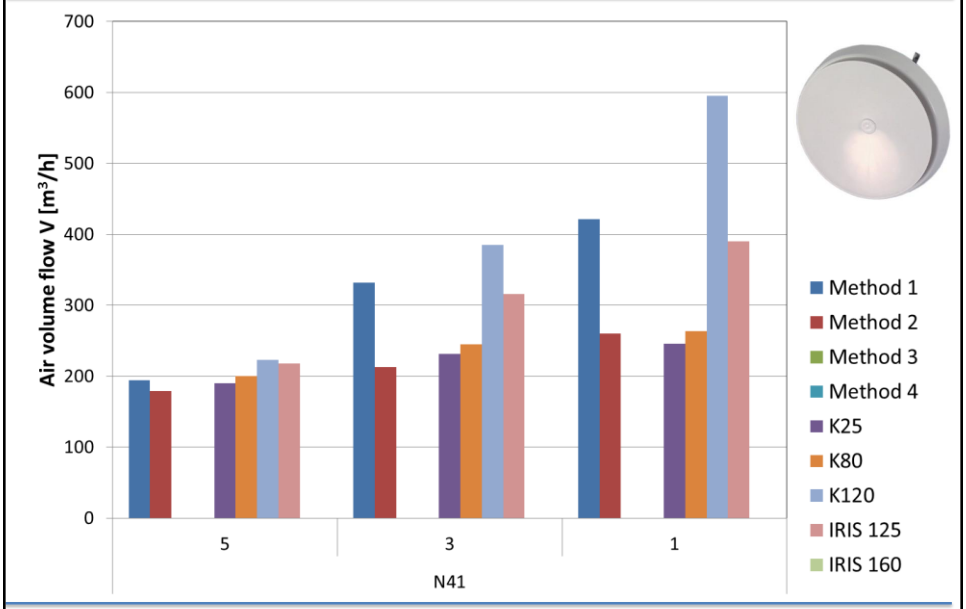

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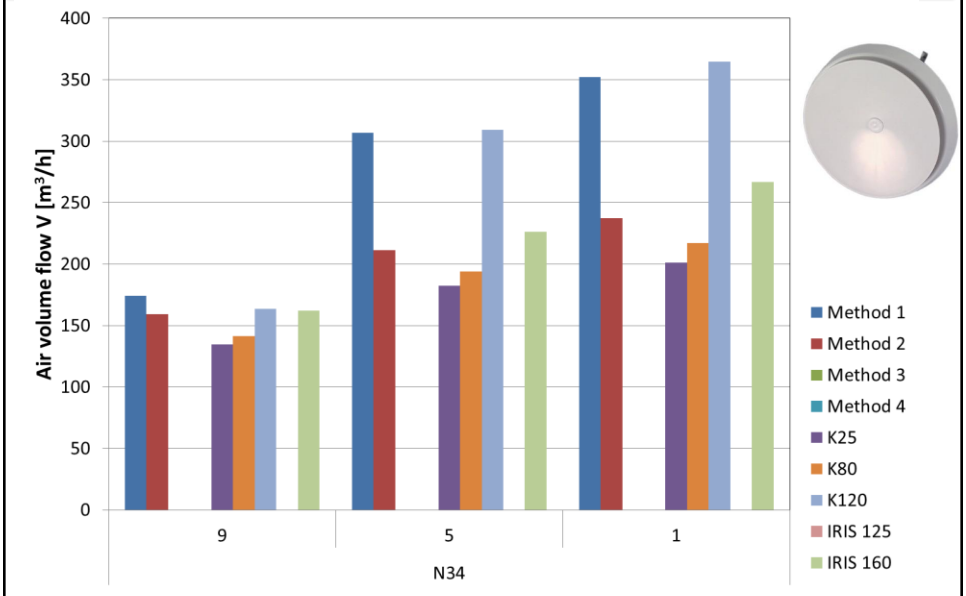

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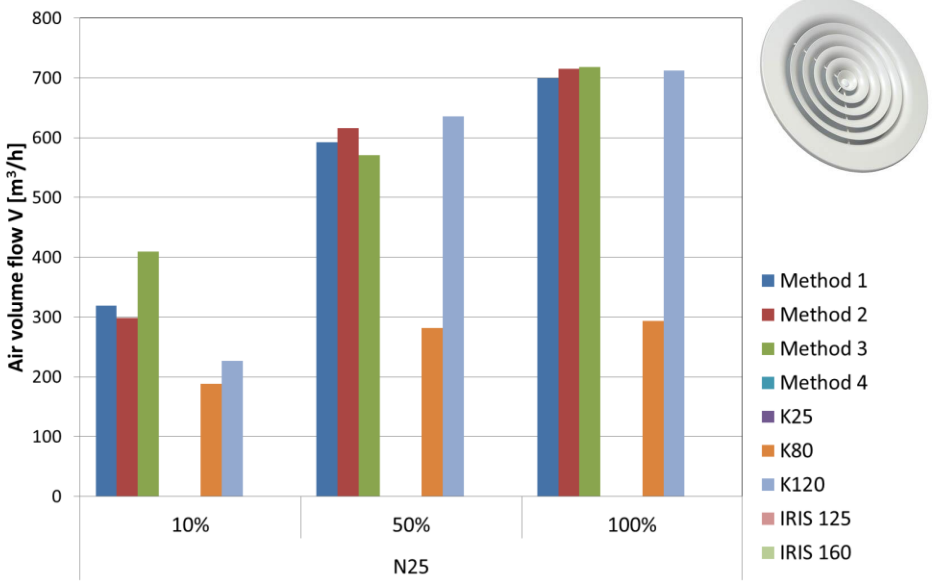

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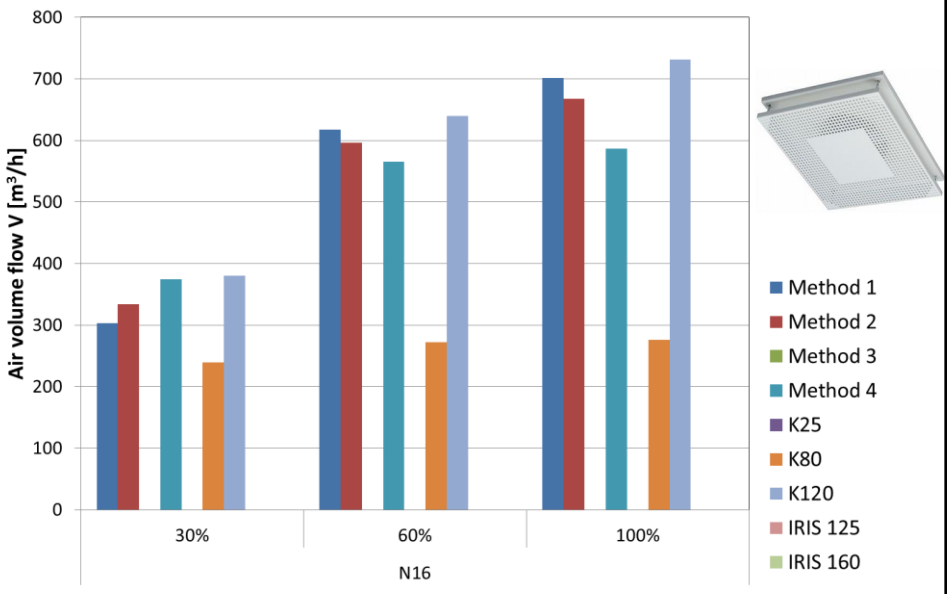

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CONCLUSIONS

As a result of measurement, it was found that:

- the results of measurements using different methods are significantly different for valves,
- it must necessarily follow the manufacturer's recommendation contained in the technical data sheet for the devices,
- proper selection of the method of measuring the specific model of each air terminal devices is essential.

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Comments and questions are welcome

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