

Department of Energy

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Turin, 14th June 2018

Annexes n. 17

TEST REPORT N. N. 05/2018

Requested by: New Air S.r.l.

Address: Via S. Quasimodo, 3/A - 46029 Suzzara (MN)

Date of request: 28th March 2018

Purpose of the test: measurement of the performance of an electrostatic precipitator for general ventilation applications according to EN ISO 16890:2016 series of standards.

Information supplied: active electrostatic precipitator named DSUTA/1. The nominal test air flow rate shall be 1800 m³/h.

Laboratory's remarks: powered electrostatic precipitator made up of:

- 16 metal plates 460*140 mm (thickness 0.6 mm);
- 99 metal plates 460*140 mm (thickness 0.3 mm);
- 15 powered polarizing metal wires.

The air filter's dimensions are: 590 mm (width) x 590 mm (height) x 220 mm (depth). The air filter's initial mass is equal to 17388 g.

A metal mesh prefilter is mounted upstream of the electrostatic precipitator unit. A metal net (14 mm x 12 mm) is used to contain the metal mesh on both sides of the prefilter. The prefilter's metal frame is U-shaped (base: 20 mm; height: 15 mm). The prefilter's dimensions are: 590 mm (width) x 590 mm (height) x 20 mm (depth). The metal filter's initial mass is equal to 1611 g.

The electrostatic precipitator performance was measured at various airflow rates: 1300, 1800, 2300, 2800 and 3300 m³/h. The synthetic aerosol for assessing the removal efficiency was DiEthylHexylSebacate (DEHS) in the size range between 0.3 and 3 µm.

The device was exposed to IsoPropyl Alcohol (IPA) vapor for 24 hours in a saturated and sealed cabinet as per EN ISO 16890-4:2016. After the exposure the efficiency by particle size of the device was measured again.

Results of the test: see Annexes 1-17.

Measurements performed by: SC.

The Head of the Department
Prof. A. Tenconi

The Laboratory Manager
Prof. P. Tronville



Testing organization	
Name:	Politecnico di Torino - DENERG
Address:	Corso Duca degli Abruzzi, 24 - Turin - Italy
Phone:	+39 011 090 44 00

ISO 16890:2016 - AIR FILTER TEST RESULTS

GENERAL

Report no.: 05/2018	Date of report: 14/06/2018	Supervisor: Paolo Tronville
Test(s) requested by New Air S.r.l.		Device obtained: Filter supplied by the customer

DEVICE TESTED

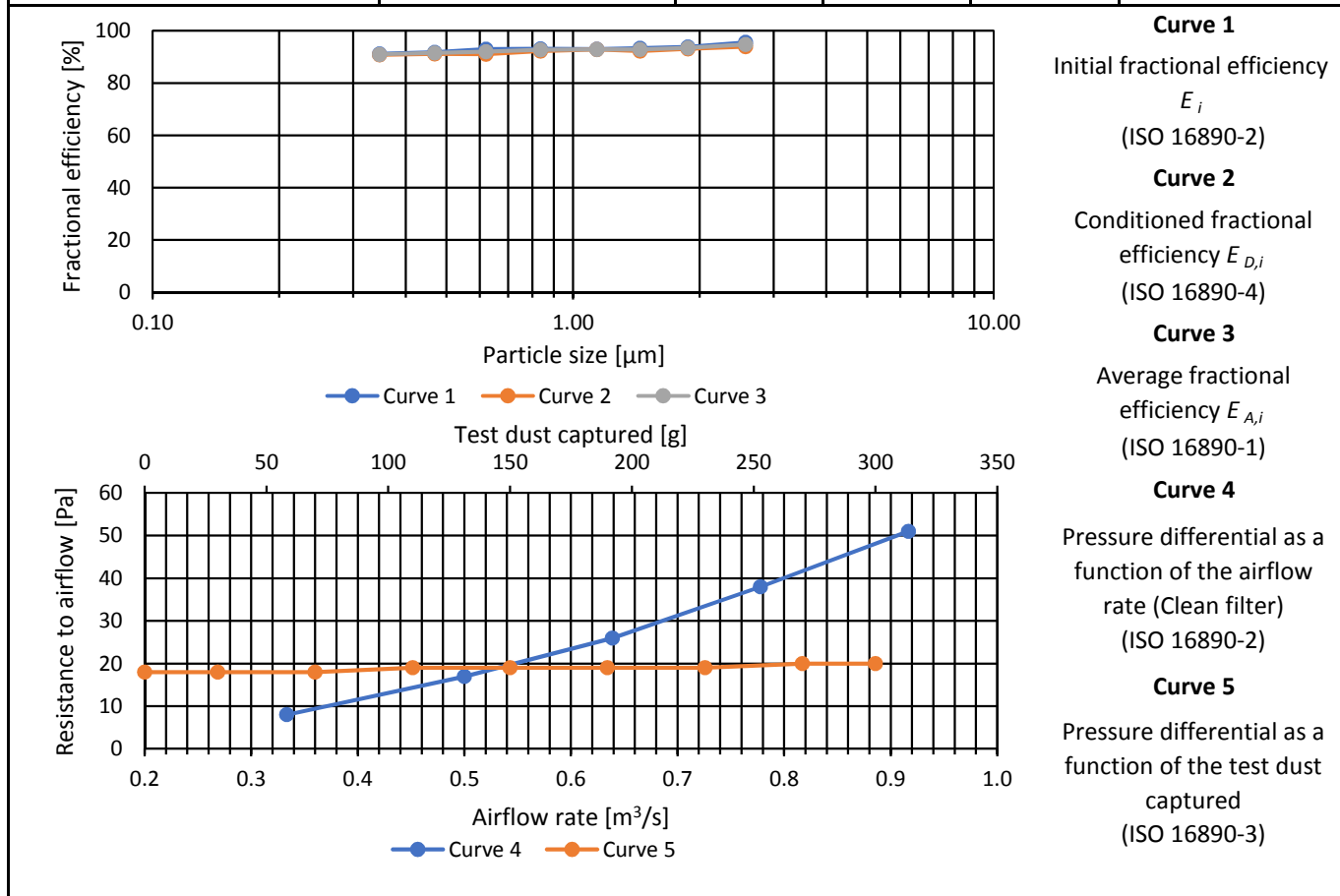
Model: DSUTA/1	Manufacturer: New Air S.r.l.	Construction: Electrostatic precipitator
Type of media: N/A	Net effective media area [m ²]: N/A	Filter dimensions (W x H x D) [mm]: 590 x 590 x 220
Filter/media electrostatic charge: +8 kV DC (Wires) / -4 kV DC (Plates)	Media colour: N/A	Media adhesive: N/A

TEST DATA AND ATTACHED TEST REPORTS

Test air flow rate [m ³ /s]: 0.5000	Test report to ISO 16890-2	Report no.: 05/2018-2
	Test report to Eurovent 4/21	Report no.: 05/2018-EU4/21

RESULTS

Initial pressure differential [Pa]: 17	Arrestance [%]: N/A	$ePM_{1,min}$ [%]: 91%	$ePM_{2.5,min}$ [%]: 92%	ISO rating ISO ePM_1 90%
Final pressure differential [Pa]: 20	Test dust capacity [g]: N/A	ePM_1 [%]: 92%	$ePM_{2.5}$ [%]: 92% ePM_{10} [%]: N/A	



Curve 1
Initial fractional efficiency E_i (ISO 16890-2)

Curve 2
Conditioned fractional efficiency $E_{D,i}$ (ISO 16890-4)

Curve 3
Average fractional efficiency $E_{A,i}$ (ISO 16890-1)

Curve 4
Pressure differential as a function of the airflow rate (Clean filter) (ISO 16890-2)

Curve 5
Pressure differential as a function of the test dust captured (ISO 16890-3)

NOTE: The results of this test relate only to the test device in the condition stated herein. The performance results cannot by themselves be quantitatively applied to predict filtration performance in all "real life" environments.

The Laboratory Manager
P. Tronville

This report must not be reproduced without the written approval of the Head of the Department. This test report is made up of eighteen pages and it should be used as a whole. The report applies to the tested device only.



Testing organization

Name: Politecnico di Torino - DENERG
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ISO 16890:2016 - FRACTIONAL EFFICIENCY VALUES

GENERAL							
Test ID: 05/2018		Date of test: 25-28/05/2018		Operator: SC			
Model: DSUTA/1			Manufacturer: New Air S.r.l.				
Test air flow rate [m ³ /s]:		0.5000					
<i>i</i>	<i>d_i</i> [μm]	<i>d_{i+1}</i> [μm]	\bar{d}_i [μm]	$\Delta \ln d_i$ [μm]	<i>E_i</i> [%]	<i>E_{D,i}</i> [%]	<i>E_{A,i}</i> [%]
1	0.30	0.40	0.35	0.2877	91.2	90.8	91.0
2	0.40	0.55	0.47	0.3185	91.8	91.2	91.5
3	0.55	0.70	0.62	0.2412	93.0	91.1	92.1
4	0.70	1.00	0.84	0.3567	93.2	92.3	92.7
5	1.00	1.30	1.14	0.2624	93.0	92.8	92.9
6	1.30	1.60	1.44	0.2076	93.4	92.3	92.8
7	1.60	2.20	1.88	0.3185	93.8	93.1	93.4
8	2.20	3.00	2.57	0.3102	95.6	93.9	94.8

Symbols and units

- d_i* Lower limit particle diameter in a size range *i*, [μm]
- d_{i+1}* Upper limit particle diameter in a size range *i*, [μm]
- \bar{d}_i Geometric mean diameter of a size range *i*, [μm]
- $\Delta \ln d_i$ Logarithmic width of a particle diameter size range *i*; ln is the natural logarithm to the base of e, where e is an irrational and transcendental constant approximately equal to 2.718281828, dimensionless. $\Delta \ln d_i = \ln(d_{i+1}/d_i)$
- E_i* Initial fractional efficiency of particle size range *i* of the untreated and unloaded filter element, [%]
- E_{D,i}* Fractional efficiency of particle size range *i* of the filter element after an artificial conditioning step, [%]
- E_{A,i}* Average fractional efficiency (*E_i* + *E_{D,i}*)/2 of particle size range *i*, [%]

NOTE: The results of this test relate only to the test device in the condition stated herein. The performance results cannot by themselves be quantitatively applied to predict filtration performance in all "real life" environments.

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ISO 16890:2016 - CALCULATION OF PM-EFFICIENCIES

GENERAL								
Test ID: 05/2018			Date of test: 25-28/05/2018			Operator: SC		
Model: DSUTA/1				Manufacturer: New Air S.r.l.				
Test air flow rate [m ³ /s]: 0.5000								
i	\bar{d}_i [μm]	$\Delta \ln d_i$	Urban distribution q_{3u}	$q_{3u} \cdot \Delta \ln d_i$	$E_{D,i} \cdot q_{3u} \cdot \Delta \ln d_i$	$E_{A,i} \cdot q_{3u} \cdot \Delta \ln d_i$	$ePM_{x,min}$ [%]	ePM_x [%]
1	0.35	0.29	0.2263	0.06509	5.9093	5.9220	$ePM_{1,min}$	ePM_1
2	0.47	0.32	0.1989	0.06334	5.7769	5.7968		
3	0.62	0.24	0.1584	0.03819	3.4794	3.5161		
4	0.84	0.36	0.1152	0.04110	3.7941	3.8114		
Σ line 1-4				0.20773	18.9597	19.0463	91%	92%
5	1.14	0.26	0.0850	0.02231	2.0708	2.0729	$ePM_{2.5,min}$	$ePM_{2.5}$
6	1.44	0.21	0.0762	0.01582	1.4603	1.4684		
7	1.88	0.32	0.0802	0.02555	2.3773	2.3870		
8	2.57	0.31	0.0998	0.03097	2.9089	2.9346		
Σ line 1-8				0.30237	27.7769	27.9092	92%	92%
i	\bar{d}_i [μm]	$\Delta \ln d_i$	Rural distribution q_{3r}	$q_{3r} \cdot \Delta \ln d_i$		$E_{A,i} \cdot q_{3r} \cdot \Delta \ln d_i$		ePM_x [%]
1	-	-	-	-	-	-		ePM_{10}
2	-	-	-	-	-	-		
3	-	-	-	-	-	-		
4	-	-	-	-	-	-		
5	-	-	-	-	-	-		
6	-	-	-	-	-	-		
7	-	-	-	-	-	-		
8	-	-	-	-	-	-		
9	-	-	-	-	-	-		
10	-	-	-	-	-	-		
11	-	-	-	-	-	-		
12	-	-	-	-	-	-		
Σ line 1-12				-	-	-	-	N/A

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ISO 16890-2:2016 - AIR FILTER TEST RESULT SUMMARY

GENERAL							
Test ID:	05/2018-2	Date of test:	25-28/05/2018	Operator:	SC		
Particle counter information			Airflow measurement:	Test sample obtained:			
Manufacturer:	Model:	Coincidence value [p/dm ³]:	Orifice plate according to ISO 5167-2	Filter supplied by the customer			
PMS	LAS-X II	1.8x10 ⁶					
DEVICE TESTED							
Model:	DSUTA/1	Manufacturer:	New Air S.r.l.	Construction:	Electrostatic precipitator		
Type of media:	N/A	Net effective media area [m ²]:	N/A	Filter dimensions (W x H x D) [mm]: 590 x 590 x 220			
Filter/media electrostatic charge: +8 kV DC (wires) / -4 kV DC (plates)	Media colour:		N/A	Media adhesive:	N/A		
Device condition:	Clean and after conditioning per ISO 16890-4						
Other descriptive information:	N/A						
TEST DATA SUMMARY							
Test airflow rate [m ³ /s]:	Test air temperature [°C]:	Test air RH [%]:	Test aerosol:	Loading dust or conditioning method:			
0.5000	24.7 -26.2	45 - 50	DEHS	IPA vapor (ISO 16890-4)			
RESULTS							
Resistance to airflow [Pa]		Fractional efficiency [%]					
Before IPA (fractional eff. config.):	16	After IPA (fractional eff. config.):	17	Range [µm]	Initial efficiency	Conditioned efficiency	Upstream concentration (Before - After IPA exposure) [p/dm ³]
				0.30 - 0.40	91.2 ±0.9	90.8 ±0.9	87414 - 94367
Test device photo				0.40 - 0.55	91.8 ±0.7	91.2 ±0.6	53236 - 58054
				0.55 - 0.70	93.0 ±0.6	91.1 ±0.6	20997 - 21552
				0.70 - 1.00	93.2 ±0.5	92.3 ±0.9	24340 - 26350
				1.00 - 1.30	93.0 ±0.8	92.8 ±1.1	5731 - 6152
				1.30 - 1.60	93.4 ±1.9	92.3 ±2.0	3815 - 3963
				1.60 - 2.20	93.8 ±1.7	93.1 ±1.3	12158 - 12300
				2.20 - 3.00	95.6 ±1.5	93.9 ±1.6	2128 - 2007
				3.00 - 4.00	- -	- -	-
				4.00 - 5.50	- -	- -	-
		5.50 - 7.00	- -	- -	-		
		7.00 - 10.00	- -	- -	-		
NOTE: The results of this test relate only to the test device in the condition stated herein. The performance results cannot by themselves be quantitatively applied to predict filtration performance in all "real life" environments.							

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ISO 16890-2:2016 - AIR FILTER TEST RESULT DETAILS

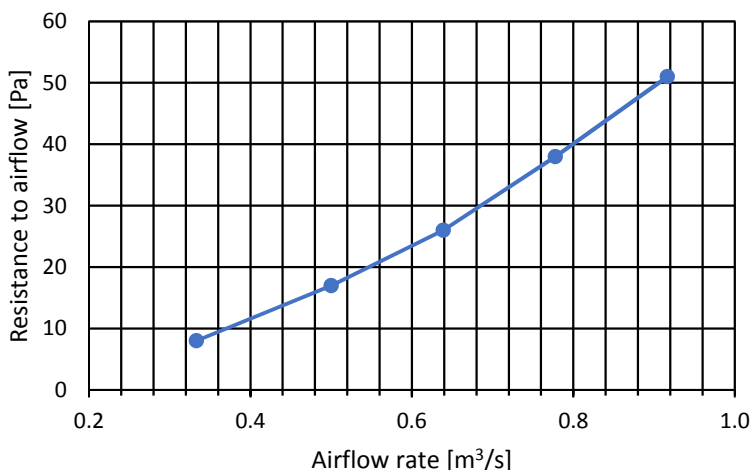
GENERAL

Test ID: 02/2018-2 Date of test: 25-28/05/2018 Operator: SC

TEST DATA DETAILS

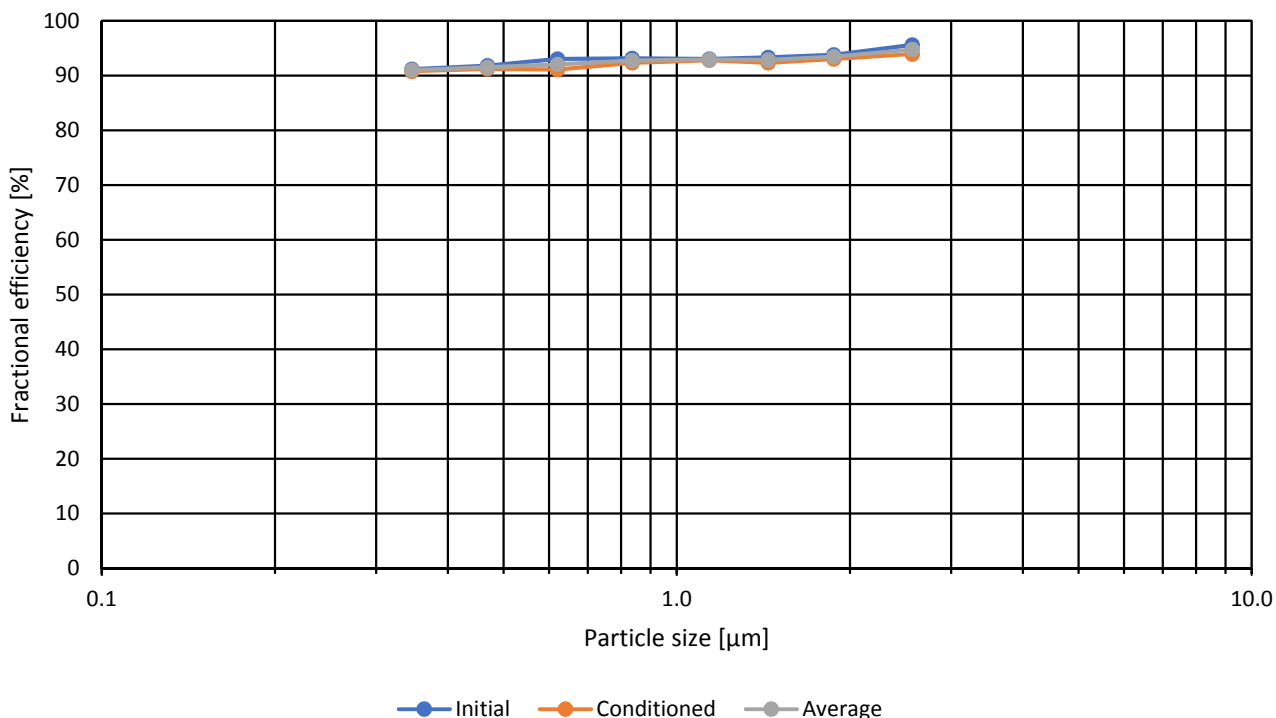
Resistance to airflow

% of rated airflow	Airflow rate [m ³ /s]	Corrected resistance to airflow [Pa]
67%	0.3333	8
100%	0.5000	17
128%	0.6389	26
156%	0.7778	38
183%	0.9167	51



Clean filter resistance to airflow is proportional to $\Delta p = c(q_v)^n$, where $n = 1.8038$

Fractional efficiency by particle size




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ISO 16890-2:2016 - AIR FILTER TEST RESULT SUMMARY

GENERAL							
Test ID:	05/2018-2	Date of test:	25-28/05/2018	Operator:	SC		
Particle counter information			Airflow measurement:	Test sample obtained:			
Manufacturer:	Model:	Coincidence value [p/dm ³]:	Orifice plate according to ISO 5167-2	Filter supplied by the customer			
PMS	LAS-X II	1.8x10 ⁶					
DEVICE TESTED							
Model:	DSUTA/1	Manufacturer:	New Air S.r.l.	Construction:	Electrostatic precipitator		
Type of media:	N/A	Net effective media area [m ²]:	N/A	Filter dimensions (W x H x D) [mm]: 590 x 590 x 220			
Filter/media electrostatic charge: +8 kV DC (wires) / -4 kV DC (plates)	Media colour:		N/A	Media adhesive:	N/A		
Device condition:	Clean filter and after conditioning per ISO 16890-4						
Other descriptive information:	N/A						
TEST DATA SUMMARY							
Test airflow rate [m ³ /s]:	Test air temperature [°C]:	Test air RH [%]:	Test aerosol:	Loading dust or conditioning method:			
0.3333	24.7 - 25.7	48 - 50	DEHS	IPA vapor (ISO 16890-4)			
RESULTS							
Resistance to airflow [Pa]		Fractional efficiency [%]					
Before IPA (fractional eff. config.):	8	After IPA (fractional eff. config.):	8	Range [µm]	Initial efficiency	Conditioned efficiency	Upstream concentration (Before - After IPA exposure) [p/dm ³]
Test device photo		0.30 - 0.40	93.2 ±0.6	91.7 ±0.7	78875 - 82747		
		0.40 - 0.55	94.3 ±0.9	92.3 ±1.0	50182 - 51680		
		0.55 - 0.70	94.0 ±1.2	92.7 ±0.9	20313 - 20246		
		0.70 - 1.00	94.6 ±0.8	92.9 ±1.2	23616 - 24650		
		1.00 - 1.30	94.7 ±2.0	94.4 ±1.3	5404 - 6077		
		1.30 - 1.60	95.4 ±1.8	93.6 ±1.7	4131 - 3987		
		1.60 - 2.20	95.3 ±1.0	93.5 ±1.6	12623 - 12192		
		2.20 - 3.00	96.3 ±3.0	95.5 ±1.3	2189 - 2135		
		3.00 - 4.00	-	-	-		
		4.00 - 5.50	-	-	-		
		5.50 - 7.00	-	-	-		
7.00 - 10.00	-	-	-				
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ISO 16890-2:2016 - AIR FILTER TEST RESULT DETAILS

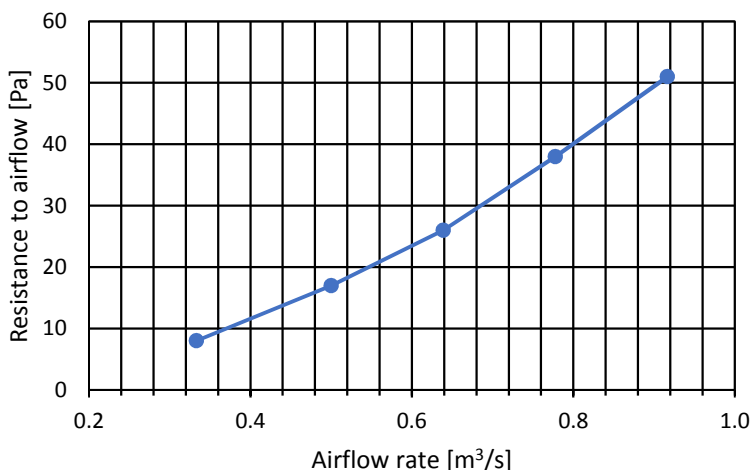
GENERAL

Test ID: 02/2018-2 Date of test: 25-28/05/2018 Operator: SC

TEST DATA DETAILS

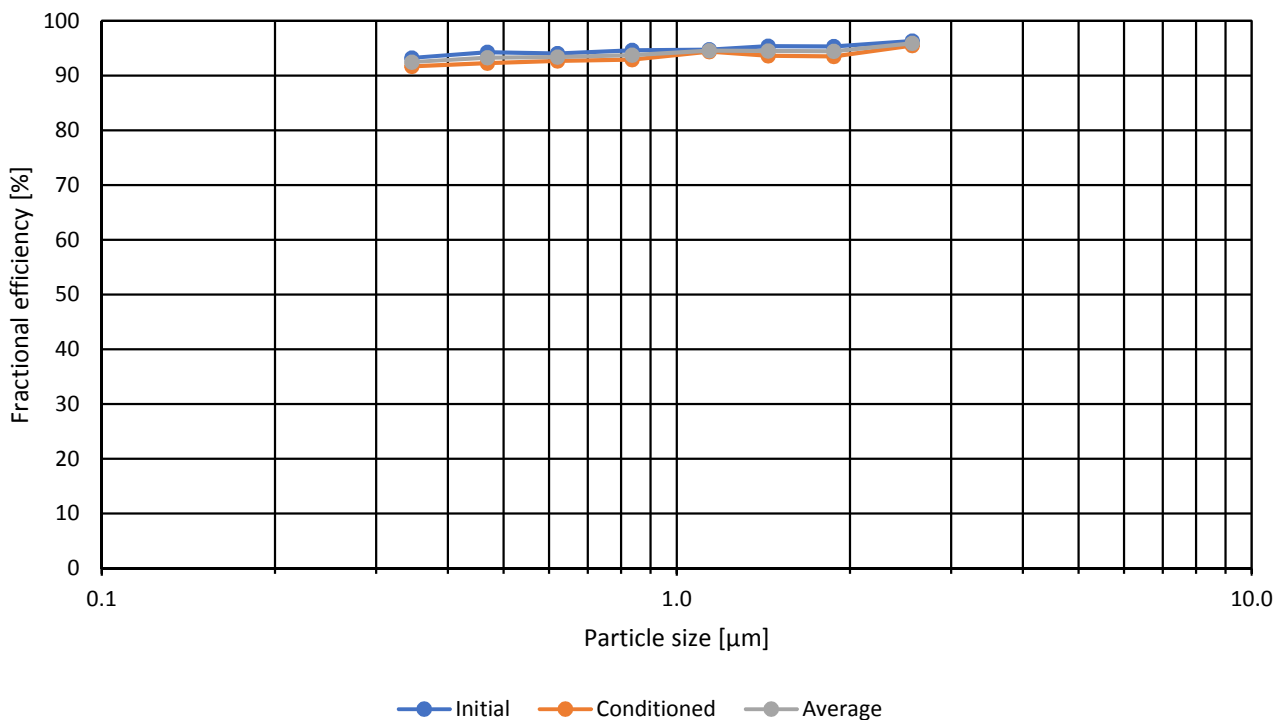
Resistance to airflow

% of rated airflow	Airflow rate [m ³ /s]	Corrected resistance to airflow [Pa]
67%	0.3333	8
100%	0.5000	17
128%	0.6389	26
156%	0.7778	38
183%	0.9167	51



Clean filter resistance to airflow is proportional to $\Delta p = c(q_v)^n$, where $n = 1.8038$

Fractional efficiency by particle size



NOTE: The results of this test relate only to the test device in the condition stated herein. The performance results cannot by themselves be quantitatively applied to predict filtration performance in all "real life" environments.

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P. Tronville**



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ISO 16890-2:2016 - AIR FILTER TEST RESULT SUMMARY

GENERAL								
Test ID:	05/2018-2		Date of test:	25-28/05/2018		Operator:	SC	
Particle counter information				Airflow measurement:	Test sample obtained:			
Manufacturer:	Model:	Coincidence value [p/dm ³]:		Orifice plate according to ISO 5167-2	Filter supplied by the customer			
PMS	LAS-X II	1.8x10 ⁶						
DEVICE TESTED								
Model:	DSUTA/1		Manufacturer:	New Air S.r.l.		Construction:	Electrostatic precipitator	
Type of media:	N/A		Net effective media area [m ²]:	N/A		Filter dimensions (W x H x D) [mm]: 590 x 590 x 220		
Filter/media electrostatic charge: +8 kV DC (wires) / -4 kV DC (plates)			Media colour:	N/A		Media adhesive:		N/A
Device condition:							Clean filter and after conditioning per ISO 16890-4	
Other descriptive information:							N/A	
TEST DATA SUMMARY								
Test airflow rate [m ³ /s]:	Test air temperature [°C]:	Test air RH [%]:	Test aerosol:	Loading dust or conditioning method:				
0.6389	25.2 - 26.7	45 - 48	DEHS	IPA vapor (ISO 16890-4)				
RESULTS								
Resistance to airflow [Pa]			Fractional efficiency [%]					
Before IPA (fractional eff. config.):	25	After IPA (fractional eff. config.):	26	Range [µm]	Initial efficiency	Conditioned efficiency	Upstream concentration (Before - After IPA exposure) [p/dm ³]	
Test device photo			0.30 - 0.40	87.3 ±1.1	86.3 ±1.4	87064 - 96791		
			0.40 - 0.55	89.2 ±1.0	88.6 ±1.4	52818 - 57751		
			0.55 - 0.70	90.5 ±1.1	90.0 ±1.7	20165 - 21923		
			0.70 - 1.00	91.8 ±0.9	90.6 ±1.9	23838 - 25939		
			1.00 - 1.30	93.4 ±1.8	89.8 ±2.1	5485 - 5667		
			1.30 - 1.60	92.2 ±1.4	91.1 ±1.2	3815 - 3852		
			1.60 - 2.20	94.1 ±0.9	91.9 ±1.3	11121 - 11768		
			2.20 - 3.00	93.9 ±4.9	95.7 ±2.1	1980 - 1970		
			3.00 - 4.00	-	-	-		
			4.00 - 5.50	-	-	-		
			5.50 - 7.00	-	-	-		
7.00 - 10.00	-	-	-					
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ISO 16890-2:2016 - AIR FILTER TEST RESULT DETAILS

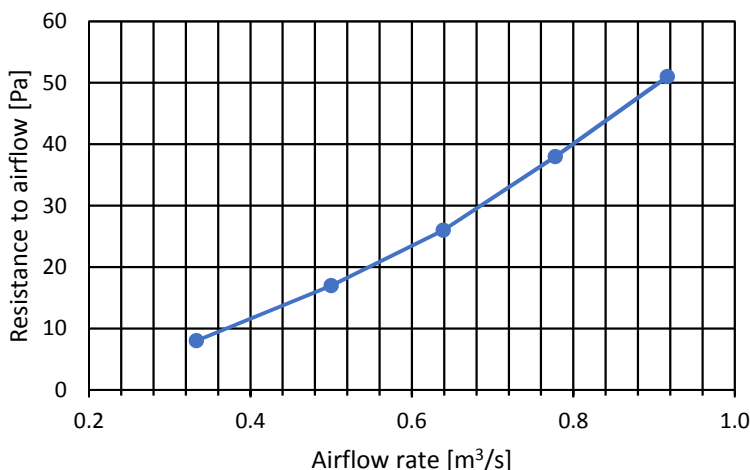
GENERAL

Test ID: 02/2018-2 Date of test: 25-28/05/2018 Operator: SC

TEST DATA DETAILS

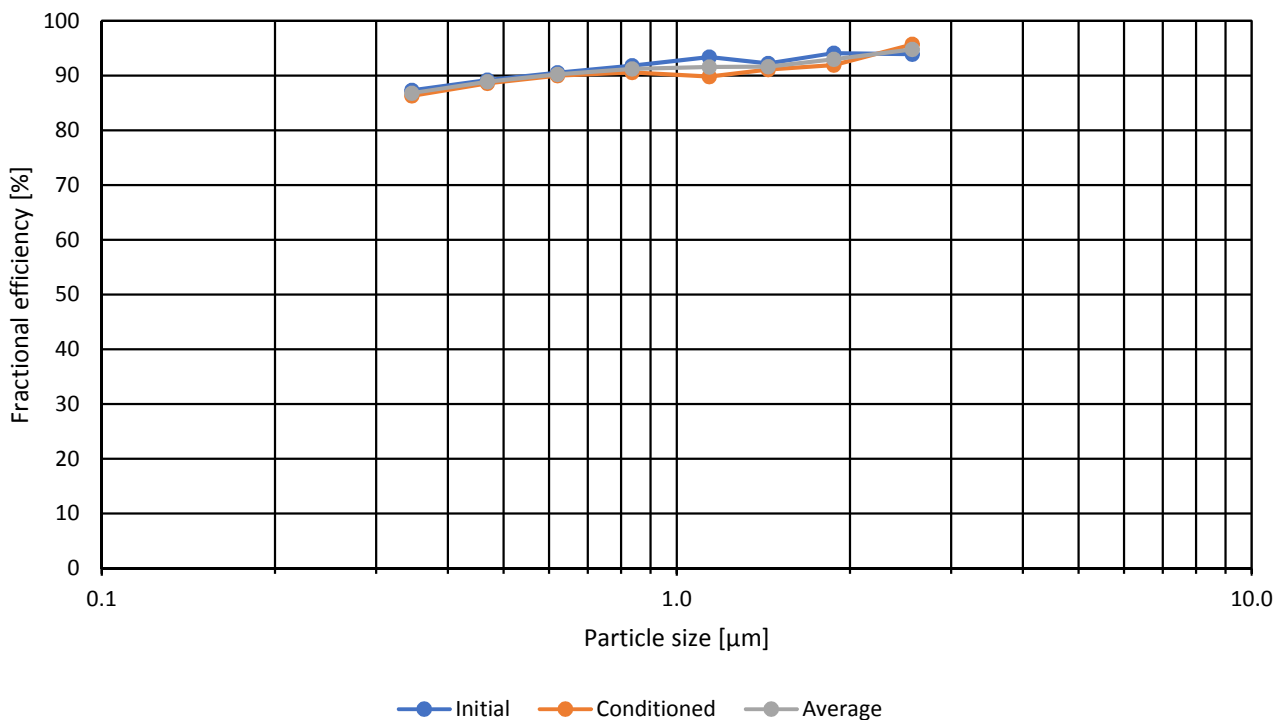
Resistance to airflow

% of rated airflow	Airflow rate [m ³ /s]	Corrected resistance to airflow [Pa]
67%	0.3333	8
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Fractional efficiency by particle size




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ISO 16890-2:2016 - AIR FILTER TEST RESULT SUMMARY

GENERAL								
Test ID:	05/2018-2		Date of test:	25-28/05/2018		Operator:	SC	
Particle counter information				Airflow measurement:	Test sample obtained:			
Manufacturer:	Model:	Coincidence value [p/dm ³]:		Orifice plate according to ISO 5167-2	Filter supplied by the customer			
PMS	LAS-X II	1.8x10 ⁶						
DEVICE TESTED								
Model:	DSUTA/1		Manufacturer:	New Air S.r.l.		Construction:	Electrostatic precipitator	
Type of media:	N/A		Net effective media area [m ²]:	N/A		Filter dimensions (W x H x D) [mm]: 590 x 590 x 220		
Filter/media electrostatic charge: +8 kV DC (wires) / -4 kV DC (plates)			Media colour:	N/A		Media adhesive:		N/A
Device condition:							Clean filter and after conditioning per ISO 16890-4	
Other descriptive information:							N/A	
TEST DATA SUMMARY								
Test airflow rate [m ³ /s]:	Test air temperature [°C]:		Test air RH [%]:	Test aerosol:	Loading dust or conditioning method:			
0.7778	25.2 - 27.2		44 - 50	DEHS	IPA vapor (ISO 16890-4)			
RESULTS								
Resistance to airflow [Pa]			Fractional efficiency [%]					
Before IPA (fractional eff. config.):	35	After IPA (fractional eff. config.):	38	Range [µm]	Initial efficiency	Conditioned efficiency	Upstream concentration (Before - After IPA exposure) [p/dm ³]	
Test device photo			0.30 - 0.40	79.6 ±0.7	79.1 ±1.8	77741 - 79774		
			0.40 - 0.55	83.3 ±0.6	84.0 ±1.1	46811 - 47552		
			0.55 - 0.70	87.3 ±1.1	84.5 ±1.8	18215 - 17835		
			0.70 - 1.00	89.8 ±1.7	87.7 ±1.5	21155 - 21747		
			1.00 - 1.30	91.1 ±1.6	89.5 ±3.1	4741 - 5003		
			1.30 - 1.60	93.2 ±2.8	89.7 ±4.3	3273 - 3205		
			1.60 - 2.20	92.7 ±1.8	91.4 ±1.2	10037 - 9498		
			2.20 - 3.00	94.7 ±3.6	95.4 ±3.2	1744 - 1579		
			3.00 - 4.00	-	-	-		
			4.00 - 5.50	-	-	-		
			5.50 - 7.00	-	-	-		
7.00 - 10.00	-	-	-					
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Phone: +39 011 090 44 00

ISO 16890-2:2016 - AIR FILTER TEST RESULT DETAILS

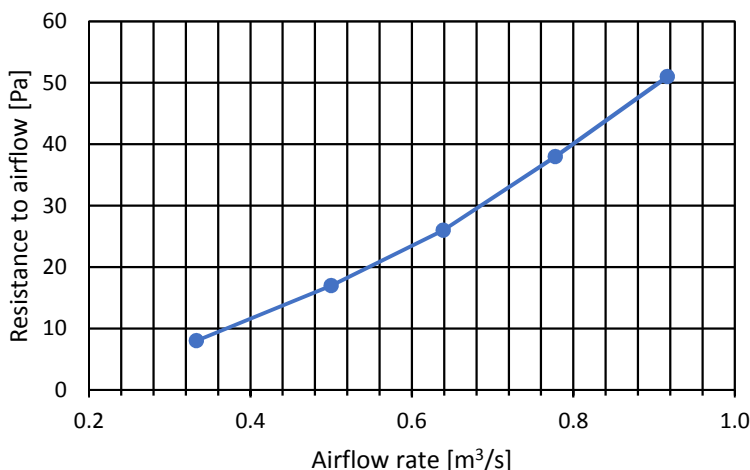
GENERAL

Test ID: 02/2018-2 Date of test: 25-28/05/2018 Operator: SC

TEST DATA DETAILS

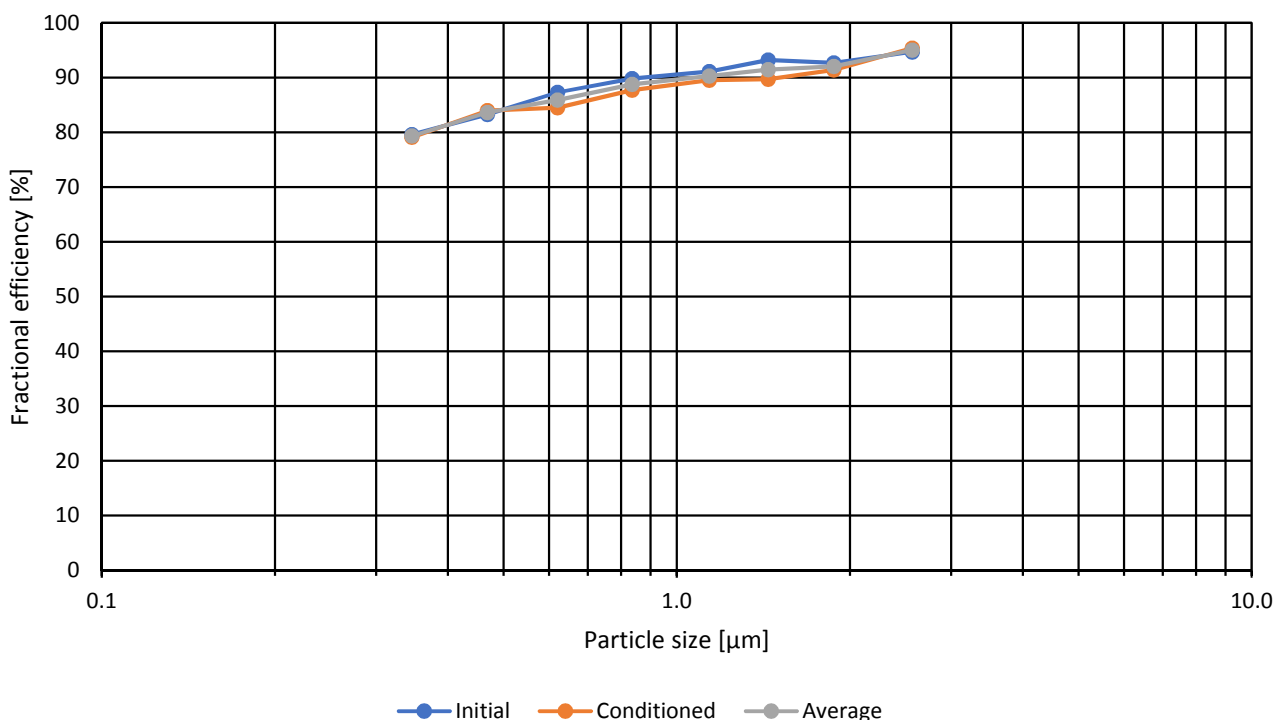
Resistance to airflow

% of rated airflow	Airflow rate [m ³ /s]	Corrected resistance to airflow [Pa]
67%	0.3333	8
100%	0.5000	17
128%	0.6389	26
156%	0.7778	38
183%	0.9167	51



Clean filter resistance to airflow is proportional to $\Delta p = c(q_v)^n$, where $n = 1.8038$

Fractional efficiency by particle size



NOTE: The results of this test relate only to the test device in the condition stated herein. The performance results cannot by themselves be quantitatively applied to predict filtration performance in all "real life" environments.

**The Laboratory Manager
P. Tronville**



Testing organization	
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ISO 16890-2:2016 - AIR FILTER TEST RESULT SUMMARY

GENERAL							
Test ID:	05/2018-2	Date of test:	25-28/05/2018	Operator:	SC		
Particle counter information			Airflow measurement:	Test sample obtained:			
Manufacturer:	Model:	Coincidence value [p/dm ³]:	Orifice plate according to ISO 5167-2	Filter supplied by the customer			
PMS	LAS-X II	1.8x10 ⁶					
DEVICE TESTED							
Model:	DSUTA/1	Manufacturer:	New Air S.r.l.	Construction:	Electrostatic precipitator		
Type of media:	N/A	Net effective media area [m ²]:	N/A	Filter dimensions (W x H x D) [mm]: 590 x 590 x 220			
Filter/media electrostatic charge: +8 kV DC (wires) / -4 kV DC (plates)	Media colour:		N/A	Media adhesive:	N/A		
Device condition:	Clean filter and after conditioning per ISO 16890-4						
Other descriptive information:	N/A						
TEST DATA SUMMARY							
Test airflow rate [m ³ /s]:	Test air temperature [°C]:	Test air RH [%]:	Test aerosol:	Loading dust or conditioning method:			
0.9167	25.2 - 27.2	44 - 51	DEHS	IPA vapor (ISO 16890-4)			
RESULTS							
Resistance to airflow [Pa]		Fractional efficiency [%]					
Before IPA (fractional eff. config.):	48	After IPA (fractional eff. config.):	51	Range [µm]	Initial efficiency	Conditioned efficiency	Upstream concentration (Before - After IPA exposure) [p/dm ³]
Test device photo		0.30 - 0.40	69.2 ±1.0	70.7 ±1.4	93162 - 111226		
		0.40 - 0.55	74.8 ±1.1	76.1 ±1.3	55926 - 65525		
		0.55 - 0.70	80.5 ±1.2	80.4 ±1.5	20505 - 24579		
		0.70 - 1.00	83.4 ±2.0	84.9 ±1.4	23630 - 27872		
		1.00 - 1.30	88.5 ±4.0	87.4 ±2.3	5330 - 6128		
		1.30 - 1.60	88.2 ±6.3	89.0 ±4.3	3626 - 4202		
		1.60 - 2.20	91.2 ±1.0	91.0 ±0.5	11219 - 12758		
		2.20 - 3.00	94.8 ±4.7	94.4 ±1.0	1838 - 2064		
		3.00 - 4.00	-	-	-		
		4.00 - 5.50	-	-	-		
		5.50 - 7.00	-	-	-		
7.00 - 10.00	-	-	-				
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ISO 16890-2:2016 - AIR FILTER TEST RESULT DETAILS

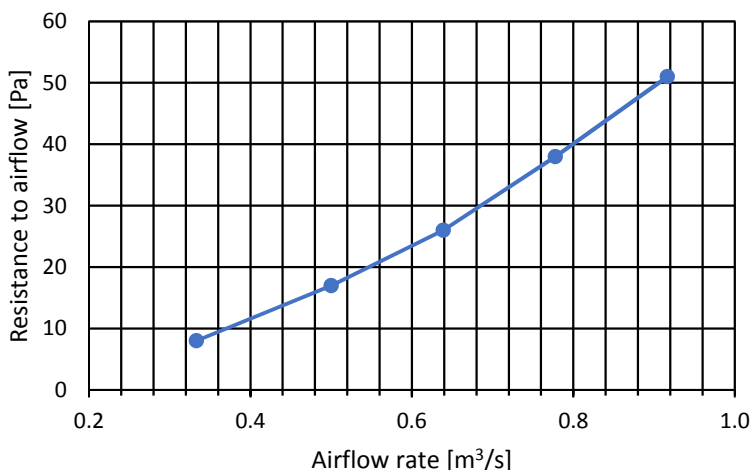
GENERAL

Test ID: 02/2018-2 Date of test: 25-28/05/2018 Operator: SC

TEST DATA DETAILS

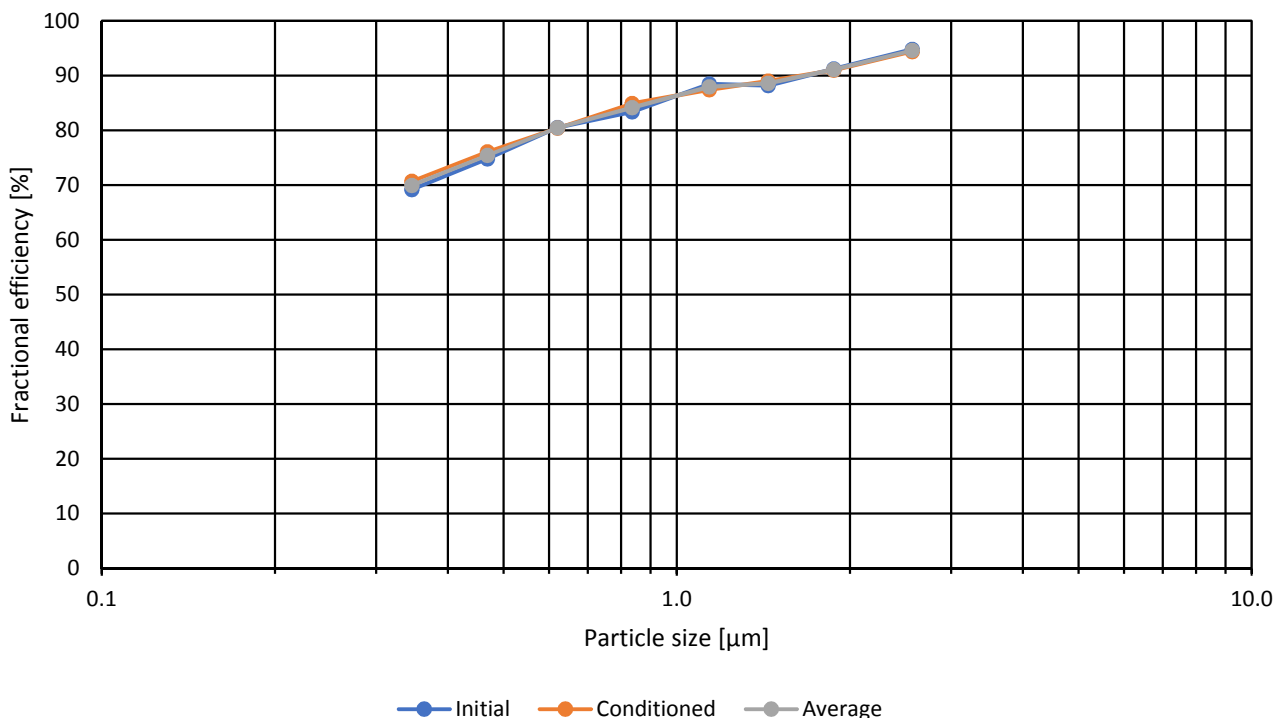
Resistance to airflow

% of rated airflow	Airflow rate [m ³ /s]	Corrected resistance to airflow [Pa]
67%	0.3333	8
100%	0.5000	17
128%	0.6389	26
156%	0.7778	38
183%	0.9167	51



Clean filter resistance to airflow is proportional to $\Delta p = c(q_v)^n$, where $n = 1.8038$

Fractional efficiency by particle size



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EUROVENT 4/21 - RESULT SUMMARY

GENERAL					
Test ID:	05/2018-EU4/21	Date of test:	29/05/2017	Operator:	SC
Particle counter information			Airflow measurement:	Test sample obtained:	
Manufacturer:	Model:	Coincidence value [p/dm ³]:	Orifice plate according to ISO 5167-2	Filter supplied by the customer	
N/A	N/A	N/A			
DEVICE TESTED					
Model:	DSUTA/1	Manufacturer:	New Air S.r.l.	Construction:	Electrostatic precipitator
Type of media:	N/A	Net effective media area [m ²]:	N/A	Filter dimensions (W x H x D) [mm]: 590 x 590 x 220	
Filter/media electrostatic charge: +8 kV DC (wires) / -4 kV DC (plates)		Media colour:	N/A	Media adhesive: N/A	
Device condition: Conditioned per ISO 16890-4					
Other descriptive information: N/A					
TEST DATA SUMMARY					
Test airflow rate [m ³ /s]:	Test air temperature [°C]:	Test air RH [%]:	Test aerosol:	Loading dust:	
0.5000	23.7 - 25.3	47 - 57	N/A	ISO 15957 L2 Dust - Batch 9308	
RISULTATI					
Resistance to airflow [Pa]		Average Δp [Pa]	Yearly energy consumption [kWh/y]	Test dust capacity [g]	
Measured initial:	18			Measured final:	20
Test device photo					
					
NOTE: The results of this test relate only to the test device in the condition stated herein. The performance results cannot by themselves be quantitatively applied to predict filtration performance in all "real life" environments.					

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EUROVENT 4/21 - RESULT DETAILS

Testing device: Electrostatic precipitator Model DSUTA/1

Test ID: 05/2018-EU4/21 Airflow rate [m³/s]: 0.5000

Date	Loaded dust m_{tot} [g]	Airflow meter				Filter						
		t_f [°C]	p_{sf} [kPa]	Δp_f [Pa]	q_m [kg/m ³]	t [°C]	ϕ [%]	p_a [kPa]	ρ [kg/m ³]	q_v [m ³ /s]	Δp [Pa]	$\Delta p_{1.2}$ [Pa]

Clean filter

25/05/2018	0	24.7	98.2	172	0	24.8	47	98.1	1.1417	0.3333	8	8
25/05/2018	0	24.7	98.2	388	0	25.3	48	98.1	1.1417	0.5000	16	17
25/05/2018	0	24.7	98.2	636	0	25.3	47	98.1	1.1418	0.6389	25	26
25/05/2018	0	24.7	98.2	945	0	25.3	47	98.1	1.1420	0.7778	37	38
25/05/2018	0	25.2	98.2	1315	0	25.3	47	98.1	1.1400	0.9167	49	51

Clean filter resistance to airflow is proportional to $(q_v)^n$, where $n = 1.8038$

Dust loading phase

29/05/2018	0	23.7	98.3	391	0.14	23.7	57	98.4	1.1474	0.5000	17	18
29/05/2018	30	23.7	98.3	391	0.14	23.7	57	98.4	1.1474	0.5000	17	18
29/05/2018	70	24.3	98.3	390	0.14	24.2	57	98.4	1.1474	0.5000	17	18
29/05/2018	110	24.3	98.3	390	0.14	24.2	57	98.4	1.1453	0.5000	18	19
29/05/2018	150	24.3	98.3	390	0.14	24.2	57	98.4	1.1474	0.5000	18	19
29/05/2018	190	24.3	98.3	390	0.14	24.2	56	98.4	1.1453	0.5000	18	19
29/05/2018	230	24.3	98.3	390	0.14	24.2	56	98.4	1.1454	0.5000	18	19
29/05/2018	270	24.8	98.1	389	0.14	24.7	55	98.2	1.1454	0.5000	19	20
29/05/2018	300	24.8	98.1	389	0.14	24.7	55	98.2	1.1411	0.5000	19	20

Symbols and units

m_{tot}	Cumulative mass of loaded dust to filter, [g]
p_a	Absolute air pressure upstream of filter, [kPa]
p_{sf}	Airflow meter static pressure, [kPa]
q_m	Mass flow rate. [kg/m ³]
q_v	Airflow rate at filter [m ³ /s]
t	Temperature upstream of filter, [°C]
t_f	Temperature at airflow meter, [°C]
ρ	Air density upstream of filter, [kg/m ³]
ϕ	Relative humidity upstream of filter, [%]
Δp	Measured filter resistance to airflow, [Pa]
Δp_f	Differential pressure used for determination of airflow rate, [Pa]
$\Delta p_{1.2}$	Filter resistance to airflow at air density 1.20 kg/m ³ , [Pa]

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EUROVENT 4/21 - RESULT DETAILS

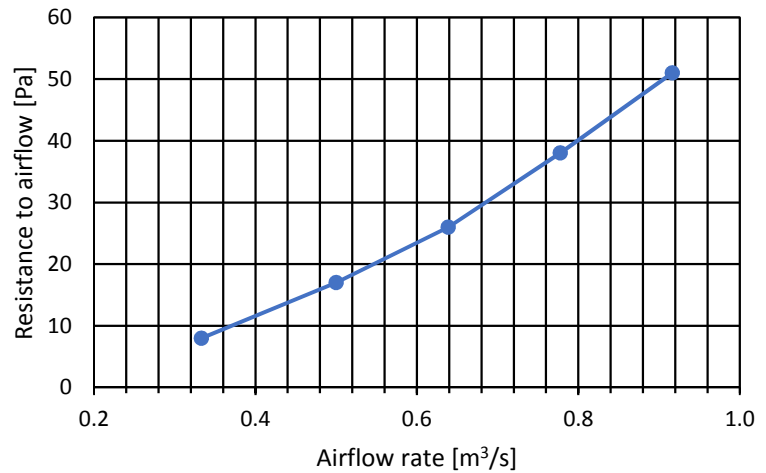
GENERAL

Test ID: 05/2018-EU4/21 Date of test: 29/05/2018 Operator: SC

TEST DATA DETAILS

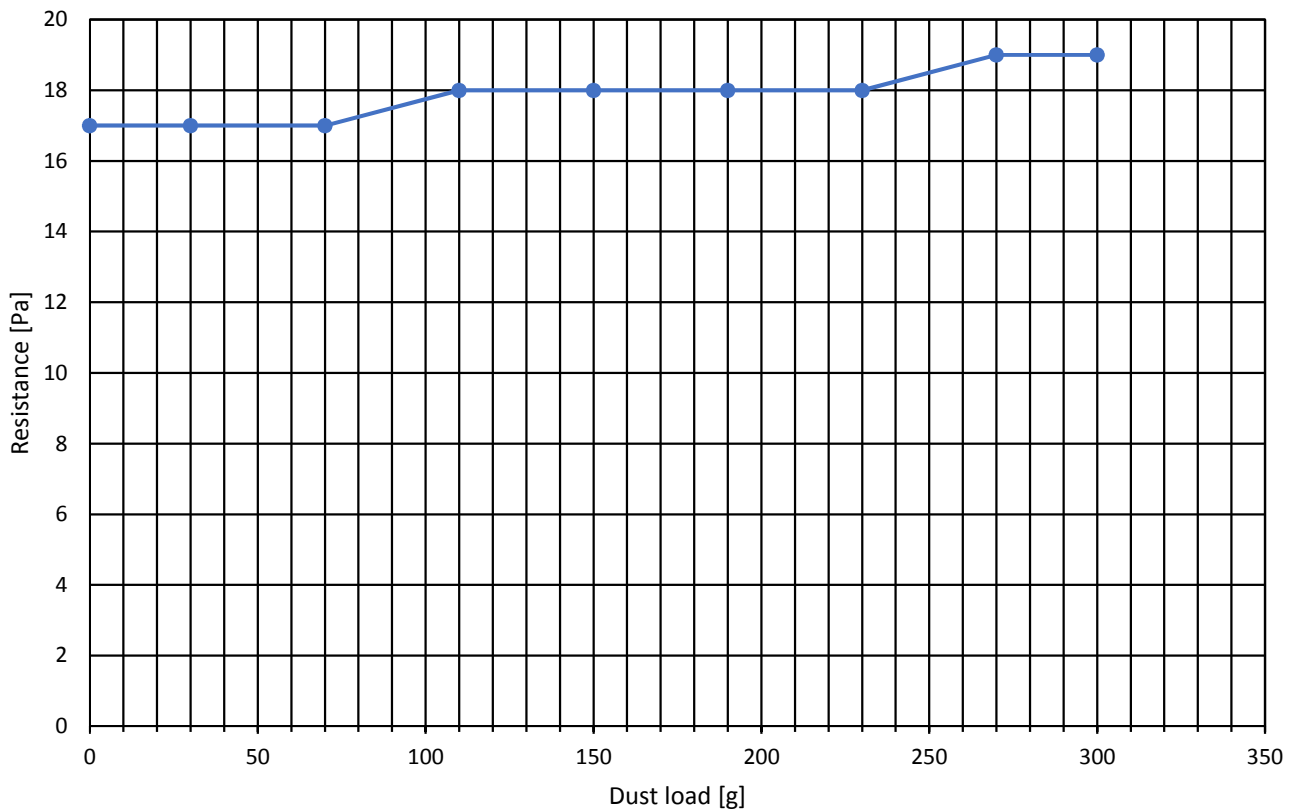
Resistance to airflow

% of rated airflow	Airflow rate [m ³ /s]	Corrected resistance to airflow [Pa]
67%	0.3333	8
100%	0.5000	17
128%	0.6389	26
156%	0.7778	38
183%	0.9167	51



Clean filter resistance to airflow is proportional to $\Delta p = c(q_v)^n$, where $n = 1.8038$

Pressure drop after different dust loading phases



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EUROVENT 4/21 - KEP CALCULATION

Testing device: Electrostatic precipitator Model DSUTA/1

Test ID: 05/2018-EU4/21 Airflow rate [m³/s]: 0.5000

Loading dust: ISO 15957 L2 Dust - Batch 9308

Date	Δp_{start} [Pa]	Δp_i [Pa]	m_i [g]	Δm_i [g]	$\overline{\Delta p_i}$ [Pa]	$\overline{\Delta p}$ [Pa]	kep	W [kWh/y]
29/05/2018	-	18	0	0	-			
29/05/2018	18	18	30	30	18			
29/05/2018	18	18	70	40	18			
29/05/2018	18	19	110	40	19			
29/05/2018	19	19	150	40	19			
29/05/2018	19	19	190	40	19			
29/05/2018	19	19	230	40	19			
29/05/2018	19	20	270	40	20			
29/05/2018	20	20	300	30	20	19	N/A	N/A

Mass of tested device

Initial mass of tested device [g]: 18999

Final mass of tested device [g]: 19272

Symbols and units

- Δp_{start} Pressure drop of the air filter before dust loading step i , [Pa]
- Δp_i Pressure drop of the air filter after dust loading step i , [Pa]
- m_i Total amount of dust fed to the air filter after the dust loading step i , [g]
- Δm_i Dust increment fed to the air filter during loading step i , [g]
- $\overline{\Delta p_i}$ Average of the pressure drops of the air filter measured before and after the dust loading step i , [Pa]
- $\overline{\Delta p}$ Average pressure drop of the air filter, [Pa]
- kep Key energy performance, dimensionless
- W Yearly energy consumption, [kWh/y]

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