

FILTRATION PERFORMANCE TEST OF A POCKET FILTER FOR GENERAL VENTILATION APPLICATIONS

UT016066610G
592 x 592 x 600 [mm]
With GM7/105 glass fiber media
ISO ePM1 50% (0,944 m³/s)



Test Report Number: USP 180901-TF1
September 25th, 2018

According to ISO 16890-2, -3 and -4



Requested by: _____

Contact Person: _____

Subject: Performance test of a pocket filter utilizing GM7/105 / glass fiber media according to ISO 16890-2, -3 and -4.

Test specimen: pocket filter with ten pockets in plastic frame.

Model/Parts ID: UT016066610G
Additional identification: pocket filter 592 x 592 x 600-10 pockets
Media ID: GM7/105
Serial- or batch number: N/A
Upstream side: marked on filter label
Printing: N/A
Dimensions (total): 592 x 592 x 630 mm
Nominal air flow: 3400 m³/h
Samples received on: September 18th, 2018.
Filter test performed on: September 18th and 20th, 2018.

Test method: Test has been performed according to the procedures as defined in ISO 16890-2, -3 and -4 "Air filter for general ventilation".

Variations from the test standard: N/A

General remarks: This test report consists of 13 pages and may only be published in its entirety.
Publications of excerpts from this report are only permitted with written permission of Fiatec experts.

Results: The detailed findings are summarized on pages 4 through 13.

The results apply to the tested media only at the test conditions mentioned above. Filtration performance data of related filters of the same design and media will be similar. Filtration performance under certain application conditions cannot necessarily be predicted from these data.



According to the classification requirements described in ISO 16890-1 the filter element complies with the grade **ISO ePM1 50%** at a nominal air flow of 3400 m³/h (media velocity of 12,7 cm/s).

The net effective filtering area of 7,4 m² was calculated using the following measured approximate dimensions:

Effective width of pockets (mean value):	618 mm
Effective length of pockets:	600 mm
Number of pockets:	10

Tuesday, September 25th, 2018


Heinz Bittermann
(Managing Director)


i.A. Vanessa Grampp
(Lab Technician)

ISO 16890-1:2016 - AIR FILTER TEST RESULT SUMMARY

Testing Organization:	fiatedec GmbH, Germany, Burgkunstadterstr. 3 , 95336 Mainleus, +49(0)9229 99390
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GENERAL

Report no.:	USP 180901	Sample no.:	TF1	Date of report:	25.09.2018
Supervisor:	Heinz Bittermann	Device obtained on:	18.09.2018		
Test requested by:	D.			Device obtained from:	

DEVICE TESTED

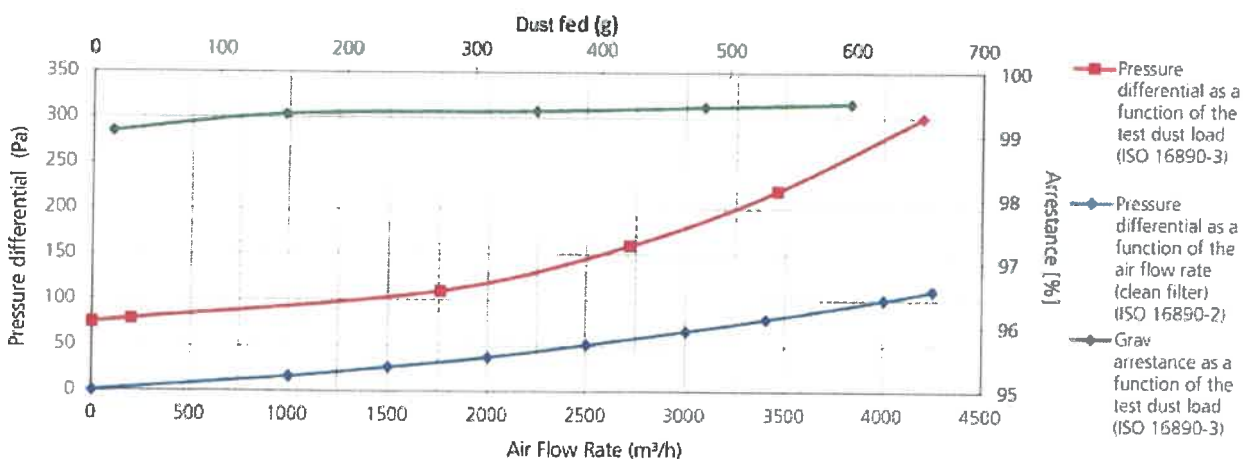
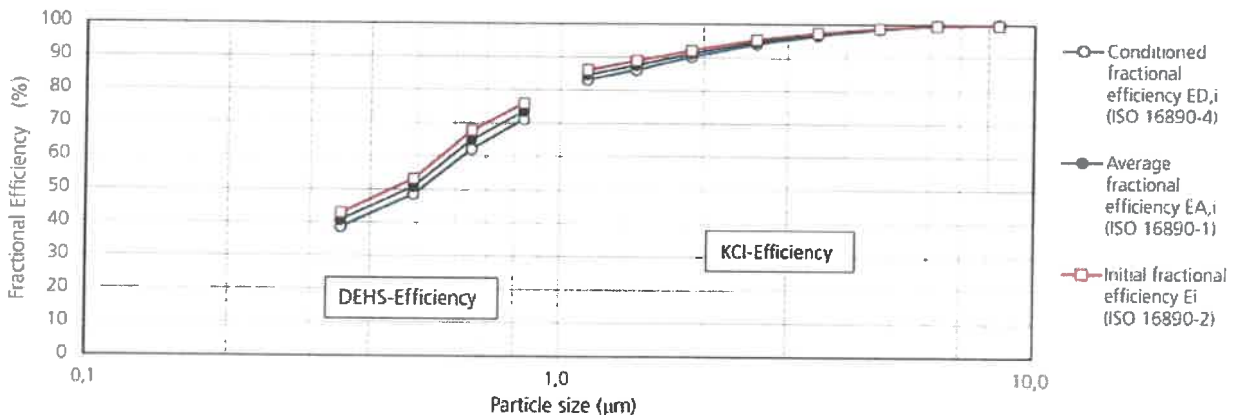
Model:	UT016066610G, pocket filter 592x592x600-10 pockets	Manufacturer:		Construction:	Pocket filter with ten pocket in plastic frame
Type of media / media ID:	glass fiber / GM7/105	Net effective filtering area [m ²]:	7,4	Filter dimensions (width x height x depth) [mm]:	Customer Data: 592 x 592 x 600 mm Measured Dimension: 592 x 592 x 600 mm

TEST DATA AND ATTACHED TEST REPORTS

Test air flow rate [m ³ /s]:	0,944	Additional information					
Test air flow rate [m ³ /h]:	3400	Test report to ISO 16890-Part 2	Yes	-Part 3	Yes	-Part 4	Yes

RESULTS

Initial pressure differential [Pa]:	79	Initial grav. Arrestance [%]:	99,1	ePM _{1, m-1} [%]	51,3 ± 1,4	ePM _{2,5, m-1} [%]	63,1 ± 1	ISO rating
Final test pressure diff. [Pa]	300	Average grav. Arrestance [%]	99,4	ePM ₁ [%]	53,7 ± 1,7	ePM _{2,5} [%]	65,1 ± 1,1	ISO ePM 1
Test dust capacity [g]:	648,8	Remarks:						
						ePM ₁₀ [%]	87,7 ± 0,9	50 %



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.

25.09.2018

Date



Signature

ISO 16890-1:2016 – Fractional efficiency values

Testing Organization:	fiatec GmbH, Germany, Burgkunstadterstr. 3, 95336 Mainleus, +49(0)9229 99390		
Report no.:	USP 180901	Sample no.:	TF1
Date of report:	25.09.2018		
Model:	UT016066610G, pocket filter 592x592x600-10 pockets		Manufacturer:
Test air flow rate [m³/h]:	3400	Efficiency Aerosol PM1 / PM2,5:	DEHS / KCI

<i>i</i>	<i>d</i> [µm]	<i>d</i> ₊₁ [µm]	<i>d</i> _{m,i} [µm]	$\Delta \ln d_i$ [µm]	<i>E</i> [%]	<i>E</i> _D [%]	<i>E</i> _A [%]
1	0,30	0,40	0,35	0,29	42,9	38,6	40,7
2	0,40	0,60	0,49	0,41	53,1	48,4	50,8
3	0,60	0,70	0,65	0,15	67,7	62,0	64,9
4	0,70	1,00	0,84	0,36	76,0	71,1	73,5
5	1,00	1,30	1,14	0,26	86,1	83,1	84,6
6	1,30	1,60	1,44	0,21	89,0	86,1	87,5
7	1,60	2,20	1,88	0,32	92,2	90,1	91,1
8	2,20	3,00	2,57	0,31	95,4	94,0	94,7
9	3,00	4,00	3,46	0,29	97,4	96,6	97,0
10	4,00	5,50	4,69	0,32	98,8	98,6	98,7
11	5,50	7,00	6,20	0,24	99,6	99,8	99,7
12	7,00	10,00	8,37	0,36	99,7	100,0	99,9

- d* Lower limit particle diameter in a size range *i*, µm
d₊₁ Lower limit particle diameter in a size range *i*, µm
*d*_{m,i} Geometric mean diameter of a size range *i*, µm
 $\Delta \ln d$ 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 Initial fractional efficiency of particle size range *i* of the untreated and unloaded filter element, %
*E*_D Fractional efficiency of particle size range *i* of the filter element after an artificial conditioning step, %
*E*_A Average fractional efficiency $(E_i + E_{D_i})/2$ of particle size range *i*, %



ISO 16890-1:2016 – Calculation of PM-efficiencies

Testing Organization:		fiatec GmbH, Germany, Burgkunstadterstr. 3, 95336 Mainleus, +49(0)9229 99390									
Report no.:		USP 180901		Sample no.:		TF1		Date of report:		25.09.2018	
Model:		UT016066610G, pocket filter 592x592x600-10 pockets						Manufacturer:			
Test air flow rate [m³/h]:		3400		Efficiency Aerosol PM1 / PM2,5:		DEHS / KCI					
<i>i</i>	$d_{m,i}$ [µm]	$\Delta \ln d_i$ [µm]	urban distribut. $q_{3,i}(d_{m,i})$	$q_{3,i}(d_{m,i})$ $\times \Delta \ln d_i$	$E_{D,i} \times q_{3,i}(d_{m,i})$ $\times \Delta \ln d_i$	$E_{A,i} \times q_{3,i}(d_{m,i})$ $\times \Delta \ln d_i$	$ePM_{x,min}$ [%]	ePM_x [%]			
1	0,35	0,29	0,2263	0,06509	2,511643	2,651910	ePM_{1,min}	ePM₁			
2	0,49	0,41	0,1932	0,07833	3,791618	3,975761					
3	0,65	0,15	0,1517	0,02339	1,449996	1,516738					
4	0,84	0,36	0,1152	0,04110	2,921053	3,022430					
Σ line 1-4				0,20791	10,67431	11,16684	51,3	53,7			
5	1,14	0,26	0,0850	0,02231	1,853970	1,887109	ePM_{2,5,min}	ePM_{2,5}			
6	1,44	0,21	0,0762	0,01582	1,362218	1,384643					
7	1,88	0,32	0,0802	0,02555	2,301657	2,327901					
8	2,57	0,31	0,0998	0,03097	2,910954	2,932546					
Σ line 1-8				0,30255	19,10311	19,69904	63,1	65,1			

<i>i</i>	$d_{m,i}$ [µm]	$\Delta \ln d_i$ [µm]	rural distribut. $q_{3,i}(d_{m,i})$	$q_{3,i}(d_{m,i})$ $\times \Delta \ln d_i$	$E_{A,i} \times q_{3,i}(d_{m,i})$ $\times \Delta \ln d_i$	ePM_x [%]
1	0,35	0,29	0,0941	0,02708	1,103085	ePM₁₀
2	0,49	0,41	0,0823	0,03337	1,693601	
3	0,65	0,15	0,0732	0,01128	0,731864	
4	0,84	0,36	0,0701	0,02502	1,839767	
5	1,14	0,26	0,0763	0,02001	1,692902	
6	1,44	0,21	0,0883	0,01834	1,605466	
7	1,88	0,32	0,1080	0,03441	3,135342	
8	2,57	0,31	0,1373	0,04257	4,031769	
9	3,46	0,29	0,1671	0,04807	4,662485	
10	4,69	0,32	0,1954	0,06223	6,141305	
11	6,20	0,24	0,2167	0,05226	5,209312	
12	8,37	0,36	0,2314	0,08254	8,243193	
Σ line 1-12				0,45718	40,09009	87,7

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

Testing Organization:	fiatec GmbH, Germany, Burgkunstadterstr. 3, 95336 Mainleus, +49(0)9229 99390
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GENERAL

Report no.:	USP 180901	Sample no.:	TF1	Date of report:	25.09.2018
Operator:	Vanessa Grampp	Date of test:	18.09.2018		
Test requested by:				Test sample obtained from:	
Particle Counter Information					
Manufacturer:	Model:	Coincidence Value (p/dm ³):		Airflow measurement:	
Klotz	Abakus	ca. 700.000		Wilson Grid (Prandtl Tube principle)	

DEVICE TESTED

Model:	Manufacturer:	Construction:
UT016066610G, pocket filter 592x592x600-10 pockets		Pocket filter with ten pocket in plastic frame
Type of media / media ID:	Net effective filter media area [m ²]:	Filter dimensions (width x height x depth) [mm]:
glass fiber / GM7/105	7,4	Customer Data: 592 x 592 x 600 mm Measured Dimension: 592 x 592 x 600 mm
Filter/media electrostatic charge:	Media colour:	Media adhesive / additive:
Not Available	Rosa	Not Available
Device Condition: (clean/initial, used, conditioned per ISO 16890-4, dust loaded per ISO 16890-3, etc.) (if dust loaded, include dust type)		
Clean / Initial		
Other descriptive information:		

TEST DATA SUMMARY

Air flow rate (m ³ /h)	Temperature (°C):	Abs.press.(mbar)	Test air RH (%):	Test aerosol:	Loading dust or Conditioning method:
3400	27	983	47	DEHS / KCl	See report sheets ISO 16890-3 and 4,

RESULTS

Initial resistance to airflow (Pressure Drop) [Pa]	79	Rated final resistance to airflow [Pa]	300		
Fractional Efficiency at rated air flow (%)					
Range (µm)	d _{pr} [µm]	Measured Initial Efficiency E (%)	95 % Uncertainty e ₉₅ (%)	Total Upstream Conc. (raw counts)	Test aerosol:
0,30 – 0,40	0,35	42,9	1,34	1.448.924	DEHS
0,40 – 0,60	0,49	53,1	0,96	1.348.753	DEHS
0,60 – 0,70	0,65	67,7	0,96	133.838	DEHS
0,70 – 1,00	0,84	76,0	0,67	320.551	DEHS
1,00 – 1,30	1,14	86,1	0,42	147.773	KCl
1,30 – 1,60	1,44	89,0	0,31	130.028	KCl
1,60 – 2,20	1,88	92,2	0,25	177.785	KCl
2,20 – 3,00	2,57	95,4	0,19	128.820	KCl
3,00 – 4,00	3,46	97,4	0,22	97.624	KCl
4,00 – 5,50	4,69	98,8	0,06	106.850	KCl
5,50 – 7,00	6,20	99,6	0,22	18.989	KCl
7,00 – 10,0	8,37	99,7	0,19	2.867	KCl

Remarks:

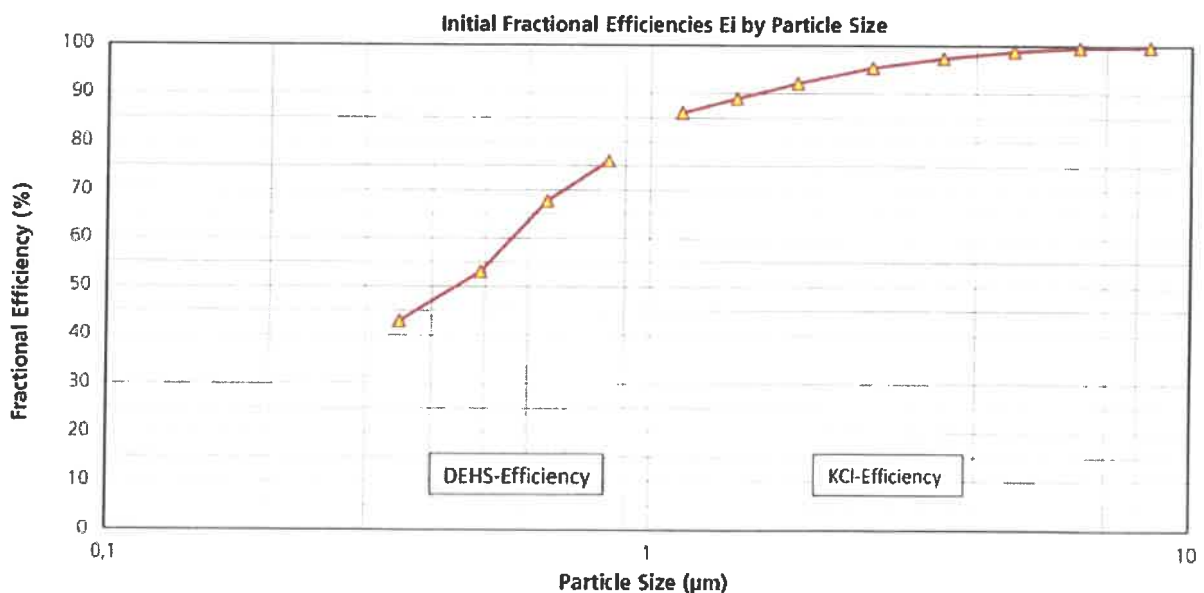
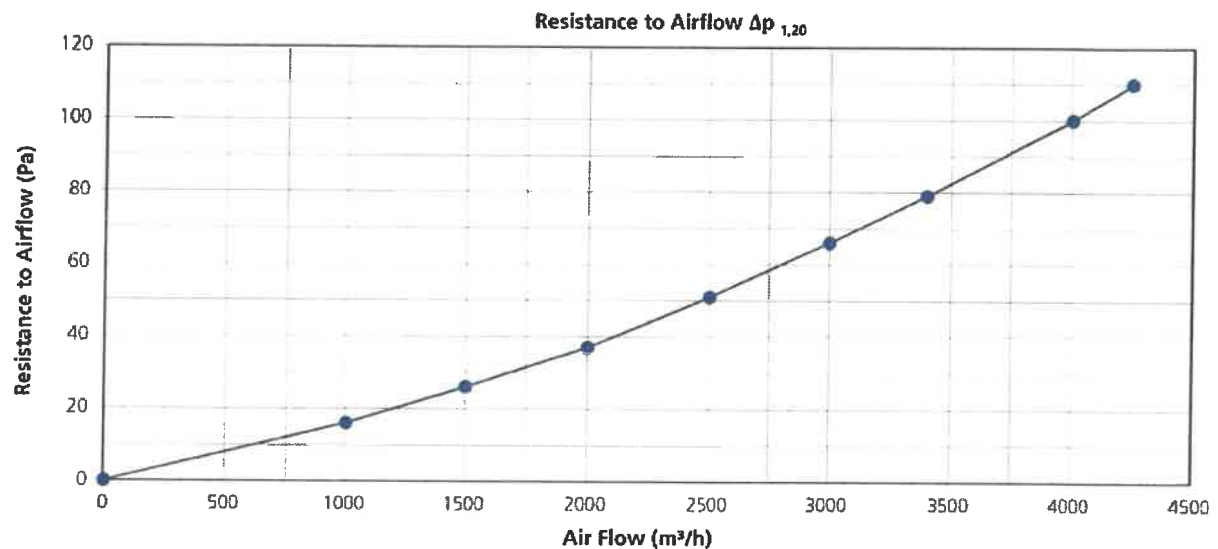
NOTE The results of this test relate only to the test device in the condition stated herein. The performance results cannot by themselves be quantitatively applied to predict filtration performance in all "real life" environments

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

Testing Organization:	fiatec GmbH, Germany, Burgkunstadterstr. 3, 95336 Mainleus, +49(0)9229 99390		
Report no.:	USP 180901	Sample no.:	TF1
Operator:	Vanessa Grampp	Date of report:	25.09.2018
		Date of test:	18.09.2018

TEST DATA DETAILS

% of Rated Airflow	Airflow (m³/s)	Airflow (m³/h)	Mass Flow Rate (kg/h), Density 1,20 kg/m³	Media Velocity (m/s)	Resistance to Airflow $\Delta p_{1,20}$ (Pa)
29	0,278	1000	1200	0,037	16
44	0,417	1500	1800	0,056	26
59	0,556	2000	2400	0,075	37
74	0,694	2500	3000	0,094	51
88	0,833	3000	3600	0,112	66
100	0,944	3400	4080	0,127	79
118	1,111	4000	4800	0,150	100
125	1,181	4250	5100	0,159	110



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.

ISO 16890-4:2016 - AIR FILTER TEST RESULT SUMMARY

Testing Organization:	fiatec GmbH, Germany, Burgkunstadterstr. 3 , 95336 Mainleus, +49(0)9229 99390
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GENERAL

Report no.:	USP 180901	Sample no.:	TF1	Date of report:	25.09.2018
Operator:	Vanessa Gramann	Date of test:	20.09.2018		
Test requested by:				Test sample obtained from:	
Particle Counter Information					
Manufacturer:	Model:	Coincidence Value (p/dm ³):		Airflow measurement:	
Klotz	Abakus	ca. 700.000		Wilson Grid (Prandtl Tube principle)	

DEVICE TESTED

Model:	Manufacturer:	Construction:
016066610G, pocket filter 592x592x600-10 pock		Pocket filter with ten pocket in plastic frame
Type of media / media ID:	Net effective filter media area [m ²]:	Filter dimensions (width x height x depth) [mm]:
glass fiber / GM7/105	7,4	Customer Data: 592 x 592 x 600 mm Measured Dimension: 592 x 592 x 600 mm
Filter/media electrostatic charge:	Media colour:	Media adhesive / additive:
Not Available	Rosa	Not Available
Device Condition: (clean/initial, used, conditioned per ISO 16890-4, dust loaded per ISO 16890-3, etc.) (if dust loaded, include dust type)		
Conditioned per ISO 16890-4		
Other descriptive information:		

TEST DATA SUMMARY

Air flow rate (m ³ /h)	Temperature (°C):	Abs.press.(mbar)	Test air RH (%):	Test aerosol:	Conditioning method:
3400	28	983	44	DEHS / KCl	ISO 16890-4, Annex A.3

CONDITIONING INFORMATIONS:

Temp. range (°C)	rel hum. Range (%)	barom. Pressure (mbar)	Purity of IPA liquid	Time of exposure / conditioning (h)	Conditioning Cabinet dimensions (mm)
22 - 24	43 - 56	983 - 983	> 99,5 %	24	650 x 610 x 950
Conditioning Cabinet Descript	Topas - Model TDC 584			Evaporated amount of IPA (ml)	Volume (dm ³)
				300	377
Test device weight before conditioning / new (g)	2020,0				
Test device weight after conditioning (g)	2021,5				

RESULTS

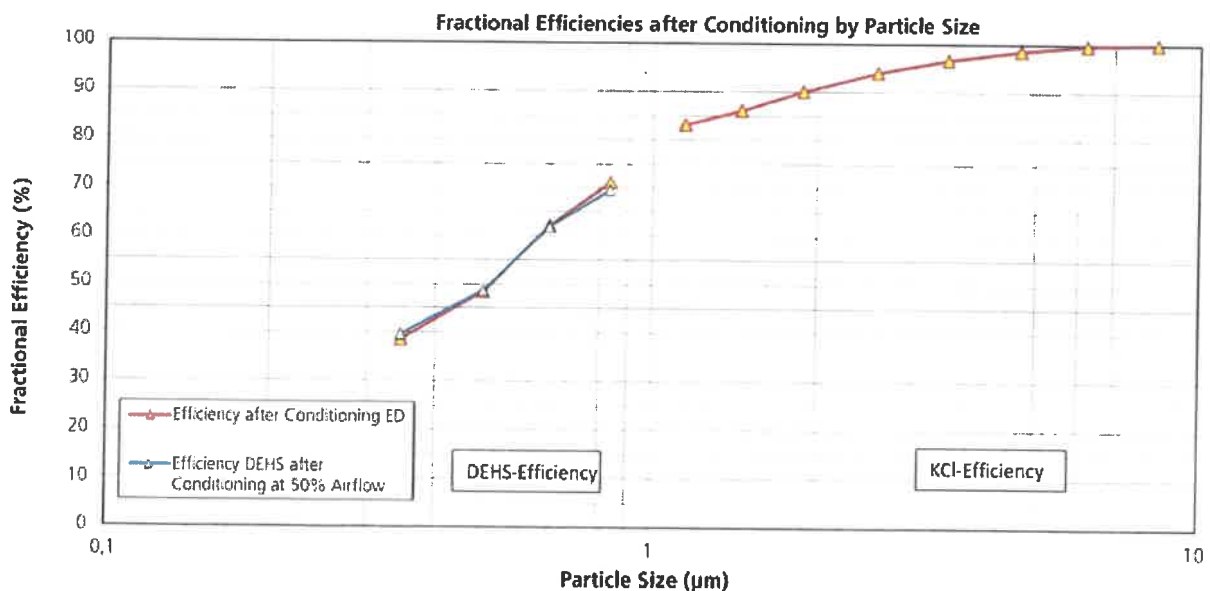
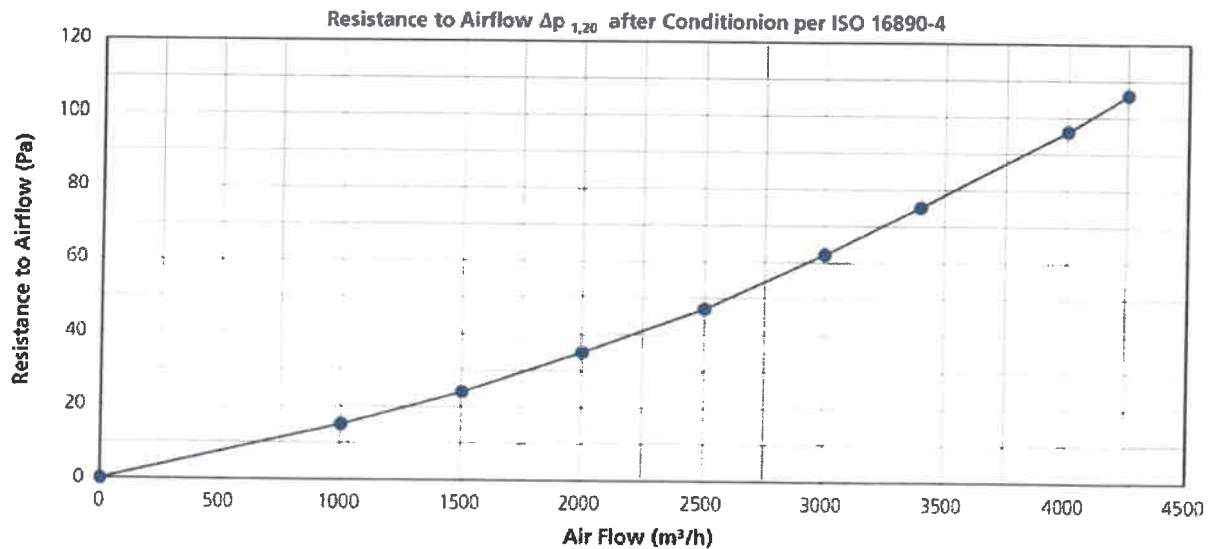
Initial resistance to (rated) test airflow [Pa]	79	Resistance to test airflow after conditioning [Pa]	75		
Fractional Efficiency after conditioning at rated air flow (%)					
Range (µm)	d _m [µm]	Measured conditioned Efficiency E _p (%)	95 % Uncertainty e _p (%)	Total Upstream Conc. (raw counts)	Test aerosol:
0,30 - 0,40	0,35	38,6	0,63	1.531.600	DEHS
0,40 - 0,60	0,49	48,4	0,81	1.433.428	DEHS
0,60 - 0,70	0,65	62,0	0,81	146.465	DEHS
0,70 - 1,00	0,84	71,1	0,53	336.557	DEHS
1,00 - 1,30	1,14	83,1	0,43	145.698	KCl
1,30 - 1,60	1,44	86,1	0,34	127.607	KCl
1,60 - 2,20	1,88	90,1	0,29	175.136	KCl
2,20 - 3,00	2,57	94,0	0,23	126.470	KCl
3,00 - 4,00	3,46	96,6	0,15	96.362	KCl
4,00 - 5,50	4,69	98,6	0,11	104.996	KCl
5,50 - 7,00	6,20	99,8	0,08	18.257	KCl
7,00 - 10,0	8,37	100,0	0,00	2.677	KCl

Remarks:

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.

ISO 16890-4:2016 - AIR FILTER TEST RESULT DETAILS

Testing Organization:		fiatec GmbH, Germany, Burgkunstadterstr. 3 , 95336 Mainleus, +49(0)9229 99390				
Report no.:	USP 180901	Sample no.:	TF1	Date of report:	25.09.2018	
Operator:	Vanessa Grampp				Date of test:	20.09.2018
TEST DATA DETAILS (AFTER CONDITIONING)						
% of Rated Airflow	Airflow (m ³ /s)	Airflow (m ³ /h)	Media Velocity (m/s)	Mass Flow Rate (kg/h), Density 1,20 kg/m ³	Resistance to Airflow Δp _{1,20} (Pa)	Init. Resistance to Airflow Δp _{1,20} (Pa)
29	0,278	1000	0,037	1200	15	16
44	0,417	1500	0,056	1800	24	26
59	0,556	2000	0,075	2400	35	37
74	0,694	2500	0,094	3000	47	51
88	0,833	3000	0,112	3600	62	66
100	0,944	3400	0,127	4080	75	79
118	1,111	4000	0,150	4800	96	100
125	1,181	4250	0,159	5100	106	110



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.

ISO 16890-3:2016 - AIR FILTER TEST RESULT SUMMARY

Testing Organization:	fiatedc GmbH, Germany, Burgkunstadterstr. 3 , 95336 Mainleus, +49(0)9229 99390
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GENERAL			
Report no.:	USP 180901	Sample no.:	TF1
Operator:	Vanessa Grampp	Date of report:	25.09.2018
Test requested by:		Date of test:	20.09.2018
Air flow measurement:	Wilson Grid (Prandtl Tube princible)	Test sample obtained from:	

DEVICE TESTED		
Model: UT016066610G, pocket filter 592x592x600-10 pockets	Manufacturer:	Construction: Pocket filter with ten pocket in plastic frame
Type of media / media ID: glass fiber / GM7/105	Net effective filter media area [m²]: 7,4	Filter dimensions (width x height x depth) [mm]: Customer Data: 592 x 592 x 600 mm Measured Dimension: 592 x 592 x 600 mm
Filter/media electrostatic charge: Not Available	Media colour: Rosa	Media adhesive / additive: Not Available
Device Condition: (clean/initial, used, conditioned per ISO 16890-4, dust loaded per ISO 16890-3, etc.) (if dust loaded, include dust type) Conditioned per ISO 16890-4, Test Dust ISO 12103-1 A2		
Other descriptive information:		

TEST DATA SUMMARY					
Air flow rate (m³/h)	Temperature (°C):	Abs.press.(mbar)	Test air RH (%):	Air density (kg/m³)	Loading dust:
3400	28	983	44	1,129	ISO 15957 - L2 (ISO 12103-A2) 140 ± 14 mg/m³

RESULTS	
Resistance to (rated) test airflow [Pa]	Dust loading results
Initial Measured: new / conditioned	Initial arrestance [%]
79 / 75	Average arrestance [%]
Final:	Test Dust capacity [g]
300	99,1
	99,4
	648,8



Remarks:

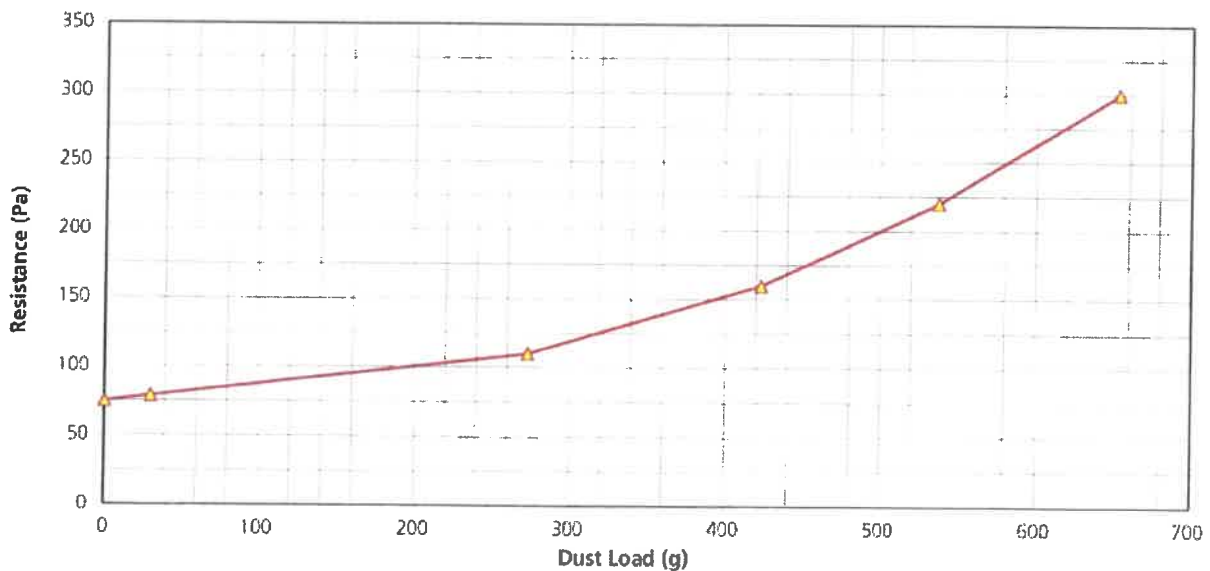
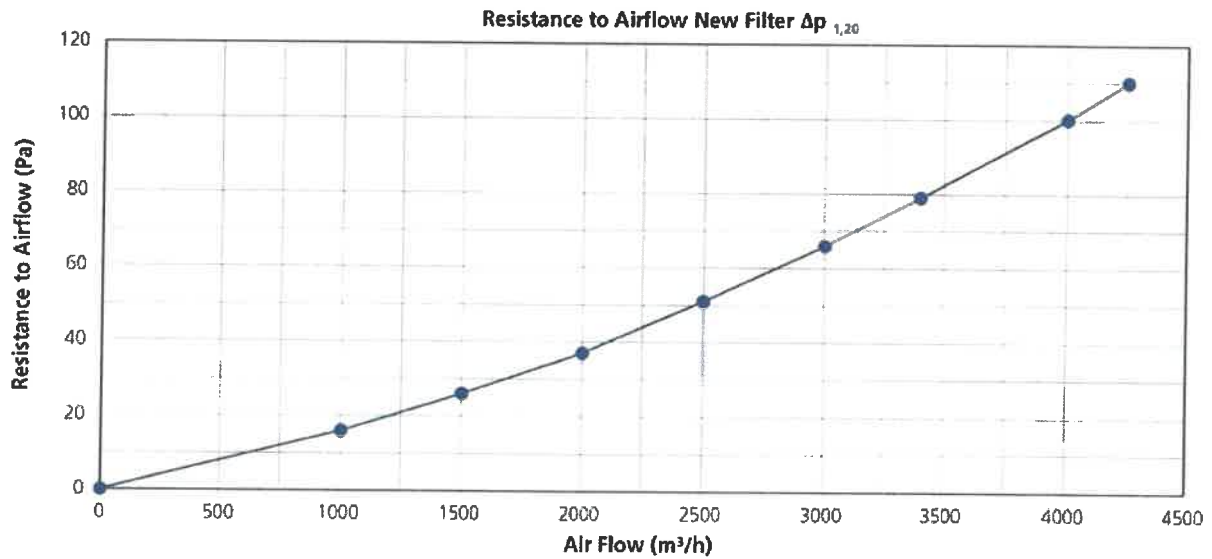
NOTE The results of this test relate only to the test device in the condition stated herein. The performance results cannot by themselves be quantitatively applied to predict filtration performance in all "real life" environments.

ISO 16890-3:2016 - AIR FILTER TEST RESULT DETAILS

Testing Organization:	fiatec GmbH, Germany, Burgkunstadterstr. 3, 95336 Mainleus, +49(0)9229 99390		
Report no.:	USP 180901	Sample no.:	TF1
Operator:	Vanessa Grampp	Date of report:	25.09.2018
		Date of test:	20.09.2018

TEST DATA DETAILS

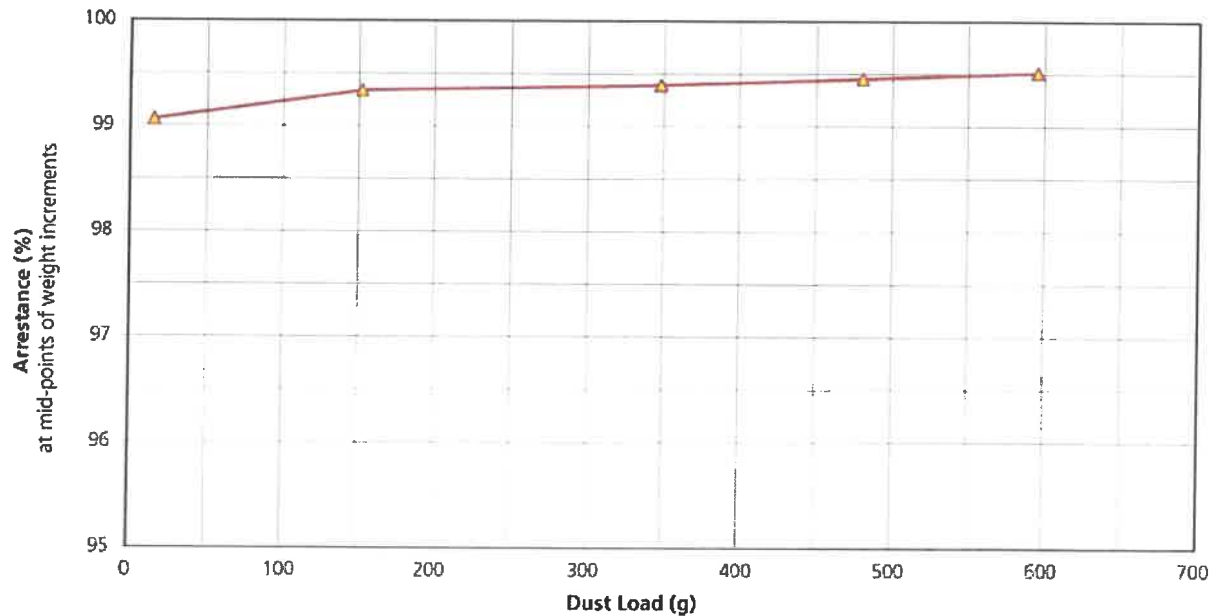
% of Rated Airflow	Airflow (m ³ /s)	Airflow (m ³ /h)	Mass Flow Rate (kg/h), Density 1,20 kg/m ³	Media Velocity (m/s)	Resistance to Airflow Δp _{1,20} (Pa)
29	0,278	1000	1200	0,037	16
44	0,417	1500	1800	0,056	26
59	0,556	2000	2400	0,075	37
74	0,694	2500	3000	0,094	51
88	0,833	3000	3600	0,112	66
100	0,944	3400	4080	0,127	79
118	1,111	4000	4800	0,150	100
125	1,181	4250	5100	0,159	110



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.

ISO 16890-3:2016 - AIR FILTER TEST RESULT DETAILS

Testing Organization:	fiatec GmbH, Germany, Burgkunstadterstr. 3 , 95336 Mainleus, +49(0)9229 99390		
Report no.:	USP 180901	Sample no.:	TF1
Date of report:	25.09.2018		
Operator:	Vanessa Grampp	Date of test:	20.09.2018


Pressure Drop and Arrestance vs Dust Loading to Filter and Dust Collection at Test Air Flow

Dp _{1,200}	Mass of tested Device at Various Loading Steps	Mass gain of final filter + Dust in duct after device (Δm _{ff})	Mass of loaded Dust to filter (differential) Δm	Mass of loaded Dust to filter (Cumulative)	Mass of loaded Dust to filter (Cumulative)	Mass of loaded Dust to filter (Cum), mid points	Dust Collected on tested device (differential)	Dust Collected on tested device (Cumulative)	Arrestance	Average Arrestance
[Pa]	[g]	[g]	[g]	[g]	[g]	[g]	[g]	[g]	[%]	[%]
75	2021,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0		
79	2051,8	0,3	30,6	30,6	15,3	30,3	30,3	30,3	99,1	99,1
110	2292,8	1,6	242,6	273,2	151,9	241,0	271,3	271,3	99,3	99,3
160	2441,6	0,9	149,6	422,9	348,0	148,7	420,0	420,0	99,4	99,3
220	2555,8	0,6	114,8	537,6	480,2	114,2	534,2	534,2	99,5	99,4
300	2670,4	0,6	115,2	652,8	595,2	114,6	648,8	648,8	99,5	99,4

Note: The mass balance might deviate slightly due to the rounding of the last digits of the weight measurements

Dust Holding Capacity [g] at 300 Pa:	648,8
Initial grav. Arrestance [%]:	99,1
Average Arrestance [%] at 300 Pa:	99,4