Blue Heaven Technologies

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TEST NO. 22-022-1D

ISO 16890:2016
Air Filter Test Result Summary

Sections 2, 3 and 4

Counter Information

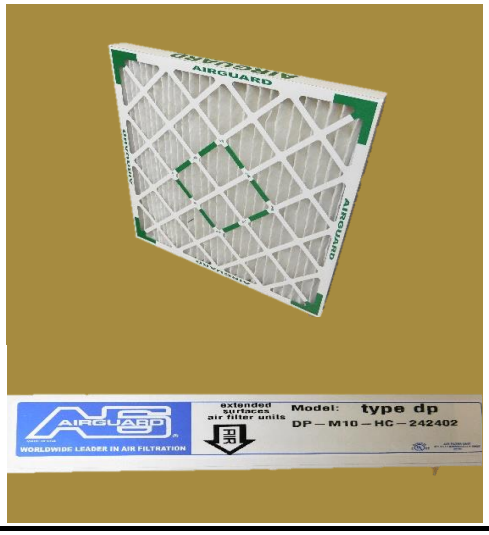
Manufacturer	TSI, Inc.
Model No.	3330

Test Conditions

Test Flow Rate (CFM)	1968
Test Aerosol	Aerosolized KCl & DEHS
Temperature (Deg F)	70.0
Relative Humidity (%)	39.0
Barometer (in Hg)	29.32
Dust Type	ISO Fine

Filter Description

Manufacturer	Parker HVAC Filtration Division
Filter Model	type dp
Part Number	DP-M10-HC-242402
Dimensions	24" x 24" x 2"
Type of Media	Synthetic
Media Area	17.2 Ft²
Construction	Cardboard Frame
Filter/Media Electrostatic Charge	No
Media Color	White
Media Adhesive	N/A
Sample Procurement	New
Initial Filter Weight (g)	482
Final Device Weight (g)	620
Initial Arrestance (%)	77.5
Initial Pressure Drop ("w.c.)	0.23



DEHS Size .03 - 1.0 and KCL Size 1.0 - 10.0

Range (µm)	Geo. Mean	Initial Efficiency (%)	Discharged Efficiency (%)	Upstream Number of Particles	
				Pre	Post
0.3-0.4	0.35	1	2	199245	468831
0.4-0.55	0.47	2	2	147828	333441
0.55-0.7	0.62	3	5	78343	170524
0.7-1.0	0.84	9	11	74459	159886
1.0-1.3	1.14	31	35	23251	19418
1.3-1.6	1.44	40	45	13187	11134
1.6-2.0	1.88	52	57	29215	24616
2.0-3.0	2.57	66	70	14679	11513
3.0-4.0	3.46	77	79	5770	4078
4.0-5.5	4.69	84	83	2708	1938
5.5-7.0	6.2	86	86	626	459
7.0-10.0	8.37	88	89	295	218

Reporting Data

	ePM 1	*ePM 2,5*	*ePM 10*
Minimum	***4%***	***20%***	***--***
Average	***4%***	***19%***	***60%***
Reported	***N/A****	***N/A****	***60%***

** Any Reporting value of N/A shows the minimum efficiency is below 50% for that ePM value*

Comments **Tested For:** **Parker HVAC Filtration Division**

Device Condition: **New**

Final Pressure Drop ("w.c.)	**1.20"w.c.**	**0.80"w.c.**
Total Dust Captured (gms)	**138**	**103**
Average Arrestance (%)	**85.7**	**83.3**

Test Operator Information | Test Performed by: CR | Approved By: RMcS | Completion Date: 4-Mar-22

ISO 16890-1

Data Entry Table

DEHS

d_i	d_{i+1}	d_m	$\Delta\ln d_i$	E_i	$E_{D,i}$	$E_{A,i}$
0.30	0.40	0.35	0.29	0.9%	1.8%	1.4%
0.40	0.55	0.47	0.32	2.1%	2.3%	2.2%
0.55	0.70	0.62	0.24	3.5%	4.7%	4.1%
0.70	1.00	0.84	0.36	9.0%	10.5%	9.8%

KCL

1.00	1.30	1.14	0.26	30.8%	35.3%	33.1%
1.30	1.60	1.44	0.21	40.0%	44.6%	42.3%
1.60	2.20	1.88	0.32	51.9%	56.7%	54.3%
2.20	3.00	2.57	0.31	66.2%	70.0%	68.1%
3.00	4.00	3.46	0.29	76.5%	78.9%	77.7%
4.00	5.50	4.69	0.32	83.5%	83.3%	83.4%
5.50	7.00	6.20	0.24	86.1%	85.8%	86.0%
7.00	10.00	8.37	0.36	88.2%	89.0%	88.6%

ePM_1 Calculations

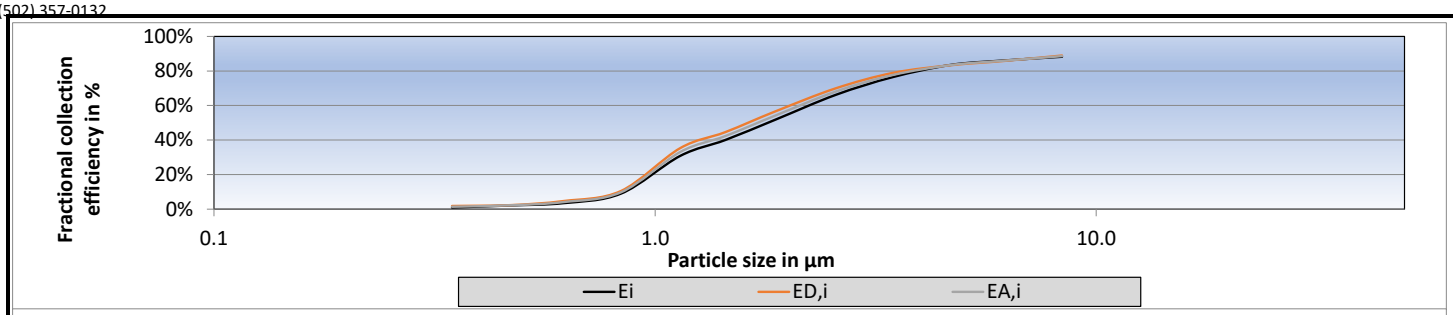
d_i	d_{i+1}	d_m	$\Delta\ln d_i$	$E_{A,i}$	q_{3u}	$q_{3u}*\Delta\ln d_i$	$E_{D,i}*q_{3u}*\Delta\ln d_i$	$E_{A,i}*q_{3u}*\Delta\ln d_i$	$E_{min}(PM_1)$	$E(PM_1)$
0.30	0.40	0.35	0.29	1.4%	22.627%	0.065095	0.001198	0.000908		
0.40	0.55	0.47	0.32	2.2%	19.891%	0.063343	0.001478	0.001414		
0.55	0.70	0.62	0.24	4.1%	15.837%	0.038193	0.001797	0.001564		
0.70	1.00	0.84	0.36	9.8%	11.522%	0.041097	0.004319	0.004008	4%	4%
					Sums:	0.207728	0.008792	0.007894		

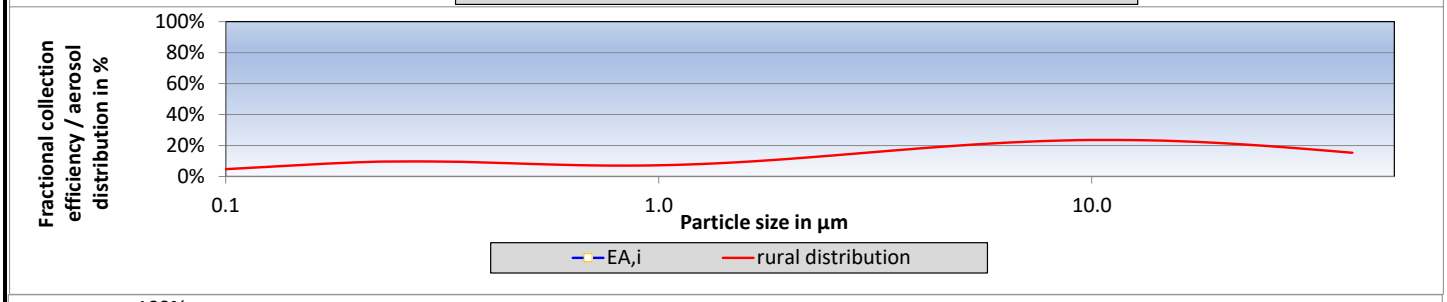
$ePM_{2,5}$ Calculations

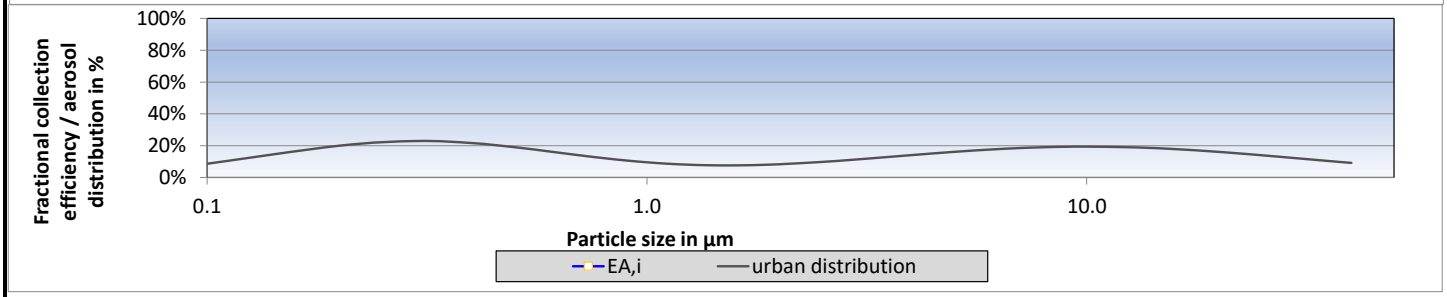
d_i	d_{i+1}	d_m	$\Delta\ln d_i$	$E_{A,i}$	q_{3u}	$q_{3u}*\Delta\ln d_i$	$E_{D,i}*q_{3u}*\Delta\ln d_i$	$E_{A,i}*q_{3u}*\Delta\ln d_i$	$E_{min}(PM_{2,5})$	$E(PM_{2,5})$
0.30	0.40	0.35	0.29	1.4%	22.627%	0.065095	0.001198	0.000908		
0.40	0.55	0.47	0.32	2.2%	19.891%	0.063343	0.001478	0.001414		
0.55	0.70	0.62	0.24	4.1%	15.837%	0.038193	0.001797	0.001564		
0.70	1.00	0.84	0.36	9.8%	11.522%	0.041097	0.004319	0.004008		
1.00	1.30	1.14	0.26	33.1%	8.503%	0.022309	0.007884	0.007382	20%	19%
1.30	1.60	1.44	0.21	42.3%	7.618%	0.015817	0.007051	0.006692		
1.60	2.20	1.88	0.32	54.3%	8.022%	0.025546	0.014475	0.013862		
2.20	3.00	2.57	0.31	68.1%	9.984%	0.030966	0.021667	0.021083		
					Sums:	0.302366	0.059870	0.056913		

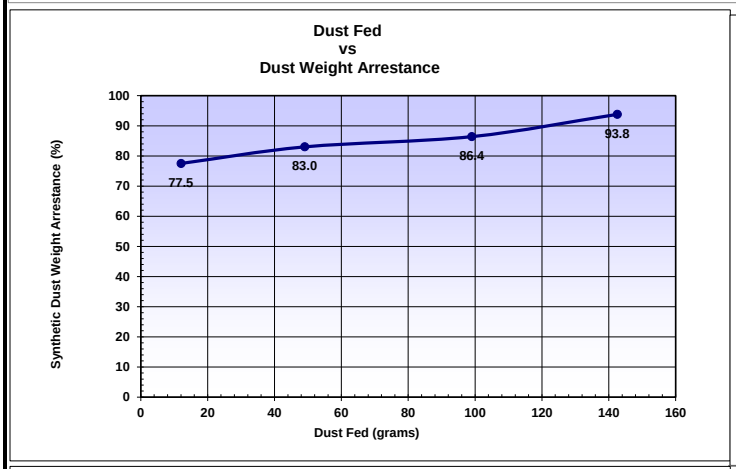
ePM_{10} Calculations

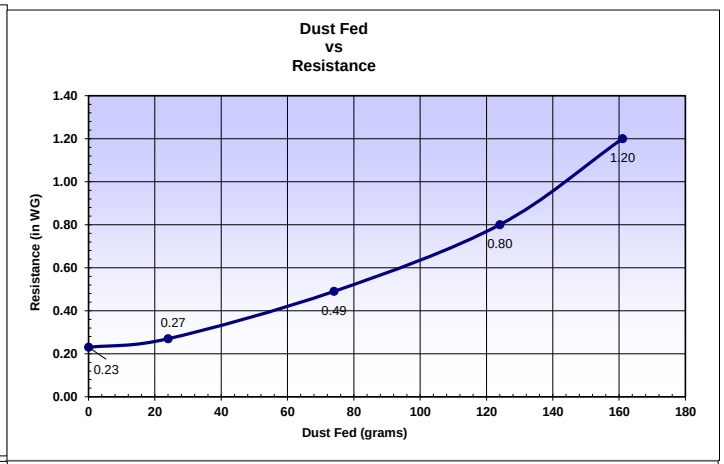
d_i	d_{i+1}	d_m	$\Delta\ln d_i$	$E_{A,i}$	q_{3r}	$q_{3r}*\Delta\ln d_i$	$E_{D,i}*q_{3u}*\Delta\ln d_i$	$E_{A,i}*q_{3r}*\Delta\ln d_i$	$Emin(PM_{10})$	$E(PM_{10})$
0.30	0.40	0.35	0.29	1.4%	9.412%	0.027077	0.000498	0.000378		
0.40	0.55	0.47	0.32	2.2%	8.395%	0.026733	0.000624	0.000597		
0.55	0.70	0.62	0.24	4.1%	7.432%	0.017924	0.000843	0.000734		
0.70	1.00	0.84	0.36	9.8%	7.014%	0.025016	0.002629	0.002439		
1.00	1.30	1.14	0.26	33.1%	7.628%	0.020013	0.007073	0.006622		
1.30	1.60	1.44	0.21	42.3%	8.833%	0.018340	0.008176	0.007759		
1.60	2.20	1.88	0.32	54.3%	10.804%	0.034406	0.019496	0.018671		
2.20	3.00	2.57	0.31	68.1%	13.726%	0.042573	0.029788	0.028986	61%	60%
3.00	4.00	3.46	0.29	77.7%	16.708%	0.048067	0.037926	0.037351		
4.00	5.50	4.69	0.32	83.4%	19.542%	0.062233	0.051870	0.051931		
5.50	7.00	6.20	0.24	86.0%	21.671%	0.052261	0.044858	0.044929		
7.00	10.00	8.37	0.36	88.6%	23.143%	0.082545	0.073431	0.073129		
					Sums:	0.457189	0.277213	0.273526		

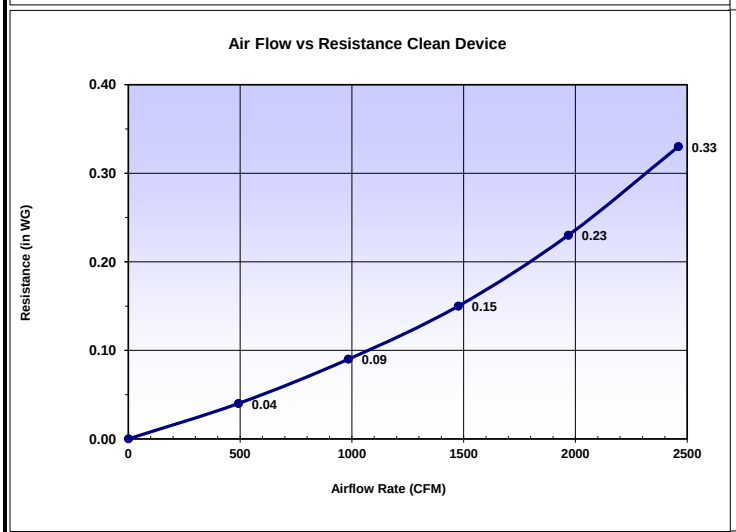

Fractional collection efficiency in %
100%
80%
60%
40%
20%
0%
0.1
1.0
10.0
Particle size in µm
Ei
ED,i
EA,i

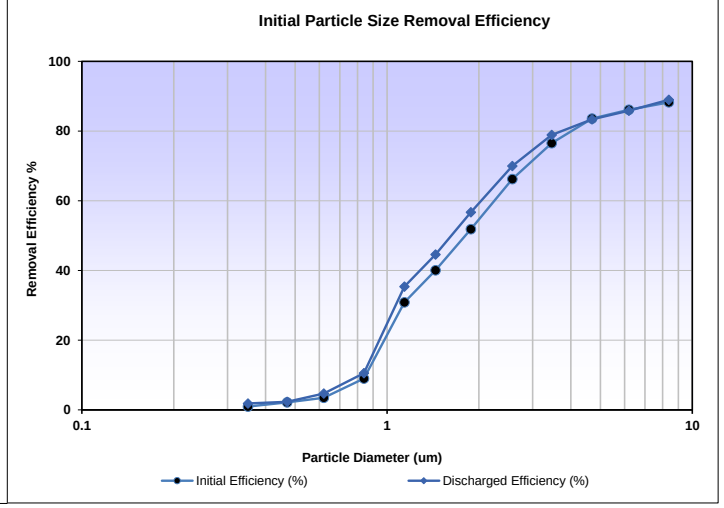

Fractional collection efficiency / aerosol distribution in %
100%
80%
60%
40%
20%
0%
0.1
1.0
10.0
Particle size in µm
EA,i
rural distribution


Fractional collection efficiency / aerosol distribution in %
100%
80%
60%
40%
20%
0%
0.1
1.0
10.0
Particle size in µm
EA,i
urban distribution


Dust Fed
vs
Dust Weight Arrestance
Synthetic Dust Weight Arrestance (%)
77.5
83.0
86.4
93.8
Dust Fed (grams)


Dust Fed
vs
Resistance
Resistance (in WG)
0.23
0.27
0.49
0.80
1.20
Dust Fed (grams)


Air Flow vs Resistance Clean Device
Resistance (in WG)
0.04
0.09
0.15
0.23
0.33
Airflow Rate (CFM)


Initial Particle Size Removal Efficiency
Removal Efficiency %
Particle Diameter (um)
Initial Efficiency (%)
Discharged Efficiency (%)

Test No. 22-022-1D
Date: 04-Mar-22

Data - Air Flow vs Resistance (Clean Device)

Airflow (CFM)	Resistance (in WG)
0	0.00
492	0.04
984	0.09
1476	0.15
1968	0.23
2460	0.33

Data - Dust Fed vs Dust Weight Arrestance

Dust Fed (gms)	Arrestance (%)
0	
12	77.5
49	83.0
99	86.4
143	93.8

Data - Dust Fed vs Resistance

Dust Fed (gms)	Res (in WG)
0	0.23
24	0.27
74	0.49
124	0.80
161	1.20

The interpretation of test reports

This brief review of the test procedures, including those for addressing the testing of electrostatic charged filters, is provided for those unfamiliar with the procedures of this series of ISO standards. It is intended to assist in understanding and interpreting the results in the test report/summary. (For further details of procedures the full ISO 16890 document series shall be consulted). Air filters may rely on the effects of passive static electric charges on the fibres to achieve high efficiencies, particularly in the initial stages of their working life. Environmental factors encountered in service may affect the action of these electric charges so that the initial efficiency may drop substantially after an initial period of service. This could be offset or countered by an increase in efficiency (“mechanical efficiency”) as dust deposits build up. The reported, untreated and conditioned (discharged) efficiency shows the extent of the electrical charge effect on initial performance and indicates the potential loss of particle removal efficiency when the charge effect is completely removed and when at the same time there is no compensating increase of the mechanical efficiency. These test results should not be assumed to represent the filter performance in all possible environmental conditions or to represent all possible “real life” behaviour. This brief review of the test procedures, including those for addressing the testing of electrostatic charged filters, is provided for those unfamiliar with the procedures of this series of ISO standards. It is intended to assist in understanding and interpreting the results in the test report/summary. (For further details of procedures the full ISO 16890 document series shall be consulted). Air filters may rely on the effects of passive static electric charges on the fibres to achieve high efficiencies, particularly in the initial stages of their working life. Environmental factors encountered in service may affect the action of these electric charges so that the initial efficiency may drop substantially after an initial period of service. This could be offset or countered by an increase in efficiency (“mechanical efficiency”) as dust deposits build up. The reported, untreated and conditioned (discharged) efficiency shows the extent of the electrical charge effect on initial performance and indicates the potential loss of particle removal efficiency when the charge effect is completely removed and when at the same time there is no compensating increase of the mechanical efficiency. These test results should not be assumed to represent the filter performance in all possible environmental conditions or to represent all possible “real life” behaviour.