

Explanation of ePMx Classification for Particulate Matter

Comprehensive Efficiency in FAH-A2 ISO16890 Standard Test

Report

1. Basis for Calculation of Comprehensive Efficiency ePM_x Classification

Based on the ISO16890 standard, the particulate matter comprehensive efficiency ePM_x of media-type filters needs to be comprehensively derived from the initial efficiency and the efficiency after static elimination. The specific calculation and classification methods are screenshots from the ISO16890 standard as follows:

7.2 Calculation of the particulate matter efficiencies (ePM)

The particulate matter efficiencies ePM_{10} , $ePM_{2.5}$ and ePM_1 are calculated from the average fractional efficiencies $E_{A,i}$, [see [Formula \(1\)](#)] and the standardized particle size distribution defined in [7.1](#) [see [Formula \(3\)](#)] by using [Formula \(4\)](#).

$$\begin{aligned}
 ePM_1 &= \sum_{i=1}^n E_{A,i} \cdot q_{3u}(\bar{d}_i) \cdot \Delta \ln d_i / \sum_{i=1}^n q_{3u}(\bar{d}_i) \cdot \Delta \ln d_i \quad (\text{urban size distribution}), \\
 ePM_{2.5} &= \sum_{i=1}^n E_{A,i} \cdot q_{3u}(\bar{d}_i) \cdot \Delta \ln d_i / \sum_{i=1}^n q_{3u}(\bar{d}_i) \cdot \Delta \ln d_i \quad (\text{urban size distribution}), \\
 ePM_{10} &= \sum_{i=1}^n E_{A,i} \cdot q_{3r}(\bar{d}_i) \cdot \Delta \ln d_i / \sum_{i=1}^n q_{3r}(\bar{d}_i) \cdot \Delta \ln d_i \quad (\text{rural size distribution})
 \end{aligned} \tag{4}$$

Additionally, the minimum efficiencies, $ePM_{2.5, \min}$ and $ePM_{1, \min}$ are defined by [Formula \(5\)](#).

$$ePM_{x, \min} = \sum_{i=1}^n E_{D,i} \cdot q_{3u}(\bar{d}_i) \cdot \Delta \ln d_i / \sum_{i=1}^n q_{3u}(\bar{d}_i) \cdot \Delta \ln d_i \tag{5}$$

7.3 Classification

The initial arrestance and the three efficiency values ePM_1 , $ePM_{2.5}$ and ePM_{10} and the minimum efficiency values $ePM_{1, \min}$ and $ePM_{2.5, \min}$ shall be used to classify a filter in one of the four groups given in [Table 4](#).

Table 4 — Filter groups

Group designation	Requirement			Class reporting value
	$ePM_{1, \min}$	$ePM_{2.5, \min}$	ePM_{10}	
ISO Coarse	—	—	<50 %	Initial grav. arrestance
ISO ePM10	—	—	≥50 %	ePM_{10}
ISO ePM2,5	—	≥50 %	—	$ePM_{2.5}$
ISO ePM1	≥50 %	—	—	ePM_1

(Note: For ePM group filters, the level reported value shall be rounded down to the nearest integer multiple of 5%.)

2. Calculation of FAH-A2 Particulate Matter Comprehensive Efficiency ePM_x

Classification

Since electrostatic filters do not involve static elimination, the particulate matter comprehensive efficiency ePM_x of electrostatic filters can only be obtained based on the initial efficiency and using the calculation formula for particulate matter comprehensive efficiency ePM_x :

No.	Test Items	Test Results
1	Counting Efficiency (%)	(0.3-0.4) μm
		94.0
		(0.4-0.55) μm
		94.8
		(0.55-0.7) μm
		95.8
		(0.7-1.0) μm
		96.7
		(1.0-1.3) μm
		97.5
		(1.3-1.6) μm
		97.6
		(1.6-2.2) μm
		97.8
		(2.2-3.0) μm
		97.8
		(3.0-4.0) μm
		98.1
		(4.0-5.5) μm
		98.4
		(5.5-7.0) μm
		98.4
		(7.0-10.0) μm
		98.6

FAH-A2 Initial Efficiency

d_i μm	d_{i+1} μm	$\bar{d}_i$ μm	$\Delta \ln d_i$	$f(d, \sigma_{gA}, d_{50A})$	$f(d, \sigma_{gB}, d_{50B})$	urban $q_{3u}(\bar{d}_i)$	$f(d, \sigma_{gA}, d_{50A})$	$f(d, \sigma_{gB}, d_{50B})$	rural $q_{3r}(\bar{d}_i)$	E_i %	E_{DJ} %	E_{AJ} %	$q_{3u}(\bar{d}_i)$ $\cdot \Delta \ln d_i$	$E_{DJ} \cdot q_{3u}(\bar{d}_i)$ $\cdot \Delta \ln d_i$	$ePM_{x, min}$ %	ePM_x %
0.30	0.40	0.35	0.29	0.49775	0.00426	0.22633	0.46460	0.01282	0.09414	94.0	94.0	94.0	0.06511394	0.061205		
0.40	0.55	0.47	0.32	0.43100	0.00911	0.19896	0.36808	0.02160	0.08397	94.8	94.8	94.8	0.063359109	0.060064		
0.55	0.70	0.62	0.24	0.33096	0.01724	0.15841	0.26037	0.03351	0.07434	95.8	95.8	95.8	0.038203031	0.036599	$ePM_{1, min}$	ePM_1
0.70	1.00	0.84	0.36	0.21717	0.03186	0.11525	0.15652	0.05120	0.07015	96.7	96.7	96.7	0.041107621	0.039751	95.1	95.1
1.00	1.30	1.14	0.26	0.12066	0.05592	0.08505	0.07941	0.07562	0.07630	97.5	97.5	97.5	0.022314989	0.021757		
1.30	1.60	1.44	0.21	0.06968	0.08153	0.07620	0.04280	0.09835	0.08835	97.6	97.6	97.6	0.015821352	0.015442		
1.60	2.20	1.88	0.32	0.03391	0.11814	0.08024	0.01929	0.12756	0.10807	97.8	97.8	97.8	0.025552289	0.024990	$ePM_{2.5, min}$	$ePM_{2.5}$
2.20	3.00	2.57	0.31	0.01240	0.17143	0.09986	0.00643	0.16602	0.13730	97.8	97.8	97.8	0.030973385	0.030292	96	96
3.00	4.00	3.46	0.29	0.00411	0.22738	0.12691	0.00195	0.20338	0.16713	98.1	98.1	98.1	0.036509067	0.035815		
4.00	5.50	4.69	0.32	0.00116	0.28195	0.15560	0.00050	0.23827	0.19547	98.4	98.4	98.4	0.049549839	0.048757		
5.50	7.00	6.20	0.24	0.00032	0.32267	0.17761	0.00013	0.26432	0.21676	98.4	98.4	98.4	0.042833471	0.042148		ePM_{10}
7.00	10.0	8.37	0.36	0.00007	0.34834	0.19162	0.00003	0.28230	0.23149	98.6	98.6	98.6	0.068345995	0.067389		98

Calculation Process of FAH-A2 Particulate Matter Comprehensive Efficiency ePM_x

The final calculated $ePM_{1, min}$ of FAH-A2 is 95.1%, $ePM_{2.5, min}$ is 96%, ePM_1 is 95.1%, $ePM_{2.5}$ is 96%, and ePM_{10} is 98%.

3. FAH-A2 Particulate Matter Comprehensive Efficiency

According to the ISO16890 standard classification method:

Based on the ISO16890 standard classification method, FAH-A2 is classified as ISO ePM₁ > 95%.