Supplementary File 1: protocols considered for measuring filtration efficiency

Solid (sodium chloride for Lab 2 and polystyrene latex sphere for Lab 3), and liquid particles (DEHS for Lab 1) were considered as testing aerosols. Aerodynamic particle sizer (APS 3021 from TSI) was used by all laboratories for measuring the aerosol number concentration. A unique size bin, centered at 3 µm was considered to compute the filtration efficiency requested within CoFC specifications. Finally, two different measurement protocols were considered. A first one, based on a unique filter holder (Lab 1) and aerosol sampling upstream and downstream this filter holder. The second approach (Lab 2 and Lab 3) is based on two similar filter holders, one empty and another one filled with the filter medium to be tested. Two valves allow selecting the appropriate filter holder and a unique sampling probe, placed downstream these valves is needed for measuring the upstream (empty filter holder line) and the downstream (filled filter holder line) aerosol concentration. For both approaches, a special care is needed to perfectly design, in terms of aerosol size distribution and concentration, similar sampling probes (for approach 1) or filter holders (for approach 2). Additional benefit of this inter-comparison was then to confirm the relevance of the qualification of the design of each test bench performed by each laboratory.

Tab. SF-T1

Experimental protocol used by Lab 1 (LRGP)

The experimental test bench used by Lab 1 is presented in figure SF1-1. DEHS (di-ethyl-hexyl-sebacate) aerosol is produced by an AGK 2000 Palas generator and diluted with compressed air. Filtration velocity is adjusted at 5.7 cm/s, with valves placed after the homogenization chamber. After dilution, the DEHS mean number aerodynamic equivalent diameter, measured upstream of the filter with an Aerodynamic Particle Sizer TSI 3021, is close to 0.85 µm.

A sample is prepared directly from CoFC and placed in a filter holder with a filtration surface of 28.3 cm^2. The efficiency measurement is done by a series of 7 counts conducted successively upstream and downstream of the filter. Before each measurement, a sampling of 30 seconds is performed in order to purge and stabilize the concentration of particles in the sampling lines.

These 7 counts give 3 efficiency results for the same material sample (repeatability test).

$$E_{N,i}(d_p) = 1 - \frac{\frac{C_{N,i,down}(d_P) - C_{N,i+1,down}(d_P)}{2}}{C_{N,i,up}(d_P)}$$

where $C_{N,i,up}$ and $C_{N,i,down}$ are respectively the particle number concentration upstream and downstream of the filter.

Efficiency measurements are conducted on three or four samples of a material (reproducibility test).

Fig. SF1-1

Experimental protocol used by Lab 2 (IRSN)

The experimental test bench used by Lab 2 is presented in figure SF1-2.

Fig. SF1-2

Sodium chloride aerosol is produced by a Collison type atomizer (Collison 4100 250F). Count median diameter of aerosol is close to 60 nm (see figure SF1-3) and mass median aerodynamic diameter has been previously measured at 600 nm for this atomizer according to an electrical low pressure impactor. The filtration efficiency measurement is based on two separate aerosol transport ducts, both instrumented with the same filter holder. 47 mm diameter samples (real filtration surface associated to 36 mm diameter) are prepared directly from CoFC and placed in the upper filter holder (line 1). The second filter holder is left empty and is used to characterize the aerosol size distribution upstream tested filter (line 2). To support this measurement protocol,

the aerosol size distributions for both filter holder lines have been measured with a Scanning Mobility Particle Sizer (X-ray neutralizer 3088, classifier 3082 with long DMA column 3081 and particle counter CPC 3775 from TSI). Comparison of measured size distributions are presented in figure SF1-3 and a close agreement could be noticed, confirming similar transport of aerosol within both lines. A second size spectrometer is also reported in figure SF1-2 (aerodynamic particle size TSI 3021) for measuring particle size in the range 1-3 µm (in terms of aerodynamic diameter).

Experimental protocol considered for measuring the filtration efficiency is described hereafter:

- measurement of two size distributions by APS and SMPS on the « empty line » corresponding to the first upstream analysis (upstream 1);
- measurement of six size distributions by APS and SMPS on the « filled line » corresponding to downstream analysis (downstream);
- measurement of two additional size distributions by APS and SMPS on the « empty line » corresponding to the second upstream analysis (upstream 2);
- computation of mean aerosol size distribution measured by APS and SMPS on one hand from all upstream measurements (« upstream 1 » and « upstream 2 ») and on the other hand from the size distribution measurements conducted downstream the filter;
- Computation of number-based filtration efficiency.

Fig. SF1-3

Experimental protocol used by Lab 3 (LNE)

Polystyrene Latex spheres (PSL) aerosol, composed of mono-disperse particles with a diameter of 3 µm, is produced by a nebulizer (AGK 2000, PALAS). The filtration efficiency measurement is based on two separate aerosol transport ducts, one instrumented with a 47 mm filter holder (real filtration surface associated to 36.9 mm diameter). These samples are prepared

directly from CoFC and placed in the filter holder (line 1). The second line is used to measure the number concentration particles upstream the tested filter (line 2). For this purpose, an aerodynamic particle size spectrometer (APS, TSI inc., model 3021) is used for measuring particle concentration in the 3 µm size bin. Figure SF1-4 presents the test bench used by Lab 3.

The experimental protocol considered for measuring the filtration efficiency is described hereafter:

- measurement of one size distribution by APS on the « empty line » corresponding to the first upstream analysis (upstream 1);
- measurement of one size distribution by APS on the « filled line » corresponding to downstream analysis (downstream);
- measurement of one size distribution by APS on the « empty line » corresponding to the second upstream analysis (upstream 2);
- computation of mean number concentration for the 3 µm size bin of the APS on one hand from all upstream measurements (« upstream 1 » and « upstream 2 ») and on the other hand from the size distribution measurements conducted downstream the filter;
- Computation of number-based filtration efficiency for the 3 µm size bin of the APS.

Fig. SF1-4

Tab. SF-T1. Resume of the test protocols.

	Lab 1 (LRGP)	Lab 2 (IRSN)	Lab 3 (LNE)
Test aerosol	DEHS (liquid)	NaCl (solid)	PSL (solid)
Filtration velocity (cm/s)	5.7	5.3	5.7
Sample area (cm^2)	28.3	10.2	10.7
Configuration	1 main pipe with samplings upstream and downstream of the filter holder with sample	2 parallel paths (P1: empty filter holder P2: filter holder with sample)	2 parallel paths (P1: continuous pipe P2: filter holder with sample)
Particle sizer	APS 3021 TSI®	APS 3021 TSI®	APS 3021 TSI®
Measurement method	7 successive counts upstream and downstream of the sample (D-U-D-U-D-U-D)	2 counts P1, 6 counts P2, 2 counts P1	1 counts P1, 1 counts P2, 1 counts P1
Measurement protocol	25 s of purge and concentration stabilization + 5 s of measurement	Purge and concentration stabilization monitored on a photometer between samples	4-5 min for upstream and downstream measurements

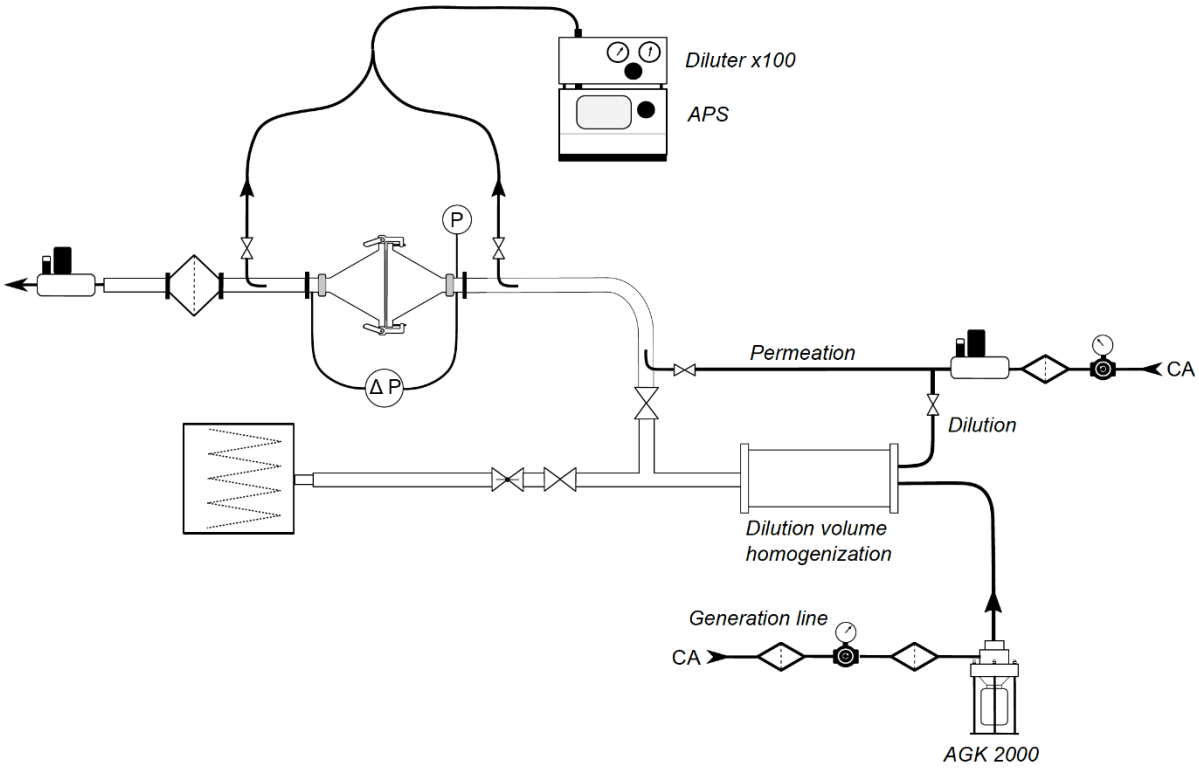


Fig. SF1-1

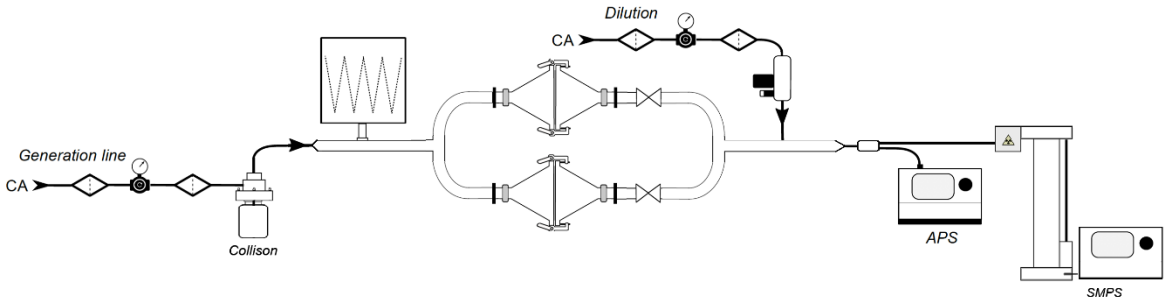
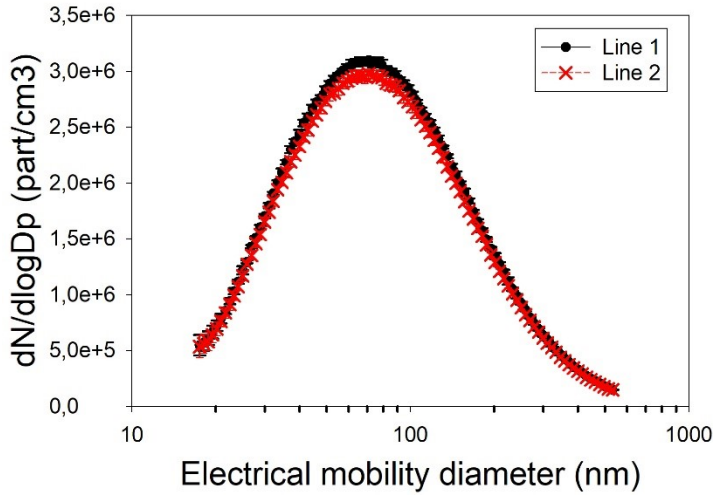


Fig. SF1-2



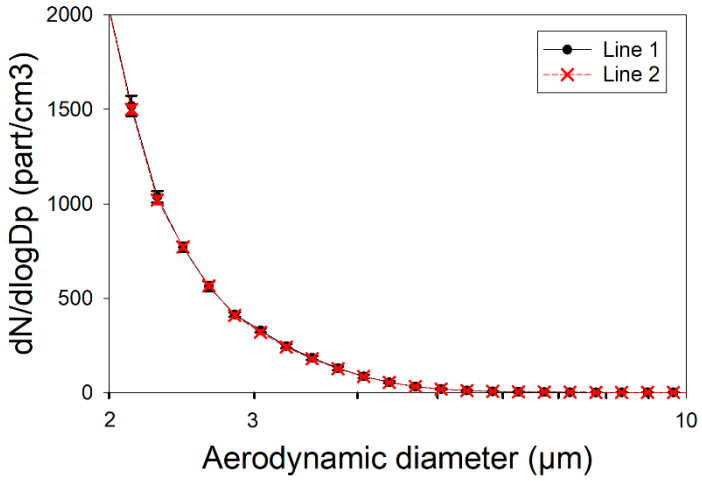


Fig. SF1-3

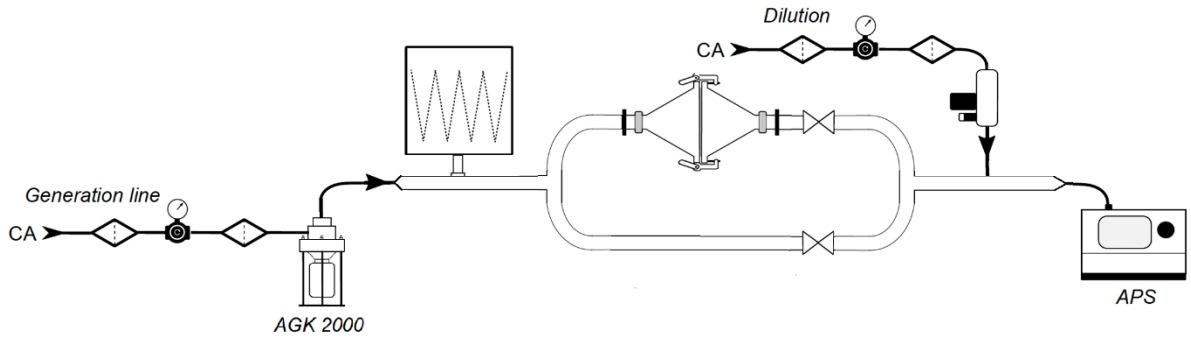


Fig. SF1-4