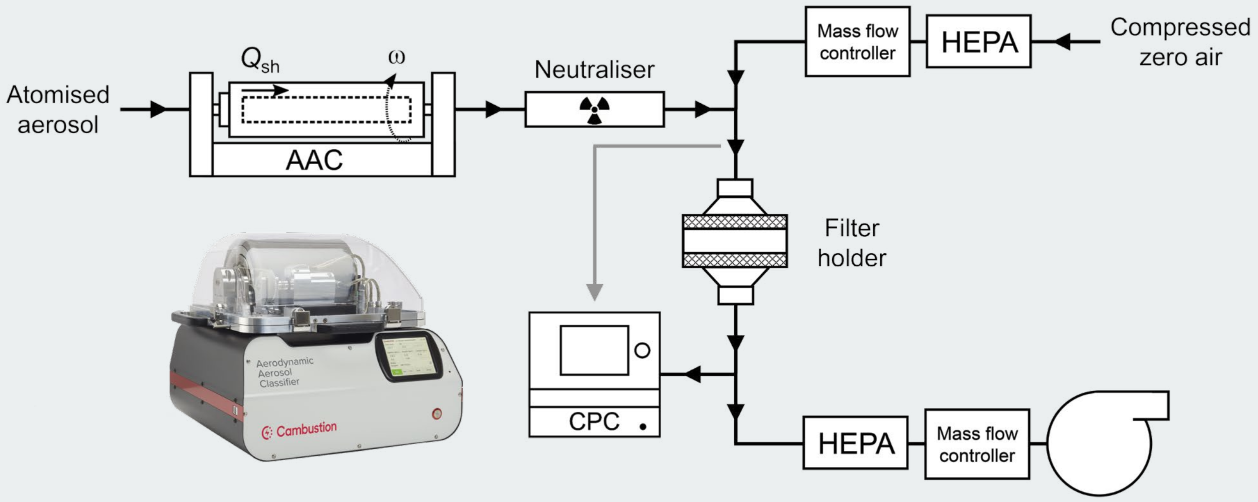
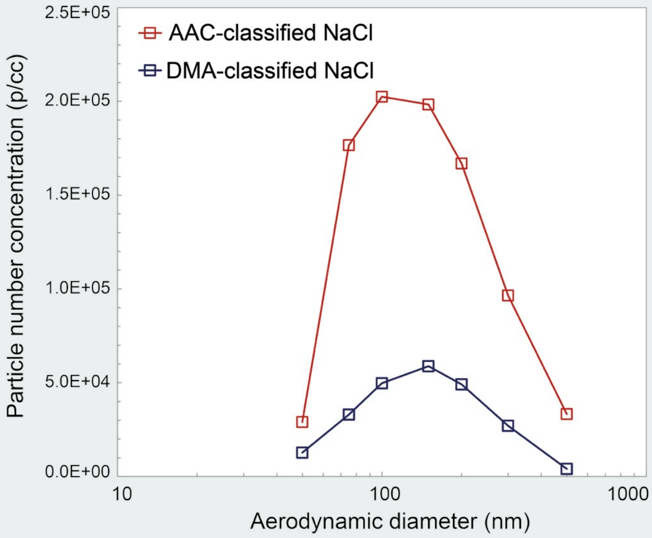
Classifying monodisperse particles for filter testing

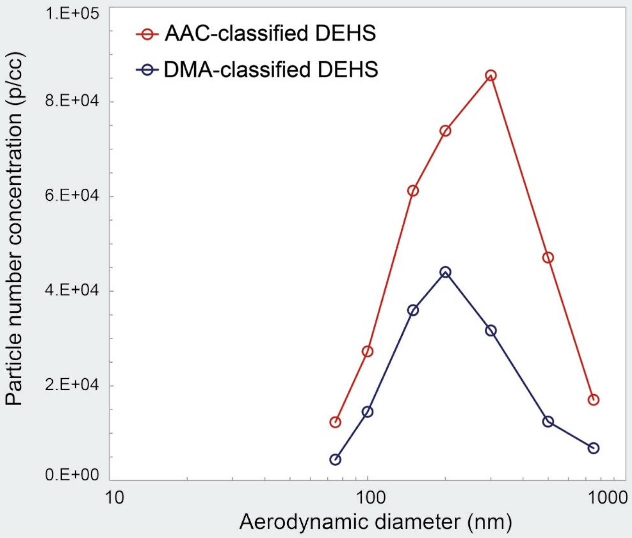
Experimental setup to determine most penetrating particle size (MPPS) of filter media samples using size-classified particles:



Using the AAC instead of the DMA as the particle classifier means higher transmission efficiency and elimination of multiple charging artifacts

In back-to-back classifier tests with nebulised NaCl and DEHS, the transmission efficiency of the AAC was 1.5 to 5.5 times higher than the DMA across particle sizes tested





HVAC & PPE filters

Size-resolved particle penetration measurements are key to understanding the interaction of aerosol particles with a filter.

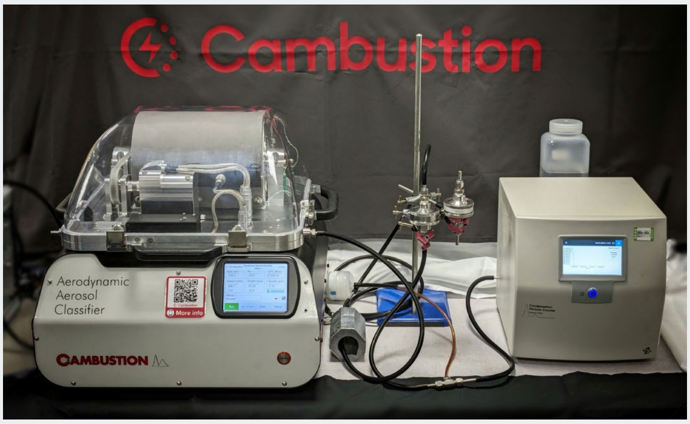
The DMA has been used for many years by aerosol scientists to classify particle size, and its operation for filtration measurements is covered in ISO 29463 (high efficiency air filters).

Since 2016, classification by a particle's aerodynamic diameter is possible with the AAC. (Rotating concentric cylinders and controlled sheath flow induce known centrifugal and drag forces on each particle.)

Aerodynamic diameter is the metric of interest when particle interception and inertia are important, such as in respiratory deposition, atmospheric lifetime and settling, and particle collection by filters, cyclones, and impactors.

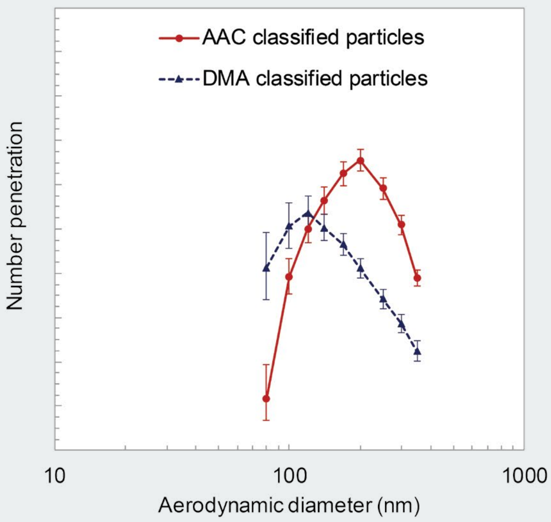
Crucially, the AAC approach holds the advantage of operating independently of particle charge. This means there is no need to condition the aerosol charge state for classification as with the DMA, which ideally would transmit only singly charged particles (generally a fraction of the particle population) yet larger, multiply charged particles with the same mobility may also pass.

The AAC consequently offers significantly higher transmission efficiency, and its output is truly aerodynamically monodisperse. These properties may be important for precise size-resolved measurements for filtration efficiency required in ISO 29463 and future standards.



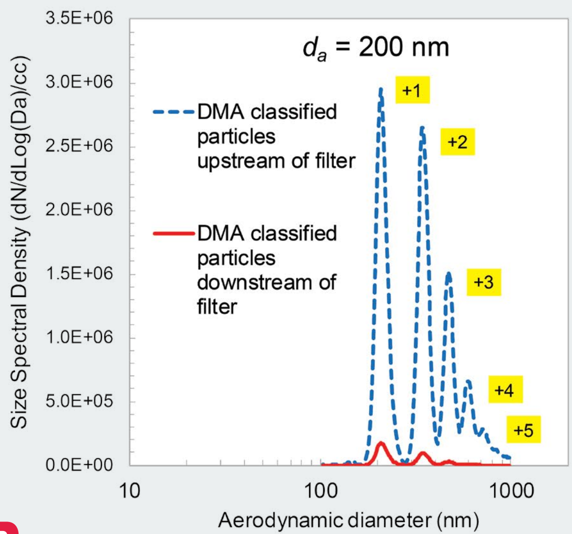
In measurements of DEHS particle penetration through air filter media, both classifiers were compared back-to-back and it was established that multiple charge artifacts in the DMA output can have a significant effect at particular particle sizes. The inaccuracy depends on the position of the size cut relative to both the peak of the input distribution and the most penetrating particle size (MPPS) of the filter:

Particle penetration through E10 air filter:



Larger, multiply-charged particles in DMA output distort measurement of filtration efficiency

Scan of DMA output at 200 nm:



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