

Aerosol dilution: the uncertainty of the dilution ratio

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Dilution systems with internal mixing gas preparation are based on the passive passage of a defined total flow rate of the aerosol to be diluted. This flow is divided into two partial flows. A small partial volume flow rate goes through a capillary, whereby its particle concentration remains constant, if losses within the capillary can be neglected. The majority of the total flow passes through a bypass, consisting of a valve and an absolute filter for particle separation and then mixes again with the capillary flow. The valve adjusts the ratio of the two volumetric flow rates and thus the dilution ratio of the system.

Typically, a diluter is installed upstream of a particle counter or an aerosol spectrometer to reduce the aerosol concentration down to the working range of the device. If not only the size distribution but also the total concentration of the aerosol has to be quantified, the dilution ratio contributes linearly to the result. This is the case when measuring the upstream concentration in filter penetration measurements. Therefore, the uncertainty of the dilution ratio is required to quantify the measurement uncertainty of the aerosol concentration or the filter penetration.

The dilution ratio is not a measurand as defined by GUM (JCGM 100, 2008), because it is not measured during the application. Nevertheless, the concept of quantifying its uncertainty can be applied here.

To quantify the measurement uncertainty of the dilution ratio, the dilution ratio of a diluter (DIL 554, Topas GmbH) was measured independently from the calibration process, according to type A evaluation of standard uncertainty of GUM. The dilution ratio was measured by two CPCs upstream and downstream the diluter employing a DMA-classified DEHS test aerosol.

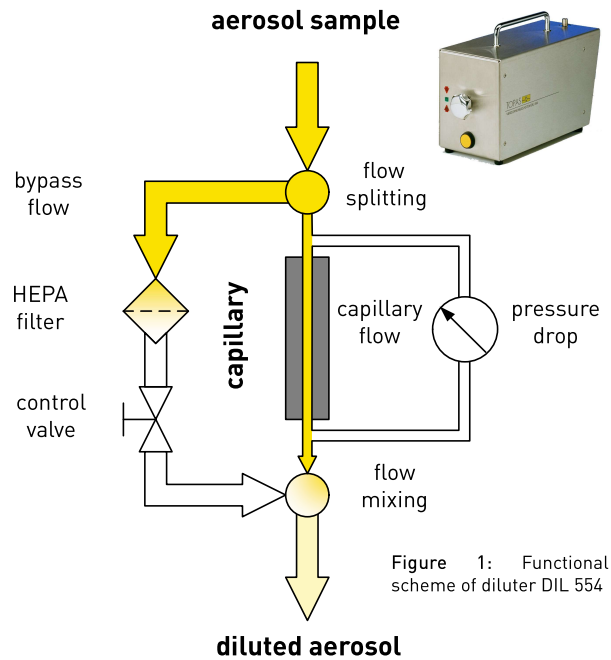
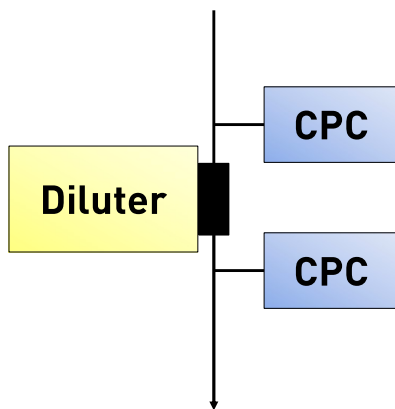


Figure 1: Functional scheme of diluter DIL 554

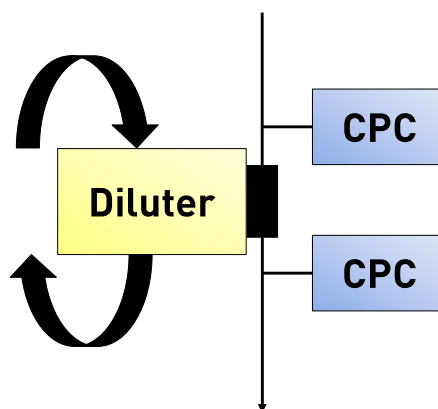
1 Diluter fixed



275 samples (115 s)

Coefficient of variation = 0,34 %

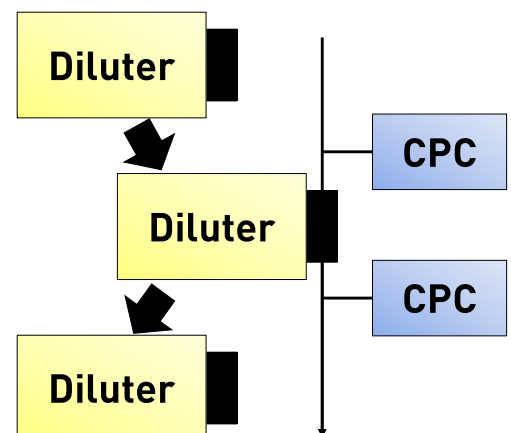
1 Diluter mounted / dismantled



90 samples (115 s)

Coefficient of variation = 1,04 %

10 Diluters randomly installed



180 samples (115 s)

Coefficient of variation = 2,75 %