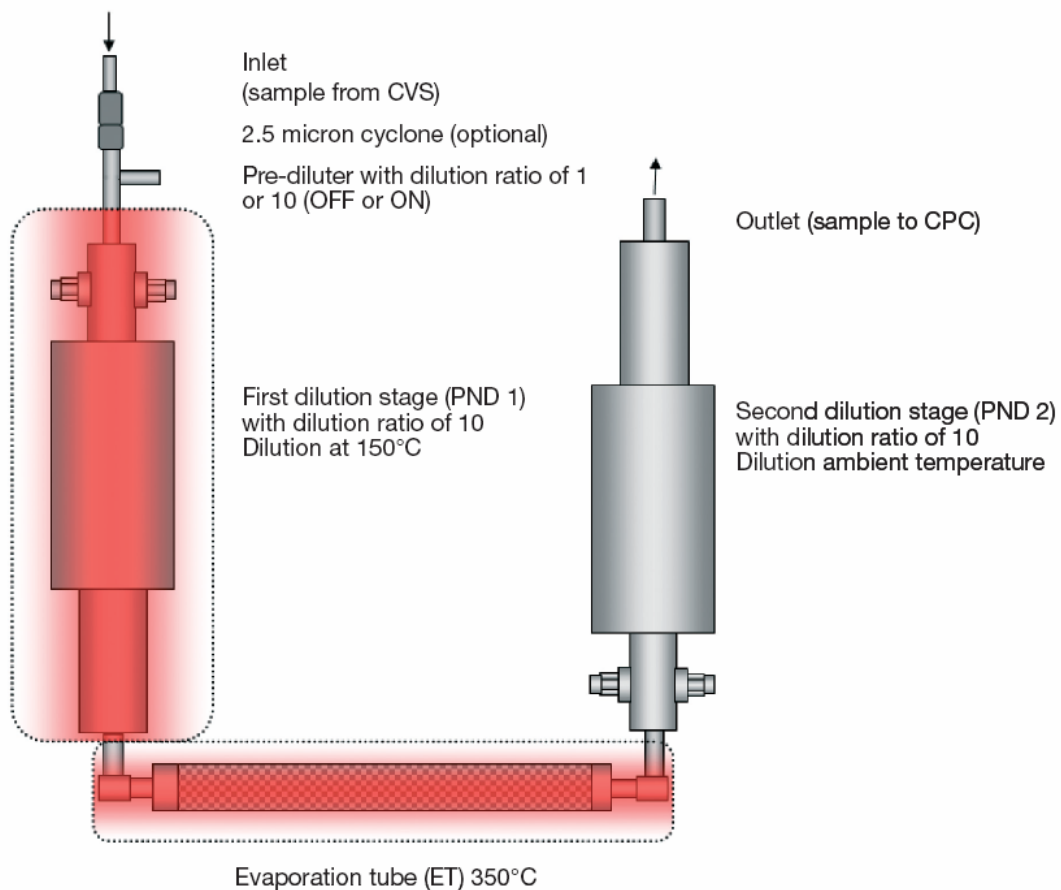


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DEKATI ENGINE EXHAUST DILUTER (DEED) SOLID PARTICLE PENETRATION AND TETRACONTANE EVAPORATION TESTS

General

This document presents the results from Dekati Engine Exhaust Diluter (DEED) regulatory verification of operation. Measurements of size resolved solid particle penetration and evaporation efficiency of tetracontane particles are presented. The schematic of the DEED can be found below:

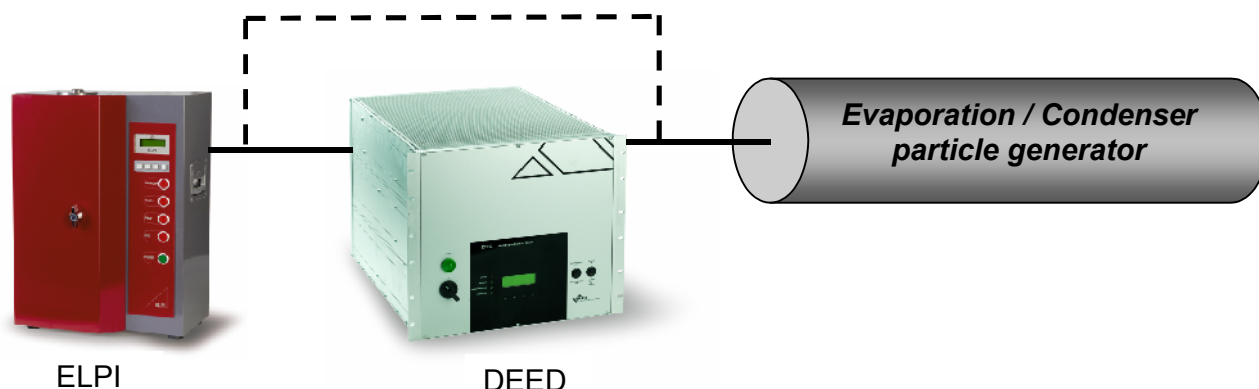


Solid particle penetration tests

The following is stated in the Regulation No. 83, Proposal for draft Supplement 7 to the 05 series of amendments to Regulation No. 83:

Achieve a particle concentration reduction factor ($fr(di)$), as defined in section 2.2.2, for particles of 30nm and 50nm electrical mobility diameters, that is no more than 30 per cent and 20 per cent respectively higher, and no more than 5 per cent lower than that for particles of 100nm electrical mobility diameter for the VPR as a whole.

To verify the compliance of the DEED to the above statement, a following measurement setup was constructed:



The evaporation/condenser generator was used to generate a polydisperse distribution of NaCl-particles. These particles were then either measured directly with an Electrical Low Pressure Impactor (ELPI), or diluted first with the DEED and then measured with the ELPI. The ELPI data was calculated using salt density and therefore all particle sizes mentioned henceforth are particle mobility sizes.

In general, the total concentration of NaCl particles larger than 30nm was approximately $9.4 \text{ E}6 \text{ \#/cm}^3$. Average concentration after DEED was $8.1 \text{ E}4 \text{ \#/cm}^3$.

Calculated dilution factors for 30, 50 and 100nm particles are given in the table below along with the specified limits according to the proposed regulation.

Particle mobility size	Particle reduction factor	Particle reduction factor upper limit	Particle reduction factor lower limit
100 nm	110.5	N/A	N/A
50 nm	113	132.6	105
30 nm	123	143.7	105

According to the above table, it can be concluded that the Dekati Engine Exhaust Diluter fulfils the requirement for solid particle penetration as specified in the proposed regulation.

The mean particle reduction factor is $\frac{110.5 + 113 + 123}{3} = 115.5$, which is 1.045 times the particle reduction factor at 100nm mobility size.

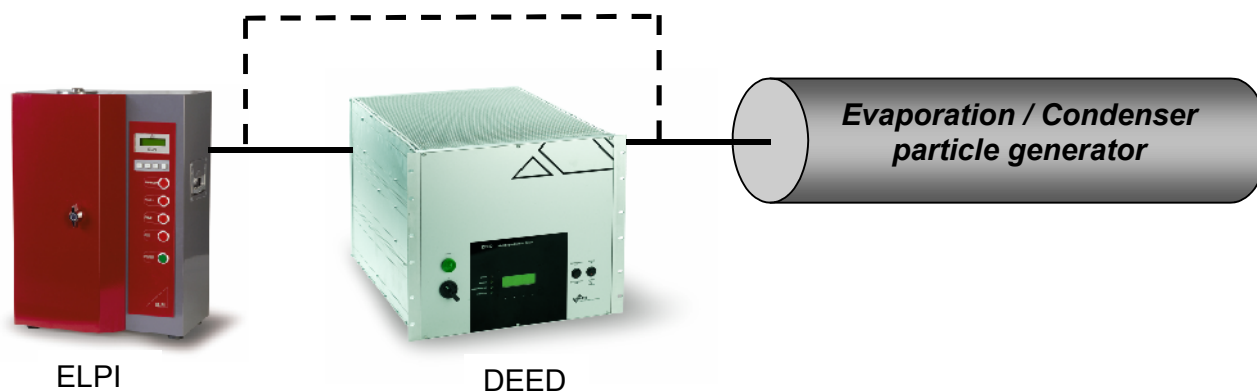
No other correction is used in the particle reduction factor calculation.

Tetracontane evaporation test

The following is stated in the Regulation No. 83, Proposal for draft Supplement 7 to the 05 series of amendments to Regulation No. 83:

(Also) achieve >99.0 per cent vaporisation of 30nm tetracontane ($\text{CH}_3(\text{CH}_2)_{38}\text{CH}_3$) particles, with an inlet concentration of $>10,000 \text{ cm}^{-3}$, by means of heating and reduction of partial pressures of the tetracontane.

To verify the compliance of the DEED to the above statement, a following measurement setup was constructed:



The evaporation/condenser generator was used to generate a polydisperse distribution of tetracontane particles. These particles were then either measured directly with an Electrical Low Pressure Impactor (ELPI), or diluted first with the DEED and then measured with the ELPI. Tetracontane particles above 30 nm were considered in this study. The results from the measurements are given in the table below:

Particle concentration before DEED	Particle concentration after DEED	Dilution ratio	Particle concentration after DEED DR corrected	Maximum allowed concentration by regulation
2.75E6 #/cm ³	1.22E2 #/cm ³	111	1.25E4 #/cm ³	2.48E4 #/cm ³

From the above table it can be seen that the Dekati Engine Exhaust Diluter fulfils the requirements of the proposed regulation.

It should be noted that the particle concentration after DEED is caused by normal ELPI electrometer noise and in reality the particle concentration after the DEED was zero.