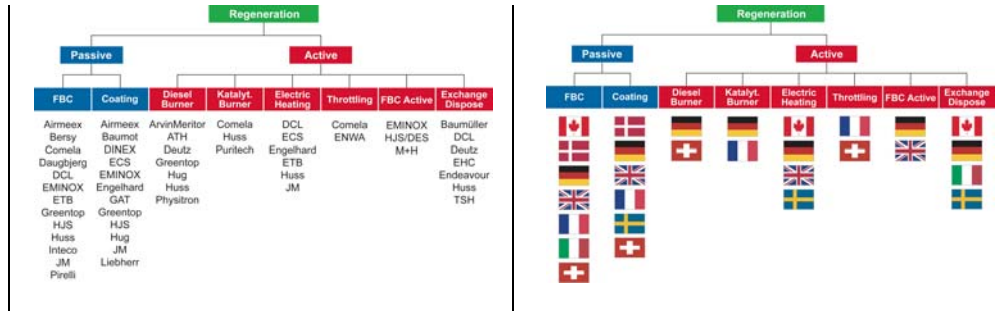


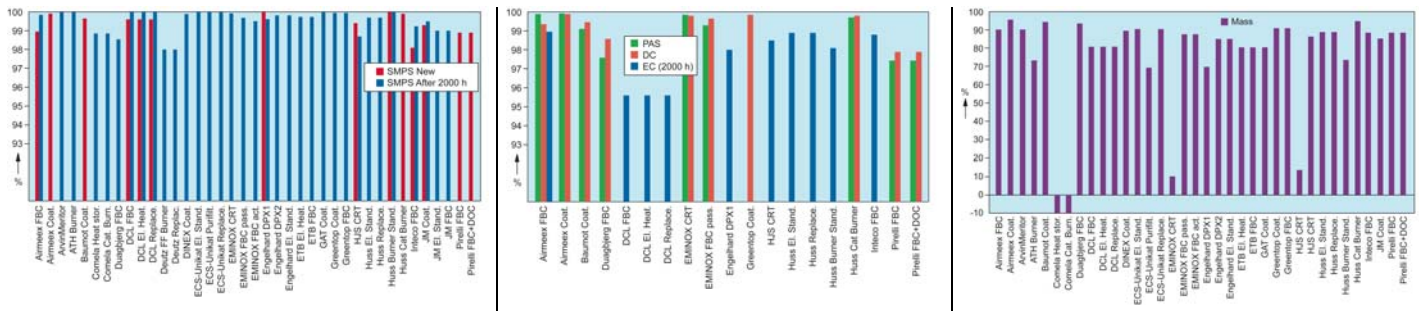
# 18'000 Particle Trap Retrofits of Diesel Engines 10-3000 kW 54 VERT-Certifications - Filtration Rate > 97 %

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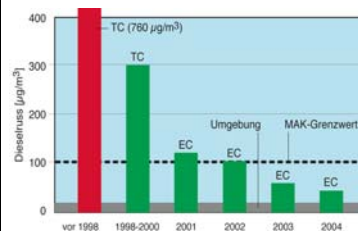
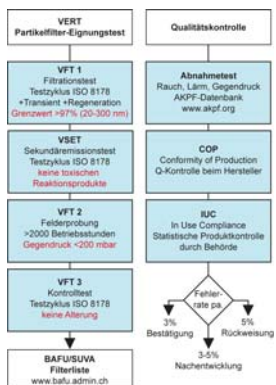
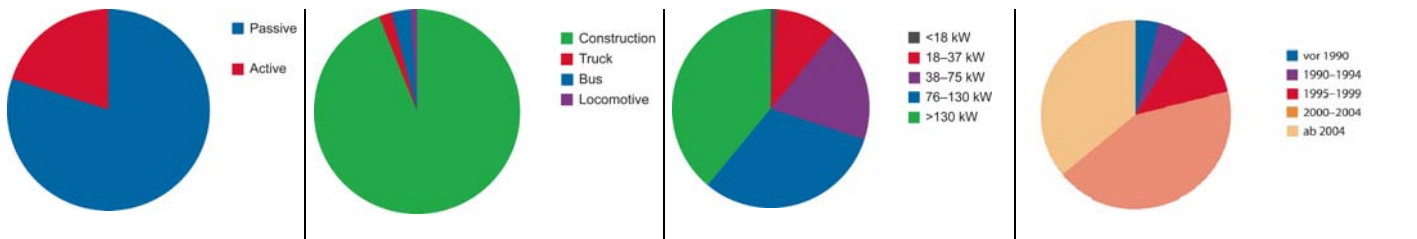
VERT-certification was introduced in 1998, based on number count per particle size class in the alveoli penetrating mobility range of 20-300 nm. 54 particle filter systems PFS are now certified and listed on the BAFU/SUVA-Filter List [www.bafu.admin.ch/](http://www.bafu.admin.ch/); Certification procedure is according to SNR 277205 and each retrofit is labeled with a running number and documented in the AKPF-data base [www.akpf.org](http://www.akpf.org); VERT-certification is accepted by Denmark, the Netherlands, LEZ London, California, Santiago de Chile, New York City, Alto Adige and in occupational health by SUVA, AUYA, BG Bau, TRGS, MSHA and DEEP.



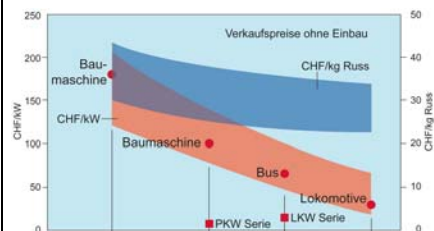
Solid particle number concentration measured by SMPS with PMP hot (300°C) sample treatment is the metric for filtration efficiency in the VERT-test. Data before and after 2000 field operation hours in the left chart (from official AFHB-certification reports) show the overall high filtration quality. This is confirmed (middle chart) by PAS and DC, the dynamic Nanomet sensors while EC using the coulometric method acc. to VDI 2460 sometimes shows lower values depending on OC/EC ratio. PM-mass values (right chart) are falsified by condensation artifacts which can be very strong if sulfate store and release phenomena are involved (SAE 2008-01-0332).



The following graphs show the AKPF-data base evaluation: by far the largest group of retrofits in Switzerland are construction machines, but also public transport buses, trucks, locomotives ships, fork lifts, any kind of industrial machines and stationary gensets are retrofitted. Engine performance runs from 10 kW to 3000 kW for large locomotive engines. Quite a few engines manufactured before 1990 are running successfully with retrofit filters – so neither size nor age of the engines excludes retrofit with high efficiency particle filters. Different regeneration methods are used as shown above, where CRT and DPX have the highest share in the market but more and more active systems are now appearing.



First application in Switzerland was in tunneling where the use of PFS became mandatory in Y 2000 by SUVA. Difficult applications but in the end extremely successful as the air quality testing proved.



Sales cost statistics show a sharp increase for the specific cost CHF/kW for the smaller engines – however the cost effectiveness CHF/kg soot is rather flat because smaller engine emit specifically much more soot.



Tailpipe of a city bus after one year of daily use (80'000 km) This endurance test is part of the VERT certification – followed by VFT3 on bench.

VERTcertification scheme