

# GENEVA: GRPE Particulate Measurement Programme (PMP)

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“There is a lot of knowledge on particles and particle measurement - so what are we going to do about it?”

**Mike Dunne - 4th ETH Nanoparticle Conference, 7 - 9 August 2000**

## Initiating Governments:

- France, Germany, Netherlands, Sweden & UK. Joined by Japan and Switzerland.

## Key Objective:

- Development of type approval test protocols for assessing vehicles fitted with advanced particulate reduction technology that would complement or replace current legislative measurement procedures.

## Target Completion:

- 2003

## Forum

-  GRPE

## Working protocol

- A co-operative programme, i.e. participants to conduct their own programmes on an agreed time scale.
- Intermittent meetings of researchers to exchange technical information.
- Main aim of the PMP Chairman is to facilitate progress to the agreed time scale and to focus activities towards a common understanding.

**PMP**



## **Government programme**

- More than 20 measuring instruments/systems have been investigated in programmes by Germany, Switzerland and the UK.
- Light-duty vehicle measurements made on NEDC and FTP test cycles.
- Heavy-duty engine measurements made on ETC, ESC, WHDC & FTP test cycles.

# Sampling Systems

## Light Duty

- Constant volume sampling (CVS)
- CVS + Sample treatment
  - thermodenuder
  - thermodiluter
- Raw exhaust

# Sampling Systems

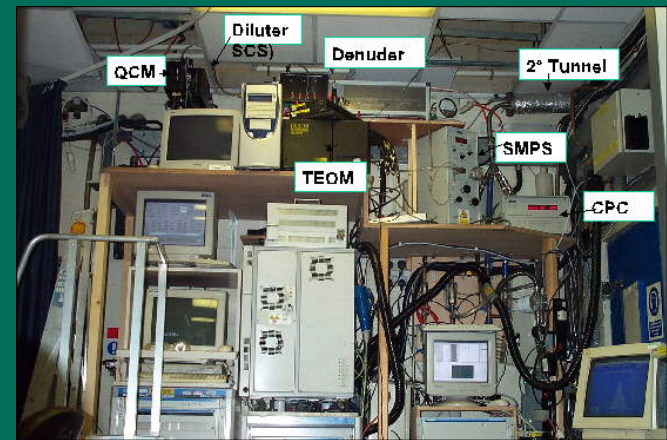
## Heavy Duty

- Constant volume sampling (CVS)
- CVS + treatment
- CVS + secondary dilution
- CVS + secondary dilution + treatment
- Raw full flow
- Raw full flow + hot dilution (rotating disk or double state ejector)

# Instruments

## Mass measurement

- MEXA
- Tapered element oscillating microbalance
- Laser induced incandescence
- Quartz crystal microbalance
- Photoacoustic Soot Sensor
- MASS-Monitor
- Coulometric
- Photoelectric aerosol sensor
- Opacimeter

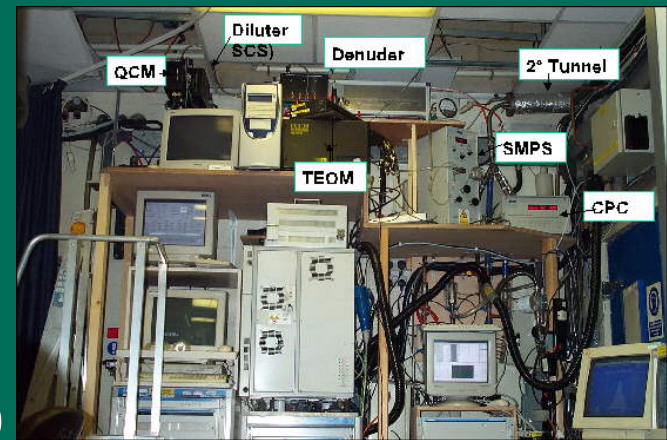




# Instruments

## Number measurement

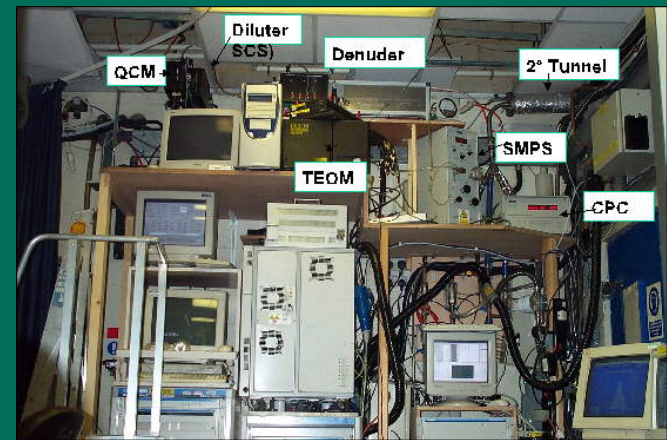
- Laser-light scattering
- Differential mobility spectrometer (number & size distribution)
- Electrical mobility (CPC)
- Electrical mobility/optical counter (number & size distribution)
- Electrical Low Pressure Impactor (ELPI) (number & size distribution)



# Instruments

## Other measurement systems

- Diffusion Charger/electric diffusion battery (DC/EDB) (surface number mobility)
- Light extinction opacitimeter (average size of primary particle)



# Sampling Conditioning

## Thermodenuders

Commercially instruments:

- TSI
- Dekati

Laboratory instruments:

- Fraunhofer Institute of Technology (Germany)
- NTSE Laboratory (Japan)

# Sampling Conditioning

## Thermodiluters

Hot dilution systems tested

- Rotating disk (Matter Engineering)
- Ejector dilution systems (Dekati & Palas)

# Results

## Mass measurement

- Modified US 2007 - offers significant improvements in COV compared to European filter method.

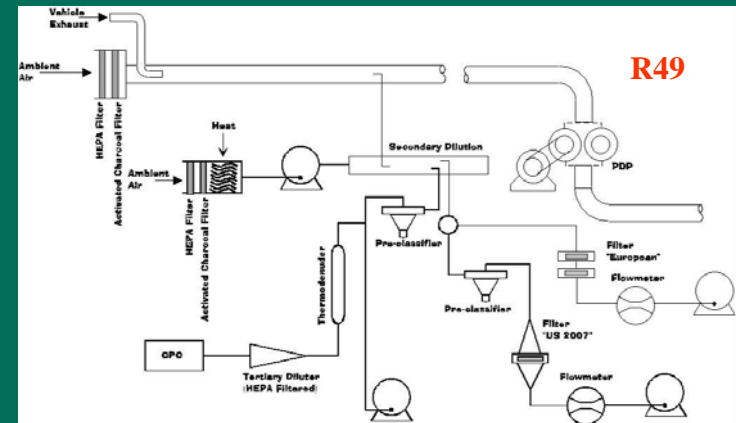
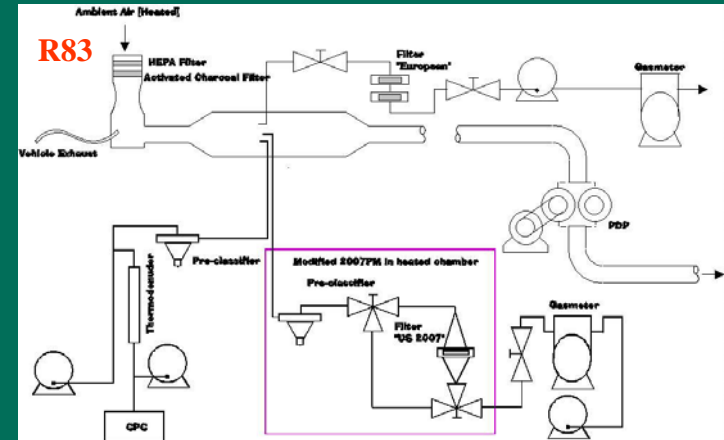
## Number Measurement

- CPC - good overall robustness & good repeatability (COV) when operated with appropriate sample pre-treatment; very linear in experiments using the CAST system

# PMP

## Next Steps

- Final report summarising the national programmes available September 2003.
- UK to table Annexes for R83 and R49 based on this final report's recommendations at September GRPE
- Discussions with Industry and Government colleagues on Annexes aimed at agreeing proposals (main principles) by end January 2004.



# PMP

## Outstanding Issues

- Round-robin
- Calibration
- Assessment of Advanced-Technology
- Health evidence (esp. number)
- Limit values

# When?

EU Commission planning 2 new directives:

- Proposals 2004
  - Light Duty (Euro V) from 2010
  - Heavy Duty (Euro VI) from 2013