HORIBA
Automotive Test Systems

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HORIBA
ONE
PLATFORM

OBS-ONE Platform
Gaseous, PM and PN

Horiba Instruments, Inc.

1. **System Features**
2. OBS-ONE-PM (Particulate Mass)
3. OBS-ONE-PN (Particle Number)

Gaseous Components:

CO, CO_2, NO, NOx, THC, CH_4

LDV Type

HDV Type

LDV : Light Duty Vehicle
HDV : Heavy Duty Vehicle

Particulate:

Mass, Solid Particle Number

OBS-ONE -PM

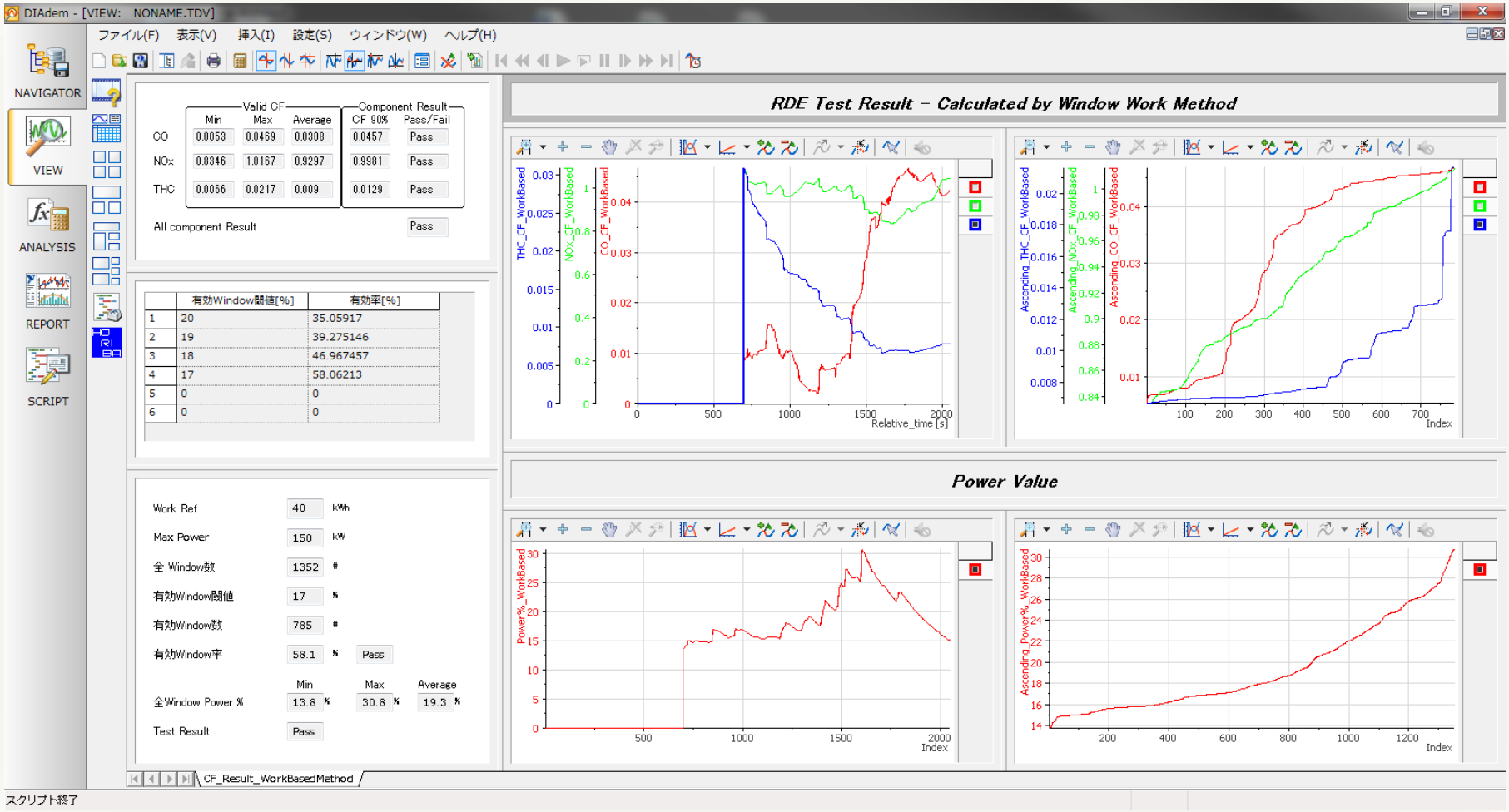
OBS-ONE -PN

OBS ONE Concept

- Same base software package for new generation laboratory equipment (MEXA ONE, CVS ONE, etc.)
  - Horiba One Platform
  - Windows based interface
  - Linux machine for equipment control
- Software includes test automation (sequence for PEMS)
  - Flexible test sequences
  - Large amount of entry fields for documentation of test
- Post processing software based on National Instruments DIADEM software
  - Standard graphical and mathematics package
  - Emission calculation and analysis
  - Default basic reports
  - Customizable report formats

Post data analysis(1)

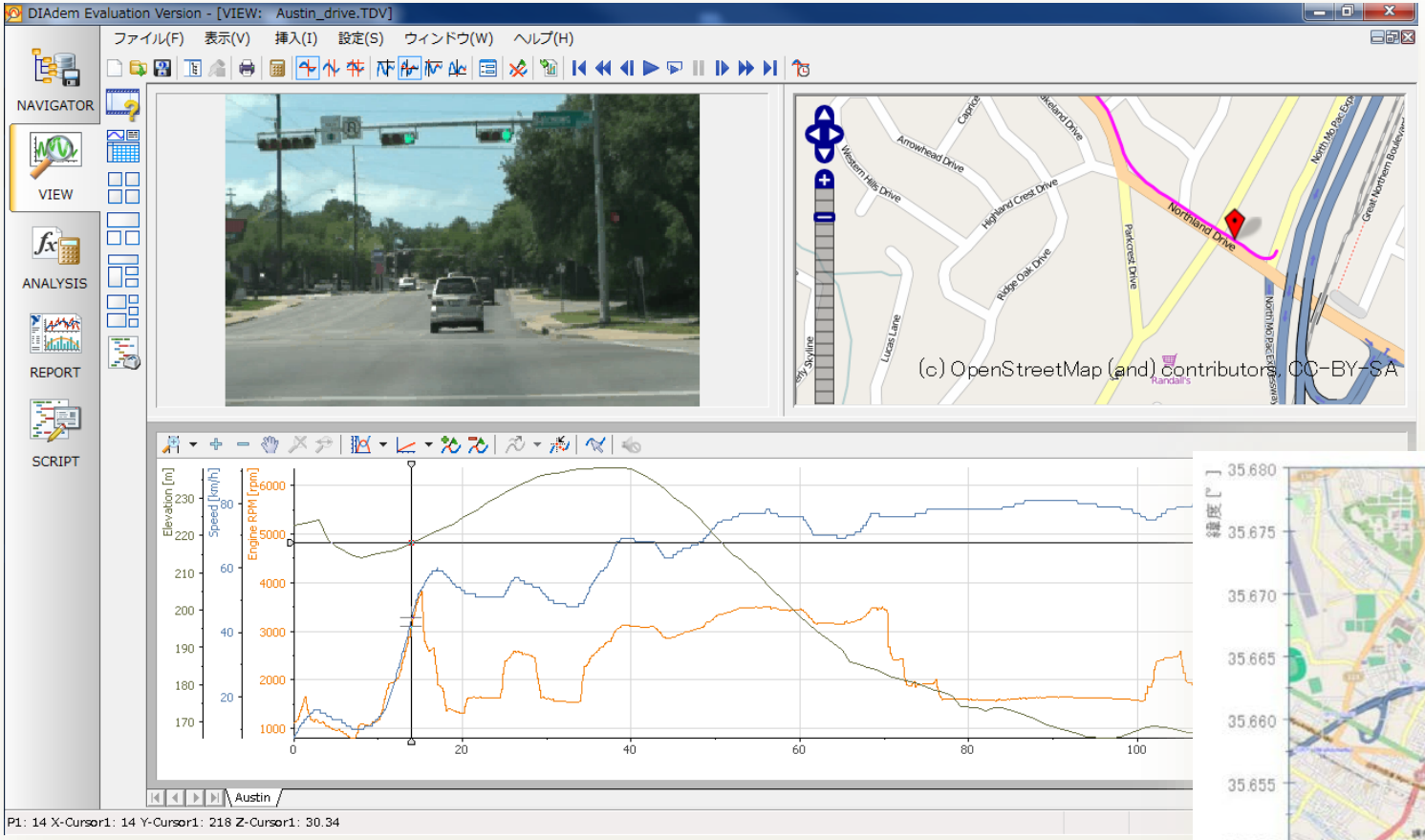
Example of Type approval result (MAW)

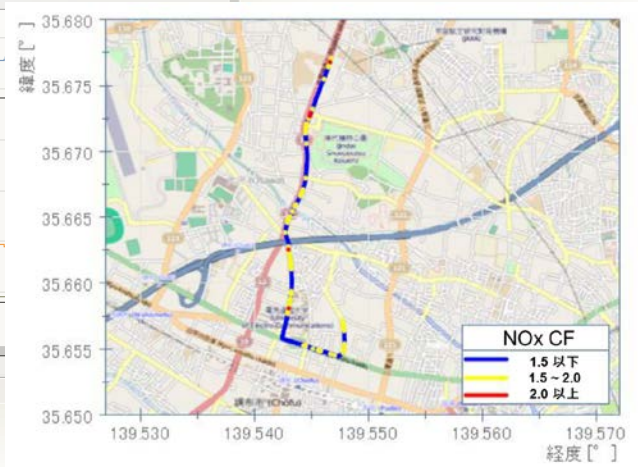


Post data analysis(2)

Example of data analysis

Optional function with video, map data





System Flexibility..

- Maintenance
  - Gas analyzers use many common parts with MEXA-ONE, MEXA-7000 and OBS-2000.
  - Linearization sequence identical to MEXA ONE
    - Automated sequence with Horiba MFC based gas dividers
    - User can update curve coefficients
  - Automated interference checks with heated bubbler
    - User can update correction coefficients

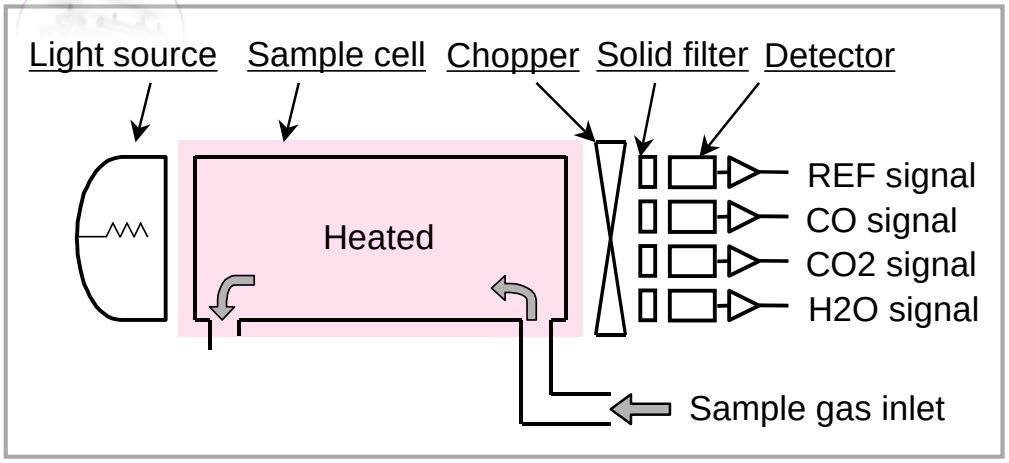
GDC-ONE
GDC-703

High performance detection

- "Wet" based concentration measurement for better performance
  - Direct conversion to mass from exhaust flow without dry to wet correction
  - Faster response using "Hot wet measurement" technique (no cooler)
  - More accurate real CO and CO_2 measurement by Heated NDIR
  - Reliable / accurate NOx measurement by CLD

Component	Detection principle	Advantage
NO, NOx	**Heated Dual-CLD**	• No dehumidifier : fast response • Small size, low sample flow rate
NO_2	**(Calculated by Dual-CLD)**	No dehumidifier so no loss of NO_2
CO	**Heated NDIR**	• No dehumidifier : fast response • Integral H_2O measurement for compensation
CO_2		
THC	**Heated FID**	• Vacuum type sampling for fast response. • 191˚C for diesel THC measurement
CH_4	**Heated FID with non-methane cutter**	• Vacuum type sampling for fast response.

Feature of Heated-NDIR

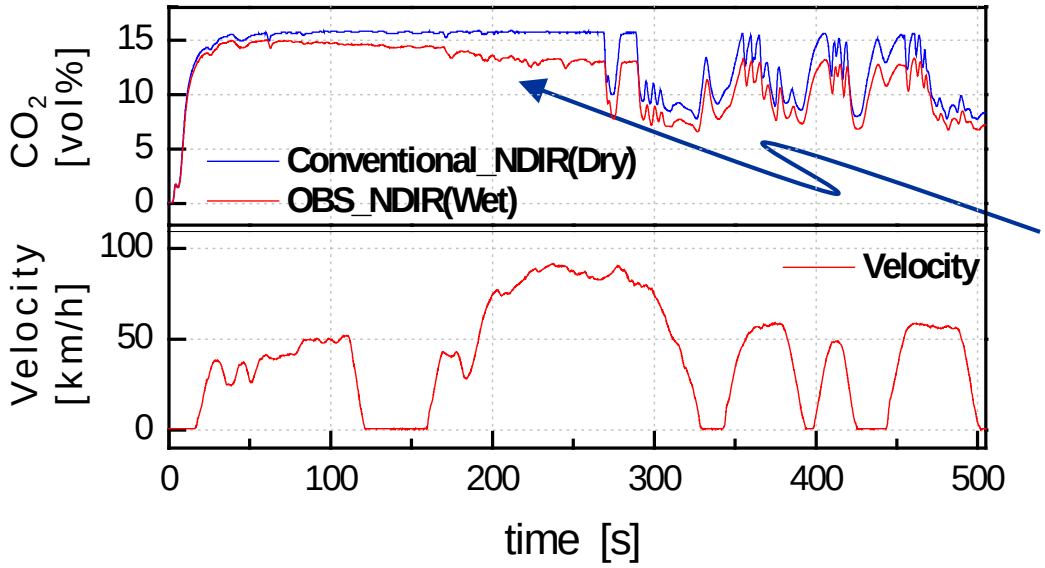


Heated-NDIR (H-NDIR)

- CO and CO2 signal are compensated by H2O signal and optimized algorithm for more accurate measureament

【Patent No. JP 03771849】

FTP-75 Phase 1 (Cold start) Lean burn gasoline vehicle

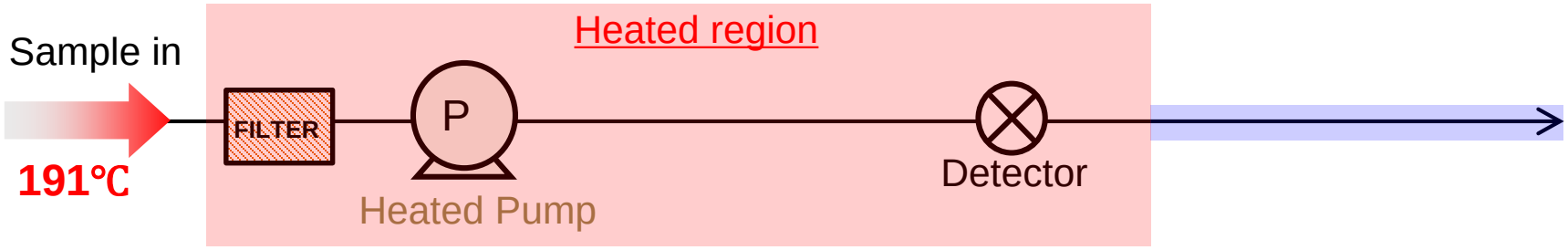


Real concentration at measuring point can be measured by H-NDIR

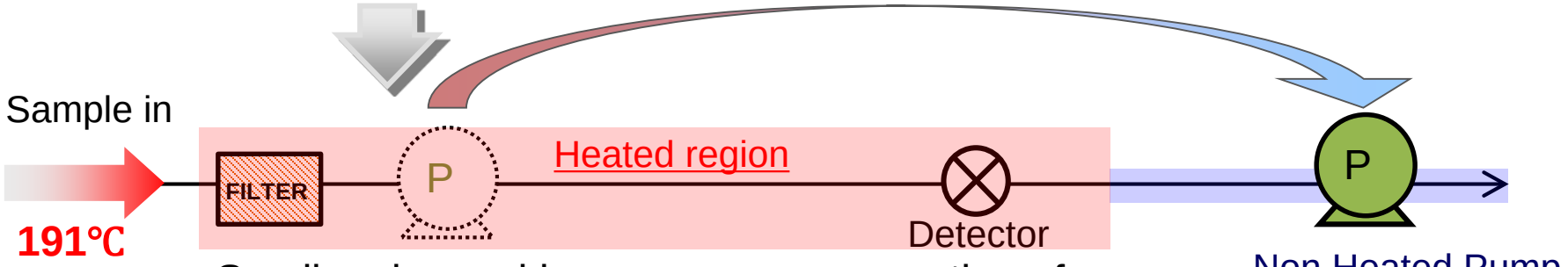
NDIR with dehumidifier increases error due to dry to wet base correction during cold start of engine or for dual fuelled vehicles

Sampling optimized

Vacuum type sampling system for size reduction



- Heated pump is bigger than cold pump
- More electrical power is required

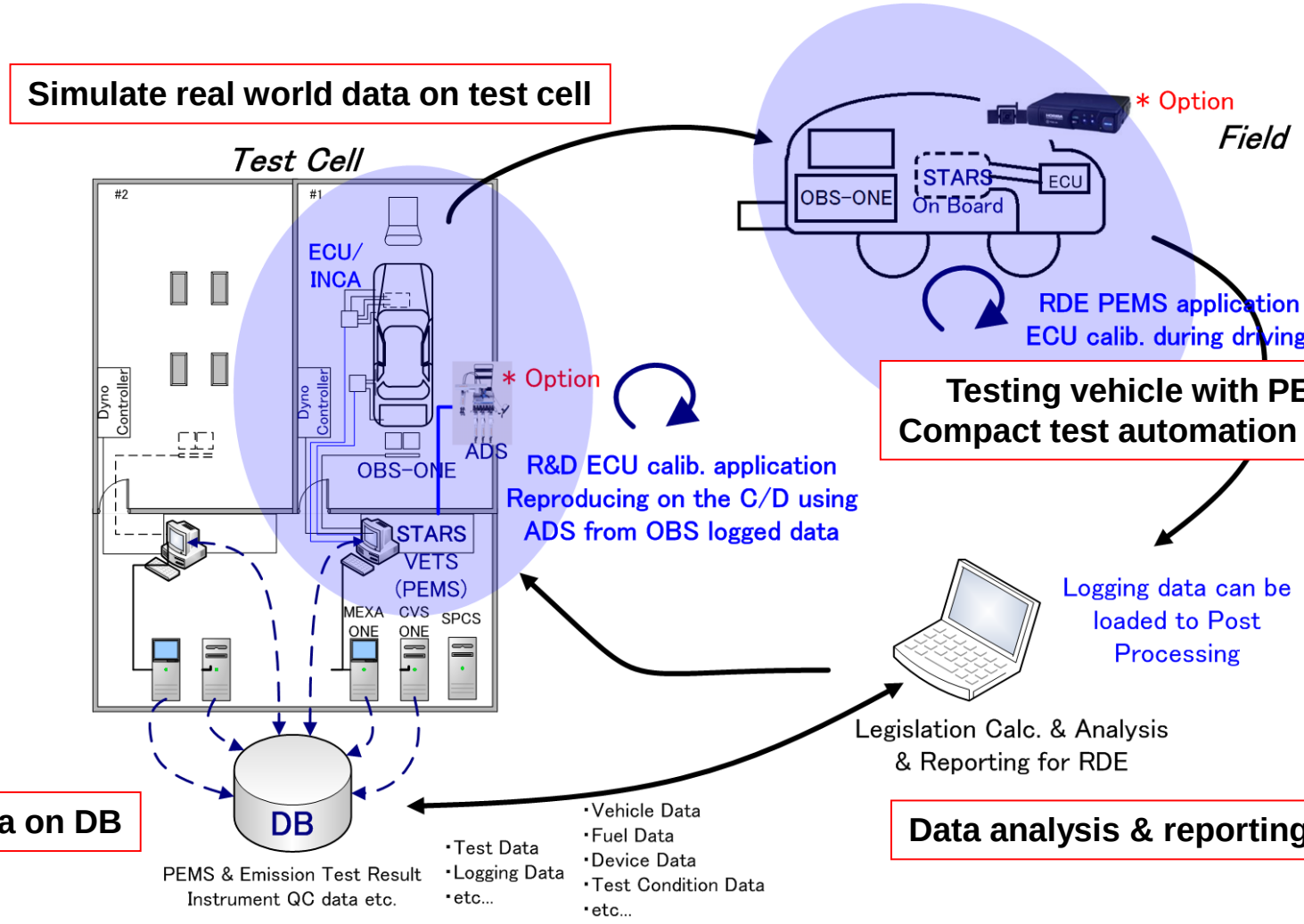


- Smaller size and lower power consumption of pump
- Less heat insulation required

Smaller instrument size and smaller battery due to lower power consumption => Smaller size of total system

Work flow Test cell & PEMS

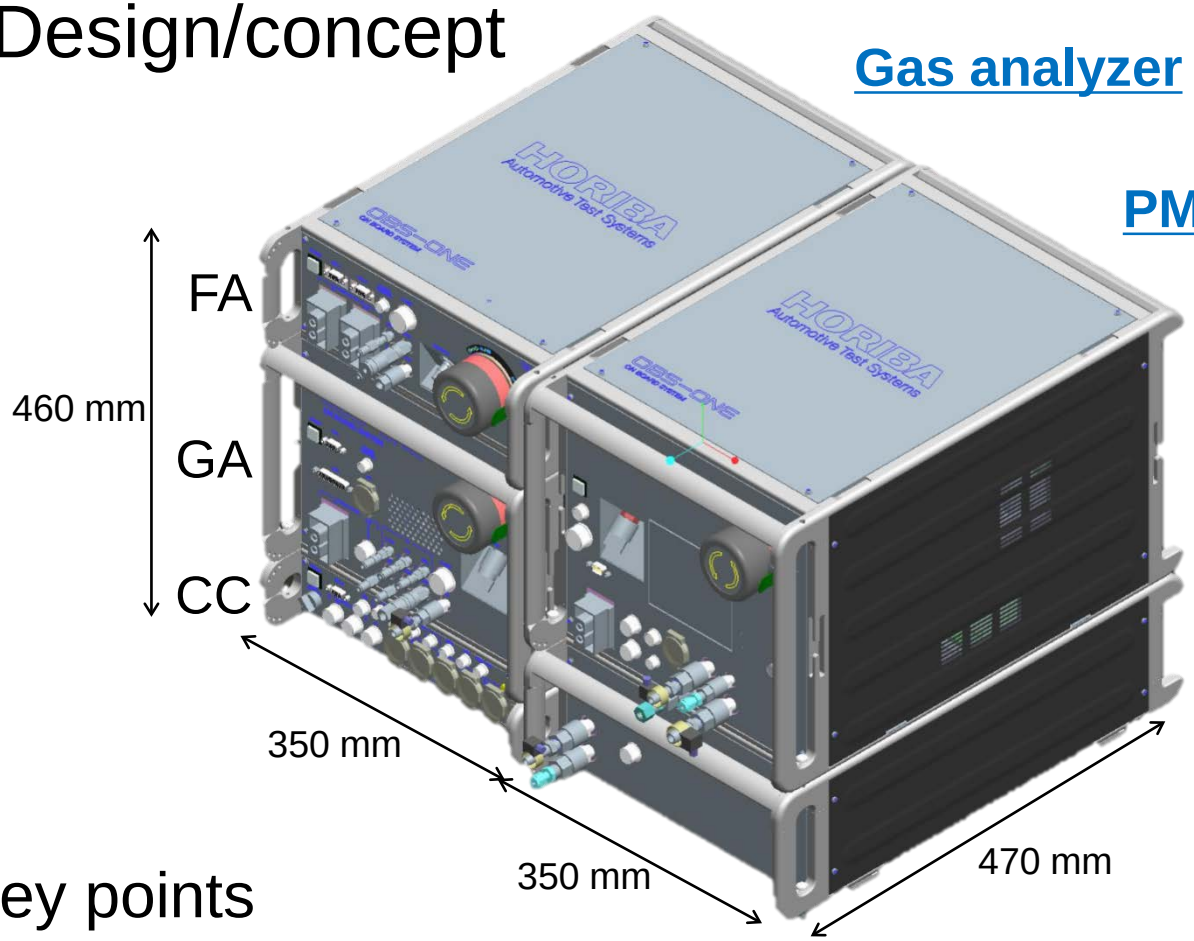
Test cell & PEMS



1. System Features
2. **OBS-ONE-PM (Particulate Mass)**
3. OBS-ONE-PN (Particle Number)

OBS-ONE-PM

- Design/concept



- Key points
  1. Same size as OBS-ONE-GAS
  2. Keep the same concept: Front Access, no tools needed for operation

PM Sampler and Real-Time Sensor

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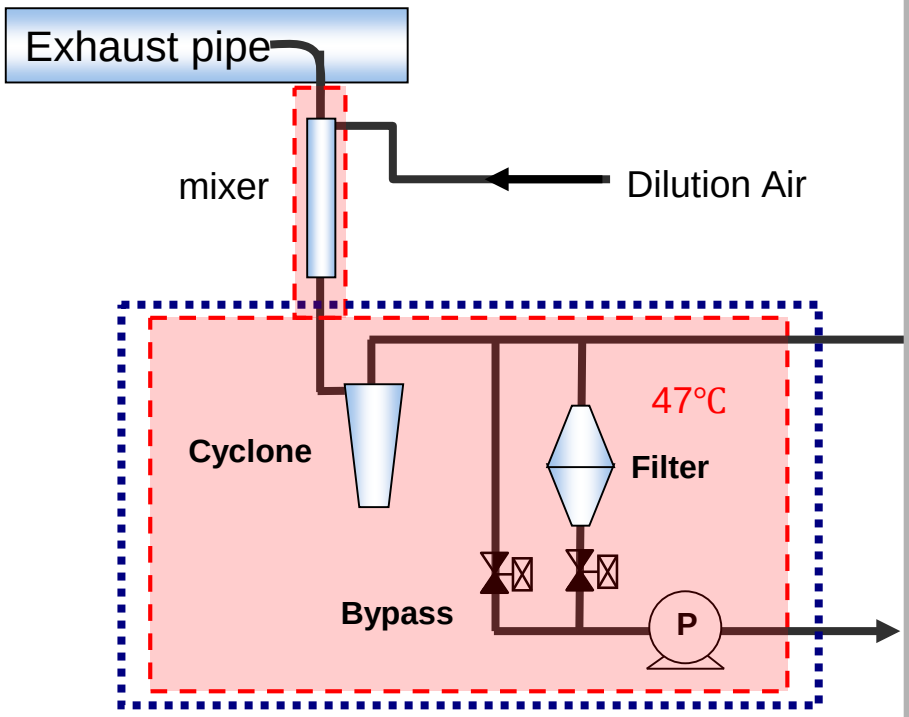
Gravimetric Method

- Correlation
- Traceability



PM mass measured by filter using a portable **exhaust flow rate proportional partial flow dilution system**

Real time measurement

- High sensitivity
- Real time measurement

Exhaust flow rate signal from pitot tube flow meter used to control proportional dilution as certification method and calculate real time particle measurement

Diffusion **C**harger **S**ensor (DCS)

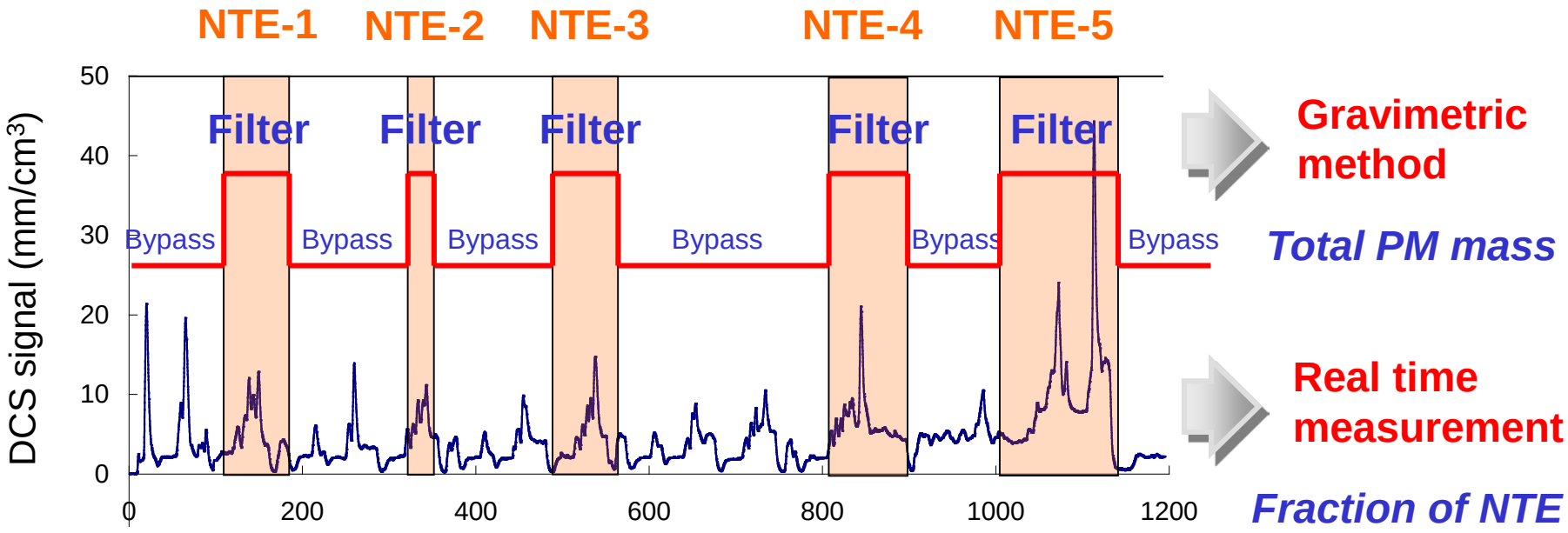
- DCS is a real-time particle sensor, based on diffusion charge principle
- DCS signal is calibrated to actual PM mass post-testing using the filter based method.
- The use of the diffusion screens to eliminate PM mass over-reading during DPF regeneration

【Patent No.JP 4956178】

This method is approved by EPA alternative approval letter

Method of OBS-PM for NTE

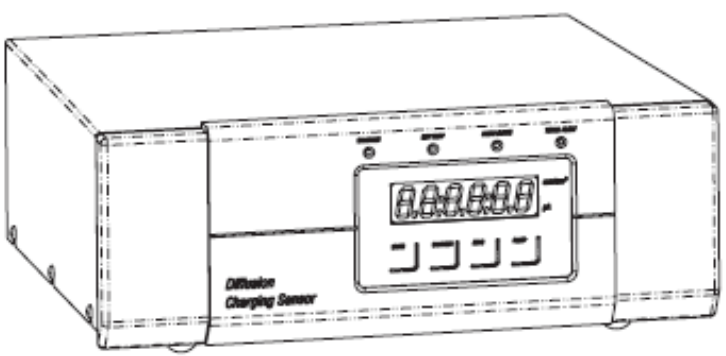
The ratio of integrated real time particle signal to PM mass (from PM filter) is used to calculate real time PM mass for US NTE and EU moving average window methods



PM mass in Individual NTE events = Total PM × Fraction

allows subtraction of the PM mass loaded during invalid NTE events < 30 seconds
Also allows determination of real time PM concentration for Moving Average Window

Real time PM (DCS-100)



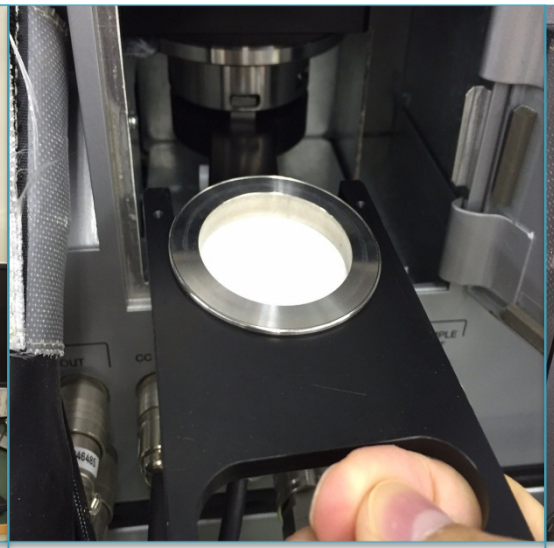
Measures Particle Length

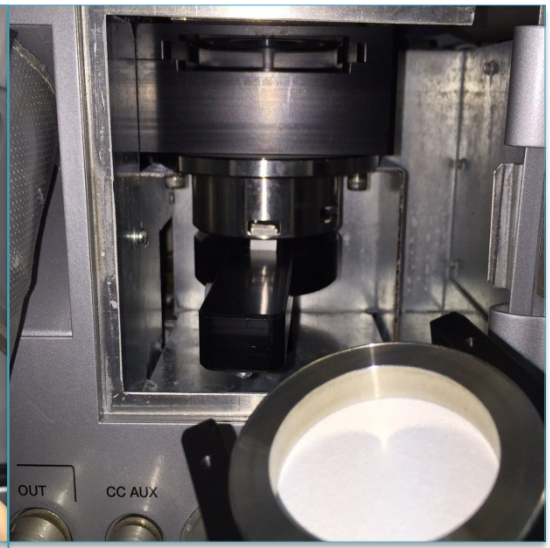
$d^{1.13}$

Specification:

- Measurement range: 0 ... 2500 **mm**/cm³
- Sensitivity limit: 0.01 **mm**/cm³
- Sample flow: 2.5 liters/min. (approx.)

Filter change method





Step 1

- Open the door

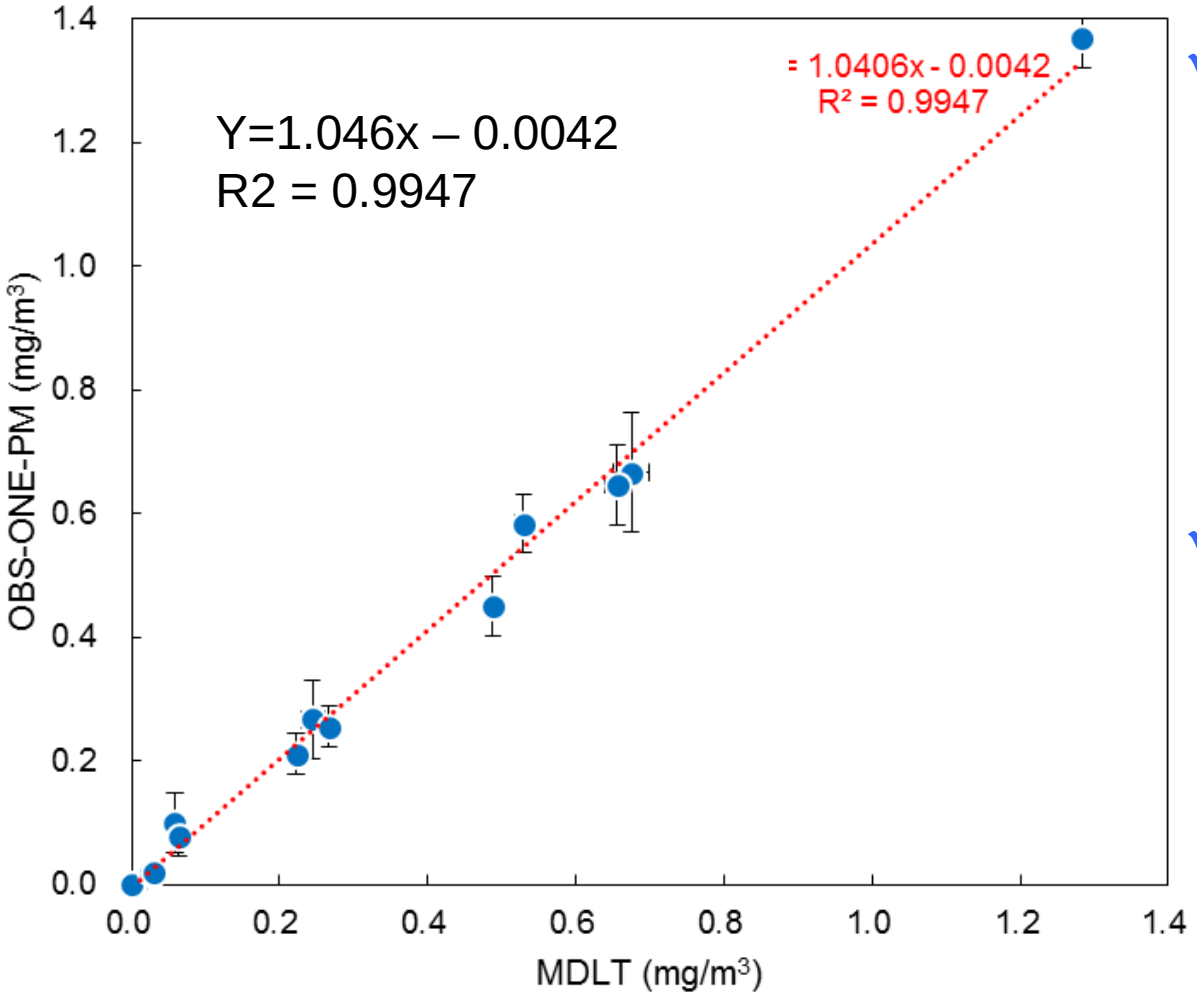
Step 2

- Release Filter lock

Step 3

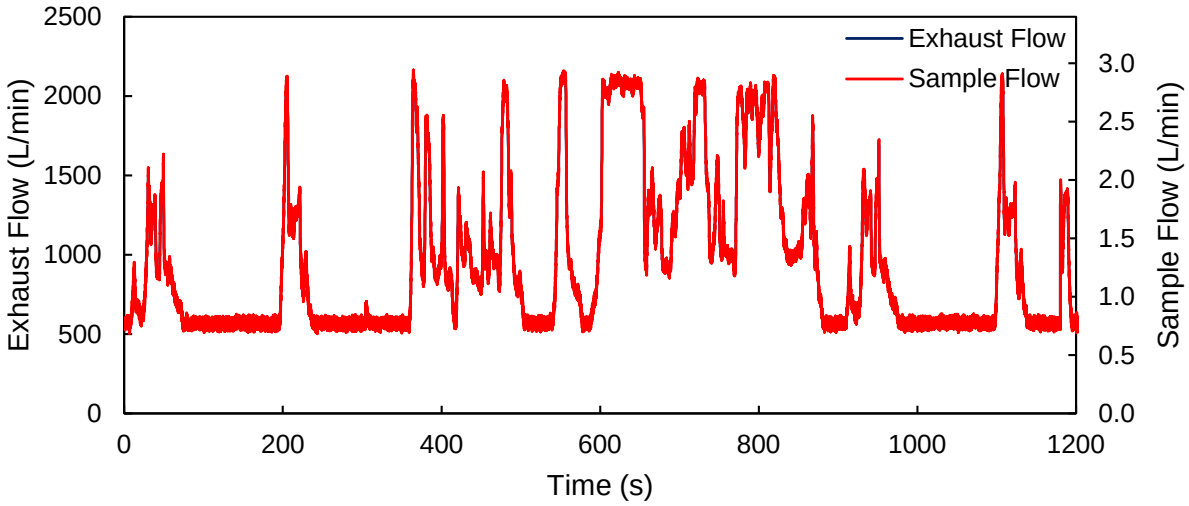
- Remove Filter and holder

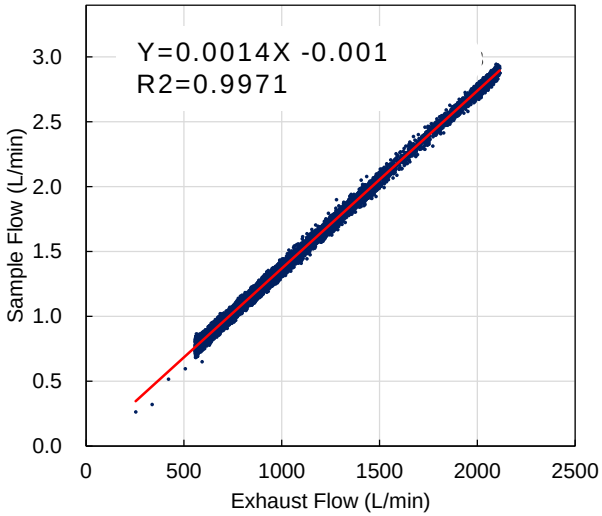
OBS-ONE-PM Correlation with MDLT



- ✓ Correlation between laboratory HORIBA MDLT partial flow and HORIBA OBS-ONE-PM PEMS
- ✓ Good agreement across wide range of PM emissions

Proportionality of PM Sample Flow



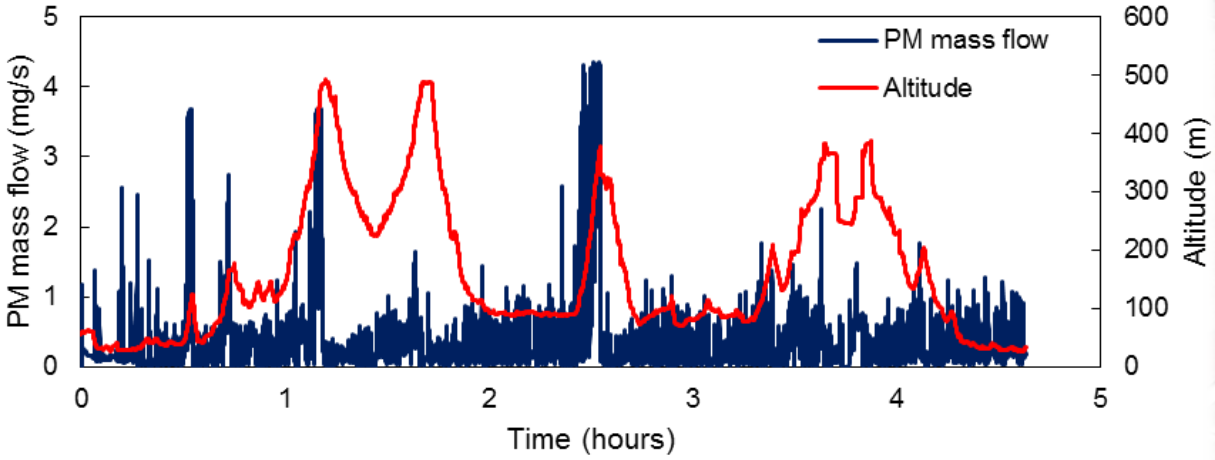


Proportionality of the PEMS-PM sample flow to engine exhaust flow during FTP cycle

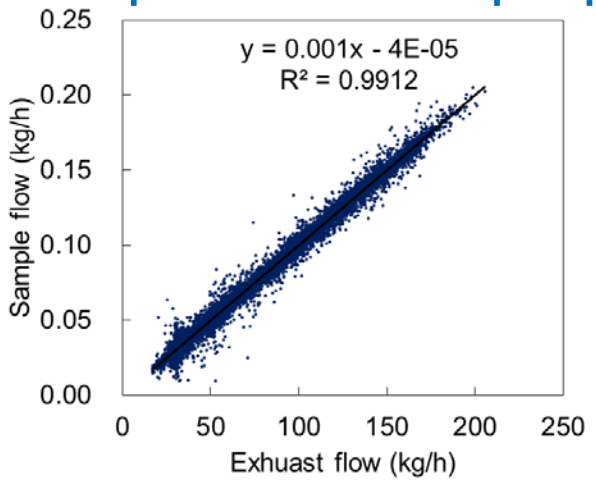
Fast response of flow controller was verified

OBS-ONE-PM Real-Time PM Test Result

Evaluation by on board testing



Sample flow rate proportionality

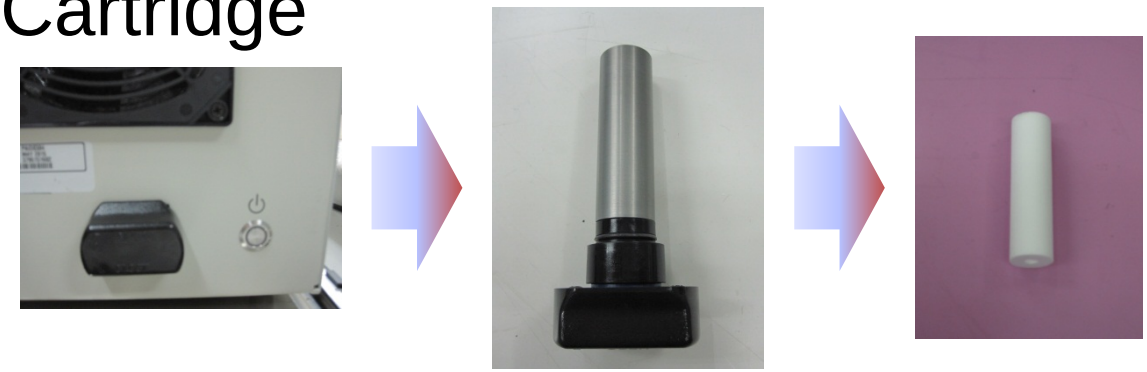


- High emission at sloping road
- Good linearity at real time testing

1. System Features
2. OBS-ONE-PM (Particulate Mass)
3. **OBS-ONE-PN (Particle Number)**

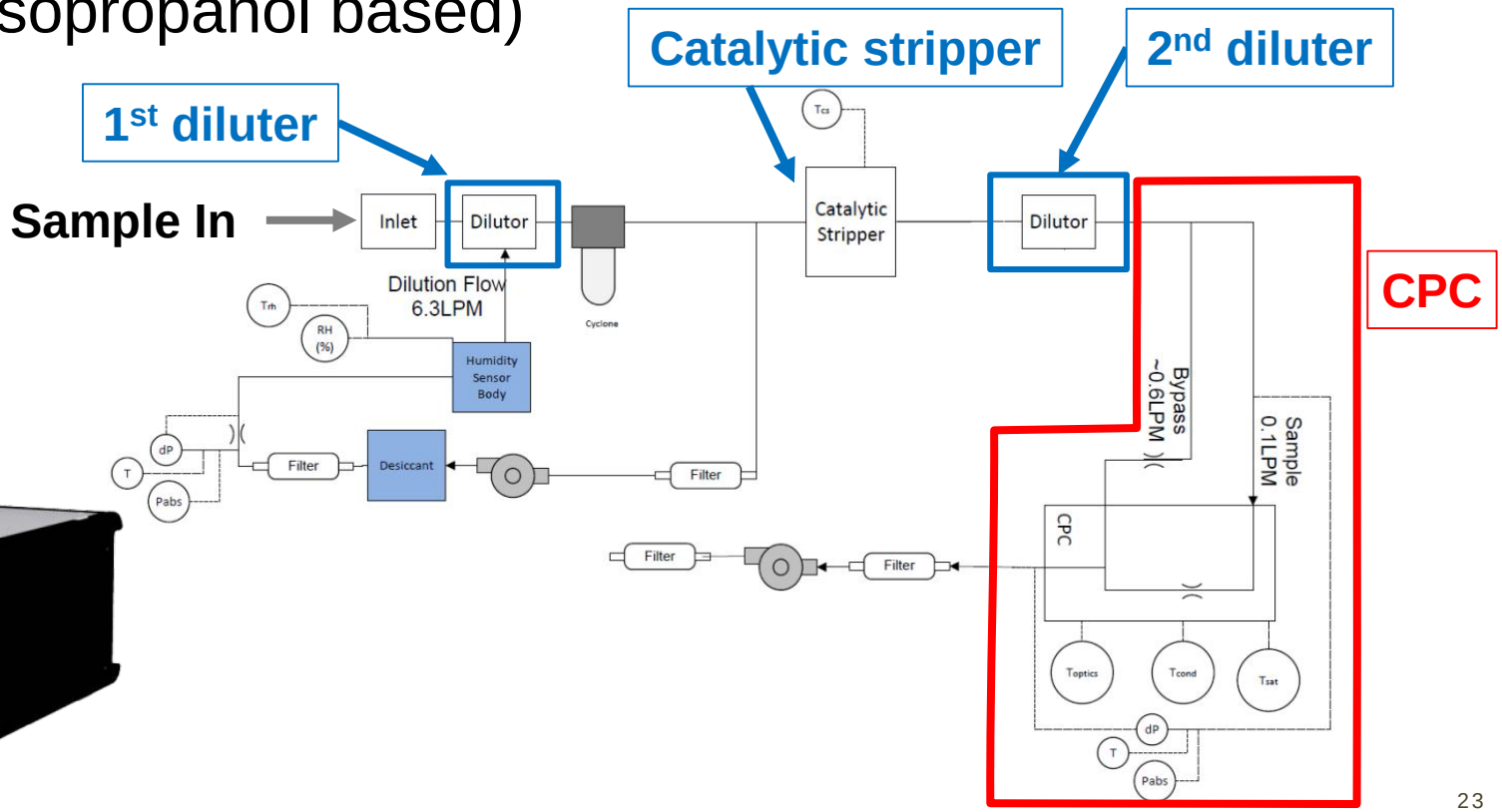
HORIBA PN-PEMS Solution

- HORIBA utilized the CPC based system
  - Main advantage of CPC
    - ✓ Particle count principle (R83)
    - ✓ No particle size dependency
    - ✓ High accuracy and high sensitivity
  - HORIBA's CPC does not have a liquid reservoir of IPA (soaked wick only)
    - ✓ "Easy" and "Safe" operation by using Cartridge



OBS-ONE-PN flow schematics

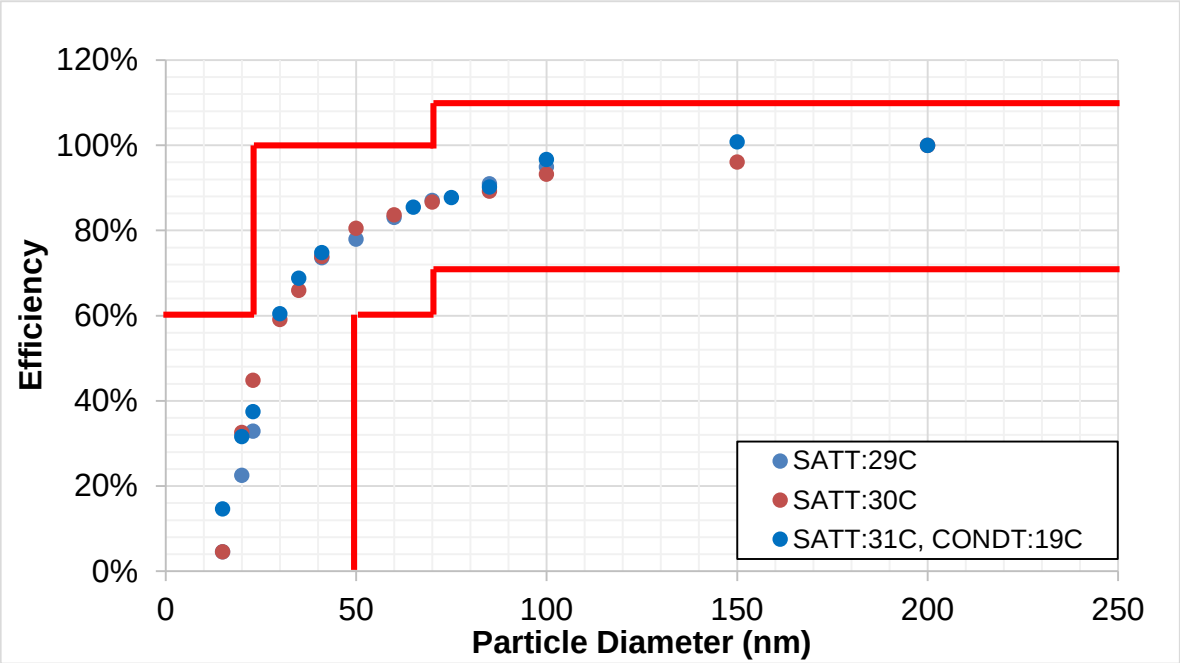
- System configuration
  - Two diluters
  - Volatile particle remover: Catalytic Stripper (350 degC)
  - CPC (Isopropanol based)



Detection Efficiency

Detection efficiency of the system

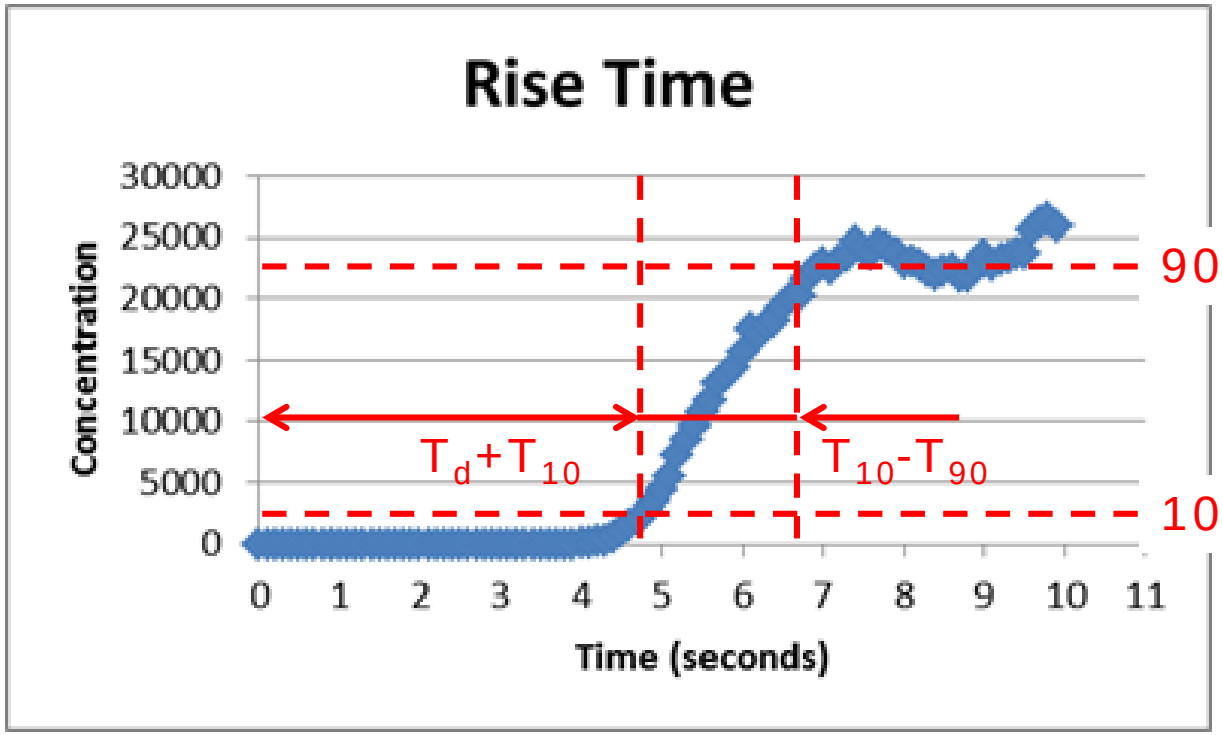
VL-05



Detection efficiencies were within all criteria defined by the draft RDE regulation

Response Time

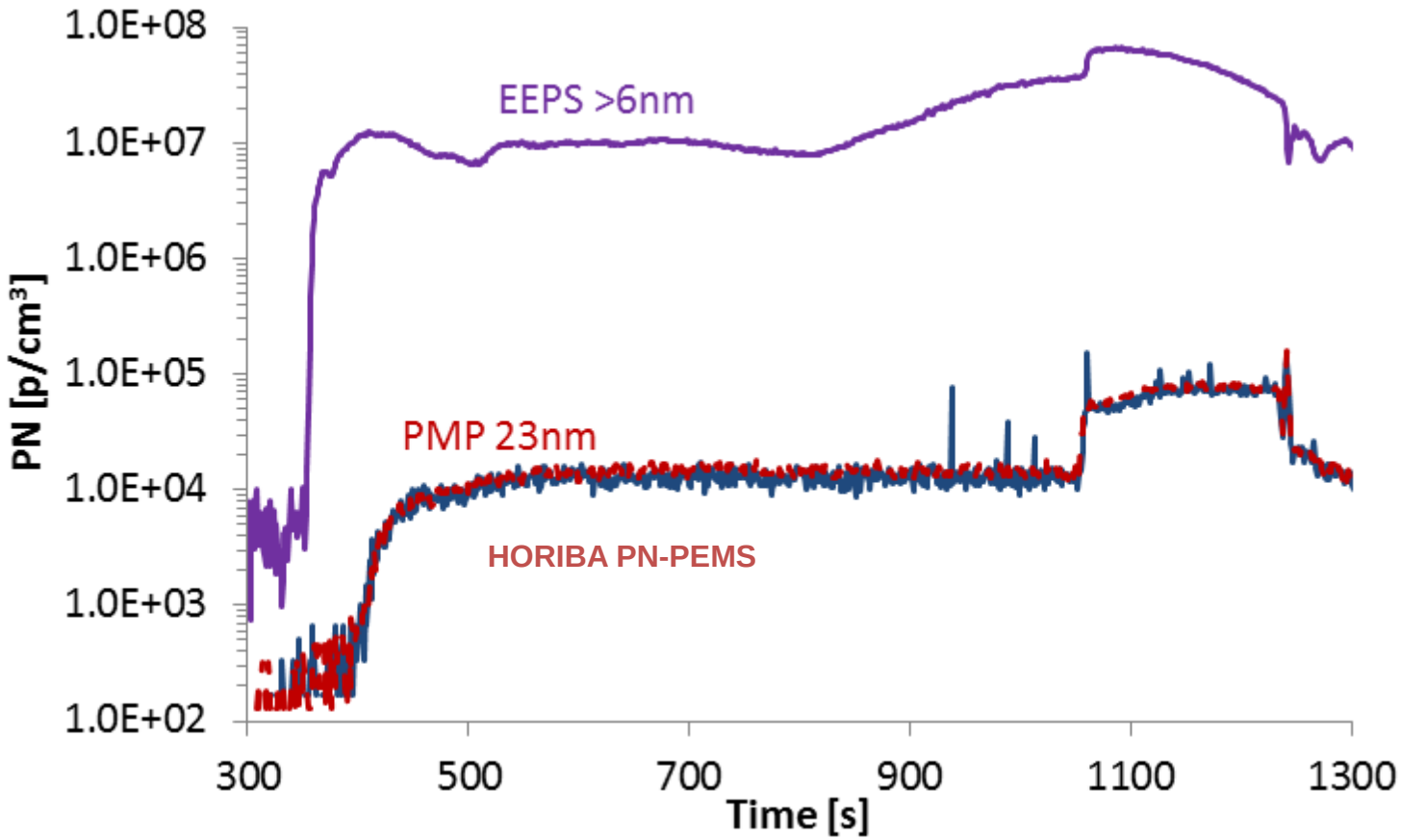
VL-07



	Criteria	Results
Delay time (T_d+T_{10})	≦5.0 sec	4.8 Sec
Rise time ($T_{10}-T_{90}$)	≦3.5 sec	2.0 Sec
System Response Time	-	6.8 Sec

HORIBA PN-PEMS result (Phase II)

- Regeneration (Volatile particle removal)

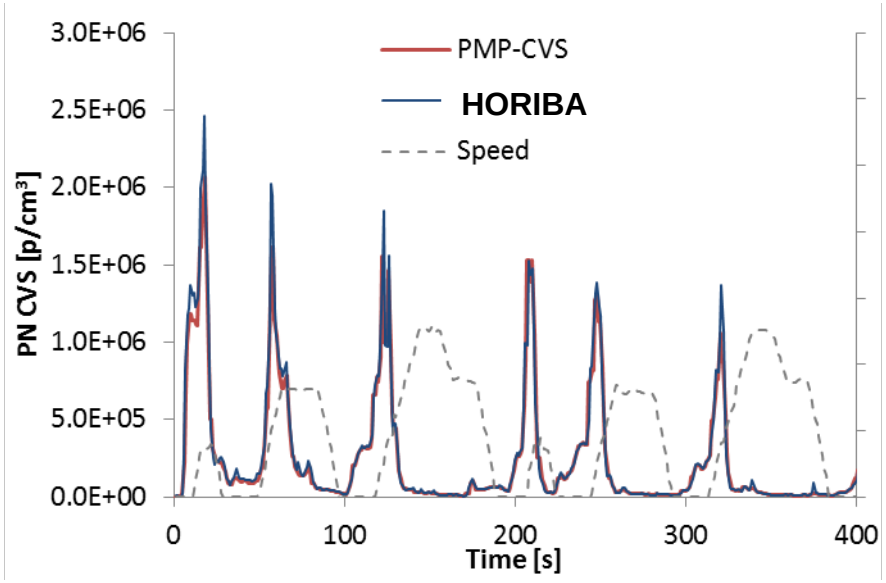


Data obtained by JRC (published in the evaluation report "Feasibility study on the extension of the RDE procedure to PN")

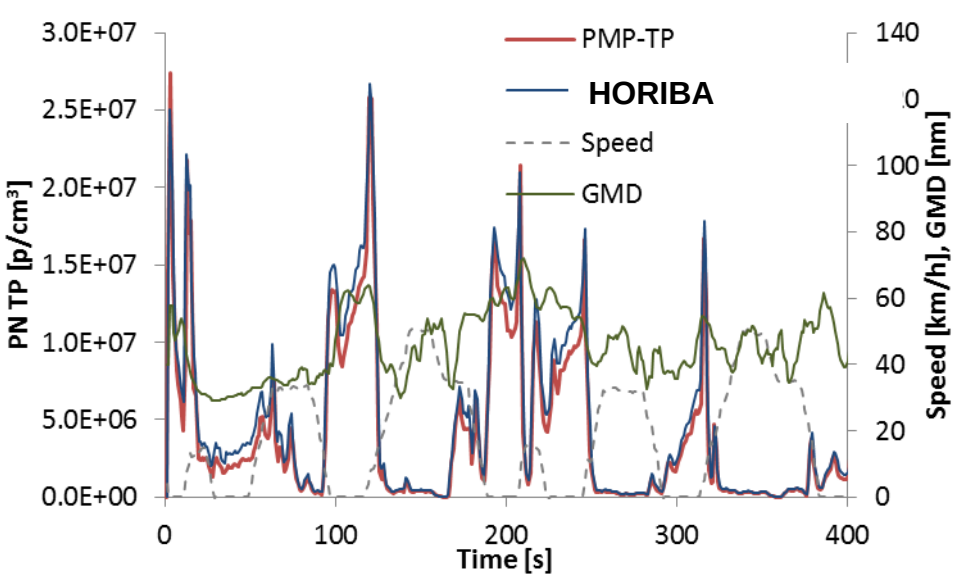
HORIBA PN-PEMS result (Phase II)

Real time

NEDC (Cold, PMP@CVS)



NEDC (Hot, PMP@tailpipe)



Data obtained by JRC (published in the evaluation report "Feasibility study on the extension of the RDE procedure to PN")

Thank you very much for your attention.

Thank you

Omoshiro-okashiku
Joy and Fun

眞峰

감사합니다

Cảm ơn

ありがとうございました

Dziękuję

धन्यवाद

Grazie

Merci

谢谢

நன்ற

ćŹńčŁ čŚń

Obrigado

Σας ευχαριστούμε

اشْكُر

Tack ska ni ha

Большое спасибо

Danke