

# **WLTP DTP PM-PN Subgroup Activities, Progress & Future Plans**

5<sup>th</sup> DTP Meeting  
Dubendorf  
12<sup>th</sup> – 14<sup>th</sup> April 2011  
Chris Parkin

# Outline

- Meetings
- Closed Issues
- Open Issues
- Broader Issues
- Future Plans

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## Subgroup Meetings

- **6<sup>th</sup> Web Conference – 31<sup>st</sup> January**
  - Large number of PM sampling issues closed
  - Weighing group reported data received on temperature and humidity control. More data on Teflo filter weighing welcome
  - Regeneration small group tasked with developing an outline for regen experiments to be taken during validation testing
  
- **7<sup>th</sup> Web Conference – 3<sup>rd</sup> March**
  - Number of PM sampling and weighing issues closed
  - Regeneration small group presented summary of available studies on regeneration PN measurements. Tasked with developing DPF loading procedures
  - PN provisional solutions presented on several issues
  - OIL version 6

## Subgroup Meetings

- **8<sup>th</sup> Web Conference - 7<sup>th</sup> April**
  - Numerous PM sampling, weighing and PN issues closed
  - JASIC comments on issues discussed
  - OIL version 7
- **9<sup>th</sup> (Face to face) Meeting – early May**
  - Plan to review and update consolidated draft text

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- Meetings
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# Closed Issues

## PM Sampling

- A1: CVS/Filter face temperature -  $\leq 52C$  at filter face
- A3: Avoidance of condensation in dilution/sampling systems – *Lab Processes Sub-Group proposed text accepted*
- A4: Transfer tube coupling sealing materials – *elastomers to be as thermally stable as possible and not be used to bridge exhaust to transfer tube connection.*
- A5: Transfer tube – *Japanese spec on transfer tube insulation adopted. Heating permitted as an alternative*
- A6: Remote mixing tee – *Permit use of RMT with conventional dilution tunnel*
- A7: Permissible variation in static pressure at exhaust tailpipe – *Lab Processes Sub-Group proposed text accepted*
- A10: Dilution tunnel pressure at mixing point – *Specification not required controlled by above*

# Closed Issues

## PM Sampling cont

- A11: Use of heat exchanger for PM sample flow control – *Lab Processes Sub-Group proposed text accepted*
- A12: Dilution system schematics – *To be updated to (optionally) permit RMT and secondary dilution on all systems*
- A13: Pre-classifier – *Clarify that shrouded probe or classifier are alternatives. Pre-classifier need not be immediately before filter holder*
- A14: Secondary dilution – *Permit subject to same accuracy and proportionality requirements as for single dilution*
- A17: Dilution system residence time - *Lab Processes Sub-Group proposed text accepted*
- A18: Molar based PM calculations – *Issue is for Lab Processes Sub-Group*



# Closed Issues

## PM sampling cont.

- A19: Verification of proportionality of sampling & P, T and flow sensor requirements – *Use US part 1065 requirements for sensor specification only*
- A21: Measurement specifications – *T +/-1C, 15s rise time, Flow 2.5% of point, 1.5% of maximum*
- A22: Dilution air temperature – *≥95% of points at 25 +/-5C (measured as close as possible to mixing point if possibility of change from inlet source)*
- A23: Secondary dilution transfer tube length – *secondary dilution air to be injected as close as possible to where transfer tube leaves primary dilution tunnel*
- A24: Particle sampling system bend radii – *WLTP should specify radius of curvature should be “as large as possible”*
- A25: Sampling pump location – *Need not be on filter holder*

# Closed Issues

## **PM sampling cont.**

- A28: Dilute exhaust gas thermocouple type – *Type need not be specified*
- A29: PM back-up filter for artefact subtraction – *Not permitted*
- A30: PM probe location on CVS centreline – *Not necessary*
- A31: PM probe diameter – *8mm min internal diameter as per WHDC*
- A32: Isokinetic sampling – *Outside of WLTP Phase 1 scope*
- A33: PM probe to filter length - *<2m*
- A34: Stability of temperature at flow meter – *Fixed temperature not required where real time temperature correction (at 1Hz) used*
- A35: Recommended minimum filter loading – *Recommend maximising PM loading but without specific recommended mass*
- A36: Filter face velocity – *20-105cm/s*

# Closed Issues

## **PM sampling cont.**

- A39: PM filter holder design/stain area – *At least 1075mm<sup>2</sup> stain area (37mm diameter)*
- A40: PM sampling vacuum side leak check – *Not mandatory*

## **PM weighing**

- B1: Weighing room conditions – *22 +/-2C (+/-1C recommended), rh 45 +/-8%, dewpoint <10.5C*
- B4: Static neutralisation – *recommend filter be neutralised. Recommend avoiding use of grounding straps and tweezers.*
- B5: Microbalance calibration – *every 12 months to a traceable national standard. Zero & span check at the start of each session*

# Closed Issues

## PN

- D2: VPR volatile removal efficiency specification – *Retain current specification*
- D3: Use of second by second particle concentration reduction factor (pcrf) – *retain current use of calibration pcrf applied to average particle concentrations over the test*
- D6: VPR pcrf validation check – *permit use of polydisperse aerosol with 50nm mode*
- D7: VPR dilution air filtration and leak check requirements – *retain Reg 83 requirements*
- D8: thermal treatment of VPR calibration aerosol – *specify that calibration aerosol should be thermally stable at VPR operating temperatures*
- D9: VPR evaporation tube setpoint – *350 +/- 10C, 0.25-0.4s residence*
- D10: PNC flow check - *Retain 5% tolerance*

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# Open Issues

## PM sampling

- A2: CVS temperature during DPF regeneration - *<190 °C subject to confirmation from validation testing*
- A8: Dilution air filtration efficiency – *proposed 99.95%, but JASIC prefer 99.97%*
- A9: PM/PN tunnel air background correction – *proposed to permit up to specified maxima. EPA & CARB can only accept dilution air, and not tunnel, background correction*
- A15: Tunnel pre-conditioning procedure – *proposed to retain recommendation of 20 mins at 120kph, JASIC view is that this may be insufficient.*
- A16: Cooling to achieve sample temperature – *do not explicitly refer to cooling in text. Awaiting draft text.*
- A20: Minimum data logging rates – *1Hz*
- A26: Number of PM filters – *Propose one for cold start and for all hot start phases. Depends on cycle structure and weighting factors*

## Open Issues

### **PM sampling cont**

- A27: Verification of proportionality of sampling – *proposal is to document on system commissioning and as required by authority*
- A35: Location of PM filter isolating valve – *proposal is for isolating valve downstream of filter. Need to review if plug-in HEV testing requires repeat tests*
- A38: PM filter media – *permit both PTFE coated and membrane filters and note that membrane more susceptible to static charge. Need input from filter manufacturers on efficiency specification*

### **PM weighing**

- B1: microbalance specification – *1 $\mu$ g resolution, 2 $\mu$ g precision proposed. JASIC prefer tighter specification*
- B2: sample filter conditioning - *>1 hour conditioning pre and post-test. JASIC suggest longer minimum post test conditioning likely to be required*

# Open Issues

## PM weighing

- B6: reference filter acceptance criteria – *reviewing data*

## Regeneration

- C1: whether to take PN measurement during regen - *limited available studies suggest additional PN during regen is volatile material excluded by VPR and PNC cut-off. Proposal is to specify additional experimental measurements to be taken during validation to confirm applicability of PN measurement system. Current regen test procedures (repeating cycles, from hot start, until regen complete) likely to give reduced PN as reduces weighting of cold start.*

## Particle Number

- D1: VPR minimum solid particle penetration efficiency – *70% at 100nm proposed, plus current max ratios for  $pcrf_{30nm} : pcrf_{100nm}$  and  $pcrf_{50nm} : pcrf_{100nm}$*



# Open Issues

## Particle Number

- D4: PNC calibration frequency – *proposal is 13 month calibration interval, with new requirement to monitor counting efficiency versus measurements with other PNCs, reference PNCs or reference vehicles or replace PNC wick every 6 months*
- D5: PNC calibration aerosol – *calibration factor to be applied where CAST aerosol used to check PNC cut-off. CAST particles used to check PNC slope should be  $\geq 70\text{nm}$  diameter. JASIC prefer a single aerosol*

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## Broader Issues

- A5: Additional Pollutants sub-group to consider whether exhaust transfer tube insulation specified is adequate for water soluble additional pollutants, e.g. carbonyls, or whether heating required
- A9: DTP decision needed on whether to permit tunnel background correction.
  - Prohibit (*EPA and CARB view*)
  - Permit (supported by other PM-PN subgroup members)
  - Specify procedure only, leaving decision on whether to allow it for regional implementation
- DPF active regenerations on test should be triggered, otherwise some method of indicating regeneration has started will be needed.
- Where do we report recommendations for future research e.g. further examination of correcting PM for artefact?

# Issues for investigation in validation

- DPF active regeneration measurements
  - Is PN measurement system capable of excluding worst case volatile material during DPF regenerations
  - CVS and filter face temperatures during passive regenerations?
- Tunnel pre-conditioning
  - Is 20 minutes at 120kph sufficient?

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# Future Plans

## **May 2011**

- Face to face meeting
  - Review and update consolidated draft text

## **June 2011**

- Objectives
  - Reach final agreement on all Open Issues
  - Finalise PM-PN elements of GTR text