

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

3rd DTP Meeting
Vienna
12th October 2010
Chris Parkin

Outline

- Objectives for June-October
- Meetings Held
- Small Groups
- Open Issues
- Cross sub-group Issues
- Future Plans

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Objectives June – October 2010

- To identify PM-PN relevant content in regional legislation
- To identify differences (“Open Issues”) in PM relevant content for discussion and resolution in next phase
- To identify elements of PN measurement procedures worth reviewing based on practical experience with PN measurement to date

Objectives June - October

Documents

- Terms of Reference & Plan of Activity
 - WLTP-DTP-PMPN-01-02
- Regional Legislation
 - US CFR Parts 86 & 1065, Manufacturer Guidance Letters (CISD-06-20, CCD-04-08, CCD-01-01, CISD-OB-17)
 - Japan Attachment 42
 - UN-ECE Reg 83.05

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Subgroup Meetings Held

- **1st Web Conference – 7th July**
 - Agreed Terms of Reference and Plan of Activity
 - Agreed decision on whether to mandate both PM and PN measurement was for DTP, WLTP or GRPE
 - Measurement ranges of $<2 - 50\text{mg/km PM}$ & $<6 \times 10^{11} - 5 \times 10^{13} \text{ \#/km PN}$ (to include OBD test cases)
 - PN during regen identified as an Open Issue
- **2nd Web Conference – 11th August**
 - Regulatory content comparison work subdivided into themes for examination by “small groups”
 - Use of secondary dilution, CVS max temperature during regen and background correction identified as additional Open Issues

Subgroup Meetings Held

- **3rd Web Conference - 15th September**
 - Relevant regulatory content template completed
 - Small group regulatory comparison initial conclusions reported
 - Planning of further small group meetings
- **4th Web Conference – 1st October**
 - Further conclusions from small group regulatory comparison work reported
 - Plan of post October Activity agreed

Small Groups

Subjects	Leader
Transfer, dilution system, residence time, diluent conditioning, PM probe, sample conditions, filter holder & media, residence times	Les Hill – Horiba les.hill@horiba.com
Weighing chamber & balance spec, PM sampling preparation, calculations, corrections & calibration	Phil Price – Ford pprice40@ford.com
DPF periodic regeneration, degreening and stabilisation/loading	Penny Dilara - JRC panagiota.dilara@jrc.ec.europa.eu
PN measurement system specification, calculations, corrections & calibration	Chris Parkin – DfT chris.parkin@dft.gsi.gov.uk

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Open Issues

Transfer & dilution system

- Transfer tube insulation (Jp) or heating or remote mixing tee for SI
- Determination of transfer tube length, especially where remote mixing tee used
- Permissible variation in static pressure at tailpipe ± 0.1 kPa @ 70 km/h (Jp), ± 1.25 kPa (US), ± 0.75 kPa @ 50 km/h ± 1.25 kPa full test (ECE)
- Dilution tunnel design, length, residence time, heating, PM probe location
- Dilution air filtration efficiency 99.97% (US), 99.95% or H13 (ECE)
- Dilution air temperature > 15 °C (Jp), 25 °C ± 5 °C (US)
- CVS temperature during regen < 190 °C (ECE & Jp), < 52 °C single dilution < 190 °C double dilution (US)
- Prevention of condensation, heating of surfaces (US)

Open Issues

Transfer & dilution system

- Clarification of measurement point for requirements on dilution tunnel pressure at mixing point
- CVS suction device capable of 5-7 dilution factor (US), preventing water condensation (ECE). Maximum CO₂ concentration needs to be specified for E85
- CVS residence time 1-5 seconds (US), undefined (ECE)
- Heat exchanger required (Jp & US Part 86), not required (ECE & US part 1065)
- Double dilution permitted (Jp & US), not permitted (ECE)
- Pre-conditioning for tunnel (ECE & US) or vehicle (ECE)
- Molar or volume based calculations

Open Issues

PM probe & sampling

- PM sample probe internal diameter 12mm (ECE)
- PM transfer tube length (ECE) or residence time (US) spec
- Confirmation of proportionality of PM sampling +/-5% (ECE) , various (US)
- Minimum data logging rates for this
- PM flow meter temperature variation +/-3K, unnecessary with real time flow calculation
- Bare wire thermocouple design (US)
- PM flow meter calibration requirements at test flow rate (ECE) over range (US)
- Pre-classifier must be immediately upstream of filter holder (Jp), only permitted with sharp edged probe (US). ECE text less clear, apparently more flexible.
- Location of PM sampling pump, on filter holder (Jp)

Open Issues

PM Filter Media & Conditions

- PM filter PTFE membrane recommended (US) membrane or coated (ECE)
- PM filter specification 99% 0.3 μ m DOP @ 35cm/s (ECE) @35-100cm/s (Jp)
- PM filter holder specific design (US) or “even flow distribution” (ECE)
- PM filter holder minimum stain area diameter 37mm (Jp & ECE) 38mm (US)
- PM filter(s) single (ECE), one for each phase (US)
- Recommended minimum filter loading 20 μ g (ECE) none (Jp)
- PM filter face temperature $\leq 52^{\circ}\text{C}$ (ECE & Jp), 47 +/-5 $^{\circ}\text{C}$ (US)
- PM filter face velocity 20-80cm/s (ECE), 100-105 cm/s (US), 35-100cm/s (Jp)

Open Issues

Weighing chamber & microbalance

- Tolerances for temperature, dew point temperature and relative humidity. Not all regions have requirements for all three parameters.
- Micro-balance precision tighter in US 1065 & J42 than for US 86 and R83. Various recommendations are given for micro-gram balance installation, static neutralisation & shielding.
- Filter conditioning time US 1065 has no maximum time. Differences exist in max time permitted between removal of filter from stabilisation environment and emissions test; time allowed to return filter to stabilisation environment after the emissions test; and max conditioning time permitted.
- Sample filter handling various guidance provided.

Open Issues

Weighing chamber & microbalance

- Microbalance calibration weight requirements not specified (US part 86 & ECE), “E2” weights (Jp), NIST traceable within 0.1 % uncertainty (US part 1065). Only US part 1065 puts a specification on cal mass relative to unused filter mass.
- Microbalance calibration frequency discrepancy between zero/span requirements and annual cal requirements.
- Reference filter weighing, max time between sample and ref filter weighing after the emissions test vary. Acceptance criteria and actions if initial results out of tolerance vary. US part 86 requires ref filters to be covered at all times. US part 1065 recommends balance exercise and substitution weighing method.
- PM calculations equivalent except US 1065 generalised, not CVS specific.
- PM dilution air background correction permitted (US & Jp), tunnel background permitted (ECE)

Open Issues

PN

- VPR filtration specification for dilution air and leak checks
- VPR minimum solid particle penetration efficiency (none at present ECE)
- Background correction consistency with PM
- PN measurement during DPF regen
 - Is VPR volatile removal efficiency sufficient
 - Is tetracontane appropriate for evaluating efficiency if used for regeneration measurements
- PNC calibration frequency (12 months)
- PNC calibration aerosol materials
- PNC flow check tolerance (+/-5%)
- VPR particle concentration factor validation (3 monodisperse sizes)

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Cross Subgroup Issues

Issue	Relevant Subgroup
CVS specification – dimensions, temperatures, residence time	Lab processes
Dilution air filtration efficiency	Lab processes
Prevention of condensation in dilution and PM sampling system	Lab processes

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Future Plans

November 2010 – May 2011

- Objectives
 - Gather (primarily existing) data to review and resolve Open Issues
 - Commence drafting of PM-PN elements of GTR text
- Working Method
 - Subject specific “small groups”, meeting by web and telephone conference, will gather data and develop proposed solutions to Open Issues
 - Proposed solutions, along with rationales, will be circulated to the subgroup. The subgroup will decide whether to accept the proposed solution or refer back to the small group for further consideration

Future Plans

June 2011

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

July – September 2011

- Objectives
 - Complete drafting of PM-PN elements of GTR text