

Revisions To Heavy Duty Validation Report

Department for
Transport

General

- Numerous clarifications to text as requested at December meeting
- Partial flow systems referred to consistently as PFDS throughout
- ‘background’ changed to ‘tunnel background’ throughout

Revisions To Heavy Duty Validation Report

Department for
Transport

Executive Summary

- Exec Summary added outlining exercise and summarising conclusions

Section 3.9 – Particle Number Measurement Systems

- ‘Alternative’ systems renamed ‘PMP type’ systems
- Description of PMP type systems tested added
- Description of additional instrumentation employed added

Section 3.10.2 – Summary of Preliminary Experiments

- Explanation of reason for <23nm solid particle investigations added along with reference to US study
- Explanation that high WHTC >3nm results are total particles added

Revisions To Heavy Duty Validation Report

Section 3.10.3 – Daily Protocol

- Description of Continuity Protocol Added

Section 4 – Statistical Analyses

- Terminology aligned with ASTM/ISO
- Explanation of relevance of unbalanced sample equations added
- CoV's defined

Section 5.1 – Calibration and Validation, Mass Systems

- Observations on PM reference filter weighings added (no deviation from temperature or relative to humidity requirements but reference filter mass variability sometimes on border of +/-5ug criteria)

Revisions To Heavy Duty Validation Report

Section 5.2 – Calibration and Validation, Number Systems

- Description of Golden System calibration added
- Penetration measured with both monodisperse & polydisperse aerosol
- Dilution ratio measured using HC tracer + FID
- PNC linearity via primary method (i.e v electrometer), electro spray PAO aerosol

Section 6.1 – Emissions Results, Full Flow & Partial Flow PM

- Purpose of PM measurements in this programme clarified (not making recommendations)
- Observations clarified as being observations of this programme only

Revisions To Heavy Duty Validation Report

Section 6.3 – Emissions Results, Gaseous Emissions

- Observations on raw v dilute differences and CO and HC diluent background levels noted
- Comparison of variability to LD_ILCE added, comparison with WHDC data to be added

Section 9.1 – Discussion and Overview, Particulate Measurement

- Filter loading recommendation deleted
- Tunnel background discussions, e.g. comparison with PM emissions results, clarified as being observations of this programme only
- Clarified that PFDSs used in this programme were relatively new and clean
- Clarified that, after exclusion of outliers all PM results were below Euro VI 10mg/kWh limit
- Comments on suitability of PFDS over CVS redrafted. PFDS may be preferable due to greater ease of controlling tunnel background. Where CVS used labs should take care to minimise tunnel background

Revisions To Heavy Duty Validation Report

Section 9.3 – Simultaneous PN and PM Measurement

- Recommendations added for;
 - 1 Hz PN sample flow signal (or feeding back sample flow) to increase accuracy of flow rate control
 - Compensation for PN sample extraction in controlling PFDS proportionality
 - Compensation for PN sample extraction in PM calculation for total sampling type PFDSs

Section 9.10 – Alternative Approach To Sampling for PN Measurements

- Clarified that discussion of fixed DF approach is an observation on a potential alternative technique which may be worthy of further research in future, not a recommendation.

Revisions To Heavy Duty Validation Report

Section 10.7 – General Conclusions

- Clarified that PM consistently below 10mg/kWh, and therefore measurement technique is suitable for assessing compliance with Euro VI limits
- Clarified that PM measurements in this programme were generally not distinguishable from tunnel background

Section 11- Recommendations

- Recommendations added that;
 - PN Tunnel background should be monitored and minimised
 - PN tunnel background subtraction should be permitted for CoP & ISC
 - Higher PN variability on WHSC needs to be considered in limit value setting
 - Retain 23nm PNC cut-off for heavy duty as well as light duty
 - Compensate for PN sample flow extraction in controlling PFDS proportionality & PM calculation (total sampling type PFDSs)

Revisions To Regulation 49 Proposal

Department for
Transport

Compensation For Particle Number Sample Extraction

- Where PN sample $>0.1\%$ of dilute exhaust gas flow, flow rate used for maintaining proportionality must be compensated by feeding back sample or mathematical correction.
- PN sample flow signal (or PN sample – equivalent returned flow) signal must be 1Hz and accurate to 0.1% of dilute exhaust flow rate
- For total flow type PFDS, PM must also be corrected for PN sample extracted

Time Alignment

- Time alignment procedure redrafted for consistency with WHDC using 'transformation time' (t_{50})

Revisions To Regulation 49 Proposal

Department for
Transport

Determination of Particle Numbers

- Clarified that instantaneous particle concentrations should be corrected to standard conditions

Periodic Regeneration Results

- Additive regeneration adjustment (k) added as an option as per WHDC

Weighted WHTC Result

- Cold start weighting factor changed to 14% in line with latest WHDC discussions

Revisions To Regulation 49 Proposal

Department for
Transport

Equipment Specification

- Clarification inserted that sampling should be from a homogeneous flow
- Particle sampling probe/point and transfer tube inner diameter deleted
- Clarification added common or separate pre-classifiers may be used for PM and PN
- EN 1822 reference updated and equivalent standards accepted
- Calibration URL reference updated
- Clarification added that upstream and downstream concentration measurements used in pcrf calibrations should be corrected to the same conditions
- Requirement for confirmation of PND1 and ET temperatures clarified