WLTP Validation 2

Assessment Criteria

DTP subgroup Lab-process ICE

Inertia Setting

Objective: Clarification of feasibility needed. Handling of stepless inertia setting has to seen in conjunction with certification and family construction

Background:

- Feasibility of stepless setting of inertia on dyno test bench to be tested

How to:

- Evaluate lowest and highest test mass following the parameter stetting advice of subgroup LabProcICE
- Setting of exact value for inertia (kg)

Measurement parameter:

- none

Test equipment:

- dyno test bench

WLTC Cycle

Objective: Evaluation of gear shifting and clutch pressing time points for optimized activation of start/stop and engine stalling procedures.

Background:

- WLTC is more dynamic than NEDC.
- Clutch pressing points are relevant for activation of start/stop.
- Gear shifting points influence engine stop strategies.

How to:

- Measurement of gear shifting and clutch pressing time points in WLTC
- Monitoring of start/stop

Measurement parameter:

Time, engine speed, clutch pressing switch, gear shifting

Test equipment: Testbench, data monitoring system

WLTC Cycle

Objective: Evaluation of OBD monitoring during WLTC.

Background:

- WLTC is more dynamic than NEDC.
- OBD monitoring needs certain conditions for demo testing.
- Real world behaviour is covered by IUMPR.

How to:

- Evaluation of OBD monitoring strategies in WLTC
- Judgement of structural restrictions
- Are future Euro6 threshold covered?

Measurement parameter:

OBD monitoring

Test equipment: Testbench, ECU monitoring system

Preconditioning Cycle

Objective: Precon as identical cycle as baseline test WLTC facilitates handling of subsequent testing. After the first emission test a precon could be exempted if soak conditions are met.

Background:

- Preconditioning cycle is needed to bring the vehicle in a consistent state.
- Consistency is required for RCB, adaption to reference fuels, etc.
- Battery charging before precon, no charging after precon

How to:

- Measurement preconditioning cycle (L,M, h, xH) with cold start. After precon soak 6(forced cooling down with coolant temperature control), > 12 – 36 h without temp condition.
- Optional testing with fully charged battery and with depleted battery

Measurement parameter:

Temperature of vehicle at representative locations, RCB, Emissions, temperature of bench, optional temperature of tyres, feasibility of process.

Test equipment: Testbench, emission measurement, temperature monitoring system, RCB monitoring system

Preconditioning Cycle for Dilution Tunnel

Objective: Dilution tunnel should be in a consistent state before measurement of low particle concentration

Background:

- Preconditioning cycle is needed to bring the dilution tunnel in a consistent state.
- Consistency is required for exact measurement of particulate matter and particle number.

How to:

- Drive vehicle at a constant speed of variable time length (e.g. 10 min at 120 km/h).
- Measurement of particulate matter and particle number before and after test

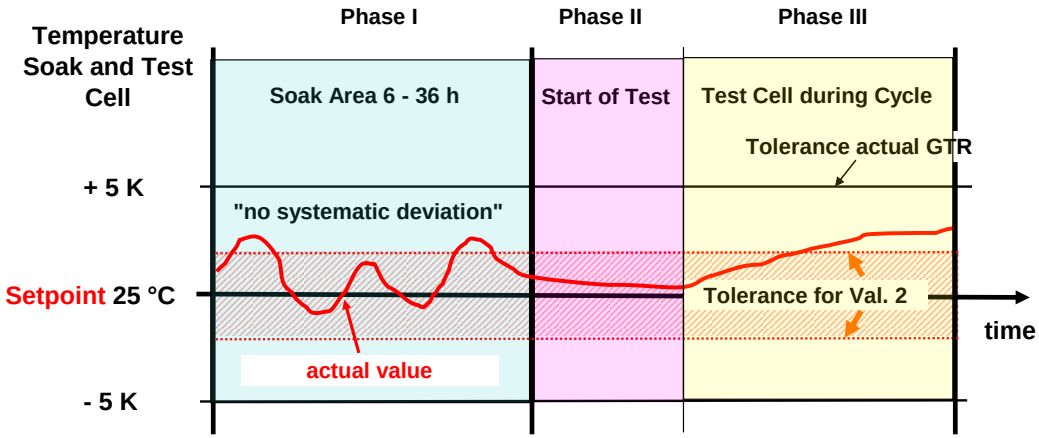
Measurement parameter:

Concentration and mass of particulate, time, vehicle speed.

Test equipment: Testbench, emission measurement system

Soak Temperature Tolerances

Objective: Feasibility of 2 K tolerance to be confirmed.



Background:

- 3 phases of temperature monitoring (soak, start of test, test cell during cycle)
- Setpoint is 25° C, Target tolerance of temperature is +- 2 K

How to:

- Measurement of local temperatures in the soak area

Measurement parameter:

- Modal air temperature in various locations, 1 Hz frequency, averaging over 5 min, ambient temperature for comparison

Test equipment:

- Testbench, emission measurement, temperature monitoring system, RCB monitoring system

Tolerances of dyno load setting

Objective: Tighter tolerances improve reproducibility. Could require enhanced dyno technique in the labs. Feasibility to be confirmed.

Background:

- The road load of vehicles has to be simulated on the dyno for testing in the lab.
- Road load forces are simulated on the dyno following a function in second order.
- Vehicle drags could behave not exactly parabolic over velocity e.g. with automatic transmissions. Therefore certain tolerance for dyno load setting is necessary.
- Evaluation if averaging of multiple coast down times is required.

How to:

- Multiple measurement of coast down times with various vehicle types

Measurement parameter:

- Time, velocity during coast down

Test equipment: Testbench automation system

Vehicle temperatures during forced cooling down

Objective: 6 h forced cooling down improves lab efficiency. Feasibility of forced cooling down and equivalency to 12 -36 h soak time to be confirmed.

Background:

- Option of minimum soak time 6 h with forced cooling down and vehicle oil within 2 K of setpoint is setout in the gtr
- Location of temperature measurement of vehicle should be representative (engineering judgement)
- For example the temperature inside the compartment, water, oil…

How to:

- Measurement of representative vehicle temperatures during soak time with/without forced cooling down

Measurement parameter:

- Temperature, time,

Test equipment:

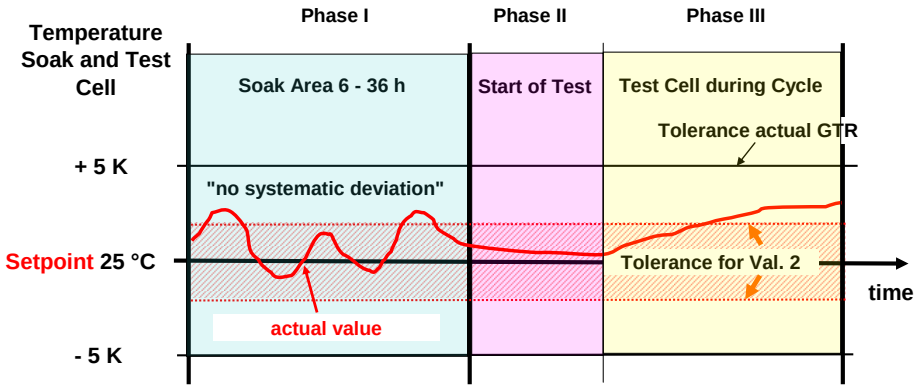
- Temperature monitoring system

Test Cell Temperature Tolerances

Objective: Feasibility of tighter tolerance to be evaluated. Might request enhanced air condition infrastructure. Evaluate worst case conditions.

Background:

- 3 phases of temperature monitoring (soak, start of test, test cell during cycle)
- Setpoint is 25° C, target tolerance of temperature is +- 2K



How to:

- Measurement of temperature between outlet of the fan and vehicle

Measurement parameter:

- Modal temperature, 1 Hz frequency, dynamic temperature behavior in phase II (before start of testing)

Test equipment:

- Temperature monitoring system

Speed Trace Tolerances

Objective: Speed tolerances should be maintained for drivability reasons to allow human driver deviations of target schedule, but with no significant impact on emission results. Feasibility to be confirmed.

Background:

- Target schedule of test cycle has to be followed as closely as possible.
- Tolerances have to be evaluated with various vehicles.
- Target tolerance is -+ 2km/h within 1 sec.

How to:

- Measurement of actual vehicle speed with min. 1 Hz, comparison with target schedule

Measurement parameter:

- Vehicle speed, time

Test equipment:

- Automation system

Handling of GSI

Objective: Testing of GSI shifting points could be mandatory in future legislation. Feasibility of handling and problems with WLTC to be evaluated.

Background:

- Shifting points of GSI shall be tested within Validation Phase 2
- Handling and feasibility for driver to be checked

How to:

- Indicate GSI shifting points during test cycle (video?)

Measurement parameter:

- Indicated shifting points of GSI, executed shifting points, vehicle speed trace

Test equipment:

- dyno test bench, GSI monitoring system

Tolerances of Humidity during Test Cycle

Objective: Tolerance to be confirmed with higher energy input through WLTC

50 % rel. humidity at 25° C could be critical for technical equipment.

Background:

- Tolerance of Humidity depends of technical specification of test cell and test cycle
- Higher thermal load can lead to exceeding of humidity tolerances

How to:

- Measurement of humidity within the test cell during cycle with 1 Hz in the vicinity of the fan

Measurement parameter:

- Humidity modal data, temperature of test cell during cycle

Test equipment:

- Humidity measurement system

Monitoring of RCB of all batteries

Objective: Measurement of RCB will be mandatory for all vehicles. Feasibility and tolerances as critical issues have to be checked thoroughly.

Background:

- RCB has an influence on CO_2 emissions
- RCB of all batteries to be considered for evaluation of CO_2 Emissions
- Thermal load of clamps is limited (< 40 ° C)

How to:

- Measurement of RCB in all phases of WLTC separately of all batteries (all low voltage and high voltage batteries). Measurement of temperature with closed bonnet.

Measurement parameter:

- Current, time, temperature in the vicinity of the clamps

Test equipment:

- RCB measurement system for all batteries, temperature monitoring system

Exhaust pressure before Remote Mixing Tee or CVS

Background:

- GTR limits maximum back pressure at end of tailpipe to avoid distortion of engine mass flow
- Evaluation of pressure averaging requirements

How to:

- Measurement of pressure at the end of tailpipe with/without CVS connected, with a frequency of 1Hz.

Measurement parameter:

- Exhaust pressure

Test equipment:

- Pressure monitoring system

Proportional Fan

Background:

- Feasibility of geometrical prescription for positioning of fan is to be tested

How to:

- Measurement of position and air flow

Measurement parameter:

- Fan speed, air flow

Test equipment:

- Scale, air flow measurement system

Cycle Mode Construction

Background:

- 2 Options to be tested (one with hot start and intermediate soak)- see Mode construction overview in OICA/JRC/UTAC Proposal (draft)
- Soak time is dependant on measurement equipment restrictions and other parameter

How to:

- Performance of hot start option with soak time variation (0,5,10,15,20 min)

Measurement parameter:

- Relevant temperatures, emissions and batteries balance, feasibility in regard to measurement equipment (gaseous, PM, PN)

Test equipment: Temperature monitoring system

Required time for bag analysis

Background:

- Option of Mode Construction for WLTC for hot start testing includes soak time for bag analysis
- Testing of PHEV: CD test requires bag analysis after each completion

How to:

- Measurement of time needed for complete bag analysis and restart between two charge depleting cycles or hot start tests.

Measurement parameter:

- System time

Test equipment:

- Automation system

Tolerances of Emission Measurement System

Objective: Higher repeatability could reduce test number and testing burden.

Background:

- Number of certification tests depends on level of emissions in relation to standard (1x < 70%, 2x <85%, 3x >85%) in actual gtr.
- Higher repeatability through enhanced equipment is predicted

How to:

- Application of calibration frequency and tolerances of actual gtr
- Measurement of statistical spread of all criteria pollutants, CO_2 and RCB in multiple tests (min. 3)

Measurement parameter:

- RCB, Emissions, additional parameters

Test equipment:

- Testbench, emission measurement equipment, RCB and temperature monitoring system

Subtraction of Intake Air Concentration

Background:

- Consideration of background emissions at low concentrations of criteria pollutants
- Relevant for HEV, PHEV with intermittent ICE operation

How to:

- Measurement of background concentrations of CO, HC, NMHC, NO_x, NO_2, PM etc. and the intake air flow

Measurement parameter:

- Emissions - Evaluation of statistical data of bags and background

Test equipment:

- Emission testbench, vehicle selection preferably PHEV with blended operation mode, air flow monitoring system

Dilution Factor

Background:

- Dilution Factor has to reach a certain level to avoid condensation of water in the CVS

How to:

- Measuring of modal CO_2 data, optional measuring of modal humidity in exhaust and diluted exhaust flow

Measurement parameter:

- CO_2 concentration, water concentration

Test equipment:

- Test bench, humidity sensor, FTIR et al.

Dyno Operation Mode

Objective: Dyno operation mode is required for safe vehicle operation on dyno. Feasibility of lab process to be checked.

….. to be supplemented

DTP subgroup PM/PN

PM filter conditioning

Background:

- Minimum conditioning time required for filter after test

How to:

- Weigh filter post test after 1 h conditioning and continue periodic weighing (recommended 30min until 3hrs and longer frequency until 24hrs) until weighings indicate stable weight. Data required to determine minimum conditioning time (aim is to trace the evolution).

Measurement parameter:

- Filter weight

Test equipment:

- Filter weighing equipment

Dilution tunnel pre-conditioning & PM/PN background levels

Background:

- Is 20 minutes pre-conditioning at 120kph sufficient?
- Define background correction levels

How to:

- Measure PM/PM tunnel backgrounds at minimum a single measurement before or after test and after any tunnel conditioning. More frequent measurements are optional.

Measurement parameter:

- Tunnel PM/PN backgrounds

Test equipment:

- Filter weighing equipment

PN during regeneration

Background:

- Experience on PN during DPF regeneration
- Confirm PN measurement system is capable of excluding worst case volatile material during DPF regenerations
- Check CVS and filter face temperatures during regenerations

How to:

- Vehicles
  - Will need regen indicator and inhibitor switch
- Measure PN before, during and after regeneration
- Different PN measurement systems
  - Two systems per lab sampling in parallel
- Impact of VPR pcrf
  - Test over range from 100-3000 (one system at high, one at low setting each test)
- Two tests at each pcrf setting
- Impact of CVS dilution on nucleation mode particles
  - Test at max and min CVS dilution
- DPF fill procedure
  - Either fast loading on engine dyno or on vehicle loading
  - Follow R83 advice on fill state stabilisation for pre-regen tests
- VPR sulphate removal capability
  - Test with highest sulphur lube oil permitted by OEM and fuel at maximum (10/15mg/kg) sulphur limit

Measurement parameters

- PN emissions, PCRF, CVS dilution factor, sulphur level of fuel

Test equipment:

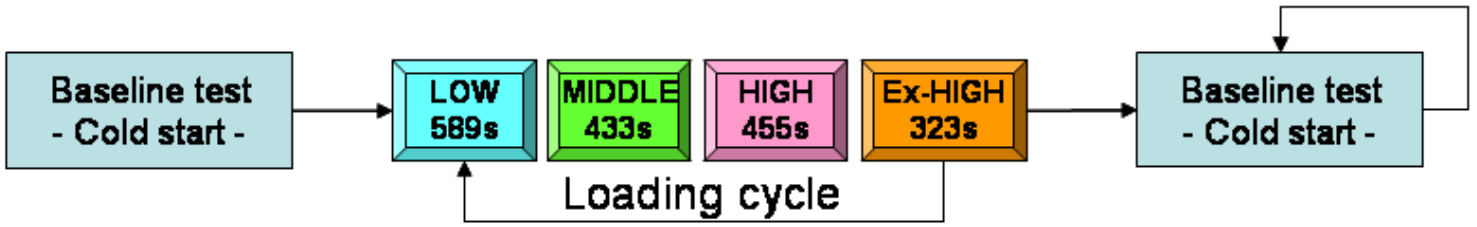
- PN equipments

Mode Construction for k_i Determination

Background:

- K_i Determination has to be performed in baseline option of mode construction

[K_i determination]



How to:

- Measuring of relevant parameters during subsequent testing with and w/o regeneration

Measurement parameter:

- PM loading, regeneration time

Test equipment:

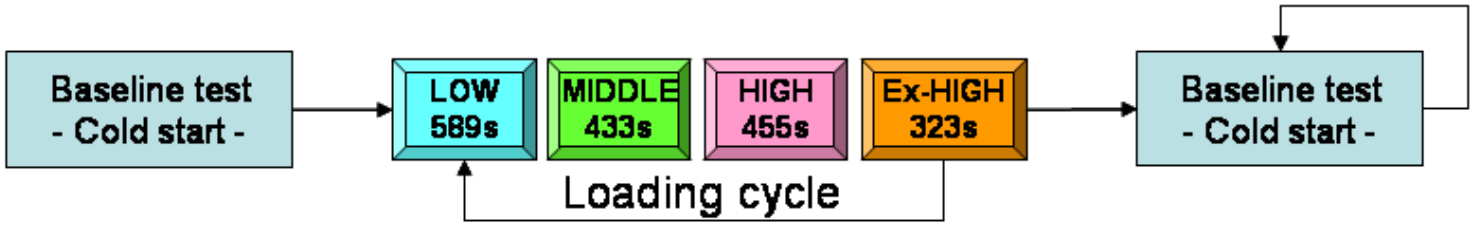
- Test bench, emission measurement system

Mode Construction for k_i Determination of multiple periodically regenerating systems

Background:

- K_i Determination has to be performed in baseline option of mode construction

[K_i determination]



How to:

- Measuring of relevant parameters during subsequent testing with and w/o regeneration of a multiple regenerating system

Measurement parameter:

- PM loading, regeneration time, NOx loading, regeneration

Test equipment:

- Test bench, emission measurement system

DTP subgroup AP

Qualitative assessment parameters for validation phase 2

NO-measurement

All participating labs should measure both ways (bag and dilute modal).

-All measurements:

- Absolute difference between dilute and modal measurement

-Repeat tests:

- Variability of NO result compared to NOx-measurement
- Variability of NO result from bag measurement versus dilute modal

Qualitative assessment parameters for validation phase 2

N2O-measurement

Use of two (or more) different systems in parallel (e.g. QCL, GC-ECD, FTIR,…)

Cal Gas: 5 ppm of N2O in N2 (+/- 2%)

-All measurements:

- repeatability of air bag measurement
- difference in result of the two systems
- stability of calibration (apply cal gas before and after test)

-Repeat tests:

- Variability of N2O result

Qualitative assessment parameters for validation phase 2

NH3-measurement

NH3 only for Diesel with SCR

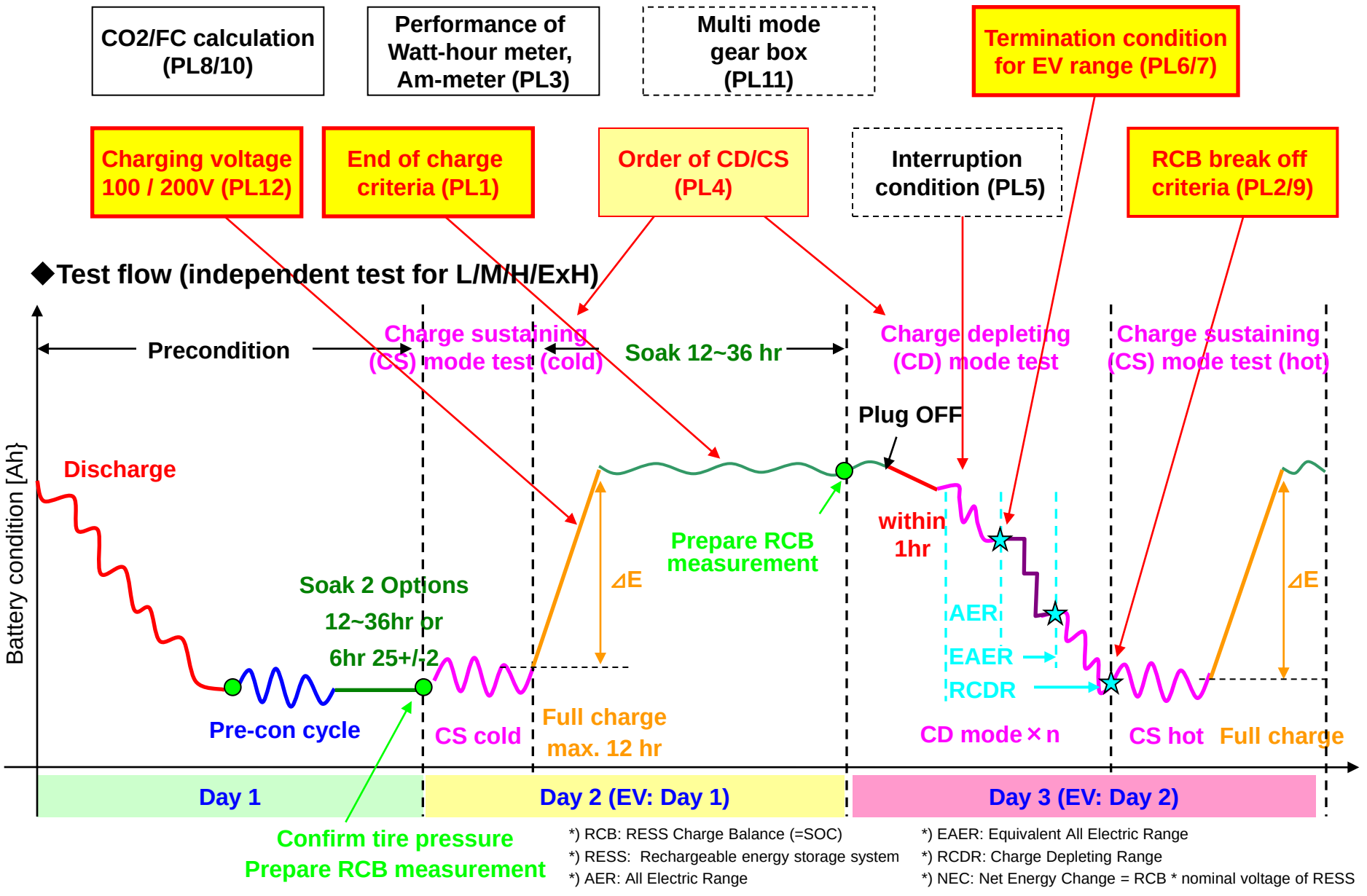
→ take care of extracted sample
→ measurement of two systems in parallel (e.g. QCL and FTIR…)
→ use of different sampling systems
    → one with smallest possible Volume, shortest possible line length
    → one with larger Volume and line length
    → where available, use in situ system in parallel

-All measurements:
- compare average concentration result
- Compare traces of the systems
    - incidence of first peak
    - rise time
    - drag

-Repeat tests:
- Variability of NH3 result

DTP subgroup EV/HEV

Consideration items on E-Lab. Gr.



PL1. End of charge criteria

Objective :

To confirm influence of fluctuation of RCB from charge completed to plug of.

Back ground:

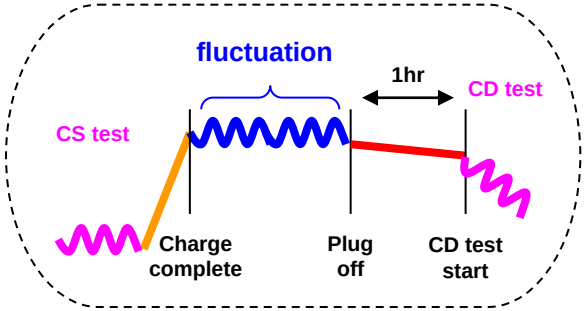
gtr draft

IV.1.2.4.2.End of charge criteria

The end of charge criteria corresponds to a charging time of 12 hours, except if a clear indication is given to the driver by the standard instrumentation that the electrical energy/power storage device is not yet fully charged.

ACEA proposal: Starting within 1 hour from “plug-off”

Japanese proposal: ”from charge completed”



How to:

Monitoring RCB fluctuation after charge complete

CD test:2（max/minimum charging）×4 phase（L/M/H/ExH）

Impact of battery type ？ (Ni-MH /Lithium，)

Measurement parameter:

RCB（Voltage/electric current & CAN）

Test equipment :

RCB measurement system

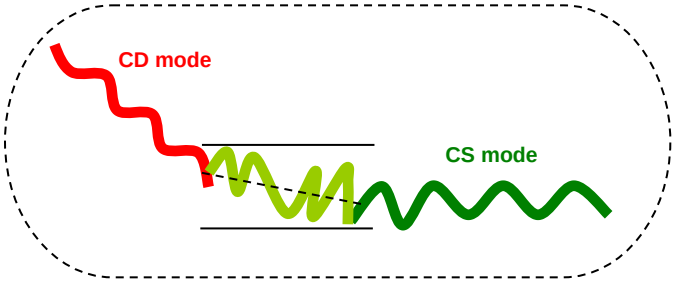
PL2/9. RCB break off criteria

Objective :

To confirm test sequence and break off criteria as absolute value Ah, detection of CS condition.

Back ground :

RCB Break off Criteria (CD→CS)



To be analyzed : a relative NEC:

1) (RCB x Nominal Voltage of the battery) / (RCB x Nominal Voltage of the battery + Energy of the Fuel)

2) (RCB x Nominal Voltage of the battery) / (total Energy demand at wheels to perform the cycle based on the theoretical profile of the WLTC)

or an absolute NEC : RCB x Nominal Voltage of the battery

How to :

Comparing 2 calculation result by each procedure

CDtest：4phase（L/M/H/ExH）×3times

Measurement parameter :

RCB, Fuel Consumption, total Energy demand at wheels to perform the cycle based on the theoretical profile of the WLTC

Test equipment :

RCB measurement system

*) RCB: RESS Charge Balance (=SOC)
*) RESS: Rechargeable energy storage system
*) NEC: Net Energy Change = RCB * nominal voltage of RESS

PL4. Order of CD/CS test

Objective：

To compare charging before test and charging after test and to compare emissions results, electric range and electric consumption. Influence or not on the results and on the battery charging.

Back ground：

Confirm impact of the order of CD/CS test

Soak -CS test –Charge or CD test –shifting CS mode-Charge

For example the temperature impact around Battery

How to：

CD and CS test：4phase（L/M/H/ExH）

Measurement parameter：

RCB（Voltage/Electric current, CAN and temperature of Battery or any other electrical parts）

Fuel consumption/CO2, Exhaust emissions

Test equipment：

RCB measurement system

PL6/7. Termination condition for EV range (EV)

Objective：

Detection of test termination condition for range tests on EV.

Back ground：

Japan：the deviation occurs not more than once within 4 second

US：more than 2 second

Europe：Target more than 50km/h：Below 50km/h,

Target Less than 50km/h：more than 5s 6 times during 1 hour

How to：

Running until completely stop and calculate EV range by each procedure

Compare each result

EV range test：4Phase（L/M/H/ExH）

Measurement parameter：

RCB（Voltage/electric current and CAN）and driving distance

Test equipment：

RCB measurement system

PL6/7. Termination condition for EV range (OVC HEV)

Objective：

Detection of test termination condition for range tests on OVC HEV.

Back Ground：

To compare OVC HEV and Range Extender, full test cycle and low power cycle.

How to：

Confirmation test procedure for range extender

Compare with OVC HEV

CD and CS test：4phase（L/M/H/ExH）

Measurement parameter：

RCB（Voltage/Electric current & CAN）, CO2 and driving distance

Test equipment：

RCB measurement system

PL 8 CO2 and FC calculation method

Objective：

Test sequence independent UF compared to one UF for the complete CD test.

Back ground：

US: possible to have one UF for each test sequence

How to ：

CD test：4phase（L/M/H/ExH)

Measurement parameter：

Emissions, CO2, FC, RCB etc.

Test equipment ：

Test equipment proposed for validation phase 2

PL 10 CO2 and FC calculation method

Objective：

Investigate the possibility to split the CO2 value of the transient cycle, the n-cycle.

Back ground：

The calculation method for CO2 and FC on the CD test is not decided

How to ：

CD test：4phase（L/M/H/ExH)

Measurement parameter：

Emissions, CO2, FC, RCB etc.

Test equipment ：

Test equipment proposed for validation phase 2

PL 11 Multi mode gearbox

Objective：

Investigate if the ICE proposal (default mode approach) is applicable to OVC HEV for CO2, FC measurement.

Back ground：

For OVC HEV, the concept of default mode developed in ICE group is not transposable and to keep the ECE concept (the most electric consuming mode to best match the driving curve in CD test and the most fuel consuming mode to best match the driving curve in CS test), irrespective of the presence of a default mode if any. This preliminary statement has to be confirmed during the validation phase 2 (to check the relevance of such an approach).

How to ：

CD and CS test：4phase（L/M/H/ExH)

Measurement parameter：

Emissions, CO2, FC, RCB etc.

Test equipment ：

Test equipment proposed for validation phase 2

PL12. Charging voltage 100 / 200V

Objective：

Influence of charging voltage on results.

Back ground：

Charging voltage has impact for charging efficiency.

There are several Voltage in all of the world.

US:110-120V, Japan:100/200V, EU:220-240V(127V)

How to ：

Measure Charging time，Fluctuation during Plug ON，impact for CS/CD test result, Electric Range.

OVC HEV: CD test：each Voltage×4phase（L/M/H/ExH）

EV: Electric range :Each Voltage × 4phase（L/M/H/ExH）

Measurement parameter：

RCB（Voltage and CAN）

Test equipment ：

RCB measurement system