Low temp type approval approach

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European Commission
DG GROW C.4 – Automotive and Mobility Industries
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Type approval approach for the low temp testing

- Scope
- Family principle
- Test procedures
- Outputs

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Scope
Low temp type approval testing

Powertrain	*Pollutant emissions*	*CO_2 emissions*	*Electric Consumption*	*Electric range*
ICE	Yes	Yes	N/A	N/A
NOVC-HEV	Yes	Yes	N/A	N/A
OVC-HEV	Yes	Yes	Yes (?)	AER, EAER
PEV	N/A	N/A	Yes (?)	PER, PERcity(?)
FCHV	N/A	N/A	Exempt from initial phase	

Family principle

- Low-T family = PEMS family*
- A PEMS test family shall comprise finished vehicles with similar emission characteristics
- The technical criteria are similar to the IP family, except:
  - **Engine volume (22%, 32% of V_{eng_max})**
  - **Type of gearbox (MT, AT)**

*=RDE family in EU; for PEV <TBD>

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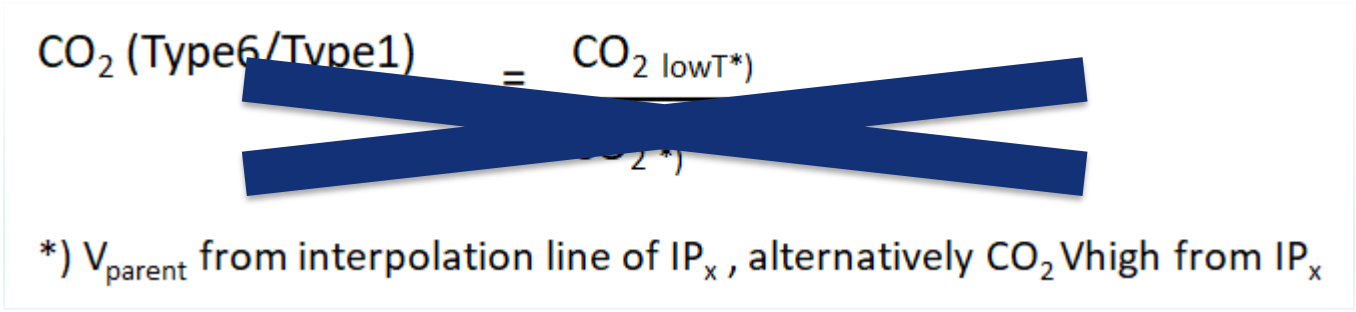
Family principle

- At least one vehicle per PEMS family shall be tested in low-T test
- A ‘parent’ vehicle is selected as worst-case representative of the family

Type approval approach ICE and NOVC-HEV

- Pollutant emissions measured on the parent vehicle of a PEMS family (belonging to IP family 'X'), according to Low-T procedure, 1 test to cover
  - **JPN: WLTC 3 phase**
  - **EU: WLTC 4 phase**
- CO2 emissions measured from the Low-T test
  - ~~**Determine Low-T ratio for CO2 (JPN & EU)**~~



- ~~Threshold approach(?) or ratio reporting~~

Type approval approach OVC-HEV

- Pollutant emissions & CO2 emissions measured on V_{high} according to Low-T procedure
  - **Pollutant & CO2 Charge Depleting emissions from Low-T test (obtain CO2 lowT-CD), 2 tests***

    JPN: WLTC 3 phase

    EU: WLTC 4 phase
  - **Pollutant & CO2 Charge Sustaining emissions from Low-T test (obtain CO2 lowT-CS), 1 test***

    WLTC 4 phase
  - **CO2 UF-weighted emissions from Low-T test (calculate CO2 lowT-WLTP)**

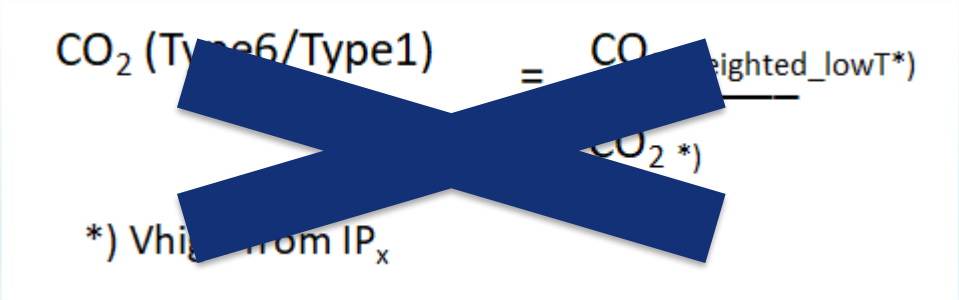
    JPN: WLTC 3 phase

    EU: WLTC 4 phase

*'Aux on': heating @21°C, lights, features needed to comply with defrost/demist reqs)

Type approval approach
OVC-HEV

- ~~Determine Low-T ratio for CO2 weighted emissions~~ (JPN & EU)



- ~~Threshold approach(?) or ratio reporting~~

Type approval approach
OVC-HEV

- Measure Electric Consumption*
- Determine Low-T ratio for All Electric Range and Equivalent Electric Range*

  JPN: WLTC 3 phase (2 tests)

  EU: WLTC 4 phase (2 tests)

$$\text{AER (EAER) (Type6/Type1)} = \frac{\text{AER (EAER)}_{\text{lowT*)}}}{\text{AER (EAER)}_{\text{*)}}}$$

*) Vhigh from IP_x

- ~~Threshold approach or~~ Ratio reporting

*'Aux on': heating @21°C, lights, features needed to comply with defrost/demist reqs)

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Type approval approach
PEV

EU base scenario for the Low Temperature test

Initial driving

The customer arrives home at 18:00 hours; ambient temperature is -7°C.
The car is driven at -7°C after having been parked at work place/shopping mall etc. at -7°C or indoor.

SOC of the battery not defined

Soaking/ charging

The PEV is connected to an electric charger, typically a home charging device.

Optionally: if there is price differentiation in grid electricity, the charging is delayed until [23:00 h.]

The vehicle is charged overnight, ambient temperature is -7°C. Charging power as defined GTR 15

Optionally: if there is a possibility to use grid power for battery heating while charging, this is switched ON

Driving conditions and auxiliary systems setting

The customer starts the vehicle at 7:00h and drives off (cold start, ambient temperature is -7°C).

Full charged battery assumed despite the car might have been at cold for many hours.

Auxiliaries (with the recommendations of the auxiliaries sub-group):

a. Heating ON at least 21°C pointed to the front window (windshield), allow to draw in outside air. To define setting of the heating system (manual operation, automatic mode, air mass flow rate [kg/h, max etc.], flow direction etc.) within/with the support of the auxiliaries sub-group.
b. If there is a windows defrost mode: Defrost ON (for 10 minutes)
c. Fan speed: at start full off or lowest setting, at second idle (around 125 s) set fan to maximum. To be defined.
d. Lights are switched ON
e. All other auxiliaries are switched OFF

The car is parked at work place/ shopping mall etc. at -7°C or indoor.

Inconsistent soak times or time between unplugging the vehicle and starting the test could result in undesirable variability in pre-test battery pack temperatures, potentially impacting test results (SAE J1634).

Some inputs to be measured during the test (to be defined)

- REESS Temperature at the start of the test to be specified; large impact on UBE at cold temperature
- Measured the energy consumption from the auxiliaries system? *scaling factor needed for high capacity heater installed on vehicles for Northern countries?*
- additional energy consumption for heating the battery
- Measuring the EC per phase; the phase specific values might be used for calculating PER_{city}
- …

Accuracy:
To revise the Table of accuracy of the instruments and measurement sensors at cold (Table A8/1 Annex 8 GTR 15)

Driving range ratio: setting a minimum requirement or reporting for customer information

$$PER_{\_Ratio} = \frac{PER_{-7°C\,Vehicle\,H}}{PER_{23°C\,Vehicle\,H}}$$

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