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European  
Automobile  
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Association

WLTP-06-14e

# Ambient Temperature Correction Test for WLTP

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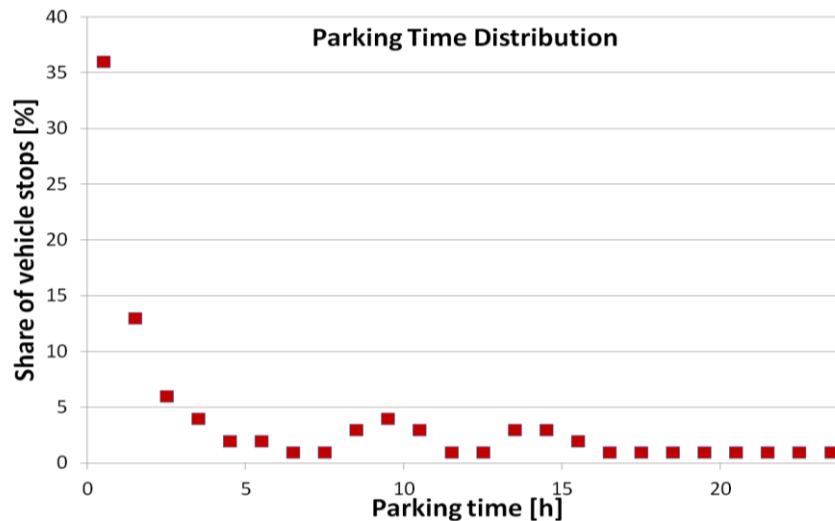
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# AMBIENT TEMPERATURE CORRECTION TEST (ATCT) FOR WLTP.

## Motivation:

- In order to reflect the CO<sub>2</sub> values obtained under “real life temperature conditions”, an additional test is proposed to be conducted on a regional base.
- For this test, the vehicle shall be soaked at a defined “regional” temperature  $T_{reg}$  over a defined soak/park time ( $t_{soak}$ ). No restrictions for oil and water temperature.



## Approach for Europe:

Typical use cases for soak time are overnight parking ~10-12h and daytime parking at work ~8h. This leads to  $t_{soak} = 9h$ .

Climate data derived from FAT Study (Prof. Köhler, Technical University Braunschweig, Germany)

- The ATCT (measurement) shall be performed only once for a temperature correction vehicle family.



# AMBIENT TEMPERATURE CORRECTION TEST (ATCT) FOR WLTP.

## Type I Test



CO<sub>2\_1</sub>



CO<sub>2\_2</sub>



CO<sub>2\_3</sub>

## Vehicle Family for ATCT

Test cell, soak: 23 °C  
Soak time: 6 – 36 h  
Engine oil, water: 23 °C

## Ambient Temperature Correction Test



CO<sub>2</sub>@C<sub>reg</sub>

Test cell, soak: T<sub>reg</sub>, e.g. [14] °C for EU  
Soak time: t<sub>soak</sub>, eg. [9 + 2] h for EU  
Engine oil, water: no restrictions

$$FCF = \frac{CO_2 @ C_{reg}}{CO_{2\_Type-I}}$$

For one vehicle out of a family (measurement)

$$CO_{2\_ATCT} = CO_{2\_Type-I} \cdot FCF$$

For all vehicles in one family (calculated value)

FCF = Family Correction Factor

CO<sub>2\_Type-I</sub> = TA CO<sub>2</sub> value for Type-I test (23°C)

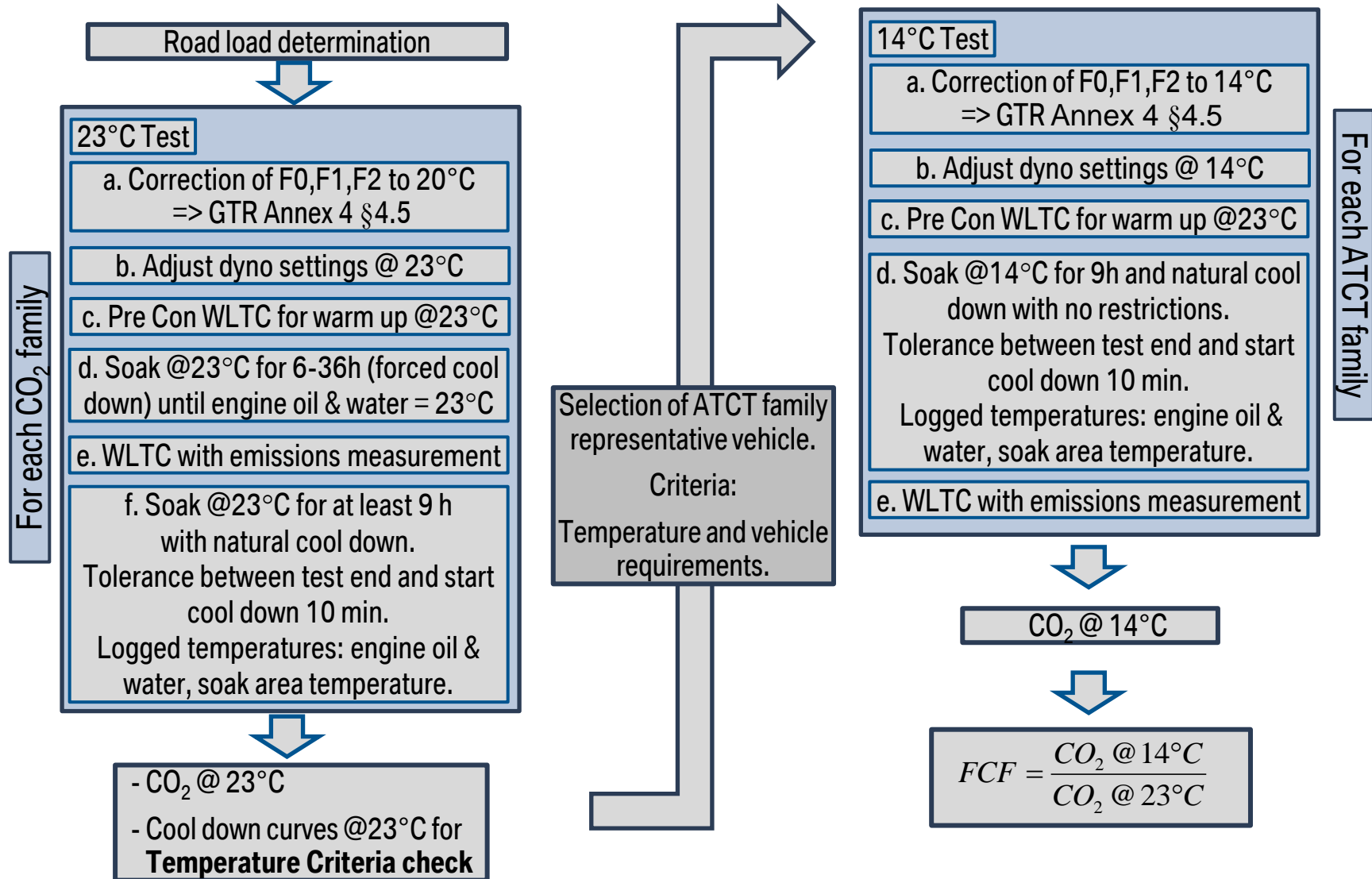
CO<sub>2\_ATCT</sub> = corrected CO<sub>2</sub> value

C<sub>reg</sub> = regional conditions



# AMBIENT TEMPERATURE CORRECTION TEST (ATCT) FOR WLTP.

## Family criteria check and ATCT (example for 14°C and 9h)





# AMBIENT TEMPERATURE CORRECTION TEST (ATCT) FOR WLTP.

## Requirements for family criteria check:

The following characteristics should be equal within the family:

- temperature at the end of soak time within a tolerance of [5/10] K
- combustion process (two stroke, four stroke, rotary)
- number of cylinders
- configuration of the cylinder block (in-line, V, radial, horizontally opposed,...)  
The inclination or orientation of the cylinders is not a criteria
- method of engine fuelling (e.g. indirect or direct injection)
- type of cooling system (air, water, oil)
- method of aspiration (naturally aspirated, pressure charged)
- fuel for which the engine is designed (petrol, diesel, NG, LPG, etc.)
- engine cylinder capacity of the largest engine within the family minus [20] %

Additional provisions for emissions control and heat storage systems available



# AMBIENT TEMPERATURE CORRECTION TEST (ATCT) FOR WLTP.

Vehicle	Engine coolant temperature @23°C, 9h	
	Test1	Test2
328xi Limo (MT)	T_amb+8.8	T_amb+6.4
320iA GT (AT)	T_amb+7.3	T_amb+5.7

$$\Delta T = 3.1K$$

Check, if ATCT family temperature criteria is met.

**ATCT at  $T_{reg} = 14^{\circ}C$  and  $t_{soak} = 9h$**

Vehicle	FCF	FCF
	Test1	Test2
328xi Limo (MT)	+1,8%	+1,5%
320iA GT (AT)	+2,0%	+1,4%

$$FCF = \frac{ATCT(CO_2 @ 14^{\circ}C)}{Type1(CO_2 @ 23^{\circ}C)}$$

PSA results show similar behavior.

→ ACEA proposal [5]K absolute temperature tolerance



# ATCT FOR PHEVS?

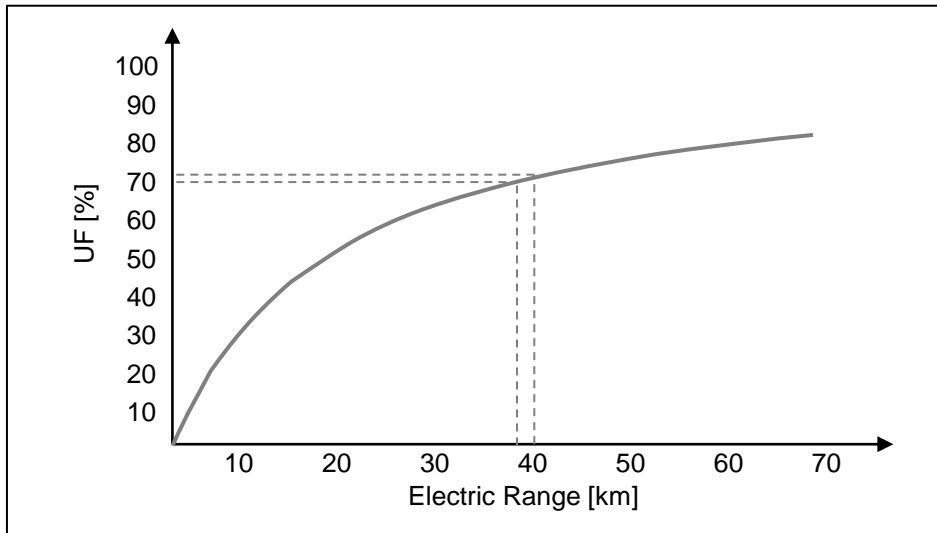
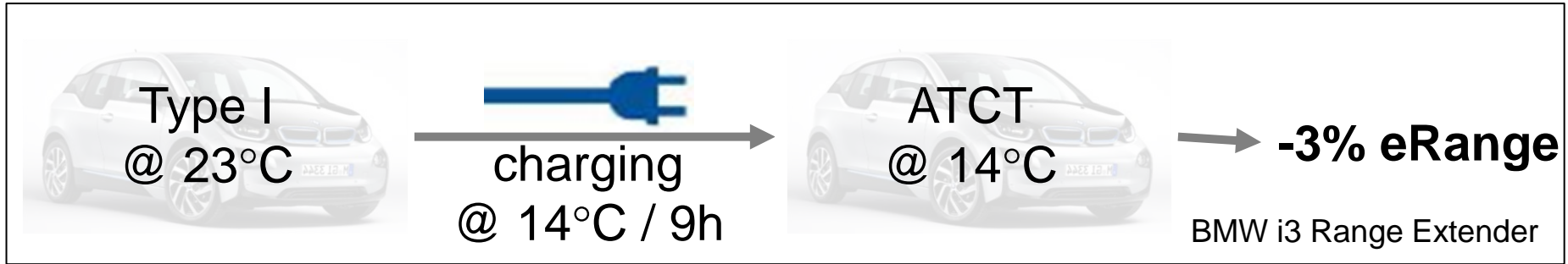
**The correction is complex and requires significant lab resources:**

- **Correction of Charge Sustaining CO<sub>2</sub> value: possible (like ICE)**
- **Correction of electric range for Utility Factor and CO<sub>2</sub>: ?**



# ATCT FOR PHEVS IN WLTP.

## ATCT IMPACT ON THE ELECTRIC RANGE OF CD TEST.



Example PHEV  
(40km eRange, 100g CO<sub>2</sub>/km)

**-3% @ 40 km electric  
range**

+

**Shift in UF curve**

**→ ΔCO<sub>2</sub> ≤ 1 g/km**

For i3 Range Extender, the influence  
would be <<1g/km CO<sub>2</sub>





# ATCT FOR PHEVS IN WLTP.

**ACEA proposal for ATCT and PHEVs :**

- **Correction of Charge Sustaining according to ICE procedure**
- **No correction of e-Range and UF.**





# AMBIENT TEMPERATURE CORRECTION TEST (ATCT) FOR WLTP.

## **Status and Summary:**

- Detailed proposal for ATCT Procedure drafted by Audi/BMW.
- Validation tests successfully conducted at BMW and PSA.
- For PHEV, only Charge Sustaining CO<sub>2</sub> shall be temperature corrected.