WLTP-E-Lab Sub Group
Test procedure

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Phase I  
(2009 ~ 2013)  

- DHC  
  (Worldwide Harmonized Light Duty Driving Cycle)  
- DTP  
  (Test Procedure)  

Phase II  
(2014 ~ 2018)  

- Low ambient temperature / High Altitude test procedure  
- Durability  
- In Service Conformity  
  
  decision made by WP29/AC3 before Phase II  

Phase III  
(2019 ~ 2021)  

- Definition of Emission Limits  
- Reference Fuel Specifications  
- Correlation with existing regional cycles  

Parallel Informal Groups  

- OCE  
  (Off-Cycle Requirement)  
- MAC  
  (Mobile Air Conditioning)  

OBD  

Other gtr
WLTP: Worldwide harmonized Light duty driving Test Procedure

**Task of DHC Group Work**
- Classification of Influencing Parameters
- Collections of In-use driving data
- Gearshift analysis
- Development of Reference Database
- Gearshift prescription
- Development of initial WLTC
  - Validation tests 1
  - Modification
    - Short trip & gearshift points
  - Validation tests 2
  - Confirmation tests
    - Modification
    - Short trip & gearshift points
    - WLTC

**Task of DTP Group Work**
- Collections of statistics on LD vehicles use
- Determine weighting factor
  - WLTC
  - Gearshift analysis
  - Gearshift prescription
- Development of Reference Database
  - Re-categorization into L/M/H
- Development of initial WLTC
  - Validation tests 1
  - Modification
    - Short trip & gearshift points
  - Validation tests 2
  - Confirmation tests
    - Modification
    - Short trip & gearshift points
    - WLTC

**Remark**
- DHC: Development of worldwide Harmonized light duty driving Cycle
- DTP: Development of Test Procedure
- WLTC: Worldwide harmonized Light duty driving Test Cycle

Today! April 2013
**WLTP road map**

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
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<tr>
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**Phase I gtr**

- **Level 1** (MUST items)
- **Level 2** (can be postponed to Phase II)

**Propose Phase II work schedule**

(ref.) work elements are listed on WP29-2009-131

However, no specific time schedule is described

Phase II gtr

(it is one of possibilities to divide into 2 stages based on work elements)
WLTC Ver 5.3 & 5.1

Low (589秒) (L3) 

Middle (433秒) (M3)

High (455秒) (H3) 

Ex-High (323秒) (ExH3)
Vehicle classification

Low power vehicle (less than PMR ≤ 34kW/t)
• Class 1: PMR ≤ 22 kW/t
• Class 2: 22 < PMR ≤ 34 kW/t
## Electrified vehicle

<table>
<thead>
<tr>
<th>Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>OVC-HEV</td>
<td>off-vehicle charging hybrid electric vehicle</td>
</tr>
<tr>
<td>NOVC-HEV</td>
<td>not off-vehicle charging hybrid electric vehicle;</td>
</tr>
<tr>
<td>Pure electric vehicle (PEV)</td>
<td>a vehicle with a power train where all energy converters are electric machines and all storage systems are rechargeable storage systems (ReESS)</td>
</tr>
</tbody>
</table>
Vehicle Classification for Electrified vehicle

To be same as ICE vehicle

A power of OVC-HEV should be considered.
Motor power + ICE power
Motor power or ICE power
Hybrid system power?

To move on Confirmation test, No classification=>Class 3 all vehicle

Maximum speed

Japan proposed to use Maximum speed in R68.
Maximum speed means:
For electric vehicle, the highest average value of the speed, which the vehicle can maintain twice over distance of 1 km.
To move on Confirmation test, Based on R68
Charge depleting test

- Discharge < NEC (net energy change)
Charge sustaining test

Charge Sustaining Mode

Unknown RESS charge level

OVVC vehicle

NOVVC vehicle

Preconditioning

Soak Time > 12h

ICE 2 options

Charge Sustaining

Cold start of ICE

Test n (cold)

Test n (hot)

Driving cycle [\ell]

CO\textsubscript{2}-emissions CS

See CD Test (Step 2)

y %

x Wh/test

Break of criteria for Discharging Mode in case of PHEV testing:

- manufacturer’s requirement

Same break off criteria as for CD Mode: X Wh
Battery charging and soak condition

5.2.5.4. Battery charging and measuring electric energy consumption
The vehicle shall be connected to the mains within 120 minutes after the conclusion of the charge-sustaining Type I test. The energy measurement equipment placed between the mains socket and the vehicle charger shall measure the charge energy $E$ and its duration. Charging stops when a fully charged battery is detected.

Soak condition

To be charged without forced cooling!

Battery temperature within criteria
5.2.4.5. Break-off criteria
5.2.4.5.1. The break-off criteria for the charge-depleting test is reached when the relative net energy change as shown in the equation below is less than \( X \) per cent.

\[
\text{Relative net energy change } [\%] = \frac{\text{NEC}}{\text{Cycle energy demand of the test vehicle}}
\]
RCB Compensation Factor for CO₂

RCB factor for each phase and whole test phases

<table>
<thead>
<tr>
<th>Phase</th>
<th>Compensation Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole phases (L ~ Ex-H)</td>
<td>measured</td>
</tr>
<tr>
<td>Each phase (L or M or H or Ex-H)</td>
<td>Apply whole phases factor (justification : ISO/TR 11955, also refer next page)</td>
</tr>
<tr>
<td>Specific combined phases (L ~ H, or others)</td>
<td></td>
</tr>
</tbody>
</table>

- RCB Compensation Factor for CO₂
- Preconditioning
  - LOW 589s
  - MIDDLE 433s
  - HIGH 455s
  - Ex-HIGH 323s
- Set SOC at several levels
- Overnight soak

Sampling

- LOW 589s
- MIDDLE 433s
- HIGH 455s
- Ex-HIGH 323s

Obtain CO₂ and RCB

Obtain RCB compensation factor for whole phases
RCB Compensation Factor (Validation2)

Horizontal unit
Ah → Ah/km
It is agreed to apply regional UFs at least for Phase I. The harmonization of the methodology seems to be difficult. Discussions to reach for a globally harmonized methodology and a globally harmonized UF will go on.
All electric range test for PEV

AER and AER(city) determination in case of (P)EV testing

\[ \Delta E = E_{AC} \text{ (recharged Energy from the Grid)} \]

- Battery discharge according to manufacturers requirements
- Soak time and Battery charge
- All Electric Range AER / AERcity
- Max. 2hr
- 12h charge
- Test 1, Test i + 1, Test i + 2, Test i + 3
- Min SOC
- Driving cycle [/]
- Recharging time according to 5.3.2.5.6 and 5.3.2.6.6.

End of AER test criteria: according 5.3.2.5.4. and 5.3.2.6.4. of this annex
5.4.2.4.1.3. The end of the test occurs when the break-off criteria is reached.

The break-off criteria shall have been reached when the vehicle cannot follow the driving trace for 4 seconds or more.

The acceleration controller shall be deactivated. The vehicle shall be braked to a standstill within 60 seconds.
Japan proposed shortening test procedure based on SAE1634.

Shorten test procedure for WLTC MCT

1) To prevent uneven condition, number of Low/Middle should be several times.
2) Before CSCm and after CSCm should be same.

<table>
<thead>
<tr>
<th>Each phase</th>
<th>Low</th>
<th>Middle</th>
<th>High</th>
<th>Ex-High</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>12.36</td>
<td>19.04</td>
<td>14.32</td>
<td>16.5</td>
<td>62.22 km</td>
</tr>
<tr>
<td>2356</td>
<td>1732</td>
<td>910</td>
<td>646</td>
<td></td>
<td>5644 sec</td>
</tr>
</tbody>
</table>

The distance exclude CSCm

- Low: 3.09 km (9 min 49 s)
- Middle: 4.76 km (7 min 13 s)
- High: 7.16 km (7 min 13 s)
- Ex-High: 8.25 km (5 min 23 s)
- Total: 62.22 km
- CSCM: 55 mph (89 km/h)
- CSCE: 55 mph (89 km/h)
## Estimated Range with MCT

<table>
<thead>
<tr>
<th>Phase</th>
<th>Measured Range (SCT)</th>
<th>Estimated Range (MCT)</th>
<th>Comparison SCT vs MCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>177.1km</td>
<td>183.2km</td>
<td>6.1km 3.6%</td>
</tr>
<tr>
<td>Middle</td>
<td>170.1km</td>
<td>172.9km</td>
<td>2.8km 1.7%</td>
</tr>
<tr>
<td>High</td>
<td>147.3km</td>
<td>146.1km</td>
<td>1.2km 0.8%</td>
</tr>
<tr>
<td>Ex-High</td>
<td>98.5km</td>
<td>99.5km</td>
<td>1.0km 1.1%</td>
</tr>
</tbody>
</table>

The results show that the error was small. Thus, it is considered that the shorten test procedure with MCT is usable.

**Time reduction effect with the shorten test procedure with MCT**

The measurement of AER and AER city with **SCT** consumed **2days**.

The measurement of four ranges with **MCT** consumed **3:30**.
Thank you for your attention!