交通安全環境研究所
National Traffic Safety and Environment Laboratory

Recommendations on HD UBE Measurement

prepared by JAPAN

63rd EVE IWG

18th -19th July, 2023

JPN introduced the HD UBE Measurement at 61st & 62nd EVE IWG

Approach

Reprint

【Focus】

✓ JPN evaluates the gap (error) of its **battery discharged energies (UBE)** obtained under the two (2) different test procedures

① Chassis Dynamometer Test
② Charge / Discharge Test

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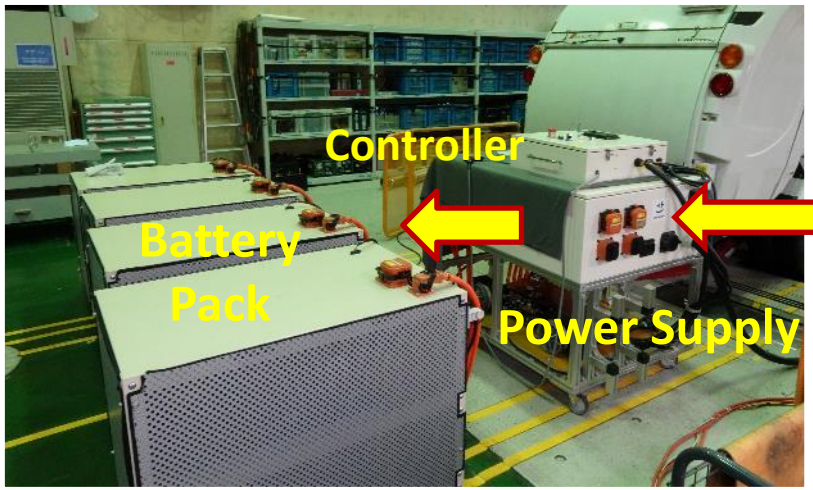
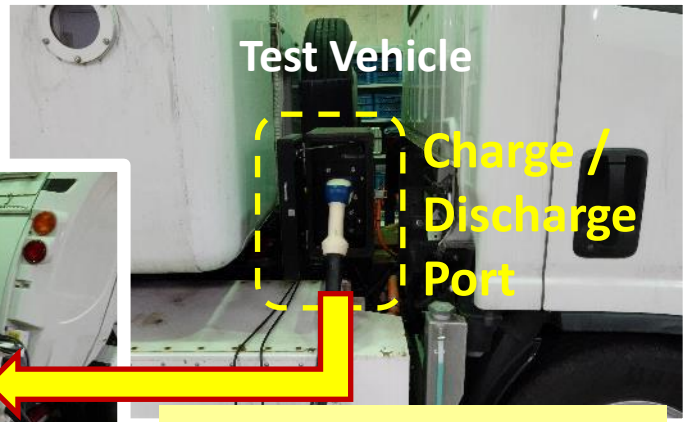
② Charge / Discharge Test





By using V2X function

Power : One-way
(Vehicle → Power supply)

【Test Vehicle】

- EV Truck（GVW：7,500kg）
- Battery Capacity：48kWh (Lithium-ion Battery)
- Motor Power : 93kW (Rated Power)

【Test condition】

- Test Room Temperature：25℃ (Setup)

→ *Vehicle Battery Temperature (CAN Signal) at Soak :23 ℃*

Test Procedure

Reprint & Recommend

① Chassis Dynamometer Test (WHVC+Road Gradient) ←*GTR No.4_ Section 9（Annex9, 10）*

(a) Obtain the discharge pattern data of the battery power from SOC max to SOC min (Cycle Repetition).

(b) Measure the total amount of battery discharged energy

② Charge / Discharge Test

→ Measure the total amount of the battery discharged energy of the following conditions

(1) Cycle Repetition : The discharge pattern simulating the chassis dynamometer test ①

(2) Constant Power : Power (10.3kW) ・・・C-rate=0.2

(3) Constant Power : Cycle Average Power (24.3kW) ・・・C-rate=0.5

(4) Constant Power : Power (48.0kW) ・・・C-rate=1.0

(5) Constant Power : Cycle Maximum Power (114kW) → V2X Power Limit (Max.=69kW) ・・・C-rate=1.4

$$\text{C-rate} = \frac{\text{Setup Power [kW]}}{\text{Battery Capacity(48kWh)}}$$

We provided the test results during the 62th EVE-IWG.

【Discharge conditions】Cycle Repetition vs. Constant Power

The “Cycle Repetition” is NOT recommended.

← The end points of the UBE measurement under the cycle repetition is influenced by the target vehicle speed. This leads the final SOC level/the measured UBE inconsistent. ← *＜Q&A_#61st EVE IWG＞*

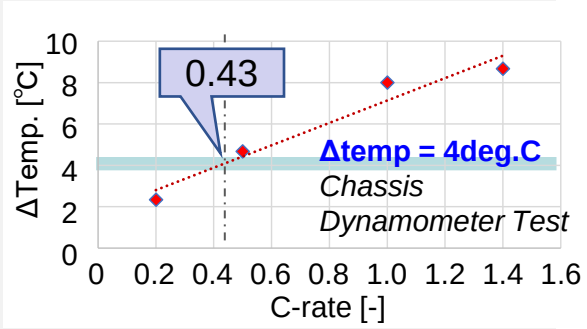
【C-rate】

The UBE cannot be estimated correctly under the C-rate condition which is over 1.0, because the protection logic against the over-discharge works. → *【IWG Member Comment】Appropriate C-rate range is under 0.5.*

Consideration of Appropriate C-rate

【Test Results】（vs. Chassis Dynamo.）

1. Four(4) different C-rates are evaluated
   - 0.2 C-rate is good correlation with Chassis Dynamo. Test
   - Over 0.5 C-rate has a gap
     → maximum C-rate seems to be 0.43
2. 0.43 C-rate is additionally evaluated with expected results

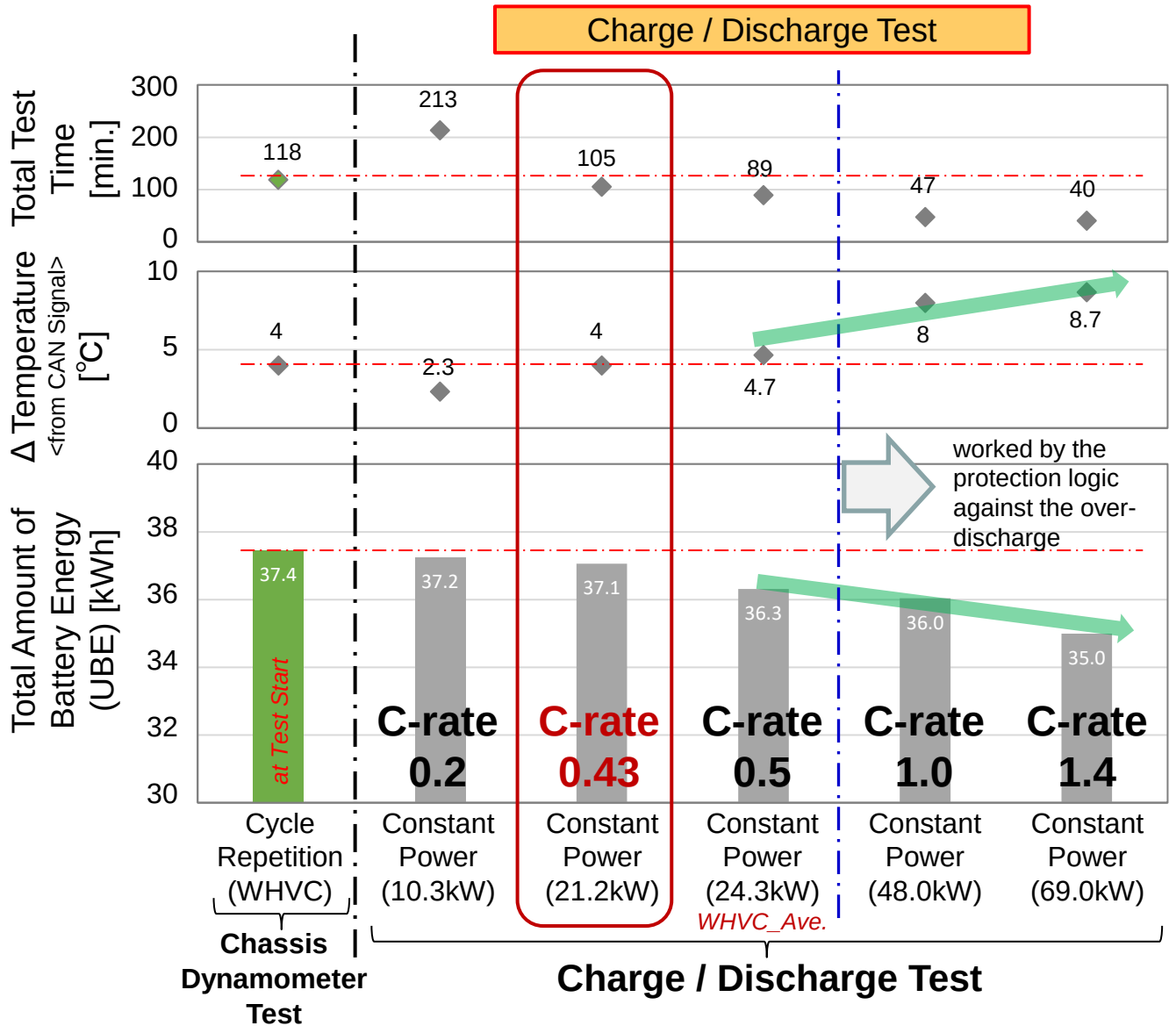


【Point】

C-rates which initiate the protection logic against the over-discharge operate should be avoided.

It's up to the vehicle manufacturers to set the thresholds of the battery protection logic based on its characteristics installed to the vehicles

The C-rate during type approval and in-service testing shall be identical and should be specified by the vehicle manufacturer.



Conclusions

- Charge/Discharge test (e.g. bidirectional charger) is one of solutions to determine HDVs UBE when considering its complexity during in-service testing.

- Charge/Discharge test result of this vehicle is shown below,
  - ✓ The constant output power discharge is recommended.
  - ✓ Appropriate C-rate range exists per its own unique BMS.
    - ・・・The C-rate is specified by the vehicle manufacturer.
  - ✓ The specified C-rate should be used during type approval and in-service testing

Next Action

- Propose concrete contents (i.e. current/voltage measurement technique, discharge pattern, C-rate range and others) to be incorporated into the GTR.

(ex) Test Procedure (Type Approval Test and In-service Test)

✓Test procedure of both tests is to set the same C-rate of the Charge / Discharge Test.

✓The CAN data of the current and voltage can be used during the in-service testing only when the accuracy of CAN data is confirmed during the Type Approval Test.