

Opportunity to Standardize Vehicle Testing Procedures

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Summary of Test Standards Development

- **J1711:** HEV/PHEV dynamometer test standards
 - Completed June 2010
- **J1634:** BEV dynamometer test standards (consumption and range)
 - Rewrite to prescribe a shorter test for long-range BEVs
- **J1715:** HEV Terminology
 - Being updated from version several years ago
- **J2951:** Drive Quality Evaluation for Chassis Dynamometer Testing
 - New standard to explain fuel economy variations
- **ISO 23274-2:** PHEV dyno testing in depleting mode
 - 23274-1 is testing in the sustaining mode
- **J2711:** Dyno testing of MD/HD vehicles including HEV
 - Work just getting started, larger scope than J1711



Battery Electric Vehicle Test Standards

SAE J1634

- Chassis dynamometer testing similar to conventional vehicles
- New Instrumentation needed
- Range must be found for each test cycle

Final Results

- AC Wh / km (energy going into the charger)
- Range in km (vehicle can no longer drive the drive trace)



Instrumentation

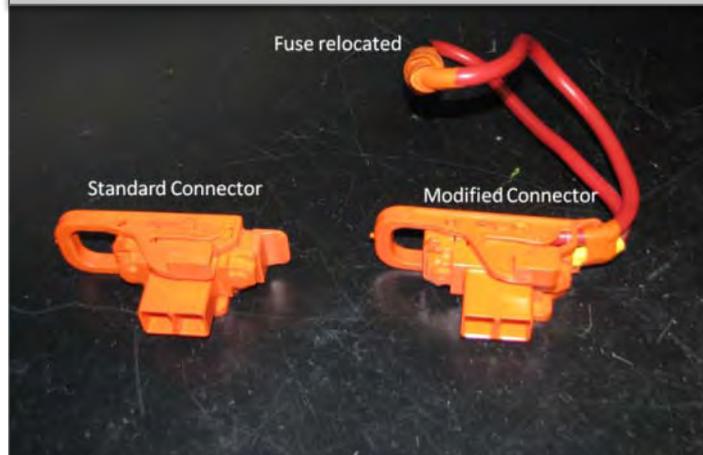


Testing Instrumentation

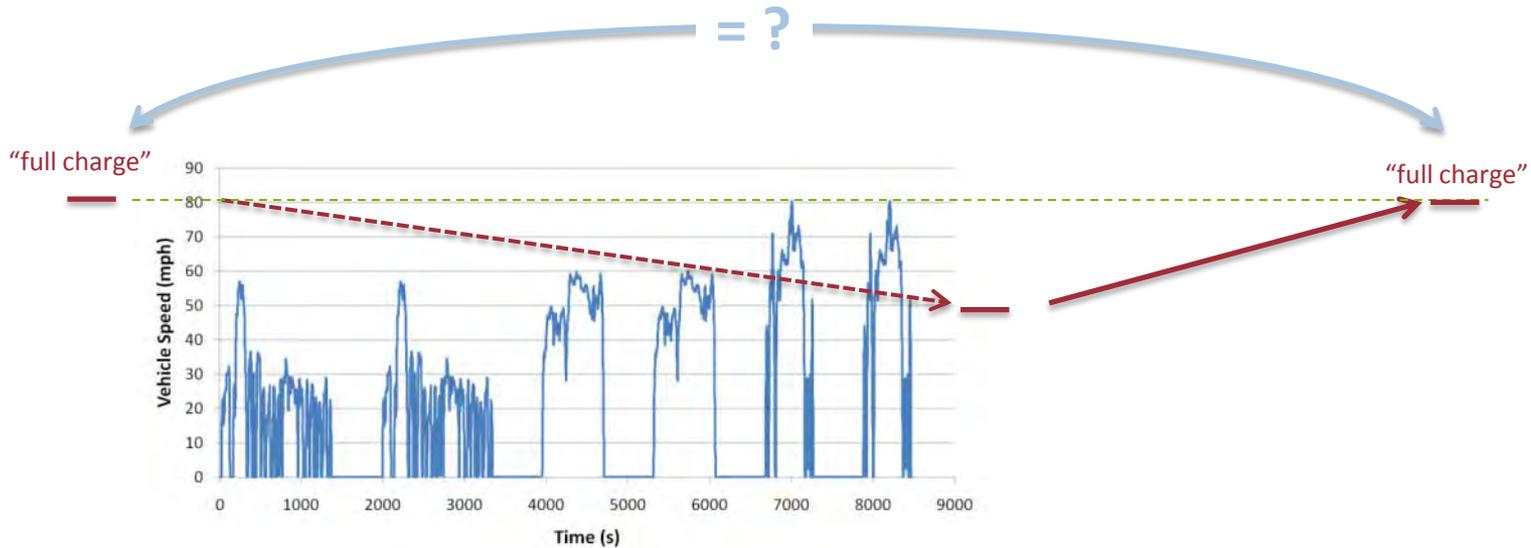


- Power analyzer used to track electrical energy flows – during testing and charging
- Minimum: Terminal voltage and total battery current running **through main traction battery pack**
- Useful: Instrument aux battery
- Useful: track total aux power going to DC/DC converter

- Allows using same current probe location for testing and charging
- Ensures true current through cells (no BMS drain)



Consumption Data Comes From Charging. Thus Specification Validating “Full Charge” is Needed



Short-Cut Method Recharge Data From Several BEVs

Vehicle	Charge AC kWh	Test A-h	Charge A-h	Charge Ratio
1	11.93	31.525	31.495	0.9991
2	16.23	42.607	42.375	0.9945
3	12.43	32.077	32.940	1.0269
4	13.02	27.385	29.457	1.0757
5	11.32	25.337	25.468	1.0052
6	19.10	49.189	49.928	1.0150

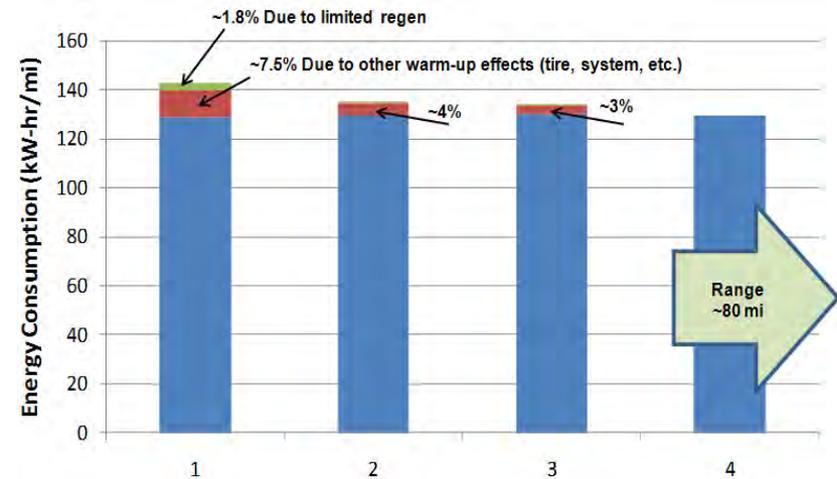
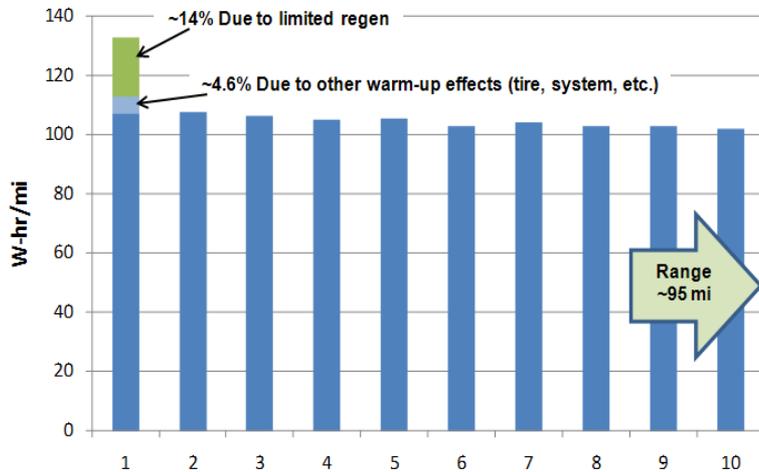
*A specification is necessary to ensure repeatable full recharge occurred.



Efficiency Testing (Wh / km)



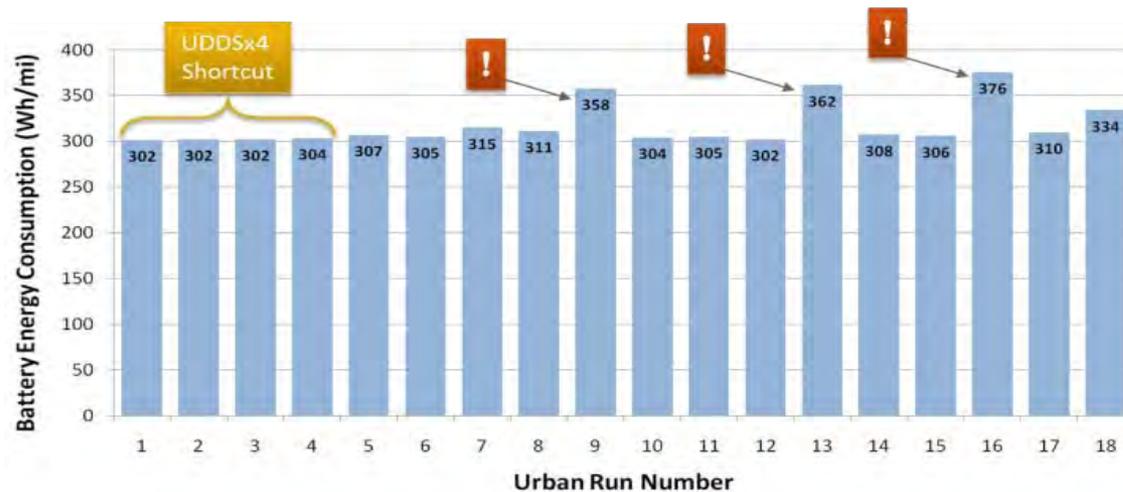
Efficiency Changes Over Full Range Test - Initial Cycles



- Several factors cause changes in consumption throughout range test
- Initial cycles differ from remainder of range test
 - Tire temperature
 - Lubricants



Efficiency Changes Over Full Range Test - Later Cycles (Active Thermal Management)



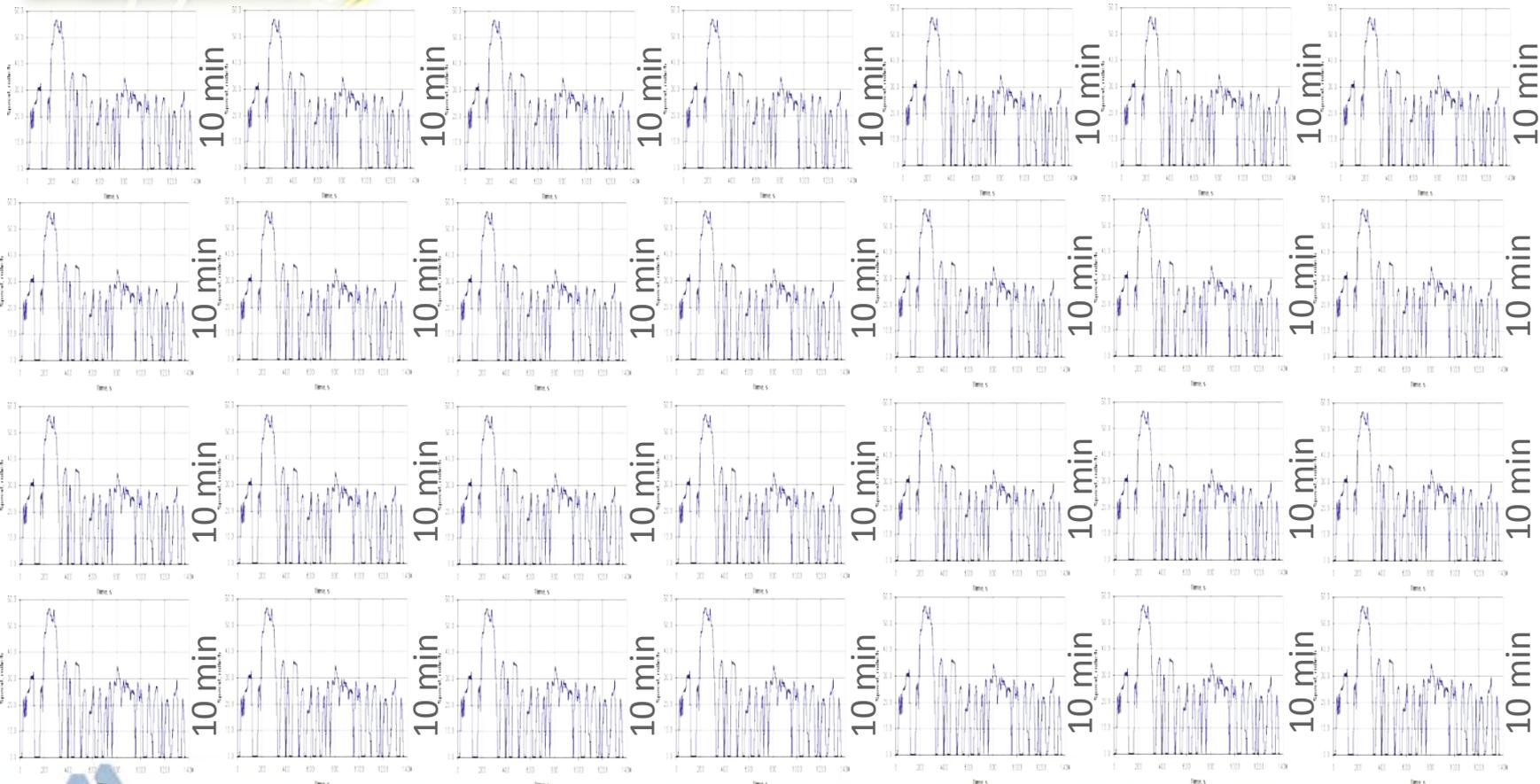
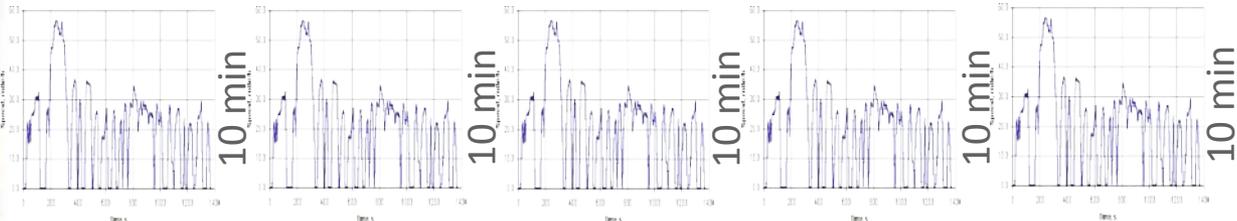
- Active thermal management may be needed as range test progresses
- This causes significant increases in consumption
- However, this effect may be small compared to the whole test
- Short procedure is actually more representative of typical daily driving (<65 km)

Range Testing

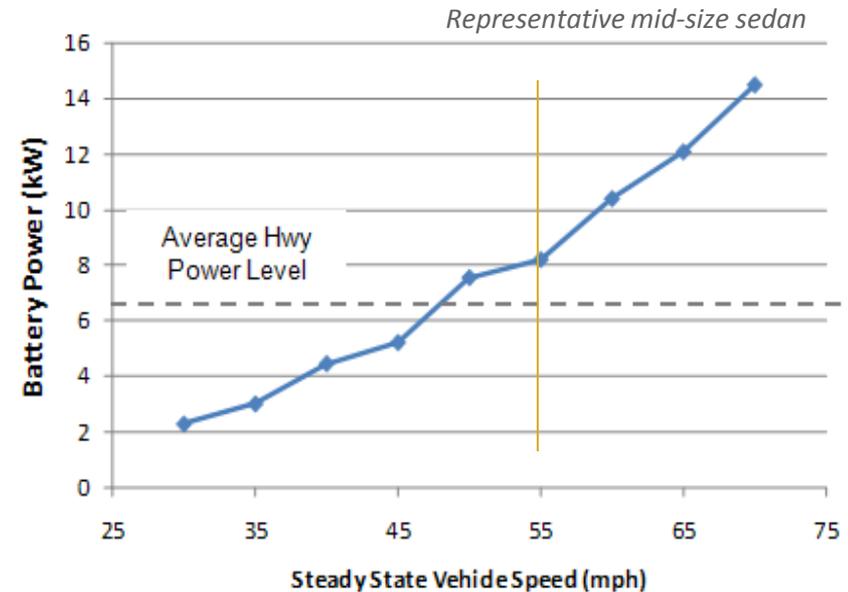
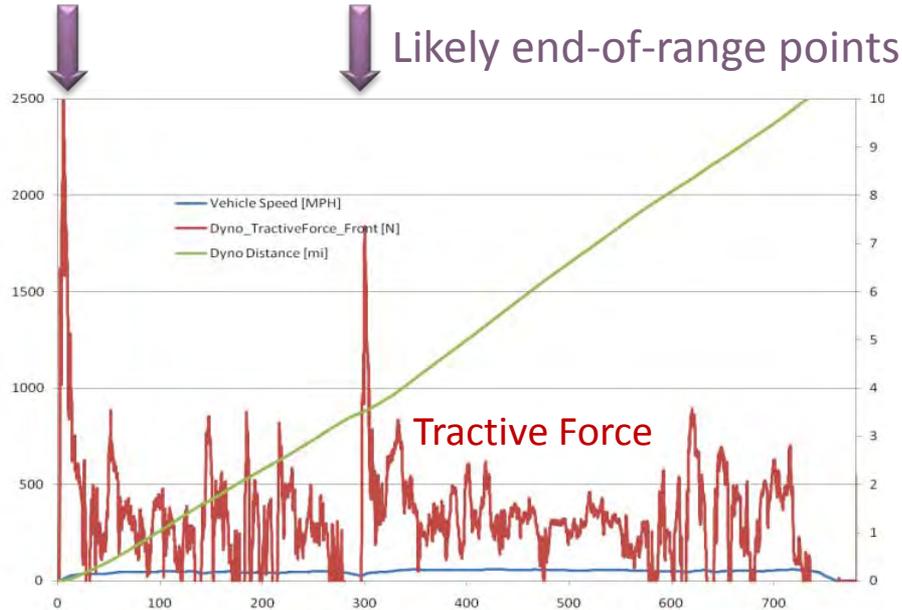


Problem Statement: Current J1634

400 km = 17+ hours of testing, no interruptions allowed



Steady-State Speed For End-of-Range

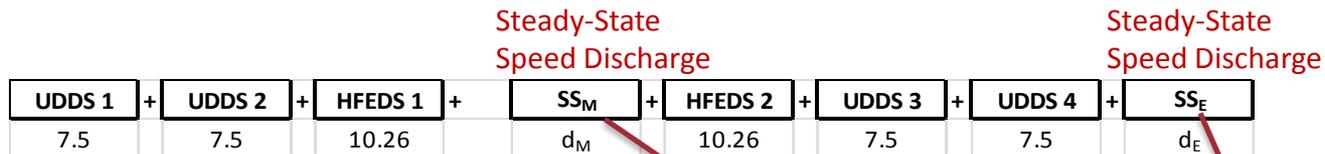


- Total battery capacity needed for range extrapolations
- Decided that after cycle testing, steady-state speed testing would provide total capacity in a short amount of time
- Steady-state speed should provide more repeatable capacity results than cycle tests



Final Test Procedure:

- Shorter test time by extrapolating range
- Runs several cycle tests on a single day
- Defines Wh / km at initial SOC and near end of range



- Tests run at beginning and near end of range – in attempt to capture near-end-of-range data.

- However, this requires prediction and may not always be repeatable or consistent among BEVs

- **Concept not validated with BEV yet**

