



Zero-Emission Motorcycle (ZEM) Range Determination Testing

Background

- CARB and U.S. EPA have proposed that the EPPR IWG should develop a standard procedure for determining range of zero emissions motorcycles (ZEMs)
- SAE J2982 may be useful as a starting point
- SAE J2982 was updated in October 2022
- [J2982 202210: Riding Range Test Procedure for On-Highway Electric Motorcycles - SAE International](#)

SAE J2982 Overview

- Develop dynamometer coefficients using U.S. EPA procedure or SAE alternative procedure
- Condition vehicle battery (>40 charge-discharge cycles)
- Charge vehicle battery to full
- Cold soak for 6-36 hours at 20-30 C
- Place vehicle on dyno and run drive cycle until end-of-test criteria is met:
 - “Low battery” warning light indicating unsafe to operate
 - Unable to reach or maintain drive cycle target speed
- Calculate distance travelled based on dyno revolutions

Test Objectives

- Evaluate various drive cycles used in SAE J2982:
 - UDDS, WMTC, constant cruising at 50mph or 70mph
- Define which drive cycle(s) most accurately represent ZEM range
 - J2982 suggests an average of UDDS and constant speed
- Determine whether procedure is suitable for use on a variety of ZEMs
 - Battery capacity, top speed, range
- Quantify run-to-run variability of ZEM range testing

Preliminary Range Data

- A ZEM manufacturer provided preliminary data on how the different test cycles impacted ZEM range using J2982 test procedure
 - Tested a single ZEM with battery approximately 15kwh
 - Only conducted one run of each drive cycle
 - Didn't factor in regenerative braking
- Range Results:
 - WMTC = 172 km (107.5 mi)
 - UDDS = 288 km (180 mi)
 - Early J2982-2022 UDDS/55mph mix = 217 km (135 mi)
 - Early J2982-2022 UDDS/70mph mix = 167 km (104 mi)
- UDDS Range > WMTC Range
- WMTC Range similar to combined UDDS/70mph cruising range

Proposed Test Matrix

Test ZEM	ZEM Specifications	UDDS	WMTC	55mph Constant	70 mph constant
Motorcycle A (small battery)	Battery Size: ~4kwh Top Speed: ~80mph Est. Range: ~80 miles city	2 Runs	2 Runs	2 Runs	2 Runs
Motorcycle B (medium battery)	Battery Size: ~8kwh Top Speed: ~85mph Est. Range ~55 miles @70mph	2 Runs	2 Runs	2 Runs	2 Runs
Motorcycle C (large battery)	Battery Size: ~15kwh Top Speed: ~100mph Est. Range ~100 miles @70mph	2 Runs	2 Runs	2 Runs	2 Runs

Notes: Additional runs may be conducted if significant variance is noted between two test of a single drive cycle

Testing is tentatively scheduled to occur at CARB lab in January, 2023. CARB staff will share results with the group once testing is completed.

Suggestions?

- Is there additional testing that should be conducted to inform development of a ZEM range procedure?
- Is data available from other sources?
 - ZEM Manufacturers, existing range reporting requirements, etc.
- Are other EPPR members conducting ZEM range testing?
 - Can this data be shared with the group?
- For your questions or suggestions contact Kevin Richardson
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Thank you

