



DC Fast Charge Effects on Battery Life and Performance Study

Four model year 2012 Nissan Leaf battery electric vehicles were instrumented with data loggers and are being operated over a fixed on-road test cycle. Each vehicle is charged twice daily, with two vehicles charged at AC Level 2 (L2), and two DC fast charged (DCFC) with a 50kW charger. The traction battery packs are removed and tested when the vehicles were new, and at 10,000 mile intervals. Battery tests include constant current discharge capacity, electric vehicle power characterization, and low peak power tests¹. The testing was halted at 63,000 miles. The first two pages of this fact sheet summarize the measured changes in capacity at 10,20,30,40, and 50 thousand miles relative to baseline test results. Final testing completed at 62,000 miles is presented on page 3.

	1011 L2	4582 L2	2183 DCFC	2078 DCFC
Baseline (New)	23.31	23.59	23.38	23.24
10,000 Miles	21.75	22.3	21.97	21.93
20,000 Miles	21.53	21.51	21.64	21.07
30,000 Miles	19.99	20.2	19.42	19.33
40,000 Miles	18.10	18.34	17.53	17.37
50,000 Miles	17.51	17.77	16.94	16.92

Table 1 - C₃ Energy capacity² (kWh)

	1011 L2	4582 L2	2183 DCFC	2078 DCFC
0-10k Miles (Oct-Jan)	28.6	28.6	32.7	32.5
10-20k Miles (Jan-Mar)	22.7	22.5	27.6	27.3
20-30k Miles (Apr-Jul)	35.7	36.0	39.8	39.5
30-40k Miles (Jul-Oct)	38.2	38.4	40.8	40.6
40-50k Miles (Oct-Mar)	23.2	23.6	27.3	26.8

Table 2 – Average pack temperature during all charging through mileage accumulation interval (°C)

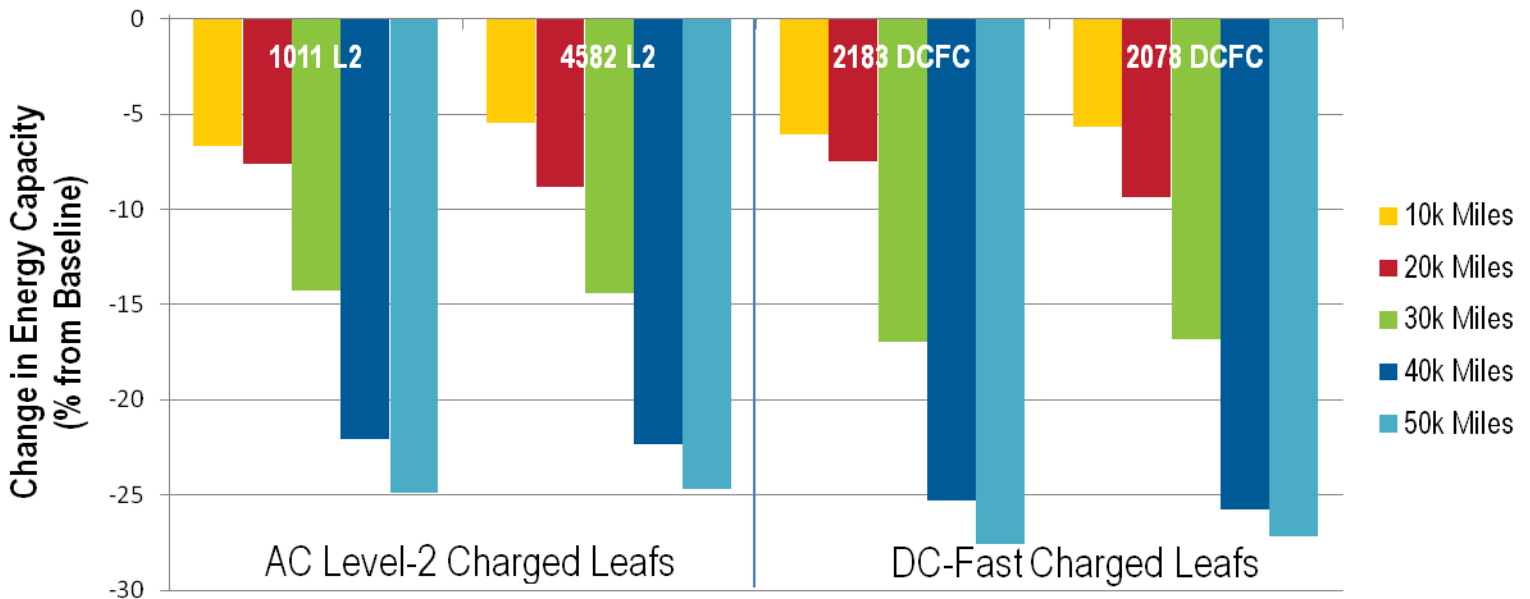


Figure 1 – Percent change in C₃ energy capacity from baseline

1. Capacity and Peak Power tests based on tests from [USABC Electric Vehicle Battery Test Procedures Manual Revision 2](#). Electric Vehicle Power Characterization test adapted from the *Hybrid Pulse Power Characterization Test* from the [FreedomCAR Battery Test Manual for Power-Assist Hybrid Electric Vehicles](#).
 2. C₃ capacity reported is the mean value of 3 tests performed sequentially.

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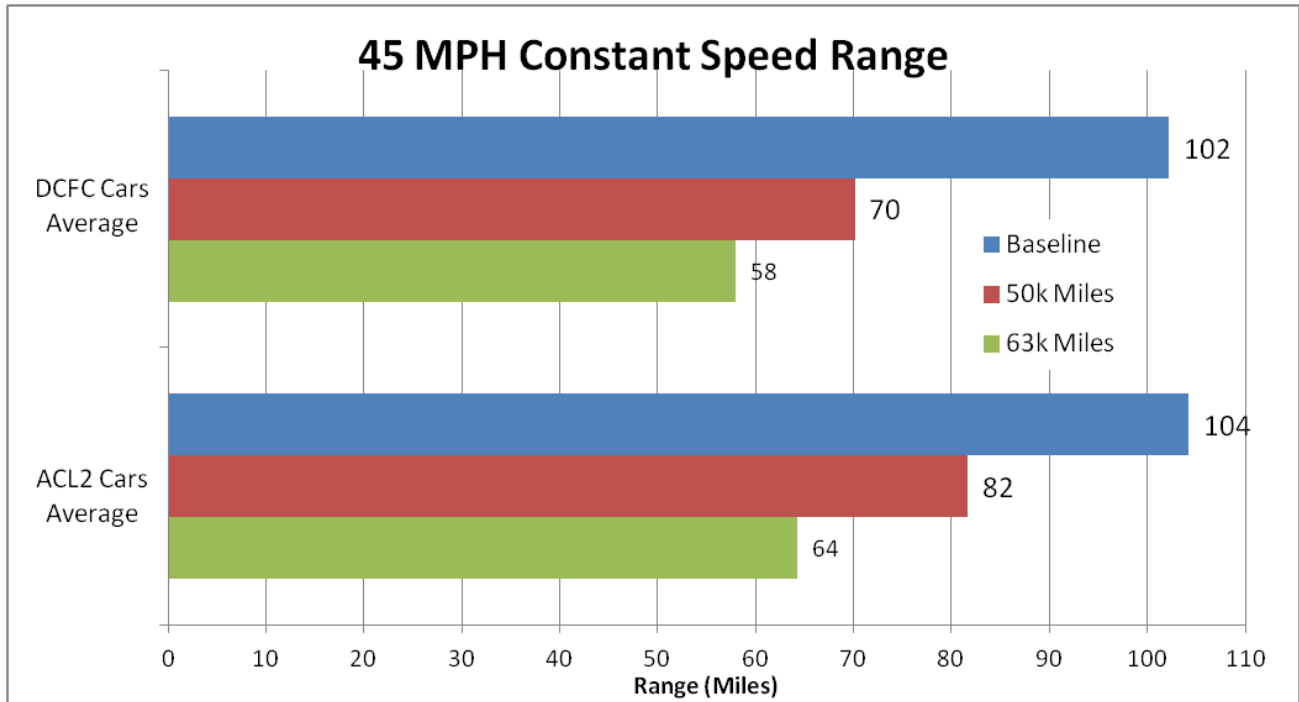


Figure 2 – 45 MPH Constant Speed Range at Baseline, 50k, and 63k³ miles

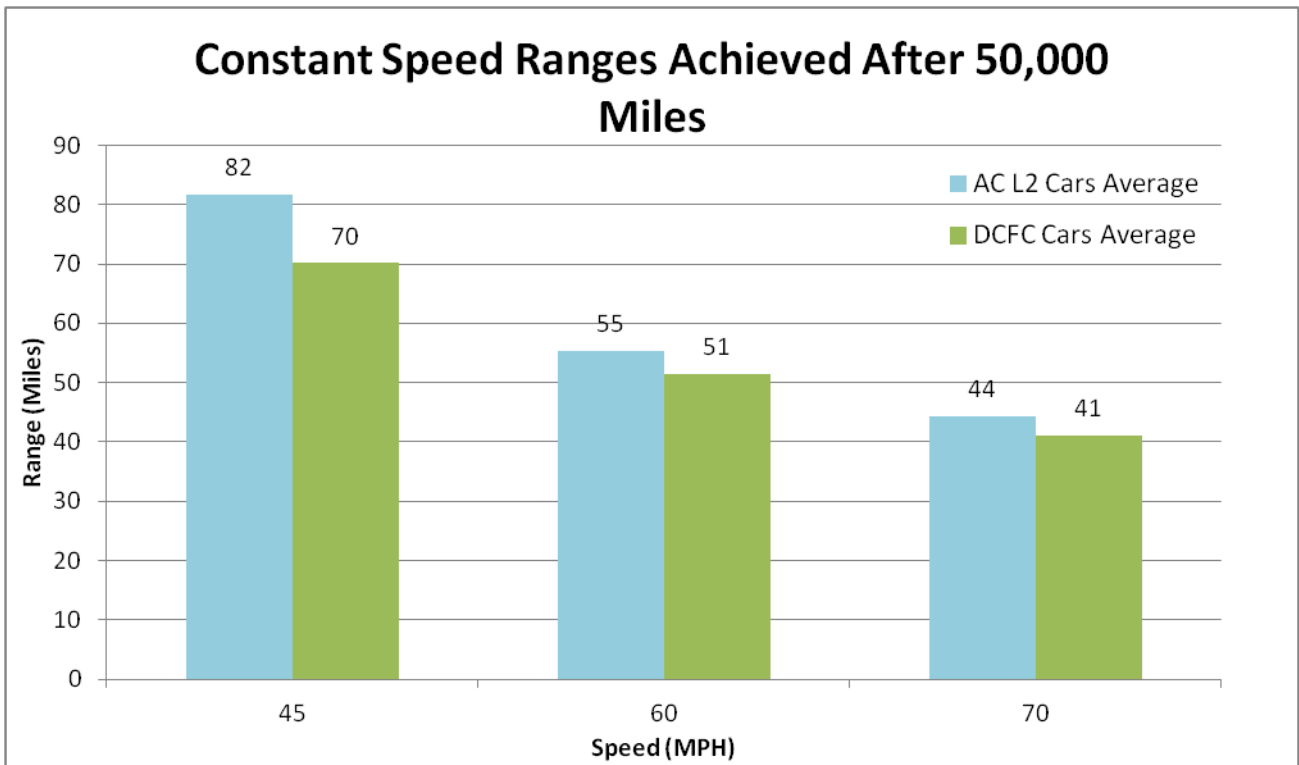


Figure 3– Constant Speed Range after 50,000 Miles for 45, 60, and 70 MPH

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C/3 Energy Capacity Test at 63,000 Miles³

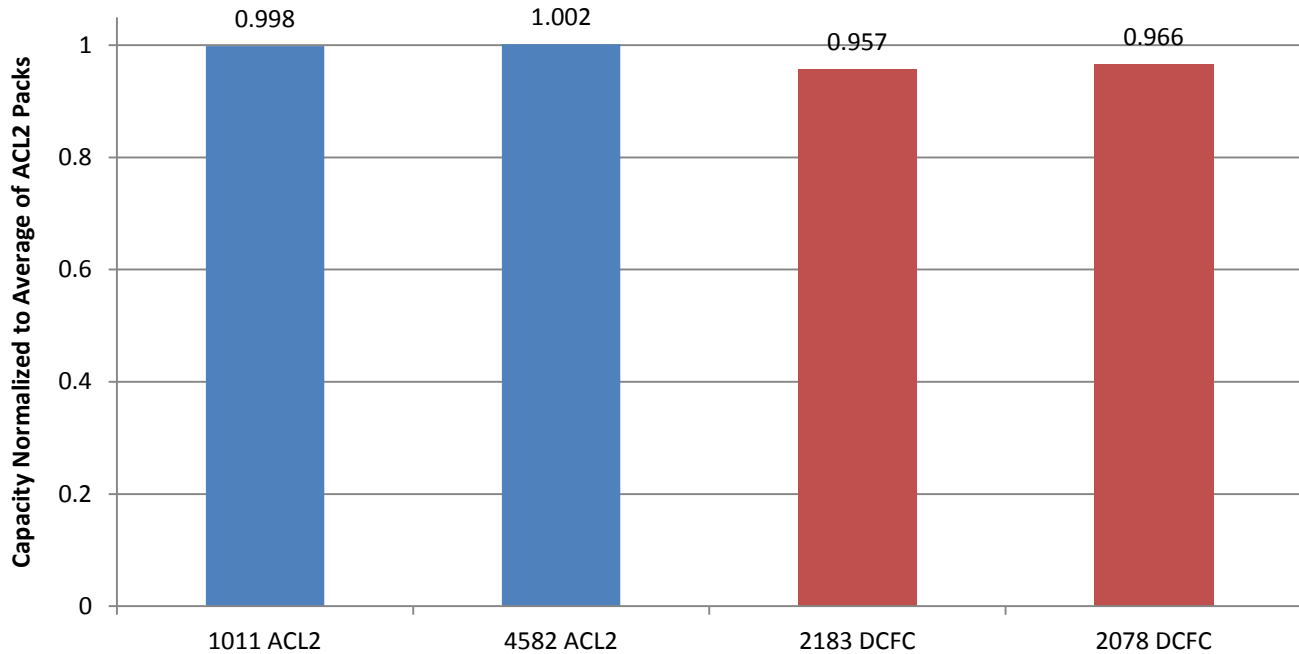


Figure 4– Relative C/3 Discharge Energy Capacity at 63,000 Miles³ for each of the ACL2 and DCFC cars. The battery packs could not be charged and discharged to the same voltage limits of previous tests due to cell imbalance, thus the absolute capacity cannot be compared to baseline. Each of the packs was charged and discharged between the following limits: $V_{max} = 390V$, $V_{min} = 310V$.

A paper titled Effects of Electric Vehicle Fast Charging on Battery Life and Vehicle Performance will be presented at SAE World Congress on April 22, 2015. This paper will be available on the AVTA website the following week.

3. Vehicle mileage accumulation was stopped on 12/13/2014 with each vehicle having accumulated about 63,000 test miles. Exact mileage readings at end-of-test were: VIN 1011:63,479. VIN 4582: 63,207. VIN 2183:63,211. VIN 2078:63,406 miles.