2015 Kia Soul EV

Advanced Vehicle Testing – Baseline Vehicle Testing Results

VEHICLE SPECIFICATIONS[1]

Vehicle Features

VIN: KNDJX3AE6F7001908
EPA Class: Five-Door Wagon
Seatbelt Positions: 5
Type: BEV
CARB Credit[2]: Type II ZEV
EPA Fuel Economy:
120 MPGe (City)
92 MPGe (Highway)
105 MPGe (Combined)
EPA Range: 93 miles
On-Board Charger: 6.6 kW

Electric Motor

Type: Permanent Magnet AC Synchronous
Maximum Power: 81 kW
Maximum Torque: 285 Nm

Transmission

Type: Single Speed
Final Drive Ratio: 8.206:1

Battery

Manufacturer: SK Innovation
Type: Lithium-ion Polymer
Cathode Material: Nickel-rich NMC (nickel-manganese-cobalt)
Cells/Modules: 192 cells, 8 modules
Pack Configuration: 96 Cells in Series, 2 Cells in Parallel
Nominal Pack Voltage: 360 V
Nominal Cell Voltage: 3.7 V
Useable Pack Capacity[3]: 75 Ah
Tested Pack Capacity[3]: 84.1 Ah
Useable Pack Energy: 27 kWh
Tested Pack Energy[3]: 32.5 kWh
Pack Weight: 203 kg
Pack Specific Density[4]: 160 Wh/kg
Approx. Pack Energy Density[4]: 150 Wh/L
Pack Location: Below center of vehicle
Thermal Management: Active – Air

Weights

Design Curb Weight: 3,289 lb
Delivered Curb Weight: 3,334 lb
Distribution F/R: 57.9%/42.1%
GVWR: 4,321 lb
GAWR F/R: 2,315 lb/2,138 lb
Maximum Payload: 987 lb

Dimensions

Wheelbase: 101.2 in
Track F/R: 62.0 in/62.4 in
Length/Width: 163.0 in/70.9 in
Height: 63.0 in

Tires

Manufacturer: NEXEN
Model: N blue EV
Size: 205/60R16
Pressure F/R: 44 psi/44 psi
Spare Installed: N/A - Tire Sealant and Inflator

NOTES:

1. Vehicle specifications were supplied by the manufacturer, measured, or derived from a literature review.
2. The vehicle was classified as a Type II ZEV by the California Air Resources Board (CARB). The range on consecutive UDDS cycles is over 100 miles (and less than 200 miles), but the vehicle does not meet the charging requirements for the Type III classification.
3. The battery specification listed by the vehicle manufacturer is usually the rated pack capacity. In this case, the useable capacity (and energy) was listed. Tested pack capacity and energy are based on capacity testing.
4. Pack Specific Density and Pack Energy Density are based on the tested pack capacity.

PERFORMANCE STATISTICS[1]

TRACK TESTING[2]

Acceleration 0-60 mph[3]

Measured Time: 10.5 s

Performance Goal: ≤ 13.5 s

Peak DC Power from Battery: 89.8 kW

Maximum Speed

At ¼ Mile: 77.1 mph

Maximum Speed[4]: 92.3 mph

Performance Goal: ≥ 90 mph at 1-mile mark

Braking from 60-0 mph at 100% SOC[5]

Measured Time: 3.8 s

Distance: 138 ft

Peak DC Power into Battery: 11.1 kW

Braking from 60-0 mph at 50% SOC[5]

Measured Time: 2.6 s

Distance: 134 ft

Peak DC Power into Battery: 8.1 kW

Deceleration 60-10 mph[6]

Measured Time: 27.9 s

Distance: 1,338 ft

Peak DC Power into Battery: 28.6 kW

Total DC Energy into Battery: 111.0 Wh

DYNAMOMETER TESTING[7]

Cycle Results[8]

	72 °F	20 °F	95 °F + 850 W/m^2
UDDS (Cold Start)	230.1 Wh/mi	513.3 Wh/mi	287.5 Wh/mi
UDDS	218.2 Wh/mi	351.6 Wh/mi	274.6 Wh/mi
HWFET	259.1 Wh/mi	358.1 Wh/mi	285.2 Wh/mi
US06	338.6 Wh/mi	409.0 Wh/mi	370.1 Wh/mi
SC03			279.4 Wh/mi

Energy Consumption at Steady-State Speed, 0% Grade

10 mph	126.9 Wh/mi		50 mph	243.3 Wh/mi
20 mph	137.5 Wh/mi		60 mph	296.7 Wh/mi
30 mph	164.5 Wh/mi		75 mph	355.3 Wh/mi
40 mph	201.3 Wh/mi		80 mph	421.4 Wh/mi

Duration of Passing Maneuver at Grade[9]

	0% Grade	3% Grade	6% Grade
35-55 mph	4.7 s	5.5 s	6.7 s
55-65 mph	3.5 s	4.4 s	5.8 s
35-70 mph	10.0 s	12.4 s	16.5 s
55-80 mph	10.5 s	14.2 s	22.6 s
Maximum Speed at 25% Grade from Stop: 41.2 mph			

NOTES:

1. Performance numbers based on "Normal" vehicle mode. Performance numbers are averaged from multiple tests unless otherwise indicated. Electricity values are AC values unless otherwise indicated.
2. Vehicle track testing occurs when the vehicle has achieved its "break-in mileage" of between 4,000 to 6,000 miles, and at the delivered curb weight plus 332 ± 10 lb (including driver and test equipment), for a test weight of 3,668 lb, distributed in a manner similar to the original curb loading of the vehicle. Track testing took place between May 19 and May 22, 2015 with the vehicle odometer reading 4,067 miles. The ambient temperatures ranged from 60 °F to 86 °F. No accessories were used except for headlights as required by track regulation. The results provided are from multiple runs unless otherwise indicated; if taken from a single run, the result is the maximum value over the set of runs.
3. The acceleration is measured from the point at which the vehicle begins to move. The acceleration and maximum speed results were averaged from 6 runs. The peak power value was taken from a single run.
4. The maximum speed was reached before the one-mile mark.
5. Controlled braking on dry surface. The test is not run at a set SOC value. The peak power into the battery value was taken from a single run.
6. Coasting in drive on dry surface. Test run data were cut off when the vehicle reached 10 mph, as vehicle creep speeds are typically below this threshold. The peak power into the battery value and total energy into the battery results were both taken from a single (but different) run.
7. Dynamometer testing occurs after the track testing is complete. Dynamometer testing began on June 22, 2015, with the vehicle odometer reading 4,527 miles. A comprehensive explanation of the dynamometer facility and methodology can be found at http://www.anl.gov/energy-systems/group/downloadable-dynamometer-database, titled "Chassis Dynamometer Testing Reference Document". The ABC coefficients derived from track coastdown testing and matched on the dynamometer were A: 25.3030 lb, B: 0.42884 lb/mph, and C: 0.01654 lb/mph^2.
8. The Cycle Results table presents the fuel economy achieved by the vehicle on five EPA drive cycles at four different ambient temperatures: (1) 72 °F with vehicle climate-control off, (2) 20 °F with vehicle climate-control set to 72 °F Auto, (3) 0 °F with vehicle climate-control set to 72 °F Auto, and (3) 95 °F with vehicle climate-control set to 72 °F Auto and where the vehicle is also subjected to 850 W/m^2 of solar load at 95 °F to simulate direct sunlight. The drive cycles include a hot start unless otherwise indicated. The conversion for Wh/mi to miles-per-gallon-of-gasoline-equivalent (MPGe) is to divide 33,700 Wh/gallon-of-gasoline-equivalent by the Wh/mi value.
9. The passing maneuver value indicates the amount of time required for the vehicle to transition from the first to the second speed, at the specified grade.

Values in red indicate that the Performance Goal was not met.

CONSTANT-SPEED RANGE AND CHARGE TESTING IN CHARGE-DEPLETING MODE[1]

	45 mph Test[2]	60 mph Test[3]	70 mph Test[4]
Average DC power out of battery at speed (kW):	11.0	18.5	24.1
(A) DC energy out of battery at set speed (kWh)[5,7,9]:	27.6	25.9	25.5
(A+) Total DC energy out of battery (kWh)[5,7,9]:	28.1	26.4	26.1
Battery capacity discharge at set speed (Ah):	77.8	73.4	72.4
(B) Range at set speed (mi)[6,8,10]:	114.6	84.8	73.6
(C) Post-test charge AC energy from EVSE @ 240 V to onboard charger (kWh):	29.8	29.5	30.1
Post-test charge duration (HH:MM):	04:55	04:52	04:57
AC electricity consumption rate (Wh/mi)[11]:	255	341	400
DC electricity consumption rate (Wh/mi)[12]:	241	305	346
(A+/C) Overall Trip Efficiency[13]:	94%	89%	87%

NOTES:

1. See Note 3 and Note 4 on page 2. The vehicle is accelerated to the desired speed and then cruise control is used to maintain the speed. Range is considered reached when the vehicle is no longer capable of maintaining a speed that is 2 mph lower than the set speed. Battery temperature data were not captured for this vehicle.
2. During the 45 mph range test, the average ambient temperature was 18 °C. During the post-test charge, the average ambient temperature was 27 °C.
3. During the 60 mph range test, the average ambient temperature was 18 °C. During the post-test charge, the average ambient temperature was 23 °C.
4. During the 70 mph range test, the average ambient temperature was 30 °C. During the post-test charge, the average ambient temperature was 24 °C.
5. In addition to the energy discharged from the battery during the 45 mph test, energy was discharged during the drive from test prep area to point at which vehicle test speed is achieved and maintained. After the range at 45 mph was completed, there is still ESS energy throughput during the drive to return the vehicle to the test prep area and the EVSE unit for the post-test charge. The pre-test drive required 0.46 kWh while the post-test drive required 0.05 kWh, and these energy inputs can be added to the energy consumed during the range test **(A)** to obtain the total output from the battery (28.1 kWh, denoted as **(A+)**) that is used in the calculations discussed in Notes 13-15.
6. In addition to the range measured for the 45 mph test, the pre-test drive required 0.97 miles from test prep area to point at which vehicle test speed is achieved and maintained. After the range at 45 mph was completed, the post-test drive required an additional drive of 0.77 miles to return to the test prep area and the EVSE unit for the post-test charge. These distances can be added to the distance traveled during the range test **(B)** to obtain the total distance traveled (116.3 miles). However, the energy consumption values consider only the distance traveled during the test itself, or value **(B)**.
7. In addition to the energy discharged from the battery during the 60 mph test, energy was discharged during the drive from test prep area to point at which vehicle test speed is achieved and maintained. After the range at 60 mph was completed, there is still ESS energy throughput during the drive to return the vehicle to the test prep area and the EVSE unit for the post-test charge. The pre-test drive required 0.52 kWh while the post-test drive required 0.03 kWh, and these energy inputs can be added to the energy consumed during the range test (A) to obtain the total output from the battery (26.4 kWh, denoted as (A+)) that is used in the calculations discussed in Notes 13-15.
8. In addition to the range measured for the 60 mph test, the pre-test drive required 1.08 miles from test prep area to point at which vehicle test speed is achieved and maintained. After the range at 60 mph was completed, the post-test drive required an additional drive of 0.72 miles to return to the test prep area and the EVSE unit for the post-test charge. These distances can be added to the distance traveled during the range test **(B)** to obtain the total distance traveled (86.6 miles). However, the energy consumption values consider only the distance traveled during the test itself, or value **(B)**.
9. In addition to the energy discharged from the battery during the 70 mph test, energy was discharged during the drive from test prep area to point at which vehicle test speed is achieved and maintained. After the range at 70 mph was completed, there is still ESS energy throughput during the drive to return the vehicle to the test prep area and the EVSE unit for the post-test charge. The pre-test drive required 0.62 kWh while the post-test drive required 0.03 kWh, and these energy inputs can be added to the energy consumed during the range test **(A)** to obtain the total output from the battery (26.1 kWh, denoted as **(A+)**) that is used in the calculations discussed in Notes 13-15.
10. In addition to the range measured for the 70 mph test, the pre-test drive required 1.31 miles from test prep area to point at which vehicle test speed is achieved and maintained. After the range at 70 mph was completed, the post-test drive required an additional drive of 1.03 miles to return to the test prep area and the EVSE unit for the post-test charge. These distances can be added to the distance traveled during the range test **(B)** to obtain the total distance traveled (76.0 miles). However, the energy consumption values consider only the distance traveled during the test itself, or value **(B)**.
11. The AC electricity consumption rate is calculated by dividing the DC electricity consumption rate (in Wh/mi) by the Overall Trip Efficiency for that particular speed.
12. The DC electricity consumption rate is calculated by dividing the DC energy from the battery as the set speed **(A)** by the range at the set speed **(B)**.
13. Overall Vehicle Efficiency is calculated by dividing the DC energy out of the battery **(A+)** by the AC energy from the EVSE **(C)**.

As a production vehicle, this vehicle is assumed to meet all Federal Motor Vehicle Safety Standards (FMVSS) for Battery Electric Vehicles.

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